

Comparison of Three Rotary File Systems of Superfile Denco, Sp1 Gold, and ProTaper Universal in terms of Debris Extrusion

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Abstract

Introduction: This study was conducted to compare three rotary files of Superfile III Denco, Sp1 Gold v taper, and ProTaper in terms of debris extrusion to find the best treatment option. **Methods:** In total, 51 extracted mandibular premolars were randomly assigned to three groups (n=17). Rotary systems of Sp1 Gold v taper, Superfile III Denco, and ProTaper Universal were used in the first, second, and third groups, respectively. Canals were prepared up to the F2 file, and this process was conducted only by one operator. Moreover, an Orifice shaper specific to each group was used first, and files were removed from canals and then cleaned by wet gauze. In the preparation procedure, canals were washed to extract all debris from the canal. Eppendorf tubes were used to collect debris. **Results:** Mean debris values extruded from canals in the Sp1 gold, Superfile Denco, and ProTaper Universal files were 0.0025, 0.0008, and 0.0014, respectively. There was no significant difference among debris extruded by Superfile Denco III, SP1 gold V taper, and ProTaper Universal files ($P<0.05$). **Conclusions:** All instrumentation systems cause the extrusion of debris to the apical area. According to the results of the present study, there was no significant difference among debris extruded by Superfile Denco, SP1 Gold, and ProTaper Universal files. It should be mentioned that because of variations in the study designs, the direct comparison of different studies that addressed

this problem is not possible, and *in vivo* studies should be performed to evaluate its clinical relevance

Keywords: Endodontics, ProTaper Universal, Root Canal Preparation, Rotary Instrumentation, Sp1 Gold V Taper, Superfile III Denco

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Introduction

One of the typical issue during root canal therapy (RCT) is extrusion of intracanal debris and irrigants, which no instrument or procedure has completely eliminated the problem (1, 2). Since any irritation of the periapical tissues can cause flare-ups, proper shape and irrigation techniques can help to reduce the risk of apical extrusion, though it cannot be completely avoided (1-5). The advancement of rotary techniques for root canal preparation has led an evolution in endodontics practice in dentistry. (6). There are differences among the extruded debris by various rotary systems that are attributed to different factors, such as applied techniques, cutting blade design, cross-section, tapering, type of alloys, number of used files, motion type, and cutting efficiency (7-9). There are various methods and

instruments for canal preparation, and it is essential to find the best technique and instrument to achieve a successful treatment (10, 11). ProTaper files were created with better flexibility, efficiency, and safety than others. Clinicians can generate more uniformly tapered shapes in anatomically challenging or considerably curved canals because to the ProTaper files' unique design features (12, 13). The series consists of three "Shaping" and three "Finishing" instruments now available in 21 mm and 25 mm lengths, and the package contains only six simple-to-use files. (12, 13).

Mittal et al. (14) conducted a study to compare apical bacterial extrusion after canal preparation using manual, ProTaper Rotary, and One Shape Rotary techniques. All the instrumentation techniques resulted in apical bacterial extrusion. The manual system exhibited significantly more bacterial extrusion, while two ProTaper and One Shape systems showed lower bacterial extrusions.

Silva et al. carried out a study to assess apically extruded debris using reciprocal and rotary system methods that were used for root canal instrumentation. The result indicated that all tested systems caused apical extrusion; however, ProTaper files were considerably associated with more apically extruded debris, compared to Reciproc and Wave One systems (14). Considering the increasing use of inexpensive rotary files, this study was conducted to compare three rotary files of Super file Denco, Sp1 gold, and ProTaper Universal in terms of debris extrusion to find the best treatment option.

Materials and Methods

This *in vitro* study investigated 51 extracted human single-rooted premolars without caries, apical resorption, root surface resorption, and cracks from patients who were referred to the surgery department of Zahedan Dental School, Zahedan, Iran, during 2019-20. Preoperative radiographs were taken in the buccolingual and mesiodistal directions to confirm the presence of a single and oval-shaped canal. The selected teeth had developed roots without any root caries and with similar working lengths. Teeth with calcified canals, open apices, external and internal root resorption, and root caries were excluded from the study. The working length was measured using a k-file No. 15 (Mani, Japan) 1 mm shorter than the anatomical apex of teeth indicated as the apical extent of the canal, and the teeth were cut through the water stream in a way to have a working length of 15 mm. The teeth were kept in 5.25% NaOCI solution for two h to remove surrounding periodontal tissues. They were then stored in buffer solution formalin phosphate 10%. According to the abovementioned criteria, 51 mandibular premolars were randomly assigned to three groups (n=17). Rotary systems of ProTaper Universal

