RSBO

ISSN:
Electronic version: 1984-5685
RSBO. 2014 Oct-Dec;11(4):340-5

Original Research Article

Evaluation of four gutta-percha removal techniques for endodontic retreatment

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Received for publication: June 30, 2014. Accepted for publication: July 22, 2014.

Keywords:
retreatment; gutta-percha; methods.

Abstract

Introduction: The endodontic retreatment is the first choice in cases of endodontic treatment failure. **Objective:** To evaluate the ability of removing gutta-percha from root canal walls, through analyzing the time and different techniques. **Material and methods:** Sixty extracted human mandibular pre-molars were used. After instrumentation with crown-down technique, the obturation was performed by Tagger's hybrid technique. The specimens were divided into 4 groups (n = 15), according to removal procedure: group I (manual + solvent), group II (manual + Gates-Glidden + solvent), group III (Protaper Universal Retreatment System) and group IV (Protaper Universal System + solvent). The time period for gutta-percha removal was measured with a stopwatch. The roots were sectioned and the remnants were visually evaluated, according to the following scores: 0 – without remnant, 1 – presence of only cement, 2 – presence of cement and gutta-percha in small amounts, and 3 – presence of cement and gutta-percha in large amounts. Data were statistically evaluated with the GraphPad InStat software. **Results:** Group II exhibited the shortest time of execution, with significant differences in relation to groups I and IV, which obtained the longest time periods. Group III showed an intermediate time period, with statistically significant differences in relation to group IV. Group IV obtained the best scores of cleaning, although there was no statistical difference among groups. **Conclusion:** There was no statistical significant difference among the techniques regarding the time and effectiveness in removing filling material from the root canal walls.

Introduction

The technologic advancement in Dentistry has allowed high indexes of endodontic treatment success. Notwithstanding, some cases still require endodontic retreatment.

Many factors lead to endodontic treatment failure, such as reinfection, contamination of root canal systems already filled [2, 4, 16, 19, 20], and incomplete obturations [9, 13, 27, 29]. Conventional retreatment is the first choice in these cases [2, 3, 5, 9, 14, 17, 18, 20, 22, 26, 27], with favorable long-term results [21, 30].

Endodontic treatment goal is re-access the apical foramen, by completely removing the obturation, making easy the cleaning and shaping of the root canals [5, 9, 18, 19].

Gutta-percha can be removed by many manners: solvents [9, 13, 18, 20], Gates-Glidden drills [32, 34], ultrasound [21], and motor-driven rotary instruments [1-9, 11-13, 15-20, 24-26, 28, 30, 32-35].

Searching an adequate retreatment system, Protaper Universal Retreatment System was launched with proper instruments for this purpose [11, 15, 17, 33]. These files have a convex triangular cross-section [26] similar to that of conventional Protaper files S and F. Moreover, D1 file has active point, making easy its initial penetration in the filling material [16, 17]. This design improves the instrument's performance in terms of removing the filling material [24].

Although specifically developed for endodontic retreatment, some studies have evidenced that rotary instruments show the same efficacy of hand files, but with shorter working time [4, 8, 26-28, 30]. Other studies have demonstrated that the flexibility, cutting, resistance to fracture, and instrument diameter influence on the filling material removal [3, 23, 27]. By comparing the velocity of filling material removal, it is believed that rotary instruments are more effective because of the gutta-percha plasticization due to the heating generated by the rotation [5, 8, 11, 18, 27, 30]. However, the complete material removal is difficultly achieved and remnants are found, regardless of the rotary technique employed [11, 25, 33, 34].

Thus, this study aimed to evaluate the capacity of gutta-percha removal from root canal walls in extracted human mandibular pre-molars and the time required for this purpose, through four different techniques: manual + solvent, manual + Gates-Glidden + solvent, Protaper Universal Retreatment System, and Protaper Universal System + solvent.

Material and methods

This research was approved by the Ethical Committee in Research of the Brigadeiro Eduardo Campos Aeronautics Gerontological Home (CGABEG), under protocol no. #0004.0.339-000-11.

One single examiner previously calibrated executed all study phases. Sixty extracted human mandibular pre-molars were selected according to the shape and length of the root. The teeth were radiographed at proximal direction and those presenting more than one root canal, incomplete roots, marked curvature and marked flattening were excluded.

The teeth were transversally cut at cervical portion, close to enamel-cementum junction, with the aid of carborundum disc (SS White Company, Philadelphia, USA) coupled to straight handpiece (Dabi Atlante, Ribeirão Preto, Brazil), under air/water refrigeration, so that the root length was standardized at 16 mm.

Working length was determined with the aid of a size #15 Flexofile instrument (Dentsply-Maillefer, Ballaigues, Switzerland), introduced into root canal up to apical foramen and then set back 1 mm.

