An Introduction to Fixed Prosthodontics

Prosthodontics: It is the dental specialty concerned with the making of artificial replacements for missing parts of the mouth and jaw. It is also named "Prosthetic Dentistry" or "Prosthodontia".

Fixed Prosthodontics (Crown and Bridge Prosthodontics); It is a branch of dental science that deals with restoration of damaged teeth with artificial crown and replacing the missing natural teeth by a dental prosthesis permanently cemented in place [Fixed partial denture].

Fixed Prosthodontics includes:

- Inlays
- Onlays
- Veneers
- Crowns
- Fixed partial dentures

Crown: It is a fixed extra-coronal artificial restoration of the coronal portion of a natural tooth. It must restore the morphology, contour and function of the tooth and should protect the remaining tooth structure from further damage.

Types of crowns (Classification of crowns):

I. According to coverage area

1. Complete crown : It is the crown that covers all the coronal portion of the tooth such as full metal crown, porcelain fused to metal crown and All Ceramic crown.
2. Partial crown : It is a crown that covers part of the coronal portion of the tooth such as 3/4 crown, 7/8Crown.
3. Complete replacement: It replaces the natural crown entirely. This type of crown retains itself by means of a dowel (post) extended inside the root canal space of the tooth such as a post crown.

Three-quarter crown which is a partial crown covering all tooth surfaces except the buccal surface.

Post crown which replaces the natural crown entirely and retains itself by means of a dowel (post) extended inside the root canal space.

II. According to the materials used in the fabrication of the crown

1. Metal crown: made from gold alloy and its alternatives such as full metal crown and 3/4 crown.

2. Non- metal crown: made from acrylic resin, zirconium or porcelain as in jacket crown.

3. A combination of metal and plastic materials such as porcelain fused to metal crown.

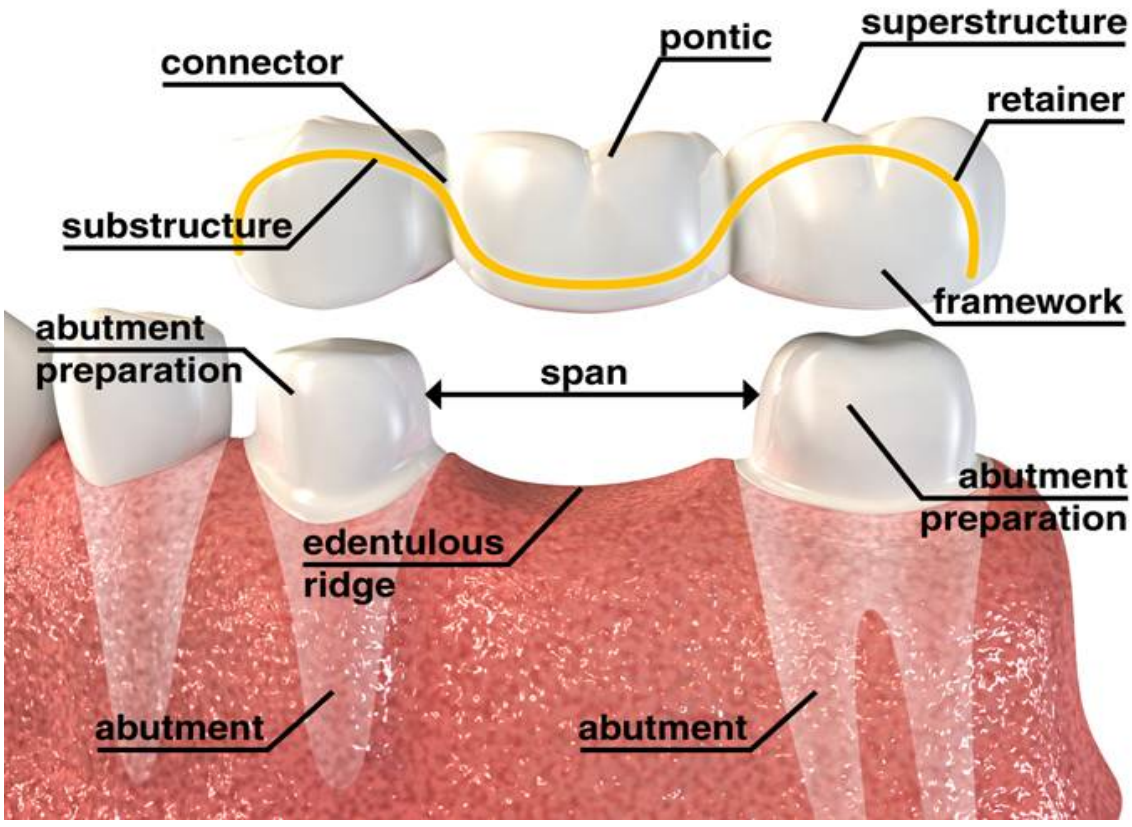
Bridge: It is a fixed dental prosthesis which replaces and restores the function and esthetic of one or more missing natural teeth and can't be removed from the mouth by the patient. It is primarily supported by natural teeth or root. The tooth that gives support to the bridge is called "abutment tooth".

Components of bridge:

1. Retainer: It's the part that seats over (on or in) the abutment tooth. It could be major or minor (will be explained later).

2. Pontic: It is the suspended member of fixed partial denture that replaces the missing tooth or teeth. It usually occupies the position of the missing natural tooth.

3. Connector: It is that part of fixed partial denture that joins the individual components of the bridge together (the retainer and the pontic). It could be fixed (rigid) or movable (flexible) connector. When the retainer is attached to a fixed connector, it is called "major retainer", but when it is attached to a flexible (movable) connector it is called "minor retainer".



Components of bridge.

Purposes of crown construction:

1.To restore the grossly damaged tooth, fractured tooth or a tooth with a heavy filling (amalgam or composite).

2.To restore the masticatory function and speech.

3.To restore the esthetic (hypoplastic condition whether heredity defect or acquired defect).

4.To maintain the periodontal health by recontouring the occlusion and prevents food impaction.

5. To alter the occlusion (occlusal relationship) as a part of occlusal reconstruction to solve occlusal problems or to improve function.

6. As a retainer for the bridge.

Steps in the construction of cast restorations

1. Diagnosis.
2. Tooth preparation.
3. Final impression.
4. Temporary restoration (Provisional restoration).
5. Construction of working model.
6. Waxing.
7. Investing.
8. Burn-out (Wax elimination).
9. Casting.
10. Cleaning and finishing.
11. Try-in and cementation.

Note: Steps (1-4, and 11) are clinical steps, while steps (5-10) are laboratory steps carried out in the lab by the laboratory technician.

Note: The steps mentioned above concern the fabrication of cast restorations which are restorations made entirely from metal or a combination of metal and plastic material. All ceramic restorations are fabricated using other laboratory procedures such as CAD/CAM (Computer Aided Design / Computer Aided Manufacturing).

Diagnosis

The first step should be the diagnosis of the case whether it is indicated for crown and bridge work or not. This is decided after a thorough examination of the tooth and surrounding structures, which includes:

(a) Periodontal Examination: The patient should have proper oral hygiene to ensure that no plaque accumulation would occur on the crown margins which might lead, if left, to caries.

(b) Dental examination: which includes:

-*Visual examination:* we should examine the occlusion of the patient, the presence of crowding, spacing, rotation of teeth, tilting (drifting) and supra-eruption of the abutment tooth (or teeth). Meanwhile, the condition of the remaining tooth structure, the presence of caries and the quality of existing old fillings in the abutment tooth (or teeth) all should be checked.

-*Radiographic examination:* The radiograph reveals the shape and number of the roots, the condition of the surrounding structures, and the bone support of the tooth (crown/root ratio). The ideal crown/root ratio of a tooth to be used as an abutment for fixed partial denture is 1:2.

The radiograph also reveals the presence of a lesion in the bone, root canal treatment, fracture in the tooth or root, bone loss, unerupted teeth, etc…These information will affect the prognosis of the treatment.

Tooth Preparation

It is the cutting or instrumentation procedure that is carried out on the tooth during crown construction procedure.

The prepared tooth is the final form or shape of the tooth after the cutting (preparation) procedure. Rotary instruments are used to reduce the height and contour of the tooth. The tooth is prepared so that the crown restoration can slide into place and be able to withstand the forces of occlusion.

Finishing line of the preparation is a line that separates between the prepared and the unprepared tooth portions. It represents the end margin of our preparation. It should be smoothly continuous from one surface to the other; otherwise, it will interfere with seating of the crown if it is poorly done.

Objectives of tooth preparation

The main objectives of tooth preparation in fixed prosthodontics includes:

1-To eliminate undercuts from the axial surfaces of the tooth.

Note: The axial surfaces are the facial (labial or buccal), proximal (mesial and distal), and palatal (lingual).

2-To provide enough space for the crown restoration to withstand the force of mastication. This space depends on the material used; metal needs little space while plastic materials need more space.

3-Not to enlarge the size of the tooth.

4-To provide good esthetic.

Disadvantages of crowns

1. Heat generation during the cutting procedure of the teeth might affect the health of the pulp; therefore, water coolant must be used during the preparation procedure.

2. Over preparation can cause pulp irritation or even pulp exposure which might lead to death of the pulp. Excessive tooth preparation can also weaken the tooth structure.

3. Periodontal problems: food impaction with subsequent gingivitis and periodontal pocket formation and secondary caries might develop.

Biomechanical Principles of Tooth Preparation

The design of the preparation of a tooth for cast metal or porcelain restorations is limited by five principles:

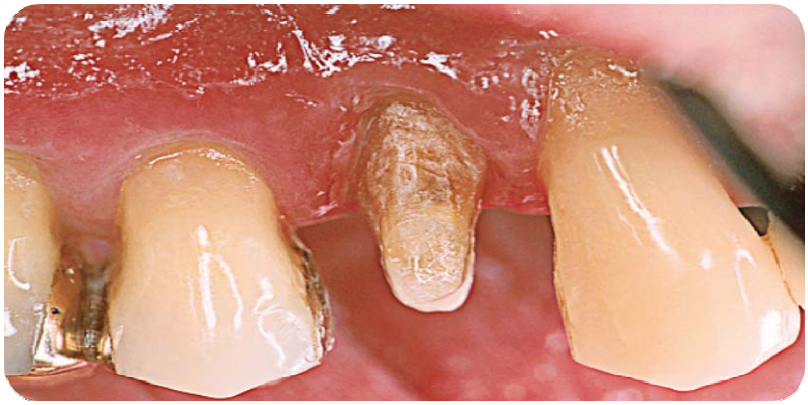
1- Preservation of tooth structure.
2- Retention and resistance from.
3- Structural durability of the restoration.
4- Preservation of periodontium.
5- Marginal integrity.

1. Preservation of the tooth structure

The preparation of the tooth must be conservative, minimal amount of tooth structure must be removed. Excessive amount of tooth structure removal, in addition to be destructive phenomenon, it has many harmful effects:

-Excessive reduction will lead to thermal hypersensitivity, pulpal inflammation and necrosis may result from approaching to the pulp closely.

-The tooth might be over tapered or shortened and this might affect the retention and resistance of the prepared tooth.

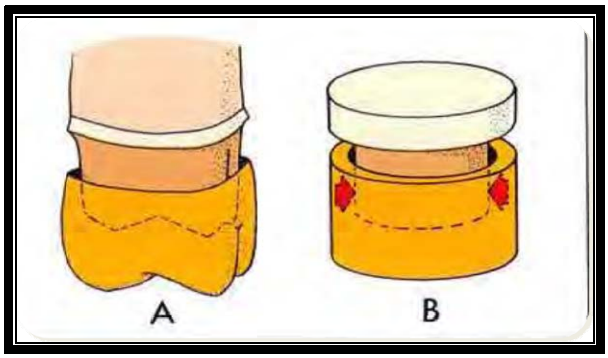


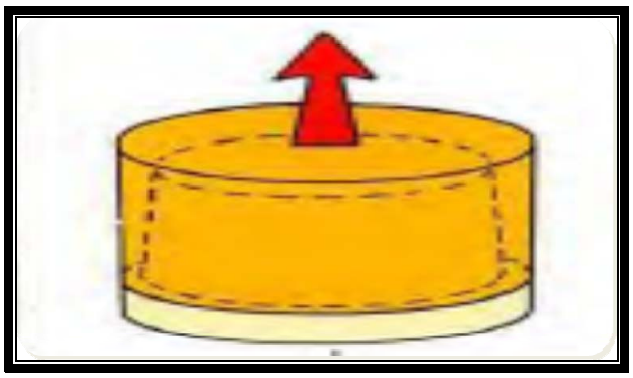
Excessive tooth reduction: The tooth is over tapered and shortened and this will affect the retention and resistance of the prepared tooth.

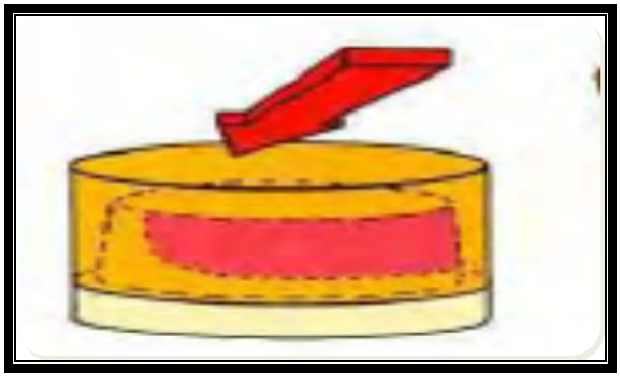
2. Retention and resistance form

Retention is the ability of the preparation to resist the dislodgement of the crown restoration by forces directed along its path of insertion.

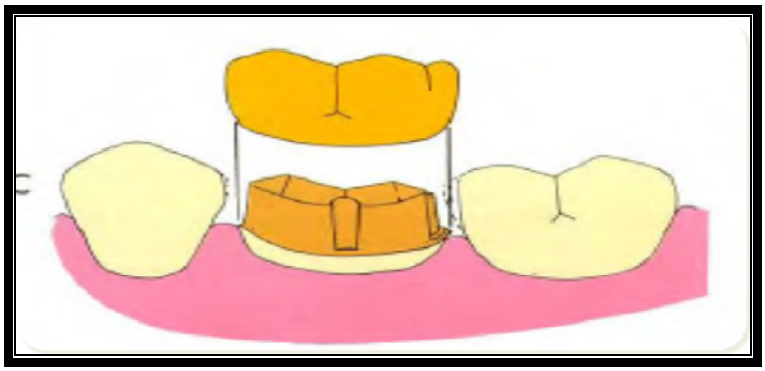
Resistance is the ability of the preparation to resist the dislodgment of the restoration by forces directed obliquely or horizontally to the restoration.







Path of insertion is an imaginary line along which the restoration can be inserted and removed without causing lateral forces on the abutment. The crown restoration should have a single path of insertion to be retentive. Most of the time, the path of insertion of the crown restoration is parallel to the long axis of the tooth, but this is not a rule as in three-quarter crown for the anterior teeth where the path of insertion should be parallel to the incisal two-thirds of the crown not to the long axis.



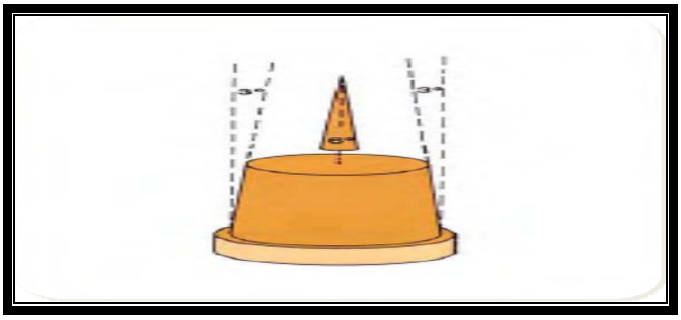
By limiting the path of withdrawal of the restoration, the retention is improved. A preparation with unlimited freedom of displacement is much less retentive.

Factors affecting retention and resistance

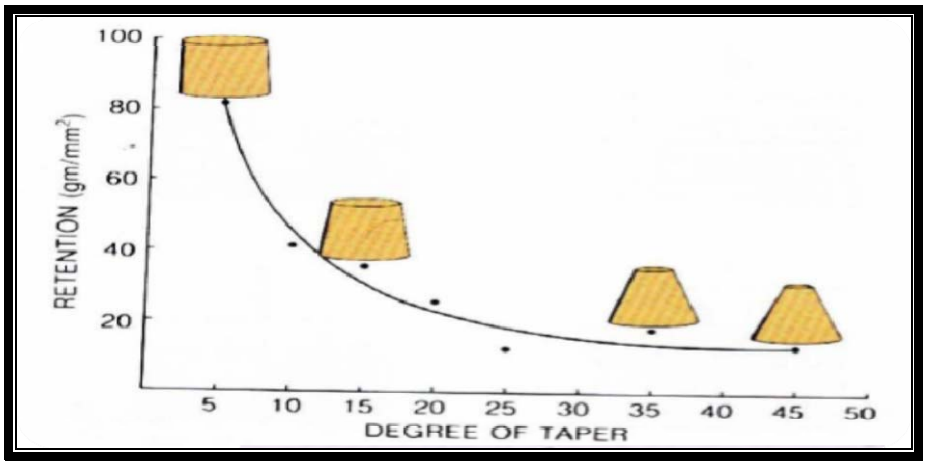
1. Taper of the preparation.
2. Surface area of the preparation.
3. Length and height of the preparation.
4. Diameter of the tooth (tooth width).
5. Texture of the preparation.
6. Accessory means.

1. Taper of the preparation

Convergence angle is the angle that is formed between each two opposing axial walls of a tooth prepared to receive a crown restoration. It determines the convergence (taper) of the prepared tooth.



The magnitude of retention depends on the degree of this angle, the greater the taper the less the retention. The degree of the convergence angle is one of the factors that determine the amount of axial and non-axial forces which can be tolerated without leading to loss of the crown restoration. 5-6 degrees convergence angle is mostly used to provide the needed retention. The more nearly parallel the opposing walls of preparation, the greater will be the retention, but parallel walls are difficult to be obtained inside the patient's mouth without creating undercuts and might lead to difficulty in seating of the crown restoration, thus 5-6 degrees convergence angle is mostly used to provide the needed retention.

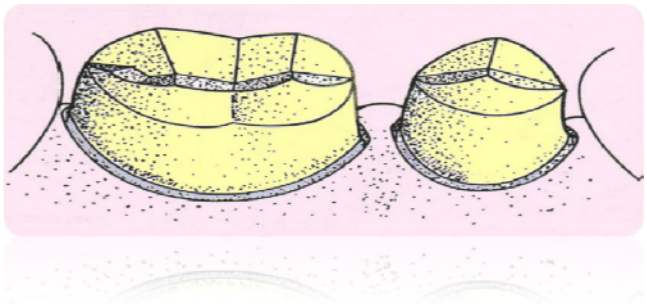


Taper and Resistance: The more parallel the axial walls of the preparation, the more will be the resistance of crown restoration. The walls of a short wide preparation must be kept nearly parallel to achieve adequate resistance from.

2. Surface area of the preparation

Increasing the surface area will increase the retention. The factors that influence the surface area are:

(a) Size of the tooth: The larger the size of the tooth, the more will be the surface area of the preparation, and thus the more will be the retention. In this issue, a full metal crown on a molar tooth will definitely be more retentive than that on a premolar tooth.

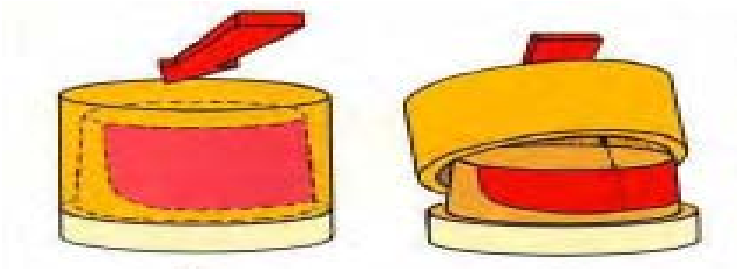


(b) Extent of tooth coverage by the restoration: The more the area that will be covered by the crown restoration, the more will be the retention. Thus full metal crown on a molar tooth is more retentive than a three-quarter crown on the same tooth.

(c) Accessory features: such as boxes, grooves, and pin holes.

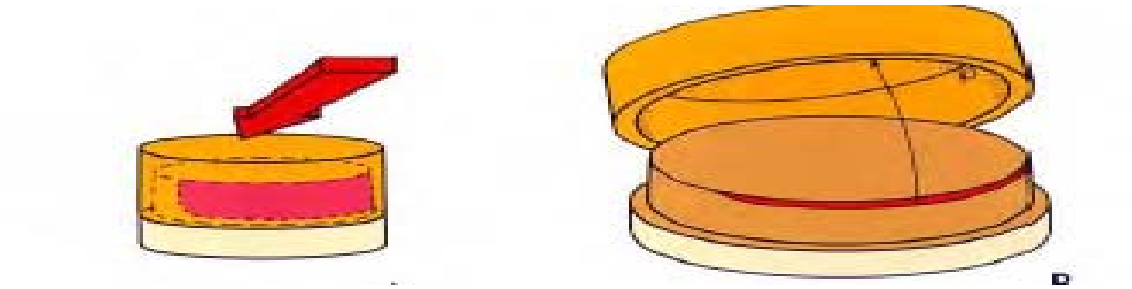
3. Length (height) of the preparation

Increasing the length of the preparation will increase the retention and resistance and vice versa.



4-Diameter of the tooth (tooth width)

Under some circumstances, a crown on a narrow tooth can have greater resistance to tipping than the one on a wider tooth. This occurs because the crown on the narrower tooth has a shorter radius for rotation resulting in a lower tangent line and a larger resisting area.

