Shaping ability of Wave One, One Shape, Hyflex CM and Trushape 3D Nickel Titanium Rotary Instruments with Different Access Angles

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Abstract: ***This study was performed to detect the shaping ability of Wave one, One shape, Hyflex CM and Trushape 3D Nickel Titanium Rotary instruments with different access angles in the L-shape stimulated canal blocks.these blocks were divided into four groups of thirty each(0^{0} ,$+45^{0}$and -45^{0}access angles (ten sample for each access angle) . Each instrument was used according to the manufacturers' instruction.Pre- and postoperative images of the simulated canals were taken under standardized mannersbyusing a stereomicroscop. The pre- and postoperative images were superimposed into a composite image using a computer software program (Adobe Photoshop 7 ME).The first measuring point was 1 mm away from the artificial apical foramen, and the last measuring point was 10 mm from the apical end, resulting in 10 measuring points on the inner and outer sides of the canal,The data were statistically analyzed with ANOVA test and Turkey's honest significant difference test.The results of this study reveled that instrumentation by Trushape file) is statistically significant less canal centering value as compared with all other groups of this studyatmost measuring points, while group instrumented by Hyflex file has statistically significant less canal centering value as compared with other groups at all measuring points.Also the results showed that 0^{0} access angle has less canal centering values than with ($+45^{0}$ and -45^{0}) access anglesin most instrument types of this study. The results of this study reveled that the canal transportation of group instrumented by Wave one file has statistically significant differences as compared with other groups at most measuring points. Also there was statistical significant differences less canal transportation in groups with (0^{0}) access angle as compared groups with ($+45^{0}$ and -45^{0}) access angles. Also the results showed that the groups with ($+45^{0}$) access angle has statistical significant less canal transportation as compared with groups with (-45^{0}) access angle. at most measuring points.***

Keywords: Transportation, Centering, Trushape, Waveone, Hyflex

1. Introduction

The normal range of mouth opening varies from person to another within the range of 40-60 mm, the lower limit at 35mmreduced mouth opening is a common problem. Many dental practitioners see the patients with restricted mouth opening. It can occur due to variety of underling conditions which may involve complex factor .Trismus or lock jaw refers to reduce opening of the jaws caused by spasm of mastication muscles or may generally refer to all causes of limited mouth opening. Which is a common complication of dental treatment in many ways. The limited access (limited mouth opening or the tooth is far back in the mouth) .The causes of Trismus either in intra articulator and extra articulator. The range of mouth opening affect the access angle of intracanal instrument that will effect on the instrumentation phase of root canal treatment.[1,2,3] Although perfect root canal treatment related to many factors, biomechanical root canal preparation is one of the most important stages. The aim of biomechanical root canal preparation is to remove microorganisms, canal contents, debris, and to shape a continuously tapered form with the smallest diameter at the apical foramen and the largest at the orifice to allow effective irrigation and filling without changing the initial canal shape.[4]Maintaining the original canal shape and avoiding canal aberrations like ledge formation and zip configuration is challenging, especially when preparing severely curved root canals. Centering ability is influenced by the design of the instrument (taper, flexibility and type of alloy) and the root canal anatomy. The instrument receives lesser constraint and is more centered in cases of straighter root canals. Conventional analytical methods may employ reassembly techniques,[5] which evaluate cross-sections of root canals before and after preparation.[6,7,8] Canal transportation is a frequent complication in the preparation of curved canals. When excessive dentin is removed in a single direction, some areas are left unprepared, favoring the presence of remaining necrotic tissue and compromising the apical seal after root canal filling.[1] In the last few years, important modifications to rotary instruments have been proposed to increase their reliability and effectiveness.[3,4] In addition to the advances made in rotary instrumentation, different methodologies have been proposed and used to assess the effects of endodontic instruments on canal transportation and on root canal anatomy. The WaveOne (Dentsply Maillefer) is known to cause only little canal transportation because of the increased flexibility of the M-wire NiTi alloy [8]and the alternating counterclockwise (cutting) and clockwise (releasing) movements of the instruments [10]. Other recently launched single-file systems isOneShape (Micro-Mega, Besanc¸on, France). The working motion of this instruments is a permanent clockwise rotation. [10] It is made of conventional NiTi and promising results concerning its shaping ability and apical debris extrusion have been described.[10,11] Other recently introduced instruments are the HyflexCM files (Coltene/Whaledent, Altst€atten, Switzerland). This is a full-sequence rotary system, and the files are ground out of CM wire. Its alloy has a lower percentage in weight of Nickel (52.1%wt) than conventional NiTi alloys [12]. A specific heat treatment during the manufacturing process [13] results in increased flexibility and higher fatigue resistance of the instruments [14, 15]. TRUShape 3D Conforming Files allow clinicians to preserve more tooth structure often removing up to 36%

