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Original Research

Comparative Evaluation of the Effect of Conventional and Truss Access Cavities on Remaining Dentin Thickness, Canal Transportation in Maxillary First Premolars Using Cone Beam Computed Tomography

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A R T I C L E I N F O

Keywords: canal transportation , cone beam computed tomography , conventional access preparation, remaining dentin thickness, truss access cavity preparation.

A B S T R A C T

Aim: To study and evaluate the remaining dentin thickness (RDT) and canal transportation in maxillary first premolar with conventional and truss access cavity preparation using CBCT.
Materials and Methods: Buccal canals of thirty maxillary first premolars were selected for the study, uncalcified canals with fully formed apex of comparable length were chosen and examined for any irregularities and discrepancies , then canals were randomly divided in to two groups of 15 each and canal preparation was done using NT Rainbow file system , Pre-instrumentation and post-instrumentation CBCT images were obtained at three levels, 3, 6 and 9 mm above the apical foramen and were compared using CBCT software. Amount of remaining dentin thickness and canal transportation were assessed. The two groups were statistically analysed.
Results: The data obtained from CBCT was statistically analysed using independent't' test by evaluating remaining dentin thickness and canal transportation at 3mm, 6mm, 9mm. upon comparing there was no significant difference in remaining dentin thickness at 6, 9mm but a significant difference was seen at 3mm, likewise a significant difference in canal transportation was noted at 3mm but there was no significant difference at 6, 9mm.
Conclusion: In conclusion to the study, there was no statistically significant difference between the conventional and the truss access cavity groups in relation to remaining dentin thickness and canal transportation as there was no significant difference at coronal third and middle third, however there was a statistical significant difference at apical third level..

Introduction

An endodontic access cavity (EAC) is the first step in nonsurgical endodontic treatment , an ideal endodontic access cavity should enable efficient chemo-mechanical preparation, instrumentation efficacy while minimizing procedural errors . Main objectives of an access preparation have been established for several decades, which are to remove any caries, deroof the pulp

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chamber, locate all of the canal orifices, and establish straight-line access to the canals while also conserving the remaining tooth structure. [1]

In recent years, Minimally invasive endodontic access cavities have gained popularity in academic discussions for their clinical applications. [2] Minimally invasive endodontics refers to a concept that advocates the preservation of as much natural tooth structure as possible by downsizing the preparation of the access cavity, the taper of prepared canals, and the prepared apical size [2], this concept of minimally invasive endodontic access cavities claims to prevent the remaining dentin of the tooth and thus providing a significant increase in fracture resistance of the tooth . Minimally invasive endodontics cavities involves several approaches ; such as (i) ninja access cavities , (ii) truss access cavities , (iii) contracted access cavities and (iv) cavities made by using guided endodontics .

Minimally invasive endodontic cavities aims to preserve to peri-cervical dentin to a great extent and this it's main aim is to preserve the tooth structure , Truss access is an approach of contracted endodontic cavity which is an orifice directed design in which separate cavities are prepared to approach the canal systems. The main objective of these access cavity designs is the preservation of dentin by leaving a truss of dentin between the two cavities thus prepared. Truss access approach mainly emphasizes on the preservation of the healthy tooth structure with the minimally invasive approach [15] . Cone beam computed tomography information of the tooth together with magnification is used to prepare strategically located truss access. These accesses are placed directly above the respective root canals, and through these holes, cleaning, shaping, and obturation is performed [14].

Non-invasive techniques such as cone beam computed tomography (CBCT), which shows three dimensional cross sectional views of the root [5], these technological advancements have given rise to more accurate research and clinical methods to be applied in endodontics. CBCT is the preferred imaging modality for complex situations demanding a more detailed localization and description of tooth anatomy because of its capacity to render 3D information compared to conventional dental radiographs. In the concept of minimally invasive endodontics, data from CBCT images can be used to obtain a detailed identification of the root canal system, its variations, and anomalies; the position and size of the pulp chamber; the presence of calcifications; the number, position, size, extent, and curvature degree of roots and canals; the root canal shape, whether it is round, oval, or has any other form at any level of the root; and the status of the surrounding bone. Then, based on the knowledge of root and canal morphologies, access cavity design can be mentally delineated according to a specific emergence profile of each canal orifice onto the occlusal surface. The convergence degree of the emergence profiles ultimately determines the size/shape of access preparation [4].

