

# Performance of the Protaper Universal and Protaper Next files in relation to the apical extrusion of debris

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• **Conflicts of interest:** none declared.

## ABSTRACT

**Objective:** the purpose of this literature review was to evaluate apical debris extrusion after root canal preparation with Protaper Universal and Protaper Next Rotary systems. **Material and Methods:** the question that supported the collection of scientific evidence for the present study was: Which rotary system presents the best performance regarding the apical extrusion of debris: Protaper Universal or Protaper Next? From the online search databases, a bibliographic research was carried out covering original research studies, using as descriptors: Apical extrusion debris, Protaper Universal and Protaper Next. Articles had to meet the following inclusion criteria: should have been published in the English language from 2014 to 2017 and should compare both mentioned rotary files systems regarding apical extrusion of debris in the same study. Ninety-six articles were found after research and six were included for this integrative review. **Results:** six studies remained included after the inclusion criteria analysis. Of these, 50% were published in 2016, 16.6% in 2015 and 33% in 2014. Weight establishment of the extruded material was the methodology used in all studies to evaluate the performance of the files. By analyzing the amount of apically extruded material, it was found that the Protaper Universal system extruded more quantity than the Protaper Next system. **Conclusion:** it was concluded that, although there is no system capable of performing the instrumentation without promoting apical extrusion, the Protaper Next rotary files system presented better performance when compared to the Protaper Universal files system, regarding the apical debris extrusion.

**Keywords:** Apical extrusion debris; Protaper universal; Protaper next.

## Introduction

The objectives of the chemomechanical preparation (CMP) are debridement, disinfection and correct shaping of the root canal system. An adequate CMP favors three-dimensional filling<sup>1</sup> and creates optimum conditions to repair periapical tissues,<sup>2</sup> thus achieving the success of endodontic treatment.

During the CMP, the cutting action of files, whether manual or engine-driven, produces both organic and inorganic residual debris known as Smear Layer.<sup>3</sup> This smear, present on the instrumented root canal walls surface, contains traces of dentin scrapings, pulp tissue, odontoblastic processes and also bacteria in infected canals cases. It is composed of two layers; a superficial layer, weakly adhered to the root canal walls with a mean thickness of 1 to 2 μm, and a deeper layer, closely connected to the dentinal tubules, obliterating them, being able to reach 40 μm thickness.<sup>4</sup>

This debris, whether organic or inorganic, frequently is extruded into the periapical tissues during the CMP, probably causing undesirable complications such as the induction of inflammatory response with a possible appearance or perpetuation of periapical lesions or Flare-ups.<sup>5,6</sup>

Flare-ups are characterized by the occurrence of pain and/or swelling subsequent to instrumentation, requiring an unscheduled appointment for treatment.<sup>7</sup> This occurs because in symptomatic condition, the chemical mediators of inflammation, which are already installed, are exacerbated, further increasing the pain symptomatology. Products such as dentine with root canal irrigants have been related with inflammatory response in the periapical tissue. Besides that, in asymptomatic chronic periradicular lesions exist a

balance between the microbial toxic effect of the infected canal and the host defenses. If bacteria-contaminated debris is apically extruded during CMP, there will be an acute inflammatory response due to the increase in the number of bacterial irritants.<sup>8</sup>

Studies evaluating the performance of different instrumentation systems have demonstrated that no instrumentation technique is able to prevent some debris from being extruded into the periapical tissues.<sup>2,3,5,6</sup> However, technological advances in rotary instruments have resulted in lower rates of this complication, due to the more conservative preparations with smaller apical diameters and to the rotation movement, which directs the debris in an apex-crown direction, producing less amount of apical dentin scrapings.<sup>8-10</sup>

An example of this is the Protaper Universal System (Dentsply Maillefer, Ballaigues, Switzerland), made from conventional Nickel-Titanium alloy, proposes to instrument the entire canal through the sequence S1, S2, F1, F2, F3, F4 e F5. In addition, it has a convex triangular cross-sectional design, with progressive tapering along the length.<sup>11</sup>

A new generation of instruments known as Protaper Next (Dentsply Maillefer, Ballaigues, Switzerland) was introduced in endodontics. Produced from M-wire technology, they feature an asymmetric rectangular cross-section design,<sup>12</sup> which ensures that only two of the rectangular angles are contacted against the walls of the canals,<sup>8</sup> thus reducing the number of files required for instrumentation.<sup>13</sup>

Due to the reduction of the number of instruments used during the PQM, as well as the differential design of the cross section of the Protaper Next instrument, it is assumed that

during root canal instrumentation this system will present a lower amount of apical extrusion of debris and consequently, it promotes the lower intensity of post-operative pain.

