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Comparison of pre operative curvature with postoperative curvature In root canals treated with K 3 rotary systems

Sana Ehsen Nagi
Aga Khan University, sana.ehsen@aku.edu

Farhan Raza Khan
Aga Khan University, farhan.raza@aku.edu

ORIGINAL ARTICLE

COMPARISON OF PRE-OPERATIVE CURVATURE WITH POST-OPERATIVE CURVATURE IN ROOT CANALS TREATED WITH K-3 ROTARY SYSTEMS

Sana Ehsen Nagi, Farhan Raza Khan
Operative Dentistry Department, Aga Khan University and Hospital, Karachi-Pakistan

Background: With root canal treatment, the organic debris and micro-organisms from pulp space is removed and an ideal canal preparation is achieved that is conducive of hermetic obturation. The purpose of this study was to correlate the pre-operative canal curvature with the post-operative curvature in human extracted teeth prepared with K-3 rotary systems. **Methods:** The root canal preparation was carried out on extracted human molars and premolars using K-3 endodontic rotary files. A pre and post-operative image of the teeth using digital radiograph were taken in order to compare pre and post-operative canal curvature. The images were saved in an images retrieval system (Gendex software, USA). Change in the canal curvature was measured using the software measuring tool (Vixwin software, USA). Student paired *t*-test and Pearson correlation test was applied at 0.05 level of significance. **Results:** There is a statistically significant difference between pre-operative and post-operative canal curvature (*p*-value <0.001) and a strong positive correlation (91% correlation) between pre-operative and post-operative canal curvature in teeth prepared with the K-3 rotary files. **Conclusions:** A significant difference between pre and post instrumentation curvature was found. Degree of canal curvature was not correlated with time taken for canal preparation.
Keywords: Endodontic treatment; K-3 files; Canal curvature

INTRODUCTION

Engine driven instruments can shorten the treatment sessions and reduce the practitioner and patient's tiredness. However, these systems have some drawbacks including straightening of the root canal, absence of a tactile sensation, inadequate debridement and the risk of file fracture. Nickel titanium instruments have revolutionized the root canal treatment. Since their introduction there is an increasing shift from manual to rotary engine driven preparation of root canal preparation. K-3 is one the popular versions of NiTi instruments.[1]

Different NiTi file systems have different characteristics in terms of the cross-sectional design, chip-removal capacity, taper, helical and rake angle, metallurgical properties, and surface treatment of the instruments or flutes per unit length. The choice of system affects the ability to shape the root canal, particularly with curved canals.[2] NiTi rotary files are in wide use in clinic as principal instruments, offering increased clinical performance and reduced complications and consequently increasing the clinical success rate.[3] The K-3 (SybronEndo, CA, USA) rotary Ni-Ti system is a three-fluted file of constant taper with variable core diameter.[4,5]

It was reported that K3 files prepared curved canals rapidly and with minimal transportation towards the outer aspect of the curve compared with stainless steel hand K-Flexofiles. It was also reported that K3 files more effectively removed outer walls of root canals compared with inner canals.[6] With an increased usage of rotary endodontic systems in Pakistan, there is paucity of data on the remaining dentine thickness (RDT) in curved canals when prepared with K-3 files.

The objective of this study was to determine the correlation between pre instrumentation root canal curvatures with post instrumentation canal curvature in extracted teeth subjected to K-3 systems. The secondary objective was to determine if there is any correlation between the time taken for canal preparation with the canal curvature.

MATERIAL AND METHODS

The study was conducted at Aga Khan University Hospital, Karachi with a duration of six months. It was an in-vitro experimental study design with non-probability consecutive sampling technique. Single as well as multi-rooted extracted maxillary and mandibular premolar and molar teeth on which no previous root canal treatment was performed were selected in the study. Teeth which were considerably carious or severely calcified teeth diagnosed on clinical and radiographic examination, teeth showing root resorption, root fractures or defects or with open apices were excluded from the study.

The sample size was calculated by using sample size calculator (Sample size Determination in Health Studies, WHO). A study conducted by Scahfer & Florek[7] in International Endodontic Journal

2003, reported that K3 files showed mean dentine removal of 0.26±0.07mm at 5mm from the apex after instrumentation, keeping this estimate in view, we calculated the sample our sample size turned out to be 107 canals. A pre-operative radiograph of all teeth using digital radiograph and scanning system was taken. The images were then saved in the dental clinics X-ray images retrieval system. Obtained radiographs were then transferred to VixWin Viewer software. Instruments were examined after every use. Each instrument was used to prepare five teeth after which it was discarded and replaced by new instruments. Time taken for preparation of a canal in both techniques was also calculated in seconds using a stop watch. The protocol was approved from any ethical issues before commencement of this study, ERC reference number: 3270-Sur-ERC-2015.

SPSS 20.0 was used for data analysis. The unit of analysis was individual canal. Mean and standard deviation were calculated for pre and post-operative canal curvature. Paired sample t test was applied to determine mean difference between pre and post-operative canal curvature. Pearson correlation test was applied to determine the correlation between pre and post-operative canal curvature. Similarly, Pearson correlation test was also applied to determine the correlation between pre-operative canal curvature and time taken to prepare the canal. Level of significance was kept at 0.05.

RESULTS

It was an in vitro experimental study conducted on teeth retrieved from the departmental tooth bank. These teeth were originally extracted due to orthodontic or periodontal reasons and were later donated by the patients for research purpose. The written informed consent was obtained for this donation. Since, these teeth were retrieved from the pool of extracted teeth therefore; there was no data available on individual tooth donor's age, gender and reason for extraction. There were 107 canals belonging to 50 teeth. The distribution of these canals with respect to type of toot and location in jaw is shown in table-1. Nearly half of the canals in all groups had curvature more than 15 degrees.

