



Evaluation of Apically Extruded Debris During Retreatment Procedures Using Various File Systems in Teeth with Simulated Apical Root Resorption: An in Vitro Study

Dr.Jasmine Mary Antony¹, Dr.Alan Winston David², Dr.Ambika Kumari.R³, Dr. Avinash Sinha⁴, Dr.Anagha Jukanti⁵, Dr.Jyoti Warad⁶,

¹ Senior Lecturer, Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere. Karnataka.

²Senior Lecturer, Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere. Karnataka.

³Senior Lecturer, Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere. Karnataka.

⁴senior lecturer Department of Conservative Dentistry and Endodontics Hazaribag college of dental sciences Hazaribag.

⁵Senior Lecturer, Conservative Dentistry and Endodontics, Nandha Dental College, Erode. Tamil Nadu.

⁶Reader, Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere. Karnataka.

Corresponding Author

Dr.Alan Winston David,

Senior Lecturer, Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere. Karnataka.

(Received: 14 April 2024

Revised: 1 May 2024

Accepted: 18 June 2024)

KEYWORDS

Neo Endo
retreatment file,
Endo ReStart
retreatment file,
protaper
universal
retreatment, root
resorption,
retreatment,
debris extrusion.

ABSTRACT:

Background: This study was conducted for Evaluation of Apically Extruded Debris During Retreatment Procedures Using Various File Systems in Teeth With Simulated Apical Root Resorption.

Material and methods: A study was conducted utilizing an in vitro approach on the root canals of 90 mandibular premolar teeth that were extracted. These teeth were prepped using a ProTaper Gold rotary file and filled with gutta-percha and an AH Plus sealer, employing a cold lateral compaction technique. A sample of 45 mandibular premolar teeth was allocated randomly into three control groups: the ProTaper Universal retreatment file group, the Neo Endo retreatment files group, and the Endo ReStart file group. These groups were used to assess the efficacy of root canal filling material removal. The remaining 45 teeth were designated as the experimental group, where the apical portion was modified to simulate apical root resorption. The teeth of the experimental group were randomly allocated into three subgroups, mirroring the three approaches employed in the control groups for the purpose of removing root canal filling materials. The debris that was extruded apically was gathered and placed into borosilicate glass tubes that had been pre-weighed. Subsequently, the collected debris was subjected to a drying process. The average weight of the debris that was extruded apically was evaluated by employing an analytical balance with a precision of 10⁻⁴ g. Additionally, the data were subjected to statistical analysis using the Kruskal-Wallis test followed by Tukey's post hoc test.

Results: Significantly more debris extrusion was seen in the groups with simulated apical root resorption when compared to the groups without simulated root resorption ($p < 0.05$) for all file systems. The ProTaper Universal retreatment file demonstrated the lowest weight of apically extruded debris ($p < 0.05$) in both the control and experimental groups. The Neo Endo file and the Endo ReStart file followed, exhibiting higher amounts of extruded debris.



Conclusion: The teeth exhibiting simulated apical root resorption demonstrated a considerably higher quantity of apically extruded debris compared to the teeth lacking this simulated condition. Moreover, in the process of eliminating the root canal filling materials, it was seen that Endo ReStart retreatment file resulted in a considerably higher amount of debris being extruded apically across all groups.

Introduction

The phrase "root resorption" pertains to the physiological or pathological activity of dentoclasts, which are tooth-resorbing cells responsible for the removal of cementum and/or dentine. Apical inflammatory root resorption, a well-known phenomenon in endodontics, refers to the inflammatory resorption of the root. [1] The inflammatory response in the periradicular region is triggered by bacterial toxins and their proteolytic enzymes. This response leads to morphological alterations that cause the resorption of the apical cementum and dentin, ultimately exposing dentinal tubules [2]. The dentinal tubules that are exposed serve as a conduit for bacteria and their byproducts to make touch with the inflamed periradicular tissues, hence sustaining inflammation and resulting in ongoing resorption of dentin and cementum. Consequently, the majority of teeth affected by apical periodontitis often display varying levels of root resorption, a phenomenon that is often undetectable on radiographic imaging and might potentially influence the overall clinical prognosis [3].

