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Lecture 1 [5th] د.حيدر سعد حنفوش

Orthodontics

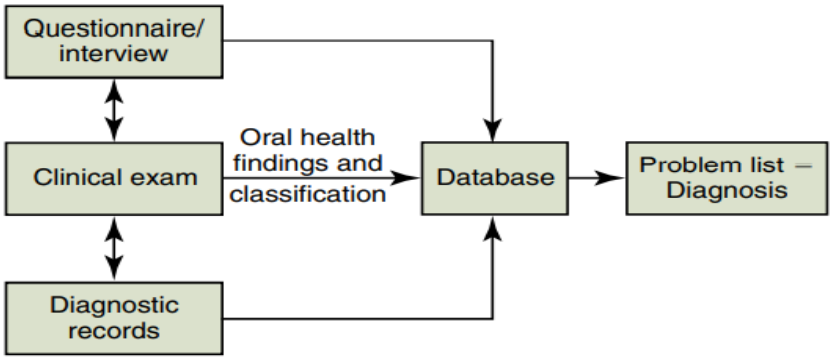
History and Clinical Examination

The purpose of an orthodontic assessment is to gather information about the patient to produce an accurate orthodontic diagnosis. Decision making in orthodontics requires the establishment of a prioritized problem list before considering treatment options.

Orthodontic treatment is nearly always elective, and so it is important that the orthodontic assessment identifies sufficient information not only to identify features that would benefit from treatment and those that don't need to be changed, but also to identify any potential risks of proposed treatment. By understanding both the risks and benefits of treatment the patient can make an informed decision as to whether they would like to proceed with treatment or not.

The elements of the database are:

1) Taking a full history
2) Undertaking a clinical examination
3) Collecting appropriate records.



1) Taking a full history.

The patient should be given the chance to describe their problem in their own words and the clinician can then guide them through a series of questions to address the areas. Case history is the information gathered from the patient and/or parent and/or guardian to aid in the overall diagnosis of the case. It includes certain personal details, the chief complaint, past and present History.

As summarized below:

1) Personal details of the patient

A) Name:

The patients name should be recorded not only for the purpose of communication and identification but because it gives a personal touch to the following conversation. It makes the patients more comfortable when he is addressed by his first name and arouses a feeling of familiarity, which has a positive psychological effect on the patient.

B) Age and Date of Birth

The chronologic age of the patient helps in diagnosis treatment planning and growth prediction. Certain transient conditions, which might be perceived as malocclusion by the patient and parents, can be identified and the concerned are counseled accordingly. The age of the patient also dictates the use of certain treatment protocols-for example, surgical correction might be advocated following cessation of growth whereas the same malocclusion might be treated using functional appliances if the patient has a potential to grow.

C) Gender

Sex of the patient also helps in treatment planning Girls mature earlier than boys, i.e. the timing of growth related events including growth spurts, eruption of teeth and onset of puberty are different in males and females. Psychologically also the reaction of males and females may be different to similar malocclusion. Females are generally more concerned about facial aesthetics.

D) Address and Occupation

These are important for communication, assessing the socioeconomic status as well as for records. The socioeconomic status might dictate the kind of appliance required. Also, patients coming from far may require a different appliance therapy as they might not be able to visit the clinician more frequently

2) Patient's perception of the problem (Chief complaint)

The patient should be given the opportunity to express, in their own words, what their problem is and what they would like corrected. They may perceive their problem as:

• Aesthetics

• Functional (speech or mastication difficulties)

• Related to dental health (like a traumatic overbite).

It is important to recognize that the patient's perception of their problem may not always seem appropriate to the trained clinician. However, the patient is unlikely to be satisfied unless their problem is addressed as part of the treatment plan. Allowing the patient to describe their concerns will

help to determine whether the patient's expectations are realistic and achievable.

3) Medical history

Knowledge of a patient's general health is essential and should be obtained prior to examination. It is best obtained by a questionnaire. In most cases orthodontic treatment can be undertaken but precautions may be required prior to extractions. Antibiotic coverage may be required in patients with rheumatic fever or cardiac anomalies even for molar band placement/removal, if the adjacent gums are inflamed or bleeding is anticipated. Mentally or physically challenged patients may require special management. For example diabetic patient may be more prone to intra-oral infections and periodontal problems and Treatment should be avoided in poorly controlled diabetics.

4) Dental history

The patient should be asked about their previous dental experience. This will provide an idea of their attitude towards dental health, what treatment they have had experienced previously, and how this may affect their compliance with orthodontic treatment. In particular, it is important to determine any ongoing dental problems, history of jaw joint problems, and any history of trauma to the teeth. There may also be a history of relevant inherited disorders affecting the dentition (e.g. hypodontia or enamel defects) and previous orthodontic treatment.

5) Habits

The patient should be asked about any previous or ongoing habits that involve the dentition. The most important are digit-sucking habits and the clinician needs to know the duration and nature of the habit. Other habits

such as nail biting may predispose to an increased risk of root resorption.

6) Physical growth status

For some orthodontic treatment, the patient's growth status is important. In some cases, orthodontic treatment is more successful if they are still growing—for example, when a patient has an underlying skeletal problem that could be improved using a process known as growth modification. In others, treatment planning is best undertaken when growth is complete (e.g. an adolescent with a severe Class III malocclusion). The patient, or their parents, can be asked questions to determine if they are still growing.

7) Socio-behavioural factors

Compliance for treatment is also affected by the patient's ability to attend regularly for appointments and any potential practical or social reasons that may make this impossible should be identified. Orthodontic treatment often requires long-term treatment with multiple appointments, and it is important to determine if the patient, and in the case of a child, their family or carer, are able to commit to the whole treatment and the retention that follows. In addition, the patient's ability to comply with treatment may be affected by some behavioural problems

2) Clinical examination in three dimensions

he purpose of the clinical examination is to identify pathological and developmental problems and determine which (if any) diagnostic records are required. It is important to remember that the face and dentition should be examined in all three planes (anteroposteriorly, vertically, and transversely).

A) Extraoral examination

Assessment of the patient should begin with an examination of the facial features because orthodontic treatment can have impact on the soft tissues of the face. Although a number of absolute measurements can be taken, a comprehensive facial assessment involves looking at the balance and harmony between component parts of the face and noting any areas of disharmony. Extraoral examination should start as the patient enters the room and it is important to look at the face and soft tissues when they are in passive and animated states. Once in the dental chair, the patient should be asked to sit and the face examined from the front and in profile, in a position of natural head posture which is the position the patient carries their head naturally. The patient should sit upright in the chair and be asked to focus on something in the distance.

The key to the extra-oral assessment is an understanding of the normal proportions of the face and recognizing when patients deviate from these normal relationships. The patient is assessed extra-orally in the:

• Frontal view (assessing in the vertical and transverse planes)

• Profile view (assessing in the anteroposterior and vertical planes).

An assessment of the smile aesthetics, soft tissues (lips and tongue), and an examination of the temporomandibular joint (TMJ) should also be undertaken.

1) Anteroposterior assessment

This aims to assess the relationship between the tooth-bearing portions of the maxilla and mandible to each other, and also their relationships to the cranial base. The anteroposterior relationship can be assessed in the following three ways:

 Assessing the relationship of the lips to a vertical line, known as the zero meridian, dropped from soft tissue nasion. Zero meridian is the true vertical line dropped from the soft tissue nasion. In a Class I relationship, the upper lip lies on or slightly anterior to this line and the chin point lies slightly behind it (Figure 1).

 Palpating intra-orally the anterior portion of the maxilla at A point and the mandible at B point (Figure 2). A fair picture of the sagittal skeletal relationship can be obtained clinically by placing the index and middle fingers at the approximate A and B points after lip retraction. Ideally, the maxilla is 2 to 3 mm anterior to the mandible in centric occlusion. In skeletal Class II cases, the index finger is much ahead of the middle finger whereas in Class III the middle finger is ahead of the index finger.

 Assessing the convexity of the face by determining the angle between the middle and lower thirds of the face in profile (Figure 3). This is assessed by the angle between the upper face (glabella to subnasale) and the lower face (subnasale to pogonion). The mean value is 12° ± 4°. A patient with a convex profile with an increased angle of facial convexity indicating a Class II skeletal pattern. A patient with a straighter profile with a normal angle of facial convexity indicating a Class I skeletal pattern. A patient with a concave profile indicating a Class III skeletal pattern.

Fig.1: Using zero meridian to estimate anteroposterior relationship.

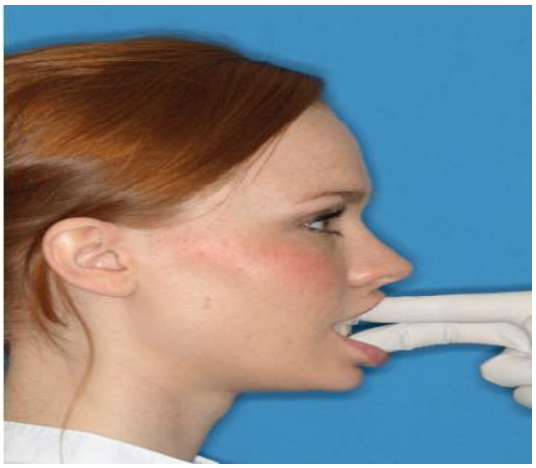


Figure 2: Palpating the anterior portion of the maxilla at A point and the mandible at B point to determine the underlying skeletal anteroposterior relationship. In a normal (Class I) skeletal relationship, as shown here, the upper jaw lies 2–4 mm in front of the lower. In a Class II, the `lower jaw would be greater than 4 mm behind the upper jaw. In a Class III, the lower jaw is less than 2 mm behind the upper (in more severe Class III cases, the lower jaw may be in front of the upper).

Figure 3: The anteroposterior relationship of the jaws can also be assessed using the convexity of the face.

2) Vertical assessment

The face can be assessed vertically in two ways:

• Using the rule of thirds.

• Measuring the angle of the lower border of the mandible to the maxilla.

The face can be split into thirds (Figure 4). In a face with normal proportions, each third is approximately equal in size. Any discrepancy in these thirds may suggest a facial disharmony in the vertical plane. In particular, orthodontists are interested in any increase or decrease in the proportion of the lower third of the face. The lower third of the face can also be split into thirds, with the upper lip lying in the upper third, and the lower lip lying in the lower two-thirds.

Figure 4: The face can be divided into equal thirds: hairline to glabella between the eyebrows (forehead), glabella to subnasale (middle third), and subnasale to lowest part of the chin (lower third). The lower third can be further divided into the thirds, with the upper lip lying in the upper third and the lower lip lying at the top of the lower two-thirds

Another clinical assessment that can be used to determine the vertical relationships is to assess the angle between the lower border of the mandible and the maxilla (Fig. 5). Placing a finger, or the handle of a dental instrument, along the lower border of the mandible gives an indication of the clinical mandibular plane angle.

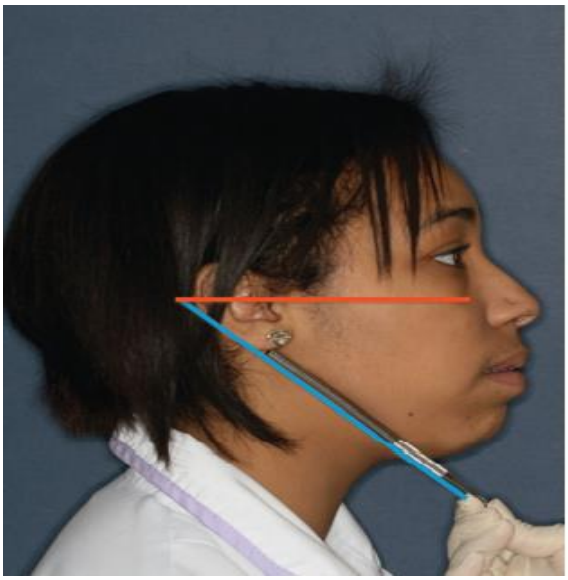


Figure 5: The mandibular plane angle can be estimated clinically by looking at the point of contact of intersecting lines made up by the lower border of the mandible (in blue) and the Frankfort horizontal plane (in red). The Frankfort plane is actually measured on a lateral cephalogram (between porion and orbital), but can be estimated clinically by palpation of the lower border of the orbit. The angle is considered normal if the two lines intersect at the occiput. In this case, the lines intersect anterior to the occiput, which is consistent with an increased angle, suggesting increased vertical proportions. If the lines intersect posterior to the occiput, then the angle would be decreased, indicating reduced vertical proportions.

3) Transverse assessment

The transverse proportions of the face can be examined from the frontal view, but also by looking down on the face, by standing behind and above the patient (Figure 6). No face is truly symmetrical, but any significant asymmetry should be noted. The soft tissue nasion, middle part of the upper lip at the vermillion border, and the chin point should all be aligned.

The face can also be divided into fifths, with each section being approximately equal to the width of an eye (Figure 7). Gross facial asymmetries may be seen in patients with i. Hemifacial hypertrophy/atrophy ii. Congenital defects iii. Unilateral condylar hyperplasia. iv. Unilateral Ankylosis.

Figure 6: The transverse examination of the face should be done from the front, and from above the patient (by standing behind and above the patient while they are seated in the dental chair). (a) The patient has a symmetrical face, with the facial midline showing alignment of the soft tissue nasion, middle part of the upper lip at the vermillion border, and the chin point. (b) The same patient viewed from behind, confirming the symmetry. (c, d) A patient with marked mandibular asymmetry to the right.

Figure 7: In a face with normal transverse proportions, the face can divided into approximately five equal sections—each the width of an eye.

4) Smile aesthetics

Most patients seek orthodontic treatment to improve their smile, so it is important to recognize the various components of a smile that will improve the aesthetics. A normal smile should show the following (Figure 8):

• The whole height of the upper incisors should be visible on full smiling, with only the interproximal gingivae visible. This smile line is usually 1–2 mm higher in females.

• The upper incisor edges should run parallel to the lower lip (smile arc).

• The upper incisors should be close to, but not touching, the lower lip.

• The gingival margins of the anterior teeth are important if they are visible in the smile. The margins of the central incisors and canines should be approximately level, with the lateral incisors lying 1 mm more incisally than the canines and central incisors.

• The width of the smile should be such that buccal corridors should be visible, but minimal. The buccal corridor is the space between the angle of the mouth and the buccal surfaces of the most distal visible tooth.

• There should be a symmetrical dental arrangement.

• The upper dental midline should be coincident to the middle of the face.

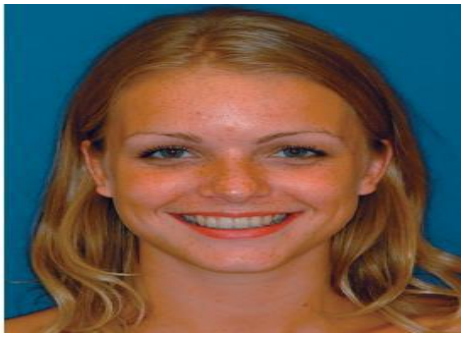


Figure 8: A normal smile.

5) Soft tissue examination

In addition to assessing the smile aesthetics, a soft tissue examination will also assess:

• lips • tongue.

Lips can be competent (i.e. meet together at rest), potentially competent (position of incisors prevents comfortable lip seal to be obtained at rest, but the patient can hold the lips together if required), or incompetent (require considerable muscular activity to obtain a lip seal). The relationship of the lips should also be evaluated from the frontal view (Figure 9):

• Competent lips are together at rest;

• Potentially competent lips are apart at rest, but this is due to a physical obstruction, such as the lower lip resting behind the upper incisors; and

• Incompetent lips are apart at rest and require excessive muscular activity to obtain a lip seal.

Lip incompetence is common in preadolescent children, but increases with age due to vertical growth of the soft tissues. The ability to achieve lip competence is particularly important when reducing an overjet in a Class II division 1 malocclusion, as the stability of the case is improved if the upper incisor position is under the control of competent lips at the end of treatment.

Lips should be everted at their base, with some vermillion border seen at rest. Protrusion of the lips does differ between different ethnic groups

with patients of Afro- Caribbean origin being more protrusive than those of Caucasian origin. The use of Ricketts' esthetic line (E-line) provides a guide to the appropriate prominence of the lips within the face).

The nasolabial angle is formed between the base of the nose and the upper lip and should be 90–110° (Figure 10). It can be affected by the shape of the nose, but also the drape of the upper lip. The drape of the upper lip can be affected by the support of the upper incisor. If the shape of the nose is normal, a high nasolabial angle could therefore indicate a retrusive lip, whereas a low nasolabial angle could indicate lip protrusion.

The reason why an assessment of the tongue is performed during the extra-oral examination is to determine the method by which patients achieve an anterior seal during swallowing, and the position of the tongue at rest. In some patients with incompetent lips, the tongue thrusts forward to contact with the lips to form an anterior seal. This is usually adaptive to the underlying malocclusion, so when the treatment is complete and normal lip competence can be achieved, the tongue thrust ceases. In some patients, there is a so-called endogenous tongue thrust, which will re-establish itself after treatment, leading to relapse. Being able to identify cases that may have this strong relapse potential would be helpful. It is, however, very difficult to confidently distinguish between an adaptive tongue thrust and an endogenous tongue thrust. Patients with an endogenous tongue thrust tend to show proclination of both the upper and lower incisors, an anterior open bite, an associated lisp, and the tongue tends to sit between the incisors at rest. It is probably the resting position of the tongue, rather than the action of the tongue in function that is more important.

Figure 9: Competent (left), potentially competent (middle) and incompetent (right) lips.

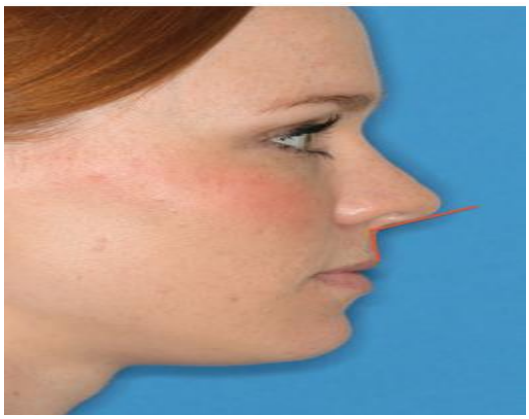


Figure 10: The normal nasolabial angle is 90–110°. This is important to note as the angle can be affected by orthodontic movement of the upper incisors.

B) Intraoral examination

The intra-oral examination allows the clinician to assess the:

• Stage of dental development (by charting the teeth present)

• Soft tissues and periodontium for pathology

• Oral hygiene

• Overall dental health, including identifying any caries and restorations

• Tooth position within each arch and between arches.

1) Assessment of oral health

It is key that any pathology is identified in the mucosal surfaces, periodontally or in the teeth themselves. Generally, any pathology needs

to be treated and stabilized before any orthodontic treatment can be undertaken. Periodontal disease is fortunately unusual in child patients, but is relatively common in adults. Any mucogingival or periodontal problems need to be carefully noted. The importance of identifying and stabilizing periodontal disease, allowing us to modify treatment planning and mechanics for these patients. Excellent oral hygiene is essential for orthodontic treatment otherwise there is a high risk of decalcification and increased attachment loss. Treatment should not begin until a patient can demonstrate they can consistently maintain high levels of oral hygiene. Dental pathology can have a significant influence on the treatment plan, and additional radiographs and special tests (such as vitality tests) may be required. We are particularly interested in detecting:

• caries. • areas of hypomineralization • effects of previous trauma • non-vital teeth • tooth wear • teeth of abnormal size or shape • existing restorations which may change the way we bond to the tooth, as well determine the choice of extractions if space is required.

2) Assessment of each dental arch

Each arch is assessed individually for:

• Crowding or spacing.

• Alignment of teeth, including displacements or rotations of teeth.

• Inclination of the labial segments (proclined, upright, or retroclined).

• Angulation of the canines (mesial, upright, or distal) as this affects anchorage assessment later.

• Arch shape and symmetry • depth of curve of Spee.

3) Assessment of arches in occlusion

The arches are now assessed in occlusion. The incisor relationships are assessed first: incisor classification, overjet or anterior crossbites (anteroposterior), overbite or open bite (vertical), and centerlines (transverse). Then the buccal relationships are assessed: canine and molar relationships (anteroposterior), any lateral open bites (vertical), and buccal crossbites (transverse).

 Incisor classification.

 Overjet

This is measured from the labial surface of the most prominent incisor to the labial surface of the mandibular incisor. This would normally be 2–4 mm. If the lower incisor lies anterior to the upper incisors, then overjet is given a negative value.

 Overbite

This measures how much the maxillary incisors overlap the mandibular incisors vertically. There are three features to note when assessing the overbite: • Amount of overlap. • Whether the lower teeth are in contact with the opposing teeth or soft tissues (complete overbite) or if they are not touching anything (incomplete overbite). • Whether any soft tissue damage is being caused (when it is described as traumatic). A normal value would be one-third coverage of the crown of the lower incisor. If the overlap is greater than this, the overbite is described as increased, and if it is less than this, it is decreased. If there is no overlap at all, it is an anterior open bite. Occasionally an overbite can be traumatic.

 Centrelines (midline)

The centrelines should ideally be coincident with each other and to the facial midline.

 Canine and molar classification.

 Crossbite

My great wishes for my lovely students for success. Thanks

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Lecture 2 [5th] د.حيدر سعد حنفوش

Orthodontics

Occlusion and Temporo-mandibular joint

Occlusion

Orthodontics is the speciality of dentistry concerned with the management and treatment of malocclusion. In the majority of cases, a malocclusion does not in itself represent a disease state, but rather a variation from what is considered ideal. It is therefore important to have a clear definition of what is meant by an ideal occlusion, as this will form a basis for diagnosis and treatment planning.

The term occlusion has both static and dynamic aspects. Static refers to the form, alignment and articulation of teeth within and between dental arches and the relationship of teeth to their supporting structures. Dynamic refers to the function of the stomatognathic system as a whole comprising teeth, supporting structures, temporomandibular joint, and neuromuscular and nutritive systems. The term normal and malocclusion as used in orthodontics refers mainly to the static aspect or the form of the dentition.

Ideal occlusion: Is the harmonious static and dynamic relationship of teeth and jaws that dentists would like to reproduce when restoring a patient's entire mouth to good form and function.

Normal occlusion: Is an absence of large or many facets, bone loss, closed vertical dimension, bruxing habit, freedom from joint pain, and

crooked and loose teeth.

Centric Occlusion: It is the maximum intercuspation or contact attained between maxillary and mandibular posterior teeth.

Centric Relation: Centric relation is the most posterior position of the mandible relative to the maxilla at a given vertical dimension.

Centric Relation Occlusion: Centric relation occlusion (when centric relation and centric occlusion coincide) is the simultaneous even contact between maxillary and mandibular teeth into maximum interdigitation with the mandible in centric relation (most retruded position).

Therapeutic Occlusion: It is an occlusion that has been modified by appropriate therapeutic modalities in order to change a nonphysiological occlusion to one that is at least physiologic, if not ideal.

Traumatic Occlusion: Traumatic occlusion is an abnormal occlusal stress, which is capable of producing or has produced an injury to the periodontium.

Types of Cusps:

The human dentitions present two types of cusps and are as follows::

 Centric Holding Cusp/Stamp Cusp/Supporting Cusp

The palatal cusps of the maxillary posterior teeth and the buccal cusps of the mandibular posterior teeth are referred to as supporting cusps. Supporting cusps are also called as centric holding cusps or stamp cusps and they occlude into the central fossa and marginal ridges of opposing teeth (Figure 1).

□ Guiding Cusp/Shear Cusp/Non-supporting Cusp

The buccal cusps of the maxillary posterior teeth and the lingual cusps of the mandibular posterior teeth are called Non-supporting cusps. These are also called as guiding or shear cusps and they guide the mandible during lateral excursions and the shear food during mastication (Figure 2).

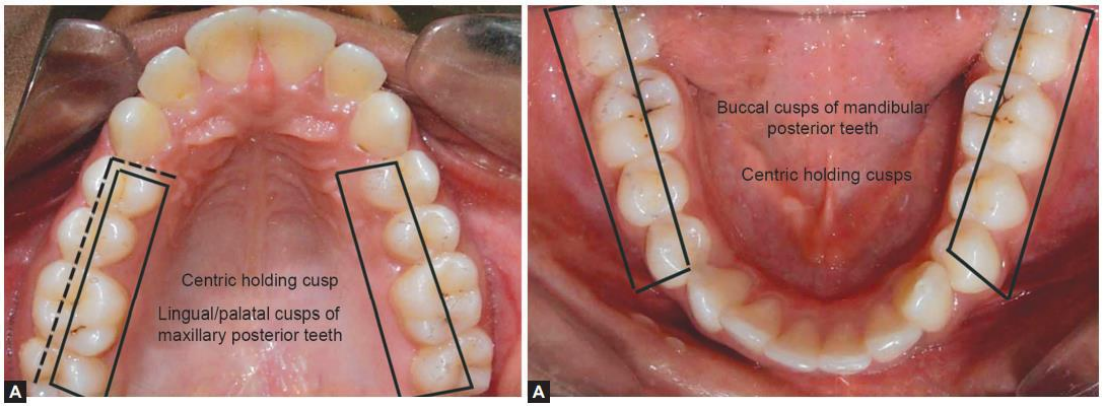


Figure 1: Supporting cusp/centric holding cusp/stamp cusp.

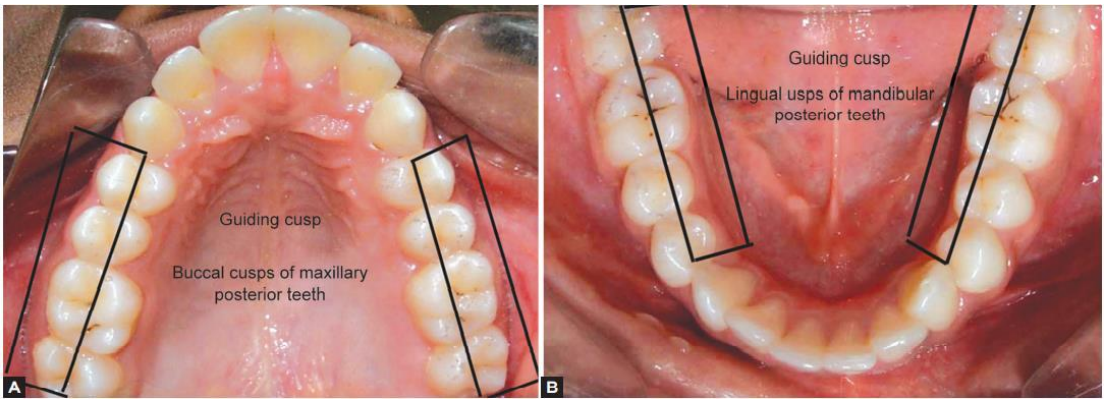


Figure 2: Non-supporting cusp/guiding cusp/shear cusp.

CENTRIC OCCLUSAL CONTACTS

One scheme of occlusal contacts, presented by Hellman included 138 points of possible occlusal contacts for 32 teeth (Figure 3). Concepts of ideal occlusion are used primarily in orthodontics and even in restorative dentistry. Centric occlusal contacts are classified into anterior centric occlusal contacts and posterior centric occlusal contacts points.

Anterior Centric Occlusal Contacts

Anterior centric occlusal contacts consist of the labial and lingual range of contacts of maxillary and mandibular anteriors and are in line with the buccal range of posterior centric contacts.

Anterior centric occlusal contacts are listed below: „

 Palatal surfaces of maxillary incisors and canines—6 „

 Labial surfaces of mandibular incisors and canines—6.

Posterior Centric Occlusal Contacts

Posterior centric occlusal contacts consist of the buccal range of contacts and the lingual range of contacts of maxillary and mandibular posteriors.

Figure 3: Occlusal contacts for the Maxillary arch and the Mandibular arch.

Cusp-Fossa Occlusion: The supporting cusp of one tooth occludes in a single fossa of a single opposing tooth are referred to as cusp-fossa occlusion or tooth-to-tooth arrangement (Figure 4).

Cusp-Embrasure Occlusion: When a tooth occludes with two opposing

teeth, it is called cuspembrasure occlusion or tooth to two teeth occlusion (Figure 4).

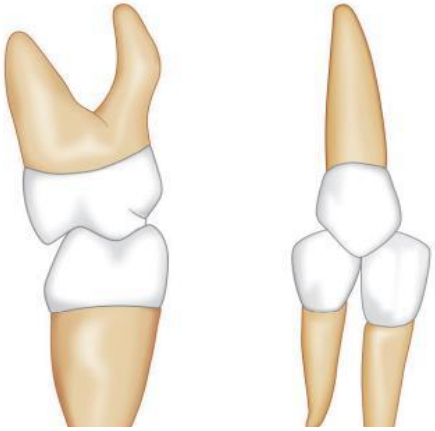


Figure 4: Cusp-Fossae (left), Cusp-embrasure (right).

IMAGINARY OCCLUSAL PLANES AND CURVES

Curve of Spee (Anteroposterior Curve/the Curve of Occlusal Plane)

lt refers to the anteroposterior curvature of the occlusal surfaces, beginning at the tip of the lower cuspid and following cusp tip of the bicuspids and molars continuing as an arc through to the condyle. If the curve were extended, it would form a circle of about 4 inches diameter. The curve of the maxillary arch is convex and that of the mandibular arch is concave (Figure 5).

Curve of Wilson (Side-to-Side Curve)

When viewed from anterior aspect with the mouth slightly open, the cusp tips of the posterior teeth follow a gradual curve from the left side to the right side (Figure 6). The curve of the maxillary arch is convex that of the mandibular arch is concave. Thus, the lingual cusps of the posterior teeth are aligned at a lower level than the buccal cusps on both sides and in both arches.

The curve helps in two ways

1. Teeth aligned parallel to the direction of medial pterygoid for optimum resistance to masticatory forces.

2. The elevated buccal cusps prevent food from going 'past the occlusal table.

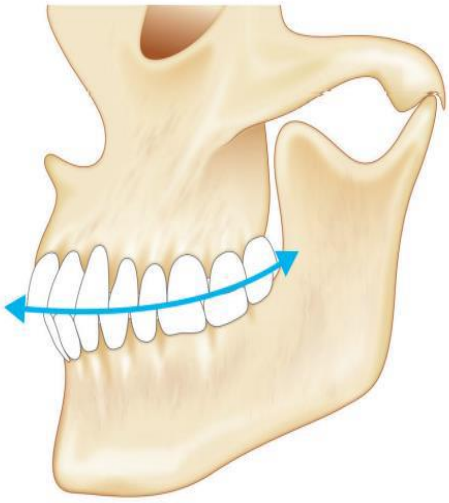


Figure 5: Curve of Spee

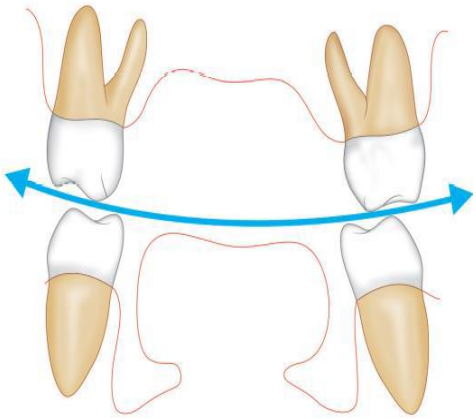


Figure 6: Curve of Wilson.

Occlusion in orthodontics

The concept and philosophy of “normal” occlusion in orthodontics developed in relation to the teeth having a “specific arrangement” in the dental arches (intra-arch) and in relation to opposing arches (inter-arch). The well-aligned dental arches that have “normal” labial and buccal overjet, some overbite, and a “normal” anteroposterior relationship between maxillary and mandibular arches constitute normal occlusion. Historically, cusp-to-fossa relationships of upper and lower teeth were regarded as being of special significance. In the late nineteenth and early twentieth centuries, Angle (1899) emphasized the relationship of the mesiobuccal cusp of the maxillary first molar to the buccal groove of the

mandibular first molar as the “key factor” in the establishment of a class I molar “normal” relationship. He considered the maxillary first molar to be a stable tooth, which occupied a distinct relationship in the maxillary bone. The position of each dental unit in the arch was also described in terms of its unique “axial inclination”.

Clinical observations on occlusion were considered both within an arch and in relation to the opposing arches. Within the arch the following were considered: tight proximal contacts, labiolingual and buccolingual placement, rotation, and labiolingual and mesiodistal inclination.

Angle also believed that a full complement of teeth was essential for teeth to be in balance with facial harmony.

Following Angle, clinical research evidence was considered. Studies from the University of Illinois reported that the maxillary first molar did not always have a distinct relationship with the key ridge in the maxilla. The research by Begg (1954) on the occlusion of Australian Aborigines suggested that reduction in tooth substance by proximal and occlusal wear was physiological. Tweed (1954) considered the face and the occlusion from the perspective of axial inclination of the lower incisors and their relationship with the mandibular plane as a guide for determining normal or abnormal relationships of other dental units to their basal bones. In 1972 Andrew’s Six Keys of Occlusion Normal occlusion can be best defined as the contact of the upper and lower teeth in the centric relationship. But the concept of “normal occlusion” is still not clear. Different authors defined normal occlusion but no single definition could be found as yet The concepts, which are described here, are based on Lawrence Andrew’s works on 120 nonorthodontic models based upon which he gave six keys to normal occlusion and developed

the “straight wire appliance.” These are:

KEY I Molar relationship (Figure 7): The molar relationship should be such that the distal surface of the distal marginal ridge of the upper first permanent molar contacts and occludes with the mesial surface of the mesial marginal ridge of the lower second molar.

Secondly, the mesiobuccal cusp of the upper first permanent molar falls within the groove between the mesial and middle cusps of the lower first permanent molar. Also, the mesiolingual cusp of the upper first molar seats in the central fossa of the lower first molar.

KEY II Crown angulation (Figure 8): The mesiodistal "tip". In normally occluded teeth, the gingival portion of the long axis (the line bisecting the clinical crown mesiodistally or the line passing through the most prominent part of the labial or buccaI surface of a tooth) of each crown is distal to the occlusal portion of that axis. The degree of tip varies with each tooth type.

KEY III Crown inclination (Figure 9): The labiolingual or buccolingual, "torque". Crown inclination is the angle between a line 90 degrees to the occlusal plane, and a line tangent to the middle of the labial or buccal surface of the clinical crown. The crowns of the maxillary incisors are so placed that the incisal portion of the labial surface is labial to the gingival portion of the clinical crown. In all other crowns, the occlusal portion of the labial or buccal surface is lingual to the gingival portion. In the maxillary molars the lingual crown inclination is slightly more pronounced as compared to the cuspids and bicuspids. In the mandibular posterior teeth the lingual inclination progressively increases.

KEY IV Absence of Rotations (Figure 10): Teeth should be free of undesirable rotations. If rotated, a molar or bicuspid occupies more space than it would normally. A rotated incisor can occupy less space than normal.

KEY V Tight contacts (Figure 11). In the absence of such abnormalities as genuine toothsize discrepancies, contact points should be tight.

KEY VI Flat curve of Spee (Figure 12). A flat occlusal plane is a must for stability of occlusion. It is measured from the most prominent cusp of the lower second molar to the lower central incisor, no curve deeper than 1.5 mm is acceptable from a stand point of stability.

Figure 7

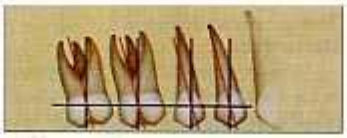


Figure 8

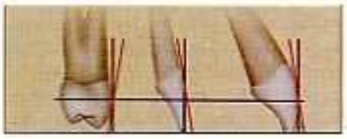


Figure 9

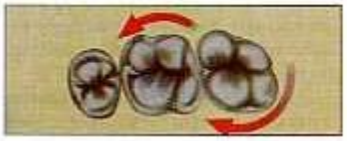


Figure 10

Figure 11

Figure 12

Temporo-mandibular joint (TMJ) examination

It is important to note the presence of any signs of pathology in the TMJ and muscles of mastication during the orthodontic assessment. Any tenderness, clicks, crepitus, and locking should be noted, as well as recording the range of movement and maximum opening. There is no strong evidence to suggest that TMJ disorders are either associated with malocclusions or cured by orthodontic treatment. However, if signs or

symptoms are detected then they must be recorded and it may be worth referring the patient to a specialist before commencing orthodontic treatment.

Dentition

Humans have two sets of dentition namely, deciduous and permanent, which contain 20 and 32 teeth respectively. The formation and eruption of these teeth follow a definite pattern and fairly consistent timetable..

Knowledge of the calcification times of the permanent dentition is invaluable if one wishes to impress patients and colleagues. It is also helpful for assessing dental as opposed to chronological age; for determining whether a developing tooth not present on radiographic examination can be considered absent; and for estimating the timing of any possible causes of localized hypocalcification or hypoplasia.

	Calcification commences (weeks *in utero*)	Eruption (months)
Primary dentition		
Central incisors	12–16	6–7
Lateral incisors	13–16	7–8
Canines	15–18	18–20
First molars	14–17	12–15
Second molars	16–23	24–36
Root development complete 1–1½ years after eruption		

	Calcification commences (months)	Eruption (years)
Permanent dentition		
Mand. central incisors	3–4	6–7
Mand. lateral incisors	3–4	7–8
Mand. canines	4–5	9–10
Mand. first premolars	21–24	10–12
Mand. second premolars	27–30	11–12
Mand. first molars	Around birth	5–6
Mand. second molars	30–36	12–13
Mand. third molars	96–120	17–25
Max. central incisors	3–4	7–8
Max. lateral incisors	10–12	8–9
Max. canines	4–5	11–12
Max. first premolars	18–21	10–11
Max. second premolars	24–27	10–12
Max. first molars	Around birth	5–6
Max. second molars	30–36	12–13
Max. third molars	84–108	17–25
Root development complete 2–3 years after eruption.		

Temporo-mandibular joint dysfunction (TMD)

The aetiology and management of TMD has caused considerable controversy in all branches of dentistry. TMD comprises a group of related disorders with multifactorial aetiology including psychological, hormonal, genetic, traumatic, and occlusal factors. Studies suggests that depression, stress, and sleep disorders are major factors in the aetiology of TMD and that parafunctional activity, for example bruxism, can contribute to muscle pain and spasm. Some authors suggested that minor occlusal imperfections can lead to abnormal paths of closure and/or bruxism, which then result in the development of TMD; however if this were the case, a much higher prevalence of TMD would be expected to reflect the level of malocclusion in the population.

The role of orthodontics in TMD has been extensively debated, with some authors claiming that orthodontic treatment can cause TMD, while others advocate appliance therapy to manage TMD. After considerable discussion in the literature, the consensus view is that orthodontic treatment, either alone or in combination with extractions, cannot be

reliably shown to either ‘cause’ or ‘cure’ TMD. The alleged success of a wide assortment of treatment modalities for TMD highlights both the multifactorial aetiology and the self-limiting nature of the condition.

Given this, conservative and reversible approaches are advised to manage TMD in the first instance. It is advisable to carry out a TMD screen for all potential orthodontic patients, including questions about symptoms, examination of the temporo-mandibular joint and associated muscles, and a record of the range of opening and movement.

Therefore, if patients present with signs/symptoms of a TMD condition, clinicians will be faced with two choices. They can either manage the TMD problem for this patient prior to initiating prolongs interventions, or they may refer to a colleague with expertise in the field of TMD and orofacial pain. If the choice is made to manage this individual, then it should be done in accordance with currently accepted guidelines for TMD diagnosis and treatment.

The history portion of a TMD assessment should be similar to that conducted by all dental practitioners.

1) Chief complaint

The chief complaints as presented in the patient’s own words. These complaints should be documented in the order of severity as expressed by the patient, and details of each complaint are elicited in a systematic manner. This is then followed by the history of the chief complaint which should include such information as the location of the pain(s), date of onset, event onset (spontaneous or stimulus induced), quality, frequency, duration, and intensity.

2) A TMD Screen Examination

The screening examination should include the palpation of facial muscle, and the TMJs as well as observations of jaw movement.

Muscle Palpation

Several important muscles of the masticatory system are palpated for pain or tenderness during the screening examination. The temporalis (Figure 13) and masseter muscles (Figure 14) are palpated bilaterally. Palpation of the muscle is accomplished mainly by the palmar surface of the middle finger, with the index finger and forefinger testing the adjacent areas. Soft but firm pressure is applied to the designated muscles, the fingers compressing the adjacent tissues in a small circular motion. A single firm thrust of 1 or 2 seconds duration is usually better than several light thrusts. During palpation, the patient is asked whether it hurts or is just uncomfortable.

Figure 13: Palpation of the temporalis.

Figure 14: Palpation of the masseter muscle

Temporomandibular Joint Palpation

The TMJs are examined for any signs or symptoms associated with pain and dysfunction.

Pain or tenderness of the TMJs is determined by digital palpation of the joints when the mandible is both stationary and during dynamic movement, fingertips are placed over the lateral aspects of both joint areas simultaneously (Figure 15). The patient is asked to report any symptoms, once the symptoms are recorded in a static position, the patient opens and closes, and any symptoms associated with this movement are recorded. As the patient opens maximally, the fingers should be rotated slightly posteriorly to apply force to the posterior aspect of the condyle. Posterior capsulitis and retrodiscitis are clinically evaluated in this manner.

Joint sounds are recorded as either clicks or crepitation. A click is a single sound of short duration. If it is relatively loud, it is sometimes referred to as a pop. Crepitation is a multiple, gravel-like sound described as “grating” and “complicated.” A more careful examination can be performed by placing a stethoscope over the joint area. Not only should the character of any joint sounds be recorded (clicking or crepitation), but also the degree of mouth opening associated with the sound. Of equal importance is whether the sound occurs during opening or closing or can be heard during both these movements.

Figure 15: Palpation of TMJ in closed, opened and fully opened mouth position.

Range of Mandibular Movement

A screening examination should also include evaluation of the patient's range of mandibular movement. The normal range of mouth opening when interincisally measured is between 53 and 58mm. Even a 6-year-old child can normally open a maximum 40mm or more. The patient is asked to open slowly until pain is first felt (Figure 16). At that point, the distance between the incisal edges of the maxillary and mandibular anterior teeth is measured. This is the maximum comfortable opening. The patient is next asked to open the mouth maximally. This is recorded as the maximum opening. In the absence of pain, the maximum comfortable opening and maximum opening are the same. A restricted mouth-opening is considered to be any distance less than 40mm. Only 1.2% of young adults open less than 40mm. Less than 40mm of mouth opening, therefore, seems to represent a reasonable point to designate

restriction; however, one should always consider the patient's age and body size. The patient is next instructed to move his mandible laterally. A lateral movement less than 8mm is recorded as a restricted movement. Protrusive movement is also evaluated in a similar manner.

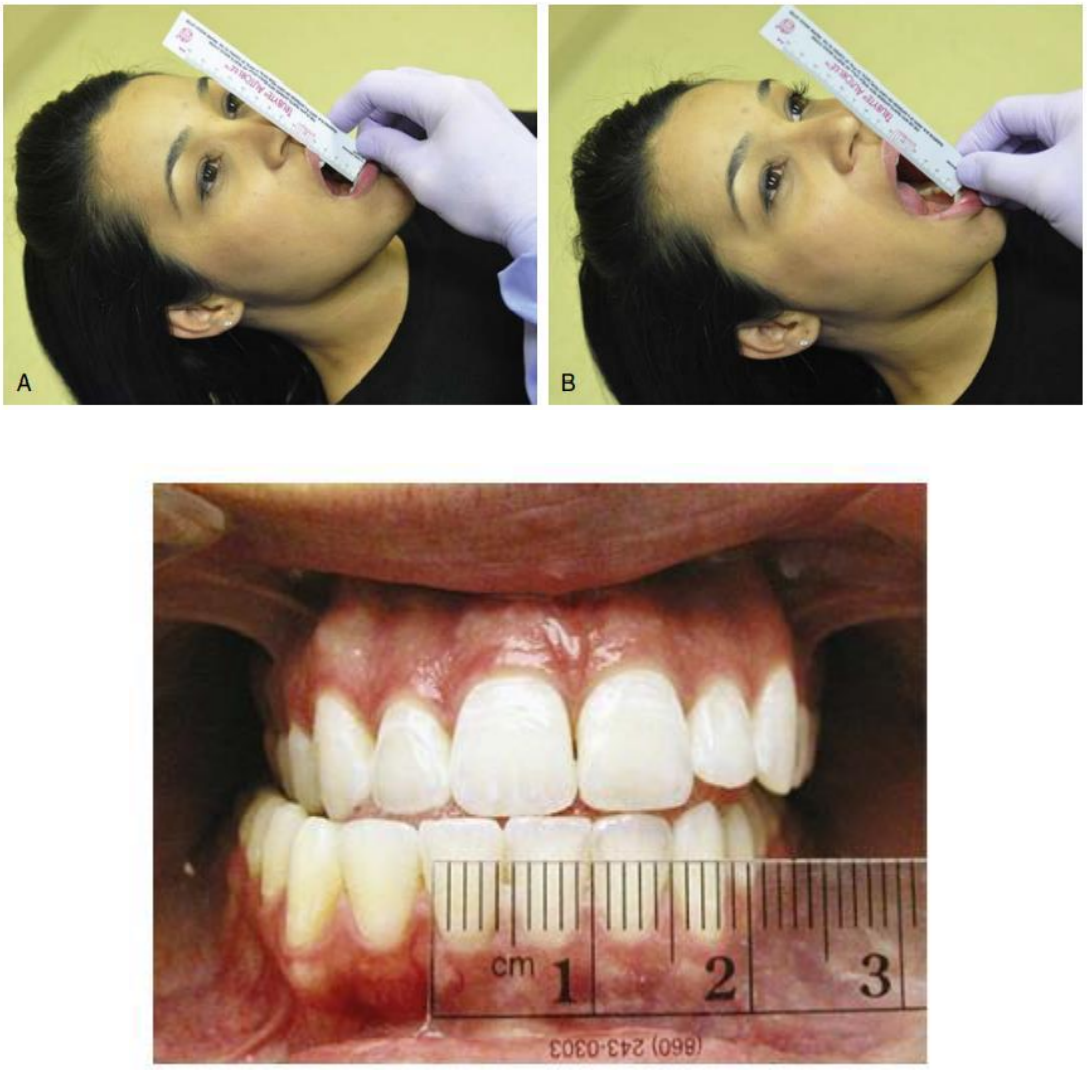


Figure 16: Measuring the amount of mouth opening and lateral eccentric movement.

My great wishes for my lovely students for success. Thanks

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Lecture 3+4 [5th] **د.حيدر سعد حنفوش**

Orthodontics

Cephalometry

Cephalometry is the analysis and interpretation of standardized radiographs of the facial bones. In practice, cephalometrics has come to be associated with a true lateral view (Fig. 1). An antero-posterior radiograph can also be taken in the cephalostat, but this view is difficult to interpret and is usually only employed in cases with a skeletal asymmetry.

Fig.1 A lateral cephalometric radiograph. An aluminium wedge has been positioned to attenuate the beam thereby enhancing the view of the soft tissues.

INTRODUCTION

Cephalometries had its beginning in craniometry. For many years anatomists and anthropologists were confined to measuring the craniofacial dimensions of skulls of dead individuals. This was not possible in case of living individuals, where the varying thickness of soft

tissues interfered with the accuracy of these measurements. With the advent of radiography, an alternative method was provided which enabled the researchers to obtain indirectly but with sufficient accuracy, and convenience the skeletal measurements of the human skull. The reproducibility of these radiographs allowed for a longitudinal serial study of growth of living individuals.

The cephalosatat:

In order to be able to compare the cephalometric radiographs of one patient taken on different occasions, or those of different individuals, some standardization is necessary.

To achieve this aim the cephalostat was developed by B. Holly Broadbent in the period after the First World War (Fig. 2). The cephalostat consists of an X-ray machine which is at a fixed distance from a set of ear posts designed to fit into the patient's external auditory meatus. Thus the central beam of the machine is directed towards the ear posts, which also serve to stabilize the patient's head. The position of the head in the vertical axis is standardized by ensuring that the patient's Frankfort plane (for definition see below) is horizontal. This can be done by manually positioning the subject or, alternatively, by placing a mirror some distance away level with the patient's head and asking him or her to look into their own eyes. This is termed the natural head position, and some orthodontists claim that it is more consistent than a manual approach.

It is normal practice to cone down the area exposed so that the skull vault is not routinely included in the X-ray beam.

Fig. 2 :Cephalostat

Unfortunately, attempts to standardize the distances from the tube to the patient (usually between 5 and 6 feet (1.5 to 1.8 m)) and from the patient to the film (usually around 1 foot (around 30 cm)) have not been entirely successful as the values in parentheses would suggest.

Some magnification, usually of the order of 7–8 per cent, is inevitable with a lateral cephalometric film. In order to be able to check the magnification and thus the comparability of different films, it is helpful if a scale is included in the view. In order to allow comparisons between radiographs of the same patient it is essential that the magnification for a particular cephalostat is standardized.

Indications for cephalometric evaluation:

An increasing awareness of the risks associated with X-rays has led clinicians to re-evaluate the indications for taking a cephalometric radiograph

1- An aid to diagnosis

It is possible to carry out successful orthodontic treatment without taking a cephalometric radiograph, particularly in Class I malocclusions.

However, the information that cephalometric analysis yields is helpful in assessing the probable aetiology of a malocclusion and in planning treatment. The benefit to the patient in terms of the additional information gained must be weighed against the X-ray dosage. Therefore a lateral cephalometric radiograph is best limited to patients with a skeletal discrepancy and/or where anteroposterior movement of the incisors is planned. In a small proportion of patients it may be helpful to monitor growth to aid the planning and timing of treatment by taking serial cephalometric radiographs, although again the dosage to the patient must be justifiable. In addition, a lateral view is often helpful in the accurate localization of unerupted displaced teeth and other pathology.

2- A pre-treatment record

A lateral cephalometric radiograph is useful in providing a baseline record prior to the placement of appliances, particularly where movement of the upper and lower incisors is planned.

3- Monitoring the progress of treatment

In the management of severe malocclusions, where tooth movement is occurring in all three planes of space (for example treatments involving functional appliances, or upper and lower fixed appliances), it may be helpful to take a lateral cephalometric radiograph during treatment to monitor incisor inclinations and anchorage requirements.

A lateral cephalometric radiograph may also be useful in monitoring the movement of unerupted teeth and for assessing upper incisor root resorption if this is felt to be a potential risk during treatment.

4- Research purposes

A great deal of information has been obtained about growth and development by longitudinal studies which involved taking serial cephalometric radiographs from birth to the late teens or beyond.