Material and Methods

Preparation of samples: 30 human maxillary first premolars which were extracted due to orthodontic reasons were used in the study. Completely erupted teeth with closed apices, sound enamel, and dentin without any carious lesion, cracks, restorations, or developmental disturbances were included in the study. Cleaning of plaque, calculus, tissue remnants, and other deposits was done using periodontal scalers. Teeth of comparable length were chosen and periapical radiographs were taken which were digitized and electronically recorded, all the specimens were embedded in wax such that the long axis of each specimen was parallel to the long axis of wax mold to ensure standardization of tomography images of pre and post canal preparation.

The pre-instrumentation images of all specimens were recorded using 4*4 field of view, 120KV, 6.3mA for 10s . Three sections from each tooth were scanned at 3,6 and 9 mm from apex to evaluate apical third , middle third, coronal third respectively.

Subsequently, random allocation of teeth was done into five groups (n = 15 in each group).

- In GROUP A conventional access cavity preparation was prepared using endo

Figure 1

access bur gaining the straight-line access. all the canals were located and patency was achieved in buccal canal using 10K file and glide preparation was done till 20K file using NT Rainbow rotary file system with initial tip diameter of 17 having 4% taper and a final tip size of 25 having 4% taper in conjugation with irrigation using 5.25% NaOcl and normal saline.

• In GROUP B, based on preoperative CBCT images, the exact location of access was determined using measurement tool of CBCT software, then by using operating microscope, oval access preparation was done in buccal and palatal canals. The pulp chamber roof was maintained beneath the truss of tooth structure in this group between buccal and palatal cavities, then biomechanical preparation was done using NT rainbow fill system with final tip diameter 25 of 4% taper.

• The RDT was determined by subtracting the un-instrumented canal width from the instrumented canal width (a1-a2) or (b1-b2). Here, a1 is the distance from the mesial wall of the unprepared canal root to the unprepared wall, b1 is the distance from the distal wall of the unprepared canal to the distal wall of the root, a2 is the distance from the mesial wall of the prepared canal to the mesial wall of the root, and b2 is the distance from distal wall of the prepared canal to the distal wall of the root.

• Canal transportation was calculated using Gambill et al. formula (a1-a2)/(b1-b2). A value of 0 indicates no transportation, negative values indicate transportation toward the distal side and positive values indicate transportation toward the mesial side.

• In relation to remaining dentin thickness, there is no statistically significant difference between truss and conventional cavity groups at 3, 6, 9mm.

• In relation to canal transportation , there is no statistically significant difference at 6,9mm but statistically significant difference at 3mm from apex.

Results

• Upon evaluating dentine thickness between Group A and Group B, a significant difference was observed at 3 mm, specifically in the comparison between a1-a2 and b1-b2. However, at 6 mm and 9 mm, the disparities in dentine thickness did not reach statistical significance .It is crucial to highlight that, even though statistical significance was achieved at 3 mm, the mean difference between measurements was minor. This implies that both techniques were comparably effective in assessing dentine thickness, emphasizing the clinical equivalence of the two approaches.

• A difference in canal transportation was noted in the 3mm between the groups, while it was non-significant at 6mm and 9mm.

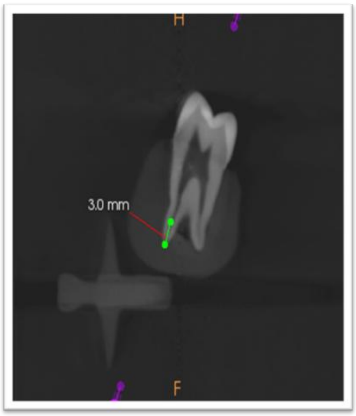
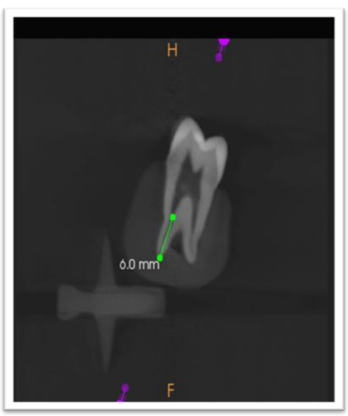


Fig 2.1



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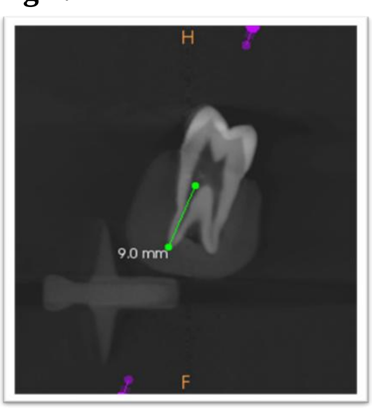


Fig 2.3

Statistical Analysis

• The data obtained were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS Version 23; Chicago Inc., IL, USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons.

