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COMPARATIVE EVALUATION BETWEEN ER,CR:YSGG LASER & ULTRASONIC TIP ON THE INTEGRITY OF ROOT APICES IN RETROGRADE ROOT-END CAVITY PREPARATION – AN IN-VITRO STUDY

Dental Science

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ABSTRACT

This study compared the effects of ultrasonic root end cavity preparation and Er,Cr:YSGG laser (Waterlase, Biolase Technology Inc., San Clement, CA, USA) on the integrity of the root ends of extracted human teeth. After cleaning, shaping, and obturating the canals of 60 removed maxillary central incisors, 3 mm of the root end was resected, and any cracks were checked for. Then, an Er, Cr:YSGG laser or an ultrasonic unit were used to prepare Class I root-end cavities. The cavity that was examined for the presence of any cracks or chippings under endodontic microscope, was prepared using 600 µm laser tips with an output power setting of 4 W and 55% water and 65% air in the laser group and Proultra ultrasonic retrotips (Dentsply Sirona) in the ultrasonic group with medium intensity. In contrast to the laser group, which had no cracks, the ultrasonic group only had one. The two groups did not differ significantly from one another ($P > 0.05$). Regarding the chipping effect, eight cases (30%) in the ultrasonic group showed chipping during cavity preparation, but the laser group's specimens showed no chipping. This difference was statistically significant ($P < 0.05$). The findings of this in vitro investigation indicate that, in terms of chipping, lasers maintain the integrity of root-end cavities more effectively than ultrasonic devices.

KEYWORDS

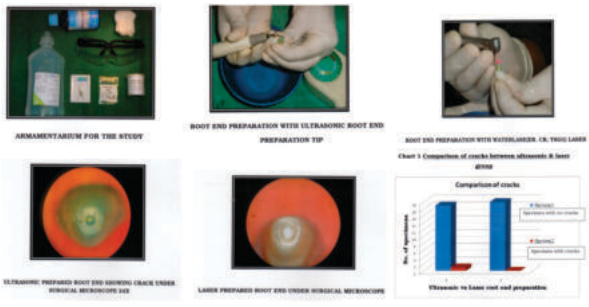
INTRODUCTION:

Due to their many benefits, such as their reduced size and better access to the removed root-end cavities, ultrasonic tips are now commonly used for root-end cavity preparation (1).When ultrasonic root-end preparation was used instead of a round bur on a slow-speed handpiece, Saunders et al. (2) were the first to report more crack propagation in the resected root-end surface. Additionally, Abedi et al. (3) investigated the effects of ultrasonic and bur root-end cavity preparation and found that bur produced noticeably fewer cracks than ultrasonic. Waplington et al. (4) discovered that bur and high power ultrasonic did not significantly differ in terms of cracking; nevertheless, the ultrasonic device was more linked to chipping. Research indicates that employing an ultrasonic device with a higher power level for root-end cavity preparation results in more cracks than using one with a medium or low power setting (5,6). After creating rootend cavities using medium and low power settings of the ultrasonic device, De Bruyne et al. (7) examined the root-end integrity in a different investigation and found no discernible difference in the cracks generated between medium and lowpowers. In endodontic surgery, the Er, Cr:YSGG laser (Erbium, Chromium: Yttrium, Scandium, Gallium, and Garnet) and the Waterlase laser (Biolase Technology Inc., San Clement, CA, USA) have been proposed as efficient methods for sterilizing the root apex and surrounding tissues, preparing the root-end cavity, stanch blood, and resecting root ends (8). Waterlase uses highly energetic water particles to cut hard tissues, whereas direct laser energy is used to make soft tissue incisions (8). Karlovic et al.'s study (9) comparing the creation of cracks in root-end cavity preparation using an Er:YAG laser and an ultrasonic device revealed that the former produced noticeably fewer cracks than the latter. During the cavity preparation of 36 teeth (10), Wallace (10) examined the impact of the Waterlase laser on root-end preparation and found only one break. Waterlase has an advantage over other lasers in that it may be used for all surgical procedures, such as soft tissue cutting, bone removal, root-end resection, pathologic and hyperplastic tissue removal, and root-end preparation (11).

Studies on several cavity preparation techniques using burs, ultrasonic devices, and other lasers have been conducted; however, the Waterlase laser has not been contrasted with other widely used cavity preparation techniques. This study compared the effects of ultrasonic root-end cavity preparation and Waterlase laser on the integrity of the root apex.

MATERIALS AND METHODS:

For this investigation, 60 upper central incisors with single roots, straight roots, and fully formed apices were chosen. The teeth were kept in a thymol aqueous solution at a concentration of 0.2%. The root's exterior was mechanically cured and then disinfected for 30 minutes by submerging it in 1% NaOCl. A diamond bur was used to cut the teeth up to CEJ after they were decoronated. One millimeter below the anatomical apex, as verified by the #15 K-file (Maillefer, Dentsply, Switzerland), the working length was determined. Root canals were flared to file #80 after being cleaned and shaped with MAF #40 utilizing the step-back technique. Following pretreatment, sterile paper points were used to dry the canals before they were sealed with AH plus sealant (Dentsply) and gutta-percha (Dentsply) using NiTi spreader (Maillefer, Dentsply, Switzerland) with cold lateral condensation technique.



