REVIEW ARTICLE

POST AND CORE: A REVIEW

[1]Arvind Arora, [2]Deepika Singla, [3]Ravneet Kaushal, [4]Harleen Kaur, [5]Artika Gupta

[1]Professor, [2,5]Senior Lecturer, [4]Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh, Punjab, India
[3]Senior Lecturer, Department of Conservative Dentistry & Endodontics, Baba Jaswant Singh Dental College, Ludhiana, Punjab, India

Correspondence:
Ravneet Kaushal
Senior Lecturer, Department of Conservative Dentistry & Endodontics, Baba Jaswant Singh Dental College, Ludhiana, Punjab, India
Email: ravneet.kaushal11@gmail.com

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ABSTRACT
A successful endodontic treatment has to be complemented with an adequate postendodontic restoration to make the pulpless tooth function indefinitely as an integral part of the oral masticatory apparatus. Careful postendodontic restoration is required, as the cumulative loss of tooth structure due to caries, trauma, and endodontic procedures combined with the loss of structural integrity contributes to the fracture of the tooth.

INTRODUCTION
Various methods of restoring pulpless teeth have been reported for more than 200 years. In 1747, Pierre Fauchard1 described the process by which roots of maxillary anterior teeth were used for the restoration of single teeth and the replacement of multiple teeth. Posts were fabricated of gold or silver and held in the root canal space with a heat-softened adhesive called ‘‘mastic.’’[1,2] The longevity of restorations made using this technique was attested to by Fauchard: ‘‘Teeth and artificial dentures, fastened with posts and gold wire, hold better than all others. They sometimes last fifteen to twenty years and even more without displacement. Common thread and silk, used ordinarily to attach all kinds of teeth or artificial pieces, do not last long.’’[1]
Endodontic therapy, by these dental pioneers, embraced only minimal efforts to clean, shape, and obturate the canal. Frequent use of the wooden posts in empty canals led to repeated episodes of swelling and pain. Wooden posts, however, did allow the escape of the so-called ‘‘morbid humors.’’ A groove in the post or the root canal provided a pathway for continual suppuration from the periradicular tissues.[1]
Although many of the restorative techniques used today had their inception in the 1800s and early 1900s, proper endodontic treatment was neglected until years later. Today, both endodontic and prosthodontic aspects of treatment have advanced significantly, new materials and techniques have been developed, and a substantial body of scientific knowledge is available upon which to base clinical treatment decisions.

ASSESSMENT OF RESTORABILITY
An endodontically treated tooth must be evaluated before definitive restorative procedures are initiated. Evaluation factors are used to determine whether the endodontically treated

tooth is restorable, unrestorable,or restorable after successful retreatment.[3] Definitive restorative treatment should not be initiated if the treated tooth exhibits any of the following:

- Poor root canal filling
- Active inflammation
- Pressure sensitivity
- Exudate
- Fistula (or parulis)
- Periodontal disease (moderate or severe periodontitis)

Severe loss of sound tooth structure (tooth would not benefit from crown lengthening or orthodontic extrusion) In short, seven categories of infection, trauma, inflammation, unacceptable endodontics, or lack of restorability, as listed, can delay or end up in no definitive restorative treatment.[4]

PROTECTING THE REMAINING CORONAL TOOTH TISSUE—CREATING THE FERRULE

A ferrule is defined as a band of extracoronal material at the cervical margin of a crown preparation that encompassess the tooth and provides resistance form to the tooth. This is usually provided by the crown that is placed over the post and core system. It is of paramount importance that as much coronal or supragingival tooth tissue is preserved as possible, as this significantly improves the prognosis of the tooth and restoration.[5] One to two millimeters of tooth tissue coronal to the finish line of the crown preparation significantly improves the fracture resistance of the tooth and is more important than the type of core and post material . The word ferrule is thought to be derived from the Latin word ferrum, meaning iron, and viriola, meaning bracelet. Thus, the ferrule effect occurs because of the crown bracing against the remaining supragingival tooth tissue. Some authors have questioned the benefit of the ferrule; however, majority of the literature would support its importance in reducing the probability of tooth fracture.[6]

