Asian J. Exp. Sci., Vol. 21, No. 2, 2007, 227-232

Application of CT-Scan in Evaluation of Transportation of Root Canal during Endodontic Retreatment

Nazari Sh.*[1], Samavat H.[2], Mirmotalebi F.[3] and Shahriari Sh.[1]

1 Endodontic Department, Faculty of Dentistry, Hamedan Universty of Medial Seiences, Hamedan, IRAN.
2 Department of Medial Physics, Hamedan University of Medial Science, Hamedan, IRAN
3 Restorative Density Department, Faulty of Density, Hamedan, IRAN

Abstract : Non surgical endodentic re-treatment is a way to correct the factors responsible for the failure of previous endodontic therapy. New Rotary Ni-Ti instruments have been shown to prepare moderate to severely curved root canals with efficient shaping and minimum straightening of the root canal. The rotary NiTi ProFile maintained the original curvature significantly better than hand stainless steel Flex-R.

Key words : Endodontic re-treatment, Apical transportation, Dental Instruments.

Introduction

One of the primary goals of root canal preparation during application of debriding instruments, is maintaining the root canal curvature. Recently flexible Rotary (Perez *et al*., 2005). Ni-Ti instruments with increased tapers and different designs have been introduced. Ni-Ti Rotary instruments allows effective shaping and have the ability to maintain root canal curvature in severely curred canals (Cohen and Burns, 2002).

Many studies have been carried out on these new filing systems and they appear to have a major advantage even in preparing curved canals (Perez *et al.,* 2005). Reduced incidence of mishaps like blockage apical transportation ledge formation and pertoration based on previous investigations are some advantages of these systems (Cohen and Burns, 2002).

The efficacy of these files during routine endodontic treatment have been approved (Schafer and Florek, 2003*;* Wei *et al.*, 2002*;* Peters *et al.*, 2003*;* Hubscher *et al.*, 2003*;* Song *et al.*, 2004*;* Xu *et al.*, 2004*;* Iqbal *et al.*, 2004*;* Calberson *et al.*, 2004*;* Tasdemir *et al.*, 2005*;* Paque *et al.*, 2005*;* Ayar and Love, 2004*;* Schafer and Vlassis, 2004*;* Schafer and Zapke, 2000, Schafer and Lohman, 2002) but very few studies have been conducted on these systems during endodontic re-treatment regarding canal curvature maintenance.

Schafer and Schlingemann (2003) evaluated efficiency of rotary nickel-titanium K3 instruments compared with stainless steel hand K-Flexofile in curved canals of molars. They concluded that K3 files maintained the original curvature significantly better (Schafer and Schlingemann, 2003).

* **Corresponding author :** Nazari Sh., DDS, MS, No .304, Pastor Street, Bu Ali Squre, Hamedan-65 166-5-7981, IRAN, Tel. : +98 811 8352122, +98 811 8353066, Fax : +98 811 8352122, Cell : +98 9183143456, 98 912190285

Peters *et. al.* (2003) evaluated the performance of ProTaper nickel-titanium instruments for shaping root canals. Canals were scanned before and after shaping, three-dimensionally reconstructed and measured for volume, surface area, diameter and canal transportation by employing micro computed tomography. The study showed that ProTaper instruments prepared canals without major procedural errors and were effective in shaping narrow canals than wider, immature ones (Peters *et al.,* 2003).

Song *et. al.* (2004) compared instrument-centering ability of Great Taper hand files, nickel-titanium flex files and stainless steel K-type files using a modified Bramante model. Compared with SS K-files, GT hand files and Ni-Tiflex files remain better centered and produce significantly less transportation in curved root canals (Song *et al.,* 2004).

Paque *et al.* (2005) evaluated changes in root canal shape assessed by micro-computed tomography. The author observed that Endo-Eze AET stainless steel instruments resulted in increased volume and surface area significantly and similarly in mesiobuccal, distobuccal and palatal canals. Root canals were significantly straightened during preparation. This study showed that Endo-Eze AET shaped root canals in maxillary molars with substantial canal transportation, particularly in mesiobuccal root canals (Paque *et al.,* 2005).

The main parameters used to evaluate an instrument for root canal preparation are 'shaping the root canal whilst protecting the curvature of the canal' and 'adequately cleaning the root canal walls' (Tasdemir *et al.,* 2005). To investigate the efficiency of instruments and techniques in preparing root canals, a number of methods have been used to compare canal shape before and after preparation. Recently, techniques that allow teeth to be evaluated without destroying the specimens have been developed to compare root canal shape prior to and after instrumentation. With the use of computed tomography (CT), appropriate sections can be prepared and 3D images can be reconstructed. Root canal instruments and preparation methods can be compared by using CT. CT imaging technique (Gambill technique) has been considered as a noninvasive method for evaluation of canal shaping and efficiency of preparation techniques (Tasdemir *et al.,* 2005). The double radiographic superimposition method provides means for two-dimensional study of the longitudinal shape of the root canal. However, the technique utilizes buccal and proximal views for evaluation of apical transportation, even though roots do not always display their maximum curvatures in the mesio-distal or bucco-lingual planes. Therefore, the Maggiore technique can be used to identify the plane of maximum curvature of the canal and set it perpendicular to the X-ray beam (Iqbal *et al.,* 2004). In 'Serial Sectionig Technique' (Bramante technique), the teeth are mounted in resin blocks, sectioned from apical to coronal and then photographed. The photographs of original and shaped canal sections are compared. As a disadvantage, physical sectioning of the teeth before preparation can result in unknown tissue changes and loss of material (Tasdemir *et al.,* 2005).

