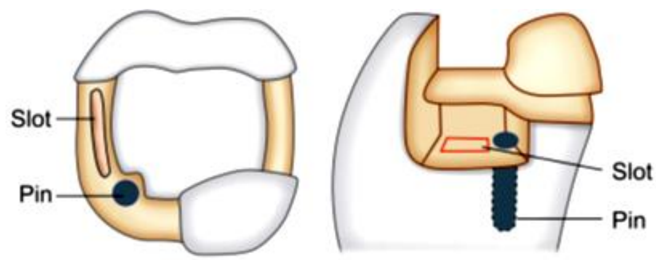
Complex amalgam restorations

Complex posterior restorations are indicated when tooth structure is missing due to cusp fracture, severe caries lesion development (two or more tooth surfaces are missing), and more retention and resistance forms are needed, or replacement of existing restorative material is necessary.

To compensate the lost tooth structure, may be moderate, severe or total, one or more than one retentive device is utilized. The routinely used retentive devices are:

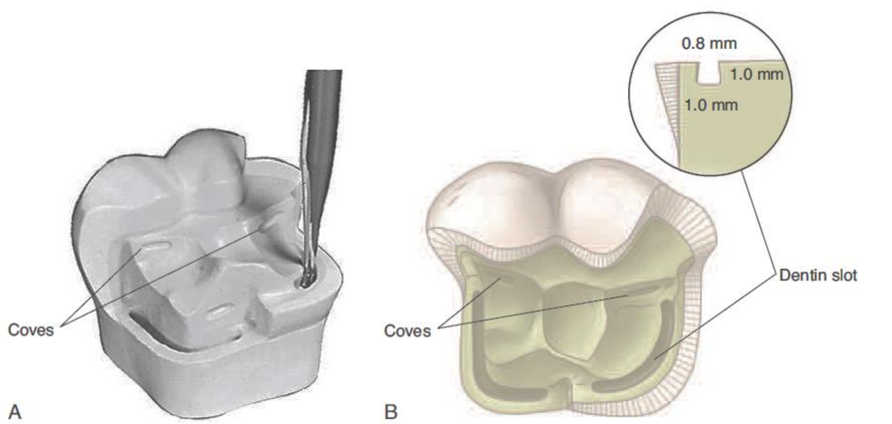
i. Slots.
ii. Locks.
iii. Coves.
iv. Cusp Coverage Complex Amalgams.
v. Crown lengthening.
vi. Pins.
vii. Amalgampin.
viii. Bonded Amalgam System.



i. *Slots:* They are a horizontal retentive groove in dentine. Slots are placed in the gingival floor of a preparation with a No. 330 bur. In general, slots should be about 1 mm wide and 1 mm deep, should be placed in the line-angle areas of the tooth, should be 2 to 4 mm in length (depending on the distance between remaining vertical walls), and be positioned 0.5 to 1 mm inside the DEJ.

ii. *Locks:* They are a vertical retentive grooves prepared in direct restorations. The lock extends upto the pulpal floor (along axiolingual line angle or axiofacial line angle).

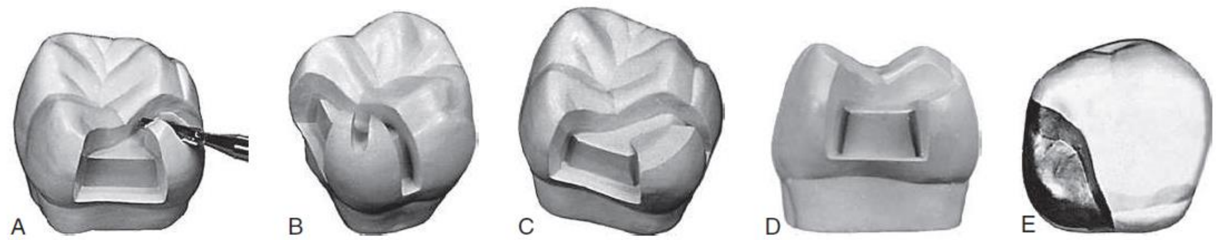
iii. Coves: They are small horizontal grooves prepared by using ¼ bur.