- Barkhordar et al. compared restored teeth prepared with and without a ferrule and showed that the ferrule reduced the incidence/possibility of vertical root fracture by one-third.
- When failure occurred in teeth with a ferrule, it was most commonly due to horizontal fracture compared to the vertical root fracture seen in teeth with no ferrule. Thus, the teeth were more likely to be retrievable.
- A 1.5-mm ferrule can be recommended labially andlingually, whereas a shorter 1-mm ferrule could beaccepted mesially and distally due to decreasedstress in these directions
- Maxillary incisor - Longer ferrule on the palatalaspect
- Mandibular incisor - Longer ferrule on the labialaspect

POST

Dowel/Post: The dowel is a post or other relatively rigid, restorative material placed in the root of the non-vital teeth. The purpose of the dowel is to provide retention for the core and coronal restoration.[7]

INDICATIONS FOR POST

To retain the restoration: When insufficient tooth structure remains to hold a restoration (extensive caries, coronal fracture, etc) placing a dowel that extends occlusally provides this coronal retention.

To protect remaining tooth structure: Since the crowns of pulpless teeth are often partially or completely destroyed , occlusal forces cannot be delivered to the remaining tooth and

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periodontium in a natural way. So posts are used to direct occlusal and lateral forces more apically.

Marginal integrity: by providing sufficient rigidity under load, this re-distribution helps maintain marginal integrity of the final restoration.

Core and crown retention: To retain a reconstituted clinical crown or "core" over which a permanent restoration can be cemented.

CONTRAINDICATIONS FOR POST

Abnormal root anatomy.
Extensive caries including root caries.
Perforations.
External resorptions.
Short roots.
Dilacerated roots.
Blunderbuss canal.
Young patients with coronal fracture, with incomplete root formation.
Patients with poor oral hygiene.

CLASSIFICATION OF POST SYSTEM[8]

INGLE AND BAKLAND

I. Custom-cast Posts
II. Prefabricated Posts
A. Tapered, smooth-sided e.g Kerr Endopost
B. Parallel-sided serrated and vented e.g Whaledent parapost
C. Tapered, self-threading screws e.g Dentatus screw
D. Parallel-sided, threaded e.g Radix anchor
E. Parallel-sided, threaded , split shank ,tapered apical end e.g Flexipost

SHILLINBURG AND KESSLER CLASSIFICATION

I. Custom-cast Posts
II. Prefabricated posts
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

DEPENDING ON MATERIALS USED

Metals

(a) Custom-cast posts
(i) Gold alloys
(ii) Chrome-cobalt alloys
(iii) Nickel-chromium alloys
(b) Prefabricated posts
(i) Stainless Steel
(ii) Titanium
(iii) Brass

Non-metals

(a) Carbon-fiber

(b) Fiber-reinforced
(i) Glass fiber
(ii) Quartz fiber
(iii) Woven Polyethylene fiber
(c) Ceramic and zirconia

ON THE MODE OF INSERTION
ADVANTAGES[9,10]
They are custom fit to the root configuration AND Provide a better geometric adaptation to excessively flared, elliptical, tapered, noncircular or irregular shape canals.
Excellent core retention.
Greater strength in the sections.
This two-step procedure improves the marginal adaptation and allows for a variation in the path of insertion of the crown.
It almost always requires minimum tooth structure removal
Custom cast post and cores adapt well to extremely tapered canals or those with a non-circular cross-section or irregular shape, and roots with minimal remaining coronal tooth structure

DISADVANTAGES
1. **Root fractures -** the modulus of elasticity of cast metal is 10 times greater than that of dentin leading to greater stress concentration and subsequent root fracture.
   The transmission of occlusal forces thorugh the metal cores can focus stresses at specific regions of the root, causing root fracture
2. **Aesthetics** – metal post alter the light transmission through the tooth and may show through the root especially where the gingiva is thin.
(a) The corrosion products may pass into the root, discolouring the tooth
(b) Metal core will also alter the optical properties of overlying ceramic restoration.
3. **Biocompatibility** – non precious metals show corrosion within the root which has been implicated as a cause of root fracture.
4. This method requires two-appointment visits and a laboratory fee.

PURPOSE OF THE POST[11]
1. Retention of the core (primary purpose)
2. Protection of the apical seal from coronal leakage

Lovdahl et al and pontius → no difference in fracture resistance in anterior teeth
Trope et al → post space weakens the tooth
Eckerbom et al → more flare up with posts

TYPES OF POSTS
They will be classified as active or passive, parallel or tapered, and by material composition.[12.13]
Active posts :are threaded and are intended to engage the walls of the canal.
Passive posts: are retained strictly by the luting agent.
Felton (1991),Burns(1990) & Standlee(1992)-Active posts are more retentive than passive posts, but introduce more stress into the root
Their use should be limited to short roots in which maximum retention is needed than passive posts.