The primary cause of failure in primary endodontic treatment can be linked to a range of issues, including the persistence of germs due to poor biomechanical preparation, inadequate obturation, or an incorrect coronal seal [4]. In such instances, the initial preference is frequently nonsurgical endodontic retreatment, as it effectively diminishes or eradicates the microbial infection within the root canal system [5]. Within the existing body of literature, a diverse range of file systems and procedures have been employed to eliminate gutta-percha from the root canal. It is important to note that the extent of debris extrusion can significantly differ across these approaches. The debris that is extruded during dental procedures has the potential to serve as a significant contributing cause for interappointment flare-ups, postoperative pain, and the failure or delay of periapical healing [6].

Hence, the present study was performed to compare the amount of apically extruded debris during retreatment procedures by using these three file systems in teeth with simulated apical root resorption.

Material and methods

The estimated sample size for the study was determined to be 90, with a statistical power of 80%, using the nMaster 2.0 software, prior to the collection of the tooth samples. The study involved the selection of 90 mandibular single-rooted premolars with closed apices that were extracted for orthodontic treatment. Ethical clearance was obtained from the Institutional Ethics Committee of the KSR Dental Science and Research Institute (KSRIDSR) under the reference number IEC-PG/FEB/2021/009. The selection process followed specific inclusion and exclusion criteria. The researchers adhered to the requirements outlined in the Preferred Reporting Items for Laboratory Research in Endodontology (PRILE). For the study, premolars with a single root and a single canal that were free from dental decay and had a root canal curvature of less than 10° (as determined by Schneider's technique) were chosen. Additionally, only teeth with a minimum length of 19 mm were included in the study.

Results

The results of the Mann-Whitney U test indicated that there were statistically significant differences among all the file systems. Specifically, the experimental group exhibited a significantly greater amount of apically extruded debris compared to the control group ($\alpha = 0.001$). The user's text is incomplete and does not provide any information to rewrite in an academic manner. The Endo Restart retreatment file group exhibited the highest amount of apically extruded debris in both the control (0.3123g) and experimental (0.5245 g) groups. This was followed by the Neo Endo file group, with the control group showing 0.2134 g and the experimental group showing 0.4214 g of extruded debris. The ProTaper Universal retreatment group had the next highest amount



of extruded debris, with the control group showing 0.2022 g and the experimental group showing 0.4450 g. The statistical analysis yielded an a-value of 0.000 for both the control and experimental groups.

Discussion

Endodontic retreatment treatments are conducted when the initial root canal treatment fails to yield satisfactory postoperative results [7]. The apical extrusion of various substances, such as pulp tissue pieces, dentine chips, necrotic tissue, bacteria, gutta-percha, sealer, solvent, and intra-canal irrigants, is commonly observed during both first and subsequent endodontic operations [8]. The extrusion of debris, commonly known as "the worm of necrotic debris," is strongly correlated with the development of periapical inflammation, inter-appointment flare-ups, and postoperative discomfort [9,10].

According to a report, a significant proportion of teeth affected by apical periodontitis exhibit varying levels of root resorption [11]. In contrast to the outcomes of primary root canal therapy, root canal retreatment demonstrates a less favorable prognosis, characterized by a reduced success rate that may be ascribed to the expulsion of debris, particularly in teeth with periapical lesions [12]. The study revealed a notable increase in the occurrence of postoperative discomfort among retreatment patients including apical periodontitis, with a statistically significant rate of 13.6% [13].

A range of methodologies have been employed for the purpose of eliminating gutta-percha from the root canal. These methods encompass the utilization of hand files, engine-driven rotary retreatment files, ultrasonic tips/files, solvents, lasers, and heat-carrying equipment [14]. Based on the extant body of research, it has been established via several investigations [15,16] that the occurrence of debris ejection is an unavoidable outcome in all root canal treatments, irrespective of the techniques employed.

