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Evaluation of Canal Preparation Using One NiTi Instrument with Reciprocating Motion Compared Standard ProTaper File to Gold protaper File (An in vitro study)

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Abstract **Original Research Article**

The present study compared the shaping efficiency of universal system F2 one file NiTi to one NiTi file gold system with reciprocating motion in curved mesiobuccal roots of maxillary first molars, were randomly divided into two groups, each one 15 roots according to the NiTi system using during shaping the roots, after use of each instrument, the canal was flushed with 5 ml of NaOCL and final rinse with EDTA 17% for 1 minute. Parameter were evaluated: Straighten the curved canals, pre and post canals curvatures images were taken using Standarization technique and analyzed using digital radiography (Digora system), the significant level was set at $P<0.05$. The result showed that NiTi universal Protaper file produced higher amount and percentage of reduction of canal curvature than gold NiTi file system.

Keywords: reciprocating motion, one file NiTi universal Protaper, gold Protaper system, shaping efficiency.

INTRODUCTION

Effective cleaning and shaping of the root canal system is essential for achieving the biological and mechanical objectives of the root canal treatment.

NiTi instruments have many advantages over conventional instruments; they are flexible, have high cutting efficiency, maintain the original canal shape and have reduced tendency to transport the apical foramen.

The single use of more expensive NiTi rotary instrument may become an economical burden on the endodontist, especially as the variable techniques involve the use of at least three to four NiTi rotary instruments.

The rotating movement of NiTi instrument, their super elasticity and centering in the canal during rotation result in a non selective cutting action along the root canal wall leaving unclean areas.

Recently reciprocating motion has been advocated. Theoretically this motion might be more adequate than rotary one.

It is assumed that oscillating file will move in all direction touching the entire canal wall with its side to side milling action.

A new concept in NiTi files has been introduced, with different working motions and root canal shaping finished with only a single file. One of these single file systems is Reciprocation motion.

(Yared) [1] describe a novel canal preparation technique using only one NiTi rotary instrument (F2 ProTaper instrument) in a reciprocating movement. This technique will reduce the number of

Instruments required for canal preparation, reduced the instrument fatigue associated with single use and hence decrease the cost.

Recently, a more flexible NiTi instrument, ProTaper Gold has been introduced. According to the manufacturer, ProTaper Gold instruments have the same geometry as that of ProTaper Universal but offer increased flexibility. The manufacturer claims that the ProTaper Gold instruments have resistance to cyclic fatigue and maintain canal centering, especially when preparing curved canals [5].

Laboratory and clinical evaluation of the cleaning and shaping efficiency of this technique would be essential to get best file use by this technique.

The Aim of the Study

The purpose of this study is to compare shaping efficiency (maintain the original canal) of one rotary Ni Ti file (F2 – universal protaper compared to Ni Ti F2 file gold protaper system in curved root canal preparation using reciprocating motion .

MATERIAL AND METHODS

1) Teeth samples selection:

Freshly thirteen separated mesiobuccal roots maxillary first molars were used with mature apices in the current study without noticeable defect or abnormal morphology.

Cleaned and were kept in 5.25% sodium hypochloride solution for 24 hours to remove any remnants of tissue and blood.

The roots ranging from 15-30 degree, according to Schneider technique.

1) Preparation of the samples:

#10 K-file for were inserted into the canals until the tip was just visible at the apical foramen and the length of the file was measured.

2) Pre –instrumentation imaging:

- All mesiobuccal samples were exposed using the Orix x-ray unit.
- A long cone was mounted to the x-ray unit and a radiographic film –holder device was used for standardization of the distance between the x-ray source and the film (E speed film size2) to provide standard geometric configuration during exposure and to assure consistent and reproducible parallel imaging of the samples.
- An aluminum step wedge with known thicknesses was specially fabricated and placed on the film in a direction below the apices of the exposed teeth to compensate for any variations during processing of the films (Fig 1).
- All images were digitized using a flat-scanner with transparency kits at standardized digitization settings and saved on compact discs to be evaluated and analyze.

Figure 1: An aluminum step wedge was specially fabricated and placed on the film in a direction below the apices to compensate for any variations during processing

Grouping of SAMPLES

The samples were coded to allow for blinded evaluation of the samples and divided into two groups (15each) (Fig 2) meeting same criteria (apical diameter, length and curvature) Sx has to be used to produce more shape in the coronal flaring.

Roots were shaped using Ni Ti FD0 ISO-25-13mm) file universal Protaper system and second group shaped by NiTi F2 (D0 ISO-25-11mm) file gold Protaper system with reciprocation motion clock wise (CW) and counter clock wise (CCW) movement in a crown - down manner with a 16:1 reduction ratio contra angle connected to an ATR vision motor (ATR Pistoia, Italy) (Fig 3).

