What are the differences between vital and endodontically treated tooth?

* No decrease in the compressive and tensile strengths of both teeth.
* No significant difference in the moisture content (up to 9% moisture decrease).
* No evidence of chemical alteration due to removal of pulp tissue.

However, the major changes are in tooth bio-mechanic which attributable to the loss of tissue following carious lesion, fracture or cavity preparation.

***Problems of endodontically treated teeth***

1. Coronal Microleakage

It is important to carry out the coronal restorations after the completion of the endodontic treatment. Otherwise this will allow the passage of microorganisms and their byproducts to the apical region of the root and into the alveolar bone, and this may lead to failure of the whole treatment

1. Fracture

Endodontically treated teeth undergo loss of tooth structure and changes in physical characteristics, such as a reduced modulus of elasticity, which often lead to increased fracture susceptibility when compared to un-restored vital teeth.

1. Discoloration

Often, discoloration and decreased opacity are aesthetic changes that accompany the previous problems.

***Restoring of endodontically treated teeth***

**Anterior teeth**

Minimal coronal damage, intact marginal ridges, intact cingulum (small access opening), Intact incisal edge, and 1-2 small proximal lesions/restorations.

**TREATMENT**🡪

Restore access opening with a composite resin.

***Restoring of ETT 🡪 criteria***

**Anterior teeth**

* Significant coronal damage, undermined marginal ridges, loss of incisal edge and/or coronal fracture.

 **TREATMENT**

* Core Reconstruction or Foundation restoration (Post/core) and then Full crown restoration.

**Posterior teeth**

* Minimal coronal damage, low risk of fracture during functioning contacts, minimal occlusal forces, intact facial and lingual cusps

**TREATMENT**

**–**Composite or amlagam

-MOD onlay🡪gold vs ceramic

-No post

* Significant coronal damage, little or no remaining coronal tooth structure, high risk of fracture and FPD/RPD abutment.
* **TREATMENT:** Foundation restoration (Post/core) and then Full crown restoration.

Therefore coronal tooth structure of ETT that was severely lost by:

 - Dental caries

 - Previous restorations

 - Tooth fracture

SHOULD be replaced by Core Reconstruction or Foundation restoration (Post/core) and then Full crown.

***Restoring of Endodontically Treated teeth by foundation restoration***

A foundation restoration is often indicated when inadequate coronal tooth structure remains (one half or more loss) to permit development of retentive and resistant forms for final crown restoration. Post and cores can be referred as one of the foundation restorations.

*Foundation Restorations for ETT Teeth*

*The concept of using the root of a tooth for retention of a crown is not new. In the 1700s Fauchard inserted wooden posts in canals of teeth to aid in crown retention*

*Post and core is a dental restoration, which is used to restore a tooth morphology followed by future restoration such as a crown, when there is no an adequate part of tooth hard tissue*

*1. Prefabricated Post*

*a. Parallel-sided smooth.*

*b. Parallel-sided serrated.*

*c. Tapered smooth.*

*d. Tapered serrated.*

*2. Cast post*

 *a. Direct technique.*

 *b. Indirect technique.*

***Cast or Prefabricated Posts (Function)***

*It is worth noting that the post itself does not strengthen or reinforce the tooth; the inherent strength of the tooth and its resistance to fracture comes from the remaining tooth structure and the surrounding alveolar bone*

***Restoring of Endodontically Treated Tooth***

*Prefabricated Post and Core*

* *Posts are fabricated by a huge number of manufacturers and can differ in material, length, diameter and design.*
* *The core itself is a dental restoration commonly made of composite resin or amalgam used to build up missing tooth structure, usually for future restoration with a crown.*

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***Cast post and core:***

*A one piece foundation restoration for an ETT that a post within root canal and a core replacing missing coronal structure to form the tooth preparation.*

***The use of Cast or Prefabricated Posts and Cores:***

*For endodontically treated* ***anterior*** *teeth with moderate to severe destruction, cast post and core have been described as the restoration method of choice.*