Slots. A and B, With a No. 330 bur, dentinal slots are prepared approximately 1 mm

Slot placement

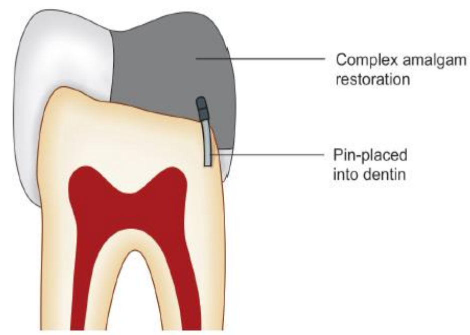
iv. Cusp Coverage Complex Amalgams: When tooth cusp is badly distracted or the cavity preparation width is more than two thirds of the inter-cuspal distance, the damaged cusp should be reduced and covered with a restoration.



Reduction of the distolingual cusp of the maxillary molar. A, Cutting a depth gauge groove with the side of the bur. B, Completed depth gauge groove. C and D, Completed cusp reduction. E, Distoocclusolingual complex amalgam.

v. *Crown lengthening*: In moderate to severe loss of tooth structure, one of the compensating procedures is to lengthen the crown surgically. The clinical crown can sometimes be lengthened surgically by electrosurgery.

vi. *Pins*: When the above mentioned retentive features are insufficient to provide desired retention, pin supported restorations are used. A pin retained restoration is defined as any restoration which requires the placement of pins in dentin in order to provide sufficient retention and resistance form to the restoration



Advantages:

1. Conservation of tooth material.
2. Increase resistance and retention form
3. One appointment (not time consuming).
4. Cost factor.

Disadvantages:

1. Dentin fracture: Use of pins in teeth where less dentin is present, produces stresses in dentin in form of craze lines or cracks.

2. Strength of amalgam: Compressive strength is not increased by use of pins, but there is decrease in tensile and transverse strength of amalgam.

3. Perforations: Using bur or pin in wrong direction can cause pulpal exposure or perforation of external tooth surface.

Indications:

1. Badly broken teeth.
2. Badly broken non-vital tooth requiring endodontic treatment.
3. Extended preparations.
4. Foundation for full coverage restoration.
5. Extensive class V restorations.
6. Time period and cost factors.

Contraindications:

1. When patient has occlusal problems.
2. When esthetics is concerned.

3. When direct restoration is not possible because of functional or anatomical considerations.

Types of pins:

Pins can be classified as:

1. Indirect pins/parallel pins:

Indirect pins are smaller in size when compared to their pinholes and they constitute an integral part of a cast restoration. These pins are also known as the parallel pins because they are placed parallel to each other and to path of insertion of restoration. Indirect pins usually have two types:

a. Cast gold pins.

b. Wrought precious metal pins.

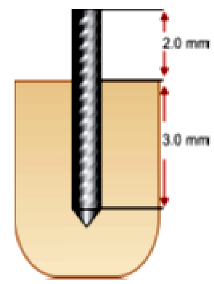
2. Direct pins/nonparallel pins:

These are commonly made of stainless steel. Other materials can be silver, titanium, stainless steel with gold plating, etc. These pins are also known as non-parallel pins because they can be inserted directly into dentin and need not be parallel.

a. Cemented pins.

b. Friction locked pins.

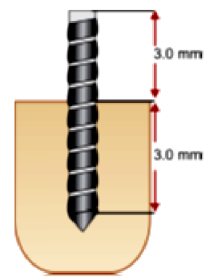
c. Self-threading pins.



Cemented pin.

a. Cemented Pins:

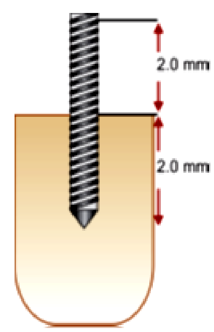
For these pins, the prepared pinholes should be 0.025 to 0.05 mm larger than the diameter of pin. This difference in diameter provides space for cementing media. Pins are available in various diameters ranging from 0.018” to 0.030” with the corresponding pinholes of 0.020 to 0.032 inches. Depth of hole in dentin for pin insertion should be 3 to 4 mm.