The purpose of this study was to compare stainless steel hand Flex-R with ProFile rotary nickel-titanium instruments used to prepare root canals, by employing CT-scan technique.

Materials and Methods

In this *in vitro* study, human extracted first molars were included. The teeth were stored in 5.25% sodium hypochlorite solution for 48 hours to remove residual

Organic debris : With application the schneider method for determining the root canal curvature so that 90 root with 20-40 degree curvature was selected. The coronal portions of the teeth are sectioned at the CEJ. The roots were examined by a negotiation of No-.10 K-type file (Mail fere Switzerland) for canal patency.

The root canals were instrumented using stainless steel Flex-R (Union Broace, Myoco, USA) from size 10 to 30 in a balanced Force manner. Two mL of 2.5% sodium hypochlorite solution was used after each instrumentation step for irrigation.

Root canal obturation :

Root canal obturation was done with gutta percha and AH 26 sealer (Dentsply,USA) Sealer consistancy was adjacent according to the manufacture ,s instruction. Cold lateral condensation method by Endo twin obturator device (VDW, GmbH, Munich, Germany)was applied according to the manufacture's instruction.

Root canal instrumentation :

Re-treatment was carried out by a single operator in short time periods and identical pressure as follows:

Group 1 : Instrumentation with S.S. hand files (Flex-R) with chloroform :

0.5 ml chloroform was injected into cervical portion of each sample Balanced force method with gentle watch winding motion was applied to remove gutta percha. Apical enlargement was done with a 30 file.

Group 2 : Instrumentation with rotary profile system:

A 0.06 tapered rotary profile file mounted on a 1:10 gear reduction contra angle hand piece was used to remove obturating material. An electric engine (Endo II, VDW, GmbH, Munich, Germany) supplied the rotational motion at 1300 rpm. File exchange sequences were strictly adhered to the manufacture's instruction for root canal re-treatment. Final apical preparation was performed with a 0.04 tapered 30 file.

Group 3 : Instrumentation with rotary profile plus chloroform:

The same procedure for instrumentation was performed as group 2. Besides chloroform was utilized similar to group1.

The criterion for completeness of re-treatment was presence of clean dentinal debris and absence of obturating material on file. A final radiograph verified this completeness.

Canal curvature Measurement :

Samples were mounted and stabilized in a standard location by laser beams. So that all samples were scanned in identical positions. Then, each sample was scanned in 1 mm slices in sagittal view. Scanning was performed in a standard window width and window level. There after three dimensional reconstructions was carried out with singo software. Canal curvature was determined according to scheider's method. Data were analyzed with one way ANNOVA and tukey HSD tests at 95% significance level.

Results

The mean and SD values of apical transportation is presented in table 1.

P. value	F	Aberration Mean ± SD	Number	Technique
P =0.000 significant	22.75	6.29 ± 3.14	30	Hand stainless steel Flex-R plus Chloroform
		2.16 ± 2.92	30	Rotary NiTi ProFile plus Chloroform
		2.16 ± 2.19	30	Rotary NiTi ProFile without Chloroform

Data analysis revealed only significant difference between Groups 1 and 2 and between Groups 1 and 3 (P=0.000). So that the highest value belonged to group 1.

Discussion

Generally, three methods are applied for evaluation the efficacy if canal preparation instruments : a) serial sectioning b) radiography c) CT-Scan was utilized in this study. Maintaining original canal curvature is a primary goal in canal preparation methods. Various studies have evaluated and revealed the superior efficacy of rotary Ni Ti files in this regards compared to S.S. hand files (Ayar and Love, 2004).

According to the outcomes of this research, the maximum apical transportation was observed in Group 1.This means that rotary NiTi files have prepared root canals more favorably which is in accordance with at least four studies (Ayar and Love, 2004; Hubscher *et al.*, 2003; Peters *et al.*, 2003; Schafer and Vlassis, 2004).

Iqbal used a digital radiographic system to evaluate root canal shaping. The author recorded that the mean transportation was 0.24 mm in mesio-buccal canals of extracted molars prepared with ProFile instruments (Schafer and Lohman, 2002). Tasdemir reported that instrumentation of mesiobuccal canals of first molars with rotary Ni-Ti Hero 642 resulted in 0.13 mm transportation in apical level (Schafer and Vlassis, 2004). Ayar prepared simulated curved canals with use of Profile and recorded 0.023 and 0.022 mm transportation of outer and inner walls, respectively, in apical level (Song *et al.*, 2004).

