EVALUATION OF DIFFERENT TYPES OF CROWNS USED FOR RESTORATION OF ENDODONTICALLY TREATED TEETH

Dr. Shivangi Shreya

PG final year, Department of Conservative Dentistry and Endodontics, Buddha Institute of Dental Science and Hospital, Patna, Bihar, India.

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Corresponding author: Dr. Shivangi Shreya

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Abstract

Endodontically treated teeth (ETT) have been problematic in most cases as a result of dental caries, fractures, previous restorations and endodontic procedures. Several post system techniques and materials are currently used to build up ETT with moderate or severe loss of coronal tooth structure and to retain final restorations. Following root filling, the custom-made cast metallic post and core with metal-ceramic crowns was the traditional restoration of choice, but this has changed. The patients' primary motivation for seeking superior dental aesthetics, particularly in the anterior aesthetic zone, has prompted the development of non-metallic restorations. Several new types of polymeric and more aesthetic quartz and glass-fibres posts, combined with direct resin composite cores, provide an aesthetic foundation for an all-ceramic crown and have overcome the aesthetic limitations of metallic posts and cores in the anterior teeth. Until recently, there has been controversy in the dental community regarding which material or technique is the most favourable for the restoration of ETT. It seems that the amount and retentive capacity of the remaining tooth structure, the position of the tooth in the dental arch, the functional or para-functional loading on the tooth, and the treatment plan to restore aesthetics and function all influence the selection of the most appropriate post system for each case. Hence the present study was planned for Evaluation of Different Types of Crowns Used For Restoration Of Endodontically Treated Teeth.

The present study was planned in Department of Conservative Dentistry and Endodontics, Buddha Institute of Dental Science and Hospital, Patna, Bihar, India. The 40 cases of maxillary anterior endodontically treated teeth (ETT). The roots were restored with reinforced GFPs (Relaxy Fiber Post, 3M ESPE, Germany), and composite resin cores (Tertic-N-Ceramic, Ivoclar Vivadent, Lichenestine).

The survival of ETT is contingent on the residual sound tooth structure that remains after the endodontic access and caries removal are performed consequently the most important factors upon restoring ETT become the maximum preservation and conservation of enamel, dentin and the dentinoenamel junction. Hence, bonded partial restorations are always preferred over full coverage cementable crowns. More clinical studies comparing adhesive crowns bonded to postless build-ups or post and -core build-ups are needed for a better understanding of postless approaches in biomimetic restorative dentistry.

Keywords: Endodontically treated teeth, Crown, cores, post, etc.

Introduction

Endodontics encompasses the study (practice) of the basic and clinical sciences of normal dental pulp, the etiology, diagnosis, prevention, and treatment of diseases and injuries of the dental pulp along with associated periradicular conditions. Endodontics has evolved tremendously in the past decade and its applications have immensely improved the quality of dental treatment.

In clinical terms, endodontics involves either preserving part, or all of the dental pulp in health, or removing all of the pulp in irreversible disease. This includes teeth with irreversibly inflamed and infected

pulpal tissue. Not only does endodontics involve treatment when a dental pulp is present, but also includes preserving teeth which have failed to respond to non-surgical endodontic treatment, or for teeth that have developed new lesions, e.g., when root canal re-treatment is required, or periradicular surgery. [1]

The main purpose of endodontic treatment (root canal therapy) is to remove the diseased pulp, clean and shape the root canal system, disinfect the contaminated root canals, and then obturate (fill) the root canal system to prevent re-infection and promote periradicular healing. The aim is to have radiographic evidence of healing, with no

postoperative lesions present, and restored periradicular health if preoperative lesions were present. The main reason for dental pulpal problems has been related to bacterial contamination of the root canals. Therefore, significantly reducing the bacterial load within the root canal system, and then filling the canals with an inert obturating material aid in preventing bacterial re-infection. [2]

