Original Article

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Dentistry Section

Comparative Cone Beam Computed Tomographic Evaluation of Conventional and Conservative Endodontic Access Cavity Designs on Pericervical Dentin Thickness and Fracture Resistance of Teeth: An In-vitro Study

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ABSTRACT

Introduction: The concept of 'extension for prevention' accelerates treatment processes but eliminates precious dentin at the pericervical area, resulting in biomechanically weakened tooth structure after endodontic treatment. Pericervical Dentin (PCD) is a new paradigm for endodontic success supports the idea that the amount of residual tooth structure is closely associated with long-term retention of the tooth and resistance to fracturing.

Aim: To determine the impact of two endodontic access cavity designs and biomechanical preparation on the pericervical dentin thickness using three-dimensional (3D) Cone Beam Computed Tomographic (CBCT) visualisation technique and fracture resistance of the maxillary anterior teeth under compressive load using universal testing machine.

Materials and Methods: The in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics at Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat, India, from October 2020 to March 2021. Study was carried out on the 30 single rooted freshly extracted maxillary central incisors and were randomly divided into two groups of conventional and conservative access preparation groups (n=15). Group 1 was conventional group, samples were accessed using endo access bur #1. Group 2 was conservative group, samples were accessed using CK micro-endodontic bur under a dental operating microscope. Cleaning and shaping was done using 17% Ethylenediamine Tetraacetic Acid (EDTA) as lubricant and 4% Hyflex CM rotary file system. The CBCT scans were taken preoperatively, following access cavity preparation and post obturation to evaluate the amount of pericervical dentin loss in mesial, lingual, facial and distal surfaces of the teeth at the levels of 1 mm to 4 mm above and below Cementoenamel Junction (CEJ). The samples were then loaded to fracture in the Universal Testing Machine, and the data were analysed using Independent sample t-test using Statistical Package for Social Sciences (SPSS) software version 20.0.

Results: In comparison to the group 2, group 1 led to an increase in substantial tooth structure loss in the pericervical region. Among all surfaces, pericervical dentin loss was more pronounced on the lingual surface in the group 1 than in the group 2 (p-value <0.001). Higher fracture resistance was observed in group 2 (1136.75 N) compared to group 1 (687.22 N) under compressive load (p-value <0.001).

Conclusion: Incisal cavity design is a less invasive method of accessing maxillary central incisors that preserves pericervical dentin. Under compressive load, pericervical dentin conservation provided greater fracture resistance in the conservative group than in the conventional group.

Keywords: Dental operating microscope, Incisal cavity design, Minimal invasive endodontics, Universal testing machine

INTRODUCTION

Minimal Invasive Endodontics (MIE) is an approach that aims to keep healthy coronal, cervical, and radicular tooth structure intact during endodontic treatment. It refers to the removal of dentin as minimal as possible during all three phases of a root canal procedure [1], coronal access preparation, [2] radicular apical preparation, and [3] flaring of the channel that joins the coronal and apical preparations. Pericervical dentin was first defined by Clark D and Khademi J, in accordance with this new integrated paradigm for endodontically treated tooth restorability. It is an area which extends 4 mm above and 4 mm below to the crestal bone [1,2].

The conventional access cavity preparation for maxillary central and lateral incisor is located just above the cingulum. This design has several drawbacks and does not fulfill the main principles of access preparation. It leads to increased tooth structure loss in the pericervical region which compromises the fracture resistance of the tooth [3,4]. Hence, GG drills and large round burs should not be used since they are not self-centred, cause gouging, which makes negotiating the canals difficult, and are not minimally invasive because they cut excessive pericervical dentin [1].

To overcome this, Clark D and Khademi J, proposed a new concept of conservative endodontic access cavity on dentin preservation to address the difficulties raised above [1]. One such variation in access cavity design is the "incisal approach." It allows for a straight line and unobstructed access to the apical third of the root, lowering the risk of perforation and improving preparation, particularly in the apical third of the canal [5]. Using a CK micro-endodontic access bur with a round ended tapered design, it allows for the construction of complete funnel with its narrowest portion remains in the pericervical dentin region. These burs have a tip size that is less than half the width of a round carbide bur [6,7].