The rotational speed is set at 400 r.p.m. the F2 instrument was used in the canal with slow peaking motion and an extremely light apical pressure until resistance was encountered. The instrument then pulled out of canal. It was cleaned with gauze to remove the debris filling the flutes, and reinserted and employed in the same manner. This step was repeated until both F2 files (universal one and gold were reached the working length.

Each instrument was coated with lubricants (EDTA 17%) during instrumentation and flushed with 5 ml of NaOCl.

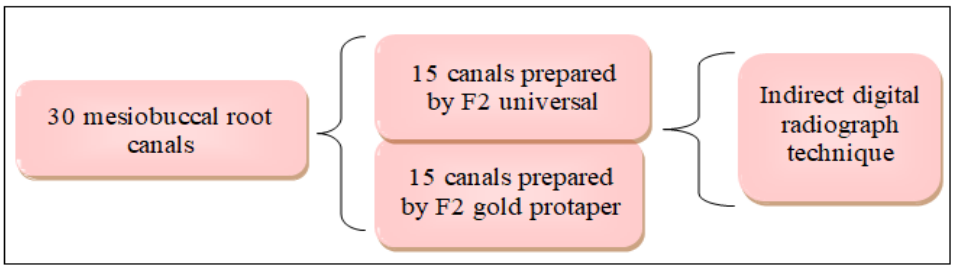


Figure 2: Diagram showing the grouping of the samples in the experimental groups

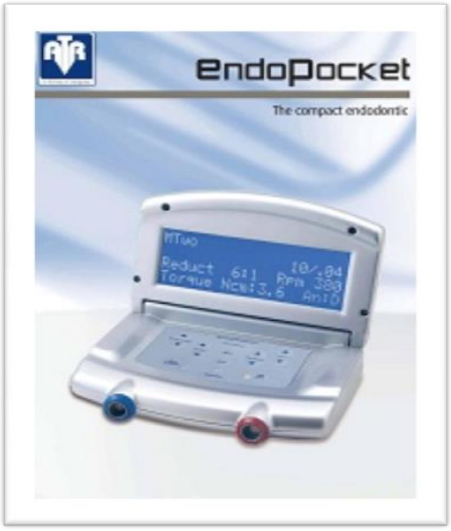


Fig 3: ATR vision motor (ATR Pistoia Italy) using reciprocation motion

4) Procedures of preparing the samples after instrumentation:

A-For evaluating root canal shaping

Pre- and post- instrumentation radiographs were taken for each mesiobuccal root canals which prepared by both systems. Images were taken using standardization technique and analysed using digital radiography software (Digora System).

Pre and post canal curvatures were measured according to Schneider technique as shown in (Fig 4).

