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RADIOGRAPHIC EVALUATION OF REMAINING DENTIN THICKNESS AFTER POST SPACE PREPARATION IN PATIENTS UNDERGOING CUSTOM CAST POST- A RETROSPECTIVE STUDY

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ABSTRACT

The aim of the present study is to radiographically evaluate the remaining dentin thickness after post space preparation in patients undergoing custom cast post. 86000 patients' records from June 2019 to March 2020 were reviewed for this study and the data of 57 patients from pertaining to our study was collected and analyzed. It is an Institutional based Retrospective study. Data were categorized based on post space preparation type for all the teeth and tabulated in excel sheets based on age, gender, type of post space preparation, and the teeth. The data were statistically analyzed with Chi square test using SPSS software. There was no statistically significant association between the variables age, teeth, and type of preparation ($p > 0.05$). However, the analysis showed that proportionist theory was followed maximum compared to other theories in the age groups and also a maximum number of cast posts was done in maxillary central incisor compared to maxillary lateral incisor and canine. The major advantages of a custom cast post are its custom fit to the root configuration, strength,

adaptability to oval shaped canals and change of angulation of crown. The postgraduate students opted for the proportionist theory with the intention of saving the tooth structure and preserving the remaining dentin thickness to enhance the retention of the post.

INTRODUCTION

The restoration of endodontically treated teeth is always challenging. A non-vital tooth which has lost a substantial amount of coronal tooth structure because of dental caries, trauma or fracture and previous restoration or due to access cavity preparation for endodontic treatment - for such teeth post and core and final restoration with a crown has become a routine and mandatory post endodontic restorative procedure (Shaikh and Shaikh, 2018).

The most common and important indication of post and core is when there is extensive coronal destruction and also when additional retention is required (Bhagat et al., 2017). The basic principles of restoration of endodontically treated teeth as per AAE guidelines area as follows:Cuspal coverage should be given for posterior teeth that have been treated by root canal treatment,Conservative treatment can be done for anterior teeth with minimal loss of tooth structure,It is desirable to preserve coronal and radicular tooth structure,the purpose of this post is to retain core build up,A ferrule is highly desirable when a post is used, a minimum of 2 mm vertical height and 1 mm of dentin thickness.

A post and core also helps to improve the fracture resistance following RCT, when the remaining tooth structure is very minimal (Ramanathan and Solete, 2015; Teja and Ramesh, 2019). A wide array of post systems are available; hence it is very crucial to choose the type of post endodontic restoration according to the clinical situation (Dewangan et al., 2012). Clinicians mostly face the dilemma of whether to select custom cast post/ prefabricated post. According to Franklin Weine, most of the Endodontically treated teeth fail owing to poor post endodontic restoration rather than the primary endodontic cause (Lloyd and Palik, 1993).

However the clinician should keep in mind the remaining coronal tooth structure following RCT, functional requirements of the tooth, esthetics, age of the patient and existing periodontal conditions before choosing an appropriate post endodontic restorative material (Dangra and Gandhewar, 2017; Hussainy et al., 2018; Kumar and Antony, 2018; Rajendran et al., 2019; Williams et al., 2014). Endodontically treated anterior teeth with minimum to moderate loss of tooth structure without any discolouration can be restored with composite resin and also teeth with intact cingulum/ incisal edge and moderate proximal lesions can be restored with composite resin (Ravinthar and Others, 2018)(Hussainy et al., 2018). If more than 50% tooth structure loss is seen, post and core followed by full coverage restoration is mandatory. When a large amount of tooth structure is lost or if an insufficient ferrule is present, a custom cast post & core is indicated. The other indications of custom case post are as follows (Schwartz and Robbins, 2004): multiple cores are being placed in the same arch,small teeth such as mandibular

incisors,when the angle of the core must change in relation to post and in excessively flared or elliptical canals.

