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Comparative evaluation of Gutta Percha removal from root canal using laser and different retreatment techniques - A CBCT study

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Abstract

Background: The retreatment of endodontic ally treated tooth requires meticulous removal of obturating material. The present study evaluated the efficacy of manual H files, Safe endo rotatory files and LASER in the removal of Gutta percha (GP) from previously endodontic ally treated tooth.

Methodology: 30 mandibular premolars with single canal were selected. Endodontic treatment was done using Niti rotatory files and obturated using GP with lateral condensation technique. The quality of filling was ensured using digital radiograph. They were then divided into 3 groups of 10 samples each: Group 1- retreatment with hand files H-file, Group 2- retreatment Safe endo rotary files, Group 3- retreatment with diode laser. After

retreatment, the samples were assessed using CBCT for proportion of residual filling. The data obtained were tabulated and subjected to statistical analysis using one-way ANOVA with Bonferroni corrections.

Results: The results showed maximum residual volume for LASER and minimum residual volume for Safe endo rotatory files. The difference obtained was statistically significant. The residual volume from H files were less than LASER (statistically significant) but more than Safe endo (not significant). The time taken for removal was maximum for LASER group.

Conclusion: Safe endo rotatory retreatment files were more efficient than LASER. The H files have shown satisfactory results but can be exhausting due to manual instrumentation. No modality obtained complete removal of GP.

Keywords: Retreatment, Gutta Percha, Laser, H-Files, Rotatory files

Introduction

The aetiology of endodontic failure includes lack in biomechanical preparation, accidental mishaps, incomplete seal of the non-vital tooth and tooth fracture. However, in case of endodontic failures, not only the biomechanical preparation is incomplete and has to be redone but also the presence of obturation material becomes a hassle.[1] Retreatment procedure requires precise removal of previous obturation material as it becomes infected. This becomes crucial for the success of subsequent endodontic therapy. Nevertheless, it comes with their own set of challenges like potential for perforation, removal of too much tooth structure making it prone for fractures.[2]

Gutta Percha (GP) removal during retreatment has been attempted using various endodontic files. H-files have been conventionally the preferred choice along with solvents for GP removal due to their cutting ability.[3] However, manual removal can be tedious at best thus, rotatory files were preferred. There may be remnants of previous filling which may be difficult to remove, thus appropriate choice of retreatment is necessary.

Retreatment NiTi rotatory filesplasticize the GP using the frictional heat facilitating faster and efficient removal. Their flexibility facilitates maintenance of canal configuration with shorter working time.[4] Numerous studies have been documented for removal efficiency of GP in retreatment cases, but Safe endo files are newer and less studied, therefore it is imperative to implore their role in retreatment cases.

Apart from files, heat transfer devices such as soft tissue LASER are gaining attention due to their novelty. LASER emits a concentrated beam of light which can generate heat to melt the GP. The literature has shown that GP removal using a LASER device is a result of photo thermal and photo ablation effects when paired with appropriate solvent.[5] This may ensure a complete removal of the residual material while avoiding any excessive cutting of the root dentin.

Therefore, aim of the present study was to evaluate the efficacy of H files, Safe endo rotatory files and Laser in removing root canal obturating materials in retreatment cases. The null hypothesis stated there was no difference in GP removal efficiency of H files, Safe endo rotatory files and Laser in retreatment cases.

Materials and Method

This in vitro study was conducted on human extracted single rooted mandibular premolar teeth. The study was approved by the Institutional ethical committee and a power analysis was done for sample size calculation. G*Power software version 3.1.9.4 software (Universitat Kiel, Kiel, Germany) was used, effect size was kept at 0.9[6] with an alpha error of 0.05 and power 0f 0.95 keeping actual power of 0.959, 30 samples were taken

into consideration. They were divided as 10 samples in each group.

