Operative Dentistry

Operative Dentistry:

Is the art and science of the diagnosis, treatment, and prognosis of defects of teeth which do not require full coverage restorations for correction; such treatment should result in the restoration of proper tooth form, function and esthetic while maintaining the physiological integrity of teeth in harmonious relationship with the adjacent hard and soft tissues; all of which enhance the general health of the patient.

Indications:

The indications for operative procedures are numerous. However, they can be categorized into three primary treatment needs:

(1) Caries.
(2) Malformed, discolored, or fractured teeth.
(3) Restoration replacement or repair.

Cavity preparation:

Is the mechanical alteration of a defective, injured or diseased tooth in order to best receive a restorative material to reestablish a healthy state of the tooth including esthetic corrections when indicated, along with normal form and function.

Objectives of cavity preparation:

1- Remove all defects and give the necessary protection of the pulp.
2- Locate the margins of the restoration as conservatively as possible.
3- Form the cavity so that under force of mastication the tooth or the restoration or both will not fracture and the restoration will not be displaced.
4- Allow for the esthetic and functional placement of a restorative material.

Definitions

Cavity preparation walls:

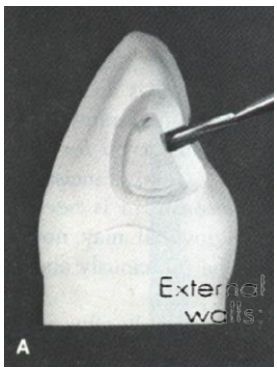
Internal walls: An internal wall is a prepared cavity surface that does not extend to the external tooth surface.

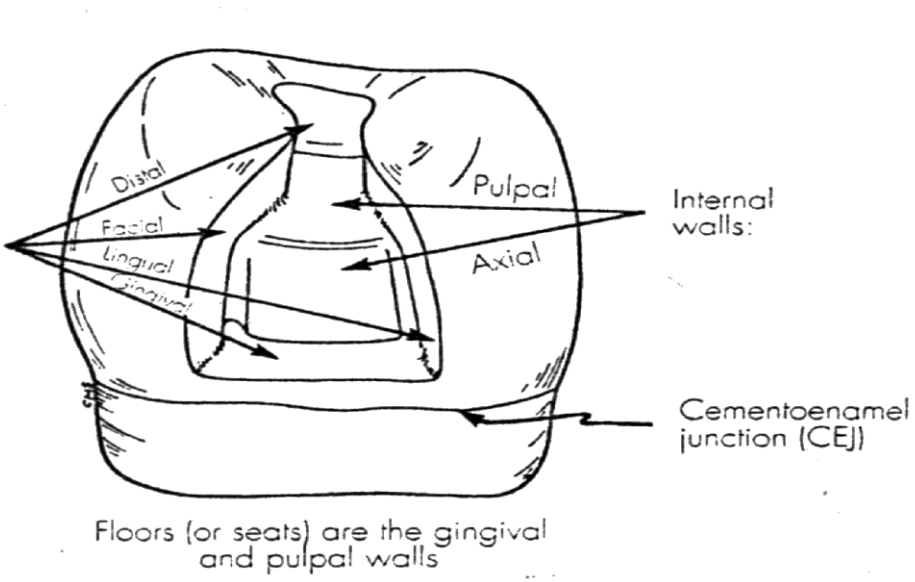
Axial wall: Is an internal wall parallel with the long axis of the tooth.

Pulpal wall: Is an internal wall that is both perpendicular to the long axis of the tooth and occlusal to the pulp.

External wall: An external wall is a prepared cavity surface that extends to the external tooth surface, and such a wall takes the name of the tooth surface (or aspect) that the wall is toward.

Floor or Seat: Is a prepared cavity wall which is reasonably flat and perpendicular to those occlusion forces that are directed occlusogingivally. Ex: gingival and pulpal walls.

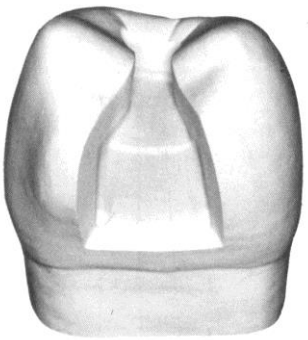


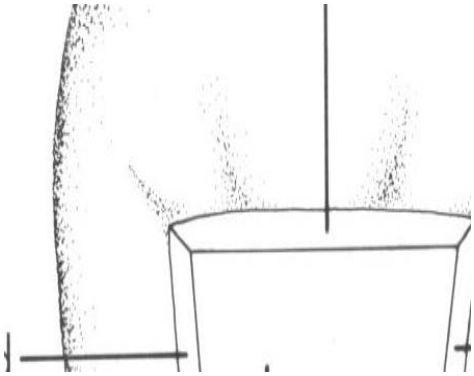


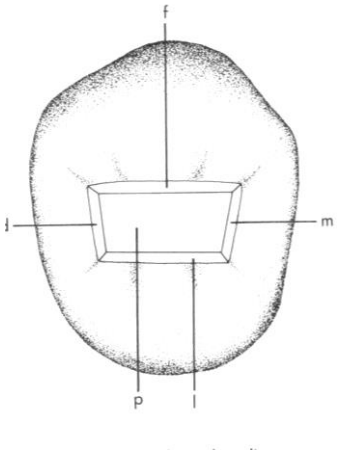
Floors (or seats) are the gingival and pulpal walls

***Enamel wall*:** The enamel wall is that portion of the prepared external wall consisting of enamel.

Dentinal wall: The dentinal wall is that portion of a prepared external wall consisting of dentin which may contain retention features.





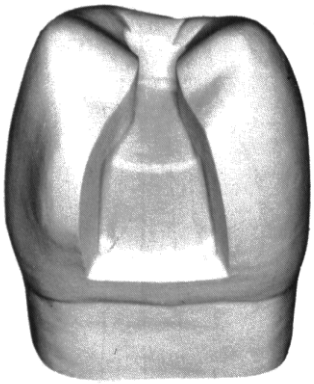


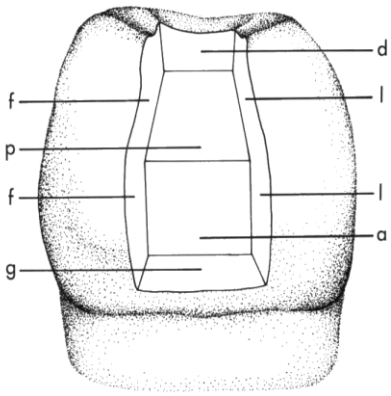
Line angle:

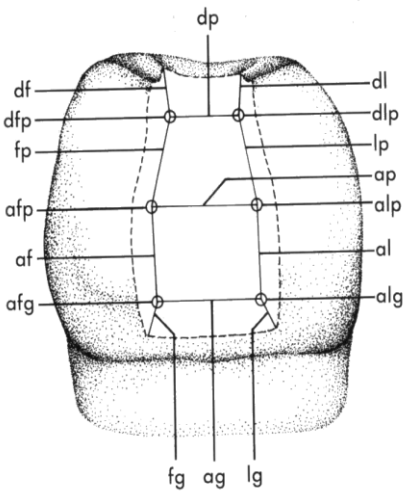
A line angle is the junction of two planal surfaces of different orientation along a line . It takes the name of the two surfaces forming the angle. An ***internal angle*** is a line angle whose apex points into the tooth. An ***external angle*** is a line angle whose apex points away from the tooth.

Point angle:

A point angle is a junction of three planal surfaces of different orientation at a common point. It takes the name of the three surfaces forming it.

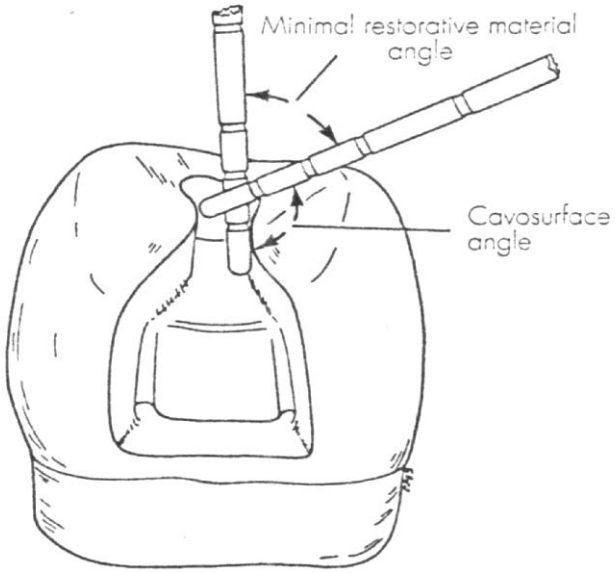






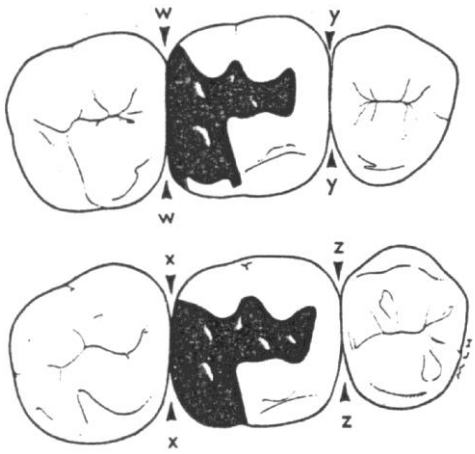
Cavosurface angle, cavosurface margin, and cavity margin:

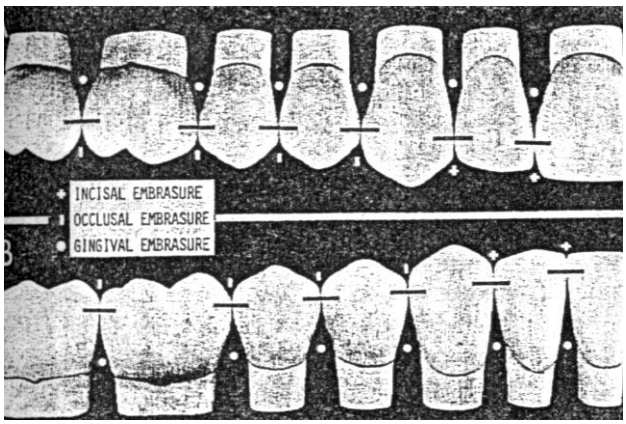
The ***cavosurface angle*** is the angle of tooth structure formed by the junction of a prepared cavity wall and the external surface of the tooth. The actual junction is referred to as ***cavity margin*** or ***cavosurface margin.***



Embrasures:

Are V - shaped spaces that originate at the proximal contact areas between adjacent teeth and are named for the direction toward which they radiate. These embrasures are: (1) facial, (2) lingual, (3) incisal or occlusal, and (4) gingival.





Undercut:

Is a portion of prepared cavity confined by the walls which converge towards the outer surface or it could be a localized channel or groove within prepared cavity.

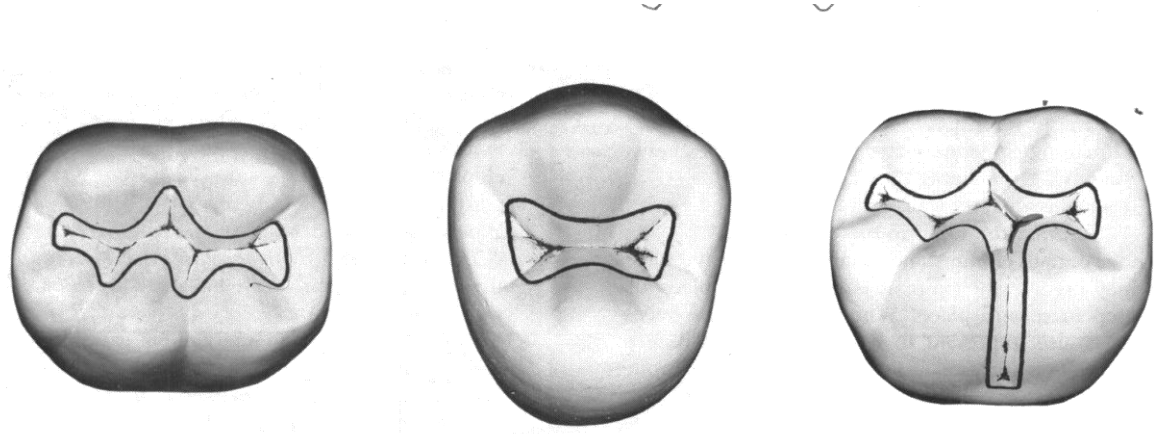
Cavity classifications

1- According to the number of surfaces involved

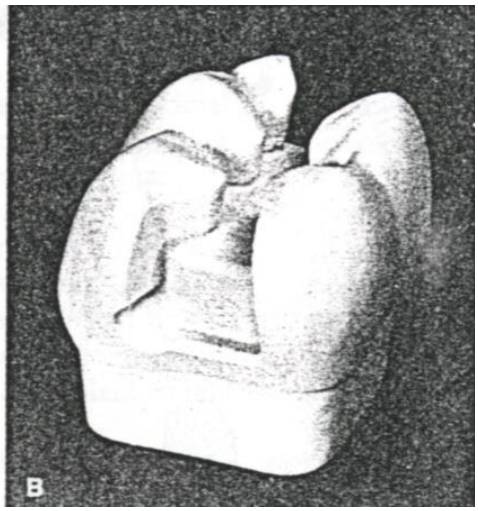
A- ***Simple cavity :*** only one surface involved
B- ***Compound cavity :*** two surfaces involved
C- ***Complex cavity :*** Three surfaces (or more) involved

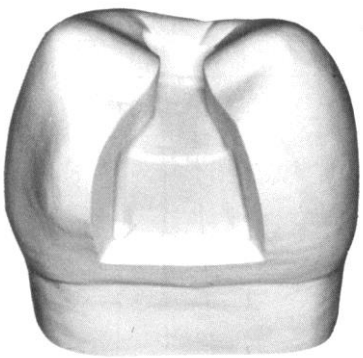
2- **According to anatomical areas involved and associated type of treatment was presented by G.V Black**

Class I : All pit and fissure cavities : cavities on the occlusal surface of premolars and molars, on the occlusal two thirds of the facial and lingual surfaces of molars , on the lingual surface of maxillary incisors.

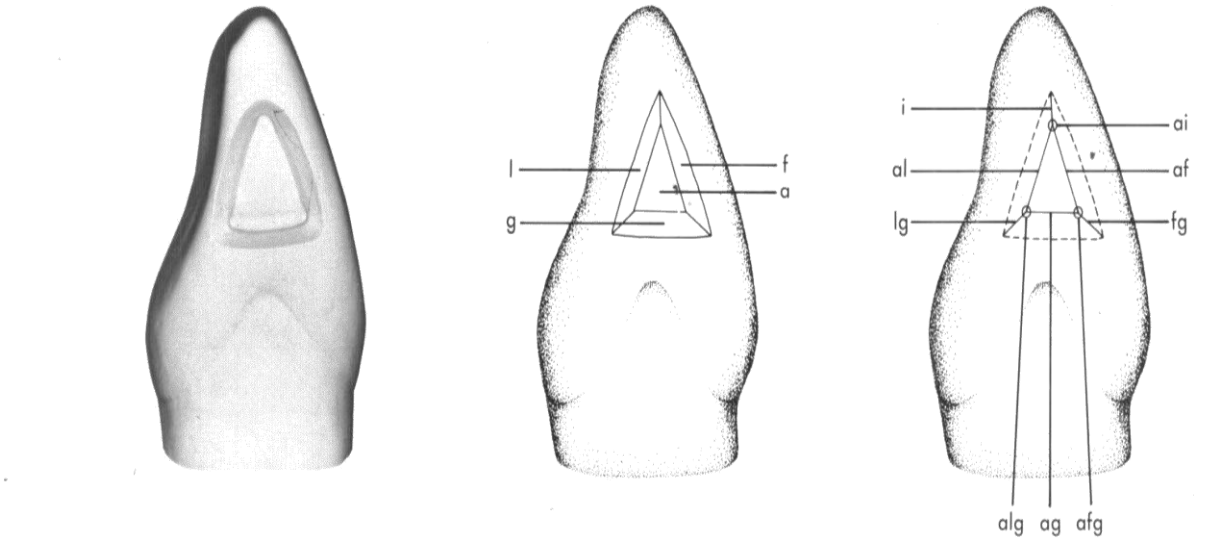


Class II : Cavities on the proximal surfaces of posterior teeth . (Mesio-oclusal MO),(Disto-oclusal DO) , (Mesio- occluso – distal MOD).

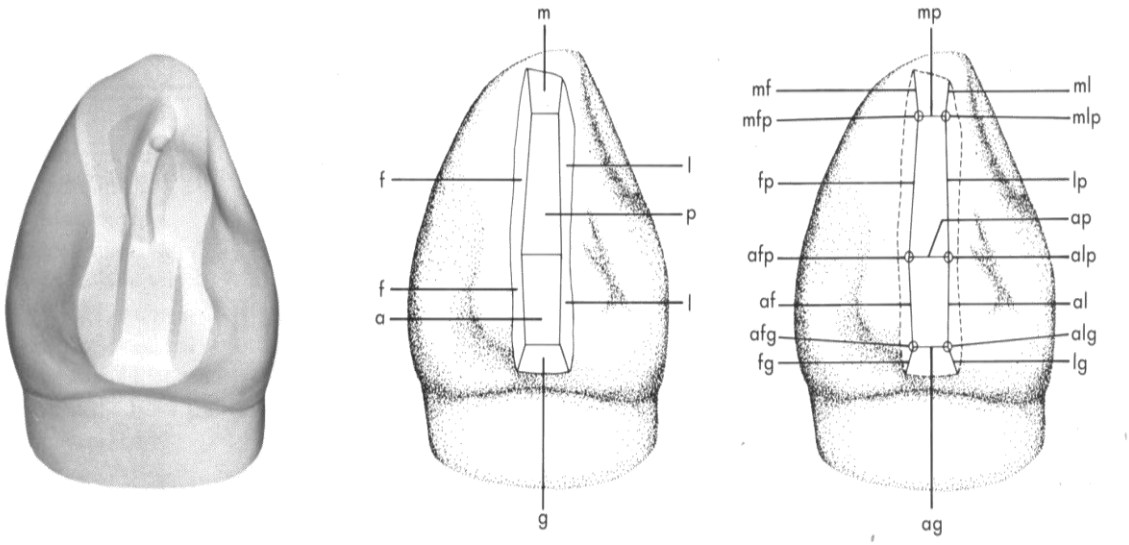




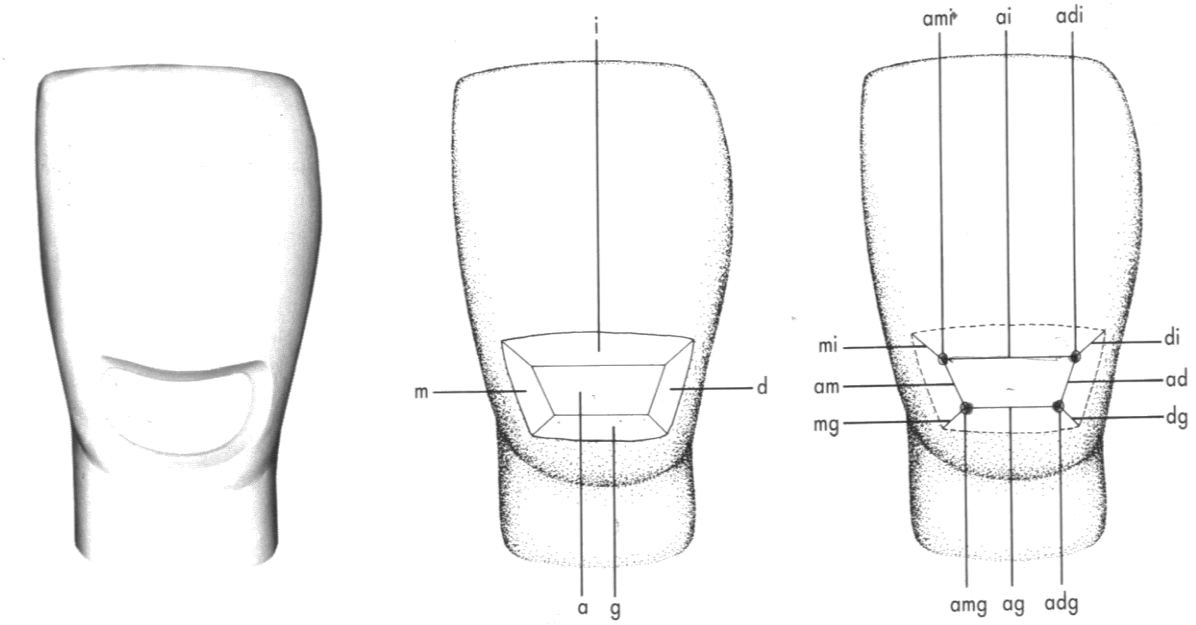
Class III : Cavities on the proximal surfaces of anterior teeth that do not involve the incisal angle.



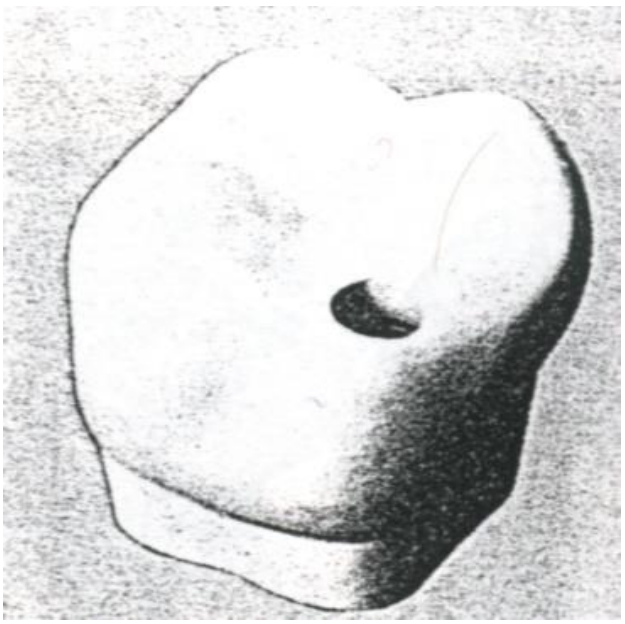
Class IV : Cavities on the proximal surfaces of anterior teeth that do do involve the incisal edge.



Class V : Cavities on the gingival third of the facial and lingual surfaces of all teeth (not pit and fissure cavities)



Class VI : Cavities on the incisal edge of anterior teeth or the occlusal cusp heights of posterior teeth.



Operative Dentistry

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Instruments and equipment for tooth preparation

The removal and shaping of tooth structures is an essential part of restorative dentistry. To achieve this, a wide variety of hand and rotary instruments are used. Other instruments are also needed for filling procedures.

Hand instruments

Materials:

Hand cutting instruments are manufactured from two main materials: ***Carbon steel*** and ***stainless steel***. in addition, some instruments are made from ***carbide*** to provide more durable cutting edges. Carbon steel is harder than stainless steel, but when unprotected, it will corrode. Stainless steel remains bright under most conditions but loses a sharp edge during use much more quickly than carbon steel. Carbide, while hard and wear resistant, is brittle and can not be used in all designs.

Other alloys of nickel, cobalt, or chromium are used in the manufacture of hand instruments, but they are usually restricted to instruments other than those used for the cutting of tooth surfaces.

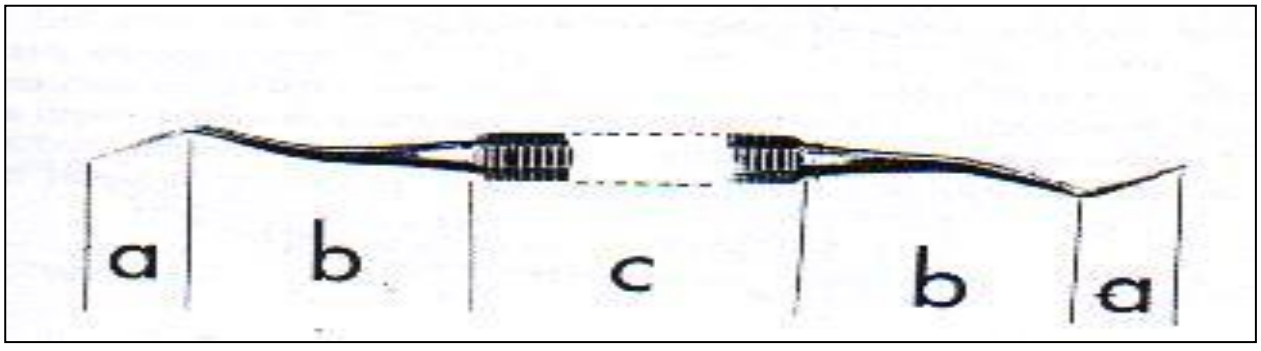
Instrument design:

Most hand instruments, regardless of use composed of three parts:

1- Handle or shaft: various sizes and shapes, grasped by hand, eight-sided to facilitate control.

2- Shank: connects the handle to the working end of the instrument, it is normally rounded, smooth and tapered; usually has one or more bends to avoid the instrument having a tendency to twist in use when force is applied.

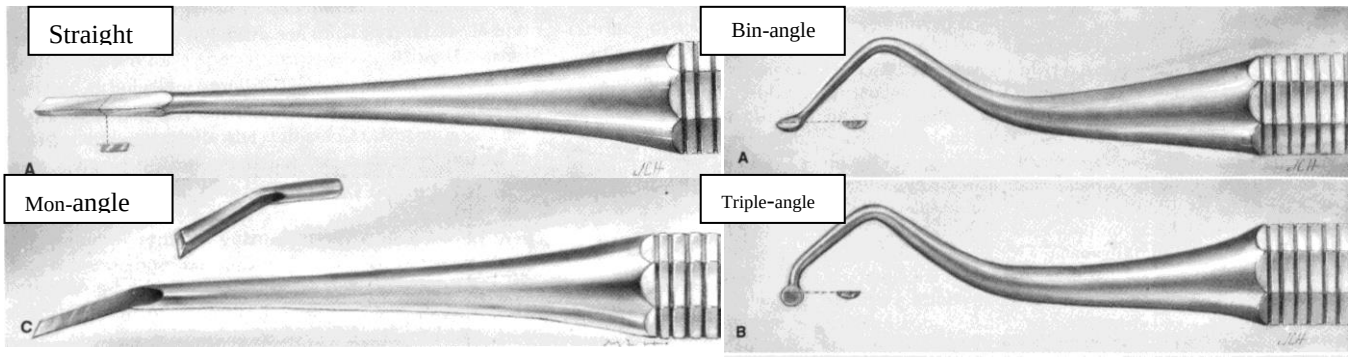
3- Blade: working end of the instrument, has many sizes and designs depending on the function, it is connected to the handle by the shank. For the non cutting instrument the part corresponding to the blade is called the ***nib***. The end of the nib or working surface is termed as the ***face***. Some instruments have a blade on both ends of the handle and are known as ***double – ended instruments***.

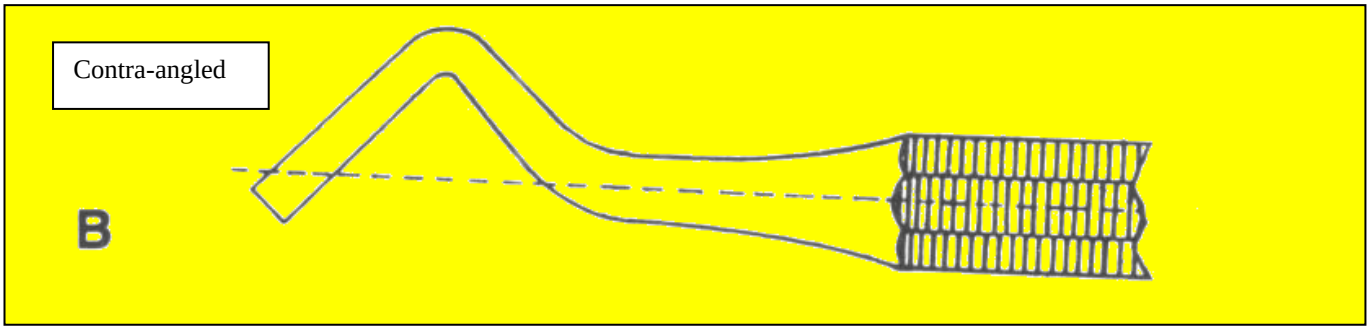


Instrument shank angles

The functional orientation and length of the blade determines the number of angles necessary in the shank to balance the instrument. G.V. Black classified instruments used based on the number of shank angles, as: ***mon-angle (one), bin-angle (two), or triple-angle (three).***

Instruments with longer blades or more complex orientations may require two or three angles in the shank to bring the cutting edge near to the long axis of the handle. This allow for concentration of force onto the blade with out causing rotation of the instrument in grasp. Such shanks are termed ***contra-angled.***





Instrument name

Black classified all instruments by ***name***. In addition, for hand cutting instruments, he developed a numeric ***formula*** to characterize the dimensions and angles of the working end. Black's classification system by instrument name categorized instruments by:

1- function (e.g., scaler, excavator)

2- manner of use (e.g., hand condenser)

3- design of the working end (e.g., spoon excavator, sickle scaler)

4- shape of the shank (e.g., mon-angle, bin-angle, contra-angle)

Cutting operative instrument formulas:

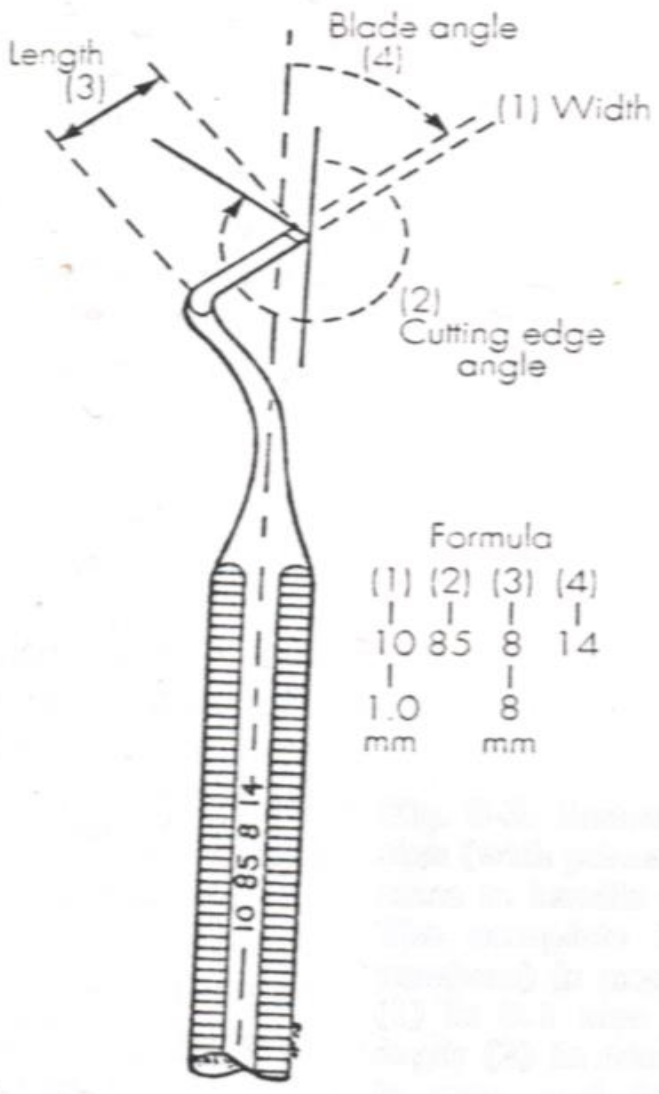
Cutting instruments have ***formulas*** describing the dimensions and angles of the working end. These are placed on a handle using a code of three or four numbers separated by dashes or spaces (e.g.: 10-85-8-14).

1- The ***first number*** indicates the **width of the blade or primary cutting edge** in tenths of mm.

2- The ***second number*** indicates the ***primary cutting edge angle*** measured from a line parallel to the long axis of the instrument handle in clockwise centigrades (The centigrade circle contain 100 centigrade with 25, 50 and 75 centigrade equal to 90, 180 , 270 degrees in the 360- degree circle). The instrument positioned so that this number is above 50. If edge is totally perpendicular to the blade, so this number is omitted resulting in a three number code.

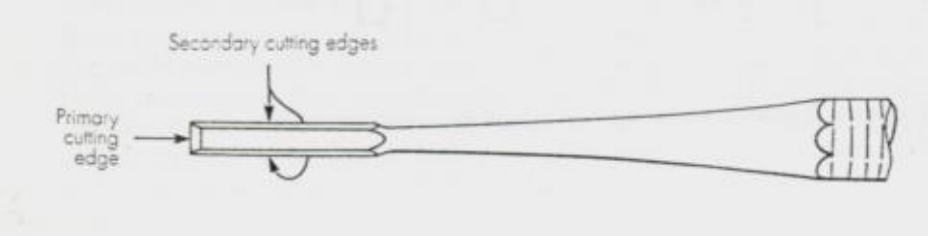
3- The ***third number*** indicates the ***blade length*** in mm .

4- The ***fourth number*** indicates the ***blade angle relative to the long axis of the handle*** in clockwise centigrade; this number is 50 or less.



Cutting instrument bevel

Most hand cutting instruments have on the end of the blade a ***single bevel*** that forms the ***primary cutting edge***. Two additional edges, called ***secondary cutting edges,*** extend from the primary edge to the length of the blade. ***Bi-beveled*** instruments, such as ordinary hatchets, have two bevels that form the cutting edge.



Cutting instruments:

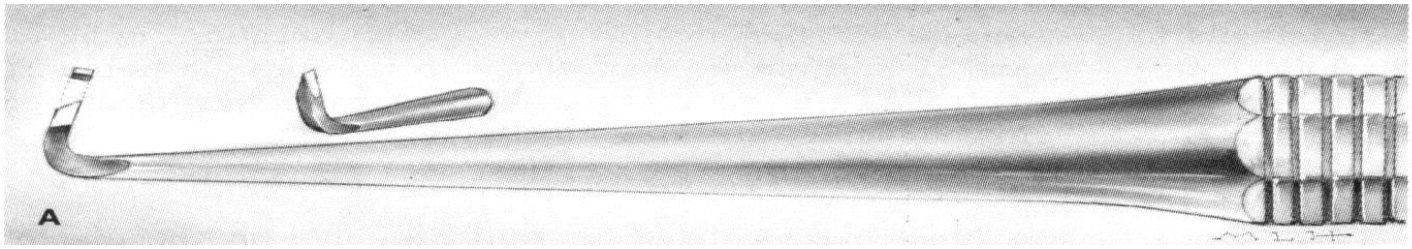
Instruments that are used to cut hard or soft tissues of the mouth, they include:

1- Excavators:

Excavators are used for removal of caries and refinement of the internal parts of the cavity. They are subdivided into the following:

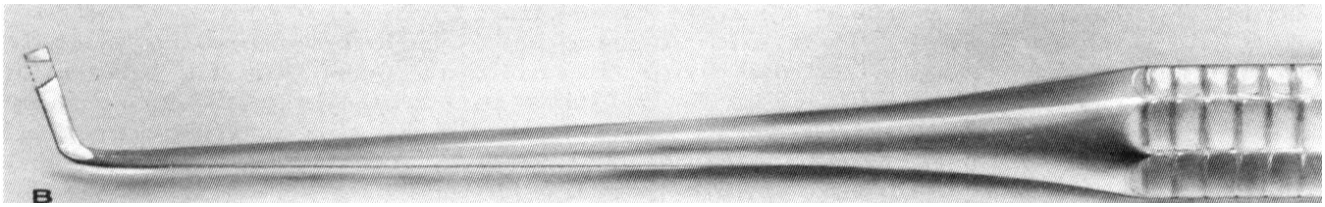
(A)- Ordinary hatchet excavator:

It has the cutting edge of the blade directed in the same plane as that of the long axis of the handle and is bibeveled. This instrument is used primarily on anterior teeth for preparing retentive areas and sharpening internal line angles, particularly in preparations for direct gold restorations.



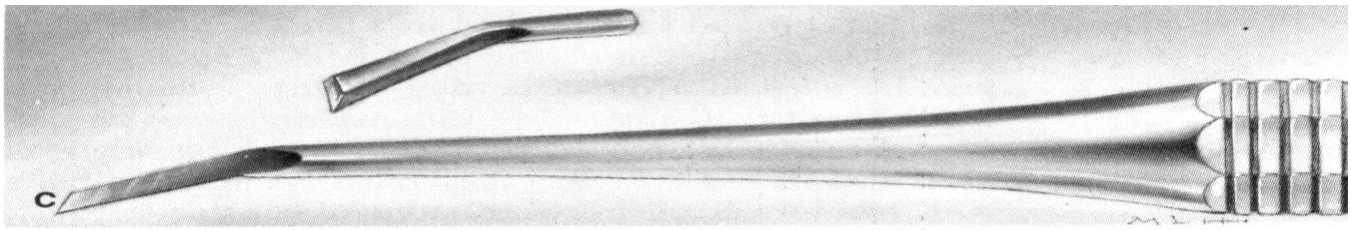
(B)- Hoe excavator:

It has the primary cutting edge of the blade perpendicular to the axis of the handle. This type of instrument is used for planning cavity preparation walls and forming line angles. It is commonly used in Class III and V preparations for direct gold restorations. Some hoes may have longer and heavier blades with the shanks contra-angled; these are intended for use on posterior teeth. It is usually used with pull motion.



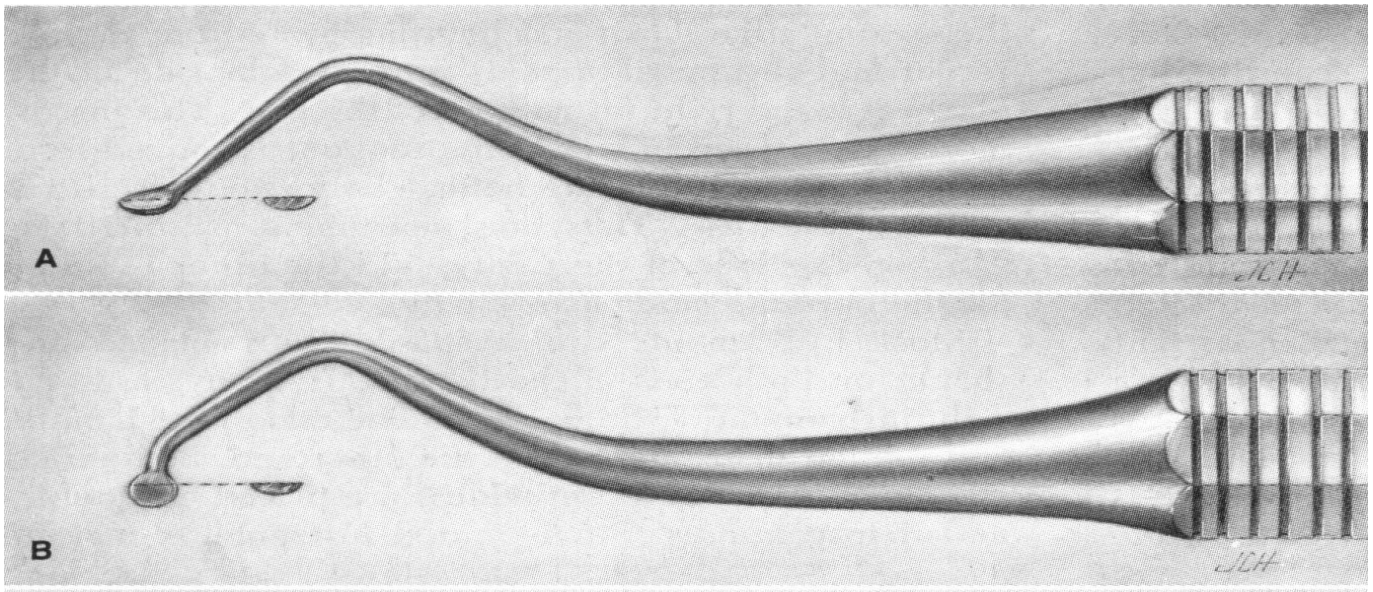
(C)- Angle former:

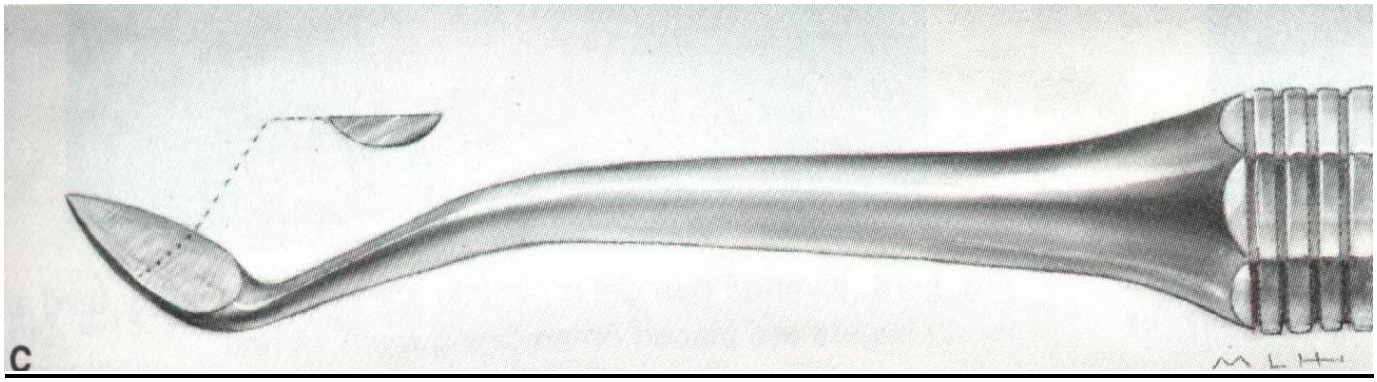
It is mon-angled and has the primary cutting edge at an angle (other than 90 degrees) to the blade. It may be described as a combination of a chisel and gingival margin trimmer. It is available in pairs (right and left). It is used primarily for sharpening line angles and creating retention features in dentin in preparations for gold restorations. It may also be used to in placing a bevel on enamel margins.



(D)- Spoon excavator:

The blades are slightly curved and the cutting edges are either circular or claw-like. The circular edge is known as a ***discoid***, where as the claw-like blade is termed a ***cleoid***. The shanks may be bin-angled or triple-angled to facilitate accessibility. They are used for removing caries and carving amalgam or direct wax patterns.



