



**AN IN-VITRO EVALUATION OF REMAINING DENTIN THICKNESS INCONSERVATIVE ACCESS CAVITY PREPARATION USING DIFFERENT ENDODONTIC ACCESS CAVITY BURS- A CONE BEAM COMPUTED TOMOGRAPHIC STUDY**

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**ABSTRACT**

The aim of this study was to evaluate the remaining dentin thickness (RDT) after conservative access preparation using traditional endodontic access cavity bur (Dentsply Maillefer, Ballaigues, Switzerland), endoguide precision micro endodontic bur (SS White) endodontic access bur 248 (Shofu) using cone beam computed tomography.

For the present study thirty freshly human sound mandibular molars extracted due to periodontal reason were included. Depending on the type of bur used the conservative preparation was done and teeth were divided into three groups (n=10). Group 1 cavity prepared using traditional endodontic access cavity bur, Group 2 cavity prepared using endoguide precision micro endodontic bur (CK Burs) and Group 3 cavity prepared using endodontic access bur 248 (shofu). Cone beam computed tomography (CBCT) images of the teeth were obtained. Conservative access cavity preparation was done using Dental Operating Microscope (DOM×13) magnification. Following access cavity preparation another CBCT scan was taken and RDT was calculated as the shortest distance from the outline of the root canal to the closest adjacent root surface, which was measured in facial, lingual, mesial, and distal surfaces for all the groups.

**Result:** The statistical analysis was performed using ANOVA. Group 1 and Group 3 showed increased removal of pericervical dentin whereas Group 2 showed decreased removal of pericervical dentin. Tukey's pairwise comparison test was performed. A significant difference was observed between conservative preparation using endoguide precision micro endodontic bur, traditional endodontic access bur and endodontic access bur 248 (P< 0.05). No significant difference was observed between conservative preparation using traditional endodontic access bur and endodontic access bur 248 (P<0.05).

**Interpretation and Conclusion:** RDT in molars was significantly conserved using endoguide precision micro endodontic bur (CK Burs). Whereas, excessive removal of crown structure which includes pericervical dentin and soffit occurred using traditional endodontic access bur and endodontic access bur 248 was observed. Pericervical dentin and soffit preservation plays a very important role during access cavity preparation. Hence, endoguide precision micro endodontic burs (CK Burs) proved to have the ability to conserve the pericervical dentin.

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**INTRODUCTION**

A successful endodontic treatment depends on thorough knowledge of root canal morphology, access cavity design, biomechanical preparation and proper obturation with complete seal of root canal system<sup>1</sup>. To fulfill these objectives correct access cavity preparation is mandatory.

Good access cavity design is of prime importance for the quality of endodontic treatment. The G V Black's concept of cavity preparation was "extension for prevention" which facilitates treatment procedures. However, it removes valuable dentin at the cervical region, leaving tooth structure biomechanically compromised after endodontic treatment. With the introduction of concept of "minimal invasive endodontics (MIE)," excessive removal of cervical and

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radicular portion of the dentin became undesirable<sup>2</sup>. Therefore, estimation of RDT is of great importance for the success of endodontic treatment. Cone-beam computed tomography (CBCT) measures dentin thickness of root canal walls, three-dimensional (3D) view, accuracy, and reliability, thus serving as a crucial diagnostic tool to gauge the RDT<sup>3</sup>.

Cervical portion of the tooth is considered to be most susceptible to fracture due to occlusal forces<sup>4,5</sup>. The dentin in this critical portion has been called as pericervical dentin (PCD) which extends 4 mm above and below the level of alveolar bone<sup>6</sup>. Clark and Khademi stated that peri-cervical dentin (PCD) is a vital structure responsible for the strength of the tooth. It acts as the “neck” of the tooth and is important for two reasons: it acts as a ferrule and improves fracture resistance. Another critical portion during access cavity preparation is soffit which is a small piece of roof around entire coronal portion of the pulp chamber<sup>7</sup>. The soffit behaves like metal band surrounding barrel. It must be maintained to avoid the collateral damage that usually occurs, namely, the gouging of lateral walls. Recently, the focus is shifting toward the preservation of pericervical dentin and soffit for the success of the endodontic treatment<sup>8</sup>.

Various studies have been published comparing the conservative access cavity preparation with traditional access cavity preparation regarding thickness of pericervical dentin in lower anteriors<sup>1</sup>, thickness of pericervical dentin after using self-adjusting files<sup>2</sup>, endodontic access cavity preparation design on the fracture strength of endodontically treated teeth<sup>9</sup>, and effect of rotary and reciprocating single-file systems on pericervical dentin<sup>10</sup>. The literature related to the combination of conservative endodontic access preparation with traditional endoaccess bur, endoguide precision micro endodontic bur and endoaccess bur 248 is limited. Hence, the study aimed to compare and evaluate the RDT of conservative access cavity preparation using different access cavity burs in the molar teeth using CBCT.