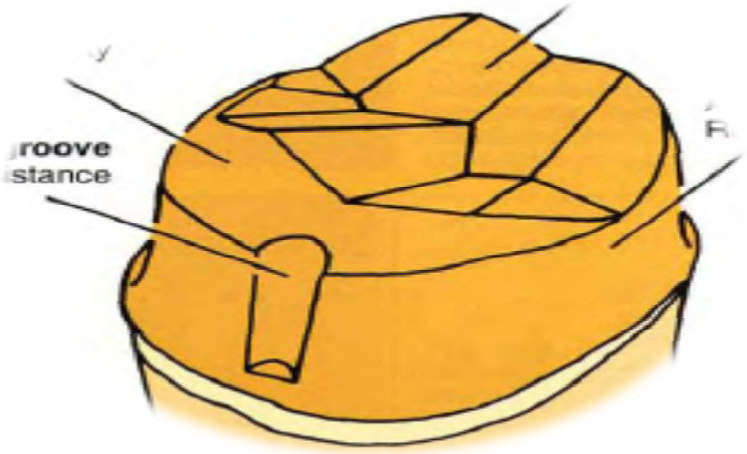


5.Texture of the preparation

Depending on the type of luting cement, the texture of the preparation might affect the retention of cast crown. Smooth surfaces are less retentive than the rough (mechanical interlocking).

6. Extra retention means

The retention of the preparation can be greatly enhanced by the addition of grooves, pin holes or boxes.

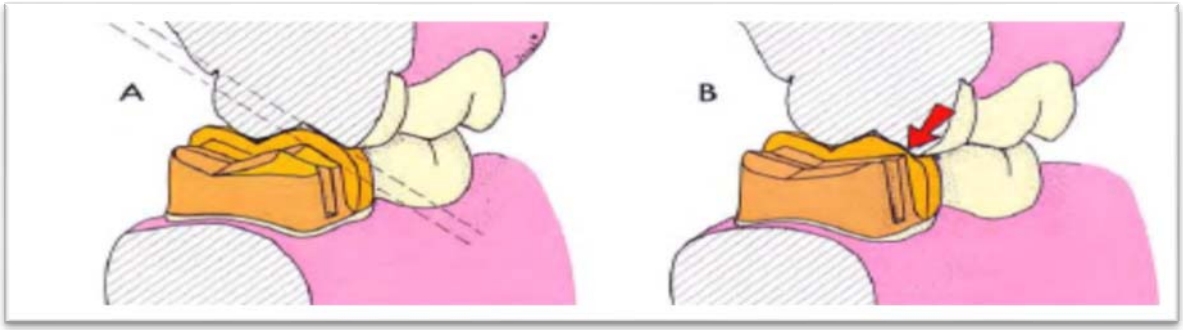


3. Structural Durability

The preparation must be designed so that it can provide structural durability to the restoration. i.e. the crown restoration must be rigid enough to not flex, perforate (if made of metal) or even fracture (if made of plastic material).

For the restoration to be rigid it needs bulk. To provide enough bulk to the crown restoration, sufficient tooth structure must be removed from the prepared tooth to create enough space. By doing so, the restoration will be allowed to withstand the forces of occlusion, preventing wearing holes in the metal and allowing proper contouring and carving of occlusal anatomy in the restoration. The preparation features related to structural durability are:

(1) Occlusal reduction: Enough tooth structure must be removed from the occlusal surface so that the restoration can be built back to ideal occlusion and thick enough to prevent wearing or distortion (1-1.5mm).

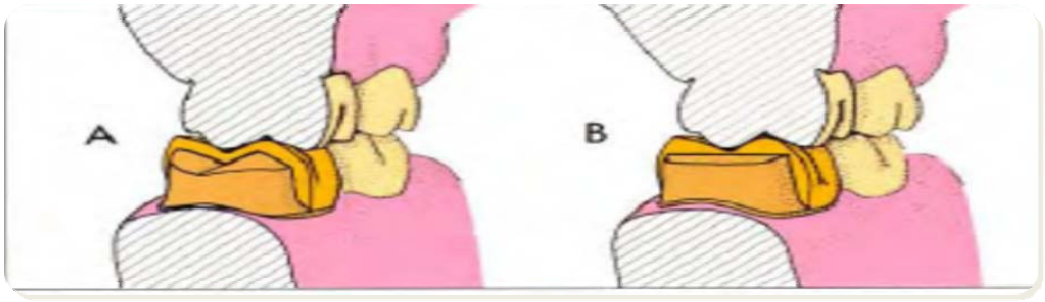


Occlusal clearance: is the space between the occlusal surface of the prepared tooth and that of opposing tooth. It should be evaluated in centric and eccentric relation. Enough tooth structure must be removed occlusally so that when the restoration is built back to ideal occlusion it will be thick enough to prevent wearing or distortion.

Functional cusps: are the cusps that give centric stops of occlusion (Palatal of upper posterior teeth and buccal of lower posterior teeth).

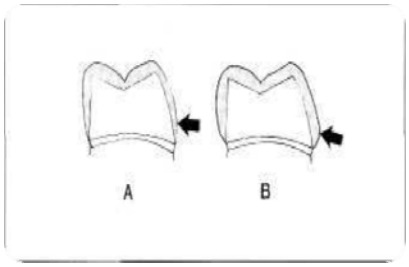
Occlusal reduction must reflect the geometric inclined planes of the occlusal surface (the so called "planar occlusal reduction" or "anatomical occlusal reduction").

When doing occlusal reduction, we should avoid creating steep planes with sharp angles because it will lead to stress. On the other hand, flat occlusal reduction will lead to too thin metal and this will lead to perforation of the crown restoration in the future. Meanwhile, lowering the entire occlussal surface in an attempt to provide sufficient space might lead to tooth structure destruction (non-conservative preparation) which interferes with the first principle of tooth preparation which is the conservation of tooth structure. In addition, lowering the entire occlusal surface will shorten the axial walls of the prepared tooth which definitely will affect the retention-resistance features of the preparation.



Functional cusp bevel (FCB): is a wide bevel placed on the functional cusps of posterior teeth to provide structural durability. It allows adequate thickness of restoration at this critical area without undue scarifying of tooth structure. If FCB is omitted, the restoration is likely to be too thin in this stress bearing area. In the absence of FCB, the laboratory technician overbuilds the crown restoration in attempt to provide structural durability for the restoration; this will lead to premature contact with the opposing tooth.

(2) Axial reduction: Sufficient axial reduction is important to provide sufficient space so that the restoration can be built with sufficient thickness. This will prevent flexing of the crown restoration when the occlusal forces act on.

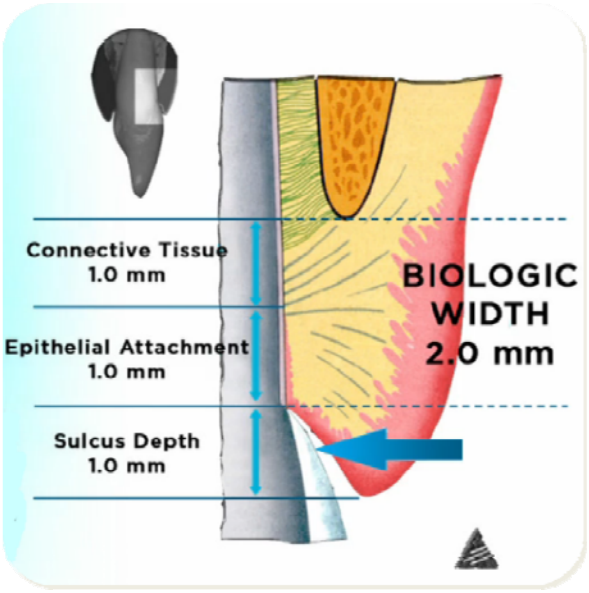


4. Preservation of the periodontium

For the preservation of the periodontium, the following points should be considered:

(a) Whenever possible, the margin of the preparation should be placed supra-gingivally.

(b) The crown restoration should have proper contact, embrasure form, occlusion and a healthy occluso-gingival contour.



Margin placement (finishing line placement): The finishing line of the preparation can be placed either supra-gingivally, sub-gingivally, or equi-gingivally (with the level of the gingiva).

Placing the margin of the preparation above the gingival tissue offers the following advantages:

a- can be easily prepared and finished by the operator.

b- to provide good vision for the operator during preparation.

c- the impression can be easily made.

d- the patient can keep the area clean more easily.

e- most of the time such a position is situated on hard enamel.

f- less destructive

So, as mentioned above and for the reasons formerly mentioned, it is better to place the margin of the preparation supra-gingivally whenever possible. However, there are some situations which require sub-gingval placement of the finishing line as listed below:

a- for esthetic.

b- when we need extra retention as in teeth with short crowns.

c- when there is caries or filling at the area of finish line (the preparation margin should be placed on sound tooth structure).

5. Marginal Integrity

The restoration can survive in the biological environment of the oral cavity only if the margin is closely adapted to the preparation margin. The configuration of the finishing line determines the shape and bulk of the restoration margin that will affect both marginal adaptation and the degree of seating of the restoration. The restoration margin should have the following requirements:

(a) it must fit as closely as possible against the finishing line of preparation.

(b) it must have sufficient strength.

(c) whenever possible, it should be placed in an area where the dentist can finish easily and the patient can clean properly.

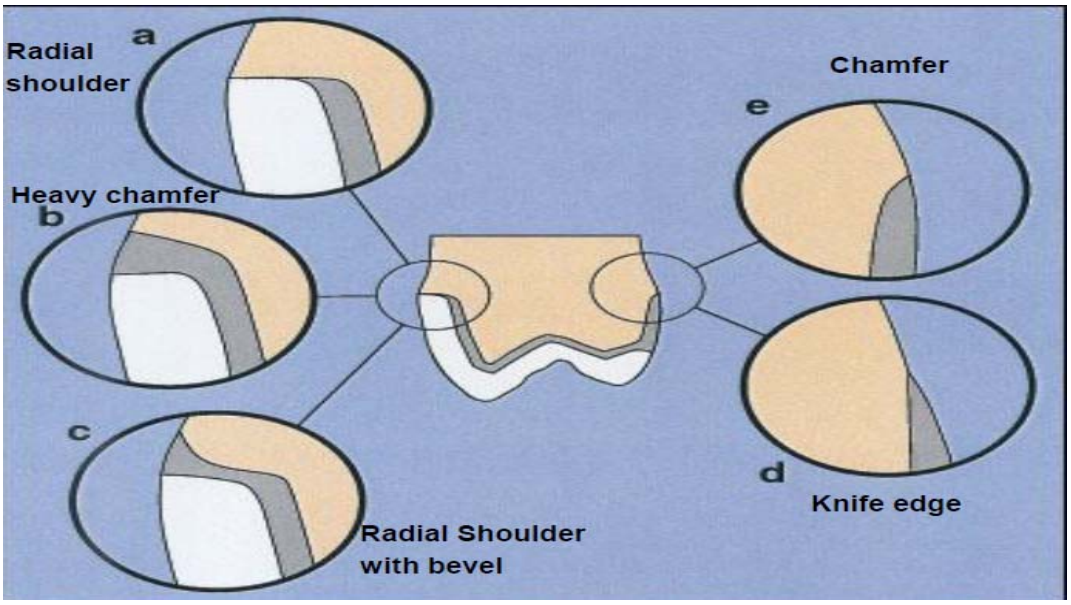
Finishing line of the preparation

The finishing line of the preparation (or the so called "The preparation margin") is the final margin that separates between the prepared and the unprepared tooth structure. This line should be smoothly continuous from one surface to another; otherwise, it will interfere with the seating of the crown if it is poorly done. The margin between the prepared and unprepared tooth structure is a very critical area as most failures start from this margin.

Types of finishing line according to its design or configuration

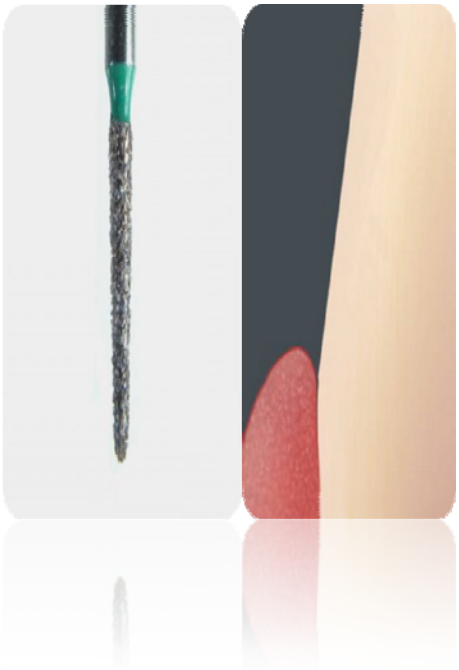
The following designs for finishing line could be used depending on the type of the crown restoration:

1. *Knife edge* (also named *"feather end"*)
2. *Chamfer*
3. *Heavy chamfer*
4. *Shoulder*
5. *Radial shoulder*
6. *Shoulder with bevel*



1. Knife edge or feather end finishing line

A pointed end tapered fissure bur (long needle diamond fissure bur) is used to provide this type of margin design. It is the most conservative type of finishing line since the least amount of tooth structure is removed, but the margin is weak since this margin design does not provide enough bulk or thickness for the material. It forms >135° cavo-surface line angle.



Advantages of knife edge finishing line

1. It is the most conservative type of finishing line.
2. It is easy to prepare.
3. It is a burnishable type of finishing line. i.e. it provides a burnishable margin.

Burnishing is the further adaptation of the margin of metal restoration to the tooth structure.

Disadvantages of knife edge finishing line

1. Difficult to be identified by the laboratory technician.
2. It provides a thin margin that is difficult to accurately wax and cast.
3. The margin of the restoration is susceptible to distortion since this type of margin design does not provide enough thickness.

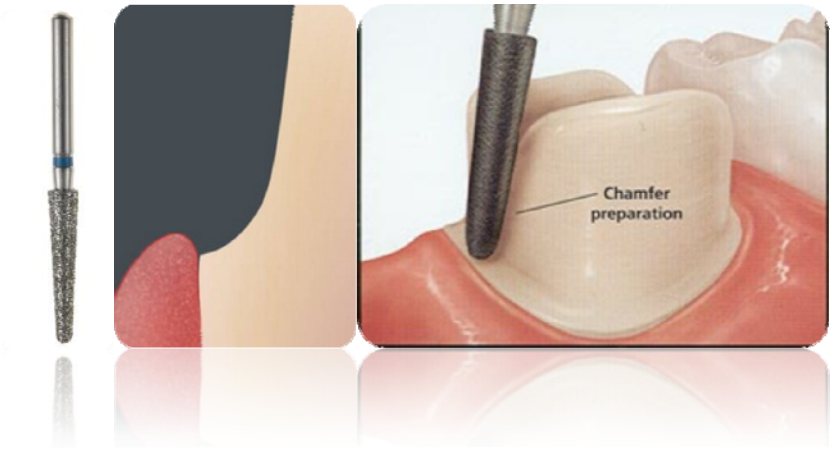
Indications of knife edge finishing line

It is mainly used for:

1. Full Metal Crown (All the surfaces).
2. The lingual and proximal surfaces of full veneer crown, three-quarter crown and post crown.

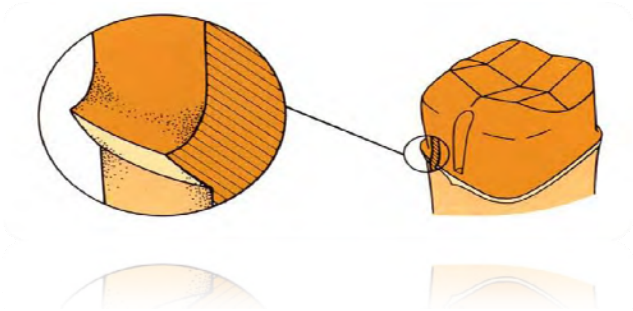
2. Chamfer finishing line

It is a well-defined finishing line somewhat like knife edge finishing line except that the cut is made deeper. It forms a 130-160° cavo-surface line angle. A round-end tapered fissure bur is used to obtain this preparation margin. It provides adequate space at the cervical region so can make the contour of the crown restoration within the contour of natural tooth without overcontouring of the final restoration. However, since the restoration margin obtained with this type of finishing line is thick, so it is unburnishable.



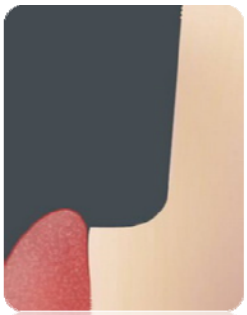
This type of finishing line is indicated for areas to be covered by metal only as the knife edge finishing line, so it is mainly used for:

1. Full Metal Crown (All the surfaces).
2. The lingual and proximal surfaces of full veneer crown, three- quarter crown and post crown.



3. Heavy chamfer finishing line

This type of finishing line provides a 90° cavo-surface line angle with a large radius internal angle, so it provides better support for the ceramic crown. It can be used with porcelain fused to metal (PFM) crown and All Ceramic crown.



4. Shoulder finishing line (Butt shoulder)

Shoulder finishing line is the least conservative type of finishing line due to the excessive amount of tooth structure removed to obtain this type of finishing line. In the "butt" type of shoulder finishing line, the axial walls meet the finishing line at a right angle. A flat-end tapered fissure bur is used to obtain this finishing line.

This type of finishing line is used when bulk is required for strength or esthetic, that's why it is almost used with jacket crown since jacket crown is made of either porcelain or acrylic resin, which are brittle materials and require enough thickness to withstand the occlusal forces without fracture. On the other hand, the increased thickness provides better shade of the material and so better esthetics.

5. Radial shoulder finishing line

Radial shoulder is a modification of the shoulder finishing line. It is a shoulder finishing line with rounded internal line angles. This will reduce the shoulder slightly and minimize stress concentration on the tooth structure from one hand and on the restoration itself from the other hand. This type of finishing line was introduced with the ongoing development in all ceramic materials in an attempt to increase the fracture strength of all ceramic crowns by decreasing stress concentration.

6. Shoulder with bevel finishing line

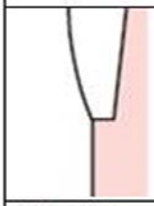
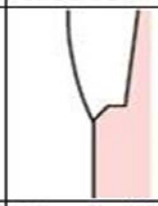
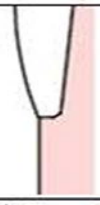
Shoulder with bevel is another modification of the shoulder finishing line by adding a bevel to the shoulder. The bevel is at 45° angle.

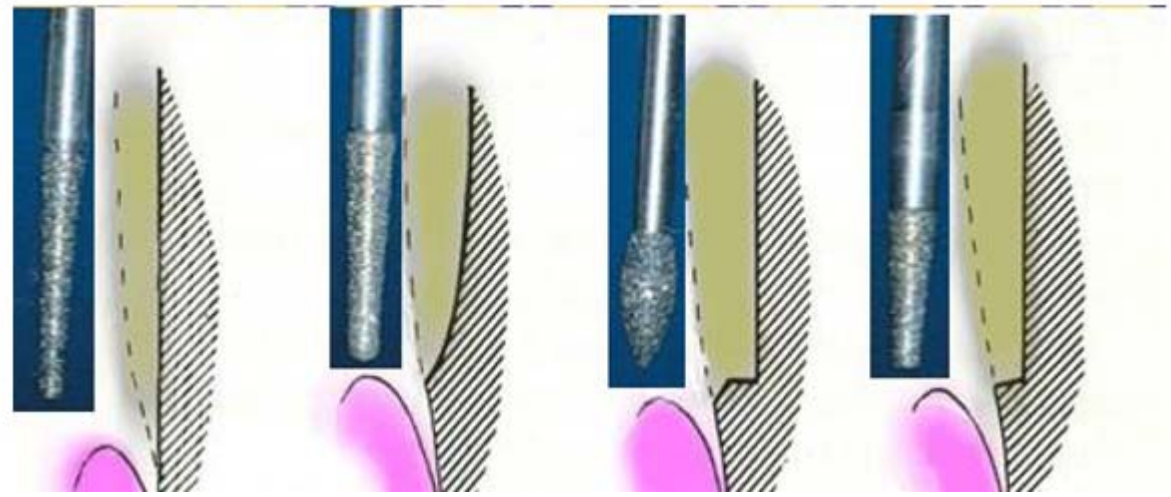
Objectives of adding a bevel to the shoulder finishing line

1. The bevel provides a burnishable margin for the metal that may extend sub-gingivally (The thinner it is, the more adaptable to the tooth surface).
2. To provide enough space for shape and contour.
3. To reduce marginal discrepancies.
4. To remove unsupported enamel.

Indications of shoulder with bevel finishing line

1. It is indicated when we use a combination of metal with facing material (acrylic or porcelain) as in full veneer crown, where it is used for the labial surface.
2. Shoulder with bevel is recommended for extremely short walls.

Shoulder	Bevelled Shoulder	Heavy Chamfer	Chamfer
			
Metal Ceramic Crown, All Ceramic/ Porcelain Jacket Crown	Buccal of Metal Ceramic Crown	High Strength Porcelain Crowns, Buccal of Metal Ceramic Crowns	Full Metal Crowns, Palatal/Lingual of MCC's, Resin Bonded Crowns



FULL METAL CROWN

Full metal crown is a full crown covering all axial surfaces of the tooth as well as the occlusal surface and made of metal. It is one of the most commonly indicated crown restorations for posterior teeth. Because it made of metal, it should be used when the patient doesn't mind the appearance of metal or when esthetic is not a factor. It can be used as a single unit or as a retainer for a F.P.D, especially when we have a small abutment tooth with long span edentulous area to overcome the occlusal forces and prevent bridge displacement.

Since it is a full crown, it has better retention and resistance than other crown restorations such as 3/4 Crown and 7/8crown because all the axial walls are included as well as the occlusal surface.

Types of metal alloys used for full metal crown

1. High noble alloys (gold alloys).
2. Low noble alloys (silver-palladium and gold-palladium alloys).
3. Non-noble alloys (Nickle-chromium alloy).

Indications of full metal crown

1. A tooth with extensive destruction due to caries or trauma in order to protect the remaining tooth structure from fracture.
2. A tooth with large amalgam restoration in order to protect the remaining tooth structure and amalgam from fracture.
3. Endodontically treated teeth.
4. When maximum retention and resistance needed as in a tooth with short crown.
5. Recontouring of the tooth as in a tooth receiving a clasp for removable partial denture.
6. As a bridge retainer.
7. Correction of minor inclination.
8. A patient with high caries index.
9. Correction of the occlusal plane.

Contra-indications of full metal crown

1. If high esthetic need is demanded.
2. When less than maximum retention and resistance necessary.
3. When a more conservative crown could be used such as 3/4 crown as in a tooth with intact buccal surface and very short span bridge.
4. When caries index is low.