Cone Beam Computed Tomography (CBCT) employs an extraoral imaging scanner that provides 3D volumetric details in limited field of view images to precisely measure pericervical dentin thickness in both orthogonal and oblique planes while emitting significantly less radiation than conventional digital radiographs [8,9]. The incisal approach and its impact on the pericervical dentin in maxillary anterior teeth utilising CBCT are topics of limited knowledge in the literature review [10-12]. Therefore, the aim of the study was to compare and evaluate the amount of pericervical dentin thickness by CBCT and fracture resistance between the conventional access cavity design and the conservative access cavity design. The null hypothesis was that there is no difference in the pericervical dentin thickness and fracture resistance between conventional and conservative access cavity preparation.

MATERIALS AND METHODS

The in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics at Karnavati School of Dentistry, Karnavati University, Oroscan CBCT centre, Gandhinagar and Ahmedabad Textile Industries Research Association (ATIRA), Ahmedabad, Gujarat, India, from October 2020 to March 2021. The present study was approved by Karnavati School of Dentistry Ethical Committee (KSDEC/19-20/Apr/021).

Sample size calculation: The study considered the data based on previous study [13] on evaluation of the strength of endodontically treated teeth after preservation of pericervical dentin where a difference between two groups reached statistical significance with samples of 15 teeth/group. Accordingly, a sample size of 15 teeth/group was used in the present study to analyse data with 80% power and 5% significance using statistical power analysis.

Inclusion criteria: The study included single rooted fully matured intact maxillary central incisors extracted for poor periodontal conditions.

Exclusion criteria: Teeth with immature apex, internal resorption, calcified canals, carious lesion, cracks and any other developmental anomalies were excluded from the study.

Study Procedure

All the teeth were immersed in 10% formalin solution (for not longer than two weeks after extraction) and then all samples were cleaned with ultrasonic scalers to remove organic debris and deposits. All teeth were kept in 3% Sodium hypochlorite (NaOCl) for two hours and stored into 0.9% normal saline solution until they are used.

A customised U-shape mounter was made from hard modelling to simulate the jaw conditions [Table/Fig-1]. All the teeth were placed on mounter to standardise the angulations and position of the samples for CBCT scans. All the teeth were recorded for preoperative CBCT scans for determining pericervical dentin thickness extending up to 4 mm above CEJ and 4 mm below CEJ. Recordings were done at 1 mm, 2 mm, 3 mm and 4 mm from Cementoenamel Junction (CEJ). It was determined as the shortest distance between the root canal outline (A1) and the nearest adjacent root surface (B1) [Table/Fig-2].

Thirty teeth were divided into two groups of 15 each. For both the groups, access opening was performed under Dental Operating Microscope (DOM) [Table/Fig-3,4].

- **Group 1:** Conventional access opening
- **Group 2:** Conservative access opening

Group 1: Endo access bur #1 (Dentsply Maillefer, Ballaigues, Switzerland) was used to make the initial site of entry into the tooth, which was kept just above the cingulum. The bur was initially angled perpendicular to the long axis of the tooth, and it was later oriented parallel to the long axis of the tooth to remove the roof of the pulp chamber. The access was roughly extended with the bur after finding the canal to form an oval shape.

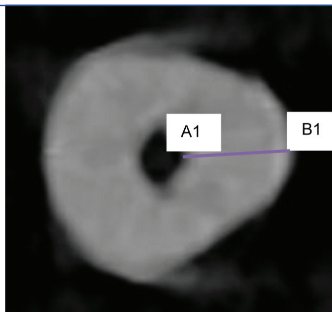
Group 2: Conservative access cavity preparation was performed under Dental Operating Microscope with the initial point of entry with the EG5 CK bur (SS White, New Jersey, USA) was held parallel to the long axis of the tooth and maintained short of the incisal edge on the lingual surface of the crown. The cavity was expanded cervically to the centre of the lingual surface, involving incisal half of the bucco-lingual width of the incisal edge and including the entire pulp chamber mesiodistally.

Following access preparation for both the groups, a second CBCT scan was taken for the evaluation of pericervical dentin at 1 mm to 4 mm from CEJ. Canal patency was made using 10 no. K-file and working length was determined using periapical RadioVisioGraphy (RVG) imaging system. Orifice opening was done using Hyflex CM orifice opener and cleaning and shaping was done using 17% EDTA as lubricant and 4% Hyflex CM rotary file system with the following sequence: 20.04%, 25.04% and 30.04%. Normal saline was used to irrigate the root canals in between use of each file.