**MATERIALS AND METHODS**

**Specimen Preparation**

The ethical clearance was obtained from the institutional ethical committee of KVG Dental College and Hospital. Teeth with extensive caries, fractures, internal or external resorption, and calcifications were excluded from this study. Thirty intact extracted human mandibular molars teeth were included. They were disinfected following the OSHA protocol, 0.5% chloramine T and stored in distilled water till further use. The conservative access cavity preparations were divided randomly into three groups (n =10).

Group 1: Access cavity using traditional endodontic access bur gaining straight-line access. Group 2: Access cavity using endoguide precision micro endodontic bur (SS White) (CK Bars) under DOM (-13) magnification. Group 3: Access cavity using endoaccess bur (shofu) under DOM (-13) magnification



BURS USED IN THE STUDY  
A. Traditional Endodontic access bur  
B. Endoguide precision micro endodontic bur  
C. Endoaccess bur 248

**Cone-beam computed tomography analysis**

Pre- and postoperative CBCT scans (DENT-CAT) were taken to evaluate the RDT at the cemento-enamel junction (CEJ). (figure 1) The RDT was calculated as the shortest distance from the canal outline to the closest adjacent root surface, which was measured in four surfaces, that is, facial, lingual, mesial, and distal for all the groups in the two obtained scans. (figure 2). Statistical analysis was done using one-way ANOVA and Intergroup comparison using Post hoc (Tukey) comparison test. P value less than 0.5 considered to be statistically significant.

**RESULTS**

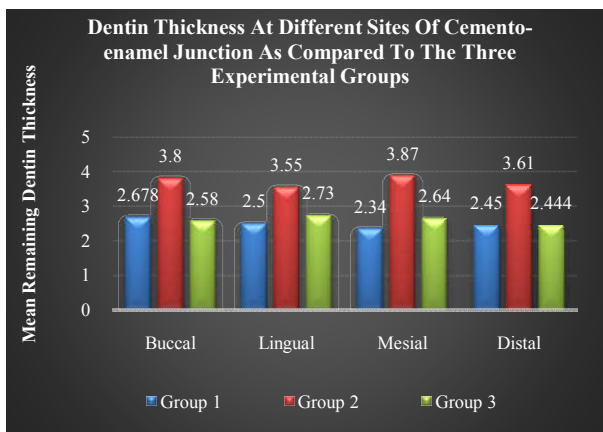
**Table 1** One-way ANOVA analysis of remaining dentin thickness at different sites of cemento-enamel junction of the three experimental groups and its level of significance

Site	Group	n	Mean	SD	p value
Buccal	Group 1	10	2.678	0.4957105	0.0000499
	Group 2	10	3.800	0.6565905	
	Group 3	10	2.580	0.5159673	
Lingual	Group 1	10	2.50	0.6497863	0.0057
	Group 2	10	3.55	0.4672615	
	Group 3	10	2.73	0.9006788	
Mesial	Group 1	10	2.34	0.4857983	0.000148
	Group 2	10	3.87	0.5056349	
	Group 3	10	2.64	1.0458383	
Distal	Group 1	10	2.450	0.5104464	0.0000504
	Group 2	10	3.610	0.5915141	
	Group 3	10	2.444	0.5623601	

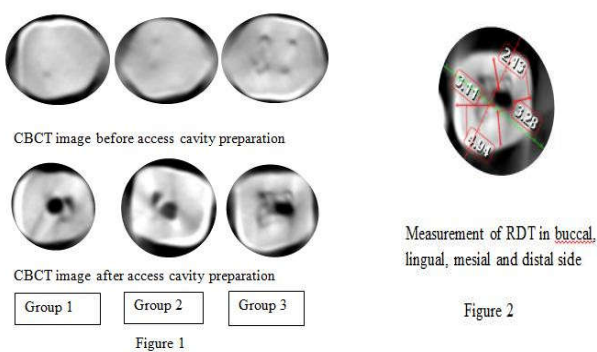
**Table 2** Post hoc (Tukey) comparisons of the mean remaining dentin thickness at different sites of cemento-enamel junction as compared to the three experimental groups and its level of significance

Site	Group	Mean Difference (95% Confidence Interval)	p value
Buccal	Group 2- Group 1	1.122 (0.5003095, 1.7436905)	0.0003569
	Group 3- Group 1	-0.098 (-0.7196905, 0.5236905)	0.9194962
	Group 3- Group 2	-1.220 (-1.8416905, -0.5983095)	0.0001260
Lingual	Group 2- Group 1	1.05 (0.2786453, 1.82135471)	0.0061616
	Group 3- Group 1	0.23 (-0.5413547, 1.00135471)	0.7425452
	Group 3- Group 2	-0.82 (-1.5913547, -0.04864529)	0.0355099
Mesial	Group 2- Group 1	1.53 (0.7239173, 2.3360827)	0.0001928
	Group 3- Group 1	0.30 (-0.5060827, 1.1060827)	0.6308804
	Group 3- Group 2	-1.23 (-2.0360827, -0.4239173)	0.0021883
Distal	Group 2- Group 1	1.160 (0.5437285, 1.7762715)	0.0002140
	Group 3- Group 1	-0.006 (-0.6222715, 0.6102715)	0.9996788
	Group 3- Group 2	-1.166 (-1.7822715, -0.5497285)	0.0002006

In one-way ANOVA it was observed that there was a statistically significant difference (P<0.05) in the mean remaining dentin thickness at the buccal, lingual, mesial and distal sites of CEJ in all the groups. The difference in between the groups with highest value in group 2 and least in group 1 signifies increase preservation of RDT after the use of endoguide precision micro endodontic bur (group 2).



