

Original research article

Retrospectively assessment of endodontically treated maxillary anterior teeth followed by restoration with different crown types**Dr. Pallawi Sinha^{1*}, Dr. Jyoti sharan², Dr. Sudipto Poddar³, Dr. Nagaveni S Somayaji⁴,
Dr. Ashutosh Sahu⁵, Dr. Nabaprakash Sahu⁶****¹ Senior Lecturer, Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India.****² MDS (Prosthodontic) Private practice****³ Professor and HOD, Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India.****⁴ Reader, Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India.****⁵ Lecturer, Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India.****⁶ Professor, Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India.****Corresponding Author: Dr. Pallawi Sinha****Abstract****Aim:** to evaluate of maxillary anterior endodontically treated teeth restored with different types of crown.**Materials and methods:** This was a retrospectively study conducted in the Department of Prosthodontic, Hi tech Dental College and Hospital, Bhubaneswar, India for 1 year. The 60 ETTs were divided into four groups depend on the crown type or the final restoration: Group A consists of 15 ETT with GFP and composite restoration. Group B consists of 15 ETT with GFP and porcelain VITA VM (R) (Vita Zahn fabric /Germany) fused to metal restoration. Group C consists of 15 ETT with GFP and e. max all ceramic (IPS e.max, Ivoclar/Vivadent) crowns. Group D consists of 15 ETT with GFP and zirconia crowns, which consisted of a core's build up with Vita In-Ceram YZ Disc (Vita Zahn fabric/ Germany), and the porcelain build-up were done with porcelain VITA VM(R) (Vita Zahn fabric/Germany) crowns Methods of fibre post preparation and cementation**Results:** A total of 80 restorations were recruited to the study and 60 ETT which met the inclusion criteria were evaluated during this study. 15 restorations for each (composite resin, e. max and zirconia). All the restorations were evaluated clinically and radiographic at the different periods one week of cementation, 3, 6, 9, 12 months respectively. On the clinical assessment, the restorations in the four groups had no changes during one week; 3 and 6 months review. While a movement of the crown margin under finger pressure was present in 2 case and loss or retention in 3 cases of zirconia. The periodontal status with violation of biological width was present in 1 case of PFM and finally the colour changes were obvious in 2 case of PFM and 3 cases of composite restoration during the follow-up review of 9 and 12 months. No clinical significant differences between the types of restoration at different time's intervals were detected. The radiographic assessment for the restorations in the four groups had no changes during the one week, and 3 months review. While during 6 months, a loosed of retention in one case of zirconia crown was detected, but during the 9 and 12-month reviews, two cases of recurrent caries at the cervical margin of the composite restoration, one case with

presence of periapical infection were recorded. Finally, the Loss of retention of the post was recorded with one of the PFM restorations. No significant differences between the types of restoration at different time's intervals were detected by the radiographs. **Conclusion:** e. Max and zirconia all ceramic crowns showed better clinical and radiographic performance than the PFM and compositerestorations over 12 months recall.

Keywords: Clinical; Endodontically Treated Teeth; Follow-Up; Glass Fiber-Reinforced Posts; Radiographic; Maxillary Teeth

Introduction

Restoration of endodontically treated teeth (ETT) is compromised primarily because of coronal destruction that results in an increased risk of tooth fracture during function. Before the introduction of adhesion technology in dentistry, the coronal restoration of ETT has been mainly performed with metallic and macro mechanically retained posts. In the past, a post length equal to three fourths of the root canal length or at least equal to the crown length was recommended.^{1,2} Metallic posts generated high stresses, often leading to non-restorable root fractures.³ In order to avoid these problems, metal-free posts with mechanical characteristics similar to those of dental tissues have been developed. Subsequently, fiber-reinforced post systems were introduced.^{4,5} At present, restoration of posterior ETT with a direct composite without placing any post has been proposed by several authors.⁶⁻⁸ Moreover, a recent study might show that in largely compromised premolars, no significant differences existed between teeth restored with and without posts.⁶ These authors argued that the results were due to the use of an adhesive restorative design. The fracture resistance of ETT has been reported to be mainly dependent on the amount of the remaining tooth structure, the amount of adhesive surface, and the quality of adhesion.⁷ The role of a post in the retention of the core material is particularly relevant for posterior teeth where masticatory loads are essentially compressive. On the other hand, as upper incisors are loaded transversally, the influence of post length on the tooth's flexural behavior is an important issue to be considered in order to reduce tooth fracture.⁸