Endodontic therapy is not only performed when pain relief from an infected or inflamed pulp is required. It is also done to prevent adverse signs and symptoms from the surrounding sequelae and promote the healing and repair of the surrounding periradicular tissues. An example of which is if there is trauma to a front tooth which has caused it to be avulsed from the bony socket; endodontic treatment is required following re-implantation to preserve the aesthetics and function of the tooth, even though there may be no adverse symptoms of the dental pulp, or pain present at the time. [3]

Endodontists are specialist dentists with additional training, experience and formal qualifications in endodontic treatment, apicectomies, microsurgery, and dental emergency and trauma management. The use of magnification devices such as microscopes, and dental loupes have been widely accepted among endodontists and practitioners; its use is believed to increase accuracy and visualization in the operating field, however, a Cochrane review in 2015 found no evidence to determine whether there's a difference in the outcome of a procedure done by magnification devices or a conventional procedure done with no magnification. The American Association of Endodontics strongly encourages its members to pursue the use of an oral microscope to ensure the highest level of excellence. The use of a CBCT is also becoming the standard of care.[10][11] Endodontic treatment is one of the most common procedures. If the dental pulp (containing nerves, arterioles, venules, lymphatic tissue, and fibrous tissue) becomes diseased or injured, endodontic treatment is required to save the tooth. [4-5]

Endodontic crown is a single prostheses fabricated from reinforced ceramics, indicated for endodontically treated molar teeth that have significant loss of coronal structure. Endocrowns are formed from a monoblock containing the coronal portion invaded in the apical projection that fills the pulp chamber space, and possibly the root canal entrances; they have the advantage of removing

lower amounts of sound tissue compared to other techniques, and with much lower chair time needed. They are luted to the tooth structure by an adhesive material. The ceramic can be milled using computer-aided techniques or molded under pressure. Endocrowns can be an alternative to conventional crown restorations. [6]

It was Bindl and Mörmann who named this restorative procedure "endocrown" in 1999 defining it as a total porcelain crown fixed to a depulped posterior tooth, which is anchored to the internal portion of the pulp chamber and to the cavity margins, thus obtaining macromechanical retention (provided by the pulpal walls) for restoring endodontically treated teeth. [7]

The classical approach is to build up the tooth with a post and core, which have physical properties close to those of natural dentin, utilizing adhesive procedures and placement of full-coverage crowns with a sufficient ferrule, but it was found that excessive amount of teeth removal may cause fracture to the teeth. The literature suggests that endocrowns may perform similarly or better than the conventional treatments using intraradicular posts, direct composite resin or inlay/onlay restorations. [8]

Endocrowns are especially indicated in cases of molar teeth with short, or fragile roots. They may also be used in situations of excessive loss of coronal dental tissue. Reinforced, acid etchable dental ceramics have been the materials of choice for the fabrication of endocrowns, because they guarantee the mechanical strength needed to withstand the forces exerted on the tooth, as well as the bond strength of the restoration to the cavity walls.

Using endocrowns for premolars is contraindicated as the tooth is more likely to be subjected to lateral forces during mastication than molars because of the steep cuspal incline. Therefore, premolars are prone to fracture after restoration. [9]

A systemic review and meta-analysis showed a success rate of endocrowns varying from 94 to 100%. Analysis in posterior and anterior teeth demonstrated that endocrowns had higher fracture strength than conventional treatments. Another study showed that an endodontic crown preparation appeared acceptable for molar crowns but inadequate for premolar crowns. The longest duration of survival is for molar endocrowns is a 5-year clinical follow-up period, with success rate of 87.1%. Root fracture is a

very possible finding in premolar and anterior teeth. [10]

Endodontic treatment may fail for many reasons: one common reason for failure is inadequate chemomechanical debridement of the root canal. This may be due to poor endodontic access, missed anatomy or inadequate shaping of the canal, particularly in the apical third of the root canal, also due to the difficulty of reaching the accessory canals which are minute canals that extend in from the pulp to the periodontium in a random direction. They are mostly found in the apical third of the root. [11]

Exposure of the obturation material to the oral environment may mean the gutta-percha is contaminated with oral bacteria. If complex and expensive restorative dentistry is contemplated then ideally the contaminated gutta percha would be replaced in a retreatment procedure to minimise the risk of failure.