Custom cast posts can be either from a direct pattern or an indirect pattern. Post space preparation is accomplished with the removal of dentin (Akhtar et al., 2018). The apical seal of 4-5 mm of gutta percha is maintained at the root apex; similarly one-third of the root width is recommended for post space preparation as it will allow at least 1 mm of dentin around the post(Standlee et al., 1978). Post diameter is approximately one-fourth of the root diameter measured at the root surface. Custom made cast post is indicated in cases where the dentin thickness after root canal treatment is <1 mm (Ree and Schwartz, 2010). The characteristics of the interface between root dentin and restorative material and rigidity of restorative material influence the mechanical properties of endontially treated teeth. Hence, diameter of the post and remaining root dentin thickness create an impact on the resistance of endodontically treated teeth(Williams et al., 2014).

The aim of the present study was to evaluate radiographically the remaining dentin thickness after post space preparation in patients undergoing custom cast post.

MATERIALS AND METHODS

This retrospective study involved : One researcher, one guide and one mentor for data collection, tabulation and for analysis. 86000 patients records were screened and the data of 57 patients from June 2019 to March 2020 pertaining to our study was collected and analyzed.

Data collected from 57 patients was divided into the criteria of age, gender, teeth, preparation type and tabulated in excel sheets. The Inclusion criteria were patients of age 18 to 60 years, maxillary anterior teeth and the exclusion criteria were mandibular teeth and maxillary posterior teeth, incompletely treated teeth. The data was statistically analysed, using Chi square test to analyze the association between age, teeth and type of preparation. The dependent variable is post space preparation technique. The independent variables include age, gender and teeth.

RESULT AND DISCUSSION

A total of 57 patients' records regarding the custom cast post treatment done in maxillary anterior teeth were included in this study. The age, gender, teeth and type of preparation were fairly distributed. The distribution of patients among different age groups were, 18-30 years [47.4%], 31-40 years [19.3%], 41-50 years [26.3%], >50 years [7%] respectively (Table 1). Across different age groups the preferred methods of post space preparation was found to be proportionist based, However no significant difference observed between age and the type of post space preparation ($p>0.05$; chi square test) [Figure 1]. The preferred method of post space preparation among the maxillary anterior teeth is proportionist followed by conservationist and preservationist theory, although maximum number of cast post treatments were performed in

Maxillary central incisor. However no significant association was found between teeth and type of preparation, ($p>0.05$; chi square test) [Figure 2].

The order of preference among different theories was proportionist theory followed by conservationist followed by preservationist in all age groups, although more number of cases were done in the age group of 18-30 years [Figure 1].The order of preference among different theories was proportionist theory followed by conservationist followed by preservationist in all the teeth. [Figure 2]

The successful treatment of teeth with pulpal necrosis or substantial damage to the tooth structure not only depends on good endodontic treatment, but also on post endodontic restoration of the teeth after the completion of endodontic treatment (Shaikh and Shaikh, 2018). Grossly decayed endodontically treated teeth with inadequate remaining coronal tooth structure or extensive conventional access cavity preparation pose a challenge to endodontists while choosing an appropriate post endodontic restorative material (Bhagat et al., 2017).

Post endodontic treatment, the tooth remains brittle and the dentin thickness is reduced post instrumentation. This affects the structural integrity and mechanical properties of the tooth (Shaikh and Shaikh, 2018). And also inadequate coronal structure hampers the tooth's efficiency to bear occlusal loads (Ramamoorthi et al., 2015; Siddique et al., 2019). All these factors might make the tooth susceptible to fracture owing to failure of the endodontically treated tooth. Hence it is very important to conserve the mechanical properties (Dewangan et al., 2012).There are many post endodontic restorative materials, one of which is a custom cast post. It was developed in the 1930s and has a long history of clinical success (Mohapatra et al., 2016). This procedure requires casting a post and core as a separate component from the crown and requires minimum tooth structure removal. The cast post and core system utilizes a customized post to fit to the canal and the post core is cast together as a single unit(Akhtar et al., 2018).

