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# EVALUATION OF ROOT-END RESECTION WITH CONVENTIONAL AND ULTRASONIC METHODS: A SINGLE-BLIND, RANDOMIZED IN-VITRO STUDY

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Cracks, Root-End Resection, Root Surface, Ultrasonics, Surgical Root Canal treatment

# EVALUATION OF ROOT-END RESECTION WITH CONVENTIONAL AND ULTRASONIC METHODS: A SINGLE-BLIND, RANDOMIZED IN-VITRO STUDY


## Abstract

The root-end resection is considered critical endodontic surgical procedure. Three millimeters of the root tip is resected and root-end cavity with parallel walls and comparable depth is cut to receive a root-end filling. The literature discussed dentinal cracks after root canal instrumentation and/or root dentine cutting. The aim of the present study was to assess cracks at root ends after resection with conventional versus ultrasonic techniques. Material and Methodology: Thirty-two extracted human lower premolar teeth with single root were used. Their root canals were prepared and received gutta-percha. Sixteen roots Group 1 were resected using tungsten carbide fissure burs, while other sixteen teeth Group 2 were resected with ultrasonic tip, then all teeth had root end preparation with the ultrasonic coated retro trip. Both amount and categories of cracks on the resected surfaces were evaluated utilizing a dental operating microscope prior and following cavity preparation. Result: Cracking was statistically significant different among the two groups after resections or after cavity preparation.



## Keywords

Cracks, Root-End Resection, Root Surface, Ultrasonics, Surgical Root Canal treatment

## 1. INTRODUCTION

The treatment modalities to handle endodontic treatment failures include orthograde retreatment and apical surgery ( Hepworth and Friedman 1997). Complete debridement and root canal system obturation are the keys to effective root canal treatment (Ektefaie et al., 2005). Different reasons of failure include incomplete obturation, root perforation, broken instruments, external root resorption, coincident periodontal-periradicular pathosis , unfilled accessory canals, unacceptably either overfilled or overextended canals, apical cysts development , neighboring teeth without pulp, unintentionally removed silver points, persistent trauma, and nasal floor perforation (Pasha et al., 2013).

For that, the ultimate objective of successful endodontic therapy is prevention and/or abolition apical periodontitis to achieve sufficient healing. Endodontic surgical procedure is usually specified in persistent or recalcitrant periradicular pathosis cases that did not show healing following proper nonsurgical retreatment (Setzer et al.,2012). Recently, many new technologies in endodontic surgery have been used and improvement of the success rates was reported, with about ninety percent better results for the entire microsurgical methods; such as the microscope, micro-instruments, ultrasonic tips and additional root-end filling materials that are biologically compatible. (Kim et al., 2008).

Various endodontically treatment options comprise curettage, root-end resection, surgery with both concurrent root canal and root end filling (Bernardes RA, 2009). Many dental root canal systems have inaccessible areas that may impede the crucial abolition of infection via the orthograde root canal treatment such as isthmus, lateral canals, and ramifications in the apical three mm (Wu and Wesselink , 2005). Therefore, the ultimate aim of the apical root resection is the eradication infection source in the root canal and root canal system ramifications. Also to clarify that root canal obturation is satisfactory in this area (Duarte et al., 2007). Resections are done at right angles to root long axis , reducing amount of dentinal tubules exposure and apical leakage (Gorman et al., 1995). Various techniques and devices have been assessed in literature, to recommend the perfect technique for apical surgery ( Morgan and Marshall 1998). Several studies attempted to utilize burs mutually at high and low speeds (Setzer et al.,2012) in addition to ultrasonic methods (Del Fabro M, 2010).

During resection, the best method should give preference to an additional regular and smoother apical surface to lessen obturation displacement. Gutman 2014, suggested that root resection approach be extremely refined to encourage controlled deletion of the radicular apex plus create clean as well as smooth surfaces, consequently inhibiting sulcus effect or excavations. To minimize apical leakage, smooth surface is important (Del Fabro M, 2010). Microcracks may raise apical leakage possibility plus endanger the total root end strength. Although this not evidence based proven, their existence establishes a clinical worry (Gray et al., 2000). Furthermore, regular plus smooth surfaces as well as minimum shattering were obtained using the Lindeman burs with and without refinement through multi-fluted carbide ones ( Carr, 1997). Nedderman *et al*., 1998, contrasted various burs at both high and low speeds. The authors stated that plain fissure burs at low speed yielded more regular plus smoother root-end surfaces in comparison to crosscut fissure burs operated at different speeds. The launch of ultrasonic activation embodies crucial innovation concerning endodontic surgical procedures as bone-tissue management as well as the root-end cavity preparation conveniently accomplished using this tool (Neilsen et al., 1955). Using several assessment techniques, Rashed et al. suggested that apical resection and ultrasonic preparation could form dentinal cracks. (Rashed et al., 2019)