Friction Locked pins.

b. Friction Locked Pins:

These pins are 0.001” larger than their pinholes, hence utilize the elasticity of dentin for retention. They are 2 to 3 times more retentive than the cemented pins.



Self-threading pin

c. Self-threading Pin:

Self-threading pins are 0.0015” to 0.004” larger than their pinholes. Elastic property of dentin allows insertion of a threaded pin into a hole of a smaller diameter. Pins are retained due to mechanical grasp of threads into dentin. These are available in stainless steel or titanium but can be gold plated to increase their passivity. Currently, threaded pins are most popular amongst the three pin systems because of their ease and rapidity of insertion and maximum retention offered. They are 3 to 6 times more retentive than the cemented pins.

Thread mate system: It is considered as the most widely used among self-threading pins.

Types of pin size:
1. Minuta: Is smallest in size among these self-threaded pins.
It is too small to provide retention in the tooth. So, it is rarely used nowadays.
2. Minikin: Is considered as the pin of choice in grossly decayed posterior teeth because of providing better retention, less dentin crazing and less chances of pulp involvement.
3. Minim pin: This pin is also preferred in some cases, depending upon the availability of dentin because it provides less dentinal crazing as compared to regular pins and can be used in cases where pinholes for minikin gets over-prepared.
4. Regular: Regular is largest diameter pin among thread mate system pins. It is rarely used because of creating great amount of stress and crazing around pins.

Factors affecting retention of pins in tooth structure and restoration:
1. Pin type: With regard to the retentiveness of the pin in dentin, the self-threading pin is the most retentive, the friction-locked pin is intermediate, and the cemented pin is the least retentive.

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

3. Pin Number: Within limits, increase in number of pins increases the retention in dentin (on the other hand it increases the stress over the dentin and causes cracks). Usually it should be one pin per missing cusp.

4. Pin Diameter: Within limits, retention increases with increase in diameter of the pin.
5. Pin Orientation: It also affects retention, for example, pins placed in non-parallel increase retention.
6. Pin Shape: Retention cleats and square or pear-shaped heads on the pins improve retention of pin.
7. Inter-pin Distance: Placing pins close to each other (minimum inter-pin distance 2 mm) increases retention. If distance is lesser than 2 mm, pin retention is reduced because of the less amount of material present in between the pins and increase the residual stresses in dentin.

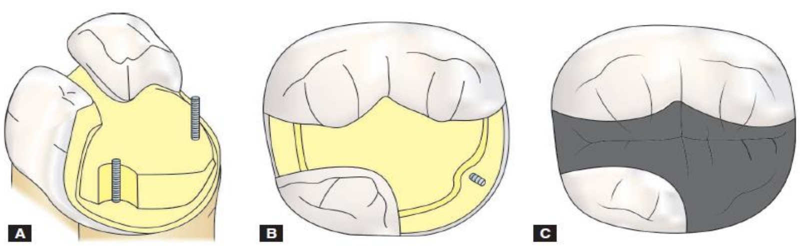
8. Cementing Agents: Zinc phosphate cement is more retentive than polycarboxylate and zinc-oxide eugenol cements. Glass ionomer cement is also more retentive.

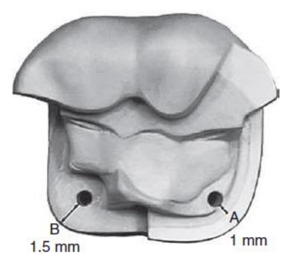
9. Extension Into Dentin and Amalgam: Self-threading pin extension into dentin and amalgam should be approximately 1.5 to 2 mm to preserve the strength of dentin and amalgam. If the extension is greater than this, is unnecessary for pin retention and it will be contraindicated.