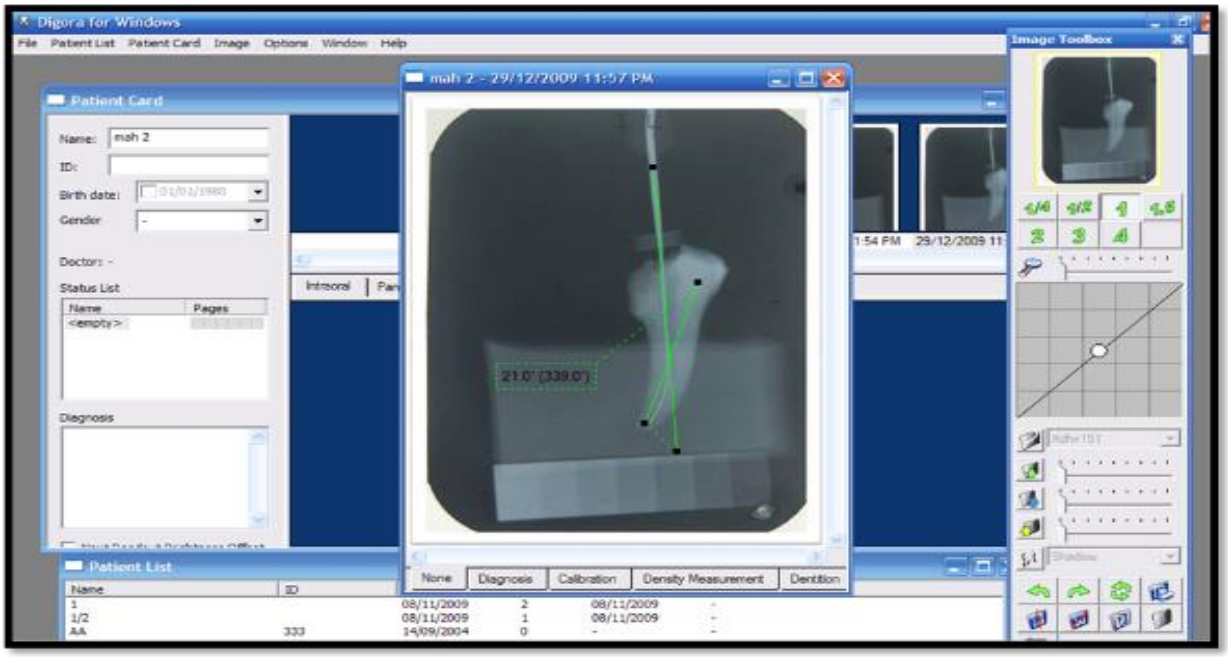


Fig 4: Diagramatic presentation for determination of the angle of curvature of the root canal

5) Evaluation:

Radiographic evaluation of curvature changes (image analysis):

Pre and post –preparation images were downloaded in JPEG format and analyzed by Digora Software by measurement the Canal curvature (angle) were performed by drawing a straight line along the main axis of the apical portion of the canal and another straight line along the main axis of the coronal portion of the canal. The angle of curvature is the angle formed by the intersection of the two lines (Fig 5 and 6) (Schneider) [2].

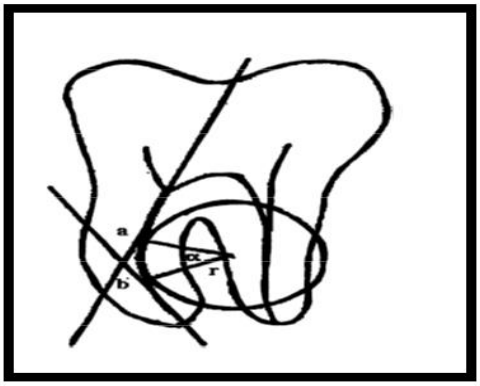


Fig 5: Radiographic analysis of the angle of curvature of one of the studied samples was using the Digora software

RESULTS

The collected data were statistically analyzed, tabulated and illustrated graphically according to the change in canal curvature.

Comparison between canal curvature before and after preparation

a) Gold Protaper File2 system: -

Buccal view: The mean and standard deviation of canal curvature for standard ProTaper technique were 19.20 ± 5.32 before preparation and 17.47 ± 5.15 after preparation. There was a statistically significant reduction in canal curvature after preparation (*P*-value < 0.001).

b) Universal ProTaper file F2 system: -

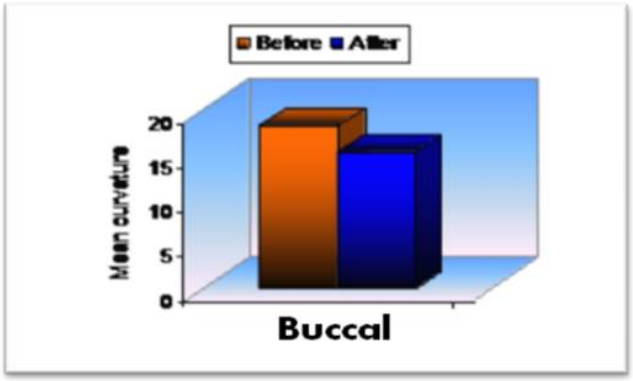
Buccal view: The mean and standard deviation of canal curvature for One NiTi file technique were 18.13 ± 3.98 before preparation and 15.27 ± 3.81 after preparation. There was a statistically significant reduction in canal curvature after preparation (*P*-value < 0.001).

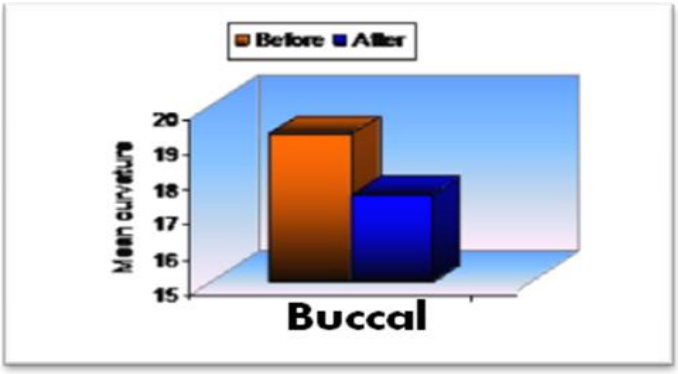
Preparation / View	Before		After		P-value
	Mean	SD	Mean	SD	
Buccal	19.20	5.32	17.47	5.15	**<0.001***

*: Significant at P ≤ 0.05

Preparation / View	Before		After		P-value
	Mean	SD	Mean	SD	
Buccal	18.13	3.98	15.27	3.81	**<0.001***

*: Significant at P ≤ 0.05





DISCUSSION

One of the objectives during instrumentation of root canals is to maintain the original canal curvature and at the same time works on all the walls to produce a continuously tapering and conical form with the smallest diameter at the end point of the preparation [3].

