

“Comparison of Root Dentin Loss by Using Two Retrieval Systems of Separated Endodontic Instruments and Its Effect on the mechanical strength of the Dental Root”

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ABSTRACT

This In-Vitro study was conducted to compare the wasted dentin during separated instrument (SI) removal using two different methods (ultrasonic versus tube technique), and to determine the mechanical strength of the dental root after this procedure. Teeth used in this study (n=40) were all single-rooted. Each tooth was first fixed in a putty silicon base, then an instrument (Protaper 25#) was intentionally separated in middle and apical third of root canal. In group I (n1=20), ultrasonic tips were used to retrieve separated instruments (SIs), while Zumax kit were used in group II (n2=20). A CBCT image were taken for all teeth before and after the removal attempt in each group, and amount of losted dentin during the procedure was compared. All the teeth were prepared for mechanical testing in Testometric machine to measure the required force for root fracture. Statistical analysis was done using PASW Statistic® 18. Results showed that tube technique removed more dentine than ultrasonic tips when SI was in the apical third of root canal, while no statistical difference was found between the two methods when SI was in the middle third. Also fracture resistance declined significantly with tube technique comparing with ultrasonic tips.



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1. INTRODUCTION

Endodontics as defined by the American Association of Endodontists (AAE) is: “The branch of dentistry concerned with the morphology, physiology and pathology of the human dental pulp and periradicular tissues” [1].

The first aim of endodontic treatment is to preserve the pulp vitality. However, when the injury exceeds the tolerance of the pulp, it requires polypectomy and cleaning and shaping of the root canal [2].

Root canal treatment (RCT) may require the use of a variety of instruments including files, ultrasonic tips, explorers, irrigation needles, Lentulo spirals, spreaders, pluggers, heat-conducting tips, and many other instruments [3], [4].

In spite of the metallurgical improvements in the design of the endodontic instruments, the separation of these instruments during canal preparation may still a big concern in the field of RCT, because when this problem happens, it transforms the case into a more difficult level, also it is the most common procedural accident that occurs with these instruments during clinical use [3], [5].

A review in the literature revealed a prevalence of retained separated instruments between 0.7 and 7.2% in teeth undergoing RCTs [6- 10].

2. Materials and Methods

Forty extracted single-root-tooth were collected and cleaned then soaked in chlorhexidine gluconate then stored in saline until used. The teeth were manually prepared to size 20# to all canal length for (Group A) and to the middle third in (Group B). Size 25/0.06 NiTi files were notched to a depth of half the instrument thickness at 3 mm from the tip by using a low-speed diamond disk. The segment were inserted into the canals at 250 rpm and fractured in apical third in half of the sample (Group A) and in middle third in the other half of the sample (Group B) once they engaged the canal wall. After that the teeth were scanned with CBCT and randomly distributed to 4 subgroups to retrieve the instruments. (Groups A1 and B1) using tube technique, (Groups A2 and B2) using ultrasonic tips.

Coronal enlargement of the canals with a funnel shape to visualize the most coronal aspect of the separated file was performed using Gates Glidden burs (#1 #2 #3). The staging platform was prepared using modified Gates Glidden burs (#3).

Once the file segment was removed, each canal was prepared with Reciproblue 25# file, then obturated with continues wave technique.

Root strength was determined by insertion of a narrow, tapered probe into the obturated canals. Before loading, each tooth was mounted vertically in a 3 mm internal diameter resin to stabilize the root during loading. The probe was centered over the canal orifice and advanced through the gutta-percha until fracture of the root occurred. The load was recorded by Newton.

Data were entered into SPSS 14 (SPSS Inc., Chicago, IL, USA) then analyzed using t test at the 0.05 level of significance.



Figure 1: Zumax kit



Figure 2: Ultrasonic tips and modified GG.

Table 1: canal volume changes in mm³

Subgroup	The mean canal volume change (mm ³)	Standard deviation
Group A1	9	0.28
Group A2	10.45	0.31
Group B1	7.32	0.33
Group B2	9.2	0.28

Table 2: The mean load required to induce root fracture in newton

Subgroup	The mean load required to induce root fracture (newton)	Standard deviation
Group A1	418.08	131.52
Group A2	555.45	147.99
Group B1	477.19	84.11
Group B2	600.56	129.46
Control group	698.54	65.88

