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A Comparative Evaluation of Fracture Resistance of Tooth With Different Access Cavity Locations: An In-Vitro Study

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ABSTRACT

Aim of the study:This study was done to evaluate the fracture resistance of root canal treated tooth with different approaches of access cavity preparation.

Methodology:Based on group, access cavity preparations was done. The working length of the canals was determined by inserting a size 10 K file into the root canal terminus and subtracting 1 mm from this measurement. Biomechanical preparation was done using Silk File System (Mani, Japan) X smart Endodontic torque control motor (Dentsply, Switzerland). The root canals was irrigated with 5.25 % sodium hypochlorite solution after each instrument change. Specimens wasobturated using thermoplasticizedguttapecha in vertical compaction technique and coronal portion was filled using composite restorative material. A silicon impression material will used for coating the surface of roots to simulate periodontal ligament space. Tooth was mounted in acrylic resin These specimens were subjected to load at an angle parallel to the long axis of the tooth. And force required for fracture wer recorded. The presence and absence of dentinal defects in each group were compared using Chi square test. Any difference of $P < 0.05$ was considered as statistically significant.

Results and conclusion:The findings of this study demonstrate that labial access preparation had better fracture resistance when compared to conventional palatal access preparation. Conventional access cavity preparation resulted in a significant loss of tooth structure as compared to labial access cavity.

KEY WORDS: endodontic access cavity, fracture resistance, contracted endodontic access cavity

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INTRODUCTION

Access cavity preparation is considered as a fundamental step in orthograde endodontic treatment.[1]An appropriate access may promote canal detection and enhance instrumentation efficacy by avoiding coronal interferences.[2]Traditional endodontic cavities (TECs) emphasize straight-line pathways into root canals to increase preparation efficacy and prevent procedural errors.[3,4]However, a concern related to TECs is the amount of tooth structure removed, which may reduce its resistance to fracture under functional loads.[5,6] As an alternative to this traditional approach, minimally invasive endodontic cavities or contracted endodontic cavities (CECs) have been described, emphasizing the importance of preserving the tooth structure, including pericervical dentin.[7,8] Contracted endodontic cavities (CECs) have stemmed from the concept of minimally invasive dentistry.[9,10]Contracted cavity design retains more dentin, it may influence the geometric shaping parameters. But the coronal interference may cause endodontic instruments to work primarily on the internal surface of the root canal, resulting in root canal transportation. [11, 12, 13]

In upper anterior teeth, this access cavity is made through the palatal surface of the tooth. The palatal access as the sole entry to the root canal in anterior teeth is routinely practiced. However, this procedure is inconsistent with the internal anatomy of most anterior teeth. Labial endodontic access is the alternative to the conventional lingual endodontic access in permanent anterior teeth. The labial access facilitates visibility and provides direct access to the root apex.[14]

Various studies were done on access cavity design, but no studies have been done comparing facture resistance of teeth with different access designs and using Mani Silk for root canal preparation. The purpose of my research is to evaluate the fracture resistance of root canal treated tooth with different approaches of access cavity preparation.

MATERIALS AND METHODS

The study was conducted in K.V.G Dental College & Hospital, Sullia, D.K and testing was done from KVG College of Engineering, Sullia, DK..The collection, storage, sterilization and handling of the sample teeth followed according to Occupational Safety & Health Administration (OSHA) and the Centre for Disease Control & Prevention recommendations and guidelines. Thirty six freshly extracted permanent maxillary central incisors were collected from the Department of Oral and Maxillofacial Surgery, K.V.G Dental College and Hospital, Sullia and other private dental clinicsin and around SulliaTaluk of Dakshina Kannada district extracted for purposes other than that for my study. Teeth with dental caries, any restoration.visible cracks, root canal treated teeth, any fracture, abrasion, structural deformities, developmental defects, open apex were excluded.

The specimens was grouped into 3 (n= 12).

Group 1- control group

Twelve teeth will be left unprepared as the negative control group.

Group 2- labial access

Twelve specimens will prepared through labial access

Group 3- lingual conventional access

Twelve specimens will prepared through lingual access Based on group, access cavity preparations will be done.

In group 1 TEC

Endodontic cavities were drilled with high-speed diamond burs (1014; KG Sorensen, S~ao Paulo, Brazil) and an Endo Z drill (DentsplyMaillefer, Ballaigues, Switzerland) following conventional guidelines already described in the literature . The roof of the chamber was removed, and an unimpeded (straight-line) access into the coronal third of the root canal was established .