Advantages of full metal crown

1. Greater retention and strength.
2. High resistance to deformation.
3. Modification of axial tooth contour is possible
4. More conservative than other types of full crown such as porcelain fused to metal and all ceramic crowns.

Disadvantages of full metal crown

1. Extensive tooth structure removal as compared with partial crown such as 3/4crown.
2. Difficulty to test the vitality of the tooth especially by electrical pulp tester.
3. May interfere with taste.
4. Display of metal.

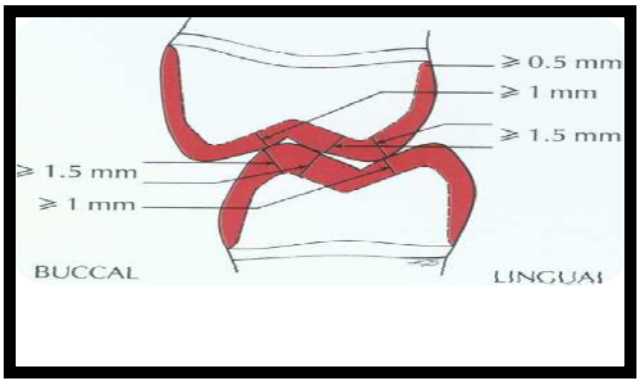
- Preparation steps:

1. Occlusal surface preparation.
2. Buccal surface preparation.
3. Lingual surface preparation.
4. Proximal surfaces preparation.

Depth Orientation grooves (D.O.G) are grooves prepared in the surface of the tooth to act as a guide or reference to determine the amount of tooth structure removed by preparation. If the preparation is done without these grooves, under and over preparation is possible, and more time will be spent by repeated checking of the preparation.

The type of finishing line recommended for full metal crown is chamfer finishing line; therefore, a round end tapered fissure bur is used in the preparation. Knife edge finishing line may also be used.

The recommended tooth reduction for full metal crown is shown in the figure below:



Occlusal surface preparation

The aim of the occlusal surface preparation is to create 1.5mm occlusal clearance over the functional cusps and 1 mm over the non-functional cusps.

Planar occlusal reduction (anatomical reduction) following the geometric inclined planes of the occlusal surface should be done for the following objectives:

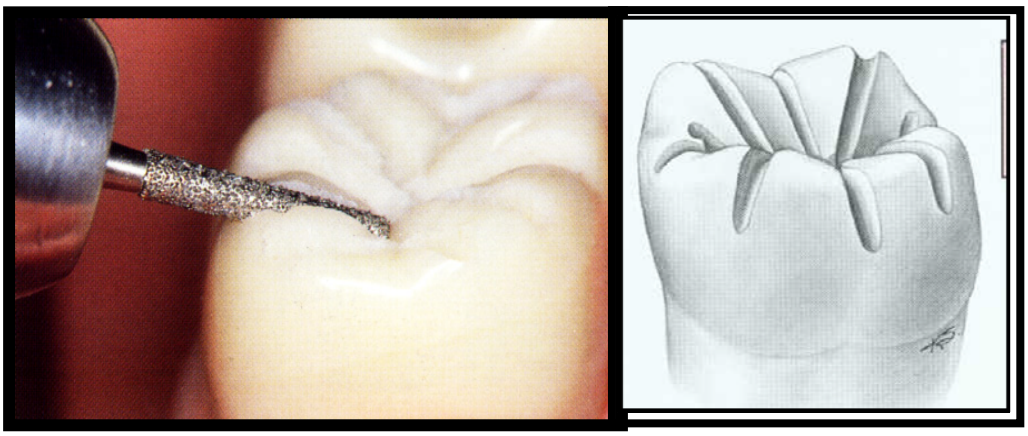
-To provide a restoration with uniform thickness.

-To preserve the tooth structure (axial wall length).

-To improve the retention- resistance features of the preparation.

The sequence of the occlusal surface preparation is as follows:

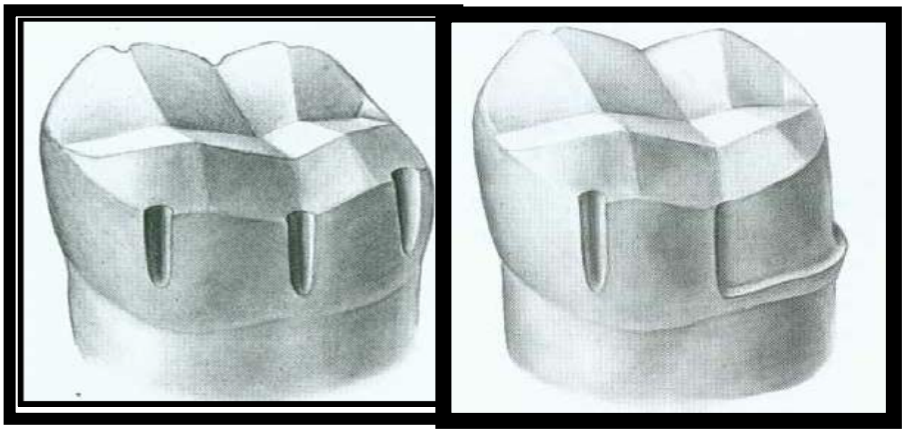
1. Depth orientation grooves (D.O.G) are prepared in the occlusal surface by a fissure bur to follow the inclines of the cusps. A D.O.G is prepared in each cusp extending from the cusp tip to the central groove, which represents the deepest part of the occlusal surface. The depth of each groove corresponds to the diameter of the fissure bur used. i.e. a fissure bur with 1.5 mm diameter is used to prepare D.O.G on the functional cusps, while a fissure bur with 1 mm diameter is used to prepare D.O.G on the non-functional cusps.
2. Any tooth structure between D.O.G should be removed following the normal contour of the cusps.
3. A wide bevel is placed on the functional cusps.
4. The occlusal clearance is then checked in centric & eccentric occlucal relations.



Buccal surface preparation

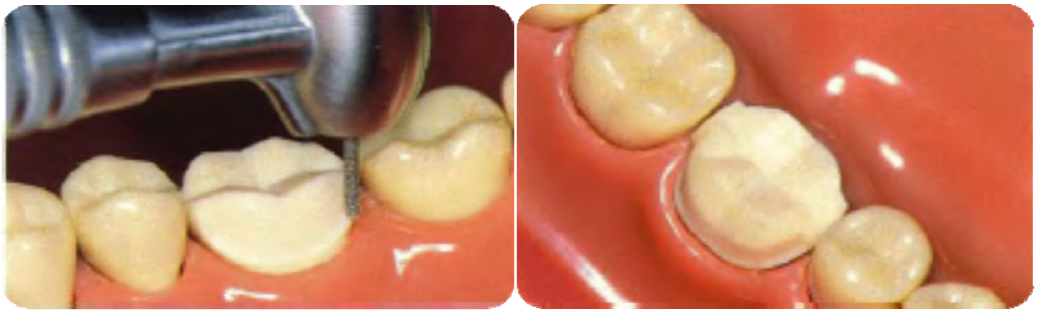
1. Three D.O.G with 1 mm depth are prepared in the buccal surface of the tooth, one placed in the center of the wall and one in each medial and distal transitional line angles. These grooves are prepared parallel to the long axis of the tooth or to the proposed path of insertion of the restoration.

2. Move the bur mesially and distally following the inclination of this surface to remove any islands of tooth structure between D.O.G. The gingival extent of the preparation will determine the position of the margin (whether to be placed supra-gingivally, which is preferable, or there is a need to extend the finishing line sub-gingivally. A round-end tapered fissure bur is used during axial reduction to obtain chamfer finishing line.



Lingual surface preparation

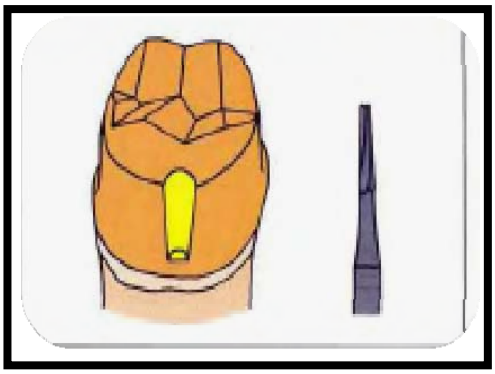
The preparation of the lingual surface is the same as that of the buccal surface.

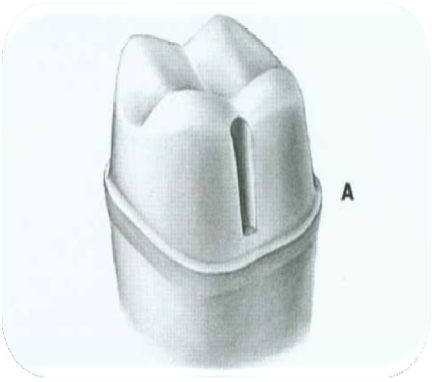


Proximal surfaces preparation

Using a very thin long pointed tapered diamond bur (long needle), the contact is removed carefully with the bur rested on the prepared tooth (to prevent any damage to the adjacent tooth), moving the bur up & down, the contact will be opened bucco-lingually. Once the contact is opened, a round-end tapered fissure bur is used to plane the wall while forming a chamfer finishing line. Safe-sided disc can also be used during the proximal reduction in order to prevent any damage to the adjacent tooth. Placing a matrix band on the adjacent tooth can also help.

After completing the preparation of the occlusal and axial surfaces, smoothening of all surfaces is done to remove sharp line and point angles because they act as stress concentration areas.



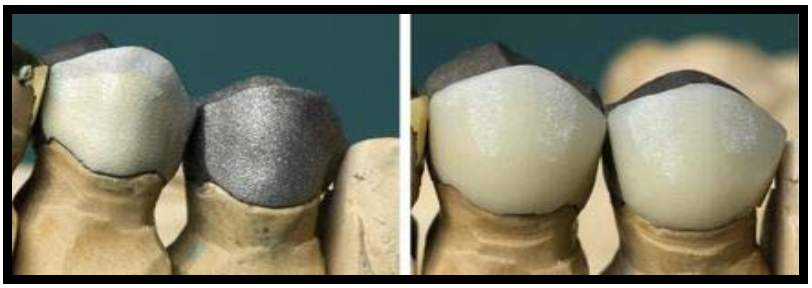


A seating groove is finally placed in the buccal surface of the lower molar and the palatal surface of the upper molar. The advantages of placing a seating groove are:

1. It acts as a guide during the placement of the crown.
2. It prevents the rotation of the crown (by increasing the resistance).
3. It improves the retention.

Porcelain Fused to Metal Crown

Porcelain fused to metal (PFM) crown is the most widely used fixed restoration. It is a full metal crown having a facial surface (or all surfaces) covered by ceramic material. It consists of a ceramic layer bonded to a thin cast metal coping. It combines the strength and accurate fit of cast metal coping with the cosmetic of ceramic.



So, this type combines the advantages of the strength of full metal crown and esthetic of all ceramic crown.

Disadvantages of PFM crown

1. Removal of substantial amount of tooth structure.

2. Subject to fracture because of the brittle nature of porcelain.

3. Shade selection can be difficult.

4. Inferior esthetic compared to porcelain jacket crown.

5. Discoloration of the gingival margin may occur with time.

6. More expensive.

Indications of PFM crown

1. Teeth need to be completely covered for esthetic demand.

2. As a retainer for fixed partial denture.

3. Similar to those of full metal crown.

Contra-indications of PFM crown

1. Teeth with large pulp (because of the possibility of pulp exposure during preparation).

2. Intact buccal wall where a more conservative retainer can be used.

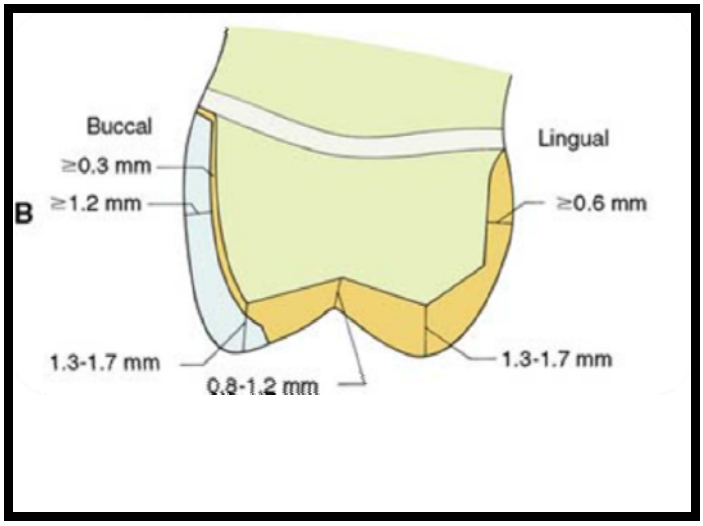
3. Teeth with short crowns.

4. Patient with bad oral hygiene.

Preparation Requirements:

- Deep facial reduction to provide enough space for the metal coping and porcelain and shallower reduction on the other surfaces covered with metal only.
- Shoulder, radial shoulder, or heavy chamfer can be used as a gingivo-facial finishing line, whereas chamfer or knife edge finishing line is used for the remaining surfaces covered with metal only.

Since this restoration is a combination of metal & porcelain, tooth preparation likewise is a combination.



Tooth preparation of PFM crown (for anterior teeth)

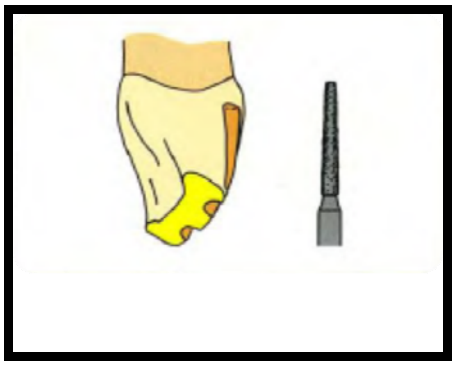
Fabrication of silicone index

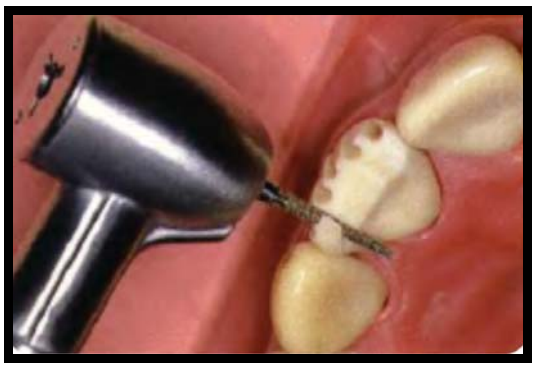
The silicone index acts as a guide to check the amount of tooth structure removal.

Incisal reduction

2 mm should be removed from the incisal edge to allow for adequate translucency of the restoration.

Flat-end tapered diamond bur is used, placed parallel to the incisal inclination (with a slight palatal inclination in the upper incisors and labial inclination in the lower incisors).





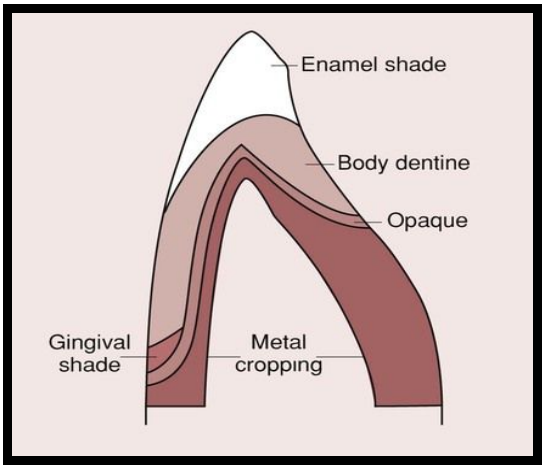
Labial reduction

PFM crown preparation requires deep facial reduction to give enough space for metal and porcelain, and thus avoiding over contouring and poor esthetic which would inevitably occur when no enough tooth structure is removed. The amount of labial reduction is 1.5-2 mm.

Advantages of adequate reduction (deep facial reduction)

1. The restoration will properly contour (effect on esthetic & gingival health).
2. The shade & translucency of the restoration will match that of the adjacent natural tooth.

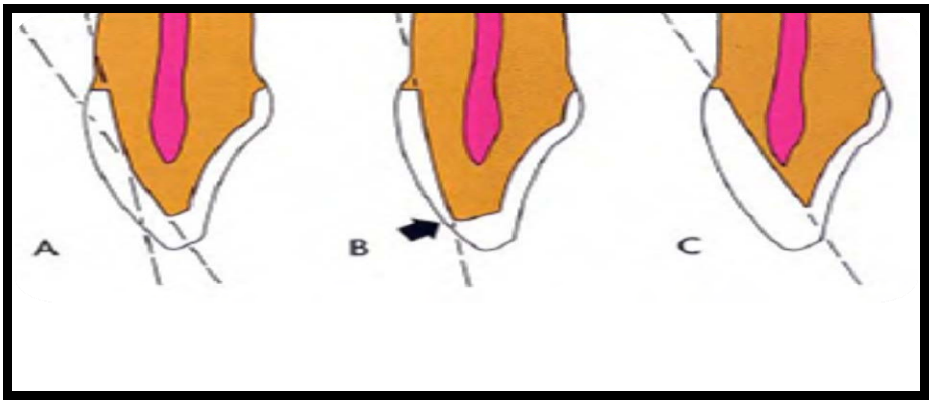
- 0.5 mm for the metal coping.
- 1 mm for porcelain (0.2 mm opaque layer, 0.5 mm body “dentin” layer, and 0.3 mm incisal “enamel” layer).



Because of the anatomy of the tooth labially, it should be reduced in two planes corresponding to the two geometric planes of the labial surface: a gingival plane and an incisal plane.

Advantages of two plane reduction

1. To follow the anatomy of the surface.
2. To avoid hitting the pulp.
3. To give enough space for the metal and porcelain layers, so that avoiding poor esthetic or over contour.



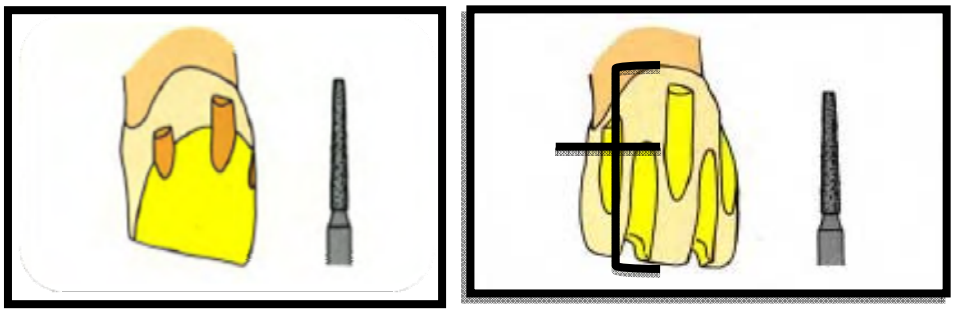
a.Gingival plane

Three D.O.G (1.5 mm in depth) are placed in the gingival third of the labial surface parallel to the long axis of the tooth.

b.Incisal plane

Three D.O.G (1.5 mm in depth) are prepared parallel to the inclination of this area.

Flat-end tapered fissure bur is used to create a shoulder finishing line extended 1mm lingual to the contact.



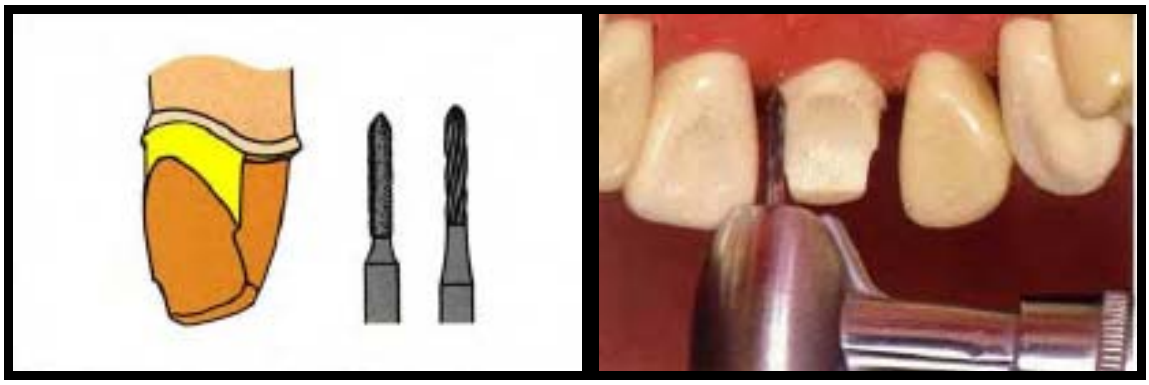
Palatal (lingual) reduction

a. Cingulum area reduction

D.O.G. of 1mm in depth is placed in the center using a round bur 1 mm in diameter. A small wheel diamond bur is then used to reduce this area following the concavity of this part of tooth surface.

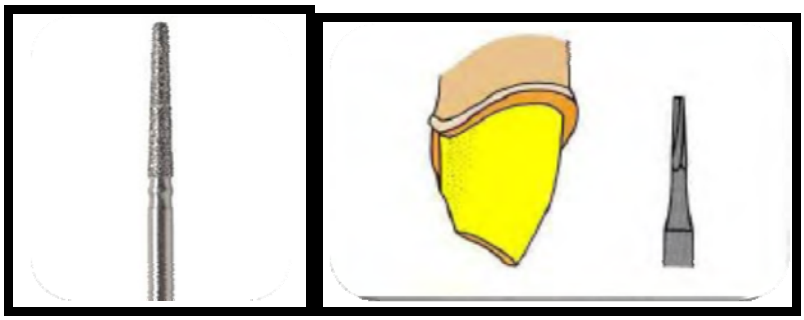
b. Lingual axial reduction

D.O.G. of 1mm in depth is placed parallel to the long axis of the tooth. A round- end tapered fissure bur is then used to reduce this area parallel to the long axis of the tooth to create chamfer finishing line.