The canals were instrumented by crown-down technique. Both the cervical and medium thirds were prepared with the aid of size 2 and 3 Gates Glidden drills (Dentsply-Maillefer, Ballaigues, Switzerland), and apical third was prepared up to size #40 Flexofile instrument (Dentsply-Maillefer, Ballaigues, Switzerland). During instrumentation, irrigation was accomplished with 2 ml of 1% sodium hypochlorite (Farmadoctor, Curitiba, Brazil), at every instrument change. Concluded the instrumentation, the canals were irrigated with 10 ml of EDTA (Farmadoctor, Curitiba, Brazil).

The specimens were filled by Tagger's hybrid [29], with the aid of size #50 MacSpadden plugger (Dentsply-Maillefer, Ballaigues, Switzerland), with size #40 gutta-percha points (Tanariman, Manucapuru, Brazil), and size R7 accessory points (Tanariman, Manucapuru, Brazil), and AHPlus sealer (Dentsply, Petrópolis, Brazil). The filling material excess was removed with the aid of heated plugger.

Then, the teeth were sealed with a provisional restorative material (Cavit, Premier, Norristown, USA). Radiographs were taken at buccal-lingual direction to observe whether the canals were completely filled and well-condensed. Next, the specimens were kept in an incubator at 37°C, in humidity, for 30 days.

Elapsed that period, the specimens were randomly distributed into four groups (n=15)

according to the retreatment technique: group I (control) – manual removal with the aid of K files (Dentsply-Maillefer, Ballaigues, Switzerland) at descending order from size #80 to #25, ending with size #30 to #40, associated with solvent (eucalyptol, S.S.White, Rio de Janeiro, Brazil); group II – manual removal, as described in group I, and associated with size 3 and 4 Gates-Glidden drills at medium and cervical thirds and solvent; group III – Protaper Universal System, with sequence of D1, D2, and D3 files coupled to X-Smart motor (Dentsply-Maillefer, Ballaigues, Switzerland) at crosshead speed of 300 rpm and torque of 4.0 N; and group IV – Protaper Universal System (Dentsply-Maillefer, Ballaigues, Switzerland), with sequence from F1 to F5, motor-driven (X-Smart motor, Dentsply-Maillefer, Ballaigues, Switzerland), at crosshead speed of 400 rpm and torque of 4.0 N, and use of solvent.

We considered the complete material removal when the instrument did not show material remnants outside root canal. The desobturation time of each specimen was obtained with the aid of a stopwatch.

Groves were vertically made on all roots at buccal-lingual direction with the aid of ¼ Carbide drill (JET, Beavers Dental, Canada), by preserving the root canal space. With the aid of chisel and hammer, the roots were cross-sectional sectioned.

The root canal walls were visually evaluated by a previously calibrated examiner. The presence of filling material was assessed through the following scores: 0 – without remnant, 1 – presence of only cement, 2 – presence of cement and gutta-percha in small amounts, and 3 – presence of cement and gutta-percha in large amounts.

The results were recorded, tabulated, and analyzed through GraphPad InStat software. Firstly, data were submitted to descriptive analysis and because of nonparametric distribution, Kruskal-Wallis test was adopted, followed by Dunn's Multiple test.

Results

Assessment of filling remnant

The score means are seen in table I.

Table I – Score means after analysis of filling material remnant, according to groups

Group I	Group II	Group III	Group IV
1.87	1.80	2.06	1.26

There were no statistically significant differences among the groups tested ($p > 0.05$).

Assessment of the time required for root canal desobturation

Table II displays the time period means (seconds).

Table II – Time means, in seconds, required for root canal desobturation according to groups

Group I	Group II	Group III	Group IV
431	199	291	455

Also, there were no statistically significant differences among the groups tested ($p > 0.05$).

Concerning to the differences among groups, the results evidenced that group II obtained the shortest time (199 s), with statistically significant differences in relation to groups I and IV, with the highest time periods, 431 s and 455 s, respectively.

Group III obtained an intermediate type, 291 s, with statistically significant difference in relation to group IV.

Discussion

The therapy of first choice for endodontic treatment failure is endodontic retreatment, whose goal is the complete removal of the filling material from all root canal extension, making easy both the cleaning and shaping [2, 3, 5, 9, 17, 18, 20, 23, 27].

Although endodontic retreatment is common in dental practice, some techniques and materials make difficult the removal of the filling material, leading to the searching for faster, safer and more effective resources, which undoubtedly, results in success [2, 3, 5, 9, 11, 17, 18, 20, 23, 27, 28].

The most common filling material to be removed is gutta-percha [13, 14]. For this purpose, either hand or rotary instruments, with or without solvents, can be used [9, 13, 18, 20].