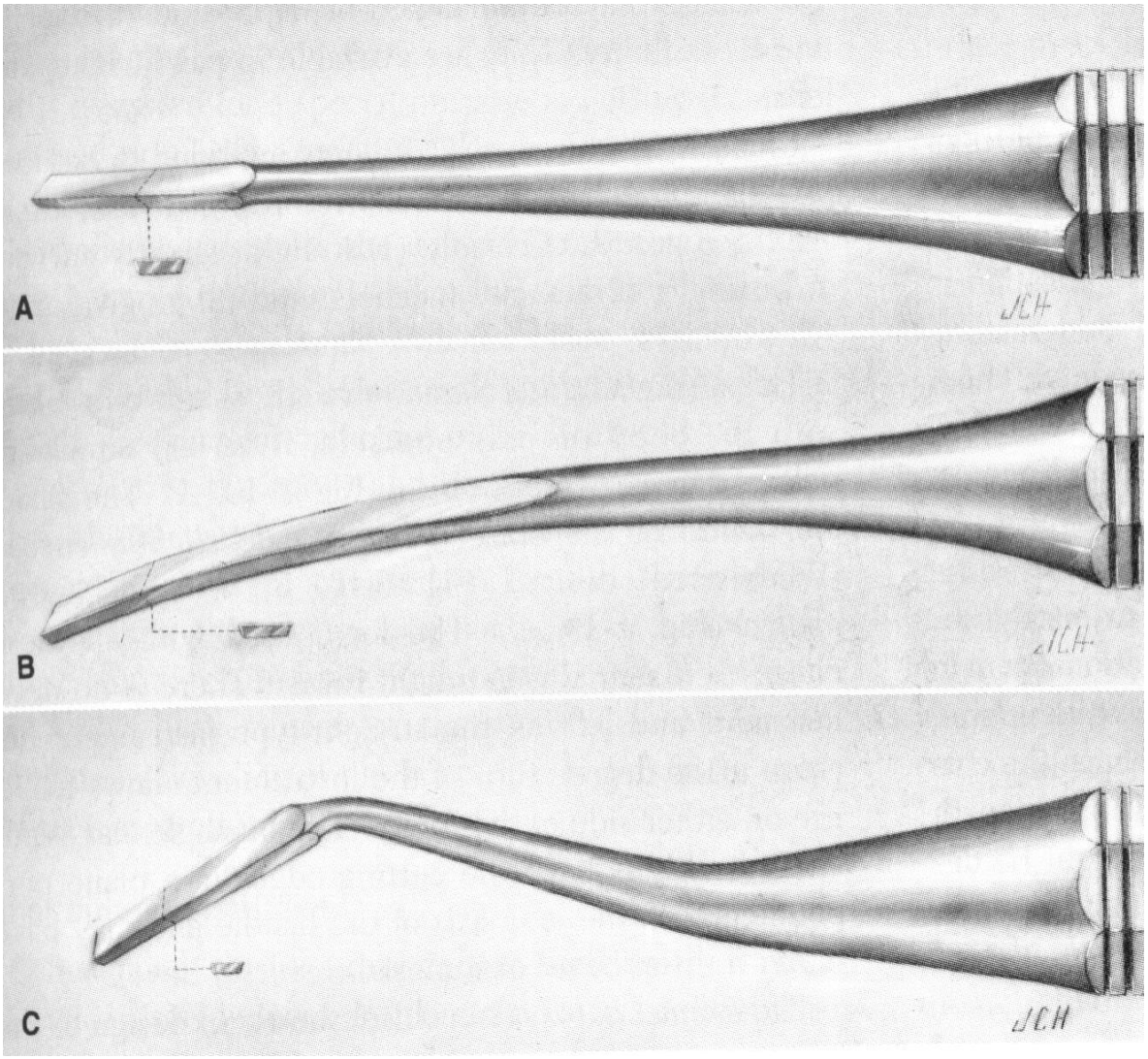


2- Chisels:

Chisels are intended primarily for cutting enamel and may be grouped as follows:

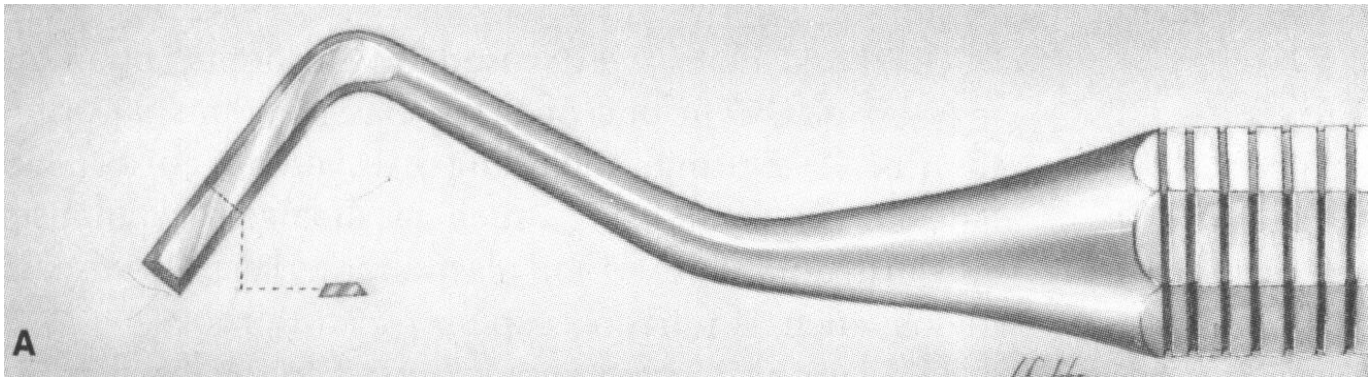
(A)- ***Straight, slightly curved, or bin-angle:***

A ***straight chisel*** has a straight shank and blade with the bevel on only one side. Its primary edge is perpendicular to the axis of the handle. It is similar in design to a carpenter's chisel. The shank and blade of the chisel also may be slightly curved ***(Wedelstaedt design)***, or may have two angles in the shank ***(bin – angled)***. There is no need for a right and left type in the straight chisel, since a 180-degree turn of the instrument allows for its use on either side of the cavity. In the bin-angled and Wdelstaedt chisels, the blade may have either a distal bevel or a mesial bevel. The blade with a distal bevel is designed to plane a wall that faces the blade's inside surface, while the blade with a mesial bevel is designed to plane a wall that faces blade's outside surface. The force used with all these chisels is essentially a straight push.



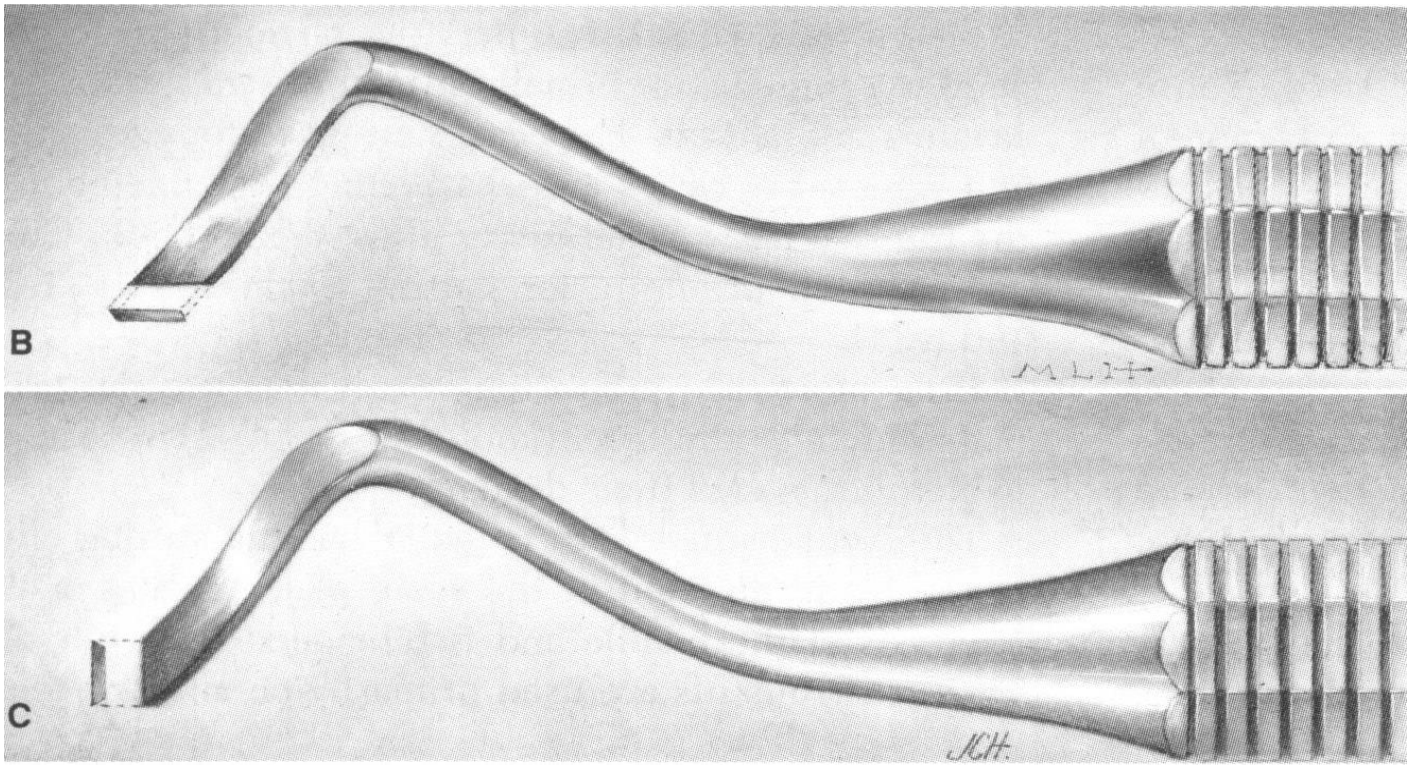
(B)- Enamel hatchet :

It is a chisel similar in design to the ordinary hatchet except that the blade is larger, heavier, and is beveled on only one side. It has its cutting edges in a plane that is parallel with the axis of the handle. It is used for cutting enamel and comes as right or left types for use on opposite sides of the cavity.



(C)- Gingival margin trimmer

It is similar in design to the enamel hatchet, except the blade is curved (similar a spoon excavator), and the primary cutting edge is at an angle (other than perpendicular) to the axis of the blade. It is made as right and left types (either a mesial pair or a distal pair). It is so designed to produce a proper level on gingival margins of proximoocclusal preparations.



3- Other cutting instruments:

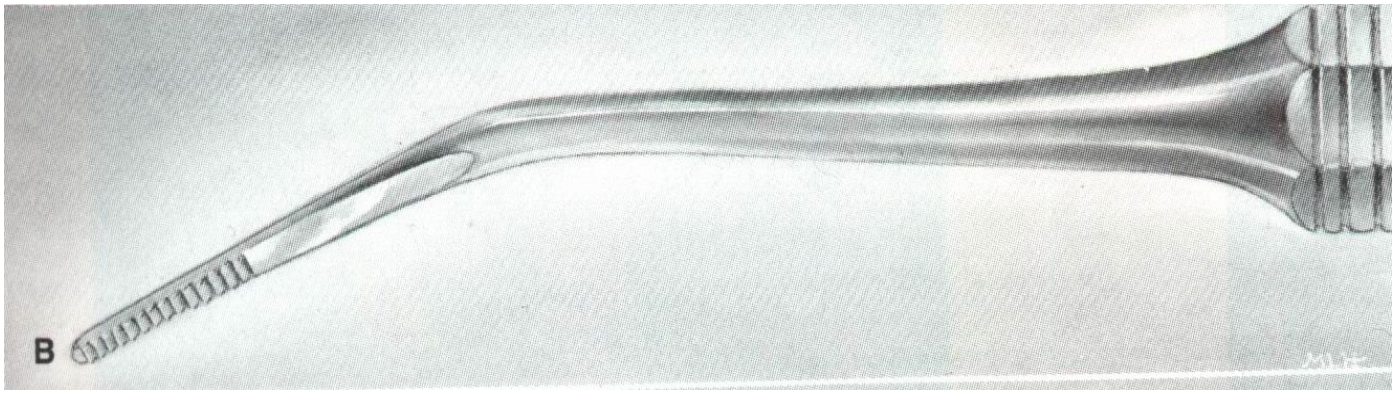
Other hand cutting instruments, such as knife, file, and discoid-cleoid instrument are used for trimming restorative material rather than for cutting tooth structure.

(A)- Knives:

They are known as finishing knives, amalgam knives, or gold knives. They are designed with a thin, knife-like blade that is made in various sizes and shapes. They are used for trimming excess filling material on the gingival, facial, or lingual margins of a proximal restoration or trimming and contouring the surface of Class V restoration.

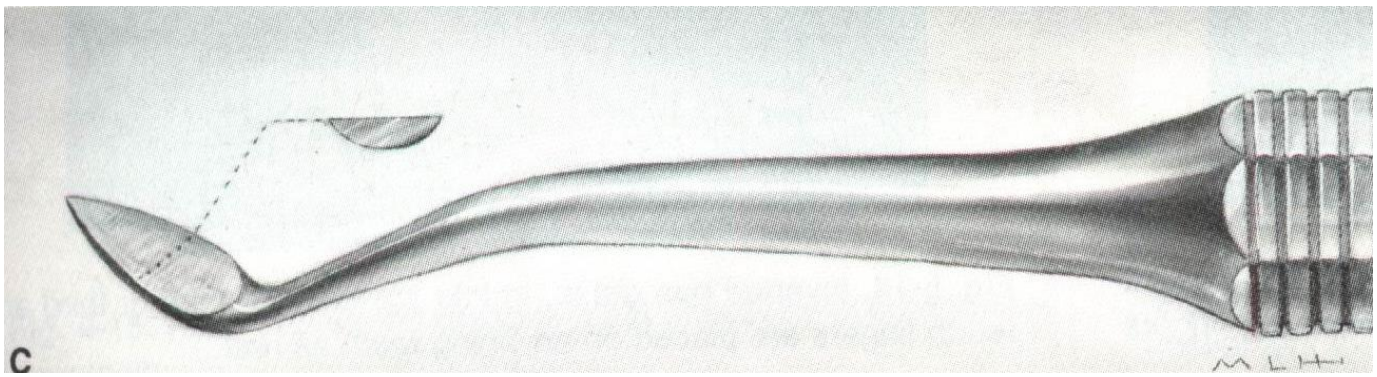
(B)- Files:

The blades of files are very thin, and the teeth on the cutting surfaces are short. The teeth of the instrument are designed to make the file either a ***push*** or a ***pull*** instrument. Files can be used to trim excess filling material, and they are particularly useful at gingival margins. They are manufactured in various shapes and angles to allow access to restoration.



(C)- Discoid-Cleoid instrument:

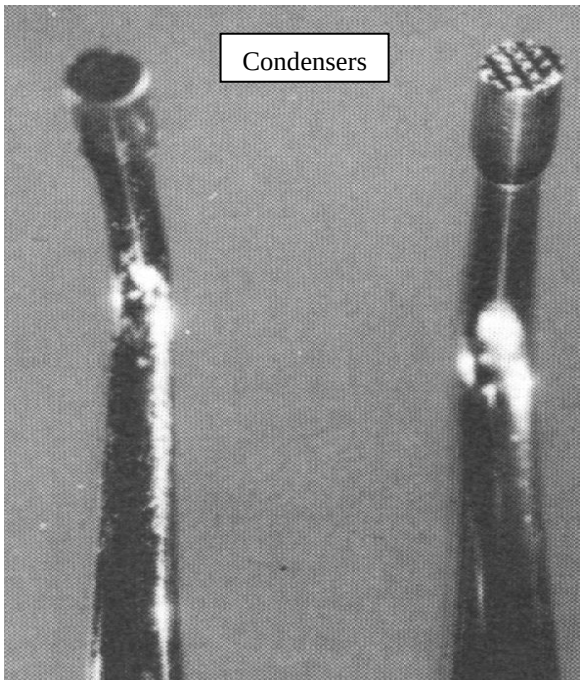
The working ends of this instrument are larger than the discoid or cleoid end of an excavator. It is used mainly for carving occlusal anatomy in amalgam restorations. It also may be used to trim or burnish inlay-onlay margins.

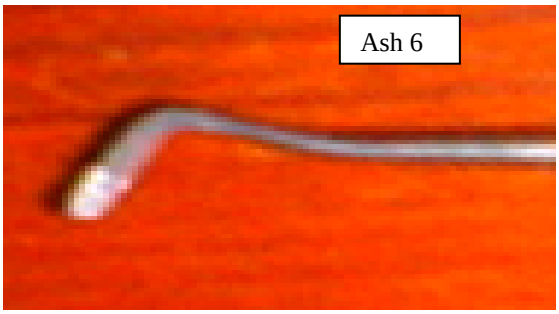


Non cutting hand instruments

1- Condensing instruments

Used to condense amalgam in the prepared cavity. So they called condensers or pluggers. The head has different sizes and shapes, and could be either smooth or serrated.





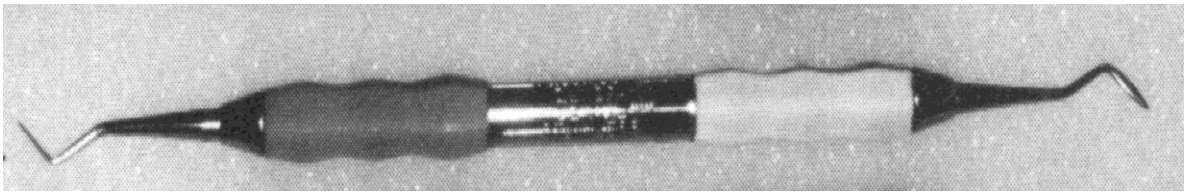
2- Plastic instruments

Used to manipulate plastic restorative material.

Examples: Ash 6 : adaptation of cement against the axial wall and finish carving of amalgam. Ash 49: adapt the cement in the cavity and finish carving of amalgam, sometimes used to condense some of the filling materials.

3- carving instruments

Used to carve amalgam to proper shape after condensation and also carve the wax pattern to the proper shape.

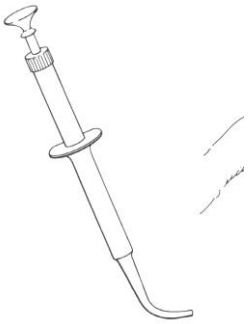


4- Burnishing instrument

Has a round heads . Usually double ended, with different sizes. Usually used to polish and burnish the surfaces of the restoration, contour the matrix band in class II cavity preparation and stretch the margin of cast gold restoration.

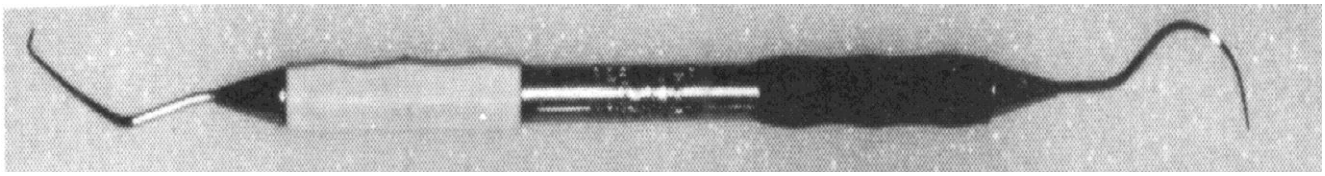
5- Amalgam carrier

Used to carry amalgam from the container to the prepared cavity.



6- Exploring instruments

Such as dental probe used to explore tissue defects like caries detection. Either sickle ,straight, angle in shape. They are circular in cross section.



7- Dental mirror

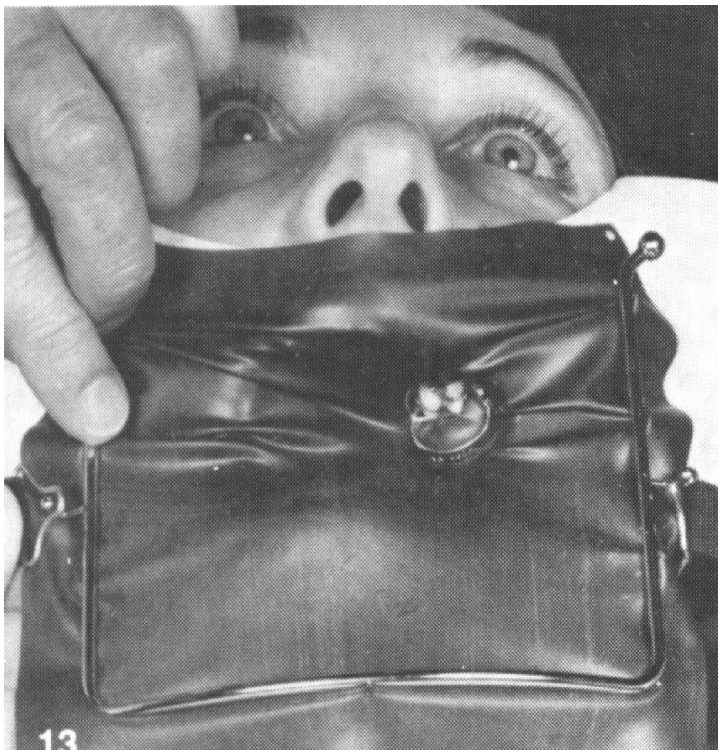
Used for examination during diagnosis and treatment.

8- Dycal applicator

Has a very small round head, used to carry ca(OH)2 subliner to the prepared cavity.

9- Isolation instruments

Rubber dam and saliva ejector.



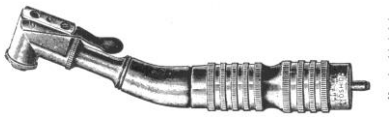
Operative Dentistry

Powered cutting equipment

Handpiece:

Is a device for holding rotary instruments, transmitting power (Source of power is motor or air) to them, and for positioning them intraorally. Handpieces and associated cutting and polishing instruments developed as two basic types, ***straight*** and ***angle***.

Straight Handpiece



Contra-angle Handpiece

Air Turbine Handpiece

Rotary speed ranges

Three speed ranges are generally recognized measured in revolutions per minute (rpm)

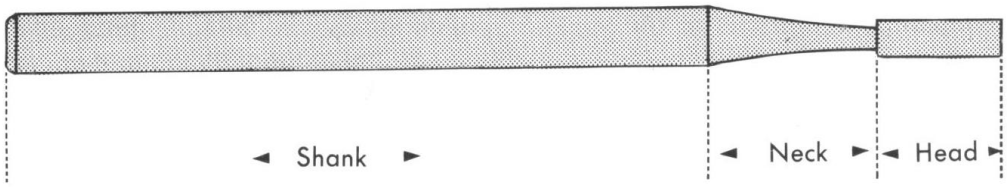
1- ***Low*** speed or slow speeds: (below 12,000 rpm.) Used for tooth cleaning, caries excavation, and finishing and polishing procedures. At low speeds, tactile sensation is a better and there is generally less chance for overheating cut surfaces.
2- ***Medium*** or intermediate speeds: (12,000 – 200,000 rpm).
3- ***High*** or ultra-high speeds: (above 200,000 rpm). Used for tooth preparation and removing old restorations.

* Most useful instruments are rotated at either low or high speed.

Rotary Cutting Instruments

The individual instruments intended for use with dental handpieces are manufactured in hundreds of sizes, shapes, and types. This variation is in part resulted from the need for specialized designs for particular clinical applications or to fit particular handpieces, but much of the variation also resulted from individual preferences on the part of dentists.

In spite of the great variation that exists among rotary cutting instruments (Burs), they have certain design features in common. Each instrument consists of three parts: shank, neck, and head.



Materials of dental burs

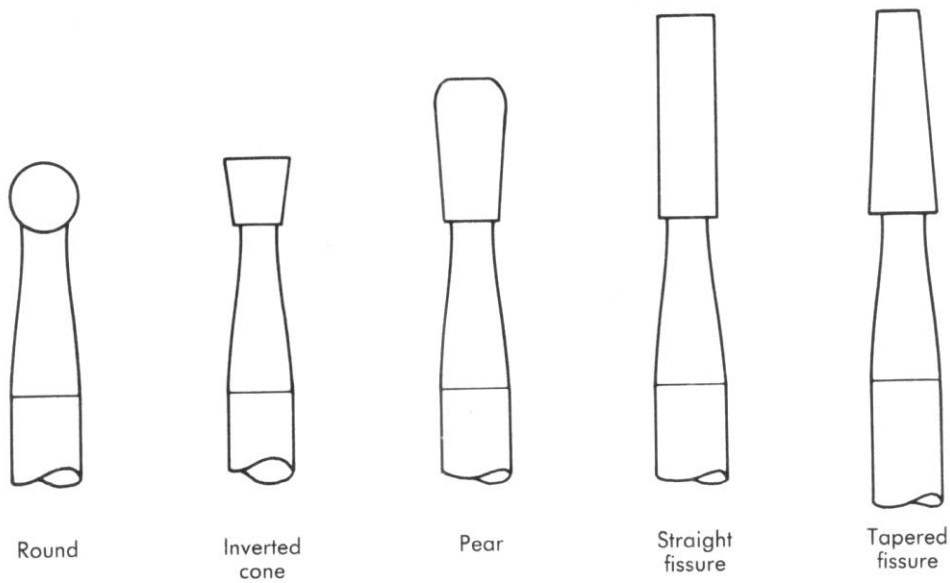
1- Stainless Steel: introduced in 1891 , perform well cutting human dentin at low speeds, but dull rapidly at high speed or when cutting enamel. Once dulled, reduced cutting effectiveness creates increased heat and vibration.

2- Carbide burs: usually tungsten carbide, they are introduced in 1947, replaced steel burs for cavity preparation, carbide is much harder than steel and less subjected to wear during cutting. But they are brittle, so they will fracture when subjected to sudden blow or shock.

3- Diamond burs: introduced in 1942, they belong to "abrasive instruments" are based on small particles of a hard substance held in a matrix of softer material.

Cutting occurs at a large number of points where individual hard particles protrude from the matrix. Diamond instrument have long life and great effectiveness in cutting enamel and dentin.

Shapes and sizes:



1- Round Burs: Spherical in shape, with different sizes (1/4 = 0.5 mm, 1/2 =0.6 mm , 1 = 0.8 mm, 2 = 1.0 mm, 3 = 1.2 mm, 4 = 1.4mm …etc) . Large round burs with slow speed used for caries removal which can not be removed by spoon excavator. Small round burs used for entry into the tooth and for preparation of retentive pinholes and grooves.

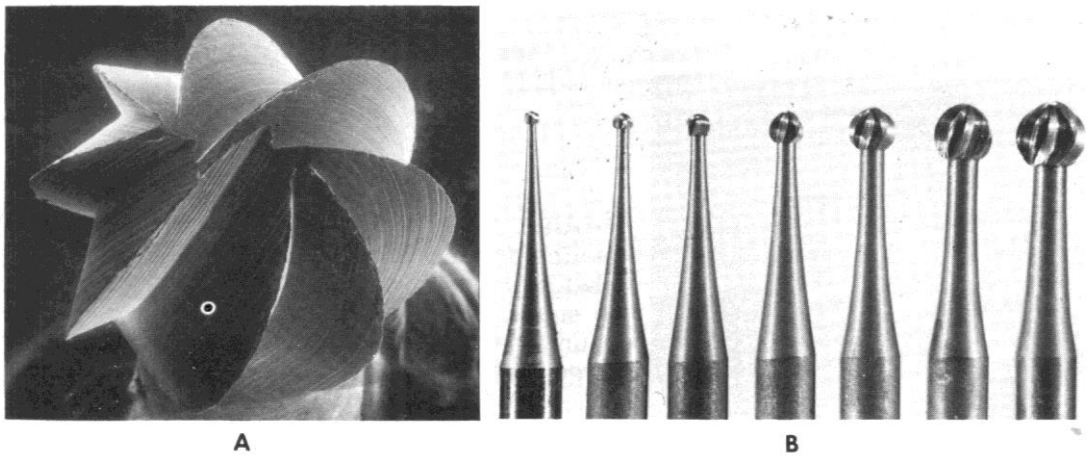
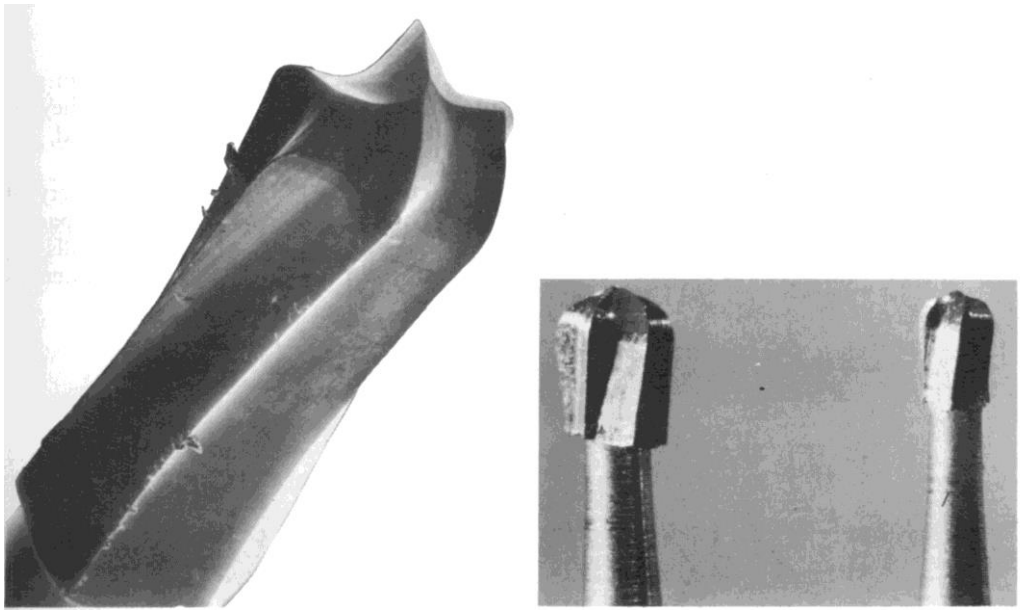


FIGURE 3–7. Round burs, *A,* Note the blades, which enable the bur to cut with its end. *B,* Round burs range in size from No. ½, 1, 2, 4, 6, 8, 10 (left to right).

Elliptical Burs (Pear shaped): Elliptical or elongated round burs have became popular as a result of a trend toward conservative cavity design. Characterized by round corners with a reverse taper. They produce a conservative cavity preparation with rounded internal corners and a minimum removal of tooth structure.

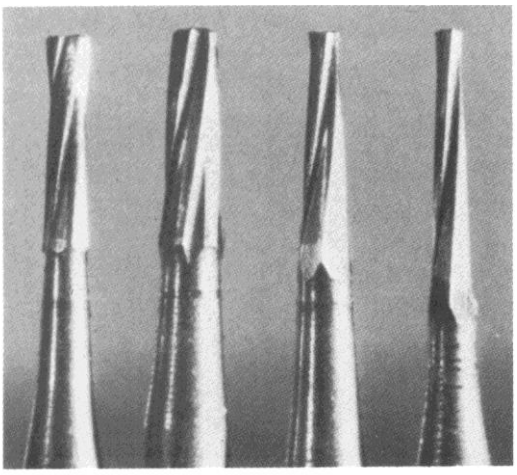


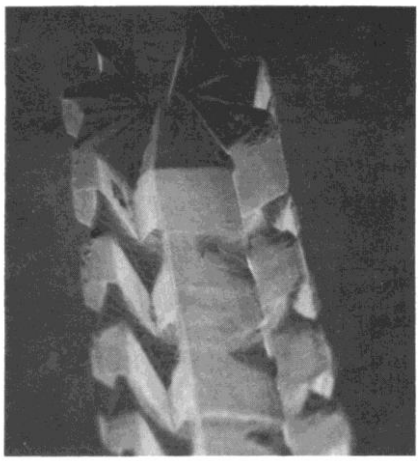
3- Straight fissure burs: Elongated cylinder, cut enamel and dentin well at high speed, establishing outline form and have advantage of leaving smooth cut surface.

Numerical code: (56 = 0.8 mm, 57= 1.0 mm, 58 = 1.2 mm, 59 = 1.4 mm…..).

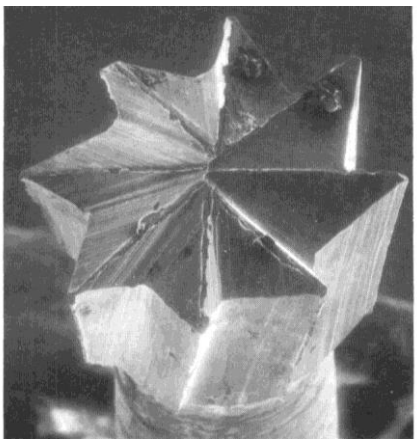
4- Tapered fissure burs: Tapered cone with the small end of the cone directed away form the shank. Used for inlay and crown preparation, where freedom of the undercut is essential.

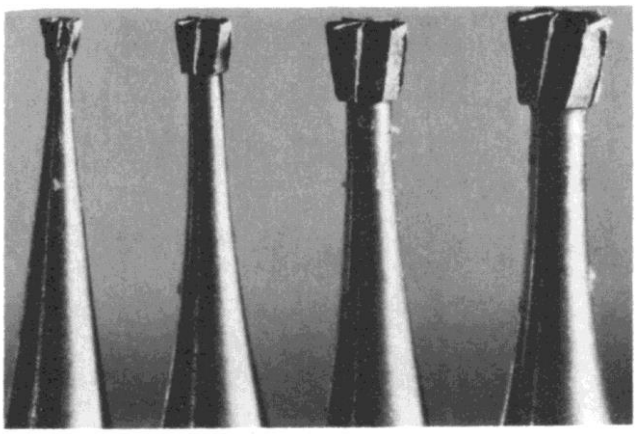
Numerical code: (700 = 1.0 mm, 701 = 1.2 , 702= 1.6 mm, 703= 2.1mm)





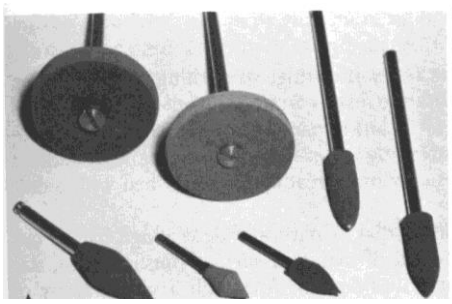
5- Inverted cone bur: Tapered cone with the apex of the cone directed toward the bur shank. The head length is about the same as the diameter. Used for providing undercut in cavity preparation and flattening of the pulpal and gingival walls. Numerical code: (33 $^{1/2}$ = 0.6 mm, 34= 0.8 mm, 35 = 1.0 mm…..).

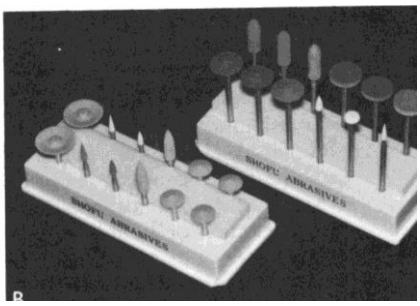


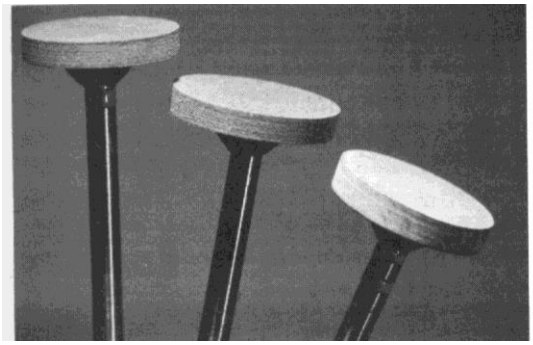


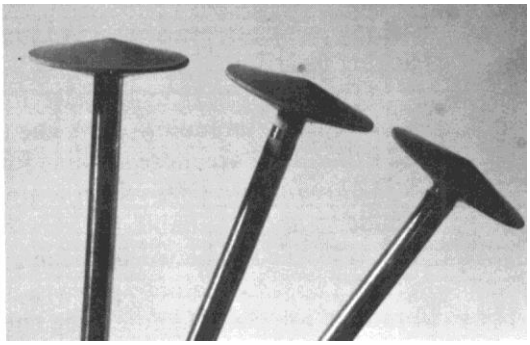
Rotary finishing and polishing instruments

Used for finishing and polishing of filling material and tooth surface, they have different sizes and shapes and colors Examples: Silicon carbide (Carborundum) , Diamond stones, Aluminum oxide discs, silicon rubber wheel and points, brushes and rubber cups.







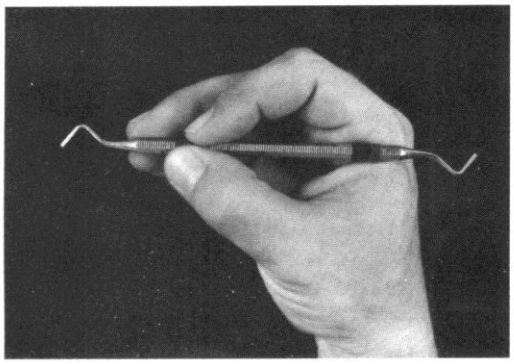


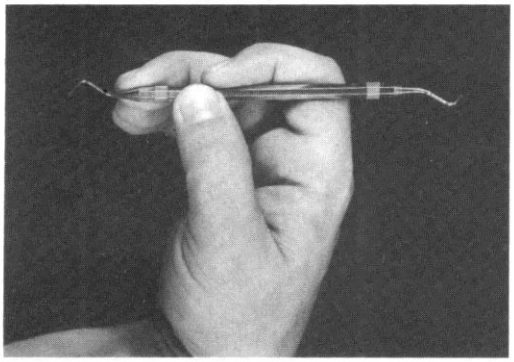
Control of operative instruments

Grasping instrument as well as resting or balancing them while in function

1- **The pen grasp**: Holding instrument similar to the pen grasp except that the pulps of the thumb and first and second fingers contact the instrument the third and fourth finger are placed on the adjoining teeth. The position of the second finger is important for obtaining thrust and preventing instrument from slipping during manipulation. It is used usually with mandibular arch; the action of the instrument is down and away from the operator.

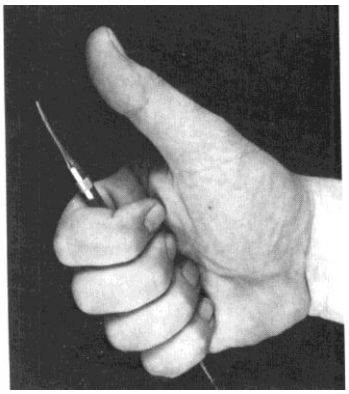
2- **Inverted pen grasp**: The same as pen grasp , but the action of the instrument is up and toward the operator . usually applied in maxillary arch either left or right side , turning the wrist so that the palm and finger tips directed towards the operator positions (stands behind and slightly at right side of the patient).





3- **Palm and thumb grasp**: The handle is placed in a palm of the hand and grasped by the four fingers. The thumb remains free resting on the area other than that being operated on. Usually used for upper arch.

4- **Modified palm and thumb grasp**: Used when it is feasible to rest the thumb on the same tooth being working on or on a tooth immediately adjacent. The handle is held between the thumb and first and second fingers; the third and fourth finger held the instrument under the first joint of each finger (to act as stabilizer and prevent slippage of the instrument) and press the instrument against the distal area of the palm.



Instrument Sharpness

It is essential that all cutting instruments should remain sharp, dull instrument with dull cutting edge cause:

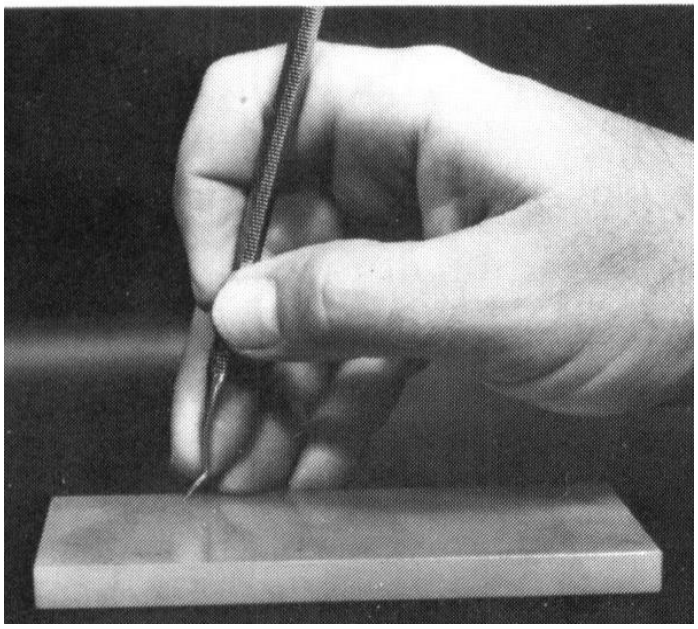
1- Excessive force required for cutting that may lead to pain.
2- Prolong operator time.
3- Less controllable.
4- Reduce quality in cavity preparation.

Sharpening of the instrument is necessary to maintain the original bevel inclination.

The majority of operative hand cutting instruments are sharpened on either Arkansas stone or the mechanical sharpeners.

With Arkansas stone the instrument should be grasped with pen grasp or thumb and palm grasp firmly maintaining the proper angle of the cutting edge to the stone. The instrument is pushed with heavy pressure and pulled with light pressure.

Testing sharpness: The sharpness of the cutting edge can be tested satisfactory on the thumbnail with very light pressure.



Principles of Cavity Preparation

Proper cavity preparation is accomplished through systematic procedures based on definite physical and mechanical principles. These are:

1-Establishing outline form
2-Obtaining resistance form
3- Obtaining retention form
4- Obtaining convenience form
5- Removing remaining caries
6- Finishing cavity walls and margins
7- Performing toilet of the cavity.

I- Outline form:

Means placing the cavity margins in the positions they will occupy in the final preparation.

1- The cavity margins should be placed in sound tooth structure. Affected enamel should be removed.
2- Extend the cavity margins to include all pits and fissures “Extension for prevention”.

All non-coalesced pits and fissure should be eliminated
Non-coalesced pits and fissure: is imperfect coalescence of enamel, the two end of enamel does not meet and a space remain.

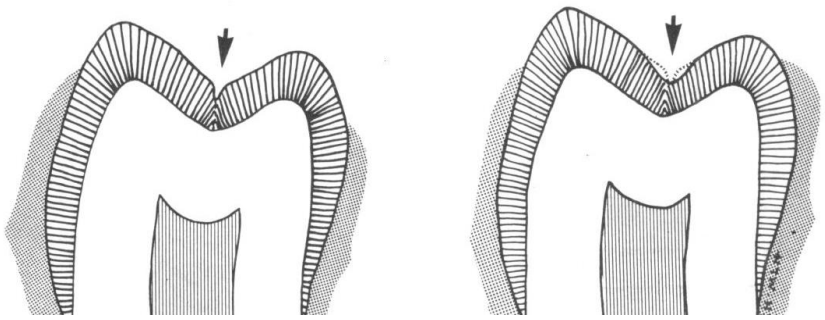
After development of high preventive measures and if the patient with high oral hygiene there is no need to extension for prevention, so we extend our cavity to the limit of caries, then we do saucering to the remaining non carious fissure "enameloplasty"

Enameloplasty: Is the process of reshaping the enamel surface “rounded or saucered" with suitable rotary instruments, so the area becomes cleanable and finishable , and allow conservative placement of the cavity margins. Not more than one third of enamel thickness should be removed.

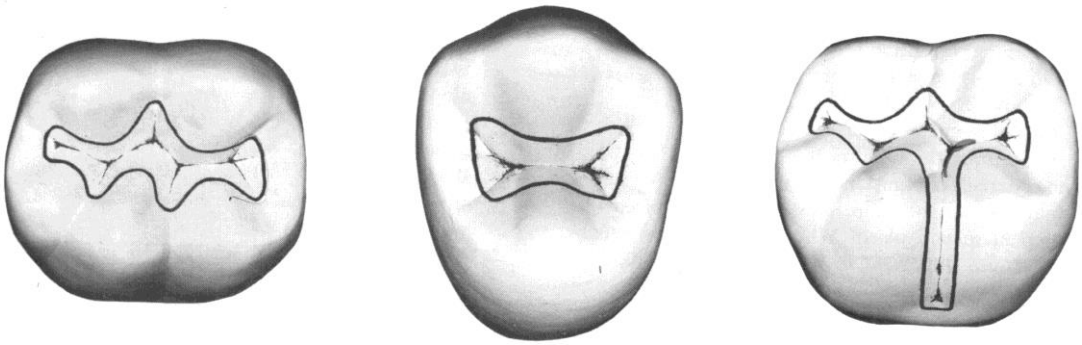
3- The margins should be placed in a cleansable area, ex: in proximal surface the contact area is hard to be cleaned by brushes and cleaning device and this lead to caries so we should extend our margin of the cavity preparation 0.5 mm gingival to the contact area to reach a cleansable area.

4- Avoid terminating the margins on extreme eminence such as cusp height or ridge crest.

Naturally the typical outline form varies with the anatomical form of the individual tooth being operated on.



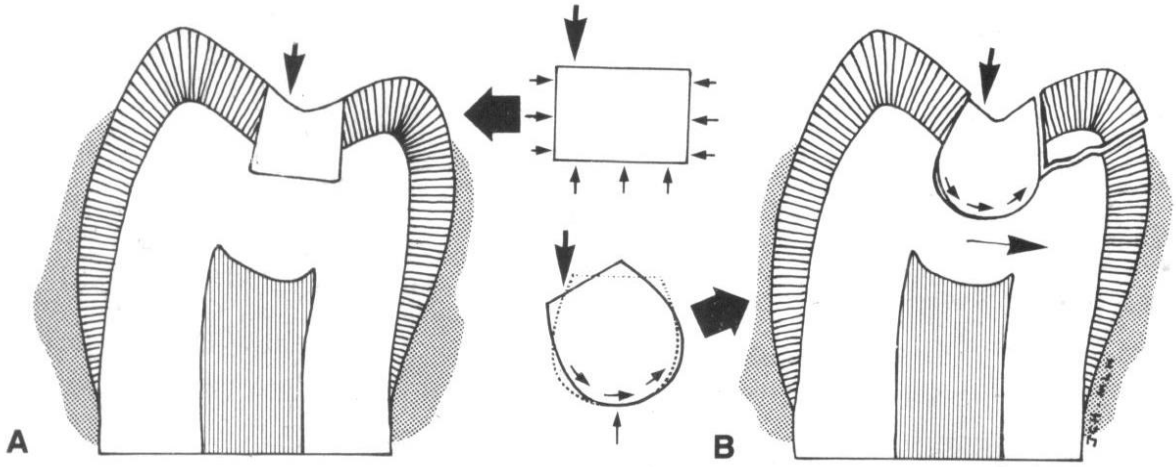
Enameloplasty



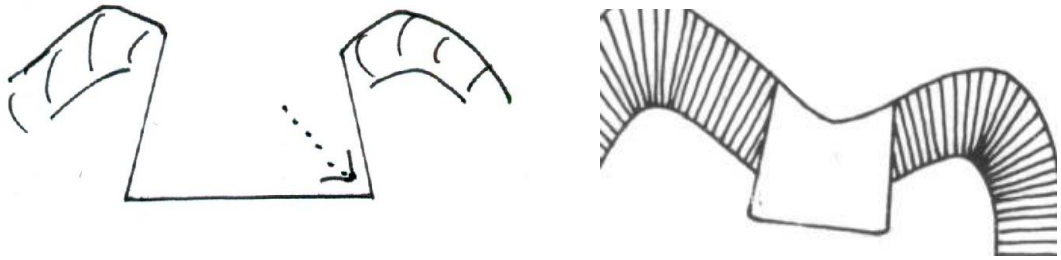
II – Resistance form:

Shaping and placement of the cavity walls that best enable both the restoration and the tooth to withstand the force of mastication without fracture.

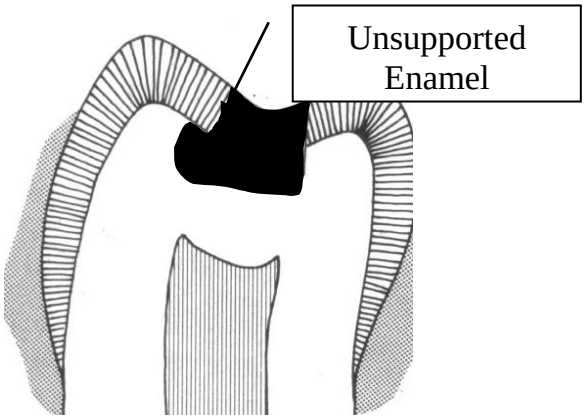
1- Flat pulpal floor will resist the restoration movement, if pulpal floor is rounded, so any force exerted on the restoration will produce a wedging action on the tooth cause a splitting or shearing of the remaining tooth structure.