(PTU, Dentsply Sirona, Ballaigues, Switzerland), Sp1 Gold v taper (SP1, Shenzhen, China), and Superfile III Denco (Denco, Shenzhen, China) were used in the first, second, and third groups, respectively. In the ProTaper Universal group (PTU, Dentsply Sirona, Ballaigues, Switzerland), SX rotary file (19/variable taper) was used first to 1/2 working length, then S1 (17/variable taper) and S2 (20/variable taper) files were used to 2/3 working length with brushing motion. After that, F1 (20/apical taper 7%) and F2 (25/apical taper 8%) files were used to the working length with gentle pecking motion (15, 16). VDW silver electric motor (VDW, Munich, Germany) was used with full rotation motion according to the manufacturer's recommendation for torque and speed (350 rpm, 1 Ncm). In the Sp1 gold V taper (sp1, Shenzhen, China) and Denco (Denco, Shenzhen, China) groups, files equivalent to ProTaper Universal were used with similar color codes in 2NCm torque, 300 rpm speed, and VDW silver rotary motor (VDW, Munich, Germany). The sequence and method of using the files were similar to the ProTaper Universal group. In the preparation procedure, the canals were rinsed with 3 mL of 2.5% sodium hypochlorite (NaOCI) to extract all debris from the canal. Eppendorf tubes were used to collect debris. The initial weight of each tube was measured using Electronic Balance (GX-324A Apollo Precision Analytical Balance, A&D COMPANY, JAPAN) with an accuracy of 10^{-5} , and the average amount was chosen as the initial weight of the tube. To prevent the effect of dust and the operator's glove-produced powder on the weight, tubes were fixed on the penicillin vial then covered with metal foil.

Debris adhered to the root surface was washed with 1 ml distilled water and collected. Subsequently, the tubes were stored at 40°C for five days until washing substances were evaporated. The mass of tubes was measured three times using Electronic Balance. The initial average rates were deducted from the second ones, and the mass of apically extruded debris during preparation was measured.

Following that, the collected data were analyzed in SPSS software (version 20, SPSS, Chicago, IL, USA) through descriptive statistics (mean±SD) AND Kruskal-Wallis test. A P-value less than 0.05 was considered statistically significant.

Results

After comparing the average weights of debris extruded from canals prepared by Superfile Denco, Sp1 Gold, and ProTaper Universal files, there was no significant difference among the amounts of debris extruded by these files (Table I, Figure 1).

Table I. Comparison among the average rates of debris extruded by three files (gr)

	Mean (gr)	Min	Max
Superfile Denco	0.00130±0.00080	0.0003	0.0032
Sp1 gold	0.00251±0.00250	0.0009	0.0120
ProTaper Universal	0.00143±0.00244	0.0003	0.0107
P-value	0.184		

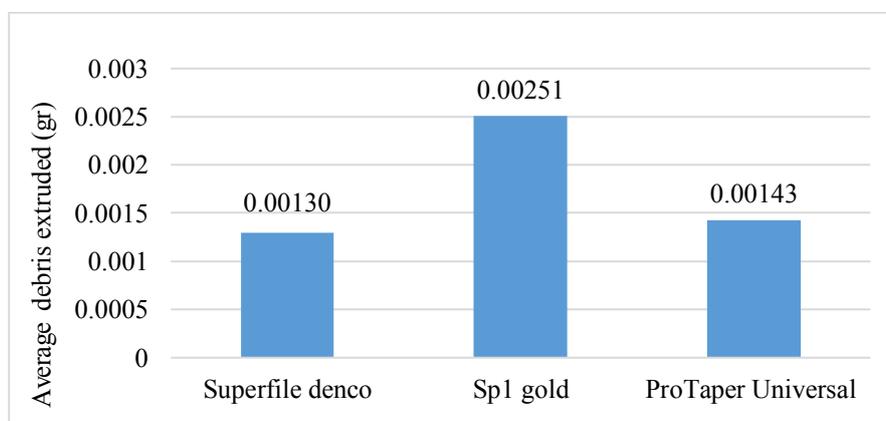


Figure 1. Comparison among the average rates of debris extruded by three files

Discussion

Decreased extrusion of debris is a major advantage of rotary systems, compared to hand files (17). Nowadays, many rotary systems are used in root canal therapy. The final purpose of these systems is to improve root canal cleaning and shaping (11). There are differences in the amount of debris extrusion among different rotary systems, which are related to the techniques used, cutting edge design, cross-section, amount of tipping, flexibility, and the type of alloy. It should be noted that many systems are designed based on the older rotary files system; therefore, they are called "imitator" files. ProTaper Universal system has been imitated regarding the design, diameter, and coding method (12, 13). On the other hand, due to sanctions and currency fluctuations, many files do not enter the market or are offered at high prices. This has led many dentists to resort to using ProTaper imitation files, which are relatively cheaper. Accordingly, this study aimed to compare debris

