

## EVALUATING THE CUTTING EFFICIENCY OF TWO NEW ULTRASONIC UNITS WITH DIFFERENT TIP MANUFACTURE

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### ABSTRACT

Thirty-two freshly extracted single-rooted anterior teeth with fully developed apices were obtained, cleaning, shaping were done for each tooth by wave Gold rotary files and obturation were done, teeth were then divided equally in two groups, then apicoectomy was done by tungsten carbide bur and retrograde was done by angled ultrasonic tips, two angled ultrasonic tips were used in this study, diamond-coated and zirconium nitride coated ultrasonic tips, time of preparation were measured and the tooth was weighed before and after by five digital scale to evaluate the cutting efficiency of ultrasonic tips, Results of intergroup comparison for working time showed E8-SD to have significantly higher mean value than SURG-1 ( $p < 0.001$ ). While results of intergroup comparison for the weight of removed dentine showed SURG-1 to have a significantly higher value ( $p < 0.001$ ). Within the limitations of the study, diamond-coated surgical retrograde tip (E8-SD) showed a significantly higher cutting efficiency that zirconium coated tip (SURG-1).

**KEYWORDS:** Ultrasonic tips, Digital Scale, reto-grade, apicoectomy.

### INTRODUCTION

The outcome of the root end preparation is well established practice, and it is frequently applied to resistance of periapical infection <sup>(1)</sup>. Thus, the retro-grade is an option for tooth with failure endodontic retreatment. Thus, the aim of surgical retreatment should be achieved by resection, root-end preparation, and an air-tight seal with bioactive retrograde filling <sup>(2)</sup>.

Surgical endodontic treatment includes multiple steps, such as root sectioning by preparation of a class I cavity in the root canal. The use of ultrasonic tips has enhanced this preparation, due to the diversity of ultrasonic tips with different designs <sup>(3)</sup>.

There are many ultrasonic tips with different shapes and sizes. The first tips that were manufactured for apical surgery were made of stainless-steel, tips have special surface coatings to enhance

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their cutting efficiency<sup>(3)</sup>. Recently an attempts have been made to enhance the ultrasonic tips in terms of usability and performance. New zirconium nitride-coated such as Pro Ultra Surg.1 and diamond-coated tip E8-SD .

The removal of an obstruction is the first phase of RCT which is improved by ultrasonic tips. Straight ultrasonic tips can be used for this to trough around pulp stone or broken fragment to maximize the advantage of vibratory forces<sup>(4,5)</sup>.

Diamond- coated ultrasonic tips has been shown to be effective and speedy in apical preparation<sup>(7)</sup>. Despite the disadvantages of ultrasonic tips such as heat generation, loss of diamond particles quickly and possible cracks propagation<sup>(4)</sup> .

Only little studies reported the cutting efficacy of ultrasonic tips<sup>(4,5,6)</sup>, so the, the purpose of the present study was to evaluate the cutting efficiency of two different ultrasonic tips used in retro-grade endodontic treatment: zirconium nitride coated tip Pro Ultra Surg.1 and diamond-coated tip E8-SD.

## MATERIAL & METHODS

Thirty-two single-rooted anterior teeth with fully developed apices were obtained. Teeth were extracted for periodontal reasons unrelated to the study. The study was approved by the ethical committee of the British University in Egypt (22-037).

All teeth were cleaned by ultra-sonic tip and then immersed in 1% Na-OCl solution for 15 minutes.<sup>(6)</sup> The coronal parts of the teeth were sectioned at the CEJ with a low-speed diamond disc, under continuous water spray, to obtain a root length of about 17 mm<sup>(5,6)</sup> The working length was determined by observing the emergence of file 10 K from the foramen, measuring it and withdrawing till 1 mm.

Biomechanical were done to all teeth (Wave one Gold Dentsply Maillefer, Baillaigues, Switzerland). The canals were irrigated with 5 %

Na-OCl between each fileA final rinse with 3 ml of 17% ethylenediaminetetraacetic acid (EDTA), 5% NaOCl and distilled water was performed to remove the smear layer. The root canal filling was performed with a single cone technique, using with bio-ceramic root canal sealer (META BIOMED, Korea).

After obturation, each tooth was numbered and an X-ray image were done to confirm the quality of obturation. The coronal 1/3 of the roots were mounted on Putty impression material – Coltène AFFINIS (Coltène/ Whaledent AG; Alstätten, Switzerland). The section line were drawn at 3 mm from the apex and all the roots were resected at a 90° angle regarding to their longitudinal axis<sup>(8)</sup>.

The 32 teeth were divided randomly into two equal groups using stattrek.com<sup>(7)</sup> according to the ultrasonic tips used to prepare the root-end cavity:

- Group A: ProUltra ultrasonic Tip Refills-Surgical Tips SURG-1.
- Group B: Eighteen ultrasonic Tips E8-SD.

Each tip was marked at 3 mm and apical preparation was performed at the intensity recommended by the fabricant, under constant distilled water irrigation<sup>(4,9)</sup>. The specimens were kept in the putty blocks and maintained wet throughout the procedures. All preparations were class I (according to Black's classification) (11). Time of preparation were measured using a stopwatch, counting only the time of actual instrument contact with the root until the tip of the instrument penetrated to 3mm<sup>(2,5)</sup>. In the incidence of a tip breaking before the end of the experiment, the sample and the tip were discarded and replaced. All preparations were done by the lead author; an endodontist of more than 15 years of experience. Every tooth was weighed before and after instrumentation to the nearest 0.01 mg<sup>(10)</sup> using a sensitive digital scale to scale the samples (Kern 770, max= 220kg, KERN, Germany). Figure (1).



Fig. (1) A photograph showing: Sensitive digital scale were used to scale the samples (Kern 770, max= 220kg, KERN, Germany).