In group 2 CEC

Technique

a shallow reference depression was cut with a small round diamond bur just occlusal to the midlabial point of the tooth (Figure 1). The correct position of the initial depression related to the size of the pulp chamber was determined by the radiograph The teeth were accessed at the mid labial surface and extended only as necessary to detect canal orifices, preserving pericervicaldentin and part of the chamber roof.

Figure 1 :Labial Access Cavity Design

The working length of the canals was determined by inserting a size 10 K file into the root canal terminus and subtracting 1 mm from this measurement. A glide path was performed via a size15 K file. Biomechanical preparation was done using Silk File System (Mani,Japan) X smart Endodontic torque control motor (Dentsply, Switzerland). The Standard Pack was used .06/20 and .06/25 till full working length with the speed of 500 rpm with a setting of 300 g/cm torque. In all the groups, the tooth was irrigated 1 mm short of the working length with 2 ml of 5.25% sodium hypochlorite after the use of each instrument. At the completion of the instrumentation, each prepared canal was flushed with 5 ml 17% liquid EDTA for 60 seconds, followed by 5.25% sodium hypochlorite for 1 minute.Specimens wasobturated using thermoplasticizedguttapecha in vertical compaction technique and coronal portion was filled using composite restorative material.

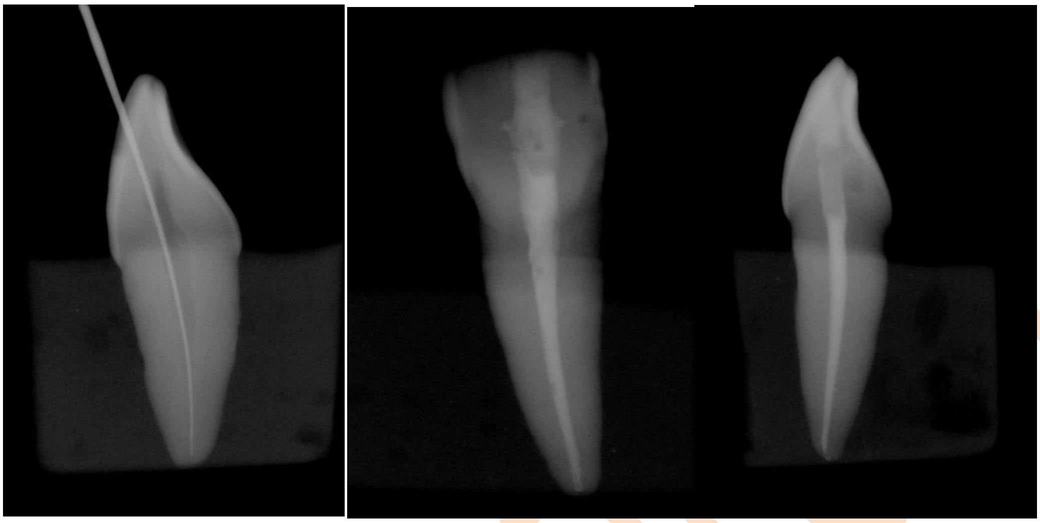


Figure 2: Radiographs Showing Working Length Determination AndObturation Through Labial Access Cavity

To stimulate periodontal ligament lining the root surfaces, utility wax was liquefied at a temperature of 70°C and applied on the roots with a paint brush up to 2 mm below CEJ, until a homogeneous wax thickness of 0.3 mm was obtained. The specimens were then embedded in metal matrices containing self-cureacrylic resin. After curing, the specimens were removed from the matrices and wax was detached from the root surface and from the space created in the acrylic resin. Later, polyether elastomeric material (AD-Sil, prime Dental products pvt. LTD, Thane, India) was manipulated and inserted into this space. The specimens were repositioned in acrylic resin blocks, and the excess polyether was removed using a scalpel.

These specimens were then subjected to forceparallel to the long axis of the tooth. And force required for fracture was recorded.

STATISTICAL ANALYSIS:

Data were analyzed statistically using test**Onewayanova (**Tukey HSD **test)**.

