

Ex vivo comparative analysis of root-canal dentin removal by MTwo and K3 rotary files using spiral computed tomography

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ABSTRACT

The main objective in root canal preparation is to develop an enlarged and shaped taper from apical to coronal, maintaining the original canal shape. The aim of this study is analysis of root canals dentin removal shaped by MTwo (Group M) and K3 (Group K) rotary files using spiral-computed tomography. A total of 40 mesiobuccal root canals of mesial roots with curvatures ranging 20-35 degree, and working length ranging 15-17 mm included the study. The initial images were reconstructed and cross- sections corresponding to distance 2, 4.5 and 7mm from the anatomic apex. Group M was prepared with Mtwo files with master apical file size 40 (single length technique) and group K was prepared with K3 files (VT technique, %4), with master apical file size 40. Post instrument images was recorded as same as the initial ones. Dentinal thickness measured in buccal, mesial, lingual and distal sections of each root canal. Statistical analysis was performed with one sample test Kolmogorov- Smirnov and T-test for comparing samples between groups. The mean total root dentine removal between group M (0.17+-0.04) and group K (0.20+_0.07) was statistically different (P<0.001). Group K showed 15% more dentin removal compared group M. Recording to our findings K3 had showed more dentin removal than Mtwo especially in apical and coronal third of curved root canals, so Mtwo acted better than K3.

KEY WORDS: MTwo, K3, RESIDUAL DENTIN THICKNESS, ROOT CANAL CBCT

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INTRODUCTION

The main objective in root canal preparation is to develop an enlarged and shaped taper from apical to coronal, maintaining the original canal shape. Shaping procedure directly related not only to the length but also to the position and curvature of each individual root canal (Schilder, 1974). When a curvature is present, endodontic preparations become challenging. Deviation from the original curvature can lead to excessive or inappropriate dentine removal, which weakens the tooth, resulting in stripping perforations or fracture of the root. Several instrument systems have been recommended in the past with different features. Today, the use of rotary Ni-Ti files has significantly reduced deviations from the original root canal shape compared with stainless steel hand files, (Kandaswamy et al 2009 Talati et al 2013 and Stavileci et al., 2015).

Several methods have been introduced for assessment of post canal instrumentation shaping such as scanning electron microscope, radiographs, photographic assessment and computer manipulation (Hülsmann, Peters, & Dummer, 2005). The methods are invasive in nature; hence accurate repositioning of pre- and post-instrumented specimens is difficult (Cumbo et al 2015).

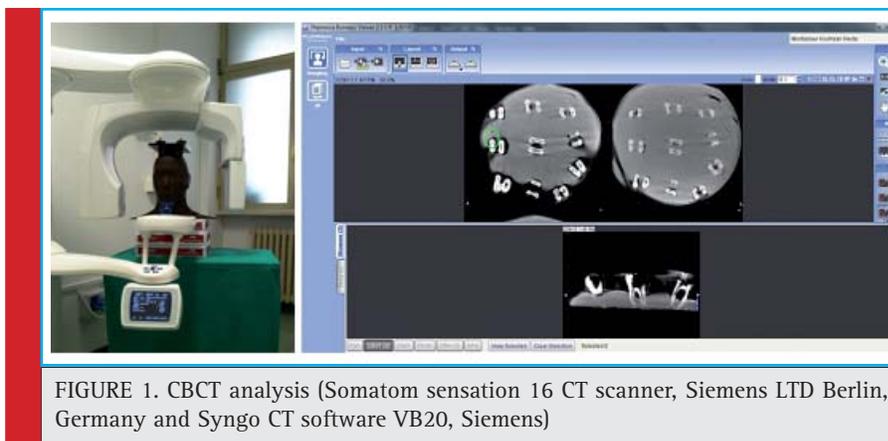
Spiral computed tomography; a non-invasive technology has been advocated for pre- and post-instrumentation evaluation of canal. It can render cross-sectional (cut plane) and 3D images that are highly accurate and quantifiable. At any level, the amount of post instrumentation dentinal removal and canal transportation can be analyzed without loss of specimen (Narayan et al., 2012, Maitin et al., 2013 and Deepak et al., 2015). The aim of this study is analysis of root canals dentin removal shaped by M Two and K3 rotary files using spiral computed tomography.

MATERIAL AND METHODS

In this experimental study human extracted mandibular first molars, which had no restorations and had been extracted due to extensive destruction of coronal structures or periodontal problems subjected the study. The teeth were disinfected in 1% hypochlorite solution for one hour and kept in sterile normal saline solution until further processing. Assessment radiographic images were taken using E-speed films (AGFA, Heraeus Kulzer GmbH; Hanau, Germany) with 70 kVp and 8 mA.