While the data provided by previous investigations are still used for reference purposes, it is no longer ethically possible to repeat this type of study. However, those views taken routinely during the course of orthodontic diagnosis and treatment can be used to study the effects of growth and treatment.

Evaluating a cephalometric radiograph

Before starting a tracing it is important to examine the radiograph for any abnormalities or pathology. For example, a pituitary tumour could result in an increase in the size of the sella turcica. A lateral cephalometric view is also helpful in assessing the patency of the airway, as enlarged adenoids can be easily seen.

A lateral skull radiograph should be hand-traced in a darkened room with suitable back illumination using a hard pencil and high-quality tracing paper attached to the radiograph.

The peripheral regions of the radiograph should be masked to highlight the cranial base and facial complex. Bilateral structures should be traced independently and then averaged. Alternatively, the landmarks and tracing can be digitized directly into a computer using specialized software, which will instantly produce an analysis .

Computer-based cephalometric analysis: The advent of personal computing has resulted in the development of many commercial and

freely available software packages that allow the digitization and manipulation of imported cephalometric lateral skull radiographs (Fig.3). Although landmark identification is still largely under control of the user, measurement error is significantly reduced because the software carries it out. However, the main advantage of these programmes is the versatility they provide, allowing the user to generate numerous different analyses or even customize their own. In addition, they can perform superimpositions, undertake prediction planning for treatment outcome and are extremely useful for planning orthognathic surgery, with superimposition of profile photographs onto the cephalometric tracing allowing the prediction of soft tissue changes associated with surgical jaw movements.

Studies have shown digitizing to be as accurate as tracing a radiograph by hand and with the increasing use of digital radiographs this now becoming the norm.

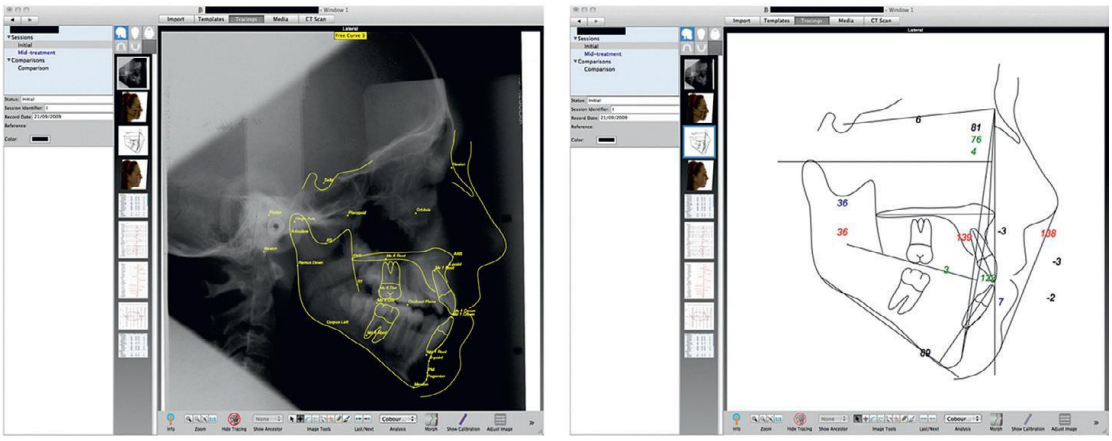


Figure 3: QuickCeph® computer-prediction software for cephalometric planning

Commonly used cephalometric points and reference lines

The points and reference lines are shown in Fig.(4) .

A Point (A): This is the point of deepest concavity on the anterior profile of the maxilla. It is also called subspinale. This point is taken to represent the anterior limit of the maxilla and is often tricky to locate accurately. However, tracing the outline of the root of the upper central incisor first and shielding all extraneous light often aids identification.

A point is located on alveolar bone and is liable to changes in position with tooth movement and growth.

Anterior nasal spine (ANS): This is the tip of the anterior process of the maxilla and is situated at the lower margin of the nasal aperture.

B point (B): The point of deepest concavity on the anterior surface of the mandibular symphysis. B point is also sited on alveolar bone and can alter with tooth movement and growth.

Gonion (Go): The most posterior inferior point on the angle of the mandible. This point can be 'guesstimated', or determined more accurately by bisecting the angle formed by the tangents from the posterior border of the ramus and the inferior border of the mandible .

Menton (Me): The lowest point on the mandibular symphysis.

Nasion (N): The most anterior point on the frontonasal suture. When difficulty is experienced locating nasion, the point of deepest concavity at the intersection of the frontal and nasal bones can be used instead.

Orbitale (Or): The most inferior anterior point on the margin of the orbit. By definition, the left orbital margin should be used to locate this point. However, this can be a little tricky to determine radiographically, and so an average of the two images of left and right is usually taken.

Pogonion (Pog): The most anterior point on the mandibular symphysis.

Porion (Po): The uppermost outermost point on the bony external auditory meatus. This landmark can be obscured by the ear posts of the cephalostat, and some advocate tracing these instead. However, this is not recommended as they do not approximate to the position of the external auditory meatus. The uppermost surface of the condylar head is at the same level, and this can be used as a guide where difficulty is experienced in determining porion.

Posterior nasal spine (PNS): This is the tip of the posterior nasal spine of the maxilla. This point is often obscured by the developing third molars, but lies directly below the pterygomaxillary fissure.

Sella (S): The midpoint of the sella turcica.

SN line: This line, connecting the midpoint of sella turcica with nasion, is taken to represent the cranial base.

Frankfort plane: This is the line joining porion and orbitale. This plane is difficult to define accurately because of the problems inherent in determining orbitale and porion.

Mandibular plane: The line joining gonion and menton. This is only one of several definitions of the mandibular plane, but is probably the most widely used.

Maxillary plane (Palatal plane): The line joining anterior nasal spine with posterior nasal spine. Where it is difficult to determine ANS and PNS accurately, a line parallel to the nasal floor can be used instead.

Functional occlusal plane: A line drawn between the cusp tips of the permanent molars and premolars (or deciduous molars in mixed

dentition). It can be difficult to decide where to draw this line, particularly.

If there is an increased curve of Spee, or only the first permanent molars are in occlusion during the transition from mixed to permanent dentition. The functional plane can change orientation with growth and/or treatment, and so is not particularly reliable for longitudinal comparisons.

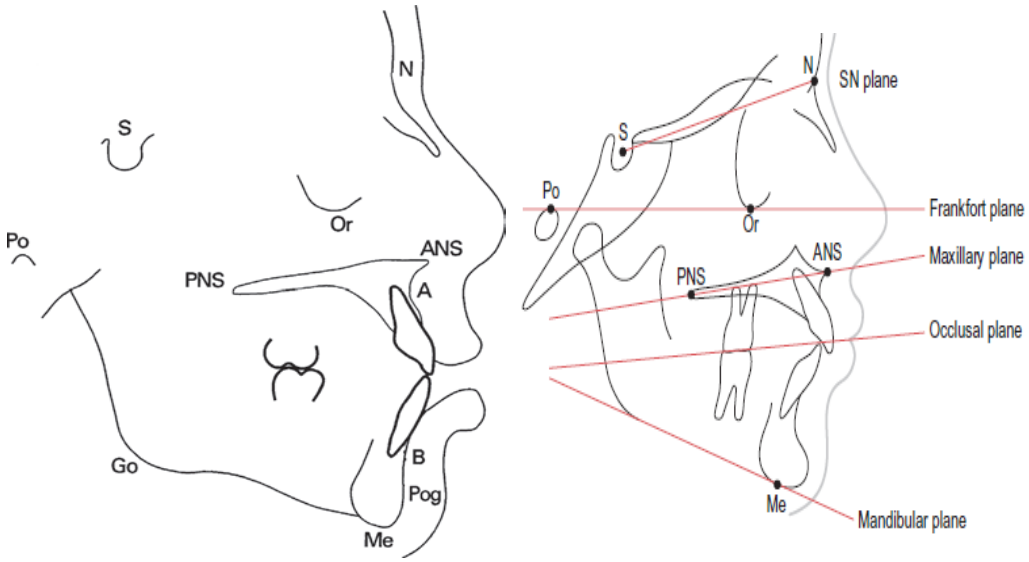
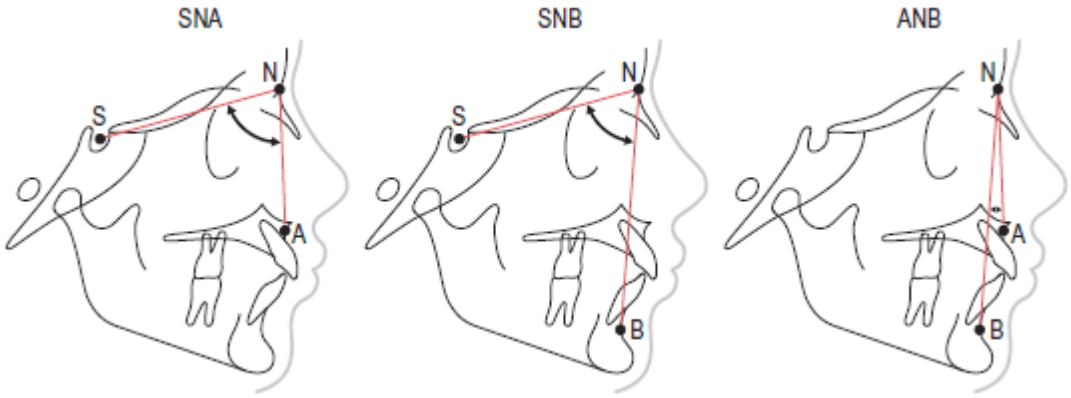


Fig.4:Commonly used cephalometric points and planes

Assessment of Anteroposterior skeletal pattern

1- Angle **ANB**: In order to be able to compare the position of the maxilla and mandible, it is necessary to have a fixed point or plane. The skeletal pattern is often determined cephalometrically by comparing the relationship of the maxilla and mandible with the cranial base by means of angles SNA and SNB. The difference between these two measurements, angle ANB, is classified broadly as follows:

ANB < 2° = Class III, 2- 4° = Class I , ANB > 4° = Class II



If SNA is increased or reduced from the average value, this could be due to either a discrepancy in the position of the maxilla (as indicated by point A) or nasion. The following (rather crude) modification is often used in order to make allowance for this:

Provided the angle between the maxillary plane and the sella–nasion line is within 5–11° :

• if SNA is increased, for every degree that SNA is greater than 81° , subtract 0.5° from ANB;

• if SNA is reduced, for every degree that SNA is less than 81° , add 0.5° to ANB.

If the angle between the maxillary plane and the sella–nasion line is not within 5–11° , this correction is not applicable.

2- Ballard conversion:

This analysis uses the incisors as indicators of the relative position of the maxilla and mandible**.** It is easy to confuse a Ballard conversion and a prognosis tracing (Fig.5), but in the former the aim is to tilt the teeth to their normal angles (thus eliminating any dento-alveolar compensation) with the result that the residual overjet will indicate the relationship of the

maxilla to the mandible.

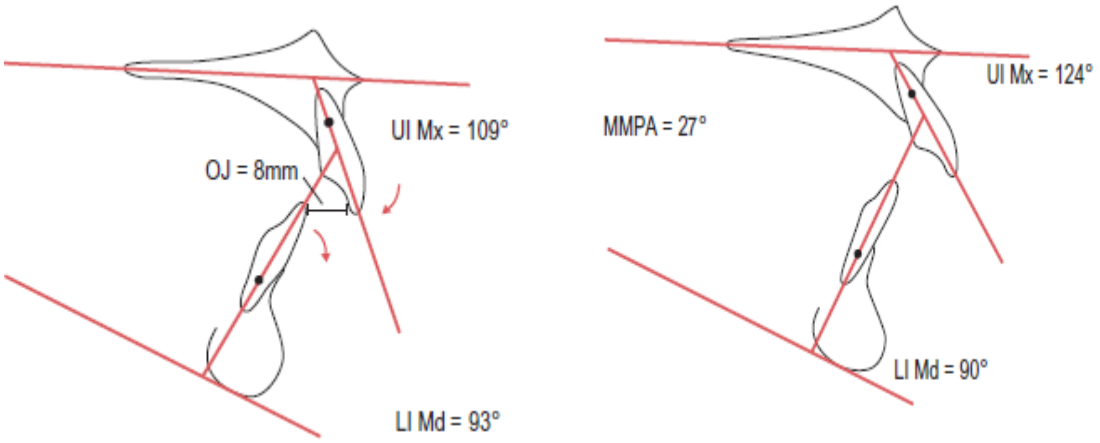


Figure .5: Ballard's conversion tracing. In the upper tracing, the UI to maxillary plane angle is 124˚ , whilst the LI to mandibular plane is 90˚ . The normal values should be 109˚ and 93˚ respectively (the lower incisor to mandibular plane value is calculated by subtracting the maxillary–mandibular plane angle (MMPA) from 120˚). By adjusting these teeth to their normal values around a fulcrum approximately one third of the root length from the apices, it can be seen that the overjet is still increased and therefore the skeletal pattern is class II.

3- Wits analysis

This analysis compares the relationship of the maxilla and mandible with the occlusal plane. There are several definitions of the occlusal plane, but for the purposes of the Wits analysis it is taken to be a line drawn between the cusp tips of the molars and premolars (or deciduous molars), which is known as the functional occlusal plane. Perpendicular lines from both point A and point B are dropped to the functional occlusal plane to give points AO and BO. The distance between AO and BO is then measured. The mean values are 1 mm (SD ±1.9 mm) for males and 0 mm (SD ±1.77 mm) for females (Fig. 6).

The main drawback to the Wits analysis is that the functional occlusal

plane is not easy to locate, which obviously affects the accuracy and reproducibility of the Wits analysis. A slight difference in the angulation of the functional occlusal plane can have a marked effect on the relative positions of AO and BO.

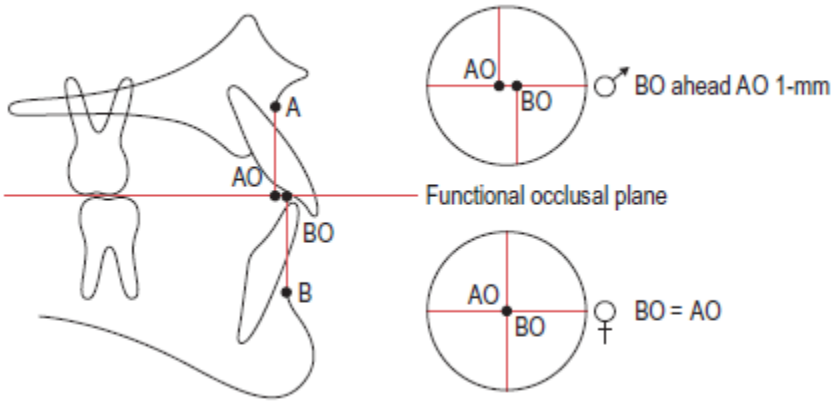


Figure (6): Wits method. Perpendicular lines are dropped from A and B points to the functional occlusal plane. For males BO should lie 1 mm ahead of AO, whilst for females AO and BO should coincide. In a skeletal class II, AO lies ahead of BO, whilst in a class III discrepancy, BO is significantly ahead of AO.

Assessing the vertical skeletal relationship

The vertical jaw relationship can also be assessed in a number of ways (Fig.7):

1- Maxillary–mandibular plane angle (MMPA)

The MMPA is a common method for evaluating the vertical jaw relationship, with horizontal reference planes that are easily located. The mean value is 27° ± 5° .

2- Frankfort–mandibular plane angle (FMPA)

The FMPA uses the Frankfort plane as a horizontal reference to the mandibular plane.

This method ignores the maxillary plane, which if affected by a significant cant can give a misleading value to the vertical jaw relationship. It is useful to use this measurement in conjunction with the MMPA plane angle. The mean value is 27° ± 5°.

3- Anterior and posterior face heights

Anterior and posterior face heights are also used as a measure of vertical facial relationships (Fig.8):

• Total anterior face height (TAFH) extends from nasion to menton, with both lines constructed perpendicular to the maxillary plane (mean 119 mm in an adult male).

TAFH is further subdivided into:

• Upper anterior face height (UAFH); nasion to maxillary plane (mean 54 mm);

• Lower anterior face height (LAFH); maxillary plane to menton (mean 65 mm); and

• Total posterior face height (TPFH) extends from sella to gonion, with both lines constructed perpendicular to the maxillary plane (mean 79 mm in an adult male). TPFH is therefore subdivided into:

• Upper posterior face height (UPFH); sella to maxillary plane (mean 46 mm);

• Lower posterior face height (LPFH); maxillary plane to gonion (mean 33 mm);

And • The TPFH should be approximately 65% of the TAFH.

It should be noted that the TPFH (unlike the TAFH) is influenced by a particularly superior or inferior position of sella and this will affect the TPFH/TAFH ratio. Referring to the SN–maxillary plane angle can cheque the relative position of sella within the cranium.• The LAFH should be approximately 55% of the TAFH.

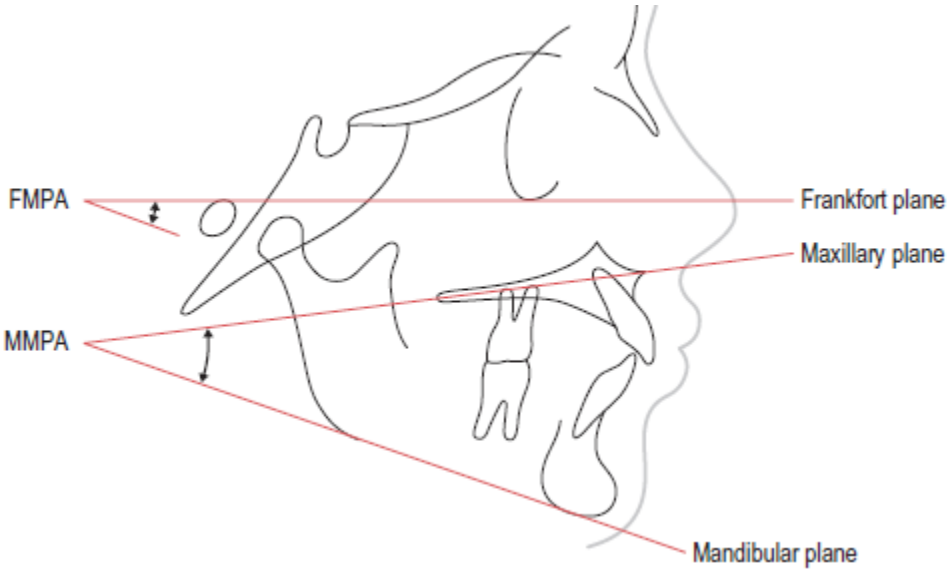


Figure 7: Vertical facial relationships. FMPA, Frankfort–mandibular plane angle; MMPA, maxillary–mandibular plane angle.

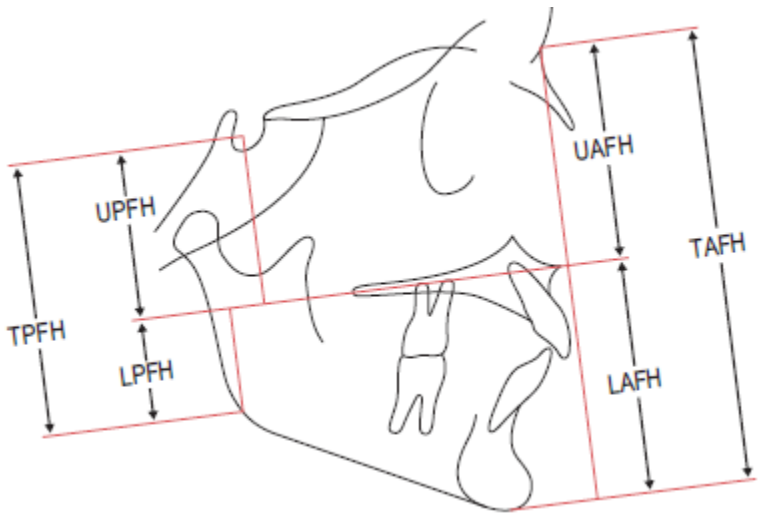


Figure 8: Face heights. LAFH, lower anterior face height; LPFH, lower posterior face height; TAFH, total anterior face height; TPFH, total posterior face height; UAFH, upper anterior face height; UPFH, upper posterior face height

Assessing the dental relationship

Several methods of assessment are available for positioning the maxillary and mandibular dentition in relation to the jaws and face.

1- Maxillary incisor relationship: The inclination of the most prominent maxillary incisor is constructed using a line through long axis of upper incisor and measured in relation to the maxillary plane (Fig. 9). The mean value is 109° ± 6° .

2- Mandibular incisor relationship: The inclination of the most prominent mandibular incisor is constructed using a line through long axis of lower incisor and measured in relation to the mandibular plane. The mean value is 93° ± 6° ; however, mandibular incisor inclination can be influenced by orientation of the mandibular plane. As the mandibular plane becomes steeper, the incisors will tend to retrocline. An alternative method of evaluating the correct mandibular incisor relationship is to subtract the MMPA from 120.

3- Interincisal angle: The interincisal angle is the angle formed between the most prominent maxillary and mandibular incisors .

The mean value is 135° ± 10° .

Figure 9: Incisor relationships

A sample of cephalometric tracing

SNA	81° ± 3°
SNB	78° ± 3°
ANB	3° ± 2°
SN Mx plane	8° ± 3°
WITS	BO + 1 mm ahead AO (males) BO = AO (females)
MMPA	27° ± 5°
UI Mx plane	109° ± 6°
LI Md plane	93° ± 6°
I/I	135° ± 10°
LI APo	1 ± 2 mm
TAFH	Mean 119 mm
UAFH	Mean 54 mm
LAFH	Mean 65 mm
% LAFH	Mean 55%
NLA	100° ± 8°
Lip relation to E-line	Upper –4 mm Lower –2 mm

SNA, angle SN (sella-nasion) to point A; SNB, angle SN to point B; ANB, difference between angles SNA and SNB; SN Mx plane, SN–maxillary plane angle; MMPA, maxillary–mandibular plane angle; UI Mx plane, upper incisor–maxillary plane angle; LI Md plane, lower incisor–mandibular plane angle; I/I, interincisal angle; LI APo, distance from lower incisor tip to A–Pog line; TAFH, total anterior face height; UAFH, upper anterior face height; LAFH, lower anterior face height; NLA, nasolabial angle.

Soft tissue analysis

This is particularly important in diagnosis and planning prior to orthognathic surgery. As with other elements of cephalometric analysis, there are a large number of different analyses of varying complexity.

The following are some of the more commonly used.

1- The Holdaway line: This is a line from the soft tissue chin to the upper lip. In a well-proportioned face this line, if extended, should bisect the nose (Fig.10).

2- Rickett's E-plane: This line joins the soft tissue chin and the tip of the nose. In a balanced face the lower lip should lie 2 mm (± 2 mm) posterior to this line with the upper lip positioned a little further posteriorly to the line (Fig.10).

3- Facial plane: The facial plane is a line between the soft tissue nasion and the soft tissue chin. In a well-balanced face the Frankfort plane should bisect the facial plane at an angle of about 86° and point A should lie on it (Fig.10).

As with other aspects of cephalometrics, but perhaps more pertinently, these analyses should be supplementary to a clinical examination, and it should also be remembered that beauty is in the eye of the beholder.

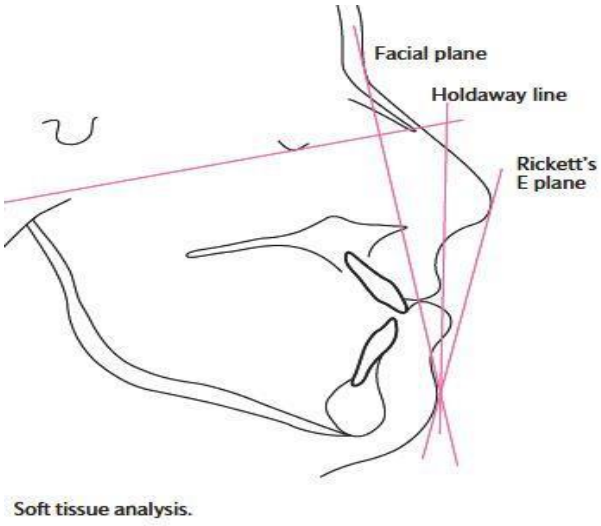


Fig. 10:Soft tissue analyses

Prognosis tracing: Sometimes it is helpful to be able to determine the type and amount of incisor movement required to correct an increased or reverse overjet.

Although the skeletal pattern will give an indication, on occasion

compensatory proclination or retroclination (known as dento-alveolar compensation) of the incisors, can confuse the issue. When planning treatment in such a case it may be helpful to carry out a prognosis tracing. This involves ‘moving’ the incisor(s) to mimic the movements achievable with different treatment approaches to help determine the best course of action for that patient.

Diagnostic Aids

1-Study Models:

INTRODUCTION

Orthodontic study models are essential diagnostic records, which help to study the occlusion and dentition from all three dimensions. They are accurate plaster reproductions of the teeth and their surrounding soft tissues.

IDEAL REQUIREMENTS OF ORTHODONTIC STUDY MODELS

1. Models should accurately reproduce the teeth and their surrounding soft tissues.

2. Models are to be trimmed so that they are symmetrical and pleasing to the eye and so that an asymmetrical arch form can be readily recognized.

3. Models are to be trimmed in such a way that the dental occlusion shows by setting the models on their backs.

4. Models are to be trimmed such that they replicate the measurements and angles proposed for trimming them.

5. Models are to have clean, smooth, bubble-free surfaces with sharp angles where the cuts meet.

6. The finished models should have a glossy mar-proof finish.

WHY WE MAKE STUDY MODELS?

1. They are the only three dimensional records of the patient's dentition.

2. Occlusion can be visualized from the lingual aspect.

3. They provide a permanent record of the intermaxillary relationships and the occlusion at the start of therapy; this is necessary for medicolegal considerations.

4. They are a visual aid for the dentist as he monitors changes taking place during tooth movement.

5. Help motivate the patient, as the patient can visualize the treatment progress.

6. They are needed for comparison at the end of treatment and act as a reference for post-treatment changes.

7. They serve as a reminder for the parent and the patient of the condition present at the start of treatment.

8. In case the patient has to be transferred to another clinician, study models are an important record.

USES OF STUDY MODELS

1. Assess and record dental anatomy

2. Assess and record intercuspation

3. Assess and record arch form

4. Assess and record the curves of occlusion

5. Evaluate occlusion with the aid of articulators

6. Measure progress during treatment

7. Detect abnormality, e.g. localized enlargements, distortion of arch form, etc.

8. Calculate total space requirements/discrepancies

9. Provide record before, immediately, after and several years following treatment for the purpose of studying treatment procedures and stability.

DISADVANTAGES OF STUDY MODELS

1- Liable to fracture

2- Takes too much space in storing

PARTS OF THE STUDY MODELS

The study models can be divided into two parts for the purpose of description:

• The anatomic portion

• The artistic portion

• The anatomic portion is that part which is the actual impression of the dental arch and its surrounding soft tissue structures. This is the part, which must be preserved when trimming the model.

• The artistic portion is the stone base supporting the anatomic portion. This portion is trimmed in a manner, which depicts, in a general way, the dental arch form and is pleasing to the eye.

STUDY MODEL FABRICATION AND TRIMMING

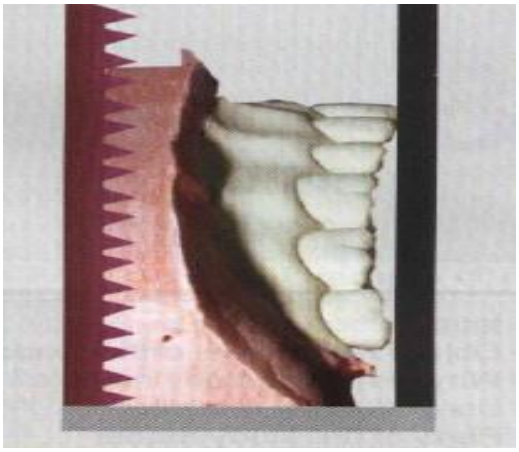
Preliminary procedures in the fabrication of study models are:

1. Remove any excess flash or obviously excessive bulk on the periphery of the models

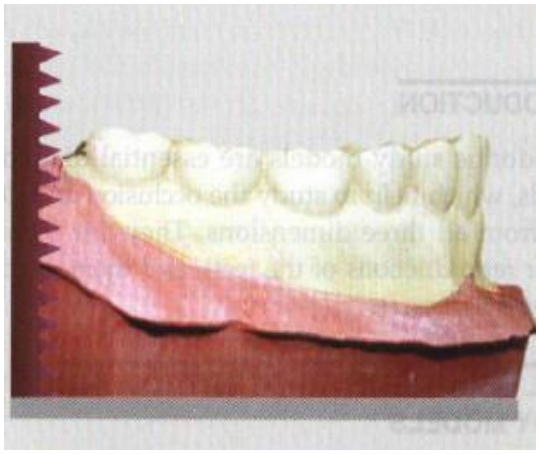
2. Remove any nodules that may be present on the occluding surfaces of the teeth

3. Remove any extensions in the posterior areas that prevent occluding of the models

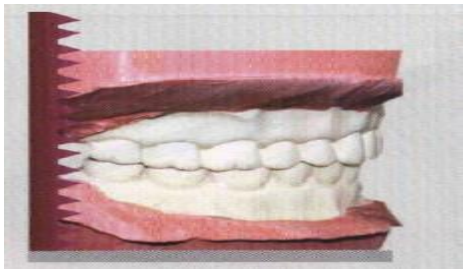
4. Using the wax bite, occlude the models.



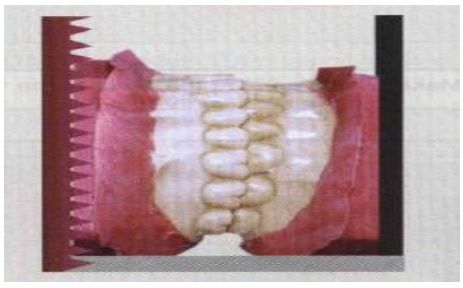
1- Trim lower base parallel to occlusal plane



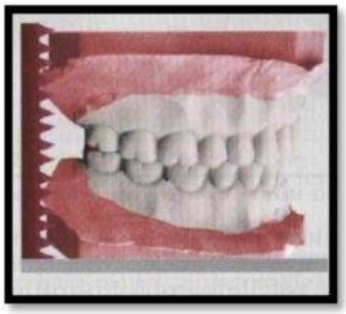
2- Trim lower back perpendicular to base



3-With models in occlusion, trim upper back so it is flush with the lower back

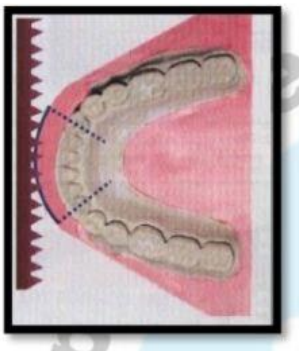


4- Place upper model (on its back) on the model trimmer. Trim until the top base is flat

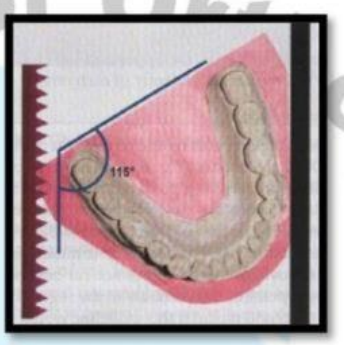


5- Occlude models. Check bases for parallelism, backs for flush plane

6- Make buccal cuts, at the edge of the vestibule 60° to the base of the model



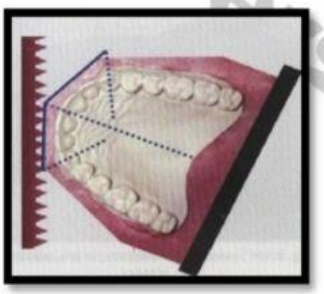
7- Make a smooth curve from canine to canine In lower models



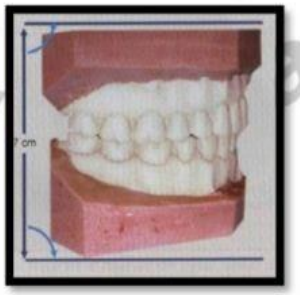
8- Move model trimmer guide to its extreme Position to make the heel

9-Make buccal cuts. at the edge of the vestibule 60°to back of the upper model

10- Occlude models. Trim upper heels so they are flush with lower heels



11- Make anterior cuts. the ends of which should be at the midline and the middle of each canine



12- Occluded models should have a sharp 90° angle between their base and back

Finishing the Models

1-The surface must be made smooth, remaining at the same time absolutely flat and at right angles to the bases of the models.

2-The finishing process should not change the dimensions or any of the angulations of the models.

3- After the surfaces have been finished, and the exact dimensions achieved, the model is set aside to dry for 48 hours or dried overnight in an orthodontic oven.

4- At this point the model should be labeled with the patient's name and date on the backs of both the upper and lower models.

5-The final glazing is put on the models by immersing them in a commercial gloss. The models are allowed to remain in this solution for one-half hour.

6-Holding each arch under cold water, the models are polished and soap solution removed by buffing with cotton.

7-The models are set on their occlusal surfaces to dry for another twelve hours, then buffed with a very light but rapid motion using cotton. The models should assume a high, even luster which will then resist soiling while handling.

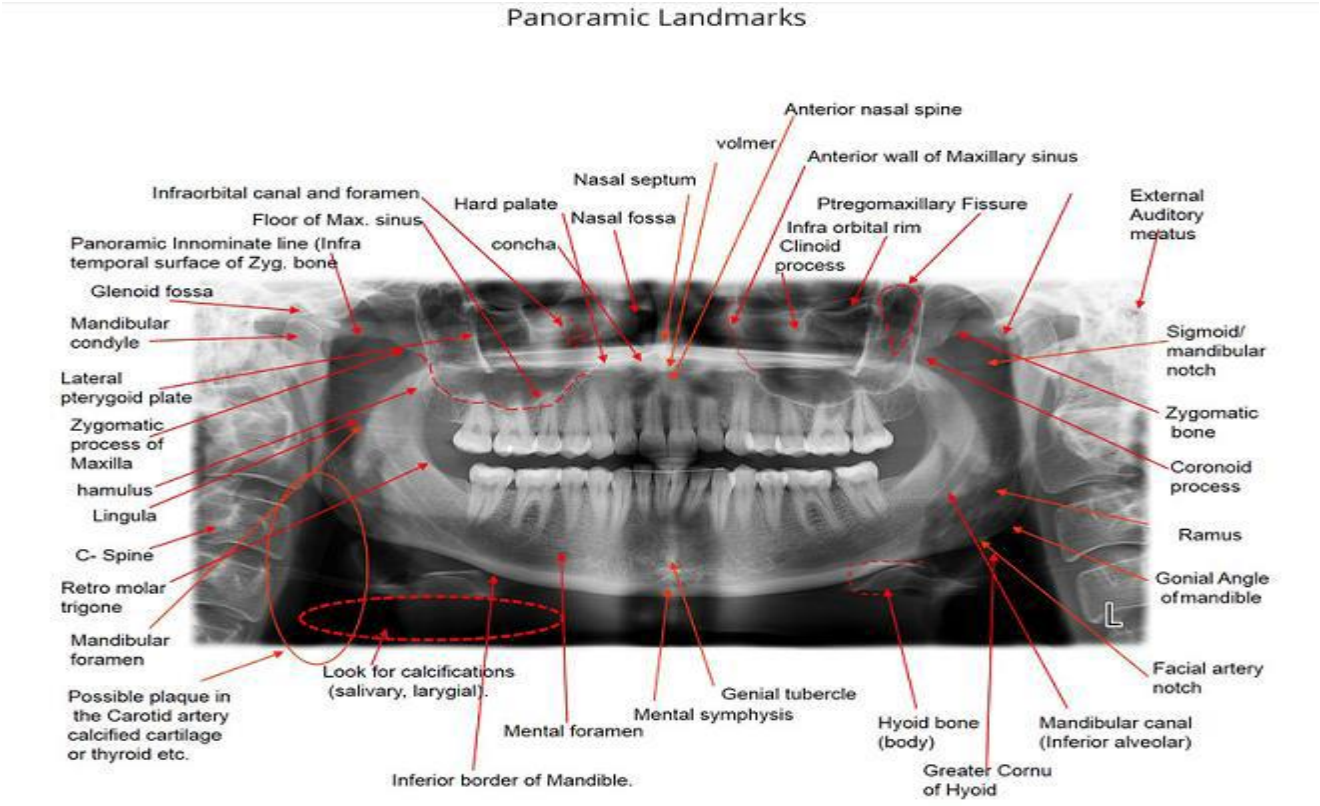
Handling of the study models:

The models should be placed on a flat surface with their backs down. They should be picked up together and always returned together. Individual handling of the models is more likely to result in damage to the models.

2- ORTHOPANTOMOGRAM: (Known as an orthopantomography (OPG), pantomogram, OPT or panaromic radiograph). It is a panoramic, two-dimensional (2-D) x-ray that captures the entire mouth in a single image, including the teeth, upper and lower jaws, surrounding structures. It is often encountered in dental practice and occasionally in the emergency department; providing a convenient, inexpensive and rapid way to evaluate the gross anatomy of the jaws and related pathology.

The orthopantomogram is considered an essential diagnostic aid and should be examined prior to undertaking any orthodontic treatment. OPG was is not always available routinely in dental clinics and the patient may require to be referred to special X-ray centers (in the past), nowadays, it become more available and may be present in most of dental clinics.

Earlier, before the advent of the OPCs, the IOPAs along with the bitewing radiographs were the main stay for an orthodontist.



Advantages of an orthopantomogram

1-A large anatomic area is visualized in a single image

2-These are probably the most frequently preserved records of any orthodontic case in areas where this facility is available

3.The radiation exposure is low, less than that for four IOPAs

4.Patient cooperation is rarely a problem

5.Inter-operator variation is minimal

Disadvantages of an orthopantomogram

1. Specialized equipment is required, needs extra space, so it is rather expensive than periapical x-ray .

2. Distortions, magnifications and overlapping of structures are a problem

3. lOPAs may still be required

4. It provides less sharp images and less accurate information about dental and oral diseases than regular intraoral periapical or bite-wing radiographs.

For any student of orthodontics, it is essential to be able to correctly read and interpret an orthopantomogram. It is advised that while reading an orthopantomogram a correct protocol must be followed so as not miss out any important diagnostic details. The most convenient and simple method is presented below.

Step 1

Orient the radiograph as when looking at the patient, i.e. with the patient's left side positioned on the clinician's right. The radiograph is then placed on a view box. It is preferred to dim the remaining lights in the room.

Step 2

Start examining from the right condylar head and follow the outline along the neck and the posterior border of the ramus. Continue following the outline of the mandibular body to the symphyseal region anteriorly along the lower border of the mandible to the left condyle. Compare the outline for discontinueties, radiopacities or radiolucencies and most importantly from an orthodontic perspective for symmetry. Asymmetry may result from faulty positioning of the patient or that of the cassette in its holder. Note the thickness and density of the mandibular cortex and the other structures including the mandibular canals, mental foramina, and the coronoid process.

Step 3

Examine the medullary bone of the mandible for the usual anatomic landmarks and note anything suggestive of pathology, especially in the periapical regions of the teeth. The third molar development and position should definitely be noted as it may play an important role in determining the type of retention planned and/or their enucleation if required.

Step 4

Next, examine the cortical outline of the maxilla starting on the right side. Trace the pterygo-maxillary fissure, hard palate with the anterior nasal spine. Examine the nasal cavities and the nasal septum followed by the

maxillary sinuses. It is advisable to compare the right and left sides especially of the nasal cavities and the maxillary sinuses. Radiopacities in these regions could be suggestive of pathology or sometimes the presence of foreign body. These might reflect upon the breathing pattern of the patient.

Step 5

Margins of a number of soft tissue structures may be seen on the orthopantomogram. These include the--- tongue, soft palate, nose and earlobes the lip lines and the nasolabial folds.

Step 6

Radiopaque shadows, which superimpose on normal anatomic structures are called "ghosts" and are actually artifacts. These can sometimes pose a problem in radiographic interpretation. These are created when the X-ray beam projects through a dense object, e.g. the spinal cord and the opaque shadow of the object projects onto the opposite side of the radiograph.

Step 7

Finally evaluate the teeth for-presence, stage of development, state of eruption unerupted or impacted teeth, placement, root morphology and position, cavities, fractures, contacts, and/or any pathology. Teeth may appear to be magnified or minimized in the horizontal dimension depending on their position. The maxillary and mandibular cusp tips should be generally separate (unless there is a change in the cant of occlusion and there should be gentle curve to the occlusal plane. The orthopantomograrm may not be sufficient by itself. If any doubt arises it is recommended that an lOP A of the concerned region be taken

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Lecture 5 [5th] **د.حيدر سعد حنفوش**

Orthodontics

Diagnostics records

(Photographs, 3D imaging and other views)

Orthodontic records may be required for a number of possible purposes:

• Diagnosis and treatment planning.

• Monitoring growth.

• Monitoring treatment.

• Medico-legal record.

• Patient communication and education.

• Audit and research.

Data required for orthodontic diagnosis are derived from routine essential diagnostic aids and also from supplemental aids when needed. Graber has categorized the diagnostic aids into essential and supplemental diagnostic aids.

Essential

As the name suggests, these aids are indispensable for appraisal of the condition and it's etiology for treatment planning. Essential diagnostic aids include: Case history, clinical examination, study models, certain radiographs, and facial and intraoral photographs.

Supplemental

Supplemental diagnostic aids may be needed in certain cases and these aids usually require specialized equipment. These include: Specialized radiographs (e.g hand-wrist radiograph). Electromyography to assess muscle activity, Endocrine tests, estimation of basal metabolic rate and Occlusograms.

Facial photographs are the easiest to store, occupy the least amount of space and provide immense information to the clinician as well as the patient.

Photographs can be:

1- Extraoral photographs.

ExtraoraI photographs are considered essential records and should be taken before starting treatment and after completion of treatment. All extraoral photographs should be taken in the natural head position, preferably without any shadows appearing in the background. The ears should be exposed (for the purpose of orientation) and the patient should not be wearing eye ware. It would be ideal if the distance and magnification could be standardized.

Uses of extraoral photograph:

1. Evaluation of craniofacial relationships and proportions before and after treatment.

2. Legal point of view.

3. Assessment of soft tissue profile.

4. Proportional facial analysis and/or photographic analysis.

6. Monitoring of treatment progress (if standardized).

7. Invaluable for longitudinal study of treatment and post retention follow-up.

8. Detection and recording muscle imbalances.

9. Identifying patients.

It is recommended that at least three extra-oral photographs be taken for all patients.

This includes (see the figure below):

A-Frontal facial with lips relaxed.

B-Facial profile with lips relaxed.

C - Three-quarter view, smiling. or D- Frontal facial, smiling.

2- INTRAORAL PHOTOGRAPHS

Intraoral photographs are simple to take, maintain and store and of course useful,nevertheless, they are neither standardized nor three dimensional. Better to be takenbefore, during and after finishing the treatment.

These are used for:

1- Helpful in explaining and motivating the patient.

2- They are also used to monitor treatment progress and results.

3- They are also helpful in medico-legal cases involving the texture and color of teeth especially pre-operatively.

4- Assessing and recording health or disease of the teeth and soft tissue structures.

5- Study of relationships before, immediately following and several years after treatment, to improve treatment planning.

These intraoral photographs should be taken (see the figure below).

1. One frontal photograph in maximum intercuspation (A).

2. Two lateral views-right (B) and left (C).

3. Optional-two occlusal views-maxillary (D) and mandibular (E).

RADIOGRAPHS

Any radiograph carries a low but identifiable risk, so each radiograph must be clinically justified.

A radiograph is only prescribed after a full clinical examination to ensure that information cannot be gained by a less invasive method. When considering interceptive or active orthodontic treatment, a radiograph may provide additional information on:

• Presence or absence of teeth • Stage of development of permanent dentition • Root morphology of teeth, including root length and any existing root resorption. • Presence of ectopic or supernumerary teeth • Presence of dental disease • Relationship of the teeth to the skeletal dental bases, and their relationship to the cranial base.

A number of radiographic views are routinely used by the orthodontist and they are important diagnostic tool in assessing an orthodontic condition and in determining suitable treatment plan.

1) Orthopantomograph (OPG) and Cephalometric radiograph.

2) PERIAPICAL RADIOGRAPHS

A full set of ten periapical x-rays was recommended before the advent of the orthopantomogram. They covered all the present teeth and the adjacent teeth. They are still ideal for the detection of anomalies related to changes in the size, shape and content of the tooth structure and/or the lamina dura and/or the periapical region.

The advantages of periapical radiographs are:

1- Low radiation dose.

2- Excellent clarity of teeth and their supporting structure.

3- Possibility of obtaining localized view of area of interest.

The main disadvantages of the Periapical x-ray includes the increased radiation that a person has to undergo to cover the full complement of his/her teeth. Also at times the patient is not cooperative, and may not allow the repeated placement of films in the desired manner in his/her mouth. With the increased use of OPGs, the use of periapical x-ray has reduced considerably. Yet, they are ideal for localized views in relatively small areas of interest because of the excellent clarity that they allow.

3) BITEWING RADIOGRAPHS

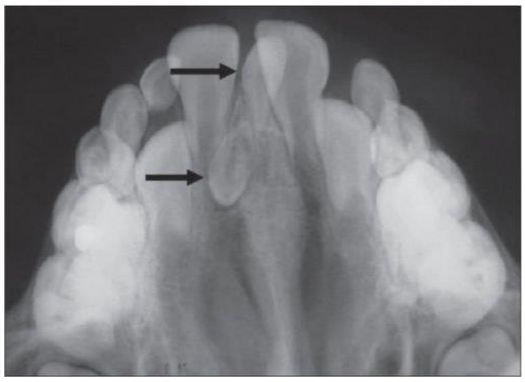
They are seldom used but are ideal for the detection of proximal caries, assessment of existing restorations and the study of interdental bone height in these areas.

4) Occlusal radiograph

Occlusal radiographs are used in patients who are unable to open their mouth wide enough for perapical radiographs and are selected in special cases. lntraoral occlusal radiographs are of special interest to an orthodontist when dealing with impacted teeth or for the study of the labio-lingual position of the root apices in the anterior segments of the maxillary and the mandibular dentition. They are particularly useful in the maxillary arch, for assessing root form of the incisors, the presence of midline supernumerary teeth and canine position, either alone or in combination with additional views using parallax. Nowadays, Cone-beam Computed Tomography (CBCT) more commonly used instead of these types of radiographs.

Periapical radiograph

Bitewing radiograph



Occlusal radiograph (showing supernumerary teeth (arrowed)

5) **Hand-Wrist and cephalometric Radiographs for skeletal maturity:**

The level of maturity attained and the amount of growth potential remaining is an important consideration while treating malocclusions. The maturational status of the patient has a strong bearing on orthodontic diagnosis, treatment planning, outcome of the treatment and post-treatment stability. The prepubertal growth spurt is considered to be an advantageous period for certain types of orthodontic treatment, such as growth modification procedures using orthopedic and functional appliances; while orthognathic surgeries are best carried out after the cessation of growth.

Chronological age is an unreliable guide for the assessment of children's maturational status due to the wide individual variation observed in terms of timing, duration and velocity of growth. Children of same age may vary in their maturity status a great deal; therefore, maturity indicators have been developed using other parameters, such as height gained,

secondary sex changes, dental development and skeletal ossification. Since orthodontist works primarily with teeth and bone, the skeletal age or bone age can provide reliable information while helping in accurate growth prediction. Handwrist radiographs have been widely used to assess skeletal maturity. However, evaluation of cervical vertebrae on lateral cephalograms is gaining popularity in the recent years.

A) Hand-Wrist radiograph

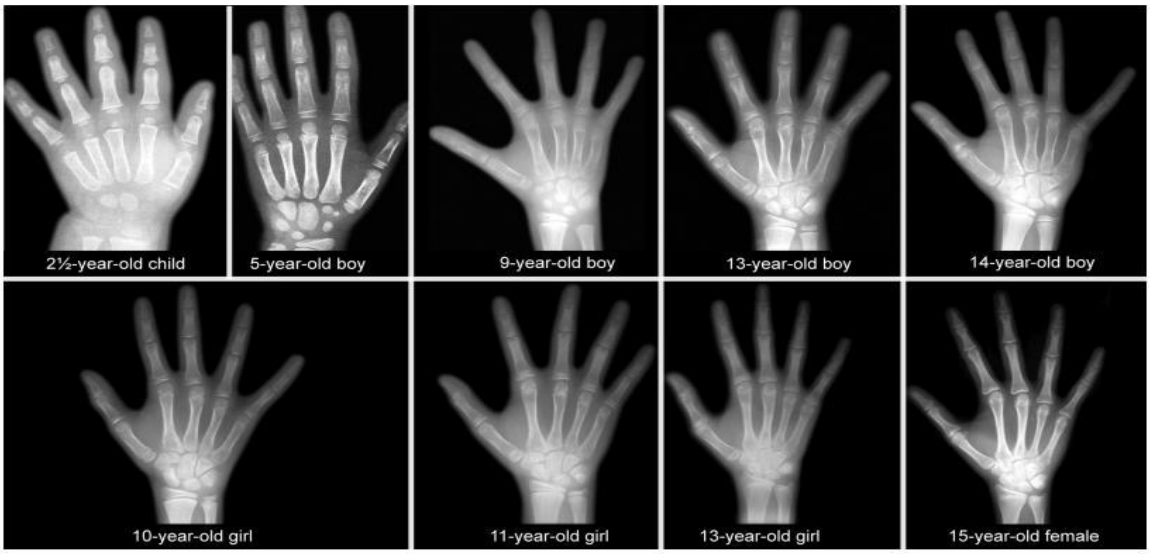
The basis of using hand-wrist radiographs for assessing skeletal age is that the skeleton in the hand-wrist region is made of numerous small bones (27 small bones + distal ends of long bones radius and ulna); these numerous bones in the hand-wrist region are derived from a total of 51 separate growth centers. The development of these bones from the appearance of calcification centers to epiphyseal plate closure occurs throughout the entire postnatal growth period and therefore provides a useful means of assessing skeletal maturity. Different ossification centers in hand and wrist appear and mature at different times. The appearance and progression of ossification in various ossification centers follows a predictable and scheduled pattern which can be standardized. To do this, a hand–wrist radiograph of the patient is simply compared with standard radiographic images in an atlas of the development of the hand and wrist. It has been shown that stages of hand– wrist development correlate reasonably well with the adolescent spurt in growth of the mandible.