- **Common active post systems**
- **Common passive post systems**

Parallel Versus Tapered Posts

Parallel metal posts are more retentive than tapered posts.
Vertically occlusal loading → even distribution of force
Oblique force or at right angle → uneven distribution of forces
Stress concentration at apical end → reduced thickness of dentin
Induce less stress into the root, because there is less of a wedging effect,
less likely to cause root fractures than tapered posts.
Sorensen and Martinoff (1984) reported a higher success rate with parallel posts than tapered posts.

TAPERED POSTS

Require less dentin removal because most roots are tapered.
They are primarily indicated in teeth with thin roots and delicate morphology

IMPORTANT PRINCIPLES FOR POSTS

A. **Retention and Resistance**
B. **Mode of failure**
C. **Preservation of tooth structure**
D. **The Ferrule Effect**
E. **Retrievability**
F. **Retention and Resistance**

Post retention refers to the ability of a post to resist vertical dislodging forces.[13]
Influenced by

- the post's length,
- diameter and taper,
- the luting cement
- whether a post is active or passive

FACTORS AFFECTING RETENTION OF POST SYSTEMS

POST LENGTH

Longer the post , greater the retention and support and better is the stress distribution. Therefore post should be as long as possible without disturbing apical seal.Ideally a post should be placed to the depth of 2/3rd -3/4th the length of bony supported root leaving a minimum of 3-5 mm apical seal. Short posts are dangerous and often lead to root fracture because of their failure to be completely surrounded by the perriradicular bone. Concentrate functional loads to the cervical area.[13]
Equal to inciso-cervical or occluso-cervical length of crown.***(Pickard (1964),Sheets CE et al. (1970)Mondelli et al (1971), Harper RH et al.(1976)***
The post should be certain fraction of the length of the root such as one half, two third, or four fifth ***(Burnell,1964)***
The post should be longer than the crown ***(Silverstein,1964)***
The post should be as long as possible without disturbing the apical seal.***(Henry et al 1977)***
The post should end halfway between the crestal bone and root apex.***(Goodacre ,1995)***
To summarize
Long roots → 3/4th length of root
Average root length → dictated by remaining gutta percha
Post should be 4 mm below the alveolar crest ***(Burandham, 1999)***
Molar post should be maximum of 7 mm ***(Abou Rass et al, 1982)***

POST DIAMETER

Increasing diameter does not provide significant retention*.(Shilinberg et al. (1982)&Turner et al (1985)*

Krupp et al. indicated that post length was the most important factor affecting retention and post diameter was a secondary factor Increases stiffness of the post at the expense of the remaining dentin and the fracture resistance of the root decreases.[14]

Goodacre-post diameters should not exceed 1/3rd of the root diameter at any location.Post diameter must be controlled to preserve radicular dentin, reduce the potential for perforation and permit the tooth to resist fracture.

Trabert et al.(1978) measured the impact resistance of extracted maxillary central incisors as post diameter increased and found that increasing post diameter decreased the tooth's resistance to fracture.

Mattison(1982) found that stress increased in the tooth as the post diameter increased.

Deutsch et al. (1985)determined that there was a sixfold increase in the potential for root fracture with every millimeter the tooth's diameter was decreased.

The Conservationist(**Mattison**)[15]

Minimal instrumentation of canal after removal of gutta percha.

Instrumentation limited to removal of undercuts in canal.

Endodontically treated teeth with smaller diameter dowels resist fracture better.

Enlarging the canal till clean dentinal shavings extruded from the orifice.

The Proportionist (Stern and Hirschfeld)

The diameter of dowel should be 1/3rd the diameter of root.

The dowel space should not exceed 1/3rd the width of root at its narrowest dimension.

They suggested that one third relationship preserved sufficient tooth structure to resist root fracture.

POST DESIGN

Tapered posts produced the greatest stress at the coronal shoulder.Parallel posts generated the greatest stress at the apex of the canal preparation. Of the threaded designs, the tapered screw produced the greatest wedging effect & highest stress levels. The parallel sided, serrated, vented post produced stresses that were distributed most uniformly along its length and appeared best able to protect the dentin.[16]

Parallel sided threaded posts that are tapered may be considered when additional retention is needed. A serrated or roughened post is more retentive than a smooth one, and controlled grooving of the post and root canal considerably increases the retention of tapered post.