Therefore, the aim of the present study was to assess dentinal cracks at root ends after resection with conventional versus ultrasonics techniques.

## 2. MATERIAL AND METHODS

Thirty-two extracted human lower premolar teeth with single root were chosen (N=32), with completely developed apices. The chosen mature teeth were defects free plus no fractures were visible. Establishment of the root's integrity was done using a 16x magnification dental operating microscope - DOM (Leica Microsystems© M320 DENT). Soft tissues and debris along roots surfaces were removed via manual scaling. The teeth were meticulously cleaned then kept thirty minutes in 5% sodium hypochlorite solution (Taschieri et al., 2004). Then washed twice in normal saline for two minutes and instantly stored in artificial saliva for one week (Manhas et al., 2018)

Thereafter, cleaning and shaping of root canals with Protaper Next files (Dentsply/Maillefer, Ballaigues, Switzerland) and 2.5% sodium hypochlorite irrigation was done. The canals were then dried with paper points. Finally, lateral condensation of gutta-percha (Diadent, ChoongchongBuk

Do, Korea) and 2Seal root canal sealer (VDW, Munich, Germany). To guarantee materials set, teeth were stored in artificial saliva for one week (Gunes and Aydinbelge2014).

Teeth were then randomly divided into two groups in accordance with the mode of root end resection, Group I (n=16): root end resection was made with high-speed impact air handpiece at (350,000 rpm) with carbide fissure bur 557# (SS white, Japan) . Group II (n=16): root end resection was done using ultrasonic tips By Piezosurgery II® unit (Mectron, Carasco, Italy) Frequencies of 25–35 kHz with serrated tip OT7S-4 (Mectron) Group 2, The section lied three mm from apex and the roots in relation to their longitudinal axis were resected at 90º angle. Thereafter, the teeth were examined for the existence of cracks and fractures underneath a DOM at 40x magnification. Photos were taken to the cutting surface of each root. Methylene blue dye 1% was applied precisely to surfaces for five minutes, subsequently rinsed with copious water for one minute to make vision of cracks easier (Aydemir et al., 2014).

After sectioning and assessment of root surfaces for cracks, root-end preparation was done in all teeth by using EMS mini piezo ultrasonic unit (EMS, Nyon, Switzerland) with diamond-coated tips: E11D (EMS) at medium power with water cooling (Taschieri et al., 2004). To standardize the 3mm cavity depth, they were examined with Hu-Friedy periodontal probe (PCPUNC15, Chicago, IL).

Assessment of cracks number and types on the resected surface, both prior and following cavity preparation underneath 40x magnification using a microscope (Leica Imaging Systems Ltd, Cambridge, UK). (2%) methylene blue dye (Canal blue - Dentsply, DeTrey, Konstanz, Germany) was employed for two min into root surfaces to assist detection (Aydemir et al., 2014).

### 2.1 Data Collection:

Both pre-and post-operative photomicrographs were coded and blinded by the operator then were evaluated.

The photomicrographs at 40x magnification were evaluated through assessment of number, type, and root surface cracking location in relation to dentinal walls.

Microcracks documentation was made according to different types as per Rainwater et al. (Rainwater at al., 2000) and De Bruyne & De Moor (De Bruyne, M. A. A., De Moor, R.J.G., 2005) as follows: incomplete cracks, intracanal cracks stem from root canal then spreading into dentine, extracanal cracks stem from root surface spreading to dentine, intradentinal cracks limited to dentine, and finally, complete cracks from the root canal to root surface.

### 2.2 Data Analysis:

All the data collected from the study were statistically analyzed by utilizing the statistical software SPSS 24.0 for Windows (Chicago, IL), summarized, and represented in suitable tables.