Conclusion

Based on the experimental parameters of this in vitro investigation, it can be inferred that an unintended expulsion of debris occurs during the extraction of root canal obturating material across all scenarios, with a particular emphasis on teeth exhibiting simulated apical root resorption. In both simulated root resorption and

normal settings, the Endo Restart retreatment file system exhibited superior performance in terms of reduced debris extrusion when compared to the ProTaper files and Neo Endo file systems. While it is acknowledged that apical debris ejection is an unavoidable outcome, it is advisable for doctors to explore potential solutions in order to minimize it during the retreatment procedure. This approach aims to mitigate postoperative discomfort and improve the overall success rate.

References

1. Apical inflammatory root resorption: a correlative radiographic and histological assessment. Laux M, Abbott PV, Pajarola G, Nair PN. *Int Endod J*. 2000;33:483–493.
2. The endo-perio lesion: a critical appraisal of the disease condition. Rotstein I, Simon JH. *Endod Topics*. 2006;13:34–56.
3. Repair of extensive apical root resorption associated with apical periodontitis: radiographic and histologic observations after 25 years. Ricucci D, Siqueira JF Jr, Loghin S, Lin LM. *J Endod*. 2014;40:1268–1274.
4. Efficacy of ProTaper universal retreatment files in removing filling materials during root canal retreatment. Giuliani V, Cocchetti R, Pagavino G. *J Endod*. 2008;34:1381–1384.
5. Evaluation of debris extruded apically during the removal of root canal filling material using ProTaper, D-RaCe, and R-Endo rotary nickel-titanium retreatment instruments and hand files. Topçuoğlu HS, Aktı A, Tuncay Ö, Dinçer AN, Düzgün S, Topçuoğlu G. *J Endod*. 2014;40:2066–2069.
6. Efficiency and apical extrusion of debris: a comparative ex vivo study of four retreatment techniques in severely curved root canals. Kaşıkçı Bilgi I, Köşeler I, Güneri P, Hülsmann M, Çalışkan MK. *Int Endod J*. 2017;50:910–918.
7. A critical analysis of research methods and experimental models to study apical extrusion of debris and irrigants. Tanalp J. *Int Endod J*. 2022;55:153–177.
8. Apical extrusion of debris: a literature review of an inherent occurrence during root canal treatment. Tanalp J, Güngör T. *Int Endod J*. 2014;47:211–221.
9. Apical periodontitis and resorption of the root canal wall. Delzangles B. *Endod Dent Traumatol*. 1988;4:273–277.



10. Factors associated with endodontic flare-ups: a prospective study. Imura N, Zuolo ML. *Int Endod J*. 1995;28:261–265.
11. Do the sealer solvents used affect apically extruded debris in retreatment? Çanakçı BC, Er O, Dincer A. *J Endod*. 2015;41:1507–1509.
12. The influence of cervical preflaring on the amount of apically extruded debris after root canal preparation using different instrumentation systems. Borges ÁH, Pereira TM, Porto AN, de Araújo Estrela CR, Miranda Pedro FL, Aranha AM, Guedes OA. *J Endod*. 2016;42:465–469.
13. Quantitative evaluation of apically extruded debris with Twisted File Adaptive instruments in straight root canals: reciprocation with different angles, adaptive motion and continuous rotation. Karataş E, Arslan H, Kırıcı DÖ, Alsancak M, Çapar ID. *Int Endod J*. 2016;49:382–385.
14. Apically extruded debris in curved root canals using the WaveOne Gold reciprocating and Twisted File adaptive systems. Bojjink D, Costa DD, Hoppe CB, Kopper PM, Grecca FS. *J Endod*. 2018;44:1289–1292.
15. Reciproc versus Twisted file for root canal filling removal: assessment of apically extruded debris. Altunbas D, Kutuk B, Toyoglu M, Kutlu G, Kuştarıcı A, Er K. *J Istanbul Univ Fac Dent*. 2016;50:31–37.
16. The effect of disruption of apical constriction on periapical extrusion. Tinaz AC, Alacam T, Uzun O, Maden M, Kayaoglu G. *J Endod*. 2005;31:533–535.