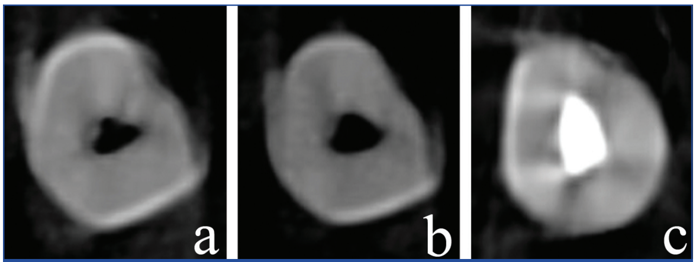
After that, canals were dried using paper points, obturated using gutta-percha and sealapex sealer utilising the single cone obturation technique, and coronally sealed using composite restoration. A third CBCT scan was taken after obturation for postoperative CBCT analysis. It was done for both these groups with 1 mm sections to calculate pericervical dentin thickness extending up to 4 mm above CEJ and 4 mm below CEJ. It was determined as the shortest distance between the nearest adjacent root surface (B2) and the canal outline (A2).

Amount of dentin loss after access cavity preparation step and after obturation step was calculated by subtracting the post access opening CBCT values and post obturation CBCT values from the preoperative CBCT values from CBCT readings (mm) in mesial, lingual, facial and distal surfaces of teeth at levels of 1 mm, 2 mm, 3 mm, 4 mm above CEJ and at 1 mm, 2 mm, 3 mm, 4 mm below CEJ [Table/Fig-5,6]. Mean difference was calculated between two groups for the amount of dentin loss after each step as stated above.

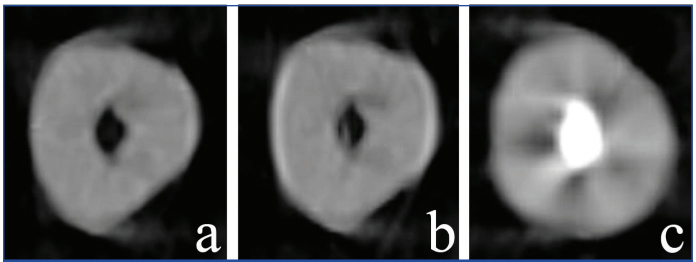
Preparation of the samples for the fracture resistance analysis: The acrylic resin mould was made to mount the teeth samples 1 mm below CEJ for the comparative evaluation of fracture resistance of both the groups under universal testing machine. The dimensions of the acrylic block were 15×15×25 mm [Table/Fig-7].



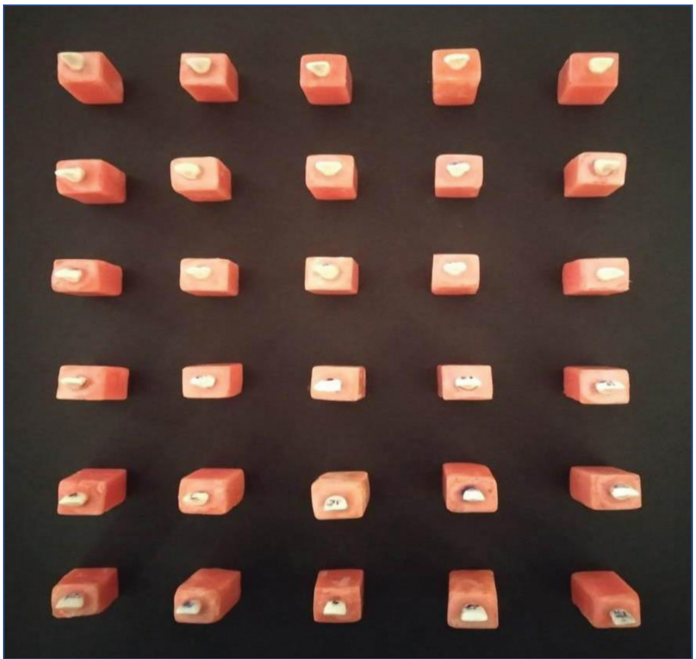
[Table/Fig-1]: A customised U-shape mounter. **[Table/Fig-2]:** Shortest distance between the root canal outline (A1) and the nearest adjacent root surface (B1). **[Table/Fig-3]:** Conventional access cavity design. **[Table/Fig-4]:** Conservative access cavity design. (Images from left to right)



[Table/Fig-5]: CBCT images of conventional access opening group. (a) Preoperative CBCT image, (b) Post access opening CBCT image, (c) Post obturation CBCT image.