The type of bacteria found within a failed canal may differ from the normal infected tooth. *Enterococcus faecalis* and/or other facultative enteric bacteria or *Pseudomonas* sp. are found in this situation.

Endodontic retreatment is technically demanding; it can be a time consuming procedure, as meticulous care is required by the dentist. Retreatment cases are typically referred to a specialist endodontist. Use of an operating microscope or other magnification may improve outcomes.

Endodontically treated teeth (ETT) have been problematic in most cases as a result of dental caries, fractures, previous restorations and endodontic procedures. Several post system techniques and materials are currently used to build up ETT with moderate or severe loss of coronal tooth structure and to retain final restorations. [12-13] Following root filling, the custom-made cast metallic post and core with metal-ceramic crowns was the traditional restoration of choice, but this has changed. The patients' primary motivation for seeking superior dental aesthetics, particularly in the anterior aesthetic zone, has prompted the development of non-metallic restorations. [14-16] Several new types of polymeric and more aesthetic quartz and glass-fibres posts, combined with direct resin composite cores, provide an aesthetic foundation for an all-ceramic crown and have overcome the aesthetic limitations of metallic posts and cores in the anterior teeth. [17] Until recently, there has been controversy

in the dental community regarding which material or technique is the most favourable for the restoration of ETT. [18] It seems that the amount and retentive capacity of the remaining tooth structure, the position of the tooth in the dental arch, the functional or para-functional loading on the tooth, and the treatment plan to restore aesthetics and function all influence the selection of the most appropriate post system for each case. [19]. Hence the present study was planned for Evaluation of Different Types of Crowns Used For Restoration Of Endodontically Treated Teeth.

Methodology:

The present study was planned in Department of Conservative Dentistry and Endodontics, Buddha Institute of Dental Science and Hospital, Patna, Bihar, India.

The 40 cases of maxillary anterior endodontically treated teeth (ETT). The roots were restored with reinforced GFPs (Relaxy Fiber Post, 3M ESPE, Germany), and composite resin cores (Tetric-N-Ceramic, Ivoclar Vivadent, Lichenestine). The 20 ETTs were divided into four groups depend on the crown type or the final restoration:

- Group I consists of 10 ETT cases with GFP and composite restoration.
- Group II consists of 10 ETT cases with GFP and porcelain VITA VM (R) 9 (Vita Zahnfabric /Germany) fused to metal restoration.
- Group III consists of 10 ETT cases with GFP and e. max all ceramic (IPS e.max, Ivoclar/Vivadent) crowns.
- Group IV consists of 10 ETT cases with GFP and zirconia crowns, which consisted of a core's build up with Vita In-Ceram YZ Disc (Vita Zahnfabric/Germany), and the porcelain build-up were done with porcelain VITA VM(R)9 (Vita Zahnfabric/Germany) crowns.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Results & Discussion:

There are few subjects in dentistry that have been studied more than the restoration of endodontically treated teeth. Yet, many practical questions and controversies remain in this clinically important element of the treatment plan. Unfortunately, the diversity of published opinions is confusing and may

lead to less than optimal treatment selections. Fortunately, there are a number of areas in which the preponderance of research supports specific clinical procedures.

Table 1: The Clinical Results of ETT at the Different Time Follow-Up

Clinical Results	One Week	3 Months	6 Months
Movement of the crown margin under finger pressure:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Fracture of the crown:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Loss retention of the crown:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Bonding at post-core/tooth interfaces:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Periodontal status/ violation of biological Width			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Aesthetic (color changes):			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Recurrent caries at crown margin:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10

