Endodontics

Lec 9 **د. بهاء عبدالرزاق**

Restorations of the Endodontically Treated Teeth

Endodontic treatment, particularly excessive access preparations, can result in significant loss and weakening of tooth structure. Tooth structure lost during endodontic treatment together with the loss of moisture (9%) in dentin and brittleness of the tooth after loss of its vitality increase the risk of crown fracture.

Restorations of endodontically treated teeth are designed to (1) protect the remaining tooth from fracture, (2) prevent reinfection of the root canal system, and (3) replace the missing tooth structure.

❖ RESTORATIVE MATERIALS AND OPTIONS

Although the use of a crown built on post and core is a traditional approach, others have advocated the use of direct composite resins for restoring small defects in endodontically treated teeth. More recently, indirect restorations such as overlays or endocrowns made of composite resins or ceramics have also been used. The selection of appropriate restorative materials and techniques is dictated by the amount of remaining tooth structure. Despite the large number of *in vitro* and *in vivo* investigations, dilemma still remains regarding ideal treatment modalities for success of the endodontically treated teeth.

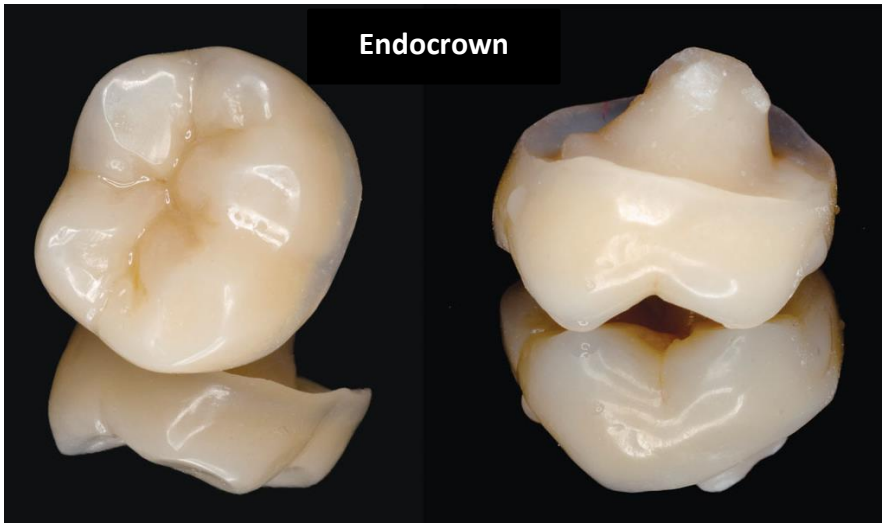
▪ Direct Composite Restorations

When a minimal amount of coronal tooth structure has been lost after endodontic therapy, a direct resin composite restoration may be indicated. In other words, a direct composite restoration may be indicated when only one proximal surface of the tooth has been lost; providing residual walls are thick enough (proximal ridges and buccolingual walls more than 1.5-mm thickness). It was reported that the resistance to fracture of endodontically treated teeth is reduced by 69% in cases where MOD cavities are present. Under such conditions, a direct composite restoration may not be appropriate to prevent the tooth structure from fracture and reinfection. In such cases, fiber-reinforced composite restorations may represent a valuable alternative to conventional restorations of endodontically treated teeth.

▪ Composite or Ceramic Onlays and Overlays

Ceramic or resin composite onlays and endocrowns can also be used to restore endodontically treated teeth. Whereas overlays incorporate a cusp or cusps by covering the missing tissue, endocrowns combine the post in the canal, the core, and the crown in one component. Both onlays and endocrowns allow for conservation of remaining tooth

structure, whereas the alternative would be to completely eliminate cusps and perimeter walls for restoration with a full crown. Onlays and overlays are generally constructed in the laboratory from either hybrid resin composite or ceramics.



- **Full Crowns**

When a significant amount of coronal tooth structure has been lost by caries, restorative procedures, and endodontics, a full crown may be the restoration of choice. In a few cases, the crown can be directly built on the remaining coronal structure, which has been prepared accordingly. More frequently, the cementation of a post inside the root canal is necessary to retain the core material and the crown. The core is anchored to the tooth by extension into the root canal through the post and replaces missing coronal structure. The crown covers the core and restores the aesthetics and function of the tooth. The post, the core, and their luting or bonding agents together form a *foundation restoration* that supports the crown.