**Statistical analysis**

Numerical data was represented as mean and standard deviation (SD) values. Shapiro-Wilk’s and Levene’s tests were used to test for normality and variance homogeneity. Data were normally distributed, had variance homogeneity and were analyzed using independent t-test. The significance level was set at  $p < 0.05$  within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows.

**RESULTS**

Results of intergroup comparison for working time presented in table (1) showed E8-SD to have significantly higher mean value than SURG-1 ( $p < 0.001$ ). While results of intergroup comparison for weight of removed dentine presented in table (2) showed SURG-1 to have significantly higher value ( $p < 0.001$ ). Mean and standard deviation values for working time and weight of removed dentine are presented in figures from (1) to (2) respectively.

TABLE (1) Intergroup comparison of operation time (seconds)

Weight of removed dentine (mg) (Mean±SD)		Mean difference (95%CI)	t-value	p-value
E8-SD	SURG-1			
13.42±1.04	6.72±1.08	6.70 (6.17:7.23)	25.24	<0.001*

\*significant ( $p < 0.05$ )

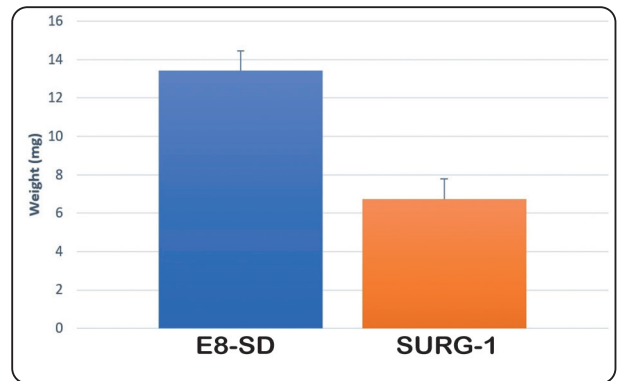


Fig. (2) Bar chart showing mean and standard deviation values for operation time (seconds)

TABLE (2) Intergroup comparison of weight of removed dentine (mg)

Operation time (seconds) (Mean±SD)		Mean difference (95%CI)	t-value	p-value
E8-SD	SURG-1			
363.72±119.07	551.69±126.10	187.97 (126.68:249.25)	6.13	<0.001*

\*significant ( $p < 0.05$ )

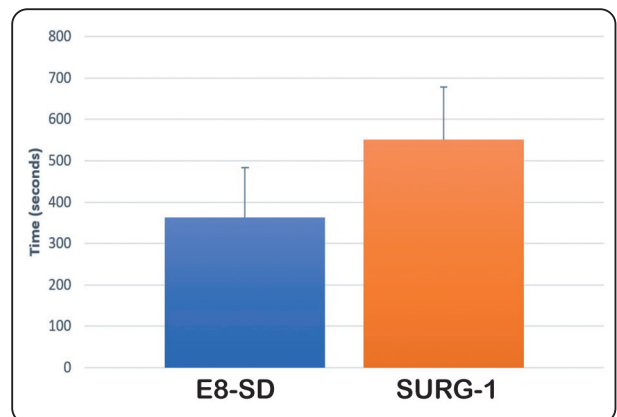


Fig. (3) Bar chart showing mean and standard deviation values for weight of removed dentine (mg)

## DISCUSSION

Different variations of Ultrasonic retrograde tips were introduced to enhance their performance. They allow faster preparation with better cavosurface angle, which at the time of their introduction a revolutionary advantage<sup>(11,12)</sup>. Among the variations introduced was the introduction of the diamond-coated and zirconium nitride-coated retro-tips<sup>(16)</sup>. Abrasive coatings were introduced to minimize the crack-inducing effect of ultrasonic tips given that they act by their tips' sides<sup>(15)</sup>.

The cutting efficiency of an instrument is best described as the capacity to remove intra-dentin under expenses of time<sup>(8)</sup>. Cutting efficiency and subsequently the time needed to perform a retrograde cavity can be decisive when it comes to clinical success chances. This is because literature showed that there is a higher chance of cracking and having larger chipping areas with longer preparation time needed<sup>(17)</sup>. Time interval is also important when it comes to patients' convenience and cooperation, especially in a surgical setup<sup>(18)</sup>.

To evaluate the cutting efficiency of different ultrasonic tips two measuring parameters were used to validate each other. Both the length of time needed to complete each preparation was recorded until 3mm penetration as well as the amount of dentin removed within a specific time interval

Results of both parameters measured showed that the E8-SD that is diamond coated had higher cutting efficiency than the SURG-1 zirconium nitride coated tips. This comes in agreement with Ricardo A. et al<sup>(13)</sup>, Gunes et al<sup>(15)</sup> and Peters et al<sup>(14)</sup> whose results showed better cutting efficiency for diamond tips.

It is worth noting that while five diamond coated tips needed replacement, no instrument breakage happened with the zirconium nitride coated tips. While this note was not a targeted outcome to be measured, it goes along with the results of

Lin et al.<sup>(19)</sup> and Wan et al.<sup>(20)</sup> who reported that orthograde diamond coated tips are more prone to fracture.

Findings of this study probably support the recommendation of Zuolo et al<sup>(21)</sup>, who suggested that retrograde cavities can be initiated with a diamond-coated tip, followed by a smooth tip for cavity furnishing<sup>(22)</sup>. However, more studies are needed to investigate whether or not the difference in results can be solely attributed to the coating and to investigate the effect of oscillation patterns of the tips that vary with variations in tip designs<sup>(23)</sup>.

## CONCLUSION

Within the limitations of the study, diamond coated surgical retrograde tip (E8-SD) showed a significantly higher cutting efficiency than zirconium coated tip (Surg-1).

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