## 3. RESULTS

This study results are briefed in tables (1, 2, 3, 4) evaluating the root-end surface after being resected either by conventional bur or ultrasonic inserts tips prior to and following root end preparation.

A Wilcoxon signed-rank test showed in Group 1a statistically significant difference in the number of “intradentinal cracks” of root-end surfaces resected with conventional bur prior to and after root-end preparation (Z = -2.666, p = 0.077) (Table 1).

Table 1: Results for the Wilcoxon Signed Rank Test analysis of root-end surface evaluation after being resected with *conventional bur, before and after* root-end preparation.

| Before vs After | Intracanal cracks | Extracanal cracks | Intradentinal cracks | Complete cracks |
|---|---|---|---|---|
| Z and P-value | 1.607, 0.1080 | 0.533, 0.5940 | -2.666, 0.0077* | -1.604, 0.1088 |

In Group 2 a statistically significant difference was found among "complete cracks" number at the resected root-end surface with ultrasonic tip prior to and following root-end preparation (Z = -2.366, p = 0.0180) (Table 2).

Table 2: Results for the Wilcoxon Signed Rank Test analysis of resected root-end surface by *ultrasonic tip*, *before and after* root-end preparation

| Before vs After | Intracanal cracks | Extracanal cracks | Intradentinal cracks | Complete cracks |
|---|---|---|---|---|
| Z and P-value | -1.600, 0.1095 | -1.572, 0.1159 | -0.917, 0.3950 | -2.366, 0.0180* |

The comparison between root end resection surfaces of Group 1 versus Group 2 before root-end preparation showed that there was no statistical significant difference in "intracanal cracks" number , while there was a statistically significant difference in "extracanal cracks" number (Z = -2.366, p = 0.0180) and "intradentinal cracks" (Z = -2.970, p = 0.0030) (Table 3).

Table 3: Results for the Wilcoxon Signed Rank Test analysis of root end resection surfaces *prior* root-end preparation: *Conventional bur versus Ultrasonic tip*.

| Before: conventional vs ultrasonic | Intracanal cracks | Extracanal cracks | Intradentinal cracks | Complete cracks |
|---|---|---|---|---|
| Z and P-value | -1.481, 0.1386 | -2.366, 0.0180 | -2.970, 0.0030 | 0.535, 0.5930 |

The comparison between root end resection surfaces with conventional bur (Group1) versus Ultrasonic (Group 2) *after* root-end preparation showed that there was a statistically significant difference in the number of "intradentinal cracks" (Z = -2.628, p = 0.0086) (Table 4), (Fig. 1)

Table 4: Results for the Wilcoxon Signed Rank Test analysis of root end surfaces following Root-End preparation: *Conventional bur versus Ultrasonic tip*.

| After: conventional vs ultrasonic | Intracanal cracks | Extracanal cracks | Intradentinal cracks | Complete cracks |
|---|---|---|---|---|
| Z and P-value | -0.588, 0.5563 | -1.540, 0.1235 | -2.628, 0.0086 | -1.066, 0.2863 |

In both crack number and type between conventional bur group versus ultrasonic group following apical resections there was a statistically significant differences ($p<0.05$) (Table 3) and after cavity preparations ($p < 0.05$) (Table 4).