Since the incidence of flare-ups has been reported ranging from 1.4% to 16% of cases,<sup>14</sup> it is essential the prevention of apical extrusion of debris to decrease the frequency of complications.<sup>15</sup> Therefore, the objective of this article was to evaluate, the performance of the Protaper Universal and Protaper Next files systems regarding the apical extrusion of debris.

## Material and Methods

To guide the achievement of the present study, the following question was asked: which rotary instrumentation technique leads to the largest amount of apical debris extrusion: Protaper Universal or Protaper Next?

Thus, an online search was carried out in the following databases: Medical Literature Analysis and Retrieval System Online (PubMed), Latin American and Caribbean Literature in Health Sciences (Lilacs) and Scientific Electronic Library Online (SciELO), using as descriptors: Apical Extrusion Debris, Protaper Universal and Protaper Next. Four reviewers performed a manual search, after reading the title, abstract and keywords. When the information contained in

these topics was insufficient, articles were read in their entirety. References of possible studies to be used, as well as the cross search of author's databases, served as a guide for the selection of new relevant articles.

As inclusion criteria for both electronic and manual research, articles of literature review or systematic review and in vitro research, published in the English language between 2014 and 2016 were considered. Such articles should address only the comparison of the amount of apically extruded material (debris) using the Protaper Universal and Protaper Next files systems. Were excluded laboratory studies in artificial teeth simulators or developed in deciduous teeth, non-English language, absence of abstract or only the presence of abstract. Studies involving extrusion of debris using different types of files or that approached the extrusion during root canal retreatment, were also discarded. The final synthesis was developed in a descriptive way, regarding the results and conclusions obtained from each of the studies.

## Results

Two hundred fifty three publications were obtained after research and six studies remained included after the inclusion criteria analysis (Table 1). Of these, 50% were published in 2016, 16.6% in 2015 and 33.4% in 2014.

**Table 1.** Identification of the selected studies for the integrative review

Article title	Author/ Year	Methodology	Results	Conclusion
Quantitative evaluation of apically extruded debris during root canal instrumentation with Protaper universal, Protaper Next, Waveone and self adjusting file systems.	Özsu <i>et al.</i> 2014	Net weight of the extruded material	PU M*=0.00028 SD**=0.0001 PN M= 0.00019 SD=0.00007	ProTaper Universal presented higher extrusion of debris than ProTaper Next
Apical extrusion of debris using Protaper Universal and Protaper Next rotary systems.	Kocak <i>et al.</i> 2015	Weight of dry material	PU M=0.001394 SD=0.00015 PTN M=0.000378 SD=0.00015	ProTaper Universal produced more apical debris than ProTaper Next
An in vitro comparison of apically extruded debris and instrumentation times with Protaper Universal, Protaper Next, Twisted File Adaptive, and Hyflex instruments.	Capar <i>et al.</i> 2014	Weight of dry material	PU M=0.001010 SD=0.00070 PN M=0.000375 SD=0.00020	ProTaper Universal produced more apical debris than ProTaper Next
Apically extruded debris during root canal preparation using Protaper Gold, Protaper Universal, Protaper next and reciproc instruments	Çakici <i>et al.</i> 2016	Average weight of the extruded material	PU M=0.0073 SD=0.00122 PN M=0.0013 SD=0.0005	Protaper Universal extruded more debris than Protaper Next
Comparison of apically extruded debris associated with several nickel-titanium systems after determining working length by apex locator	Çiçek <i>et al.</i> 2016	Net weight of the extruded material	PU M=0.008125 SD=0.003 PN M=0.005791 SD=0.001421	All NiTi systems evaluated in this study, extrude debris. This situation might be dependent on the apex locator used to determine the working length.
Comparison of apically extruded debris after large apical preparations by full-sequence rotary and singles-file reciprocating systems	Silva <i>et al.</i> 2016	Net weight of the extruded material	PU M=0.001282 SD=0.00058 PN M=0.000487 SD=0.00028	Protaper Universal extrudes more debris than Protaper Next

A total of 44 bibliographical references were identified in Scielo, no articles were selected. No longer Lilacs were identified 113 references and no articles were used. In PubMed, 96 references were identified, six articles remaining. As to the design of the study, 100% of the articles were cross-sectional and 100% structured in the English language. Of the articles selected, two were published in Oxford and the others in Copenhagen, Baltimore, Milan and India.