less dentin compared to conventional instrumentation techniques while removing the pulp and debris along the root canal. The file's design enables it to create a predictable apical shape, while producing 32% less apical transportation than conventional ISO-prepared canals.1TRUShape files have a proprietary design that resembles an "S," which gives the file a unique ability to flex within the canal rotation and allows it to conform to the anatomy to reduce the amount of tooth structure removed . In addition to conforming to the canal, this design creates an envelope of motion that better disrupts. [16,17]This study was done to detect the shaping ability of different new rotary instrument and to get better selection of new rotary Nickel titanium rotary instrument for those patient with limited rang of mouth opening that results in excessive bending of endodontic file during instrumentation to accommodate the limitation in mouth opening.

2. Materials and Methods

A total of 120L-shaped simulated plastic canals (Endo Training Bloc-S; Dentsply-Maillefer) made of clear polyester resin were used in this study, these blocks were divided into four groups of thirty each(0^0 , $+45^0$and, -45^0) access angles with long access of stimulated plastic canal block, ten sample for each access angle); group A for Wave one instrument , group B for One shape instrument, group C for Hyflex CM instrument and group D for True shape instrument Nickel titanium Rotary instruments. All the simulated canals were standardized as follows: they were 16.5mm long, the apical foramen diameter was 0.15 mm, and the initial taper was 0.02. The radius and angle of curvature were 4.5mm and 60^o,respectively. Prior to experimental instrumentation of the resin blocks, all canals were stained with blue ink to obtain a clear image of the canal. Three landmarks were made with a round bur in the resin blocks from sidewall to near the inner and outer curve of the canal without penetrating into the canal.

Preparation of simulated canals

The stimulated canals were first scouted with a #10 K-file (FlexoFile; Dentsply-Maillefer, Ballaigues, Switzerland) to check patency and precisely determine the working length (16mm). Before shaping, a drop of EDTA gel (Glyde File Prep; Dentsply-Maillefer, Ballaigues-Switzerland) was placed inside the coronal reservoir for lubrication. The final apical preparation was set to a size 25 for all resin stimulated blocks canals of all groups of this study. The apical end point of instrumentation was 0.5 mm short of the artificial apical foramen. Each instrument was used according to the manufacturers' instructions and by using X -Smart plus endodontic hand piece and engine (Dentsply Mailler, Switzerland)the hand piece and the Stimulated canal block was arrange by using surveyor to get $+45^o$, $-45^o$and 0^oaccess angleof endodontic file with long access of stimulated plastic canal block (ten sample for each access angle for all groups of the study);

Group A: canal preparation by Wave one done by insertion the primary file with rubber stopper at full working length (16 mm) into stimulated plastic canal block, initial shaping was done with gentle inward pecking motion, with short 2-3 mm amplitude strokes, to passively advance the file until it dose not easily progress any more, The file was then withdrawn, cleaned then canal was irrigated and checked for potency. The Wave one file was then reinserted and the procedure is repeated until full working length is reached, final irrigation and checking for potency was done.