Samples collected were rid of any calculus or debris using ultrasonic scalers. Decoro nation of the teeth were done at the cementoenamel junction with the diamond disc and handpieces. The remaining roots measured at 14±1mm of length. These roots were mounted on to an acrylic mould. A 10k file was used to measure the working length of each tooth and a radiograph was taken to establish that. Then #15k and #20k files were used along with alternate irrigation and filing of the canal till working length. The instrumentation was done with Niti rotatory files (Revo-S Micromega files, Hero gold file system) using crown down technique. A #20 file with 4% taper (0.04) which was operated at 300 rpm with a torque of 2Ncm was used in the canal. The final shaping was completed using #25/4% and 25/6% files up to working length. A #10file was used for recapitulation, after each instrumentation, irrigation was done using 2 ml of 3% sodium hypochlorite. This was followed by application of 5ml of17% ethylene diamine tetraacetic acid, followed by 5ml rinse with distilled water. The canals were dried using paper points and obturation was done using GP (Dentsply, Switzerland) and bio ceramic sealer (Prime MTA bio ceramic root canal sealer) via cold lateral compaction technique using spreaders.

Instrumentation was performed by a single operator. A digital radiograph was obtained to assess the complete buccolingual and mesiodistal obturation without leaving any gaps within the canal. The access cavity was filled with temporary filling (Cavit G, 3M, Espe, Germany). The samples were kept at 100% humidity for the next weeks at 37% to mimic human conditions and complete setting of the sealer.

The samples were scanned for measurements using CBCT (Vatech Imaging technology, South Korea). Each specimen block was placed in a rubber base block which housed 5 samples in each scan to assess for axial, frontal and in sagittal planes. The resolution used was 0.2mm voxel for 5*5 cm block for an exposure of 1.2 seconds at 3.2 mA at 90 Kvp and 34mGycm^2. All the data was imported into 3D image automatic segmenting software for calculation of root filling volumes. Volume measurement was done using Ez3D-i's cutting-edge software (Vatech). Exact volume of root filling from coronal to apical third was selected using the green colour selector of the software and intra class correlation coefficient (ICC) was calculated as 0.998cc. an experienced oral and maxillofacial radiologist interpreted all the images.

Samples were then divided as

- Group 1- retreatment with hand files H-file
- Group 2- retreatment with Safe endo rotary files
- Group 3- retreatment with diode laser

Retreatment procedure: The retreatment was timed using a chronometer. The temporary fillings from all the three groups were removed. Following technique was used to remove the GP in all the groups:

Group 1- Entire GP was removed from the coronal, middle and apical third of the tooth till the working length of the tooth. Canals were re-instrumented with a size 25 H-file using a circumferential, quarter-turn push-pull technique. Files were withdrawn after every 4 strokes to remove trapped debris using a sterile sponge. Retreatment was considered completed when the file reached working length with no remnants left in the canal. The canals were then irrigated with 10 mL of distilled water using a 27G side-vented needle and dried using paper points.

Group 2- A pilot hole of 2–3 mm was drilled into the gutta-percha using a NiTi Safe endo smart file (Micro-Mega) at a constant speed of 400 rpm and 1 N·cm torque,

as per manufacturer instructions. The REM file was used in continuous rotational mode at 800 rpm and 2.5 N·cm torque, which was advanced into the coronal and middle thirds up to 3 mm from working length using 2–3 mm back-and-forth movements without apical pressure, after that 25/.06 Micro-Mega rotary file used to prepare the apical third to WL, at a constant speed of 350 rpm and 2.5 Ncm torque. Canals were irrigated with 10 mL distilled water using a 27G side-vented needle and dried using paper points.

Group 3- GP was removed using a diode laser (Dr. Smile, Lambda S. p. A., Italy) at a wavelength of 980 nm and power of 5 W, for 20-second cycles. It was repeated until working length was achieved. After each lasing cycle, GP remnants and debris removed using distilled water irrigation. Remnants on the optical fiber tip was wiped clean with moist gauze. A reamer used to check working length. Laser treatment was performed in contact mode; retreatment considered complete when the laser fiber tip reached the working length.