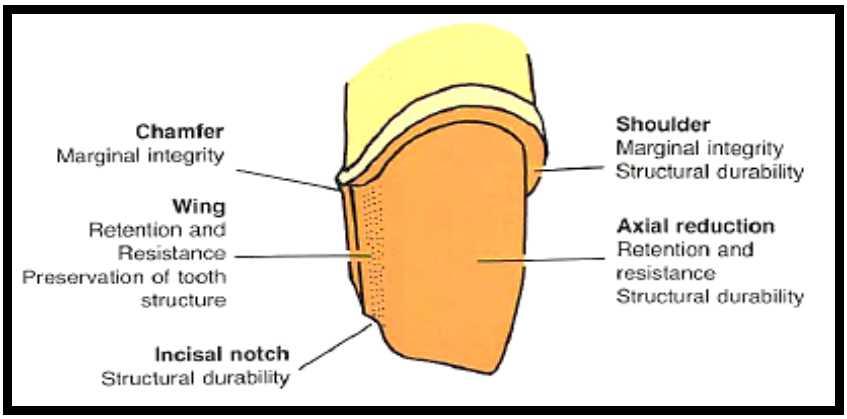


Proximal reduction

A pointed tapered fissure bur (long needle) is used to break the contact with the adjacent tooth, moving the bur up and down from the palatal to the labial. A round-end tapered fissure bur is then used to create a chamfer finishing line continuous with the chamfer finishing line of the palatal surface and joining the shoulder finishing line of the labial surface at a line angle called "wing".



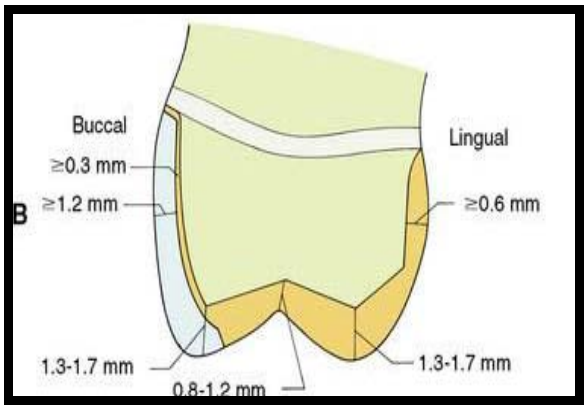
Checking of the amount of tooth reduction using the silicone index.



Tooth preparation of PFM crown for posterior teeth

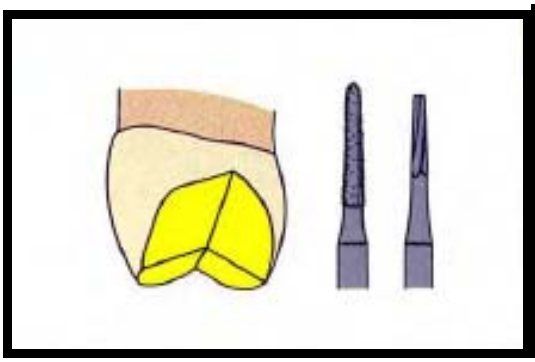
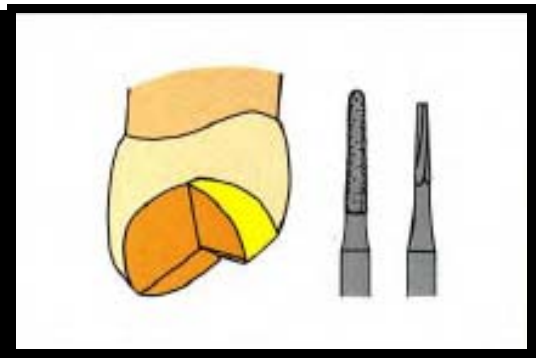
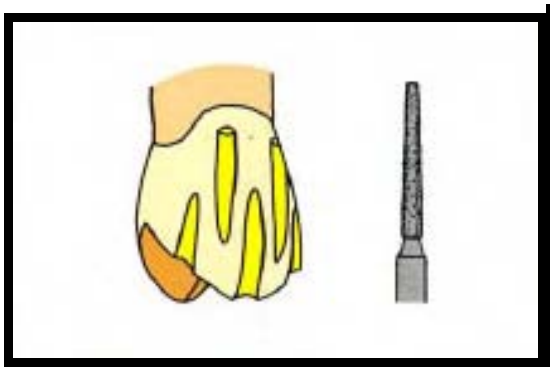
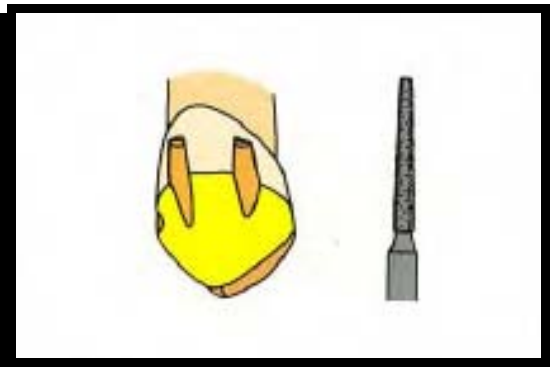
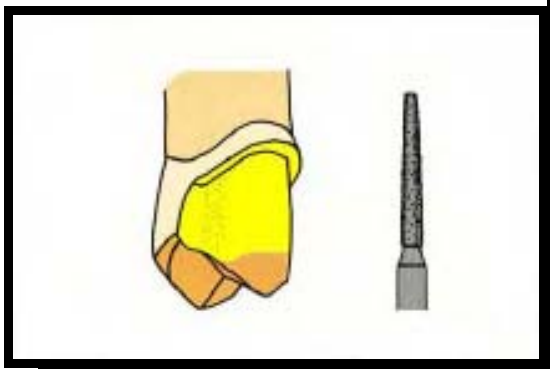
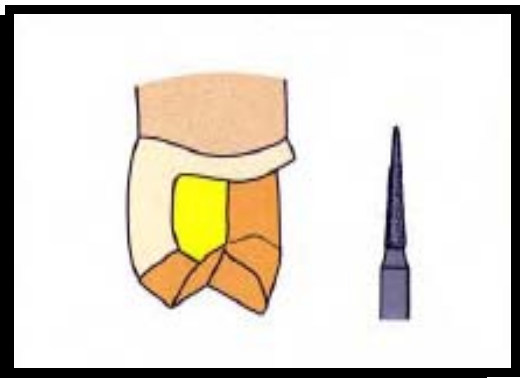
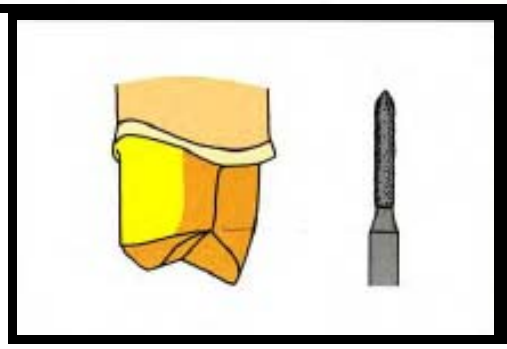
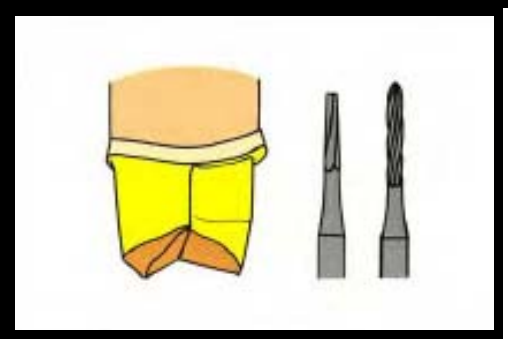
The same principles of full metal crown preparation are used with exception of providing a deep reduction in the area that is to be covered with both metal and porcelain.

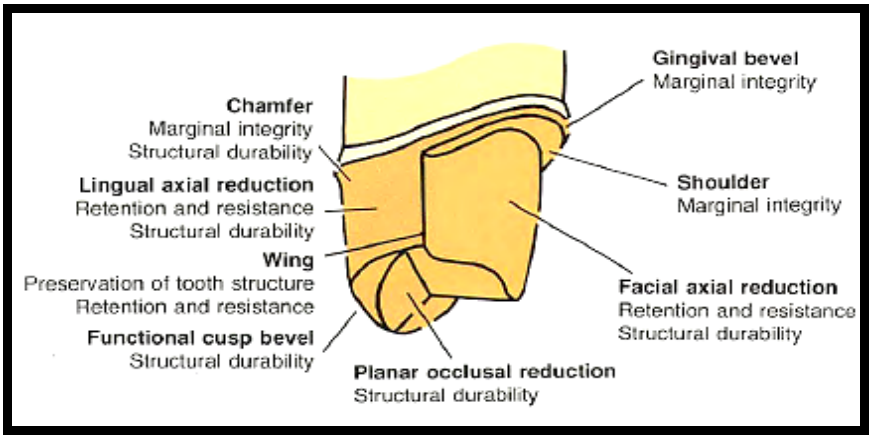
- 1.5 mm for the non-functional cusps.
- 2 mm for the functional cusps.
- 1.5-2 mm for the facial reduction.



The same steps of PFM crown preparation for the anterior teeth are used for the posterior teeth starting with fabrication of a silicone index.





Full metal crown with acrylic facing

- It is a full metal crown whose labial or buccal surface is covered with tooth-colored acrylic resin. It has been widely used previously before the use of porcelain as a facing material, but still used nowadays due to its lower cost as compared to PFM.
- It combines the strength and accuracy of full metal crown with the esthetics of tooth-colored acrylic resin.
- It is less expensive than PFM crown.
- The preparation involves deep facial reduction to provide enough space for both metal and facing material.
- The finishing line is shoulder with bevel facially (labially or buccally) and chamfer or knife edge for the other surfaces. When esthetic is critical, sub-gingival positioning of the finish line is recommended.

The main disadvantages of this type of crown are related to the acrylic facing material, including discoloration with time, wearing, and poor compatibility of the acrylic resin with the gingival tissue.

Complete Ceramic Crown (All ceramic Crown)

The most esthetically pleasing fixed restoration. Because, there is no metal understructure to block light transmission, it can resemble natural tooth in term of color and translucency than can any other restoration.
Since it made entirely from ceramic substance, it is the weakest type of crown restorations (more susceptible to fracture). It isn't conservative type of crowns. **Most of the time** it used as single restoration on upper or lower incisors.

Advantages;

1. Superior esthetic.
2. Good tissue response even for subgingival margins.
3. Slightly more conservative of facial wall.

Disadvantages;

1-Reduced strength compared to MCR (PFMC).
2-Proper preparation extremely critical.
3-Among the least conservative preparations.
4-Britle nature of the material.
5-Can be used as single restoration only.

Indications;

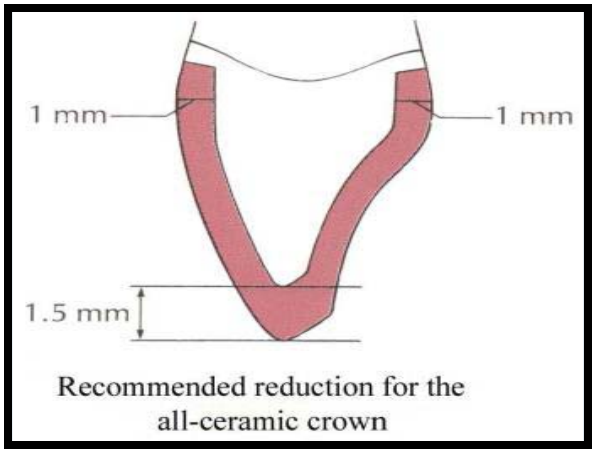
1. High esthetic requirements.
2. Considerable proximal caries.
3. Endodontically treated teeth with post & cor.
4. Incisal edge reasonably intact.
5. Favorable distribution of occlusal load

Contra-Indications;

1-When superior strength required & PFMC more appropriate.
2-Thin teeth faciolingually.
3-Unfavorable distribution of occlusal load.
4-Insufficent coronal tooth structure for support. (Very short teeth)
4-Edge to edge occlusion.
5-Bruxism

Tooth Preparation (PJC)

Recommended dimensions



Recommended reduction for the all-ceramic crown

Preparation requirements:

1. The preparation must be as long as possible to give support to porcelain. Short prep ---- stress concentration in lingual area ----- fracture in this area.
2. A shoulder of uniform width (1mm) is used as gingival FL to provide a flat seat to resist force directed from incisal.

3. Incisal edge is flat and should prepared with slight inclination toward the lingual. , for the lower – labial inclination.
4. All sharp angles of preparation should be slightly rounded to reduce the danger of fracture by point of stress concentration.
5. It should be avoided on teeth with edge to edge occlussal relation.
6. The occlusion on all ceramic crown is critical for avoiding fracture. Centric contacts are best confined to the middle third of the lingual surface.

Steps in preparation;

Prior to tooth reduction a silicon index is constructed.

1. Incisal Reduction;

-- Complete reduction of incisal edge should provide 1.5 – 2mm of clearance for porcelain in all mandibular movements, this important to have cosmetically pleasing restoration with adequate strength.
Flat end taper diamond bur is used, placed parallel to the incisal inclination. (For post. teeth 2mm.occl clearance is needed ion all cusps).
1))) Depth orientation grooves (D.O.G.) 1.3mm in depth are made on the incisal edge using a flat end T.F.B, parallel to the incisal inclination of the prepared incisal edge
2))) Any tooth structure between D.O.G should be removed using the same bur at the same angle. (1.5 mm)
3))) Incisal clearance then checks in centric & eccentric occlusal relations.

2. Labial (Facial) Reduction

Two planes reduction

Because of the anatomy of the tooth labially it should be reduced in two planes corresponding to the two geometric planes of the labial surface gingival plane and incisal plane.

Incisal plan;

1. Three D.O.G. (1mm.) are placed, the angle of these grooves should be parallel to the inclination of this area.
2. Any tooth structure between D.O.G were then removed following the contour of the tooth (keep the bur at the same angle)

Gingival plan;

1. D.O.G.(1mm) are placed in gingival part of L.S. parallel to the long axis of the tooth.
2. Any tooth structure between D.O.G should be removed using flat end T.F.B to create shoulder F.L.

3. ***Lingual reduction:***

As for **PFM** but with **deeper reduction** (1mm)

a. Cingulum area reduction;

-----D.O.G. of 0.8mm placed in the center.
----small wheel diamond is used (following the inclination of the tooth) to reduce this area.

a. Lingual axial reduction;

a. Cingulum area reduction;
-----D.O.G. of 0.8mm placed in the center.
----small wheel diamond is used (following the inclination of the tooth) to reduce this area.
a. Lingual axial reduction;
-----D.O.G. of 0.8mm placed parallel to the long axis of the tooth.
----Flat end T.F.B is used to reduce this area using the same angle (to create shoulder F.L.).

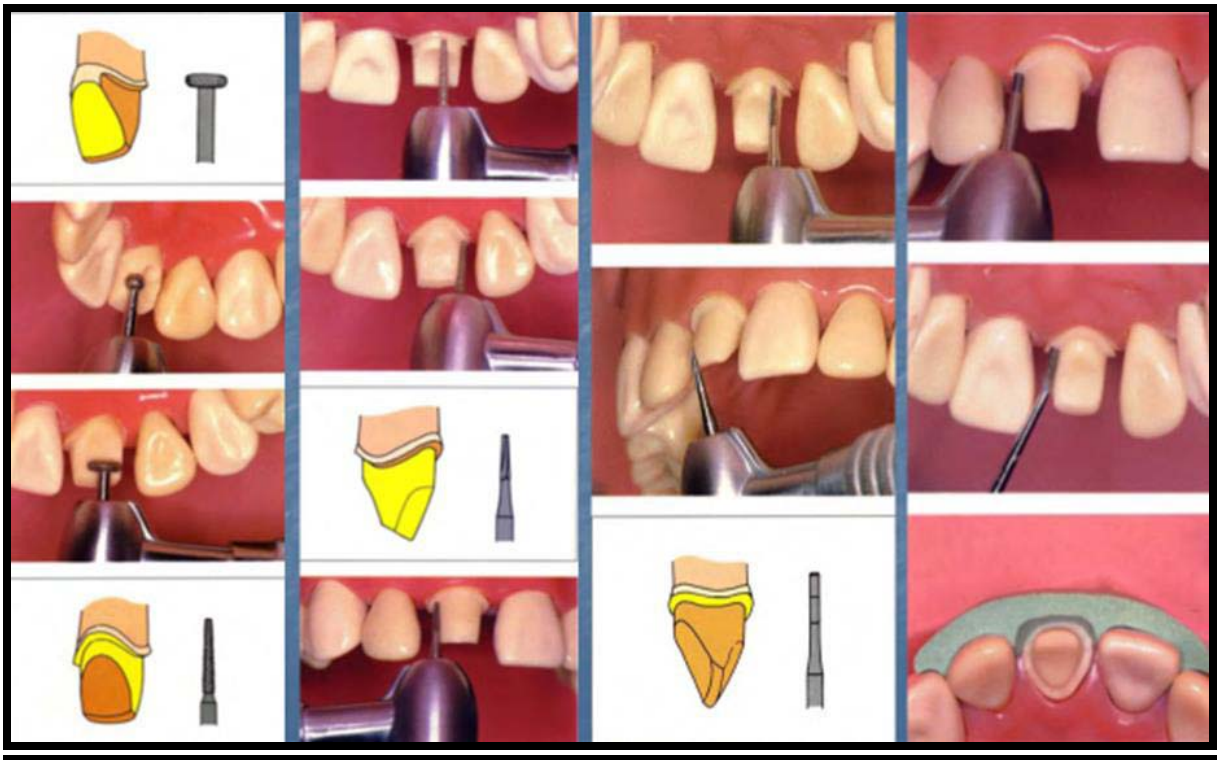
4. Proximal reduction.

Preparation of the proximal surfaces is done in the same manner as in the full
metal crown preparation.
----Silicon index can be used now to check tooth reduction

----- ***Smoothing of the preparation*** *finally you should smooth the preparation to remove any sharp angle.*

<u>Types of finishing lines used for PJC (all ceramic crown)</u>

Shoulder or RS all around has been advocated as gingival finishing line to be use with PJC. The depth and contour of shoulder is established with the tip of flat end tapered fissure bur. *Sharp angles should be rounded to avoid creation of point of stress concentration.*



Acrylic Jacket Crown

AJC is totally made from tooth colored acrylic resin; it can be near perfect in appearance when fitted but later on discoloration, loss of contour take place. Poor adaptation is great disadvantages of acrylic crowns-------- Coefficient Thermal Expansion.

AJC is used in treatment of selected patient such as young patient for whom other type of crown restoration are planned but delay until complete eruption of tooth take place.

Most of time, AJC is used as temporary crown restoration.

The preparation of the tooth is basically the same as that for PJC .

Disadvantages;

1. Poor marginal fitness.
2. Poor tissue response.
3. Discoloration with time.
4. Loss of contour (wear easily).

Partial Veneer Crown(Three quarter crown)

It is a cast metal crown restoration that cover only a part of the clinical crown, most commonly used type of partial veneer crown is ¾ (three quarter) crown.

Three quarter (¾)crown:

It is a cast metal crown restoration that cover three quarter of crown (occlusal or incisal, palatal or lingual and proximal) leaving the labial or buccal surface unprepared, it tend to be less retentive and resistance than full veneer crown .It can be used for anterior or posterior teeth. It can be used as single restoration or as a retainer for short span bridge.

Uses:

1. As a retainer for short span bridge.
2. As a single restoration.
3. As a splint in anterior teeth.

Indications

---- For posterior teeth;

1. Lost moderate amount of tooth structure with intact and well supported buccal surface.
2. Retainer for fixed partial denture.

----- For anterior teeth;

1. Suitable for teeth with a sufficient bulk and intact labial surface.
2. Retainer for F.P.D. or splinting of anterior teeth.

Contraindication:

1. Short clinical crown.
2. High carries index.
3. Extensive destruction
4. Poor alignment.
5. Thin teeth
6. Long span bridge.
7. Non-vital teeth.

Advantages of 3/4 crown:

1- Conservative of tooth structure.

2- Easy access of margins.

3- Less gingival irritation than complete crown.

4- Easy escape of cement and good seating.

5- Electrical pulp test is possible.

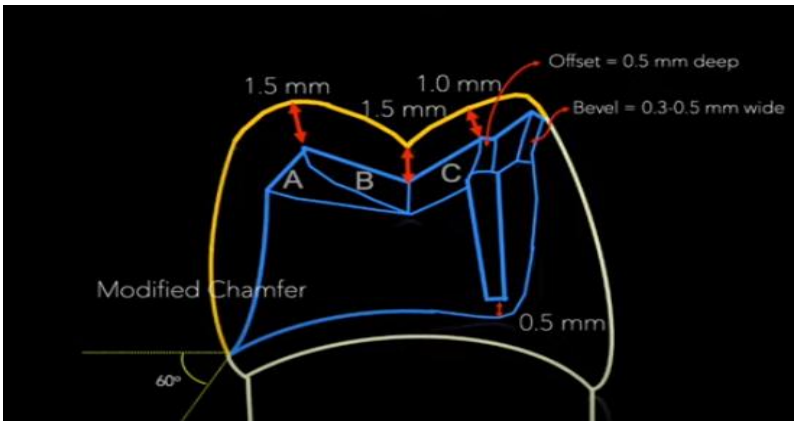
6- Complete seating of the crown can be easily seen by direct observation.

Disadvantages:

1-Difficult in preparation compared to other types of crown restorations.
2- Possibility of recurrent caries more along the cavo-surface line angle.
3- Possibility of showing metal especially in the lower anterior &posterior teeth.
4-Less retention and resistance than complete cast crown.
5-Limited adjustment can be done in the path of withdrawal.

Tooth Preparation :

Recommended dimensions



- *1.5 mm on functional cusp (lingual)*
- *1.0 mm on non-functional cusp (facial)*
- *Less than 0.5 mm on facial cusp tip if sufficient horizontal overlap*
- 1.5 mm clearance
- Follow contours of opposing tooth
- Maintain contours of tooth being prepared
- Extend bevel into lingual embrasure

Steps in preparation on maxillary posterior teeth ;

1.Occlusal surface preparation

1. D.O.G. placed on the anatomic ridge and grooves of occlusal surface using round end taper fissure bur, the grooves should extend through occluso-buccal line angle but only with 0.5mm deep to prevent metal display.
2.Occlusal reduction were then complete by removing tooth structure between grooves reproducing the geometric inclined plan pattern of cusps, the depth of reduction should be decrease at the OB line angle.
3.Awide bevel is placed on the functional cusps using the same bur .
4.Occlusal clearance were then check in centric & eccentric mand.relations.