Group B; Canal preparation by One shape file done first by introduction the G1 file 12/0.03 into the canal in a slow downward movements in a free progression and without pressure motion to working length at 250-400 rpm and max torque of 1.2 N/cm. Canal is then irrigated and G2 file 17/0.03 used to working length in the same fashion. Canal was irrigated and patency checked with a size # 15 K-file. One shape file was then used at 400 rpm and 2.5 N/cm with in and out movement for about 2-3 mm without pressure, then the file is withdrawn and cleaned and canal irrigated and patency checked with #15K- file. This is repeated until working length is reached.

Group C; Canal preparation done by HyflexCM with speed of rotation was set to 500 rpm and torque at 2.5 N/cm on the X-Smart plus endodontic engine. The orifice opener 25/0.08 was used first for the coronal preparation in a smooth in and out tipping motion. Then the 20/0.04 file used in the same motion to full working length for apical preparation. Then the 25/0.04 file was then used to full working length to finish apical preparation. Finally, the 20/0.06 file was used to full working length for middle segment preparation .After each file application the spirals of the file were inspected for straightening, the file was placed in glass bead bath to regain its original shape

Group D; Canal preparation done by Trushape instrument; first flooding the canal with irrigant then the first Trushape file 20/0.06 with a yellow ring was introduced into the canal by using X-Smart plus endodontic engine at speed of 300 rpm and torque at 3 N/cm with gentle 2-5 mm in and out motion to shape the middle, with a 2-3 mm amplitude in and out motion towards the apex. abrupt pecking motion were avoided. File was withdrawn and its flutes were cleaned and the canal was irrigated and canal patency reconfirmed with a #15 K-file. The procedure is then repeated until working length was reached. The next file 25/0.06 with a red ring was then used in the same movement fashioned until working length was reached then withdrawn once it has reached working length. Canal was irrigated thoroughly and patency was reconfirmed.

For all groups of this study the Irrigation was done with 5 mL distilled water after each instrument by using a 31-gauge Navi-Tip flexible irrigation needle (NaviTip 31ga side port; Ultradent, South Jordan, UT). The needle was inserted as deep as possible into the root canal without binding, NaviTip needles were selected because of their flexibility ensuring sufficient insertion of the needle into the L-shaped canal.

Assessment of canal preparation and analysis of data:

Pre- and postoperative images of the simulated canals were taken under standardized manners using a stereomicroscope (Leica MZ 12.5, Heerbrugg, Germany). A specially custom made designed arrangement was prepared to allow the pre- and postoperative images of the canals to be taken in a standardized condition. The graduated ruler was fixed adjacent stimulated resin block in holding base to provide calibration of measurements. Before preparation, Blue dye (Seek R ,caries indicator, Utradent products, Inc. USA) was injected into the canal, and a preoperative image was obtained. Then distilled water was used to remove the dye. After the last instrument, red dye (Seek R ,caries indicator, Utradent products, Inc. USA) was injected, and postoperative image was obtained using the same previously described method. The pre- and postoperative images were superimposed into a composite image using a computer software program (Adobe Photoshop 7 ME, Adobe Systems Incorporated, San Jose, CA).The first measuring point was 1 mm away from the artificial apical foramen, and the last measuring point was 10 mm from the apical end, resulting in 10 measuring points on the inner and outer sides of the canal, for a total of 20 measuring points1) in this study the measurement ofthe distance between the upper limit of the initial canal and the upper limit of the instrumented canal represented by (*X*sup),the distance between the inferior limit of the initial canal and the inferior limit of the instrumented canal represented by (*X*inf), andthe width of the shaped canal represented by (*Y*) was done at each measuring points (D0 to D10).

The centering ability was calculated by subtracting the amount of resin removed from the inner wall from that removed from the outer wall (centering ratio =*X*sup− *X*inf)/*Y*). According to this calculation, values closer to "0" indicate better centering ability. The direction of transportation was determined by the wider width of resin removal from the two walls of the canal (amount and direction of transportation= *X*sup− *X*inf.

The data were statistically analyzed with. one-way analysis of variance (ANOVA) and Turkey's honest significant difference tests SPSS, version 15.0 :SPSS, Chicago, IL, USA).)(were performed to find any significant differences between groups and within each group.

3. Results

Centering ability: The mean of canal centering ability in (mm) at the different levels of all groups are shown in table (1) and figure (1).

