



## Case Report

# **Tooth Preparation, Impression Technique, Provisionalization and Bonding PFZ Crown for Restoring Endodontically Treated Tooth: A Case Report**

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### **Abstract**

*Restoration of endodontically treated tooth is considered to be one of the important factors in long term success. The full-coverage crown has significantly improved the rate of clinical success, especially in the posterior tooth. Numerous essential steps such as treatment planning, proper tooth preparation, impression technique, selection of suitable tooth material, and discussion with the lab technician are key to establish the long-term survival of fixed prosthesis. This paper aims to describe in detail the various steps and techniques for fabricating porcelain fused zirconium (PFZ) crown in restoring endodontically treated tooth.*

**Keywords:** *Endodontically treated tooth, Porcelain fused zirconium, Fixed prosthesis.*

### **Introduction**

Endodontically treated posterior teeth present numerous problems because of coronal destruction from dental caries, fractures, and previous restorations or endodontic techniques. The result is the loss of tooth structure and a reduction in the capacity of the tooth to resist a myriad of intraoral forces. Preservation of sound tooth structure is regarded as one of the most important aspects in the increasing survival rate of endodontically treated teeth (1-3). From this perspective, direct restorations seem to have an advantage over crowns, since the preparation of a crown weakens the tooth exposing it



to more likely failure. On the other hand, the need for a full-coverage crown to prevent root fracture in endodontically treated posterior teeth has been supported by in vitro studies. (4, 5) and by retrospective clinical studies. (6, 7) Another study showed that coronal coverage did not significantly improve the rate of clinical success for anterior teeth, whereas it improved success for premolars and molars. (7)

Coronal coverage significantly improves the clinical success rate of endodontically treated posterior teeth. (8) Endodontically treated teeth with crowns have a survival rate six times greater than that of teeth without crowns. (9)

Protocols of every step from tooth preparation, temporization, impression technique, bonding all are essential in the long-term success of the crown. The skill of the dentist and lab technician, the material used and appropriate treatment planning and case selection are important factors affecting the lifespan of any fixed prosthesis.

**History of presenting complaints:** A 40-year-old female patient came to the dental department to restore her root treated tooth. She complained about chipping off of the filling on that tooth hence she wants to restore it permanently. The patient has no significant past medical history and she brushes twice daily using interdental aids.

## Clinical photographs



**Patient's smile**

The patient has an average smile estimated as 25- 75% of the interproximal gingivae visible. The **curvature** of the incisal edges of the maxillary teeth and the curvature of the lower lip are coincident.



Anterior View teeth in occlusion



Anterior View teeth apart



Right Buccal view



Left buccal view



Maxillary occlusal view



Mandibular occlusal view

**Radiographs:-**

An intraoral periapical radiograph was taken to assess the periapical region of the tooth. The tooth showed radiograph evidence of good seal and complete obturation of all the canals without any periapical radiolucency.

**Panoramic radiograph**

IOPA of 35, 36, and 37

**Pre-assessment**

When the treatment of an endodontically treated tooth has been completed to a technically satisfactory standard and the tooth is symptom-free then it is realistic to proceed with the final restoration immediately. This is particularly true when dealing with a previously vital, uninfected tooth. If the tooth was symptomatic that is, tender to biting and on lateral pressure, then delaying the final restoration for a few weeks while the tooth settles would be prudent. In this case, the quality of the treatment was assessed clinically as well as radiographically and the tooth was symptom-free, the root filling was good and no periapical radiolucency was seen.

Assessing whether the remaining tooth structure after preparation will have sufficient strength, assessing the need for crown lengthening before treatment and occlusal considerations all were considered before treatment planning.

**Colour assessment:** - Of the three **components of color**, **value** (brightness, luminosity) is the most influential, followed by **Chroma** (saturation/ intensity) and **hue** (the color itself) Value can significantly affect the perception of dimensions and position of a tooth. To reproduce a natural tooth color and



respond to the expectations of patients, accurate evaluation of the natural tooth color is necessary so that it is reflected in the prosthesis (10) Color matching of teeth is recorded through visual shade matching or instrumental color analysis (11). Visual shade matching is most (12, 13) frequently performed using shade guides. However, commercially available shade guides contain a limited selection of colors when compared to those found in natural teeth and visual shade matching is affected by many factors such as variable viewer interpretation and environmental influences (14). Conversely, color-measuring devices are efficacious to quantify the natural tooth color and enable communication between technicians and dentists to be more uniform and accurate. Because eyes usually tire after 5 -7 seconds, the recommended selection was made quickly and to accept the first decision. It is important not to stare at the tooth for longer than 5 seconds when determining hue and Chroma.



