# Materials and Techniques of fabrication of custom cast post and core – A Literature review

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## ABSTRACT

A widely used technique for restoring teeth with impaired tooth structure after endodontic treatment is post and core restorations. Various techniques of fabrication of cast post like modified indirect technique, prosthetically guided technique, cast post fabrication using CAD- CAM along with the conventional techniques have been discussed in this literature. Customised post and core fabrication using computerised technology is a quick and easy substitute for traditional techniques. After doing a literature search, a summary of publications covering the fabrication processes and materials utilised to create post and cores using both traditional methods and CAD/CAM have been supplied. There have been reports of both direct and indirect ways for using CAD/CAM post and cores to restore teeth that have undergone endodontic treatment. The materials that were reported the most frequently were zirconia and hybrid ceramic. There are few published data on CAD/CAM post and core; however additional research is required to see how this treatment will perform over the long run.

## BACKGROUND

Custom cast post and core are frequently recommended to treat severely damaged teeth from trauma or cavities.[1] It is recommended for curved or elliptical canals because it offers an accurate fit for the prepared post space. Prefabricated posts are not a good choice in these situations since they cannot suitably adjust to the canal.[2] Custom-cast post and core's improved flexibility aids in resistance to torsional stress.[3] For single-rooted and premolar teeth, which become weak as a result of the cumulative effect of dental structure loss during tooth and access preparation, these unique posts and cores act as corono-radicular stabilisers. Likewise, these customised posts can withstand rotational stresses in multi-rooted teeth with significant tooth structural loss.[4]

An ideal post and core would help with crown retention. [5] It should have a high tensile strength, be safe, and have a good fatigue resistance to an occlusal and shear stress. A post should extend apically to at least crown height or two-thirds of the root's length, and it should transfer stresses to the surrounding root surface uniformly.[6,7] provides resistance to occlusal load and aids in evenly dispersing the tension. Additionally, particularly when restoring anterior teeth, the colour of the post and core should be quite near to that of natural dentin.[8] An overview of the materials and manufacturing processes for cast posts is provided in this review.

## MATERIALS AND METHODS

A comprehensive electronic search was conducted in the PubMed database. All peer-reviewed and full-length studies in the English language were included. The search was performed using the following keywords: “cast post” or “Custom cast post,” and “post and

core," "post-and-core," or "post-core." Articles included were indexed in Google Scholar, PubMed Central, Scopus and/or Web of Science database.

## MATERIALS USED FOR FABRICATION

Custom cast post and cores are made from gold alloys, such as type III and type IV, silver-palladium, or base metal alloys.

**Gold -** When gold is hardened by the addition of other metals, such as copper, silver, nickel, palladium and zinc. This combination of metals is called gold alloy. Type 3 gold alloys contains 71.0–79.8% of Au and 7.1-12.6%of Pd Type 4 gold alloys contains 62.4-71.9 % of Au and 8 .6–15.4 Pd

**Silver Palladium alloy** was developed by Heraeus in 1931 have been used for dentistry in applications such as bridges and crowns.

**Base metal alloys** is a metal or alloy (such as zinc, lead, or brass) of comparatively low value and relatively inferior in certain properties (such as resistance to corrosion) opposed to noble metal[9].

Cast gold post and cores are preferred over other materials due to their high success rate, excellent mechanical qualities, and ease of manufacture, while base metal alloys are seen as a more affordable alternative.But because base metals are stiffer than dentin, they put a lot of stress on the tooth. Moreover, the breakdown of base metal alloys produces impurities that may be dangerous to patients. After at least seven years, a retrospective analysis found that cast post and cores for single crown restorations had an 89% to 98.5% success rate These cast posts and cores can be used to prepare multiple abutments and in people who have severely worn teeth. However, these tailored posts and cores raise the risk of root fracture since dentin has a lower modulus of elasticity than bone.Additionally, they can discolour the delicate gingival and bone tissue, which would be less aesthetically pleasing. If the crown thickness is less than 1.6 mm, the colour of the core may also have an effect on the outcomes of the translucent ceramic crown. Cast posts and cores were the industry standard for many years, but as patient demand for better aesthetics increased, ceramic posts and cores were developed.