For example the phalanges are ossified from a primary center for the shaft and a proximal epiphyseal center. Ossification in the shaft (primary center) begins prenatally.

The epiphyseal centers (secondary centers) appear postnatally around two to four years of age. Ossification in the epiphyses continues progressively

and the fusion of the epiphyses with their respective diaphyses is completed during puberty at about 15th–16th year in females and 17th–18th year in males. The phalanges appear to ossify in three stages. Stage 1: The epiphysis and the diaphysis are equal. „ Stage 2: The epiphysis caps the diaphysis by covering it like a cap. „ Stage 3: Fusion occurs between the epiphysis and the diaphysis.

Figure 1: Stages in ossification of phalanges; (A) Stage 1: The epiphysis and the diaphysis are equal; (B) Stage 2: The epiphysis caps the diaphysis by connecting it like a cap; (C) Stage 3: Fusion occurs between the epiphysis and the diaphysis.



Development of numerous small bones of the hand-wrist region occurs throughout the entire postnatal growth period and thus provides a useful means of assessing skeletal maturity

Correlation: Hand-wrist radiographs have been correlated to: „

 Dental development. „

 Peak height velocity. „

 Cervical vertebrae. „

 Cranial base outline. „

 Spheno–occipital synchondrosis.

B) Cervical vertebrae skeletal maturity indicator.

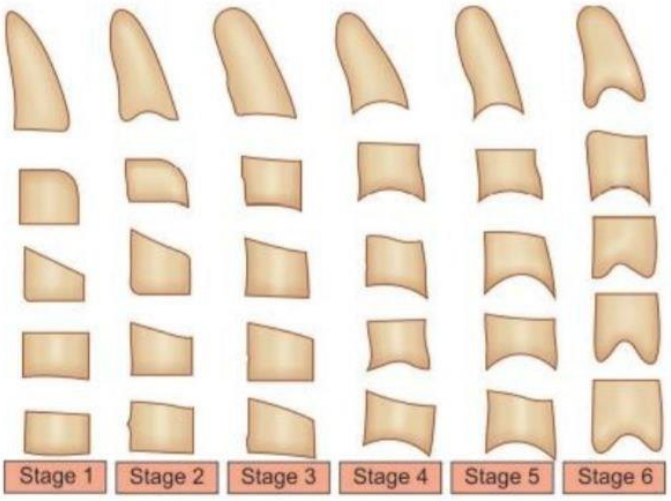
Hand-wrist radiographs have been used conventionally as the standard method of evaluating skeletal maturity. Although accurate, this method necessitates additional radiation exposure to patients. Furthermore, the handwrist site is far removed from the jaw, which is the site of orthodontic correction. In recent years, evaluation of cervical vertebrae has been increasingly used to determine skeletal maturation. A new system of skeletal maturation assessment using the cervical vertebrae was first developed by Hassel and Farman. A number of subsequent studies have shown significant correlation between developmental or maturational changes occurring in the cervical vertebrae than that of the hand-wrist region. Cervical vertebrae maturity indicator (CMVI) method is increasingly being used in the recent years instead of the conventional hand-wrist radiograph method. One of the main reasons for the rising popularity of the method is that cervical vertebral maturation can be assessed on lateral cephalograms, which is used regularly in orthodontic diagnosis, thus, precluding the need for an additional radiograph.

Most methods of cervical vertebral maturation are based on morphologic changes that occur in cervical vertebral bodies as growth progresses.

Hassel and Farman developed a method of skeletal maturation assessment using cervical vertebrae in which there are six stages of development.

They take into account the morphologic characteristics of the cervical (C2, C3 and C4) vertebrae, such as: Shape of the vertebral bodies, Height of the vertebral bodies and the concavity of the lower border of the cervical bodies. The changes in the shape of cervical vertebral bodies of C3 and C4 at each level of skeletal development are assessed.

Cephalometric radiograph



Assessment of skeletal maturity using cervical vertebrae

Stage 1: 80–95% of pubertal growth is remaining.

Stage 2: 65–85% of pubertal growth remains.

Stage 3: 25–65% pubertal growth is remaining.

Stage 4: 10–25% of pubertal growth is remaining

Stage 5: 5–10% pubertal growth remaining.

Stage 6: Pubertal growth is complete with no more growth potential remaining.

6) Three-Dimensional imaging

` Plain film and cephalometric radiography are invaluable for accurate diagnosis and treatment planning, but they only provide a two dimensional image of a threedimensional structure, with all the associated errors of projection, anatomical superimposition, landmark identification, measurement and interpretation. A number of three-dimensional imaging techniques have been developed over the past decade, which help to overcome some of these shortcomings and give the orthodontist greater information for diagnosis, treatment planning and research as:

A) Cone-beam Computed Tomography (CBCT)

Imaging of the hard tissues composing the jaws and dentition using conventional computed tomography (CT) is largely impractical, due to the high radiation dosage, lack of resolution and significant cost. The introduction of conebeam computed tomography (CBCT) for views of the face and jaws in the early 21st century has resulted in the dosage being reduced and the resolution significantly improved, with its adaption and refinement for imaging of the teeth and jaws now providing a useful three-dimensional diagnostic tool. There is little doubt that the images that can be obtained from CBCT are impressive, allowing accurate visualization and analysis of the teeth and jaws in three-dimensions. CBCT can also be very useful for airway analysis, assessment of alveolar bone height and volume prior to implant placement and imaging of temporo-mandibular joint morphology.

Orthodontic Applications of Cone Beam Computed Tomography:

Conventional computed tomography (CT) imaging involves the use of rotating X-ray equipment, combined with a digital computer, to obtain

images of the body.

Using CT imaging, cross-sectional images of body organs and tissues can be produced. CBCT is a faster, more compact version of traditional CT with a lower dose of radiation. Through the use of a cone-shaped X-ray beam, the size of the scanner, radiation dosage, and time needed for scanning are all dramatically reduced. The three dimensional (3D) views produced may be useful in certain orthodontic cases:

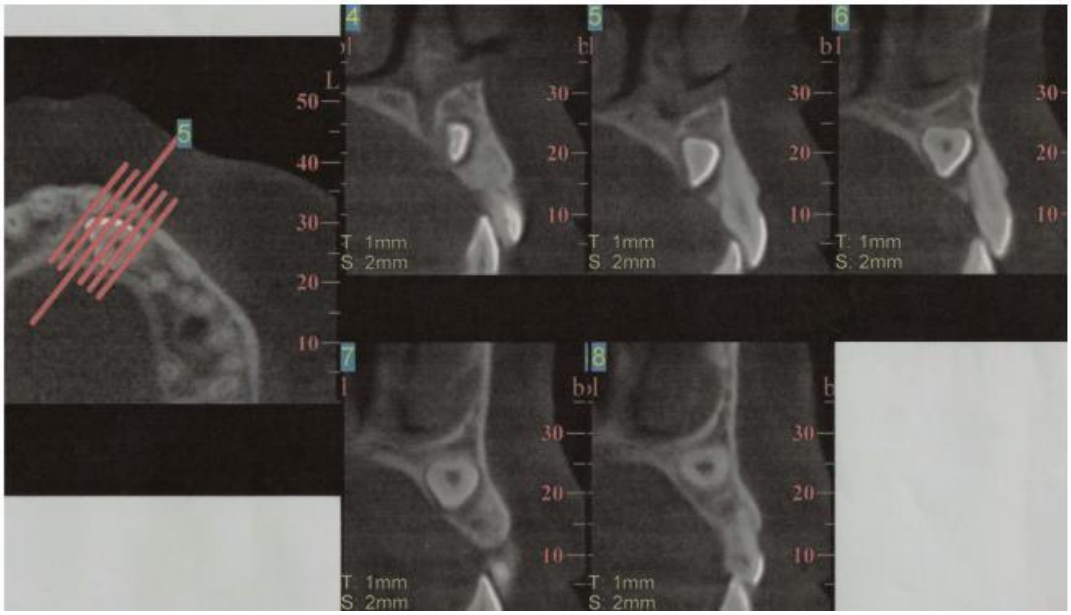
• Accurate location of impacted teeth and a more accurate assessment of any associated pathology, particularly resorption of adjacent teeth.

• Assessment of alveolar bone coverage, height and volume.

• Severe facial asymmetry, especially asymmetries involving roll and yaw.

• Syndromes, congenital deformities, and sequelae of facial trauma.

• Planning of some complex combined orthodontics and orthognathic surgery cases



Cone-beam computed tomography (CBCT) of the patient with the impacted canine, confirming that there is a small amount of root resorption occurring on the palatal aspect of the upper left lateral incisor, close to the apex of the tooth.

There is a consensus that it provides new information that could improve the treatment plan in certain situations, and enough enthusiasm to lead some orthodontists to advocate use of CBCT on all orthodontic patients, replacing panoramic, cephalometric, and occlusal radiographs, as well as tomograms of the TMJ. There is a significant radiation dose increase in doing this. However, it should not be forgotten that the radiation dose from traditional intraoral and extraoral radiography is significantly less than that from CBCT imaging of the same area (see Table below).

Table 6.1 Radiographs used in orthodontics and dose equivalence

Radiographic examination	Effective radiation dose (μSv)	Equivalent background radiation (days)	Risk of fatal cancer (per million)
DPT	3–38	0.5–5	0.2–1.9
Cephalometric lateral skull	2–5.6	0.3–0.45	0.34
Upper standard occlusal	8	1.2	0.4
Bitewing/periapical	0.3–2.2	0.15–0.27	0.02–0.6
Conventional CT scan (maxilla)	100–3000	15–455	8–242
Conventional CT scan (mandible)	350–1200	53–182	18–88
Chest	14	3	2
CBCT (small volume)[a]	10–67	4–10	
CBCT (large volume)[a]	30–1100	10–42	

Figures are based upon Radiation Protection 136, (2004). European Guidelines on Radiation Protection in Dental Radiology. The Safe Use of Radiographs in Dental Practice. European Commission. It should be emphasized that these only represent a guide and are regularly updated as new recommendations are made, particularly with regard to tissue weighting factors in the calculation of effective doses.
CBCT, cone-beam CT; CT, computerized tomography; DPT, dental panoramic tomograph.
[a]Cone-beam CT data is based upon Pauwels et al (2012) and the 2011 SEDENTEXCT publication.

Cone beam computed tomography (CBCT) now allows the acquisition of detailed 3D images of the face in high resolution. Using this ’virtual’ 3D information, software is being developed that could revolutionize the way that orthognathic planning and surgery is undertaken.

Computer-aided surgery (CAS) is now being introduced that will allow surgical planning and simulation using the information captured from CBCT.

This technology offers a number of potential exciting possibilities:

• A more detailed appreciation of the anatomy of the patient in three dimensions (Fig.a).

• The data from CBCT can be combined with the data captured from 3D facial camera systems. This allows the clinicians to see the relationship of the soft tissues with the underlying hard tissues (Fig. b). Virtual surgery can then be undertaken on this 3D model and the effect on the overlying soft tissues assessed (Fig. c). The accuracy of these 3D predictions will improve as we gather more data on the 3D effects on soft tissues of combined orthodontics and orthognathic surgical treatment.

• Virtual surgery will allow the surgeon to calculate the most appropriate and safest osteotomy lines in advance of the operation (Fig. d).

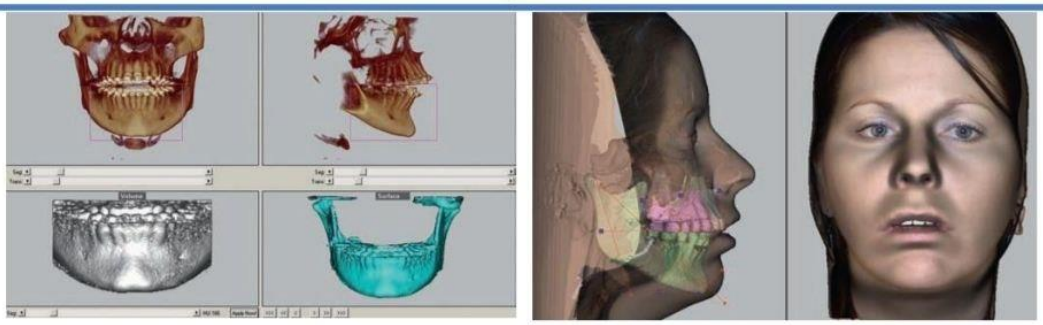
• Once the team is happy with the final virtual surgery, this virtual setup can be used to manufacture positioning splints (Fig. e,f) and construct customized fixation plates.

• The developments described so far have been based on the surgery being planned and executed virtually. However, the surgeon, not the computer, will perform the actual surgery, so the next challenge is to ensure the surgeon follows the virtual plan.

Surgical navigation systems are being developed to help transfer the information from the virtual plan into the operating room. They will use tracking devices to follow surgical instruments and the patient's changing

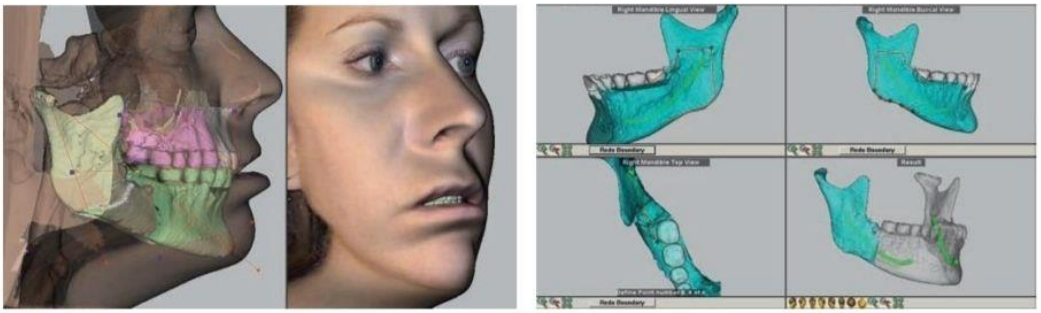
anatomy, and using a navigation screen will help to guide the surgeon in making the appropriate cuts and ensure correct positioning and fixation of the bone segments.

Future developments in 3D technology are likely to fundamentally change our approach to combined orthodontic and orthognathic treatment in the future, in terms of diagnosis, treatment planning and, eventually, in the execution of the surgery.



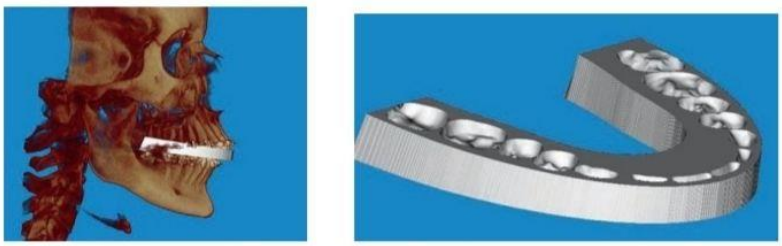
A- Detailed 3D information of the anterior mandible captured from CBCT

B- Information from the CBCT has been combined with information.



c- 3D prediction of bimaxillary osteotomy.

d- Virtual osteotomy cuts in the mandible. Note the inferior alveolar nerve clearly marked in green.



e,f- Designing a surgical splint to be used during the operation.

B-Optical laser scanning and stereo photogrammetry

Other less invasive techniques for generating three-dimensional images of the facial soft tissues have also been developed. Optical laser scanning utilizes a laser beam, which is captured by a video camera at a set distance from the laser and produces a three dimensional image.

The mechanical bed offers a safe surface upon which to secure a booster seat, while allowing the photographer to adjust the participant to ensure an optimal image capture.

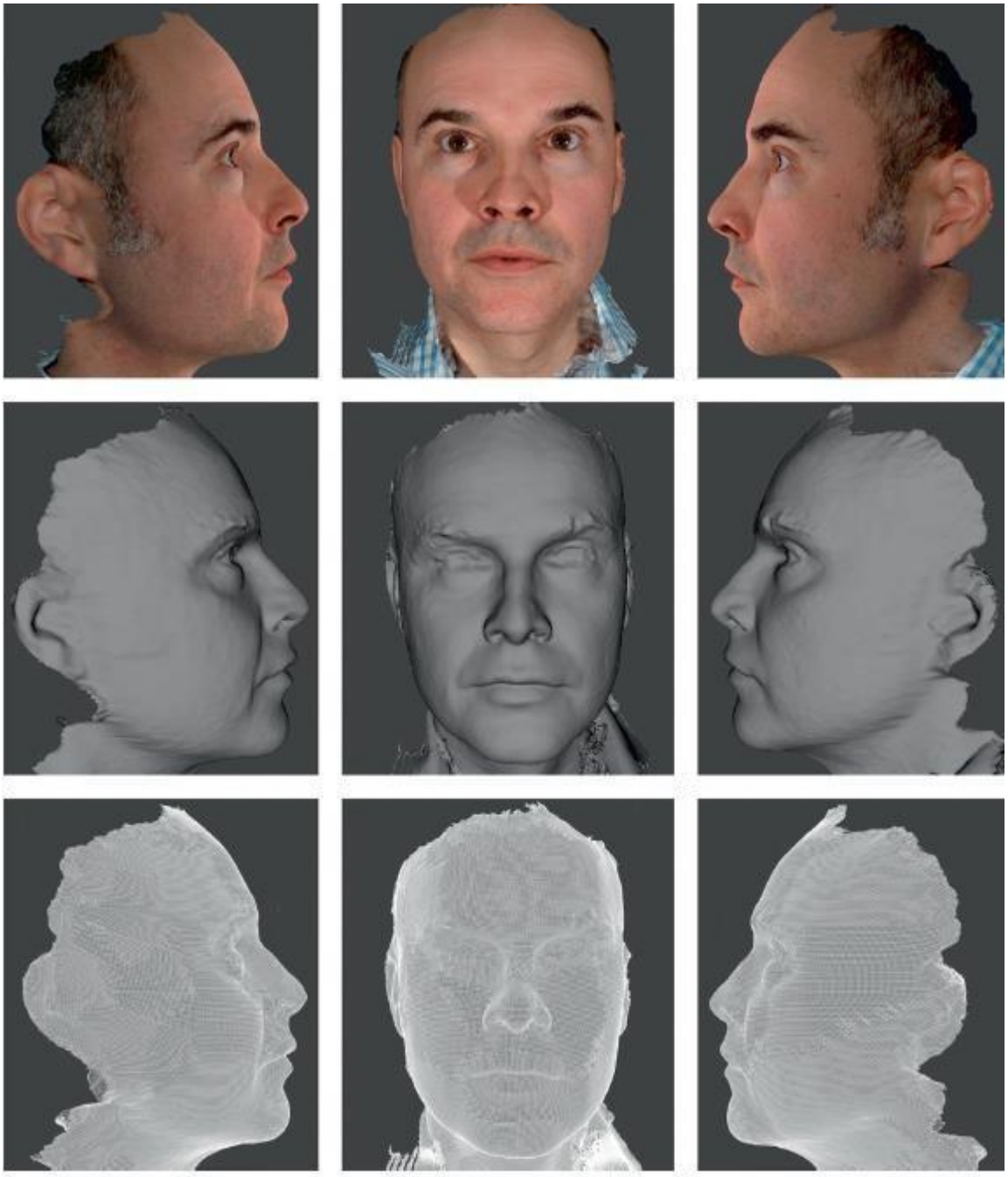
More recently, stereo photogrammetry has been developed, which involves taking multiple pictures of the facial region simultaneously. This allows the creation of a three-dimensional model image using sophisticated stereo triangulation algorithms.

These techniques are now being used to:

1-Study facial growth

2- Soft tissue changes in normal populations

3- Investigate the effects of orthodontic and surgical treatment.



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Lecture 6 5th د.حيدر سعد حنفوش

Orthodontics

Treatment plan

Treatment planning is the most complex area in orthodontics. In order to formulate an appropriate treatment plan the clinician needs to be competent in history taking, examination of the patient, and collection of appropriate records. The clinician also needs to have an understanding of growth and development, facial and dental aesthetics, occlusion, aetiology of malocclusion, different orthodontic appliances and mechanics, the physiology of tooth movement, the risks and benefits of treatment, retention, and relapse. It involves producing a road map of each step to be executed sequentially for a particular case so as to achieve the desired results.

General Objectives of orthodontic treatment

When planning treatment, the following areas need to be considered:

• Aesthetics.

• Oral health.

• Function.

• Stability.

Ideally, orthodontic treatment should ensure a good aesthetic result, both facially and dentally; it should not compromise dental health; it should promote good function; and it should produce as stable results as

possible. Treatment should never compromise dental health or function, but occasionally, it may not be possible to produce a treatment plan that creates ideal aesthetics and the most stable result. In these cases, a compromise may need to be reached and this must be discussed with the patient as part of the consent process, explaining the limited treatment objectives.

Forming an orthodontic problem list

By following a logical process, the clinician can draw up a problem list that will help to provide the information needed to form the treatment plan. This process is shown in the figure below.

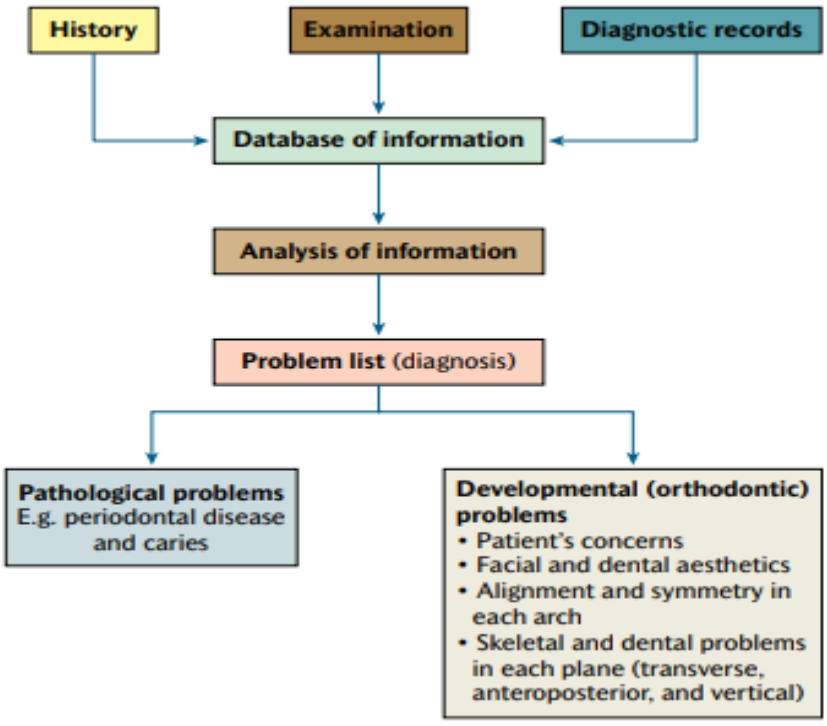

Figure: Problem list flowchart (Mitchell and Littlewood 2019).

The history, examination, and collection of appropriate records are required to identify the problems in any case. This list of problems helps to formulate a diagnosis. Problems can be divided into pathological

problems and developmental problems. Pathological problems are problems related to disease, such as caries and periodontal disease, and need to be addressed before any orthodontic treatment is undertaken. Developmental problems are those factors related to the malocclusion and make up the orthodontic problem list.

 In order to make this problem list more understandable, it can be classified into these sections:

1- The patient's concerns

The patient's role in orthodontic treatment success is vital.

The following areas need to be considered:

• Patient's concerns

• Patient's expectations

• Patient's motivation.

A patient will only be satisfied if those aspects of their malocclusion which trouble them are addressed. An appropriate history should reveal which features they are unhappy with and importantly, the result they are hoping for, or expect, at the end of treatment. Where possible, the clinician should formulate a plan that addresses the patient's area of complaint. However, occasionally the patient's perception of their problem or expectations may be unrealistic.

The role of the orthodontist is then to counsel the patient carefully to explain what can or cannot be achieved. If the patient's expectations are unrealistic, then treatment should not be undertaken. It is also often helpful for the orthodontist to explain to the patient the parts of the

occlusion which are normal and that are therefore not going to be changed. Undergoing orthodontics requires a great deal of active participation and cooperation from the patient. No matter how skillful the orthodontist, treatment will not succeed unless the patient is sufficiently motivated to cooperate with all aspects of their orthodontic care. If the patient is not sufficiently motivated, then treatment should not be undertaken.

2- Facial and smile aesthetics

Straight teeth do not necessarily create a good smile and appropriate facial aesthetics. The position of the teeth within the face, and the effects of tooth movements on the overlying soft tissues of the lips, need to be considered. This is a complex area for a number of reasons. The perception of facial aesthetics is affected by personal and cultural factors and also by fashions and trends. There has been a recent trend towards more protrusive profiles, with proclination of both the upper and lower dentitions to produce more lip support. Advocates suggest that this treatment approach leads to increased lip protrusion and can produce a more youthful appearance, but it does come with some potential risks.

Firstly, proclination of incisors may move the teeth into areas of increased instability, with a tendency for the lips and cheeks to push the teeth back and cause relapse. In addition, excess expansion and proclination may lead to teeth perforating the buccal plate, causing bony dehiscences and possibly compromising future periodontal health. It is also important for patients to understand that excessive protrusion of the dentition can produce an unaesthetic result. The effect of tooth movement on the overlying soft tissues is unpredictable. It is untrue to suggest that extracting teeth and retroclining the upper incisors will automatically

compromise the facial aesthetics. However, care must be taken in cases where excessive retroclination of the upper labial segment is being considered, to avoid flattening of the facial profile. This would be particularly contraindicated in patients with an increased nasolabial angle, large nose, and retrognathic mandible as explained in the figure below.

Figure: Consideration of facial aesthetics in orthodontic treatment planning. Patient presented with a markedly increased overjet of 12 mm. Although the patient complained about the prominent upper teeth, a large proportion of the problem is the retrognathic mandible. Simply retracting the upper labial segment would reduce the overjet, but this would have an unfavourable effect on the facial profile. The soft tissue response to dental movement is unpredictable, but in this case, with such a large dental movement required and the retrognathic mandible, reducing the overjet by reduction of the incisors alone would unfavourably flatten the facial profile (Mitchell and Littlewood 2019).

3- Alignment and symmetry in each arch

The amount of crowding or spacing in each arch needs to be assessed, as well as the inclination of the upper and lower incisors and any tooth size discrepancies identified. This will play a major role in assessing the amount of space required to treat the case. The process of determining the amount of space required is called ‘space analysis’. The shape and symmetry within each arch is also noted.

4- Skeletal and dental relationships in all three dimensions

The aim is to describe the occlusion, distinguishing between the dental and skeletal factors contributing to the malocclusion in each plane. Generally, it is easier to correct malocclusions that are due to dental problems alone—if there are underlying skeletal problems, these are often more difficult to treat.

□ Basic principles in orthodontic treatment planning

Once the aims of treatment have been established, treatment planning can begin. The basic principles are discussed below.

1- Oral health

The first part of any orthodontic treatment plan is to establish and maintain good oral health. While definitive restorations, such as crowns and bridges, may be placed after alignment of the teeth, all active disease must be fully treated before beginning any orthodontic treatment.

2- The lower arch

Traditionally, treatment planning has been based around the lower labial segment. Once the position of the lower labial segment is determined, the rest of the occlusion can be planned around this. In most cases it is advisable to maintain the current position of the lower labial segment. This is because the lower labial segment is positioned in an area of relative stability between the tongue lingually, and the lips and cheeks labially and buccally. Any excessive movement of the lower labial segment would increase the risk of relapse. Treatment planning around the lower incisor position is less rigidly adhered to in contemporary orthodontic treatment planning, due to the increasing emphasis on facial and soft tissue aesthetics.

3- The upper arch

The upper arch should be positioned within the face to provide the best facial and dental aesthetic result, within the confines of the existing skeletal and soft tissue environment. The secret to achieving a Class I incisor relationship is to get the canines into a Class I relationship. It is helpful to anticipate the position of the lower canine once the lower labial segment has been aligned and positioned appropriately. It is then possible to mentally reposition the maxillary canine so that it is in a Class I relationship with the lower canine. This gives the clinician an idea of how much space will be required and how far the upper canine will need to be moved. This will also give an indication of the type of movement and therefore type of appliance required, as well as providing information about anchorage requirements.

4- Buccal segments

Although the aim is usually to obtain a Class I canine relationship, it is not necessary to always have a Class I molar relationship. If teeth are extracted in the upper arch, but not in the lower, the molars will be in a Class II relationship. Conversely, if teeth are extracted in the lower arch but not in the upper, the molars will be in a Class III relationship. Whether extractions are needed or not will depend upon the space requirement in each arch. Typically, extractions are more likely to be needed in the upper arch in Class II cases, to allow retraction of the upper labial segment to camouflage the underlying skeletal pattern. However, in Class III cases treated orthodontically, extractions are more likely in the lower arch to allow retroclination of the lower labial segment.

5- Anchorage

Anchorage planning is about resisting unwanted tooth movement. Whenever teeth are moved, there is always an equal and opposite reaction. This means that when teeth are moved there is often a side effect of unwanted tooth movement of other teeth in the arch. When planning a case, it is therefore important to decide how to limit the movement of teeth that do not need to move. It is vital that anchorage is understood

Factors affecting the choice of a specific treatment plan

The final treatment plan is the result of a discussion between the patient and the orthodontist. It is designed keeping in mind the priorities given to the various problems in the problem list. The choice of a specific treatment plan is based upon:

1- THE TYPE OF TOOTH MOVEMENTS REQUIRED

Simple tipping movements can be achieved using removable appliances. If multiple, complex tooth movements are desired, it is advisable to use one of the available fixed orthodontic appliances.

2- PATIENT'S EXPECTATIONS

Patients who have high expectations are expecting ideal finishes which might not be possible using removable appliances. Such patients are concerned about their esthetics to such an extent that the labial appliances might not be an option, they might desire the use of lingual appliances or ceramic appliances.

A compromise might need to be arrived at regarding treatment results and the patient's expectations, it is advised to inform the patient exactly what is achievable with which appliance, to the best of the clinician's ability before commencing the treatment.

3- GROWTH POTENTIAL OF THE PATIENT

Growing patients can be considered as advantage or disadvantage. Results achieved during growth are more stable yet sometimes the return of un-favorable growth pattern following completion of treatment can result in relapse of the treatment results. This is especially true for Class III skeletal pattern cases. Sufficient planning and follow up is advised in growing patients.

4- PATIENT'S ABILITY TO MAINTAIN ORAL HYGIENE

Certain age groups or patients might not be able to maintain adequate oral hygiene with fixed appliance therapy.

Such patients can be treated using removable appliances with compromised treatment results.

5-THE COST OF THE TREATMENT

Fixed orthodontic treatment is more costly as compared to removable appliance therapy. Sometimes the patient might not be able to afford costly yet ideal treatment plans. The financial implications of the treatment should be considered and explained to the patient at the time of deciding upon a particular treatment plan.

6-THE SKILLS OF THE TREATING CLINICIAN

A- It is always better to work within your means and to present treatment plans that can be achieved. It is not possible for every clinician to be good at everything he/she does. Being truthful to the patient before treatment is better than being sorry for him/her following treatment.

B- It is the duty of the clinician to choose an appliance that is appropriate for the particular case and not just appropriate for the clinician. If one has to continue to treat cases, the clinicians need to upgrade their knowledge and skills with the change in developing technology.

7- DISCUSSION WITH THE PATIENT AND PATIENT CONSENT

Patient today act as co-decision makers. Hence, it is the orthodontist legal and moral duty to discuss the risk/benefit of the treatment and alternatives as well as the risks of no treatment at all.

Informed consent

Informed consent: means the patient is given information to help them to understand the:

• Malocclusion

• Proposed treatment and alternatives

• Commitment required

• Duration of treatment

• Cost implications

Treatment alternatives, which must always include no treatment as an option, must be clearly explained, with the risks and benefits of each approach carefully discussed.

Patients who are 16 years or older are presumed to have competence to give consent for themselves. Many orthodontic patients are younger than this, but provided that they fully understand the process, they can give consent. If a competent child consents to treatment, a parent cannot override this decision – this is known as ‘Gillick competence’.

However, it is preferable to have full parental support for the treatment if possible. If the converse occurs – the parent wants the treatment, but the child does not – then it is best not to proceed. Orthodontic treatment requires a great deal of compliance, and unless the patient is totally committed, it is best to delay until such time as they are.

It is advisable to obtain a written consent for the treatment. A copy should be given to the patient with clear details of the:

1- Aims of the treatment,

2- Risks and benefits,

3- Types of appliances to be used,

4- Details of any teeth to be extracted,

5- Commitment required,

6- Likely duration of treatment

Note: When estimating treatment time, it is always better to slightly overestimate the likely treatment duration. If the treatment is completed quicker than first promised, the patient will be pleased. However, if the treatment takes longer, the patient may lose interest, resulting in compliance problems.

7- Any financial implications,

8- As well as long-term retention requirements.

As well as providing a written record of the aims of the treatment and the treatment plan, it is useful to give the patient a summary of exactly what is expected from them, this involves information about:

1- Maintenance of good oral hygiene.

2- Appropriate diet and regular attendance.

3- Also any specific requirements relevant to their case, such as headgear wear, turning expansion screws and elastic wear. A fully prepared and committed patient is more likely to result in more successful orthodontic treatment.

Orthodontic treatment plan phases:

1-Preventive Orthodontics

2- Interceptive Orthodontics

3-Corrective Orthodontics

 Preventive Orthodontics: Includes all those procedures undertaken to preserve the integrity of normally developing occlusion by protecting current conditions or preventing situations that would interfere with growth by the following measures:

1-Parent education:

A- Should ideally begin much before the birth of the child. The expecting mother should be educated on matters such as nutrition to provide an ideal environment for the developing fetus.

B- Soon after the birth, the mother should be educated on proper nursing and care of the child. In case the child is being bottle fed, the other is advised on the use of physiologic nipple (designed to permit suckling of milk, which more or less resembles normal functional activity as in breastfeeding) and not the conventional nipple.

C- The parents should also be educated on the need for maintaining good oral hygiene of the child's oral cavity (avoid nursing during all the night)

2- Maintenance of shedding and eruption timetable.

3 -Management of premature loss of deciduous teeth.

4- Management of ankylosis of deciduous teeth.

5- Prolonged retention of deciduous teeth.

6- Extraction of Supernumerary Teeth.

7- Management of Oral Habits.

8- Management of deeply locked first permanent molars.

Occasionally, the first permanent molar may get deeply locked under the crest of contour of the distal surface of deciduous second molar due to distal inclination of the latter tooth.

To Prevent that: Re approximation /proximal stripping to a certain extent on mesial and distal surface of second deciduous molar will guide the eruption of deeply locked first permanent molar.

9-Treatment of Occlusal Prematurities:

Occlusal prematurities due to over or underfilled restoration or uneven attrition of teeth causes a tendency of forward placement of mandible. This may lead to pseudo class III malocclusion.

To Prevent that:

a-Correcting the improper restoration. b-Treatment of attrition by composite restoration.

10- Management of Abnormal Frenum Attachment.

11- Space maintainers.

 Interceptive Orthodontics:

Interceptive orthodontics is undertaken at a time when malocclusion has already developed or developing. The difference between preventive and interceptive orthodontics lies in the timing of the services rendered. Preventive orthodontic procedures are undertaken when the dentition and occlusion are perfectly normal, while the interceptive procedures are carried out when signs and symptoms of a developing malocclusion are evident.

Interceptive orthodontic procedures may include:

1-Serial extraction/guidance of occlusion:

2-Correction of developing cross-bites

3-Control of abnormal oral habits: Correction of deleterious oral habits, such as:

a- Thumb sucking. b-tongue thrusting. c- Mouth breathing.

4- Proximal stripping of deciduous teeth to facilitate the eruption of adjacent permanent teeth.

6- Interception of skeletal mal-relations.

7- Space regaining:

8- Muscle exercises:

Dentoalveolar structures are surrounded on sides by the soft tissue envelop made of orofacial musculature. Development and maintenance of normal occlusion depends on presence of normal oro-facial muscular balance. Muscle exercises help in improving aberrant muscle activity.

9- Removal of soft tissue and bony barriers:

Removal of soft tissue and bony barrier is a surgical interceptive orthodontic procedure, which involves excision of the soft tissue and removal of bone, covering the crown of the unerupted. tooth, to create the space so that the tooth can erupt without any hindrance.

The extent of soft tissue and bone removal should be such that the greatest diameter of the crown of the tooth should be able to easily emerge. The surgical wound is given a cement dressing for a period of two weeks.

My great wishes for my lovely students for success. Thanks

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Lecture 7 5th د.حيدر سعد حنفوش

Orthodontics

SPACE ANALYSIS

Space analysis is a process that allows an estimation of the space required in each arch to fulfill the treatment aims. It helps to determine whether the treatment aims are feasible, and assists with the planning of treatment mechanics and anchorage control. Space planning is carried out in 2 phases:

1- to determine the space required for relief of crowding, overjet correction and creating space for any planned prostheses.

2- calculates the amount of space that will be created during treatment by molar distalization, arch expansion, inter-proximal stripping …etc.

Before undertaking a space analysis, the aims of the treatment should be determined as this will affect the amount of space required or created.

Space analysis can act only as a guide, as many aspects of orthodontics cannot be accurately predicted, such as growth, the individual patient’s biological response and patient compliance.

MIXED DENTITION ANALYSIS:

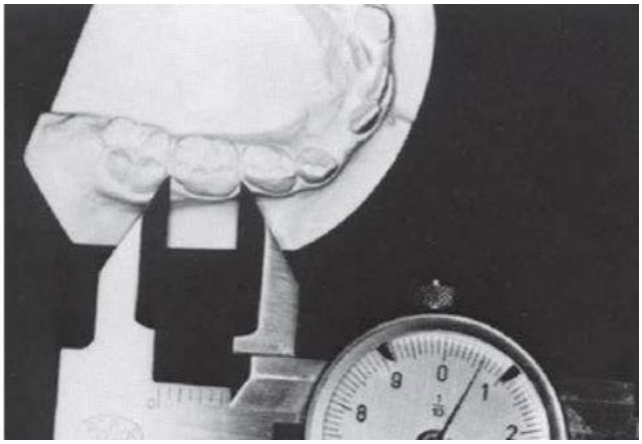
The purpose of a mixed dentition analysis is to evaluate the amount of space available in the arch for succeeding permanent teeth and necessary occlusal adjustments. The mesiodistal width of unerupted canine and

premolars is calculated either from radiographs or predicted from the sizes of permanent teeth already erupted in the mouth:

1) Measurement from radiographs:

The widths of the unerupted canine and premolars is estimated using proportionate measurement from radiographs, which takes into account any magnification. The width of the unerupted tooth is measured directly from radiograph and the width of a deciduous molar is measured from the radiograph and from the dental cast and the following equation is used:

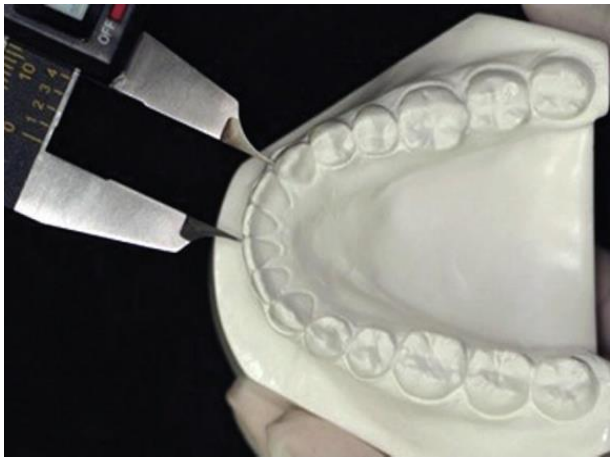
$$\frac{\text{True MD width of erupted primary molar}}{\text{MD width of erupted primary molar on X-ray}} = \frac{\text{True MD width of unerupted tooth}}{\text{MD width of unerupted tooth on X-ray}}$$



2) Prediction tables or equation:

They are based on the direct measurement of the mesiodistal width of already erupted permanent teeth especially mandibular incisors to estimate the size of unerupted canine and premolars. The mandibular incisors were chosen since they erupt into the mouth early in the mixed dentition. The maxillary incisors are not used since they show a lot of variability in size.

The most commonly used methods are Moyer' s Mixed Dentition Analysis and Tanaka and Johnson Analysis.



Moyers Mixed Dentition Analysis: The greatest mesiodistal width of each of the four mandibular incisors is measured from a cast and summed up. Then the combined widths of the unerupted canine and premolars are predicted by use of probability charts with 75% probability level.

	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0
Max 75%	20.6	20.9	21.2	21.5	21.8	22.0	22.3	22.6	22.9	23.1
Man 75%	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5	22.8

Tanaka and Johnson Analysis: They simplified Moyers table into a formula to predict the combined widths of the unerupted permanent canine and premolars (in one quadrant):

$$Upper\ canine\ \&\ premolars\ widths = \frac{width\ of\ four\ lower\ incisors}{2} + 11mm$$

$$Lower\ canine\ \&\ premolars\ widths = \frac{width\ of\ four\ lower\ incisors}{2} + 10.5mm$$

Remember that the width of the lower incisors is used to predict upper canine and premolars widths too.

Procedure of Mixed Dentition Space Analysis:

1. Measure the greatest mesiodistal width of each of the four mandibular incisors and determine the amount of space needed for their alignment.

2. Measure the distance from the mesial surface of the first permanent molar to the distal surface of the lateral incisor. Subtract the space needed for incisor alignment, any necessary molar adjustment and overjet correction to get the actual space available for the canine and two premolars. Repeat this process for both sides of the arch.

3. Predict the combined widths of the canine and premolars by the use of a probability chart or equation.

4. Finally, compare the space available with the predicted canine and premolars widths to estimate space need.

This will help decide on the use of space regainers or space maintainers.

a) Space need of 2mm per quadrant can be treated by lingual or palatal arch to preserve Leeway space giving room for eruption of the permanent premolars and canines and proper alignment of incisors.

b) Space need of 3mm per quadrant should be referred to the orthodontist to plan for space creation during the mixed dentition or later during comprehensive orthodontic treatment.

PERMANENT DENTITION ANALYSIS:

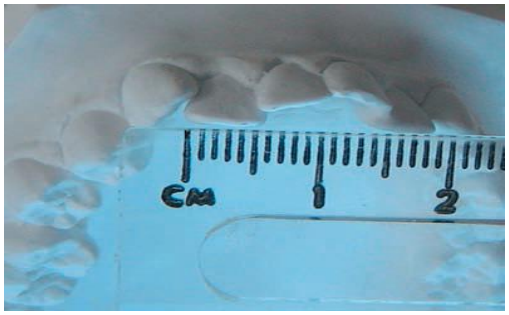
The aim of space analysis is to determine the space and anchorage

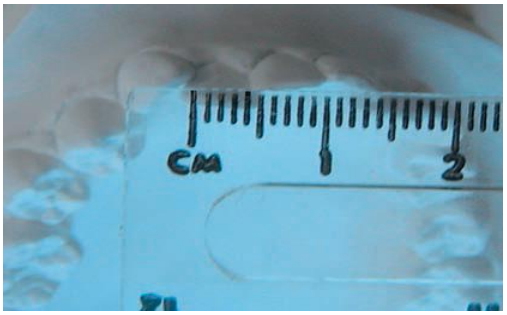
requirements for orthodontic treatment.

Commonly Used Methods

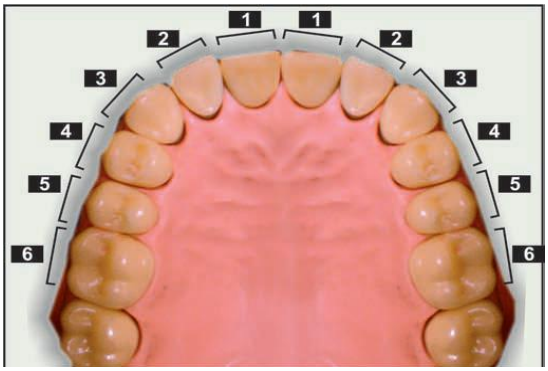
1- Visualization is the most commonly used method but is inaccurate in quantifying crowding.

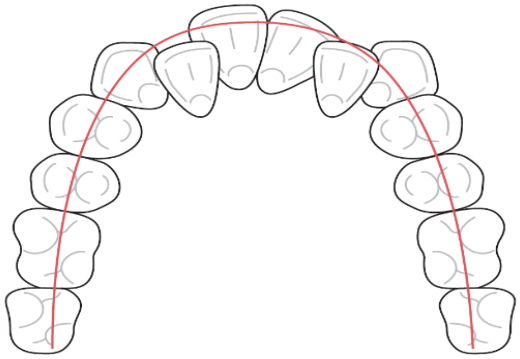
2- The amount of crowding can be calculated by measuring the mesiodistal width of any misaligned tooth in relation to the available space in the arch. This process is repeated for all the misaligned teeth in the arch to give the total extent of crowding.

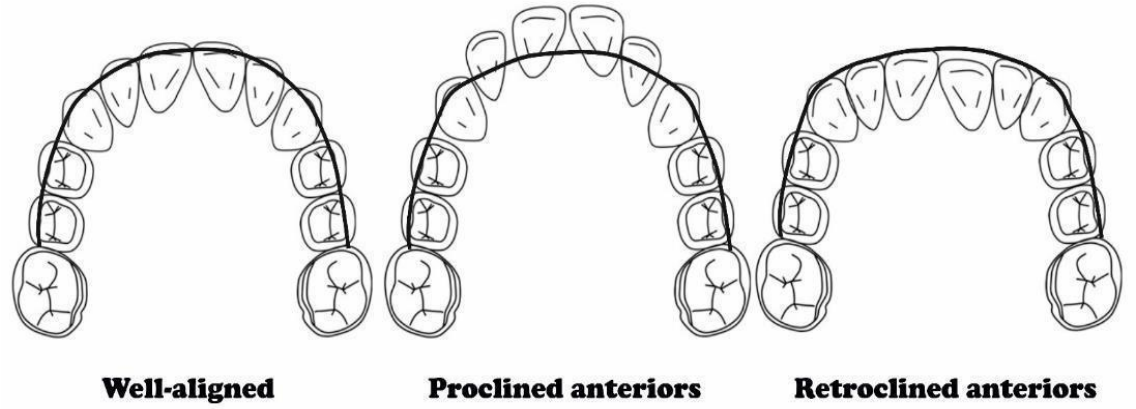




3- Arch perimeter/ Carey’ s Analysis: the mesiodistal widths of the incisors, canines and premolars are measured by a divider and the sum represents the space needed. A soft brass wire is passed from the mesial surface of the first molar to the contra-lateral side. The wire passes along the buccal cusps of premolars and incisal edges of the anteriors. In crowded arches, the wire should be pass according to the arch form that reflects the majority of the teeth. The wire should pass along the cingula of anterior teeth if they are proclined and along their labial surfaces if they are retroclined. The wire is then straightened to measure the space available. The difference is the space need or excess.







4- Segmental arch analysis: The same as Carey' s Analysis but done in three segments; from the mesial of the first molars to the mesial of the canines for the distal segments and between the mesial of the canines for the anterior segment.

5- Digital 3D scanning: Many software programs are equipped with a facility to plot contact points in order to identify the arch form, as well as a ‘virtual ruler’ that can measure mesiodistal tooth widths.

Malocclusion Features to Consider in Space Analysis:

1) Crowding and spacing:

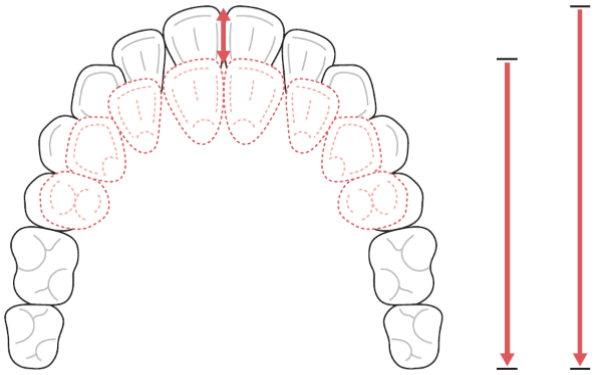
Crowding and spacing should be measured mesial to the first permanent molars in relationship to the archform that fits the majority of teeth. The mesiodistal width of the malaligned teeth is measured followed by the available space within the archform. Crowding can be quantified as mild (<4 mm), moderate (4‑8 mm) or severe (≥8 mm).

If the second deciduous molars are retained, approximately 1 mm of space per quadrant will be available following exfoliation and eruption of second premolars in the upper arch and 2 mm in each quadrant in the lower arch.

2) Incisor anteroposterior movement

With few exceptions, the lower incisor anteroposterior (AP) position should be accepted to maximize stability. In Class II malocclusions, the upper incisors must be retracted for overjet reduction.

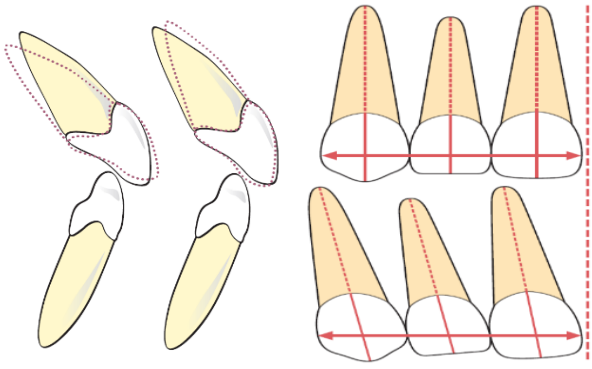
Conversely, in Class III malocclusions the upper incisors may be advanced and the lowers retracted to correct a reverse overjet. For every 1 mm all four incisors are retracted, 2 mm of space (1 mm per quadrant) is required. Conversely, for every 1 mm all four incisors are advanced, 2 mm of space will be created.



3) Correction of upper incisor angulation and inclination

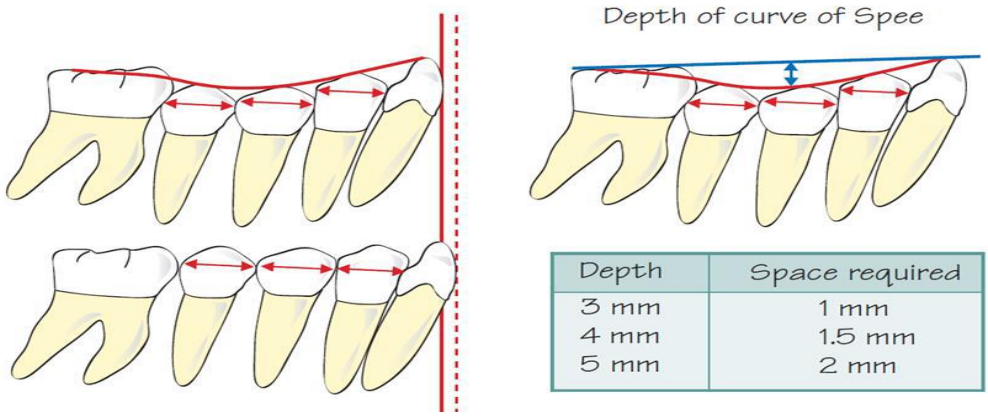
Changing the inclination (torque) of incisors has space implications. When the upper incisors are proclined, the overjet increases and space is required to normalise this increase. When proclined incisors are retroclined, every 5° of retroclination will reduce the overjet by 0.5mm and requires 1mm of space.