Samples were spread out like a fan



Shade taking on canine



Shade taking

The teeth to be matched were cleaned and bright colors were removed from the field of view, Patient was viewed at eye level and shade was evaluated under multiple light sources.

All-natural tooth shades are determined systematically and can be perfectly reproduced with the unique VITA SYSTEM 3D-MASTER

**Determining the lightness level (value)**, the shade guide was held at arm's length to the patient's mouth. Selection of groups 0, 1, 2, 3, 4, or 5 was done. Selection with the darkest group was done first **Selecting the chroma**: - Based on the determined lightness level, the middle hue group (M) was chosen to determine the chroma and samples were spread out like a fan. The selection of one of the three-shade samples was done.

**Determining the hue** • Checking whether the natural tooth is more reddish or more yellowish as compared to the shade sample selected. It was slightly more yellowish at the cervical half

## Treatment options

### Option 1

**Do nothing**: Placing a direct restoration as an alternative, especially one that will need to be quite large, typically isn't considered to be the ideal treatment. Restoration cannot give the same type of longevity, or have an ideal shape, like a crown. Additionally, composite restoration doesn't provide the same level



of protection from fracture. Without a crown, a tooth may crack or break sometime in the future, possibly irreparably.

## Option 2

Placing a post and core. Where “substantial remaining dentin” is available, a post and core do not perform better than a post-free core a post is not necessary when substantial tooth structure is present after a tooth has been prepared. (15)

Post-placement has indicated if both of the following clinical conditions exist:

- a) The remaining coronal tooth structure is inadequate for the retention of a restoration.
- b) When there is sufficient root length to accommodate the post while maintaining an adequate apical seal. (16) In this case, there is substantial remaining dentine, so post and core is not a good option.

## Option 3

As the patient doesn't want an option that may chip or stain, porcelain bonded crowns are a good option. The increasing demand by the patient for aesthetic and metal-free restorations has been considered and mechanical stability is also needed. Hence these points lead to discussions of full-coverage crowns and helped to justify crowns as the best restorative option in this case.

**Confirmative approach:** There is no reason to change occlusion if there are sufficient good occlusal contacts on teeth that are not going to be restored to ensure that the patient will occlude into the same jaw relation (17). The patient doesn't have a TMJ problem so the confirmative approach is the obvious decision.

## Reorganized approach:

The occlusal adjustment can be made as to the removal of occlusal interferences, through selective tooth grinding or the use of restorative materials only in cases where interference exists on the tooth to be prepared. However, where interferences exist on teeth that are not themselves to be prepared, the need for adjustment may be less important. Many people have asymptomatic interferences and seem to be



able to lead a normal existence and it is certainly not advocating for the removal of all interferences as a public health measure. (18) In this case, as interference was asymptomatic and does not exist on the tooth to be prepared so no adjustments were made.

## Final decision

The patient was certain that she did not want any metalwork in her crowns. This point was discussed in detail. Porcelain fused with zirconium was chosen.

## Treatment Plan

Before any treatment being carried out the proposed treatment was discussed in great detail including longevity and potential complications.

- Wax up mockup.
- Prepare teeth for all-ceramic crowns.
- Provisionals and soft tissue conditioning.
- Impression and delivery of final crowns.

## Diagnostic Wax Up



Lab-made diagnostic wax-up



After a judgment has been made as to what is achievable about patient demands, there are ways to help a patient visualize what the restorations may look like. Time spent showing the patient aesthetic possibilities at this stage is invaluable in saving future disappointment.

**Silicon impression should be made from diagnostic wax-up:-**



Silicon index made from diagnostic wax-up

Once the wax-up was complete, a silicone matrix was formed over the waxed model of the proposed restoration. The silicone putty matrix was filled with bisacrylic resin and placed in the patient’s mouth. When the bis acrylic resin was set, it was removed leaving the restoration in place over the patient’s teeth. A silicon index is used to transfer the new shape and size of the proposed crowns from the diagnostic wax to the mouth as well as for preparing the teeth.

**Material choices**

Material selection is crucial to the success of any restoration. (19) In choosing the right material, one factor to consider is longevity. No matter how esthetically beautiful the restorations are, if they do not last, it is inconvenient for the patient, the clinician, and the dental laboratory. The material chosen in this case was porcelain fused to zirconium due to the following advantages.

