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Evaluating canal transportation and canal straightening of two nickel titanium instruments in curved canals- An invitro study

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Abstract:

Introduction: The Study aims at comparing the shaping ability of Hyflex-EDM &OneShape rotary Nickel-Titanium files in human extracted teeth with curved canals.
Material &Method: Using computer digital image analysis system, pre-instrumentation and post instrumentation radiographs of twenty curved root canals, instrumented using One shape and Hyflex EDM each as per manufacturer's instructions, were assessed for canal transportation and canal straightening and the statistical analysis of the data thus obtained was carried out using ANalysis Of Variance& Post hoc tests.
Results: One shape showed more canal straightening as compared to Hyflex EDM while both maintained canal curvature equivalently
Conclusion: It can be concluded that Hyflex EDM maintained canal shape better than One shape, within the limitations of the study.

Keywords: Canal straightening, Canal transportation, One shape, Hyflex EDM

I. INTRODUCTION:

One of the important steps in determining efficacy of step by step procedures in root canal therapy is cleaning and shaping.[1-2] Efficient shaping preserves the original canal curvature along with preparation of the canal for adequate filling.[2-4]RotaryNiTi (Nickel-Titanium) instruments results in faster root canal preparation with lesser procedural errors than thehand instruments made of stainless steel.[5-7] They are also shown to maintain original canal shape, in curved canals. [8,9]

The Hyflex EDM one file (Coltene/WhaledentAG, Alstatten, Switzerland) is introduced to shape root canals using a single file in continuous rotation.[10] One shape (Micro mega, besancon, France) is too a single file system used to shape root canals in continuous clockwise rotation.[11]

HEDM is maufactured using EDM technique, where in the shape of working end is changed by developing a potential difference and hence sparks between the end and the tools which melts and vaporizes the top layer of working end.[10,12] This process creates roughened hard surface that is claimed to increase the cutting efficiency of these files.[10,12]

HEDM files have tip size of 25 and 0.08 taper. The taper is constant in apical 4 mm of the file but reduces progressively upto 0.04 in the coronal portion of the file. It has three different cross-sections over the working length portion such as quadratic, trapezoid & triangular in the apical, middle and coronal parts respectively. It is also claimed to have a non-cutting tip,[10] hence reducing canal aberrations.

One shape file has size 25 and 0.06 taper with three cutting edge at its tip and cross-section progressively changing to s-shape near shaft.[11]

II. PROCEDURE:

Forty human extracted mandibular molars with root canals having degree of curvature ranging between 25°and 35° according to schneider [13] were selected. Access opening was done with diamond burs and apical patency was established with size 10-k file.

Standardized digital radiographs were taken prior to instrumentation with a size 15-k file inserted into the canal with the x-ray tube aligned perpendicular to the root canal and the exposure parameters (0.08s, 8mA, 70kv) were the same for all radiographs. The radiographs thus obtained were transferred to AutoCAD 2008 (Autodesk, San Rafael, CA, USA) and angle of curvature of root canals were determined.[14] The teeth were divided into two groups of 20 canals each. The homogenity of groups with respect to the above parameter was analysed with ANOVA test(Table 1).

Curvature (degrees)			
Instrument	Mean+/-SD	Minimum	Maximum
One shape	33.38+/-1.41	25	35
Hyflex EDM	33.57+/-0.99	25	35
P-Value (ANOVA) : 0.674			

Table 1: Homogenization of Canal Curvature

The instrumentation in the root canals was carried out using both thefiles as described below. Irrigation of the root canals was carried out with 3% sodium hypochlorite and Normal Saline.

Group A: The One shape (tip size 25, taper 0.06) was used in the clockwise rotation atthe speed of 350 RPM and torque 4 NCm using X-Smart EndoMotor (Dentsply Maillefer), as per the instructions given by the manufacturer.

Group B: Hyflex EDM One file (tip size 25, taper 0.08) was also used in continuous rotation at the speed of 500 rpm and torque 4 NCm using X-Smart EndoMotor(DentsplyMaillefer), as per the instructions given by the manufacturer.

Post Instrumentation radiograph with the master apical file placed in the canal were obtained as described above. The pre instrumentation and post instrumentation radiographs were compared to obtain the degree of canal straightening.(Figure 1).

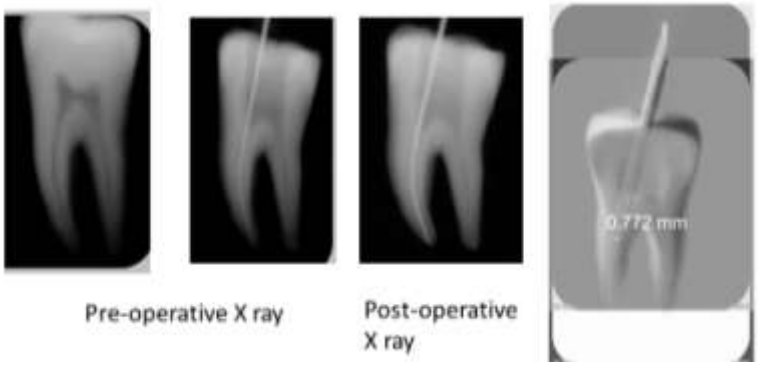

Figure 1: Superimposition of Pre-operative and post-operative x-ray images to obtain degree of canal-straightening

The canal transportation between the groups was obtained as the difference in the apical 3-5mm of the apical section of the teeth using double digital radiograph technique. (Figure 2).
Coral Draw was used to overlap pre-instrumentation and post-instrumentation radiographs.