**Zirconia posts** were originally made available in 1995 as a replacement for cast metal posts and cores, making them the perfect choice for teeth that have experienced significant coronal structural loss. These posts were more visually pleasing and produced restorations that looked like natural teeth because of their great translucency and ability to match tooth colour. Endodontically treated teeth with custom-made zirconia posts had higher fracture resistance than glass fibre posts with composite resin cores and cast metal posts and cores. The risk of root fractures is raised by the high modulus of elasticity of zirconia, which transfers significant stresses to root dentin. Additionally, it can be difficult to create a solid bond with acid-resistant zirconia, and if treatment is unsuccessful, zirconia recovery may be very problematic. [9]

## FABRICATION OF CUSTOM CAST POST

### 1. Conventional Technique-

A cast metal post can be made from two techniques 1. Direct technique – In this pattern is fabricated in patient's mouth 2. Indirect technique- in this pattern is fabricated in laboratory

**A. Direct Pattern Procedure** This procedure can be done by either using autopolymerizing resin or by using thermoplastic resin.

**Using autopolymerizing resin**A plastic dowel is attatched to the root canal. Only the apical half of the planned post space will fit properly for a flared canal. It must go all the way down the prepared canal's depth. The canal is very slightly lubricated. For risk of introducing air

into the tissues, never blow air directly into a root canal. Resin is then added to the occlusal half-dowel and placed it in the canal using the "brush-bead" technique. Utilising a little condenser, resin is forced into the canal. Avoid letting the glue inside the canal completely set. While it is still stretchy, loosen and reposition it many times. After the resin polymerizes, the pattern is taken away. By incorporating additional autopolymerizing resin or lightpolymerized resin, the core portion of the post is formed.

**Pattern Fabrication with Thermoplastic Resin**-Plastic rod is fitted into the ready-made post space in step 1. Rod is trimmed so that the bevel area is roughly 1.5 to 2 mm occlusal to the core's completion point. Petroleum jelly and a periodontal probe is used tolubricate the canal. A low-temperature glue gun is used (Thermogrip, Black & Decker) to heat the thermoplastic resin until it turns clear. Two thirds ofpredicted length of the post pattern is covered with a little amount of the heated resin applied to the rod's apical end. The rod is fully affixed to the ready post opening. It is reseated after 5 to 10 seconds of lifting. Using a scalpel blade, any protrusion caused by canal undercuts should be removed. For the direct method, either a light-polymerized pattern resin is applied with a syringe (a simpler method) or construct the core with traditional autopolymerizing resin using the "brush-bead" method. If the indirect method is preferred, an elastomeric impression medium is used that can be poured in the usual way to take up the pattern. To assist the pattern release, the cast is soaked in warm water. The core is waxed and the post pattern is reinstalled. Invest in the post and core restoration and cast it. Investments that are phosphate-bonded are advised due to their greater strength

**B. Indirect Procedure**

If wire reinforcement is used to prevent deformation, any elastomeric material will accurately imprint the root canal.Orthodontic wire pieces are trimmed to the appropriate length and form them into the letter J. Ensure the wire fits snugly in each channel. It ought to extend past the depth of the post space and fit loosely. When the impression is taken off, the impression material will be torn away from the wire if the fit is too tight. Tray adhesive is applied to the wire. When there are subgingival margins, tissue displacement may be beneficial. The canals are lubricated (die lubricant is appropriate) to make it easier to remove the impression without distorting it. An elastomeric imprint material is inserted gradually into the canals using a Lentulo spiral (Dentsply Maillefer). The largest Lentulo spiral that will fit into the post space should be used to pick up a little amount of material. With the handpiece set to a low rotational speed, the Lentulo spiral is inserted gradually to convey material into the apical region of the post space. The Lentulo spiral is then gently removed from the post space after increasing handpiece speed. By using this method, the impression material is kept from dragging on. It is continued until the post space is full. A syringe is used to fully embed the wire reinforcement into each post space to fill in more impression material around the prepared teeth, and the impression tray is inserted. Generally access for waxing is sufficient without the need of dowel pins or cast sectioning. Using the imprint as a guide, a loose-fitting plastic post is roughened (a plastic toothpick works well) and made sure it extended the whole depth of the canal. After lubricating the stone cast, a thin layer of sticky wax is applied to the plastic post and soft inlay wax is added in small amounts. Make sure the post is correctly positioned as it is seated to adapt the wax. Begin at the most apical point. The wax core can be added and moulded after this post design has been created.The impression is removed, evaluated, and poured the definitive cast as usual