Principles of pin placement:

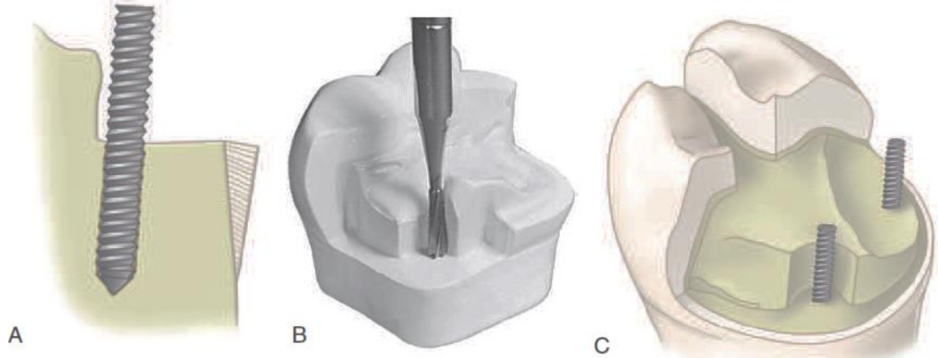
1. Number of pins: It should be one pin per missing cusp or one pin per missing axial line angle. In case if more than one pin is used, 3-5 mm space between pins is required. or cemented pins, it is 2 mm; for friction lock, it is 4 mm; and for threaded pins, it is 5 mm.
Increasing the number of pins increases the chances of increased stresses, pulpal damage and/or perforation, hence the aim should be to achieve adequate retention with minimum possible number of pins.

2. Pin site: The most desirable locations for pinholes are the facio/linguo-proximal line angles or corners of the tooth. The site should be half way between the pulp and the dentino-enamel junction/external surface of the tooth. There should be at least 1.0 mm of sound dentin around the whole circumference of the pin. It should also be located no closer than 0.5 mm to the dentino-enamel junction to avoid crazing of enamel. When three or more pins are to be placed in the same tooth, they should preferably be located in different planes/levels to preclude interaction of
stresses in the same plane. The position of a pinhole must not result in the pin being so close to a vertical wall of tooth structure that condensation of amalgam against the pin or wall is difficult.

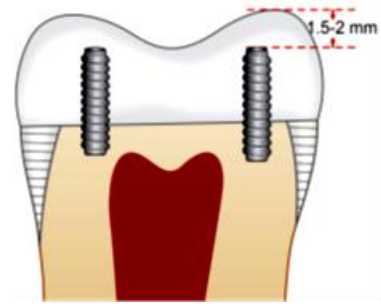




(A) When pin placement would be close to the longitudinal wall of the cavity, a cove is prepared in the adjacent vertical wall to create space for pin placement (proximo-occlusal view); (B) Mesioocclusodistal cavity in mandibular second molar with one pin replacing the disto-lingual cusp (occlusal view); (C) Completed pin-retained restoration



A, Pin placed too close to the vertical wall such that adequate condensation of amalgam is jeopardized. B and C, Recessed area prepared in the vertical wall of the mandibular molar with a No. 245 bur to provide adequate space for amalgam condensation around the pin.

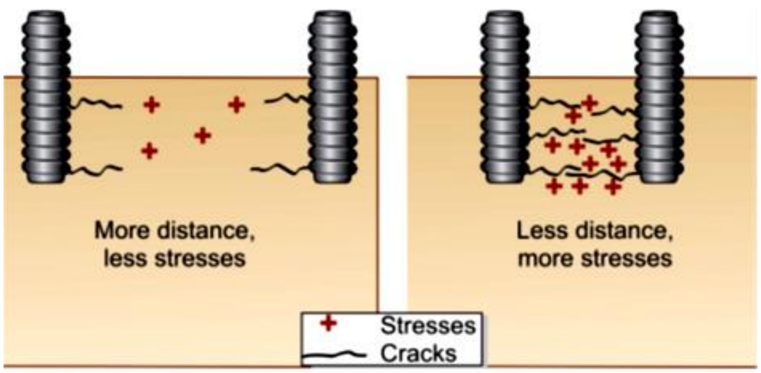


3. Pin orientation: Pins should be oriented parallel to the long axis of the tooth.

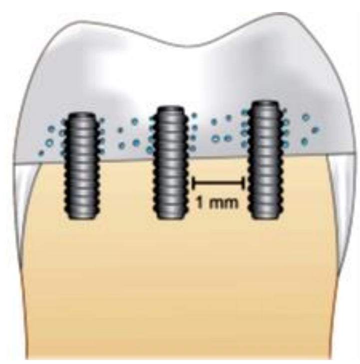
4. Pin diameter: The selection for the diameter of the pin depends upon:
(a) The amount of dentin available.
(b) The size of the concerned tooth.
(c) The amount of retention required.
Generally, increasing the diameter of the pin offers increased retention, but large sized pins are also associated with a heavy concentration of stresses in dentin.