The major advantage of custom cast post and core is customized fit to the prepared canal, minimal instrumentation, better fit and adaptation within flared and irregularly shaped canal, elliptical canals, angulate crown with respect to post, sound junction between post and core as the casting is a single unit (Rajakeerthi and Ms, 2019). Often, these advantages are negated by disadvantages. Base metal alloys which are used for the construction of posts have a significant influence on weight, strength, stiffness and oxide formation (Noor, 2016; Teja et al., 2018). However, the hardness of non precious and semi precious alloys present a major challenge when it comes to adjustments which eventually predisposes the tooth to root fracture (Noor, 2016). The other disadvantages include long clinical and laboratory time, difficult temporization, high chances of root fractures during insertion and function, possibility of casting defects and failures, difficulty in fitting the prosthesis within the root canal, difficulty associated with casting and questionable esthetics (Butail et al., 2018).

However, in case of tooth preparation for cast post, minimal removal of tooth structure removal is indicated. Post space preparation is accomplished with root dentin removal. One third of root width is recommended for post space preparation (Shaikh et al., 2017). This allows 1 mm of dentin to remain around the post. Hence the recommended diameter of post is 1/4th of root diameter. Thus narrow post fails under occlusal loading without affecting root whereas the large diameter post will tolerate occlusal loading but will result in root fracture (Al-Rashed and Al-Rashed, 2015).

A study by Pilo and Tamse stated that maxillary central and lateral incisors, and maxillary first molar palatal roots possessed adequate 1 mm or more root dentin after normal post instrumentation. All other teeth have <1 mm of RDT following RCT for the single canal in maxillary first premolars, 0.7 mm or less in diameter, a post that preserves 1mm of dentin lateral to the post was recommended (Pilo and Tamse, 2000; Zuckerman et al., 2003). Based on the measurements of remaining dentin thickness for mesial roots in mandibular molars, canal preparation can result in perforation or very thin areas of remaining dentin. Hence it is recommended to avoid any post in these roots. Therefore the thickness of remaining dentin post post space preparation is very crucial as it influences the mechanical properties, such as resistance to tooth fracture and also retention of the post (Janani et al., 2020).Post width plays a pivotal role in preventing the tooth structure and reducing the chances of perforation. There have been different approaches regarding the selection of post diameter and categorized into: conservationist, preservationist and proportions.(Lloyd and Palik, 1993)

Stern and Hirshfield (1973) proportions approach suggest the post width should not be greater than one-third of root width at its narrowest dimension. Preservationist (Halle EB et al 1984). proposed that posts should be surrounded by a minimum of 1 mm of sound dentin. Pilo and Tamse (2000) advocated minimal canal preparation and maintaining as much residual dentin as possible (conservationist approach) (Nandini and Venkatesh, 2006).

In a study by Standlee JP et al, it was shown that an increase in post width has no significant effect on its retention. It is recommended to avoid any post in these roots. Therefore, the thickness of remaining dentin, post space preparation is very crucial as it influences the mechanical properties, such as resistance to tooth fracture and also retention of the post (Standlee et al., 1978).

Post width plays a pivotal role in preserving the tooth structure and reducing the chances of perforation. There have been different approaches regarding the selection of pot diameter and categorised into conservationist, preservationist and proportions and provided least resistance to fracture (Trabert KC et al, 1978), (Manohar and Sharma, 2018). The post diameter should be as small as possible while providing the necessary rigidity, it is always important to leave as much tooth structure as possible in all phases of treatment (Deutsch AS et al)(Cheung, 2005).

In this study, it can be seen that among the post space theories, the postgraduate students preferred proportionist theory for all cases followed by conservationist theory and by preservationist theory. Although there is no significant association between the post diameter theories followed by postgraduate students. The postgraduate students opted for the proportionist theory with an intention of saving the tooth structure and preserving the remaining dentin thickness to enhance the retention of the post.

Stern and Hirshfield advocated the proportionist theory with the intent of saving the tooth structure, wherein the root structure is equally divided into three proportions so that the post width influences the retention and fracture resistance. Overall it can be inferred that proportionist theory was embraced maximum by post graduate compared to other theories.

However, there are certain limitations of the study: Population is restricted to a single hospital, Small sample size . Hence, in future, multicentric study is advised, which can also help in further treatment planning. Overall consensus from previous literature supports our study.

Table 1: Frequency of age distribution of patients undergoing custom cast post, which shows that 18-30 years have undergone more number of cast post treatments (47.4%) followed by 41-50 years (26.3%).