Posts

The large number of post designs and materials available on the market reflects the absence of consensus in that field. Posts can be fabricated from metal (gold, titanium, stainless steel), ceramic, or fiber-reinforced resins.

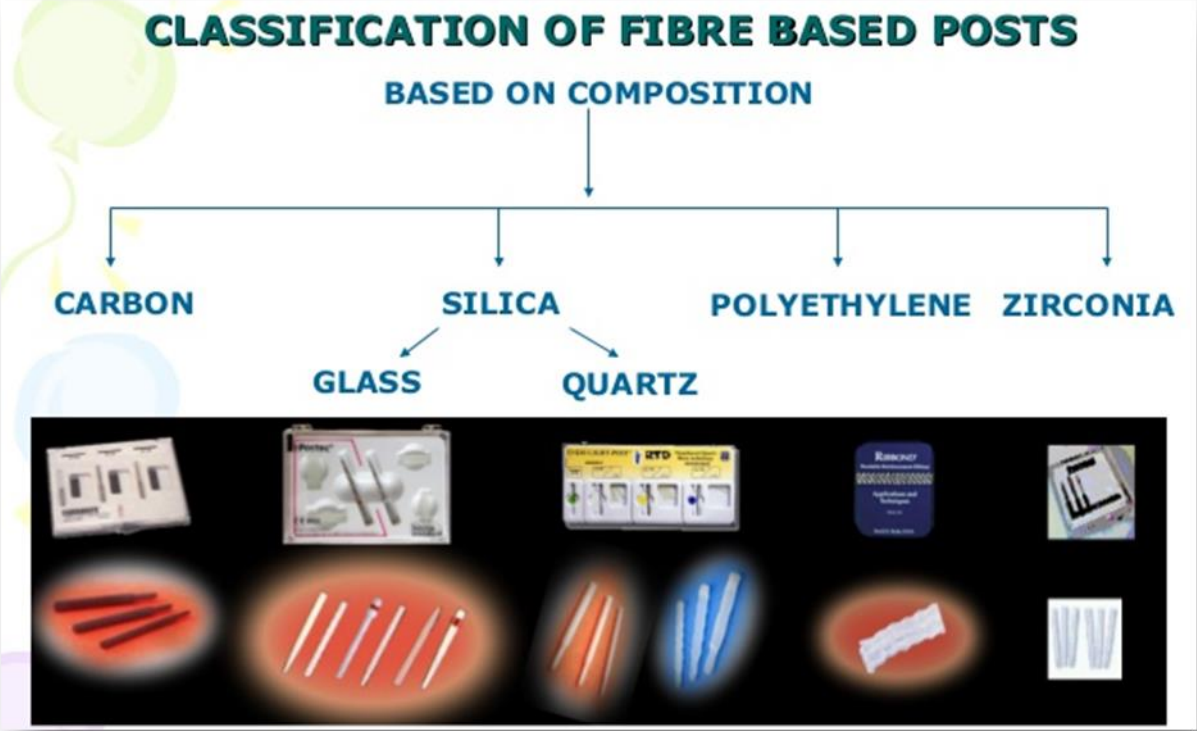
- ***Prefabricated Metallic Posts***

Prefabricated metallic posts are frequently used for the fabrication of a direct foundation restoration. These posts are classified several ways, including by alloy composition, retention mode, and shape. Materials used to fabricate metallic posts include gold alloys, stainless steel, or titanium alloys. Metallic posts are very strong and, with the exception of the titanium alloys, very rigid.

The retention of prefabricated posts inside the root canal is also essential for successful restorations. Two basic concepts have been used to promote the retention of endodontic posts: active posts and passive posts. Active posts derive their primary retention directly from the root dentin by the use of threads. Most active posts are threaded and are intended to be screwed into the walls of the root canal. A major concern about threaded posts has been the potential for vertical root fracture during placement. As the post is screwed into place, it introduces great stresses within the root, causing a wedging effect. Therefore, it is generally accepted that *the use of threaded posts should be avoided.* Furthermore, the improved retention once offered by threaded posts can now be achieved with adhesive luting cements. Passive posts are passively placed in close contact to the dentin walls, and their retention primarily relies on the luting cement used for cementation. The shape of a passive post may be either tapered or parallel. A parallel post is more retentive than a tapered post but also requires removal of more root dentin during the preparation of the post space.