→ High stress can be generated during insertion, particularly with smooth, parallel sided posts that have no vent for cement escape.

(Threaded posts)

Threaded post can produce high stress concentration during insertion and loading, but they have been shown to distribute stress evenly if posts are backed off a half turn. The cement layer results in a more even stress distribution to the root with less stress concentration.

POST SURFACE TEXTURE

A serrated or roughened post is more retentive than a smooth one, and controlled grooving of the post and root canal considerably increases the retention of tapered post.[17]

CORE MATERIALS

Thecore 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 glass ionomer materials.

COMPOSITE RESIN CORE

Composite core materials take a number of strategies toenhance their strength and resistance; metal may be added,filler levels may begreater, or faster-setting ionomers may beused.[18]Composite core materials have been shown to exhibitslightly better mechanical values than conventional materials,but improvements are negligible.[19,29]

AMALGAM CORE

Amalgam can be used with or without a post. In the 1980s,investigators described the amalcore.[20,30]With the amalcoretechnique, amalgam is compacted into the pulp chamber and2 to 3 mm coronally of each canal. The following criteria wereconsidered for the application of this technique: the remaining pulp chamber should be of sufficient width and depth toprovide adequate bulk and retention of the amalgam restoration,and an adequate dentin thickness around the pulpchamber was required for the tooth-restoration continuumrigidity and strength. The fracture resistance of the amalgamcoronal-radicular restoration with four or more millimeters ofchamber wall was shown to be adequate, although the extensioninto the root canal space had little influence.[21,31]

GLASS IONOMER CORE AND MODIFIED GLASS IONOMER CORE

Glass ionomer and resin-modified glass ionomer cements areadhesive materials useful for small buildups or to fill undercutsin prepared teeth. The rationale for using glass ionomer materialsis based on their cariostatic effect resulting from fluoriderelease. However, their low strength and fracture toughnessresult in brittleness, which contraindicates the use of glassionomerbuildups in thin anterior teeth or to replace unsupportedcusps. They may be indicated in posterior teeth inwhich (1) a bulk of core material is possible, (2) significant sound dentin remains, and (3) caries control is indicated.[23,33]

INDIRECT FOUNDATION RESTORATIONS: CAST POST AND CORE

For many years, use of the cast metal post and core has beenthe traditional method for fabricating thefoundation restorationof a prosthetic crown. Classically, smooth-sided, taperedposts conforming to the taper of the root canal are fabricatedfrom high noble alloys, although noble and base-metal classesof dental alloys have also been used. Noble alloys used for postand core fabrication have high stiffness (approximately 80 to100 GPa), strength (1500 MPa), hardness, and excellent resistanceto corrosion.[23]One advantage of the cast post/core system is that the coreis an integral extension of the post and that the core does notdepend on mechanical means for retention on the post. Thisconstruction prevents dislodgment of the core from the postand root when minimal tooth structure remains. However, thecast post/core system also has several disadvantages. Valuabletooth structure must be removed to create a path of insertion or withdrawal. Second,the procedure is expensive because twoappointments are needed, and laboratory costs may be significant.The laboratory phase is technique sensitive. Metal castingof a pattern with a large core and a small-diameter post canresult in porosity in the gold at the post/core interface. Fractureof the metal at this interface under function results in failureof the restoration. Most important, the cast post/core systemhas a higher clinical rate of root fracture than preformedposts.[24,34]

LUTING CEMENTS

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

TRADITIONAL CEMENTS

Zinc phosphate cements or polycarboxylate cements are stillused for cementation of posts and crowns. They are generallysupplied as a powder and a liquid, and their physical propertiesare highly influenced by the mixing ratio of the components.Their compressive strength is about 100 MPa, and elasticmoduli are lower than that of dentin (5 to 12 GPa). Zinc phosphatecement is mostly used for cementing metal restorationsand posts; filmthickness of the zinc phosphate cement is lessthan 25 µm. These cements provide retention through mechanicalmeans and have no chemical bond to the post or to dentinbut provide clinically sufficient retention for posts in teeth withadequate tooth structure.

GLASS IONOMER LUTING CEMENTS

Glass ionomer cements are a mixture of glass particlesand polyacids, but resin monomers may also be added. Dependingon the resin content, glass ionomer cements can be classified as either conventional or resin-modified glass ionomer cements. Conventional glass ionomer cements have compressivestrengths ranging between 100 and 200 MPa; the Youngmodulus is generally about 5 GPa. They are mechanically moreresistant than zinc phosphate cements, and they can bond todentin with values ranging between 3 and 5 MPa.