***Cast or Prefabricated Posts and Cores***

*Molars often perform satisfactorily with direct cores retained by engaging the pulp chamber and portions of root canals, and retention of the core can be increased by placement of 1 or more prefabricated posts.*

*Premolars may be restored with either custom cast posts and cores or prefabricated post (s) with direct core.*

***Cast or Prefabricated Posts and Cores***

*Cast post and core preparation*

*1. Removal of carious tooth structure (???).*

*2. Reduction for remaining tooth structure and prepare finishing lines.*

*3. Maintain at least 2mm tooth structure coronally “****Ferrule****”.*

*4. Prepare post space.*

*5. Prepare “Keyway”*

***Cast post and core Clinical Techniques:***

* *Retain as much coronal tooth structure as possible, in order to increase the effective post length and to enable the subsequent crown to produce a “ferrule” effect. Ensure the remaining dentin is strong, and does not have sharp angles, and is contoured and aligned correctly.*
* *Remove gutta-percha from the root canal. Using progressively larger diameter Pesso reamers or Gates-Glidden burs to remove the gutta percha to the predetermined* ***initial*** *depth (established by measurement of a radiograph).*
* ***The post space*** *should provide resistance to rotation of the post and core. If the configuration of the prepared canal is circular in cross section, it will not provide this resistance to rotation.*

*A* ***Keyway*** *should be placed within the canal. The keyway provides a positive seat for the core at the opening of the post space and prevents the over-seating of the post which may wedge the root and cause vertical fracture. The keyway should be cut to the width of “approx. 0.6mm” and depth of “approx. 2mm”.*

***Guidelines of canal preparation
Length of post***

***For a cast post the*** *length of the post should be at least as long as the length of the clinical crown, provided that 4-5mm of gutta percha remain as apical seal. A post length of 7-8 mm is frequently stated as a typical guideline.* ***For prefabricated*** *post, the length of post should about 7 mm (mainly for molar teeth).*

***Cast or Prefabricated Posts and Cores***

***Many clinical*** *studies have suggested that clinical success of posts is directly proportional to their length, so it is rational to prepare a post channel as long as it is consistent with anatomic limitations while maintaining 4 to 5mm of apical gutta percha seal.*

***The*** *width of the post is also an important consideration because randomly widening the diameter of the post will reduce the thickness and strength of the radicular dentine. The thickness of remaining tooth structure should at least 1mm thin.*

*The post diameter should be no more than 1/3 of the root diameter*

***Role of the Ferrule Effect:***

* ***A*** *post and core in a pulpless tooth can transfer occlusal forces intraradicularly with resultant tendency to vertical fracture of the tooth.*
* ***The*** *role of the final “Crown” restoration in the protection of the post-restored pulpless tooth is very important.*

*A ferrule is defined as a vertical band of tooth structure at the gingival aspect of a crown preparation. It adds some retention, but primarily provides resistance form and enhances longevity of the final crown restoration.*

*The term* ***“ferrule effect”*** *was used to describe the 360-degree ring of cast metal “Crown” and recommended extension of the crown restoration at least 2mm apical to the junction of the core and remaining tooth structure.*

*The ferrule effect is very important in increasing the fracture resistance, improving the integrity of the cement seal of cast crown, and improving resistance to fatigue failure of the cement seal of crown.*

***Current*** *knowledge has confirmed that the dentists should retain as much coronal tooth structure as possible when preparing pulpless teeth for complete crowns to maximize the ferrule effect.*

*Surgical* ***crown lengthening*** *or orthodontic extrusion should be considered with severely damaged teeth to expose additional tooth structure in order to establish a ferrule….. extraction of the tooth.*

***Orthodontic extrusion***

***Cast or Prefabricated Posts and Cores***

*Studies have demonstrated that roots restored with individual cast posts exhibited significantly higher resistance to fracture forces than that in prefabricated posts with composite cores.*