The standard filling material is gutta-percha, a natural polymer prepared from latex from the percha tree (*Palaquium gutta*). The standard endodontic technique involves inserting a gutta-percha cone (a "point") into the cleaned-out root canal along with a sealing cement.⁹ Another technique uses melted or heat-softened gutta-percha which is then injected or pressed into the root canal passage (s). However, since gutta-percha shrinks as it cools, thermal techniques can be unreliable and sometimes a combination of techniques is used. Gutta-percha is radiopaque, allowing verification afterwards that the root canal passages have been completely filled and are without voids. An alternative filling material was invented in the early 1950s by Angelo Sargenti. Filling material has undergone several formulations over the years (N2, N2 Universal, RC2B, RC-2B White), but all contain paraformaldehyde. The paraformaldehyde, when placed into the root canal, forms formaldehyde, which penetrates and sterilizes the passage. The formaldehyde is then theoretically transformed into harmless water and carbon dioxide. According to some research, the outcome of this method is better than a root canal procedure performed with gutta-percha. There is, however, a lack of indisputable scientific studies according to the Swedish Council on Health Technology Assessment. In rare cases, the paste, like any other material, can be forced past the root tip into the surrounding bone. If this happens, the formaldehyde will immediately be transformed into a harmless substance. Blood normally contains 2 mg formaldehyde per litter and the body regulates this in seconds. The rest of an overfill will be gradually absorbed and the end result is normally good. In 1991, the ADA Council on Dental Therapeutics resolved that the treatment was "not recommended", and it is not taught in American dental schools. Scientific evidence in endodontic therapy was, and still

is lacking.¹⁰ Despite this lack of support, the Sargenti technique has advocates who believe N2 to be less expensive and at least as safe as gutta-percha.¹¹ Pain control can be difficult to achieve at times because of anesthetic inactivation by the acidity of the abscess around the tooth apex. Sometimes the abscess can be drained, antibiotics prescribed, and the procedure reattempted when inflammation has been mitigated. The tooth can also be unroofed to allow drainage and help relieve pressure. Endodontics is recognized as a specialty by many national dental organizations including the Dental Board of Australia, British General Dental Council, American Dental Association, Royal College of Dentists of Canada, Indian Dental Association, and Royal Australasian College of Dental Surgeons. The present study was planned to evaluate the performance between different types of crowns and composite restoration. Those restorations were used for ETT in maxillary anterior teeth, after a glass-fibre post with composite resin core build up

Materials and methods

This was a retrospectively study conducted in the Department of Prosthodontics, Hi tech Dental College and Hospital, Bhubaneswar, India for 1 year.

Inclusion criteria

- Ages of the patients were between 18-30 years from both genders.
- All the cases were ETT at maxillary anterior teeth and re- stored with GFP then composite resin core build up.
- The quality of ETT should be RCT with no evidence of periapical pathology or root fracture. The periodontium was stable with no evidence of bleeding on probing and with a good bone support. All teeth should have enough ferrule and biological width, to allow the creation of the finish line on a sound tooth structure.

Exclusion criteria

1. Teeth with pulpal and periapical pathosis and those that could be used or diagnosed to be used as an abutment for prostheses.
2. Patients with absent from adequate posterior support and posterior vertical stops (absence of all molar teeth), or if there were any obvious occlusal interference or fremitus affecting the tooth to be restored.

Methodology

A total of 60 maxillary anterior ETT were involved in this study. After RCTs of all teeth were finished, the roots were restored with reinforced GFPs (Relaxy Fiber Post, 3M ESPE, Germany), and composite resin cores (Tetric-N-Ceramic, Ivoclar Vivadent, Li- chenestine). The 60 ETTs were divided into four groups depend on the crown type or the final restoration: Group A consists of 15 ETT with GFP and composite restoration. Group B consists of 15 ETT with GFP and porcelain VITA VM (R) 9 (Vita Zahn fabric /Germany) fused to metal restoration. Group C consists of 15 ETT with GFP and e. max all ceramic (IPS e.max, Ivoclar/Vivadent) crowns. Group D consists of 15 ETT with GFP and zirconia crowns, which consisted of a core's build up with Vita In-Ceram YZ Disc (Vita Zahn fabric/ Germany), and the porcelain build-up were done with porcelain VITA VM(R)9 (Vita Zahn fabric/Germany) crowns Methods of fibre post preparation and cementation

After the RCTs were done. The gutta-percha (GP) was removed to maintain a 4–5 mm apical seal. The canals were irrigated with a saline solution and sodium hypochlorite. The lengths of the posts in the canals were determined and marked, and the selected posts were placed into the canal to confirm its length. The canals were etched with 37% phosphoric acid for 15 seconds; the etch ant was rinsed with water and dried with paper points. Adhesive bonding agents were applied to the canal, and dual adhesive resin cements Rely X, TM. Unicem

AppliCap Resin Cement (3M ESPE, Germany) was used for cementing of the posts, then light-cured for 60 seconds were applied. The cores were re-build up with composite resin in incremental techniques. All finish lines were on sound tooth structures.