[Table/Fig-6]: CBCT images of conservative access opening group. (a) Preoperative CBCT image, (b): Post access opening CBCT image, (c): Post obturation CBCT image.



[Table/Fig-7]: The acrylic resin mould to mount the teeth samples.

Analysis of fracture resistance: The test specimens were placed on the platform of the universal testing machine and stainless steel rod with tip diameter of 1 mm was used to apply the compressive load parallel to the long axis of the tooth at the speed of 1 mm/min using Universal Testing Machine until fracture and fracture resistance was calculated in Newton (N) [12] [Table/Fig-8].

STATISTICAL ANALYSIS

An Independent sample t-test was applied to calculate the amount of pericervical dentin loss post access opening and post obturation between the two groups by using Statistical Package for Social Sciences (SPSS) software version 20.0. In addition, the fracture resistance of the endodontically treated teeth under compressive load in Newton (N) was calculated between the two groups by performing independent sample t-test using SPSS software version 20.0. The level of significance was set at p-value <0.001.

RESULTS

According to the findings of the study, incisal cavity design was a more conservative method of accessing maxillary central incisors. On comparison, group 1 had more amount of pericervical dentin loss amongst than group 2.

[Table/Fig-8]: Analysis of fracture resistance under compressive load using universal testing machine.

Comparison between group 1 and group 2 for the amount of pericervical dentin loss at the level of 1 mm to 4 mm below CEJ and 1 mm to 4 mm below CEJ on facial, lingual, mesial and distal surfaces, following observations were recorded:

At the level of 1 mm above the CEJ post access opening and post obturation, the lingual surface showed statistically significant results with a p-value of <0.001 [Table/Fig-9]. At the level of 2 mm above the CEJ post access opening and post obturation, the lingual surface showed statistically significant results with a p-value of <0.001 [Table/Fig-10]. At the level of 3 mm above the CEJ post access opening and post obturation, the lingual surface showed statistically significant results with a p-value of <0.001 [Table/Fig-11]. At the level of 4 mm above the CEJ post access opening and post obturation, the lingual surface and the distal surface showed statistically significant results with a p-value of <0.001 [Table/Fig-12]. At the level of 1 mm, 2 mm, 3 mm and 4 mm below the CEJ post access opening and post obturation, the results were not statistically significant on each surface [Table/Fig-13-16].

Among all the surfaces, pericervical dentin loss was more significant on the lingual surface in the conventional group as compared to conservative group.

Comparison of the fracture resistance between the two groups showed that compressive strength (load at fracture) was higher in

1 mm above CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.36±0.29	0.31±0.12	0.556	0.583
Facial surface dentin loss post obturation CBCT	0.57±0.28	0.5±0.16	0.819	0.419
Lingual surface dentin loss post access CBCT	1.12±0.43	0.34±0.1	6.841	<0.001
Lingual surface dentin loss post obturation CBCT	1.45±0.37	0.67±0.16	7.453	<0.001
Mesial surface dentin loss post access CBCT	0.33±0.16	0.25±0.11	1.623	0.117
Mesial surface dentin loss post obturation CBCT	0.54±0.15	0.45±0.12	1.851	0.075
Distal surface dentin loss post access CBCT	0.28±0.21	0.21±0.13	1.015	0.319
Distal surface dentin loss post obturation CBCT	0.46±0.27	0.41±0.19	0.634	0.531

[Table/Fig-9]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 1 mm above CEJ.

2 mm above CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.47±0.09	0.35±0.29	1.489	0.155
Facial surface dentin loss post obturation CBCT	0.7±0.08	0.59±0.35	1.234	0.236
Lingual surface dentin loss post access CBCT	1.77±0.53	0.39±0.12	9.809	<0.001
Lingual surface dentin loss post obturation CBCT	2.01±0.51	0.87±0.15	8.241	<0.001
Mesial surface dentin loss post access CBCT	0.52±0.43	0.23±0.08	2.552	0.022
Mesial surface dentin loss post obturation CBCT	0.78±0.37	0.59±0.14	1.787	0.091
Distal surface dentin loss post access CBCT	0.3±0.08	0.2±0.11	2.653	0.013
Distal surface dentin loss post obturation CBCT	0.58±0.11	0.5±0.22	1.197	0.245

[Table/Fig-10]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 2 mm above CEJ.