5. Pin length: The optimum ratio of pin length in dentin to pin length in restorative material varies with the different types of pins, i.e. for cemented pins it is 3.0 mm and 2.0 mm; for friction locked pins it is 3.0 mm and 3.0 mm; and for threaded pins it is 2.0 mm and 2.0 mm respectively.

6. Interpin distance: The minimal inter-pin distance is 2.0 mm for cemented pins, 4.0 mm for friction locked pins, 3.0 mm for Minikin threaded pins and 5.0 mm for Minim threaded pins. The accepted principle is to have 2.0 mm of dentin around each pin.

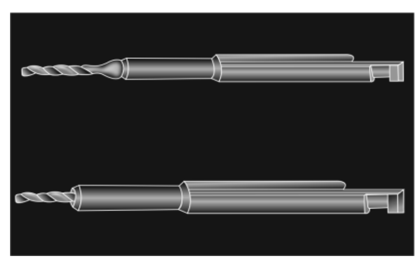


Lesser is the interpin distance, more are the stresses generated



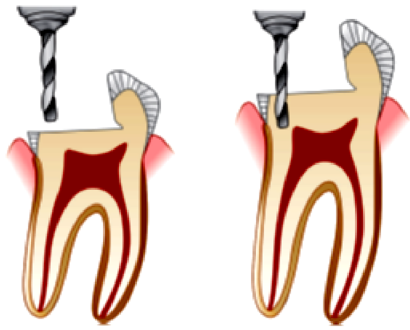
Unnecessary use of pins can cause stresses and voids in restoration

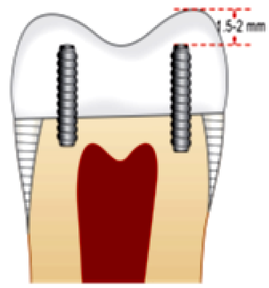
Technique of Preparation of Pinhole:



1. Pinholes are prepared using twist drills. Commonly used drill for pinhole preparation is Kodex drill.
2. Omni-depth gauge is used to measure accurate depth of pinhole
3. Mark the point where pin is supposed to be placed. Penetrate a small round bur (No. ¼) at low speed up to half of its diameter.
This will make lead hole which allows accurate positioning of twist drill.
4. Direct the drill towards desired location of pin placement. Drill should be kept continuously moving only in one axis and one direction from the time of insertion till removal to avoid fracture of the drill in the pinhole and over-cutting.
5. While cutting dentin, apply slight pressure. During drilling, avoid slanting of the handpiece, or allowing the drill to rotate more at the bottom of the pinhole as this may result in a large hole.

6. After pin preparation is complete, confirm the depth using omni-depth gauge and take a radiograph.
7. Pin is then inserted to the hole either by using hand wrench or low speed hand-piece.
8. To trim the pin, cut it short with a sharp fissure bur running in a high-speed hand-piece keeping bur perpendicular to the pin. Matrix band then should be placed around the tooth and amalgam restoration should be inserted, condensed, carved and polished properly.





At least 1.5-2 mm space for restoration material should be present occlusal to pin.

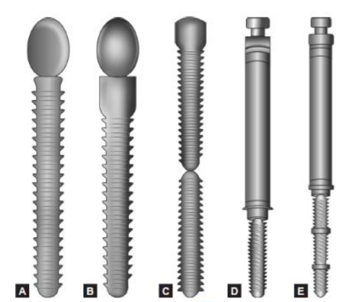

A, Use of sharp No. 1/4 bur held perpendicular to the pin to shorten the pin.

A, Use of a hand wrench to place a pin. B, Threading the pin to the bottom of the pinhole and reversing the wrench one quarter to one half turn. C, Evaluating the length of the pin extending fromdentin.