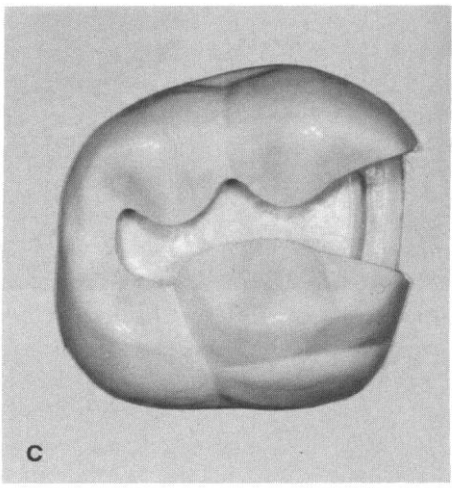
2- Internal line angles should be slightly curved (rounded). Sharp internal line angles lead to stress concentration at these areas and fracture of tooth structure.



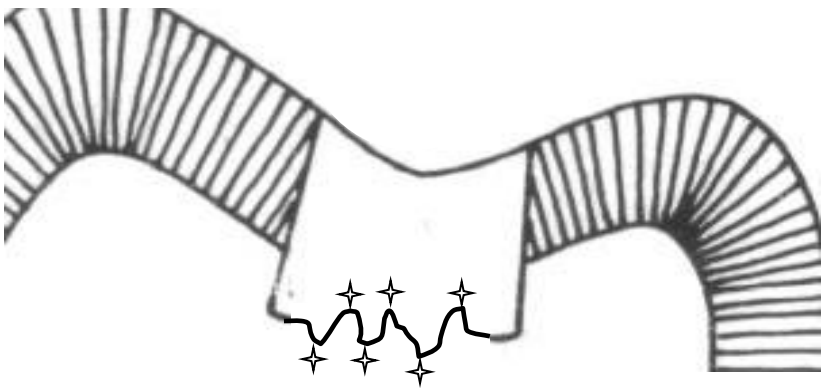
3- Unsupported enamel should be removed because enamel is brittle non vital structure so unsupported enamel will fracture easily when subjected to force of mastication. Caries is spread quickly and widely in dentin than enamel because of the difference in their structure. So during cavity preparation if we remove too much from carious dentin this lead to unsupported enamel that should be removed.



4- Width of the cavity: restrict the extension of the walls to allow strong cusp and ridge with sufficient dentin support. The width of the cavity should be 1/4 of the intercuspal distance (the distance between the tips of the apposing cusps in the same tooth) this to preserve sound tooth structure. Increasing the width of the cavity lead to weak remaining tooth structure, which will be fractured in the future. Also wide cavity lead to wide surface of the restoration, so the force of mastication on the large surface area of the restoration will be more, this cause fracture of the restoration. Narrow cavity will interfere with convenient form. Nowadays, new instruments were made in some countries enable them to reduce the width of the cavity to 1/6 of the intercuspal distance.



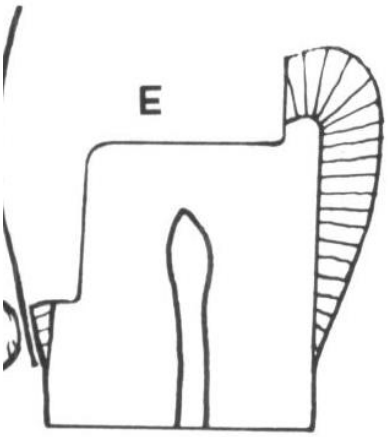
5- Smooth pulpal floor: irregular pulpal floor created by removing caries form areas other than others so the occlusal force that exerted will be concentrated on deepest areas which will cause fracture of the tooth structure. And the forces concentrated on the elevated areas cause fracture of the restoration.



6- Mesial and distal walls should be made parallel or slightly diverge because of little amount of dentin supported enamel so any convergence cause unsupported enamel , that will be fractured if subjected to occlusal load.

7- Axiopulpal line angle should be beveled. If remain sharp this lead to stress concentration at that area which will lead to fracture of the restoration.

8- Gingival cavosurface line angle should be slightly rounded to prevent the unsupported enamel.



9- Thickness of amalgam: the minimum thickness of amalgam should be 1-1.5 mm. to withstand the load applied without being fractured.

10- Carving of amalgam: over carving lead to reduce thickness of amalgam which will lead to fracture . under carving of amalgam lead to stress concentration on one area other than others which will lead to fracture.

11- Cavosurface line angle should be 90^0 if beveled, a thin layer of amalgam will be present which will be fractured under occlusal load. Less than 90^0 cause unsupported enamel and this cause fracture of the tooth surface.

III- Retention Form:

Is that shape or form of the prepared cavity that resists displacement or removal of the restoration against tipping or lifting forces.

There is no restorative material that adheres to the tooth chemically, so our aim is to place the restoration in the cavity and prevent it form dislocation against the force of mastication and also against the pull of sticky food.

1- Convergence of buccal and lingual (palatal) walls about 5^0, because of good bulk of dentin under the cusp supported enamel. Too much convergence by cutting more from dentinal structure leads to unsupported enamel which may fracture under occlusal load

2- Dove tail

3- Flat pulpal floor, if rounded this cause displacement of the filling, or movement, which may cause a space between the tooth and the filling, and this lead to secondary caries.

4- Extra retention like pins, pinholes, grooves in case of complete destruction of the buccal wall for example.

5- Acid etching of enamel and applying bonding agent for resin based restorative materials like composite resin.

IV- Convenience form

Is that shape and form of the cavity that allow adequate observation, accessibility and ease of operation in preparing and restoring the cavity.

The form of the cavity should allow the operator to distinguish all internal line angles to ensure removing of all caries , also allow the operator to use instrument easily in removing caries , shaping of cavity walls and restoring the tooth .

V- Removing of remaining caries

Caries is removed during outline form and the margins should be placed in sound tooth structure , and the typical depth of the cavity is 1.5 mm , if caries is present in pulpal floor or axial wall or both , it should be removed using spoon excavator or handpiece with large round bur. The caries dentin is soft, either has the same color of normal dentin which can be detected using sharp probe or most of the time has a different color from normal dentin. If we have one spot of caries on the pulpal floor we can remove only this area lead to depression , if we remove all pulpal floor this result in

1) Unnecessary cutting tooth structure

2) Increase the possibility of hitting the pulp. This depression is small compared with total surface area and is covered by cement to make flat pulpal floor.

If multiple spots of caries is present we should not remove each one alone this may result in many depressions and if covered with cement and filling , so the stress concentration lead to fracture of the cement , filling and tooth .In this case we should increase the depth of cavity till all caries has been removed.

VI- Finishing of cavity walls:

The objectives of finishing the walls are:

1- To have best marginal seal between the restorative material and tooth structure.
2- To afford a smooth marginal junction.
3- To provide maximum strength of both the tooth and the restorative material at and near the margin.

Several factors must be considered in the finishing of enamel walls and margins:

1- Direction of enamel rods
2- Support of enamel rods
3- Type of the restorative material to be placed in the cavity
4- The location of the margins
5- Degree of the smoothness desired.

VII- ***Toilet of the cavity***

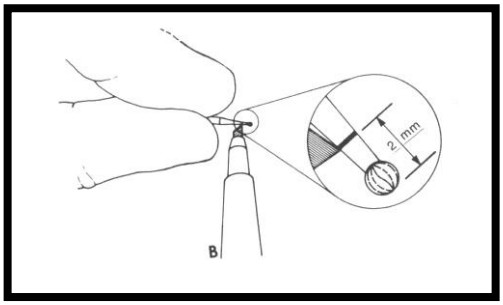
Toilet of the cavity is cleaning of the cavity from small chips of cutting tooth structure and removing carious lesion, using water – air spray, cotton pellets then dryness with oil free air.

Operative Dentistry

Cavity preparation

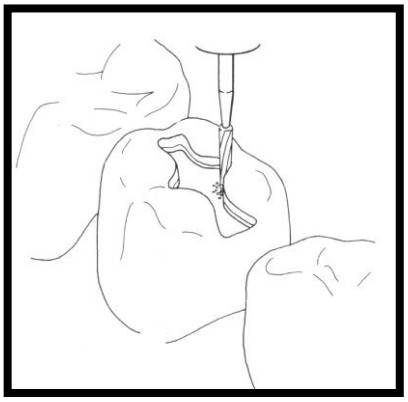
Class I Cavity Preparation for amalgam

Using small round bur with turbine handpiece at high speed (above 200.000 rpm) directed with the long axis of the tooth started from the central pit or carious lesion, then entered about 1.5 – 2 mm. That is to ensure that we exceeded the DEJ because of the widely and quickly spread of caries at this area, and to have sufficient bulk of amalgam to withstand the force applied. To be at 1.5 mm usually enter the head of the bur and little from the neck.



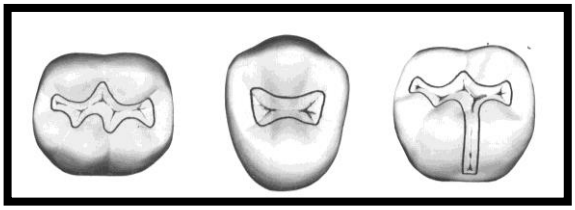
Outline form

After we determined the depth of the cavity with round bur, we use the fissure bur to perform outline form of the cavity with the same depth determined by round bur, all non coalesced pits and fissures should be included in the outline form, placing the margins in the sound tooth structure (free of caries). Cutting should be smooth, conservative, with small curve around the cusp. The outline form mesially and distally should be parallel to external tooth surface (to have even thickness of marginal ridge) leaving about 1.5 mm to preserve mesial and distal marginal ridges because they have smooth surface.



Retention is obtained by:

1- Flat pulpal floor
2- Dove tail
3- Convergence of buccal and lingual wall at 5^0



Resistance is obtained by

1- Width of the cavity 1/4 of ICD
2- Unsupported enamel should be removed
3- Depth of the cavity 1.5-2 mm
4- Mesial and distal walls should be parallel or slightly diverged
5- Smooth pulpal floor
6- Cavosurface line angle should be between ($90 – 110^{0}$).
7- Internal line angles should be rounded. Using fissure bur and inverted cone bur create sharp internal line angles , so after preparation , we should use small round bur along line angles to make them rounded to prevent formation of stress concentration area.

Convenience form

Cavity design should allow the operator to do preparation and filling the cavity conveniently.

Removing remaining caries, finishing enamel walls and toilet of the cavity.

Class I cavity preparation of Buccal and Palatal Pit

Class I cavity of buccal pit of lower first molars

The lower first molar has three cusps buccally: mesiobuccal , distobuccal and distal cusp and have a buccal groove between the mesiobuccal and distobuccal cusps and has a buccal pit which is susceptible to caries , the buccal pit has a triangular shape, due to inclination of mesiobuccal and distobuccal cusps towards the buccal groove, so we should be conservative in our cavity preparation and make triangular outline form, the buccal pit located at the center of the triangle.

1- Outline form : first at the centre of the pit we do enterance using small round bur to the depth of 1.5 mm, after that , using fissure bur with high speed turbine making the triangular outline form the base of triangle is towards the gingival and the tip of the triangle is towards the occlusal surface. The margins of triangle should be at sound tooth structure.

2- Retention form : the mesial and distal walls of the cavity should be slightly converged to the outside , the gingival seat should be perpendicular to the outer surface. The axial wall should be flat.

3- Resistance form : can be achieved by the followings :
    a- depth of the cavity is 1.5 – 2 mm
    b- rounded internal line angles
    c- gingival seat is perpendicular to the outer surface (if converged this cause unsupported enamel, because the buccal surface at this area is flat)
    d- cavosurface line angle (90^0 - 110^0)

Note : the occlusal one third of the buccal surface of the lower molars has an inclination occlusally, so we should make sure the depth of the cavity will be 1.5 mm all around to have equal stress distribution if not this will cause fracture of the restoration.

4- Convenient form

5- Removing remaining caries

6- Finishing enamel walls and toilet of the cavity

Class I cavity of palatal pit of upper incisors

There is a non coalesced pit in the palatal surface of the upper incisors , incisal to the cingulum with two small grooves radiated. The caries in this area attack this pit with the two grooves , so the cavity has triangular shape, the pit is located at the apex of triangle .

1- outline form : the entrance with small round bur. Then using a fissure bur with high speed turbine to perform the outline form which should be triangular in shape, the base is directed incisally and the apex is directed cervically. Make sure to preserve the cingulum and the mesial and distal marginal ridges if they are not affected by caries.

2- Retention form : mesial and distal walls is slightly converged to the outside, incisal wall is flat , the axial wall is flat.

3- Resistance form : rounded internal line angles, cavosurface line angle at right angle , depth of the cavity 1.5 -2mm all around, flat incisal wall to remove the unsupported enamel.

4- Convenient form

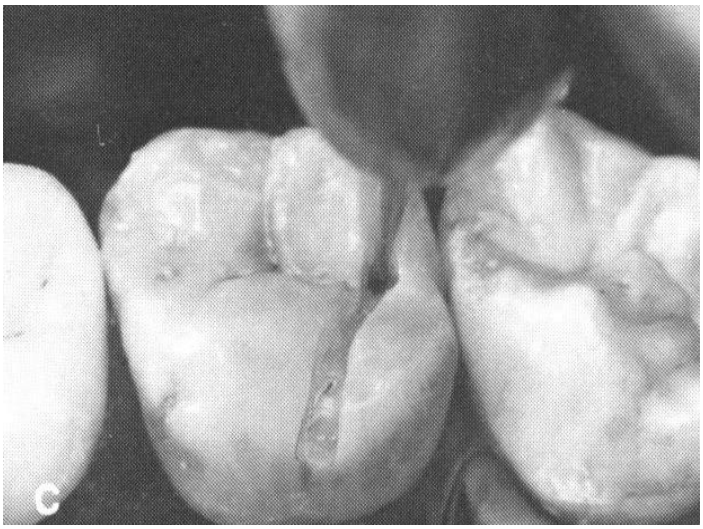
5- Removing remaining caries

6- Finishing enamel walls and toilet of the cavity

Class I cavity of upper molars

The upper molars has oblique ridge from the distobuccal cusp to the mesiolingual cusp. The ridge is smooth , has a good bulk of enamel, so it is highly resistance to dental caries, we should preserve this ridge and do two separate class *I* cavities one mesially and other distally. (but if this oblique ridge is evolved with caries , we should included in our cavity and do one class I cavity , also if the width of the oblique ridge is very small 0.5 mm or less , it could not withstand the force of mastication so we should included in our cavity preparation).

Distal cavity (Distal to the oblique ridge) : Distally there is a groove which is extend from the occlusal surface to the palatal surface and end by non coalesced pit., so caries almost extend along this groove , and our cavity preparation should be extend palatally , (applying all the principles of the cavity preparation) the entrance by small round bur than using fissure bur perpendicular to the occlusal surface to make outline form extend the bur palatally at the same depth (1.5) and include the carious groove , then when the cavity is opened to the palatal surface , we should extend out cavity lingually to include the carious pit by two ways :



1- keep the bur perpendicular to the occlusal surface and cut 1.5-2mm from the occlusal surface and ascend in cutting gingivally till we include the carious fissure and reach sound tooth structure.

2- Or tilt the bur to be perpendicular to the palatal surface, cutting about 1.5-2mm form the occlusal surface extending gingivally to remove all caries and reach sound tooth structure.

We end our preparation in the lingual surface by what we called (Step)

Note: making a step is necessary otherwise if we deepening the all occlusal surface to include all caries palatally this make a danger of hitting the pulp.

All principles of cavity preparation should be applied during our preparation.

Mesial cavity (Mesial to the oblique ridge) we do a class I cavity applying all principles (outline form, retention form , resistance form …etc)

Class I cavity of lower first premolar

-There is a transverse ridge between buccal cusp and lingual cusp of lower first premolar , which should be preserved during cavity preparation because of its resistance to caries, so we do two class I cavity mesially and distally, and do all principles of cavity preparation. But if this ridge is involved by caries so we should do one class one cavity.

- The pulpal floor of the cavity should be inclined lingually because the lower first premolars have a prominent buccal cusp and the buccal pulp horn is much higher than lingual pulp horn, if we do flat pulpal floor, the possibility of hitting the pulp will be high , so the bur should be inclined 45^0 lingually to make inclined pulpal floor to protect the pulp.

Operative Dentistry

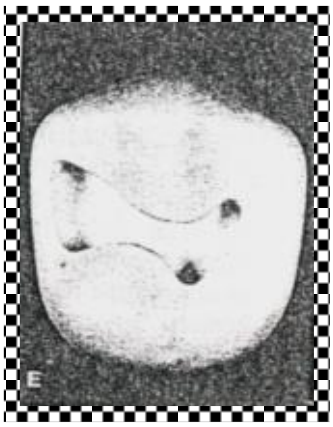
Class II Cavity Preparation for Amalgam

When the lesion present in the proximal surface of premolars and molars, this requires class II cavity preparation, which is either MO or DO or MOD.

If the carious lesion is present only in proximal surface and not involve the occlusal surface, the class II cavity should include all pits and fissures in the occlusal surface in addition to the proximal surface (extension for prevention).

Nowadays , if the patient with low caries index and has a good oral hygiene , in countries with high preventive measures , in this case , class II cavity could include only the proximal surface which is called "box design" and do enameloplasty to the non coalesced pits in the occlusal surface.

Steps of Class II cavity preparation



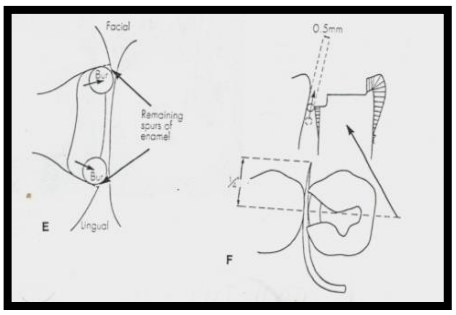
- First, we do class I cavity preparation on the occlusal surface applying all Black's principles of cavity preparation, because it gives vision and proximity to reach caries in the proximal contact area. Usually caries occur in the contact area, because of difficulty to clean this area by dental brush, this leads to food accumulation, and development of caries.

- One of the most important point in class II cavity is that we should not hit the adjacent tooth by rotary bur, since the proximal surface of the adjacent tooth is intact and smooth , so any cut will produce a rough surface and this facilitate food and bacterial accumulation which will cause caries to the sound tooth. To avoid this :

A-

- Placing a matrix band between the two adjacent teeth , place the fissure bur at the same depth of class I cavity and continue cutting towards the proximal marginal ridge until reach the end of the tooth. (the opening has the same width of the bur and same depth of class I)

- Placing the fissure bur perpendicular to the occlusal surface , and ascend gingivally to create a step and reach caries in the proximal contact area , continue cutting to remove caries and extend the base of the box just beyond the proximal contact area (0.5 mm below the contact area) so the margin of the restoration will be in cleansable area.



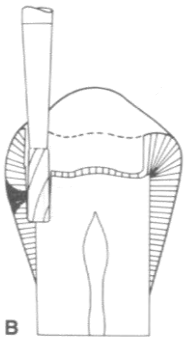
- Move the fissure bur buccolingually until the buccal wall and lingual wall will be free form the contact area to be in cleansable area.

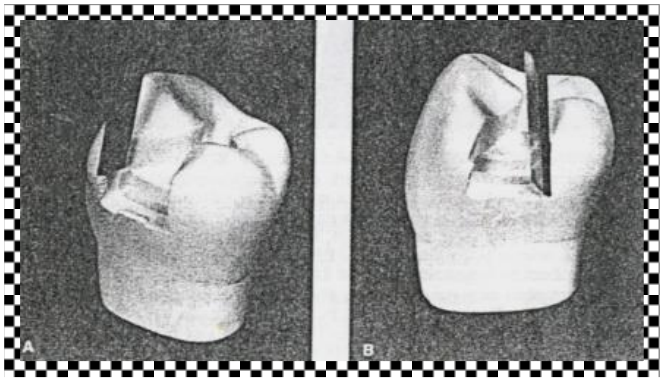
- The contact should be opened o.5 mm gingivally, buccally and lingually (palatally), the tip of the probe should pass freely between the two teeth.

Or

B-

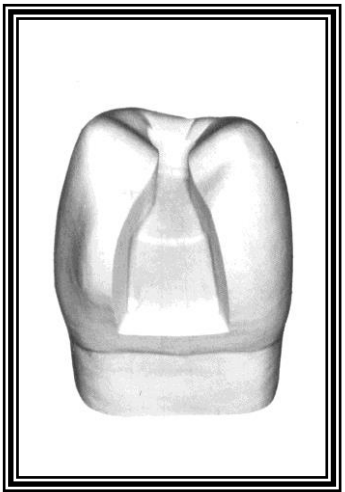
- Place the fissure bur at the same depth of class I cavity and continue cutting towards the proximal marginal ridge leaving a thin shell of marginal ridge, after that move the bur occlusogingival creating a step beyond the contact point, then move the bur buccolingually, remove the thin shell by a chisel or hatchet. Finish enamel walls by chisel or hatchet to remove any undermined enamel, and free the contact gingivally , buccally and lingually.





-at the end we will have a proximal box with the following walls:

- axial wall: parallel with long axis of the tooth.



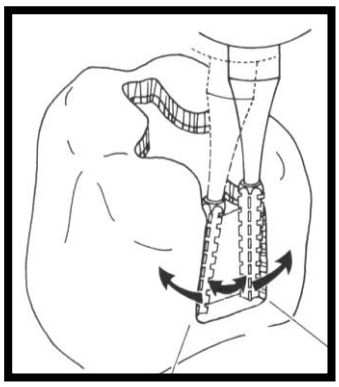
- gingival seat : perpendicular to the ling axis of the tooth.
- buccal wall
- lingual (palatal wall)

and has the following line angles

- Axiogingival line angle
- Axiobuccal line angle
- Axiolingual (palatal) line angle
- Axiopulpal line angle

Retention form

1. In addition to the convergence of the buccal and lingual walls of the occlusal class I cavity, and the dovetail. We do convergence of the buccal and lingual walls of the box occlusally.

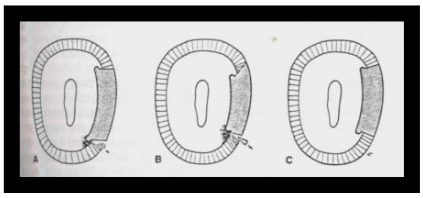


2. Flat gingival wall (seat) to prevent dislodgement of the restoration.

3. Retentive grooves: using a small fissure bur to make a retentive grooves on axiobuccal and axiolingual line angles, they should be placed in dentine because its resiliency.

Resistance form

1. width of the cavity 1/4 of intercuspal distance.
2. cavosurface line angle ($90^{0} – 110^{0}$).
3. Axiopulpal line angle is beveled. To eliminate stress concentration on the restoration.
4. Gingival cavosurface line angle is beveled. To remove the unsupported enamel.
5. rounded internal line angles.
6. Removal of the unsupported enamel.



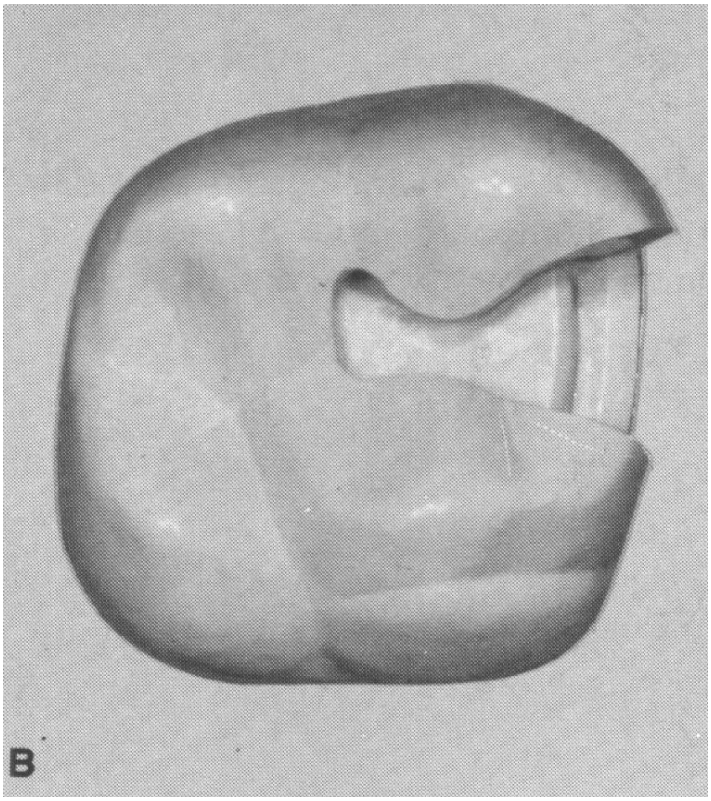
Note : the buccal and lingual walls of the box is diverge proximally to free them form the contact and to remove the unsupported enamel , but the restoration will not be dislodged proximally , due to the retention means in the occlusal cavity , the dovetail act as a lock preventing the restoration from being dislodged proximally, in addition to the retention grooves.

Isthmus: is the area present at the junction between the occlusal part and proximal part of the cavity (proximal box), it should be as narrow as possible (1/4 of ICD) to reduce the force on it and prevent fracture of the restoration. The depth of Isthmus is 1.5 – 2 mm to have a good bulk of the restoration at this area.

Convenience form

The axial wall should be parallel to the long axis of the tooth, to have a good accessibility to the deepest point of the cavity.

Removal of the remaining caries and toilet of the cavity.



CLASS V CAVITY PREPARATION FOR AMAGLAM

Indications

The selection of amalgam as a restorative material for class V cavity should involve the following considerations:

1- Caries:

When the caries rate is high, the amalgam is chosen over more expensive filling materials.

2- Erosion or abrasion, or both:

Erosion: tooth loss at the cervical area due to non bacterial acid attack.

Abrasion: tooth loss at the cervical area of the tooth due to abrasive slurry between two surfaces (mechanical action) e.g: tooth brush – dentifrice abrasion.

In both cases there is no caries if we prepare a class V cavity it is better to be filled by amalgam, because of high abrasive resistance of amalgam.

3- Sensitive areas at, or apical to, the cementoenamel junction :

Because of gingival recession or periodontal surgery or both the cementum may be extremely sensitive, when the method of desensitizing the area is failed, so a class v cavity preparation is necessary.

4- Esthetics:

Class V cavity for all anterior teeth should be filled by tooth colored restorative materials, because the metallic color of amalgam does not match the color of tooth. While for posterior, it is less visible, usually, the class V amalgam fillings at the buccal surface of mandibular premolar and molar are not visible; where as those at maxillary premolars and first molar are more visible.

Note: the patient's view of esthetics should be considered when planning treatment in area of esthetic concern.

Nowadays, improved tooth colored restorative material make them a good substitute for amalgam in class V cavity.

5- Abutment teeth for removable partial dentures:

Amalgam is chosen over a tooth colored restorative material when placed on abutment teeth for partial dentures because it is better to be contoured and less wear will occur as a clasps move on the restoration.

6- Economics:

The patient's economic situation may influence the selection of restorative materials such that the amalgam may be chosen over more expensive materials.

Isolation

Moisture in the form of saliva, gingival sulcus fluid or gingival hemorrhage must be excluded during caries removal, cementation, and filling procedure because:

1- It may contaminate the pulp during caries removal especially with pulp exposure.
2- Negatively affect the physical properties of the cement and filling material.

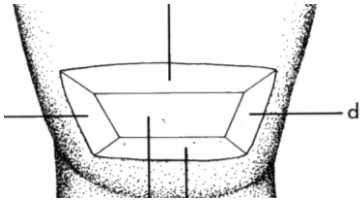
So isolation is important during class V cavity preparation because sometimes the caries may extend subgingivally and should extend the margin of the restoration subgingivally, so we do isolation to protect the gingiva and provide access while eliminating seepage of sulcular fluid into the cavity preparation or restorative material.

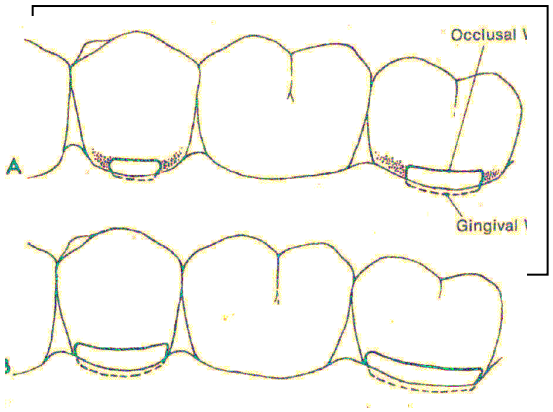
Isolation done by:

1- Cotton roll
2- Retraction cord
3- Rubber dam.

- ## Outline form :

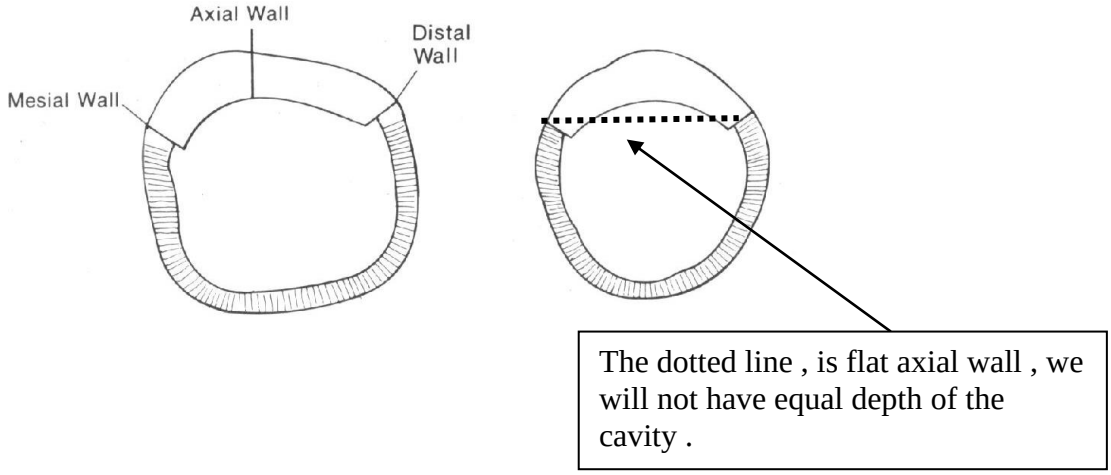
Using round bur to start entry to the cavity, the direction of the bur should perpendicular to the buccal (or palatal) surface of the tooth , then using the fissure bur to do the outline form , just remove the caries and the margins should be in sound tooth structure , there is no need to "extension for prevention" the shape of class V cavity is trapezoidal in shape or could be kidney shaped to be more conservative.



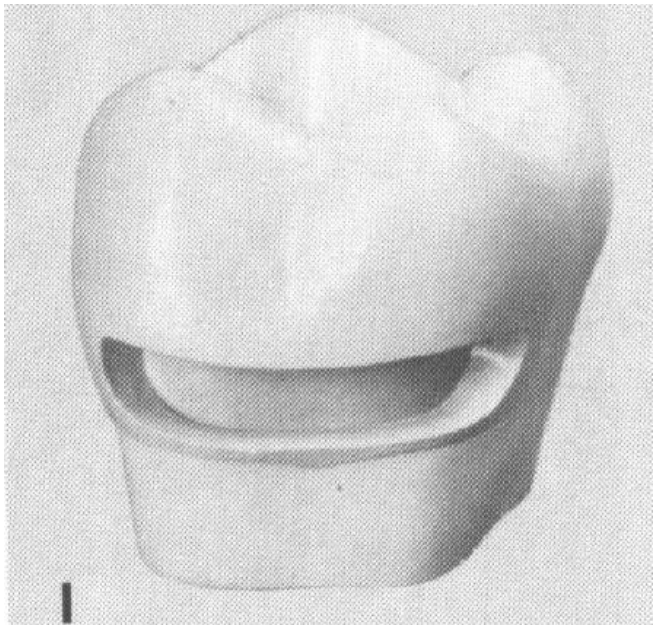


- **Resistance form**

  - Depth of the cavity is 1.5 mm : the axial wall of the cavity should not be flat , if we do so will not have even depth of the cavity because of convexity of tooth structure , so the axial wall should be slightly convex .



  - cavosurface line angle (90-110^0).
  - Rounded internal line angles
  - Removal of unsupported enamel
  - Mesial and distal walls should be slightly diverge
  - Occlusal and gingival walls should be perpendicular to the long axis of the tooth and parallel to each other, any convergence of these walls will create unsupported enamel.



- **Retention form**

I- Retention mean in class V cavity is made by making retention grooves or retention holes. This depend on the size of cavity , in small conservative cavity , retention holes is made , while in large class V cavity , retention grooves are necessary.

II- In case of more extensive class V cavity we may need to (pins) as extraretention.

Position of the retentive means:

Best position is axioocclusal and axiogingival line angles.

Method of placement :

1- **Retention holes:** using a small round bur (no. 1/4) and make two holes at axioocclusal line angle and two holes at axiogingival line angle.
2- **Retention grooves:** using a small round bur (no. 1/4) making two holes at axioocclusal line angle then connecting between them by small round bur or by small fissure bur, holding the bur in oblique direction. Same thing is done on axiogingival line angle.

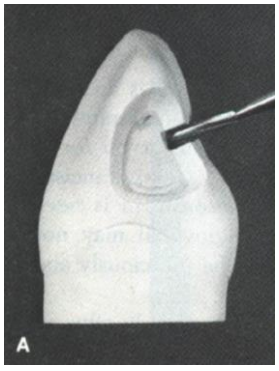
Note: if the retention means (holes or groves) are placed on the axial wall this increase the danger to the pulp and it will not prevent the displacement of the restoration. Also don’t place the retentive means on mesial and distal walls, because of small amount of dentin at this area so the small holes "compared with the large surface area of the amalgam" will not resist the tipping or lifting force which may undergo fracture.

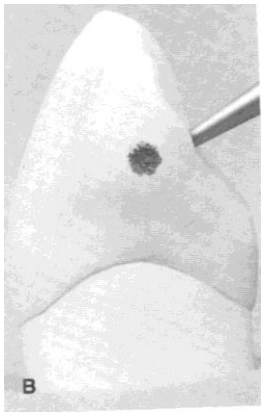
- **Removal of remaining caries at the axial wall and cleaning and drying the cavity.**

CLASS III CAVITY PREPARATION FOR AMAGLAM

Class III cavity is prepared when the caries occur at the proximal surface of all anterior teeth. All class III cavity should be filled with tooth colored restorative material (composite resin) except the distal surface of maxillary canine , it is better to be filled with amalgam, because the distal surface of the maxillary canine is the contact between anterior teeth and posterior teeth , and usually there is a mesial shifting of the posterior teeth , so there will be continuous force at the distal surface of the maxillary canine , if it is filled with composite , this cause wear of composite with time and decrease the mesiodistal width of canine , so it is better to fill it with amalgam because of higher wear resistance of amalgam compared with composite.

- Caries usually occur at the contact area of upper canine , the access to the cavity is from the lingual surface, never do access to the cavity form the labial surface because of esthetic purposes , only if the caries is extended to the labial surface, we can make access from the labial surface.





- Placing the bur on the distal marginal ridge at the contact area and do entry , then use the fissure bur moving it gingivally and labially and incisally creating the outline form removing all caries lesion .

- The contact with the adjacent tooth should be opened to be in a cleansable area.

- The gingival wall should be perpendicular to the long axis of the tooth, the axial wall should be parallel to the long axis of the tooth, to have good vision and good access to the cavity (convenience form).

- Remove any unsupported enamel.

- Cavosurface line angle (90-110 ^{0}).

Retention form

- Flat gingival wall and should be perpendicular to the long axis of the tooth.

- Lingual access area should be minimal.

- Lingual inclination of the incisal third of the labial wall.

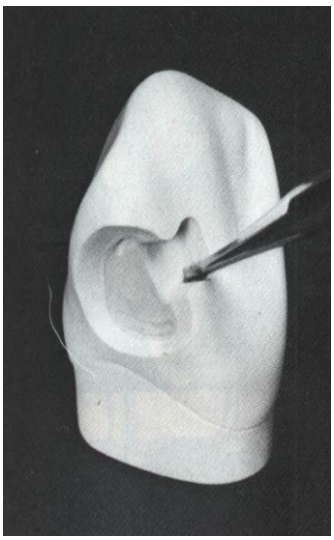
- Labial and lingual walls are parallel as much as possible to prevent displacement of the filling material.

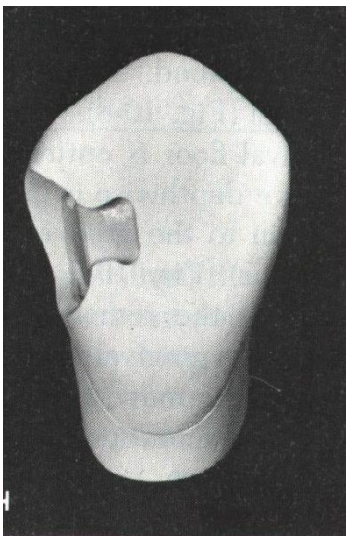
- Retention grooves axioincisally and axiogingivally.

- Dovetail on the lingual surface.

  If we have extensive caries and large class III cavity and previous retentive means is not enough, so we do dovetail on the lingual surface of maxillary canine , but this should be as conservative as possible, it should not exceed the midpoint of the lingual surface also the depth should not be more than 1mm , if we make it with the same depth of the cavity , it may hit the pulp.

  If we create a dovetail we will have axiopulpal line angle which should be beveled.





Operative dentistry

Dental Amalgam:-Is a union of mercury (liquid) with amalgam alloys (powder) to give a plastic mass, which, hardens in the cavity.

Amalgam alloy:- Is a combination or union of two or more metals, which are miscible in a liquid state.

Dental amalgam is a very old restorative material but still the most widely used material in operative dentistry.

Advantages:-

- An adequate compressive strength.
- Insoluble in oral fluid.
- Has a good adaptability to the walls and the floor of the cavity.
- Compatible with oral tissue.
- Durable.
- Dental amalgam is the least time consuming to place and has the lowest cost.

Disadvantages:-

- Low tensile and sheer strength, therefore, amalgam should be always supported by tooth structure.
- Inharmonious color.
- Creep: a slow change in shaped caused by compression. Amalgam could be pushed by adjacent and apposing teeth to cause open, chipped and overhanging margins. Recurrent decay would then result.
- Has a high thermal conductivity.
- Susceptible to tarnish which is the discoloration of the surface of amalgam restoration by chemical attack of component in food or in saliva.
- Electrical conductivity (Galvanism).
- Dental amalgam does not adhere to tooth structure, so mechanical retention means are needed (undercuts, grooves).

Composition: -

1- Mercury: it's a dense liquid metal, highly toxic, shiny surface. Improper handling of this material is health hazard by inhalation or absorption through the skin.

2- Amalgam alloy:

I) conventional silver tin system:

69% silver (Ag)	↑ strength expansion setting rate ↓ corrosion creep
26.2% tin (Sn) (↑ reaction rate)	↓ strength expansion setting rate
3.6% copper (Cu)	↑ strength and hardness corrosion ↓ creep substitutes for silver
0.8% zinc (Zn) scavenger prevent formation of metal oxide	Deoxidizes Reduce the brittleness of the alloy. Cause delayed expansion with water.

The Amalgamation reaction: the reaction between mercury and alloy

$Hg + Ag_3Sn \longrightarrow Ag_3Sn + Ag_2Hg_3 + Sn_8Hg$

(gamma) gamma gamma1 gamma2

The hardening of amalgam is the result of:

- Wetting of the alloy particles by mercury.
- Dissolution of silver and tin in mercury.
- Diffusion of mercury into the alloy.
- Precipitation of gamma1 and 2 from the liquid phase.
- Crystal growth of 1 and 2.

Gamma	Strongest, intermediate corrosion resistance.
Gamma 1	Intermediate strength, high corrosion resistance.
Gamma 2	Low strength, greater creep, low corrosion resistance.

II) High copper alloy: 12-30% Cu.

These are formed in 2 ways:

1- The three constituents, silver, tin, copper are melted together to form a single, high copper alloy (single composition copper enriched alloy).

2- Particles of Ag/Cu alloy are mixed with particles of conventional type this is an admixture e.g. dispersalloy (dispersion-modified copper enriched alloy).

$Ag_3Sn + Ag\text{-}Cu + Hg \longrightarrow Ag_3Sn + Ag_2Hg_3 + Cu_6/Sn_5$

Advantages of high copper alloy:-

- Low creep, tarnish, and corrosion.
- ↑ Compressive strength.
- ↓ Dimensional change.
- Improve marginal integrity.
- Less release of mercury.

Particle size and shape:-

1) Filings ⟶
   - regular ↑ 50 Mm
   - Fin cut 35 Mm
   - Micro cut 26 Mm

2) Spheres.

Advantages of spheres particles:-

1- Smoother surface.
2- It is easier to condense around retention pin.
3- Need lower condensation (inaccessible cavities).
4- Greater early compressive strength.
5- Rapid and complete amalgamation.

But ↑ difficulty in obtaining a good contact point and carving is more difficult.

Manipulation:-

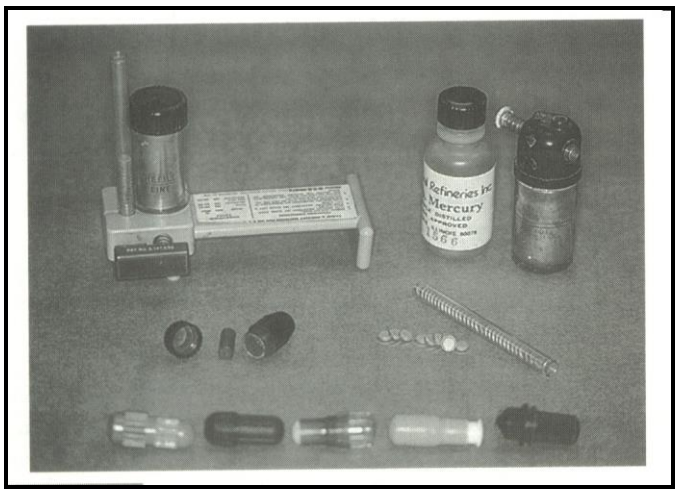
1) Mercury and alloy ratio: correct proportioning of alloy and mercury is essential for forming a suitable mass of amalgam for placement in a prepared cavity. The amount of mercury and alloy to be mixed is described by M-A ratio. Some alloys require mercury-alloy ratios in excess of 1:1 (1:1 indicate one part of mercury to one part of alloy), whereas others use ratios of less than 1:1, with the percentage of mercury varying from 43-54%. These ratios depend on:

- Alloy composition.
- Particle size.
- Particle shape.

Therefore, the manufacturer's recommended ratio should be followed; the setting reaction of dental amalgam occurs at the boundary of alloy particles, each one should be completely covered with mercury to achieve a good amalgam.

2) proportioning of M to A:

- Alloy and mercury are supplied in a capsule (precapsuled) with alloy at on end and mercury at the other end, separated by a diaphragm which is broken just before placing the capsule in an amalgamator.
- Alloy and mercury in bulk for insertion into mechanical amalgamator, this machine volumetrically dispenses portions of alloy and mercury and mixes them together.
- Alloy pellet and mercury dispenser.
- Reusable capsule, amalgam alloy pellets.



Top row (moving left to right): alloy pellet and mercury dispenser bulk mercury in plastic bottle**,. Central row**: reusable capsule, amalgam alloy pellets**. Bottom row**: several precapsuled amalgam products.

Advantages of precapsuled amalgam alloy:-

-Ready for trituration and provide more consistent mixes of amalgam

- Safety (mercury doesn't need to be stored in bulk).
- Mixing carried out in a closed capsule (less risk of air contamination by mercury vapor).

3) **Trituration:** mixing process of the amalgam alloy powder with the liquid mercury to give a moldable and plastic mass of amalgam alloy.

Mercury must be brought into intimate contact to the particles of alloy so that physiochemical reaction of amalgam can be initiated. Particles of alloy are each covered with an oxide film, which inhibits the wetting of their surface by mercury. Rubbing together particles of alloy in presence of mercury breaks up this film and allows wetting. Mixing can be achieved:-

-Mortar and pestle (hand mixing)

*Absence of dry particles.

*Coherence of amalgam mass

-Mechanical amalgamator: (rapidly, less health hazard).

4) **Mulling procedure:** it's a continuation of amalgamation process to produce a more homogeneous amalgam. It's an effective way for collecting triturative amalgam.

Testing of mixture:-

- Amalgam mass should take the print of the thumb and retain it. This indicates normal mixing (shining in appearance).
- Under mixing: dull, crumbly (failed to take the print).
- Over mixing: soupy and tends to stick to the inside of the capsule (failed to retain the print).

Condensation of dental amalgam:-

Objectives:-

1) Proper condensation of amalgam promotes adaptation of amalgam to the cavity walls and matrix band.
2) Eliminating voids and reducing the amount of residual mercury in the restoration to increase the strength and serviceability of the restoration.