**2. Prosthetically guided Cast post Fabrication technique-**

Jason De lee et al.proposed the new technique to facilitate the creation of an anatomically guided cast post-and-core pattern. In this technique post spaces are irrigated with sodium hypochlorite and dried with paperpoints. The post spaces are lubricated with a thin layer of

Vaseline petroleum jelly, and the post-and-core patterns are initiated following the traditional direct method with an autopolymerizing acrylic resinon a plastic burnout.
Once an accurate and passive pattern of each post space is confirmed, additional increments of theacrylic resin are added coronally to minimally capture the pulp chamber and seal any existing voidsbetween the pattern resin and the tooth structure. The plastic burnout post is cut with scissors,leaving about 2 mm extending above the post pattern. Next, a putty impression of the idealized wax-up is filled with a bis-acrylic provisional material) and should be seated in the patient's mouth. The bis-acrylic provisional material is allowed to fully set inthe mouth, and the putty matrix is then removed. This results in a full-contour "mock-up" of the idealizedrestorations connected to the post space patterns that are confirmed to be accurate in the previous clinical step.Depth grooves are then made into the bis-acrylic mock-up with a coarse diamond bur to the desireddepths based on the restorative material of choice, and crown preparations are carried out in the conventional manner.
Lastly, the individual patterns are then removed from the mouth and refined outside of the mouth withremoval of any flashes of material and/or sharp corners. The patterns are then sent to thelaboratory for burnout and casting in a type III gold alloy.Once the cast post-and-core restorations are returned from the dental laboratory, they should be checked for passive seating and accurate marginal fit before being cemented intothe mouth with a glass-ionomer cement. Minimalrefinements of the crown preparations are needed following cementation.[10]

**3.Modified indirect custom cast post and core procedure**:
The choice of the lentulospiral, also known as the mechanical cement carrier, is the initial step in this method. The biggest lentulospiral (Mani) that fits in the postspace and grew to the required length should be taken. After that an impression tray based on the arch and the arch size is taken. Silicone with a light and putty-like consistency (Aqua) is employed as the elastomeric imprint material.The light body that is offered in syringe form. The mixing tip is attached to one end of the syringe, which is attached to the gun on the other. The prepared tooth should completely covered with the impression substance. Then selected lentulospiral is attached to the micromotor handpiece (NSK) and is then loaded with impression material. While loading the lentulospiral, the lentulospiral should not be kept rotating. However, while carrying the impression material in the postspace, the lentulospiral is kept initially at low rotational speed; the speed is then gradually increased as it reached the apical portion of the post space.The speed is again reduced wile withdrawing the letulospiral. This procedure of carrying the impression material into the post space is repeated until the entire canal got filled with impression material.
While performing this procedure, care is taken that each time the lentulospiral iswithdrawn from the canal and is kept rotating to get a void-free impression .After this, the heavy body impression material is mixed, i.e., base and catalyst and is loaded onto the impression tray. The impression is taken using putty wash one-step technique, i.e., the heavy body is placed on to the light body that was filled all around the prepared tooth. Since the heavy body picks up the light body, such impressions are also called pick up impressions. The impression is then removed and later evaluated. After making the impression the access cavity is sealed by a temporary restoration.The impression is then sent to the dental laboratory for its fabrication. The cast post and core is made in Nickel-Chromium-based dental alloy-Duracast V[13-20]