Table 1: Centering Ability Means and Standard Deviation at Different Levels of All Groups. (D0 to D10) Measure Points (in mm From the Foramen)

	D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*D10*
Wave one instrument(group A)											
0^0angle											
Mean	0.657	0.685	0.773	0.775	0.673	0.534	0.360	0.352	0.274	0.256	0.261
±SD	0.005	0.004	0.014	0.073	0.019	0.699	0.016	0.011	0.020	0.015	0.015
(+45^0angle)											
Mean	0.845	0.842	0.078	0.743	0.655	0.549	0.343	0.360	0.452	0.368	0.492
±SD	0.010	0.012	0.014	0.013	0.013	0.011	0.015	0.012	0.014	0.019	0.004
(-45 ^{0}angle)											
Mean	0.947	0.952	0.882	0.840	0.754	0.748	0.446	0.457	0.448	0.466	0.454
±SD	0.004	0.009	0.026	0.077	0.006	0.004	0.013	0.013	0.180	0.015	0.012
one shape instrument (groupB)											
0^0angle											
Mean	0.671	0.671	0.788	0.760	0.728	0.553	0.366	0.348	0.254	0.249	0.138
±SD	0.015	0.022	0.064	0.027	0.015	0.016	0.016	0.020	0.038	0.012	0.012
(+45^0angle)											
Mean	0.852	0.867	0.861	0.880	0.753	0.660	0.448	0.348	0.360	0.356	0.383
±SD	0.123	0.814	0.848	0.118	0.316	0.148	0.121	0.125	0.120	0.173	0.895
(-45^0 angle)											
Mean	0.952	0.959	0.983	0.884	0.900	0.948	0.659	0.472	0.441	0.430	0.393
±SD	0.735	0.150	0.641	0.454	0.707	0.459	0.124	0.769	0.331	0.334	0.234
Hyflex instrument (group C)											
0^0angle											
Mean	0.458	0.444	0.554	0.559	0.659	0.454	0.362	0.369	0.179	0.160	0.137
±SD	0.019	0.014	0.210	0.020	0.023	0.022	0.045	0.052	0.016	0.016	0.061
(+45^0 angle)											
Mean	0.523	0.484	0.543	0.654	0.547	0.359	0.352	0.254	0.193	0.156	0.152
±SD	0.125	0.350	0.502	0.368	0.101	0.127	0.789	11963.000	0.271	0.849	0.686
(-45^0 angle)											
Mean	0.527	0.524	0.576	0.674	0.663	0.642	0.484	0.424	0.376	0.254	0.184
±SD	0.131	0.120	0.595	0.107	0.121	0.560	0.362	0.502	0.144	0.111	0.408
Trushape instrument (group D)											
0 ^{0} angle											
Mean	0.344	0.336	0.442	0.455	0.452	0.453	0.245	0.151	0.134	0.091	0.095
±SD	0.023	0.021	0.017	0.022	0.019	0.023	0.017	0.026	0.009	0.029	0.004
(+45^0 angle)											
Mean	0.315	0.325	0.470	0.437	0.443	0.427	0.257	0.138	0.134	0.122	0.999
±SD	0.532	0.549	0.405	0.110	0.132	0.987	0.629	0.534	0.105	0.984	0.961
(-45^0 angle)											

Mean	0.353	0.355	0.358	0.369	0.427	0.417	0.244	0.147	0.123	0.114	0.920
±SD	0.981	0.877	0.109	0.231	0.354	0.397	0.536	0.955	0.130	0.782	0.604