***Conservative, Controlled approach to
Removal of Gutta-Percha:***

* *A safe, rapid technique for removal of G.P. is the use of a heated instrument.*
* *Gates-Glidden burs or Pesso reamers can then be used to remove the gutta percha and endodontic sealer.*

***Removal of Gutta-Percha***

* *The friction generated between the filling and the tip of these burs softens the gutta-percha allowing the rotary instrument to track the canal with reasonable predictability.*
* *Choose a rotary instrument that is slightly narrower than the canal.*
* *Make sure that the instrument follows the center of the gutta percha and does not cut dentine.*

*Cast post can be made from a direct pattern fabricated in patient’s mouth or an indirect pattern fabricated in the dental laboratory.*

* *Direct Technique Indirect Technique*

***Cast Posts and Cores*** *Direct Procedure*

***Numerous*** *materials have been described for fabrication of the post-core pattern. These materials included:*

* *Auto-polymerizing or light cure resin with plastic rod ‘plastic post’.*
* *Wax with a solid plastic rod or s.s. wire as carrier and support.*

***Cast Posts and Cores****Direct Procedure “Acrylic resin"*

* *Try-in the preformed plastic post and be sure it goes all the way down the prepared canal without bending (a totally passive fit). Trim it as necessary.*
* *Lubricate the canal with Duralay lubricant. Use a perio probe, paper point, or cotton on a barbed broach. A thin coating is necessary.*
* *Also be sure a thin layer of lubricant covers all coronal surfaces of the tooth that will come into contact with the Duralay resin.*
* *Using the "bead -brush" technique, fill the canal completely with Duralay resin. Use the bristles of a brush to force acrylic down the canal and express any trapped air.*
* *Immediately, dip the plastic post in acrylic liquid (to soften post and enhance bond of acrylic) and seat it in the canal to its full depth.*
* *Allow the Duralay to set completely with moving the post up and down in the canal to avoid getting it "locked in."*

*Notes:*

* *Do not allow the resin to harden fully within the canal. Loosen and seat it several times while it is still rubbery.*
* *Once the resin has polymerized, removed the pattern.*
* *Identify any undercuts that can be trimmed away carefully with a scalpel.*
* *Use the "bead brush" technique to build the core portion of the pattern to full contour.*
* *Using a large diameter coarse diamond (high speed handpiece speed with water spray), shape the pattern to ideal preparation form (on the tooth).*
* *Using hemostats to remove the pattern from the tooth. The pattern should not be removed until it is completed. There is risk of breakage each additional time the pattern is removed.*

***Cast Posts and Cores
Ind****irect Procedure*

* *Select the preformed plastic post and be sure it goes all the way down the prepared canal without bending (passive fit). Trim it as necessary.*
* *Coat the plastic post with tray adhesive. Lubricate the canals to facilitate removal of the impression without distortion (die lubricant).*
* *Using a lentulo spiral, fill the canals with an elastomeric impression material.*
* *Seat the plastic post to the full depth of each post space, inject more impression material around the prepared tooth, and insert the impression tray.*
* *Remove the impression, evaluate it, and pour the master cast as usual.*

***Cast post and cores requires 2 Visits:***

* ***A*** *primary disadvantage of direct method of fabricating posts and cores is the chair side time to fabricate the pattern.*
* ***The*** *indirect method conserves chair side time by delegating the pattern for the post and core to a dental lab technician. Nevertheless the accurate impression of the prepared post space that extends deeply in the canal of endo treated tooth is a challenge.*
* ***Success*** *of the indirect method depends on the accuracy of the impression replicating the internal surface of the prepared root canal and work of the dental lab technician.*