3 mm above CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.48±0.1	0.37±0.26	1.456	0.162
Facial surface dentin loss post obturation CBCT	0.71±0.12	0.61±0.26	1.33	0.199
Lingual surface dentin loss post access CBCT	1.83±0.51	0.51±0.32	8.536	<0.001
Lingual surface dentin loss post obturation CBCT	2.01±0.5	1.02±0.33	6.405	<0.001
Mesial surface dentin loss post access CBCT	0.41±0.23	0.23±0.1	2.813	0.011
Mesial surface dentin loss post obturation CBCT	0.7±0.28	0.54±0.19	1.854	0.076
Distal surface dentin loss post access CBCT	0.35±0.19	0.22±0.14	1.987	0.057
Distal surface dentin loss post obturation CBCT	0.53±0.2	0.42±0.19	1.477	0.151

[Table/Fig-11]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 3 mm above CEJ.

4 mm above CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.55±0.05	0.37±0.32	2.143	0.049
Facial surface dentin loss post obturation CBCT	0.75±0.06	0.57±0.25	2.712	0.016
Lingual surface dentin loss post access CBCT	2.65±0.37	0.58±0.58	11.679	<0.001
Lingual surface dentin loss post obturation CBCT	2.65±0.37	1.02±0.59	9.078	<0.001
Mesial surface dentin loss post access CBCT	0.44±0.19	0.22±0.1	3.941	0.001
Mesial surface dentin loss post obturation CBCT	0.63±0.17	0.43±0.1	4.011	0.001
Distal surface dentin loss post access CBCT	0.38±0.05	0.23±0.06	7.477	<0.001
Distal surface dentin loss post obturation CBCT	0.53±0.05	0.39±0.06	6.585	<0.001

[Table/Fig-12]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 4 mm above CEJ.

1 mm below CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.27±0.07	0.21±0.12	1.641	0.115
Facial surface dentin loss post obturation CBCT	0.46±0.09	0.38±0.22	1.286	0.215
Lingual surface dentin loss post access CBCT	0.32±0.11	0.26±0.1	1.463	0.155
Lingual surface dentin loss post obturation CBCT	0.67±0.12	0.61±0.21	0.932	0.361
Mesial surface dentin loss post access CBCT	0.32±0.1	0.19±0.11	3.345	0.002
Mesial surface dentin loss post obturation CBCT	0.54±0.2	0.49±0.22	0.684	0.5
Distal surface dentin loss post access CBCT	0.18±0.09	0.11±0.07	2.426	0.022
Distal surface dentin loss post obturation CBCT	0.33±0.11	0.29±0.13	1.026	0.314

[Table/Fig-13]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 1 mm below CEJ.

2 mm below CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.19±0.08	0.15±0.1	1.347	0.189
Facial surface dentin loss post obturation CBCT	0.35±0.13	0.31±0.12	0.867	0.393
Lingual surface dentin loss post access CBCT	0.26±0.12	0.18±0.09	1.978	0.058
Lingual surface dentin loss post obturation CBCT	0.51±0.16	0.49±0.2	0.33	0.744
Mesial surface dentin loss post access CBCT	0.23±0.15	0.17±0.09	1.323	0.199
Mesial surface dentin loss post obturation CBCT	0.47±0.17	0.41±0.16	0.974	0.338
Distal surface dentin loss post access CBCT	0.21±0.09	0.16±0.09	1.555	0.131
Distal surface dentin loss post obturation CBCT	0.38±0.14	0.3±0.1	1.758	0.09

[Table/Fig-14]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 2 mm below CEJ.