• Kolmogorov –Smirnov test was performed to determine the normality of the data for the five groups to check for fracture resistance. The test showed no significant differences and hence confirmed that the data obtained were normally distributed.

• Variables were compared using mean values and standard deviation. The mean for different readings for dentine thickness and canal transportation between groups were compared using independent 't' test. P value lesser than 0.05 was considered to be statistically significant.

Figure 3

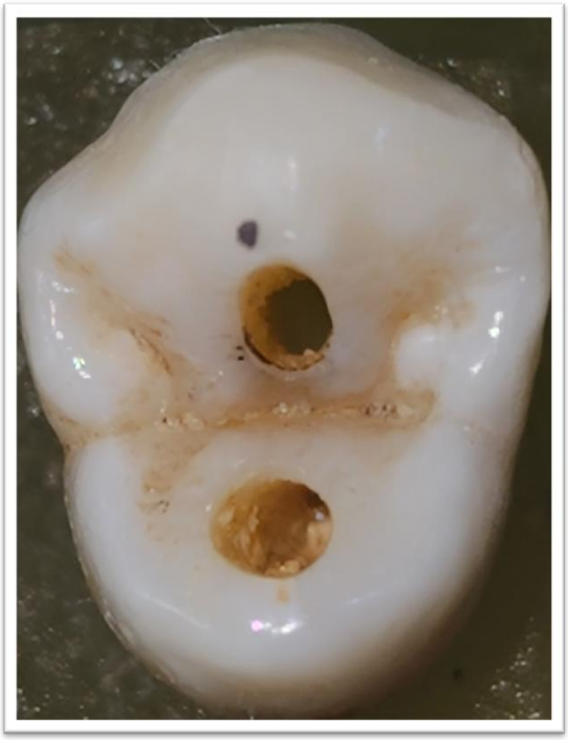


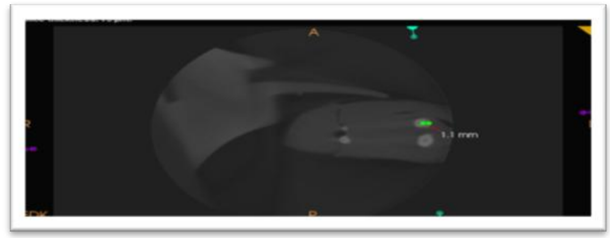
Figure 4

Discussion

• Conventional root canal preparation provides straight-line access to the root canals, which results in more loss of tooth structure which may affect the structural integrity of the tooth, the fracture resistance of the tooth decreases, However, such access preparation may compromise the instrumentation efficacy [5], Ultimately poor access cavity design could lead to inadequate cleaning, shaping and obturation compromising successful outcome.[3] Therefore , minimally invasive endodontic cavity preparation was incorporated in to clinical practice in place of traditional endodontic cavities to preserve the structural integrity of tooth structure thereby increasing the life and sustainability of natural teeth.

• Minimally invasive endodontic cavities

Pre-operative images of truss access cavity 3mm, 6mm, 9mm



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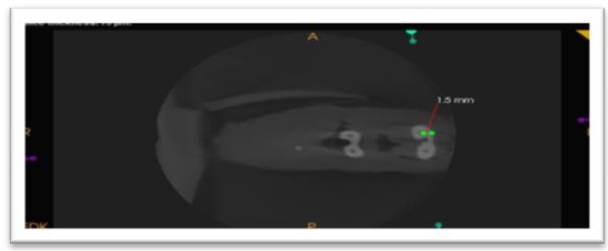

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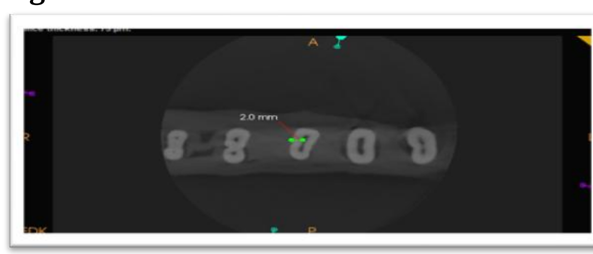