Methods of crowns preparation, fabrication and cementation

Some of the composite cores with the remaining natural tooth structures were stayed in place, while others were prepared according to the type of the final restoration. Then the prepared areas were registered with addition silicon impression material using two steps technique and the shades were selected, metal and core tryin, and the final porcelain veneer layers were applied according to the selected shade guide. Finally, all the manufactured crowns were cemented. All the clinical and laboratory steps were done according to manufactures instructions.

Post-operative evaluations

All the cases were subjected to post-operative flow-up in form of clinical and radio-graphical evaluations after cementation of the crowns at periods of one week, 3, 6, and 12 months. All the restorations were evaluated by expert staffs who were not involved in the study or during the restoration (single-blind trial). The patients were educated about oral hygiene and motivated to use proper oral hygiene aids at the end of each treatment.

The evaluation of success or failure criteria's of the restorative tooth complex were judged to have failed if each post crown satisfied one or more of the following criteria presented in [table 1] over a period of 12 months.

Table 1: The Clinical and Radiographic Evaluation Criteria's of ETT

Restoration type	Clinical examination of the restoration	Radiographic examination of the restoration
Composite	Movement of crown margin under finger pressure	Caries at cervical margin
PFM	Fracture of crown	Presence of periapical /endodontic infection
e.max	Loss of retention of the crown	Post fracture/ root fracture/crown fracture
Zirconia	De-bonding at post-core / tooth interfaces	Loss of retention of the post
	Periodontal status/violation of biological width	Post adaptation in the root canal
	Aesthetics (color changed)	
	Recurrent caries at crown margin	

Statistical analyses

All the data were recorded, and subjected to statistical analysis using statistical software SPSS (Statistical Package for the Social Sciences, IBM) version 21. The survival rates of the crowns were determined and compared during the different recall's periods using Kaplan - Meier analysis and log-rank test. The level of significance was set at 5%.

Results

A total of 80 restorations were recruited to the study and 60 ETT which met the inclusion criteria were evaluated during this study. 15 restorations for each (composite resin, e. max and zirconia). All the restorations were evaluated clinically and radiographic at the different periods one week of cementation, 3, 6, 9, 12 months respectively.

On the clinical assessment, the restorations in the four groups had no changes during one week; 3 and 6 months review [table 2]. While a movement of the crown margin under finger pressure was present in 2 case and loss or retention in 3 cases of zirconia. The periodontal status with violation of biological width was present in 1 case of PFM and finally the colour changes were

obvious in 2 case of PFM and 3 cases of composite restoration during the follow-up review of 9 and 12 months. No clinical significant differences between the types of restoration at different time's intervals were detected [table 2].

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

Clinical Results	One Week	3 Mont hs	6 Mont hs	9 Mont hs	12 Month s
Movement of the crown margin under finger pressure					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	13	13
Fracture of the crown					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Loss retention of the crown					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	12	12
Bonding at post-core/tooth interfaces					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Periodontal status/ violation of biological Width					
Composite	15	15	15	15	15
PFM	15	15	15	14	14
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Aesthetic (color changes):					
Composite	15	15	15	12	12
PFM	15	15	15	13	13
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Recurrent caries at crown margin					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15

The radiographic assessment for the restorations in the four groups had no changes during the one week, and 3 months review [table 3]. While during 6 months, a loosened of retention in one case of zirconia crown was detected, but during the 9 and 12-month reviews, two cases of recurrent caries at the cervical margin of the composite restoration, one case with presence of periapical infection were recorded. Finally, the Loss of retention of the post was recorded with

one of the PFM restorations. No significant differences between the types of restoration at different time's intervals were detected by the radiographs [table 3].

Table 3: Radiographic Results of ETT at the Different Time Follow-Up

Clinical Results	One Week	3 Months	6 Months	9 Months	12 Months
Caries at cervical margin					
Composite	15	15	15	13	13
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Presence of periapical infection					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	14	14
Post fracture / root fracture					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15
Loss of retention of post					
Composite	15	15	15	15	15
PFM	15	15	15	14	14
e max	15	15	15	15	15
Zirconia	15	15	14	15	15
Post adaptation in root canal					
Composite	15	15	15	15	15
PFM	15	15	15	15	15
e max	15	15	15	15	15
Zirconia	15	15	15	15	15

Discussion

The present study was set out to test and compare the clinical performance of four types of restorations (composite resin, PFM, E max and Zircon), on maxillary anterior ETT teeth with glass fibre posts. GFPs are relatively new and becoming increasingly popular in restoration of ETT in the maxillary aesthetic zone teeth.