RESIN-BASED LUTING CEMENTS

Today there is a trend toward the use of adhesive cements forbonding endodontic posts during the restoration of nonvitalteeth. The rationale for using adhesive cements is based on thepremise that bonding posts to root canal dentin will reinforcethe tooth and help retain the post and the restoration.[26,36] Contemporaryresin-based luting cements have been shown toexhibit compressive strengths around 200 MPa and elasticmoduli between 4 and 10 GPa.[27,37]These materials may bepolymerized through a chemical reaction, a photopolymerizationprocess, or a combination of both mechanisms. Photopolymerizationof these resin-based materials is often necessaryto maximize strength and rigidity.

SELF-ADHESIVE CEMENTS

More recently, self-adhesive resin cements have been introducedas an alternative toconventional resin-based lutingcements. Self-adhesive luting cements contain multifunctiona lphosphoric acid methacrylates that react with hydroxyl apatite and simultaneously demineralize and infiltrate dental hardtissue.[28,38] They do not require any pretreatment of the toothsubstrates, and their clinical application is accomplished in asingle step.

PREPARATION GUIDELINES FOR POST AND CORE FABRICATION

1. Coronal tooth preparation
2. Root canal preparation and pulp chamber preparation
3. Pattern fabrication
4. Investing and casting procedures
5. Clinical adjustment and cementation

➢ Coronal Tooth Preparation

Post and core fabrication done after the coronal tooth preparation has been completed.
Remove all undercuts that will prevent removal of pattern.
Preserve as much tooth structure as possible.
Prepare the finish line at least 2mm gingival to the core - This establishes the ferrule.
Complete the preparations by eliminating sharp angles and establishing a smooth finish line.

PREPARATION OF CANAL SPACE AND TOOTH

A. Removal of endodontic filling material to the appropriate depth.
B. Enlargement of the canal.
C. Preparation of the coronal tooth structure.

REMOVAL OF GUTTA PERCHA

Three methods
Chemical (oil of eucalyptus, chloroform)
Thermal (electrical and heated instrument)
Mechanical (gates glidden drills, peeso reamers)

CHEMICAL METHOD

- Solvents
- Chloroform
- Methylchloroform
- Eucalyptol
- Halothane
- Rectified turpentine
- Xylene

All these solvents have some level of toxicity so their use should be avoided.
Chloroform:
- most popular solvent, long history of clinical use
- ***Mc Donald (1992)*** – no associated ban on its use
- ***Chutich MJ (1998)-*** chloroform regarded as a safe and effective solvent

Disadvantages –
1. difficult to control the depth of softening of the gutta-percha
2. potential leakage of the solvents into the periradicular tissues

Xylene and eucalyptol – dissolve gutta percha slowly and only reach the effectivenes of chloroform when heated.(Wourms DJ et al (1990)
Rectified turpentine oil – higher level of toxicity than chloroform (Barbosa et al (1994)
- Pungent odor

Halothane
- effective solvent as chloroform
- takes longer time to remove filling than chloroform
- Increased cost
- Volatility of halothane and idiosyncratic hepatic necrosis

Mechanical method

GATES GLIDDEN DRILL

a non-cutting tip
numbered 1-6, range in diameter from 0.5 to 1.5 mm in graduated increments of 0.2 mm.
shorter cutting flutes (1.5-4.0mm)
instruments measure 18 mm from the cutting end
ISO standardization – 50-150.

ADVANTAGES OF USING GATES GLIDDEN DRILLS
- Cutting portion is smaller and more maneuverable
- Easier to use in starting very small canals
- Shorter cutting flutes and more flexible shafts.

PEESO REAMER
non-cutting tip
numbered 1-6, range in diameter from 0.7 to 1.7 mm in graduated increments of 0.2 mm.
Longer cutting flutes (7.5-8.5mm).
instruments measure 18 mm from the cutting end
ISO standardization – 70-170.