After obturation, samples were stored for 48 hours. Next, using a fissure bur (D&Z, Diamant, Germany) under water spray, 3 mm of the root end was cut off perpendicular to the roots' long axis. Following root end resection, the teeth were submerged in a 0.004% methylene blue solution for 48 hours before being inspected for fractures using a ×24 magnification endodontic microscope (Zeiss, Oberkochen, Germany). Cracked teeth were removed and replaced with ones that weren't. After the resected root ends were imaged, the teeth were split into two groups of thirty at random. Using ultrasonic Proultra ultrasonic retrotips (Dentsply Sirona) and an ultrasonic unit (Satelac Ultrasonic Scaler) at a frequency of 32 kHz and medium intensity, one group underwent root-end cavity preparation. A depth of 3 mm was prepared using cooling water and intermittent pressure with a in-and-

out motion from the resected surface. Lastly, the preparation was finished using circumferential motion. In the other group, the root-end cavity was made using a 600 µm Er, Cr:YSGG laser tip, set to 4 W of power, and 55% water and 65% air in accordance with the manufacturer's instructions. A 3 mm deep and 1 mm wide Class I cavity was created. For both approaches, the total preparation time was under two minutes. In the interim between tests, teeth were submerged in saline. Following a 48-hour immersion in 0.004% methylene blue solution, the teeth were once more examined under a endodontic microscope at ×24 magnification by a skilled operator who was blind to the experimental groups (using an ultrasonic device or Waterlase laser) to check for cracks and chippings. Statistical analyses were carried out.

RESULTS:

The ultrasonic group only had eight crack, whereas the laser group had none (Figs. 1e), and the difference was not statistically significant ($P > 0.05$). Eight samples from the ultrasonic group had chipping (Fig. 1d), whereas the laser group did not have any chipping. This difference was statistically significant ($P = 0.01$).

DISCUSSION:

One of the most crucial procedures in periradicular surgery for creating an apical seal is creating a root-end cavity in the removed root end that has adequate room for the insertion of rootend filling material and avoids needless tooth structure damage (1,12). In order to examine the integrity of the root end after root-end cavity preparation using a laser and ultrasonic equipment, the current study was created. Gray et al.'s study from 2013 found no difference in the formation of cracks between removed and cadaver teeth, hence extracted teeth were employed in this investigation. Furthermore, fissure bur was employed for root excision. But Gondim et al. (14) stopped cracks from forming by using a hard tissue microtome.

Teeth exhibiting cracks after root removal were not included in the study for homogeneity reasons, although burs were utilized for root resection to mimic the clinical scenario. Wright et al. (2015) stated that the methylene blue dye technique, which is a precise approach for investigating cracks, was utilized in conjunction with a stereomicroscope to evaluate the existing cracks at the root end. During specimen preparation, an electron microscope was not utilized due to the potential for creating false cracks (16). Less than 5% of cracks propagated in the ultrasonic group, which was less than what Ishikawa et al. (19) found but comparable to the findings of Morgan et al. (17) and Peters et al. (18). The medium intensity of the ultrasonic unit may be the cause of the lower cracking in this investigation. De Bruyne et al. (7) claim that employing medium ultrasonic intensity results in noticeably fewer cracks than high ultrasonic intensity. Furthermore, the pre-experiment cracks were caused by the teeth's drying, storage medium, and stress reduction during tooth extraction (18). Er, Cr:YSGG pulsed laser was employed in the laser group to prepare the root-end cavity (10). In order to maintain a low root surface temperature during cavity preparation—a crucial factor for the surrounding bone—energized water molecules slice the dentin. The cavities were made with a 3 mm depth and the Cr:YSGG laser was utilized in accordance with the manufacturer's instructions.

The absence of crack-causing elements, such as pressure and vibration during root-end cavity preparation, may have contributed to the prepared cavities' lack of cracks (10). After cavity preparation, chipping was also examined, and there was a notable difference between the techniques used (seven cases with ultrasonic vs. none with laser). Following preparation using the ultrasonic equipment, greater chippings were seen in the earlier experiments (13, 20). Chipping may have an impact on the marginal seal and treatment's long-term prognosis, even if its significance in root-end cavity preparation has not been established (7). In the current study, chipping was defined as intracanal and/or resected surface damage to the tooth structure. One potential benefit of laser preparation over ultrasonic preparation is the absence of chipping during root-end cavity preparation.

According to the findings of Rahimi et al. (21), even at a thickness of 1 mm, there were no appreciable differences in the ability of three different MTA thicknesses (1, 2, and 3 mm) to prevent leakage. It appears that using an Er, Cr:YSGG laser to prepare the rootend cavity and then using MTA as a root-end filling material results in better periradicular surgery outcomes.Nevertheless, future research is necessary to ascertain the impact of chipping on the marginal seal and sealing ability of root-end filling materials in periradicular surgery using various laser parameters, as the cause of chipping or crack formation cannot be determined without SEM studies, and temperature measurements during cavity preparation are clinically significant topics that warrant investigation.

CONCLUSION:

We can conclude from the resorses available for this study that retrograde preparation using the Er., Cr., YSGG laser demonstrated no cracks compared to ultrasonic root end preparation tip, Which would ultimately improve the quality of endodontic root end surgeries.

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