Exceptional strength: Greater flexural strength than any other all-ceramic available.

Excellent esthetics: No black lines or gingival graying. Semi-transparent with high opacity to mask underlying tooth discoloration, metal cores and implant abutments. Outstanding marginal fit:

Reduced seating time compared to PFMs.



Biocompatible: No allergic reactions or tissue irritation.

**Tooth preparation:**



Tooth before preparation



Sectioned silicon matrix



Crown prep lingual view



Crown prep Buccal view



Crown prep occlusal view



Crown margins were placed supragingival, to avoid the problems associated with gingival recession. A minimum of 2mm of sound tooth structure is required to create a “ferrule”, which is essential to distribute lateral forces, and this didn’t include the core build-up material.

### **Retraction technique:**

One of the most challenging aspects of crown and bridge is the management of the gingival tissues when making an impression. Tissue management includes placing the gingival tissues away from the preparation margins so they can be impressed combined with providing for hemostasis when the gingival tissues are susceptible to bleeding.(20,21) The rationale for tissue management is a critical aspect of impression making whether the impression is made with a conventional impression material or by a digital impression technique so that all tooth preparation margins are captured in the impression to assure an excellent marginal fit of a laboratory fabricated restoration. (20). Knitted cords when saturated with astringents and when placed in the gingival sulcus expand creating a physical effect of enlarging the sulcus for access for impressions or to displace the gingival tissues when placing direct restorative materials. Also, the unique knitted weave (UltraPak, Ultradent) minimizes unraveling and fraying after cutting and during cord placement. Knitted cords offer ease in their placement and they expand when wet opening up the sulcus greater than the original diameter of the cord (22)

Tooth preparation was accomplished and cervical margins were dropped carefully to their pre-determined intra-crevicular position. A length of gingival retraction cord was selected to specifically match the anatomy of the gingival sulcus. Knit cord (Ultrapack Cord; Ultradent Dental Products, Salt Lake City, Utah) that fitted in the sulcus was used. The cord was soaked in the medicament (Homodont; Premier Dental Products, Norristown, Pennsylvania). Excess medicament was blotted from the soaked cord with a sterile cotton sponge. The cord was carefully packed into the sulcus in a counter clock-wise direction. After the cord is in place, the tooth preparation was carefully inspected to ascertain that the entire cervical margin can be visualized and that there is no soft tissue impediment to easy injection of the impression material to capture all of the cervical margin detail.

After the cord was placed, the prepared tooth was carefully examined to determine that the entire cervical margin can be visualized. Before removing the cord, the cord was soaked in water to allow it to be easily removed from the sulcus. Removal of the cord when dry is traumatic and tears the inner epithelial lining and initiates hemorrhage (23)



The above images show retraction has opened up the sulcus and displaced the gingivae vertically and horizontally.

### **Impression Technique:**

Well-fitting indirect restorations can only be made if there are accurate casts of the oral tissues available, made from high-quality impressions. A good quality impression is only obtained when we have a thorough knowledge of materials, their properties, and techniques for their best manipulation.



## Silicone impression



Silicone impression

On behalf of the several impression, protocols suggested, the double-mix techniques, in which two materials of different viscosity are used together (25,27,28,29) have been preferred especially when polyether and vinyl polysiloxane materials are adopted. Single-step or 2-step procedures may be performed with putty and light body, putty and medium body, or heavy body and light body (28, 29,).

The single-step technique, in which both materials polymerize simultaneously, reduces chairside time and saves impression material. Although time is a limiting factor since the professional has to accommodate both low and high consistency materials simultaneously before setting occurs, this technique yields accurate impressions independently of the curing kinetics of the syringed material alone. According to the literature, the single-step technique with vinyl polysiloxanes or polyethers leads to very accurate impressions (25,26,27)

Low viscosity impression material was injected around the prepared teeth than the putty impression material was immediately placed intraorally and the materials polymerize simultaneously.

## Provisional crowns

Provisionalization is an integral part of fixed prosthetic treatment. Success with this phase of treatment needs to take into consideration the biologic, mechanical, and esthetic requirements of provisionalization. Multiple types of provisional materials are available and, depending on the



provisionalization requirements for that particular patient, some materials are better suited than others. Those materials used chairside sometimes trade strength for lower esthetic values, or those that are highly esthetic are structurally weaker. Selection should be based on how long the provisional will need to be in function, how esthetic it needs to be, and the parafunctional habits of the patient (30).