***Alloys for Cast Posts and Cores:***

* ***Base*** *metal alloys traditionally used to cast frameworks for removable partial dentures were suggested as logical alternative to gold alloys and their use for post and cores was advocated.*
* ***A*** *major disadvantage of base-metal alloys is that their ground castings and contouring at the chair side is difficult due to their extreme hardness.*
* ***Post and cores*** *made from silver-palladium alloys are more easily adjusted at chair side and are suitable casting.*
* ***Many*** *properties of these silver-palladium alloys are similar to those of gold casting alloys and they offer an economical and satisfactory alternative for fabricating custom-cast post and cores.*

***Cast Posts and Cores*** *Metal Try-in:*

* *You must be particularly careful that casting defects do not interfere with seating of the post, least root fracture result. Post and cores should be inserted with gentle pressure. However, the marginal fit of a cast foundation is not as critical as that of other cast restorations, because the margins will be covered by the final crown restoration.*

***Cast Post and Cores as a method of restoring pulpless teeth:***

***It*** *has been* ***reported*** *that cast post and cores provide excellent service for anterior endodontically treated teeth with moderate to severe damage regardless the way of the fabrication.*

***Prefabricated Posts:***

* ***P.P.*** *has become more popular and there is a variety of systems available.*
* ***P****osts are supplied in various shapes with numerous surfaces configurations. They may be parallel-sided (threaded and non-threaded), and tapered, (threaded and non- threaded).*

*The most popular prefabricated post was the parallel serrated post. These systems are pre-threaded (not threaded in the canal) and that placement is passive (not active), as the posts themselves are not cutting into dentine at cementation.*

*Prefabricated Posts
Clinical Technique:*

* *Retain as much coronal tooth structure as possible and ensure the remaining dentin is strong. Every effort should made to preserve as much coronal tooth tissue as possible.*
* *Remove gutta-percha from the root canal using Gate-Gildden burs and successively larger burs. Enlarge the canal one or two sizes with a drill, endodontic file, or reamer that matches the configuration of the post. The length of post space should be*

 *7mm, furthermore:*

* *An initial path is made with hot instruments or with Gates Gildden drills, number 2 and 3, which should be running at the maximum speed achievable with slow speed handpiece to generate frictional heat which will soften the gutta percha and ease its removal without disturbing the apical root filling.*
* *Post should usually be placed in the straightest and most bulky root, commonly the distal in lower molars and the palatal in the upper molars. Premolars roots should be judged on their merits. Even if a post is placed, root filling materials should always be removed from the entrances of other canals to provide supplementary retention for the core and resistance to rotational torque.*

***Prefabricated Posts Clinical Technique:***

* *Be careful not to remove more dentine especially at the apical extent of post space.*
* *Use a prefabricated post that matches standard endodontic instruments.*
* *The post is cemented into the canal preparation and kept under constant pressure.*

***Prefabricated PostsPreparation Technique***

*Core is built-up with amalgam, composite or any plastic material*

***Physical properties of core materials***

1. *Adequate compressive strength to resist intra-oral forces.*
2. *Sufficient flexural strength to resist intra-oral forces.*
3. *Biocompatibility.*
4. *Resistance to leakage of oral fluids at the core tooth structure interface*
5. *Ease of manipulation*
6. *Ability to bond to remaining tooth structure*
7. *Thermal coefficient of expansion and contraction similar to tooth structure*
8. *Dimensional stability*
9. *Minimal potential for water absorption*
10. *Inhibition of dental caries*

***Core Materials***

* *Core materials include composite, amalgam, glass ionomer, and cast alloy.*
* *The elastic modulus of some commonly used core materials are as follows: 16.6 GPa (composite), 27.6 GPa (amalgam), and 99.3 GPa (Type 4 gold alloy).*
* *A low-modulus material allows greater bending under load. When a structure comprised of dissimilar materials (such as core material and dentin) is stressed, the material with the higher modulus of elasticity deforms less.*
* *This difference causes more stress concentration at the walls and line angles of tooth/restorative interfaces before the material is permanently deformed.*
* *Amalgam cores have the lowest failure rate, followed by composite cores.*
* *All teeth restored with crowns over glass-ionomer build-ups* ***failed****!!!!!*