2.Lingual surface preparation;

It is done similar to other types of crown:

- D.O.G. are placed using the same bur, they should be placed parallel to the long axis of the tooth.

-Reaming tooth structure between grooves were then removed following the contour of the tooth holding the bur parallel to the long axis at the tooth

-A round –end tapered fissure bur is used to obtain Chamfer finish line that 0.5 mm supragingival

3.Interproximal Reduction

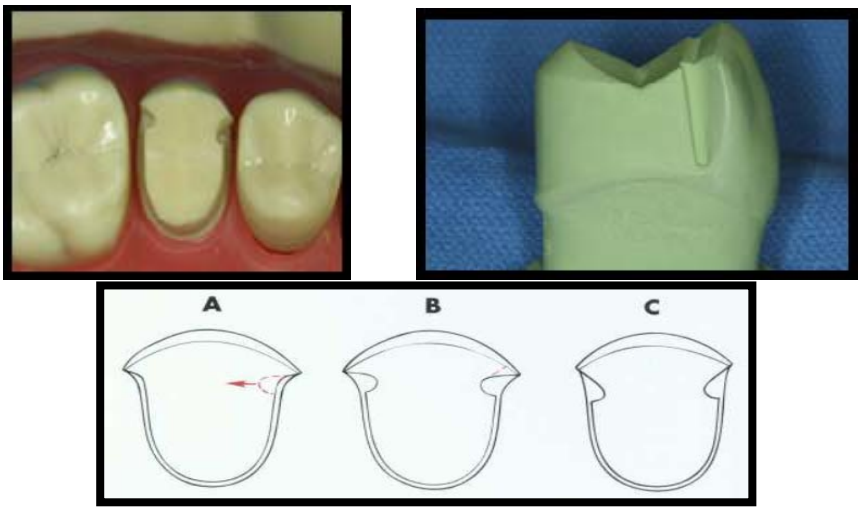
- Proximal access is gained by short needle diamond, up and down movement, this continue until contact with adjacent tooth is broken & access for larger bur is produced .
- extend facially and gingivally to break contact with adjacent tooth
- Proximal grooves (mesial and distal) are placed parallel to the path of withdrawal and parallel to each other using carbide fissure bur. Normally, unsupported tooth structure will remain on the buccal side, and this side is flared to remove it.
- Avoid damage to adjacent tooth and excessive axial reduction

Proximal grooves:

As a part of proximal reduction& in order to improve retention feature of the preparation &as a substitution for the uncover wall, proximal grooves should be placed on each proximal wall. It should be parallel to the long axis of the tooth or path of insertion & parallel to each other. Carbide fissure bur is used to place these grooves.

-Requirements:

1.It should cut to full diameter of carbide bur No.171(0.5mm) to create defiant lingual wall.
2.It should extend to the full length of proximal wall (ending about 0.5mm to the chamfer).
3.It should be placed as far as facially as possible without underming facial surface (bet. Middle &labial third).
4.It should be parallel to the long axis of the tooth.



Advantages of Proximal grooves;

1.Increase retention.
2. Prevent rotation (resistance).
3.Reinforce the margin of restoration at this area.
4.They act as a guide during placement.

Occlusal offset;

1mm.wide groove made on the lingual incline of the facial cusp, it is V shape inverted lie at uniform distance from occlusal finish line.

Advantages;

1. Improve the strength of the casting.
2. Reinforce the margin of the restoration at this area.

Finishing line :

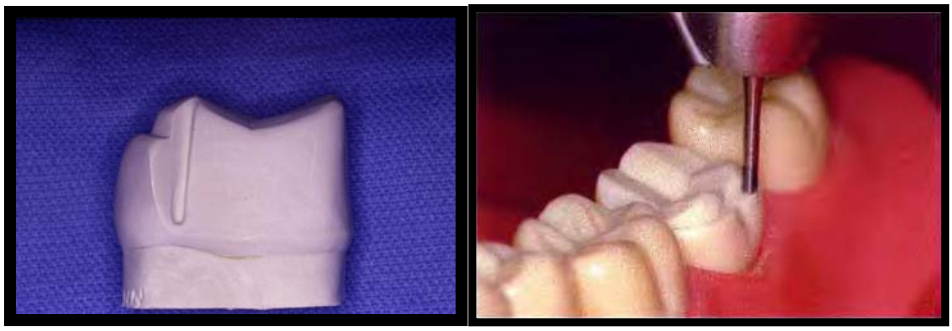
- *Chamfer is used as gingival finish line on lingual &proximal surfaces*
- *45 degree bevel F.L. were used on proximofacial & occlusofacial margins*

Mandibular posterior 3/4 Crown

Differences between upper &lower posterior ¾ crown preparation:

1. Big difference is the position of FL on facial surface, for max.pos. teeth it terminate near the bucco-occlusal line angle while in mand.pos. teeth the occlusal FL is 1mm. gingival to the lower occlusal contact with the upper teeth, this is because the buccal cusps in lower are the functional cusps.

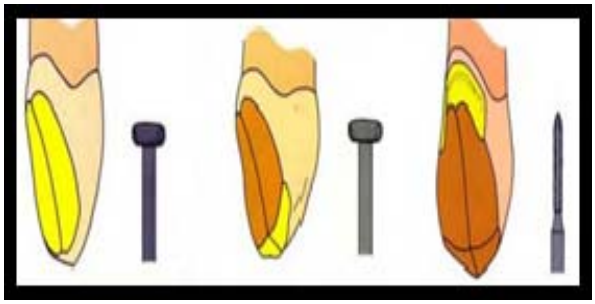
2.In upper, there should be occlusal offset however , for the lower there is no offset, in state, there is bucco-occlusal shoulder (occlusal shoulder on the buccal aspect of the buccal surface), it serve the same purpose as the offset.



3/4 Crown Maxillary Anterior

1-lingual reduction: **t**his is done by two steps similar to other types of crowns.

a. Cingulum area reduction;
b. Lingual axial reduction;



2.Incisal termination:

For max. ant. teeth lingo-incisal bevel is place using diamond bur at 45˚to the path of insertion, this termination should not be extended labially to

prevent showing of metal, however, for lower anterior a reverse bevel is placed on the labial surface . This means that, the metal will extend to cover the incisal edge in order to;

1. Protect the area of unsupported enamel from fracture.

2. To prevent the dislodgment of the crown in lingual direction.

3.Proximal reduction:

The area is prepared similar to the full veneer crown except that the preparation should have a path of insertion parallel to the incisal 2/3 of the labial surface(not to the long axis of the tooth).

Two proximal grooves should be placed ,at the junction between the labial and middle third of the proximal surface, parallel to the incisal 2/3 of the labial surface (path of insertion) using a carbide fissure bur **, this is because;**

1. *We can place the longest groove in this direction (better retention).*
2. *to avoid over cutting to the labial surface (if we do it parallel to the long axis) that effect on esthetic.*

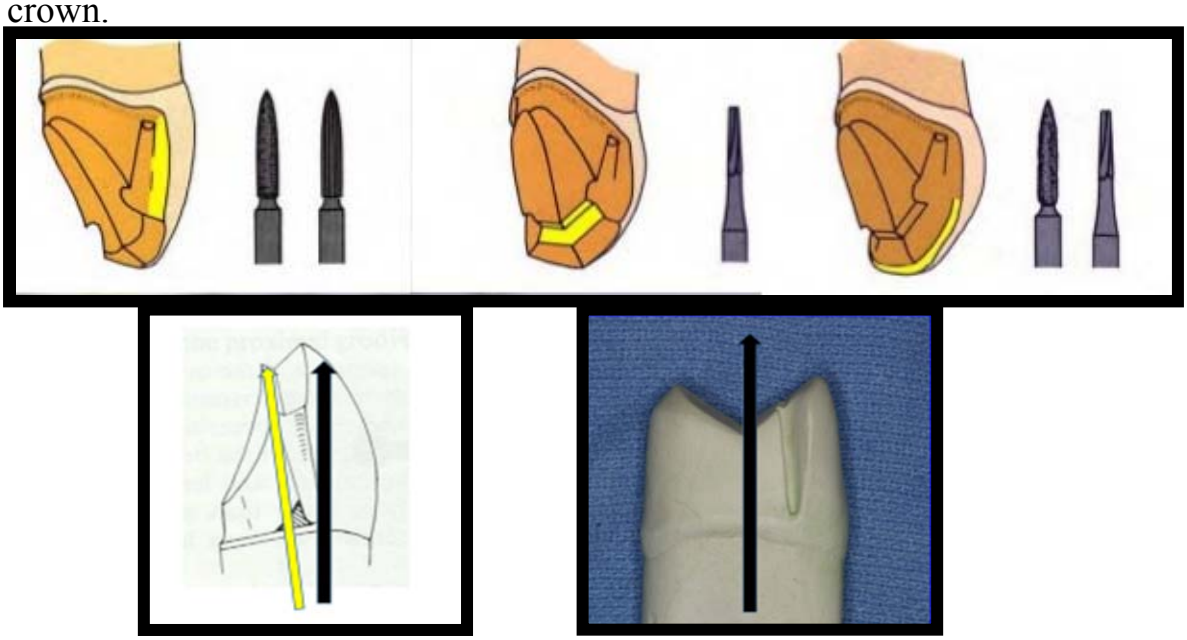
The mesial and distal grooves should be connected with V shape groove incisal offset. **The advantage of the incisal offset are;**

1. *improvement of the strength of casting at this area*

2*.reinforcement of margin by connecting the two proximal grooves together*

Differences between anterior and posterior teeth preparation

In the anterior teeth the retentive proximal groove should be parallel to the incisal 2/3 of the labial surface while in the posterior teeth it is parallel to long axis to get the longest groove for better retention of crown.



Post crown

It is a fixed artificial cast restoration which replaces the coronal portion of the natural tooth completely; retains itself by a mean of post (dowel) that extended and cemented into the root canal space of endodontically treated tooth.

The dowel post serves two functions;

1) Intra-canal retentive mean for the coronal restoration.
2) It increases the horizontal fracture resistance of the remaining tooth structure.

Indications:

1. It is commonly indicated on endodontically treated teeth that have;
a) Remaining tooth structure unsuitable for any other mean of restoration.
b) Core reconstruction is needed.
c) Intra-canal retention is the only mean for retention possible for the coronal restoration.
2. Re-alignment of malposed tooth.
3. As bridge retainer.
4. Tooth with short clinical crown.

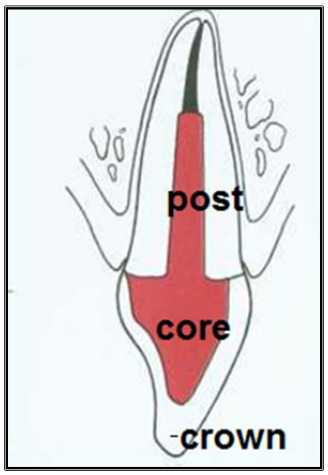
Contraindications(Custom Cast Dowel Core)

1. Unsuccessful endedontic treatment.
2. Significant coronal tooth structure remain
3. Inadequate root length
4. Caries on root or in canal

***Factors to be considered in assesment of a tooth for post crown*:**

1. Quality of the root filling, it should be filled with a well condense gutta percha filling material especially at the apical third of root space.
2. The root should have proper alignment, because any abnormality in the alignment of the root in relation to the adjacent teeth make the construction of post crown difficult. .
3. The root should be without internal or external resorption
4. Periodontal condition and mobility of the tooth.
5. Occlusal relationship should be evaluated.

Basic components of post crown :



a)Crown:

It is the final restoration that placed over the core, it could be a full metal, full veneer or jacket crown.

b) Core:

It is the coronal extension or addition to the dowel post necessary to provide the desire retention for the final crown restoration.

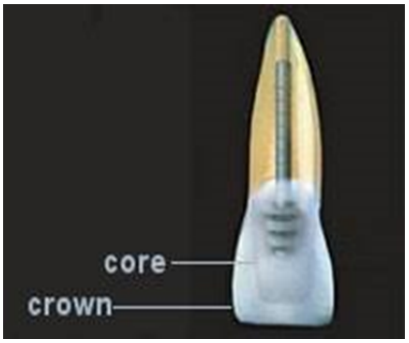
c) Post (dowel):

It is the part of the restoration that extended into the root canal and give support and retention for the coronal restoration.

There are two types of post- crowns

1-Two unit post crown (post and core +crown)

2-One unit post crown (post + core + crown one piece).



One unit post-crown

Two unit post crown

One unit post-crown

The final crown restoration is direct extension of the dowel post. It indicated in some cases , for example tooth with very short clinical crown (as with lower incisor) in such a case there is insufficient space within the crown of the tooth to make both retentive core and separated crown so one piece post crown often the solution.

Two unit post-crown

Advantages and indications

1) Crown restoration can replaced at some future time, if necessary, without disturbing the dowel core part of restoration. That is why two units post crown indicated in young patient (under 18 year age).

2) When the endodontically treated tooth is to be used as abutment for fixed bridge (bridge retainer), it is not necessary to make the post crown preparation parallel to the 2ed abutment.

3) Marginal adaptation and fit of the crown restoration are independent of any dowel that must be used

Post classification;

1) Prefabricate or ready-made dowel post

One advantage of using prefabricated posts is the simplicity of the technique it doesn't need a negative reproduction of the prepared canal. Stainless steel, Carbone fiber or fibro glass material might be used in it construction, it come in different size, design (parallel side, taper, parallel with taper end…etc). A post is selected to match the dimensions of the canal, and only minimum adjustment is needed for seating it to the full depth of the post-space.

2) Customized Cast Post :

It is fabricate from a negative reproduction of the prepared canal, it constructed from metal alloy. The main advantage of this type that is it conform closely to the configuration of the prepared canal. It indicated on avoid canal and contraindicated in narrow and severely curved canal.

Prefabricate dowel post

Customized Cast Post

Tooth Preparation

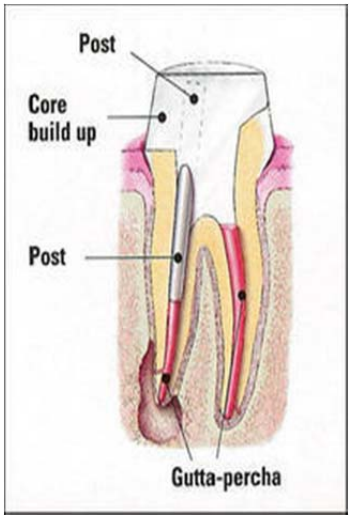
1)Preparation of the coronal portion:

1. Remove any existing restoration, caries, and any thin or unsupported wall of tooth structure. Most of the time, this will end with leaving about 2—5 mm. of sound tooth structure super gingivally.
2. The coronal portion (remaining) were then prepared according to the type of the final crown restoration. For example, if the final restoration was Jacket crown; shoulder F.L. should be created all around.

2) Preparation of the Canal:

The instrument of choice for removing gutta percha and enlarging the canal are Pesso reamers, they come in different size ranging from 07—1.7mm , **advantage of using this bur**, it has a blunt non cutting end so it will follow the path of least resistance without perforating the root.

The steps will be as following:



1) Taking a radiograph to show the length, width, shape of the canal in addition to the type and the quality of the filling material especially in the apical third of the root.

2) Removal of gutta percha filling material from the pulp champers using hot instrument (endodontic condenser).

3) Measure a Pesso reamer against radiographic film of the tooth being restored to determine the length to which the bur will be inserted into the canal (2/3 of root length).

The length of the dowel should be equal to 2/3 of root length or equal to the crown length, whichever is greater keeping in your mind you should have at least 3-5 mm filling at the apex to get the maximum retention and support for the post and to prevent the dislodgment of the apical gutta-percha filling material on the other side this if happen will lead to the leakage followed by failure of the case

4) Remove gutta percha with Pesso reamer up to 2/3 of root length, the canal sides should be parallel to each other with slight flaring toward the outside**.**

In short teeth accessory retention means may be used as pins, where the pin hole should be placed parallel to the post canal preparation. Diameter of the prepared canal should be no more than one third the root diameter at C.E.J.and should be at least 2mm less than root diameter at mid root area.

5) A **key way** is done about 1 mm width and 4 mm extended into the orifice of the canal using a flat ended fissure bur; it should be placed in the area of the greatest bulk**.**

Advantages of Key Way:

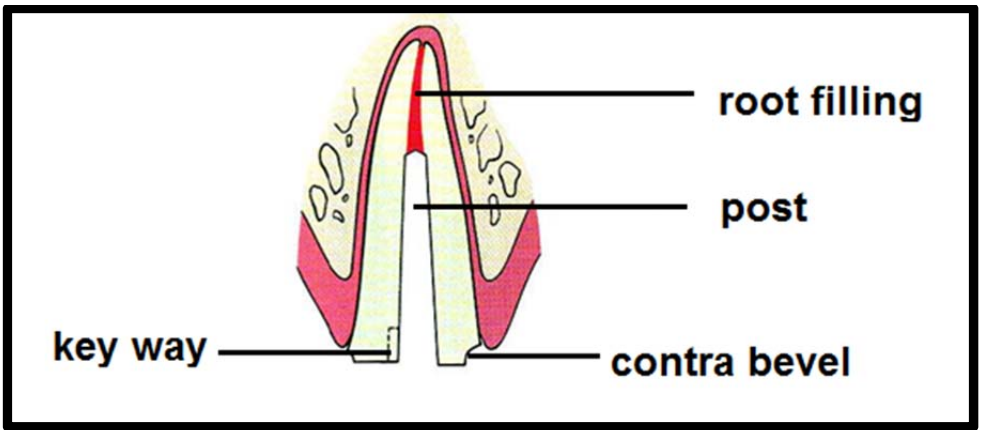
1. It acts as a guide during placement of the dowel post restoration.
2. It acts as ant-rotational device by preventing the post from rotation.
3. Improve the retention.

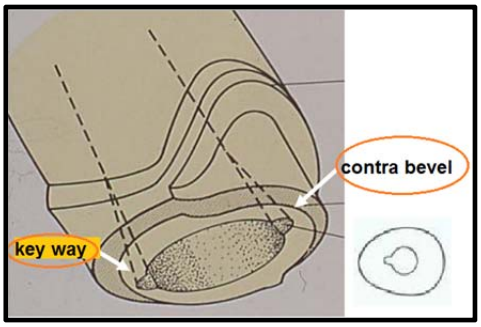
For multirooted teeth, the post dowel should place in the largest canal, usually it's the palatal canal for upper molar, distal canal for lower molar and the buccal canal for the maxillary premolar. The other canal used for the keyway.

6) If there is supra gingival tooth structure a flame bur is used to place **contra bevel**; It is the bevel placed around the occlusal external surface of the periphery of the preparation, this will provide a good collar around the occlusal surface periphery of the preparation which will help in holding the tooth structure together and preventing the fracture of the remaining tooth structure.

Antirotation devices

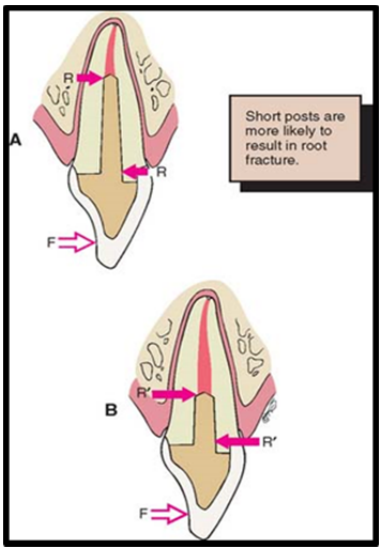
A. Keyway.
B. Triangular shape for the incisors and elliptical shape for upper canine.
C. Pins.





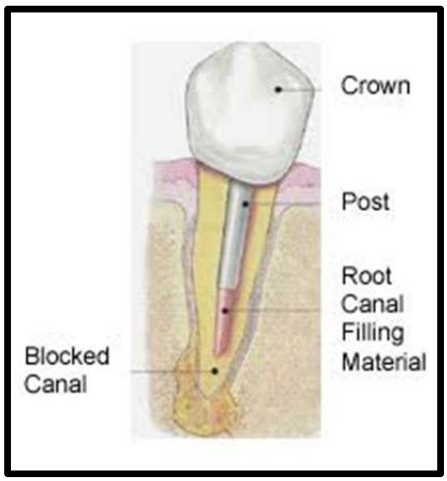
Factors affecting on retention of Post Crown;

1. Length of the dowel post. (2/3 length of root, Equal to length of clinical crown, 4-5 mm from apex, 8 mm deep from CEJ)
2. Diameter of dowel post. (No more than one third the root diameter at C.E.J .and should be at least 2mm less than root diameter at mid root area)
3. Shape of the prepared canal. (Parallel sided prep. more retentive than tapered)
4. Accessory means. (Pin, groove, keyway)
5. Post surface texture, a post with rough surface is more retentive than post with smooth surface.



Post Prep. Requirements;

1) The length of post should be the greatest length provided that the apical seal not to be jeopardised.
2) Whenever possible the occlusal surface of the tooth is prepared with contra bevel.
3) Diameter of the prepared canal should be no more than one third the root diameter at C.E.J .and should be at least 2mm less than root diameter at mid root area .
4) Leaving 1mm.vertical wall between core margin and the shoulder of the preparation to provide sufficient support and prevent the root fracture.
5) Avoid using of burs in canal preparations which may penetrate dentine causing undesirable undercut.



Impression for crown and bridge work

Definition: an impression is a negative reproduction or likeness of an object from which a positive copy (or cast) could be obtained.

The objective of making an impression

Because it is neither possible nor desirable to make patterns for fixed prostheses directly in the mouth, an impression or negative likeness of the teeth and surrounding structures is necessary to obtain a cast. This cast is used to make restoration in the laboratory. Elastic impression material is placed in a tray and inserted into the patient's mouth to obtain the cast. When the material has been set, it is removed from the patient's mouth. A suitable dental stone is poured into the "negative" impression, and a positive likeness or working cast is obtained.

Requirements of an acceptable impression

1. a good impression must be a detailed record of all aspects of the prepared tooth. This means it must include sufficient unprepared tooth structure immediately adjacent to the margins so that the laboratory technician can fabricate the restoration with proper contour.