Hand condensing:-

The condensing instrument of choice is a double-ended plastic instrument with flat condensing surface. Instruments available with different shape and size. The diameter of the tip must be such that it can be accommodated on the floor of the cavity at its narrowest point otherwise, condensation of deepest layers is impossible. A force applied to the hand condenser should be as great as possible under the existing clinical condition and should apply on the center of the cavity and then stepping the condenser towards the walls of the cavity and the ends of the fissure. Pressure should be firm, uniform to small increments of amalgam, only when first increment has been condensed adequately, should the next increment be added. It is wrong to suppose that the earlier layers inserted can later be condensed by heavy pressure in the later stages of packing only porosity close too the surface would be eliminated, and voids would remain in the deeper part. The condensation started at the box till we fill the cavity.

As the amalgam level reaches the cavity margins, packing continues to allow an excess to build up over the ultimate level of the finished restoration.(Why)

- ❖ Cover the cavosurface margin completely to avoid exposure of the margins during carving.
- ❖ To do a proper carving, and to remove excess mercury.

Carving:-

May be beginning immediately after condensation before the setting of the amalgam. As amalgam sufficiently firm, the amalgam is carved with sharp carving instrument.

- ❖ The carver is held so that its blade lies across the margin of the filling, half on tooth and half on amalgam, and moving parallel to the margins ——→small increment of the amalgam is removed, defining the margin of restoration.
- ❖ Deep occlusal groove should not be carved into the restoration since these weaken the restoration and cause chipping of the thinned amalgam at the occlusal margins.
- ❖ In large restorations, cuspal slopes should be carved and fissures may be delineated.

Smooth and uniform surface should be achieved, the occlusion should be checked by asking the patient to place the teeth lightly together, some times the restoration will fell high to the patient and then brightly mark will be seen on the amalgam surface (high spot should be removed).

Polishing:-

The goal of polishing is to produce a smooth and lustrous surface that reduced the likelihood of corrosion and the ability of plaque to adhere to the surface. Polishing should be done at least 24 hours after it has been placed with finishing burs, disks and cups of suitable size.

Success depends upon the use of a light uniform touch and constant movement of the instrument and care should be taken to retain the carving and avoid over heating.

Matrix band and retainer:-

The function of the matrix band:-

- To retain the amalgam in the cavity during condensation.
- To permit close adaptation of the amalgam to cervical and axial margins.
- To help to restore the contact area and external contour of the crown.

Matrices are of 3 types:-

1) The band encircles the tooth and is secured by a retainer (universal matrix) indicated when we have 3 surfaces (MOD), 2 surfaces class II. Positioned from buccal. Band has different shapes: straight, curved, and contoured. The chief advantage of this type is that it can be firmly adapted to the tooth.

2) The band encircles ¾ (three- quarters) of the crown and is retained by retainer no.1 into the free embrasure. Indicated when the contact points are so tight that it is difficult to place the other types.

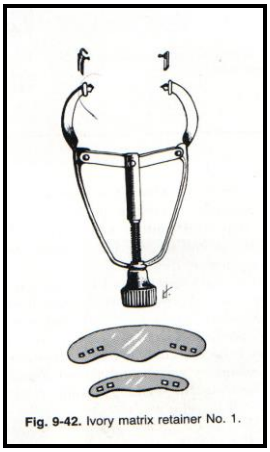
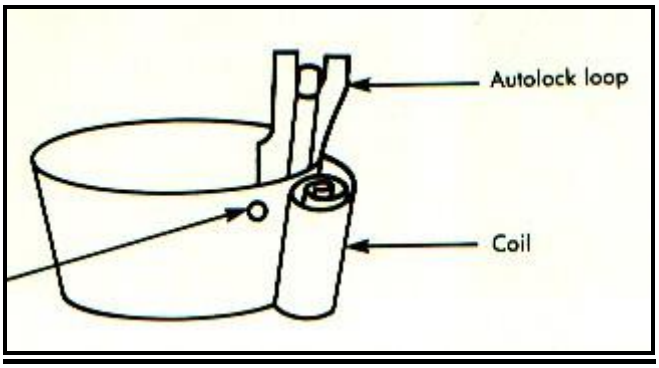


Fig. 9-42. Ivory matrix retainer No. 1.

3) In the third type only a matrix band is used without a retainer. Indicated in badly broken teeth, patient with gagging reflex.



<u>The band should be:-</u>

1- Strong, smooth, establishes proper anatomical contour.
2- Restoration of correct proximal contact relation.
3- Easy for insertion and removal.

<u>Wedge:-</u>

<u>Objectives:-</u>

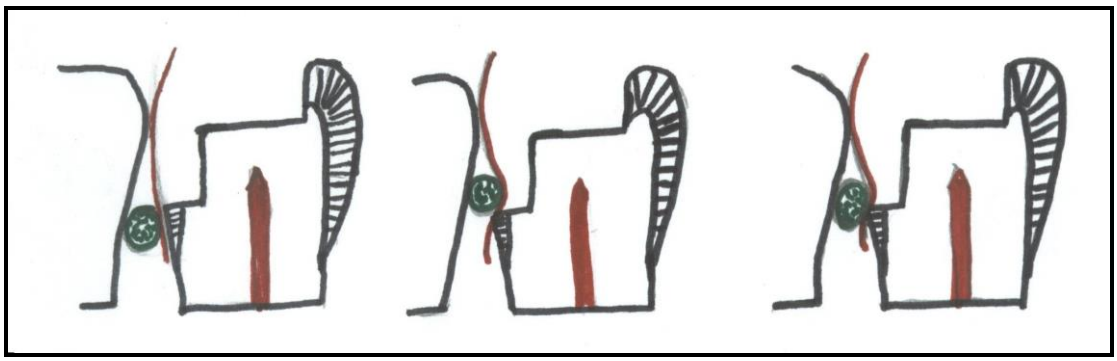
1) To hold the band tightly against the gingival margin of restoration (excess contour of the cervical area)
2) To prevent over hang amalgam.

3) To provide sufficient separation of the teeth to compensate for thickness of the band material. the effective force of the wedge is horizontally directed to the cervical edge of the band, so when the wedge is forcefully driven into place resulting in separation of the approximate teeth, such temporary tooth movement will make up for the thickness of the matrix band material.

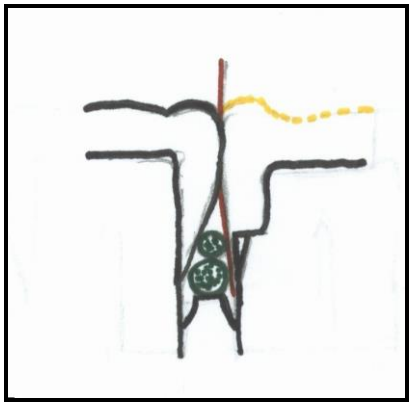
The wedge should be positioned as near as to the gingival margin (just beneath to the gingival margin). If the wedge positioned:

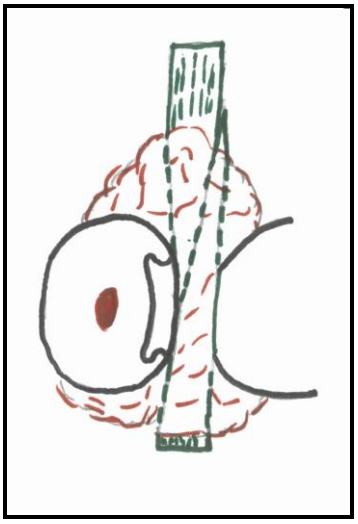
*Occlusal to gingival margin, the band will be pressed into the preparation creating an abnormal concavity.

*As far as apical to margin, the band will not be held tightly against the gingival margin result in gingival excess (over hang).

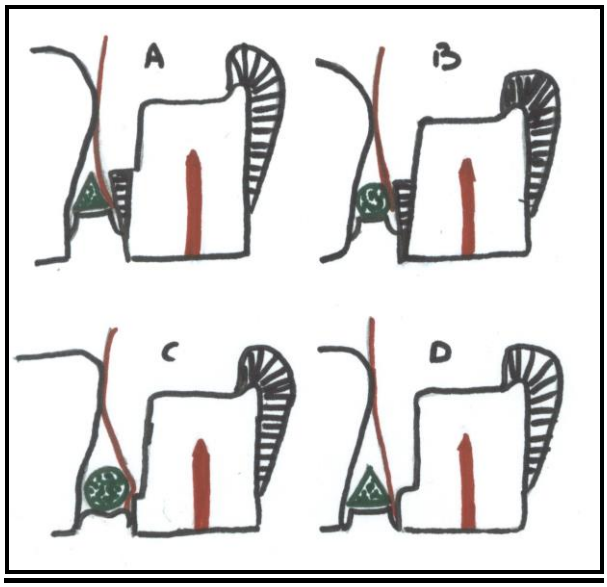


If the wedge significantly apical of the gingival margin, a second smaller wedge placed on the first one to wedge adequately the matrix against the margin (in case of recession of inter proximal tissue level). Occasionally a double- wedging is permitted if access allows, securing the matrix when the proximal box is wide faciolingually. One from lingual side and the second from facial embrasure.





The wedge is either triangular or round. The triangular can be modified (by knife) to conform the approximating tooth contours. It's recommended for the deep gingival margin, because the base of the wedge will more readily engage enough tooth gingival to the margin without causing excessive soft tissue displacement. The round is preferred with conservative proximal boxes because its wedging action is more occlusal (near the gingival margin) without impinging the soft tissue.



Before inserting the amalgam, a final check should be made for the following points:-

1) Is the matrix system stable (by wedge…)
2) Does it fit the cervical margin? It should not possible to insert a probe between the cervical margin and the band.
3) Is the height of the band sufficient (1-2 mm above the adjacent tooth, any attempt to remove the band before the reduction of the marginal ridge to its approximate height by contouring its outer incline is an invitation to marginal ridge fracture.
4) Is the cavity clean and dry?

*Contamination with saliva increases leakage of the restoration. Zinc- containing amalgam expands excessively if contaminated by moisture when they are condensed. Zinc react with water to produce hydrogen gas. The hydrogen gas causes the amalgam restoration to expand, seeming to push out of the preparation.

Operative dentistry

Lec.11 (Complex Amalgam Restorations)

Complex posterior amalgam restorations should be considered when large amounts of tooth structure are missing and when one or more cusps need capping.

Indications:

Complex amalgams can be used as:

(1) Definitive final restorations.

(2) Foundations.

(3) Control restorations in teeth that have a questionable pulpal or periodontal prognosis.

(4) Control restorations in teeth with acute or severe caries.

Contraindications:

The complex amalgam restoration might be contraindicated

1) If the patient has significant occlusal problems.

2) If the tooth cannot be restored properly with direct restoration because of anatomic or functional considerations (or both).

3) The complex amalgam restoration also might be contraindicated if the area to be restored has esthetic importance for the patient.

Resistance and Retention Form:

- In a tooth severely involved with caries or, any undermined enamel or weak tooth structure subject to fracture must be removed and restored.
- When conventional retention features are not adequate because of insufficient remaining tooth structure, pins, slots, and amalgam bonding techniques may be used to enhance retention.
- The retention features needed depend on the amount of tooth structure remaining and the tooth being restored. As more tooth structure is lost, more auxiliary retention is required.
- Pins, slots, and bonding also provide additional resistance form to the restoration.
- Capping cusps:

a) When caries is extensive, reduction of one or more of the cusps for capping may be indicated (capping cusps).

b) When the facial-lingual extension of the occlusal preparation exceeds two third the distance between the facial and lingual cusp tips (inter-cuspal-distance), reduction of the cusp(s) for amalgam is usually required for the development of adequate resistance form.

c) The reduction should be 2mm as minimum depth on the occlusal surface of each cusp to be capped using the side of carbide fissure bur, to ensure that the final restoration has restored cusps with a minimal thickness of 2 mm of amalgam

d) The occlusal contour of the reduced cusp should be similar to the normal contour of the unreduced cusp. Any sharp internal corners of the tooth preparation formed should be rounded to reduce stress concentration in the amalgam and thus improve its resistance to fracture from occlusal forces.

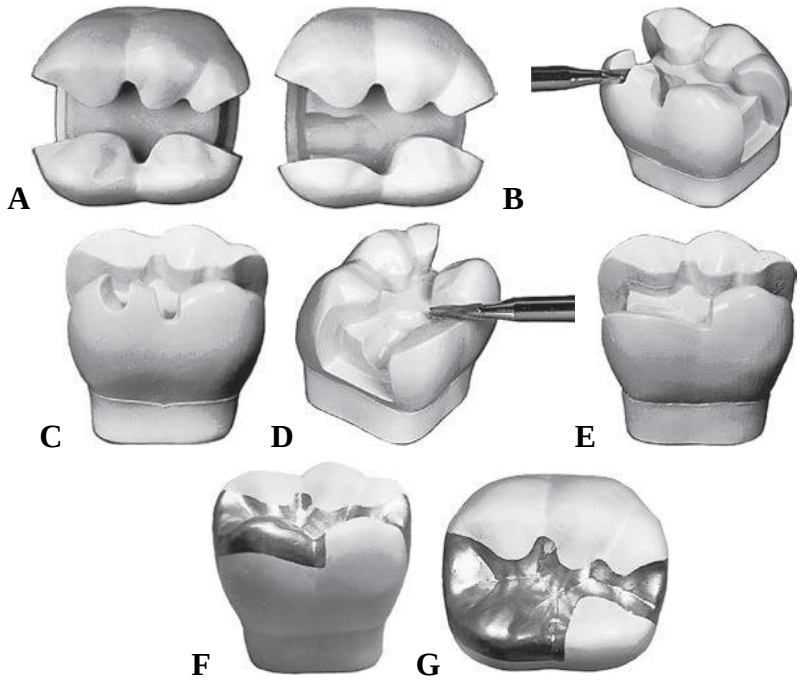


FIG. (1) Capping cusp with amalgam. A, Comparison of mesial aspects of normally extended (left) and extensive (right) mesioocclusodistal tooth preparation. Note that the resistance form of the mesiolingual cusp of extensive preparation is compromised and indicated for capping with malgam. B, Preparing depth cuts. C, Depth cuts prepared. D, Reducing cusp. E, Cusp reduced. F and G, Final restoration.

When possible, opposing vertical walls should be prepared to be converge occlusally, to enhance primary retention form. The pulpal and gingival walls should be relatively flat and perpendicular to the long axis of the tooth.

Secondary retention means:

Cusp reduction significantly diminishes retention form by decreasing the height of the vertical walls, so secondary retention means are required which may include:

1- **Coves and locks:** Coves are prepared in a horizontal plane and locks are prepared in a vertical plane. These locks and coves should be prepared before preparing pinholes and inserting pins. (see fig. 2 A&C)

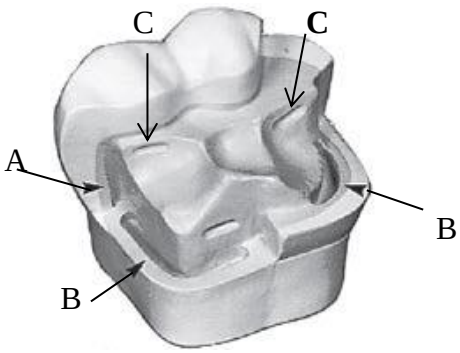


Fig. 2 Locks (A), slots (B), and coves (C).

2- Slots: which may be prepared along the gingival floor, or in addition to, pinholes (as appear in fig. 2 B). The slot should be prepared 0.5 mm pulpal to the dentino-enamel junction and at least 0.5 mm in depth.

3- Pins: Pins placed into prepared pinholes provide auxiliary resistance and retention forms.

PIN RETAINED AMALGAM RESTORATION:

It's any filling may needs one or more pins to provide adequate resistance and retention forms.

Advantages:

1- Conservative; means the pin is more conservative in tooth cutting than slot and crown preparation.
2- Time value: Pined amalgam needs only one visit; the cast may needs two visits.
3- Resistance and retention are better by using pins.
4- More economic than cast.

Disadvantages:

1- It's difficult to penetrate when there is little dentin left.
2- Stress induced into tooth structure.
3- Perforation may occur to the pulp or to the external tooth surface.
4- Requires at least 4 mm's of occlusal clearance.

Types of pins:

1. Self threading pins: The pin is retained by threads on pin surface through engaging the dentin when it's inserted. It is the most retentive type of pins and also it is the most widely used than the other types. However, vertical and horizontal stresses can be generated in the dentin when a self-threading pin is inserted causing craze lines in the dentin which are related to the size of the pin. The diameter of pin hole is 0.1 mm smaller than pin diameter. The elasticity of dentin allows the insertion of pin into a hole of smaller diameter. The depth of pin hole is about 1.5-2mm. (Fig 3, C)

2. Cemented pins: Its threaded or serrated stainless steel pins cemented into pin holes 0.05mm larger than the diameter of the pin. The cement used may be any standared dental luting agent such as Zinc phosphate or polycarboxylate cement. The cemented pins produce less stresses in the dentin. The depth of pin hole should be 3 mm. (Fig 3, A)

3. Friction-locked pin: The diameter of the prepared pin hole is 0.025 mm less than diameter of the pin ; the pin is tapped in place retained by resiliency of dentin; Its 2-3 time more retentive than cemented pins; its inserted by specially designed instrument.(Fig 3, B)

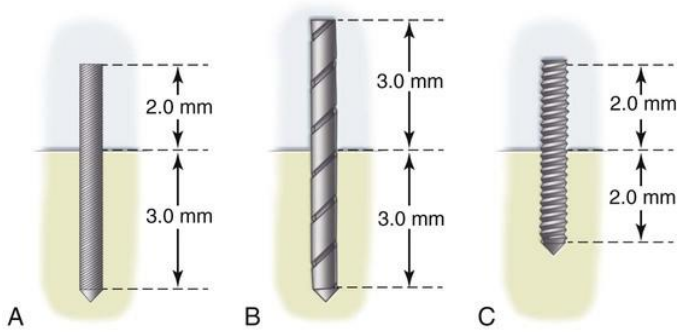


FIG. 3 Three types of pins. A, Cemented. B, Friction-locked. C, Self threading.

Factors Affecting the Retention of the Pin in Dentin and Amalgam:

1- Type of pin: The self-threading pin is the most retentive, the friction locked pin is intermediate, and the cemented pin the least retentive.

2- Surface characteristics: The number and depth of the elevations (serrations or threads) on the pin influence retention of the pin in the amalgam restoration. The shape of the self-threading pin gives it the greatest retention value.

3- Orientation, number, and diameter: Retention provided by placing the pins in a non parallel manner; also excessive bending of pins to improve retention in amalgam is not desirable, because bending interfere with the adequate condensation of amalgam around the pin, also bending may weakens the pins. Pins should be bent only to provide an adequate amount of amalgam (approximately 1 mm,) between the pin and the external surface of the finished restoration.

4-Extension of pin into amalgam and dentin: The extension of pin into dentin and amalgam greater than 2 mm is unnecessary for pin retention and is contraindicated to preserve the strength of the dentin and the amalgam. (Fig.3)

Pin Placement Factors and Techniques:

1- Pin size: Two determining factors for selecting the appropriate pin size are the amount of dentin available to safely receive the pin, and the amount of retention desired. In the Thread Mate System (TMS) four sizes of pins are available (from the largest size to smaller size: Regular, Minim, Minikin and Minuta).The Minikin pins usually the pins of choice for severely involved posterior teeth to reduce the risk of dentin crazing, pulpal penetration, and potential perforation. The Minim pins usually are used as a backup in cases where the pinhole for the Minikin was over prepared. The Regular or largest diameter pin is rarely used because a significant amount of stress in the tooth (dentin and enamel) may be created during its insertion. The Minuta pin is usually too small to provide adequate retention in posterior teeth so this pin can be benefit for providing retention for anterior teeth restorations.

2- Number of pins:

a- As a rule one pin per cusp or marginal ridge.

b- The fewest pins possible should be used to achieve the desired retention for a given restoration.

c- If more than one pin is used, 3-5 mm space between pins is required.

d- As the number of pins increases the retention of the restoration increases, while an excessive number of pins can fracture the tooth and significantly weaken the amalgam restoration.

3- Location:

a- Occlusal clearance should be sufficient to provide 2 mm of amalgam over the pin.

b- Pinholes should be located halfway between the pulp and the DEJ or external surface of the tooth root. The pinhole should be positioned no closer than 0.5 to 1 mm to the DEJ or no closer than 1 to 1.5 mm to the external surface of the tooth. (See Fig. 4)

c- The pinhole should be parallel to the adjacent external surface of the tooth.

d- A minimum space of 0.5 mm is required around the circumference of the pin for adequate condensation of amalgam.

e- Pinholes should be prepared on a flat surface that is perpendicular to the proposed direction of the pinhole.

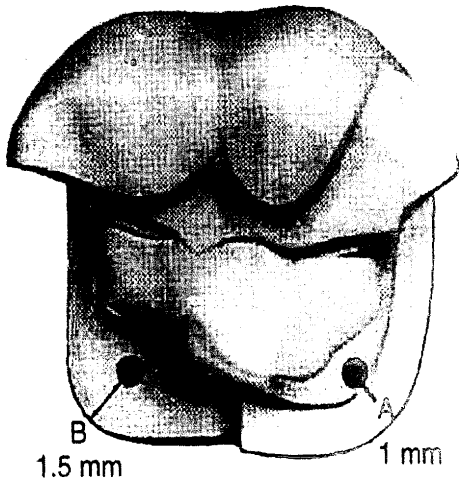


Fig. 4 Pinhole position. A, Position relative to DEJ.

B, Position relative to external tooth surface.

f- Several posterior teeth have anatomic features that maypreclude safe pinhole placement. External perforation may result from pinhole placement on these areas:

i- Over the prominent mesial concavity of the maxillary first premolar.

ii- Over bifurcation areas of the lower molars and trifurcation areas of the upper molars.

iii- The distal aspect of mandibular molars and the lingual aspect of maxillary molars because of root angulations of these teeth just apical to CEJ.

iv- Teeth that are rotated in the arch.

v- Abnormal tilted teeth. (See Fig 6)

Pinhole preparation:

1- The drill is a twist drill made of aluminum shank, which acts as a heat absorber, and is color coded so that it can be easily matched with the appropriate pin size. A drill with limited depth of 2mm should be used to prepare the hole.

2- When the pinhole locations have been determined, a No. 1/4 round bur is first used to prepare a hole. The purpose of this hole is to permit more accurate placement of the twist drill and to prevent the drill from "crawling" once it has begun to rotate.

3- Put the handpiece on clockwise rotation at very low speed 1300 to 500 rpm).

4- Prepare the hole parallel to nearest external tooth surface. Align twist drill with external tooth surface. Drill the hole in one continuous motion until the depth is reached then pulls the drill without stopping the rotation to prevent breaking of the drill while it's in the hole. (See fig. 5)

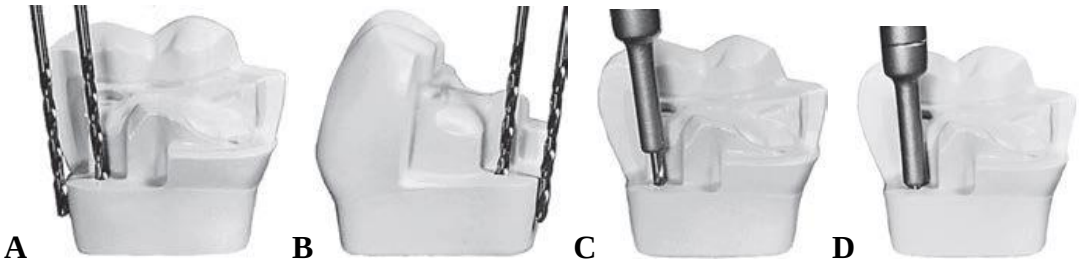


Fig 5: Determining the angulation for the twist drill. A, Drill placed in the gingival crevice, positioned flat against the tooth, and moved occlusally into position without changing the angulation obtained. B, *A* repeated while viewing the drill from position 90 degrees left or right of that viewed in *A*. C and D, With twist drill at correct angulation, the pinhole is prepared in one or two thrusts until the depth-limiting portion of drill is reached.

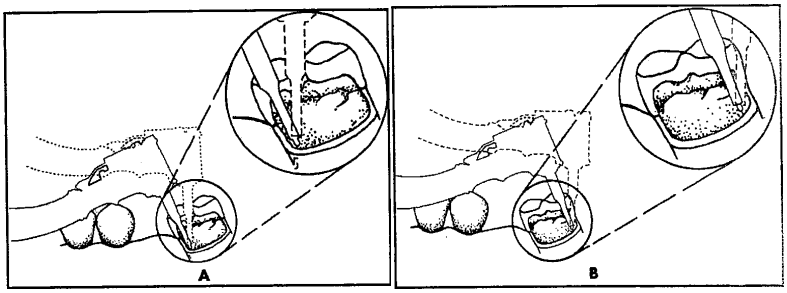


Fig. (6) Care must be exercised when preparing pinholes in mesially tilted annoiars prevent external perforation on mesial surface (A) and pulpal penetration on the distal surface (B). Broken line is incorrect angulation of twist drill.

Pin design:

For each of the four sizes of pins, several designs are available: standard, self-shearing, two-in one, Link Series, and Link Plus (Fig. 7). The Link Series and Link Plus pins are recommended. TMS pins are available in titanium or stainless steel plated with gold.

When the pin reaches the bottom of the hole, the top portion of the pin shears off, leaving a length of pin extending from the dentin.

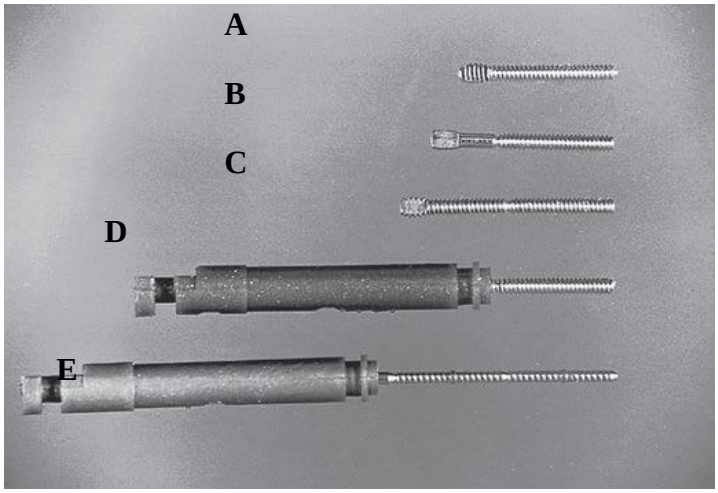


Fig7: Five designs of the Thread Mate System (TMS) pins. A, Standard. B, Self-shearing. C, Two-in-one. D, Link Series. E, Link Plus.

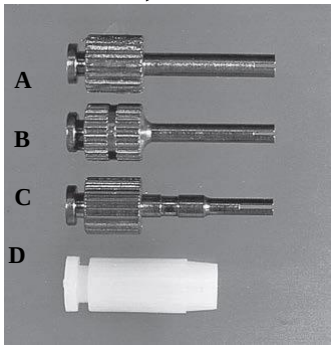


Fig 8: Hand wrenches for the Thread Mate System (TMS) pins. A, Regular and Minikin. B, Minim. C, Minuta. D, Link Series and Link Plus

Fig9: Handpiece chucks for

(A) TMS regular self-shearing and Minikin pins, and (B) TMS Minuta pins

Notes:

When pin is placed in the pin hole, the pin should not exceed 2 mm in length in the amalgam, if the length is more than that, the excess should be cut. It is desired to have at least 2 mm of thickness of the amalgam occlusal to the end of the pin to prevent weakening of the restoration.

Possible Problems with Pins:

1-Failure of pin-retained restorations: The failure of pin retained restorations might occur at any of five different locations (Fig. 10). Failure can occur:

a- Within the restoration (restoration fracture).

b- At the interface between the pin and the restorative material (pin-restoration separation).

c- Within the pin (pin fracture).

d- At the interface between the pin and the dentin (pin-dentin separation).

e- Within the dentin (dentin fracture).

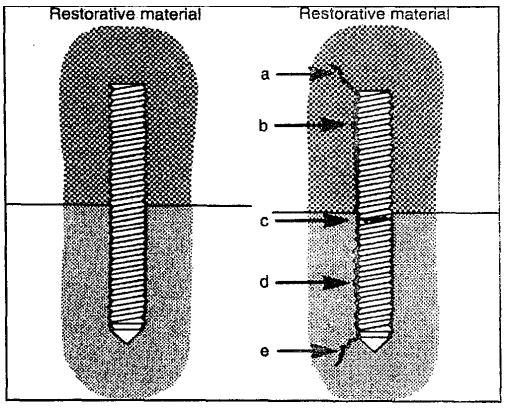


Fig (10) Five possible locations of failure of pin-retained restorations. a, Fracture of restorative material;b, Separation of pin from restorative material; c, Fracture of pin;d, Separation of pin from dentin; e, Fracture of dentin.

2-Broken drills and broken pins: A twist drill will break if it is stressed laterally or allowed to stop rotating before being removed from the pinhole. Pins also may break during bending, if care is not exercised. The treatment for both broken drills and broken pins is to choose an alternate location, at least 1.5 mm away from the broken item, and prepare another pinhole.

3-Loose pins: The pin should be removed from the tooth and the pinhole re-prepared with the next largest size drill, and the appropriate pin inserted. Preparing another pinhole of the same size 1.5 mm from the original pinhole also is acceptable.

4- Penetration into the pulp and perforation of the external tooth surface:
It is obvious if there is hemorrhage in the pinhole following removal of the drill, also the operator can feel when a penetration or perforation has occurred by an abrupt loss of resistance of the drill to hand pressure. In an asymptomatic tooth, a pulpal penetration is treated as any other small mechanical exposure by control the hemorrhage, then place a calcium hydroxide liner over the opening of the pinhole, and prepare another hole 1.5 to 2 mm away. Perforation of the external surface of the tooth can occur occlusal or apical to the gingival attachment. When the perforations occur occlusal to the gingival attachment, the pin can be cut off flush with the tooth surface and no further treatment. Or the pin can be removed, if still present, and the external aspect of the pinhole enlarged slightly and restored with amalgam. If the perforations occur apical to the attachment, reflect the tissue surgically, remove the necessary bone, enlarge the pinhole slightly, and restore with amalgam.

FAILURE OF AMALGAM RESTORATION:
The failure of amalgam restoration may include:

1- Secondary caries: Class I and Class I I amalgam restorations, caries around margins was the predominant cause of restoration failure. Also amalgam restoration in high caries incidence individuals may fail as a result of secondary caries.
2- Isthmus fractures or marginal ridge fracture of restoration: the marginal ridge fracture in CI II restoration may be caused by:
a- Axio-pulpal line angle not rounded in class II cavity.
b- Marginal ridge left too high.
c- Improper removal of the matrix.
3- Tooth fractures: Excessive tooth cutting or excessive caries, may resulted in large cavity with thin walls that cannot withstand occlusal forces, and will cause tooth fracture. Also sharp internal line angles may cause stress concentration of the restoration on the tooth walls and lead to fracture.
4- Improper marginal adaptation and marginal fractures: Marginal deterioration of amalgam restorations are mainly caused by the following factors:
a- Improper marginal preparation.
b- Improper carving and finishing. `
c- Excess mercury.
d- Use of low copper amalgam.
e- Amalgam expansion.

5- Other reasons: these includes faults in the clinical procedures during amalgam placement such as: gingival overhang of the restoration (due to not or improper using of the wedge), improper contact area with the adjacent tooth which will lead to periodontal problems.

Operative Dentistry

Lecture: 9	3rd Stage 2020-2021	د. هاشم مُعين حسين/ د. أحمد ساطع رأفت

Liners and Bases (Part 1)

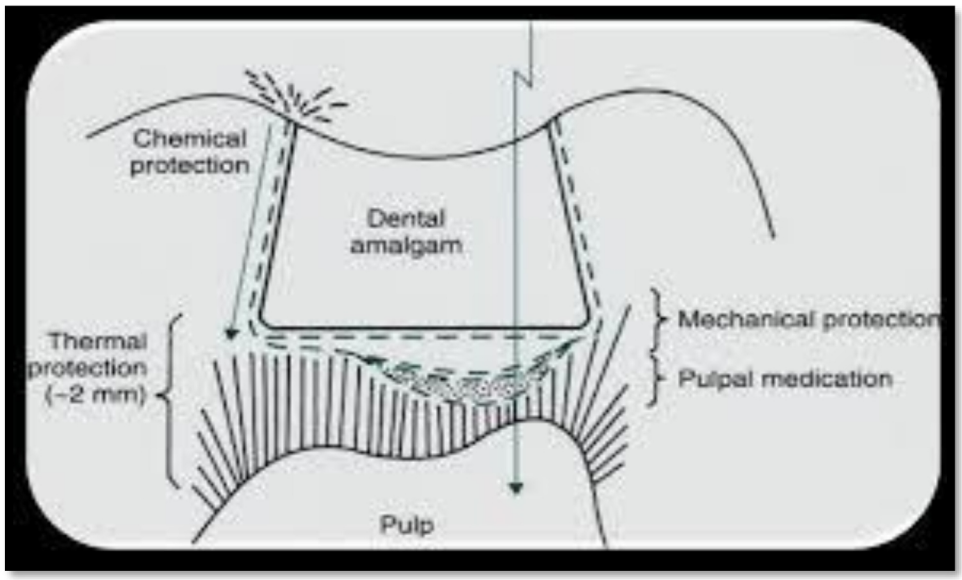
The materials placed between dentin and the restoration must provide pulpal protection. Protective needs for a restoration vary depending upon:

1) The extent and location of the preparation (depth of cavity).
2) The restoration material to be used (the type of restoration).

The characteristics of the liner or base selected are largely determined by the purposes that it is expected to serve.

Properties of ideal lining material (Liner & Base)

1) It should be easy to supply.
2) The strength should be enough to withstand the condensation forces.
3) It should not irritate the pulp or interfere with the setting reaction of the restoration (compatible with restorative materials).
4) Radiopaque (to facilitate subsequent interpretation of x-rays in diagnosis of recurrent caries).
5) It should have a bacteriostatic effect.
6) Well adapted to the cavity walls (have the good sealing ability).
7) Reduce the thermal conductivity of the restoration.
8) It should prevent chemical exchange between the restoration and the tooth.



Types of the lining material

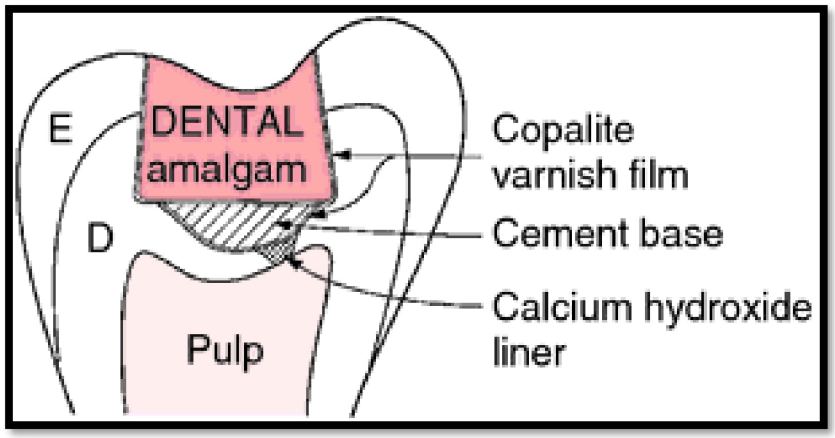
1. Sealers

These materials provide a *protective coating to the walls* of the prepared cavity and a *barrier to leakage* at the interface of the restorative material and the walls.

Varnish sealer

It is a natural gum (Copal resin) or a synthetic resin dissolved in a solvent such as chloroform, alcohol, and acetone. The solvents evaporate, leaving the resin behind. **It used:**

1) The varnish is frequently used **under amalgam restoration** because they reduce significantly the leakage around the margins and the walls of the restoration. Varnishes have been used for many years to fill the gap in the amalgam-tooth interface until corrosion products form and fill the interface.
2) Used **as a barrier** against the passage of irritants from cement or other restorative materials.
3) **Reduce the sensitivity** of freshly cut dentin.



Varnish *not thick enough* to provide thermal insulation. Also, it's *not used with composite* materials, as they would interfere with adhesion.

Manipulation:

Usually applied by means of a *small round piece of cotton or micro brush* according to the size of the cavity, we paint the entire cavity preparation. A *minimum of 2 thin films* should be applied, as the initial layer dries it leaves small pinholes and the second coating fills the voids and produces a more continuous coating.

2. Liners

Liners are relatively thin layers (< 0.5 mm) of material example (calcium hydroxide) used primarily:

1) To provide a **physical barrier** to protect the dentin from residual reactants diffusing out of restoration and/or oral fluids that may penetrate through tooth restoration interfaces.
2) Provide a **therapeutic effect**, such as anti-bacterial or pulpal sedative effects and provide pulpal treatment.

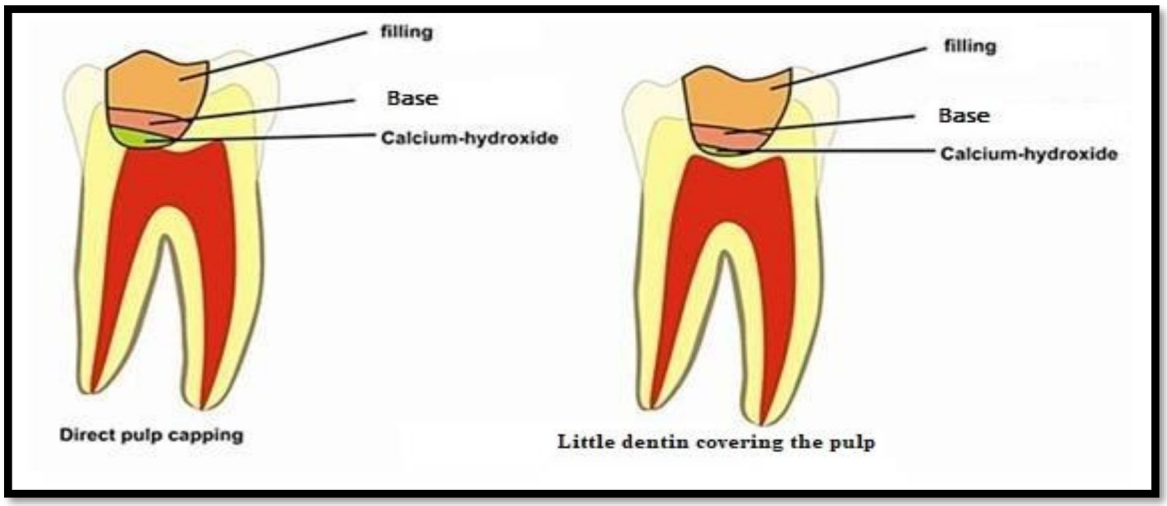
The need for the liner is *greatest* with pulpally extended metallic restoration that isn't will bond to tooth structure such as amalgam.

In composite restorations that routinely bind to the tooth structure. The insulator nature of this tooth-colored material and the sealing effect of bonding agents precluded the need of traditional liner and bases unless the tooth preparation is extremely closed to the pulp and pulpal medication become a concern (usually applied only to dentin cavity walls that are near the pulp; i.e. pulpal and axial walls.

Calcium hydroxide $Ca(OH)_2$

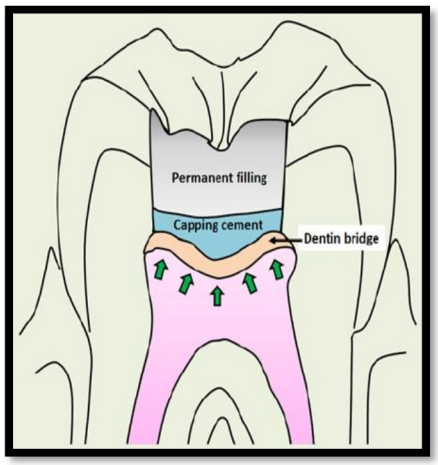
Has long been used as a liner under restorative material. $Ca(OH)_2$ is supplied either as a suspension type or as a paste system, one paste contains **calcium hydroxide (catalyst)** while the other contains **salicylate (base)**, e.g (dycal, calcipulp). **It used:**

1) They are recommended materials for *direct pulp capping (micro pulp exposure).*
2) *As a liner* under other dental restorative materials. They are still recommended when a cavity preparation leaves a *little dentin covering the pulp*.



Properties:

1) It can stimulate the reparative dentin formation with direct pulpal contact (because it stimulates the odontoblast cells when placed on the dentin close to the pulp or in direct contact with the pulp exposed).

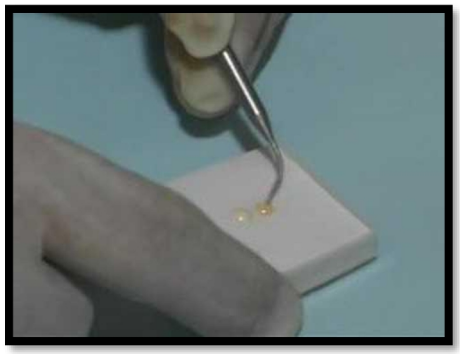


2) Serve as a protective barrier between tooth tissues and acid-containing cement and restorative materials since it has a high pH (9.2-11.7), so it neutralizes the acidity of zinc phosphate cement during sitting and protect the pulp.
3) It has an antibacterial action that reduces the inflammatory effects of bacteria on the pulp and the formation of reparative dentin.
4) Conventional calcium hydroxide liners (chemical cured type, base, and catalyst) have demonstrated poor physical properties (high solubility, have low values of tensile and compression strength). Visible light-activated calcium hydroxide overcomes most of these deficiencies.

Manipulation:

Equal lengths of the different colored pastes are dispensed on a paper pad and then mixed to a uniform color with a ball-point instrument; the setting time is **(2-3) minutes** mixing time **10 seconds** at room temperature.

To ensure the complete adaptation and the filling of the deepest portions of the cavity, $Ca(OH)_2$ should be placed on dry dentin. The setting reaction of $Ca(OH)_2$ is accelerated by water, the moisture present in dentin is sufficient to cause the material to set within seconds of application on the dentin surface.



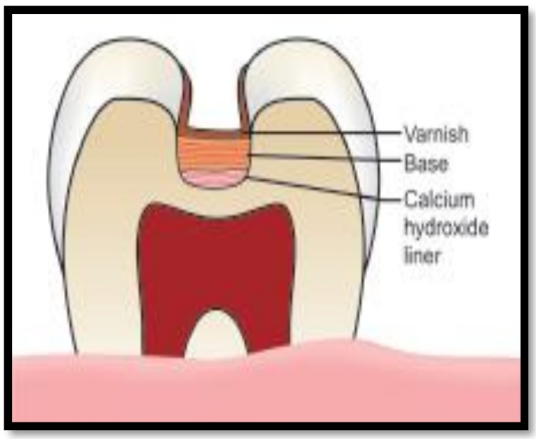
3. Bases (cement bases ≥ 0.5mm layer thickness and up to 1-2 mm)

Bases are used to:

1) Provide *thermal protection* for the pulp.
2) Provide *mechanical support* for the restoration by distributing local stresses from the restoration across the underlying dentin surface. This mechanical support provides *resistance against disruption of thin dentin* over the pulp during amalgam condensation procedures or cementation procedures.

Some base materials are irritating to the pulp before the setting reaction has completed, such a base may be used in conjunction with a liner.

Metallic restorations must be seated on sound dentin peripheral to the liner and/or based regions that result from excavating infected dentin.

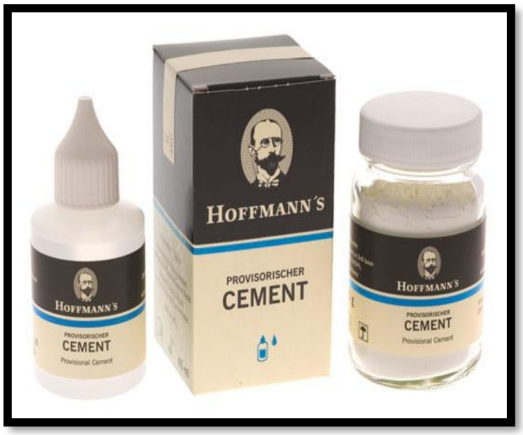


The thickness of the base depends on its physical properties, but always allowing adequate thickness for final restorative material. Numerous types of bases example (zinc phosphate cement, zinc oxide eugenol cement, polycarboxylate cement, glass ionomer cement).

Zinc-phosphate cement (ZPC)

It has developed in the early 1900s. It has been used in dentistry for centuries, and still quite popular. The ZPC is supplied as a powder and liquid.

- **Powder:** consist of zinc oxide chiefly with additions of magnesium oxide and silicon dioxide, and other minor ingredients.
- **Liquid:** consists of a water solution (aqueous solution) of *phosphoric acid 37%*.