Retreatment scanning

A second CBCT examination was performed for each root after retreatment, at the same position as that of the initial scan. The parameters for CBCT scanning were kept same as that of initial scans. Assessment conducted using VATECH Ez3D-i Viewer (WOOSOFT company, Version 5.2.12.0) using a DICOM file type.

Green labelling and staining were used for segmentation, as in the initial CBCT procedure, to determine residual filling material. Images were examined 3 times by the same experienced oral and maxillofacial radiologist. ICC calculated as 0.992

Formula for Residual Filling

Proportion of residual root canal filling was determined by dividing the volume of the remaining filling by the volume of the original filling

Proportion of Residual Filling = Volume of Remaining Filling ÷ Volume of Original Filling

Statistical Analysis

All the data were tabulated and analysed using SPSS version 25 (SPSS Inc., Chicago, IL, USA.). the normality of data was assessed using levenes test of homogeneity and it showed normal distribution of data amongst the three groups at both the scanning. One-way ANOVA was used along with Bonferroni corrections to assess the difference amongst the three groups. Statistical significance was set at $p < 0.05$.

Results

The results were expressed in terms of mean and standard deviation. The initial filling volume (Table 1 and 2) was compared with the retreatment volume filling which was reduced (Table 3 and 4); however, all the groups had some residual filling remaining in the canal. Rotatory files have shown minimum residual material while LASER had maximum residual materials. There was statistically significant difference in the post retreatment residual volume between LASER and both files but no statistically significant difference between rotatory and H file. The time taken for removal was also maximum for LASER.

Table 1: Descriptive statistics showing mean and standard deviation at the initial scan.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
H files	10	0.16890	0.044596	0.014102	0.13700	0.20080
SAFEENDO	10	0.15280	0.031219	0.009872	0.13047	0.17513
LASER	10	0.14160	0.026684	0.008438	0.12251	0.16069

Table 2: Bonferroni test values at initial scan

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
H files	SAFEENDO	0.016100	0.015653	0.938	-0.02385	0.05605
	LASER	0.027300	0.015653	0.278	-0.01265	0.06725
SAFEENDO	LASER	0.011200	0.015653	1.000	-0.02875	0.05115

Table 3: Descriptive statistics showing mean and standard deviation at post retreatment scan showing residual material

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
H FILES	10	0.02420	0.014891	0.004709	0.01355	0.03485
SAFE ENDO	10	0.01440	0.008099	0.002561	0.00861	0.02019
LASER	10	0.11520	0.013579	0.004294	0.10549	0.12491

Table 4: Bonferroni test values at post retreatment scan showing mean difference of residual material

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
H FILES	SAFE ENDO	0.009800	0.005608	0.276	-0.00451	0.02411
	LASER	-0.091000*	0.005608	0.000	-0.10531	-0.07669
SAFE ENDO	LASER	-0.100800*	0.005608	0.000	-0.11511	-0.08649

Discussion

Retreatment of a previously endodontic ally treated tooth requires to undergo all the steps as in the previous treatment and also including the removal of previously condensed obturating material. Since GP is accepted and most widely used, removal of it becomes a crucial step in the success of "RETREATODONTICS". In clinical conditions, when the patients come back with a lapse of few months to few years for a retreatment, the condensed GP removal becomes a formidable task since the residual material may cause re-infection, excess or injudicious use of instrument may considerably weaken the remaining root structure making it prone for fractures leading to loss of tooth.