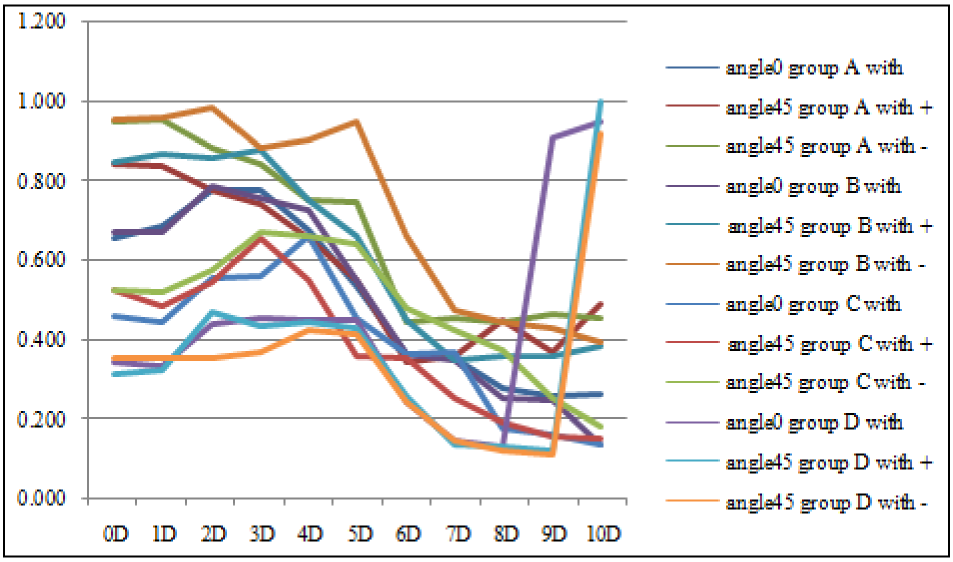

Figure 1: Line Chart of Centering Ability

Comparison between the groups

Analysis of variance (ANOVA) test was performed to identify the presence of any statistically significant difference among the means of canal centering ability of all groups. ANOVA test showed that there was a high significant difference ($p < 0.001$) among the groups. Further analysis of all data was needed to examine the difference between each two groups so Turkey's honest significant difference (HSD)test was performed for multiple comparison between groups. The result showed that macroscopic observation of the superimposed preoperative and postoperative photographs in all groups of this study reveled that the centering ability of group D(instrumentation by Trushape file) is statistically significant less canal centering value as compared with all other groups of this studyat most measuring point(D0 - D10), while group C (instrumentation by Hyflex file) has statistically significant less canal centering value as compared with as group A (instrumentation by Wave one instrument) and group B (instrumentation by One shape). At most measuring point(D0 - D10), while there was no statistical significant difference between group A and group B at all measuring points.

Comparison of canal centering ability within the groups (with different access angles)

Analysis of variance (ANOVA) test showed that there was statistical significant differences with all groups of this study with different access angles (0^o, $+45^o$ and -45^o). While the TukeysHSD test showed that there was statistical significant differences when compared the group D of different access angle at all measuring points and the results showed that the group D with 0^o access angle has less canal centering values than group D with ($+45^o$ and -45^o) access angle, while the group D with (-45^o) access angle has less canal centering values as compared with group D with ($+45^o$) access angle. Also the results showed that the group C with (-450 access angle at the measuring points (D0, D3, D 5,D6, D8, D9 and D10)has statistical significant differences less canal centering value as compared with ($+45^o$) access angle , while the canal centering values at measuring points (D1, D2, D 3,D4, D5, D8 and D10) there was statistical significant difference less canal centering with group C with (0^oangle as compared with group C with ($+45^o$and -45^o) access angles. Also the results of this study showed that the centering value of group A and group B with different access angles (0^0, $+45^o$ and -45^o) in most measuring points have no statistical significant differences except at points (D2 ,D3 and D4) there was statistical significant differences.

Canal transportation

The mean of canal transportation in (mm) at the different levels of all groups are shown in table (2) and figure (2).