Properties:

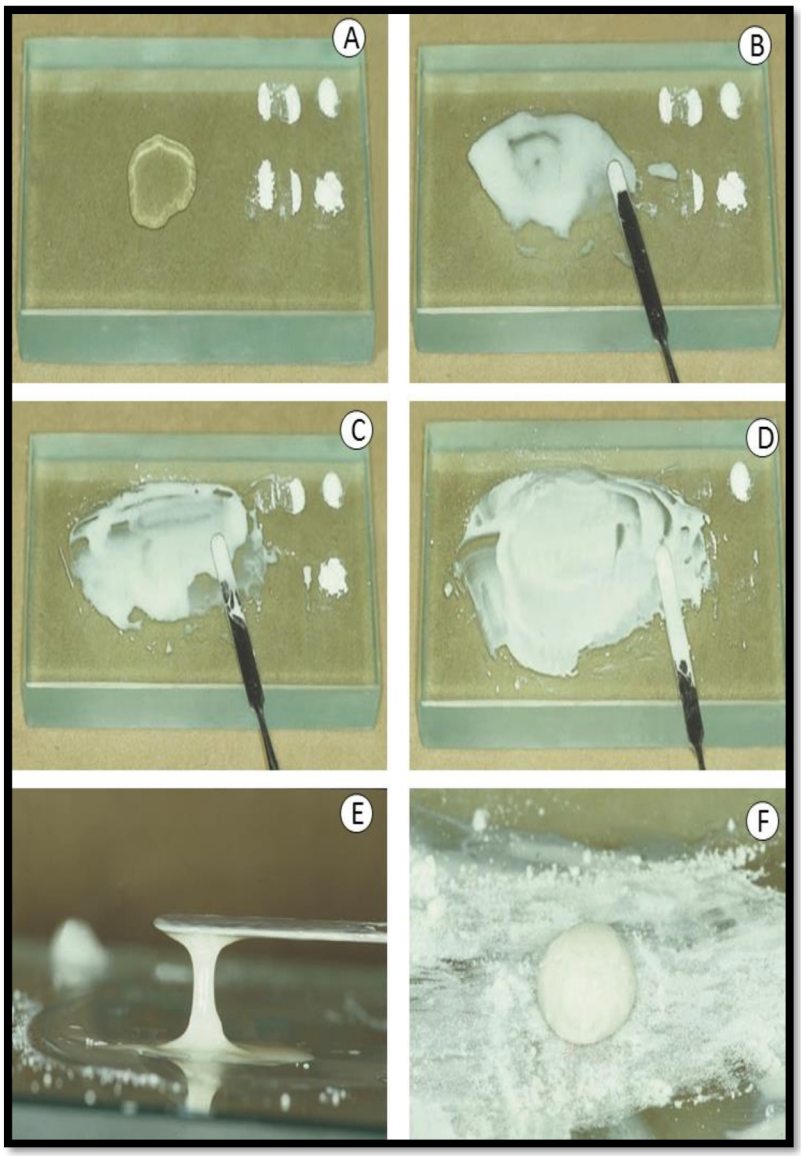
1) Strong and has a low solubility compared to other cement.
2) Because the mixed cement has a low pH until it has set, ZPC is irritating to the pulp. The *initial acidity* of the setting cement *(less than 2.0 pH)* may cause sensitivity during and after cementation. The pH, however slowly *rises to 5.9 within 24 hours* and is neutral *(pH 7.0) by 48 hours*.
3) ZPC sets to a hard-brittle material. It can *withstand amalgam condensation forces* and support the overlying amalgam restoration.
4) Provide good protection against *thermal shock*.
5) This cement, however, is *not recommended for use in ceramic crowns and composite* crowns because of their inferior compressive and flexural strength.

Uses:

1) For luting inlays, crowns, bridges, orthodontic bands. The ZPC has a long working time compared to other luting cement **(1-1.5 minutes)**.
2) Used as a base material. It is acidic and the pulp may need to be protected with a liner.
3) Also, ZPC indicated for replacement of lost dentin in deep cavities.

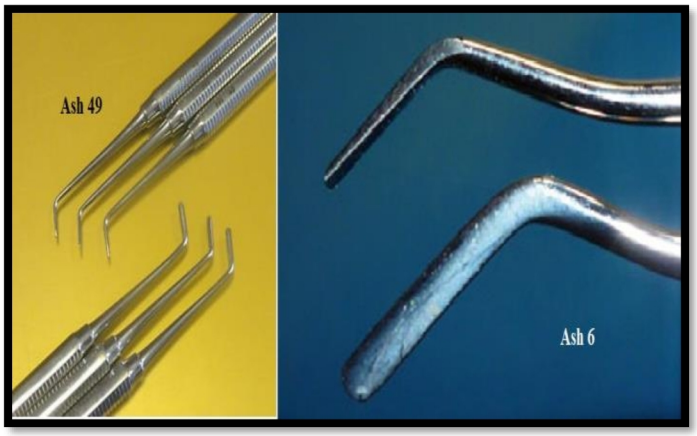
Mixing:

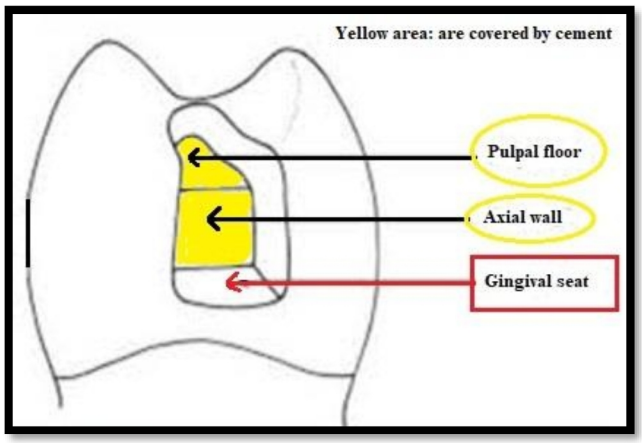
- The ZPC is dispensed as scoops of powder and drops of liquid, the number of drops and scoops of powder required are found in the directions provided by the manufacturer. A cement spatula and glass slab are used.
- The **reaction is very exothermic**, the heat of the reaction *accelerates the setting rate* so it is important to *dissipate this heat to lengthen the setting rate* and this is done by:
  a) A large portion of a cooled mixing slab (21 °C) must be used during mixing (cooling obtained by placing the slab under cool water or in a refrigerator).
  b) The powder must be added in small increments.
  c) The mixing is spread over a wide area of the glass slab.
- The powder is dispensed in the middle area of the slab and divided into small equal parts (3-6 increments); the liquid is dispensed with an eyedropper on the other area of the slab. The mixing is started by adding the 1^{st} small increment of the powder into the liquid and continuously spatulated, then the 2^{nd} part of the powder incorporated and so on. A primary consistency is usually attended at the end of 1.5 minutes.
- The **advantages of incorporating small increments of powder over a large area of the slab** are:
  a) Dissipating the heat of reaction.
  b) Permit a greater quality of powder to be incorporated (increase cement strength).
  c) Smoother mix.
  d) Longer working time.
  e) Less acidity.
- ZPC is mixed to the proper consistency depending on the clinical use. The mix *is thinner* (lower P/L ratio) when used for *luting*, and *thicker consistency* (*Putty-like consistency*) (higher P/L ratio) used as a *base*.



Insertion:

- At the end of our mixing, a putty consistency is usually attended.
- A small quantity of cement is rolled into a ball with fingers and picked up on the point of a right-angled probe, and placed on the floor of the cavity.
- Then it's tapped with an instrument, covered with a powder of cement?? To prevent the cement from sticking to the instrument.
- The cement, then shaped with an instrument such as Ash no. 6?? and no. 49??
- For **class II** the cement is pressed against the *axial wall, pulpal floor, and the axiopulpal line angle*.
- Any trimming with bur should be *delayed until the complete set* of the cement to avoid dislodgment and should be carried out *with sharp bur and low speed and minimum pressure*. The same technique applied to **class V** cavities by placing the cement on the *axial wall only*.





General notes:

- It is important *not to dispense the liquid until one is ready to mix* the cement because *high or low humidity will affect the water content* and, therefore, affect the reactivity and the properties of the resulting cement.
- ZPC powder comes in shades. The color of any cement can affect the esthetic of translucent restorative material.
- In the patient's mouth, the *cavity should be completely dry*, otherwise, the *cement will not adhere, and brittle cement is produced*.
- A very fine excavator may be used to remove cement which has obliterated the under grooves.
- Characteristic of a proper mix: for the luting agent, the mix should be stretched 1 inch between the slab and a spatula. As a base material, it should be thicker, putty-like and it can be rolled into a ball with fingers covered with cement powder. A proper base mix will not stick to instruments and can be pushed or condensed into place.
- The setting time of the ZPC was **2-3 minutes for a thick consistency**, **5-8 minutes for a thin consistency**.

$$2\,ZnO + 4\,H_2PO_4 \xrightarrow[\text{Reaction}]{\text{Exothermic}} 2\,ZnHPO_4\text{-}3H_2O + \text{heat}$$

Operative Dentistry

Lecture: 10	3rd Stage 2020-2021	د. هاشم مُعين حسين/ د. أحمد ساطع رأفت

Liners and Bases (Part 2)

Zinc oxide eugenol (ZOE):

Zinc oxide eugenol (ZOE) cement has been used extensively in dentistry since the 1850s. ***They are the cements of low strength**. Also, ***they are the least irritating of all dental cements** and are known to* **have an abundant effect on exposed dentin** (soothing effect on pulp). There are 2 types:

1) **Unreinforced ZOE (ordinary type):** It used as a temporary cement **(temporary filling materials)**, which are popular and perform adequately. It's composed of:
   - Powder: **Zinc oxide** + some additives like (zinc acetate, white resin**?? To increase the strength of the material).**
   - Liquid: **Eugenol.**

2) **Reinforced ZOE (modified type):** It ***stronger** and ***less soluble** than the ordinary type.* **It used as intermediate bases**. It's composed of:
   - Powder: Zinc oxide + some Additives include (either alumina or polymethyl methacrylate resin) is added to the powder.
   - Liquid: contains, in addition to eugenol, **Ethoxybenzoic acid** (EBA).

Properties:

1) ZOE has a sedative effect on dental pulp, and it is for this reason that is **used as a temporary restoration before a permanent one is used**??
2) Radiopaque.

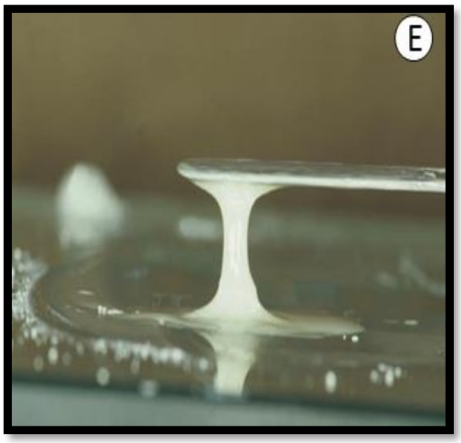
3) It adapts very closely to dentin, thus **providing a good marginal seal**??
4) Its **antibacterial properties**?? inhibit bacterial growth on the cavity walls.
5) Eugenol inhibits free radical polymerization of composite materials, so **ZOE is contra-indicated under composite**??
6) Neutral in pH, so it **can be safely used in moderately deep cavities**??
7) **Water accelerates the setting reaction.** The mixing time for ZOE is **(1-1.5 minutes)**, while the setting time for conventional types is **(4-10 minutes)** and the setting time for the modified type is **(3-5 minutes)**.

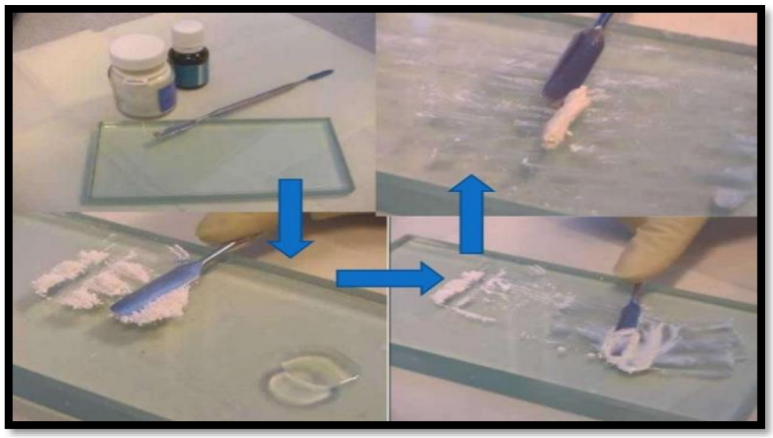
Uses:

1) As a temporary restoration (ordinary type).
2) As a base under permanent restorations (modified type). It provides a good insulator.
3) Cementation of the temporary crown.

Mixing:

- The powder is measured and dispensed with a scoop. The liquid is dispensed as drops. A glass slab is used for mixing the P/L ratio (4:1-6:1). The powder is forced into the liquid using a cement spatula. The mixing process first incorporates large increment of powder, then smaller increments. Spatulated the powder and liquid in a quick circular motion with the flat side of the spatula, using a small portion of the mixing surface.
- **For cementation**: we use the same way, just with a different consistency **(creamy).**
- **For temporary restoration or as a cement base:** Continue the procedure until the mix becomes **(thick, putty-like)** and it **can be rolled into a ball with the fingers without sticking to the skin.**





Insertion:

- **As a temporary restoration** is carried with any suitable flat-bladed instrument to the cavity, and the **packing is best preferable by the use of a ball-shaped piece of cotton damped with water or a plastic instrument that may be used after dipping them in dry ZOE powder.** The patient is requested to close his mouth, bringing his teeth together in occlusion function, the proximal and cervical areas are contoured as carefully as if this was used as a temporary restoration for a prolonged time.
- **As a base,** inserted in the same manner described for ZPC. A small quantity of cement is picked up on the point of a right-angled probe (lightly rolled into a ball with fingers) replaced on the floor of the cavity. Then it's tapped and shaped with an Ash instrument, **covered with a powder of cement**?? To prevent the cement from sticking to the instrument.


Polycarboxylate cement (PCC):

It was the **first adhesive material** developed for use in dentistry (first cement **shows chemical adhesion to the tooth**). It has been introduced later in the 1900s. It supplied as:

1) **Powder + liquid:**
   - Powder: is consists of Zinc oxide and Magnesium oxide mainly, in addition to Stainless steel fibers + Alumina to increase the strength.
   - Liquid: is a weak solution of polyacrylic acid (30-50%) which is very viscous.
2) **Water hardening cement or water setting:**
   - Powder: Zinc oxide or Glass powder is mixed with the **powdered anhydrous, freeze, dried polyacrylic acid.**
   - Liquid: water.

Properties:

1) Polycarboxylate cement is **not as acidic as ZPC ?? Because of:**
   a) The PH of polycarboxylate rises more rapidly than that of the ZPC.
   b) The larger size of the polyacrylic acid molecules compared with phosphoric acid may limit its diffusion through the dental tubules and is very biocompatible.
2) The carboxylate group of polyacrylic acid is **bonded to calcium in tooth structure** and the **bond of it to the enamel is stronger than dentin**.
3) Polycarboxylate cement adheres to gold casting alloy.
4) The polyacrylic acid solution improves its resistance to solubility in oral fluids.
5) The compressive strength of it is lower than that of the ZPC.

Uses:

1) Intermediate base.
2) Luting cement.
3) Used for direct bonding of orthodontic brackets to teeth.

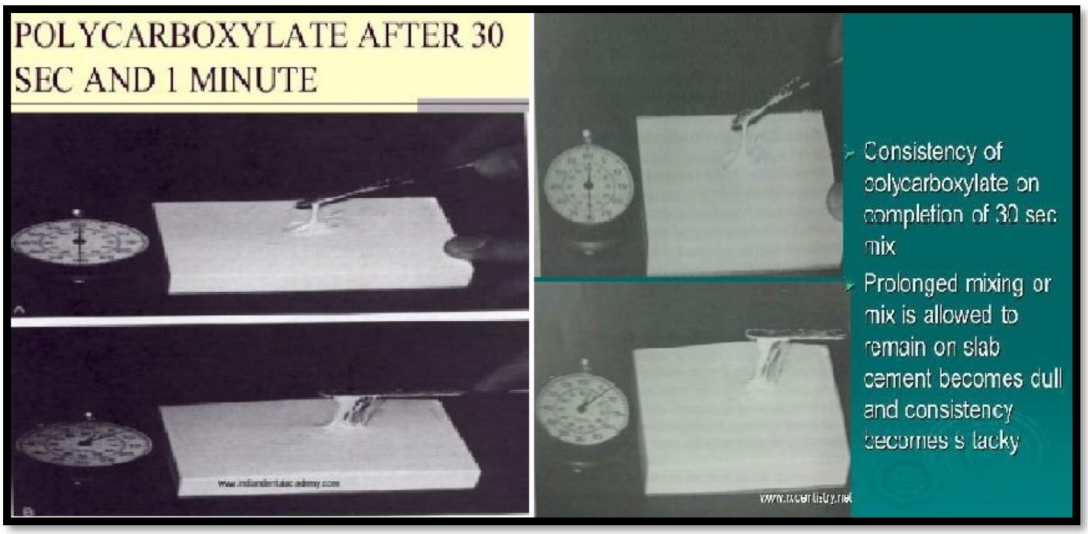
Disadvantages:

1) Short mixing time **(30-45 seconds)**, short working time **(2.5 minutes).**
2) The luck of any anti-cariogenic properties.

3) The sensitivity of the cement to distinguish as related to P/L ratio. Thin mix (P/L ratio= 1.5:1) used for cementing purposes. While thick mix (P/L ratio = 2.5:1) used as cavity base.

Mixing:

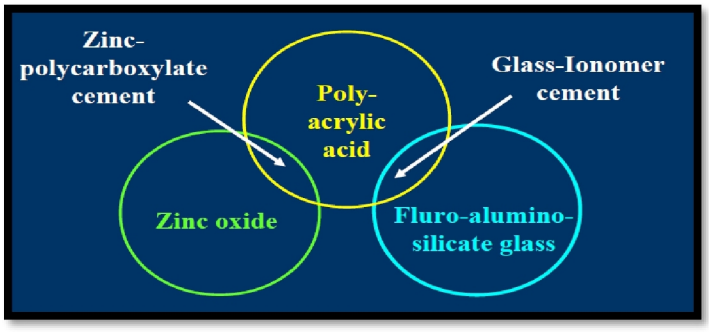
- The powder and liquid are dispensed and mixed on a paper pad with a cement spatula. **The liquid should not be dispensed until one is ready to mix**?? **Because; *the water content of the cement can evaporate and *cause increase in viscosity with *decrease in strength and *increase solubility.** The powder is rapidly incorporated into the liquid in large quantities; we should complete mixing within 30-45 seconds to provide sufficient working time (2.5 minutes).
- **The mixed material must be placed while the cement is still glossy??** which **indicates that the liquid is still available to bond to the tooth "adhesion depends on unreacted carboxylic acid groups".**
- For placing the material as a base, the procedure is similar to that of the ZPC. The setting time for PCC is about **(6-9 minutes)**.



Glass ionomer cement (GIC):

Glass ionomer cement is a tooth-colored material, introduced by Wilson and Kent in 1972. The material was based on the reaction between silicate glass powder and polyacrylic acid. They bond chemically to the tooth structure and release fluoride for a relatively long period. It's composed of:

- Powder: is an **acid-soluble, calcium-fluoro-alumino-silicate glass**.
- Liquid: an aqueous solution of polyacrylic acid that contains a carboxyl group (viscous liquid).



Uses:

1) As a base material in the deep cavity.
2) As a luting agent for permanently cement crown and orthodontic band.
3) As a restorative material in deciduous teeth, difficult subgingival class V permanent teeth.

Properties:

1) GIC materials are the **strongest and least soluble dental cement**.
2) **Adhesive to the tooth structure**.
3) **Release fluorides** (anti-cariogeneic effect).
4) They have **good biocompatibility**.
5) Also, they **bond to the tooth structure**, they **bond to stainless steel and alloys of the metal-ceramic crown.**
6) **Dehydration** causes crazing and cracking and produces an opaque restoration during its initial set stage. **Water absorption** can cause swelling and surface disruption and protection is required for 10-30 minutes after placement, so **it is recommended to protect the setting cement with a coat of varnish, petroleum jelly, or resin bonding to prevent fluid contamination and desiccation especially on the critical margins.**
7) **Glass ionomer cements undergo expansion, an average of 1.7-1.8% during setting. They also expand when they absorb fluids. This property can be both advantageous and disadvantageous.** The expansion of glass ionomer cement as they set can contribute to a stronger fit of metal crowns and metal posts. However, this expansion can cause crazing of ceramic crowns as it transmits undue stress to the internal surface of the ceramic restoration.
8) When glass ionomer cement is used for cementation, care should be taken not to dry or desiccate the tooth as this will result to lower bond strengths and postoperative sensitivity.

Advantages:

1) It offers some degree of chemical adhesion due to its polyacrylic acid component (the liquid).
2) It releases fluoride, which is from the fluoro-alumino-silicate glass component (the powder).

- ***Types of GIC:*** Various improvements in the original material have been made and incorporated into several formulations:

A. Conventional GIC: It used as a liner, base, cement.

- Powder: Ca, fluoro-aluminosilicate glass.
- Liquid: polyacrylic acid.

B. Metal-modified GI:

- It's used as:
  - **a.** Filling material for class V (permanent teeth), class I and II (primary teeth).
  - **b.** Bases under composite and amalgam.
  - **c.** Cores.
- It's composed of:
  - **a.** Powder (Ca, fluoro-aluminosilicate glass).
  - **b.** Liquid (polyacrylic acid).
  - **c.** In addition to a metal which are:
    - ✓ Miracle mixture (amalgam alloy particle admixed with cement powder).
    - ✓ Cermet particle reinforcement (Silver-Palladium alloy) (Ag-Pd).
- It's much stronger than unmodified (conventional) but had poor esthetic.

C. Light cured GI:

- It used as liners or bases.
- It's composed of:
  - **a.** The hydroxyethyl methacrylate (HEMA) added to the liquid component (polyacrylic acid) and light cure accelerator.
  - **b.** Other powder particles mixed with alumina-silicate glass.
- It is more desirable under composite materials because this type is acid resistant.

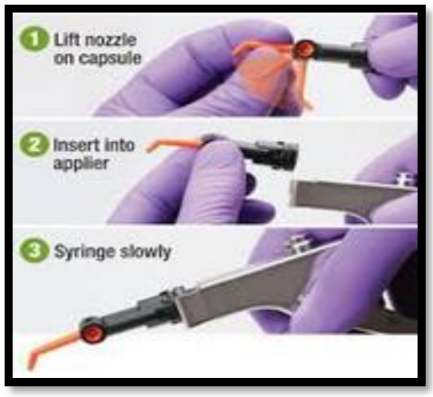
D. <u>Hybrid (resin-modified) GI:</u>

- It developed in 1992 to improve on the weaknesses of conventional GIC (the hybrid is stronger than conventional). It may be light-cured, less technique sensitive.

- It's used as:
  - **a.** Cement.
  - **b.** Restorative filling material.
  - **c.** Cores.
  - **d.** Cementation of metal and metal-based crowns.
- It's composed of:
  - **a.** HEMA and other polymers added to the liquid component.
  - **b.** Polymers added to the powder component.
  - **c.** A silicate glass of composites substituted for some powder.

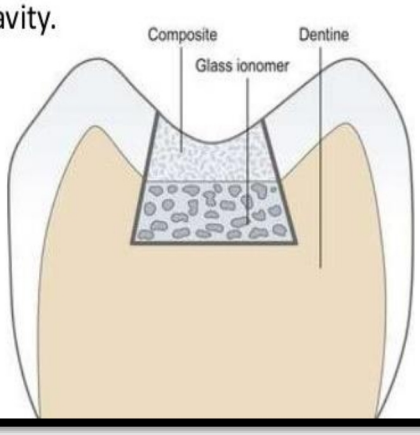
Mixing:

- The mixing and handling of GIC are properly critical. If it is not, non-adhesive materials result. The powder is dispensed with a scoop, and the liquid is dispensed as drops. A cement spatula and paper pad are typically used "special mixing pad will keep all the liquid available for the reaction and facilitate spatulation". The powder incorporated into the liquid in one or two portions and the mixing process is much quicker than for ZOE, ZPC, if the mixing procedure is too slow, the resulting mix becomes too thick.
- Mixing time **(30-45 seconds)**, working time **(2 minutes)**, setting time **(7 minutes)**.
- The best results have been obtained when the material is applied to clean cavity walls that are well isolated in a dry field. The mixed cement should be used only as long as it still appears glossy on the surface.
- The GIC may be dispensed in disposable capsules that mixed in an amalgamator. Specific directions for mixing are provided by the manufacturer. The capsule has a "spout" where the mixed material is expressed from the capsule with a gun or dispenser.

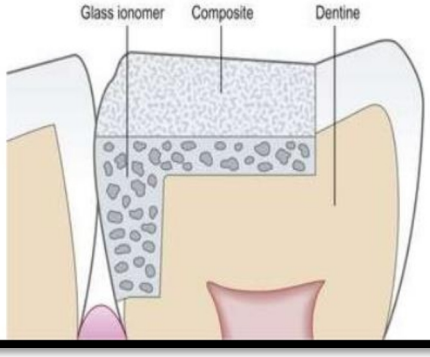


- The use of GIC as an intermediate layer between dentin and resin composite is often referred to as (sandwich technique). Sandwich technique is indicated in class V when any part of the gingival margin of class II preparation has been extended past the CEJ.

Closed sandwich technique: The underlying material does not come into contact with the oral cavity.



Open sandwich technique: Usually used for Class II restorations where the underlying material forms part of the axial wall and is exposed to the oral environment.



- GIC use most often in conjunction with class II resin composite restorations is sometimes called the bonded-base techniques.

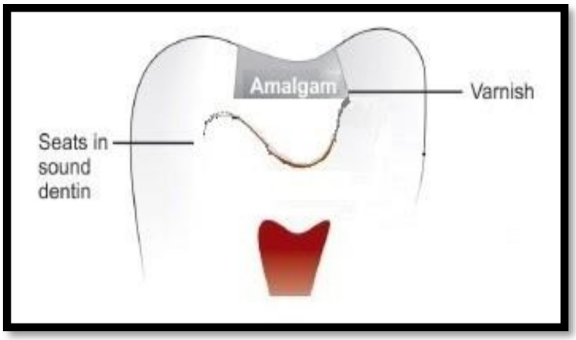
Mixing time: time needed for mixing the material.

Working time (Initial setting time): time which the material can't flow easily under pressure.

Setting time: time which material can't flow permanently.

Clinical considerations:

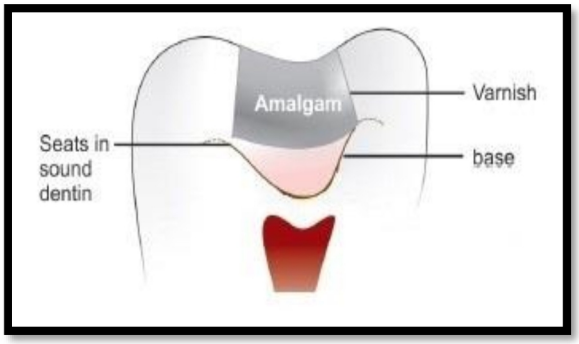
1. **In shallow cavity preparation (remaining dentin thickness >2mm):** there is no need for pulp protection because of the sufficient thick of remaining dentin for amalgam restoration. The cavity is coated with two thin coats of varnish to fill the gap in the amalgam-tooth interface until corrosion products form and fill the interface. For composite restoration, the cavity is etched and coated with a bonding agent (dentin-bonding system) that provides the suitable protection in a shallow cavity. **With composite varnish is not indicated??** Because it interferes with adhesion.



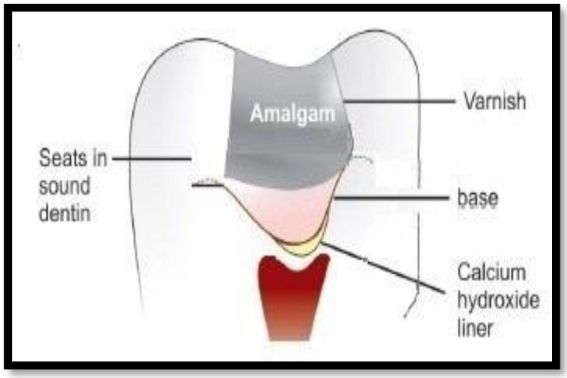
2. **In moderately deep cavity (remaining dentin about 0.5-2mm):** when the cavity preparation extends beyond the minimum depth. At first, cement base such as ZPC or modified ZOE cement may be contoured to replace the missing dentin, then varnish is used to coat the floors and walls, and then amalgam restoration. In composite, a thin liner of resin-modified glass ionomer or light-cured GI was used on the deeper dentin surfaces. Then, the acid etch and a bonding agent are applied.

   Notes:

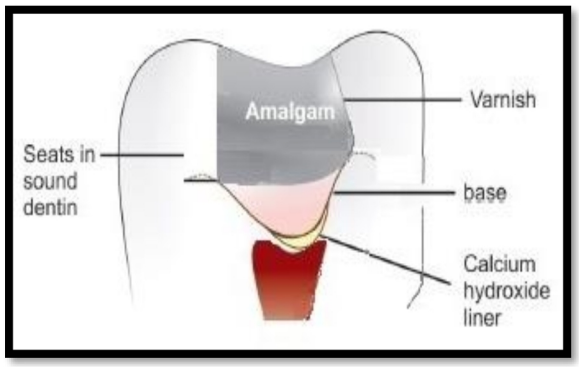
   - *If we want to use adhesive base cement (GIC, PCC), the varnish or bonding agent is not used at first, then base and restoration.*
   - *This is related to that the use of these materials (varnish or bonding agent) at first can eliminate the potential effect of adhesion of cement base to the tooth structure.*

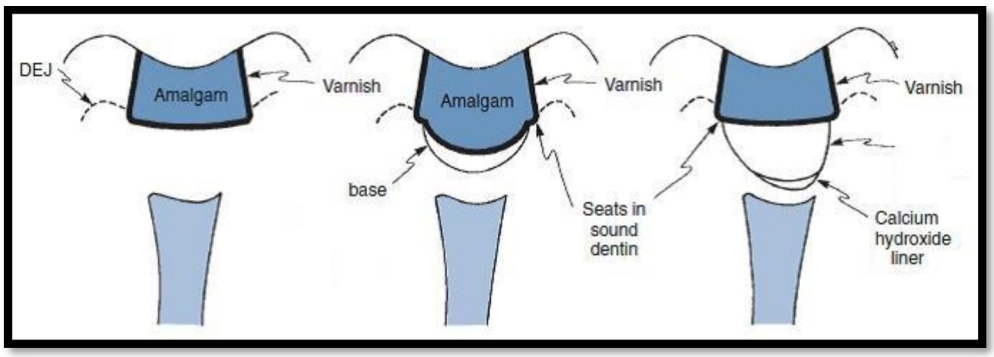


3. **In deep cavity (remaining dentin about <0.5mm):** when the cavity includes some extensions toward the pulp we need a liner such as $Ca(OH)_2$ on the pulp and axial walls, followed the cement base is placed such as ZPC or reinforced ZOE or PCC then varnish is used to coat the walls after that restoration amalgam was filled. In composite, dycal was applied first, followed GIC as a base which was enough to protect the pulp, then the acid etch and bonding system.



4. **In a deep cavity with pulp exposure:** when there is **exposure in a small area of the pulp (about 0.5mm)** with **no sign and symptoms** of degenerating pulp, the choice of **conservative pulp capping is recommended** in an isolated clean field, $Ca(OH)_2$ is carefully placed over the pulp and the border of dentin that surrounded the exposure. The base material is placed on the top, then the cavity wall is varnished for amalgam, or acid etch and bonding agent for composite. Then, restoration of the tooth is complete as soon as possible (secondary dentin bridge is likely to form within a few months). But, ***if the exposure size was large**, or ***if it has been contaminated with saliva plaque or carious dentin** at the time of injury and ***if there is a history of pain** in these cases **endodontic treatment is indicated**.





- The best possible base for any restoration is a sound tooth structure. So, you must remember that:
- Don't remove the sound tooth structure to provide space for a base. Maintaining sound dentin will enhance restoration support and provide maximum dentin thickness for pulpal protection.

Operative Dentistry

Lecture: 12	3rd Stage 2020-2021	د. أحمد ساطع رأفت / د. هاشم مُعين حسين

Amalgam, Matrix band and Wedge (Part 2)

Condensation of dental amalgam:

Means placement of dental amalgam into the prepared cavity. The **objectives of the condensation of amalgam are:**

1) Proper condensation of amalgam promotes the adaptation of amalgam to the cavity walls and matrix band.
2) Eliminating voids and reducing the amount of residual mercury in the restoration to increase the strength and serviceability of the restoration.
3) Pack alloy particles as closely together as possible.

Proper condensation is depending on:

1) **Plasticity of the mass** (good mixing, accurate M: A ratio).
2) **Size of condenser:** with irregularly shaped alloy, the small tip condenser should be used (1-2mm) with high condensation force in the vertical direction. With spherical alloys, larger condenser tips should be used.
3) **Direction and amount of the applied force** (3 Mpa).
4) **Size of amalgam increment:** small increment of amalgam must be used for better adaptation in the prepared cavity, because if a large amount is placed into the cavity (all amalgam mass is placed at one time) improper condensation at a lower level of the mass resulting incomplete adaptation and layering of the increment.
5) **Condensation should be completed within the working time:** when inserting amalgam into large cavity preparation and we passed the working time a new mix should be made (Why?) Because the crystallization of the unused portion of the amalgam will be too advanced permit proper adaptation with minimal voids in the restoration.

- ✓ The *amalgam mixture should not be touched with the hands*; it should be carried to the cavity with amalgam carrier.
- ✓ *Immediate condensation with sufficient pressure* should be used; the applied force to the hand condenser should be as great as possible under the existing clinical condition and should apply to the center of the cavity and then stepping the condenser towards the walls of the cavity and the ends of the fissure. Pressure should be firm, uniform too small increments of amalgam.
- ✓ When the *first increment has been condensed adequately*, the next increment be should add. It is wrong to suppose that the earlier layers inserted can later be condensed by heavy pressure in the later stages of packing only porosity closer to the surface would be eliminated, and voids would remain in the deepest part.

- ✓ After condensation of each increment, the *surface should be shiny (in appearance)*? This indicates that there is sufficient mercury present at the surface, which is desirable to be removed. The condensation started at the box until we fill the cavity.
- ✓ ***Hand condensing:*** the condensing instrument of choice is a double-ended plastic instrument with a flat condensing surface. Instruments available in different shapes and sizes. The diameter of the tip must be such that it can be accommodated on the floor of the cavity at its narrowest point otherwise, condensation of the deepest layers is impossible.

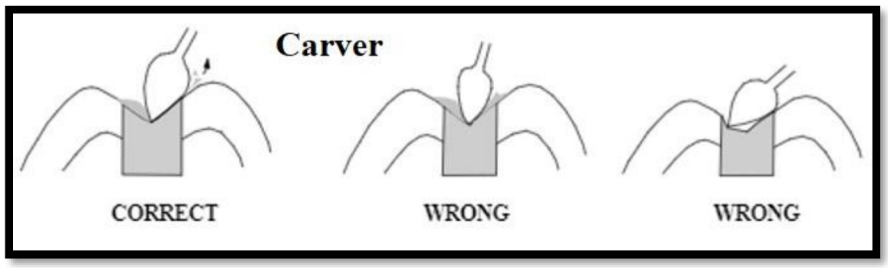
- ✓ ***Mechanical condensers:*** Many mechanical devices are available for condensation; they are more popular and *more useful for condensing irregular shape alloy when high concentration force is required,* but with the development of spherical alloys, the need for mechanical condensers was eliminated.

- ✓ ***Overfilling the cavity:*** as the amalgam level reaches the cavity margins, *packing continues* to allow excess to build up over the ultimate level of the finished restoration (Why?) To:
  - Cover the cavosurface margin completely to avoid exposure of the margins during carving.
  - To do a proper carving, and to remove mercury-rich amalgam.

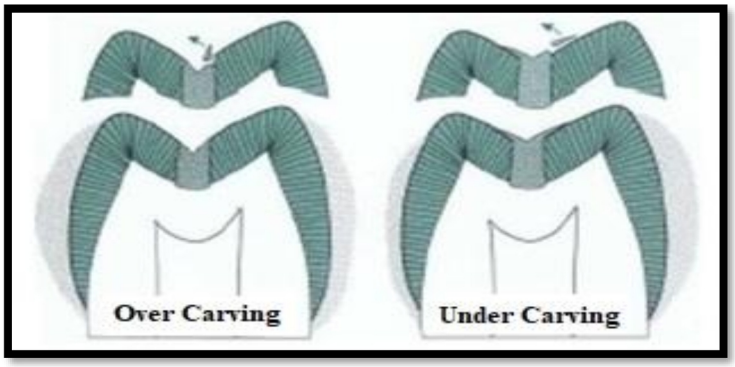
Carving:

Should be *begun immediately after condensation and before the setting of the amalgam*. As an amalgam sufficiently firm, the amalgam is carved with a sharp carving instrument. A scraping or ringing sound should be heard when amalgam is carved.

- ✓ **If carving is delayed too long:**
  - *The amalgam may be too hard to carve and,*
  - *There is a danger of chipping at the margin.*
- ✓ The carver is held so that its blade lies across the margin of the filling, half on tooth and half on amalgam, and moving parallel to the margins, so small increment of the amalgam is removed? Why? The placement of the blade of the carving instrument over the external tooth surface adjacent to the cavity margins is:
  - To prevent over carving the amalgam and,
  - To produce continuity of the surface contour across the margins.



- ✓ *Deep occlusal carving* (deep occlusal grooves) should not be carved into the restoration? Why? Since these weaken the restoration and cause chipping of the thinned amalgam at the occlusal margins.
- ✓ While *under occlusal carving* leaves thin portions of the amalgam on the external tooth surface that will break away, giving the appearance that the amalgam has grown out of the cavity.



- ✓ In large restorations, cuspal slopes should be carved and fissures may be delineated.

The smooth and uniform surface should be achieved, the occlusion should be checked by asking the patient to place the teeth lightly together, sometimes the restoration will fell high to the patient (high spotted) and then *brightly mark* will be seen on the amalgam surface *(high spot should be removed)*? Why? Because:

- It will cause pulp hyperemia and post-operative pain.
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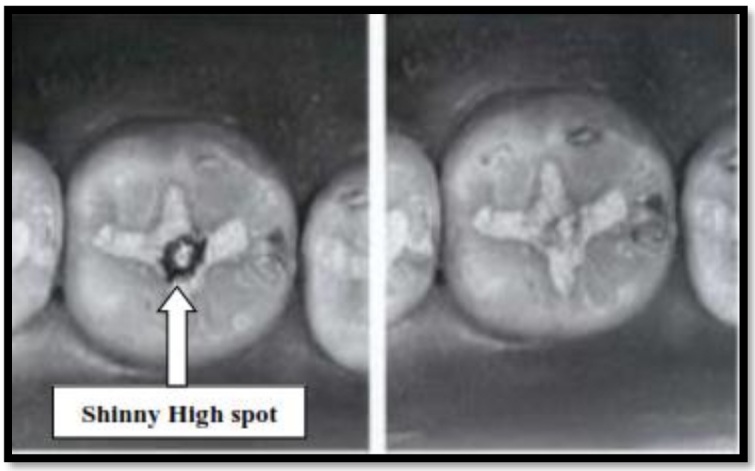


Burnishing:

It is defined as the process of rubbing the surface of fresh amalgam restoration to *obtain better adaptation of the restoration to the cavosurface margin* and to *improve smoothness and produce a satiny ‘‘not shiny’’ appearance*.

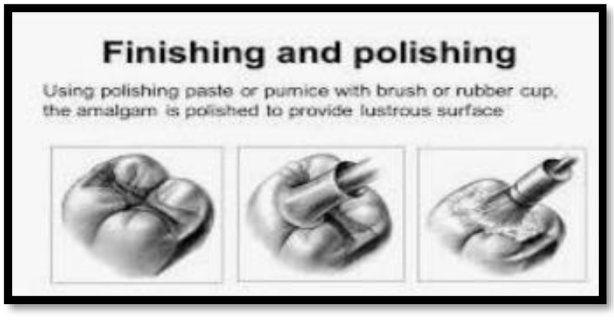
Sometimes pre-carved burnishing is made with a large burnisher by using light force and move from the center of the restoration outwards to the margins? This will bring further mercury to the surface (which must remove).

Polishing:

The goal of polishing is:

- To produce a smooth and lustrous surface.
- Reduced the likelihood of corrosion.
- Reduce the ability of plaque to adhere to the surface.

Polishing should be done *at least 24 hours* after amalgam placement. It is done with finishing burs, disks, and cups of suitable size. Success depends upon the use of light uniform touch and constant movement of the instrument and care should be taken to retain the carving and avoid overheating.



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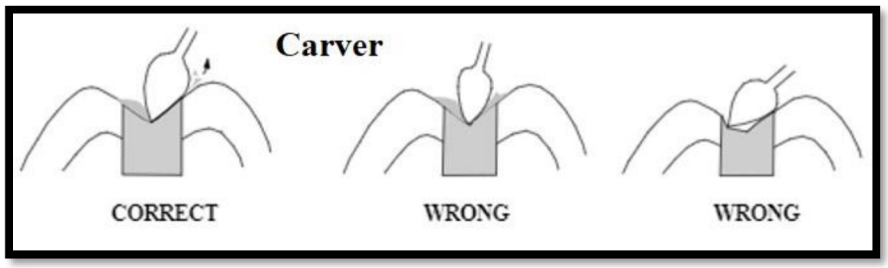

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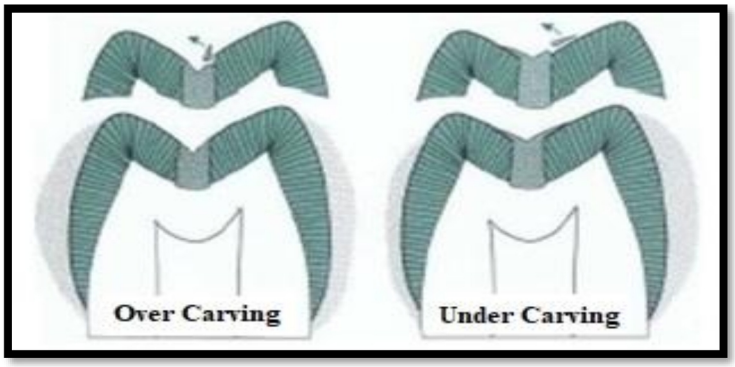

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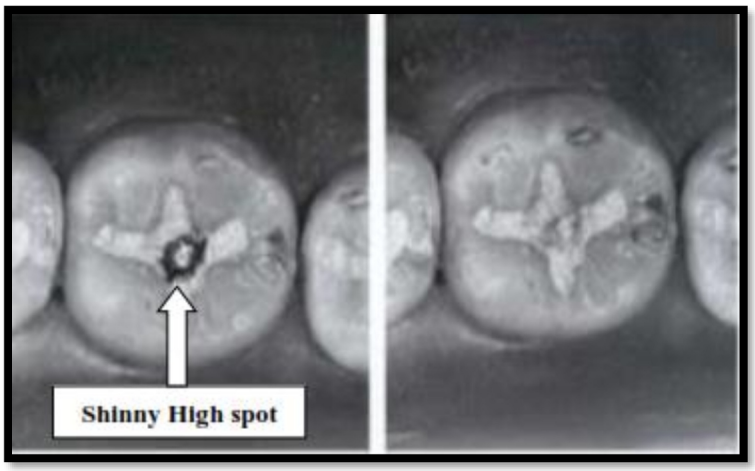

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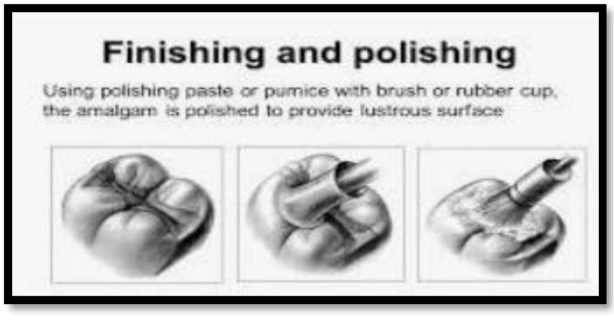


An Introduction to Fixed Prosthodontics

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.

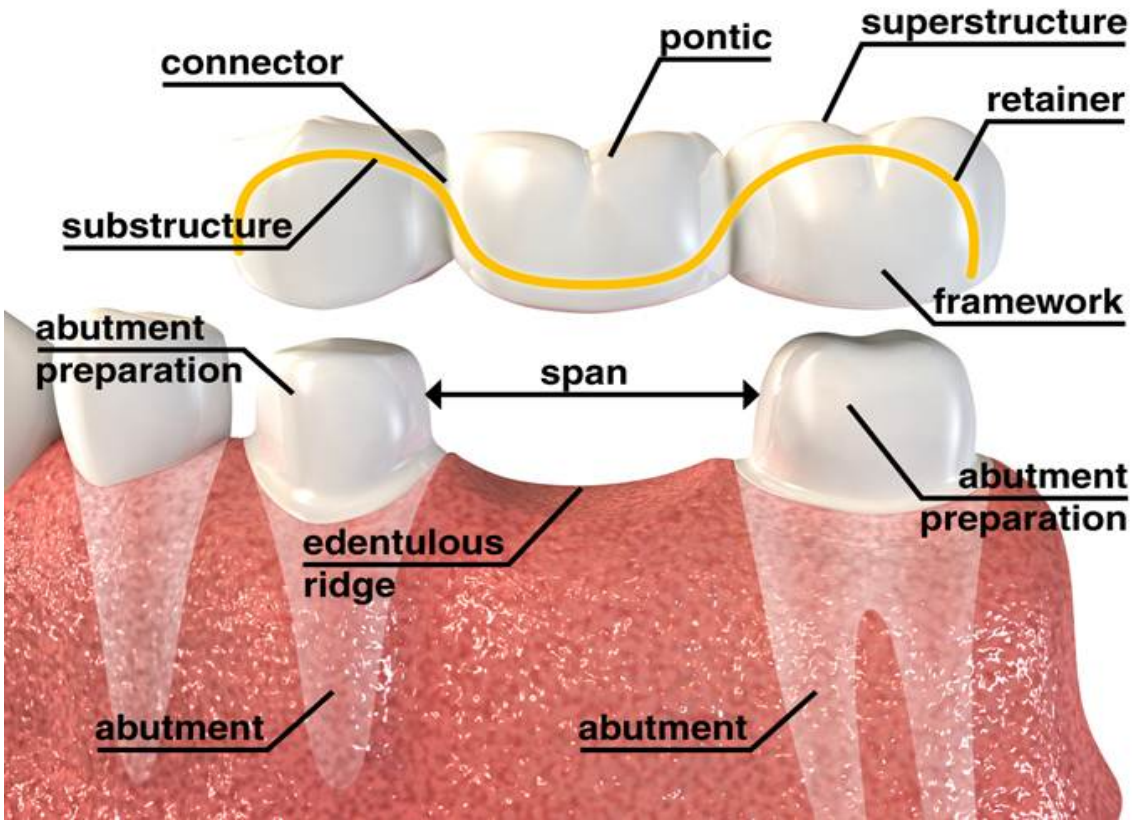
Bridge: It is a fixed dental prosthesis which replaces and restores the function and esthetic of one or more missing natural teeth and can't be removed from the mouth by the patient. It is primarily supported by natural teeth or root. The tooth that gives support to the bridge is called "abutment tooth".