Provisional crowns Buccal aspect



Provisional crowns occlusal aspect



Provisional crowns lingual aspect

A properly fabricated provisional restoration is important in achieving a successful indirect restoration. Provisional restorations must satisfy the requirements of pulpal protection, positional stability, occlusal function, ability to be cleansed, margin accuracy, wear resistance, strength, and esthetics. They serve the critical function of providing a template for the final restorations once they have been evaluated intraorally. (31)

Bis-acryl composites produce less heat and shrinkage during polymerization than other resins, resulting in a better marginal fit (32). Aesthetically they are reasonable, but few shades are available and they stain easily if the unpolymerised surface layer is not removed which may be accomplished with alcohol and polishing. They are more color stable than polyethyl methacrylate materials and are therefore better suited for use as long-term provisional. (33)

The silicone putty matrix was filled with bisacrylic resin and placed in the patient's mouth. When the bis acrylic resin was set, it was removed leaving the restoration in place over the patient's tooth. Temporary restorations also provide an excellent opportunity to trial proposed changes to the appearance of the teeth. Any shortcomings can be readily identified and remedied at this stage rather than be carried through to the final restorations where adjustments can be costly and demoralizing



### **Prescription to the lab technician**

By enabling the technician to see the patient's dentition, clinicians are better serving their patients and dentistry as a whole. Communication between the patient, clinician and laboratory technician is critical to the process of providing the best possible results and to meet the patient's expectations. Research has shown that there are differences between individuals' perceptions and those of dental professionals regarding not only teeth but other factors affecting smiles and facial appearance.

A very important stage in the consent process and another example of the importance of communication between the patient and the dentist and the lab technician is the prescription of the indirect restorations.

Information sent to the lab technician included:

- (a) Lab sheet with patient and dentist information, tooth specific information and the detail of tooth shade.
- (b) An email was sent with photos of tooth preparations and the provisional crowns

### **Pre-operative evaluation of crowns:**



The fit surface of the crown



The crown on fixed model



Buccal view of the crown on working die



Distal view of the crown on working die

**Checking the crown on the die:-** It was worth checking the fit of the crown on the cast before trying it on the patient. In this way problems involving marginal fit, aesthetics and articulation can be anticipated before try in. The fit surface of the crown was checked for defects and the die for damage with good light and under magnification. The crown fit was assessed on the die before the patient's crown fit appointment was made. This way problems involving marginal fit, aesthetics and articulation can be anticipated before try-in.



Crown in situ: lingual view



crown in situ: occlusal view



Crowns in situ: buccal view



The occlusion was the last assessment to make articulating foils were used. Once ICP has been re-established the excursions and checked with a different colored foil (eg red). ICP contacts are then remarked with the original color (eg black) allowing the excursive contact to be differentiated and refined. When the fit of the crown was considered satisfactory and all adjustments were been made the crown was cemented with Resin modified glass ionomer cement.



Crown in situ: anterior view: in occlusion

The patient has instructed the effect of the crown verbally as well as written instructions were provided.

### Review and maintenance

The patient is reviewed one week later to ensure that all excess resin cement has been removed and that correct plaque control procedures are being employed. The marginal integrity was checked for signs of marginal leakage. Restoration of teeth, color, aesthetic acceptability and gingival health at regular recall.

### Discussion

Although treatment recommendations should be made on an individual basis, the association between crowns and the survival of endodontically treated teeth should be recognized during the treatment planning if long-term tooth survival is the primary criteria for success in endodontics. Root canal treated posterior teeth without crowns are lost at a much higher rate than teeth supported with full cast crowns. When crowns are used to restore endodontically treated teeth, they reduce the likelihood of the tooth



fracturing due to the brittle devitalized nature of the tooth and provide a better seal against invading bacteria. Clinical success depends on the application of sound biomechanical principles for the specific tooth and clinical situation.

This case emphasizes that proper selection, meticulous treatment planning and team work with dental technicians are essential to achieve the long-term success of endodontically treated teeth. The clinician should carefully balance between strength of restoration, protection of remaining teeth and long term prognosis of the treatment. Although no dental restoration lasts forever, the average lifespan of a crown is around ten years. The important factors affecting the lifespan of any restoration are case selection, treatment planning, the material used and the skill of the dentist & laboratory technician.

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