The space requirement to correct incisor angulation (mesiodistal tip) is usually minimal.



4) Levelling the curve of Spee

Where there is no occlusal stop the lower incisors may over-erupt resulting in an occlusal curve which runs from the molars to the incisors (Curve of Spee). Levelling an increased curve of Spee requires 1 to 2mm of space depending on the depth of the curve, which is measured from the premolar cusps to a flat plane joining the distal cusps of first permanent molars and incisors. Flattening deep curves of Spee increasing arch length and labially proclines the incisor teeth.



5) Arch contraction and expansion

Upper arch lateral expansion is undertaken for posterior crossbite correction and is useful in providing space for the relief of crowding and/or overjet reduction. Every 1 mm of lateral expansion creates approximately 0.5 mm of space within the arch. While, arch contraction requires space.

6) Tooth reshaping or replacement

Mesiodistal enlargement of microdont teeth and replacement of missing teeth require space. Also, extremely large teeth need to be stripped to normal size. This needs to be taken into account when determining total arch space requirements.

Once all of the above factors have been considered, it is possible to calculate the space required within each arch.

Calculating Space Requirement:

A patient has:

• 6mm overjet

• 3mm curve of Spee in the lower arch

• 2mm upper arch crowding

• 2mm lower arch spacing

• requires upper arch expansion of 4mm

• requires 2mm stripping of his large upper central incisors

Calculate the space requirement.

• The overjet is increased by 4mm (6 - 2 = 4mm). To reduce overjet to normal 8mm of space is required (4 x 2 = 8mm, 4mm of each side).

• Leveling a 3mm deep curve of Spee requires 1mm of space.

• 4mm of expansion creates 2mm of space within the upper arch

	Upper arch	Lower arch
Crowding / spacing	-2 mm	+2 mm
Incisor AP movement	-8 mm	
Incisor inclination		
Levelling the curve of Spee		-1 mm
Arch contraction / expansion	+2 mm	
Tooth enlargement / replacement	+2 mm	
Total	-6 mm	+1 mm

A positive score shows space gain; a negative score shows space requirement.

The patient has 6mm space need in the upper arch and 1mm extra space in the lower arch.

BOLTON RATIOS AND TOOTH-SIZE DISCREPANCY

A tooth-size discrepancy is a disproportion amongst the sizes of individual teeth and is a reason why it can be impossible to achieve an ideal occlusion orthodontically (interdigitation, overjet, overbite).

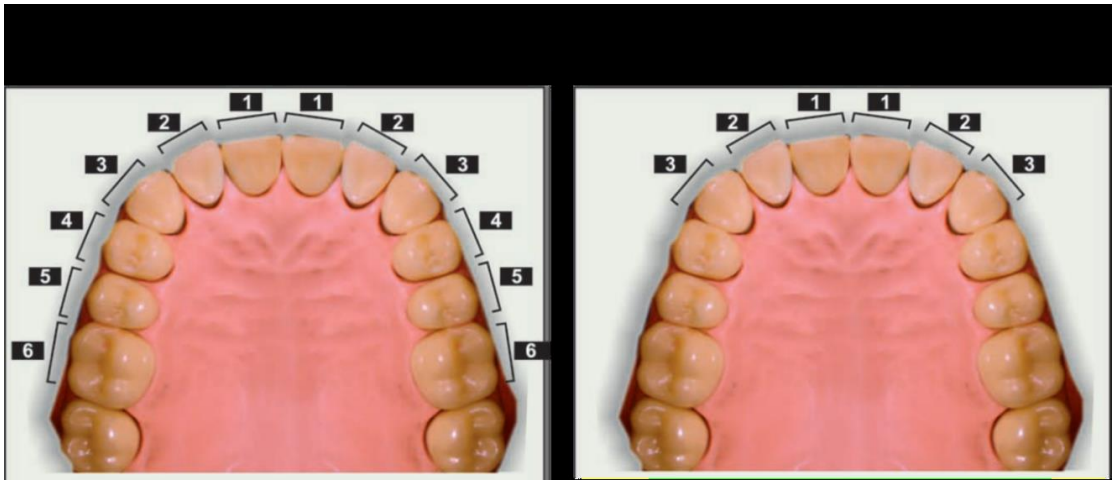
Common examples of a Bolton discrepancy include the presence of small maxillary lateral incisors and class III malocclusions, where there is a tendency towards a relative mandibular tooth excess.

Bolton evaluated the ideal ratio of tooth material between the maxillary and mandibular arch on 55 cases with excellent occlusions. The maxillary tooth material should approximate desirable ratios, as compared to the mandibular tooth material. Bolton’ s analysis helps to determine the disproportion between the size of the maxillary and mandibular teeth.

There are two ratios for ideal occlusion: the first for the ratio of tooth widths associated with the anterior teeth (anterior ratio) and the second for the whole arch from the first molars forwards (overall ratio).

$$\text{Overall ratio} = \frac{\text{sum of the mesiodistal widths of the mandibular 12 teeth}}{\text{sum of the mesiodistal widths of the maxillary 12 teeth}} \times 100$$

$$\text{Anterior ratio} = \frac{\text{sum of the mesiodistal widths of the mandibular anterior 6 teeth}}{\text{sum of the mesiodistal widths of the maxillary anterior 6 teeth}} \times 100$$



Overall ratio: The sum of the mesiodistal widths of the 12 mandibular teeth should be 91.3% the mesiodistal widths of the 12 maxillary teeth. If the overall ratio is greater than 91.3%, then the mandibular tooth material is excessive; but if the overall ratio is less than 91.3%, then the maxillary tooth material is excessive.

Anterior ratio: The sum of the mesiodistal diameter of the 6 mandibular anterior teeth should be 77.2% the mesiodistal widths of the 6 maxillary anterior teeth. If the anterior ratio is greater than 77.2%, then the mandibular anterior tooth material is excessive. This means that orthodontic treatment will end with Class II canine relationship because the mandibular canine is more distal. But if the anterior ratio is less than 77.2%, then the maxillary anterior tooth material is excessive. This means that orthodontic treatment will end with Class III canine relationship because the maxillary canine is more distal.

In the case of discrepancy, reduction of tooth material can be done on the arch with excess material or composite buildups on the arch with decreased tooth material. If the arch length discrepancy is:

· 0 to 2.5 mm - Proximal stripping can be carried out to reduce the minimal tooth material excess.

· 2.5 to 5 mm - Extraction of 2nd premolar is indicated

· Greater than 5 mm - Extraction of first premolar is usually required.

Drawbacks of Bolton Analysis:

1. This study was done on a specific population.

2. It doesn’ t take into account gender difference in the maxillary canine widths.

My great wishes for my lovely students for success. Thanks

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Lecture 8+9 [5th] **د.حيدر سعد حنفوش**

Orthodontics

SERIAL EXTRACTION

Serial extraction involves the timed extraction of primary and, ultimately, permanent teeth to relieve severe crowding and to guide the erupting permanent teeth into a more favorable position. It is better termed it 'Guidance of Eruption' or 'Guidance of Occlusion'.

Commonly at 7-8 years of age the maxillary and mandibular central incisors have erupted, but there is inadequate space in anterior segments to allow normal eruption and positioning of lateral incisors. In some cases, mandibular lateral incisors have already erupted but they are usually lingually positioned and rotated. The same is with the maxillary lateral incisors. The orthodontist has four option:

• Wait for growth to provide more space and re-evaluate later.

• Expansion of the dental arch. However, the stability of expansion may be compromised by the insufficient alveolar basal bone.

• Cement a transpalatal or lingual bar to preserve the Leeway space for later on.

• Serial extraction can reduce crowding and irregularity during the mixed dentition.

HISTORY

Bunon (1743) made the first reference to the extraction of deciduous teeth to achieve a better alignment of permanent teeth. In 1929, Kjellgren of

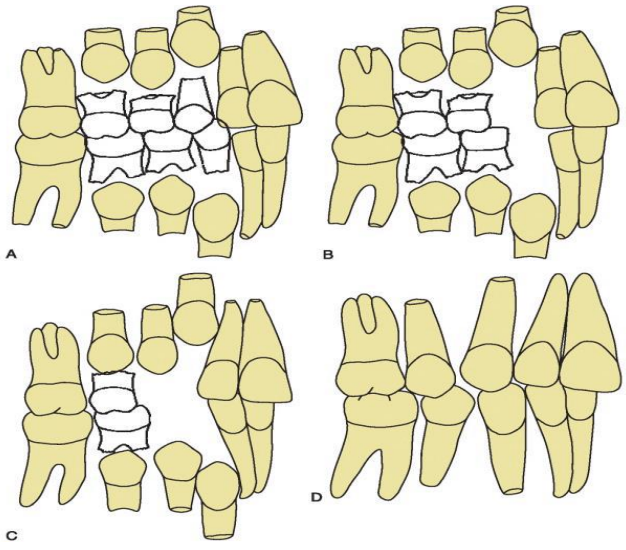
Sweden first used the term ‘serial extraction’. In the 1940s, the technique was popularised in the United States by Nance who is known as the Father of serial extraction.

It was advocated originally as a method to treat severe crowding by their own dentists without or with only minimal use of appliance therapy, thus minimizing demands upon the orthodontic service.

Although serial extraction makes later comprehensive treatment easier and often quicker, by itself it almost never results in ideal tooth position or closure of excess space. Also, the patients must be chosen carefully and supervised carefully as they develop.

PROCEDURE

There is no fixed technique to be followed while carrying out serial extractions. Different authors have given different sequences for following guidance of occlusion. Some of the most common and accepted sequences are Tweed’s, Dewel’s, Nance’s, and Grewe’s methods. Careful diagnosis and continuous re-evaluation during the course of treatment is mandatory to achieve required results. However, based on the usual eruption sequence of teeth when the first premolar is ahead of the canine, there are several stages:



1. Extraction of primary lateral incisors as permanent central incisors erupt, if necessary. Most often this occurs spontaneously.

2. Extraction of primary canines as permanent laterals erupt at 8 to 9 years of age to allow eruption and alignment of permanent incisors. As the permanent teeth align without any appliances in place, there is usually some lingual tipping of the lower incisors, and overbite often increases during this stage. But this does not pose a problem because labio-lingual displacements are better resolved than rotational displacements.

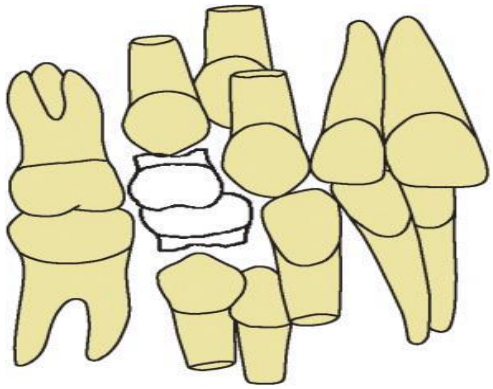
3. Extraction of primary first molars 6 to 12 months before their normal exfoliation time when there is one half or two-third root formation of the first premolar usually between 9 to 10 years of age. This is done to encourage first premolars to erupt ahead of permanent canines, so that they can be extracted and permit canines to move distally into the space.

4. Extraction of first premolars, just as they emerge through the mucosa after checking that all other teeth are present and sound and that the permanent canines are mesially inclined.

5. After the first premolar has been extracted, the second primary molars should exfoliate normally. The premolar extraction spaces close partially by mesial drift of the second premolars and permanent first molars but largely by distal eruption of the canines. If serial extraction is not followed by mechanotherapy, ideal alignment, root positioning, correct rather than deep overbite, and space closure usually are not achieved.

In the lower arch, the canines often erupt before the first premolars, which causes the canines to be displaced facially. If the primary first molar is extracted early and the first premolar still does not erupt before the canine, this can lead to impaction of the premolar that requires later

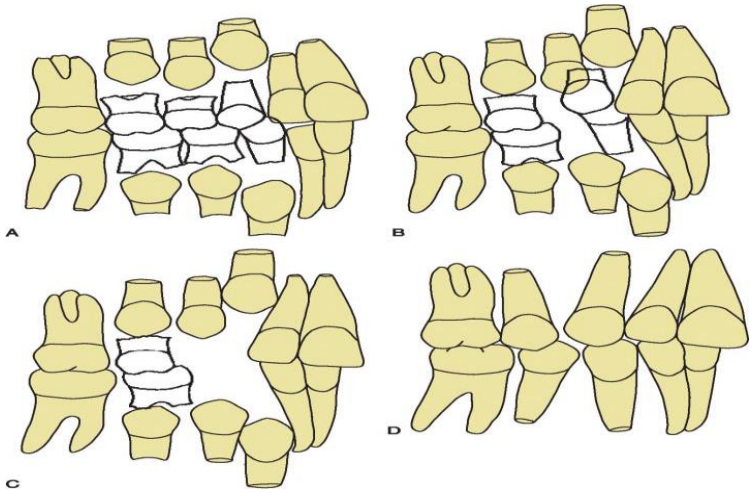
surgical removal. If radiographic examination shows that it is obvious that the canine will erupt before the premolar, to avoid this complication:



• Deciduous first molars are extracted and first premolars surgically enucleated at the same time. If possible, however, enucleation should be avoided because the erupting premolar brings alveolar bone with it. Early enucleation can leave a bone defect that persists.

• The primary canines are retained, and the primary first molars are extracted to speed up the premolar eruption and cause them to enter the arch before the canines, but this has a minimal effect on relief of incisor crowding and in many patients with severe crowding, the primary canines are lost to ectopic eruption of the laterals and cannot be maintained. The first premolars are extracted as they emerge through the mucosa and the deciduous canines are also removed allowing the permanent canines to erupt distally. This technique can also be used to prevent lingual tipping of the lower incisors and deepening of the bite.

• Deciduous first molars are extracted first, and 6 months later deciduous second molars are extracted. A lingual bar prevents permanent first molars from migrating mesially. Unerupted first premolars move distally into the alveolar bone as the canine erupts. When first premolar erupts, it is extracted.



RATIONALE:

• If primary teeth are extracted prematurely 1½ years or more before the time of normal exfoliation, the eruption of the permanent teeth will be delayed. Conversely, the eruption rate can be accelerated if the primary tooth overlying the permanent tooth is extracted less than a year before the time of normal exfoliation.

• Crowded teeth adjacent to an extraction site tend to align themselves.

• Intercanine width increases in the mandible up to 9 years of age by an average of 3mm. In maxilla, it increases up to 12 years in females and 16 years in males by about 4.5mm.

• Serial extraction allows the teeth to erupt over the alveolus and through keratinized tissue, rather than being displaced buccally or lingually.

• It is normal for children to have more prominent lips which flatten out with growth, so lip fullness is not a reliable criterion for extraction in the mixed dentition. Also, the growth of the nose and chin are unpredictable and continue to grow long after other facial parts. Therefore, extraction in an attempt to end with straight profile may actually end with a concave one.

INDICATIONS

Serial extraction is directed toward severe dental crowding. Typically, Class I malocclusion with an arch size-tooth size deficiency of 5mm or more per quadrant (10mm per arch), normal eruption sequence as assessed radiographically and a skeletal growth pattern within normal limits.

The average width of first premolar is 7-8mm. After serial extraction, incisors tend to drift lingually and the posterior teeth tend to drift mesially to some extent, leading to 2-3mm of space closure in each quadrant. Thus the remaining 5mm is available for resolution of crowding.

If the crowding is severe, little space will remain after the teeth are aligned, which means there will be little tipping and uncontrolled movement of the adjacent teeth into the extraction sites. If the initial crowding is smaller, more residual space must be expected.

It is unwise for a non-specialist to start serial extraction in a child who has a skeletal problem (Class II or III) because the closure of extraction spaces would be affected by the treatment of the skeletal problem. Sometimes serial extraction can be used only in the maxillary arch of Class II maxillary alveolodental protrusion patients.

CONTRAINDICATIONS

1. Mild to moderate crowding less than 4mm per quadrant.

2. Class II division 2 and Class III malocclusions.

3. Spaced dentition.

4. Congenital absent second premolars.

5. Extensive caries involving permanent first molars, which cannot be conserved.

6. Open bite, deep bite, and crossbite which should be corrected first.

ADVANTAGES

1. More physiologic treatment as teeth are guided into normal positions using physiologic forces.

2. Duration of fixed treatment is reduced.

3. Health of investing tissues is preserved.

4. Lesser retention period is required.

5. Results are more stable.

DISADVANTAGES

1. Long-term procedure that requires thorough knowledge of growth, development, eruption sequence and calcification of permanent teeth. No single approach can be universally applied.

2. It is done as intercanine growth is occurring and hence it is difficult to assess accurately how crowded the dentition will be.

3. Treatment time is prolonged over 2-3 years.

4. Psychological trauma to the child because of repeated extractions.

5. Patient cooperation is very important.

6. Tendency to develop tongue thrust as extraction spaces close gradually.

7. Tendency to deepen the bite because of lingual tipping of incisors.

8. Residual spaces can remain between the canine and second premolar.

9. Some amount of fixed appliance therapy is usually required at the end of serial extraction.

BORDERLINE CROWDING CASES

Since serial extraction is only for patients with severe crowding, and early expansion offers little advantage over expansion during later comprehensive treatment, the best approach to moderately crowded and irregular teeth during the mixed dentition is to maintaining Leeway space increases the chance of successful non-extraction treatment if space is adequate or borderline. Lingual and palatal arches are needed.

Also, extraction of deciduous canines may avoid more complicated treatment later in these cases:

1. To prevent crowded erupting upper lateral incisors from being forced palatally into a crossbite and its apex palatally positioned, making later correction more difficult.

2. To provide space for appliance therapy for correction of an instanding upper lateral incisor.

3. To spontaneously align crowded mandibular incisors where one incisor has been pushed through the labial plate of bone with a compromised labial periodontal attachment.

4. In Class III malocclusion by extraction of the mandibular deciduous canines

5. To improve the position of a displaced permanent canine and to decrease the chance of canine impaction**.**

CROWDING

Crowding affects approximately 60% of Caucasians. Both jaw size and tooth size are mainly genetically determined and appear to be reducing; however, environmental factors, for example premature deciduous tooth loss, can increase crowding. In evolutionary terms both jaw size and tooth size appear to be reducing. However, crowding is much more prevalent in modern populations than it was in prehistoric times. This may be due to the introduction of a less abrasive diet, so that less interproximal tooth wear occurs during the lifetime of an individual. Also, a change from a rural to an urban life-style can also apparently lead to an increase in crowding after about two generations.

CLASSIFICATION OF CROWDING:

Considering the amount of space deficiency, crowding is divided into:

• Mild crowding (<4mm)

• Moderate crowding (4-8mm)

• Severe crowding (>8mm)

Considering its etiology, crowding is divided into:

• Primary crowding (hereditary): crowding is determined genetically and is caused by disproportionately sized teeth and jaws. The malalignment of the anterior teeth is characteristic of this type of crowding.

• Secondary crowding: it is an acquired anomaly caused by mesial drift of the posterior teeth after premature loss of deciduous teeth in the lateral segments.

• Tertiary crowding: occurs between the ages of 18 and 20 primarily of

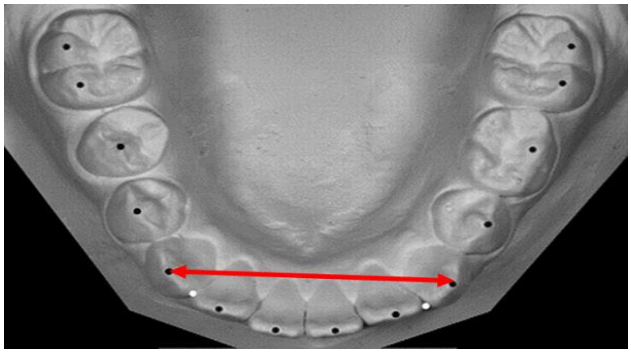
the lower anterior teeth. It may be attributed to:

❖ mesial migration of the posterior teeth owing to forces from the erupting third molars. The third molar has a weak association with late lower incisor crowding. Furthermore, this crowding can still occur in patients with congenitally absent third molars. Therefore, prophylactic removal of lower third molars to prevent lower labial segment crowding cannot be justified.

❖ uprightening of the lower incisors as a result of forward growth of the mandible when maxillary growth has slowed.

❖ soft tissue pressures being stronger from the lips and cheeks than from the tongue.

❖ reduction in lower intercanine width: In most individuals intercanine width increases up to around 12 to 13 years of age, and this is followed by a very gradual diminution throughout adult life. The rate of decrease is most noticeable during the mid to late teens.



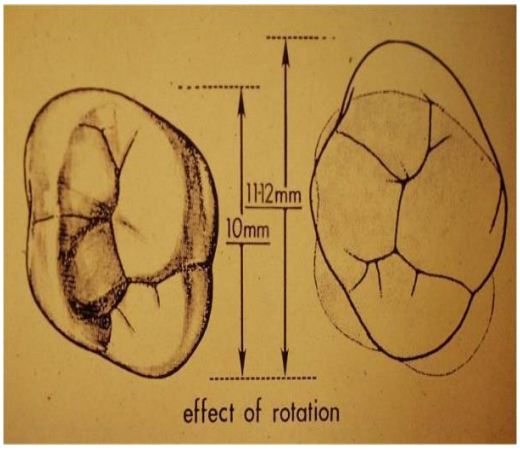
METHODS OF SPACE CREATION

The amount of space that will be created during treatment can also be assessed. The aim is to balance the space required with the space created. Space can be created by one or more of the following:

1- Derotation

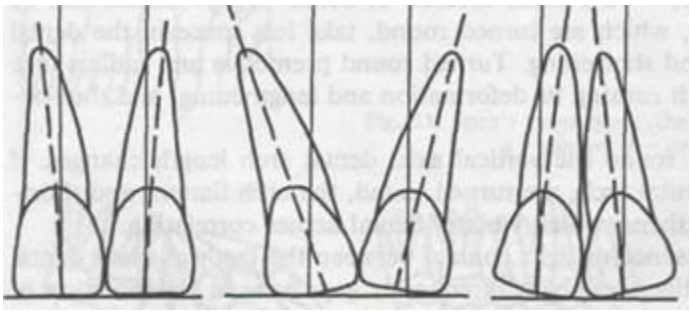
Derotating anterior teeth needs space because rotated incisors take up less space than aligned ones.

While, derotating posterior teeth creates space because rotated molars take up more space than aligned ones.



2- Uprightening

Uprightening tilted teeth creates space because mesially or distally tipped teeth take up more space than upright ones.



3- Distal movement of molars

Distal movement of molars in the upper arch can be achieved with headgear. Extra-oral traction using headgear will usually produce up to 2–3 mm per side (creating 4–6 mm space in total). It is used:

• when there is a mild space requirement where extractions may produce too much space

• in addition to extractions when there is a very high space requirement.

Temporary anchorage devices (TADS) offer an alternative to headgear. Appliances attached to these anchorage devices can be used to distalize upper molars.

Distal movement of the lower first molar is very difficult and in reality the best that can be achieved is uprighting mesially tipped molars.

4- Expansion

Space can be created by expanding the upper arch laterally; approximately 0.5 mm is created for every 1 mm of posterior arch expansion. Expansion should ideally only be undertaken when there is a crossbite. Expansion without a crossbite may increase the risk of instability and the risk of perforation of the buccal plate.

Expansion of the lower arch may be indicated if a lingual crossbite (scissors bite) of the lower premolars and/or molars exists. Any significant expansion in the lower arch, particularly the lower intercanine width, is unstable.

5- Proclination of incisors

Space can be created by proclining incisors, but this depends on the aims of the treatment, so proclining upper incisors in Class III malocclusion and lower incisors in Class II malocclusion can help correct the incisor relationship and relief crowding at the same time. Each millimetre of incisor advancement creates approximately 2mm of space within the dental arch.

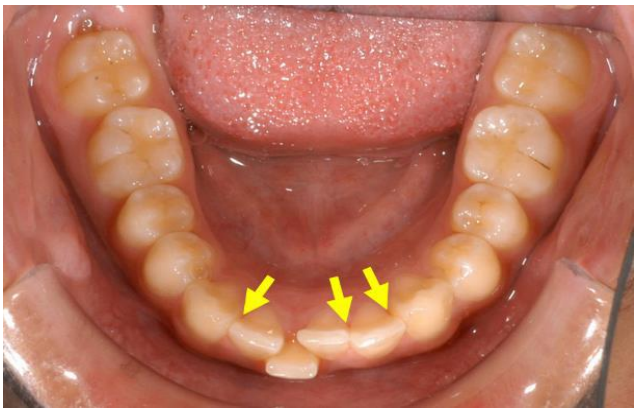
6- Enamel stripping

Enamel interproximal reduction or ‘stripping’ is the removal of a small amount of enamel on the mesial and distal aspect of teeth. In addition to creating space, the process can improve the shape and contact points of teeth, and possibly enhance stability at the end of treatment.

On the anterior teeth approximately 0.5mm can be removed on each tooth (0.25mm mesial and distal) without compromising the health of the teeth. Enamel can be carefully removed with an abrasive strip, then treated topically with fluoride.

A high-speed air-turbine handpiece can be used to remove enamel from the posterior teeth. However, both teeth and periodontium can be damaged unless care is taken. Removal of filling materials is preferred over sound enamel when applicable.

It is important that teeth are reasonably aligned before enamel reduction begins.



7- Extractions

Before planning extractions of any permanent teeth, it is essential to ensure that all remaining teeth are present and developing appropriately.

SPACING

Generalized spacing is not common and is due to either hypodontia or small teeth in well-developed arches. Orthodontic management of generalized spacing is frequently difficult as there is usually a tendency for the spaces to re-open unless permanently retained.

• In milder cases it may be wiser to encourage the patient to accept the spacing, or if the teeth are narrower than average, acid-etch composite additions or porcelain veneers can be used to widen them and thus improve aesthetics.

• Spaces can be closed by retracting
protruded anterior teeth or by mesializing the posterior teeth.

• In severe cases of hypodontia a combined orthodontic–restorative approach to localize space for the provision of prostheses, or implants, may be required.

Localized spacing may be due to hypodontia; or loss of a tooth as a result of trauma or extraction. This problem is most noticeable if an upper incisor is missing as the symmetry of the smile is affected.

Upper central incisors are rarely congenitally absent. They can be lost as a result of trauma, or occasionally their extraction may be indicated because of dilaceration. Lost central incisors should be replaced to prevent adjacent teeth from drifting into the extraction site. The resulting midline shift will complicate later treatment.

Autotransplantation is the surgical repositioning of a tooth into a surgically created socket within the same patient. It is successful to transplant open apex premolars from crowded arches into the sockets of uvulsed central incisors.

MISSING UPPER LATERAL INCISORS

Hypodontia is defined as the congenital absence of one or more teeth. The prevalence hypodontia in a Caucasian population (excluding the third molars) is between 3.5 to 6.5%. One or more third molar is missing in approximately 25–35% of the population. The next most commonly missing teeth are the second premolars (3%) followed by the upper lateral incisors (2%). Both can occur unilaterally or bilaterally.

Whatever the reason for the absence of lateral incisors, there are two treatment options:

1- closure of the space and camouflage the canines (grinding the cusp tip and flattening the labial surface and adding composite when needed).


2- opening of the space and placement of a fixed or removable prosthesis.


The choice for a particular patient will depend upon a number of factors:

1- Skeletal relationship: space closure by incisor retraction may be preferable in Class II division 1 as it will aid overjet reduction, but unfavorable in Class III malocclusion.

2- Presence of crowding or spacing: where the space of the missing lateral incisors can be used to resolve crowding of adjacent teeth. On the other hand, generalized spaces can be collected in the lateral incisor area for prosthetic replacement.

3- Colour and form of adjacent teeth: if the permanent canines are much darker than the incisors and/or pointed in shape, modification to make them resemble lateral incisors will be difficult. Also, if a lateral incisor is to be brought forward to replace a missing single upper central incisor, an aesthetically pleasing result will only be possible if the lateral is fairly large and has a broad gingival circumference.

4- The inclination of adjacent teeth: as this will influence whether it is easier to open or close the space. It is easier to retract a mesially inclined canine and open the space, while distally inclined canines are more readily protracted to close the space.

5- The buccal segment occlusion: if the buccal segment relationship is Class I space opening is preferable because closing the space by mesial movement of the buccal segment will result in a Class II molar relationship.

6- The patient's wishes and ability to co-operate with complex treatment: some patients have definite ideas about whether they are willing to proceed with appliance treatment, and whether they wish to have the space closed or opened for a prosthetic replacement.

7- Long-term maintenance/ replacement of a prosthesis.

Closing the space	Opening the space
Class II division 1 malocclusion	Class III malocclusion
Crowded dentition	Spaced dentition
Good form and colour of canine	Dark coloured or pointed canine
Distally inclined canine	Mesially inclined canine
Not class I molar relationship	Class I molar relationship
Patient does not want a prosthetic replacement	Patient accepts a prosthetic replacement
Patient does not want any long-term maintenance/ replacement costs	Patient accepts long-term maintenance/ replacement costs

SPACE CLOSURE

It is carried out by:

1- Molar protraction: early extraction of any deciduous teeth allows forward movement of the first permanent molars, but fixed appliances are required to complete alignment and correct the axial inclinations. Temporary anchorage screws may be helpful where large spaces need to be closed.

2- Incisor retraction where there is an increased overjet

3- Conservative closure of the space: If any masking procedures (for example contouring a canine incisally, palatally, and interproximally to resemble a lateral incisor) or acid-etch composite additions are required, these should be carried out prior to the placement of appliances to facilitate final tooth alignment (although definitive restorations e.g. crowns or veneers, are best delayed until treatment is completed).

Placement of a bonded retainer post-treatment is advisable.

SPACE OPENING

In cases with congenitally absent upper lateral incisors early extraction of the deciduous lateral incisors may be indicated to encourage the permanent canine to erupt mesially achieving a greater volume of alveolar bone. Later the canine is retracted during active space opening. This bone will aid in implant placement.

Definitive treatment when the permanent dentition is established will require fixed appliances to open the space. Whenever space is opened prior to bridgework, it is important to retain with a partial denture for at least 3 to 6 months, particularly if an adhesive acid-etch retained bridge is to be used. Acid-etch bridges placed immediately after the completion of tooth movement, have a greater incidence of failure than those placed following a period of retention with a removable retainer.

Implants are commonly use but require root parallism. Since orthodontically re-positioned roots may show some relapse, prolonged retention may be necessary to prevent the roots from contacting the implant.

MEDIAN DIASTEMA

As median diastemas tend to reduce or close with the eruption of the canines, management can be subdivided as follows.

• Before eruption of the permanent canines intervention is only necessary if the diastema is greater than 3 mm and there is a lack of space for the lateral incisors to erupt. Care is required not to cause resorption of the incisor roots against the unerupted canines.

• After eruption of the permanent canines space closure is usually straightforward. Fixed appliances are required to achieve uprighting of the incisors after space closure. Prolonged retention is usually necessary as diastemas exhibit a great tendency to re-open, particularly if there is a familial tendency, the upper arch is spaced or the initial diastema was greater than 2 mm. Alternatively, if the central incisors are narrow a restorative solution by composite or veneers can be considered.

A U- or V-shaped radiographic appearance of the interproximal bone between the maxillary central incisors is a diagnostic key to the persistent midline diastema. The patient should be informed before orthodontic treatment of the need for long-term retention with bonding of the central incisors after treatment to prevent return of the maxillary midline diastema.

If it is thought that the frenum is a contributory factor, then frenectomy should be considered. Opinions differ as to whether this should be done before treatment; during space closure; or following completion of closure of the diastema. Generally, surgical removal of a maxillary labial frenum should be delayed until after orthodontic treatment unless the tissue prevents space closure or becomes painful and traumatized. Removal may be indicated after treatment to change irreversible hyperplastic tissue to normal gingival form and to enhance posttreatment stability.

My great wishes for my lovely students for success. Thanks

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Lecture 10 [5th] د.حيدر سعد حنفوش

Orthodontics

EXTRACTION IN ORTHODONTICS

The indications of extraction of teeth as a part of orthodontic treatment include:

1- Arch Length-Tooth Material Discrepancy (Crowding)

Ideally the arch length and tooth material should be in harmony with each other. If the dentition is too large to fit in the dental arch without irregularity, it may be necessary to reduce the dentition size by the extraction of teeth. Avoiding extractions by excessively increasing in the dental arch size would not be tolerated by the oral musculature and would lead to relapse.

2- Correction of Sagittal (anteroposterior) Interarch Relationship

Abnormal sagittal malrelationship such as Class II /Ill malocclusion may require extraction to achieve a normal interarch relationship.

In Class I malocclusion, it is preferable to extract in both the arches because it is not advisable to discourage the development of only one arch more than the other.

In most Class II cases (with abnormal upper proclination, normal alignment of the lower teeth and where A point is abnormally forward relative to the B point), it is advisable to extract teeth only in the upper arch and to retract the upper incisors and canines. However, when the lower arch is crowded and/or molars are not in full cusp Class II molar

relationship, lower extractions may be needed to relief the lower crowding and bring the lower molars mesially into a Class I molar relationship.

Class III cases are usually treated by extracting teeth only in the lower arch.

Guidelines for extraction:

After a careful space analysis:

• Less than 4 mm space need, extractions rarely indicated.

• 4-9 mm space need, non-extraction or extraction possible; depends on the details of the therapy.

• 10 mm or more space need, extractions almost always required

SELECTION OF TEETH TO BE EXTRACTED:

Extraction for orthodontic reasons will be governed by:

1- Condition of the tooth:

Fractured, hypoplastic, grossly carious teeth, root canal treated teeth and teeth with large restorations are preferred for extraction over healthy teeth. The main consideration is the long-term prognosis for the tooth rather than the appearance.

2- Position of the tooth:

Grossly malpositioned teeth which are difficult to align may often be the teeth of choice for extraction. The position of the apex of the tooth must be considered as it is more difficult to move the apex than the crown.

3- Position of the crowding:

Crowding in one part of the arch is more readily corrected if extractions are done in that part rather than a remote area of the arch. However, incisor crowding is usually relieved by premolar extraction as it gives a more pleasing appearance and occlusal balance than with incisor extraction.

The first premolar, positioned in the center of each quadrant, is usually near the area of crowding whether in the anterior or buccal segment. Hence, it is also the tooth most frequently extracted along with orthodontic treatment.

TYPES OF EXTRACTION PROCEDURES

Balancing Extractions

Balancing extractions may be defined as the removal of a tooth on the opposite side of the same arch (although not necessarily the same) in order to preserve symmetry.

If a tooth is removed from one side of the dental arch which is crowded, or which has complete contact of teeth all around, there is a tendency for the remaining teeth to move towards the extraction space. This is in the form of forward movement of teeth behind the space, or movement of anterior teeth across the center of the arch, resulting in asymmetry. It is usual to balance extractions in order to prevent such asymmetry.

Compensating Extractions

Removal of the equivalent tooth in the opposing arch to maintain buccal occlusion. In some Class I crowding cases, it is necessary to extract in both arches to maintain lateral symmetry. Compensating extractions preserve interarch relationship by allowing the posterior teeth to drift forward together.

Enforced Extractions

These extractions are carried out because they are necessary as in the case of grossly decayed teeth, poor periodontal status, fractured tooth, impacted tooth, etc.

EXTRACTION OF UPPER INCISORS

The incisors, especially the upper central incisors, are rarely extracted as a part of orthodontic therapy. Indications for upper incisor extraction:

1- Unfavorably impacted upper incisors (especially dilacerated).

2- Grossly carious incisor that cannot be restored.

3- Trauma/irreparable damage to incisors by fracture (especially root fracture).

4- Severe root resorption (e.g. caused by impacted canine)

5- Buccally or lingually blocked out lateral incisor with good contact between central incisor and canines.

6- If a lateral incisor is crowded in linguo-occlusion with its apex palatally displaced and the canine is erupting in a forward position and is upright or distally inclined, lateral incisor extraction may be indicated.

EXTRACTION OF LOWER INCISORS

Indications:

1- When one incisor is completely excluded from the arch and there are satisfactory approximal contacts between other incisors.

2- Poor prognosis as in case of trauma, caries, bone loss, etc.

3- Severely malpositioned incisor.

4- When lower canines are severely inclined distally with crowded lower incisors, it is very difficult to correct this condition by extractions further back in the arch. An incisor is extracted so that the other incisors can be tipped into correct position.

5- In mild Class III incisor relation with an acceptable upper arch and lower incisor crowding, a lower incisor may be extracted to achieve normal overjet, overbite and to relieve crowding.

6- Tooth size discrepancy with Bolton's mandibular anterior excess of 4 mm or more.

Disadvantages:

1- It is not possible to fit four upper incisors around three lower incisors, either an increase in overjet or upper incisor crowding have to be

accepted.

2- Retroclination of lower incisors

3- Deep bite

4- Although crowding may be relieved in the short term, forward movement of buccal teeth may cause further crowding

5- Lower intercanine width (ICW) decreases resulting in a secondary reduction in the upper lCW with crowding in the upper labial segment

Contraindications:

1- Deep bite cases with horizontal growth pattern.

2- All cases which require upper first premolar extraction while canines are in a Class I relationship.

3- Bimaxillary crowding cases with no tooth size discrepancy in the incisor area.

4- Cases having anterior discrepancy due to either small lower incisors or large upper incisors.

EXTRACTION OF CANINES

The permanent canines are important teeth and are not frequently extracted as a part of orthodontic treatment. Their extraction causes flattening of the face, altered facial balance and change in facial expression.

Indications:

Canine may be extracted in one of the following instances:

• Lower canines which are unfavorably impacted.

• Extraction of crowded lower canines should be avoided because of the poor contact between the lateral incisor and first premolar, unless they are very difficult to align, e.g. when excluded from the arch with severely malpositioned apex.

• Upper canines develop far away from their final location and have a long path of eruption from their development site to their final position in the oral cavity. Therefore, they are commonly impacted or ectopic and their alignment is difficult, even impossible. Extraction may be required in such cases.

• When upper canine is completely excluded from the arch and approximal contact between lateral incisor and first premolar is good, extraction of the canine may be considered.

EXTRACTION OF FIRST PREMOLARS

lt is the tooth most commonly extracted as part of orthodontic therapy especially for the relief of crowding because:

• It is positioned near the center of each quadrant of the arch and is therefore near the site of crowding, i.e. the space gained by their extraction can be utilized for correction both in the anterior and posterior region.

• First premolar extraction is the least likely to upset molar occlusion and is the best alternative to maintain vertical dimension.

• The contact between the canine and second premolar is satisfactory.

• First premolar extraction leaves behind a posterior segment that offers

adequate anchorage for retraction of the 6 anterior teeth.

Indications

1. To relieve moderate to severe anterior crowding in both arches. In lower arch crowding, where canines are mesially inclined, spontaneous improvement in incisor alignment will follow.

2. Correction of moderate to severe anterior proclination as in Class lI div 1 or Class I bimaxillary protrusion.

3. In high anchorage cases, it is preferred over second premolars.

4. As a part of serial extraction.

Timing of Extraction

The first premolars should not be extracted until all premolars, permanent incisors and canines have erupted sufficiently for brackets to be placed on them, as mesial migration is greatly increased by extraction. Extraction should be done no more than three weeks before starting active treatment to avoid mesial migration of posterior teeth and therefore leaving insufficient space for retraction.

The only exception to this rule is when second premolars cannot erupt and are impacted due to crowding.

EXTRACTION OF SECOND PREMOLARS

Indications:

1. Second premolar extraction is preferred in mild anterior crowding cases. The presence of first premolar anterior to extraction site strengthens the anterior anchorage, thereby facilitating closure from

behind.

2. Second premolar extraction is preferred when one wishes to maintain soft tissue profile and esthetics.

3. In open bite cases second premolar is preferred for extraction as it encourages deepening of the bite.

4. When second premolar is completely excluded from the arch following forwards drift of first molar after early loss of deciduous second molar.

5. Unfavorably impacted second premolars.

6. Grossly carious or periodontally compromised second premolar.

EXTRACTION OF FIRST MOLARS

The first permanent molar has been seen as untouchable from the very beginning of the history of orthodontics. It is considered as the cornerstone of the dentition. Extraction of first molars is avoided because:

1- it does not give adequate space to relieve anterior crowding.

2- it deepens the bite

3- second premolar and second molar may tip into extraction space

4- poor approximal contact between second premolar and second molar

5- mastication is affected

However, if fixed appliances are used skillfully most problems caused by enforced first molar extractions can be overcome, but treatment lasts somewhat longer than with first premolar extraction.

Indications

1. Minimum space requirement for correction of anterior crowding or mild proclination

2. Grossly decayed/periodontally compromised molar with poor prognosis

3. Impacted molar (rarely seen).

Time for Extraction

When crowding is absent or confined to the premolar segment and no space is needed for anterior alignment then first molar is removed before second molar erupts to allow it to move forward during eruption and take up the first molar position.

Lower first molar needs to be removed earlier than upper first molar because second molar moves forward less readily in the lower jaw.

When space is required for alignment of anteriors, it is preferable to wait for second molar eruption before first molar extraction to avoid space closure by forward movement of second molar.

EXTRACTION OF SECOND MOLARS

Second molars are positioned at the end of the dental arch and therefore is away from the site of crowding. Its extraction does not help in relieving the crowding.

Lower Second Molar:

Extraction may be indicated in the following cases:

1. After premature loss of the second deciduous molar, forward drift of the first permanent molar causes insufficient space for second premolar

eruption. Extraction of the second molar allows distal movement of the first permanent molar to provide enough space for premolar eruption.

2. To relieve impaction of lower third molar:

a. if the third molar is upright or its long axis is not tilted mesially more than 30° to the long axis of second molar.

b. just after root formation of the third molar has started (12 - 14 years).

3. Severely carious, ectopically erupted or severely rotated second molar.

4. Extraction may help in correcting anterior open bite.

Upper Second Molars

Extraction may be indicated in the following cases:

1. In mildly crowded cases, where less than 3-4 mm space is required for the labial segments, good results can be obtained after retraction of the buccaI segments.

2. To make space for crowded second premolar by distalization of first molar.

3. To make space for impacted upper third molar,

a. if the third molar is in favorable angulation for eruption

b. if the size and shape of the third molar is sufficient to serve in place of the second molar

c. before the eruption time of the third molar

d. If the second molar is in buccal position and third molar is positioned in the tuberosity

4. When second molar is impacted against first molar.

5. Second molar severely carious with questionable prognosis.

EXTRACTION OF THIRD MOLARS

Extraction of third molars during orthodontic treatment does not yield space for decrowding or reduction of proclination.

Indications:

1. Impacted third molar: third molars are commonly impacted and unless other teeth are missing or have been extracted, there is rarely room to accommodate them in the arch.

The conventional timing of extraction of a third molar is when two-thirds of its root is formed. Extraction of third molar should not be delayed because:

• More difficult to remove when roots are completed.

• Danger of root dilacerations which may make removal more difficult.

• Pericoronitis can develop and cause bone loss and pocket formation may occur distal to second molar.

2. Erupting lower third molars in an attempt to prevent or minimize late lower anterior crowding.

3. Malformed third molars, which interfere with normal occlusion, should be extracted.

My great wishes for my lovely students for success. Thanks

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Lecture 11 [5th] د.حيدر سعد حنفوش

Orthodontics

Orthodontic Indices

What is an index and why we use it?

An index is a tool used to provide a numerical value describing the status of a case on a graded scale. In orthodontics, indices are essential component in diagnosis or assessing treatment need, severity, complexity and outcome.

General requirements of an index:

• **Validity** (can the index measure what it was designed to measure?)

• **Reliability (Reproducibility**) (does the index give the same result when recorded on two different occasions, and by different examiners?)

• **Acceptability to profession and public**

• **Simplicity and cheapness**

This lecture will briefly discuss some of the most commonly used indices in orthodontics.

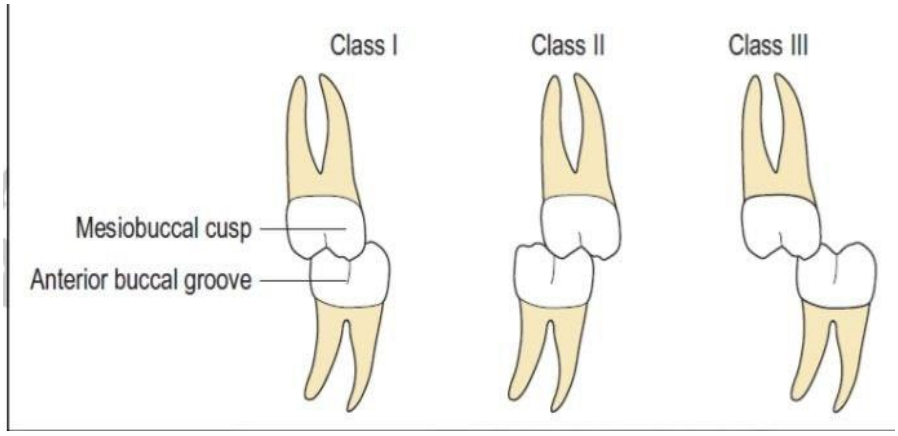
Diagnostic Indices	• Angle's Classification (1899) • Canine Classification • Incisor Classification (1964, 1983) • Skeletal Classification (1993)
Treatment Complexity Indices	• Little's Irregularity Index (LII) (1975) • Discrepancy Index (DI) (2004)
Treatment Need Indices	• Index of Orthodontic Treatment Need (IOTN) (1989)
Treatment Outcome Indices	• Peer Assessment Rating Index (PAR Index) (1992) • Cast-Radiograph Evaluation (CR-EVAL) (1999)
Multi-purpose Orthodontic Indices	• Index of Complexity, Outcome, and Need (ICON) (2000)

Diagnostic Indices

These indices provide descriptive classification of the dentition or skeletons. As all these indices were covered in other lectures, this lecture will just enumerate them.

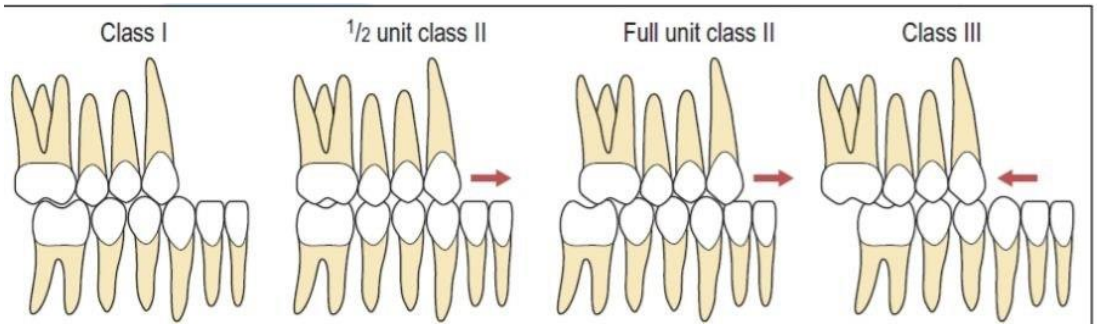
1. Angle's Classification

The Angle classification of malocclusion was described by Edward H Angle in 1899 and is based on the relative anteroposterior position of the first permanent molars.



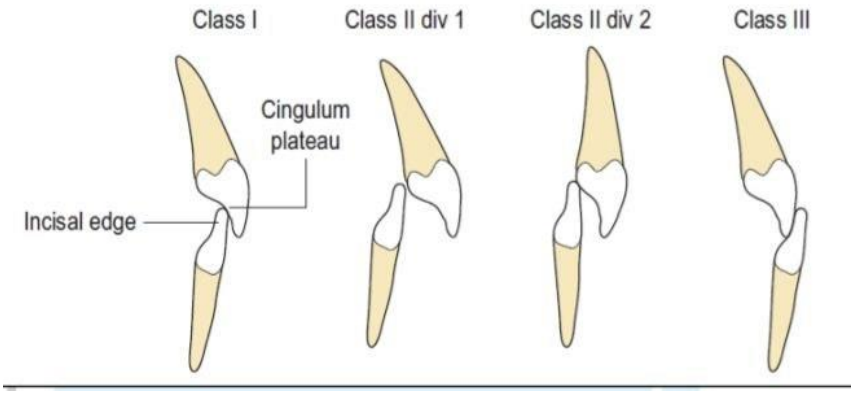
2. Canine Classification

The canine relationship is based upon anteroposterior position of canines.



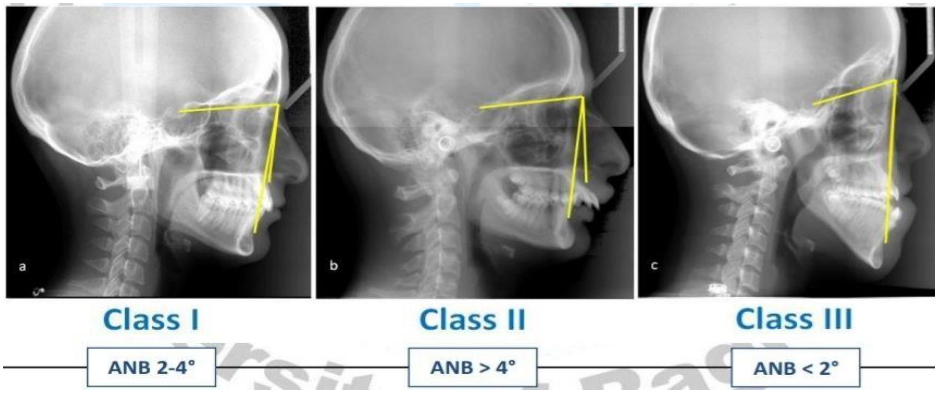
3.Incisor Classification

The British Standards Institute classification is based upon anteroposterior position of incisors.