- ***Fiber Posts***

A fiber post consists of reinforcing fibers embedded in a resin polymerized matrix. Monomers used to form the resin matrix are typically bifunctional methacrylates (Bis-GMA, UDMA, TEGDMA), but epoxies have also been used. Common fibers in today's fiber posts are made of carbon or silica (glass or quartz), but the type, volume content, and uniformity of the fibers and the matrix vary among fiber post systems. The original fiber posts consisted of carbon fibers embedded in epoxy resin, but quartz-fiber posts are currently preferred for their favorable mechanical properties, aesthetic qualities, and ability to chemically bond to the polymer matrix. Current fiber posts are radiopaque and may also conduct the light for polymerization of resin-based luting cements. A light-transmitting post results in better polymerization of resin composites in the apical area. To enhance bonding at the post/core/cement interfaces, several physicochemical pretreatments such as hydrofluoric etching, silanization or sand blasting of the post surface have been described. It is generally accepted that bonding fiber posts to root canal dentin can improve the distribution of forces applied along the root, thereby decreasing the risk of root fracture and contributing to the reinforcement of the remaining tooth structure. A well-adapted adhesively cemented fiber post is considered the most retentive with the least stress generated on the canal walls.



Core Materials

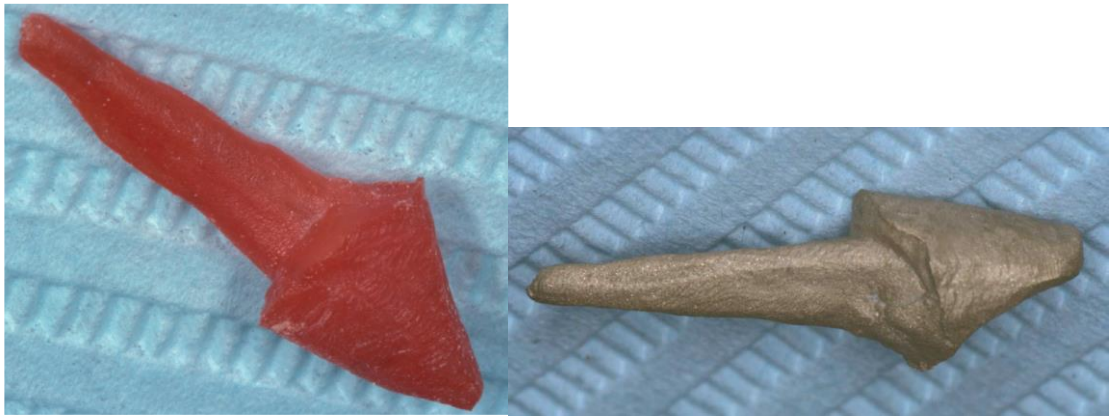
The core replaces carious, fractured, or missing coronal structure and helps to retain the final restoration. Desirable physical characteristics of a core include (1) high compressive and flexural strength, (2) dimensional stability, (3) ease of manipulation, (4) short setting time, and (5) the ability to bond to both tooth and post. Core materials include composite resin, cast metal or ceramic, amalgam, and sometimes glassionomer materials.

Indirect Foundation Restorations: Custom Cast Post and Core

For many years, use of the cast metal post and core has been the traditional method for fabricating the foundation restoration of a prosthetic crown. Classically, smooth-sided, tapered posts conforming to the taper of the root canal are fabricated from high noble alloys, although noble and base-metal classes of dental alloys have also been used. Custom-cast posts and cores are preferred for roots that have oval or very tapered root canals because the post made to fit the existing morphology after root canal treatment rather than removing tooth structure to make the root fit the form of a prefabricated post. One advantage of the cast post/core system is that the core is an integral extension of the post and that the core does not depend on mechanical means for retention on the post. This construction prevents dislodgment of the core from the post

and root when minimal tooth structure remains. However, the cast post/core system also has several disadvantages; the procedure is expensive because two appointments are needed, and laboratory costs may be significant. The laboratory phase is technique sensitive. Most important, the cast post/core system has a higher clinical rate of root fracture than preformed posts.