2. All teeth in the dental arch and the soft tissues immediately surrounding the prepared tooth must be reproduced in the impression. This will allow the cast to be accurately articulated and contribute to the proper contouring of the planned restoration.

3. The impression must be free of air bubbles, tears, thin spots, and other imperfections that might induce inaccuracy.

Requirements of an impression material

1. It should be *elastic* after placement in the patient's mouth so that it can be removed from the undercut areas on the external tooth surfaces adjacent to the prepared tooth without distortion or fracture.

2. It should have adequate *strength* to resist breakage or tear on removal from the patient's mouth *(good tear strength).*

3. It should have adequate *dimensional stability* over temperature and humidity ranges normally found in clinical or laboratory procedures for long enough to permit the production of a cast or die.

4. It should have adequate *accuracy* for producing the fine details so that it is an exact negative reproduction of the prepared and unprepared teeth.

5. It should be *easy to use with a minimum of equipment.*

6. It should be *free of toxic or irritating components.*

Classification of impression materials

1. Non-elastic impression materials:

a. Impression compound.
b. Impression plaster.
c. Zinc-oxide non-eugenol paste.

These materials are not used routinely in crown and bridge work because when they are set, they become rigid, so upon removal from the undercut areas, they will fracture.

2. Elastic impression materials:

a. Hydrocolloids (water-based systems):
-Reversible hydrocolloids (agar impression material).
-Irreversible hydrocolloids (alginate impression material).
b. Elastomers:
-Polysulfide impression material.
-Condensation silicone impression material.
-Polyether impression material.
-Addition silicone impression material.

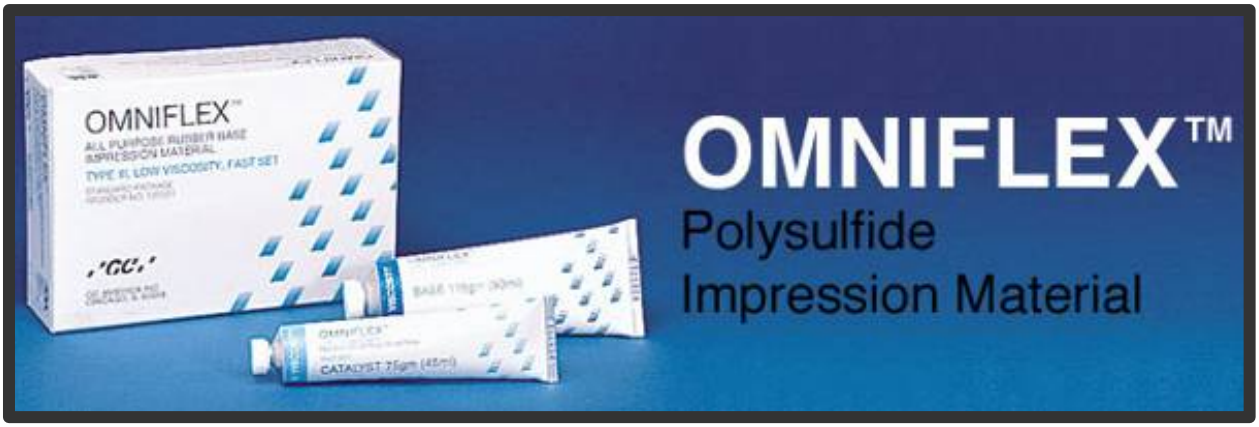
Polysulfide impression material

Polysulfides, commonly known as "rubber bases," were introduced in the early to middle 1950s and used widely by dentists because of their better dimensional stability and tear strength than hydrocolloids. Nevertheless, the polysulfide impression needed to be poured as soon as possible after impression taking since the delay of over an hour resulted in clinically significant dimensional change.

Chemical composition of polysulfide impression material

The material is supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in three consistencies (heavy, medium, and light bodies) which differ only in the amount of filler loading. The base is composed of polysulfide polymer, titanium dioxide, zinc sulfate, copper carbonate, or silica. The accelerator or catalyst is composed of lead dioxide, dibutyl or dioctyl phthalate, sulfur, and other ingredients such as magnesium stearate and deodorants.

Water is a by-product of polysulfide polymerization. Its evaporation results in a slight contraction of the polymerized material, which can be minimized by using a special tray as this reduce the material's thickness.



Advantages of polysulfide impression material

1. It has high tear resistance and elastic properties which facilitate impression-making in sulcular areas and pinholes.
2. It has improved dimensional stability over hydrocolloids but is inferior to polyether and additional silicone.
3. It is the least expensive of elastomers.

Disadvantages of polysulfide impression material

1. It has dimensional instability due to the mode of polymerization of polysulfide, which is of condensation type which gives off the water as a by-product, whose evaporation from the set material causes dimensional contraction.
2. It has a long setting time in the mouth (typically 10 minutes) which induces poor patient acceptance (mainly because of its unpleasant sulfide odor).
3. Humidity and temperature dramatically reduce its working time, which may be so short that polymerization begins before insertion in the mouth with resultant severe distortion.
4. Most polysulfide materials are polymerized with lead peroxide (catalyst), which gives the material its distinctive brown color. The polymerized material is so sticky and should be handled carefully since it could stain the clothes permanently.

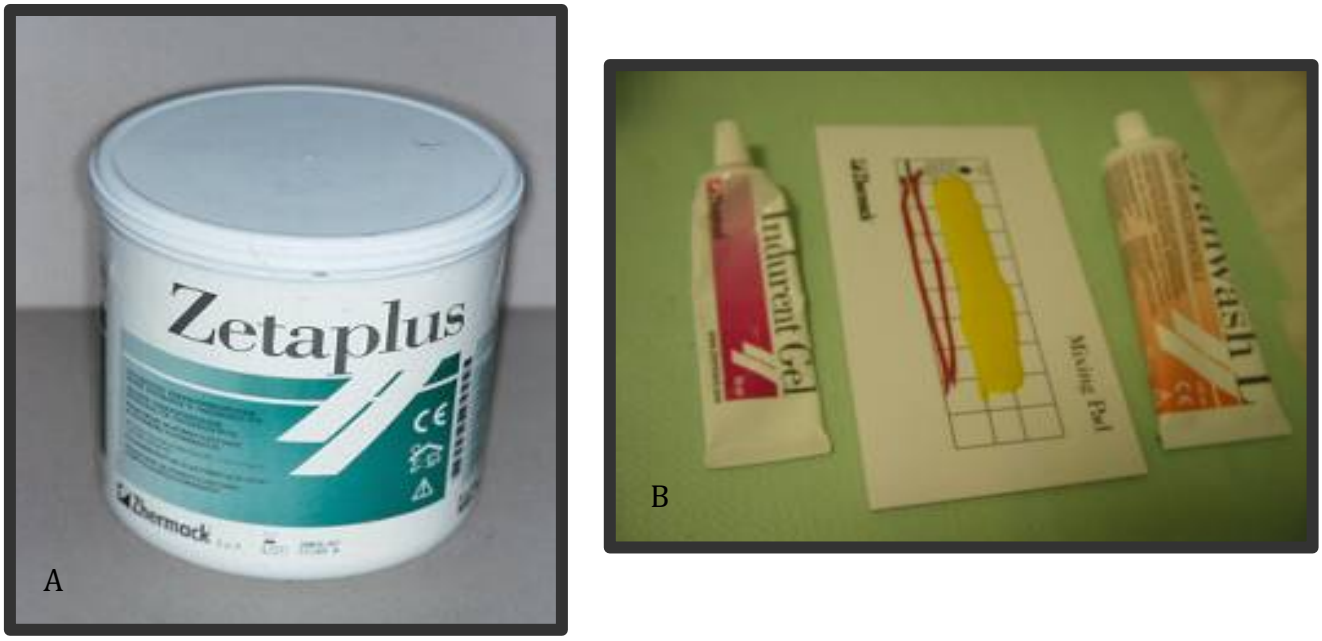
Condensation silicone impression material

Condensation silicone has been developed to overcome some of the disadvantages of polysulfide. It is odorless and can be pigmented to virtually any shade. Another advantage of condensation silicone over polysulfide is its relatively short setting time in the mouth (typically 6-8 minutes). As a result, patient acceptance is better than polysulfide. It is also less affected by high operatory temperatures and humidity. Unfortunately, its dimensional stability is less than that of polysulfide but greater than that of reversible hydrocolloids.

Chemical composition of condensation silicone impression material

The material is supplied as a *base* and an *accelerator* in a low and putty-like consistency. The base comprises a linear silicone called polydimethylsiloxane and fillers (calcium carbonate or silica). The accelerator may be a liquid that consists of

stannous octoate suspension and alkyl silicate, or it may be supplied as a paste by adding a thickening agent.



The condensation silicone impression material: The putty-like (A), and the low consistency (B).

Disadvantages of condensation silicone impression material

1. The main disadvantage of condensation silicone is its poor wetting characteristics because it is highly hydrophobic; therefore, the prepared teeth and gingival sulci must be completely free of moisture for a defect-free impression.
2. It has dimensional instability due to the mode of polymerization which is of condensation type which gives off ethyl alcohol as a by-product, whose evaporation from the set material causes dimensional contraction.
3. Pouring the impression made of condensation silicone without trapping air bubbles is more difficult than with other impression materials.

Polyether impression material

Polyether impression material has a polymerization mechanism unlike those of the other elastomers. As a result, no volatile by-product is formed, and thus it has excellent dimensional stability.

Chemical composition of polyether impression material

The material is also supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in three consistencies (low, medium, and heavy bodies). The base paste consists of a long-chain polyether copolymer, silica fillers, compatible plasticizers of a non-phthalate type, and triglycerides. The catalyst paste consists of an aliphatic cationic initiator (as a cross-linking agent), silica fillers, and plasticizers. In addition, coloring agents are added to the base and catalyst to aid in recognizing different material types.

Advantages of polyether impression material

1. It has high dimensional stability since no volatile by-product is formed and its polymerization shrinkage is unusually low compared with most room temperature-cured polymer systems. Therefore, an impression made of polyether can be poured more than a day after the impression has been made and still have accurate casts. This is especially useful when it may be impossible or inconvenient to pour the impression immediately. The new polyether materials can be poured up to fourteen days after impression taking.
2. It has a short setting time in the mouth (typically 5 minutes, or less than half the time required for polysulfide).

Disadvantages of polyether impression material

1. The set material is stiff. This causes problems when separating a stone cast from the impression, especially in thin and single teeth, as in the mandibular incisors. However, this problem has been recently solved by introducing soft polyether materials such as Impregum Penta Soft.
2. The polyether is stable only if stored dry since it will absorb moisture (imbibition) and significantly change dimensionally.
3. There are reported cases of allergic hypersensitivity to polyether, manifested as a sudden onset of burning, itching, and general oral discomfort.

Addition silicone impression material (polyvinylsiloxane)

The main difference between the additional silicone and the condensation silicone is that it has much better dimensional stability than the condensation type, as its polymerization reaction does not give off any by-product.

Chemical composition of additional silicone impression material

The material is also supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in extra-low, low, medium, heavy, and very heavy (putty) consistencies. The base (paste) consists of dimethylsiloxane, vinyl terminal groups, and fillers. The accelerator (catalyst) also contains dimethylsiloxane with vinyl terminal groups, fillers, and platinum catalysts.

Advantages of additional silicone impression material

1. It has high dimensional stability, which is equivalent to polyether.
2. The set material is less rigid than polyether.

Disadvantages of additional silicone impression material

1. Like other materials, adverse tissue responses have been reported.
2. Setting inhibition by some brands of latex gloves.

Final impression

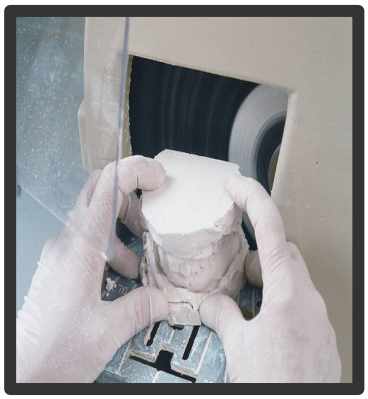
To take a final impression, we need a special tray (custom tray), an impression syringe, and an impression material.

The special tray is constructed on the study cast.

The impression syringe.

The advantages of the study cast

1. It is helpful for diagnosis and treatment planning.
2. It is used for the construction of a provisional restoration.
3. It is used for the construction of a special tray.



The study cast after its removal from the impression and its trimming,

Advantages of the special tray

1. It allows the use of the impression material in minimum thickness, so it reduces its dimensional changes.
2. It reduces the patients discomfort because it is well-fitted to the patient's mouth.
3. Its small size prevents the forcible opening of the mouth.
4. It allows free snap removal of the impression from the patient's mouth without applying rotary movement.

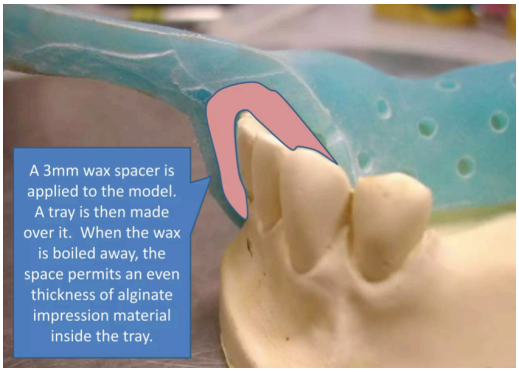
Materials used to construct the special tray

1. Auto-polymerizing acrylic resin (mainly used).
2. Shellac base plate.
3. Vacuum thermoplastic material.

Requirements of the special tray

1. It should be rigid enough to resist breakage; therefore, it should have a thickness of 2-3 mm.
2. It should extend about 5 mm cervical to the gingival margin.
3. It should be stable on the cast with stoppers.
4. It should be constructed at least 9 hours before its use.

To construct a special tray, we need the following:
1. Study cast.
2. Pink base plate wax.
3. Self-cured acrylic resin.



Construction of the special tray

1. With a pencil, we draw a line on the study cast around the dental arch about 5 mm cervical to the gingival margin. This line represents the finishing line of our special tray.
2. We adapt two layers of base plate wax on the study cast. Then we remove the wax from the periphery until we see the line we have drawn (cut back).
3. After that, we create two perforations in the occlusal surface of the wax (two posterior and one anterior) to obtain stoppers for our special tray. The stoppers are made in the area of non-functional cusps. The stoppers serve the following advantages:

-They help equalize the pressure that will be applied to the tray.
-They help to localize the tray in the patient's mouth during impression taking.
-They maintain even space for the impression material.
-They prevent the sinking down of the impression tray.

4. A layer of tin foil is adapted to the two layers of the wax.
5. Auto-polymerizing acrylic resin is mixed according to the manufacturer's instructions. When it reaches the dough stage, it is adapted to the wax that has been covered with tin foil. The excess acrylic resin beyond the line previously drawn is removed. The excess acrylic removed can be used to construct a handle for the special tray.

After the complete polymerization of the acrylic resin, the tray is removed from the cast. Removal is facilitated by the tinfoil, which will prevent the acrylic resin from sticking to the wax. Then the margins of the special tray can be finished, smoothed, and polished.

Gingival retraction

In cases when the finishing line is located below the level of the gum (subgingivally) or with the level of the gum, we need to do a gingival retraction, which is a procedure by which the finishing line is temporarily exposed by enlarging the gingival sulcus so that we can take a good impression which involves the details of the end margin of the preparation that is located subgingivally.

Objectives of gingival retraction

1. To create access for the impression material to the preparation area that is located subgingivally.
2. To provide enough thickness of the impression material at the finishing line area to prevent tearing and distortion of the impression material.
3. To control the amount of fluid in the gingival sulcus (crevicular fluid) that will cause voids in the impression.

The

objectives of gingival retraction: are (1) to create access and (2) to provide enough thickness for the impression material at the area of the preparation that is located subgingivally.

Techniques of gingival retraction

1. Mechanical.
2. Chemo-mechanical.
3. Chemical: Gingival retraction paste (cordless technique).

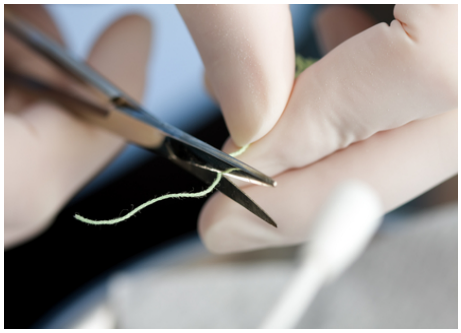
4. Electrosurgical.
5. Laser.

1. Mechanical:

In this technique, we apply pressure on the gingival to open the gingival sulcus. Either of the following might do it:

-Construction of a temporary crown with a slightly long margin leaving it in place for 24 hours, or

-Using a plane retraction cord (free of any medicament), which is the most common. The retraction cord is a special cord made of cotton which comes either plane (free of medicament) or is pre-impregnated with a medicament (usually a vasoconstrictor). Using a plane retraction cord is considered a mechanical means only.




2. Chemo-mechanical:

This technique uses a retraction cord pre-impregnated with a medicament, usually a vasoconstrictor (adrenaline, aluminum chloride, or ferric sulfate). By packing this cord with a plastic instrument (Ash No.6 or Ash No.49) in the gingival sulcus between the gingival tissue and the prepared tooth, the cord will mechanically push the gingiva away from the finishing line. The combination of the chemical action of the medicament and the pressure exerted by the cord will cause transient gingival ischemia. This will lead to shrinkage of the gingival tissue and control the fluid seepage from the gingival sulcus.

The retraction cord is left inside the gingival sulcus all around the tooth for 10 minutes. The working area should be kept dry during this period. Then the cord can be removed leaving the gingival tissue in an expanding state. This will provide a

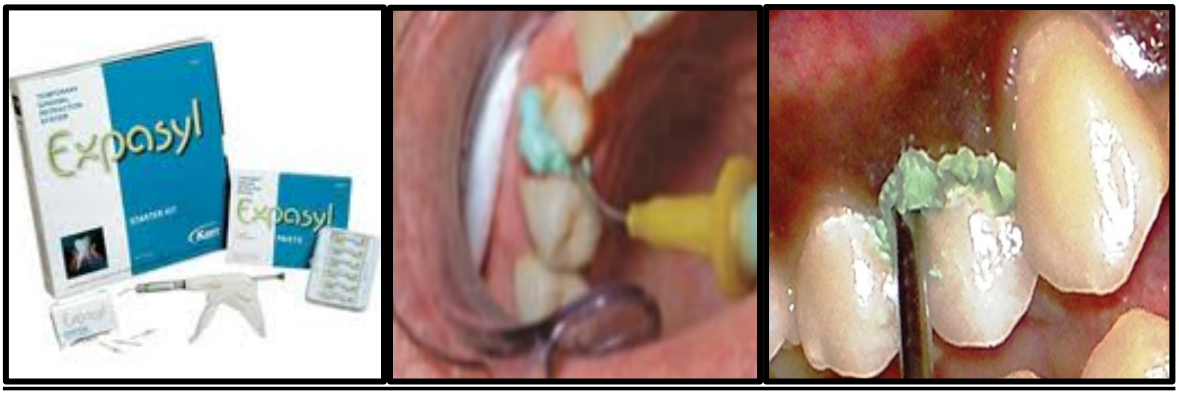
space to inject the impression material all around the tooth at the finishing line area by using an impression syringe.

The retraction cords are in place inside the gingival sulci of the prepared teeth.

3. Gingival retraction paste (Cordless technique):

In most cases, the gingival retraction cord is the most effective method for retracting tissue to the depth of the sulcus. Unfortunately, the gingival retraction cord may injure the gingival sulcular epithelium, and the gingival bleeding is difficult to control when packing a cord into the sulcus, making the impression difficult or impossible. In addition, using a retraction cord requires proper tissue manipulation and is technique sensitive. For this reason, a new class of gingival retraction materials has been introduced as retraction pastes like Expasyl (Aluminum chloride 15%) and Magic Foam Cord (Polyvinylsiloxane, addition type silicone elastomer).

The advantage of the cordless retraction technique is providing non-traumatic, non-invasive tissue management and excellent hemostasis in the gingival sulcus for fixed prosthodontic impressions.



The Expasyl gingival retraction paste injected in place inside the gingival sulcus of the prepared tooth.

Magic Foam Cord gingival retraction paste injected in place inside the gingival sulcus of the prepared tooth.

4. Electro-surgical:

In this technique, an electro-surgical unit could be used to remove the gingival tissue from the finishing line area with the advantage of controlling the post-surgical hemorrhage. However, electrosurgery is contraindicated when there is gingival inflammation or periodontal disease. In this case, a gingivectomy could be performed.

The electrosurgical unit.

5. Laser :

Advantages of laser:

1. Specific laser dentistry procedures do not require anesthesia.

2. Laser procedures minimize bleeding because the high-energy light beam aids in the clotting (coagulation) of exposed blood vessels, thus inhibiting blood loss.
3. Bacterial infections are minimized because the high-energy beam sterilizes the area being worked on.
4. Damage to surrounding tissue is minimized.
5. Wounds heal faster and tissues can be regenerated.

Disadvantages:

1. Slow technique.
2. Expensive

Gingival retraction obtained by laser.

Impression Techniques

1. Single mix technique (monophase technique).
2. Double mix technique.
3. Putty-wash technique.

1. Single mix technique

This technique is often used when we have an impression material with single viscosity (such as the medium body consistency of polyether or additional silicone impression materials). This is because both materials are pseudoplastic materials and have the capacity for shear thinning. Pseudoplastic materials demonstrate a decreased viscosity when subjected to high shear rates, such as when mixing and syringing. When the medium viscosity material is forced through an impression syringe, the viscosity is reduced, whereas the viscosity of the same material in the tray is unaffected. In this manner, such materials can be used for syringing and trays.

In this technique, after mixing the material, part of the material is loaded into the tray, and the remaining amount is loaded in the impression syringe. i.e., the same mix of the material is used to load the tray and the syringe. The impression material is injected from the impression syringe around the preparation area, starting with the most critical parts such as the finishing line, then the prepared teeth and the other teeth in the dental arch. Then the special tray loaded with the impression material is inserted inside the patient's mouth and seated over the whole

dental arch. After the complete set of the material, the impression tray is removed from the patient's mouth.