4. Skeletal Classification

Usually assessed by lateral cephalometric radiographs:

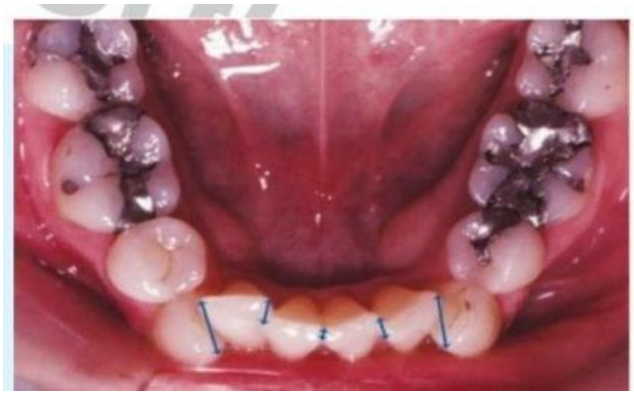


Treatment Complexity Indices

1. Little's Irregularity Index (LII)

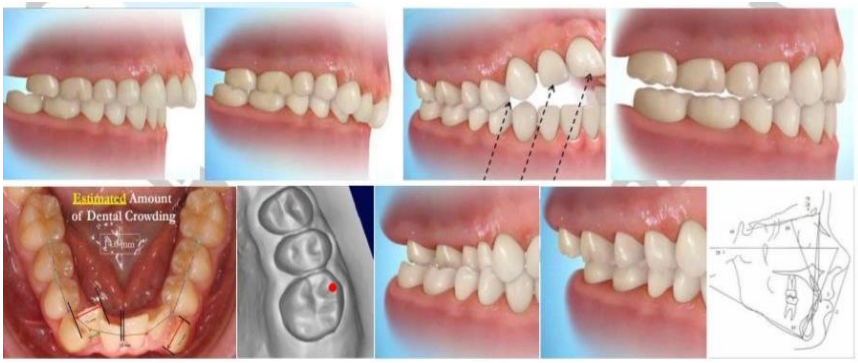
This index assesses irregularity of lower labial segment to establish the severity of malocclusion and priority of treatment by measuring linear displacement of five anatomic contact point (from mesial of right lower canine to mesial of left lower canine). Then, these displacements are summed and the model cast is ranked on a scale ranging from 0-10.

Example: The irregularity index assesses the total of the millimeter distances from the contact point on each incisor tooth to the contact point that it should touch, as shown by the lines. For this patient, the irregularity index is 10 mm.



2. Discrepancy Index (DI)

This index used to evaluate the difficulty of the cases presented for the American Board of Orthodontics examination. It evaluates criteria from dental models and cephalometric radiographs. These are overjet, overbite, openbite, crowding, occlusion, lingual/buccal posterior crossbite, cephalometric variables.



Treatment Need Indices

1. Index of Orthodontic Treatment Need (IOTN)

This index is used to rank malocclusions in terms of various occlusal features and perceived aesthetic impairment. The intention is to identify those individuals who would receive the greatest benefit from orthodontic treatment. IOTN has two components:

Dental Health Component (DHC) / Aesthetic Component (AC)

• **Dental Health Component (DHC)**: The DHC records the worst occlusal feature of the malocclusion that impacts on dental health on a dental cast with a specially designed ruler. **A hierarchal scale** is used to identify the worst feature. In order of reducing dental health impact these are: **M**issing teeth > **O**verjet > **C**rossbite > **D**isplacement of contact points > **O**verbite. The acronym **MOCDO** can be used to remember this hierarchal scale. Once the worst occlusal feature has been recorded, the malocclusion can be characterized into one of five grades:

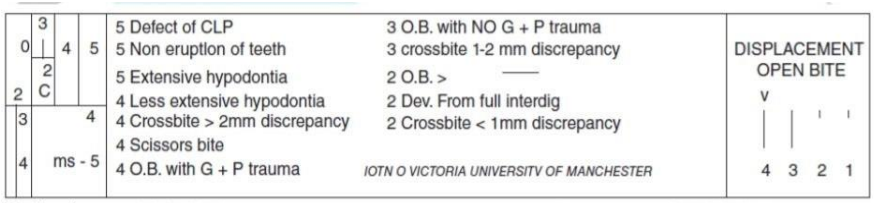
Grade 1 : No need for treatment

Grade 2: Little need for treatment

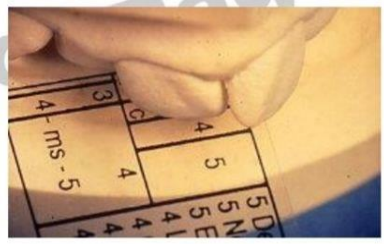
Grade 3: Moderate need for treatment

Grade 4 : Great need for treatment

Grade 5 : Very great need for treatment



IOTN ruler



IOTN DENTAL HEALTH	5	4	3	2	1
Missing teeth	5h = extensive hypodontia + restorative implications (more then 1 tooth missing in any quadrant) requiring pre-restorative orthodontics 5s = submerged primary teeth	4h = less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure (no prosthesis)			
Overjet	5a = inc OJ > 9 mm 5m = reverse overjet > 3.5 mm + masticatory and speech difficulties	4a = inc OJ 6.1 – 9 mm 4b = reverse overjet > 3.5 mm no masticatory or speech difficulties 4m = reverse overjet 1.1 – 3.5 mm + recorded masticatory or speech difficulties	3a = inc OJ 3.6 – 6 mm + incompetent lips 3b = reverse OJ 1.1 – 3.5 mm	2a = inc OJ 3.6 – 6 mm +competent lips 2b = reverse OJ 0.1 – 1 mm	
Crossbite		4c = ant or post X-bites + > 2 mm discrepancy between retruded and intercuspal position 4l = posterior lingual X-bites: no contact 1 or both buccal segments	3c = ant or post X-bites + 1.1 – 2 mm discrepancy	2c = ant or post X-bites – up to 1 mm discrepancy between retruded contact and intercuspal position	
Displacement of contact points	5i = impeded eruption (except 3rd molars) due to crowding, displacement, supernumerary teeth, retained primary teeth and any pathological cause	4d = displacements > 4 mm 4t = partially erupted teeth, tipped and impacted against adjacent teeth 4x = supplemental teeth	3d = displacements 2.1 – 4 mm	2d = displacements 1.1 – 2 mm	
Overbite (including open bite)		4e = lateral or anterior open bites > 4 mm 4f = increased and complete overbite + gingival or palatal trauma	3e = lat or ant open bite 2.1 – 4 mm 3 f = inc, complete OB no gingival trauma	2e = ant or post open bite 1.1 – 2 mm 2f = inc OB > 3.5 mm no gingival contact	

Aesthetic Component (AC): It consists of 10 color photographs showing different levels of dental attractiveness. The patient is asked to close the front teeth together and the examiner compares the appearance of the patient's teeth with the visual 1-10 scale. Sometimes, the patients (or parents) are also asked to choose a photograph which most closely represents their own dental appearance to give a score according to this

scale (1: the most attractive and 10: the least attractive). Treatment need can be categorized according to the score given as follows:

Score 1 or 2 : No need for treatment

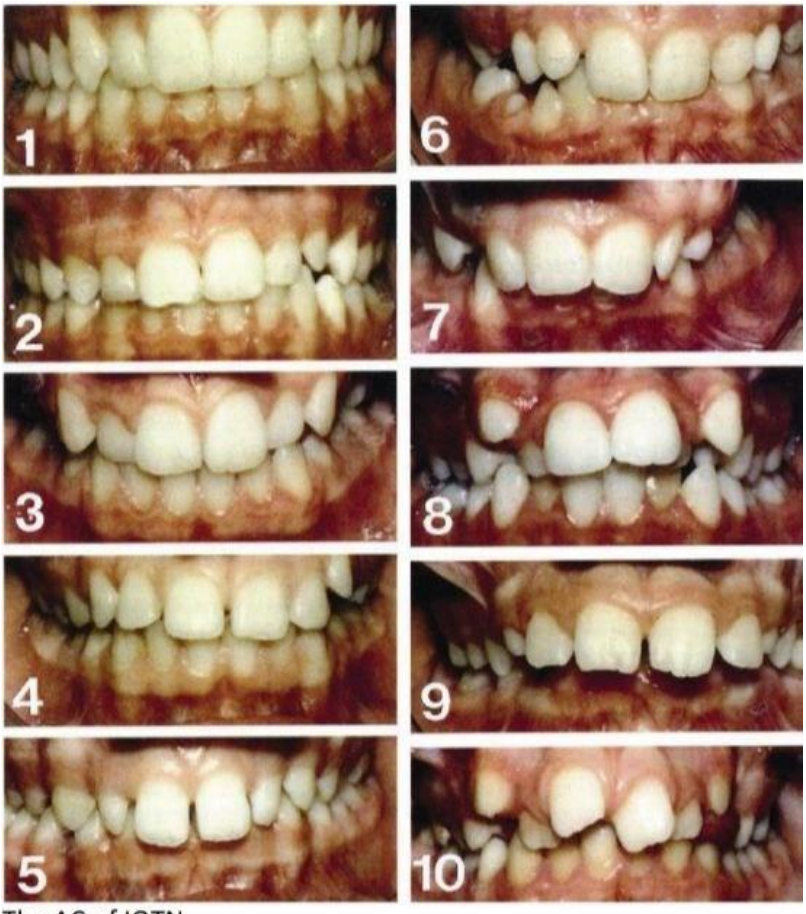
Score 3 or 4 : Slight need for treatment

Score 5, 6, or 7 : Moderate/borderline need for treatment

Score 8, 9, or 10 : Definite need for treatment

A total score combining the DHC and AC can be given to define treatment need.

IOTN has its limitations when it is applied to the mixed dentition patients and the AC component can be considered as subjective assessment. Nonetheless, the DHC component of the IOTN provides a structured method for the assessment of a malocclusion.



The AC of IOTN

Treatment Outcome Indices

1. Peer Assessment Rating Index (PAR Index)

This index has been developed to:

 Provide a single score assessing the degree of malocclusion (Pre-treatment PAR score).

 Assess the quality and standard of orthodontic treatment results, and the degree of improvement by comparing pre- and post-treatment PAR scores on a dental cast using a specially designed ruler. It measures the following features of the malocclusion:

Anterior crowding (×1)	upper and lower labial segment contact point displacements
Buccal occlusion (×1)	Left and right molar relationship, crossbites and lateral open bites
Overjet (×6)	
Overbite (×2)	
Centrelines (×4)	

The score for each feature is multiplied by weighting factors (given in brackets above), so that some occlusal features bear more importance than others.

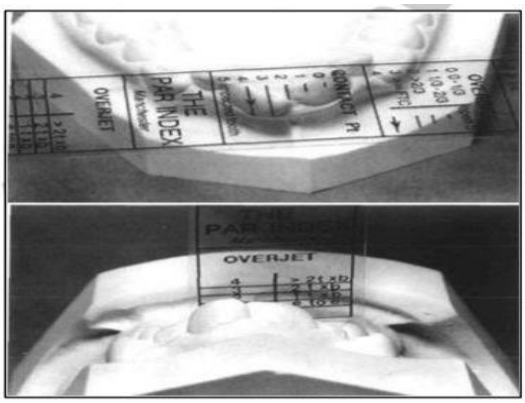
The difference between pre- and post-treatment PAR scores can be calculated and from this the percentage change in PAR score is derived.

PAR reduction < 30%	Worse or no better
PAR reduction > 30%	Improved
PAR reduction > 70%	A high standard of treatment
PAR reduction of 22 points or greater	Greatly improved

Since the pre-treatment PAR score gives an indication of the severity of a malocclusion. Obviously it is difficult to achieve a significant reduction in PAR in cases with a low pre-treatment score.

PAR index is totally dependent on the patient's study models and does not account for improvement in the facial profile, tooth inclinations, arch width and spacing between posterior teeth. It also is not appropriate for assessment of mixed dentition treatment results.

However, it is a valid and reliable tool in assessing performance of practitioners or services.



PAR scoring

2. Cast-Radiograph Evaluation (CR-EVAL)

The American Board of Orthodontics Cast-Radiograph Evaluation (ABO CR-EVAL) was developed to evaluate orthodontic treatment outcomes of the cases presented for the American Board of Orthodontics examination. It has been subsequently considered as a precise and objective index when compared to other indices.

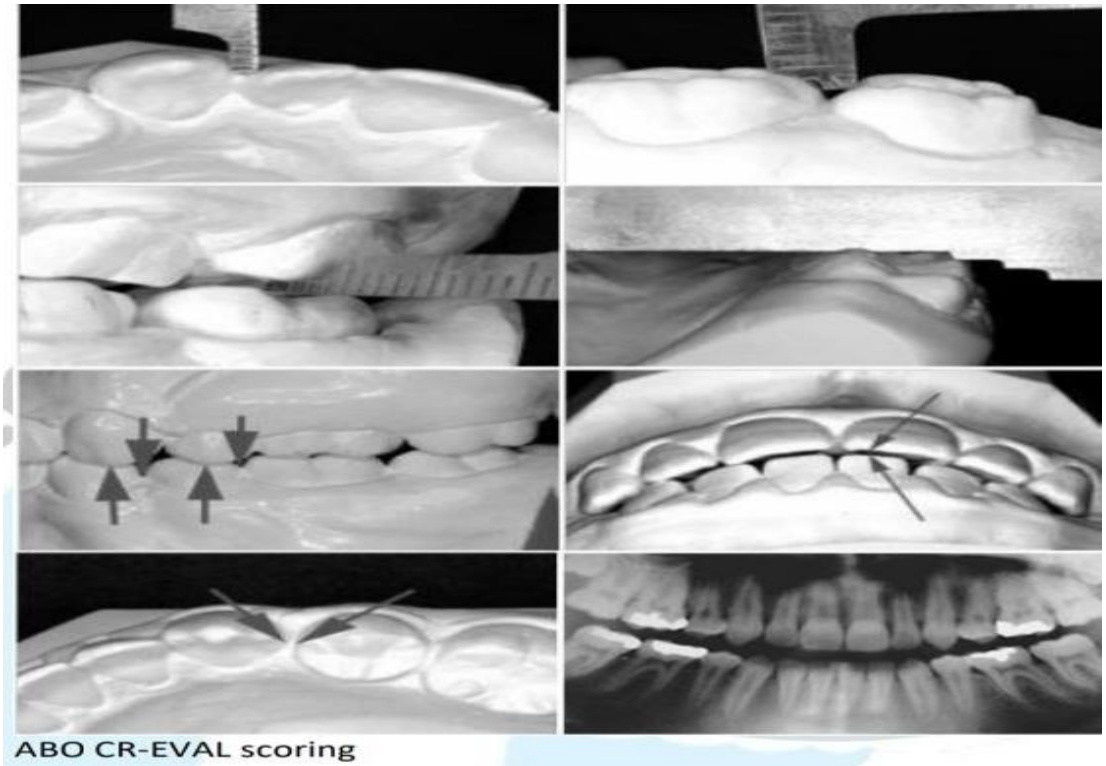
The CR-EVAL included eight criteria:

Alignment/rotation	Study model
Marginal ridges	Study model
Buccolingual inclination	Study model
Overjet	Study model
Occlusal contacts	Study model
Occlusal relationship	Study model
Interproximal contacts	Study model
Root angulation	Panoramic radiograph

Post-treatment study models and panoramic radiographs are measured according to the above eight criteria and scored 0, 1, or 2 depending on the amount of deviation from the standards established by the ABO. The sum of points of these criteria for each treated case represents the overall score of the ABO CR-EVAL.

Total score > 30 points	Unacceptable or incomplete treatment results
Total score of 20-30 points	Needs re-evaluation and then will be passed or considered incomplete
Total score < 20 points	Satisfactory treatment results

CR-EVAL offers an objective and stringent assessment of treatment outcomes, especially for detailed tooth position. When compared to the PAR index, it adds angulation, spacing and crowding of buccal segments, and root parallelism. Additionally, it uses the final models only to assess treatment outcomes, unlike the PAR index where both pre- and post-treatment models.



ABO CR-EVAL scoring

Multi-Purpose Orthodontic Indices

1. Index of Complexity, Outcome, and Need (ICON)

This index was developed to evaluate the complexity of a case, as well as treatment need and outcome. It incorporates features of both IOTN and PAR indices:

IOTN AC (x7)
Crossbite (x5)
Upper arch crowding and spacing (x5)
Buccal segment anteroposterior relationships (x3)
Anterior vertical relationship (x4)

Note: The IOTN and PAR indices are widely used in the UK, while the ABO CR-EVAL is widely used in the USA.

My great wishes for my lovely students for success. Thanks

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Lecture 12 [5th] **د.حيدر سعد حنفوش**

Orthodontics

CROSSBITE

Crossbite is a discrepancy in the buccolingual relationship of the upper and lower teeth. Under normal circumstances the maxillary arch overlaps the mandibular arch both labially and buccally. But when the mandibular teeth, single tooth or a segment of teeth, overlap the opposing maxillary teeth labially or buccally, a crossbite is said to exist.

Classification of Crossbite

Based on Etiological Structure

1. Dental crossbite.
2. Skeletal crossbite.
3. Functional crossbite.

Based on Location

1. Anterior crossbite

- Single tooth crossbite (Instanding tooth).
- Segmental crossbite.

2. Posterior crossbite

Posterior crossbites can also be further classified:

According to the number of teeth involved

- Single tooth crossbite.
- Segmental crossbite.

According to the existence of the crossbite on one side or both sides of the arch

- Unilateral crossbite.
- Bilateral crossbite.

According to the extent of the crossbite

- Buccal crossbite.
- Lingual crossbite (scissor bite).

DENTAL CROSSBITE

Crossbite which confined to the dentition is referred to as dental crossbite.

SKELETAL CROSSBITE

It refers to a crossbite which is due to malposition or malformation of the jaws. Maxillary retrognathim, mandibular prognathism or a combination of both can result in skeletal crossbite, e.g. skeletal class III malocclusion.

FUNCTIONAL CROSSBITE

Functional crossbites are usually caused due to the presence of occlusal interference leading to displacement of the mandible anteriorly or laterally to achieve maximum intercuspation.

Example; when there is an edge to edge incisors relationship in centric relation, the patient tends to habitually move the mandible forward, so as to achieve maximum intercuspation. This may lead to pseudo Class III malocclusion. If the patient moves the mandible laterally to achieve maximum intercuspation due to the presence of occlusal interference a unilateral posterior crossbite may appear.

ANTERIOR CROSSBITE

It is a condition, where mandibular anterior teeth overlap the maxillary anteriors (reverse overjet). The condition is often due to lingual position of maxillary anterior teeth in relation to the mandibular anterior teeth.

It may be single tooth crossbite or segmental anterior crossbite depending on the number of teeth involved in crossbite. It may or may not be associated with forward displacement of the mandible.

POSTERIOR CROSSBITE

It refers to a condition where there is an abnormal transverse relationship between upper and lower posterior teeth. It may be single tooth crossbite or segmental crossbite, unilateral or bilateral, buccal or lingual.

Buccal crossbite: the buccal cusps of the lower posterior teeth occlude buccal to the buccal cusps of the upper teeth.

Lingual crossbite: the buccal cusps of the lower teeth occlude lingual to the palatal cusps of the upper teeth. This is also known as a scissors bite.

Posterior Crossbite Usually Seen As:

Unilateral buccal crossbite with displacement: usually arises when the mandible displaced laterally due to the presence of deflecting contact either from a displaced tooth or because of narrowing of the maxilla which result in cusp-to-cusp relationship of posterior teeth in occlusion.

Unilateral buccal crossbite without displacement: usually arises either due to displacement of tooth or due to underlying skeletal asymmetry of the arch when a greater number of teeth are involved.

Bilateral buccal crossbite: usually associated with skeletal discrepancy (Cl III).

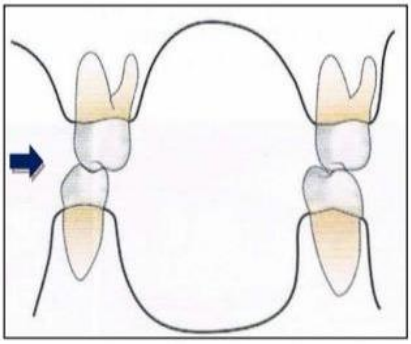
Unilateral lingual crossbite: usually due to displacement of teeth as a result of crowding.

Bilateral lingual crossbite (scissors bite): usually associated with skeletal discrepancy (Cl II).

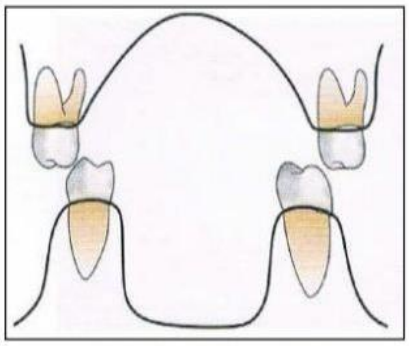
Anterior Crossbite

Anterior Crossbite. **A:** Dental single tooth crossbite. **B:** Skeletal segmental anterior crossbite

Functional Crossbite. **A:** Anterior displacement. **B:** Lateral displacement



Unilateral buccal crossbite



Bilateral lingual crossbite

A: Unilateral buccal crossbite. **B:** Bilateral buccal and anterior crossbite. **C** and **D:** Unilateral lingual crossbite

Etiology of Crossbite

Etiology of Dental Crossbite

1. Crowding: due to lack of space in the dental arch.
2. Anomalies of teeth number, size, and shape: like supernumerary teeth, macrodontia.
3. Premature loss or prolong retention of primary teeth: lead to crowding and displacement of permanent teeth into crossbite position.
4. Occlusal interference/prematurities.

Etiology of Skeletal Crossbite

1. Hereditary or discrepancy in the size of the dental arches:skeletal Cl III and Cl II.
2. Habits: thumb sucking, mouth breathing, etc.
3. Cleft lip and palate: the scar tissue of the cleft repair restricts maxillary growth.
4. Trauma or pathology of the TMJ: it can restrict mandibular growth.

Generally, the greater the number of teeth in crossbite, the greater is the skeletal component of the etiology.

TREATMENT OF CROSSBITE

Crossbites, anterior or posterior especially functional crossbite with mandibular displacement should be corrected as soon as they are detected. If the condition is left untreated it may develop into severe skeletal malocclusion.

Correction of Anterior Crossbite

Anterior crossbites, in addition to be frequently associated with displacement, can lead to movement of a lower incisor labially through the labial supporting tissues, resulting in gingival recession. In this case early treatment is advisable.

Dental Anterior Crossbite

1. Tongue blade therapy: used to treat the developing anterior crossbite by placing a wooden tongue blade behind the tooth erupting in crossbite and biting on it using the lower teeth as a fulcrum for a period of 5-10 minutes. Usually the tooth will erupt into normal position over a period of time.

2. Removable orthodontic appliance: can be used with:

- Z-spring to correct single tooth in crossbite.
- Recurved Z-spring to correct more than single tooth in crossbite.
- Screw to correct single tooth or segmental crossbite.

Removable appliances should incorporate posterior bite plane to open the bite anteriorly during correction of anterior crossbite. For treatment to be successful,there must be some overbite present to retain the corrected incisor position.

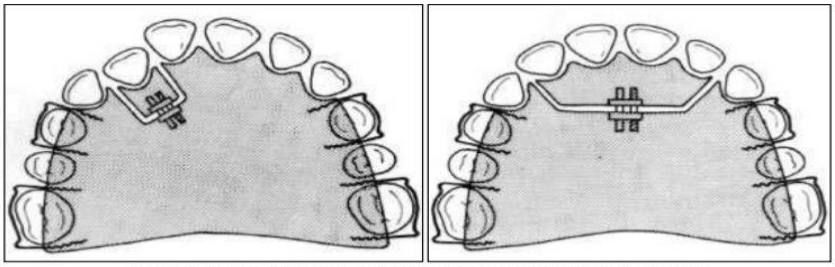
3. Fixed orthodontic appliance: indicated when bodily or apical movement is required.

required.

Tongue blade therapy

Recurved Z-spring

Hawley appliance with Z-spring and posterior bite plate



Screws for correction of single tooth and segmental anterior crossbite

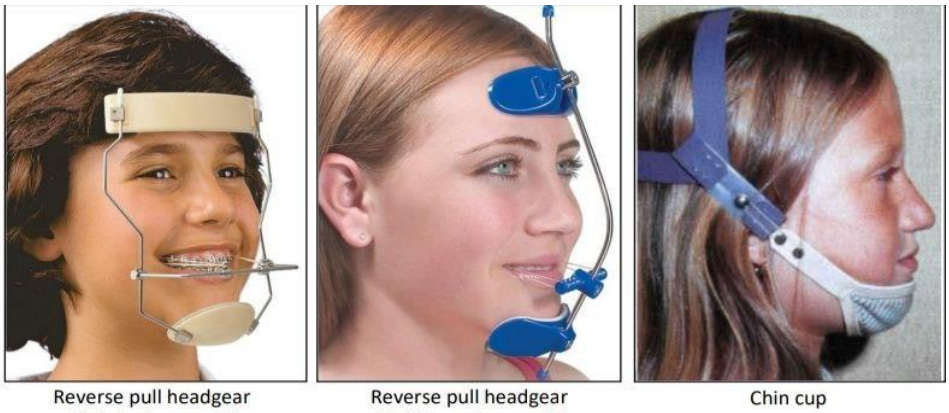
Skeletal Anterior Crossbite in Growing Patient

1. Orthopedic appliances

• ***Facemask with rapid maxillary expander***: can be used in case of skeletal anterior crossbite due to maxillary retrognathism.

• ***Chin cup:*** can be used in case of skeletal anterior crossbite due to mandibular prognathism.

2. Functional appliances: Frankel III appliance may be used to correct a developing Class III skeletal jaw relation with anterior crossbite.



Reverse pull headgear (Delaire facemask) | Reverse pull headgear (Petit type facemask) | Chin cup

Skeletal Anterior Crossbite in Adults

Non-growing patients with severe skeletal anterior crossbite can be treated by either mandibular set back or maxillary advancement surgical procedures.

Correction of posterior crossbite

Correction of posterior crossbite is usually achieved by expansion of the arch or segment of the arch. The inclination of the affected teeth should also be evaluated.

Upper arch expansion is more likely to be stable if the teeth to be moved were tilted palatally initially.

Single Tooth Crossbite

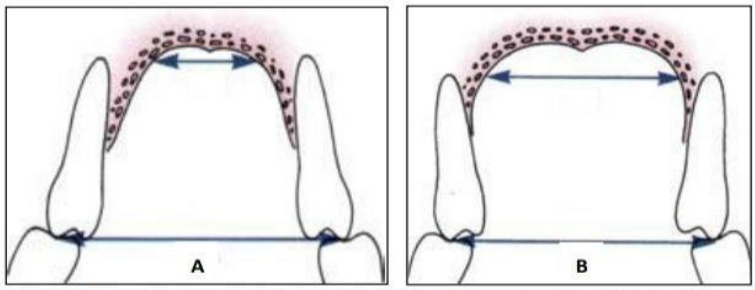
• ***Extraction***: if the tooth in crossbite is severely displaced.

• ***Movement of the displaced tooth into the line of the arch using:***

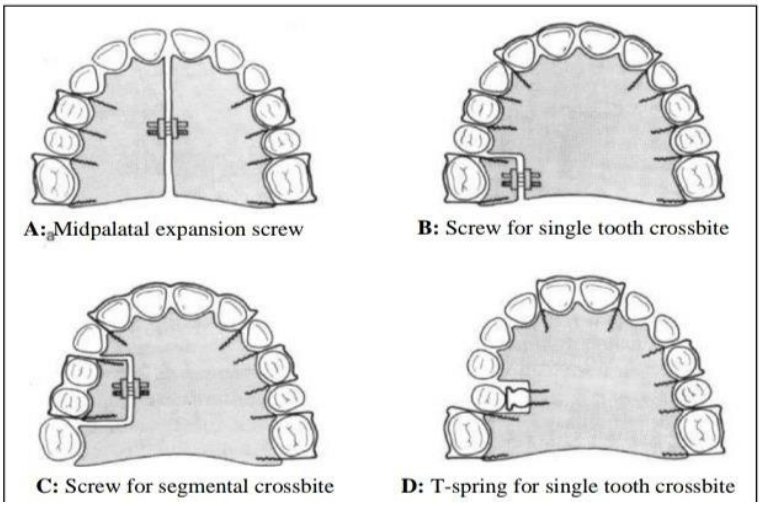
➢ Removable appliance with screw or T spring.

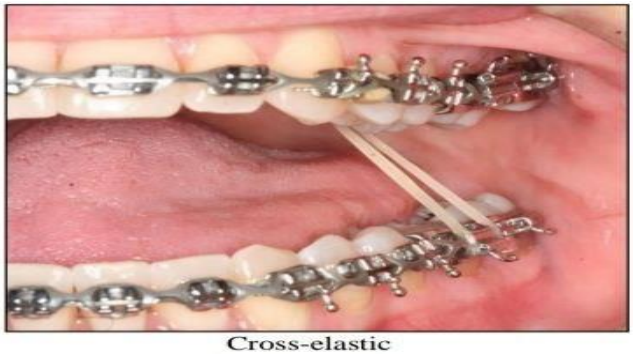
➢ Fixed appliance if bodily movement is required.

• **Fixed orthodontic appliance with cross-elastics**: if correction of a crossbite requires movement of the opposing teeth in opposite directions.



Narrow palate with normal inclination of posterior teeth. **B:** Normal width of palate and palatally tilted posterior teeth (indicated for expansion)





Cross-elastic

Unilateral Segmental Buccal Crossbite

• **With displacement:** bilateral expansion of the arch using:

➢ Removable appliance with expansion screw.

➢ Quad helix appliance.

➢ Fixed orthodontic appliance: mild degree of arch expansion can be brought about by using arch wires or appliances like transpalatal arch.

• **Without displacement**: unilateral segmental expansion of the arch.

Bilateral Buccal Crossbite

• Acceptance with no treatment

• In severe skeletal cases, rapid maxillary expander (HYRAX) can be used for growing patient. For adults surgically assisted rapid palatal expansion (SARPE) with HYRAX can be used.

• Bilateral buccal crossbite in patients with a repaired cleft palate: expansion of the upper arch by stretching of the scar tissue is often indicated using a Quad helix appliance

Treatment for a bilateral crossbite without displacement should be approached with caution, as partial relapse may result in a unilateral crossbite with displacement. In addition, a bilateral crossbite is probably as efficient for chewing as the normal buccolingual relationship of the teeth.

Note: Miniscrew assisted rapid palatal expansion **(MARPE)** and surgically assisted rapid palatal expansion **(SARPE)** are frequently used modalities of RME preferred in skeletally mature individuals to overcome potential suture resistance.

Lingual Crossbite

Fixed orthodontic appliance.

Dental Expansion (Slow Maxillary Expansion Devices)

Slow expansion has been also termed dentoalveolar expansion. The most commonly used appliances are:

Removable Appliance with Jackscew: it can be used in both arches, usually activated by turning the screw 1-2 quarter turn (0.25-0.5 mm) /week.

Coffin Spring: it is removable type, ideal to treat unilateral crossbites, and usually activated by pulling the two parts of the appliance apart manually or by using special pliers at the base of Omega wire.

Quad Helix Appliance: it can be used as a removable or fixed expansion appliance. The quad-helix consists of two anterior and two posterior helices. The appliance is capable of producing differential expansion, i.e. it can be activated to produce different expansion levels in the premolar and molar regions.

Fixed Orthodontic Appliance: mild degree of arch expansion can be brought about by using arch wires or appliances like transpalatal arch.

Skeletal Expansion (Rapid Maxillary Expansion Devices)

1. The Rapid maxillary expander is essentially a dentofacial orthopedic appliance,which tends to produce its changes by splitting the mid-palatine suture. The rationale is being that if extreme forces are applied on to the palatal shelves, the interlying suture splits and results in true skeletal changes. The teeth are generally used for the purpose of transmitting the forces onto the maxillary bone proper. The most commonly used type is **HYRAX RME appliances** and **Miniscrew assisted rapid palatal expansion (MARPE).** There are also different types of RME like **Isaacson RME appliances, Hass RME appliance**.

Acivation of the RME Appliance

Rapid expansion typically is done by turning the screw 1-2 quarter turn (0.25-0.5 mm) daily especially for HYRAX which most commonly used. With rapid or semi- rapid expansion, a diastema usually appears between the central incisors as the bones separate in this area. Expansion usually is continued until the maxillary lingual cusps occlude with the lingual inclines of the buccal cusps of the mandibular molars.

Retention Following RME Therapy

When expansion has been completed, a 3-month period of retention with the appliance in place is recommended. After the 3-month retention period, the fixed appliance can be removed, but a removable retainer that covers the palate is often needed as further insurance against early relapse. Traspalatal arch provides retention if further treatment is being accomplished immediately.

2. Surgically assisted rapid palatal expansion (SARPE) using the HYRAX can be used to correct skeletal posterior crossbite in adults.

Although **Coffin spring** and Quad helix appliances are mainly used for dental expansion, but they are capable of producing slight skeletal changes when they are used in mixed dentition stage (preadolescent or growing patient).

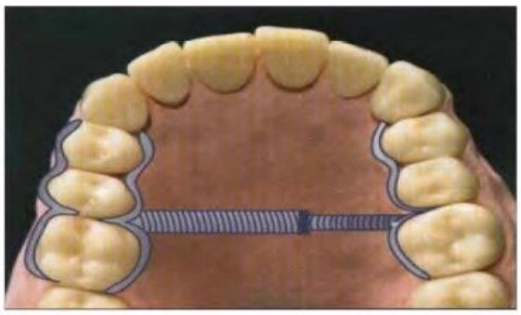
Notes:

• Unilateral buccal crossbite with displacement may be associated with a centreline shift in the lower arch in the direction of the mandibular displacement on closure, and this differentiates it from unilateral buccal crossbite without displacement which may occur due to skeletal asymmetry.

• Expansion of the upper buccal segment teeth will result in some tipping down of the palatal cusps. This has the effect of hinging the mandible downwards leading to an increase in lower face height, which may be undesirable in patients who already have an increased lower facial height and/or reduced overbite. If expansion is indicated in these patients, buccal capping or buccal root torque to the buccal segment teeth is required to resist this tendency.

• For correction to be successful there should be a good post-treatment overbite for stability. Over correction and prolong retention after expansion is mandatory for a stable result.

• Crossbites in the deciduous or mixed dentition may result from premature contact between the deciduous canines with a resultant lateral mandibular displacement. These maybe treated by grinding the canines tips (just the enamel) to eliminate the premature contact.



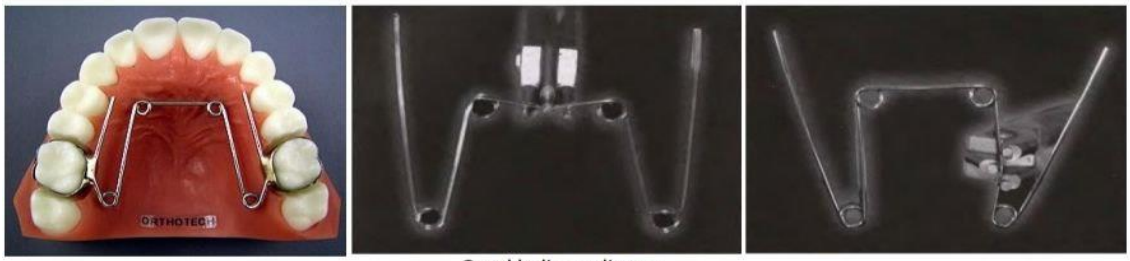
Issacson RME appliance

Hass RME appliance

MARPE

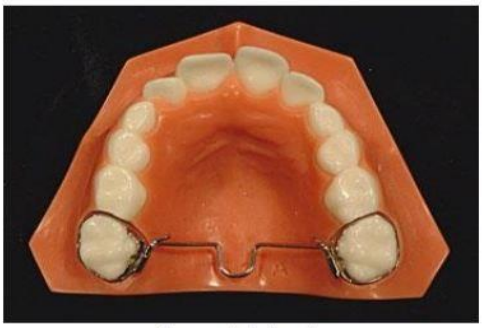
Removable appliance with expansion screw and buccal capping of posterior teeth

Coffin spring



Quad helix appliance

Activation of quad helix appliance. *Left:* activation at the anterior bridge produces expansion in the molar region. *Right:* activation of the outer arm produces expansion in the premolar and canine region



Transpalatal arch

HYRAX RME appliance

My great wishes for my lovely students for success. Thanks

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Lecture 13+14 [5th] **د.حيدر سعد حنفوش**

Orthodontics

ETIOLOGY OF MALOCCLUSION

Localized Factors Affecting the Development of The Occlusion

The local factors affecting the development of malocclusion include:

Anomalies of Tooth Number

- Supernumerary Teeth
- Congenitally Missing Teeth

Anomalies of Tooth Size

Anomalies of Tooth Shape

- Fusion, Gemination and Concrescence
- Dilaceration

Premature Loss of Deciduous Teeth

Retained Deciduous Teeth

Delayed Eruption of Permanent Teeth

Ankylosed Deciduous Teeth

Abnormal Eruptive Path

- Transposition

Abnormal Labial Frenum

Dental Caries

Gingival and Periodontal Diseases

Improper Dental Restorations

Bad Oral Habits

Anomalies of Tooth Number

Supernumerary Teeth

A supernumerary tooth is one that is additional to the normal series. This anomaly occurs in the permanent dentition in approximately 2 per cent of the population and in the deciduous dentition in less than 1 per cent, though a supernumerary in the deciduous dentition is often followed by a supernumerary in the permanent dentition. The etiology is not completely understood, but suggestions include an offshoot of the dental lamina of the permanent dentition or a tertiary dentition. This anomaly occurs more commonly in males than females. Supernumerary teeth are also commonly found in the region of the cleft in individuals with a cleft of the alveolus.

Supernumerary teeth can be described according to their morphology or position in the arch.

1. Supplemental

Position: This type resembles a tooth and occurs at the end of a tooth series, for example an additional lateral incisor, second premolar or fourth molar (Fig. 1).

Shape and properties: It is often impossible to distinguish between the supplemental tooth and the normal tooth.

Main effect: crowding and displacement of adjacent teeth.

Figure 1: A supplemental lower lateral incisor.

2. Conical

Position: The typical conical supernumerary tooth occurs in the premaxilla, near the mid-line, and is often called the 'mesiodens' (Fig. 2). ***Shape and properties***: It is usually conical in shape, and may occur singly or in pairs, and occasionally more than two such teeth are present. It is sometimes inverted, in which case it does not erupt into the mouth. ***Main effect***: malalignment or rotation of the upper incisors, median diastema.

Figure 2: Conical supernumerary tooth.

3. Tuberculate

Position: It appears, characteristically, on the palatal aspect of the permanent central incisor (Fig. 3).

Shape and properties: This type is described as being barrel-shaped, but usually any supernumerary which does not fall into the conical or supplemental categories is included. It does not normally erupt in childhood, may be unilateral or bilateral, and rarely is associated with supernumerary teeth of other types. Because of its late development and its typical position, the tuberculate tooth has been regarded as

representing a third dentition.

Main effect: delayed or failure of the eruption of the permanent upper central incisor.

Figure 3: Tuberculate supernumerary teeth.

4.Odontome

This variant is rare. Both compound (a conglomeration of small tooth-like structures) and complex (an amorphous mass of enamel and dentine) forms have been described. (Fig. 4).

Figure 4: Complex odontome.

Note: Supernumerary teeth can occur within the arch, but when they develop between the central incisors they are often described as a **mesiodens.** A supernumerary tooth distal to the arch is called a **distomolar,** and one adjacent to the molars is known as a **paramolar.**

Effects of Supernumerary Teeth and their Management

Effect on teeth	Management
Crowding	Remove the most poorly formed or more displaced tooth and may be followed by removable or fixed appliance treatment (**Usually cased by supplemental type**)
Displacement and rotation	Remove the supernumerary tooth and usually followed by fixed appliances to align the affected tooth or teeth. (**Can be caused by any type**)
Delayed or failure of eruption	Remove the supernumerary tooth and ensure that there is sufficient space for the unerupted tooth. Then it is either erupted unaided or need a fixed appliance treatment. (**Usually caused by tuberculate type**)
No effect	Usually detected by chance on a radiograph in the upper incisor region. If the supernumerary tooth will not interfere with any planned movement of the upper incisor, it can be left in situ under periodic radiographic observation, particularly if it is high in the jaw and inverted, or if its removal would involve damage to other teeth (**Usually caused by conical type**)

Congenitally Missing Teeth

Congenitally missing teeth are far more commonly seen as compared to supernumerary teeth. Anadontia is the total absence of teeth, while oligodontia is the congenital absence of many but not all teeth. Hypodontia is the absence of only few teeth (Fig. 5). The most common congenitally missing teeth are the third molars, maxillary lateral incisors, and madibular second premolars.

Causes: This could be due to:

- Disturbances during the initial stages of formation of a tooth.
- Inherited characteristic, though the precise genetic mechanisms responsible are not completely understood.
- Associated with an unusual but mild systemic abnormality, ectodermal dysplasia. Individuals with ectodermal dysplasia have thin, sparse hair and an absence of sweat glands in addition to their characteristically missing teeth (Anodontia or oligodontia).

Effects:

- Spaced dentition.
- Malposition and tilting of the adjacent teeth.
- Malformation of other teeth may be associated with hypodontia (e.g. peg shaped lateral incisor).
- Reduction in the growth of the alveolar bone in the affected area.

Management: This could be either space closure and correct teeth alignment with orthodontic treatment, or replace the missing tooth with an implant or prosthesis.

Figure 5: Congenitally missing lateral incisors.

Anomalies of Tooth Size

Only two anomalies of tooth size are of interest to an orthodontist; ***microdontia*** (small teeth) and ***macrodontia*** (large teeth).

The most commonly seen form of localized microdontia involves the maxillary lateral incisors. The tooth is called a "peg lateral" and exhibits a peg shaped crown with the mesial and distal sides converging incisally (Fig. 6). Treatment of microdontia is usually with building-up the affected tooth, while crowding due to macrodontia is usually treated orthodontically with extraction or interproximal reduction.

Figure 6: Peg shaped lateral incisor.

Anomalies of Tooth Shape

Fusion, Gemination and Concrescence

It is sometimes difficult to distinguish between fusion and gemination. True fusion is seen when the tooth arises through the union of two normally separated tooth germs. It might lead to spacing or sometimes it might complicate its movement by orthodontic means and there is reduction in the number of teeth (Fig. 7).

Geminated teeth are anomalies, which arise from division of a single germ by an invagination, leading to the formation of two incomplete teeth and there is normal number of teeth (Fig. 7).

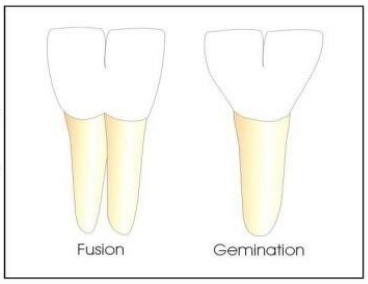

Figure 7: Fusion and gemination.

The term concrescence refers to fusion of teeth which occurs after root formation has been completed (Fig. 8)

Figure 8: Concrescence.

Dilaceration

Is distortion or bend in the root of a tooth (Fig. 9). It usually affects the upper central and/or lateral incisor. The etiology is described in two categories:

a) Developmental: this anomaly usually affects an isolated central incisor and occurs in females more often than males. The crown of the affected tooth is turned upward and labially and no disturbance of enamel and dentine is seen.

b) Trauma: intrusion of deciduous incisor leads to displacement of the underlying developing permanent tooth germ. This causes the developing permanent tooth crown to be deflected palatally and the enamel and dentin forming at the time of the injury are disturbed giving rise to hypoplasia, both sexes are affected equally.

Management

Dilaceration usually causes failure of eruption, where the dilaceration is severe there is often no alternative but to remove the affected tooth, in milder cases it may be possible to expose the crown surgically and apply traction to align the tooth provided that the root apex will be sited within cancellous bone at the completion of crown alignment.

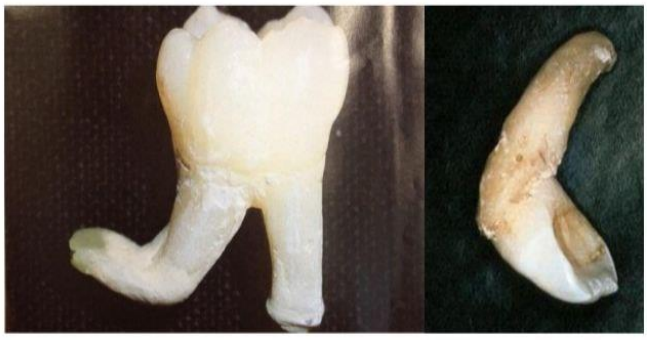

Figure 9: Dilaceration.

Premature Loss of Deciduous Teeth

Deciduous incisor: premature loss of a deciduous incisor has little impact, mainly because they are shed relatively early in the mixed dentition.

Deciduous canine: unilateral loss of a deciduous canine in a crowded mouth will lead to a centerline shift. As this is a difficult problem to treat, often requiring fixed appliances, prevention is preferable and

therefore premature loss of a deciduous canine ***should be balanced*** in any patient with even the mildest crowding.

Deciduous first molar: unilateral loss of this tooth may result in a centerline shift. In most cases an automatic balancing extraction is not necessary, but the centerline ***should be kept under observation*** and space maintainer may be indicated.

Deciduous second molar: if a second deciduous molar is extracted the first permanent molar will drift forwards (Fig. 10). This is particularly marked if loss occurs before the eruption of the permanent tooth and for this reason it is better, if at all possible, ***to try to preserve the second deciduous molar*** at least until the first permanent molar has appeared. Otherwise, use ***space maintainer*** if it is prematurely lost. In most cases balancing or compensating extractions of other sound second deciduous molars is not necessary unless they are also of poor long-term prognosis.

Figure 10: Loss of a lower second deciduous molar leading to forward drift of first permanent molar.

Early loss of deciduous tooth or teeth whether due to caries, premature exfoliation, or planned extraction results in drifting or tilting of the adjacent tooth into the edentulous space. This in turn results in decrease in the dental arch length and may be impaction of the unerupted permanent tooth.

Space maintainer is defined as the appliances that prevent the loss of the dental arch length and which in turn guide the permanent tooth into

correct position in the dental arch. It may be removable like partial denture or fixed like band and loop and lingual arch. Whereas, ***Space regainer*** used to regain the lost space by applying orthodontic force to realign the tilted teeth.

Retained Deciduous Teeth

A difference of more than 6 months between the shedding of contralateral teeth should be regarded with suspicion. Provided that the permanent successor is present, retained deciduous teeth should be extracted, particularly if they may cause impaction or deflection of the permanent tooth that can result in irregularity, crowding, and crossbite (Fig. 11).

Figure 11: Retained deciduous tooth contributing to deflection of the permanent successor.

Delayed Eruption of Permanent Teeth

If a tooth on one side of the arch has erupted and 6 months later there is still no sign of its equivalent on the other side, radiographic examination is indicated and there is a likelihood of migration of other teeth into the available space. As a result, the tooth whose eruption has been delayed might get displaced or impacted. Whatever the reasons for the delay in eruption, it is important from a clinician's point of view ***to maintain*** and if required ***to create space*** for its eruption (Fig. 12). Extraction of the affected teeth is often necessary.

Figure 12: Delayed eruption of maxillary central incisor.

Causes of Delayed Eruption

Generalized causes

- Hereditary gingival fibromatosis
- Down syndrome
- Cleidocranial dysostosis
- Cleft lip and palate
- Rickets
- Hypothyroidism

Localized causes

- Congenital absence
- Crowding
- Retained/Ankylosed/Premature loss of the primary predecessor
- Supernumerary tooth
- Dilaceration
- Abnormal position of crypt
- Primary failure of eruption

Ankylosed Deciduous Teeth

Ankylosis is a condition which involves the union of the root or part of a root directly to the bone, i.e., without the intervening periodontal membrane. It may be associated with past history of trauma or apicoectomy. Ankylosed deciduous teeth, especially ankylosed deciduous molars, constitute a potential alignment problem for the permanent teeth. This delays the erupting permanent tooth and can deflect it from the normal eruption path (Fig. 13). Treatment may involve surgical removal of the ankylosed tooth.

Figure 13: Ankylosis of second deciduous molar.

Abnormal Eruptive Path

Generally, each tooth travels on a distinct path since its inception to the location at which it erupts. It can deviate from this eruption path because of many reasons. The tooth that most frequently erupts in an abnormal location is the maxillary canine (Fig.14). Various reasons have been attributed for this behavior. These include:

1. It travels the longest distance, from near the floor of the orbit.
2. It is the last anterior tooth to erupt and loss in arch length, anterior or posterior, may impinge on the space required for it to erupt.
3. Ideally it should slide along the distal aspect of the root of the lateral incisor. Any problem in the position of the lateral incisor may divert the erupting canine.

Note: Treatment of displaced canine has been mentioned in previous lecture.

Figure 14: Abnormal path of eruption of the maxillary canines.

Transposition

Transposition is a positional interchange of two adjacent teeth. There appears to be a genetic component to this problem as well. It usually occurs between the maxillary canine and first premolar, either partial or complete transposition (Fig. 15). Treatment of partial transposition needs fixed orthodontic appliance, while complete transposition may be left untreated.

Figure 15: Partial and complete transposition of the canine and first premolar.

Abnormal Labial Frenum

At birth the labial frenum is attached to the alveolar ridge with some fibers crossing over and attaching with the lingual dental papilla. As the teeth erupt, bone is deposited and the frenal attachment migrates superiorly with respect to the alveolar ridge. Some fibers may persist between the maxillary central incisors. These fibers which persist between these teeth are capable of preventing the two contralateral central incisors from coming into close approximation, in such cases surgical removal of the frenum may offer little advantage (Fig. 16).

The 'blanch test' is used to determine the role of frenum as a causative factor.

Step 1: The lip is pulled superiorly and anteriorly

Step 2: Any blanching in the interdental region is indicative of the fibers of the frenum crossing the alveolar ridge.

Step 3: The blanch test can be collaborated with an intraoral periapical radiograph of the region which shows a slight radiolucent wedging/notching in the interdental alveolar ridge region (Fig. 17).

Figure 16: Thick labial frenum.

Figure 17: Notch in the interdental alveolar bone due to frenal insertion into the incisive papilla.

Dental Caries

Proximal caries is especially to blame for the reduction in arch length. It can cause:

- ***Migration*** of adjacent teeth (Fig. 18).
- ***Tilting*** of adjacent teeth into the space available (Fig. 19).
- ***Overeruption*** of the teeth in the opposing arch (Fig. 19).
- ***Premature*** loss of deciduous or permanent teeth. A substantial reduction in arch length can be expected if several adjacent teeth involved by proximal caries are left unrestored.

Treatment of caries is necessary to avoid the above problems.

Figure 18: Loss of space due to grossly decayed deciduous first molar.