The Post Hoc comparison showed significant difference ( $P < 0.05$ ) between endoguide precision micro endodontic bur (CK Burs) and traditional endoaccess bur. There was a significant difference ( $P < 0.05$ ) between the endoguide precision micro endodontic bur (CK Burs) and endodontic access bur 248 groups at all the four sites of CEJ (buccal, lingual, mesial and distal). No significant difference was observed between the traditional endoaccess bur and endodontic access bur 248 groups. The study results suggest that there is an increased loss of pericervical dentin while preparing an access cavity using traditional endoaccess bur and endoaccess 248 bur compared to endoguide precision micro endodontic bur.



**DISCUSSION**

In line with Minimal Invasive Dentistry (MID) the focus of access cavity preparation has shifted towards Conservative Endodontic Cavities (CECs) which involves preservation of the pulp chamber roof (soffit) and pericervical dentin as described by Clark and Khademi. They reported least removal of pericervical dentin using endoguide precision micro endodontic bur (CK).

In the present study, pericervical dentin thickness was measured using CBCT and was compared using three different endodontic burs. Endoguide precision micro endodontic bur (CK bur) resulted in less reduction in pericervical dentin removal during access cavity preparation and it was statistically significant. Remaining dentin thickness was measured in all the four sites (buccal, lingual, mesial and distal) and the difference was statistically insignificant. During access cavity preparation the difference does not play an important role but while instrumenting the mesiobuccal canal of the mesial root in mandibular molar teeth distolingual aspect becomes the danger zone and preservation of this area should be the prime concern<sup>12</sup>.

Design of burs plays a very important role in the preservation of pericervical dentin and soffit. To preserve these critical structures use of round burs and GG burs should be avoided as they have various drawbacks which includes excessive removal of pericervical dentin and soffit, not self-centered and create gouging which leads to difficulties in negotiating the canals<sup>5,6</sup>. Excessive removal of pericervical dentin will weaken the tooth structure. Hence, a direct relationship exists between the RDT to the strength of the root. Minimum of 1 mm of root dentin should remain in all the sites along its entire length of root after endodontic procedures are completed<sup>13</sup>.

Endoguide precision micro endodontic bur (CK bur) has a conical sharp tip and tip size of the bur is less than half as wide as corresponding round bur of traditional Endodontic access bur and Endodontic access bur 248. Sharp tip increases the cutting efficiency and helps in the preservation of pericervical dentin to the maximum. However, its drawbacks include rough and uneven surface of the access cavity and there is no control on cutting leading to maximum chance of perforation if the clinician is not aware about the anatomy of the root canal<sup>5</sup>.

To the present study a study was done by Deep Makati *et al* evaluating the thickness of pericervical dentin after CECs, they concluded that coronal dentin was conserved in molars when accessed through CECs than through conventional endodontic cavity. In latter study they used DOM to visualize through minimal invasive access cavity, locate the orifices of the root canal whose access is not in straight line, to locate any calcification and obliteration, to reduce the chances of any procedural errors such as gouging and strip perforation, and to preserve more pericervical dentin. Same procedure was followed in the present study.

Another study done by Gabriela Rover *et al* concluded there was no benefits associated with CEC and no significant difference was observed in fracture resistance between the traditional<sup>11</sup>. In the present study only the remaining dentin thickness was evaluated in which endoguide precision endodontic bur showed superior properties. The difference between the two studies is the different parameter used to evaluate the benefits of different type of access cavities. According to Lenchner NH *et al* endoguide bur is ideal for magnification driven endodontics<sup>14</sup>.

In the present study the amount of pericervical dentin removal is similar in traditional endodontic access bur and endodontic access bur 248. However, the advantages of endodontic access bur 248 includes diamond coating of 7.5 mm length and its ball end is modified with a hole in the centre for the debris to escape which improves the visibility and cutting efficiency resulting in reduced removal of pericervical dentin. Loss of pericervical dentin was appreciated accurately using CBCT. Further studies on the influence of different burs on the preservation of pericervical dentin and different access preparation approaches should be done before incorporating this technique into our routine clinical practice.

**CONCLUSION**

Within the limitations of this *in vitro* study, the following conclusions can be drawn: Excessive removal of crown structure which includes pericervical dentin and soffit occurs using traditional endodontic access bur and endodontic access bur 248 compared to endoguide precision micro endodontic bur

(CK Bur). Hence, endoguide precision micro endodontic bur (CK Bur) has more conservative approach to access cavity preparation in mandibular molars.

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