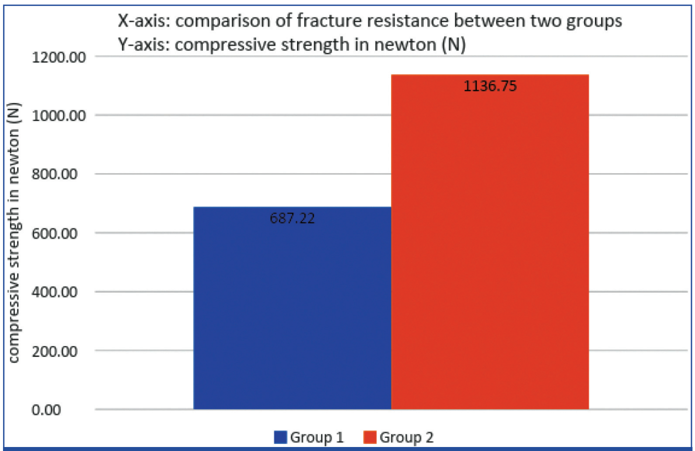
3 mm below CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.22±0.1	0.17±0.12	1.243	0.224
Facial surface dentin loss post obturation CBCT	0.44±0.08	0.38±0.18	1.304	0.208
Lingual surface dentin loss post access CBCT	0.25±0.07	0.19±0.06	2.633	0.014
Lingual surface dentin loss post obturation CBCT	0.63±0.09	0.57±0.18	1.183	0.247
Mesial surface dentin loss post access CBCT	0.3±0.16	0.2±0.11	1.954	0.061
Mesial surface dentin loss post obturation CBCT	0.51±0.18	0.45±0.21	0.922	0.365
Distal surface dentin loss post access CBCT	0.26±0.15	0.14±0.08	2.971	0.007
Distal surface dentin loss post obturation CBCT	0.42±0.14	0.33±0.1	2.094	0.045

[Table/Fig-15]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 3 mm below CEJ.

group 2 (1136.75 N) as compared to group 1 (687.22 N) with a t-value of -9.373 and was statistically significant with a p-value of <0.001 [Table/Fig-17].

4 mm below CEJ	Group 1 Mean±SD (mm)	Group 2 Mean±SD (mm)	t	p-value
Facial surface dentin loss post access CBCT	0.22±0.1	0.16±0.1	1.763	0.089
Facial surface dentin loss post obturation CBCT	0.42±0.07	0.36±0.12	1.622	0.116
Lingual surface dentin loss post access CBCT	0.24±0.1	0.18±0.08	1.637	0.113
Lingual surface dentin loss post obturation CBCT	0.57±0.12	0.51±0.16	1.244	0.224
Mesial surface dentin loss post access CBCT	0.3±0.2	0.19±0.14	1.859	0.074
Mesial surface dentin loss post obturation CBCT	0.49±0.19	0.45±0.22	0.622	0.539
Distal surface dentin loss post access CBCT	0.26±0.13	0.18±0.1	1.86	0.073
Distal surface dentin loss post obturation CBCT	0.42±0.14	0.36±0.1	1.55	0.132

[Table/Fig-16]: Comparison between Group 1 and Group 2 for the amount of pericervical dentin lost post access opening and post obturation at the level of 4 mm below CEJ.



[Table/Fig-17]: Graphical representation of the fracture resistance between two groups in Newton under compressive load.

DISCUSSION

The present study showed that the conservative access cavity design preserved more pericervical dentin compared to conventional access cavity design. Among all the surfaces, pericervical dentin loss was more pronounced on the lingual surface in the conventional group than in the conservative group. Higher fracture resistance was observed in conservative access cavity designs compared to conventional access cavity designs under compressive load.

According to Clark D and Khademi J, failures of endodontically treated teeth occur not only as a result of chronic or acute apical lesions, but also as a result of structural impairment to the teeth [6]. The dentin near the alveolar crest is known as pericervical dentin. This crucial zone extends 4 mm above and 4 mm apical to the CEJ. Although the root apex and the coronal third of the clinical crown can be excised and replaced prosthetically, the dentin around the alveolar crest is irreplaceable [14-16].

In the current study, intact maxillary central incisors were used to measure the fracture resistance under simulated occlusal force while being treated with various access cavity designs. Magne P and Belser U, determined the significance of the cingulum in the case of incisor access, where the conventional cingulum positioned endodontic access approach affects the conservation of pericervical dentin thickness [17]. When the maxillary anterior teeth are functionally loaded, there are significant tensile stresses localised at the cingulum. When the pericervical dentin is damaged during conventional access at the cingulum, these stresses can lead to structural failure.

CBCT was used in the current study to determine the precise pericervical dentin thickness prior to and after endodontic access cavity preparation. The most essential characteristics of CBCT are its non invasive nature and quantitative precision of samples analysis of images in three dimensions, reducing the possibility of a radiographic or photographic transfer error [8,9]. The DOM was used in magnification to visualise through minimal invasive access cavity preparation, locate the root canal orifices whose access is not in a straight line, to locate any calcific obstructions, to minimise the risk of any procedural errors such as gouging and strip perforation, and to preserve more pericervical dentin [18].