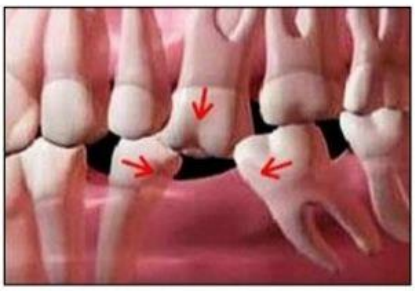

Figure 19: Tilting and over-eruption of the teeth in the space available due to premature extraction of carious tooth.

Gingival and Periodontal Diseases

Infections and other disorders of the periodontal membrane and gingivae have a direct and highly localized effect on the teeth. They may cause ***loss of teeth, changes in the closure patterns*** of the mandible to avoid trauma to sensitive areas, ***ankylosis*** of the teeth, and other conditions that influence the position of the teeth.

Improper Dental Restorations

Malocclusions can be caused due to improper dental restorations.

• Under contoured proximal restoration can lead to a significant decrease in the arch length especially in the deciduous molars.

• Over contoured proximal restorations might bulge into the space to be occupied by a succedaneous tooth and result in a reduction of this space.

• Overhang or poor proximal contacts may predispose to periodontal breakdown around these teeth.

• Premature contacts on over contoured occlusal restoration can cause a functional shift of the mandible during jaw closure.

• Under-contoured occlusal restorations can lead to the overeruption of the opposing dentition.

BAD ORAL HABITS

Habit: is a fixed or constant practice established by frequent repetition. Useful habits include habits that are essential for normal physiologic function. For example, correct tongue posture, proper respiration and deglutition. While bad habits can interfere with the child's physical, emotional and social functions.

Etiological Agents in the Development of Bad Oral Habits

1. Anatomical

For example, posture of the tongue. Infantile swallow occurs due to a large tongue in a small oral cavity coupled with anterior openbite of gum pads.

2. Mechanical Interferences

Mechanical interferences lead to undesirable oral habits, such as when the permanent incisor is ectopically erupted or missed, this will lead to anterior tongue thrust to achieve the anterior oral seal.

3. Pathological

Certain conditions of oral and perioral structures can cause an undesirable oral habit, e.g. tonsillitis, hypertrophy of inferior nasal turbinates (can cause mouth breathing).

4. Emotional

Upset children regress towards infancy, assume infantile postures, e.g. digit sucking which gives the child a feeling of security.

5. Imitation

Young children are extremely observant and sensitive to environment and highly affected by parents and siblings. The child may imitate jaw positions/speech disorders of parents.

6. Random Behavior

Behavior appears purposeless if not completely accidental.

Digit Sucking Habit (Thumb/Finger-Sucking)

Repeated and forceful sucking of thumb/finger with associated strong buccal and lip contractions. Almost all children take up this habit, but eventually discontinue it spontaneously with age and maturation (Fig. 1).

There are essentially two forms of sucking:

1. Nutritive sucking: it is the sucking observed during breast/bottle feeding, which provides nutrition to the infant.

2. Non-nutritive sucking: it is the earliest sucking habit adopted by infants in response to frustration and to satisfy their need for contact. Children who neither receive breast feeding nor have access to a pacifier may satisfy their need with habits like thumb sucking which ensures a feeling of warmth and sense of security but may be harmful to their dentofacial development.

Main Effects of Digit Sucking

If these habits persist beyond the time that the permanent teeth erupt then it will cause the following effects:

1. Extra -oral effects: the offending digit is exceptionally clean, reddened or sometimes deformed. Fibrous roughened callus may be present on the digit and sometimes there may be viral or fungal infection.

2. Intra-oral effects:

a) Proclination and spacing of upper incisors (Fig. 2).

b) Retroclination of lower incisors (Fig. 2).

c) Anterior openbite (usually asymmetrical) (Fig. 3).

d) Narrow maxillary arch (posterior cross bite) (Fig. 3).

The severity of malocclusion caused by digit sucking depends on several factors:

a) Frequency: number of times/day habit is practiced.

b) Duration: amount of time spent on habit.

c) Intensity: amount of force applied to the teeth during sucking.

Diagnosis of Digit Sucking

1. History
2. Extra oral effect/examination
3. Intra oral effect/examination

Figure 1: Digit sucking habit.

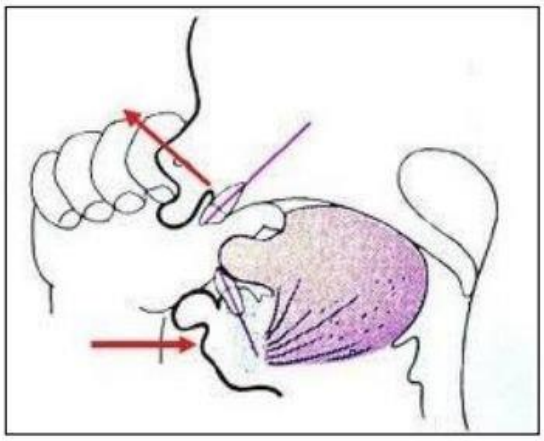

Figure 2: Proclination of upper incisors and retroclination of lower incisors due to digit sucking.

Figure 3: Anterior openbite and posterior crossbite due to digit sucking.

Treatment of Digit Sucking

1. Discussion: the simplest approach to habit therapy is a straightforward discussion between the child and the dentist that expresses concern and includes an explanation by the dentist. This "adult" approach is often enough to terminate the habit but is most effective with older children.

2. Reminder therapy: best suited for those patients who desire to stop the habit but need assistance to do so. Includes adhesive tapes, bandages to offending digits, or distasteful liquid/ointments like hot -flavored, bitter-tasting or foul-smelling preparations, placed on the thumb or fingers that are sucked (Fig 4).

3. Reward system: if the reminder approach fails, a reward system can be implemented that provides a small tangible reward daily for not engaging in the habit. In some cases, a large reward must be negotiated for complete cessation of the habit.

4. Appliance therapy: either removable appliance with tongue guard/crib or fixed appliance like quadhelix or maxillary lingual arch with palatal crib (Fig. 5).

In general, if the child is younger than 3 years, no active intervention regardless of type and severity of malocclusion because of general emotional immaturity, most children outgrow the habit by 5 years of age, and malocclusion is self-correcting if ceased by the time of eruption of permanent teeth.

The patient should be at least 7 years old to receive an appliance therapy to reason and understand the need for an appliance. Always parents support and encouragement is necessary to help the child through the treatment period. When sucking ceases, appliance should be retained for approximately 3 months to ensure that the habit has truly stopped.

Figure 4: A reminder placed on the thumb to remind the child not to suck.

Figure 5: A: Removable appliance with tongue crib. B: Qaudhelix appliance. C: Maxillary lingual arch with palatal cribs.

Tongue Thrusting Habit

It is a condition in which the tongue protrudes between the anterior or posterior teeth during swallowing with or without affecting tooth position.

Classification of Tongue Thrusting

1. Etiologic classification

a. Physiologic tongue thrust

This comprises of the normal tongue thrust swallow of infancy.

b. Habitual tongue thrust

The tongue thrust is developed due to repeated placement of the tongue.

c. Functional (Adaptive) tongue thrust

The tongue thrust is an adaptive behavior developed to achieve an oral seal.

d. Endogenous tongue thrust

The tongue thrust is due to neuromuscular mechanism.

e. Anatomic tongue thrust

The tongue thrust is due to macroglossia (enlarged tongue).

2. Backlund classification

a. Anterior tongue thrust

Forceful anterior thrust leading to anterior openbite (Fig. 6).

b. Posterior tongue thrust

Lateral thrusting in case of missing posterior teeth leading to posterior openbite (Fig. 6).

Moyers classification

a. Simple tongue thrust (teeth are together)

The buccal teeth are together with a forward positioning of the tongue between the anterior teeth during swallowing, this usually results in production of an incomplete overbite or anterior openbite.

b. Complex tongue thrust (teeth are apart)

The buccal teeth apart during swallowing, the tongue is positioned between them and does not fill the upper jaw, pressure of muscles of the cheek narrowing the upper arch, leading to buccal crossbite usually unilateral.

c. Retained infantile thrust (endogenous tongue thrust)

Persistence of infantile swallowing reflex even after permanent teeth appear.

In a small proportion of subjects, the swallowing activity is accompanied by an anterior thrust of the tongue which appears to be a basic neuromuscular mechanism. This so-called 'endogenous' tongue thrust is sometimes associated with an anterior ***lisp (sigmatism)*** during speech. It usually affects the developing teeth to the extent of preventing the full vertical development of the anterior dento-alveolar segments, so that an incomplete overbite or, more usually, ***an anterior openbite***, develops. The upper and lower incisors may be ***proclined*** by the action of the tongue. Occasionally this type of swallowing activity appears to have no adverse effect on the developing occlusion.

The endogenous tongue thrust is fortunately not common, appearing in only 3.1% of the population. A tongue thrust associated with a noticeable lisp and a wide anterior openbite may reasonably be assumed to be of the 'endogenous' type, particularly if a parent has the same condition. This type would not be modified by orthodontic treatment and it must be realized that re-positioning the teeth would not be likely to alter the tongue activity, and any openbite caused by the tongue thrust would be likely to recur (***treatment will not always be successful***).

Figure 6: Anterior tongue thrust (left), posterior tongue thrust (right)

Management of Tongue Thrusting

Situation	Treatment considerations
Up to 7-8 years old (by the time the permanent anterior teeth erupt completely)	▪ Self-correcting (no treatment) ▪ Reassures parents
Tongue thrusting without malocclusion or speech disturbance	▪ Treatment is generally not recommended
Tongue thrusting with malocclusion	▪ Orthodontic correction of the malocclusion caused by tongue thrusting will usually eliminate the tongue thrusting habit
Tongue thrusting with other oral habits	▪ If the patient has both thumb sucking and tongue thrusting, the thumb sucking should be treated first

Treatment Options

▪ **Correction of malocclusion**: using removable, myofunctional therapy, or fixed appliances.

▪ **Muscle exercises**: This can be done by asking the patient to place the tip of the tongue in the rugae area for 5 minutes and then swallow or by using appliances like orthodontic trainer) (Fig. 7).

▪ **Habit breaking appliances:** for example, removable appliances with tongue cribs, oral screen, Nance palatal arch with tongue cribs, tongue tamer (Fig. 8,9,10).

Figure 7: Orthodontic trainer

Figure 8: Oral screen.

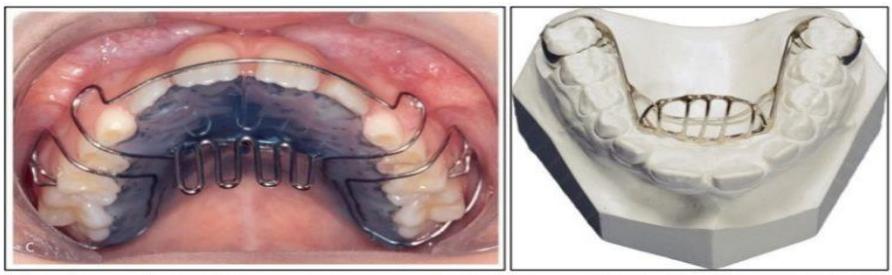

Figure 9: Removable habit breaker with tongue cribs (left), Nance palatal arch with tongue cribs (right)

Figure 10: Tongue tamer (spikes)

Mouth Breathing Habit

It is the habitual respiration through the mouth instead of the nose. The main causes of mouth breathing habit are related to nasal obstruction which may be due to hypertrophy of pharyngeal lymphoid tissue (adenoids), defects in the nasal septum, polyps, allergic rhinitis, etc. It may be also habitual mouth breathing when it continues even after the obstruction has been removed.

Effects of Mouth Breathing Habit

1. 'Adenoid Facies' appearance characterized by long narrow face with underdeveloped paranasal area and small nostrils (Fig. 11).
2. Increased facial height.
3. Mandible would rotate down and back
4. Posterior teeth would overerupt
5. Anterior openbite and increased overjet
6. Posterior crossbite, constricted maxilla with narrow shaped palate
7. Incompetent, dry, and fissured lips
8. Gingival hypertrophy

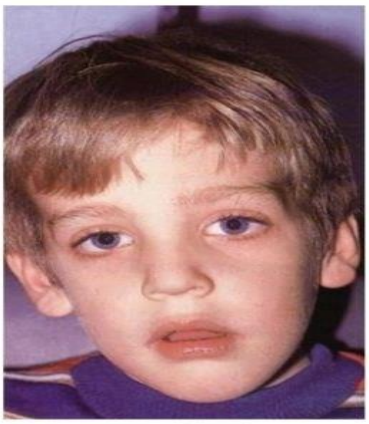

Figure 11: Adenoid Facies.

Diagnosis of Mouth Breathing Habit

In addition to the clinical features, mouth breathing habit can be diagnosed by the following tests (Fig. 12):

a) Ask the patient to take a deep breath: Most mouth breathers respond to this request by inspiring through the mouth without changing the size or shape of external nares.

b) Mirror test: a double-sided mirror is held between the nose and mouth. Fogging on the nasal side of the mirror indicates nasal breathing while fogging on oral side indicates mouth breathing.

c) Cotton test/Massler's butterfly test: butterfly shaped cotton strand is placed over the upper lip below nostrils. If the cotton flutters down, it is a sign of nasal breathing. This test can be used to determine unilateral nasal blockage.

d) Water test: the patient is asked to fill the mouth with water and retain it for a period of time. Mouth breathers find this task difficult.

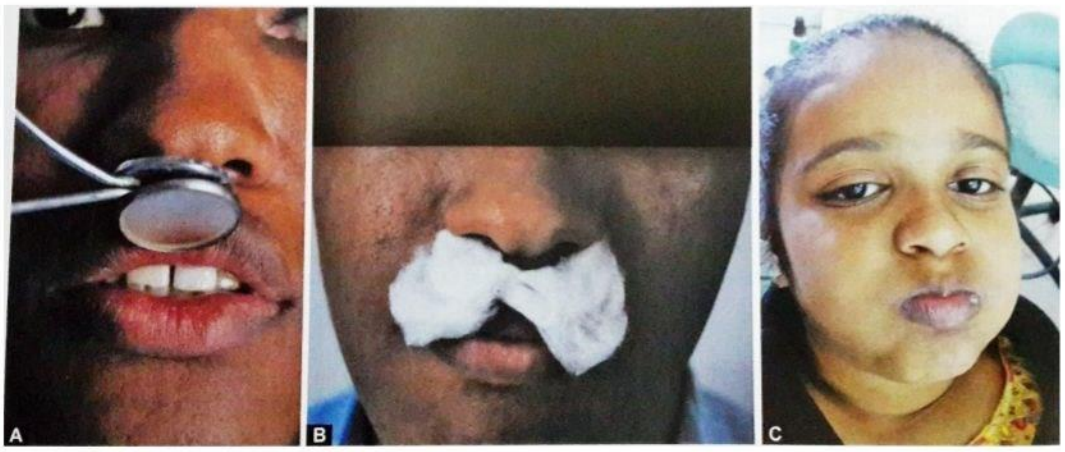

Figure 12: Diagnostic tests of mouth breathing habit. A: Mirror test, B: Cotton test, C: Water test.

Management of Mouth Breathing Habit

ENT referral for management of nasopharyngeal obstruction is necessary before any orthodontic treatment. ***Maxillary expansion***, ***myofunctional therapy and oral screen*** can also use for treatment of mouth breathing**.**

Bruxism

It is the term used to indicate the non-functional contact of the teeth which may include clenching, grinding and tapping of the teeth. The main etiological factors are ***occlusion defects and psychological factors***. It may cause occlusal wear, sensitivity, teeth mobility, fracture, and TMJ problems (Fig. 13).

Management of Bruxism

a) Determine the underlying cause and eliminate it.

b) Occlusal adjustment including restoration and occlusal splints/bite guards.

c) Psychotherapy like relaxation exercises.

d) Drugs like local anesthetic injections into TMJ for muscles, sedatives, and muscle relaxants.

Figure 13: Attrition of the teeth due to bruxism.

Lip-Sucking and Lip-Biting

Lip-sucking may appear by itself or it may be seen with thumb-sucking or as a compensatory activity that results from an excessive overjet and the relative difficulty of closing the lips properly during deglutition. In almost all-instances, it is the lower lip that is involved in sucking and biting, although biting habits of the upper lip are observed as well. When the lower lip is repeatedly held beneath the maxillary anterior teeth, the result is proclination of these teeth, often an openbite, and sometimes ***retroclination*** of the mandibular incisors (Fig. 14). Sometimes there may be ***eczematous appearance*** of the skin below the lower lip.

Management of Lip-Sucking and Lip-Biting

a) Lip over lip exercises.

b) Lip bumper: it could be fixed or removable with labial acrylic pads used to stop lip sucking or biting habits and eliminate the backward pressure of the lower lip on the lower labial dental segment (Fig. 14).

c) Oral screen.

d) Correction of malocclusion with removable or fixed appliances.

Figure 14: From left: lip sucking habit, lip biting habit, lip bumper appliance.

Nail Biting Habit

It is one of the most common habits in children and adults which may be due to emotional and social problems that may affect the psychology of the individual.

Clinical Features of Nail Biting Habit

1. Crowding
2. Rotation
3. Attrition of lower or upper incisors.
4. Effect on nails: inflammation of nailbeds and heavily cut nails (Fig. 15).

Management of Nail Biting Habit

1. No treatment in mild cases.
2. Treat the basic emotional factor causing the habit.
3. Encourage outdoor activities.
4. Reminders like nail polish.

Figure 15: Nail biting.

Notes and questions for the students

The essential features of normal swallowing of solid food and saliva are:

1. Closure of the lips.
2. Teeth in light occlusal contact.
3. Tongue elevated to the palate.
4. Momentary clenching of the teeth as food passes into the pharynx.

Sometimes, when the lips cannot produce the anterior oral seal (flaccid or short lips), so the tongue will do this job by thrusting between the teeth as an adaptive measure during swallowing (adaptive swallowing)

My great wishes for my lovely students for success. Thanks

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Lecture 15 5th د.حيدر سعد حنفوش

Orthodontics

Orthodontic treatment for medically compromised patients

In recent years, there has been an increase in the number of patients seeking orthodontic treatment. Some of them are medically compromised or on medications. They are obligated to coordinate with their patients' physicians about some orthodontic procedures and whether any modification to the treatment will be needed during the treatment. Orthodontic treatment is not contraindicated in most of these conditions unless it is uncontrolled because the tissues' response to orthodontic treatment is jeopardized during the active or acute phase of an illness.

1-Hypersensitivity reactions:

In modern orthodontic practice, adverse patient reactions to orthodontic materials, hypersensitivity reactions are related to the antigenicity of some materials that result in an adverse patient response.

Management:

1- Sensitivity test if possible
2- Avoid using materials that cause sensitivity

2-Infective endocarditis (IE):

This condition results from infection of the heart or blood vessels endothelium. Heart valves are specifically susceptible, but this condition can affect any endothelial lined surfaces found in ventricles, atria, and pulmonary artery.

The association between IE and orthodontics has not been completely identified. The American Heart Association's committee found no significant risk for bacteremia from adjustment of orthodontic appliances. Thus, prophylaxis is not recommended for routine adjustment of removable or fixed orthodontic appliances or placement of orthodontic brackets.

Prophylaxis is recommended for any orthodontic procedures that might perforate oral mucosa or manipulate gingival tissues. These include insertion and removal of orthodontic bands, interproximal reduction, and placement of temporary anchorage devices.

The antibiotic prophylaxis should be given as one dose before the procedure or up to 2 hours later.

Management:

1-Proper antibiotic prescription based on the risk level and orthodontic procedure intended

2- Bonded brackets and elastomeric ties are preferable.

3- All sharp edges should be smoothed and polished, and excess adhesives should be removed and cleaned.

4-Fixed acrylic appliances, like Nance and acrylic rapid maxillary expanders, should be avoided

3-Thrombocytopenia:

This condition results from a reduction of blood platelet count due to bone marrow disruption. This can be caused by malignancy of the bone marrow (leukaemia) or an autoimmune disease (aplastic anaemia). Spontaneous gingival bleeding in the presence of good oral hygiene is considered to be one of the early signs of leukaemia

Management

1-If the diagnosis of leukaemia is confirmed before the orthodontic treatment, orthodontic treatment should be delayed until chemotherapy is complete and at least two years after bone marrow transplantation.

2-If the diagnosis is confirmed during the orthodontic treatment, the orthodontist must remove all existing orthodontic appliances and a removable retainer can be used. Orthodontic treatment can be restarted after completion of all required therapy, and the patient has a minimum of two-year event-free survival

3-Orthodontic mechanics should be simple and light

4-The orthodontist needs to accept compromised results and treat the maxilla only

5-Clear aligners might be the best choice to treat these patients

6-Non-irritating orthodontic appliances are preferable

7-Nickel-free brackets are recommended over stainless-steel brackets

8-The use of aesthetic brackets or clear aligners is recommended since they cause minimal MRI distortion

9-For cancer patients in general, orthodontic treatment should start at least 2 years after the anticancer therapy

4-Haemophilia

This condition results from a deficiency of one of the blood clotting factors. Haemophilia A and B are caused by factor VIII and IX deficiency, respectively. Von Willebrand's disease is caused by a defect of Von Willebrand's factor.

Management:

1-Mucosal injury should be minimized. Sharp edges need to be smoothed, and excess wires should be cut.

2-Self-ligating brackets are preferable over the conventional type. Arch

wires should be ligated with elastomeric rather than wire ligatures.

3-It is preferable to make an impression with a non-metal tray to minimize trauma. During bonding, a saliva ejector is recommended to be placed on a gauze placed on the mouth's floor

4-Minimal treatment time

5-Fixed appliances are preferable over the removable ones. Bonding over banding are advisable, if possible. A non-extraction treatment plan is recommended

6-For pain management, Acetaminophen is a safer than NSAIDs

7-Clear aligners should be trimmed carefully to avoid gingival irritation

5-Thalassemia:

This condition is manifested by reduction of synthesis of a or b polypeptide chains that make the normal haemoglobin compound HbA. This reduces the amount of haemoglobin in red blood cells and causes anaemia .

B-Thalassemia major (Cooley's anaemia) is considered to be the most severe type. Orthodontic problems include skeletal class II maloc-clusion, small teeth size, reduced dental arch dimensions, everted lips, anterior teeth spacing and flaring, open bite, protrusion, maxillary enlargement, and increased overjet. Maxillary bone marrow undergoes hyperplasia more than the mandible, which causes a distinctive "chip-munk face" .

Management

1-Orthodontic interceptive treatment is recommended to begin at early age by using functional appliances and extra-oral appliances to treat dentofacial problems. It is recommended to apply a medium force in short intervals

2-Tooth movement must be monitored by the orthodontist for short intervals of time. 3-Lighter forces than usual are highly recommended

6-Diabetes mellitus (DM)

This condition is characterized by a persistent elevation in blood glucose (chronic hyperglycaemia) due to insulin deficiency. Types 1 and 2 are the main types of DM.

Type 1 results from insulin secretion deficiency. Type 2 results from insulin resistance and inadequate insulin production. Periodontal problems are the main concern for poorly controlled DM.

Management:

1-Appointments early in the morning are preferable, and the patient is encouraged to eat a regular meal and take usual medication before the visit

2-Light orthodontic forces should be used

3-A periodontist should be involved, especially with adult patients, to evaluate periodontal condition before and during orthodontic treatment

4-Orthodontists and staff should be trained and ready to deal with any diabetic emergencies, especially sudden hypoglycaemia.

7-Thyroid disorders

Hyperthyroidism is caused by unregulated thyroid hormone synthesis. In contrast, hypothyroidism results from a reduction in thyroid gland

function and its hormone production. Orthodontic problems with hyperthyroidism include high bone turnover and accelerated dental eruption. Orthodontic problems with hypothyroidism include anterior open bite, macroglossia, delayed eruption of teeth, impaction of the mandibular second molars, and low bone turnover

Management

1- A stress reduction protocol should be implemented NSAIDs and aspirin are not recommended, and alternative pain medication should be prescribed

2- Patients with hyperthyroidism tend to have an increased amount of tooth movement Patients with hypothyroidism tend to have an increased risk of root resorption

8-HIV/AIDS:

Human immunodeficiency virus (HIV) is a bloodborne retrovirus which infects the immune system cells (including T helper lymphocytes and macrophages) resulting in acquired immunodeficiency syndrome (AIDS). Oral lesions are usually detected first in these patients. These lesions include hairy leukoplakia and oral candidiasis. Depending on the progress and stage of HIV infection, patients with HIV/AIDS may become medically compromised and require special considerations.

Management

1- An orthodontist can aid in detecting a possible HIV infection by recognizing the first oral manifestations of the disease HIV patients with no symptoms should be treated as regular patients.

2- These patients can receive regular orthodontic treatment after ruling out the possibility of neutropenia, immunosuppression, or thrombocytopenia

3- If any oral lesion is detected during the treatment, an appropriate referral is recommended

4- For pain management, Acetaminophen and aspirin should be used with caution

9-Juvenile idiopathic arthritis (JIA)

JIA is a destructive inflammatory disease that affects children, and results in joint pain, swelling, and interference with range of motion. JIA affects females more than males and begins before the age of 16. Articular surfaces of joints undergo progressive destruction, including hands, wrists, fingers, toes, knees, shoulders, and elbows. In 45% of cases diagnosed with JIA, the temporomandibular joint (TMJ) is involved. Orthodontic problems include mandibular retrognathia, condylar hypoplasia, steep mandibular plane angle, open bite, antegonial notching, increased lower face height, and skeletal class II.

Most of these problems are attributed to condylar bone resorption. Unilateral TMJ involvement results in facial asymmetry.

Management

1- The treatment of JIA involves medications, physical therapy, and psychosocial support to counteract the progressive and long-term nature of the disease

2- Joint inflammation should be controlled as early as possible with medications to prevent deteriorating effects on the mandibular growth Once the inflammation is under control, orthodontic treatment should aim at restoring optimal occlusion and function of the mandible

3- Heavy class II elastics should not be used.

4- The use of functional appliances is controversial, in the case of a moderate mandibular deficiency, headgear is recommended

5- Orthognathic surgery should be performed when growth is complete except in case of TMJ's ankylosis, which mandates surgical intervention sooner Maxillary surgery and advancement genioplasty have been advocated to treat severe mandibular deficiency

6- In case of severe deformity, distraction osteogenesis is recommended

10-Autism Spectrum Disorder (ASD):

It is a neurodevelopmental syndrome which starts before three years of age and continues for life. This spectrum presents with Asperger Disorder (AD), autism, Pervasive Developmental Dis- order, and Childhood Disintegrative Disorder (CID). This results in repetitive and limited behaviors in addition to impairments of communication and social interaction and responsiveness.

Orthodontically, these patients have more malocclusion than normal people. In particular, they have a higher prevalence of class II malocclusion, increased overjet, high and narrow palate, posterior crossbite, open bite, and severe maxillary crowding. These traits might be attributed to persistent parafunctional habits, including bruxism, lip biting, pacifier use, and tongue thrusting.

Moreover, autistic children tend to be rewarded with sweets when they perform certain tasks during therapy or at home. Therefore, they might have a high risk of caries if these rewards continue regularly.

Management

1- The presence of parents, giving short and clear sentences, voice control,

2- Tell-Show-Do technique, behaviour modification, and positive reinforcement can be utilized to improve communication and acceptance. This must be done over several visits before starting the orthodontic treatment .

3- Desensitization techniques can be used by gradually introducing the patient to the items used in the orthodontic office

4- Some procedures can be conducted using behaviour management and protective stabilization (restraint). Others might need sedation, or even general anaesthesia.

5- Removable orthodontic appliances are recommended for autistic patients. They should be as small as possible and be reinforced by wires.

11-Attention-deficit hyperactivity disorder (ADHD):

Attention-deficit hyperactivity disorder is characterized by inattention, impulsivity, forgetfulness, and inappropriate hyperactivity. Children with ADHD might have their growth disturbed by the disorder or medications used for its treatment. Dental manifestations include a high prevalence of caries, molar-incisor hypoplasia, and becoming more prone to dental trauma.

Management

Due to poor compliance, some orthodontic tasks, including activation of appliances and placement of elastics, need more follow-ups and the involvement of parents and other family members.

Strict oral hygiene is mandatory.

Short appointments scheduled early in the morning are recommended. Frequent breaks during the appointment are beneficial to gain compliance and attention.

Instructions should be simple and clear.

The Tell-Show-Do method has a great impact on behavior modification in these patients.

Orthodontic treatment plans that require high compliance should be avoided.

My great wishes for my lovely students for success. Thanks

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Lecture 16+17 5th

د.حيدر سعد حنفوش

Orthodontics

Vertical Plane Discrepancies

(Deep Bite)

Vertical relationship

The face is vertically split into thirds, with these thirds being approximately equidistant. Any discrepancy in this rule of thirds will give an indication of disharmony within the facial proportions and where this lies. The upper face extends from the hairline or top of forehead (trichion) to the base of the forehead between the eyebrows (glabellar). The midface extends from the base of the forehead to the base of the nose (subnasale). The lower face extends from the base of the nose to the bottom of the chin (menton). The lower third of the face can be further subdivided into thirds, with the upper lip in the upper one-third and the lower lip in the lower two-thirds. Of particular relevance is an increase or decrease in the lower face height.

Factors Affecting the Development of Deep Overbite

Discrepancies in the size and/or position of the jaws can adversely affect the normal vertical development, resulting in a deep bite malocclusion. Mandibular growth rotations play an important part in the etiology of some malocclusions, as well as the stability of the result. A marked

forward growth rotation tends to result in reduced anterior facial proportions and an increased overbite, while marked backward rotations tend to result in an increased anterior vertical facial height and a reduced overbite (or anterior open bite). The development of the vertical dimension is also affected by the equilibrium between the tongue, lips, cheeks, and opposing dentition on the developing dento-facial complex. This equilibrium of the biologic system is determined more by the duration than the magnitude of a force. The occlusal forces of teeth serve to maintain equilibrium in the vertical dimension of the orofacial complex, but pathologic (parafunctional) habits such as clenching, bruxism, or hyperactive muscles of mastication have the potential to influence the vertical equilibrium. This may result in the incomplete eruption of posterior teeth and a decreased vertical development of the posterior maxillary and mandibular alveolar processes producing an increased anterior overbite.

Incisor Overbite

Normal incisor overbite refers to the maxillary incisors overlapping the mandibular incisors by 2–4 mm vertically, or one-third to one-half of their crown height, when the opposing posterior teeth are in contact in centric occlusion. Overbite is described as:

• Increased, if the maxillary incisors overlap the mandibular incisor crowns vertically by greater than one-half of the lower incisor crown height;

• Decreased, if the maxillary incisors overlap the mandibular incisors by less than one third of the lower incisor crown height. If there is no vertical overlap between the anterior teeth, this is described as an anterior open bite and a measurement should be made of

the incisor separation;

• Complete, if there is contact between opposing incisors, or the incisors

and opposing mucosa;

• Incomplete, if there is no contact between opposing incisors, or the incisors and opposing mucosa;

• Reverse overbite, if the mandibular incisors overlap the maxillary incisors (e.g. class III).

If the overbite is complete to the gingival tissues, it is described as traumatic if there is evidence of damage. This is most commonly seen on the palatal aspect of the upper incisors or labial aspect of the lower incisors (e.g. inflammation, bleeding, recession).

Traumatic overbites causing palatal (left panels) and labial (right panels) gingival trauma

Increased Overbite (Deep Bite)

An increased overbite can be dental or skeletal in origin. Infra-occlusion of posterior teeth/ supra-occlusion of anterior teeth, extraction of posterior teeth (causing lingual collapse of anterior teeth) are contributing factors to dental deep bite. Convergent rotation of jaw bases, mal-relationships of the size and/or position of the jaws can lead to skeletal deep bite. An increased overbite can be seen in any class of malocclusion, but it is a common feature of class II division 2 malocclusion.

Dental Features of Deep Bite

The dental arches tend to be short, wide and mildly crowded with deep overbite. The lower labial segment is often retroclined with an increased (exaggerated) curve of Spee as a result of the lower incisors over-erupting

due to the lack of occlusal contact with the maxillary incisors.

Soft Tissue Features

Acute nasolabial angle, deep mentolabial sulcus with prominent Pogonion. The retroclination of the lower anterior teeth can result in lack of support for the lip, which relative to the chin and nose appears retrusive.

Ceph/Skeletal Features

Palatal, occlusal, and mandibular planes, which run almost parallel, lead to a low (flat) mandibular plane angle. The mandible shows upward and forward rotation in Individuals with this condition, who tend to have a longer ramus (increased posterior facial height), a nearly right-angle or acute gonial angle, and reduced anterior lower facial height.

Sequelae of Deep Bite

If left untreated, deep bite can impose adverse effects on facial aesthetics, TMJ problems, wear of mandibular incisors, gingival trauma and periodontal destruction.

Treatment of an Increased Overbite

There are essentially four ways to reduce a deep overbite associated with an increased curve of Spee in the lower arch using conventional orthodontic mechanics:

• Relative incisor intrusion/ buccal segment extrusion;

• Buccal segment extrusion;

• Incisor intrusion;

• Incisor proclination (only where the lower labial segment is markedly retroclined).

In many cases, overbite reduction will be achieved using a combination of these tooth movements, but the presence of vertical skeletal growth can significantly aid the process.

Growth can be utilized in adolescent patients to help correct dental and

skeletal discrepancies because growth of the mandibular condyles can help compensate for any posterior dental extrusion that may be used to facilitate overbite reduction. In adults, however, the orthodontist must rely upon tooth movement or surgery. A deep bite in a growing individual can be corrected using a myo-functional appliance or a removable appliance with a flat anterior bite plane, which allows extrusion of the posterior dentition, levelling the curve of Spee and reducing the overbite. Facial improvement is therefore achieved via an increase in the lower face height. In an adult, buccal segment extrusion (e.g. using inter-maxillary elastics and/or cervicalpull headgear) can result in a downward and backwards rotation of the mandible, steepening of the occlusal plane and an increase in the lower face height. This will reduce the overbite but is prone to relapse following treatment because there will be very little or no potential for compensatory growth at the condyle as the lower face height increases.

For these reasons, overbite reduction can be more difficult in adult patients and the focus is often on incisor intrusion using fixed orthodontic appliances.

Retention after Deep Bite Correction

Because vertical growth continues into the late teens, a maxillary removable retainer with an anterior bite plane often is needed for several years after fixed appliance orthodontics is completed, hence the lower incisors will encounter the baseplate of the retainer if they begin to slip vertically behind the upper incisors. Bite depth can be maintained by wearing the retainer only at night, after stability in other regards has been achieved.

Important Clinical Tips When Treating Deep Bite

 Correction of the inter-incisal angle is important for the stability of overbite reduction, as the establishment of an occlusal stop is essential to

prevent the incisors from erupting past each other and the overbite increasing again following treatment. This is especially relevant for class II division 1 cases associated with proclined upper incisors, because unless maxillary incisor inclination is corrected, an occlusal stop will not be established and the overbite will relapse. Simple retroclination by tipping of the upper incisors to reduce an increased overjet in the presence of an increased overbite is an inappropriate treatment because no occlusal stop is created. The upper incisors can retrocline and the lower incisors over-erupt, resulting in a worsening of the overbite. Instead, bodily retraction (with or without torqueing) of the upper incisors using fixed appliances can ensure better inter-incisal relationships.

 Management of a deep overbite in cases with a low maxillary–mandibular plane angle is made easier with a non-extraction approach. If teeth are extracted, as space is closed towards the end of the treatment, overbite control becomes difficult as the incisors will tend to upright, which can lead to the overbite deepening again.

 The amount of upper incisor display at rest and on smile is a critical aesthetic parameter during treatment because one of the inevitable characteristics of aging is diminished upper incisor display at rest and on smile. As patients get older, the amount of incisor display at rest decreases with age, as does the amount of tooth display on smile. The orthodontist must be aware of this because the effect of diminishing incisor display results in hastening the aging process in terms of smile appearance. For this reason, in orthodontic treatment the choice to open a deep bite with only upper incisor intrusion may correct the occlusion at the cost of making the patient look significantly older; hence, intrusion of lower incisors/extrusion of posterior segment should also be considered. In contrast, the favorable cases for merely upper incisor intrusion are patients with a gummy smile.

(Open Bite)

Open bite means no overlap or a gap exists between the maxillary and mandibular teeth when the patient bites in centric occlusion. An open bite can exist in the anterior or the posterior region. It can vary from being simply dental in nature to involving the underlying skeletal structures. The classification and treatment will depend mainly on the location, etiology and the extent of the open bite. An open bite present in the anterior segment is the most unaesthetic, as the patient has to bring his tongue anteriorly between the teeth and the lips during speech and while swallowing, and this in turn proclines and may worsen the separation between the upper and lower anterior teeth. Anterior open-bite may arise by a combination of interference to normal eruption of incisors and excessive eruption of posterior teeth. Posterior open bites are relatively rare and are caused mainly because of a lateral tongue thrust (e.g. due to a large tongue) or submerged/ankylosed posterior teeth. Posterior open bites may hamper mastication and are more difficult to treat.

In the presence of an anterior open bite, the tongue will come forwards between the incisors to fill the gap and create an anterior seal during swallowing. For many years it was thought that this tongue activity or ‘tongue thrust’ was the primary etiological factor in the development of anterior open bite; but it is now recognized that in the vast majority of cases this is an adaptive behavior since the tongue could adapt to the confines of the inter-maxillary space following some orthognathic surgical procedures. The evidence for this came from studies which reported that superior repositioning of the maxilla to close a skeletal open bite can result in autorotation of the mandible and a decrease in the intermaxillary space with the resultant adaptation of the tongue position, yielding acceptable speech and function.

Etiologic Factors

1- Genetic Factors

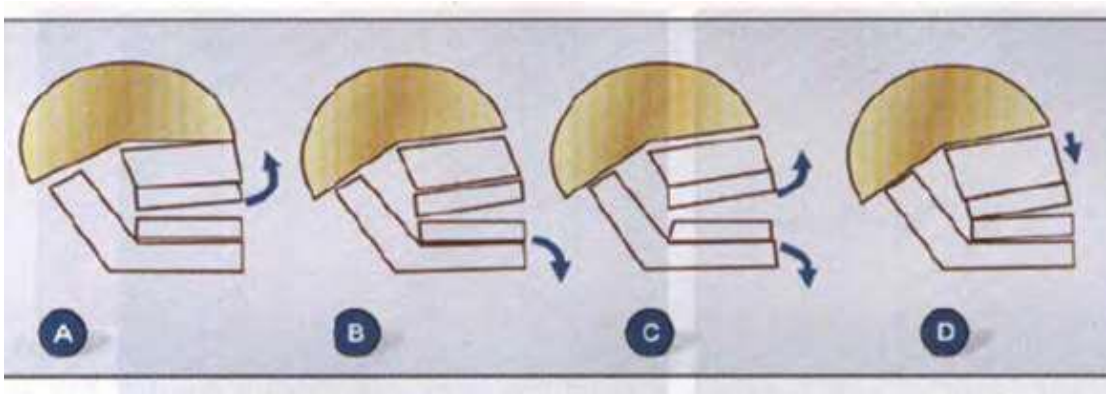
These include inherited traits such as abnormally large tongue size (main cause for posterior open bite) or abnormal skeletal growth patterns causing anterior open bite, which may be due to:

A- Upward maxillary rotation.

B- Downward, backward mandibular rotation.

C- Divergent rotation of the maxilla and mandible anteriorly.

D- Vertical maxillary excess.



2- Habits

Habits such as digit sucking, mouth breathing and tongue thrusting are also implicated in the etiology of open bites. With the majority of these habits the patient dis-occludes his/her jaw, in other words keeps his mouth perpetually open. This over a period of time causes the posterior teeth to supra-erupt (about 1 mm supra-eruption posteriorly opens the bite about 2 mm anteriorly resulting in an open bite) in addition to flaring and infra-occlusion of the anterior teeth; this may lead to the malocclusion acquiring a skeletal component.

In case of digit sucking, the amount of tooth displacement is dependent on the duration of hours per day of digit sucking and not only on the magnitude of the pressure created. A digit routinely placed in an asymmetric position may result in the development of an asymmetric

increase in overjet and open bite, whereas anterior tongue thrusting is commonly associated with symmetrical anterior open bite.

If the main etiological factor is a digit-sucking habit, as long as this ceases at an appropriate time, there can be complete and stable resolution of the anterior open bite. The main problems, which are particularly challenging to treat, arise with anterior open bites that are skeletal in origin or due to a digit habit that persists into the adult dentition and results in a permanent skeletal change.

Nasal obstruction and the resultant mouth breathing has been implicated in causing overeruption of the posterior teeth and an increase in the vertical lower face dimension caused by the open mouth posture.

3- Dental Factors

Ankylosis of posterior teeth can lead to the development of posterior open bites.

Dental Features of Open Bite

Narrow maxillary arch, excessive eruption of posterior teeth, posterior crossbite, proclination (with spacing) of maxillary and/or mandibular incisors, and anterior or posterior open bite.

Soft Tissue Features

Shallow mentolabial sulcus, lip incompetence and excessive gingival display on full smile (especially in cases associated with vertical maxillary excess).

Ceph/Skeletal Features

Tipping of the palatal and occlusal planes downwards posteriorly, high (steep) mandibular plane angle, short ramus (decreased posterior facial

height), marked antigonial notch, obtuse gonial angle, increased saddle angle and increased anterior lower facial height.

Treatment of Open Bite

In addition to the aesthetic issues, treatment is often required because the patient has trouble biting food due to the lack of an anterior or posterior occlusion. Speech may also be a concern, as an anterior open bite can be associated with lisping. Whilst treatment can improve both the occlusion and function, there is no guarantee that speech will improve, as speech patterns are established early in life, long before establishment of the permanent dentition.

There are essentially 2 ways that an open bite can be treated:

1- Vertical control or intrusion of the buccal segments. The aim is to reduce posterior dental heights, which will result in a forward autorotation of the mandible and closing down of the anterior open bite. Because the molars are closer to the condylar hinge, even a small amount of intrusion should result in a greater closure anteriorly.

In children, the use of a high-pull headgear will control posterior vertical growth of the maxilla. This will theoretically redirect mandibular growth in a more anterior than vertical direction. The headgear can be run directly either to bands on the upper first molars or to a removable appliance with posterior acrylic capping (an intrusion splint). Headgear can also be used in combination with a myo-functional appliance (e.g. Vertical Activator) to correct an increased overjet associated with a reduced overbite and a vertical growth pattern. The main problem with this approach is that vertical growth continues throughout adolescence; therefore, to be truly effective, headgear will have to be worn until adolescent growth has significantly diminished. A chin cup with a vertical-pull head cap can also be used for the correction of anterior open

bites in the pre-adolescent age group.

In adults, growth will have essentially ceased; therefore, treatment of an anterior open bite will necessitate some intrusion of the buccal segments using fixed orthodontic appliances with miniscrew implants or a high-pull headgear therapy. The most predictable and stable way of correcting severe cases of long-face patterns in adults is by surgical impaction of the maxilla posteriorly.

2- Extrusion of the labial segments. An anterior open bite occurs when the labial dentition is at the limits of its eruptive potential. Therefore, any further mechanical eruption or extrusion will be inherently unstable and is not advised unless it is related to a digitsucking habit that has prevented eruption of the incisors. Occasionally, towards the end of fixed appliance therapy, a small anterior open bite can be resolved and occlusal settling achieved by the short-term use of anterior vertical inter-maxillary elastics. When planning extrusion of the labial segments to close an anterior open bite, the amount of upper incisor display must be evaluated both at rest and on smile to avoid ending up with a gummy smile.

Retention after Open Bite Correction

Excessive vertical growth and eruption of the posterior teeth often continue until late in the teens or early twenties, so retention must also continue till then. An appliance with posterior occlusal stops (posterior bite plane), e.g. an open bite activator or bionator, can provide forces opposing eruption of posterior teeth.

Important Clinical Tips When Treating Open Bite

 If extraction is needed to treat open bite cases, second premolars (or molars) extraction is preferred as it encourages deepening of the bite.

 If the open bite was caused by a habit, controlling the habit is imperative for the success of treatment. Anterior palatal crib can be used

for anterior tongue thrust and digit sucking habits. For posterior open bites, lateral tongue spikes must be used to control the lateral tongue thrust habit, then vertical inter-maxillary elastics along with fixed orthodontic appliances can be used to close the posterior open bite.

 Posterior expansion to treat crossbite in cases with anterior open bite should be performed carefully with proper mechanics because any extrusion of the molars will worsen the anterior open bite. Similarly, it is important to avoid the use of class II and class III elastics in anterior open bite cases (due to the tendency for molars extrusion). If inter-maxillary traction is required, the extension of elastics should be short and not run to the molars.

My great wishes for my lovely students for success. Thanks

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Lecture 18+19 [5th] **د.حيدر سعد حنفوش**

Orthodontics

TREATMENT OF ECTOPIC CANINES

The development of the upper canine starts around 4 to 5 months of age, high in the maxilla. Crown calcification is complete around 6 to 7 years of age. The permanent canine then migrates forwards and downwards to lie buccal and mesial to the apex of the deciduous canine before erupting down the distal aspect of the root of the upper lateral incisor. Pressure from the unerupted canine on the root of the lateral incisor, leads to flaring of the incisor crowns (ugly duckling stage), which resolves as the canine erupts. In normal development the upper canines should be palpable in the labial sulcus by age 10 years.

PREVALENCE OF COMMON CANINE PROBLEMS:

In a Caucasian population, the prevalence of common canine problems are:

- congenital absence of upper canines (0.3%) and lower canines (0.1%)
- impaction of upper canines (1-2%) and lower canines (0.35%)
- resorption of upper incisors due to impacted canine (0.7% of 10-13 year olds)
- transposition of upper canines (0.33%)

CLASSIFICATION OF CANINE DISPLACEMENT

Canine displacement is generally classified into buccal or palatal (lingual) displacement. More rarely, canines can be found lying horizontally above the apices of the teeth of the upper arch or displaced high adjacent to the nose.

AETIOLOGY OF CANINE DISPLACEMENT

Possible causative factors of canine displacement include:

1. Displacement of the crypt. This is the probable aetiology behind severe displacements.

2. Long path of eruption.

3. Short-rooted or absent upper lateral incisor. Patients with absent or short-rooted lateral incisors are more likely to have palatally displaced canines due to the lack of guidance during eruption. Therefore, it is important to follow up canine eruption in patients with missing or peg-shaped lateral incisors.

4. Crowding. As the upper canine is the last tooth anterior to the molar to erupt, it usually has insufficient space to erupt in crowded arches. In normal development the canine lies buccal to the arch and in the presence of crowding will be deflected buccally. On the other hand, most of palatal displacements have sufficient space for eruption.

5. Retention of the deciduous canine. This usually results in mild displacement of the permanent tooth buccally. However, if the permanent canine itself is displaced, normal resorption of the deciduous canine will not occur. In this situation the retained deciduous tooth is an indicator, rather than the cause, of displacement.

6. Genetic factors. The evidence to support inheritance of palatal displacement of the upper canine includes:

a) greater prevalence in Caucasians

b) affects females more commonly than males

c) familial occurrence

d) 8% of the cases are bilateral

e) occurs in association with other dental anomalies

INTERCEPTION OF DISPLACED CANINES

Because management of ectopic canines is difficult and early detection of an abnormal eruption path gives the opportunity for interceptive measures, it is essential to routinely palpate for unerupted canines when examining any child aged 10 years and older.

Canines, which are palpable in the normal developmental position, which is buccal and slightly distal to the upper lateral incisor root, have a good prognosis for eruption. Clinically, if a definite hollow and/or asymmetry is found on palpation, OPG examination may show asymmetry in the position and development of the canines.

If a palatally displaced canine is detected in the mixed dentition, extraction of the deciduous canine may improve the unerupted canine position.

ASSESSING UPPER CANINE POSITION

The position of an unerupted canine should initially be assessed clinically, followed by radiographic examination if displacement is suspected.

Clinically: by palpation (in the buccal sulcus and palatally) and by the inclination of the lateral incisor.

Radiographically: The radiographic assessment of a displaced canine should include:

· locate the position of canine crown and root apex relative to adjacent teeth and the arch

· the prognosis of adjacent teeth and deciduous canine, if present

· the presence of resorption, particularly of the adjacent central and/or lateral incisors

The views commonly used for assessing ectopic canines include the following:

· Orthopantomogram (OPG). This film gives a good overall assessment of the development of the dentition and canine position. However, it shows the canine to be further away from the midline and more vertical than reality, i.e. more favourably positioned for alignment. This view should be supplemented with an intra-oral view. Also, a unilateral palatally displaced canine will appear enlarged compared to the contralateral canine.

· Periapical. This view is useful for assessing the prognosis of a retained deciduous canine and for detecting resorption.

· Upper anterior occlusal. Taken at 70-75° to use vertical parallax with OPG radiograph.

· Lateral cephalometric. For accurate localization this view should be combined with an anteroposterior view.

· Cone beam computerized tomography (CBCT). Due to the increased radiographic dose, CBCT is restricted to those ectopic canines where accurate localization is not possible with conventional views and/or root resorption of adjacent teeth is suspected.

MANAGEMENT OF BUCCAL DISPLACEMENT

Buccal displacement is usually associated with crowding, and therefore relief of crowding prior to eruption of the canine will usually effect some spontaneous improvement. Buccal displacements are more likely to erupt than palatal displacements because of the thinner buccal mucosa and bone.

More rarely a buccally displaced canine tooth does not erupt or its eruption is so delayed that treatment for other aspects of the malocclusion is compromised. In these situations, exposure of the impacted tooth may be indicated. To ensure an adequate width of attached gingiva either an

apically repositioned or, preferably, a replaced flap should be used. In the latter case, in order to be able to apply traction to align the canine, an attachment can be bonded to the tooth at the time of surgery, and a gold chain or a stainless steel ligature can be attached to the bond and used to apply traction.

In severely crowded cases where the upper lateral incisor and first premolar are in contact and no additional space exists to accommodate the wider canine tooth, extraction of the canine itself may be indicated. In some patients the canine is so severely displaced that a good result is unlikely, necessitating removal of the canine tooth and the use of fixed appliances to close any residual spacing.

MANAGEMENT OF PALATAL DISPLACEMENT

The treatment options available are as follows:

1- Surgical removal of canine

This option can be considered under the following conditions:

· The retained deciduous canine has an acceptable appearance and the patient is happy with the aesthetics and/or reluctant to do more complicated treatment. However, the primary canine will be lost eventually and a prosthetic replacement required.