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:

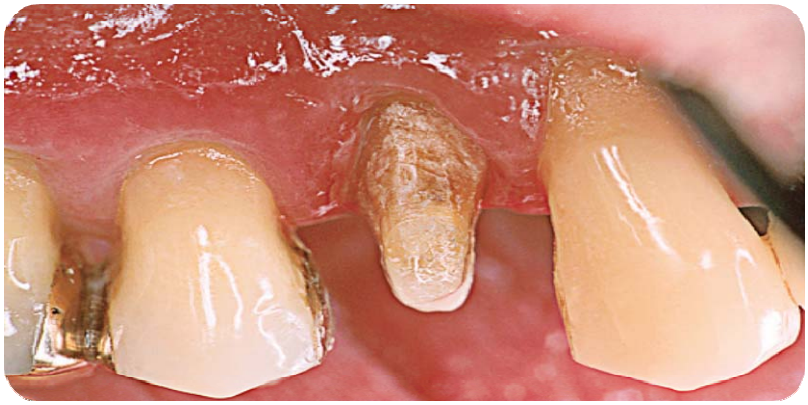
1- Preservation of tooth structure.
2- Retention and resistance from.
3- Structural durability of the restoration.
4- Preservation of periodontium.
5- Marginal integrity.

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.

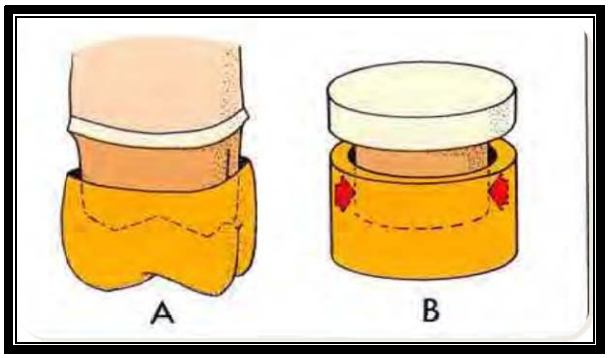


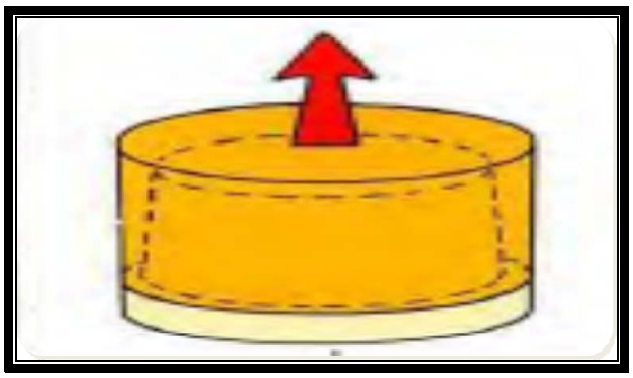
Excessive tooth reduction: The tooth is over tapered and shortened and this will affect the retention and resistance of the prepared tooth.

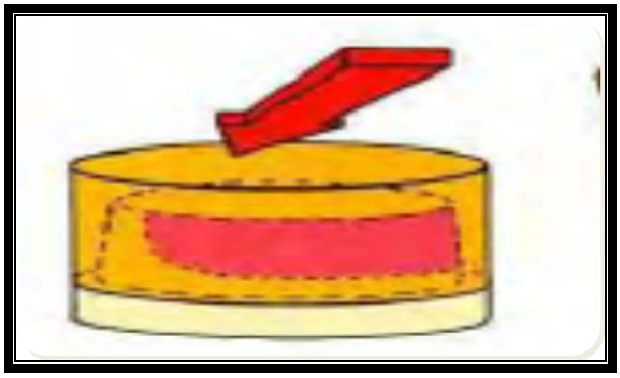
2. Retention and resistance form

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

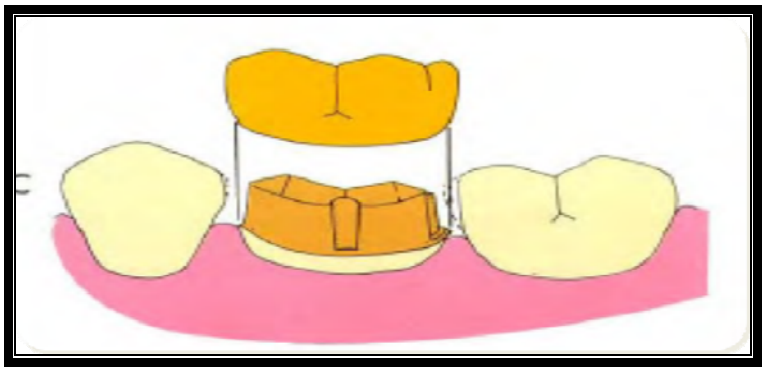
Resistance is the ability of the preparation to resist the dislodgment of the restoration by forces directed obliquely or horizontally to the restoration.







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.



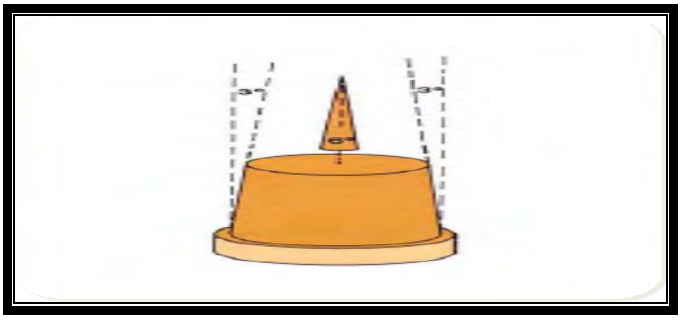
By limiting the path of withdrawal of the restoration, the retention is improved. A preparation with unlimited freedom of displacement is much less retentive.

Factors affecting retention and resistance

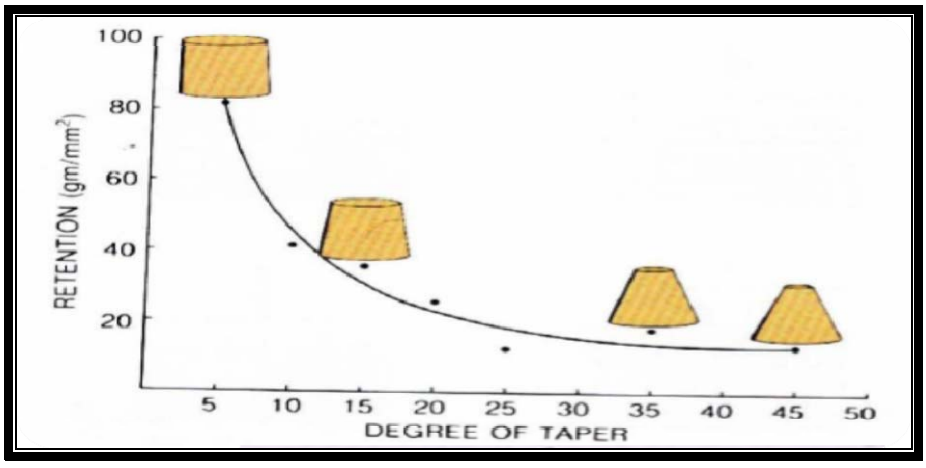
1. Taper of the preparation.
2. Surface area of the preparation.
3. Length and height of the preparation.
4. Diameter of the tooth (tooth width).
5. Texture of the preparation.
6. Accessory means.

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.

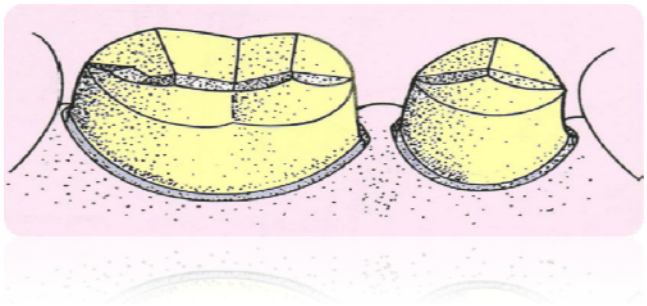


Taper and Resistance: The more parallel the axial walls of the preparation, the more will be the resistance of crown restoration. The walls of a short wide preparation must be kept nearly parallel to achieve adequate resistance from.

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.

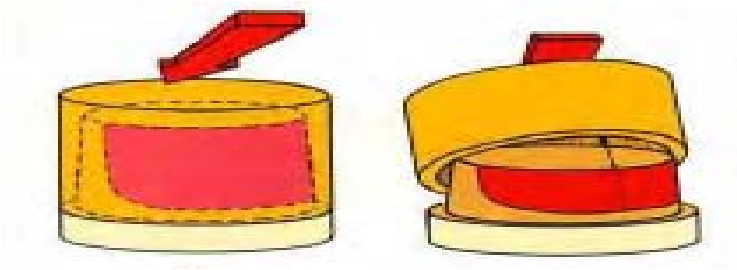


(b) Extent of tooth coverage by the restoration: The more the area that will be covered by the crown restoration, the more will be the retention. Thus full metal crown on a molar tooth is more retentive than a three-quarter crown on the same tooth.

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

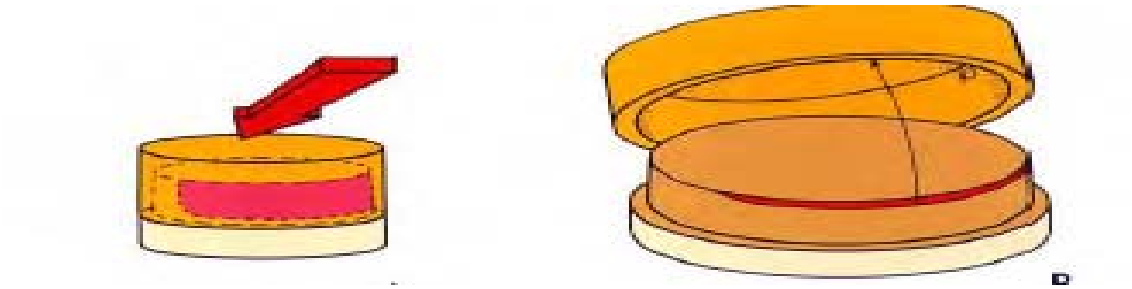
3. Length (height) of the preparation

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.

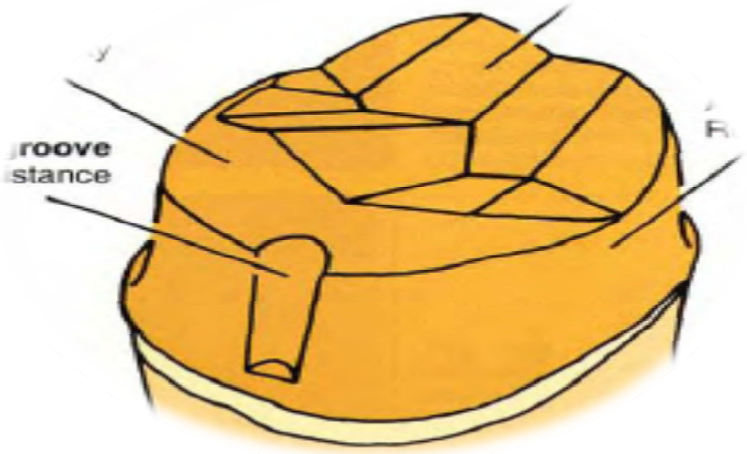


5.Texture of the preparation

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.

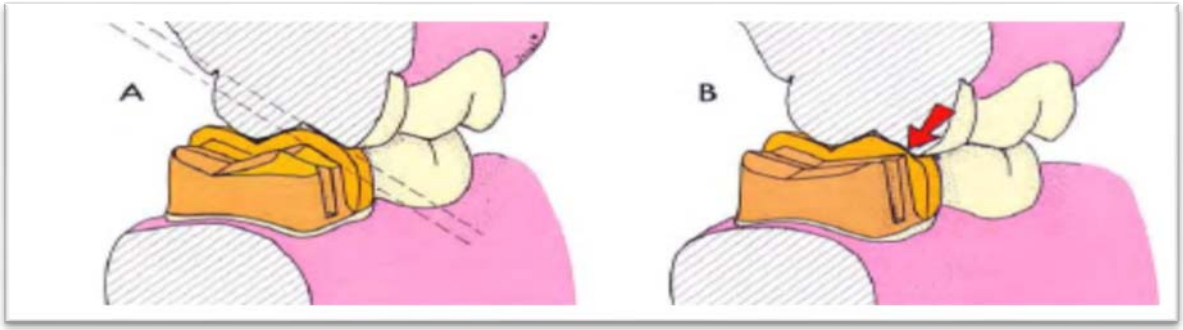


3. Structural Durability

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).

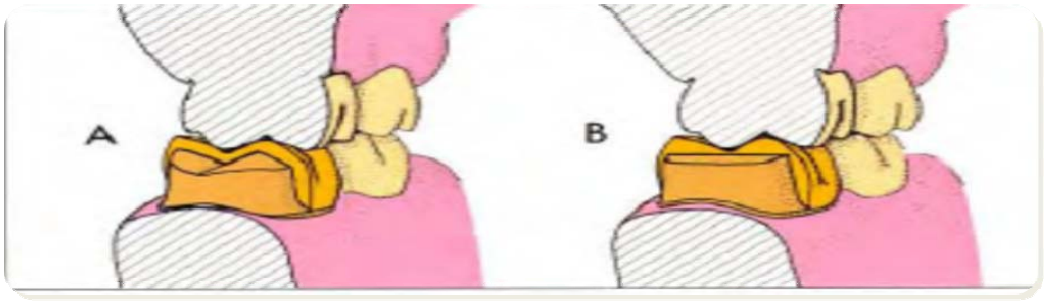


Occlusal clearance: is the space between the occlusal surface of the prepared tooth and that of opposing tooth. It should be evaluated in centric and eccentric relation. Enough tooth structure must be removed occlusally so that when the restoration is built back to ideal occlusion it will be thick enough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

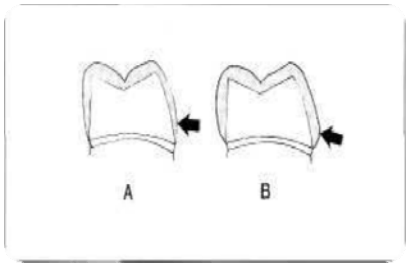
Occlusal reduction must reflect the geometric inclined planes of the occlusal surface (the so called "planar occlusal reduction" or "anatomical occlusal reduction").

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.

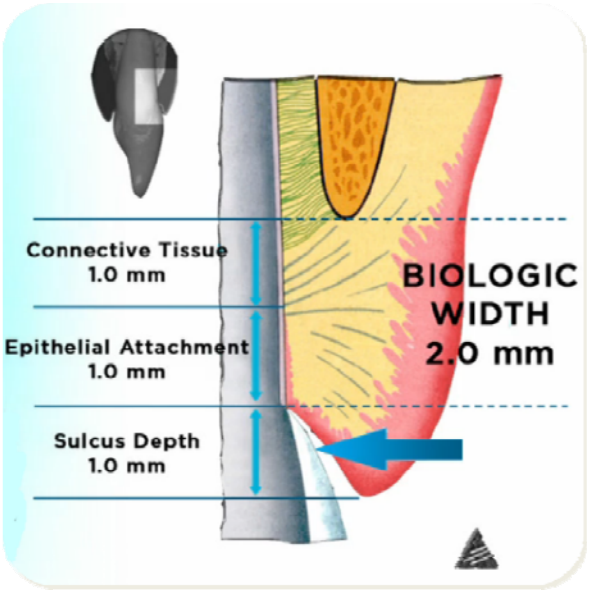


4. Preservation of the periodontium

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.

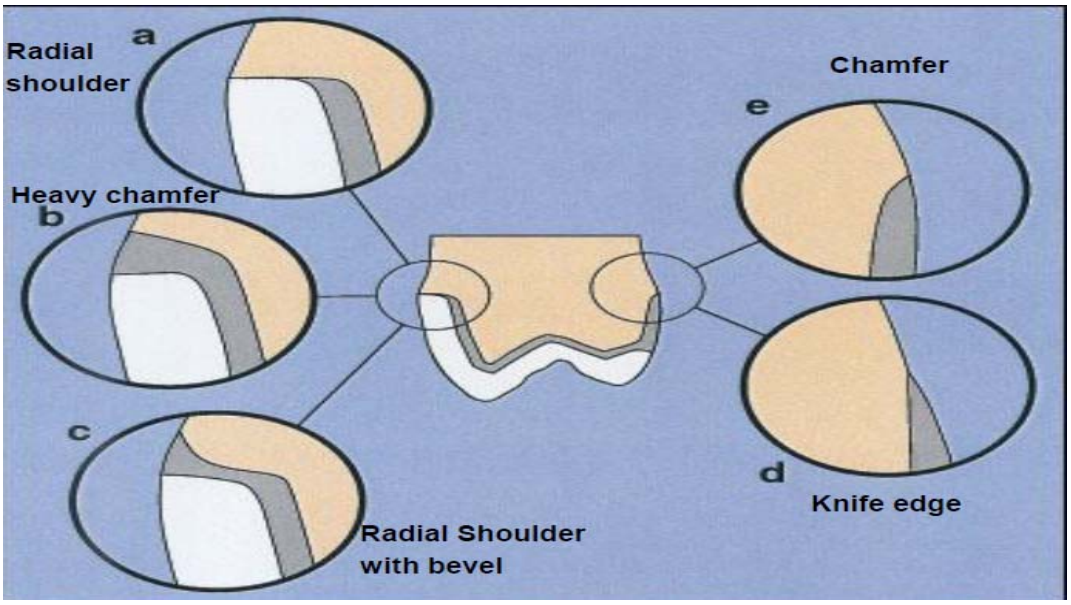
Finishing line of the preparation

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

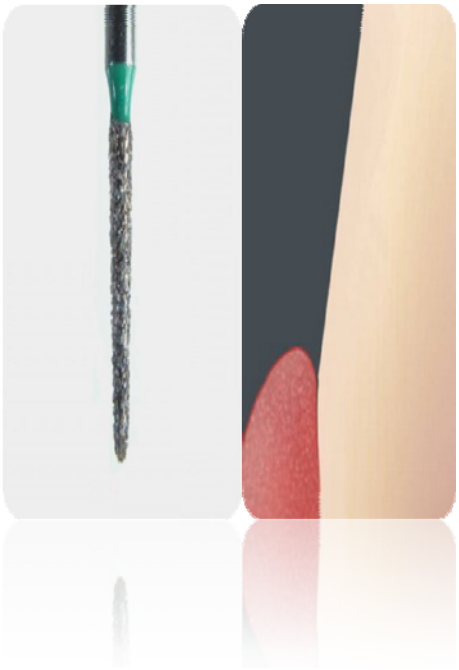
The following designs for finishing line could be used depending on the type of the crown restoration:

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.

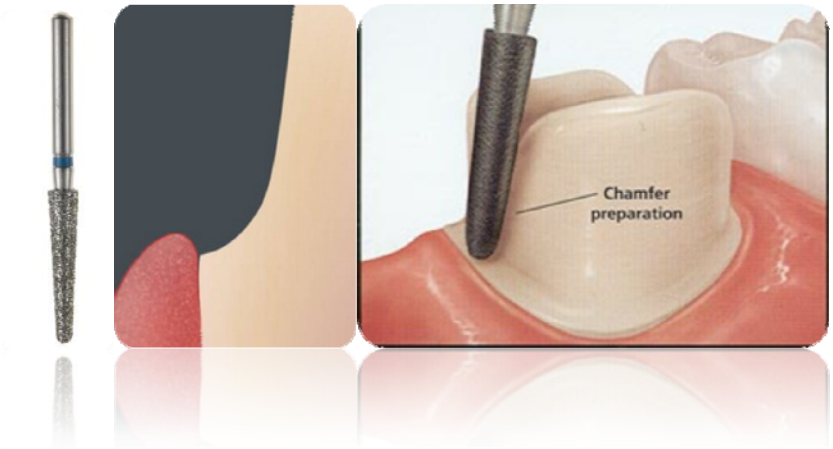
Indications of knife edge finishing line

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.

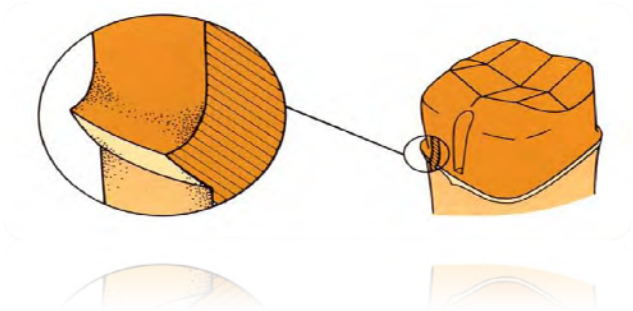
2. Chamfer finishing line

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.



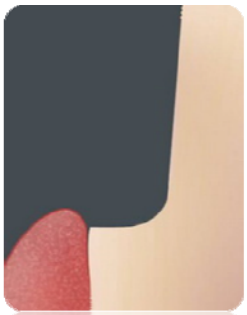
This type of finishing line is indicated for areas to be covered by metal only as the knife edge finishing line, so it is mainly used for:

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

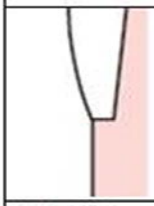
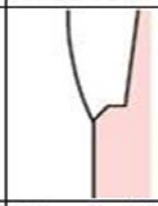
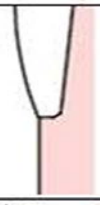
Shoulder with bevel is another modification of the shoulder finishing line by adding a bevel to the shoulder. The bevel is at 45° angle.

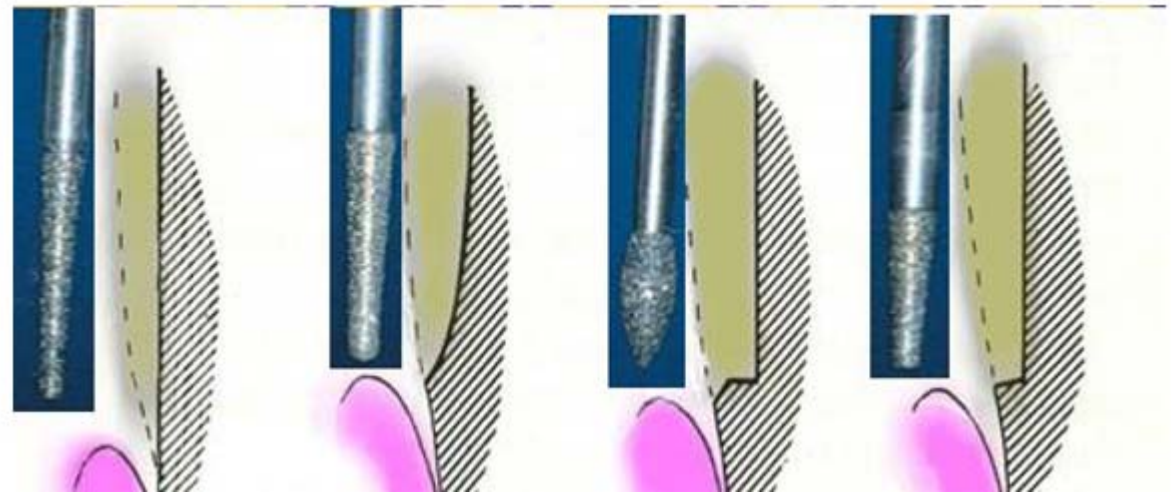
Objectives of adding a bevel to the shoulder finishing line

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.

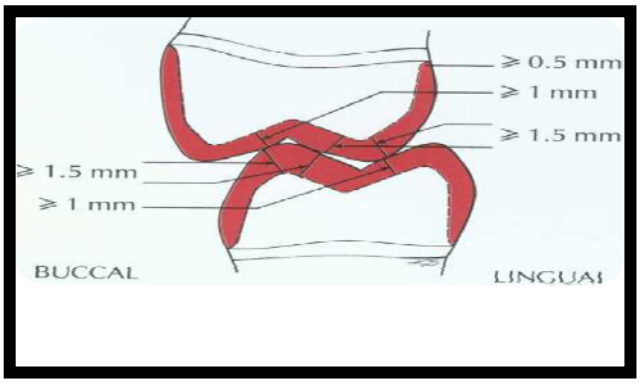
- Preparation steps:

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:

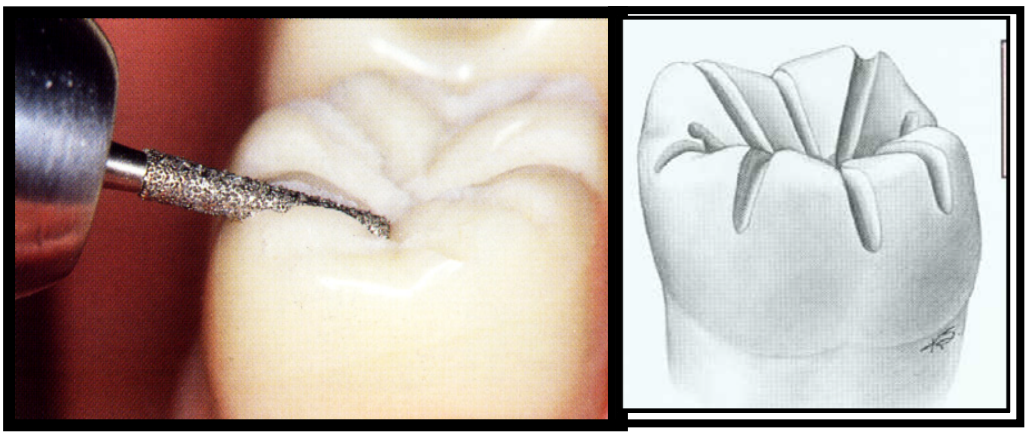
-To provide a restoration with uniform thickness.

-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:

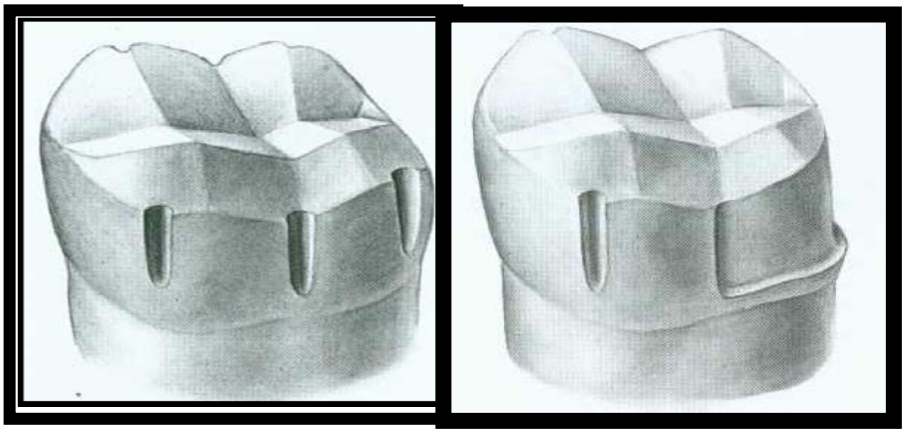
1. Depth orientation grooves (D.O.G) are prepared in the occlusal surface by a fissure bur to follow the inclines of the cusps. A D.O.G is prepared in each cusp extending from the cusp tip to the central groove, which represents the deepest part of the occlusal surface. The depth of each groove corresponds 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

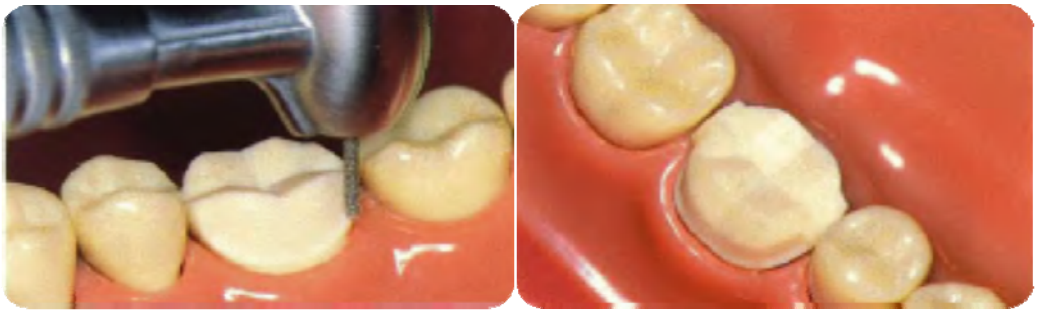
1. Three D.O.G with 1 mm depth are prepared in the buccal surface of the tooth, one placed in the center of the wall and one in each medial and distal transitional line angles. These grooves are prepared parallel to the long axis of the tooth or to the proposed path of insertion of the restoration.

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

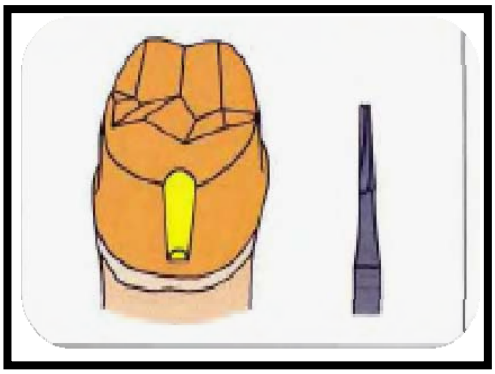
The preparation of the lingual surface is the same as that of the buccal surface.

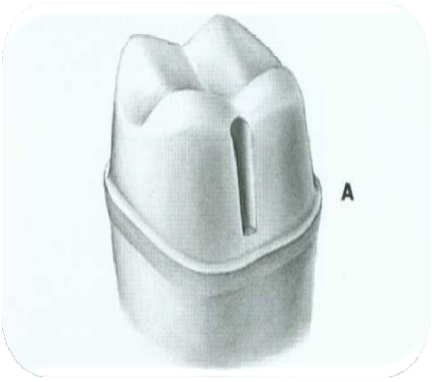


Proximal surfaces preparation

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.



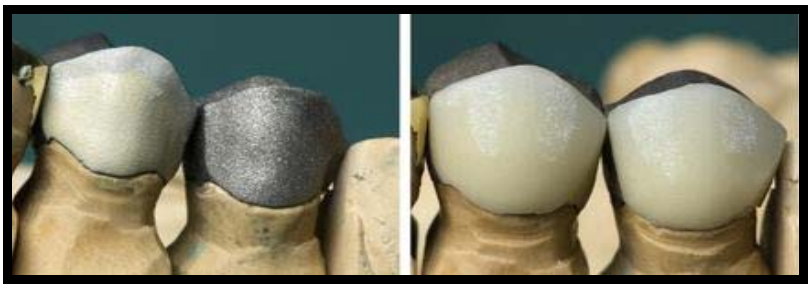


A seating groove is finally placed in the buccal surface of the lower molar and the palatal surface of the upper molar. The advantages of placing a seating groove are:

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.

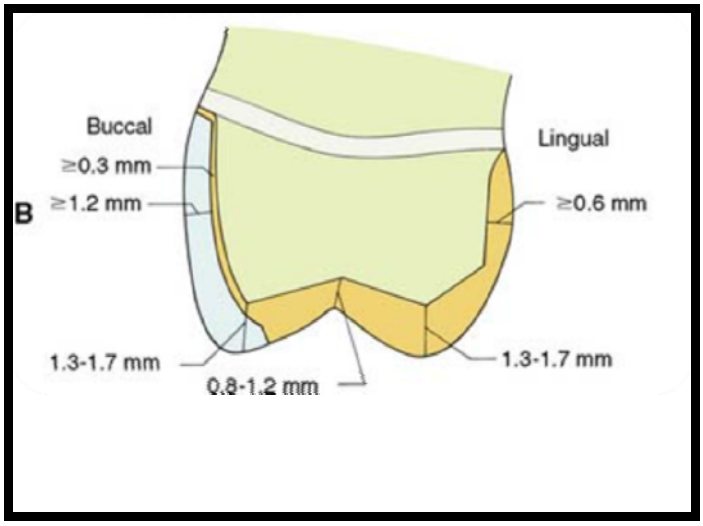
3. Teeth with short crowns.

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)

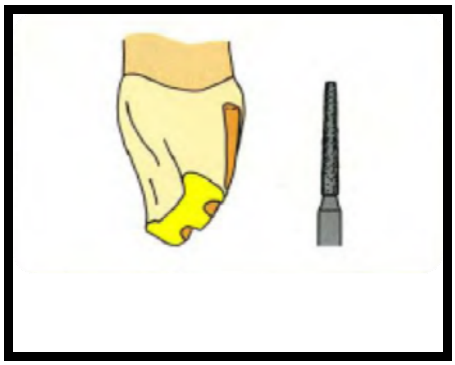
Fabrication of silicone index

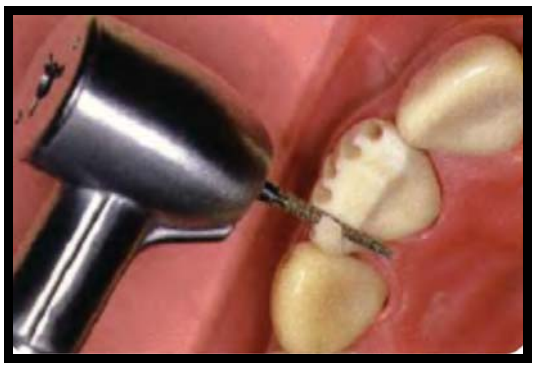
The silicone index acts as a guide to check the amount of tooth structure removal.

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).





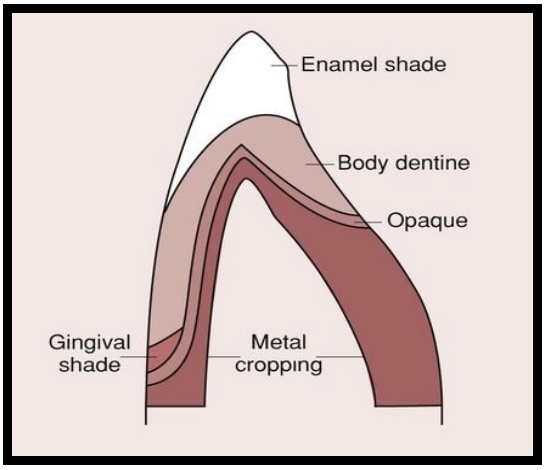
Labial reduction

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.

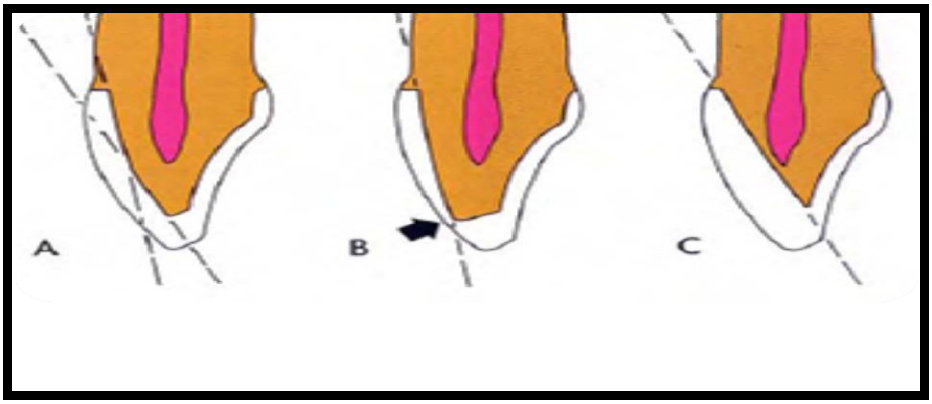
- 0.5 mm for the metal coping.
- 1 mm for porcelain (0.2 mm opaque layer, 0.5 mm body “dentin” layer, and 0.3 mm incisal “enamel” layer).



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.



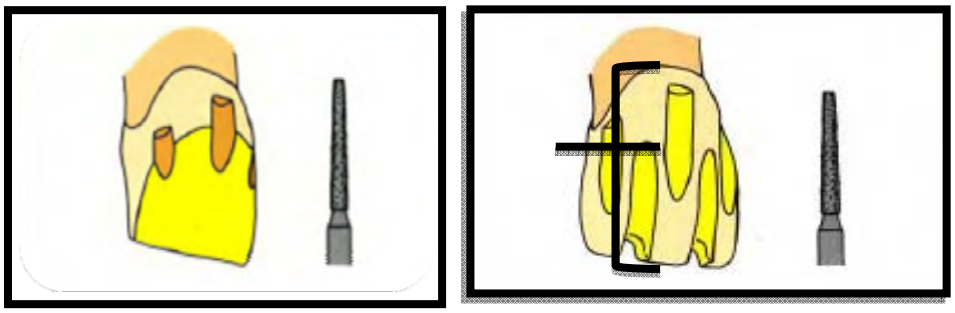
a.Gingival plane

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.



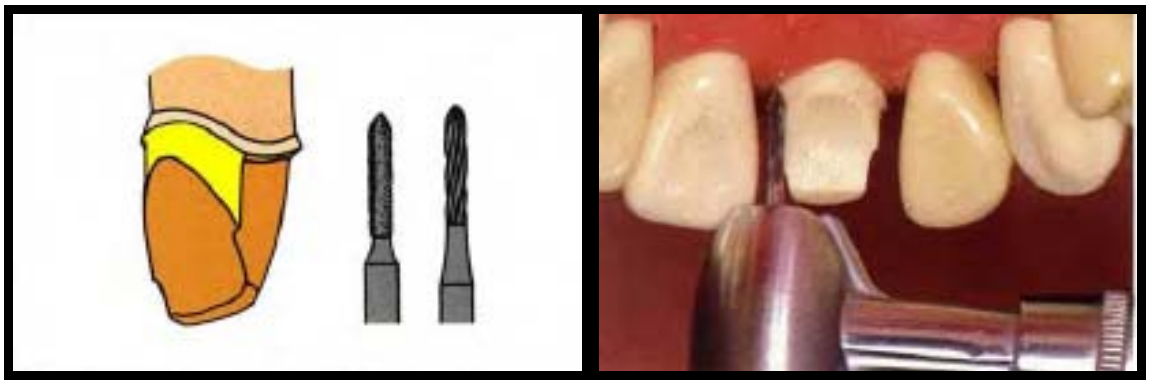
Palatal (lingual) reduction

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.

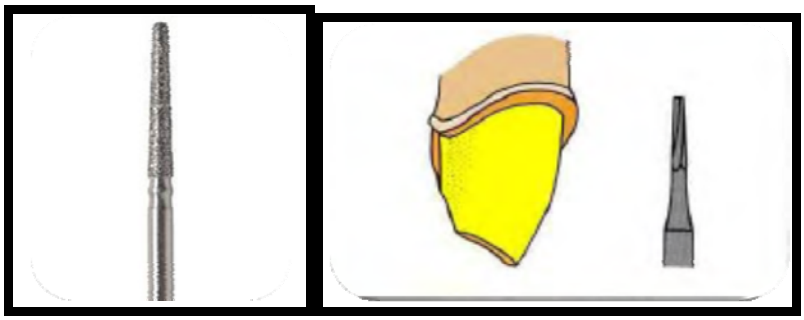
b. Lingual axial reduction

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.

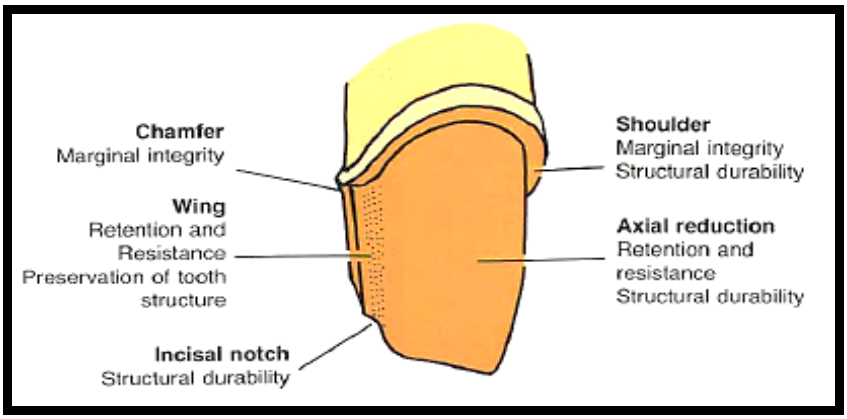


Proximal reduction

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".



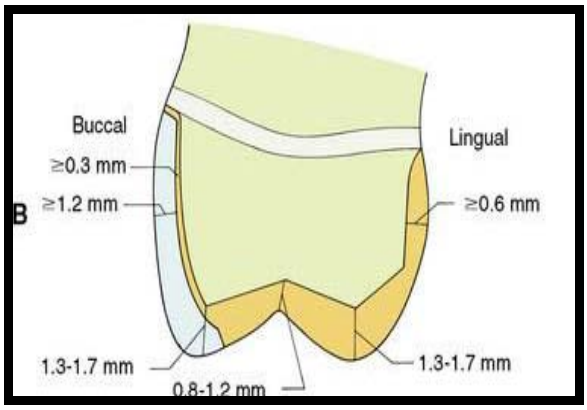
Checking of the amount of tooth reduction using the silicone index.



Tooth preparation of PFM crown for posterior teeth

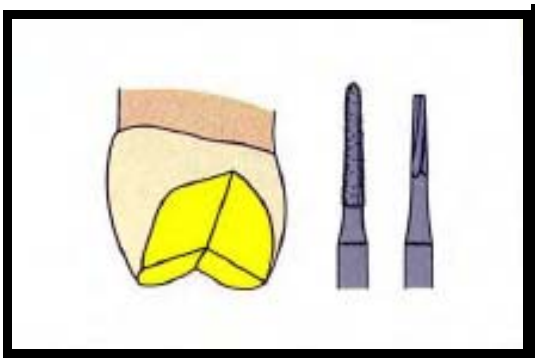
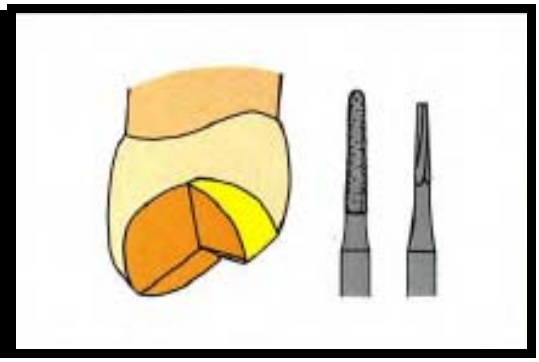
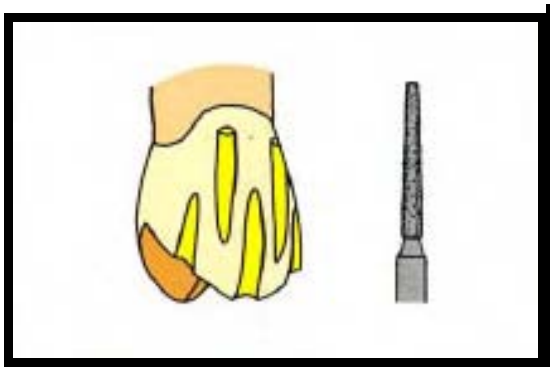
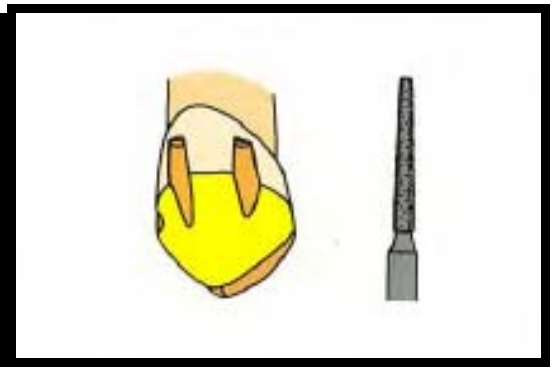
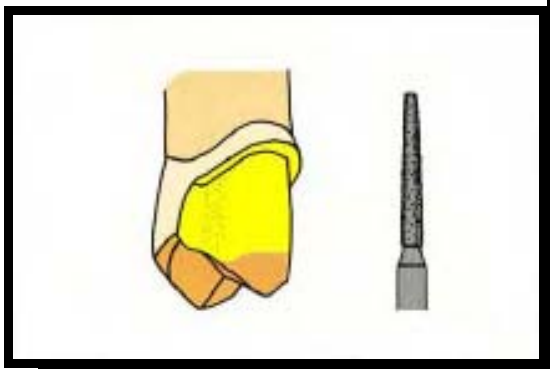
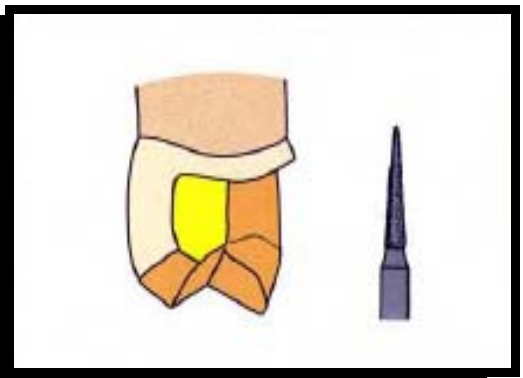
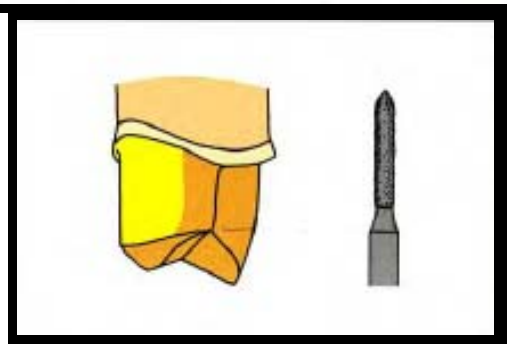
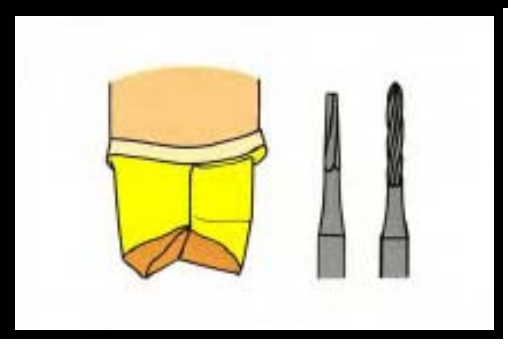
The same principles of full metal crown preparation are used with exception of providing a deep reduction in the area that is to be covered with both metal and porcelain.