Age Groups	Number of Cast Post cases	Percentage (%)
18-30 YRS	27	47.4
31-40 YRS	11	19.3
41-50 YRS	15	26.3
> 50 YRS	4	7.0
Total	57	100.0

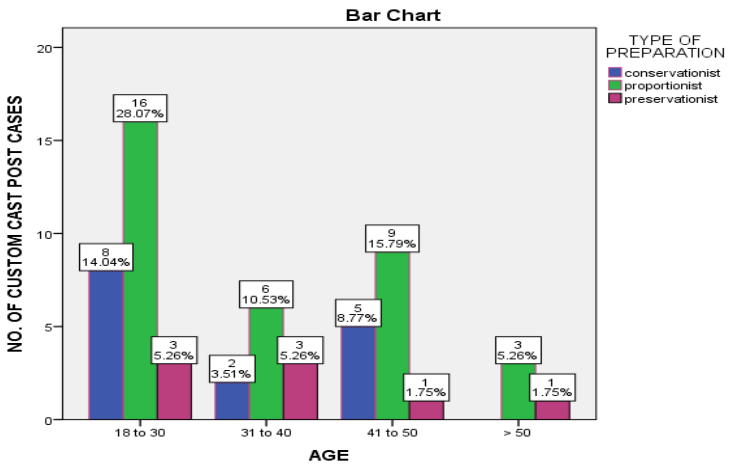

Figure 1: Graph representing the association of age and type of preparation in patients undergoing custom cast post. X axis denotes the age groups and Y axis denotes number of cast post cases, where blue colour denotes conservationist theory, green colour denotes proportionist theory and purple

colour denotes preservationist theory. The graph shows that proportionist theory was followed maximum in all age groups, followed by conservationist and preservationist theory.However Chi square test, p=0.624, no significant difference seen (p>0.05).

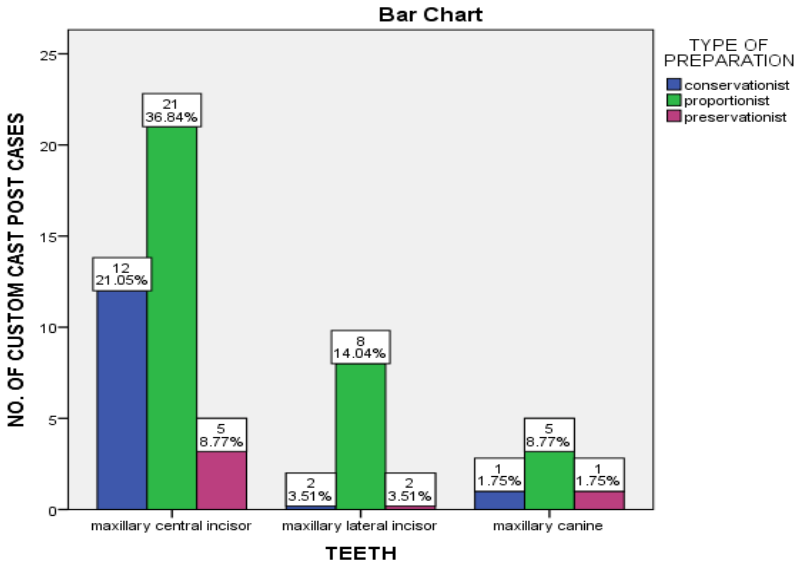

Figure 2: Graph representing the association of Teeth and type of preparation in patients undergoing custom cast post.X axis denotes the age groups and Y axis denotes number of cast post cases, where blue colour denotes conservationist theory, green colour denotes proportionist theory and purple colour denotes preservationist theory. The graph shows that proportionist theory was followed maximum in all the maxillary anterior teeth followed by conservationist and preservationist theory. However Chi square test, p=0.795, no significant difference seen (p>0.05).

CONCLUSION

It can be inferred from our study that the postgraduate students preferred proportionist theory among the different post diameter theories, as this theory follows that the post width should not be greater than the root width at its narrowest dimension and thereby enhances retention of the post.

AUTHORCONTRIBUTIONS

All authors contributed equally for the study.

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Nil.

CONFLICTS OF INTEREST

Nil.

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