· The upper arch is very crowded and the upper first premolar is adjacent to the upper lateral incisor with acceptable aesthetics.

· The canine is severely displaced. Any residual spacing can be closed orthodontically or by prosthetic replacement.

2- Surgical exposure and orthodontic alignment

Indications are as follows:

· well-motivated patient

· well-cared-for dentition

· favourable canine position

· space available (or can be created)

Whether orthodontic alignment is feasible or not depends upon the three-dimensional position of the unerupted canine:

· Height: highly positioned canines have poorer prognosis and more restricted access for surgical exposure.

· Anteroposterior position: the nearer the canine crown is to the midline, the more difficult alignment will be.

· Position of the apex: the further away the canine apex is from normal, the poorer the prognosis for successful alignment.

· Inclination: more horizontal canines need for greater traction.

If these factors are favourable, the usual sequence of treatment is as follows:

1) Make space available (permanent extractions should be delayed until after the canine has been exposed and traction successfully started).

2) Arrange exposure and allow the tooth to erupt for 2 to 3 months.

3) With deeply buried canines, an attachment plus a gold chain can be bonded to the tooth at the time of exposure or 2 days after pack removal.

4) Start traction using either a removable or fixed appliance. To complete alignment a fixed appliance is necessary, as movement of the root apex buccally is required to complete positioning of the canine into a functional relationship with the lower arch.

RESORPTION

Unerupted and impacted canines can cause resorption of adjacent lateral incisor roots and may sometimes progress to cause resorption of the central incisor. CBCT has shown that ⅔ of upper lateral incisors associated with ectopic canines showed signs of resorption. This sequela is more common in females than males.

Swift intervention is essential, as resorption often proceeds at a rapid rate. Extraction of the canine may be necessary to halt the resorption. However, if the resorption is severe it may be wiser to extract the affected incisor(s), thus allowing the canine to erupt.

TRANSPLANTATION

Transplantation should be carried out when the canine root is ⅔ to ¾ of its final length; unfortunately, by the time most ectopic canines are diagnosed root development is almost complete.

If transplantation is to be attempted, it must be possible to remove the canine intact and there must be space available to accommodate the canine within the arch and occlusion. The transplanted canine should be positioned out of occlusion and splinted with a sectional archwire for 6 weeks.

The main causes of failure of transplanted canines are:

1- Replacement resorption occurs when the root surface is damaged during the surgical procedure.

2- Ankylosis is promoted by rigid splinting of the transplanted tooth, which encourages healing by bony rather than fibrous union.

3- Inflammatory resorption follows death of the pulpal tissues, and therefore the vitality of the transplanted tooth must be carefully monitored.

TRANSPOSITION

Transposition is the interchange in the position of two teeth. This anomaly is rare but almost always affects the canine tooth. It affects males and females equally and is more common in the maxilla. It usually involves:

1- the upper canine and first premolar

2- the upper canine and lateral incisor

3- the lower canine and lateral incisor

Management depends upon:

1- whether the transposition is complete (i.e. the apices of the affected teeth are transposed) or partial

2- the malocclusion

3- the presence or absence of crowding.

Possible treatment options include:

1- acceptance (particularly if transposition is complete)

2- extraction of the most displaced tooth if the arch is crowded

3- orthodontic alignment

TREATMENT OF CLASS I

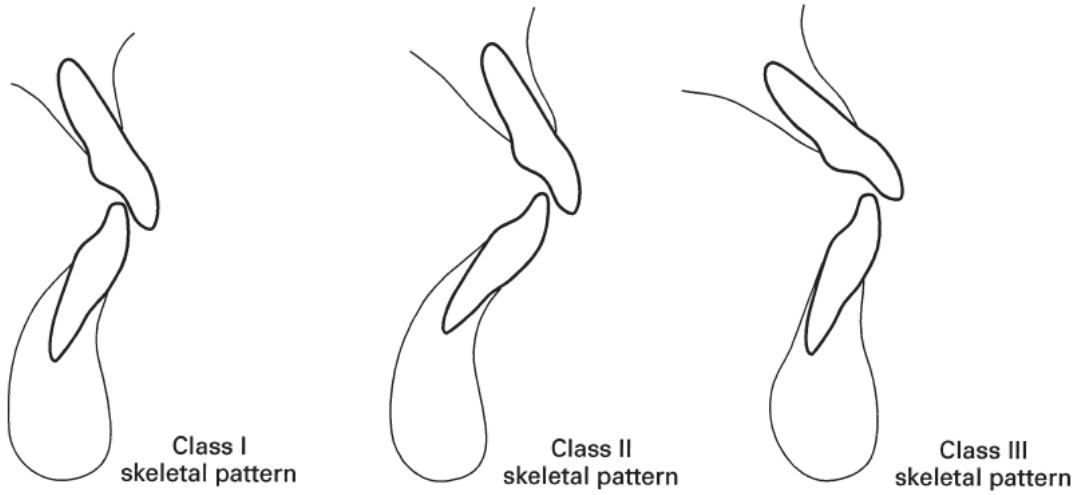
I. Definition:

Class I malocclusions is a situation where the anteroposterior occlusal relationship is normal and there is a discrepancy either within the arches and/or in the transverse or vertical relationship between the arches.

II. Aetiology

1. Skeletal causes

In Class I malocclusions, the skeletal pattern is usually Class I, but it can also be Class II or Class III with the inclination of the incisors compensating for the underlying skeletal discrepancy i.e. dento-alveolar compensation.



Marked ***transverse skeletal*** discrepancies between the arches are more commonly associated with Class II or Class III occlusions, but milder transverse discrepancies are often seen in Class I cases.

Increased vertical skeletal proportions and anterior open bite can also occur where the anteroposterior incisor relationship is Class I.

2. Soft tissue causes

In most Class I cases, the soft tissue environment is favourable (for example resulting in dento-alveolar compensation) and is not an aetiological factor.

Lip competence related effects

In bimaxillary proclination, the upper and lower incisors are proclined. This may be racial in origin and can also occur because lack of lip tonicity results in the incisors being moulded forwards under tongue pressure.

3. Dental and local causes

Dental factors are the main aetiological influences in Class I malocclusions. The most common are tooth/arch size discrepancies, leading to crowding or, less frequently, spacing.

The size of the teeth is genetically determined and so, to a great extent, is the size of the jaws. Environmental factors can also contribute to crowding or spacing. For example, premature loss of a deciduous tooth can lead to a localization of any pre-existing crowding.

Local factors also include displaced or impacted teeth, and anomalies in the size, number, and form of the teeth, all of which can lead to a localized malocclusion. However, it is important to remember that these factors can also be found in association with Class II or Class III malocclusions.

III. Common features in Class 1 malocclusion

1. Crowding

Crowding occurs where there is a discrepancy between the size of the teeth and the size of the arches.

In a crowded arch loss of a permanent or deciduous tooth will result in the remaining teeth tilting or drifting into the space created. This tendency is greatest when the adjacent teeth are erupting.

Most spontaneous improvement occurs in the first 6 months after the extractions. If alignment is not complete after 1 year, then further improvement will require active tooth movement with appliances.

2. Late lower incisor crowding

Physiologically, in most individuals, the intercanine width increases up to around 12 to 13 years of age, and this is followed by a very gradual diminution throughout adult life. The rate of decrease is most noticeable during the mid to late teens. This reduction in intercanine width results in an increase of any pre-existing lower labial crowding, or the emergence of crowding in arches which were well aligned or even spaced in the early teens. Therefore, to some extent, lower incisor crowding can be considered as an age change.

The aetiology of late lower incisor crowding is recognized as being multifactorial: the following have been proposed as influences in the development of this phenomenon;

1. Forward growth of the mandible (either horizontally or manifesting as a growth rotation) when maxillary growth has slowed, together with soft tissue pressures, which result in a reduction in lower arch perimeter and labial segment crowding.
2. Soft tissue maturation.
3. Mesial migration of the posterior teeth owing to forces from the interseptal fibres and/or from the anterior component of the forces

of occlusion.

4. The presence of an erupting third molar pushes the dentition anteriorly, i.e. the third molar plays an active role.

3. Spacing

Generalized spacing is rare and is due to either hypodontia or small teeth in well-developed arches. Orthodontic management of generalized spacing is frequently difficult as there is usually a tendency for the spaces to re-open unless permanently retained. In milder cases, it may be wiser to encourage the patient to accept the spacing, or if the teeth are narrower than average, acid-etch composite additions or porcelain veneers can be used to widen them and thus improve aesthetics. In severe cases of hypodontia, a combined orthodontic–restorative approach to localize space for the provision of prostheses, or implants, may be required. Localized spacing may be due to hypodontia; or loss of a tooth as a result of trauma; or because extraction is indicated because of displacement, morphology, or pathology. This problem is most noticeable if an upper incisor is missing as the symmetry of the smile is affected, a feature which is usually noticed more by the lay public than other aspects of a malocclusion.

A. Hypodontia

Hypodontia is defined as the congenital absence of one or more teeth. The prevalence in a Caucasian population (excluding the third molars) has been reported as being between 3.5 to 6.5 percent.

The third molars are missing in approximately 25–35 percent of the population. The next most commonly missing teeth are the second premolars (3 percent) followed by the upper lateral incisors (2 percent). Missing teeth are also found more commonly in patients with a cleft lip and/or palate.

Etiological factors

1. Familial tendency.
2. Association with syndromes (e.g. ectodermal dysplasia).
3. Small teeth.
4. Delayed dental development.
5. Retained deciduous teeth.

Management of missing upper incisors

There are basically three approached to manage missing incisors:

1. Space closure
2. Space maintenance or opening
3. Auto-transplantation

Criteria for successful auto-transplantation

• Root development of tooth to be transplanted – 2 / 3 to 3 / 4 complete.

• Sufficient space in arch and occlusally to accommodate transplanted tooth.

• Careful preparation of donor site to ensure good root to bone adaptation.

• Careful surgical technique to avoid damage to root surface of transplanted tooth.

• Transplanted teeth positioned at same level as donor site and splinted for 7–10 days.

Requirements for the placement of implant to replace missing upper incisor

• Growth rate slowed to adult levels.

• Adequate bone height.

• Adequate bone width.

• Adequate space between roots of adjacent teeth.

• Adequate space for crown between adjacent crowns and occlusally.

4. Median diastema

5. Displaced teeth

Teeth can be displaced for a variety of reasons including the following:

• Abnormal position of the tooth germ:

Canines and second premolars are the most commonly affected teeth. Management depends upon the degree of displacement. If this is mild, extraction of the associated primary tooth plus space maintenance, if indicated, may result in an improvement in position in some cases. Alternatively, exposure and the application of orthodontic traction may be used to bring the mildly displaced tooth into the arch. If the displacement is severe, extraction is usually necessary.

• Crowding:

Lack of space for a permanent tooth to erupt within the arch can lead to or contribute to displacement. Those teeth that erupt last in a segment, for example upper lateral incisors, upper canines, second premolars, and third molars, are most commonly affected. Management involves relief of crowding, followed by active tooth movement where necessary. However, if the displacement is severe it may be prudent to extract the displaced tooth.

• Retention of a deciduous predecessor:

Extraction of the retained primary tooth should be carried out as soon as possible provided that the permanent successor is not displaced.

• Habit.

• Secondary to the presence of a supernumerary tooth or teeth:

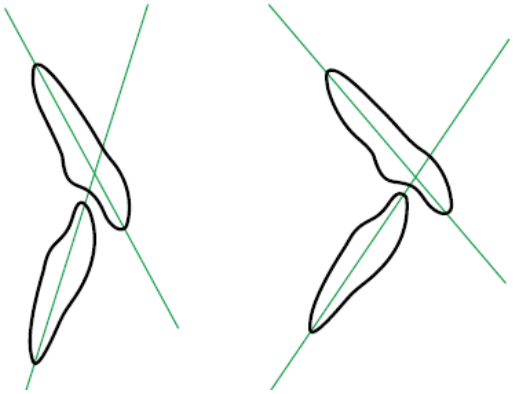
Management involves extraction of the supernumerary followed by tooth alignment, usually with fixed appliances. Displacements due to supernumeraries have a tendency to relapse and prolonged retention is required.

• **Secondary to pathology**, for example a dentigerous cyst. This is the rarest cause.

6. Bimaxillary proclination

Bimaxillary proclination is the term used to describe occlusions where both the upper and lower incisors are proclined.

Bimaxillary proclination is seen more commonly in some racial groups (for example Afro-Caribbean), and this needs to be borne in mind during assessment (including cephalometric analysis) and treatment planning.



Normal vs bimaxillary proclination

Management is difficult because the upper and lower incisors need to be retroclined to reduce the overjet. Retroclination of the lower labial segment will encroach on tongue space and therefore has a high likelihood of relapse following removal of appliances. For these reasons, treatment of bimaxillary proclination should be approached with caution and consideration should be given to accepting the incisor relationship. If the lips are incompetent, but have a good muscle tone and are likely to achieve a lip-to-lip seal when the incisors are retracted, the chances of a stable result are increased. However, the patient should still be warned that the prognosis for stability is guarded. Where bimaxillary proclination is associated with competent lips, or with grossly incompetent lips which are unlikely to retain the corrected incisor position, permanent retention is advisable.

7.Vertical discrepancies

Variations in the vertical dimension can occur in association with any anteroposterior skeletal relationship. It ranges from overbite to deepbite of dental or skeletal cause.

8. Transverse discrepancies

A transverse discrepancy between the arches results in a crossbite and can occur in association with Class I, Class II, and Class III malocclusions.

My great wishes for my lovely students for success. Thanks

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Lecture 20 5th

د.حيدر سعد حنفوش

Orthodontics

TREATMENT OF CLASS 2 DIV 1

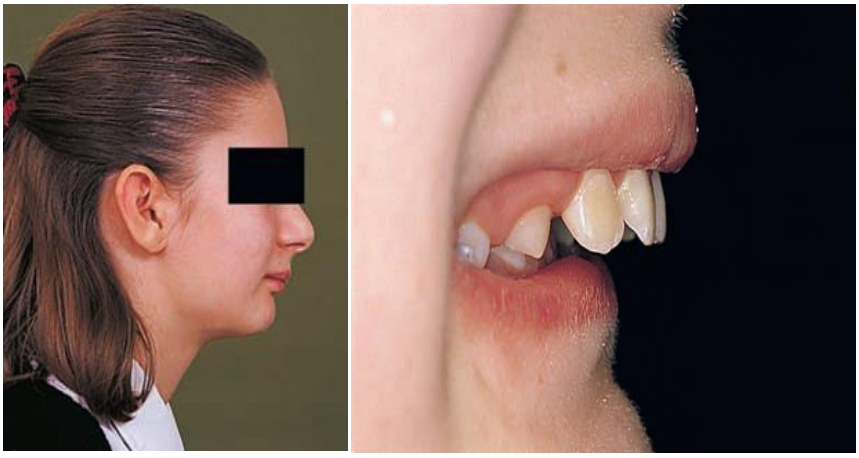
Class II division 1 incisor relationship is defined as 'the lower incisor edges lie posterior to the cingulum plateau of the upper incisors, there is an increase in overjet and the upper central incisors are usually proclined'. In a Caucasian population the incidence of Class II division 1 incisor relationship is approximately 15–20 per cent.

Aetiology

1. Skeletal causes

A Class II division 1 incisor relationship is usually associated with a Class II skeletal pattern or Class I skeletal pattern, commonly due to a retrognathic mandible However, proclination of the upper incisors and/or retroclination of the lower incisors by a habit or the soft tissues can result in an increased overjet on a Class I or even a Class III skeletal pattern.

A Class II division 1 incisor relationship is found in association with a range of vertical skeletal patterns. Management of those patients with significantly increased or significantly reduced vertical proportions is usually difficult and is the province of the specialist.



2. Soft tissue causes

The influence of the soft tissues on a Class II division 1 malocclusion is mainly mediated by the skeletal pattern, both anteroposteriorly and vertically. Nevertheless, the resting position of the patient's soft tissues and their functional activity are important.

In a Class II division 1 malocclusion the lips are typically incompetent owing to the prominence of the upper incisors and/or the underlying skeletal pattern. Where the patient can achieve lip-to-lip contact by circumoral muscle activity or the mandible is postured forwards, the influence of the soft tissues is often to moderate the effect of the underlying skeletal pattern by dento-alveolar compensation. More commonly the lower lip functions by being drawn up behind the upper incisors, which leads to retroclination of the lower labial segment and/or proclination of the upper incisors with the result that the incisor relationship is more severe than the underlying skeletal pattern.

However, if the tongue habitually comes forward to contact the lower lip, proclination of the lower incisors may occur, helping to compensate for the underlying skeletal pattern. Infrequently, a Class II division 1 incisor relationship occurs owing to retroclination of the lower incisors by a very active lower lip.

3. Dental factors

A Class II division 1 incisor relationship may occur in the presence of crowding or spacing. Where the arches are crowded, lack of space may result in the upper incisors being crowded out of the arch labially and thus to exacerbation of the overjet. Conversely, crowding of the lower labial segment may help to compensate for an increased overjet in the same manner

4. Habits

A persistent digit-sucking habit will act like an orthodontic force upon the teeth if indulged in for more than a few hours per day. The severity of the effects produced will depend upon the duration and the intensity, but the following are commonly associated with a determined habit:

- proclination of the upper incisors;
- retroclination of the lower labial segment;
- an incomplete overbite or a localized anterior open bite;
- narrowing of the upper arch thought to be mediated by the tongue taking up a lower position in the mouth and the negative pressure generated during sucking of the digit.

The first two effects will contribute to an increase in overjet. The effects of a habit will be superimposed upon the child's existing skeletal pattern and incisor relationship, and thus can lead to an increased overjet in a child with a Class I or Class III skeletal pattern, or can exacerbate a pre-existing Class II malocclusion. The effects may be asymmetric if a single finger or thumb is sucked.

Occlusal features

The overjet is increased, and the upper incisors may be proclined, perhaps as the result of the influence of the soft tissues or a habit; or upright, with the increased overjet reflecting the skeletal pattern. Anterior open bite

may result. If the lips are grossly incompetent and are habitually apart at rest, drying of the gingivae may lead to an exacerbation of any pre-existing gingivitis. The molar relationship usually reflects the skeletal pattern unless early deciduous tooth loss has resulted in mesial drift of the first permanent molars.

Assessment and treatment planning in Class II division 1 Malocclusions

Factors influencing a definitive treatment plan

Before deciding upon a definitive treatment plan the following factors should be considered:

- The patient's age
- The difficulty of treatment
- The likely stability of overjet reduction
- The patient's facial appearance
- Early treatment

Treatment for Class II division 1 malocclusions is best deferred until the late mixed/early permanent dentition where the transition from the functional to the fixed appliance can be made straightaway without having to wait for teeth to erupt; space can be gained for relief of crowding and reduction of the overjet by the extraction of permanent teeth (if indicated), and soft tissue maturity increases the likelihood of lip competence. If the upper incisors are thought to be at particular risk of trauma during the mixed dentition, treatment with a functional appliance can be considered.

When early treatment with myofunctional appliance is considered, the overall treatment time is considerably longer compared to preadolescent stage plus a period of "retention" is required between completion of the functional appliance phase and the commencement of fixed appliances which is problematic to manage.

Management of an increased overjet associated with a Class I or mild Class II skeletal pattern

Management of the more severe cases is the province of the experienced specialist. There are three possible approaches to treatment.

1. Growth modification

This can be either restraint of maxillary growth, encouraging mandibular growth, or by a combination of the two. Headgear can be used to try and restrain growth of the maxilla horizontally and/or vertically, depending upon the direction of force relative to the maxilla. Functional appliances appear to produce limited restraint of maxillary growth whilst encouraging mandibular growth. Success is dependent upon favourable growth and an enthusiastic patient.

2. Orthodontic camouflage

By using fixed appliances, bodily retraction of the upper incisors is achieved. The severity of the case that can be approached in this way is limited by the availability of cortical bone palatal to the upper incisors and by the patient's facial profile.

Malocclusions can be managed with orthodontics alone. Although growth modification with myofunctional appliances is limited, a small amount of skeletal change is appreciated and can be helpful.

In practice, the child with a moderately severe Class II skeletal pattern can often be managed by a combination of the previous approaches, provided that growth is not unfavourable. This usually involves initially functional appliance therapy carried out during the pubertal growth spurt, after which fixed appliances are used, plus extractions if indicated.

Orthodontic camouflage can also be achieved by proclination of the lower labial segment. However, this movement is inherently unstable, but it can be stable in a number of cases (where the lower incisors have been trapped lingually by an increased overbite or pushed lingually by a habit

or by a lower lip trap).

Gummy smiles associated with increased vertical skeletal proportions and/or a short upper lip will often worsen as the incisors are retracted. Therefore active steps should be taken to manage this problem. Milder cases are best managed by either the use of high pull headgear to either a functional type of appliance or removable appliances.

3. Surgical correction

In severe cases of vertical maxillary excess or where there is an excessive amount of upper incisor show in an adult patient, surgery to impact the maxilla is advisable.

In cases with a severe Class II skeletal pattern, particularly where the lower facial height is significantly increased or reduced, a combination of orthodontics and surgery may be required to produce an aesthetic and stable correction of the malocclusion. The threshold for surgery is lower in adults because of a lack of growth.

Retention

Relapse encompasses the return following treatment of the original features of the malocclusion as well as long-term growth and soft tissue changes. Unfortunately it is not possible to accurately predict those patients who will relapse and so retention must be discussed with, and planned, for every patient. To aid stability, full reduction of the overjet and the achievement of lip competence are advisable.

If the overjet is not fully reduced there is the risk that the lower lip will continue to function behind the upper incisors, with a subsequent relapse in incisor position.

My great wishes for my lovely students for success. Thanks

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Lecture 21+22 [5th] **د.حيدر سعد حنفوش**

Orthodontics

TREATMENT OF CLASS 2 DIV 2

A Class II incisor relationship is defined as being present when the lower incisor edges occlude posterior to the cingulum plateau of the upper incisors. Class II division 2 includes those malocclusions where the upper central incisors are retroclined. The overjet is usually minimal, but may be increased. The prevalence of this malocclusion in a Caucasian population is approximately 10 percent.

Aetiology

1. Skeletal pattern

Class II division 2 malocclusion is commonly associated with a mild Class II skeletal pattern, but may also occur in association with a Class I or even a Class III dental base relationship. Where the skeletal pattern is more markedly Class II the upper incisors usually lie outside the control of the lower lip, resulting in a Class II division 1 relationship, but where the lower lip line is high relative to the upper incisors a Class II division 2 malocclusion can result.

The vertical dimension is also important in the aetiology of Class II division 2 malocclusions, and typically is reduced. A reduced lower face height occurs in conjunction with a Class II jaw relationship often results in the absence of an occlusal stop to the lower incisors, which then continue to erupt leading to an increased overbite. A reduced lower facial height is associated with a forward rotational pattern of growth. This usually means that the mandible becomes more prognathic with growth. While this pattern of growth is helpful in reducing the severity of a Class

II skeletal pattern, it also has the effect of increasing overbite

2. Soft tissue causes

The influence of the soft tissues in Class II division 2 malocclusions is usually mediated by the skeletal pattern. If the lower facial height is reduced, the lower lip line will effectively be higher relative to the crown of the upper incisors (more than the normal one-third coverage). A high lower lip line will tend to retrocline the upper incisors.

In some cases, the upper lateral incisors, which have a shorter crown length, will escape the action of the lower lip and therefore lie at an average inclination, whereas the central incisors are retroclined.

Class II division 2 incisor relationships may also result from bimaxillary retroclination caused by active muscular lips, irrespective of the skeletal pattern.

3. Dental factors

Crowding is commonly seen in conjunction with a Class II division 2 incisor relationship. In addition, any pre-existing crowding is exacerbated because retroclination of the upper central incisors results in them being positioned in an arc of smaller circumference.

In the upper labial segment this usually manifests in a lack of space for the upper lateral incisors which are crowded and are typically rotated mesiolabially out of the arch. In the same manner lower arch crowding is often exacerbated by retroclination of the lower labial segment. This can occur because the lower

labial segment becomes 'trapped' lingually to the upper labial segment by an increased overbite. Lack of an effective occlusal stop to eruption of the lower incisors may result in their continued development, giving rise to an increased overbite.

This may be due to a Class II skeletal pattern or retroclination of the incisors as a result of the action of the lips, leading to an increased inter-incisal angle. In addition, it has been found that in some Class II division 2 cases, the upper central incisors exhibit a more acute crown and root angulation. However, rather than being the cause, this crown–root angulation could itself be due to the action of a high lower lip line causing deflection of the crown of the tooth relative to the root after eruption.

4. Occlusal features

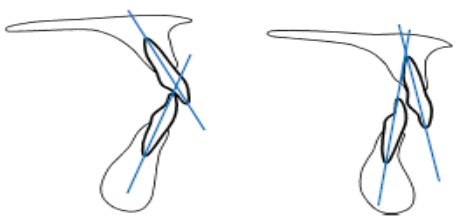
The upper central incisors are retroclined and the lateral incisors are at an average angulation or are proclined, depending upon their position relative to the lower lip. Where the lower lip line is very high, the lateral incisors may be retroclined. The more severe malocclusions occur either where the underlying skeletal pattern is more Class II or where the lip musculature is active, causing bimaxillary retroclination. In mild cases

the lower incisors occlude with the upper incisors, but in patients with a more severe Class II skeletal pattern the overbite may be complete onto the palatal mucosa. In a small proportion of cases, the lower incisors may cause ulceration of the palatal tissues and, in some patients, retroclination of the upper incisors leads to stripping of the labial gingivae of the lower incisors. In these cases, the overbite is described as traumatic, but fortunately both are comparatively rare.

Another feature associated with a more severe underlying Class II skeletal pattern is lingual crossbite of the first and occasionally the second premolars.

Management

Stable correction of a Class II division 2 incisor relationship is difficult as it requires not only reduction of the increased overbite but also reduction of the inter-incisal angle which classically is increased. If re-eruption of the incisors and, therefore, an increase in overbite is to be resisted, the inter-incisal angle needs to be reduced, preferably close to 135°, so that an effective occlusal stop is created. In addition, it has been shown that stability is increased if at the end of treatment the lower incisor edge lies 0–2 mm anterior to the mid-point of the root axis of the upper incisors.



The treatment approach chosen for a particular patient will depend upon the aetiology of the malocclusion, the presence and degree of crowding, the patient's profile, their age and their wishes.

It is advisable in the management of Class II division 2 malocclusions to minimize lingual movement of the lower incisors in order to avoid any possibility of worsening the patient's overbite; indeed, it may be preferable to accept some proclination of the lower incisors and permanent retention rather than run this risk. Certainly, extraction of permanent teeth in the lower arch in Class II division 2 malocclusions should be approached with caution.

Space closure occurs less readily in patients with reduced vertical skeletal proportions, which are commonly associated with Class II division 2 malocclusions, than in those with increased lower face heights. In view of this, it is not surprising that Class II division 2 malocclusions are managed more frequently on a non-extraction basis, particularly in the lower arch, than are other types of malocclusion.

Proclination of the lower incisors is helpful in reducing both overbite and the inter-incisal angle. In general, proclination of the lower labial segment should be considered unstable, but it has been argued that in some Class II division 2 malocclusions due to the increased overbite, the lower labial segment is trapped behind the upper labial segment, resulting in retroclination of the lower incisors and constriction of the lower intercanine width with growth.

Approaches to the reduction of overbite

Intrusion of the incisors

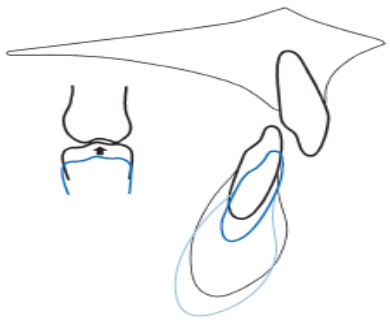
Actual intrusion of the incisors is difficult to achieve. Fixed appliances are necessary and the mechanics employed pit intrusion of the incisors against extrusion of the buccal segment teeth; as it is easier to move the molars occlusally than to intrude the incisors into bone, the former tends

to predominate. In practice, the effects achieved are relative intrusion, where the incisors are held still while vertical growth of the face occurs around them, plus extrusion of the molars.

Increasing anchorage by using temporary anchorage screws or by reinforcing the anchorage unit posteriorly by including second permanent molars (or even third molars in adults) will aid intrusion of the incisors and help to limit extrusion of the molars .

Eruption of the molars

Use of a flat anterior bite-plane on an upper removable appliance to free the occlusion of the buccal segment teeth will, if worn conscientiously, limit further occlusal movement of the incisors and allow the lower molars to erupt, thus reducing the overbite. This method requires a growing patient to accommodate the increase in vertical dimension that results, otherwise the molars will re-intrude under the forces of occlusion once the appliance is withdrawn. However, this tendency can be resisted to a degree if the treatment creates an effective occlusal stop and reduction of the inter-incisal angle.



Extrusion of the molars

As mentioned, the major effect of attempting intrusion of the incisors is often extrusion of the molars. This may be advantageous in Class II division 2 cases as this type of malocclusion is usually associated with reduced vertical proportions. Again, vertical growth is required if the overbite reduction achieved in this way is to be stable.

 Proclination of the lower incisors

Advancement of the lower labial segment anteriorly will result in a reduction of overbite as the incisors tip labially. However, in a few cases where the lower incisors have been trapped behind the upper labial segment by an increased overbite, fitting of an upper bite-plane appliance may allow the lower labial segment to procline spontaneously.

 Surgery

In adults with a markedly increased overbite and those patients where the underlying skeletal pattern is more markedly Class II, a combination of orthodontics and surgery is required.

Practical management

Where treatment is indicated there are three possible treatment modalities as described below:

1. Fixed appliances

When fixed appliances are used the inter-incisal angle can be reduced by palatal/lingual root torque or by proclination of the lower incisors.

The relative role of these two approaches in the management of a particular malocclusion is a matter of fine judgement.

Torquing of incisor apices is dependent upon the presence of sufficient cortical bone palatally/lingually and places a considerable strain on anchorage. This type of movement is also more likely to result in resorption of the root apices than other types of tooth movement.

Mild crowding in the lower arch may be eliminated by forward movement of the lower labial segment and/or interdental stripping.

If crowding is more marked, extractions will be required and a lower fixed appliance used to ensure that space closure occurs without movement of the lower incisor edges lingually. For this reason lower second premolars are often extracted rather than first premolars.

Space for correction of the incisor relationship and for relief of crowding, if indicated, can be gained by upper arch extractions or by distal movement of the upper buccal segments. If headgear is used for anchorage or distal movement, a direction of pull below the occlusal plane (cervical pull) is usually indicated in Class II division 2 malocclusions as the vertical facial proportions are reduced.

Following treatment, the prognosis for the corrected position is good as cuspal interlock will help to prevent relapse.

The retention phase is particularly important in Class II division 2 malocclusions, with regard to the following:

• To prevent an increase in overbite.

• To retain any de-rotated teeth, for example, the upper lateral incisors.

• To maintain alignment of the lower labial segment, particularly if it has been proclined during treatment.

2. Functional appliances

Functional appliances can be utilized in the correction of Class II division 2 malocclusions in growing patients with a mild to moderate Class II skeletal pattern.

Reduction of the inter-incisal angle is achieved mainly by proclination of the upper incisors, although some proclination of the lower labial segment may occur as a result of the functional appliance. If the upper incisors are retroclined it may be helpful to have a pre-functional phase to procline them and, if indicated to ensure the correct buccolingual arch relationship at the end of treatment, to expand the upper arch.

Alternatively a sectional-fixed appliance can be placed on the upper labial segment teeth to achieve their alignment during the functional phase After anteroposterior correction with the functional appliance, fixed appliances are required to detail the occlusion.

3. Surgery

A stable aesthetic orthodontic correction may not be possible in patients with an unfavourable skeletal pattern anteroposteriorly and/or vertically, particularly if growth is complete. In these cases, surgery may be necessary.

A phase of presurgical orthodontics is required to align the teeth. However, arch levelling is usually not completed as extrusion of the molars is much more easily accomplished after surgery.

TREATMENT OF CLASS 3

Class III incisor relationship includes those malocclusions where the lower incisor edge occludes anterior to the cingulum plateau of the upper incisors. Class III malocclusions affect around 3 percent of Caucasians.

Aetiology

1. Skeletal causes

The skeletal relationship is the most important factor in the aetiology of most Class III malocclusions, and the majority of Class III incisor relationships are associated with an underlying Class III skeletal relationship.

Class III malocclusions exhibit the following:

• Increased mandibular length;

 A more anteriorly placed glenoid fossa so that the condylar head is Positioned more anteriorly leading to mandibular prognathism;

• Reduced maxillary length;

• A more retruded position of the maxilla leading to maxillary retrusion.

The first two of these factors are the most influential.

Class III malocclusions occur in association with a range of vertical skeletal proportions, ranging from increased to reduced. Class III skeletal patterns may exhibit less maxillary growth and more mandibular growth than Class I skeletal patterns.

2. Soft tissue causes

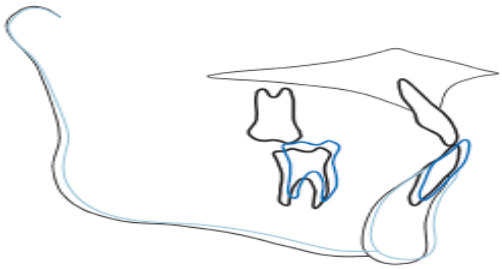
In the majority of Class III malocclusions, the soft tissues do not play a major aetiological role. In fact, the reverse is often the case, with the soft tissues tending to tilt the upper and lower incisors towards each other so that the incisor relationship is often less severe than the underlying skeletal pattern due to the dento-alveolar compensation. However, in patients with increased vertical skeletal proportions where the lips are more likely to be incompetent, an anterior oral seal is often accomplished by tongue to lower lip contact.

3. Dental factors

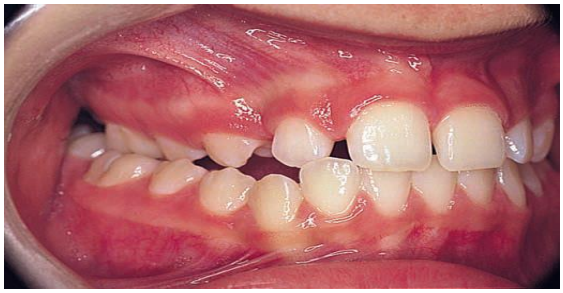
Class III malocclusions are often associated with a narrow upper arch and a broad lower arch, with the result that crowding is seen more commonly, and to a greater degree, in the upper arch than in the lower. Frequently, the lower arch is well aligned or even spaced.

Occlusal features

An anterior crossbite of one or more of the incisors is a common feature of Class III malocclusions. This may be associated with displacement of the mandible on closure from a premature contact into maximal interdigitation. If such a displacement is present, the prognosis for correction of the incisor relationship is more favourable.



Another common feature of Class III malocclusions is buccal crossbite, which is usually due to a discrepancy in the relative width of the arches. This occurs because the lower arch is positioned relatively more anteriorly in Class III malocclusions and is often well developed, while the upper arch is narrow. This is also reflected in the relative crowding within the arches with the upper arch commonly more crowded.



Moreover, Class III malocclusions often exhibit dentoalveolar compensation with the upper incisors proclined and the lower incisors retroclined, which reduces the severity of the incisor relationship.

Treatment planning in Class III malocclusions

A number of factors should be considered before planning treatment.

• Patient's concerns and motivation towards treatment

• Severity of skeletal pattern

• Amount and direction of any future growth

• Can patient achieve edge-to-edge incisor contact

• Overbite

• Amount of dento-alveolar compensation present

• Degree of crowding

Treatment options

1. Accepting the incisor relationship

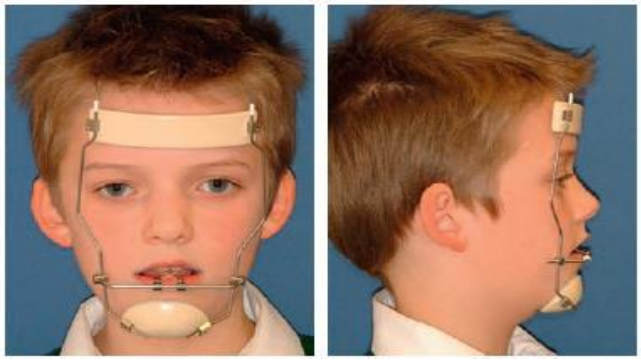
In mild Class III malocclusions, particularly those cases where the overbite is minimal, it may be preferable to accept the incisor relationship and direct treatment towards achieving arch alignment. Also some patients with more severe Class III incisor relationships are unwilling to undergo comprehensive treatment involving orthognathic surgery which would be required to correct their incisor relationship.

2. Early orthopaedic treatment

Orthopaedic correction of Class III malocclusions aims to enhance or encourage maxillary growth and/or restrain or re-direct mandibular growth. Orthopaedic correction treatment is more likely to be successful if it is carried out prior to the pubertal growth spurt.

The following are some of the early orthopaedic treatment modalities:

 Protraction face-mask used to advance the maxilla. Co-operative patient is necessary to achieve the 14 hours per day wear required.



 Bone anchored maxillary protraction (known as BAMP). Screws or mini-plates are used in the posterior maxilla and anterior mandible for Class III elastics.

 A combination of these two techniques – elastics are run between skeletal anchorage in the maxilla and a face mask.

 Chin-cup – this has the effect of rotating the mandible downwards and backwards with a reduction of overbite.

3. Orthodontic camouflage

Correction of an anterior crossbite in a Class I or mild Class III skeletal pattern can be undertaken in the mixed dentition when the unerupted permanent canines are high above the roots of the upper lateral incisors. Extraction of the lower deciduous canines at the same time may allow the lower labial segment to move lingually slightly. Indeed, early correction of a Class III incisor relationship has the advantage that further forward mandibular growth may be counter-balanced by dento-alveolar compensation. Furthermore, orthodontic correction of a Class III incisor relationship can be achieved by proclination of the upper incisors, retroclination of the lower incisors or a combination of both. Proclination of the upper incisors reduces the overbite, whereas retroclination of the lower incisors helps to increase overbite. Space for relief of crowding in the upper arch can often be gained by expansion of the arch anteriorly to correct the incisor relationship and/or buccolingually to correct buccal segment crossbites. However, expansion of the upper arch to correct a crossbite will have the effect of reducing overbite, which is a disadvantage in Class III cases.

Intermaxillary Class III elastic traction from the lower labial segment to the upper molars can also be used to help move the upper arch forwards and the lower arch backwards, but care is required to avoid extrusion of the molars which will reduce overbite.

Headgear to the mandibular dentition may be used in conjunction with conventional fixed appliance treatment.

4. Surgery

In a proportion of cases, the severity of the skeletal pattern and/or the presence of a reduced overbite or an anterior open bite preclude orthodontics alone, and surgery is necessary to correct the underlying skeletal discrepancy.

Because the actual surgery needs to be delayed until the growth rate has diminished to adult levels, planning and commencement of a combined orthodontic and orthognathic approach is best delayed until an age of 15 years in girls and 16 years in boys. This has the advantage that the patient is of an age when they can make up their own mind as to whether they wish to proceed with a combined approach.

My great wishes for my lovely students for success. Thanks

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Lecture 23 [5th] **د.حيدر سعد حنفوش**

Orthodontics

ORTHOGNATHIC SURGERY

Orthognathic surgery or surgical orthodontics is the surgical correction of skeletal anomalies or malformations involving the mandible or the maxilla. orthognathic surgery is performed in conjunction with orthodontics so that the teeth are in proper position after surgery.

Objectives of orthognathic surgery

- Correction of maxillofacial aesthetic
- Correction of dental aesthetic
- Achieve good functional occlusion
- Stability after treatment

Indications of Orthognathic surgery

Orthognathic surgery is indicated for patients whose orthodontic problems are so severe that neither growth modification nor camouflage offers a solution, and surgery to realign the jaws or reposition the dentoalveolar segments is the only possible treatment. Surgery alone is not a substitute solution for those patients; instead, it must be properly coordinated with orthodontics and other dental disciplines to achieve good overall results.

Dramatic progress in recent years has made it possible for combined treatment to correct many severe problems that simply were untreatable only a few years ago.

Maxillary anomalies require orthognathic surgery

1. Maxillary base may be anteriorly placed (Prognathic) or being large in all dimensions. Maxillary excess may cause either protrusion of the upper

jaw or elongation of the face with downward displacement of the mandible. In vertical maxillary excess, the disfigurement causes a "long-face syndrome" with accompanying distortion of facial features.

2. Maxillary Retrognathism occurs when maxillary base being posteriorly placed or too small in all dimensions. In the latter condition, also called maxillary hypoplasia, the growth of the maxilla does not match that of the lower jaw. In this condition there is a collapse of the normal mid-face supporting structures. In addition to causing difficulties with eating and speech, this deficiency may be associated with anomalies of the supporting structures of the nose and cheeks. Partial obstruction of the nasal passages may be present. Hence, reconstruction of the nasal and malar tissues may be intimately related to the treatment for maxillary deficiency.

3. Maxillary asymmetry may occur when the maxillary base positioned laterally or when there is asymmetric length and width of the maxilla as in hemifacial microsomia.

Mandibular base anomalies

1. Mandibular prognathism could either be that the mandible is too large in all dimensions or the base of the body is positioned anteriorly. Excess mandibular bone causes protrusion of the lower jaw beyond the normal alignment with the upper jaw; with a resultant Class III malocclusion. This can prevent effective biting and chewing of food and predispose to periodontal disease. Temporomandibular joint function and speech may be impaired. In addition there may be chin hyperplasia or malposition which will require correction.

2. Mandibular Retrognathism could be as a result of the mandible being too small in all dimensions or the base of the body being positioned posteriorly Sleep may be impaired due to a retruded or deficient lower jaw. A deficiency of bone supporting the chin is recognised.

3. Mandibular asymmetry. The two halves of the base of the mandible have unequal dimensions. This may be seen in patients with hemimandibular hyperplasia, hemimandibular hypertrophy. Both halves of the base of the mandible may have equal dimensions but may be shifted to one.

Abnormalities of the chin

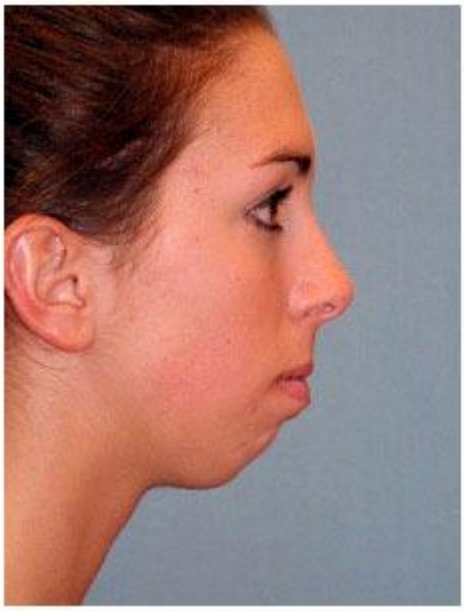
The chin should be evaluated separately from the mandible. The chin prominence includes both bone and soft tissue that may require separate surgical management.

Macrogenia

The chin is too large in all dimensions. An anteriorly placed normal sized chin prominence (antegenia) will also give a macrogenic appearance.

Microgenia

The chin is small in all dimensions. A normal sized chin, placed posteriorly (retrogenia) should be distinguished from microgenia.



Abnormalities of the alveolar processes

The alveolar process abnormalities should be assessed independent of the anomalies of the bases of the mandible and maxilla. The alveolar processes may be abnormal either in size, i.e. macro/micro or in position, i.e. retro/ ante. In addition they may be either too high or too low.

Other abnormalities which require surgical correction include long face and short face syndromes and open bite (apertognathism) cases.

Planning procedure in surgical orthodontics

Clinical examination

This should include a general medical examination to rule out any systemic disorders e.g., acromegaly. Local oral examination should include overall dental health. Any pulpal or periodontal infections should

be eradicated before surgery. The TMJ is assessed for any preexisting pathology, e.g. clicking, locking, tenderness, deviation, etc. Rule out any hormal imbalance especially pituitary hormones.

Socio-psychological evaluation

Assessment of the patient's awareness of his/her dentofacial deformity and *expectation* from treatment should be done. This helps in determining the patient's motivation towards surgery. The patient's social status should also be evaluated.

Radiological examination

A complete dental radiographic survey can be done with an orthopantomogram (OPG) to rule out a periapical or periodontal pathological condition. The X-ray will also aid in the determination of the stability of teeth in the supporting tissue and their ability to withstand the stresses of fixation devices and immobilization. Any impacted/embedded or ectopic teeth, which may come in the line of the osteotomy cut, should be preferably extracted 6 months prior to surgery. The position of the inferior dental canal and the anteroposterior width of the ramus is assessed when mandibular ramus osteotomy is planned. The flare of the rami is assessed on a submentovertex view when intraoral approach for ramus osteotomy is planned.

Photographs

Preoperative photographs are necessary in order to have a record of the pretreatment profile. Morphometric measurements can also be done on these photographs. Frontal and lateral photographs are usually taken in a natural head positions.

Cephalometric evaluation

This is essential for preoperative evaluation of all patients regardless of the type of deformity. Lateral cephalogram and/or anteroposterior cephalogram (in asymmetry cases) is most helpful in determining

precisely the location of the deformity and in selecting the proper operative sites for surgical correction. Soft tissue outline on the cephalogram aids the treatment planning. A combination of commonly used landmarks and measurements determine the degree and location of dentoskeletal deformity. Different analyses were proposed to assess those cases.

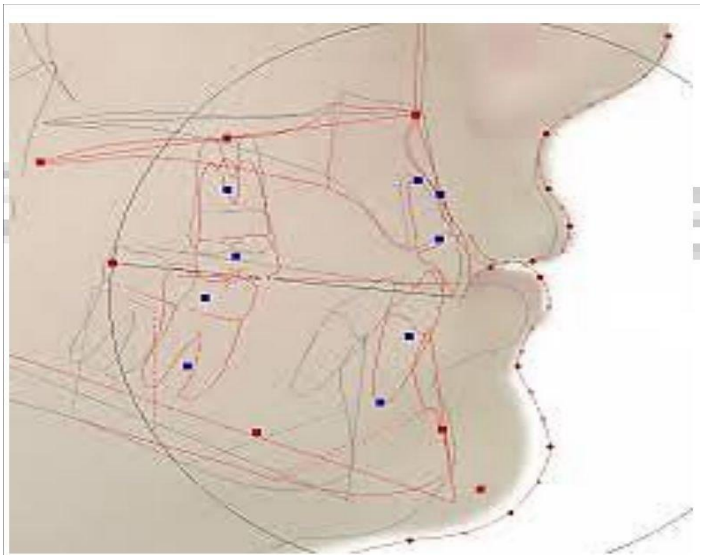
Study models

Two sets of dental stone models are constructed from the patient's impressions. Bite registration is useful while mounting the models on an articulator. One set of study models are evaluated for intra-arch, inter-arch discrepancies and for occlusion. The study models are invaluable aids when assessing the feasibility of surgical correction as they provide a permanent three dimensional record of the dental and underlying skeletal structures. They also present the various permutations of movement area involved that will need to be explored to correct the presenting facial and jaw disharmony. A second articulated set is used as working models on which mock surgery is performed.

Prediction tracing

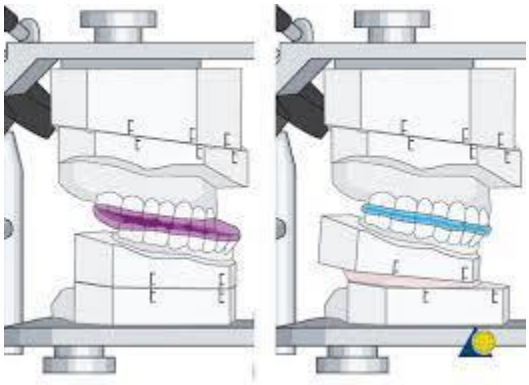
The postoperative profile of the patient can be predicted with some degree of accuracy by cephalometric means. This is called "prediction tracing".

Essentially, after knowing the location and severity of deformity, the osteotomy and the extent of movement of the osteotomized segment is determined. On anacetate tracing of the cephalogram, the osteotomized segment is cut out and moved as calculated. The soft tissue follow the movement of bone in a ratio determined by the type of movement and the technique performed. However, these soft tissue changes are only meant to be a guide for prediction tracings and are variable. These tissue changes are marked on the tracing to give the postoperative profile.



Model surgery

Using prediction tracings, a surgical plan is decided and then the surgery is simulated on articulated working models. The models are cut and repositioned in the desirable position and the segments secured in their new position with sticky wax. The occlusion achieved is evaluated for stability and any modifications required noted. Splints are then constructed which are of immense help during surgery.



Surgical procedures

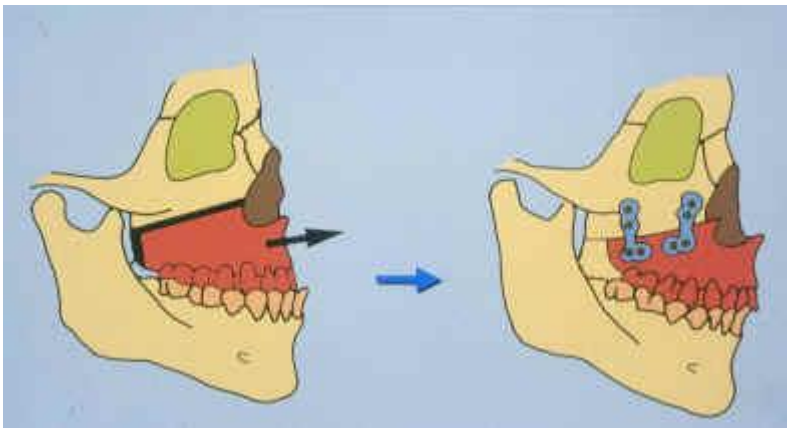
1. Anteroposterior correction

Maxillary Surgery

Advancement LeFort I downfracture and advancement is the preferred technique for maxillary retrognathism. The length of the vascular pedicle and soft tissue compliance limits the extent of anterior movement.