Weight establishment of the extruded material was the methodology used in all studies to evaluate the performance of the files.

By analyzing the amount of apically extruded material (mean and standard deviation), it was found that the Protaper Universal system extruded more quantity than the Protaper Next system.

## Discussion

During root canal preparation procedures, dentin scrapings, pulp tissue, microorganisms and/or irrigants may be extruded into the periapical tissues. These extruded irritants are responsible for post-operative inflammation and poor healing of the periradicular tissues, which can cause post-treatment complications, like as flare-up.<sup>5</sup>

According to the literature, all instrumentation techniques exhibit some degree of apical extrusion of debris during treatment, however the amount of extruded product will vary depending on the used instrument.<sup>12,16,18,20</sup> Therefore, the present study aimed to evaluate which rotary instrumentation technique leads to the greatest amount of extruded apical debris, using two different systems instrumentation (Protaper Universal and Protaper Next).

The teeth instrumented with the Protaper next system presented a lower percentage of extruded irritants when compared to the Protaper Universal system, as reported by 83% of the articles under study,<sup>10,17-20</sup> as well as when another system was evaluated together.<sup>17</sup>

Such findings can be justified by the fact that the Protaper Next instruments are made with memory wire technology

(M-wire) and have a rectangular design, which minimizes the contact between the file and the dentin walls.<sup>21</sup> The Protaper Universal files, these are made of conventional Nickel Titanium wire and have triangular convex cut design with progressive tapering along its length, which entails greater contact between the instrument and the root canal walls and consequently, greater accumulation of extruded material.<sup>22</sup>

In addition, a reduction in the number of instruments decreases the number of walls played during instrumentation, one of the reasons why systems with smaller numbers of files result in less extrusion of debris.<sup>23</sup> In contrast, although in another study was concluded that Protaper Next, Protaper Universal and TF extruded similar amounts of debris,<sup>2</sup> differences in results may be due to different employed methodologies, since apical locator was used to determine the working length, which may influence the results directly, once keeping the length one millimeter short of the foramen contributes to less extrusion.<sup>24</sup>

Another factor that interferes with the amount of material extruded apically is the pulp condition. In vital teeth, the present pulp tissue serves as a physical barrier preventing the extrusion of debris, whereas, in necrotic teeth, such resistance is not found.<sup>25</sup> In addition, it can be said that normal periapical tissues or with some degree of bone resorption determine the extent to which the debris can reach.<sup>26</sup>

According to the results, it was noticed that Protaper Next files produced less amount of apically extruded material when compared to Protaper Universal files. It was also verified that other parameters should be evaluated to quantify the extruded material, as the state of the pulp (if vital or necrotic), the apical limit of instrumentation, the technique and the type of instrument.

## Conclusion

Articles selected in this study mostly reported that the Protaper Next rotary files system presented better performance than the Protaper Universal rotary files system regarding the apical extrusion of debris.

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### Mini Curriculum and Author's Contribution

1. Odilma Mariana Gonçalves Furtado – DDS. Contribution: bibliographic research, interpretation of data and preparation of the manuscript.
  2. Caroline Felipe Magalhães Girelli – DDS and MSc. Contribution: effective scientific and intellectual contribution to the study; conception and design of the study.
  3. Viviane Ferreira Guimarães Xavier - DDS. Contribution: bibliographic research according to inclusion criteria.
  4. Mariane Floriano Lopes Santos Lacerda - DDS and PhD. Contribution: effective scientific and intellectual contribution to the study; conception and design of the study.
  5. Renato Girelli Coelho - DDS and PhD. Contribution: bibliographic research according to inclusion criteria, English text formatting.
  6. Ludmila de Almeida Cunha – DDS. Contribution: work supervisor, manuscript writing, bibliographic research and conception and design of the study.
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