***Prefabricated Posts:***

* ***Most*** *P.P. are metallic, but there are several newer non-metallic ones available.*
* *Metallic posts are made of stainless steel, titanium and its alloys, platinum-gold-palladium, chromium-containing alloys and brass.*
* *The increased demand for esthetic and biocompatible restorations has led to the development of tooth-colored, translucent, metal free post and core:*
* *Zirconium-coated carbon fiber*
* *Glass fiber-reinforced epoxy*
* *Fiber -reinforced composite*
* *Zirconia post*

***Carbon fiber post***

* *The carbon fiber post is comprised of a longitudinally aligned carbon fibers embedded in an epoxy resin matrix. This type of post has no radiopacity and is black color.*

***Glass Fiber Post***

* *They contain glass or quartz fiber in an epoxy resin.*
* *They have a modulus of elasticity similar to dentin…. the root less susceptible to fracture.*

***Fiber-reinforced and composite core***

* *They may allow movement of the core during function or parafunction or deep overbite.*
* *Thinner in diameter, it will flex more under a load. This may cause leakage under the crown and buildup. Optimal ferrule and normal function for a single ant. aesthetic….fracture*

***Cements and Cementation of Posts:***

***Dental*** *cements lute the post to radicular dentin and properties such as compressive strength, tensile strength, and adhesion of the cement are commonly described as predictors for success of a cemented post.*

*Other factors such as potential for plastic deformation, microleakage, water imbibitions behavior of the cement during the setting process and handling characteristics can also influence the survival rate of a cement post.*

***Cements and Cementation of Posts:***

* *Zinc phosphate cement.*
* *Poly carboxylate cement.*
* *Glass ionomer cement.*
* *Resin modified glass ionomer.*
* *Resin-based cement.*

*Apply the cement in the canal with periodontal probe or with* ***lentulo spiral****; the cement is placed then on post and following insertion, upward and downward movements. This movement of the post allows the entrapped air within the canal to escape through the cement avoiding the development of voids within the cement film.*

***Venting***

*A means for cement to escape must always be provided to reduce the intraradicular hydrostatic pressure created during cementation of the post; this factor is importance especially with custom cast post. Virtually most prefabricated posts have a venting mechanism incorporated in their design.*

***Conclusions***

* *Conservation of tooth structure improved the prognosis of ETT.*
* *Posts don’t reinforce a pulpless tooth.*
* *Ferrule effect is critical and it should come from the completed crown not from the cast core.*
* *The clinical success of posts is directly related to their length; so it is rational to prepare a post channel as long as it is consistent with anatomical limitations while maintaining 4-5mm of apical gutta-percha seal.*
* *When little coronal tooth structure remains and direct core is placed, strength of the core material is critical. Ranking of core materials according to their strength in descending order is amalgam, composite and glass-ionomer cement.*
* *Custom cast posts are potentially more conservative of tooth structure particularly in anterior teeth because the post is made to fit the available tooth structure.*
* *Prefabricated posts require preparation of the tooth to fit the post so these are often less conservative especially when using parallel-sided posts for teeth with small tapered roots.*
* *Because cast posts require a path of insertion which requires more cutting in posterior teeth, a P.P. is usually more conservative in molars. Molars often perform satisfactorily with direct cores retained by engaging pulp and portion of the canals and retention of the core can be augmented by placement of one or more prefabricated posts.*
* *Premolars may be restored with either custom cast post or prefabricated post.*
* *Threaded posts that engage dentine could be dangerous and generally not recommended.*
* *Various cements are likely to produce acceptable results as long as the post and core are well executed.*
* *Endodontically treated teeth (incisors and canines) with conservative access preparations and enough remaining tooth structure may be restored without the need for further tooth destruction to accommodate a crown restoration.*