Concerning to rotary instruments, Protaper Retreatment System has instruments with active point enabling the filling material removal without using solvents, eliminating the formation of a gutta-percha film on root canal walls, which could prevent the action of intracanal medication on root canal disinfection process during endodontic retreatment [13]. It is noteworthy to mention that some authors do not considered this additional procedure as essential for seeking a better disinfection [10].

On the other hand, Protaper Universal System does not have instruments with active point, and consequently, in this present study, it was employed

together with solvents, aiming at favoring the penetration of the instruments.

The rationale for the choice of mandibular premolars was based on previous studies using the same teeth [12, 13, 19, 26, 28]. Both the execution by one examiner and the storage conditions followed the same guidelines of previous researches that justified those strategies as important and close to real conditions [19].

Concerning to the time period required for filling material setting, the literature shows lack of consensus with periods ranging from 14 days [19] to one year [5]. In this present study, we chose a period of 30 days. Both the removal of the coronal portion [34], the longitudinal cleavage of the teeth [12, 19], and the visual analysis of the filling material remnant [1] were methodological options based on previous studies.

After the sample preparation and storage, endodontic retreatment was accomplished to evaluate the amount of both filling material remnant and time period for desobturation. We found that the faster desobturation technique (manual + Gates-Glidden + solvent) was not the most effective.

The literature does not reach a consensus on both the time and efficacy of desobturation techniques. The hand technique with the aid of either different instruments [3, 19], ultrasound [7], or Gates-Glidden drills [19], has been considered as the fastest one. Also, in relation to efficacy, many studies have pointed out the advantages of this technique [3-5].

With the advent of rotary instruments, studies have been conducted on their performance during endodontic retreatments. Thus, some systems achieved expressive results in terms of cleaning efficacy and time period when compared with manual technique [5, 11, 12, 24].

The use of solvents associated with rotary instrument has been discussed because of some contraindications of its use [14]. However, many comparisons have been conducted among different rotary systems associated with the solvent. According to Hülsmann and Bluhm [18], Protaper System associated with eucalyptol was the fastest technique, while o Flex Master System associated with eucalyptol was the most effective technique in removing the filling material. Schirrmeister *et al.* [28] compared the manual technique associated with Gates-Glidden drills with three rotary systems also associated with drills and identified that RaCe System presented the best result, in relation to both the cleaning of the root canal walls and the time period required for desobturation.

In this present study, the group that obtained the best cleaning scores was that using Protaper Universal System, corroborating the findings of Saad *et al.* [26], who employed Protaper System, K3 System and manual technique. Conversely, the results of Unal *et al.* [32] showed that manual instrumentation was the most effective than Protaper System, although there were no statistically significant differences. Similarly, Zuolo *et al.* [35] pointed out the greatest cleaning capacity of root canal walls after the use of hand files associated with Gates-Glidden drills.

By comparing this study with researches employing similar methods, regarding to the time period required for removing the filling material, the group using manual + Gates-Glidden technique was faster, disagreeing with the study of Takahashi *et al.* [30]. These authors compared manual files + Gates-Glidden drills with Protaper Retreatment System, with or without the use of solvent, and concluded that rotary system without solvent was the fastest technique. Bramante *et al.* [6], studying two rotary systems and comparing them with manual technique, indicated that Protaper Retreatment System had the best performance, corroborating the findings of Vale *et al.* [33]. In this present study, Protaper Universal System was the slowest technique, contradicting the results of Hülsmann and Bluhm [18], who compared different rotary systems with manual instrumentation for desobturation and concluded that Protaper System associated with eucalyptol was the fastest technique.

The rationale behind the fastest manual technique employed in this study is the fact that the solvent dissolves the gutta-percha and the oval-shaped design of the Gates-Glidden drill, which favors the cutting and reduces the resistance of the filing material by the heating generated by the friction of the drill that plasticizes the gutta-percha.

It is believed that Protaper Universal System was more effective in the cleaning of root canals because of the association of the solvent with the instrument rotation, which causes the dilution and plasticization of gutta-percha. Still, the design of these instruments, according to the manufacturer's instructions, makes easy the removal of the filling material, because of the tendency of the gutta-percha to be pulled towards coronal direction [24].

A general analysis of the results regarding to the retreatment time differed from most of the previous studies reporting that rotary instruments were faster in removing the filling material. The possible physical characteristics of Gates-Glidden

drills associated with the use of solvent and the manual control of the instrument may have led to the results found by this present study. Finally, it is noteworthy to mention that none procedure promoted the complete removal of the filling material, fact that has been identified by other studies [25, 33, 34].

Conclusion

There were no statistically significant differences among the techniques in relation to the time period and efficacy in removing the filling material from root canal walls.

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