Figure 5.3

Pre-operative images of truss access cavity 3mm, 6mm, 9mm

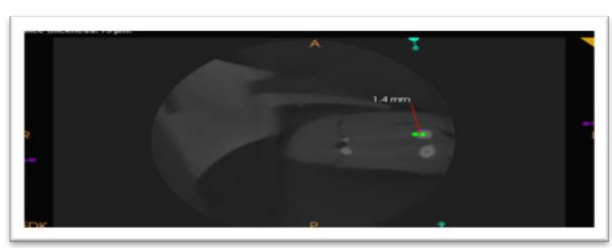


Figure 6.1

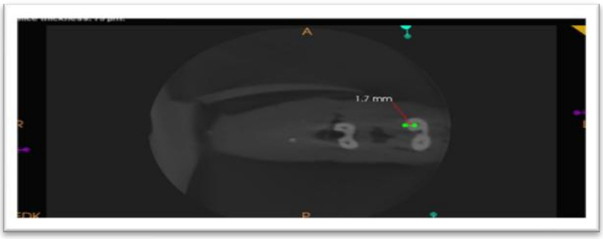
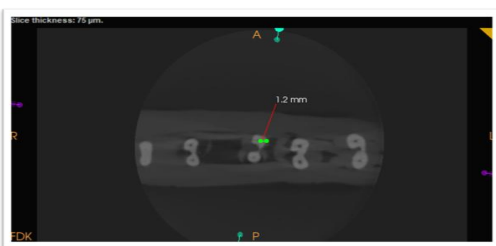
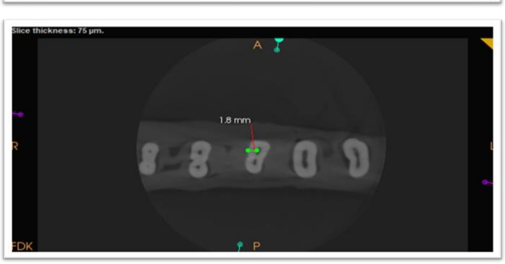
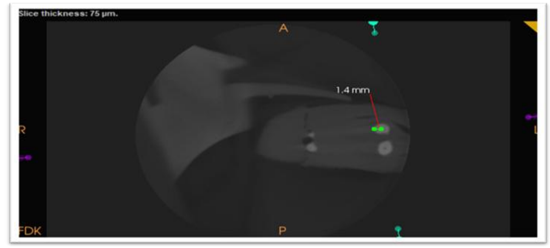