2. Double mix technique

This technique is usually used with materials that have two viscosities (heavy and light bodies). We mix the heavy body and the light body at the same time. The light body is loaded in the syringe, while the heavy body is loaded in the tray. We start to inject the light body into the dental arch, beginning with the prepared tooth, and then the tray loaded with the heavy body is inserted inside the patient's mouth and seated over the dental arch. The pressure created by the heavy body after the seating of the tray will cause a direct flow of the light body into the preparation details, including the finishing line.

3. Putty-wash technique

This technique requires the use of a high-viscosity material. We take an impression with the heavy body either before or after tooth preparation:

-*Before preparation:* we take a preoperative impression with the heavy body only before tooth preparation. After the complete set of the heavy body, we remove the impression tray from the patient's mouth and leave it aside. Then we do tooth preparation. After tooth preparation, we mix the light body, load it in the syringe, and inject it over the preparation area. Then we reseat the impression tray inside the patient's mouth and wait for the complete set of the light body.

-*After preparation:* in this technique, after mixing the heavy body and loading it in the tray, a spacer made of polyethylene is placed over the heavy body, and the tray is inserted inside the patient's mouth. After the complete set of the heavy body, the tray and the spacer are removed. The light body is mixed, and part is loaded in the syringe, and the other part is loaded in the tray over the heavy body. Then the light body is injected over the whole dental arch starting from the area of tooth preparation, and the tray is reseated inside the patient's mouth. After the complete set of the light body, the tray is removed from the patient's mouth.

This technique was developed for condensation silicones to minimize the effects of dimensional changes during polymerization. Most of the shrinkage during polymerization occurs in the putty material when the preliminary impression is made, confining the final shrinkage to the thin wash portion of the impression.

Impression for post crown

In case of post crown, we need to take an impression of the inside of the root canal. Most of the time, it isn't easy to insert the impression material inside the tiny root canal. Even when inserted inside the canal, it might tear during removal or become distorted during the pouring of the impression. Therefore, the impression material needs a type of reinforcement. Such reinforcement could be obtained either by using a plastic post (impression post) or a stainless steel wire. After

injection of the light body inside the root canal, the impression post or the stainless steel wire is inserted inside the canal. This will support the impression material and prevents its tearing or distortion during the removal of the impression.

An impression for the post crown with the plastic post (impression post) recording the inside of the canal.

After the removal of the impression from the patient's mouth, it should be inspected for the following:

1. The finishing line should be continuous all around the prepared tooth.
2. No air bubbles should be present in the tooth preparation area.
3. The impression material should be attached well to the impression tray.

Disinfection of the impression

Disinfection of the impression is a concern with respect to viral diseases such as hepatitis B, AIDS, and herpes simplex, because the viruses may be transferred to the gypsum models and present a risk to a dental laboratory and operating personnel.

The most common form of disinfection is spraying or immersion in disinfectants like 1% sodium hypochlorite or 2% potentiated glutaraldehyde solutions and iodophor.

Digital impression

Digital impression represents the most recent development in Dentistry. The basics of digital impression start with capturing an image of the prepared teeth. This system uses an intra-oral camera (scanner) to capture the desired image (optical impression). This image is then electronically transferred to a manufacturing facility which fabricates a working, articulated model. On this model, many different restorations can be designed (crowns, bridges, inlays/onlays, and veneers) with special computer software connected to a milling machine. This

procedure is termed CAD-CAM (Computer Aided Designing - Computer Aided Manufacturing).

Advantages of digital impression

1. Digital impressions eliminate the uncomfortable experience of making a physical impression.
2. The image on the monitor shows you if you have captured all the needed details before sending it to the lab.
3. The accuracy of the mounting, bite registration, and stability of the dies create a model allowing the laboratory technician to fabricate a final restoration with the excellent marginal fit and incredibly accurate occlusion.
4. The ability to see if proper occlusal reduction has been achieved.

Chairside CAD-CAM unit.

Laboratory CAD-CAM unit.

Remember that you need the following requirements to obtain an excellent final impression:

1. Special tray.
2. Impression syringe.
3. Gingival retraction when needed.
4. Good understanding of the physical properties of the impression material, which results in good handling of the material.
5. Dry field of operation. This is because all elastic impression materials, except hydrocolloids, are hydrophobic. i.e., they don't displace moisture; therefore, any moisture if present will result in voids or folds within the final impression.

Provisional Restoration (Temporary Restoration)

Definition: A crown restoration that is used in fixed prosthodontics during the interim between tooth preparation and final placement of the definitive crown restoration.

Objectives of provisional restoration:

1. To protect the tooth from pain stimuli as a result of thermal (hot and cold), chemical, and osmotic changes in the mouth.
2. To prevent sensitivity and further irritation to the pulp since a certain degree of pulp trauma is inevitable during tooth preparation because of the sectioning of the dentinal tubules.
3. To prevent movement of the prepared, adjacent, and opposing teeth. i.e., to prevent supraeruption and drifting.
4. To protect the gingival tissue from irritation and food impaction.
5. To provide esthetic, phonetic, and function.
6. To prevent tooth fracture.

Requirements of an optimum provisional restoration:

1. A provisional restoration must seal and insulate the prepared tooth surface from the oral environment to prevent sensitivity and further irritation to the pulp.
2. A provisional restoration must have good marginal fit, proper contour, and a smooth surface to maintain the health of the gingival tissue and facilitate plaque control by the patient.
3. A provisional restoration should maintain proper contacts with the adjacent and opposing teeth to prevent Supraeruption and horizontal movement (drifting).
4. A provisional restoration should have enough strength and retention to withstand the forces to which it is subjected without fracture or coming off the tooth. In addition, it should remain intact during its removal so that it can be reused again-if necessary.
5. A provisional restoration should provide esthetic, phonetic, and function.

Types of provisional restoration:

1. Preformed temporary crowns.
2. Customized temporary restorations (chairside temporary restorations).
3. Laboratory-made temporary restorations.

1. Preformed temporary crowns:

Generally, preformed temporary crowns consist of a shell of plastic or metal that could be cemented directly on the prepared tooth following adjustment, or after its lining with a resin material. They could be used for single or multiple preparations.

Types of preformed temporary crowns:

a. Metal temporary crowns.

6. Plastic temporary crowns.

c. Celluloid crown forms.

a. Metal temporary crowns:

Metal temporary crowns are mainly indicated for use in the posterior teeth. They are made of stainless steel, nickel-chromium, or aluminum. The most commonly used type is aluminum temporary crowns, which are of two types:

1. Non-anatomical or flat-topped cylindrical temporary crowns.
2. Anatomical or morphological aluminum temporary crowns.

Clinical procedure:

1. Select ·the proper size and shape of the temporary crown according to the prepared tooth.

2. Trim the cervical margin of the temporary crown using a scissor to conform to the gingival margin of the preparation (finishing line) and to accommodate the vertical height of the prepared tooth.

3. Seat the temporary crown on the prepared tooth and ask the patient to bite on it. Check the margins and the occlusion (centric and eccentric).

4. Smooth the margins with a stone bur.

5. Cement the temporary crown on the prepared tooth using zinc oxide-eugenol cement.

b. Plastic temporary crowns:

Plastic temporary crowns are used mostly for the anterior teeth. The clinical procedure for the use of plastic temporary crown is nearly the same as that for metal temporary crown.

Types of plastic temporary crowns:

1. Acrylic temporary crowns: Acrylic resins restorations have been widely used in dentistry in the past but since higher quality materials have emerged, they have lost ground .These are made from acrylic resin and are available in different sizes and colors. Preformed acrylic temporary crowns are used for the anterior teeth.

2. Polycarbonate temporary crowns: these are made from polycarbonate plastic combined with micro glass fibers. Preformed polycarbonate temporary crowns are available for the anterior and posterior teeth.

In case we need to improve the fitness of the temporary crown or if there is no size which approximately fits the prepared tooth, we can reline the temporary crown with a resin material to improve its fitness after the selection of the most suitable size and shade (color) of the temporary crown and cutting its margin according to the finishing line of the prepared tooth.

The procedure of relining could be done either directly on the prepared tooth in a manner similar to that of celluloid temporary crown (will be discussed later) or could be done indirectly on a study cast of the prepared tooth.

C. Celluloid crown forms:

They are mainly used for the anterior teeth, but can be used for the posterior teeth also. They are made from a very thin translucent layer of cellulose acetate. They act as a mold for the construction of the temporary crown. They come in different sizes.

Clinical procedure:

1. Coat the prepared tooth with Vaseline to facilitate removal of the temporary crown.
2. Select the proper size and shape of the celluloid crown.
3. Make two holes in the corners of the temporary crown to provide an escape way for the excess material.
4. Cut the gingival margin of the crown to accommodate that of the prepared tooth.
5. Fill the celluloid crown with a provisional crown material (Bis-acryl composite resin or composite resin) of the same shade of the tooth and seat it over the prepared tooth until setting.

If Bis-acryl composite resin is used as a provisional material, the celluloid crown should be removed at its semi-plastic stage so that the polymerization reaction of the acrylic resin will occur outside the

mouth to prevent pulpal irritation since the polymerization reaction of the acrylic resin is exothermic.

6. Take the crown out and remove the excess material. Then place it again on the prepared tooth and check the occlusion, contact with the adjacent teeth, fitness, and extension.

2. Customized temporary crown and bridge:

The fabrication of customized temporary crowns requires the construction of a mold of the patient's teeth before their preparation. This may be obtained from any type of elastic impression material, into which resin polymer material (Bis-acryl or composite) is placed and the mold is held either directly on the prepared tooth (or teeth) or indirectly against a cast of the patient's teeth.

Indications of customized temporary restoration:

1. Coverage of multiple individual crown preparations.
2. Coverage of a single tooth preparation which is usually large or of a special design. i.e., when a preformed temporary crown is not fit to the tooth.
3. Abutment preparations for fixed partial denture to construct a temporary bridge.

Methods of construction of customized temporary restorations:

Impression method (over-impression method):

-Indirect impression method (indirect chairside technique).

-Direct impression method (direct chairside technique).

Clinical procedure of the indirect impression method:

1. A preoperative over-impression with alginate or silicone impression material is made from the patient's teeth or from a study model and carefully stored until completing tooth preparation.

2. After completing the preparation of teeth, another alginate impression was

then taken and poured with fast-setting plaster or stone. After setting of the plaster or stone, the cast is separated from the impression.

3. Coat the prepared tooth (or teeth) on the cast with a separating medium (such as petroleum jelly).

4. Mix tooth colored resin according to the manufacturer's instructions and place the mixed resin in the over-impression at the area of tooth preparation only.

5. Seat the cast into the over-impression in an upright position and maintain constant pressure until the resin sets completely. It is important to note that the cast is correctly seated in the over impression.

6. After complete polymerization of the resin, separate the cast from the over-impression. The formed crown is then removed from the prepared tooth in the cast.

7. Trim any excess material from the formed crown. Then the crown is seated on the prepared tooth inside the patient's mouth. Check the occlusion and remove any premature contact in centric and eccentric occlusion.

8. Cement the temporary crown on the prepared tooth using zinc oxide-eugenol cement.

Clinical procedure of the direct impression method:

The clinical procedure of the direct impression method is the same as that of the indirect method except that it is done directly inside the patient's mouth. In this method, we need a preoperative over-impression but there is no need to have a study cast. Prepare the tooth (or teeth), mix the resin, place it in the over-impression in the area of tooth preparation, and seat the over-impression inside the patient's mouth. Then follow the same steps that are used in the indirect method.

Advantages of the indirect method over the direct method:

1. There is no direct contact of the free monomer of the resin with the prepared tooth or gingival tissue which might cause tissue irritation or allergic reaction.

2. The indirect method avoids subjecting the prepared tooth to the heat of polymerization of the resin since the polymerization reaction of the resin is exothermic.

3. The indirect method saves the clinician's chair time.

Visible Light-Activated (VLA) Composites (no need for a preoperative impression)

***Maleable composites*:**

These are light-cured composites with a clay- or dough-like consistency allowing them to be molded over tooth preparation and then cured. The simplest system, Revotek LC™, GC, consists of a UDMA putty stick from which a portion can be cut.

Revotek LC™ is a VLA, single-component, sculptable resin composite. It is supplied in a Putty Stick form in a lightproof plastic tray. To make a provisional restoration, a small portion of the material is cut from the stick and adapted to the preparation directly in the mouth. It is then sculpted using hand instruments after which the patient is instructed to occlude into it to establish a functionally-generated occlusal scheme. The provisional is then light-activated for 10 seconds in the mouth, removed, and given a final 20-second light exposure. After finishing and polishing, the restoration is cemented with temporary cement.

Advantages:

1. There's no methyl methacrylate so there's no exothermic heat, odor or irritation.

2. Fast and Easy to use.

3. There's no mixing required, no messy powder-liquids and no wasteful cartridges and mixing tips.

4. Unlike bis-acrylics, there's no heavy oxygen-inhibited layer to contend with.

5. There's no need for a preoperative impression, stent fabrication, wax-ups or model modifications.

Temporary restoration for a tooth prepared to receive a post crown:

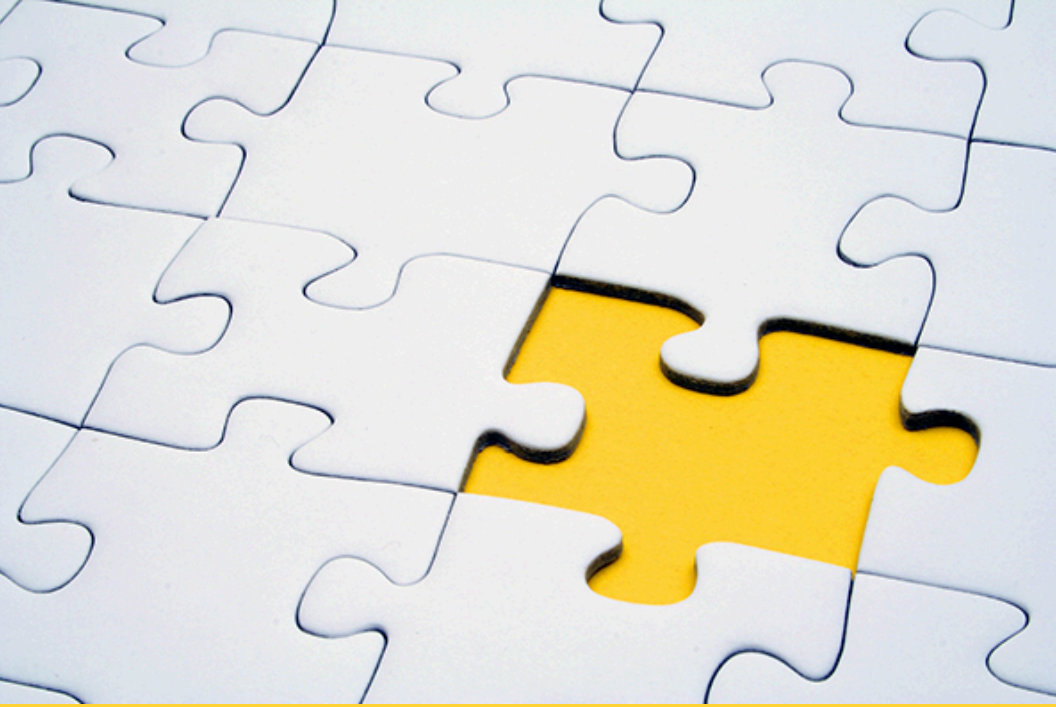
It is often difficult to fabricate a temporary crown for a tooth that has been prepared to receive a post crown because there is so little tooth structure supragingivally that cannot give support to the temporary crown, so in such a case

we need intracanal retentive means to give retention to the temporary crown.

A piece of stainless steel wire could be used as an intracanal retentive means. The wire should be adapted to the prepared root canal and should extend coronally at least 4 mm. i.e., 4 mm of the wire should extend supragingivally outside the canal prior to the construction of the temporary crown. After that, a temporary crown could be constructed and the stainless steel wire will be part of the temporary crown.

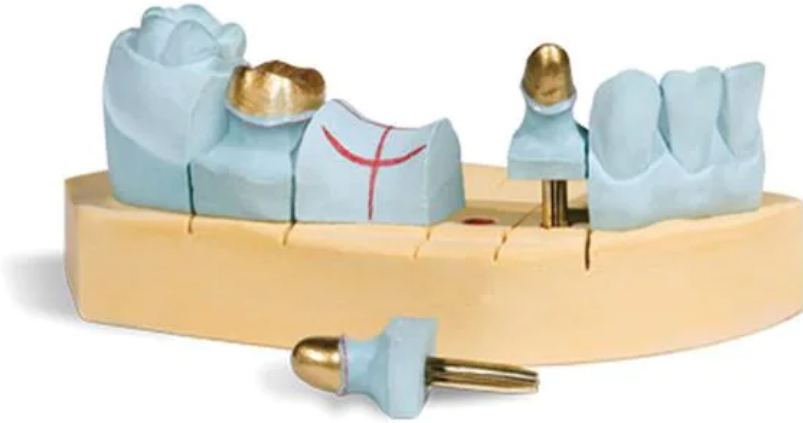
Cementation of the temporary restoration:

Zinc oxide-eugenol cement is the most commonly used cement for temporary crowns and bridges. This cement promotes healing and allows easy removal of the temporary restoration.



Working cast and die

By Ass. prof. Samer Aun 2023



Working cast (master cast)

It replicates the prepared tooth (or teeth), ridge area, and other parts of the dental arch. It is obtained from the final impression on which the wax pattern is made (laboratory work).

Requirements of a good working cast:

1. It must reproduce all the details captured in the impression.
2. It must be free from air bubbles, especially at the area of the finishing line and the occlusal surface.
3. It must be free from any distortion.
4. It should be trimmed at the margins of the prepared tooth (or teeth) to ensure access for carving the wax pattern (ditching).
5. It should allow precise articulation.

Die: It is the positive reproduction of the individual (single) prepared tooth on which the wax pattern is made. It is obtained from the final impression.

Requirements of the die:

1. It must reproduce the prepared tooth exactly.
2. It must be free from air bubbles and voids.
3. When removed, it must return to its exact position on the cast.
4. It must be stable even when the cast is inverted.

Types of dies according to material's type:

The two critical properties of the die material are dimensional stability (or accuracy) and abrasion resistance during the construction of the wax pattern.

1. Silver-plated dies.
2. Copper-plated dies.
3. Amalgam dies.
4. Stone dies.

Stone die:

Advantages of ideal stone die:

1. Easy to be prepared.
2. Can be used with all types of impression material.
3. Cheap.
4. Need fewer requirements and easy to manipulate.

Types of dental gypsum products (according to AD Specification):

1. Type I: impression plaster.
2. Type II: model plaster.
3. Type III: dental stone.
4. Type IV: high-strength dental stone (die stone).
5. Type V: high-strength high expansion dental stone

Types of die according to the method of fabrication:

1. Working cast with separated dies.
2. Working cast with removable dies:
   - Dowel pin system - straight and curved
   - Pindex system
   - Die - locking system
   - DVA model system
   - Zeiser model system

Working cast with separated dies (Multiple pour system):

The final impression is poured twice to obtain two working casts: one of these casts is sectioned to get the individual dies that are separated from that cast. In contrast, the other working cast is articulated on the articulator. The wax pattern is prepared on the die and later transferred to the working cast

Advantage

•Simplest and easiest method

Disadvantage

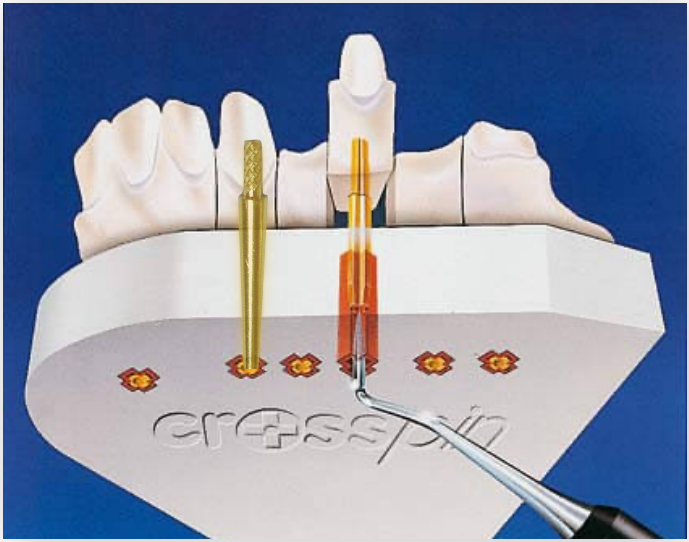
•The wax pattern may get distorted while transferring it from the die to the cast.

•Proximal margins tend to get over contoured

Working cast with removable dies:

•In this system a special type of working cast is prepared and the dies are carefully sectioned so that the individual dies can be removed and replaced in their original position in the cast

• Dowel pin systems, di-Iok tray systems, and the pindex systems come under this category.