ADVANTAGES
- Have a sharp, but noncutting tip, they will follow the path of least resistance
- Conform more consistently to the original canal in the apical region than other types of instruments

TOUCH 'N HEAT
Provide constant ,consistent heat application to soften the gutta percha in the coronal portion.
Care must be exercised , not to overheat the root which can damage to the PDL
Heat should be in a short burst to allow instrument to penetrate the gutta percha mass followed by cooling,which cause material to adhere to the heat carrier, facilitates its removal
Enlargement of the canal

FOR PREFABRICATED POSTS
Enlarge the canal one or two sizes with a drill, endodontic file, or reamer that matches the configuration of the post.
Use a prefabricated post that matches standard endodontic instruments

FOR CUSTOM MADE POSTS
Use custom made posts in canals that have a non-circular cross section or extreme taper. Enlarging canals to conform to a preformed post may lead to perforation. Often very little preparation will be needed for a custom made post.
undercuts within the canal should be removed and some additional shaping is necessary.

PATTERN FABRICATION
Prefabricated plastic patterns
Inlay wax
Autopolymerizing resins
Custom-made posts :
Direct procedure : patients mouth
Indirect procedure : laboratory

DIRECT PATTERN TECHNIQUE
ADVANTAGES
Carved on tooth itself so less discrepancies
Little laboratory work

DISADVANTAGES
- Great skill and practice
- Indirect vision reduces stereoscopic judgement.
- Increased chairside time
- If casting fails, patient has to be recalled

Direct Wax Pattern Technique

Hard plastic post or thin metal needle is used as the central reinforcement around which resin or wax pattern is formed.Selected pin is roughened with carborandum disc. Alternatively , an old reamer or file can be used.
A thin layer of sticky wax is applied over the prepared pinInstrument is tried in the root canal.Once tried instrument is coated with blue inlay wax. Warm a little and insert it into the root canal.Keep their for 60secs and then gently withdraw the instrument.
The post impression is readyAfter the post, the core is built in patient's mouth using blue inlay wax.Impression is then invested and casting prepared. Apply blue inlay wax and insert again

TAKE OUT THE PATTERN
CORE FABRICATION
Final impression
Wax pattern
Direct resin pattern technique

- Prefabricated patterns
- Resin is mixed
- Notches placed over plastic pattern
- Canal lubricated
- Canal filled with resin with hand instrument or lentulospiral
- Plastic pattern coated with monomer and inserted
- Begins to stiffen → moved in and out
- Stiffens→ completely removed
- Core is build up

INDIRECT PATTERN TECHNIQUE
ADVANTAGES
All margins can be finished in direct vision
Less strain
Wax pattern can be made in inaccessible area
Lingual portion directly visible
All adjustments can be done prior to insertion
Less fear of fracture of tooth
If casting fails, another pattern can be made

DISADVANTAGES
Multiple steps so lots of discrepancies
More of laboratory time
Technique
To prepare the cast, impression can be made by injecting impression material into the canal. (lentulospirals)
Impression is reinforced with some type of rigid material viz. paper clips, steel wire, plastic sprue or a root canal instrument.
A custom acrylic post can also be made in the prepared canal.
The acrylic serves as the impression of the canal, which is transferred to a cast.A precision prefabricated plastic pin may be used to draw a post pattern.In cast with prepared space for post, the impression is made using blue inlay wax along with metal pin as described for direct methods.

- Impression of root space

- Impression on cast
- Pin and Blue Inlay Wax
- Final Impression [38]