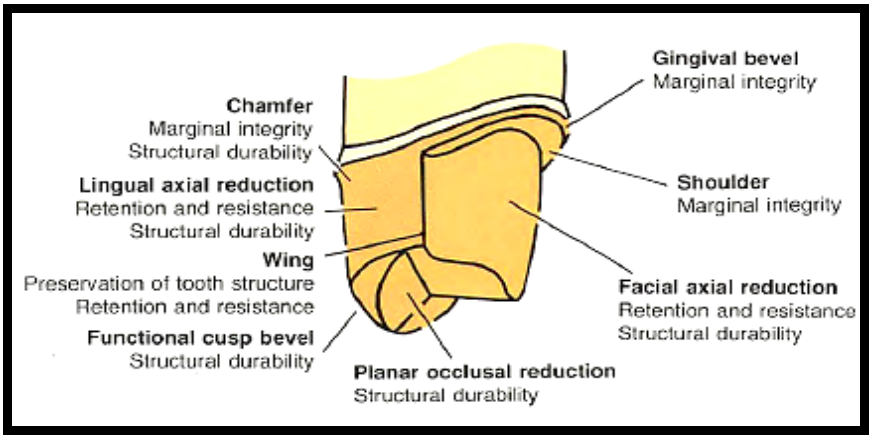
- 1.5 mm for the non-functional cusps.
- 2 mm for the functional cusps.
- 1.5-2 mm for the facial reduction.



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;

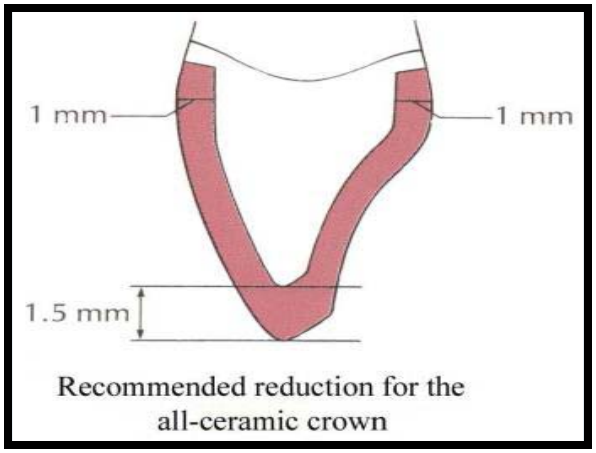
1. High esthetic requirements.
2. Considerable proximal caries.
3. Endodontically treated teeth with post & cor.
4. Incisal edge reasonably intact.
5. Favorable distribution of occlusal load

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.).

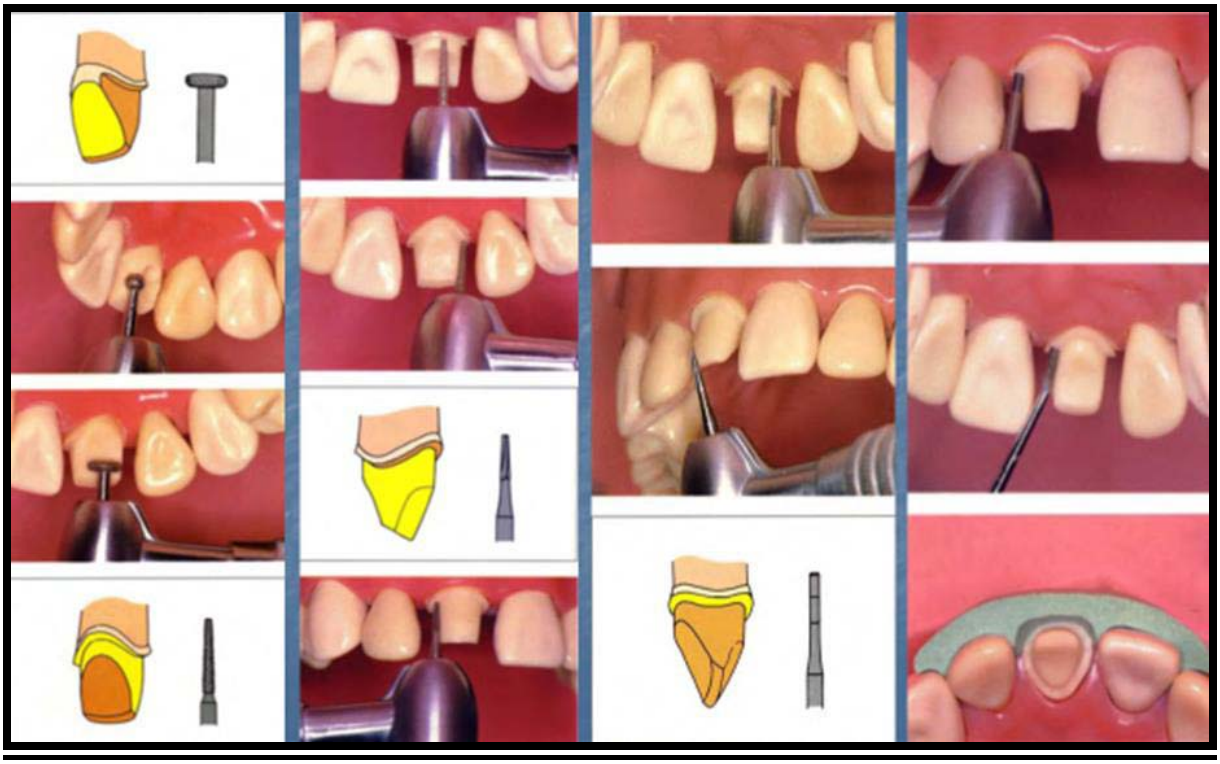
4. Proximal reduction.

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).

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.

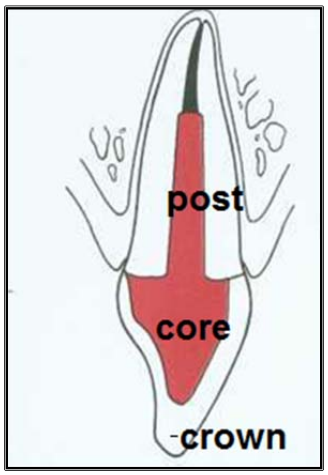
Contraindications(Custom Cast Dowel Core)

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.

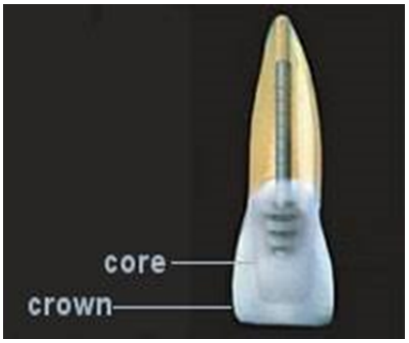
c) Post (dowel):

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

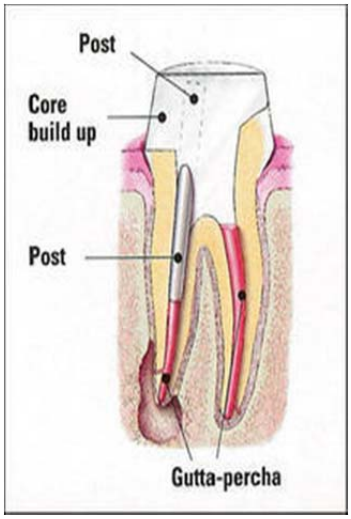
1)Preparation of the coronal portion:

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:

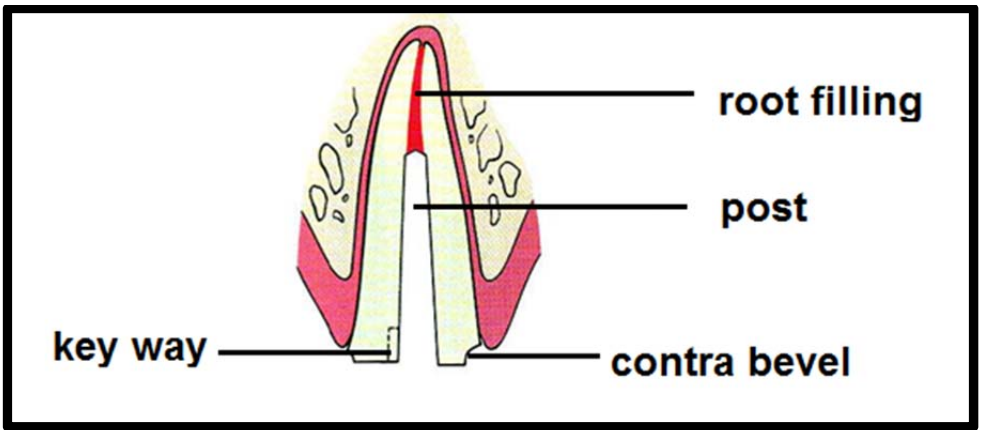
1. It acts as a guide during placement of the dowel post restoration.
2. It acts as ant-rotational device by preventing the post from rotation.
3. Improve the retention.

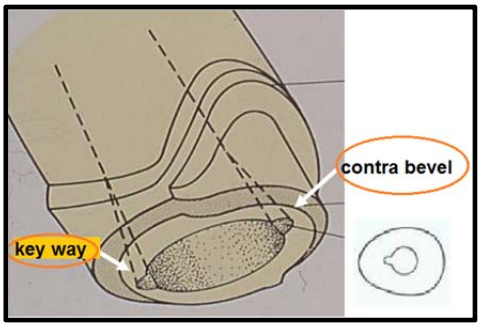
For multirooted teeth, the post dowel should place in the largest canal, usually it's the palatal canal for upper molar, distal canal for lower molar and the buccal canal for the maxillary premolar. The other canal used for the keyway.

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

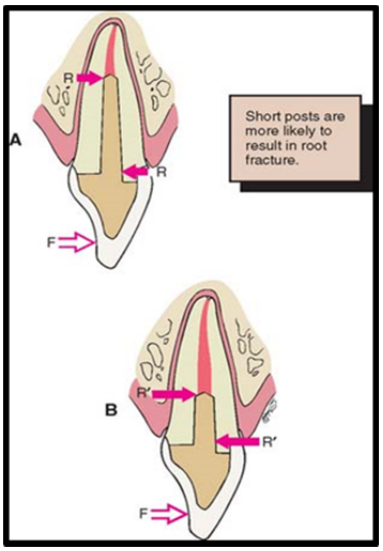
A. Keyway.
B. Triangular shape for the incisors and elliptical shape for upper canine.
C. Pins.





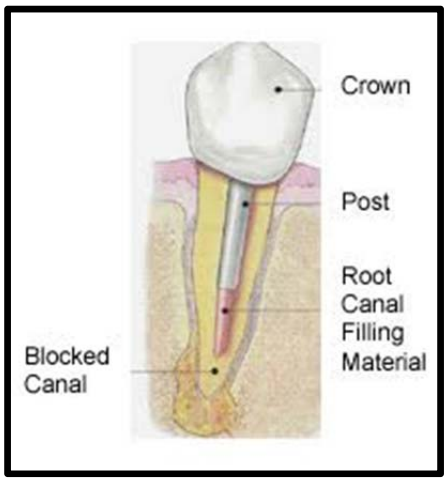
Factors affecting on retention of Post Crown;

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.



Crown and Bridge

Lecture: 7

Pontic

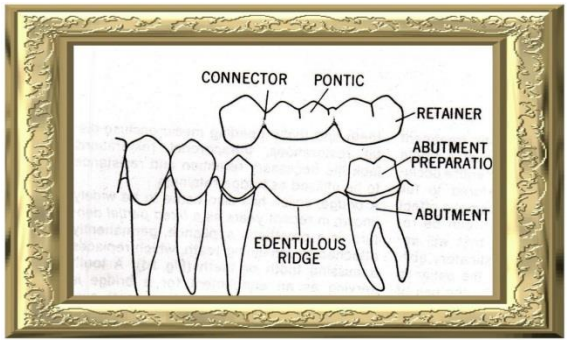
It is the suspended portion of the fixed partial denture (bridge) replacing the missing natural tooth or teeth and restoring its function.

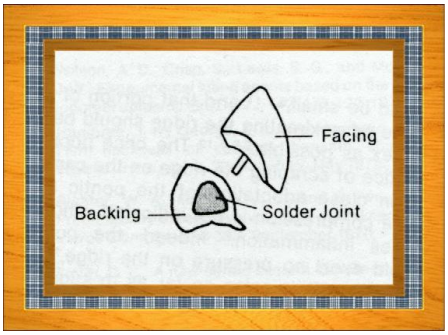
The abutment tooth is the tooth that supports the bridge by retainer which connects to the pontic by connector, the retainer is either:

1- Major retainer (fixed by solder joint).

2-Minor retainer when the connection is not rigid (flexible) ex. Stress breaker.

Each part of the bridge whether the retainer or pontic is called a **unit**, example: 2 retainers and 1 pontic are called 3-unit bridge.





Components of the pontic:

In longitudinal section the pontic is divided into:

1- Metal backing.

2- Solder joint.

3- Facing.

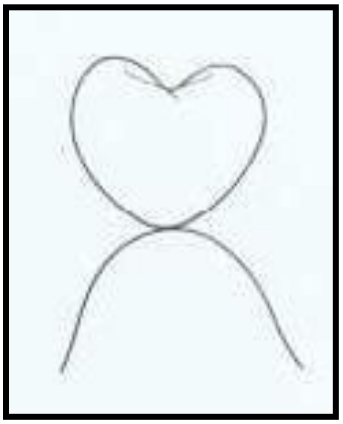
Materials used in pontic fabrication

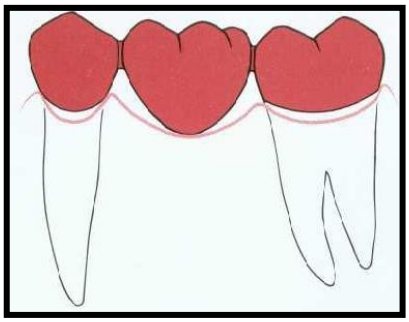
The pontic may be fabricated from casting metal or combination of metal and porcelain or acrylic facing. Usually full metal pontic is used for the posterior region while the combination of metal and facing (porcelain or acrylic) is used in anterior region for esthetic reason.

The glazed porcelain is more preferable than acrylic in pontic fabrication because acrylic is porous in nature and difficult in obtaining highly polished surface which leads to plaque accumulation and cause gingival inflammation.

Requirements of the pontic

1- The pontic must be hygienic so the patient can easily maintain good oral hygiene. The pontic must not cause any irritation to the underlying soft tissue by pressure or by food accumulation. Therefore, the contact of the pontic tissue surface with the underlying soft tissue should be **convex** to prevent entrapment of food under the pontic.





2- The contact area or solder joint should guard the interproximal area and the embrasure should be opened well to allow massage of the gingival tissue.

If the solder joint is too small there will be an increase interproximal space and possible food accumulation. The connector region would be weak and prone to fracture. If we have too wide contact area there will be impingement of the pontic on the interproximal gingival tissue.

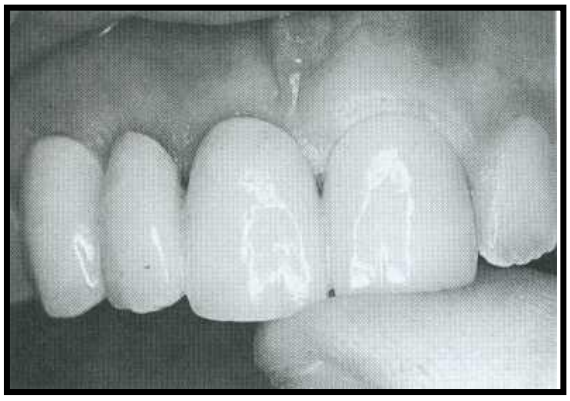
3- The contour of the labial and lingual surfaces of the pontic must be proper and lie with the same line of contour of the adjacent teeth so it will allow protection of the underlying tissue

4- The pontic must restore the masticatory function of the tooth it replaces efficiently.

It is advisable to narrow the occlusal surface of pontic to reduce the stress that is going to be transmitted to the abutment tooth by occlusal forces.

5- The pontic must be strong enough to withstand the force to which it is subjected so mostly we use full metal in posterior region to withstand the heavy occlusal stress.

6- Pontic must provide good esthetic to improve the appearance of the patient.

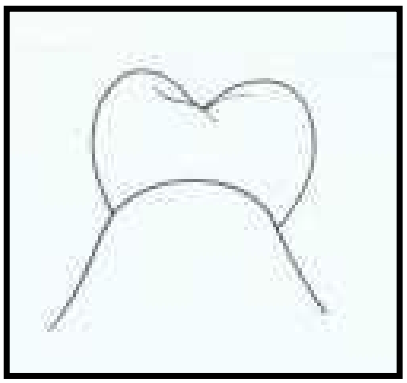


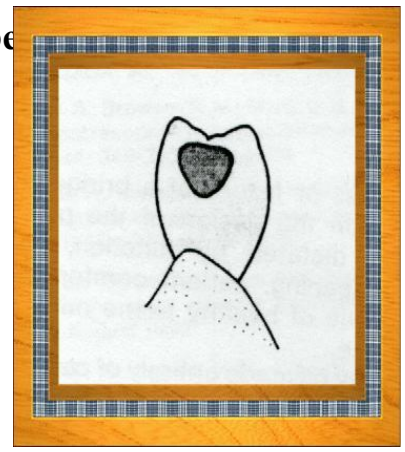
Pontic design

1) Saddle pontic:

The tissue surface of the pontic has the shape of the ridge. This design gives the illusion of a non-extracted tooth, which is accepted by the

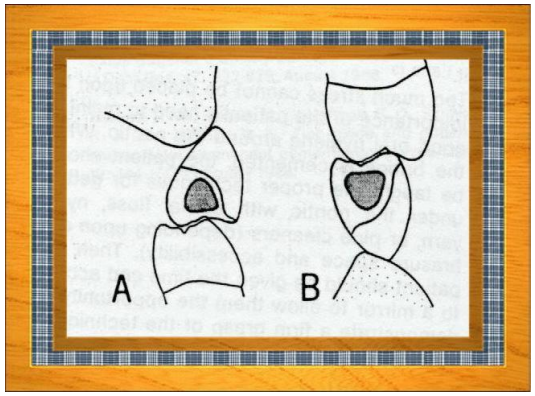
patient. This design is the most difficult to clean because there will be food accumulation between the tissue surface of the pontic and the alveolar ridge surface which will lead to tissue inflammation and failure of restoration. **This design shouldn't be**





2) Ridge lap pontic:

This design gives the illusion of a non-extracted tooth. The tissue surface of the pontic is convex so there will be slight contact with the underlying soft tissue. This is the best design for all upper and lower teeth (the deciding factor of appearance zone depends on smile line).

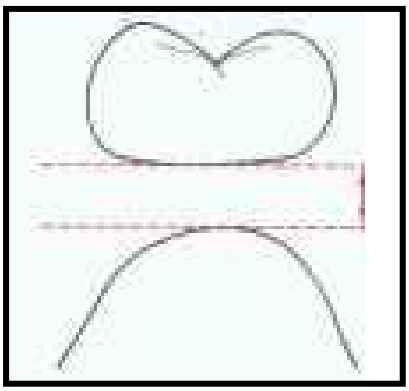


3) Hygienic pontic (sanitary pontic):

In this type there isn't any contact between the ridge and the pontic. This is used when the missing tooth is located in the non-appearance zone (mostly the posterior teeth)

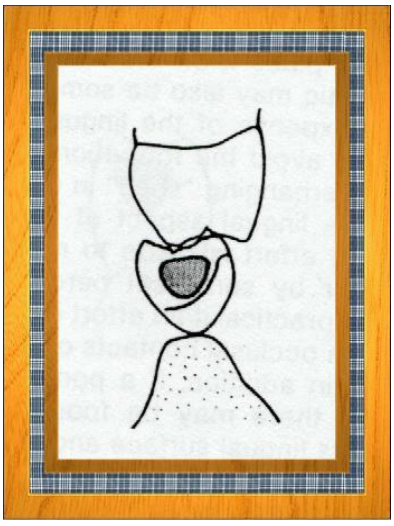
The pontic is completely made of metal and there is at least 3 mm space between the ridge and the pontic to facilitate proper cleaning of the region.

The pontic thickness should be at least 3mm to be strong enough to withstand the occlusal force.



4) Conical pontic: (spheroid or bullet)

It is used when the occlusal two thirds of the pontic lie in the appearance zone and this is mostly seen when we restore the lower incisors, premolars and sometimes molars because the gingival third is not seen (is not in the appearance zone) In this design there is no extension toward the labial surface.



Lecture 9	

Restoration of Endodontically Treated Teeth

Special techniques are needed to restore endodontically treated teeth. Usually a considerable amount of tooth structure has been lost because of caries, endodontic treatment, and the placement of previous restoration. The loss of tooth structure makes retention of subsequent restoration more problematic and increase likelihood of fracture during functional load.

Factors influence the choice of technique:-

1- The type of tooth (whether it is an incisor, canine, premolar or molar).

2- The amount of remaining coronal tooth structure. Which is the most important indicator when determine the prognosis.

Before restoration, existing endodontically treated teeth need to be assessed carefully for the following:-

- Good apical seal.
- No sensitivity to pressure.
- No exudates.
- No fistula.
- No active inflammation.

Indications:

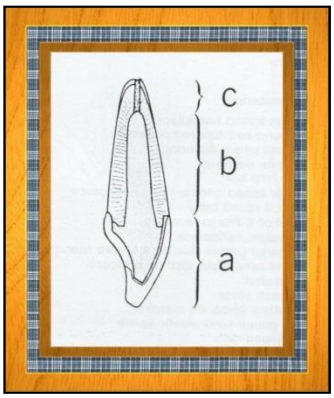
1. Restoration of endodontically treated teeth when excessive amount of the tooth structure is removed or lost by caries, trauma , filling, and making the retention of other types impossible.
2. Realignment of malposed teeth.
3. As bridge retainer (short span bridge).
4. Tooth with short clinical crown.

Factors to be considered in selection of a tooth for post crown

1. The root of the tooth should be sufficiently shaped, with adequate length and width.
2. The root should be without internal or external resorption.
3. Alignment of the root, any abnormality in the alignment of the root in relation to the adjacent teeth will affect the steps of post crown construction.
4. Quality of the root filling, in order to construct a post crown the tooth should be filled endodontically with gutta percha.

Parts of post crown:

1. **The post (dowel):** it is the part of the crown, which extended into the root canal; it should be 2/3 of the root length.
2. **The core:** it is the coronal part of the post crown.
3. **The crown:** the crown should be a full metal, full veneer or jacket crown (acrylic or porcelain).



There are two types of post- crowns

1. Two-unit post crown (post and core +crown).
2. One unit post crown (post + core + crown).

Advantages and indications of two unit system post-crown

1. Young patients under 18 years old, because the gingival-tooth relationship will change with time.

2. The two-unit system can be repaired if crown is damaged.

3. When the endodontically treated tooth is to be used as a bridge abutment, it is necessary to do a two unit system post crown.

POST-CROWN

Procedures:-

A three – stage operation:-

1- Removal of the root canal filling material to the appropriate depth.

2- Enlargement of the canal.

3- Preparation of the coronal tooth structure.

- A post cannot be placed if the canal is filled with a full – length silver point, so these must be removed and the tooth retreated with gutta-percha.

Before removing G.P. calculate the appropriate length of the post. It should be adequate for retention and resistance but not long enough to weaken the apical seal. As a guide, make the post length equal to:-

1- The height of the anatomic crown

2- Two – thirds the length of the root).

But leave 5mm of apical gutta -percha. On short teeth, it will not be possible to meet both these restrictions, and a compromise must be made. An absolute minimum of 3mm of apical fill is needed.

The operator should have acknowledged about the average values for crown and root length.

Methods for removing G.P.:-

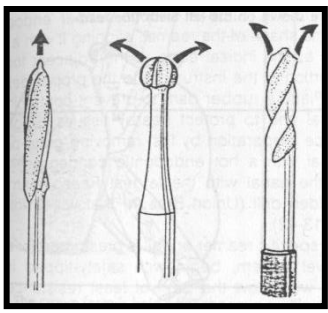
A – Using a warmed endodontic plugger.

- Select large enough plugger to hold heat well but not so large that is binds against the canal walls.

- Mark it at the appropriate length (normally endodontic working length minus 5mm) heats it, and places it in the canal to soften the G.P.

B- Using a rotary instrument.

These are special post preparation instruments, these considered (safe-tip) instruments because they are not end-cutting burs.



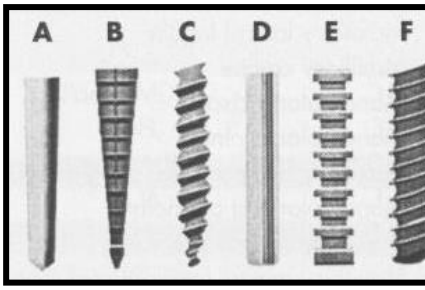
- The friction generated between the fill and the tip of these burs softens the G.P. Peeso-Reamers and Gates Glidden drills are often used for this purpose.
- End-cutting instruments should never be used to gain length because root perforation will result.
- The rotary instrument should be slightly narrower than the canal.
- Make sure the instrument follows the center of the G.P. and does not cut dentin.
- Knowledge of average root dimensions is important, because the post should be no more than one third the diameter of the root. With 1mm root wall thickness.

Post can be classified into two main types:-

1- Prefabricated post.

2- Custom-made post: casted in metal, indicated for teeth with root canals whose cross section is not circular or is extremely tapered.

Many classifications of prefabricated posts are available

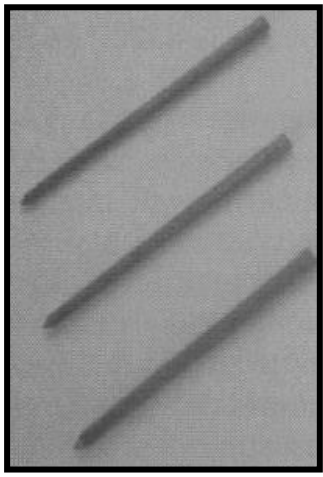


A-tapered, smooth-sided posts, **B**-tapered, serrated posts

C-tapered threaded posts, **D**-parallel, smooth-sided posts

E-parallel, serrated posts, **F**-parallel, threaded posts.

Prefabricated posts fabricated from different materials:-



- Posts made from precious, semiprecious, and non precious alloys.
- Carbon –fiber posts gave increased popularity in recent years consist of bundles of stretched, aligned carbon fibers embedded in an epoxy matrix; it is strong with lower stiffness.

One advantage of carbon fiber post is the ease of its removal for retreatment.

The chief disadvantage of a carbon fiber post is its black appearance, which presents an esthetic problem.

- High strength ceramic posts (Zirconium) have excellent esthetic properties.

In case of prefabricated post system is chosen

Technique simplicity is one advantage of using prefabricated posts.

Enlargement of the canal

1- Enlarge the canal one or two sizes with a drill, endodontic file or reamer that matches the configurations of the post

2- Use a prefabricated post that matches standard endodontic instrument**.**

- A tapered post will conform better to the canal than a parallel-sided post and require less removal of dentin to achieve an adequate fit. However, it will be slightly less retentive and will cause greater stress concentration.

Modified post are available with tapered ends, conform better to the shape of the canal, although they have slightly less retention than parallel-sided do. In the absence of a vertical stop on sound tooth structure, such posts can also create an undesirable wedging effect.

In case of custom made post system is chosen.

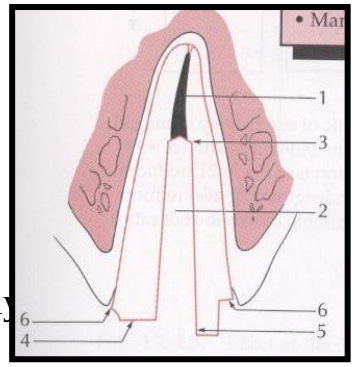
Enlargement of the canal:-

- Often very little preparation will be needed. However, undercuts within the canal must be removed, and some additional shaping usually is necessary.
- Be most careful on molars to avoid root perforation.

In mandible molars the distal wall of the mesial root is particularly susceptible. In maxillary molars the curvature of the mesiobuccal root makes mesial or distal perforation more likely.

PREPARATION OF THE CORONAL TOOTH STRUCTURE:-

After the post space has been prepared, the coronal tooth structure is reduced for the extra coronal restoration.



1- Ignore any missing tooth structure (from previous restorative procedures, caries, fracture, or endodontic access) and prepare the remaining tooth as though it were undamaged.

2- Be sure that the facial structure of the tooth is adequately good esthetics.

3- Remove all internal and external undercuts that will prevent withdrawal of the pattern.

4- Remove any unsupported tooth structure, but preserve as much of the crown as possible. Because tooth structure has been removed internally and externally. The remaining walls, ideally, should be at least 1mm wide.

5- Be sure that part of the remaining coronal tissue is prepared perpendicular to the post, because this will create a positive stop to prevent over seating and splitting of the tooth.

- Rotation of the post must be prevented by preparing a flat surface parallel to the post. If insufficient tooth structure for this feature remains, an antirotation groove should be place in the canal.
- If there is supragingival tooth structure, use a flame diamond to place a contrabevel around the external periphery of the preparation. This feature provides a metal collar around the occlusal circumference of the

preparation to aid in bracing the tooth against fracture of the remaining tooth structure (ferrule effect).

6- Complete the preparation by eliminating sharp angles and establishing smooth finish line.

Crown & bridge

Lecture: 10

Effects of tooth loss:

If any tooth is lost, future problem will arise in the neighboring teeth, and skeletal and muscular components of the face.

1. **Drift of the neighboring teeth:**

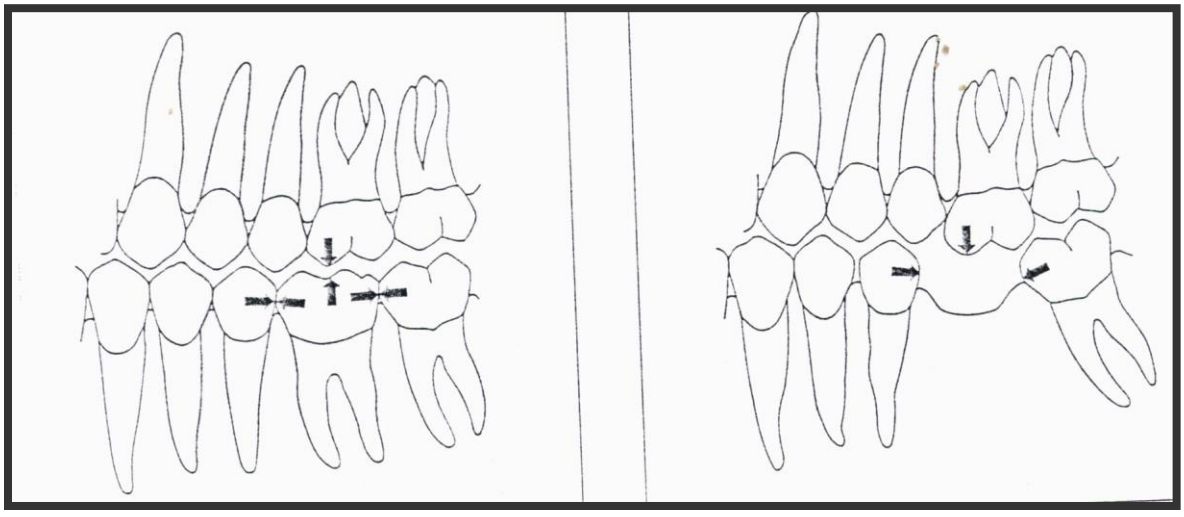
   If any tooth is extracted, the adjacent teeth will drift to the extracted tooth's space. This will lead to loss of contact between the existing teeth, and future caries. Excessive drifting will cause the gingival proximal area difficult to clean, therefore gingival inflammation and recession might occur.

2. **Over eruption of the opposing teeth:**

   Due to loss of a tooth, the occluding tooth in the opposing jaw will over erupt until it occludes again, either with the other opposing teeth or the alveolar ridge. This eruption will cause root exposure in the cervical part of the roots.

3. **Occlusal malalignement:**

   Disturbance in the intercuspation of the teeth due to loss of a tooth will cause muscle spasm and pain in the TMJ.



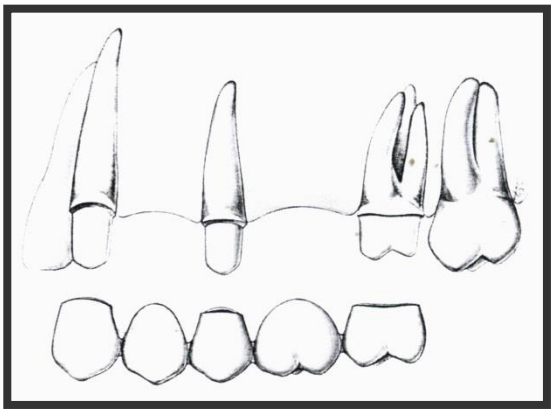
Reasons for treating tooth loss:

1- Esthetics restoration.
2- Restoring function.
3- Resolve pain in the muscles and TMJ.
4- Maintenance of dental health.
5- Restoring speech.

Types of bridges:

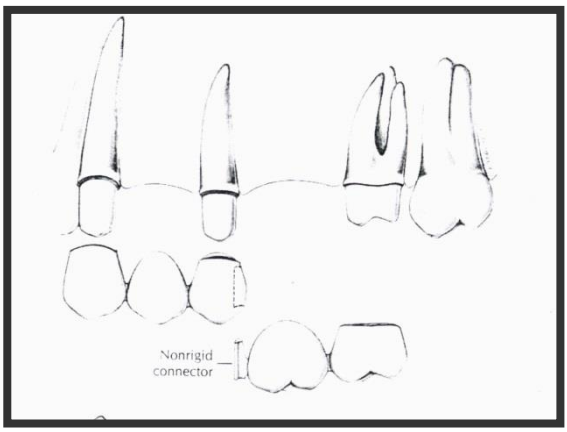
1. Fixed-fixed bridge:

All the components of this bridge are fixed at the connector area.



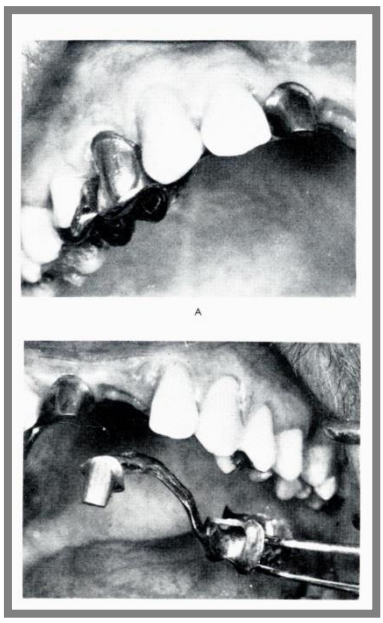
2. Fixed-movable bridge:

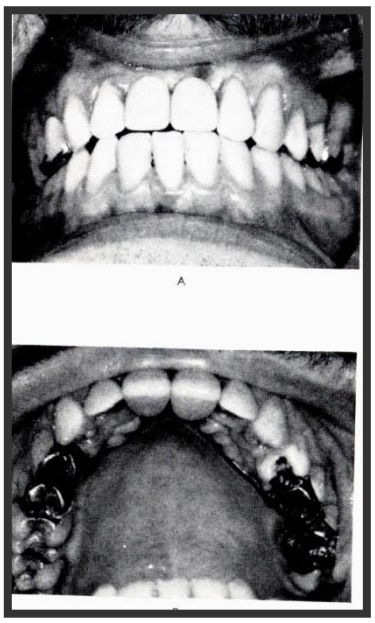
The bridge is divided into 2 segments and they are joined in a movable connector which is a slot or a dove tail. This type of bridge is used when there is no alignment in the path of insertion of the abutments.



3. Spring bridge:

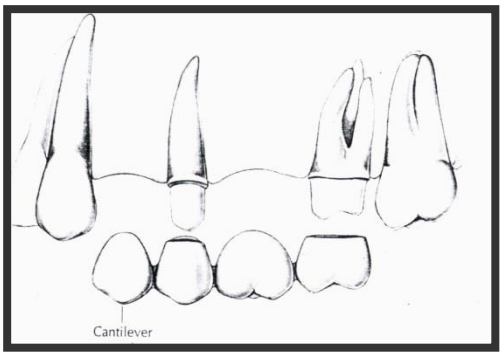
This bridge consist of a retainer usually a premolar, along palatal bar and a pontic far away from the abutment tooth, it's used when there are spaced anterior teeth.





4. Cantilever bridge:

This bridge consist of a pontic fixed to one retainer, the pontic size must be small in relation to abutment tooth so that the bridge can withstand the masticatory forces.



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.

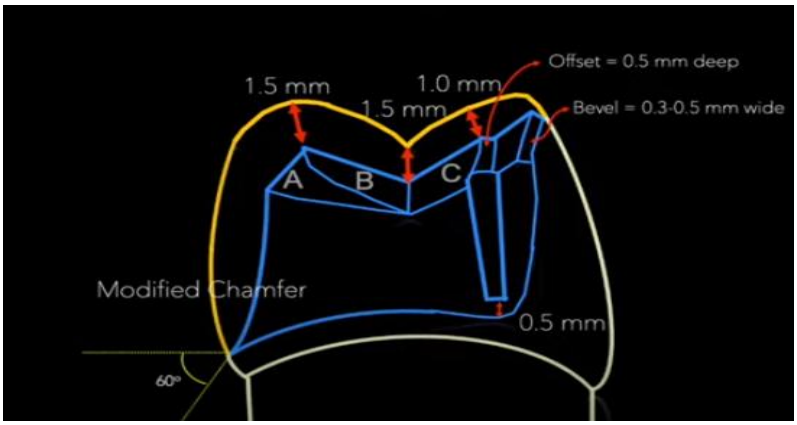
6- Complete seating of the crown can be easily seen by direct observation.

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

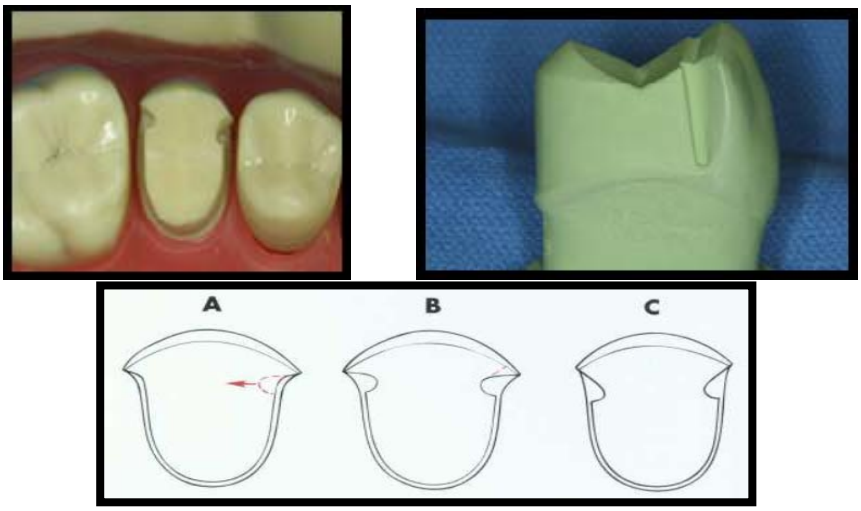
- Proximal access is gained by short needle diamond, up and down movement, this continue until contact with adjacent tooth is broken & access for larger bur is produced .
- extend facially and gingivally to break contact with adjacent tooth
- Proximal grooves (mesial and distal) are placed parallel to 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 :

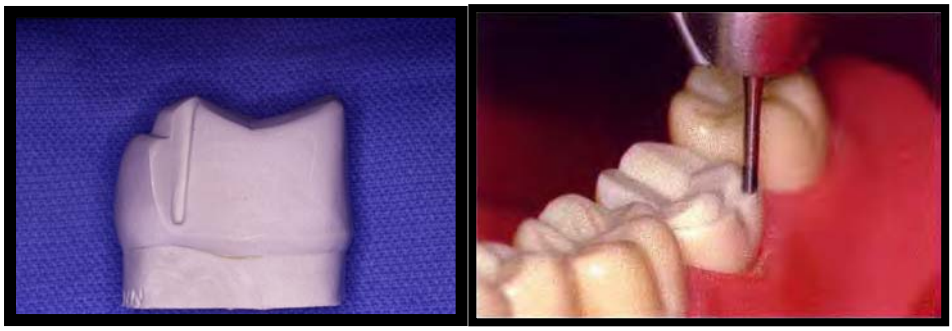
- *Chamfer is used as gingival finish line on lingual &proximal surfaces*
- *45 degree bevel F.L. were used on proximofacial & occlusofacial margins*

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.

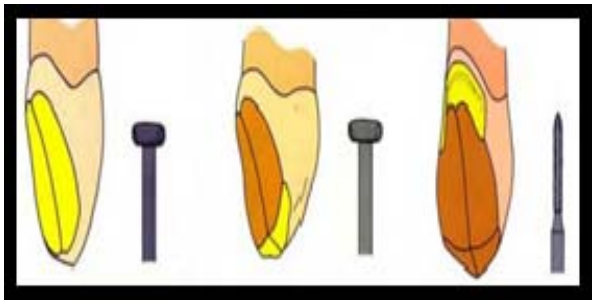
2.In upper, there should be occlusal offset however , for the lower there is no offset, in state, there is bucco-occlusal shoulder (occlusal shoulder on the buccal aspect of the buccal surface), it serve the same purpose as the offset.



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.*

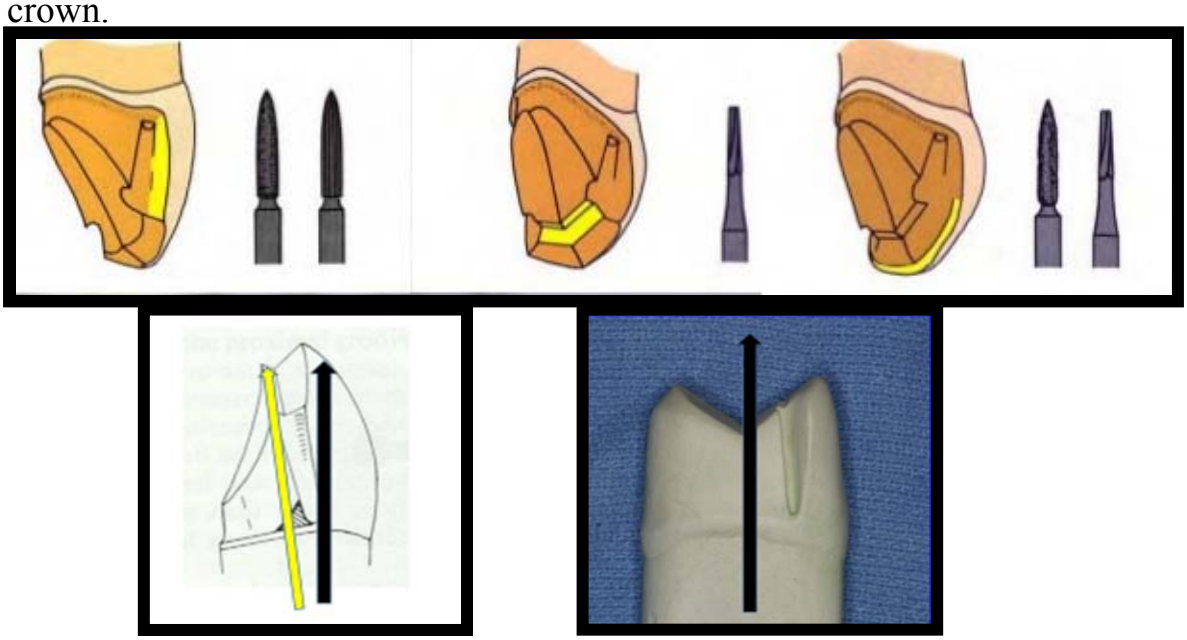
The mesial and distal grooves should be connected with V shape groove incisal offset. **The advantage of the incisal offset are;**

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.