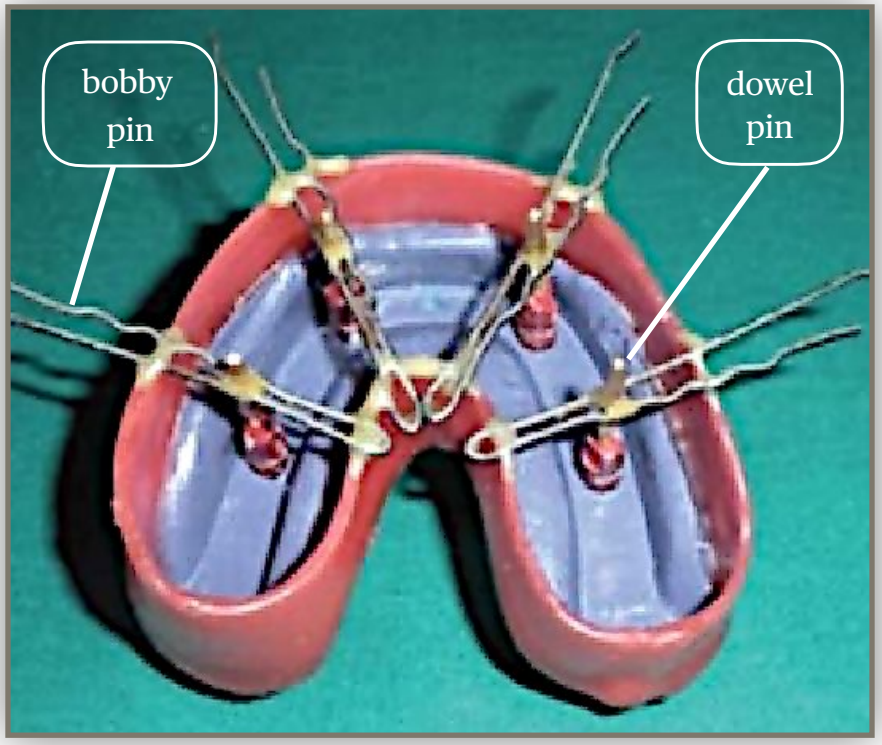


Dowel pins *are ready-made metal pins that orient the die(s) to the original working cast, allowing the die(s) to be easily removed and accurately replaced into the working cast. The dowel pin is tapered and cylindrical, with one flat side for positive seating.*

Clinical procedure to obtain a working cast with removable dies:

1. Dry the impression.
2. A dowel pin is used for each prepared tooth. It is placed over the center of the prepared tooth parallel to its long axis. A bobby pin holds the dowel pin in this position by placing it between its arms. The bobby pin is positioned bucco- lingually across the impression so that the dowel pin is centered directly over the prepared tooth. Then a straight paper pin is inserted between the arms of the bobby pin and into the impression buccally and lingually. The dowel pin is then stabilized within the bobby pin, and the bobby pins itself is against the straight pin with sticky wax
3. The impression is placed over the vibrator, and dental stone is added in small increments to about 2 mm above the cervical margin. The dental stone should cover the serrated end of the dowel pin.
4. A retentive means is placed in the poured stone before its setting, such as paper clips, to retain the second layer of the stone that will be poured later.
5. When the first layer of the stone has been set, the bobby pin(s) and the paper pin(s) are removed from the impression. Next, a ball of soft wax is placed on the tip of each dowel pin.
6. The surface of the first layer of the stone is lubricated with a separating medium, and a second layer of stone is poured (base) that should cover the dowel pin(s) thoroughly.

7. After the complete set of the second layer of the stone, the cast is removed from the impression. Then using a sharp knife, the wax ball placed on each dowel pin's tip is removed.
8. To obtain the die, a saw is used to section each prepared tooth's proximal sides (mesial and distal) bucco-lingually. The cutting should be through the first layer only, and the cutting should be diverged toward the occlusal surface to facilitate the die removal.
9. The end of the dowel pin is tapped gently with a hand instrument to loosen the die.



Pindex system:

In the pindex system, a reverse drill creates a master cast with dies that can be removed and replaced repeatedly with great precision. The impression is poured without a positioning and attaching dowel pins.

The machine accurately drills parallel holes from the underside of a trimmed cast.

Technique:

Pour the impression in a usual manner, adding approximately 20 mm of stone beyond the edge of the tray. Allow the cast to set for 60 minutes and remove it from the impression, trim the side and the bottom of the cast, The cast should be trimmed until all rough, irregular, and undercut areas are removed from its underside. The cast should be perfectly flat on the tabletop, and its thickness

from the base to the preparation finish must be a minimum of 15 mm. If the bottom of the cast is flat, it ensures that the pinholes drilled into it will be parallel. Mark the location of each dowel on the occlusal surface. Two dowels are needed to stabilize each segment. Alternative single pins are used for small preparation.

Position the cast on the drilling stage; a light indicates the location of the drill. Hold the cast firmly and press the lever; this activates the drill, penetrating the cast.

Di-Lok Tray

The Di-Lok technique uses a specially articulated tray to precisely reassemble a sectioned definitive cast. First, the impression is poured, and the cast is trimmed into a horseshoe configuration that fits in the special tray. Next, the tray is filled with a second mix, and the cast is seated. When the stone has set, the tray is disassembled, saw cuts are made on each side of the preparation, and the resulting die is trimmed. The cast and die can be reassembled in the tray, then mounted on an articulator. A disadvantage of this system is that the overall size of the tray can make articulation and manipulation awkward and difficult.

DVA Model System and the Zeiser model system :

Their new systems include all auxiliary items necessary for producing very professional appearing models and dies.

These Systems include a specially designed Pin Alignment and Drilling Machine, which determines dowel pin locations before the pouring of the model; pre-manufactured Base Plates; and specially designed dowel pins.

Interocclusal Record (Bite Registration)

The objectives of bite registration:

We need bite registration to transfer the relation between the upper and lower dental arches from the patient's mouth to the articulator. In addition, a proper interocclusal record is essential to orient the die (s) of the same arch to the opposing arch.

When enough teeth are present in both dental arches, we can transfer the relation by hand articulating the casts. i.e., no bite registration is needed in such cases so that we can occlude the opposing casts by hand and then mount them on the articulator.

If the remaining teeth are insufficient to produce hand articulation of the casts, we have to record the bite by using either of the followings:

1. Pink base plate wax.
2. Bite registration paste.
3. Bite rim or occlusal rim.

How to record?

Whatever the material used to record the relationship between the upper and lower dental arches, we have to guide the mandible to the required relation (centric or eccentric). So, the patient is asked to close, put reference points, and

then we put the recording material and register the relation.

Pink base blate wax is the most widely used material to record the relation. The procedure is by softening the wax at first, then we ask the patient to bite on it, keeping in mind that we must guide the mandible to the reference points we have marked to have the correct bite registration. Meanwhile, the patient is asked to mold the wax at the lingual area by his tongue while our fingers adapt the wax on the labial and buccal sides. After the complete wax set, we remove it from the patient's mouth, trim the excess wax, attach it to the cast, and transfer it to the articulator.

Bite rim: The bite rim is used in the following cases:

1. Free end saddle.
2. When we need to restore the anterior teeth.
3. When we don't have enough teeth to obtain the centric relation.

LEC 14 2023

BY DR. SAMER AUN

WAXING

Ditching

before waxing, we should do **ditching,** which is the trimming of the stone that represents the gingiva around the prepared tooth to expose our finishing line, which is located subgingivally or with the gum level. It is done by using a sharp hand instrument (sharp knife).

Cutting of the stone representing the gingiva to expose the finishing line

WAX PATTERN

It is the precursor of the final cast restoration that will be placed on the prepared tooth.

REQUIREMENTS OF THE WAX PATTERN:

1. It should be clean and smooth.

2. It should accurately duplicate the anatomical features of the original tooth.

3. It should be free from any debris.

Information needed for duplication of the anatomical features is taken from the adjacent teeth, the opposing teeth, and from general knowledge of dental anatomy.

Why do we use wax for duplication?

1. It's easily manipulated.
2. Inexpensive.
3. It is easily eliminated from the mold cavity during the burnout procedure.

Types of wax used for duplication

The type of wax used in the construction of the wax pattern is inlay casting wax according to the ADA, we have two types of inlay casting wax:

Type I inlay casting wax: is a hard wax used for the intra-oral waxing technique. It has a higher melting temperature.
Type II inlay casting wax is softer than type I and is used for the extra-oral waxing technique. It has a lower melting temperature. It is used to construct the wax pattern on the cast.

Requirements of good inlay wax

1. It must flow readily when heated.
2. It must become rigid when cooled.
3. It must be capable of carving without chipping or smearing when done in fine margins.

TECHNIQUES OF CONSTRUCTION OF THE WAX PATTERN

1. Intraoral technique (direct technique):
The wax pattern is constructed inside the patient's mouth using type I inlay wax. This technique is mainly used to build the posterior inlay restoration and anterior post-crown.

2. Extraoral technique (indirect technique):

Type II inlay wax is used to construct the wax pattern on the die of the working cast.

ADVANTAGES OF INDIRECT TECHNIQUE OVER DIRECT TECHNIQUE:

1. It reduces chair time, saves the dentist's time, and is more comfortable for the patient.

2. It offers an opportunity for visualization of the restoration and direct access to the waxing of the margin.

3. It is probably the easiest mean of fabricating a cast restoration.

WAXING PROCEDURE (EXTRAORAL TECHNIQUE):

1. Cover all the preparation at once with molten wax to make a coping of wax. This can be obtained by immersing the preparation in a dish containing molten wax, so now obtain the 1st layer of the wax pattern.

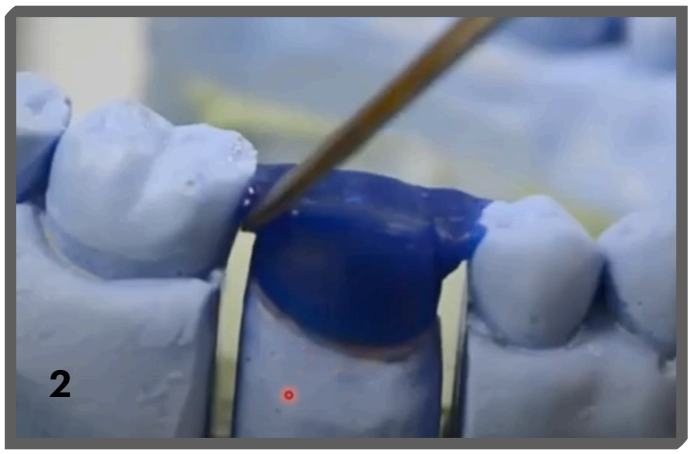
2. Add wax to the proximal surface (wall) of the restoration in relation to the adjacent teeth (to build the contact area in relation to the adjacent teeth).

3. Build the axial wall (buccal & lingual) to the normal counter.

4. Build the occlusal surface of the restoration following (in relation) the curve of spee & curve of Wilson, then check & adjust the occlusal relation with opposing teeth in centric & eccentric relation

5. Check all the margins of the restoration again (wax pattern) to ensure that the margin of the (wax pattern) has no over or under extension, so the wax pattern is now ready for the next step.


1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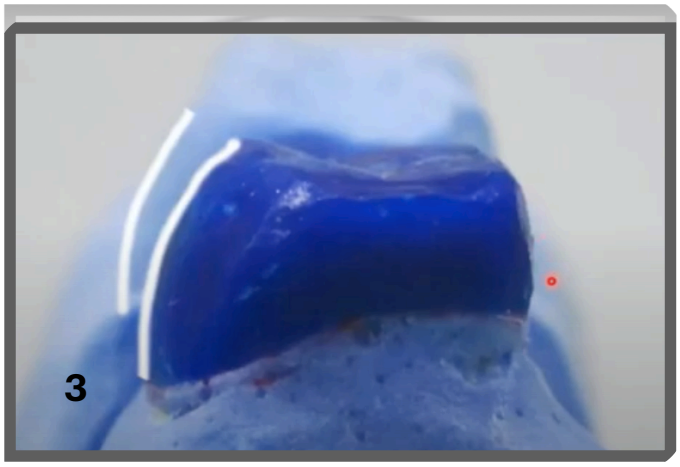
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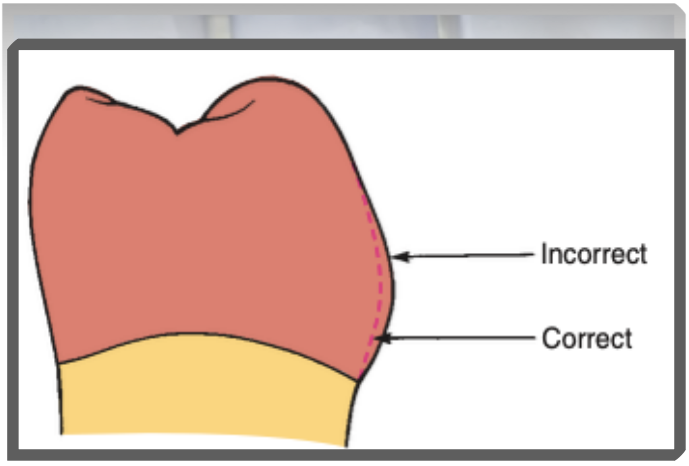
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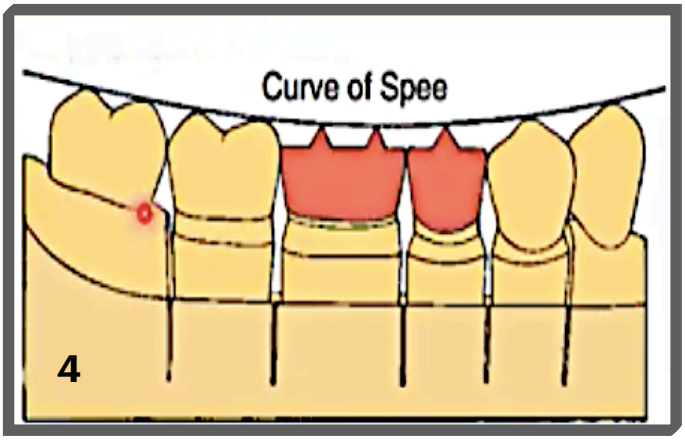
Curve of Spee
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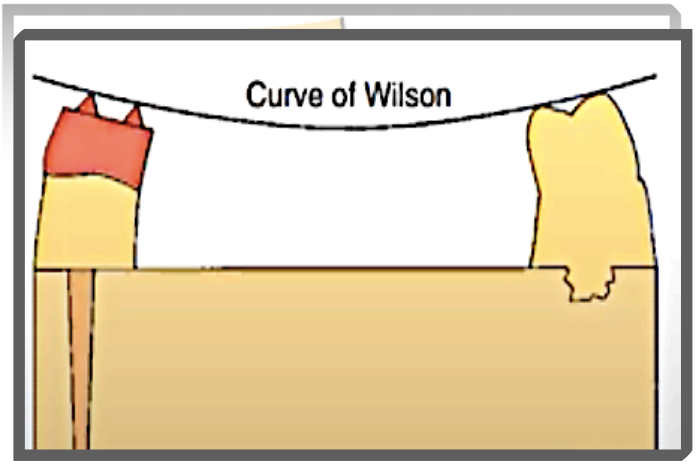
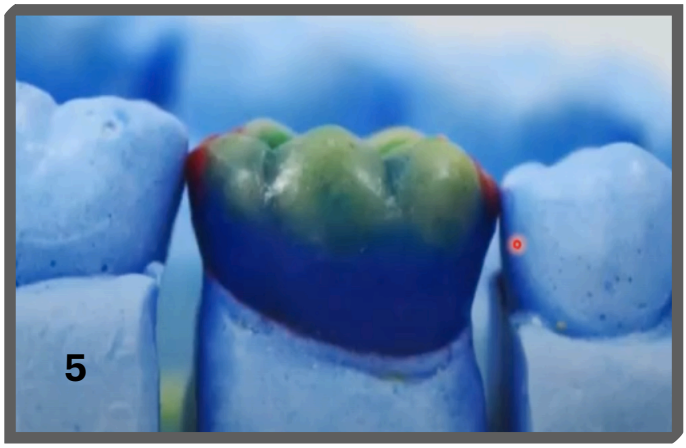

Curve of Wilson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SAMER AUN

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INVESTING

INVESTING:

It is the surrounding of the wax pattern with a mold of heat-resistant material that can accurately duplicate the shape and anatomical features of the wax pattern to obtain a mold after burning out the wax pattern.

OBJECTIVES OF INVESTING:

1. It should provide an accurate reproduction of the anatomical form of the wax pattern.

2. It should provide sufficient strength to withstand the heat of the burnout procedure and the actual casting of the molten metal.

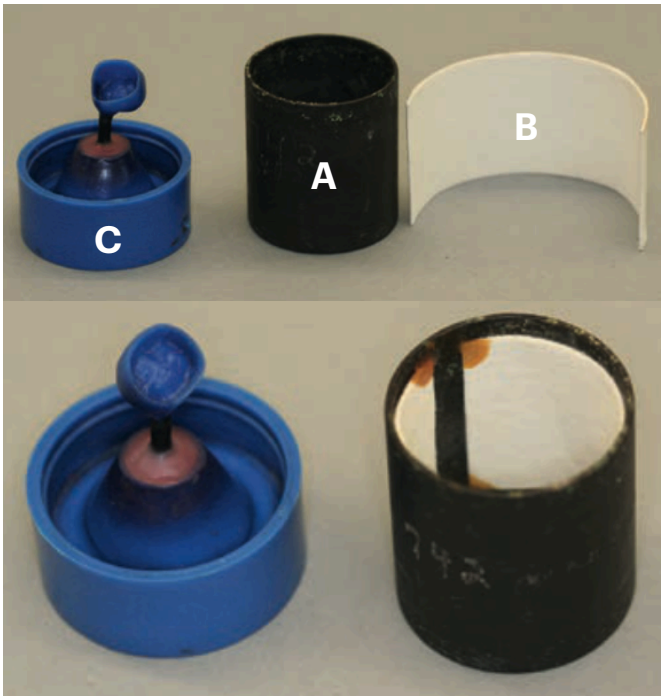
3. It should provide compensation expansion equal to the solidification shrinkage of the metal; therefore, the mold cavity should be larger than the wax pattern (if this does not happen, the restoration will be smaller than the wax pattern).

TO DO INVESTING, WE NEED:

1. -Casting ring.
2. -Ring liner.
3. -Crucible former.
4. -Investment material.

CASTING RING:

The casting ring is made of metal and is used to hold the investment material in place during its setting and to restrict



Components for investing, a,casting ring, b. Ring liner, c.crucible former

its expansion. If we use the casting ring alone, we will not have an expansion, so we need to use the ring liner to allow 22 certain degree of expansion.

RING LINER:

The liner is used to line the inside of the casting ring. It is made from a compressible material. e.g., asbestos (0.6mm thick) that allows the investment material to expand to some degree, but as it is carcinogenic, other materials such as

fiberglass may be used. If there is no room for expansion outward, the mold cavity would produce a small casting. The liner should be 3mm shorter than both ends of the casting ring because it will bind the investment to the ring to prevent the slipping of the whole mass during the casting procedure.

ADVANTAGES OF THE RING LINER:

1. It provides a room of pliable material against which the investment can expand to enlarge the mold cavity to compensate for the solidification shrinkage of the metal.

2. It permits easier removal of the investment and casting from the ring after the burnout procedure.

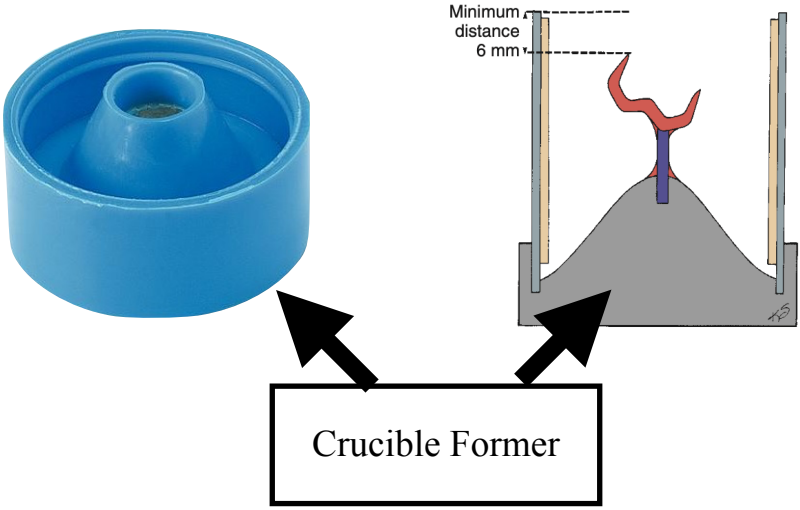
3. It acts as an insulator against loss of heat during the casting procedure.

CRUCIBLE FORMER:

It is a cone-shaped base made of rubber or metal, which forms the base of the casting ring, and to which the other end of the sprue is attached.

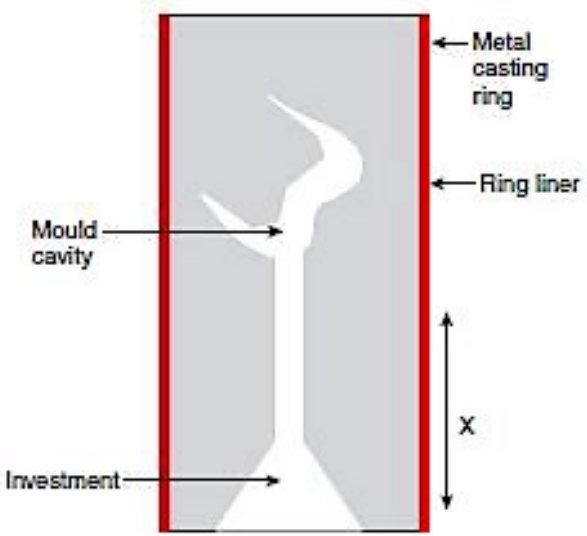
PURPOSES OF USING CONICAL CRUCIBLE FORMER:

1. To get a proper position of the wax pattern inside the casting ring. **2.** To create a cone-shaped way for easy entrance of the molten metal.



MOLD CAVITY:

It is the space created inside the investment after the burnout procedure which was occupied by the wax pattern, sprue, and crucible former



INVESTMENT MATERIALS:

According to the type of the binder we have 2 types:

1. Gypsum-bonded investment material.
2. Phosphate-bonded investment material.

Both consist of a binder and a refractory material (silica).

1. GYPSUM-BONDED INVESTMENT MATERIAL:

The binder is calcium sulfate hemihydrate. It is used with an alloy that has a low melting temperature. At high temperatures, decomposition of calcium sulfate occurs which results in the release of sulfur into the mold and mixes with gold resulting in brittle casting, so it is unstable in burnout temperatures above 650 ^{o}C.

2. PHOSPHATE-BONDED INVESTMENT MATERIAL:

The binder is magnesium phosphate and ammonium phosphate. The binder can withstand high casting temperature; therefore, it is used for investing and casting alloys with higher casting temperatures.

METHODS OF MIXING THE INVESTMENT MATERIAL:

1. Manual: mixing and pouring of the investment is done

by the spatula manually.

2. Mechanical: mixing is done by a vacuum mixer to ensure that the mix is completely free from any bubbles.

POURING THE INVESTMENT IS DONE BY ONE OF THE FOLLOWING METHODS:

i. Brush technique: the investment is applied to the wax pattern with a brush and then we fill the casting ring.

ii. Vacuum technique: the casting ring is attached to the vacuum mixing bowl. The bowl is inverted under vibration to fill the casting ring.

vacuum mixing machine