Cast post and core restorations can be fabricated with either direct or indirect techniques. In the **direct technique**, a castable post and core pattern is fabricated in the mouth on the prepared tooth. A preformed plastic post pattern is seated in the post space. Acrylic resin is added to create a core directly attached to the post pattern. The finished pattern is removed from the tooth and cast in the laboratory. With the **indirect technique**, a final impression of the prepared tooth and post space is made. The castable final post and core pattern are fabricated on a die from this impression.

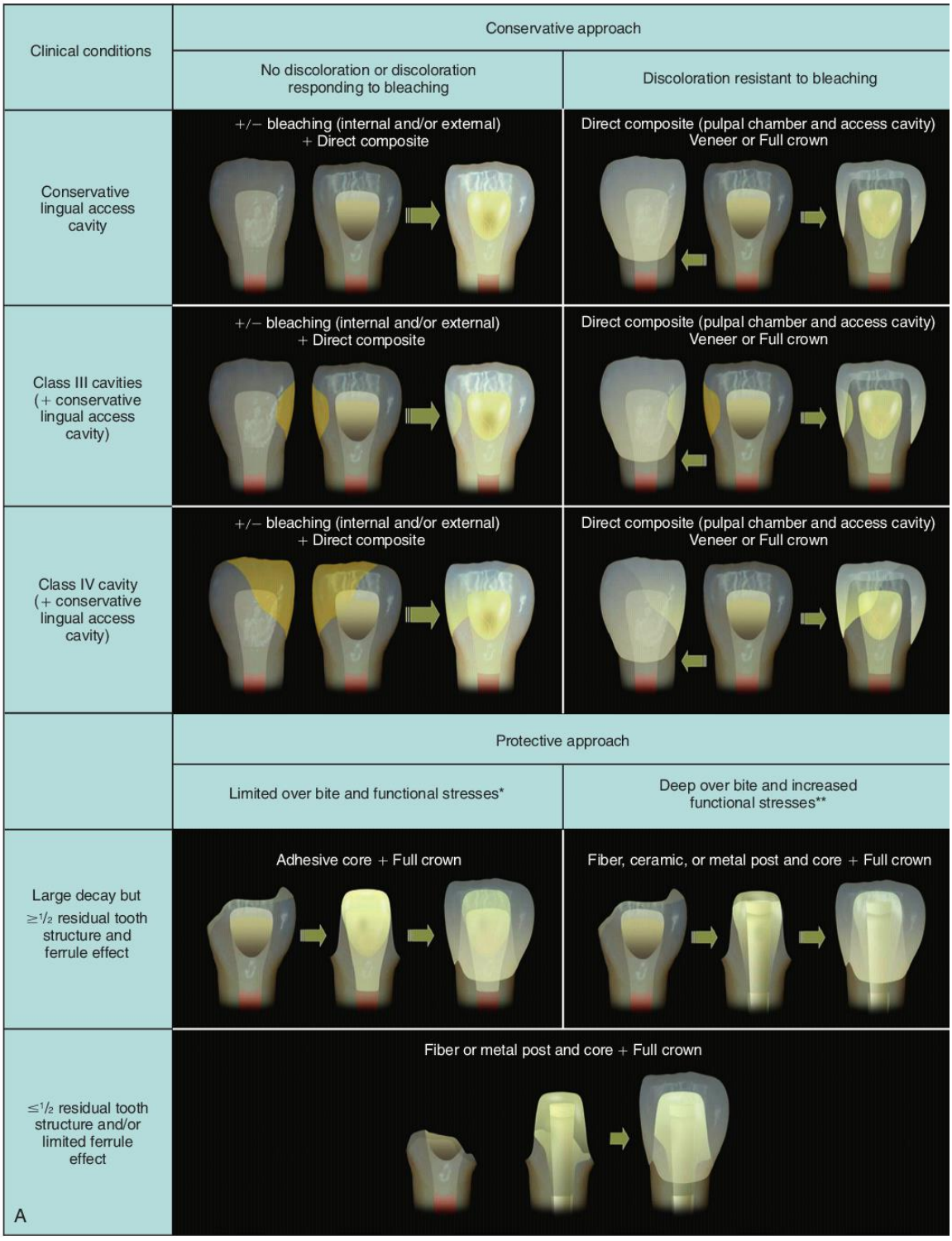


Cast post and core

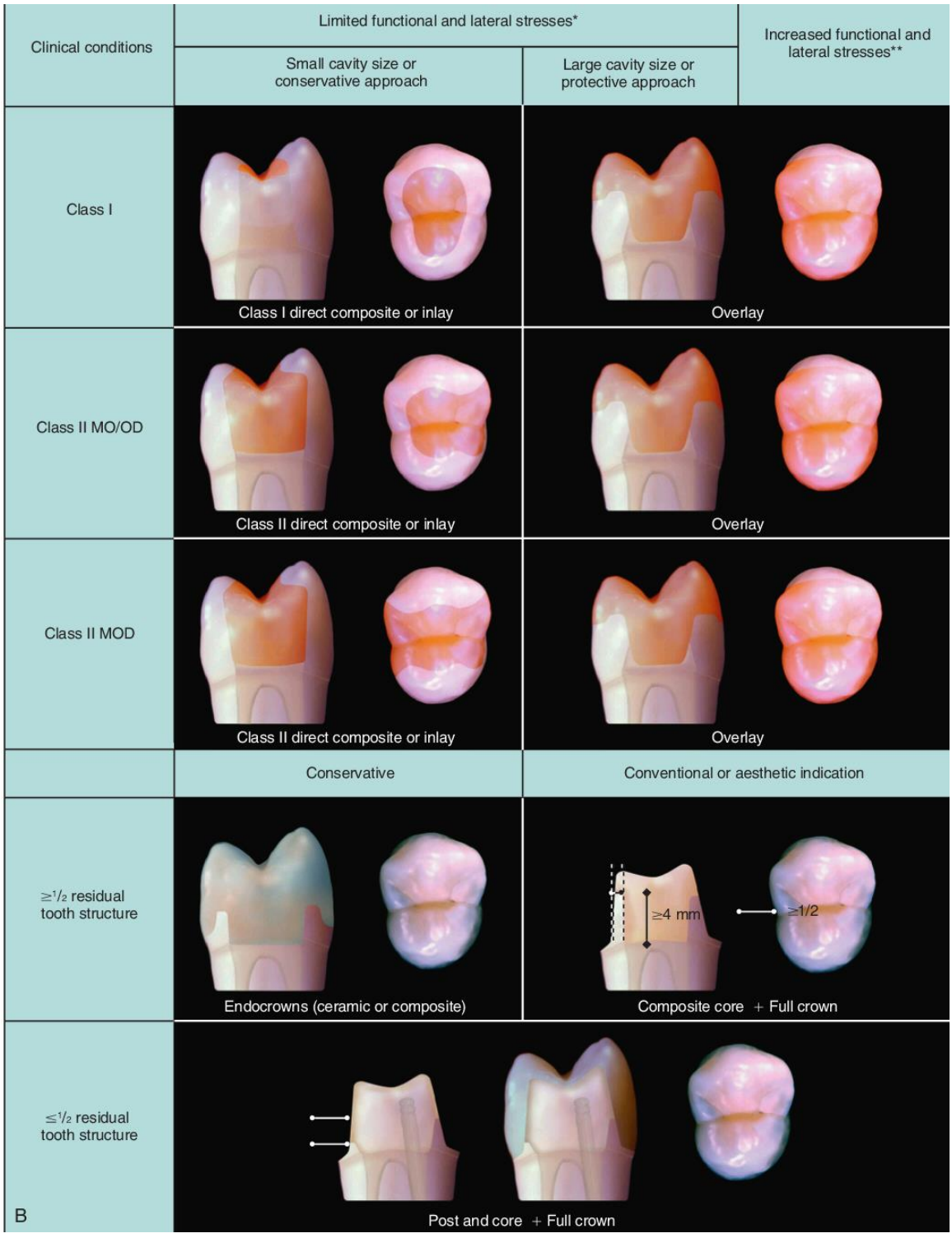
Luting Cements

A variety of cements have been used to cement endodontic posts and include traditional cements, glass ionomer cements, and preferably resin-based luting cements.