A total of 40 mesiobuccal root canals of mesial roots with curvatures ranging 20-35 degree, and working length ranging 15-17 mm were included in the study. They were randomly divided in two experimental groups of 18 canals each, and the remaining two for control group. The teeth were imbedded in a self-cure acrylic material (Acropars OP, Marlic medical industries, Tehran, Iran) and submitted to CBCT analysis (Somatom sensation 16 CT scanner, Siemens LTD Berlin, Germany). The initial images were reconstructed and cross-sections corresponding to distance 2, 4.5 and 7mm from the anatomic apex (Syngo CT software VB20, Siemens) (Fig.1).

The access cavities of all samples were prepared and Initial filing was done from 08 to 15 size k file and both experimental groups were instrumented with X-Smart (Dentsply Maillefer, Ballaigues, Switzerland). Between each instrument, the root canals were irrigated with 5 ml of 5.25% sodium hypochlorite and finally flushed with normal saline. Single length technique was used in a gentle in and outward motion according to the manufacturers' instruction. Group M was prepared with Mtwo files with master apical file size 40 and group K was prepared with K3 files (VT technique, %4), with master apical file size 40 according to manufactures protocol. Post instrument images was recorded as same as the initial ones. Dentinal thickness measured in buccal, mesial,



lingual and distal sections of each root canal. Statistical analysis was performed with one sample test Kolmogorov-Smirnov and T-test for comparing samples between groups.

RESULTS

No specimens excluded because of file fracture or other mishaps. The two specimens in control group showed the fixing method was accurate and there was no difference between first and second scans. In 2mm sections from the apices, root canal dentin removal for group M (0.12 +- 0.20) and group K (0.14 +- 0.04) was statistically different ($P < 0.001$). Group K showed 16% more dentin removal compared group M. In 4.5mm sections from the apices, root canal dentin removal for group M (0.18 +- 0.04) and group K (0.18 +- 0.04) was the same ($P < 0.09$).

In 7mm sections from the apices, root canal dentin removal for group M (0.21 +- 0.01) and group K (0.27 +- 0.06) was statistically different ($P < 0.001$). Group K showed 27% more dentin removal compared group M (table-1). The mean total root dentine removal between group M (0.17+-0.04) and group K (0.20+_0.07) was statistically different ($P < 0.001$). Group K showed 15% more dentin removal compared group M (table-2).

DISCUSSION

NiTi rotary files have superior shaping ability to maintain canal centered during instrumentation compared to stainless steel hand files (Gergi, Rjeily, Sader, & Naaman,

2010). But this advantage is differ among different brands of NiTi rotary files, depends on their specifics. In this study, we analyzed the effect of canal instrumentation on dentin removal using MTwo and K3 rotary files. The method used for dentin removal in the current study (spiral tomography) allowed us to evaluate morphological changes after root canal preparation in a conservative manner (Özer, 2011).

Within the limits of an “in vitro” study, the cone beam computed tomography offers a method that is relatively simple and economical and provides useful information about the action of instruments in the canal space (Gergi et al., 2010; Maitin et al., 2013; Özer, 2011; Tasdemir, Aydemir, Inan, & Ünal, 2005). An alternative conservative method of assessing root canal instrumentation techniques is the microcomputer tomography that is more expensive and requires well-trained operators in order to obtain valid results (Peters et al 2001; You et al., 2011; Zhao et al 2013).

Cumbo et al reported that M Two and BioRace rotary files had comparable results in amount of dentine removal in different levels of root canals (Cumbo et al., 2015). For this comparison they had used specimens with single root canals with a curvature lower than 20 degrees that is lower than our specimens (20-35 degrees). They had used resin blocks and digital photographs for shaping ability assessment (the Bramante technique) but the technique they had used is not conservative compared the technique had used in this study (CBCT).

In an ex vivo study by Maitin et al, they reported the MTwo rotary files had better well centered preparation in coronal and mid root compared to ProTaper, K3 and Race (Maitin et al., 2013). They had used single rooted specimens with a curvature ranging 20 to 40 degrees comparable to our specimens (20-35 degrees). The severity of curvature makes the preparation procedure more challenging. The result of our study confirms their results and shows MTwo has little dentine removal and better centering ability compared to K3 rotary files. In contrast of our results Narayan et al concluded that MTwo rotary files shaped root canals enlarger in volume and with compared K3 and Race. This difference can be explained by difference in shaping procedures (Narayan et al., 2012).