In one study apical transportation of mesiobuccal roots of first molars which were prepared with rotary Ni Ti Ra Ce and pro taper systems was scored 0.8 and 0.9 degree respectively (Schafer and Zapke, 2000). This values show less transportation compared to profile system based on this study. An explanation to this, is that less curvatured roots had been used in that study.

Schafer and Vlassis (2004) prepared root canals of extracted molars with curvatures ranging 25-35 degrees. Based on comparison of pre- and postinstrumentation radiographs, ProTaper and RaCe appeared to result in 3.22 and 1.72 degrees transportation, Respectively (Tasdemir *et al.*, 2005). Schafer and Zapke (2000) showed the use of ProFile instruments resulted 1.36 degree straightening (Wei *et al.*, 2002).

Schafer and Lohmann (2002) prepared root canals with use of FlexMaster and observed that the mean canal deviation was 2.14 degrees. Schafer and Schlingemann (2003) stated the use of K3 instruments resulted in 1.36 degree straightening (Hubscher *et al.*, 2003).

The results of the above studies verify the validity of this research. Apical transportation has been measured in length unit based on the most previous studies. But, in this study we applied CT-Scan images which used singo software. So that .3D reconstruction of images was able to show canal straightening in degrees, precisely.

Conclusion

Under the condition of this study, the rotary NiTi ProFile maintained the original curvature significantly better than hand stainless steel Flex-R.

References

Ayar L.R. and Love R.M. (2004) : Shaping ability of ProFile and K3 rotary Ni-Ti instruments when used in variable tip sequence in simulated curved root canals. *Int Endod J*. **37**:593-601.

Calberson F.L., Deroose C.A. and Hommes G.M. (2004) : Shaping ability of ProTaper nickel-titanium files in simulated resin root canals. *Int Endod J*. **37(9)**:613-23.

Cohen S., Burns R.C. (2002) : Pathways of the Pulp. 8th Ed. St Louis Mosby USA. ch 22: 765-774.

Hubscher W, Barbakow F. and Peters O.A. (2003): Root-canal preparation with FlexMaster: canal shapes analysed by micro-computed tomography. *Int Endod J*. **36(11)**:740-747.

Iqbal M.K., Firic S. and Tulcan J. (2004) : Comparison of apical transportation between ProFile and ProTaper NiTi rotary instruments. *Int Endod J*. **37(6)**:359-364.

Paque F., Barbakow F. and Peters O.A. (2005) : Root canal preparation with Endo-Eze AET: changes in root canal shape assessed by micro-computed tomography. *Int Endod J*. **38(7)**:456-408.

Perez F., Schoumacher M. and Peli J.F. (2005) : Shaping ability of two rotary instrumens in simulated canals: stainless steel ENDOflash and nickel-titanium HERO Shaper. *Int Endod J*. **38**:637-644.

Peters O.A., Peters C.I. and Schonenberger K. (2003): ProTaper rotary root canal preparation: effects of canal anatomy on final shape analysed by micro CT. *Int Endod J*. **36(2)**:86-92.

Schafer E. and Zapke K. (2000) : A comparative scanning electron microscopic investigation of the efficacy of manual and automated instrumentation of root canals. *Int Endod J*. **26**:660-664.

Schafer E. and Lohman D. (2002) : Efficiency of rotary nickel-titanium FlexMaster instruments compared with stainless steel hand K-Flexofile. Part 2. Cleaning effectiveness and instrumentation results in severely curved root canals of extracted teeth. *Int Endod J*. **35**:514-521.

Schafer E. and Florek H. (2003) : Efficiency of rotary nickel-titanium K3 instruments compared with stainless steel hand K-Flexofile. Part 1. Shaping ability in simulated curved canals. *Int Endod J*. **36**:199-207.

Schafer E. and Schlingemann R. (2003) : Efficiency of rotary nickel-titanium K3 instruments compared with stainless steel hand K-Flexofile. Part 2. Cleaning effectivness and shaping ability in severely curved root canals of extracted teeth. *Int Endod J*. **36**:208-217.

Schafer E. and Vlassis M. (2004) : Comparative investigation of two rotary Ni-Ti instruments: ProTaper versus RaCe. Part 2. Cleaning effectiveness and shaping ability in severely curved root canals of extracted teeth. *Int Endod J*. **37**:239-248.

Song Y.L., Bian Z. and Fan B. (2004) : A comparison of instrument-centering ability within the root canal for three contemporary instrumentation techniques. *Int Endod J*. **37**(4):265-271.

Tasdemir T., Aydemir H. and Inan O. (2005) : Canal preparation with Hero 642 rotary NiTi instruments compared with stainless steel hand K-file assessed using computed tomography. *Int Endod J*. **38(6)**:402-408.

Wei X., Ling J. and Zhang S. (2002) : The shaping effects of three nickel-titanium rotary instruments on preparing curved canals in posterior teeth. Zhonghua Kou Qiang Yi Xue Za Zhi. **37(5)**:333-335.

Xu Q., Fan B. and Fan M.W. (2004) : Clinical evaluation of ProTaper NiTi rotary instruments in management of curved root canals. Zhongua Kou Qiang Yi Xue Za Zhi. **39(2)**:136-138.