❖ Treatment planning:



A. Current recommendations for the treatment of nonvital anterior teeth. *Normal function and anterior guidance; **moderate to severe parafunctions and abnormal occlusion/anterior guidance.



B, Current recommendations for the treatment of nonvital posterior teeth. *Relatively flat anatomy and canine guidance, normal function; **group guidance, steep occlusal anatomy, parafunctions.

Clinical guidelines for post length:

• *For metal posts (non-adhesive cementation):*

– The post should be as long as two-third the length of the canal

– The length of the post should be at least the coronal length of the core

– The post should be at least half the length of root in the bone.

• *For fiber posts (adhesive cementation):*

– The post should extend to a maximum of one-third to one half the length of the canal

– The length of the post should be at least the coronal length of the core

Other important factors to be considered in the selection of the post length include:

• The post should be as long as possible without disturbing the apical seal. At least 3-5 mm of the apical gutta-percha should be retained

• To decrease the dentinal stress, the post should extend at least 4 mm apical to the bone crest

• Molar posts should not extend more than 7 mm apical to the canal orifice so as to avoid the risk of perforation of the root canal.

Clinical guidelines for post diameter:

1. Instrument used to prepare posts space should be related in size to root dimensions to avoid excessive post diameters that lead to root perforation.
2. A frequently used and clinically appropriate guideline for post diameter is not to exceed one-third of the root diameter.
3. Optimal post diameter measurements have been determined to be approximately 0.6 mm for mandibular incisors, 1.0 mm for maxillary central incisors, maxillary and mandibular canines, and the palatal root of the maxillary first molar. The recommended post diameter for the other teeth was 0.8 mm.
4. Molar posts longer than 7 mm have an increased chance of perforations and therefore, should be avoided even when using instruments of an appropriate diameter.
5. It is best to fabricate a post that fits into the existing morphologic form and diameter rather than additionally preparing the root to accept a prefabricated type of post. This is one of the primary indications for use of a custom cast post and core.

Procedure for post space preparation and post placement:

1. Take an x-ray to evaluate the condition, length and width of the tooth.
2. Preserve as much as possible of the tooth structure coronally but at the same time offers an easy access of the Pesso drill to the root canal.
3. The gutta percha is removed by the Pesso drill with as minimum tooth structure removal as possible.
4. A suitable sized post should be placed to fit the space in the root canal.
5. The post is cemented in the root canal with a luting agent (composite luting cement or glass ionomer cement) in the canal.
6. Threaded posts do not require to be cemented.

7. The core is built up with a suitable material as composite or amalgam.

Notes:

1- When a post is needed it gives retention to the core but it does not strengthen the tooth against fracture especially metal posts.
2- Adequately condensed gutta percha can be safely removed immediately after endodontic treatment. Both rotary and hot instruments can be safely used to remove gutta percha.
3- When posts and cores are needed in premolars, posts are best placed in the palatal root of the maxillary premolar. The buccal root could be prepared to a depth of 1 to 2 mm and to serve as an antirotational lock, if needed.
4- When posts and cores are needed in molars, posts are best placed in roots that have the greatest dentin thickness and the smallest developmental root depressions. The most appropriate roots (the primary roots) in maxillary molars are the palatal roots and in mandibular molars are the distal roots. The facial roots of maxillary molars and the mesial root of mandibular molars should be avoided if at all possible. If these roots must be used in addition to the primary roots, then the post length should be short (3 to 4 mm) and a small-diameter instrument should be used (no larger than a No. 2 Peeso instrument).
5- As a general rule, the more tooth structure that remains, the better the long-term prognosis of the restoration. The coronal tooth structure located above the gingival level will help to create a ferrule. The *ferrule* is formed by the walls and margins of the crown, encasing at least 2 to 3 mm of sound tooth structure. A properly made ferrule significantly reduces the incidence of fracture in endodontically treated teeth.