A comparison of two NiTi rotary systems, ProTaper Next and Silk for root canal cleaning ability (An in vitro study)

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Abstract

Aim: To evaluate and compare the cleaning efficacy of teeth instrumented with ProTaper Next and Silk File Systems.
Materials and Methods: Forty permanent mandibular premolar teeth with single canal were selected. ProTaper Next file system was used to prepare the root canals of group one comprising of twenty samples, and the Silk file system was used to shape the root canals of group two. After cleaning and shaping, the teeth were sectioned longitudinally. The debris score evaluation with a stereomicroscope (30 x magnifications) preceded the statistical analysis with ANOVA and Student-t tests.
Results: No statistically significant difference seen between the two experimental groups (Protaper Next and Silk) concerning the debris in the apical, middle and coronal thirds of root canals.
Conclusions: Rotary Systems (ProTaper next and Silk) showed acceptable cleaning ability in permanent Root Canals.

Keywords: Root canal preparation, debris, NiTi rotary file systems.

Introduction

The removal of organic debris is the primary purpose of cleaning and shaping in endodontic procedures in permanent teeth.[1] Root canal preparation is performed with files, reamers, sonic instruments or mechanical apparatus, and with nickel-titanium (Ni-Ti) rotary file systems. Since most hand techniques are time-consuming and may lead to iatrogenic errors (i.e. ledging, zipping, canal transportation and apical blockage), much attention has been directed towards root canal preparation techniques with Nickel-Titanium Rotary instruments.[2] The design and flexibility of Nickel-Titanium alloy allow these files to keep the original anatomy of root canals and reduce procedural errors.[3,4] Also, because of the funnel-shaped canal preparation, a more predictably uniform paste filling can be obtained in permanent teeth.[5] Rotary files facilitate better patient's cooperation by shortening treatment time for cleaning canals.[6] The cleaning capacity of different NiTi rotary systems varies because of the different cross-sections and blade designs of each system.[7] Two such new models used in this study are; ProTaper Next (PTN, Dentsply Maillefer, Ballaigues, Switzerland) and Silk (Mani, Japan). There are 5 PTN files available, in different lengths, for shaping canals, namely X1, X2, X3, X4, and X5. In sequence, these files have yellow, red, blue, double black, and double yellow identification rings on their handles, corresponding to sizes 17/04, 25/06, 30/07, 40/06, and 50/06, respectively.[8] Another rotary Nickel Titanium system is Silk (Mani, Japan). These are available as simple, standard and complex packs. Each one is a pack of three instruments with different size and taper. Simple pack has .08/25, .06/25, .06/30; standard pack has.08/25, .06/20, .06/25; complex pack has .08/25, .04/20, .04/25. In each pack.08/25 is the orifice opener. Additional sizes (.04/30, .04/35, .04/40, .06/35, and .06/40) are available separately. Each pack is available with 21and 25mm lengths. Though various studies have concluded the effectiveness of Nickel Titanium Rotary systems over hand files, as regards time required, error reduction during root canal preparation, and preservation of root canal shape, no literature is present on comparing the cleaning ability of Protaper Next and Silk file system. Thus, the aim of present study is to evaluate and compare the cleaning efficacy of teeth instrumented with two rotary instrumentation systems viz. Protaper Next File System and Silk's File System.

Materials and Methods

All extracted single-rooted human mandibular premolar teeth were stored in distilled water at 37°C immediately after extraction. They were then immersed in 0.5% sodium hypochlorite for one week for disinfection and again stored in distilled water at 37°C. After Radiographing in buccolingual and mesiodistal direction, teeth with open apices, severely curved, bifurcated canals, internal resorption were excluded, and teeth with single canal were included in the study.

Forty teeth randomly divided into two experimental groups of 20 teeth each, were decoronated using the diamond disk, and root lengths were standardized to 16 mm. Working length was determined 0.5 mm short of the apical foramen using #10 K file. Teeth with the apical diameter larger than size 15 K-file excluded from the study helped standardization. The Apical foramen was sealed using modelling wax.

X-smart Endo motor (Dentsply Maillefer) was utilized for preparing both the test groups, with speed and torque adjusted according to manufacturer recommendation.

Group 1 – ProTaper Next

The ProTtaper Next files used in the sequence as per manufacturer's instructions ProTaper Next X1(0.17/0.04), and X2(0.25/0.06) at a rotational speed of 200 rpm and 200-g/cm torque with a brushing motion.

Group 2 - Silk

Standard Pack was used .06/20 and .06/25 till full working length with the speed of 500 rpm with a setting of 300 g/cm torque.

In all the groups, the tooth was irrigated 1 mm short of the working length with 2 ml of 5% sodium hypochlorite after the use of each instrument. At the completion of the instrumentation, each prepared canal was flushed with 5 ml 17% liquid EDTA for 60 seconds, followed by 5.25% sodium hypochlorite for 1 minute. After preparation and final irrigation, longitudinal sectioning of all the teeth was done according to Sabet et al.[9] Two longitudinal grooves were placed on the outer surface of the roots and teeth were split in half with a chisel and mallet. Each half was further divided into three parts for evaluation (i.e. coronal third, middle third and apical third) and each third was evaluated at a magnification of 30X under a stereomicroscope.

The scoring system used in this study was as proposed by Hulsmann et al.[10] Criteria for the scoring is as follows: For Debris (Dentin chips, pulp remnants, and particles loosely attached to the canal wall).

Score 1: Clean canal wall, only few small debris particles.