Table 2 shows that there is a statistically significant difference between the mean pre-operative and post-

operative canal curvature of teeth prepared with K-3 files (p value <0.001).

There was a strong positive correlation (91% correlation) observed between the pre-operative canal curvature with the post-operative canal curvature. It means that in over 90% of the canals, the post-operative curvature turned out to be high when the pre-operative curvature was also high. However, there was no correlation detected between the pre-operative canal curvature and the time taken for the canal preparation (-0.04%). Similarly, post-operative curvature had no correlation with the time for canal preparation. This signifies that canal curvature has no significant effect on the time required for root canal preparation. (Table-3)
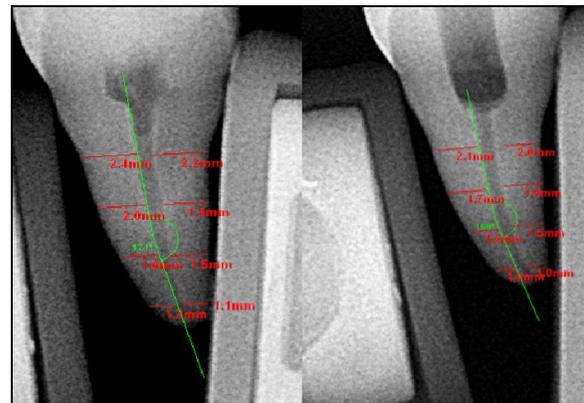

Figure-1: Premolar tooth showing pre and post instrumentation curvature.

Table-1: Distribution of tooth canals with respect to the curvature, location and tooth type

Location	Tooth type	<15 degrees	>15.1 degrees	n=107
Maxilla	Premolar	12	14	26
	molar	15	15	30
Mandible	Premolar	12	13	25
	molar	13	13	26

Table-2: Pre and post-operative canal curvature in the canals operated with K-3 endodontic rotary files

Variables	n	Mean	SD	*p*-value
Pre-operative curvature	107	167.21	8.08	<0.001
Post-operative curvature	107	169.95	7.48	

Paired sample t test was applied to compare mean canal curvature at 0.05 level of significance

Table-3: Correlation between pre-operative curvature and time taken for the preparation

Correlation test n=107		Pre-operative curvature (in degrees)	Post-operative curvature (in degrees)	Time taken to prepare the canal (in seconds)
Pre-operative curvature (in degrees)	Pearson Correlation	1	0.91	-0.04
	p-value		<0.01	0.63
Post-operative curvature (in degrees)	Pearson Correlation		1	-0.09
	p-value			0.35
Time taken to prepare the canal (in seconds)	Pearson Correlation			1
	p-value			

Pearson correlation coefficient was applied. Level of significance kept at 0.05

DISCUSSION

Nickel-titanium (NiTi) rotary files are now essential materials in endodontic therapy. They have many advantages over stainless steel files such as excellent flexibility and improved cutting efficiency thus are helpful for successful preparing and maintaining the shape of curved root canals due to their high elasticity and shape memory.[8–16] The usage of NiTi rotary instruments have reduced operator fatigue, time required to finish the preparation and has also minimized procedural errors associated with hand instrumentation.

Schafer and Florek[7] conducted a study to compare the ability of shaping of simulated root canals, comparing K-3 rotary files with protapers, in which K-3 instrument provided better root canal geometry and less root canal transportation and thus maintained the original root canal curvature. However, another study conducted by Schafer[17] on Mtwo, K-3 and RaCe showed straightening of canal when prepared with K3 and RaCe.

A study conducted by Kariem M,[18] concluded that K3 files showed a change in post instrumentation canal curvature than the twisted file group. Bergmans et al.[19] evaluated the influence of shaft design of K-3 (constant taper) versus Protapers (progressive taper) on total volume of dentine removal. They observed that K-3 system did better by its less tendency of transporting towards furcation in the coronal region. These studies are in accordance to the present study in which a statistically significant difference was found between pre and post instrumentation curvature. Working time is highly dependent on operator and type of instruments used e.g, Protaper utilizes only fewer instruments and prepare canals faster than K3 system utilizing larger number of instruments. This fact is also supported by previous studies, which clearly demonstrated that the difference in the working time is highly dependent on operator's experience and effectiveness in root canal preparation.[7,20–22] In this study, no significant difference was found between time and instrumentation of canal possessing a curvature of less or more than fifteen degrees of curvature. A study conducted by Yun and Kim compared four different types of rotary Ni-Ti systems that is ProFile, GT Rotary, Quantec and ProTaper in which ProTaper system required shorter preparation time in comparison to other file systems and promoted larger wear of the root canal curvature.[23]

The strength of the present study is that we used extracted teeth instead of resin blocks to mimic the actual clinical situation, randomized assignment of the specimen to treatment group was done and two commonly used rotary systems were compared.

However, our study had a major limitation of not employing the micro CT/ CBCT (cone bean computerized tomogram) images that has become the modern method of studying canal curvature. We recommend that more studies should be conducted to compare other rotary systems.

CONCLUSIONS

There was a significant difference observed between pre and post-operative canal curvature of premolars and molars instrumented with K-3 rotary files. A high correlation was seen between pre-operative and post-operative canal curvature. No correlation was found between pre-instrumentation curvature and time required for the preparation of root canals with K-3 files.

AUTHORS' CONTRIBUTION

AEN: Conducted the experiment and wrote the manuscript. FRK: Reviewed, critically appraised and analysed the data.

DISCLOSURE

The authors declare that we do not have any financial interest in the companies whose products were mentioned in this study.

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Address for Correspondence:
Sana Ehsan Nagi, Operative Dentistry Department, Aga Khan University Hospital, Karachi-Pakistan
Email: dr_sanas@hotmail.com