Table 2: Canal Transportation and Standard Deviation at Different Levels of All Groups. (D0 to D10) Measure Points (in mm from the Foramen)

	D0	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*D10*
Wave one instrument(group A)											
0^0 angle											
Mean	0.256	0.244	0.332	0.466	0.447	0.522	0.502	0.358	0.261	0.249	0.223
±SD	0.157	0.536	0.334	0.417	0.129	0.503	0.286	0.460	0.578	0.833	0.135
($+45^0$angle)											
Mean	0.325	0.351	0.347	0.576	0.576	0.581	0.482	0.482	0.378	0.327	0.332
±SD	0.463	0.799	0.813	0.760	0.760	0.617	0.807	0.643	0.105	0.268	0.412
(-45^0 angle)											
Mean	0.432	0.521	0.451	0.536	0.585	0.539	0.437	0.455	0.422	0.457	0.422
±SD	0.320	0.112	0.562	0.249	0.264	0.353	0.420	0.357	0.501	0.375	0.529
one shape instrument (groupB)											
0^0 angle											
Mean	0.266	0.244	0.278	0.359	0.442	0.484	0.495	0.388	0.327	0.289	0.209
±SD	0.631	0.539	0.190	0.109	0.323	0.222	0.375	0.564	0.268	0.395	0.327
($+45^0$ angle)											
Mean	0.327	0.352	0.353	0.352	0.548	0.537	0.513	0.424	0.462	0.381	0.317
±SD	0.268	0.908	0.885	0.886	0.658	0.470	0.110	0.452	0.504	0.127	0.386
(-45^0angle)											
Mean	0.429	0.455	0.455	0.435	0.609	0.560	0.615	0.535	0.529	0.531	0.420
±SD	0.987	0.176	0.215	0.251	0.246	0.638	0.896	0.300	0.441	0.572	0.437
Hyflex instrument (groupC)											
0^0 angle											
Mean	0.247	0.247	0.335	0.384	0.388	0.483	0.384	0.280	0.247	0.151	0.160
±SD	0.101	0.157	0.882	0.402	0.931	0.671	0.295	0.628	0.652	0.600	0.520
($+45^0$ angle)											
Mean	0.282	0.248	0.382	0.391	0.484	0.435	0.292	0.282	0.251	0.276	0.144
±SD	0.444	0.478	0.642	0.316	0.846	0.236	0.521	0.146	0.499	0.543	0.408
(-45^0 angle)											
Mean	0.343	0.352	0.434	0.452	0.484	0.450	0.336	0.384	0.317	0.281	0.293
±SD	0.170	0.445	0.842	0.684	0.413	0.772	0.461	0.760	0.415	0.193	0.440
Trushape instrument (groupD)											
0^0 angle											
Mean	0.156	0.272	0.326	0.352	0.393	0.461	0.259	0.157	0.102	0.830	0.813
±SD	0.495	0.610	0.510	0.450	0.527	0.388	0.957	0.155	0.909	0.400	0.542
($+45^0$ angle)											
Mean	0.184	0.285	0.386	0.388	0.382	0.389	0.316	0.287	0.184	0.915	0.942
±SD	0.734	0.835	0.242	0.447	0.608	0.555	0.483	0.907	0.354	0.479	0.253
(-45^0 angle)											
Mean	0.213	0.316	0.436	0.387	0.392	0.420	0.386	0.343	0.283	0.134	0.134
±SD	0.133	0.319	0.489	0.578	0.699	0.125	0.340	0.542	0.447	0.566	0.158