Recording to our findings K3 had showed more dentin removal than Mtwo especially in apical and coronal third of curved root canals, so M two acted better than K3.

The authors deny any conflicts of interest related to this study.

REFERENCES

Cumbo, E., Russo, R., & Gallina, G. (2015). Assessment of Root Canal Enlargement Using Mtwo and BioRace Rotary Files. The Scientific World Journal, 2015.

Table 1: Root dentine removal in different sections

Rotary systems	Root sections	Dentin removal (mm)	Coefficient Variations
MTwo	2mm	0.12+-0.02	17
	4.5mm	0.18+-0.04	22
	7mm	0.21+-0.01	5
K3	2mm	0.14+-0.04	28
	4.5mm	0.18+-0.04	22
	7mm	0.27+-0.06	22

Table 2: The mean total root dentine removal

Rotary systems	Mean dentin removal (mm)	Coefficient Variations
MTwo	0.17+-0.04	23
K3	0.20+-0.07	35

- Deepak, J., Ashish, M., Patil, N., Kadam, N., Yadav, V., & Jagdale, H. (2015). Shaping Ability of 5th Generation Ni-Ti Rotary Systems for Root Canal Preparation in Curved Root Canals using CBCT: An In Vitro Study. *Journal of international oral health: JIOH*, 7(Suppl 1), 57.
- Gergi, R., Rjeily, J. A., Sader, J., & Naaman, A. (2010). Comparison of canal transportation and centering ability of twisted files, Pathfile-ProTaper system, and stainless steel hand K-files by using computed tomography. *Journal of Endodontics*, 36(5), 904-907.
- Hülsmann, M., Peters, O. A., & Dummer, P. M. (2005). Mechanical preparation of root canals: shaping goals, techniques and means. *Endodontic topics*, 10(1), 30-76.
- Kandaswamy, D., Venkateshababu, N., Porkodi, I., & Pradeep, G. (2009). Canal-centering ability: An endodontic challenge. *Journal of conservative dentistry*, 12(1), 3.
- Maitin, N., Arunagiri, D., Brave, D., Maitin, S. N., Kaushik, S., & Roy, S. (2013). An ex vivo comparative analysis on shaping ability of four NiTi rotary endodontic instruments using spiral computed tomography. *Journal of conservative dentistry*, 16(3), 219.
- Narayan, G. S., Venkatesan, S. M., Karumaran, C., Indira, R., Ramachandran, S., & Srinivasan, M. (2012). A comparative evaluation on the cleaning and shaping ability of three nickel titanium rotary instruments using computerized tomography-An ex vivo study. *Contemporary clinical dentistry*, 3(6), 151.
- Özer, S. Y. (2011). Comparison of root canal transportation induced by three rotary systems with noncutting tips using computed tomography. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 111(2), 244-250.
- Peters, O., Schönenberger, K., & Laib, A. (2001). Effects of four Ni-Ti preparation techniques on root canal geometry assessed by micro computed tomography. *International endodontic journal*, 34(3), 221-230.
- Schilder, H. (1974). Cleaning and shaping the root canal. *Dent Clin North Am*, 18, 269-296.
- Stavileci, M., Hoxha, V., Görduysus, Ö., Tatar, I., Laperre, K., Hostens, J. Muhaxheri, E. (2015). Evaluation of root canal preparation using rotary system and hand instruments assessed by micro-computed tomography. *Medical science monitor basic research*, 21, 123.
- Talati, A., Moradi, S., Forgani, M., & Monajemzadeh, A. (2013). Shaping ability of nickel-titanium rotary instruments in curved root canals. *Iranian endodontic journal*, 8(2), 55-58.
- Tasdemir, T., Aydemir, H., Inan, U., & Ünal, O. (2005). Canal preparation with Hero 642 rotary Ni-Ti instruments compared with stainless steel hand K-file assessed using computed tomography. *International endodontic journal*, 38(6), 402-408.
- You, S.-Y., Kim, H.C., Bae, K.S., Baek, S.-H., Kum, K.Y. & Lee, W. (2011). Shaping ability of reciprocating motion in curved root canals: a comparative study with micro-computed tomography. *Journal of Endodontics*, 37(9), 1296-1300.
- Zhao, D., Shen, Y., Peng, B., & Haapasalo, M. (2013). Micro-computed tomography evaluation of the preparation of mesiobuccal root canals in maxillary first molars with Hyflex CM, Twisted Files, and K3 instruments. *Journal of Endodontics*, 39(3), 385-388.