REFERENCES

1. Fauchard P. The surgeon dentist. 2nd ed. Vol. II. Birmingham, AL: Reprinted by the Classics of Dentistry Library;1980. pp. 173–204.
2. Prothero JH. Prosthetic dentistry. 2nd ed. Chicago, IL: Medico- Dental Publishing Co.; 1916. pp. 1116:1152–62.
3. Balkenhol, M., Wostmann, B., Rein, C., and Ferger, P.: J. Dent., 1:50, 2007
4. Barkhordar, R.A., Radke, R., and Abbasi, J.: J. Prosthet. Dent., 61:676–78, 1989.
5. Ettinger, R.L., and Qian, F.: J. Endod., 5:310, 2004.
6. Eriksen, H.M.: In D. Ørstavik and T.R. PittFord (eds.) Essential Endodontology, 1st ed. Oxford: BlackwellScience, 1998, p. 179.
7. Eissmann, H.F., and Radke, R.A.: In S. Cohen and R. Burns (eds.) Pathways of the Pulp, 4th ed. St. Louis: C.V. Mosby, 1999, pp. 582, 643.
8. Goerig, A.C.: J. Prosthet. Dent., 34:634, 1975. 33. Going R.E.: J. Am. Dent. Assoc., 73:619, 1966.
9. Panitvisai, P., and Messer, H.: J. Endod., 21:57, 1995.
10. Pashley, D.H.: J. Prosthet. Dent., 66:181, 1991. 127. Pashley, D.H., et al.: Dent. Mater., 11:117, 1995.
11. Reeh, E.S., and Messer, H.H.: J. Endod., 15:512, 1989.
12. Riel, D.C., et al.: J. Prosthet. Dent., 62:1002, 1983.
13. Pilo, R., et al.: J. Prosthet. Dent., 88:302–6, 2002.
14. Krupp, J.D., et al.: J. Prosthet. Dent., 41:163–66, 1976.
15. Mattison, G.C.: J. Prosthet. Dent., 48:407–11, 1982.
16. Kern, M., and Knode, H.: Quintessem. Zahntech., 17:917, 1991.
17. Kern, M., and Simon, M.H.P.: J. Dent. Res., 76:293, 1997. (Abstract 2234)
18. Powers JM, Sakaguchi RL: Craig's restorative dental materials, ed 12, St. Louis, 2006, Mosby.
19. Yüzügüllü B, Ciftçi Y, Saygili G, Canay S: Diametral tensile and compressive strengths of several types of core materials, J Prosthodont 17:102, 2008.
20. Nayyar A, Zalton RE, Leonard LA: An amalgam coronal-radicular dowel and core technique for endodontically treated posterior teeth, J Prosthet Dent 43:511, 1980.
21. Kane JJ, Burgess JO, Summitt JB: Fracture resistance of amalgam coronal-radicular restorations, J Prosthet Dent 63:607, 1990.
22. \Wiegand A, Buchalla W, Attin T: Review on fluoridereleasing restorative materials—fluoride release and uptake characteristics, antibacterial activity and influence on caries formation, Dent Mater 23:343, 2007.
23. Council on Dental Materials, Instruments, and Equipment, American Dental Association: Classification system for cast alloys, J Am Dent Assoc 109:766, 1984.
24. Drummo
25. nd JL, Toepke TR, King TJ: Thermal and cyclic loading of endodontic posts, Eur J Oral Sci 107:220,1999.
26. Duncan JP, Pameijer CH: Retention of parallel-sided titanium posts cemented with six luting agents: an in vitro study, *J Prosthet Dent* 80:423, 1998.
27. Ceballos L, Garrido MA, Fuentes V, Rodríguez J: Mechanical characterization of resin cements used for luting fiber posts by nanoindentation, *Dent Mater* 23:100,2007.
28. Moszner N, Salz U, Zimmermann J: Chemical aspects of self-etching enamel-dentin adhesives: a systematic review, *Dent Mater* 21:895, 2005.

29. Sethi K,Shefally, Raji J,Working Length Determination: A Review,International Journal of Health Sciences (2021) 5 (S1) 45-55.
30. Arora A, Gupta U, Gupta I,Dentin Hypersentivity: A Literature Review,International Journal of Health Sciences (2021) 5 (S1) 63-72.
31. Arora A, Pareek A, Danish Prabhakar, Liners, Bases and Varnishes: A Review,International Journal of Health Sciences (2021)5 (S1)1-9.
32. Sood H, Virk J, Pareek A,Traumatic Injuries of Teeth: A Review,International Journal of Health Sciences (2021) 5 (S1) 23-28.
33. Mahajan A, Kaur NP, Ayoub K,Monoblocks in Root Canals: A Review,International Journal of Health Sciences (2021) 5 (S1) 113-121.
34. Singla D, Kataria B, Kaur U, Root Canal Cleaning and Shaping : A Review,International Journal of Health Sciences (2021) 5 (S1) 95-112.
35. Kaur G, Kaushal R, Danish Prabhakar,Esthetic Restorations and Smile Designing – A Review,International Journal of Health Sciences (2021) 5 (S1) 10-22.
36. Mehta SD, Malhan S, Bansal C,Latrogenic Complications Arising From Cleaning and Shaping – A Review,International Journal of Health Sciences (2021) 5 (S1) 56-62.
37. Pareek A, Sood H, Aggarwal G,Tooth Wear: A Review,International Journal of Health Sciences (2021) 5 (S1) 122-133.
38. Kaushal R, Gupta I, Gupta U,Recent Advances in Dental Composite: A Review,International Journal of Health Sciences (2021) 5 (S1) 36-44.