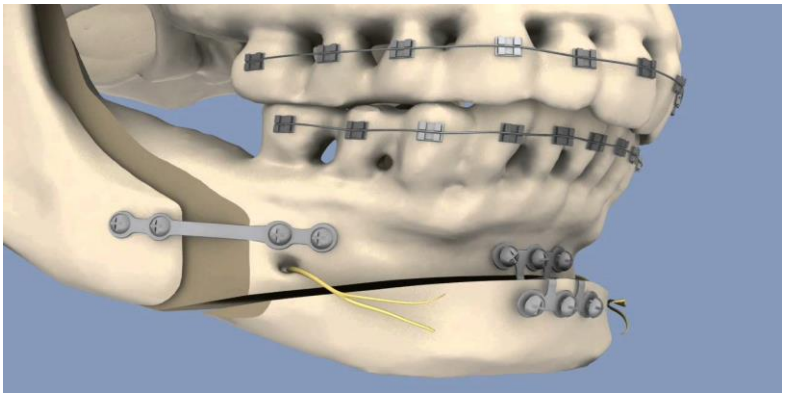
Retraction of a LeFort I segment is difficult because of the presence of

the pterygomandibular plates and tuberosity. Therefore, anterior segmental osteotomy (Wassmund, Wunderer procedure or Cupar's technique) after extraction of a premolar on either side is most commonly performed in maxillary prognathism cases.



Mandibular Surgery

Advancement Bilateral Sagittal Split Osteotomy (BSSO) is currently the most preferred technique since it can be performed easily intraorally.



Inverted L-osteotomy and C-osteotomy are also procedures performed in the ramus for advancement of the mandible. The former can be performed intraorally whereas the C-osteotomy is done extraorally. Anterior segmental subapical osteotomy can be performed if the alveolar segment needs to be advanced without moving the chin-point.

Setback BSSO or oblique ramus osteotomy are usually performed for this backward movement of the mandible. If closure of bilateral edentulous spaces or narrowing of the arch is required, then a body *ostectomy* is

performed where a segment of full-thickness bone is removed.

Anterior segmental subapical osteotomy and posterior movement of the dentoalveolar segment can be performed in case of mandibular excess with chin deficiency.

2. Vertical correction

Maxillary Surgery

Both superior positioning (for long face correction) and inferior positioning (for short face correction) can be performed by LeFort I down-fracture technique. Inferior movements, however, is less stable and usually require insertion of bone graft or hydroxyapatite blocks between the segments in order to increase stability.

Mandibular Surgery

Shortening of vertically excessive mandible should be done by inferior border osteotomy and chin augmentation horizontally. Elongation of the lower facial height can be done with BSSO, which rotates the mandible down and forward.

3. Skeletal openbite correction (apertognathia)

Skeletal openbite is a difficult problem to treat. It is commonly occurs in long face individuals who have vertical maxillary excess and deficient mandible with short ramus height. Lower anterior teeth may be overerupted.

LeFort I down fracture and superior repositioning of the maxilla especially posteriorly best treat those patients (posterior impaction of the maxilla). The mandible will autorotate upward and forward, which brings the chin anteriorly. If further anterior placement of the chin is desired, an augmentation genioplasty is performed.

4. Genioplasty

The chin can be moved in all three planes after osteotomy or may be augmented by an onlay autograft or allograft. Genioplasty is done to

improve the results of mandibular advancement or to correct asymmetry.

5. Distraction Osteogenesis

Distraction osteogenesis is based on manipulation of a healing bone, stretching an osteotomized area before calcification has occurred in order to generate the formation of additional bone and investing soft tissue. For correction of facial deformities, this has two significant advantages and one equally significant disadvantage.

The advantages of the distraction are:

(1) large distances of movement are possible than with conventional orthognathic surgery.

(2) Deficient jaws can be increased in size at an earlier age.

The great disadvantage is that precise movements are not possible. With distraction, the mandible or maxilla can be moved forward, but there is no way to position the jaw or teeth in exactly a preplanned place, as can be done routinely with orthognathic procedures. This means that patients with *craniofacial syndromes* who are likely needed intervention at early ages and large distances of movement and for *whom precision in establishing* the posttreatment jaw relationship is not so critical are the prime candidates for distraction of the jaws.

Adjunctive surgical procedures

Rhinoplasty

The smile is framed by the chin below and the nose above. It may be necessary to change both structures to achieve optimal changes in facial appearance. Moving the maxilla up and/or forward can result in an unwanted rotation of the nasal tip upward.

Rhinoplasty usually is focused on the contour of the nasal dorsum, the shape of the nasal tip and the width of the alar base

Lip Procedures

Instead of changing soft tissue contours indirectly with skeletal surgery,

lip procedures directly augment or reduce the lips. Lip augmentation rarely accompanies orthognathic procedures. This is usually done to counteract the loss of lip fullness that accompanies aging.

The role of orthodontics in Orthognathic surgery

Presurgical orthodontics

The objective of presurgical treatment is to prepare the patient for surgery, placing the teeth relative to their own supporting bone without concern for the dental occlusion at that stage.

The amount of presurgical orthodontics can be quite variable, ranging from only appliance placement in a few months to 12 months.

The essential steps in presurgical orthodontics are to align the arches or arch segments and make them compatible, and to establish the anteroposterior and vertical position of the incisors. Both are necessary so that the teeth will not interfere with placing the jaws in the desired position.

The presurgical orthodontics involves:

1. Alignment of the dentition
2. Flattening of the curve of spee

When an accentuated curve of Spee is present in the lower arch, the decision to level by intrusion of incisors or extrusion of premolars must be based on the desired final face height.

3. Establishment of Incisor Position and Space Closure

The anteroposterior position of the incisors determines where the mandible will be placed relative to the maxilla at surgery, and therefore, is a critical element in planning treatment. This is often the major consideration in planning the closure of extraction sites.

4. Good arch coordination

The upper and lower arches should be coordinated so that the intermolar and intercanine distances of the upper jaw are larger than that of the

lower jaw.

Postsurgical orthodontics

Once a satisfactory range of motion is achieved and the surgeon is satisfied with the initial healing, the finishing stage of orthodontics can be started. With rigid fixation, this is at 2 to 4 weeks postsurgery. During the postsurgical orthodontic treatment, intermaxillary elastic and rigid wires should be used until a solid occlusion is established. Correction of dental rotation, lateral openbite and space closure is the main objectives in this period.

My great wishes for my lovely students for success. Thanks

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Lecture 24+25 [5th] **د.حيدر سعد حنفوش**

Orthodontics

Cleft lip and palate

Clefts involving the lip and/or palate (CLP) or isolated clefts of the palate (CP) are the most common congenital anomaly to affect the craniofacial region in man, comprising about 65% of all anomalies affecting the head and neck. They represent a complex phenotype and reflect a failure of the normal mechanisms involved during early embryological development of the face. In human populations, CLP and CP can be broadly subdivided into:

• Nonsyndromic, which occur in isolation; and

• Syndromic, which occur in combination with other physical and developmental anomalies.

Clefts of the lip and palate

The prevalence of cleft lip and palate varies geographically and between different racial groups. Among Caucasians, this anomaly occurs in approximately 1 in every 700 live births and the prevalence is increasing. A family history can be found in around 40% of cases of cleft lip with or without cleft palate, and the risk of unaffected parents having another child with this anomaly is 1 in 25 (Box 1). Males are affected more frequently than females, and the left side is involved more commonly than the right. Interestingly, the severity of the cleft is usually more marked when it arises in the less common variant.

Box 1: Genetic risks of cleft lip and palate

- Parents with no cleft but with one affected child: risk for next child = 1 in 25 (4%).
- One parent with cleft lip and palate: risk for first child = 1 in 50 (2%).
- One parent with cleft lip and palate and first child with cleft lip and palate: risk for next child = 1 in 10 (10%).
- Both parents affected: risk for first child = 3 in 5 (60%).

Isolated cleft of the secondary palate

Isolated cleft occurs in around 1 in 2000 live births and affects females more often than males. Clefts of the secondary palate have a lesser genetic component, with a family history in around 20% and a reduced risk of further affected offspring to normal parents (1 in 80). Isolated cleft palate is also found as a feature in a number of syndromes including Down, Treacher–Collins, Pierre–Robin, and Klippel–Fiel syndromes.

Aetiology

In normal development, fusion of the embryological processes that comprise the upper lip occurs around the sixth week of intrauterine life. 'Flip-up' of the palatal shelves from a vertical to a horizontal position followed by fusion to form the secondary palate occurs around the eighth week. Before fusion can take place, the embryological processes must grow until they come into contact. Then breakdown of the overlying epithelium is followed by invasion of mesenchyme. If this process is to take place successfully, a number of different factors need to interact at the right time. Evidence from population studies and experimental data suggests that both genetic and environmental factors play a part in the aetiology of clefts. Specific gene mutations have been shown to be linked to cleft lip and/or cleft palate. Environmental factors that have been implicated include anticonvulsant drugs, folic acid deficiency, and maternal smoking.

It is postulated that isolated cleft palate is more common in females than males because transposition of the palatal shelves occurs later in the female fetus. Thus, greater opportunity exists for an environmental insult to affect successful elevation, which is further hampered by widening of the face as a result of growth in the intervening period.

At the embryological level, perturbations in a variety of mechanisms during facial development are known to cause clefting (Figure 1).

A number of possible causes of cleft lip and palate have been identified, including exposure to some teratogens. Insults to developing tissues usually precede the steps that culminate with closure of the lip and palate, and it is interesting that maternal smoking is a definite risk factor.

In addition to "typical" cleft lip and cleft palate, unusual facial clefts occur that also result from the failure of facial prominences to properly form or unite. Examples include macrostomia, a defect at the junction of the maxillary and mandibular prominences that may result from a growth deficiency in either or both of these growth centers, and oblique

facial clefts that occur at the junction of the maxillary growth center with either the lateral nasal or maxillary growth center.

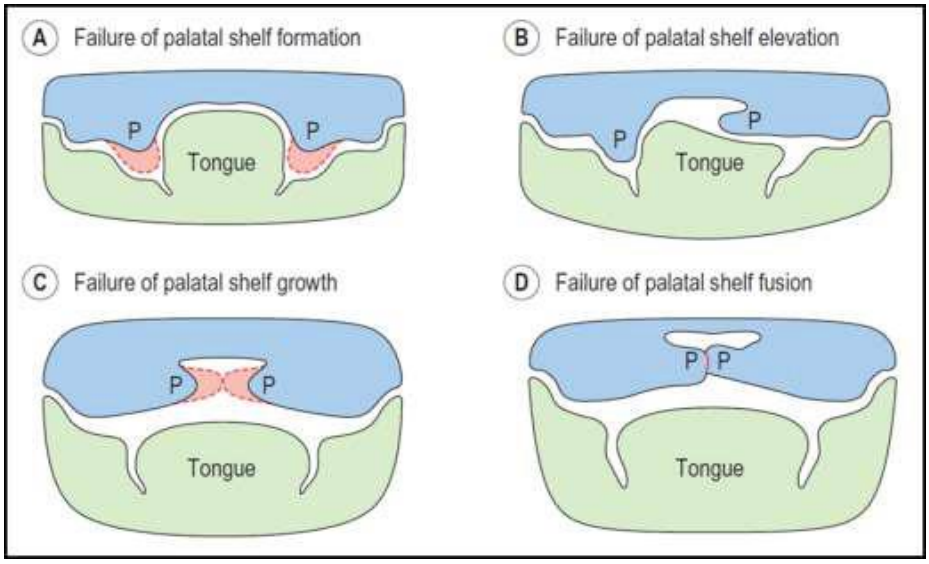

Figure 1: Embryonic causes of cleft palate.

Classification

A number of formal classifications have been described for CLP and CP; however, the clinical presentation of these conditions is so variable that a specific description of each individual case is more useful (Figure 2).

• CLP can range from simple notching or isolated clefting of the upper lip with or without involvement of the alveolus, to complete unilateral or bilateral clefts of the lip, alveolus and hard/soft palate; and

• CP can range from a simple submucous cleft (a lack of continuity of the muscles across the palate) or bifid uvula to a complete cleft involving the primary and secondary palate.

Figure 2: Orofacial clefting. Unilateral cleft lip (top row), unilateral cleft lip and palate (second row), bilateral cleft lip and palate (third row), isolated cleft palate (bottom row).

Treatment

A child born with orofacial clefting will require complex long-term treatment, depending upon the severity of the cleft, and there may be life-long implications for some of those patients. The principal objectives of treatment are to establish:

• Good facial appearance;

• Good orofacial function during speech, eating and swallowing;

• An aesthetic, functional and stable occlusion; and

• Good hearing.

If these objectives are achieved, they maximize the chances of an affected child growing up and developing normally within their social environment. The clinical management of children born with clefting is most effective when carried out by a fully integrated team, in a centralized unit that treats a high number of patients. The modern cleft team therefore includes a number of key members, in addition to other specialists who may be involved with long-term care including: Cleft surgeon, Orthodontist, Speech therapist, Cleft nurse, Ear–nose–throat surgeon, Paediatrician, Paediatric dentist, Restorative dentist, Psychologist, Paedodontist, Audiologist, Geneticist, General dental practitioner and Nutritionist. Orthodontic intervention will usually be required at several time points during the first two decades of an affected child's life, often to facilitate the intervention of other specialities.

Problems in management

Congenital anomalies:

The disturbances in dental and skeletal development caused by the clefting process itself depend upon the site and severity of the cleft.

Lip only:

There is little effect in this type, although notching of the alveolus adjacent to the cleft lip may sometimes be seen.

Lip and alveolus:

A unilateral cleft of the lip and alveolus is not usually associated with segmental displacement. However, in bilateral cases the premaxilla may be rotated forwards. The lateral incisor on the side of the cleft may exhibit some of the following dental anomalies:

• Congenital absence

• An abnormality of tooth size and/or shape

• Defects of the enamel

• Or present as two conical teeth, one on each side of the cleft.

Lip and palate:

In unilateral clefts, rotation and collapse of both segments inwards anteriorly is usually seen, although this is usually more marked on the side of the cleft (the lesser segment).

In bilateral clefts, both lateral segments are often collapsed behind a prominent premaxilla (Fig. 3).

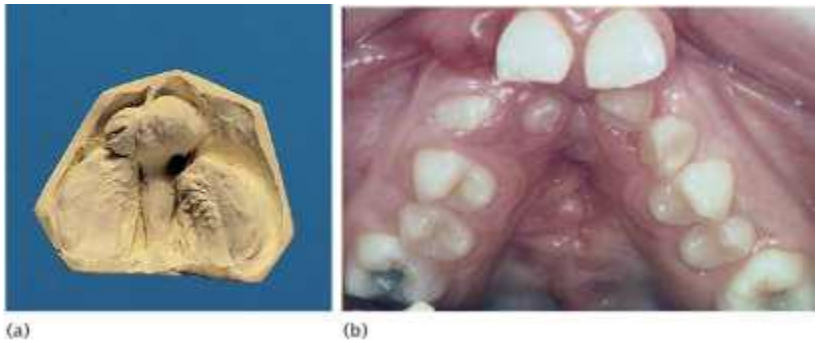

Figure 3: (a) Upper model of a bilateral complete cleft lip and palate showing the inward collapse of the lateral segments behind the pre-maxillary segment; (b) upper arch of a patient in the late mixed dentition with a bilateral complete cleft lip and palate.

Palate only:

A widening of the arch posteriorly is usually seen. It has been shown that individuals with a cleft have a more concave profile, and while a degree of this is due to a restriction of maxillary growth, research indicates that cleft patients have a tendency towards a more retrognathic maxilla and

mandible and also a reduced upper face height compared with the normal population.

Treatment of Cleft lip and palate

At Birth

Giving birth to a child affected by a cleft can be a distressing experience for the parents, particularly if this condition has not been diagnosed in utero. A multitude of emotions can occur, including shock, anger, guilt, grief and even rejection. It is important that adequate support is given to the parents and that a bond is quickly established between the parents and child.

• The clinical nurse specialist from the regional cleft team provides initial support, help and advice as soon as possible after diagnosis; and

• Patient support groups such as the Cleft Lip and Palate Association (CLAPA) also play an important role in providing continued help and advice.

A baby born with CLP may experience difficulty in feeding at birth. CP produces an open communication between the oral and nasal cavities. Suckling can be slow because the baby will have difficulty generating adequate intraoral pressure and milk can be lost through the nose before it is swallowed. It is important to establish an effective feeding regime as soon as possible:

• Feeding is generally successful using an assisted feeding bottle (Fig. 1) with a standard orthodontic teat, which can be squeezed to generate the necessary pressure; and

• Breastfeeding is occasionally possible, but may need supplementary feeding from a bottle.

Figure 1: Special feeding bottles for CLP.

Presurgical orthopaedics

A period of active presurgical orthopaedic alignment of the cleft alveolar segments is occasionally carried out in the neonate to reduce the size of the cleft defect and facilitate surgical repair. Specialized facial strapping or orthodontic plates (Fig. 2) are used, which can be passive or active and help mould or reposition the divided facial and maxillary segments. In particular, these plates have been used for:

• Reducing protrusion of the premaxillary segment in bilateral CLP cases;

• Reducing the size of an alveolar cleft and approximating the lip margins in unilateral CLP; and

• Reducing the width of an isolated palatal cleft.

Presurgical orthopaedic treatment is usually carried out at the discretion of the operating surgeon. There is currently little substantive evidence to suggest that any of these techniques provide long-term benefit for the dental arch relationship or facial appearance and their use remains controversial.

Figure 2: Orthopaedic cleft appliance to approximate the lip segments prior to repair (left panel) and intraoral orthopaedic appliance to approximate the palatal shelves (right panel).

Surgical repair of cleft lip and palate

A number of individual surgical techniques for repairing the embryonic deficits associated with both the lip and palate have been described. However, evaluating which technique, sequence or timing will provide optimum results is difficult and currently no true consensus for any of these criteria exists. Early surgery does allow the child to establish good

orofacial function as soon as possible and this is particularly important for the development of normal speech. However, surgical repair can be associated with scarring in the maxillary region, which can produce growth deficiencies in all three planes of space:

• Midline scar tissue can prevent transverse growth and produce crossbites; and

• Scar tissue within the tuberosity region can tether the maxilla to the sphenoid bone, preventing downward and forwards growth and producing a class III skeletal pattern.

It is clear from comparative studies that facial growth is compromised in operated cleft subjects when compared with those from unoperated samples, particularly those that have undergone palatal repair. The goal of surgical correction is to minimize any potential growth discrepancy, whilst maximizing the aesthetic and functional outcome.

Lip repair

Surgical repair of cleft lip is usually carried out between 3 and 6 months of age as a single procedure, the exact age being dictated by surgeon preference. Classically, the rule of ‘tens’ has been used, with surgery only taking place once the child is at least 10 weeks old, 10 pounds in weight, and having a haemoglobin level of 10%. However, waiting until these criteria are achieved can delay surgery and it has been argued that this can cause problems with both parent–infant bonding and early growth and development. Indeed, advances in neonatal care and paediatric anaesthesia have made it possible to perform cleft surgery during the neonatal period, although there is currently no clear evidence to suggest that this is particularly advantageous.

Palate repair (palatoplasty)

The timing of palate repair represents a balance between maximizing the positive effects of early palate closure on feeding and speech

development, whilst minimizing the potentially negative effects of inhibited maxillary growth and development as a result of surgical scarring. Currently, repair of CP is normally undertaken between 9 and 12 months of age and usually involves a palatoplasty to move tissue towards the midline, with or without some lengthening of the palate to improve the posterior soft palate seal.

Speech and language

Following repair of the palate, a speech and language therapist monitors speech development closely. Velopharyngeal insufficiency is the result of an inadequately functioning soft palate, which may be unable to lift and produce a good seal with the posterior pharyngeal wall. Velopharyngeal insufficiency can produce:

• Nasal escape on pressure consonants (i.e. k, p, t); and

• Hypernasality.

The main problem is a lack of mobility in the soft palate, secondary to scarring from the palate repair. In combination with the dental abnormalities, malocclusion and hearing difficulties, which are all often seen in cleft children, velopharyngeal insufficiency can also produce poor articulation, which results in significant difficulties with speech. Surgery is usually carried out as soon as velopharyngeal insufficiency is diagnosed, around the age of 4 before the child begins school, and generally involves either a re-repair of the soft palate or pharyngoplasty. Pharyngoplasty aims to reduce hypernasality by narrowing the velopharyngeal space.

Middle ear disease

Otitis media is also a common finding in children with CP, disruption to the muscles of the soft palate affecting function of the Eustachian tube. This can reduce the acuity of their hearing, causing further potential adverse effects on the development of speech and language. It is

important that an audiologist monitors these children and, if necessary, tympanostomy tubes (or grommets) are placed by an ENT surgeon.

Dental care in the primary dentition

A program of preventive dentistry should be established during early dental development, particularly as many children affected by clefting are vulnerable to caries. Dietary advice should be provided, good oral hygiene established and fluoride supplementation instituted, if necessary. It is vitally important that the dentition of a cleft child is not compromised by dental disease and the cleft team will liaise closely with the general dental practitioner to ensure that this is the case.

There is occasionally delay in the eruption of primary teeth adjacent to the cleft and the lateral incisor can be absent, hypoplastic or even duplicated. Crossbites can occur in the buccal segments; however, active orthodontic treatment is rarely indicated in the primary dentition.

Dental care during the mixed dentition

As the permanent teeth begin to erupt, crossbites affecting both the incisor and molar dentitions can occur and their severity often reflects the degree of disruption that has occurred to maxillary growth and development as a result of previous surgery. The maxillary incisors can also be crowded, rotated and tilted, particularly those adjacent to the cleft, and significant centreline discrepancies are common. In addition, anomalies of dental development affecting teeth around the site of a cleft alveolus can also be seen.

These include the presence of supernumerary teeth or agenesis of the permanent lateral incisor; anomalies of shape and size, or enamel defects.

Dental preventive measures should continue during the mixed dentition; in particular, the first molars should be fissure sealed and monitored to ensure these teeth do not become carious.

Alveolar bone grafting

The presence of a residual bony defect in the maxillary alveolus of children affected by complete clefts is a deformity associated with a number of functional and aesthetic problems, which can affect both the occlusion and local orofacial region:

• Adjacent teeth are often displaced, rotated or tipped;

• Teeth in the region of the defect are unable to erupt (particularly the maxillary canine and if present, the lateral incisor);

• The bony defect can lead to collapse of the maxillary dental arch with a loss of alveolar contour;

• Bony support around the base of the nose can also be compromised, with flattening on the cleft side;

• In bilateral cases, there can be instability and mobility of the premaxillary segment; and

• Larger defects can be associated with oronasal fistulae (communications between the oral and nasal cavities in the anterior palate).

Alveolar or secondary bone grafting involves placing cancellous bone, usually harvested from the iliac crest, directly into the maxillary alveolar defect. This procedure is normally carried out at around 8–10 years of age, prior to eruption of the permanent canine, when root formation of this tooth is around two-thirds complete. A period of orthodontic treatment is usually required prior to graft placement to expand the collapsed maxillary arch and create surgical access, maximizing the amount of bone that can be placed. This expansion is often achieved with a quadhelix appliance, followed by a period of retention with a palatal arch. During this phase of orthodontic treatment, some alignment of the maxillary incisors can be achieved by either extending the arms of the helix or using a simple fixed appliance, but care needs to be taken not to move any teeth into the cleft site where there is no bone; if this is a

concern, these teeth should be aligned after the bone graft.

Alveolar bone grafting has made a significant contribution to the oral rehabilitation of children with cleft palate. Grafting cancellous bone into the cleft allows teeth to erupt into this region and facilitates tooth movement, which means that orthodontic tooth alignment and space closure can be achieved. Moreover, the timing of alveolar bone grafting means that it does not interfere with growth in the width and length of the anterior maxilla, because this is essentially complete by 8 years of age. Vertical development of the maxilla would appear to continue normally after the insertion of a bone graft.

Dental care during the permanent dentition

Once the permanent dentition is established a decision is made regarding the need for orthodontic treatment alone to correct any malocclusion, or a combination of orthodontics and orthognathic surgery. A key factor is the degree of maxillary and midfacial retrusion, but it should be remembered that these patients also exhibit a full range of mandibular growth patterns and mandibular prognathia can also be seen. A period of time monitoring further facial growth may be required before a final decision is made, but if surgery is indicated, presurgical orthodontic treatment will usually begin once facial growth is complete. Occasionally, in cases with severe maxillary retrusion, osteogenic distraction is employed to move the maxilla forwards in a younger, growing patient. This will provide some early improvement in the profile and reduce the size of the jaw movements that will be required for definitive orthognathic surgery in the late teenage years, once facial growth is complete. Similarly, severe maxillary crowding can be treated prior to definitive surgical set up in younger patients, to provide some improvement in dental aesthetics without compromising later combined orthodontic surgical treatment.

In those cases that can be treated with orthodontics alone, there are often

a number of specific problems that exist:

• Crowding associated with a narrow and retrusive maxillary arch;

• Crossbites affecting teeth in the anterior and posterior maxilla; and

• Congenital absence or anomalies associated with teeth in the cleft region.

Orthodontic treatment with fixed appliances is usually indicated in these cases, often in conjunction with some maxillary expansion, but following the same general principles of treatment planning for any malocclusion. Correction of the severely rotated teeth and posterior crossbites often seen in these cases usually requires long-term retention.

Cleft lip nose

In young adults affected by a cleft lip, the nasal aesthetics can be poor; in particular, the nose can be asymmetrical at the tip and the alar base can be collapsed on the side of the cleft repair, both of which may require surgical revision. Primary cleft rhinoplasty can be effective, particularly in unilateral cases and nasal tip correction can also be achieved.

These procedures are commonly undertaken in the later teens. Revision of any surgical scarring associated with the primary lip repair may also be required. These procedures are also usually carried out following the completion of definitive orthodontic or combined treatment in the late teenage years.

My great wishes for my lovely students for success. Thanks

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Lecture 26+27 [5th] **د.حيدر سعد حنفوش**

Orthodontics

Digital Orthodontics

Orthodontics, like the other dentistry disciplines, has recently benefited from the influx of technological innovations. These innovations have principally involved the means and procedures of diagnosis, with new developments being introduced in the field of photography, tomography, optical and laser scanning. Several orthodontic systems implement these new technologies, providing the orthodontist with a comprehensive orthodontic treatment package consisting of digital diagnostics, 3-dimensional (3D) digital planning, and computer-designed customized brackets and arch wires. Customized orthodontic treatment systems rely on digital models of the patient's occlusion, which are generated from accurate impressions taken before treatment, scans of the dental arches, scans of the plaster casts, or cone beam computed tomography (CBCT) acquisition. A virtual setup of the desired outcome is then derived, which serves as a 3D interactive treatment planning tool and is used for the production of personalized appliances (archwires, brackets, and indirect bonding transfer devices).

Tools used in digital orthodontic diagnosis and treatment planning

Orthodontics and dentofacial orthopaedics is one of the most complex branches of dentistry that requires a careful interpretation of a large amount of information to attain a correct diagnosis and treatment planning. Similar to a wax setup, the digital setup is a tool that helps with diagnosis and treatment planning and it is up to the creator of the setup to respect the biologic limitations of tooth movement and mimic realistic

biomechanics. The creation of a digital setup is much faster than creating a wax setup due to the lab work required when working with plaster. Working with digital setups offers many advantages such as relatively time saving, the ability to superimpose the setup with the original models, determining the precise amount of movement for each tooth, and it can be instantly stored and shared with others easily.

Digital Study Models

Plaster study models were the "gold standard" in orthodontic diagnosis and treatment planning. Later advances brought about more dimensionally stable impression materials than wax and alginate, such as polyvinyl siloxane (PVS). Study models provide a three-dimensional view of a patient's occlusion and are more amenable to routine measurements such as tooth size, arch length, arch width, overjet, overbite, midline discrepancy, curve of Spee, etc. On the other hand, the concept of 3D virtual orthodontic models seems very favorable in eliminating the problems of conventional plaster models, and simplifying the practice management and communication between different specialties (Figure 1). However, it has disadvantages such as lack of tactile input, scarcity of digital model supplier companies, questions surrounding the accuracy of digital models, additional costs, and time required to learn how to utilize the system; so if it was not achieved accurately, it will need extra time to repeat it.

Figure 1: Digital casts, usually produced from intraoral scans, can be displayed with or without symmetric bases. The advantage of the bases is that they help the observer detect asymmetries within the dental arches.

Physical versus Virtual Casts

Whether physical plaster or virtual orthodontic diagnostic casts are to be produced, an impression of the teeth that also gives maximum displacement of the lips and cheeks is desired. Being able to visualize the inclination of the teeth, not just the location of the crown, is important. If the impression is not well extended, important diagnostic information may be missing. If the impressions are to be poured in dental stone without great delay, alginate impressions are satisfactory; if virtual models will be produced, a more accurate and stable impression material (such as PVS) should be used. In specialty practice, virtual models have the great advantage that they eliminate the need for storage space and can be used for computer-assisted fabrication of appliances. There are three ways to generate digital casts: from laser scans of impressions, from scans of casts poured up from impressions, or from direct intraoral scans. Direct intraoral scanning with adequate lip and cheek retraction eliminates impressions that are unpleasant for patients, which becomes more important when multiple scans may be needed to obtain data required for a computer-controlled wirebending robot to fabricate archwires.

Space Analysis

Space analysis can be accomplished by a computer algorithm. The data for the arch dimensions and tooth widths can be entered by digitizing the already present digital casts, then the computer does the calculations (Figure 2).

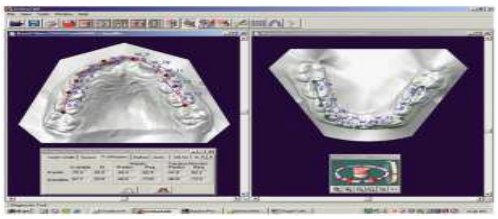


Figure 2: Digital space analysis.

Digital Photographs

Digital photography has replaced films, and digital images have done the same for radiographs. The digital single lens reflex cameras were verified for use in intra- and extra-oral photography and proven to produce perfect images when used with the recommended macro-lens and macro-flash techniques. Digital photography was introduced to evaluate facial harmony. It allows clinicians to establish a more proportional focus on all three structures of the triad to assess patient's deformity (Figure 3).

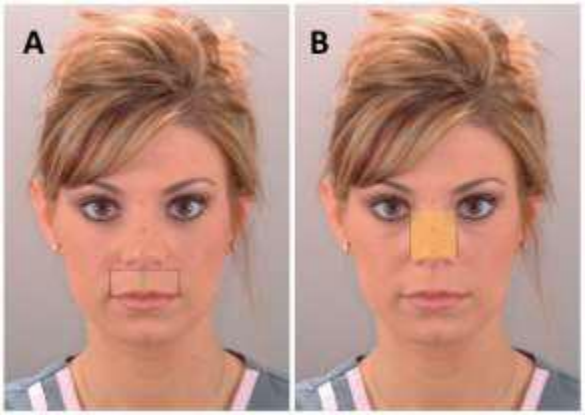


Figure 3: In evaluating facial proportional relationships while looking at digital images on the computer screen, it can be helpful to put a box around the structures to be related, as in A, where the lip commissure height is being related to the central philtrum height, or as in B, where the width of the nose is being related to the interocular width. For this girl, both relationships are normal. Boxes like this can be added to the facial images during the clinical examination and become part of the record.

Examples of Digital Orthodontic Systems

1- Clear Aligner Therapy

The term Clear Aligner Therapy (CAT) embraces a wide range of appliances with differing modes of action, methods of construction, and applicability to various malocclusion treatments. However, there are some limitations such as it depends on patient compliance, which is a

crucial factor to achieve the designed tooth movement. Alteration of tooth morphology can result in unfitted aligners, thus rescanning or PVS impression is required. In addition, posterior open bite is a common side effect of clear aligner therapy.

In 1997, a new company named Align Technology computerized the process of producing a sequence of casts with incremental changes on which aligners could be fabricated. With careful planning, this would result in a sequence of clear aligners (called Invisalign) that could correct a certain range of malocclusions. Diagnostic records for aligner treatment are the same photographs, radiographs, and dental casts as for any other type of orthodontic treatment. For Invisalign sequenced aligners, either an intraoral optical scan (which also records the initial occlusion) or PVS impressions and a bite registration (maximum intercuspation) are obtained. The scan or impressions, photographs, and radiographs are submitted to the company along with the doctor's initial instructions. The production process begins when the intraoral scan or impressions are used to create an accurate 3D digital model of each dental arch. These records are transferred electronically to a digital treatment facility. At the digital treatment facility, technicians virtually segment the individual teeth and clean up obvious artifacts. Then the dental arches are related to each other, gingiva is added, movement is staged following the doctor's instructions, and this preliminary plan is placed online for the doctor's review as a "ClinCheck" (a software that enables discussing a Digital Model Treatment Plan between the orthodontist and the company). After the orthodontist is satisfied with the planned sequence of aligners, the set of digital models for a patient is transferred to a cast production facility, where a stereolithographic model for each step is fabricated. A clear plastic aligner is formed over each model, using a material that has high quality physical properties, and the set of aligners is sent directly to the

orthodontist.

There is increasing interest in the possibility of doing aligner production in the doctor's own office, using computer software to create the sequence of models, a 3- D printer to make the models for each stage, and a vacuum-forming unit to make the aligners. At this point the available software is much less advanced than Invisalign's, printing the models for each stage is time-consuming, and the improved aligner material is not available; but for simpler cases this already is quite feasible and much less expensive.

Clinician's Role in "ClinCheck": With experience, doctors tend to be more specific in their initial prescription of what they want, or do all the sequencing of steps themselves to set things up for a better result, but the sequence of steps and the amount of movement between steps is specified by algorithms built into a specific software if this is not spelled out in detail in the prescription. In essence, when the ClinCheck is posted for the doctor to examine, the computer technician has sent a draft treatment plan for reviewing. The software used by the computer technicians has default scenarios for different types of malocclusions and default rates of tooth movement. These defaults are satisfactory for simpler cases but not for the more complex ones.

For complex treatment, the doctor must customize the plan in terms of the extent to which "bonded composite attachments" are to be used to increase the aligner's grip on the teeth, the rate of tooth movement with each subsequent aligner (often reducing the amount of movement at critical points), any special components of aligners that need to be added, and the amount and location of interproximal reduction of teeth (if any) that is to be done. These modifications to the original ClinCheck then are used to produce the aligners for that patient.

Patients must be monitored carefully to verify that tooth movement is tracking with the series of aligners (i.e., that all teeth are seated completely in the aligner after it has been worn for the specified period of time). If the teeth are not tracking, there are several possibilities: not enough wear of the aligners by the patient, insufficient interproximal reduction, insufficient crown height or shape to allow a grip on the tooth or teeth to be moved, wrong type or position of bonded attachments, or movement created in ClinCheck that is too fast to be biologically possible. A refinement or midcourse correction, with a new intraoral scan or PVS impressions and revision of the treatment plan, often is necessary when tracking deviates significantly from the plan. This is likely to be encountered in the treatment of complex problems even with good patient cooperation.

2- Insignia system (Individually Customized Brackets)

Because of individual variations in the contours of the teeth, no appliance prescription can be optimal for all patients, and compensatory bends in finishing archwires often are necessary. Custom brackets for the facial surface of teeth offer the prospect of eliminating almost all archwire bending (i.e., they could provide the perfect straight-wire appliance). The Insignia system marketed by Ormco company uses custom brackets on each tooth and focuses on eliminating wire bending to make the appliance more time-efficient for the doctor and patient (Figure 4).

The first step in producing the Insignia customized bracket is a 3-D scan of the dentition to produce an STL file (now the most frequent input), or a scan of an impression with high-accuracy impression material, or a scan of dental casts from such an impression. If a CBCT radiograph is available, Ormco processes the crown and root with a proprietary “build

up" process, following the contours of the 3-D image to generate a crown and root as a single unit. If a CBCT image is not available, a software calculation of ideal arch form is used to place the roots in the center of the cancellous bone of the jaw. Based on this "anatomically correct" arch form, the software then aligns the virtual teeth and places them in occlusion, with each tooth position determined from the best-fit buccal cusp orientation. The doctor can adjust the tooth positions at this point, and would need to be aware of the software assumptions as this is done.

This digital information then is used to precisely cut each bracket by using computeraided design/computer-aided manufacturing (CAD/CAM) technology, so that the slot for each bracket has the appropriate thickness, inclination, and torque needed for ideal positioning of that tooth, and archwires with an arch form established for that patient are supplied. The result is "the ultimate straight-wire appliance," with wire bending reduced to a minimum if not totally avoided. Attempts were made to integrate images of tooth–lip relationships into the database for Insignia, so that tooth display on smile is built into where the brackets are placed on the anterior teeth, and moving the brackets automatically changes the tooth display. It is likely that at the point of approving the set-up for making the brackets, it soon will be possible for the orthodontist to check not only on whether the arch form assumptions are correct, but also to adjust where the bracket is to be placed on the teeth to obtain the best incisor display. It is not possible to get this just by adjusting the bracket slot angulation and prescription; instead, the bracket must be placed properly on the teeth relative to the lips.

Figure 4: The Insignia system is built around the use of a custom prescription bracket for each individual tooth, coupled with custom archwires with that patient's individual arch form, to produce the "ultimate straight-wire appliance." A polyvinyl siloxane (PVS) impression is used to obtain accurate dental casts, which are scanned into computer memory. (A) This data set is used to place virtual brackets on each tooth and develop a template of the change needed to obtain ideal occlusion. (B) The digital data are used to mill a custom prescription slot for each bracket that incorporates the in-out, tip, and torque needed to position each tooth. (C) Then bonding jigs are fabricated so that each bracket can be placed in the planned location. (D) The appliance in the mouth with an archwire in place.

Periodontal consideration in adult orthodontic treatment

In general, orthodontists consider adults as those whose growth is essentially completed. The mean cutoff age for females is 18 (which means for some slow maturers it would be later), but for males it is 20 or 21, simply because males often are still growing up to that age.

Patients who seek orthodontic treatment beyond those ages fall into two quite different groups:

1- Younger adults (typically younger than 35, often in their 20s) who desired but did not receive comprehensive orthodontic treatment at youths and now seek it as they become financially independent and, the goal of treatment is to improve their quality of life.

They usually seek the maximum improvement that is possible. They may or may not need extensive treatment by other dental specialists but frequently need interdisciplinary consultation.

2- An older group, typically in their 40s or 50s, who have other dental problems and need orthodontics as part of a larger treatment plan.

The goal is quite different, they usually seek to maintain what they have, not necessarily to achieve as ideal an orthodontic result as possible. For them, orthodontic treatment is needed to meet specific goals that would make control of dental disease and restoration of missing teeth easier and more effective, so the orthodontics is an adjunctive procedure to the larger periodontal and restorative goals.

Adjunctive orthodontic treatment, particularly the simpler procedures, often can be carried out within the context of general dental practice. In adults, growth has been essentially completed and is no longer a variable requiring major consideration in managing treatment, and the types and magnitude of tooth movement required for most adjunctive procedures are straightforward. Adjunctive treatment does not require familiarity with the principles of comprehensive orthodontic treatment, but it does presume an understanding of orthodontic diagnosis and treatment planning.

Comprehensive orthodontics for adults tends to be difficult and technically demanding. The absence of growth means that growth modification to treat jaw discrepancies is not possible. The only possibilities are tooth movement for camouflage or orthognathic surgery, but applications of skeletal anchorage now are broadening the scope of

orthodontics to include some patients who would have required surgery even a few years ago (fig. 1).

Fig. 1: Miniscrew (skeletal anchorage) used to retract anterior teeth.

Adjunctive orthodontic treatment for adults is, by definition, tooth movement carried out to facilitate other dental procedures necessary to control disease, restore function, and/or enhance appearance, Usually:

1- it involves only a part of the dentition,

2- The primary goal usually is to make it easier or more effective to replace missing or damaged teeth.

3- Making it easier for the patient to control periodontal problems is a frequent secondary goal and sometimes the primary goal.

4- The treatment duration tends to be a few months, rarely more than a year,

5- Iong-term retention often is supplied by the restorations.

6- Whether one or several practitioners are involved, adjunctive orthodontics must be coordinated carefully with the periodontal and restorative treatment.

In contrast, the comprehensive orthodontics for adults is the same as for adolescents:

1- It aims to acquiring the best combination of dental and facial appearance, dental occlusion, and stability of the result to maximize benefit to the patient.

2- Comprehensive orthodontics requires either a complete fixed

orthodontic appliance or a high level of skill in managing clear aligner therapy.

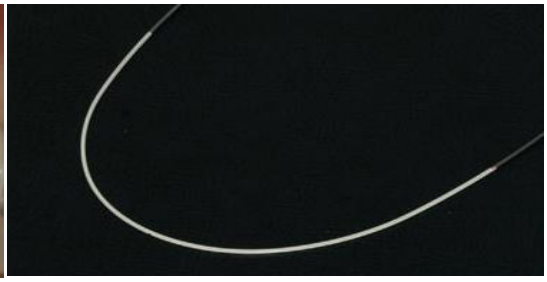
3- Intrusion of some teeth is likely to be needed,

4- Orthognathic surgery may be considered to improve jaw relationships.

5- The duration of treatment from braces on to braces off exceeds 1 year.

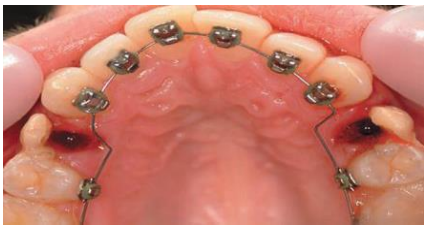
6- Adults receiving comprehensive treatment are the main candidates for esthetically enhanced appliances; although aesthetic orthodontic appliances are not restricted to adult patients, the drive for less visible appliances has come from adults. This demand has led to the development of a number of orthodontic appliances with improved aesthetics such as:

1- Aesthetic fixed appliance and aesthetic wires

2- Invisalign or clear aligner

3- Lingual orthodontic appliance



Principles of Adjunctive Treatment

Treatment Goals

A-Facilitate restorative work by appropriate positioning of teeth

B-Improve the periodontal health by reducing areas that harbor plaque, and making it simpler for the patient to maintain good oral hygiene

C- Position the teeth so that occlusal forces are transmitted along the long axis of the tooth, and tooth wear is more evenly distributed throughout the arch The following are examples of problems that benefit from a joint approach between the orthodontist and the restorative dentist:

D-*Uprighting of abutment teeth* : following tooth loss adjacent teeth may Drif0t into the space. Uprighting these abutment teeth can facilitate the placement of replacement prosthetic teeth (Fig. 2).

Fig. 2:Uprighting needed

E-Redistribution or closure of spaces : following tooth loss it may be possible to close the remaining space, or move a proposed abutment tooth into the middle of an edentulous span, in order to aid construction of a more robust prosthesis. If implants are required then the roots may need to be repositioned to permit surgical placement.

F-*Intrusion of over-erupted teeth* : one of the side effects of tooth loss is over-eruption of the opposing tooth. This can interfere with restoration of the space, so the over-erupted tooth can be intruded using orthodontics.

G-*Extrusion of fractured teeth* : sometimes it is necessary to extrude a fractured tooth, to bring the fracture line supragingivally to allow placement of a crown or restoration. There is a limit to this, as excess

extrusion will reduce the amount of tooth supported by bone, reducing the crown-to-root ratio.

An old rule says that to make clear what something is, it helps to point out what it isn't but might be mistaken for. So, some important things must be kept in mind:

1- Orthodontic treatment for temporomandibular dysfunction (TMD) should not be considered adjunctive treatment.

2- Although intrusion of teeth can be an important part of comprehensive treatment for adults, it probably should be managed by an orthodontist even as an adjunctive procedure because of the technical difficulties involved and the possibility of periodontal complications.

As a general guideline in treatment of adults with periodontal involvement and bone loss, lower incisor teeth that are excessively extruded are best treated by reduction of crown height, which has the added advantage of improving the ultimate crown-to-root ratio of the teeth. For other teeth, tooth–lip relationships must be kept in mind when crown height reduction is considered.

3- Crowding of more than 3 to 4 mm should not be attempted by stripping enamel from the contact surfaces of the anterior teeth. It may be advantageous to strip posterior teeth to provide space for alignment of the incisors, but this requires a complete orthodontic appliance and cannot be considered adjunctive treatment.

Once all the problems have been identified and categorized, the key treatment planning question is: can the occlusion be restored within the existing tooth positions or must some teeth be moved to achieve a satisfactory, stable, healthy, and esthetic result?

The goal of providing a physiologic occlusion and facilitating other

dental treatment has little to do with Angle's concept of an ideal occlusion. At this point, it is important to consider the difference between realistic and idealistic treatment planning. In older patients, searching for an "ideal" result could involve more treatment than would really benefit the patient.

Obviously, the time needed for any orthodontic treatment depends on the severity of the problem and the amount of tooth movement desired, but with efficient use of orthodontic appliances, it should be possible to reach the objectives of adjunctive treatment within 6 months as a practical matter, this means that like comprehensive orthodontics, most adjunctive orthodontics cannot be managed well with traditional removable appliances. It requires either fixed appliances or a sequence of clear aligners to get the job done in a reasonable time frame. In addition, it is becoming increasingly apparent that skeletal anchorage makes adjunctive tooth movement more effective and efficient. For adjunctive treatment, this is almost always in the form of alveolar bone screws.

In many ways the approach to treatment in adult patients follows the same process as that for children. There are however some problems that are specific to adult patients:

1-Lack of growth:

Although growth continues at a very slow rate throughout adulthood, the majority of growth changes have occurred by the end of puberty. This means that there is no scope for growth modification, so skeletal discrepancies can only be treated with either orthodontic camouflage, or combined orthodontics and orthognathic surgery. It can also be more difficult to reduce overbites without the benefit of growth. Where possible, overbite reduction should be achieved by intrusion of the incisors, rather than the more common method of extruding the molars (provided this does not compromise the smile aesthetics). This is because

extrusion of posterior teeth is more prone to relapse in adults.

2-Periodontal disease:

Adult patients are more likely to be suffering, or have suffered, from periodontal disease. A reduced periodontium is not a contraindication to orthodontic treatment, but it is vital that any active periodontal disease is treated and stabilized before orthodontic treatment can begin.

Periodontal disease is more common in adults, and is therefore an important factor that must be considered in all adult orthodontic patients. It is wise to undertake a full periodontal examination in all adult patients to exclude the presence of active periodontal disease. Periodontal attachment loss is not a contraindication to orthodontic treatment, but active periodontal disease must be treated and stabilized before treatment begins. The presence of plaque is the most important factor in the initiation, progression and recurrence of periodontal disease. Teeth with reduced periodontal support can be safely moved provided there is adequate plaque control.

Malalignment problems caused by periodontal disease:

Loss of periodontal support can lead to pathological tooth migration of a single tooth or a group of teeth. The commonest presentation of periodontal attachment loss is labial migration and spacing of the incisors (Fig. 3).

Fig. 3: Migration of teeth

The teeth lie in an area of balance between the tongue lingually and the lips and cheeks buccally. The forces from the tongue are higher than those exerted by the lips and cheeks, but a normal healthy periodontium resists these proclining forces from the tongue. If, however periodontal attachment is lost as a result of disease, then the teeth will be proclined forwards. In addition, if posterior teeth are lost then this lack of posterior support produces more pressures on the labial segment, leading to further proclination of the incisors.

Orthodontic management of patients with periodontal disease:

Once the periodontal disease has been fully stabilized, and the patient is able to maintain a good standard of oral hygiene, treatment can begin (Fig.4) and as following:-

Fig.4: Controlled periodontal status in adult

A- Lighter forces are required, due to the reduced periodontal support,

B- ideally bonds rather than bands should be used on the molars to aid oral hygiene.

C- Removal of excess adhesive will also help to reduce plaque retention.

D- Due to the reduced alveolar bone support the centre of resistance of the tooth moves apically. This means there is a greater tendency for teeth to tip excessively, so this must be carefully controlled with appropriate treatment mechanics.

E- Retention at the end of treatment needs to be carefully

considered. Even when the teeth are aligned and the periodontium is healthy, the problem of reduced periodontal support remains. With reduced periodontal attachment there will always be a tendency for the forces of the tongue to procline the incisors. These cases require permanent retention, often in the form of bonded retainers (fig. 5), and the patient must be taught how to maintain excellent oral hygiene around
these retainers.

Fig. 5:Bonded retainer (permanent retention)

3-Missing or heavily restored teeth:

Tooth loss may lead to drifting and/or tilting of adjacent teeth and overeruption of opposing teeth into the space. In addition, atrophy of the alveolar bone can occur, leading to a narrowing or 'necking' in the site of the missing tooth or teeth (Fig. 6). This can make tooth movement into these areas more difficult. Heavily restored teeth are more common in adults and may complicate the orthodontic treatment. The choice of extractions may be determined by the prognosis of the restored teeth, and bonding to certain restorative materials is more difficult than bonding directly to enamel. Specialist techniques and materials are needed when bonding fixed appliances to gold, amalgam and porcelain, and the patient needs to be warned that the restoration may be damaged when removing the fixed appliance. For this reason, if possible, it is best to leave any definitive restorations until after the orthodontic treatment.

Fig. 6

4-Physiological factors affecting tooth movement:

There is a reduced tissue blood supply and decreased cell turnover in adults, which can mean that initial tooth movement is slower in adults, and may be more painful. Lighter initial forces are therefore advisable.

5-Adult motivation and attitude towards treatment:

Adults have the potential to be excellent, well-motivated patients. ; however, this is not always the case. It has been suggested that the increased co-operation may compensate for slower initial tooth movement.

Adults tend to be more conscious of the appearance of the appliance, so there has been a drive towards more aesthetic orthodontic appliances (like transparent bracket, lingual appliance or clear aligner). Although distal movement of the upper molars with headgear is technically feasible, adults are more reluctant to wear extra-oral appliances. Alternative sources of anchorage are therefore more commonly used in adult patients, such as implant-based anchorage (Fig. 7).

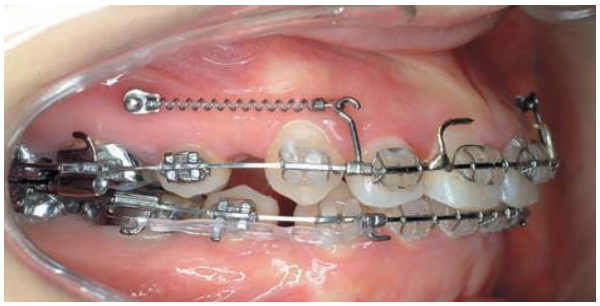


Fig.7: Anchorage by mini screw (implant –based)

With an increasing number of patients keeping their teeth for longer, there is a greater need for interdisciplinary treatment of patients with

complex dental problems. Where collaboration is needed between the orthodontist and the restorative dentist, it is helpful to see the patients jointly to formulate a coordinated and appropriate treatment plan. Orthodontic treatment in these cases does not necessarily require comprehensive correction aiming for an ideal occlusion.

My great wishes for my lovely students for success. Thanks