extrusion in three rotary files of Super file Denco, Sp1 gold, and ProTaper Universal to find the best treatment option. The debris extruded by two samples of commonly used files, called SP1 gold and Superfile Denco, were compared with the ProTaper Universal file to choose the best system for root canal therapy. The results of this study showed that all three Superfile Denco, SP1 gold, and ProTaper Universal files had almost similar average weights of debris extruded, which is not significant statistically.

Surakanti et al. (8) carried out a comparative study on apically extruded debris during root canal preparation using HyFlex, ProTaper Universal (Dentsply), and Wave one rotary systems. In this study, 60 mandibular first premolars were randomly assigned to three groups. The prepared canals were then assessed using Wave one, HyFlex, and ProTaper Universal rotary systems. The results indicated that Wave one and ProTaper Universal (Dentsply) rotary instruments produced more apically

debris extrusion, compared to the HyFlex instrument. In this study, Wave one showed a different motion, compared to other systems, and the highest amount of debris extrusion was produced by the ProTaper Universal system. This finding was not in line with the results in the present study.

Koçak et al. (19) compared the apical extrusion of debris using two rotary systems called ProTaper Universal (Dentsply) and ProTaper Next. In this study, 40 extracted mandibular premolars with single canals and of similar lengths were divided into two groups, and they were then instrumented. The results showed that the ProTaper Next rotary system produced less apically extruded debris, compared to ProTaper Universal (Dentsply) rotary system. It must be noted this study is somehow similar to the present study regarding full rotation motion and studied systems; however, it is not consistent with this study regarding the amount of debris extruded by the ProTaper Universal system. Capar et al. (20) carried out a study to compare the amount of apical debris extrusion after preparing the canal using Twisted File Adaptive, ProTaper Universal (Dentsply), and HyFlex instruments. They classified 60 extracted mandibular premolars into four groups. The dried debris in four groups was compared, and the results indicated that ProTaper Next and Twisted File Adaptive instrumentation systems were associated with less debris extrusion, compared to the ProTaper Universal (Dentsply) and HyFlex systems. In this study, ProTaper Universal produced more extrusion debris, which is not in line with the results of the current study. However, the studied files by Capar et al. were different structurally although they had similar motions.

According to previous studies and results of the present study on Superfile Denco, SP1 gold, and ProTaper Universal files, some features can be examined. In this study, the amounts of debris extrusion in ProTaper and Denco rotary systems are close to each other, and in general, there is no statistically significant difference between these systems and Sp1. It can be concluded that the role of the alloy and preparation phase has no effects on the volume of debris extrusion.

Among NiTi rotary systems, ProTaper Universal is made of conventional austenite NiTi alloy (20). These files have a variable taper and convex triangular cross-section (21). According to the manufacturer's descriptions, Denco rotary files are made of high-quality NiTi alloy, and Sp1 rotary system is made of CM wire alloy the surface of which is treated with Titanium oxide. These files have two active cutting points and a cross-sectional design. On the other hand, all PTU, Sp1, and Denco files work with full rotation motion; therefore, this factor may be effective in comparison with reciprocal files. It seems

that Reciproc files lead to less debris extrusion (22). However, they had no significant effects on the results of this study.

Moreover, regarding the fact that Denco and ProTaper Universal have some kinds of similarities in design, the slight differences between the amounts of debris extrusions of these two files, compared to Sp1, can be attributed to the design and surface treating of these three files (22, 23). Therefore, the generalization of these results to the *in vivo* conditions should be performed with caution. Additionally, it should be noted that other factors, such as anatomic variation, type of irrigants and multiple foramina are also effective. Finally, all three files can be chosen by therapists since there is not any significant difference among debris extrusions in these files.

Conclusions

All instrumentation systems cause the extrusion of debris to the apical area. According to the results of the present study, there was no significant difference among debris extruded by Superfile Denco III, SP1 gold V taper, and ProTaper Universal files. Accordingly, it seems that these imitator files are not different from the ProTaper Universal file in terms of problems caused by debris extrusions, such as flare-up and post-operative pain. It should be mentioned that because of variations in the study designs, the direct comparison of different studies that addressed this problem is not possible, and *in vivo* studies should be conducted to evaluate its clinical relevance.

Conflict of Interest

None declared

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