According to Clark D and Khademi J, the conservative endodontic cavity (CEC) involves the preservation of the roof of pulp chamber and pericervical dentin. EndoGuide burs, also known as CK micro-endodontic burs by Clark D and Khademi J, were used in the current study to preserve pericervical dentin [6]. As per Lenchner NH, EndoGuide burs are ideal for magnification driven endodontics [19]. It increases visibility and control during endodontic exploration while locating canals. It provides precision guidance with its passive safe-ended tip and extended shank for efficient canal access, creating an ideal glide path for instrumentation and conserves pericervical dentin to preserve the strength of the tooth.

In the present study, Hyflex CM rotary file system was used to prepare the canals in both the groups as this Nitinol rotary instrument is machined from a CM wire (controlled memory), which provides self-centering ability, resistance to cyclic fatigue, flexibility, super elasticity, and control memory, reducing the risk of dentinal microcracks. Tziafas D et al., proposed the review literature for the preparation prerequisites for effective irrigation of apical third of root canal which states that average diameters of apical constriction and apical foramen of cross sections of maxillary central incisors at 1 mm from the apex ranges at 0.30 and 0.34, respectively [20]. Hence, for better comparison and reproducibility, the sample teeth in both the groups were prepared to have an apical diameter #30 and 0.04 taper.

The current study found a significant loss of pericervical dentin in the mesial, distal, facial and lingual surfaces following access preparation in group 1 (conventional group) when compared to group 2 (conservative group). This difference is due to the use of the SS White Endoguide EG5 bur (Clarke-Khademi), which has a tapered round-ended design that allows the formation of a complete funnel with the narrow portion of the funnel in the pericervical dentin zone, as compared to a conventional round endo access bur [1]. There was statistically significant difference observed between the two groups on lingual surface at the level of 1 mm, 2 mm, 3 mm and 4 mm incisal to CEJ. The significant results would be seen because conventional access cavity preparation was closer to the cingulum portion on the lingual surface of maxillary central incisor, which might reduce more amount of pericervical dentin when compared to incisal approach in group 2. Among all the four surfaces, the lingual surface showed statistically significant difference between the two groups at 1 mm, 2 mm, 3 mm and 4 mm incisal to CEJ.

In a study, done by Varghese VS et al., it was found that conventional access cavity preparation resulted in a significant loss of pericervical dentin in the mesial, distal, facial and lingual surfaces [10]. Only the lingual and distal surfaces of group II (incisal access cavity) showed a significant loss of pericervical dentin, when compared to the other two surfaces. The loss of pericervical dentin was greater in group I (conventional) than in group II (incisal). Haralur SB et al., concluded that the remaining coronal tooth structure width contributes significantly towards the fracture strength of endodontically treated teeth which is in accordance with the present study [21]. The researchers strongly suggest the self-supported coronal dentin improves the fracture resistance by favorable stress transmission to the root [22].

The results of the present study is in accordance with the previous studies performed by Makati D et al., [7], Varghese VS et al., [10] and Krishan R et al., [23] which shows that conventional access cavity preparation caused a considerable loss of tooth structure in the pericervical region as compared to incisal access cavity preparation and increased resistance to fracture in conservative group as compared to conventional group in incisors, premolars and molars, thus rejecting the null hypothesis.

Limitation(s)

Conservative access cavity designs are likely to benefit patients, but they present clinicians with the challenge of addressing all canals, debriding all pulp tissue from pulp horns, and avoiding procedural complications while lacking "convenience form." Another limitation of the present study is that it is in-vitro. The clinical situation differs in terms of force, angulation, and surrounding supporting tooth structure. Despite the fact that the study was conducted on healthy extracted natural teeth, the presence of invisible microcracks, changes in moisture content, functional age changes, and morphological changes of dentin and pulp are difficult to standardise.

CONCLUSION(S)

Within the limitations of the present in-vitro study, it was concluded that, when compared to the conservative access cavity design group, conventional access cavity design resulted in a significant loss of tooth structure in the pericervical region. As a result, incisal cavity design is a more conservative approach to accessing maxillary central incisors. Under compressive load, pericervical dentin conservation provided greater fracture resistance in the conservative group than in the conventional group. Future research could be done on the impact of various access cavity preparation approaches on the ability to detect and negotiate the root canals, quality of chemomechanical debridement, obturation and postendodontic restorations, before implementing this procedure into our standard clinical practice.

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