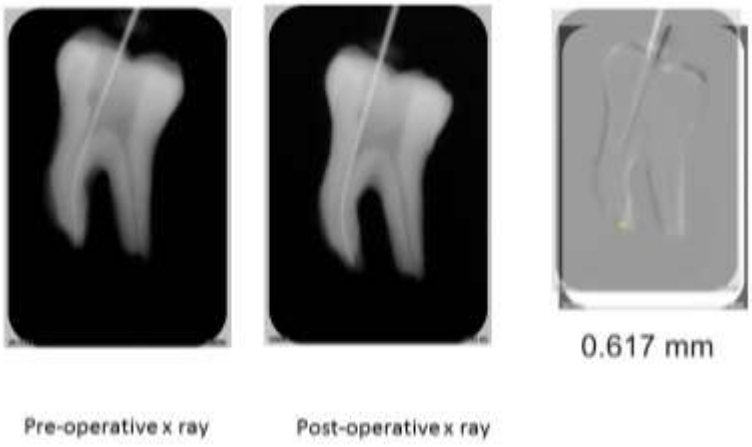

Figure-2: Superimposition of Pre-operative and post-operative x-ray images to obtain degree of canal-transportation.

Statistical Analysis:
Statistical analysis of the results was carried out with the help of One Way ANalysis Of Variance and Post hoc test. The level of significance was set at $p<0.05$

III. RESULTS:

Canal straightening was seen to be more with the use of One-Shape file as compared to Hyflex-EDM ($p>0.05$) (Table 2). Both One shape and HEDM showed canal transportation almost equivalently (Table 3).

Canal Straightening				
Instrument	Mean	SD (Standard Deviation)	Minimum	Maximum
One Shape	0.543	0.11	0.43	0.86
Hyflex EDM	0.430	0.10	0.26	0.56
P-Value (ANOVA) : 0.002				

Table 2:Canal Straightening comparison of the two NiTi-Files.

Canal Transportation				
Instrument	Mean	SD (standard deviation)	Minimum	Maximum
One Shape	0.673	0.14	0.52	1.20
Hyflex EDM	0.589	0.12	0.38	0.78
P-Value (ANOVA) : 0.046				

Table 3: Canal Transportation comparison of two NiTi-Files.

IV. DISCUSSION:

Obtaining an uniformly tapered funnel shaped canal preparation is the pre-requisite for appropriate obturation of the root canal systems.[15] Failure to respect canal anatomy, especially in the apical area of the root canal may result in root canal aberrations such as zipping, ledging or perforation. This can also lead to the harbouringof the infected debris and the proper canal sealing can be adversely affected.[16,17] Nickel titanium alloy is more flexible than Stainless steel which hence has more centric ability in the canal and consequently less canal transportation.[18-20]Centering ability of a rotary file depends on complex inter-

relationship of different parameters like the type of alloy, cross-section, taper, diameter of the instrument etc.[1,2,21,22] Due to shape memory effect of alloy, even though the NiTifiles are flexible, possible transportation may occur due to increase in the file diameter.[21]

Canal preparation using single file was first introduced by Yared in 2008[23], using Pro-Taper F2 file (Tulsa Dentsply, Tulsa, OK) in a reciprocating motion for curved root canal preparation. Later, many manufacturers using this technique, introduced different files with different flute design, cross-section, alloy & working motion to the market. The single use of endodontic instruments is cost effective, tend to decrease instrument fatigue and possible cross contamination & reduce the number of NiTi rotary files required for canal preparation as well.[24,25]

Canal deviation can be evaluated by several methods, amongst which radiographic methods, silicone impression of root canals, scanning electron microscope, computed tomography and analysis of histological sections are commonly used ones out of which radiographic method is used in this study. [26,27]

The flexibility of root canal instrument depends on inter-relationship of various parameters such as cross section, pitch, core diameter, metallurgical properties and surface treatment of the instruments.[28] In this study One shape demonstrated statistically significant tendency to straighten the canal as compared to HEDM which can be attributed to its higher cutting efficiency due to the typical instrument design as described above. On the other hand HEDM in spite of having greater taper respected canal curvature better which can be attributed to the instrument design as described above as well as novel EDM technique and the heat treatment during its manufacturing, which makes the file more flexible and stronger at the same time.[10,12]Both the files did not show much statistically significant difference in canal transportation.

V. CONCLUSION

It can be concluded that Hyflex EDM maintained canal shape better than One shape, within the limitations of the study.

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