**4. CAD/CAM Fabricated Post and Core**
Single crowns, fixed partial dentures, detachable partial dentures, and complete dentures have all been created with the assistance of computer technology.[22,23] This technology has a number of benefits, including improved manufacturing efficiency, an easier and quicker

method of constructing restorations in a greater capacity, and effective quality control methods.[24] Either "additive" or "subtractive" manufacturing processes are used by CAD/CAM technology. By gradually printing out structures, layer by layer, additive manufacturing creates goods. Numerous printing technologies, including stereolithography (SLA), selective laser melting (SLM), and many others, have been described.[25] The subtractive approach, on the other hand, uses laser ablation or machining to remove material in order to manufacture the desired output. According to reports, the subtractive process of production results in mechanically superior restorations than those performed with additive method .[26]] However, about 90% of the prefabricated block material gets wasted while creating the desired restoration. The additive method approach has gained in popularity, as it produces complex structures with high precision without any waste of material. Given the advantages, the CAD/CAM technology has been considered for the fabrication of custom-cast post and core. The use of CAD/CAM technology in the post and core fabrication was first elaborated in 2007 by Awad and Marghalani and later by Strecker and Geissberger.
Techniques for Fabricating CAD/CAM Post and Core As with conventionally made cast post and cores, the fabrication of CAD/CAM post and cores can be either indirect or direct

## 5. Indirect (Semi-Digital) Technique

The semi-digital technique involves a digital scan of a wax or resin pattern, or a scan of a post-space impression. Following the scan, a virtual design is created, and the cast post and core restoration is milled (or printed). This technique was adopted in the earliest report on CAD/CAM fabricated post and cores,14 where a custom-made zirconia post and core were milled from a zirconia block. Initially, a direct acrylic-resin pattern was fabricated to record the anatomy of the post space. Later, the resin pattern was scanned, milled, and sintered to create a custom-made ceramic post and core. A similar report exhibited the fabrication of post and core patterns with an auto-polymerizing resin.[47]Following this, the pattern was sent to a laboratory where it was scanned and milled. Another clinical report demonstrated a different indirect technique. An impression of the cast was taken, and then a wax pattern was created and digitized with a scanner.[58] More recently, a report discussed a method of fabricating a CAD/CAM-customized post and core design based on a scan of a polyvinyl siloxane impression instead of an acrylic resin or wax pattern[59] The reported technique involved scanning the impression followed by milling the nanoparticle filled resin block to obtain a customized post and core. This method requires less chairside time and therefore results in better work efficiency, compared to the use of direct acrylic-resin patterns. Alternatively, the fabrication of CAD/CAM post and core can be performed indirectly by making an impression of the post space, followed by pouring with scannable stone. The stone cast can then be scanned, followed by designing and milling.[60] Perucelli et al [48] compared the adaptation of CAD/CAM post and cores made with different indirect fabrication workflows ie, a scan of a resin pattern made on the tooth or on the cast, or a scan of an impression. All techniques had comparable adaptations that were within the clinically acceptable range.[48].

## 6. Direct (Fully Digital) Technique

The fully digital or direct technique involves the direct optical impression of the post space. It uses a digital scan of compatible scan posts in conjunction with drills that prepare the root canal space,[61] or a direct scan of the root canal space intraorally.[62] Afterward, a restoration design is created using software, followed by milling. The fully digital or direct technique is beneficial as it reduces chairside time and simplifies the laboratory procedure for post and core fabrication[.57] Directly scanning the post space eliminates the risk of

inaccuracies incurred by the use of impression materials, gypsum models, and pattern materials, such as resin and wax.

## CONCLUSION

The custom-fabricated cast post-and-core approach has long been advocated as the gold standard because of its high success rate and favorable long-term prognosis.Traditionally, two main techniques have been described for the fabrication of a cast post-and-core pattern: indirect and direct technique. Various new techniques for fabrication of customized cast post like Modified indirect cast post fabrication technique, Prosthetically guided cast post fabrication technique, Fabrication of custom cast post using CAD-CAM have been introduced. With increasing evidence of success with CAD/CAM customized post and cores, this approach can be considered as an alternative to conventional techniques. Since the clinical data regarding the prosthetically guided technique and modified indirect technique is limited so there is a need for further clinical evaluation of these technique.

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