Score 2: Few small agglomerations of debris present

Score 3: Many agglomerations of debris <50% of the canal wall

Score 4 : >50% of the root canal wall covered by debris.

Score 5: Complete or nearly complete root canal wall covered by debris

Statistical Analysis

All the data was analyzed and subjected to ANOVA test for comparing the three areas of the canal. *P-value was set at P<0.05

Results

Representative Stereomicroscope Images

Group I – ProTaper Next (Fig. 1)

Group II – Silk (Fig. 1)

Table showing mean debris scores in ProTaper Next and Silk (Fig. 2)

Graph showing comparison for coronal-middle-apical areas. (Fig. 3)

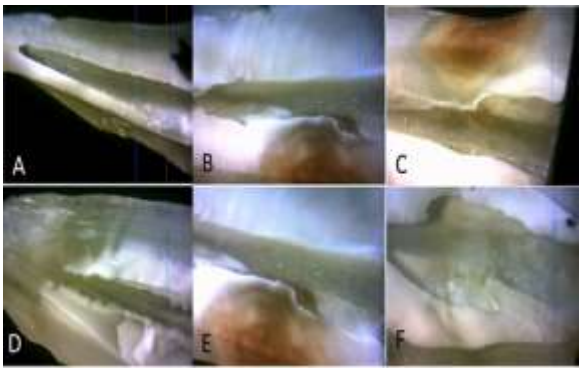


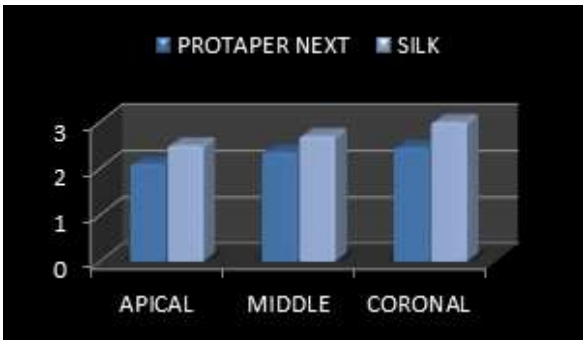
Fig. 1 Stereomicroscope Images

Group I – ProTaper Next; Apical (A), Middle (B), Coronal (C)

Group II – Silk; Apical (D), Middle (E), Coronal (F)

Rotary file system	ProTaper Next	Silk	P value
3 areas	**Mean**	**Mean**	
Apical	2.1	2.5	0.358
Middle	2.35	2.7	0.937
Coronal	2.45	3	0.375

Fig. 2: Table showing mean debris scores in ProTaper Next and Silk



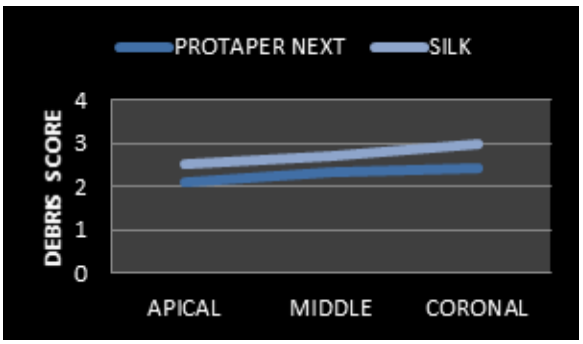


Fig. 3: Graph showing comparison for coronal-middle-apical areas

Discussion

Premolars were selected in this study because they are extracted commonly for orthodontic treatment. Decoronation assured standardization of specimens. In modern day endodontic practice, use of NiTi instruments for root canal shaping has gained

momentum. Review of literature suggests that rotary instrumentation is more efficient in their cleaning ability and safety.

The ProTaper NEXT (PTN) System provides shaping advantages through the convergence of a variable tapered design on a given file (ProTaper Universal), innovative M-Wire technology, and a different offset mass of rotation. This rotary file system utilizes both an increasing and decreasing percentage tapered design on a single file. This design feature serves to minimize the contact between a file and dentin, which reduces dangerous taper lock and the screw effect while increasing efficiency. Incorporating M-Wire into the mechanical design of ProTaper NEXT improves the resistance to cyclic fatigue, decreases the potential for broken instruments, and increases flexibility. PTN files produce a unique asymmetrical rotary motion and, at any given cross-section, the file only contacts the wall at 2 points. Clinically, PTN provides three significant advantages: (a) Reduced engagement due to the swaggering effect which limits undesirable taper lock; (b) Affords more cross-sectional space for enhanced cutting, loading, and augering debris; and (c) Allows any PTN file to cut a bigger envelope of motion compared to a similarly-sized file with a symmetrical mass and axis of rotation. A Smaller-Sized and more flexible PTN file can cut the same size preparation as a larger and stiffer file with a centred mass and axis of rotation. Silk's unique cross-sectional tear drop design cuts exceptionally well and resists fracture, which eliminates the "screwing-in" effect common with many other systems while removing debris efficiently and reducing instrument stress. Heat treatment provides excellent flexibility without sacrificing efficiency and safety. Reduced number of instruments decreases the number of procedural steps, allowing for more efficient treatment.

In the present study both the systems were effective in cleaning the root canals. Statistically, no significant difference was observed between the two test groups as far as debris in the apical, middle and coronal thirds were concerned.

Conclusion

Within the limitations of this study, based on the statistical data, it can be concluded that:

ProTaper Next and Silk rotary file systems both are effective in cleaning the canals; also, statistically no significant difference between the three areas coronal, middle & apical thirds.

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