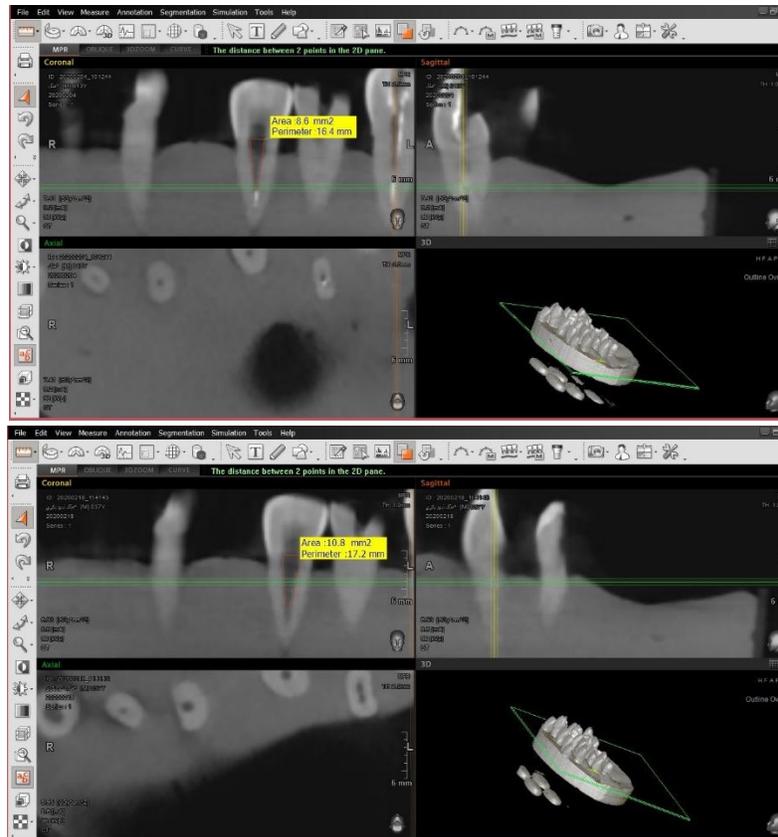


Figure 3: CBCT view before and after retrieval procedure.

3. Results

Results of the canal volume changes are presented in Table 1, and significantly shows (at $p < 0.05$) the higher dentin loss in apical third ($m = 9.725 \text{ mm}^3$) comparing with middle ($m = 8.26 \text{ mm}^3$) when using both techniques. Also, tube technique consumes dentin significantly higher than ultrasonic tips technique when the instrument locates in middle third, whereas no significant differences found between the two techniques when the instruments locates in apical third.

The mean load required to induce root fracture decreased with tube technique (at $p < 0.05$) ($m = 447.63 \text{ newton}$) comparing with ultrasonic tips ($m = 578.00 \text{ newton}$). Whilst no significant difference of root strength regarding apical location of separated instrument versus middle location.

4. Discussion

Retrieving of a separated endodontic instrument considered an aggressive procedure [4]. Also, this procedure put the root structure at a high risk to perforation and vertical fracture [2], [11], [12]. The remain structures must be enough to resist vertical forces applied during obturation [13]. This must be considered before such procedure when the instrument located in roots with low thickness, as in lower molars where distal wall thickness of the mesial root is about only one mm^3 in pre-prepared canal [14].

This study was conducted to assess the changes in root canal volume after the retrieval of separated instrument process using two different methods: ultrasonic tips and tube technique in middle and apical thirds and to determine the mechanical strength of the dental root after this procedure.

Although separated instrument exists more widely in molars, the sample consists of only single-root-tooth in

order to eliminate the uncontrolled variables and the anatomical variety and complexity in multi rooted teeth compering with single ones [8].

The results show a higher dentin loss rate in apical third comparing with middle one using both techniques. This might be because of the huge amount of dentin losing during establishing the deeper straight path to the apical third comparing with the middle one.

Our results were similar to the results of several studies showing that tube technique consumes more dentin of dental root comparing with ultrasonic tips, but they have been used conventional periapical radiograph to collecting data. However, Madarati and collogues used micro-CT after its application in dentistry researches, so their study shows losing dentinal volume of 4.20 mm^3 when the separated instrument located in apical third and 10.56 mm^3 and 17.53 mm^3 respectively when separated instrument located in middle and apical third, In this context, Gang et al were founded that the difference in canal volume after the retrieval of the separated instrument using two ultrasonic tips system (ProUltra[®] and EMS[®]), were 5.41 mm^3 and 9.78 mm^3 respectively [15].

Vertical root fracture (VRF) is essentially untreatable, and usually results in tooth loss. The causes of VRF include stresses produced during condensation and post placement. File retrieval typically results in ledge formation, and therefore, a possible stress concentration point formation [16]. Our study has shown that the retrieval procedure significantly reduced root strength when the file was located either in middle or apical third of the root, using either tube or ultrasonic technique comparing with the control group. Also, root strength was decreased when using tube technique comparing with ultrasonic technique, may be due to the wide platform created by the trephine comparing with the ultrasonic tips' one. This was similar to two separated studies used finite element analysis the impact of fractured endodontic file removal on vertical root fracture resistance in apical third [17] and middle third [18].

5. Conclusion

Tube technique removed more dentine than ultrasonic tips when SI located in the apical third of root canal, while no statistical difference was found between the two methods when SI was in the middle third. Also tube technique declines fracture resistance significantly with comparing with ultrasonic tips.

6. References

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