RESULTS

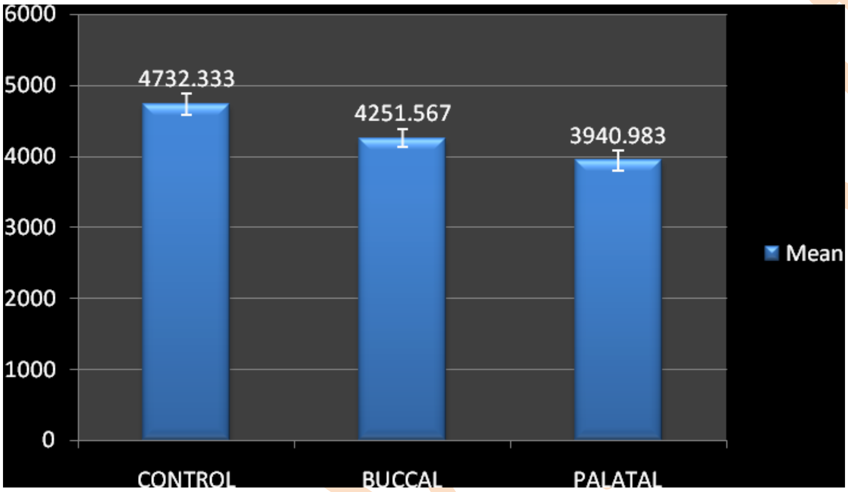
The mean load at fracture for teeth in the TEC and buccal groups were significantly lower than the control group (P < .05), difference was observed among the buccal and TEC groups (P <.05) in all types of teeth (Table 2)

Table1 : force required to fracture given in newton

	N	Mean	Std. Deviation	Minimum	Maximum
CONTROL	12	4732.333	156.7003	4527.6	4995.0
BUCCAL	12	4251.567	124.7920	4096.4	4508.0
PALATAL	12	3940.983	136.5640	3613.2	4116.0
Total	36	4308.294	357.0470	3613.2	4995.0

Table 2: multiple comparisons

Group		Mean Difference	Sig
CONTROL	BUCCAL	480.767	<0.001
CONTROL	PALATAL	791.350	<0.001
BUCCAL	PALATAL	310.583	<0.001



Graph 1: Graphical Representation Of Force Required To Fracture Given In Newton

DISCUSSION

One of the most important causes of fractures in root-filled teeth is the loss of tooth structure. The preparation of the endodontic access cavity following the TEC principals was reported as the second largest cause of loss of tooth structure . Thus, a proper and reduced endodontic access design could improve the prognosis for an endodontically treated tooth .

It is crucial to shift the modern operative approach toward a conservative philosophy, but it is also mandatory to ensure sufficient endodontic access to enable optimal shaping. It is argued that contracted endodontic cavities may lead to operative difficulties during canal shaping, with coronal interferences having the potential to cause root canal transportation toward the outer aspect of the curvature.

Until now, in the literature, the fracture strength of endodonticallytreated maxillary central incisor with buccal and Palatal access was investigated inno studies. For this reason, the fracture strength of endodontically treated teeth with buccal and palatal access cavity was tested in the present study. A force parallel to long axis was used because most of the trauma to anterior tooth occurred either perpendicular or parallel to long axis .

The findings of this study demonstrate that labial access preparation had better fracture resistance when compared to conventional palatal access preparation. The difference in fracture resistance might be due to greater dentin thickness on the lingual surface compared with the labial surface of anterior teeth. This finding was supported by Stambaugh and Wittrock[15].In addition, preparations for labial endodontic entries are usually smaller than the conventional lingual surface that funnels toward the incisal edge and weakens the clinical crown.The labial approach facilitates visibility and provides direct access to the root apex.[16]

Labial access cavity design has proved to be more conservative than traditional lingual access cavity design. Their clinical applications includes cases of proclined maxillary incisors for which intentional root canal treatment is advised followed by crowns or veneers, labial erosive lesions or deep class five lesions where teeth is indicated for root canal therapy followed by post endodontic restoration. Studies conducted on prevalence of erosive lesions on teeth of different populations concluded that labial surface of maxillary incisors are the second commonest surface effected by erosive lesion and majority of which extends into 28% dentin thickness.[17,18,19,20]In such cases, tooth integrity is well preserved by gaining access through labial approach and improves the fracture resistance.

Traditional access openings for anterior teeth were placed on the lingual side for esthetic reasons and because of the lack of strength of restorative esthetic materials.With advances in restorative techniques, these concerns are not as much of a consideration as they once were.

CONCLUSION

Within the limitations of this *in vitro study, the following* conclusions can be drawn:

- Both the experimental access cavity designs resulted in the loss of tooth structure and reduced fracture resistance.
- Conventional access cavity preparation resulted in a significant loss of tooth structure as compared to labial access cavity. Hence, it may be concluded that labial cavity design is a more conservative approach to access maxillary central incisors.

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