Various files have been used for GP removal, H files have been most favored but with presence of rotatory files, the time consumption for GP removal has reduced. However, the inadvertent loss off tooth structure still remains a concern. Thus, newer techniques such as use of LASER for the same can be effective. Therefore, the present study explored the benefits of H files, Retreatment rotary files and LASER for GP removal as evaluated as remaining residual volume filling. The rotary files have shown best removal with remaining volume as low as 0.024 while LASER group has shown most volume as 0.115, difference being statistically significant. Although, the time taken was not assessed statistically however, the pattern observed was similar, that LASER took the maximum time to remove the GP. H files had no significant difference when compared to rotatory files. The results obtained were similar to that of Jaiswal et al, Atique et al [7] and Jayasenthil et al [4] where H files were as effective as rotatory files.[8] However, Ozkan et al have shown contradictory results to as observed in the present study. [9]

LASER, acronym for light amplification by stimulated emission of radiation, uses a photothermal effect within the root canal which is converted into heat leading to melting of the GP. LASER is used in an intermittent mode in order to control the thermal emission. It is effective in sterilization of the canal and is able to penetrate up to 1 mm within the dentinal walls. However, solvent plays an important role in case of GP removal. [10] Since the specific solvent was not used, it may have accounted for the maximum residual material in the present study.

Numerous techniques for evaluation of GP removal have been used in the literature such as sectioning of teeth, radiography, projection of photograph on the screen, digitized imaging, stereomicroscope but all has their own limitations. CBCT has a higher efficacy due to 3-D representation, precise imaging as well as preserving the integrity of root volume. It can produce excellent resolution and voxel imaging for assessment; hence it was the preferred choice of the study.

There were certain limitations to the present study such as smaller sample size, in vitro design which differs from in vivo conditions, as well as use of second rotatory retreatment files. However, the balanced use of control group with H files increase the credibility of the study design.

Conclusion

All the treatment modalities left certain residual volume however, it was minimum for rotatory files and maximum for LASER. H files have shown no statistical significance in terms of residual material with rotatory files but the time taken was more. Thus, based on the results of the present study, Safe endo files have proven efficacious in the retreatment procedure.

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References

1. Siqueira J, Rôças IN, Ricucci D, Hulsmann M. Causes and management of post - treatment apical periodontitis. Br Dent J 2014; 216:305–12.

2. Del Fabbro M, Corbella S, Sequeira-Byron P, Tsesis I, Rosen E, Lolato A et al. Endodontic procedures for retreatment of periapical lesions. Cochrane Database Syst Rev 2016; 10: CD005511.

3. Gencoglu N, Helvacioglu D. Comparison of the different techniques to remove fractured endodontic instruments from root canal systems. Eur J Dermatol 2009; 3:90-5.

4. Jayasenthil A, Sathish ES, Prakash P. Evaluation of manual and two-rotary niti retreatment systems in removing gutta-percha obturated with two root canal sealers. ISRN Dent 2012; 2012:208241.

5. Tachinami H, Katsuumi I. Removal of root canal filling materials using Er: YAG laser irradiation. Dent Mater J 2010; 29:246-52.

6. Jagtap AR, Aher G, Gulve M, Kolhe SJ. Comparative evaluation of effectiveness of manual and various rotary retreatment techniques for removal of root canal filling material: An in-vitro study. Endodontology 2022; 34:184-8.

7. Atique S, Ali K, Haroon S, Ahmed A, Javed MQ, Zafar MS, Abulhamael AM. Effectiveness of H-files and Pro-Taper universal systems in removing Gutta-percha during endodontic retreatment: A comparative study. J Taibah Univ Med Sci 2024;19:537-44.

8. Jaiswal KR, Meenal G, Akolkar K, Roshan S, Kolhe S, Aher G. Efficacy of three retreatment systems Mtwo, Protaper-R, and R-endo in removing gutta-percha from root canal as compared to manual instrumentation: an in vitro study. J Int Oral Health 2015;7:80-3.

9. Büyüközer Özkan HB, Çimen T, Kaya Apaydın S, Er K. Efficacy of two different retreatment techniques in

removing gutta-percha from root canals: A CBCT study. Turk Endod J 2024; 10:1-9.

10. Devi M, Mahajan P, Bhandari SB, Monga P, Bajaj N, Singh F. Comparative evaluation of removal of gutta-percha from root canals with laser using different solvents: An in vitro study. Endodontology 2019; 31:51-6.