Pin Design

All of the above-mentioned pins are available in the following designs:

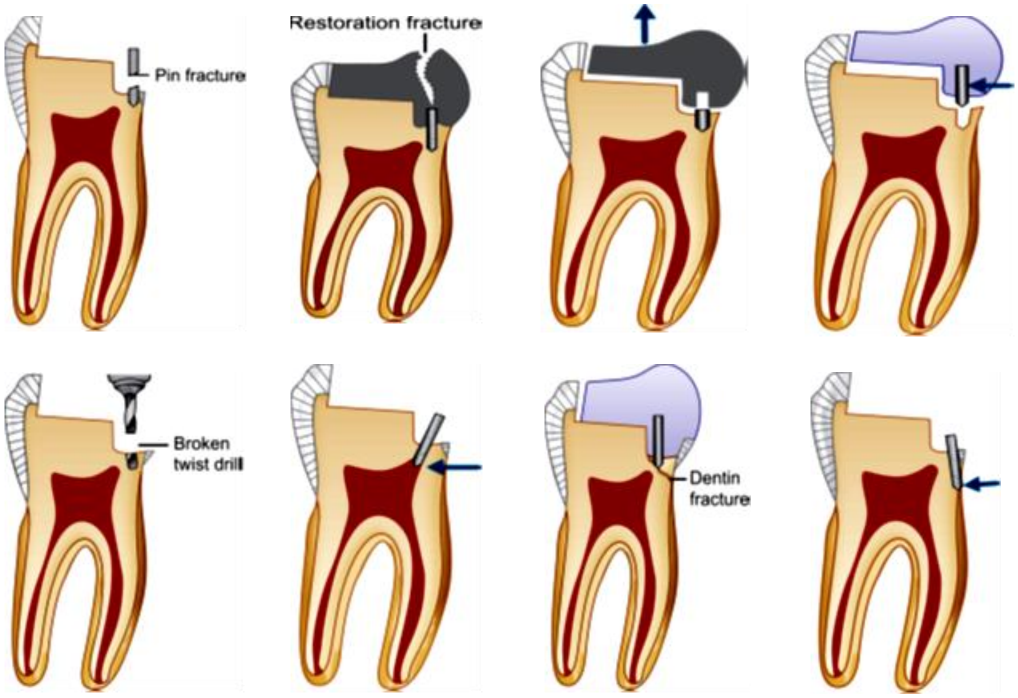
1. Standard.
2. Self-shearing.
3. Two-in-one.
4. Link series.
5. Link plus series.



(A) Standard pin; (B) Self-shearing pin; Figure (C) Two-in-one design; (D) Link series; (E) Link plus series.

Failures:

1. Pin fracture.
2. Restoration fracture.
3. Restoration pulled away from the pin.
4. Separation of pin along with restoration.
5. Broken twist drill.
6. Pulp penetration while pin placement.
7. Dentin fracture.
8. Perforation of periodontium.



vii. Amalgampin.

Amalgapins are vertical posts of amalgam anchored in dentin. Pits prepared in dentin are shallow and little wider than pinholes. These are called 'dentin chambers'. Post formed by amalgam in dentin chamber is called 'amalgapin'. Dentin chamber is prepared by using inverted cone bur on gingival floor 0.5 mm in dentin with 1 to 2 mm depth and 0.5 to 1 mm width. Amalgapins increase the retention and resistance of complete restoration.

viii. Bonded Amalgam System:

One of major disadvantages of the amalgam is that it does not adhere to the preparation walls. To conquer this problem, bonded amalgam is developed. In this, dentin bonding system is used along with a viscous resin liner which physically mixes with the amalgam and forms a micromechanical union to increase amalgam's retention to tooth structure. It provides chemical binding to inorganic and organic components of dentin and enamel. Its main disadvantage is reduction in bond strength over years because of repeated thermocycling in the oral cavity.

Reference:

1. Sturdevant's art & science of operative dentistry. Seventh edition (2015).
2. Textbook of operative dentistry. Nisha Garg and Amit Garg. (2015).
3. Textbook of Operative Dentistry. Vimal K Sikri. Fourth edition (2014).