Recently reciprocating motion has been advocated. Theoretically this motion might be more adequate than rotary one. It is assumed that oscillating file will move in all directions touching the entire canal wall with its side-to-side milling action [4, 7, 6].

The aim of this study was to compare shaping efficiency (maintain the original canal) of one rotary Ni Ti file (F2- Universal Protaper with F2 -Gold Protaper system using reciprocation motion) in curved root canal Preparation.

The curvature change of the curved root canals was evaluated by using standardization technique and analyzed using digital radiography software (Digora System). Also, mesiobuccal root canals usually present an accentuated curvature and mesiodistal flattening and show better results in assessment of new endodontic technique [8].

Regarding curvature change evaluation, pre and postoprative canal curvature images were measured according to Schneider technique as it was previously reported by other research to be a reliable and effective method to determine and evaluate root canal curvature [2, 10, 11].

E-speed conventional films have clarity as superior to digital images [9, 12]. That's why film-based analogue images were used in the current work and were further digitized using a flat-scanner with transparency kits at standardized digitization settings (standardized brightness and contrast settings).

An aluminum step wedge with known thicknesses was specially fabricated and placed on the film in a direction below the apices of the exposed teeth to compensate for any variations during processing of the films. Aluminum was used for the step wedge because it has a linear absorption coefficient similar to the tooth and surrounding structures [14, 13].

Regarding Protaper system, the F2 ProTaper instrument able to cut dentine in both directions clockwise and counterclockwise. Also, this instrument with a 0.08 mm mm^{-1} taper at its tip would provide adequate taper to allow the filling of the root canal system even with the vertical compaction of warm gutta-percha. One other important aspect of the F2 instrument is the variable taper. This feature would provide an increased flexibility for this larger instrument which can be used in one file technique to prepare severely curved canals [1].

The Protaper Gold has a convex triangular cross- section and progressive taper. It's also has noncutting tip design, allowing the instrument to follow the original shape of the root canal.

The protaper universal has the same features .one important difference between these two systems is that the Protaper gold has been metallurgically enhanced through heat – treatment technology 5.

The reciprocation and rotary systems were powered by an electric engine because compressed air–driven systems do not allow torque control and might undergo air pressure variations that might affect the rotational speed and torque [15].

The ATR Vision motor (ATR, Pistoia, Italy) was the only one available in North America to allow the setting of the specific values of the CW and CCW rotations [1].

As regards to the results of this study concerning the change in canal curvature one NiTi file F2 universal system showed statistically significantly higher in amount and percentage of reduction in canal curvature than NiTi file F2 gold system in buccal view. This means that gold Protaper system maintaining the original canal curvature during preparation better than universal Protaper system.

This could be explained by the fact that, F2 Protaper gold finishing files are more flexible so you

can shape and finish the canals with minimum root canal curvature change.

In general, ProTaper demonstrated the greatest changes in canal curvature, indicating a tendency to straighten curved canals. These results are in accordance with the previous report of (Yun and Kim) [16, 17] this is probably due to the increased taper of the ProTaper Shaping Files of up to 19%. Even though the ProTaper file system has a convex triangular cross-sectional cutting blade designed for increased flexibility and cutting efficiency.

SUMMARY AND CONCLUSIONS

The purpose of this study was to compare the shaping efficiency (maintain the original canal) of (F2 – ProTaper gold and universal ProTaper system in curved root canal preparation.

Thirteen mesiobuccal canals of first maxillary molars meeting these criteria (apical diameter, length and curvature) were divided equally into two groups according to the NiTi rotary system used during shaping.

Pre and post instrumentation radiographs were taken for each curved mesiobuccal root canal.

Images were taken using standardization technique and analyzed using digital radiography software (Digora System). Pre and post canal curvatures were measured according to Schneider technique.

The results showed that one NiTi Protaper universal file F2 produced higher amount and percentage of reduction of canal curvature than file F2 protaper gold which mean that maintained the canal curvature much better.

CONCLUSION

From the obtained results in this study the following conclusion could be drawn out.

1. One NiTi Protaper universal file produced straightening of the curved canals by increased reduction in canal curvature.
2. One NiTi Protaper gold file maintained original canal curvature during preparation much better.

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