From table (2,3) after different periods of clinical and radiographic follow-up, the performance of GFP and composite restorations group was good and show excellent survival rates. This was in agreement with (Grandin S et al, 2005, Preeth & Kala, 2008)^{12,13}, those examined teeth restored with GFPs with direct composite restorations, which exhibited favourable clinical serves and results. Also we were totally agreed with Altun C et al, 2008,¹⁴ about restoration of ETT with composite restoration after GFPs which recorded several advantages, such as an immediate aesthetic and functional rehabilitation, less time required and accepted by the patient.

Marginal discoloration of the composite resin restoration some- times occurred, and their correction provided acceptable clinical results. There are many advantages of composite restorations; it is easy and familiar technique, cost-effectiveness and, it can be re- polished after marginal discoloration.¹⁵ The colour changes and wear of the surfaces of composite restoration

appeared at the 9 and 12 months recall, and were solved by the re-polishing of the restoration of the tooth or margin interferences.

The observed changes in the marginal fitting and the violation of the biological width of a restored tooth in the PFM group at 9 and 12 months recalls were recorded. This is in agreement with Preethi & Kala, 2008,¹³ who similarly observed minor differences in the marginal fit of teeth restored with these types of crowns. Always the marginal defect is mainly seen on the buccal surface of the tooth, while the palatal margin was intact.

In our study, the recurrent of caries was detected in 2 cases during the radiographic assessment of the composite restoration cases during 9 and 12 months recall (table 3). This could be due to the patient neglects and difficulty in practicing good oral hygiene. Furthermore, it could be due to the sub gingival finish line place in this case. The composite restoration usually showed some surface wear of the composite, which is the predisposing reason for collection of bacteria in this area.¹⁵ The clinical and radiographic performances of both e. max and zirconia all ceramic crowns over the 12 months period were good in the issues of aesthetic, colour stability, fractures of either crown or post, recurrent caries, this were close to the results of the study conducted by (Gemalmaz & Ergin, 2002, Etman & Woolford, Taskonak & Sertgöz, 2006.^{16,17,18} the result of the present study was agreed with (Gemalmaz & Ergin, 2002),¹⁶ about the condition of the slight inflammation of the gingiva, in respective of the place of the finish line. From table 2, 2 case of zirconia showed a movement of the crown margin under finger presser of a crown and 3 cases with loss of retention during clinical recall examination at 9 and 12 months. These were corrected by the removal of the crowns and re-cement it after occlusal adjustment during different mandibular movement and premature occlusal adjustment. This is totally agreed with Preethi & Kala 2008, Öztürk E et al, 2011),^{13,19} those shows similar results of movement of crowns under finger pressure at the 18 months recall of their cases. During the radiographic assessment, at an interval of 6, 9 and 12 months (table 3), 2 cases showed a presence of periapical infection associated with zirconia crowns. This was strongly agreed with Ajayi DM et al.²⁰

In our study, no clinical cases showed chipping or fractured of the restorative materials. This is in contrast with the finding of Rinke S et al, 2013, Muhittin & Sun,^{18,9,21,22} and those showed chipping of zirconia ceramic crown after 24, 36 months respectively. This could be related to the different survival time in the oral cavity.

The e. max crowns showed the best clinical and radiographic performances among the four groups. This is because of the physical and mechanical properties of the ceramic, such as biocompatibility, durability, radioactivity, flexure strength, and it does not pose any risk to the health of patients, dental technicians or dentists. Also if e.max CAD material is applied by the manufacturer's instructions, it does not show any toxic potential (Ivoclar V 2005).²³

Overall, the results of the present study were totally agreed with the results mentioned by Preethi & Kala, 2008, Ozurik K et al 2011; Altun C et al 2008, (Gemalmaz & Ergin, 2002, Etman & Woolford) and Ajayi DM et al 2014, Rinke S et al 2013,^{13,19,14,2017,21} in that, the ETT at the aesthetic zone can be restored with composite resin core for long temporary restoration, while all ceramic crowns can be used to replace the PFM restorations because of their better physical, mechanical and excellent biocompatible properties of the all ceramic materials. In the light of the limitation of the present 12-month clinical and radiographic study design, a composite build-up can be used for ETT with GFP for long-temporary restoration under certain indications. Zirconia and e. max restorations showed promising results and appear to be an excellent alternative to the PFM restoration. However, long-term clinical and radiographic observation and assessment are required to authenticate this conclusion. The clinical success

of those cases may be related to the education level of the patient in keep up high quality of oral hygiene. Also long-term study should be conducted.

Conclusion

e. Max and zirconia all ceramic crowns showed better clinical and radiographic performance than the PFM and composite restorations over 12 months recall.

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