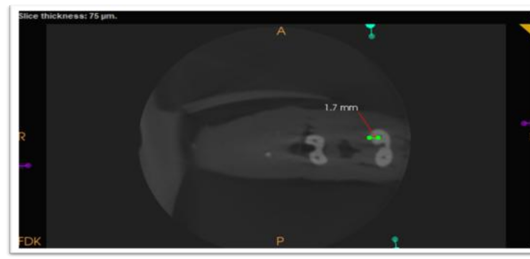
Figure 6.2

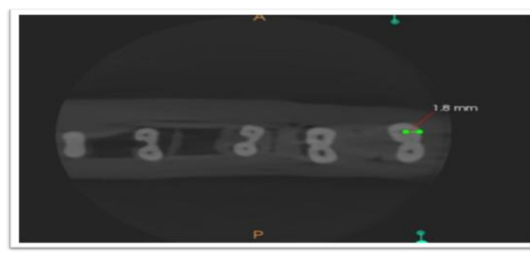
Figure 6.3

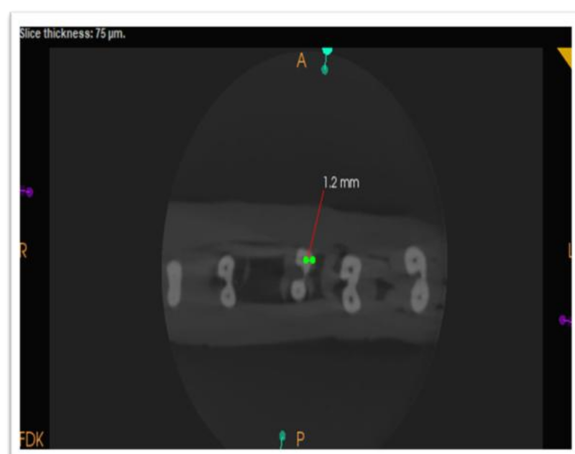


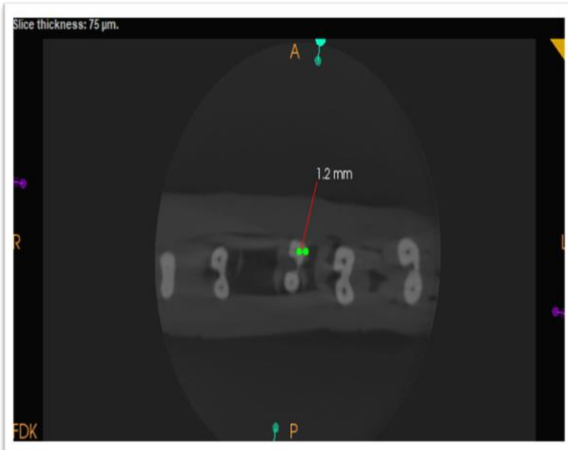


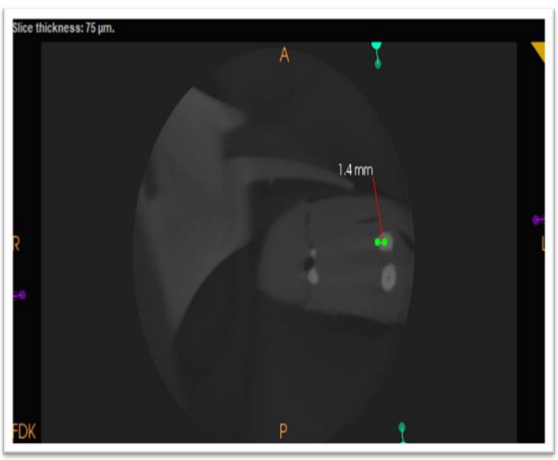


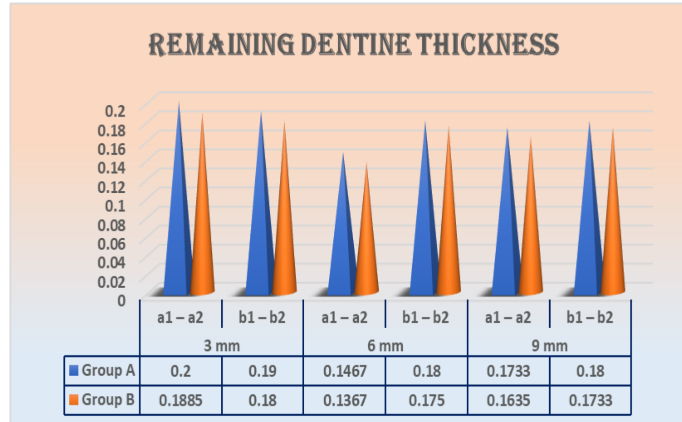


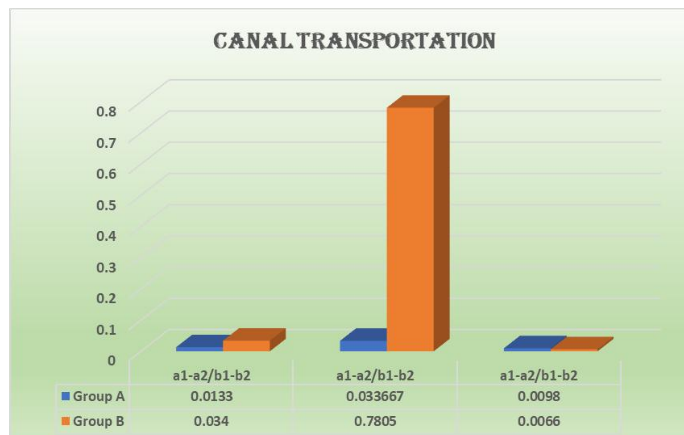












incorporates several methods to open access cavities, and by including these methods in daily clinical practice , one can preserve the great amount of remaining tooth structure, and improve the fracture resistance .Minimally invasive access cavities usually provide a curved path for the endodontic instruments to enter the canal and reach the apical area rather than the straight-line access achieved with traditional approaches. Thus, it can potentially give rise to more canal transportation and iatrogenic errors. However, this was only observed in a few studies, possibly due to the improved metallurgy and heat treatment of the recent endodontic file system, which increased their flexibility and centering abilities [1].

- Thus, to check such any irregularity or discrepancy in minimally invasive endodontic intervention , cone beam computed tomography is used to identify any such iatrogenic errors . CBCT is crucial in endodontics. Because of its ability to provide detailed information about root morphology, it contributes significantly to optimal diagnosis and treatment planning. CBCT is superior in evaluating root features, detecting complex morphologies, thus making it a valuable tool for the diagnosis and treatment of root canal anomalies.[6]
- In this study one such technique of creating minimal endodontic access cavities

was opted known as truss access cavity, thus truss access cavities and traditional endodontic cavities were compared for remaining dentin thickness and canal transportation . A truss access cavity in the comparison group as it is hypothesized that there was increased tooth structure preservation in such access cavities.

Conclusion

• Within the limitations of the study, there is no statistically significant difference between the conventional and the truss access cavity groups in relation to RDT on the mesial and distal sides of the buccal canal at the coronal, middle, and apical third levels. There is no statistically significant difference between the groups in terms of canal transportation at the middle and coronal third of the root canal; however, there is a statistically significant difference present at the apical third level.

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