Table 2: Radiographic Results of ETT at the Different Time Follow-Up

Clinical Results	One Week	3 Months	6 Months
Caries at cervical margin:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Presence of periapical infection:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Post fracture / root fracture:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10
Loss of retention of post:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	8
Post adaptation in root canal:			
Composite	10	10	10
PFM	10	10	10
e max	10	10	10
Zirconia	10	10	10

dentically treated teeth is substantially different than dentin in teeth with “vital” pulps. [20-22] It was thought that the dentin in endodontically treated teeth was more brittle because of water loss [20] and loss of collagen cross-linking. [22] However, more recent studies [23-24] dispute this finding. In 1991, Huang et al. [23] compared the physical and mechanical properties of dentin specimens from teeth with and without endodontic treatment at different levels of hydration. They concluded that neither dehydration nor endodontic treatment caused degradation of the physical or mechanical properties of dentin. Sedgley and Messer[24] tested the biomechanical properties of dentin from 23 endodontically treated teeth with an average of 10 yr of post treatment. They compared them to their contralateral “vital” pairs. Aside from a slight difference in hardness, the properties were comparable. The study did not support the conclusion that endodontically treated teeth are

more brittle. These and other studies support the interpretation that it is the loss of structural integrity associated with the access preparation, rather than changes in the dentin, that lead to a higher occurrence of fractures in endodontically treated teeth compared with “vital” teeth. [25] Access preparations result in increased cuspal deflection during function [26-27] and increase the possibility of cusp fracture and microleakage at the margins of restorations. In most endodontically treated teeth, there also is missing tooth structure caused by caries or existing restorations. Randow and Glantz [28] reported that teeth have a protective feedback mechanism that is lost when the pulp is removed, which also may contribute to tooth fracture. Fennis et al. [29] studied more than 46,000 patients from insurance claims and reported significantly more fractures in teeth with endodontic treatment. Taken together, these studies indicate that restorations that enhance structural integrity would be expected to increase the prognosis of endodontically treated teeth exposed to heavy masticatory loading forces.

Anterior teeth with minimal loss of tooth structure may be restored conservatively with a bonded restoration in the access opening. A post is of little or no benefit in a structurally sound anterior tooth [30-31], and increases the chances for a nonrestorable failure. The same conclusion holds for an anterior tooth with a porcelain veneer. [32] If an endodontically treated anterior tooth is to receive a crown, a post often is indicated. In most cases, the remaining coronal tooth structure is quite thin after it has received root-canal treatment and been prepared for a crown. Anterior teeth must resist lateral and shearing types of forces, and the pulp chambers are too small to provide adequate retention and resistance without a post. The amount of remaining coronal tooth structure and the functional requirements of the tooth determine whether an anterior tooth requires a post.

Comparison between custom and prefabricated posts has been issue of the researches. Fokkinga et al. [33] evaluated the fracture resistance when prefabricated metallic or glass fiber posts or custom glass fiber posts were compared to endodontically treated teeth without posts, and the authors did not find significant difference in failure loads and failure modes. Similar results were found in other studies [34-35], that compared the fracture resistance of endodontically treated teeth restored with custom or prefabricated posts using several designs, planning fixed prostheses

for them. However, when Hayashi et al. [36] studied the mode of fractures when tooth restored with fiber post, prefabricated metallic post and cast metallic post-core were subjected to oblique and vertical load, they concluded that greater loads are necessary to fracture tooth restored with cast metallic post-core when subjected to vertical loads, but at the case of the oblique loads, prefabricated metallic posts required smaller loads. Considering the mode of fractures, vertical loadings caused cracks propagated in the middle and apical portion of the roots while at the situation which oblique loads were applied, most of the fractures occurred in the cervical part of the root when fiber posts were used, and in the middle part, when prefabricated metallic or cast metallic post-core were used. Although metal cast post presents higher fracture resistance, when fractures happen, tooth are lost because of the position of the fracture while cervical root fractures of teeth restored with fiber posts did not necessarily represents lost of the teeth.

Conclusion:

The survival of ETT is contingent on the residual sound tooth structure that remains after the endodontic access and caries removal are performed, consequently the most important factors upon restoring ETT become the maximum preservation and conservation of enamel, dentin and the dentinoenamel junction. Hence, bonded partial restorations are always preferred over full coverage cementable crowns. More clinical studies comparing adhesive crowns bonded to postless build-ups or post and -core build-ups are needed for a better understanding of postless approaches in biomimetic restorative dentistry.

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