Sterilization in Operative Dentistry

د. رشا

Is a term referring to any process that eliminates (removes) or kills all forms of microbial life, including the resistant bacterial spores using physical or chemical means. Sterilization in dentistry is a very important and crucial aspect of providing successful dental treatments. Since most instruments contact mucosa and/or penetrate oral tissues, it is essential that reused instruments be thoroughly cleaned and sterilized by accepted methods that can be routinely tested and monitored.

DISINFECTION:

A much lesser term of sterilization and indicate procedure offering variable measures of control of infection, in this way we not going to kill all living microorganism may viruses kept survive.

Classification of sterilization

♦ PHYSICAL METHODS
♦ CHEMICAL METHODS
♦ COMBINATION OF BOTH

Physical methods	*Chemical methods*
Moist heat	Alcohols
Dry heat	Aldehydes
Filtration	Halogens
Radiation	Phenols

Methods of sterilization

There are five accepted methods of sterilization:

1. Steam pressure sterilization (autoclave)
2. Chemical vapor pressure sterilization (chemi-clave)
3. Dry heat sterilization (dryclave)
4. Ethylene oxide sterilization

1. STEAM PRESSURE STERILIZATION (AUTOCLAVING)

Sterilization with steam under pressure is performed in a steam autoclave. For a light load of instruments, the time required at 250° F (121° C) is a minimum of 15 minutes at 15 psi pressure.

Time for wrapped instruments can be reduced to 3 minutes if the temperature is raised to approximately 273° F (134° C) to give 20 psi of pressure. Time required for the sterilizer to reach the correct temperature is not included.

Instruments which are sterilized by using autoclave is

Handpieces, orthodontic pliers, impression trays, and surgical instruments.

Advantages of autoclaves

1- Autoclaving is the most rapid and effective method for sterilizing cloth surgical packs and towel packs.

2- Economical

3- Good penetration on all surfaces.

4- Short procedure time

5- Easily monitored

Disadvantages of autoclaves

1- Items sensitive to the elevated temperature cannot be autoclaved.

2- Autoclaving tends to rust carbon steel instruments and burs.

3- Steam appears to corrode the steel neck and shank portions of some diamond instruments and carbide burs.

4- Dulling of unprotected cutting edges.

2. CHEMICAL VAPOR PRESSURE STERILIZATION (CHEMICLAVING)

- Sterilization by chemical vapor under pressure is performed in a Chemiclave.
- Chemical vapor pressure sterilizers operate at 270° F (131° C) and 20 lbs pressure.
- They are similar to steam sterilizers and have a cycle time of about half an hour.
- Like ethylene oxide sterilizers, they must be used with a prescribed chemical by

the manufacture.

- **Instruments which are sterilized by using chemiclave is:**
  - ❑Periodontal, restorative and endodontic instruments
  - ❑ Carbon steel and other corrosion sensitive burs and pliers

Advantages of Chemiclaves

Carbon steel and other corrosion-sensitive burs, instruments, and pliers are said to be sterilized without rust or corrosion.

Disadvantages of Chemiclaves

1- Items sensitive to the elevated temperature will be damaged.
2- Instruments must be lightly packaged in bags obtained from the sterilizer manufacturer.
3- Towels and heavy cloth wrappings of surgical instruments may not be penetrated to provide sterilization.

3-DRY HEAT STERILIZATION (hot air ovens)

It is the most widely used method of sterilization by dry heat. Dry heat sterilization is readily achieved at temperatures above 320° F (160° C) for 1-2 hours. The oven is electrically heated and is fitted with a fan to ensure adequate and even distribution of hat air in the chamber. It is also fitted with a thermostat that maintains the chamber air at a chosen temperature.

Instruments which are sterilized by using hot air oven are :

❑ Endodontic instruments
❑ Condensers
❑ Hand instruments
❑ Orthodontic pliers
❑ Surgical instruments
❑ Burs

Advantages of dry heat

1- Carbon steel instruments and burs do not rust, corrode, or lose their temper or cutting edges if they are well dried before processing.
2- Economical.
3- Easily monitored.

Disadvantages of dry heat

1- High temperatures may damage more heat-sensitive items, such as rubber or plastic goods.

2- Sterilization cycles are prolonged at the lower temperatures.

3- Heavy loads of instruments, crowding of packs, and heavy wrapping easily defeat sterilization.

4-Hot air is bad conductor of heat hence it has less penetrating power.

4 - Ethylene Oxide sterilization

Ethylene oxide sterilization is the best method for sterilizing complex, heat sensitive instruments and delicate materials like rotary handpiece. Ethylene oxide is a gas at a temperature below 100°C. It is highly explosive and inflammable. It is highly penetrative, non-corrosive agent with a bactericidal action. It is used for the sterilization of towels, metal and plastic instruments.

LIQUID STERILANTS/HIGH-LEVEL DISINFECTANTS

. Sterilants used for high-level disinfection of items for reuse are glutaraldehydes at 2% to 3% concentrations; it kills bactereial spores in 6-10 hours.

· Greater dilutions are not encouraged for repeated use.

· Placing wet items into disinfectant trays dilutes the solution.

· Glutaraldehydes are irritating, sensitizing to skin and respiratory passages, and can be toxic as indicated in manufacturers' safety data sheets.Keep trays tightly covered in a well-vented area.

· *Do not use 2% glutaraldehyde solutions to wipe counters or equipment* (e.g., dental unit and chair).

Infection control program in minimum dental office

1.Sterilization of instruments

2.Comprehensive medical history

3.Hepatitis B vaccine to prevent any cross infection

4.Antiseptic and mouthwash

5.Disposal mask and gloves

6.Protective eye glass

7.Rubber dam

8.Surface cleaning and cover tray

9.Needle and sharp instrument safety

DENTAL INSTRUMENTS CLASSIFICATION

based on risk of transmission and need of sterilization
-CRITICAL
-SEMI-CRITICAL
-NON-CRITICAL

Category	Definitions	Dental instrument or item	Type of sterilization
Critical	Penetrate soft tissue, contact bone, enters into or contacts the blood stream	Surgical instruments, periodontal scalers, scalpel blades, surgical dental burs.	HEAT STERILIZE between uses or use sterile single-use, DISPOSABLE devices
Semicritical	Contact mucous membranes or non intact skin, will not penetrate tissue, contact bone, enter into or contact blood stream.	Dental mouth mirror, amalgam condenser, reusable dental impression trays, dental handpieces	HEAT STERILIZE or HIGH-LEVEL DISINFECT
Noncritical	Contact intact skin	Radiograph head\cone, blood pressure cuff, facebow	Clean and disinfect using a LOW TO INTERMEDIATE LEVEL DISINFECTANT

Stages for instrument sterilization

►Presoaking - Placing the instrument in a presoak solution until time is available for full cleaning prevents drying and begins to dissolve or soften the debris. Presoak solutions used are detergents

►Cleaning - Clean instruments in an ultrasonic cleaner (preferred), instrument washer, or by hand while wearing proper protection. Ultrasonic cleaners are safest and most efficient ways to clean instruments, ultrasonic cleaning is 9 times more effective than hand cleaning ,it provides fast and thorough cleaning without damage to instruments.

►Packaging - Place instruments in a sealed package or pouch, unless you're going to use them immediately after sterilization.

►Sterilization- Sterilize instruments using steam autoclaving, dry-heat, or chemical vapor machines.

►Drying or cooling- Store Instruments in a Dry, Protected Area

CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

- Countertops and dental unit surfaces that may have become contaminated with patient material should be cleaned with disposable toweling, using an appropriate cleaning agent and water as necessary.

-Surfaces then should be disinfected with a suitable chemical germicide. Including: phenolics, iodophors, and chlorine-containing compounds.

-A fresh solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective intermediate-level germicide. Concentration (1/4 cup of bleach to 1 gallon of water) is effective on environmental surfaces that have been cleaned of visible contamination. Caution should be exercised, since chlorine solutions are corrosive to metals, especially aluminum.

DISINFECTION OF THE DENTAL LABORATORY

Laboratory materials and other items that have been used in the mouth (e.g., impressions, bite registrations, fixed and removable prostheses, orthodontic appliances) should be cleaned and disinfected before and after being manipulated in the laboratory, whether an on-site or remote location and before placement in the patient's mouth.

STERILISATION OF HANDPIECES

After each patient use,

► run any handpiece that is connected to the dental air/water system, to discharge water and/or air for at least 30 seconds

► Leave the bur in place while you clean the outside of the handpiece with detergent and warm water.

►Sterilize in an autoclave.

►If recommended by the manufacturer, lubricate the handpiece with pressurized oil until clean oil appears from handpiece.

Some dental instruments have components that are heat sensitive or are permanently attached to dental unit water lines. Some items may not enter the patient's oral cavity, but are likely to become contaminated with oral fluids during treatment procedures, including, for example, handles or dental unit attachments of saliva

ejectors, high-speed air evacuators, and air/water syringes. These components should be covered with disposable covers that are changed after each use or, if the surface permits, carefully cleaned and then treated with a chemical germicide having at least an intermediate level of activity.

DISPOSAL OF WASTE MATERIALS

►Blood, suctioned fluids, or other liquid waste may be poured carefully into a drain connected to a sanitary sewer system.

►Disposable needles, scalpels, or other sharp items should be placed intact into puncture-resistant containers before disposal.

►Solid waste contaminated with blood or other body fluids should be placed in sealed, sturdy impervious bags to prevent leakage of the contained

Lec. 13

د. رشا

Fluoride – Releasing Materials

Fluoride exists only in combination with other elements as a fluoride compound.It is present in the body in bone and teeth.The fluoride's effect is to serve as an aid for both the mineralization of developing tooth enamel prior to tooth eruption and for remineralization of surface enamel. The combination of these fluoride effects greatly reduce occurrence of dental caries. Fluoride is incorporated in tooth structure when small amounts are swallowed daily while the teeth are forming. Fluoride becomes concentrated in the outer enamel surfaces when applied after teeth erupt into the mouth.Dental plaque and saliva act as fluoride reservoirs to enhance the remineralization process.

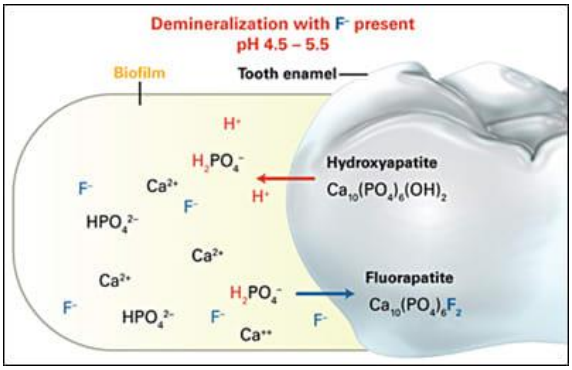
Mechanism of Action of Fluoride:

1- Inhibition of demineralization:

The mechanism is that it binds calcium and phosphate dissolving as a result of the acid penetration in to the dental tissue.

2- Enhancing remineralization:

The fluoride from topical sources enhances remineralization by speeding up the growth of a new surface on the partially demineralized subsurface crystals in the caries lesion, fluoride adsorb to the crystal surface and attract calcium ions followed by phosphate ions leading to new mineral formation.



3- Antimicrobial action:

Fluorides interfere with the decay-causing bacteria colonizing on teeth and reduce their acid production by reduce carbohydrate metabolism, thus slowing demineralization.

Fluoride Varnish:

Fluoride varnish has been found to be effective in preventing caries on permanent teeth. Fluoride varnish also has recently been shown to prevent or reduce caries in the primary teeth of young children.

How is the varnish applied?

Application is quick and easy: small droplets of varnish are applied directly to the tooth surface.

Glass ionomer cements:

Glass ionomer cements release fluoride by two mechanisms, which are the dissolution and diffusion. The large release of fluoride ion during the first few days after replacement declines rapidly during the first week and stabilizes after 2-3 month. Fluoride release normally takes place from the matrix into the adjacent environment but, in the presence of a high fluoride concentration in the month, fluoride ion can be taken up into the cement again. Glass ionomer materials, can therefore be regarded as a fluoride reservoir.

Their main characteristics are:

1. An ability to chemically bond to enamel and dentine with insignificant heat formation or shrinkage.

2. Biocompatibility with the pulp and periodontal tissues.
3. Fluoride release producing a cariostatic and antimicrobial action.
4. Less volumetric setting contraction; and a similar coefficient of thermal expansion to tooth structure.

These advantages have made them successful as luting cements and lining materials. However, as a restorative material, their sensitivity to moisture and low mechanical strength and wear resistance make them the least durable. This may be adequate for primary teeth because they will exofoliate in a number of years.

Resin-modified glass ionomer cements:

The fluoride release of the RMGICs would be affected by methacrylate-components and the polymerization systems. The contribution from the dissolution mechanism is, however very little because of the presence of the hydrophobic resin which will repel the water.

Their main characteristics are:

1. Resin-modified glass ionomer cements bond chemically to enamel and dentine with insignificant heat formation or shrinkage of material during the hardening reaction. So that the cement can firmly adhere to both enamel and dentine without signs of marginal leakage.

2. Shear bond strength of the resin-modified cement to dentine is significantly higher than that of conventional glass ionomer cement and the bond is a stable one.

3. Resin-modified glass ionomers have the advantage of being able to directly bond to resin composite, making them useful in glass ionomer/composite laminate restorations.

4. The resin modified glass ionomers are also highly biocompatible to the pulp and it has better adaptation and seal to the cavity preparation than conventional glass ionomer materials.

5. The final set structure shows a dramatic increase in compressive strength but is rather brittle and comparatively low in tensile strength and has low abrasion resistance making it unsuitable for high stress - bearing areas such as posterior teeth.

6. The fluoride release from and uptake by the resin-modified products was higher than or the same as that of conventional glass ionomers and has no adverse effect on the bond strength.

7. resin-modified glass ionomers have greater curing shrinkage than the conventional chemically-cured cements. Incremental placement techniques should always be used to ensure complete curing at depth and to minimize polymerization shrinkage.

Clinical use

Usually came as two-paste system . It has a longer working time. It sets sharply once the polymerization reaction is initiated by light. Most manufacturers state that immediate polishing can be carried out after light-curing. However, the setting reaction will continue slowly for at least 24 hours and the best result can be obtained if finishing is delayed. When immediate polishing is required, care must be taken not to overheat the restoration as this may cause excessive drying and cracking and may prevent setting of the ionomeric component. Highly desirable, alternative to amalgam for restoring primary teeth, and as a liner/base material.

Composite

In recent years, resin composite has been formulated to release fluoride. A slow release of small amount of fluoride from composite resin would be advantageous even more than periodic high concentration of fluoride applications.

Resin cements

It consists of a resin matrix with inorganic fillers that are bonded to the matrix with monomers. Polymerization of resin cement is achieved either by chemical reaction (self cure), light activation (light cure), or both (dual cure). The self cured composite cement are typically two pastes system (base and catalyst), while the light cure cement is a single component system. In some products fluoride is added to act as anti cariogenic factor, and reduce the resin cement sensitivities.

Polyacid-modified resin composites (compomers)

Recently, other resin-ionomer hybrid restoratives have been marketed as multipurpose materials or are resins that may release fluoride but have only limited glass ionomer properties. One such new material is the 'compomer' which contains the major ingredients of both composites (resin component) and glass ionomer cements (polyalkenoate acid and glass fillers component) except for water. The fluoride release from compomers has been demonstrate, more than composite but at lower level from that of GICs. Although low, the level of fluoride release has been reported to last at least 300 days.

Their main characteristics are:

1. It have two different mechanisms are responsible for the formation of adhesive bonds to the cavity wall. One of these is the self-adhesive property of the restorative itself, it can bond to both enamel and dentine without acid etching by carboxyl (-COOH) groups, the functional carboxyl groups can form ionic bonds with the calcium ions of the tooth surface. The second mechanism is adhesion to the tooth surface through the primer/adhesive system.
2. Can only be hardened through light-curing.
3. It has a significantly less bond strength to dentine than other resin-modified glass ionomer cements and chemically cured glass ionomer.

4. Often one component with an adhesive system.
5. Little is known about the clinical wear performance on the recently marketed compomer restorative materials.
6. Recently, studies have found that the release of fluoride by compomers was significantly less than resin modified glass ionomer cement more than other fluoride releasing resin composite. However, the antibacterial action decreased significantly over time. In addition, the caries inhibition effect of compomer restorative material was higher than the conventional type of resin composite.
7. Radiopacity of compomers is differing from that of dentine and it slightly higher than that of enamel. This value is considered to be desirable for radiographic detection of recurrent caries and offers an easy method for documentation of dental work.

Clinical use:

Ease of manipulation is another advantage of the compomer restoratives. Similar to resin composites, since the adhesive can provide sufficient bond strength for retention, no acid etching procedure is required prior to placement of the restorative. The consistency makes it easy to apply and contour without stickiness and, therefore, less time will be required for final finishing. These properties are especially beneficial in treating children because restorations usually can be completed much faster and within the tolerance of the child patient. A recent study has shown that curing shrinkage is similar to that of the conventional hybrid resin composites. Therefore, placement in increments of 3 mm or less is recommended for Dyract AP, 2 mm or less for other newer compomers, and then each to be cured for at least 40 seconds. Finishing can be undertaken immediately after curing using fluted tungsten carbide finishing burs or polishing discs.

They may or may not have the typical features of true glass ionomers such as chemical adhesion to tooth structures and long-term fluoride release.

Therefore, they should be used carefully, closely following the instructions of the manufacturers because different handling methods may influence their clinical behavior. It is used as liner/base, restoration, fissure sealant.

Amalgam

Fluoride containing amalgams have been shown to have anticaries properties that is sufficient to inhibit the development of caries in cavity walls. Studies have shown that the concentration of fluoride in the saliva by fluoriden releasing amalgams is sufficient to enhance remineralization. Therefore, fluoride releasing amalgam restorations may have a favourable effect on initial demineralization in the mouth. Restorative materials show an initial release that is significant. However, this release of fluoride decreases to minor amounts after 1 week.

Lec 12 **Resin-based Composites resin** **Dr. Zainab**

It is introduced commercially in 1962 by Bowen of the National Bureau of Standards most popular tooth colour material consist of a continuous polymeric or resin matrix in which an inorganic fillers is dispersed.

Indications:

1. Classes I, II, III, IV, V and VI restorations
2. Foundations or core buildups
3. Fissure sealants and conservative composite restorations (preventive resin restorations)
4. Esthetic enhancement procedures

• Partial veneers
• Full veneers
• Tooth contour modifications
• Diasthema closures

5. Cements (for indirect restorations)
6. Temporary restorations

Contraindications:

1. An operating area that cannot be adequately isolated.
2. Class V restorations that are not aesthetically critical.
3. Restorations that extend into the root surface (may exhibit gap formation).

Advantages:

1. Aesthetics
2. conservative of tooth structure removal (less extension; uniform depth not necessary; mechanical retention usually not necessary)
3. less complex when preparing the tooth
4. low thermal conductivity

5. bonded to tooth structure resulting in good retention, low micro leakage, minimal interfacial staining, and increased strength of remaining tooth structure
6. Repairable

Disadvantages

1. may result to gap formation, usually occurring on root surfaces as a result of the forces of polymerization shrinkage of the composite material
2. restoration is more difficult, time-consuming, costly (compared to amalgam restorations)
3. Are more technique sensitive because the operating site must be appropriately isolated and the placement of etchant, primer, and adhesive on the tooth structure (enamel and dentin) is very demanding of proper technique
4. May exhibit greater occlusal wear in areas of high occlusal stress or when all of the tooth's occlusal contacts are on the composite material
5. Have a higher linear coefficient of thermal expansion, resulting in potential marginal percolation if an inadequate bonding technique is utilized

Composition

A. Organic Resin – forms the matrix

-dimethacrylate monomer (BIS-GMA)

B. Inorganic filler

- inhibits deformation of the matrix
- reduce the coefficient of thermal expansion of the resin matrix

e.g. fused silica, crystalline quartz, lithium aluminum silicate, borosilicate glass

- better mechanical properties, such as compressive strength;
- greater aesthetics;
- confers radio-opacity

C. Coupling Agent

- unite the resin with the filler
- stress absorber of the filler and resin

D. Initiator System – activate the setting mechanism

E. Stabilizers

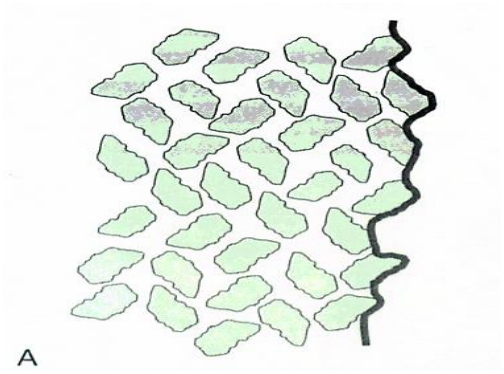
F. Pigments

Classification

1. Conventional
2. Microfilled
3. Hybrid -Flowable - Packable
4. Nano-composite (nanofilled) - Completely nanofilled - Nanohybrids
5. Reinforced

Conventional Composites

1. contains 75-80% inorganic filler by weight
2. average particle size 8µm
3. large size particle and extremely hard filler
4. rough surface structure, strontium and barium glass (radiopaque)



Microfilled Composites

1. introduced in the late 1970
2. polishable
3. smooth lustrous surface similar to tooth enamel
4. particle size is 0.01 – 0.04µm
5. contains 35-60% inorganic filler by weight

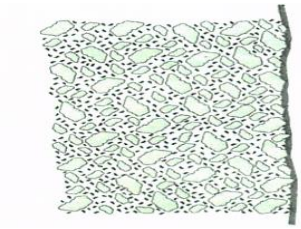
6. some of physical and mechanical properties are inferior; wear resistant
7. low modulus of elasticity (allow restoration to flex)
8. high resin content results in an increased coefficient of thermal expansion and lower strength

Use of Microfilled Composites

- used for low stress restorations, buccal and lingual surfaces of class III and class V

Hybrid Composites

1. combines the properties of conventional and microfilled
2. contains 75-85% inorganic filler by weight
3. particle size is 0.4 – 1µm
4. physical properties is superior to conventional
5. predominant direct aesthetic resin
6. have universal clinical applicability



Use of Hybrid Composites

- used in moderate stress restorations where strength and wear resistance are more important than surface luster; Class I, class II, class IV

Flowable composites

1. flows into cavity due to lower viscosity
2. have lower filler content
3. inferior physical properties (lower wear resistance, lower strength)

4. used in small class I, pit and fissure sealant, marginal repair materials, as the first increment placed as a liner under hybrid or packable composites
5. easy to use
6. good wet ability
7. favourable handling properties are popular features
8. clinical indications for their use are limited.

Packable (Condensable) composites

1. more viscous, "thicker, stiffer feel"
2. have filler particle feature that prevents sliding of the filler particle by one another
3. easier restoration of proximal contact
4. similar to the handling of amalgam

Nanofill composites

1. Contain filler particles that are extremely small (0.005-001 microm.)
2. Because of these small particles a high filler levels can be generated in the restorative material, resulting in good physical properties and esthetics
3. Nanofills highly polishable
4. These materials are likely to become a popular composite restorative material choice

Completely nanofilled resins

Contain nano-meter sized particles throughout the resin particles

Nanohybrids resins

Consist of large partials surrounded by nano-meter sized particles

Reinforced composites

It consists of a combination of a resin matrex, randomly orientated E-glass fiber and inorganic particulate fillers.

Used as base filling material in high stress bearing areas especially in large cavities of vital and non- vital posterior teeth

Classification according to the method of activation:

1. Chemically-activated composites:

Also they are called self -curing composite resins. Most commonly available as two-paste system composed of a catalyst and base materials. When these two components are property mixed, the polymerization process is chemically activated. The rate of set is uniform through the bulk of the material causing a gradual increase in viscosity at room temperature. Hence the material have a limited working time, making the technique time sensitive with the increased possibility of air bubble incorporation during mixing of the two pastes and thus affecting the composite physical and mechanical properties .

2. Light-activated: composites:

Light activated materials afford a number of advantages over chemically activated ones. The light curable materials are single components, and require no mixing, and so have reduced porosity, and better resistance to wear and abrasion. The working time is virtually that chosen by the clinicians, and the material hardens rapidly when exposed to light. The components of light -activated composites are contained in single paste system. The mixture is supplied in various shades in disposable syringes. These syringes are made of opaque plastic to protect the material from exposure to light.

3. Dual cured composites:

Combine self curing and light curing materials .The self curing rate is slow and is designed to cure only those portions that are not adequately light cured Specially in the interproximal areas where the access is limited and require special approaches to guarantee adequate light curing energy

1. Ultraviolet light source:

The introduction of photopolymerization to dentistry began in the late 1960s. Initially, ultraviolet cured pit and fissure sealant were put into clinical practice, UV radiation cause possible eye problems that might develop in office personnel and the possibility of selectively altering the oral flora of the patient's mouth through exposure to ionizing radiation.

2. Visible light sources:

A- Quartz-Tungsten-halogen (QTH) light source:

A modified light source delivery was introduced in the form of the handheld dental curing light.

Visible radiation passed through the infrared filter, is then further filtered by a band pass filter, providing energy restricted to a narrow visible light region where the absorbance of the photoinitiator is maximum, so that, only blue light is emitted. However, only the wavelengths around 470 nm are strongly absorbed by the Composite.

B- Argon laser lights

When laser technology provided sources that emitted high-intensity light within the energy band required by the photoinitiator in light-activated dental materials, the dental industry developed this type of curing source for the practitioner. The argon-ion laser provides high output energy at 488 nm for rapid polymerization of commercially available dental restorative

C. Short-Arc Xenon Sources (Plasma-Arc Curing lights (PAC)):

In the mid 1990s, Xenon arc light units were introduced in restorative dentistry as alternative for rapid light curing. Manufacturers claimed that these sources can effectively reduce clinical exposure duration to only 1 to 10-seconds or some manufacturers claimed that composites could be adequately polymerized in less than 1 second.

D. Blue light- emitting diode curing units (LED) s

The blue LED has become available in output wavelengths that fell within the spectral absorbance of a common dental photoinitiator (CQ). The intensity of these devices has increased at a rapid rate, and now commercial devices are available for the photopolymerization of dental composites. Instead of the hot filaments used in halogen bulbs, LED, use junction of doped semiconductors for generation light.

Polymerization:

Resin composite restoratives solidify by means of the chemical process termed polymerization. The polymerization of the resin matrix produces a gelation in which the restorative material is transformed from a viscous-plastic into a rigid-elastic phase. During the early stages of polymerization, monomers are mainly converted into polymeric chains.

After a certain degree of conversion has been attained, the predominant reaction is the cross-linking of the polymeric chains, resulting in a strong polymeric network.

Factors affecting polymerization shrinkage stress:

1-Factors related to the cavity design:

Stress developed during curing can be minimized by consideration of the ratio between the bonded and unbonded surface area (c- factor). When this ratio increases, as in Class I and Class V situations, increase the shrinkage stress loading on the tooth- resin interface leading to de bonding.

2-Factors related to the placement technique:

The second factor that might reduce polymerization shrinkage is to insert resin composites in increments to reduce the volume of the resin that is shrinking during polymerization.

3-Factors related to the composite formulation:

Nonbonded microfiller particles have been found to produce significant decreases in polymerization stress by acting as stress-relieving sites within the composite.

Acid Etching:

- A physical process that creates a microscopically rough enamel surface (enamel tags)
- first successful technique developed to bond dental materials to tooth structure
- acid used is 37% ortho-phosphoric acid
- sometimes referred to as conditioner

Smear Layer: When a rotary or handheld instrument is used on dentin it creates a special surface texture called a smear or smear layer that closes off the dentinal tubules. This layer is lightly adhered to the dentin surface and contains tooth cuttings, saliva, bacteria, and other surface debris

Enamel Etching

Enamel consists of organic and inorganic components. Application of 37% phosphoric acid removes about 10 microns of enamel to expose prisms of enamel rods and create the classic honeycomb effect. Acid also increases surface energy for better wetting of the enamel. Resins flow into micromechanical retentive areas. Resin tags fill microscopic holes to provide retention. Retention is about 30 MPa.

Acid etching is done for a minimum of 15 to 30 seconds. Thorough rinsing for 10 seconds removes acid and dissolved calcium phosphates.

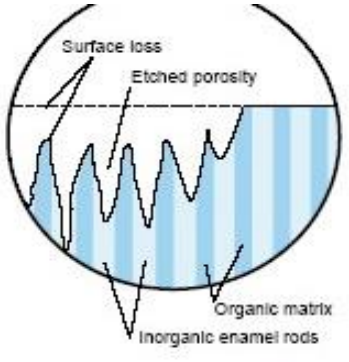


Figure 8–3. Schematic diagram depicting how acid etching produces microporosities in enamel.

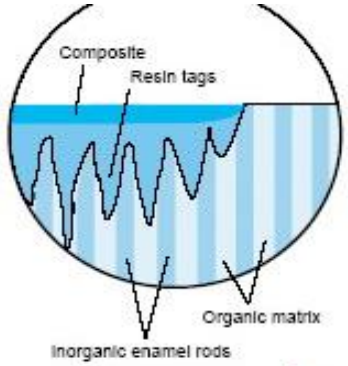


Figure 8–4. Schematic diagram depicting how resin tags penetrate the microporosities produced by acid etching of enamel.

- Over-etching results to formation of crystals (precipitates) that inhibits bonding
- Built-in quality control check – if properly etched it appears frosty or chalky white.

Dentin Etching

- 37% ortho-phosphoric acid
- removes the smear layer from the surface of the of the dentin as well as the plugs of material forces into dentinal tubules during cavity preparation.
- decalcifies a layer of dentin several microns thick.Time:10-15 seconds

If the etched tooth surfaces are contaminated with saliva or blood, they need to be reetched. Such a reetching procedure requires only 5 seconds.

Adhesion to Dentin

Conditioning or Etchant (E):-dentin etching time 15 sec only

-Removes the smear layer.

- Exposes the intertubuler and peritubular collagen.

- Opens the tubules.

-Decreases the surface free energy.

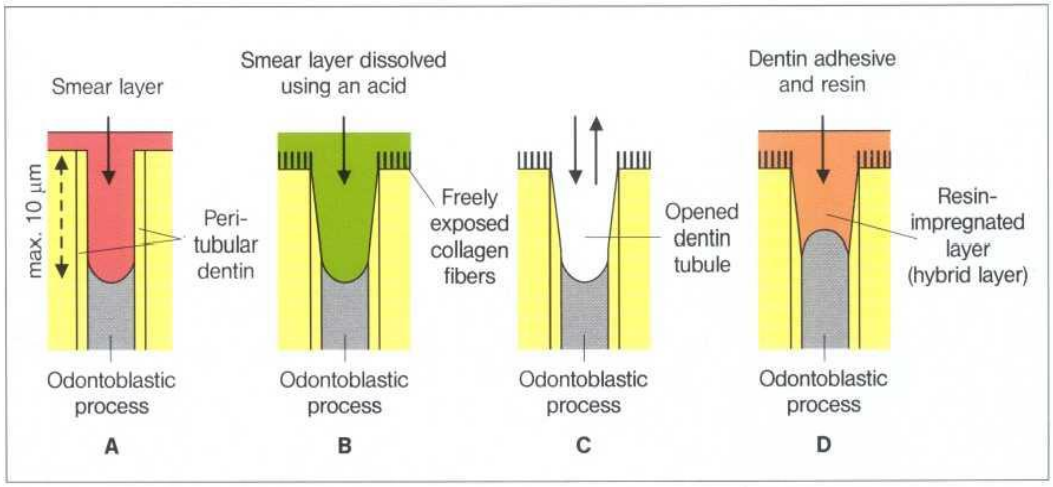
Primer (P):-

- Includes bifunctional molecules hydrophilic and hydrophobic).
- Envelops the external surface of collagen fibrils.
- Re-establishes surface free energy to levels compatible with more hydrophobic restorative materials

Bonding Agent (B): (Adhesive resin)

- Includes monomers that are mostly hydrophobic such as Bis-GMA
- Copolymerize with the primer molecules penetrates and polymerizes into interfibriller spaces to serve as a structural backbone to hybrid layer.

Adhesion to Dentin protects the pulp, because after removal of the smear layer with a mild acid (conditioner) the opened dentin wound was sealed with a hydrophilic resin, for example, HEMA (primer) and a bonding agent (adhesive). During this treatment a dentin surface impregnated with resin (hybrid layer) is formed that guarantees an optimal dentin wound closure which is acid resistant and prevents bacteria penetrating.



Effect of the total etch technique on the opening of the dentin canals

A- Prepared cavity
B -The smear layer is dissolved through treatment with phosphoric acid
C- The acid and the dissolved smear layer are washed away using a water-air spray
D- Forming the hybrid layer with a dentin adhesive

Current strategies for Adhesion of Resin to Dentin:

I-Total etch adhesive

A- Three step total etch adhesive:

Etchant (E) + Primer (P) + Bonding Agent (B)

B- One-bottle total –etch (two step total-etch adhesive):

Etchant (E) +Primer and Bonding agent (PB)

II-Self-etch adhesive:

A- Two –bottle self-etch:

Etchant and Primer (EP) + Bonding (B)

B- All-in-one self-etch (EPB) we call it single application:

-it demineralises and penetrates dentin simultaneously leaving a precipitate on the hybrid layer.

- Forms a thin layer of adhesive.
- a multi-coat approach is recommended.

Adhesive strategies – principles:

1- Acid etch will remove smear layer with collagen fibers upright, tubules open, primer and adhesive penetrate.

2- Leave smear intact, tubules plugged, partially demineralize smear layer with self- etching primer and replaced with resin filler in to tubuler dentin.

CAVITY PREPARATION FOR COMPOSITE RESTORATIONS

Three designs of tooth preparations for composite restorations, and sometimes they are used in combination. The designs include:

(1) Conventional (2) Beveled conventional (3) Modified

Class III Tooth Preparation:

There is a choice between facial or lingual entry into the tooth

Indications for Lingual Approach

1- To conserve facial enamel for enhanced esthetics.

2- Carious lesion is positioned lingually.

3- Lesion is accessible from the lingual.

4-Color matching of the composite is not as critical.

5- Discoloration or deterioration of the restoration is less visible.

Indications for Facial Approach

1- The carious lesion is positioned facially

2-Teeth are irregularly aligned, making lingual access undesirable.

3- Extensive caries extent into the facial surface.

4- Faulty restoration that was originally placed at the facial.

Conventional Class III

Indicated for restorations involving the root surface

1. Using a No. ½, 1, 2 round bur prepare the outline form on the root surface
2. Extend the preparation into sound walls
3. Extend pulpally 0.75mm in depth
4. The gingival/cervical and incisal wall is perpendicular to the root surface (box like design)
5. A continuous groove retention can be prepared 0.25 mm (½ of diameter of bur) into dentin of the gingival and incisal walls with a ¼ round bur.
6. The groove is placed at the junction of the axial and the external walls.
7. Clean preparation and inspect the final preparation.

Bevelled Conventional Class III

- Indicated for replacing an existing defective restoration in the crown portion of the tooth
- When restoring a large carious lesion for which the need for increased retention and/or resistance form is anticipated.

Lingual Access

1. Use a round bur No. 1/2, 1. 2 depending on the size of the caries to enlarge the opening sufficiently to allow for caries removal.
2. Extend external walls to sound tooth structure using a straight bur

3. Extend the gingival and incisal walls up to extent of caries or location of old restoration.

Unless necessary, DO NOT:

- include the proximal contact.
- extend into the facial surface.
- extend subgingivally

4. Create an initial axial wall depth of 0.2mm into the dentin/DEJ (approximately 0.75 – 1.25mm in depth)

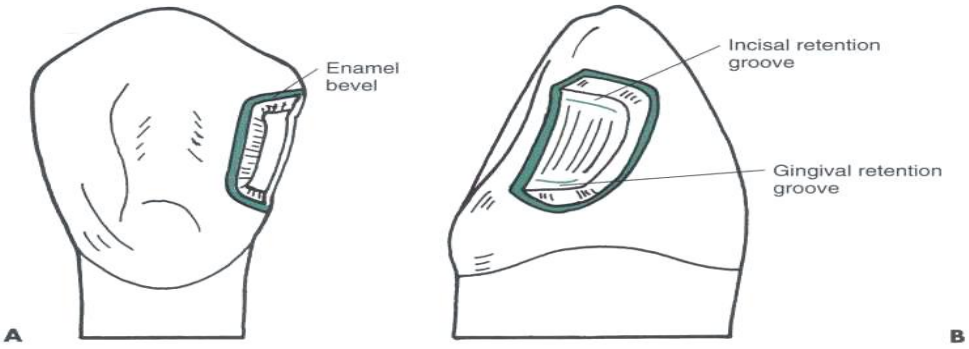
5. Axial wall is convex, following the external contour of the tooth.

6. Remove all remaining infected dentin, using a round bur or small spoon excavator.

7. Remove friable enamel at the margins.

8. If necessary, prepare retention (grooves or coves)

- prepare it along the gingivoxial line angle, and sometimes at the incisoaxial line angle 0.25 mm with a ¼ round bur.

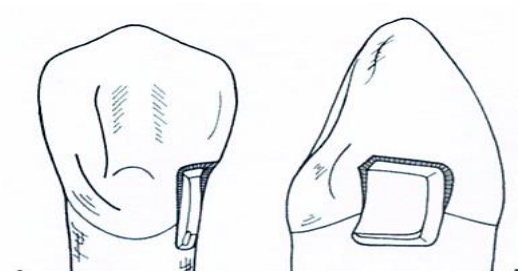


9. Place cavosurface bevel or flare at the enamel except at the gingival margin area.

10. Use a flame shape or round bur resulting in a 45 degrees angle to the external tooth surface.

11. Bevel width should be 0.25 to 0.5mm.

12. Clean the preparation of any debris and inspect final preparation.



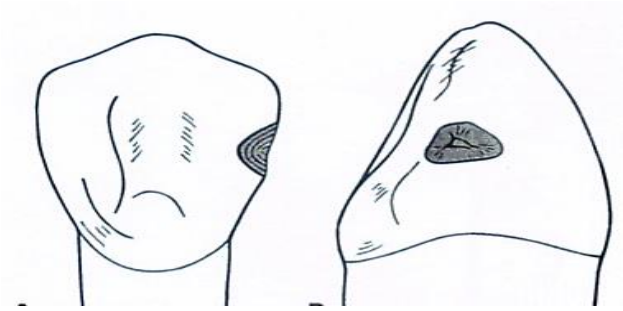
Facial Access

- same stages and steps are followed
- procedure is simplified because of easy access

Modified Class III

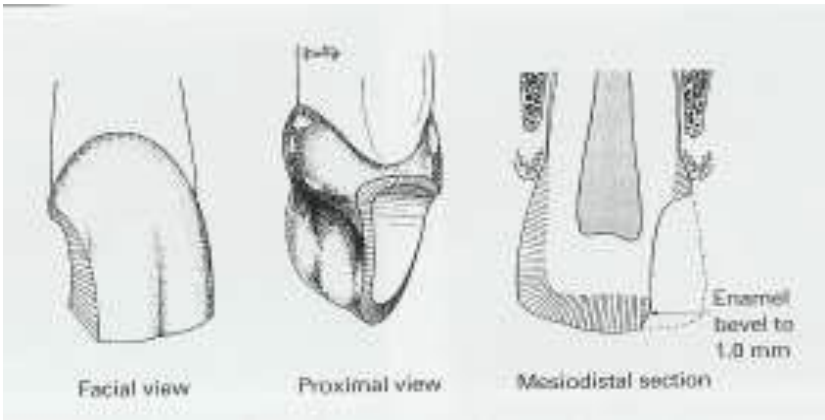
- most used type of cavity preparation.
- indicated for small and moderate lesions or faults.
- designed to be as conservative as possible.
- preparation walls have no specific shapes or forms.
- preparation design appears to be scooped or concave

1. Use a 1/2, 1, 2 round bur, point of entry is within the incisogingival dimension of the lesion, perpendicular to the enamel surface.
2. Remove all remaining caries or defect.



3. No attempt is made to create a uniform axial wall.
4. Place cavosurface bevel or flare at the enamel except at the gingival margin area.
5. Use a flame shape or round bur resulting in a 45 degrees angle to the external tooth surface.
6. Bevel width should be 0.25 to 0.5mm.
7. Clean the preparation of any debris and inspect final preparation.

Class IV Tooth Preparation



- preoperative assessment of occlusion is very important (placement of margin in noncontact areas)
- shade selection is more difficult
- preparation is similar to Class III except that the preparation for class IV is extended to the incisal angles

For fracture: If no caries or pulpal involvement a bevel is the only preparation necessary 1.0-2 mm enamel bevel should be placed around the periphery of the cavity

Use of Pins:

* Retentive pins are not needed because the adhesive technique provides sufficient retention for the restoration

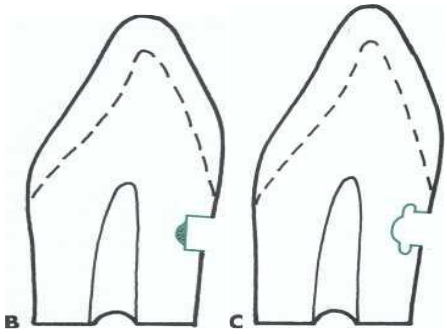
Class V Tooth Preparation

Conventional

- the feature of the preparation include a 90 degree cavosurface angle, uniform depth of the axial line angle, and sometimes, groove retention form.
- conventional design is indicated only for portion of the lesion extended onto the root surface

1. Use a tapered fissure (No. 700, 701, or 271) or No.1 or 2 round bur.
2. Make entry at 45 degrees angle to tooth surface, this should result to a 90 degree cavosurface.

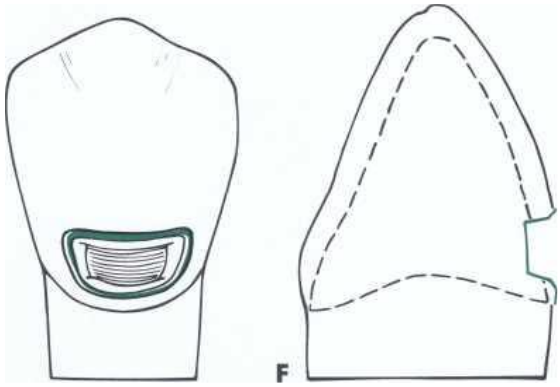
3. Axial depth is 0.75 mm to strength of preparation wall, strength of composite and placement of retention groove
4. Axial should follow contour of the tooth.
5. Extent of outline form is dictated by the carious lesion extent.
6. Remove remaining carious lesion
7. Prepare retention groove (similar to Class III preparation)
8. Clean preparation



Bevelled Conventional Class V

- Indications

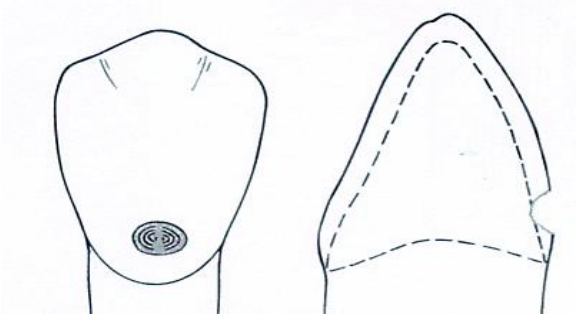
1. replacement of defective class V restorations
2. large carious lesion
   - exhibits 90 degrees of cavosurface
   - axial wall depth is uniform (0.2mm or 0.5 when retention groove is to placed)



- groove is not indicated when periphery of tooth preparation is located in enamel.
- remove all infected dentin
- clean preparation

Modified Class V

- indicated for small and moderate lesion and lesion entirely in the enamel
- no effort to prepare a butt-joint
- no retention groove
- lesion is scooped out
- preparation has divergent wall
- axial wall does not have uniform depth
- prepare tooth with round or elliptical instrument
- preparation is extended initially no deeper than 0.2 mm
- no effort is made to prepare a 90 degree cavosurface margins.
- infected enamel is removed with a round bur or excavator.



Restorative Technique

1. Determine shade of tooth

Shade Selection:

After caries removal and cavity preparation shade selection was done using shade guide

Restorative Technique

1. Determine shade of tooth
2. Clean the tooth preparation using slurry of pumice, polishing cup.
3. Isolate the tooth, preferably with a rubber dam or cotton rolls, to keep the prepared teeth from saliva, blood, debris and other fluids..
4. Protect adjacent unprepared tooth from the acid etchant with a polyester strip apply the wedge.
5. Apply the gel etchant 0.5 beyond the prepared margins onto the adjacent unprepared tooth.
6. Etchant is left undisturbed for 15 seconds.
7. The area is washed to remove the etchant.

8. Dry the tooth structure

9. Bonding system is applied on all tooth structure that has been etched with a microbrush or other suitable applicators

10-Application of Bonding Agent: Application of the bonding agent and then cured for 10 seconds.

11. Incrementally place composite material and cure.

12. **Curing of the Composite:** The material is cured using the light curing machine for 20 seconds for every increment of composite that was placed.

13. **Finishing and Polishing:** The use of polishers with enhancers and polishing paste were done after the trimming of the excess composites.