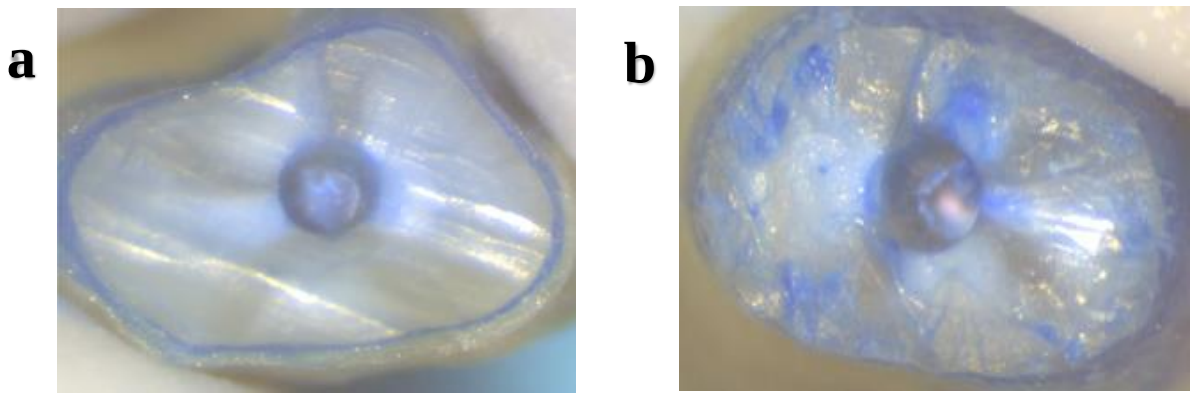


Fig.1: Root surface after root resection by conventional bur (a), and ultrasonic tip (b), after root end preparation by ultrasonic retrograde tip.

## 4. DISCUSSION

Improvement of endodontic surgeries results recently is mainly due to using the microsurgical instruments that allow superior management of the root end (Bernardes, 2015). The importance of these instruments exists in reducing the possible adverse effects like angled root-end resections and cracks. Moreover, retrograde cavity marginal quality and resected apical surface smoothness, factors to be considered for better healing accomplishment (Kim and Kratchman 2006).

In this study we had used filled root canals to mimic in vivo environment (Ishikawa et al., 2003), while other studies had used unprepared teeth (Gouw-Soares et al., 2001), (Gondim et al., 2002). Onnink et al. (Onnink, 1994) reported statistically significant difference between gutta-percha filled teeth and unprepared teeth.

The precise angulation in root-end resection is considered important since it was reported that an angle lower than 90°, relative to the root long axis, lead to additional dentinal tubules exposure, that can boost surface roughness plus bacterial contamination hazard. Therefore, in this study, a ninety-degree angle was applied for the entire groups, with a 3mm extension as of apices, in agreement to an earlier study (Vercellotti et al., 2001).

The possible consequence of using piezosurgery on root apices integrity following cavity preparation is seldomly investigated (Abella, 2014). Ultrasonic devices are lately the favored prime to prepare root-end cavity (Eliyas et al., 2014).

While the ultrasonic machine set at different power levels, not many authors had examined the impact of ultrasonic retro tips on resected root surfaces following preparation of root end. Confrontational results when some studies had used only stainless-steel retro tips (Gray et al., 2000). While others examined how resected root surfaces during preparation of root end possibly differ when using diamond or zirconium nitride coating and stainless steel. (Peters et al., 2001) (Navarre and Steiman. 2002).

The ultrasonic root end preparation during endodontic surgical procedures become routine nowadays. In contrary to root-end cavities preparation utilizing bur, those designed utilizing ultrasonic retro tips are deeper, seldom depart from canal space, and need lesser both bony crypts and bevel angles (Waplington et al., 1997). Nevertheless, elimination or lessen the adverse effects during root end preparation for instance incidence of dentinal cracks must be deemed by any possible approach.

This vitro research examined the impact of conventional bur and ultrasonic tip used in the root-end resection. Then investigated the root end surface after root end preparation amplitude levels in relation to both root end surface cracks number and type. A statistically significant difference among the conventional bur and ultrasonic tip groups: A greater occurrence of cracks was noticed in the Group 2 by utilizing the ultrasonic device.

The present study revealed that using the ultrasonic insert tips made more incidence of dentine cracks than the conventional bur. A significantly greater variation of root end in addition to qualitatively graver cavity margin was noticed after ultrasonic device being used. The latter working mode (piezosurgery tips) was more forceful and appropriate for cutting bone tissue.

In Group 1, the root end surface following root resection showed some cracks, but the cracks increased following root end preparation especially the incomplete cracks (intradentinal cracks) (Table 1). In Group2, the root end surface following root end resection showed even some cracks which increased after root end preparation especially the complete cracks (Table 2).

Number of cracks showed in (Group1) was fewer than Group 2 after root end resection. Concerning type of cracks, in Group 2 they were incomplete (extra canal cracks and intradentinal cracks) (Table 3).

After root end preparation by the ultrasonic retrograde tip, Group 2 still had more cracks than Group1especially the incomplete intradentinal cracks (Table 4).

## 5. CONCLUSIONS

Based on the results under circumstances of the present in vitro endodontic study, it can be assumed that resection and root-end preparation approach applied had a significant impact on both crack numbers and type.

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