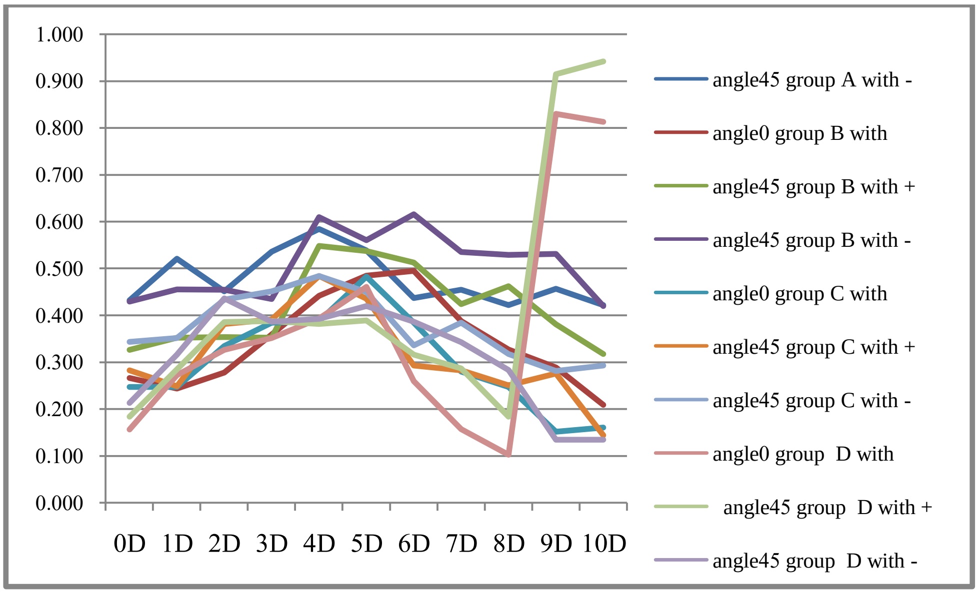

Figure 2: Line Chart of Canal Transportation

Comparison of canal transportation between the groups

Analysis of variance (ANOVA) test was performed to identify the presence of any statistically significant difference among the means of canal transportation of all groups. ANOVA test showed that there was a high significant difference ($p < 0.001$) among the groups. Further analysis of all data was needed to examine the difference between each two groups so Turkey's honest significant difference (HSD)test was performed for multiple comparison between groups. The result showed that macroscopic observation of the superimposed preoperative and postoperative photographs in all groups of this study reveled that the canal transportation of group A (instrumentation by Wave one file) is statistically significant differences as compared with Group Bat measuring points (D2, D3, D5, D8 and D9), with group C at measuring point(D3, D5, D6, D7, D9 and D10), and with group D at measuring point(D2 and D3). Also the results showed that the group B (instrumentation by One shape) has statistically significant differences as compared withGroup Cat measuring points (D1, D3, D5 and D10) , and with group D at measuring points (D1, D2, D3, D4,and D5), while the results of this study showed that the group C(instrumentation by Hyflex file) has statistically significant differences as compared with group D (Instrumentation by True shape) at the measuring points (D0, D6, D7, D8, D9 and D10).

Comparison of canal transportation within the groups (with different access angles):

The results of (ANOVA) test showed that there was statistical significant differences within all groups of this study with different access angles (0^o, $+45^o$ and -45^o),while the results of Tukeys HSD test showed that there was statistical significant differences less canal transportation in group D with (0^o) access angle as compared group D with ($+45^o$and -45^o)access angles. Also the results showed that the group D with ($+45^o$) access angle has statistical significant less canal transportation as compared with group D with (-45^o) access angle. this result is true for most measuring points except at points (D6, D7and D8), The results of Tuheys HSD test also showed that the group C with (0^o) access angle has statistically significant less transportation as compared with group C with ($+45^o$) access angle in most measuring points. Also the results showed that there was no statistical significant differences inthe canal transportation within different access angle (0^o, $+45^o$ and -45^o)of group A andthe same results for group B when comparison done within different access angle(0^o, $+45^o$ and -45^o)the result was no statistical significant differences in the canal transportation except at measuring point (D3 and D5) there was statistical significant differences.

4. Discussion

Many factors have an impact on the incidence of canal transportation and centering ability like root anatomy, file design, alloy of the endodontic instrumentation files ,and technique[18,19,20] ,thus less taper of the endodontic instrumentation files caused less canal transportation and more centering ability [21,22] and this factor have great impact on this study.

From the result of this study it showed that Trushapefile gave the more canal centering (less centering values) as compared with the other files of tested groups then followed by hyflex file with a significant difference and then followed by Wave one file and Oneshapefile. This is may be due to that the True shape file has unique S-shape design, allowing it to conform to areas of the canal larger than the nominal file size. TRUShape 3D Conforming Files allow preserving more dentinal structure while removing pulp and debris along the entire root canal. Their unique shape and motion provide superior overall shaping over conventional ISO rotary files even as they remove less dentin, less transportation and more canal centering ,. The other reason is the .taperness of the files as Trushape has 0.06 variable reduced taper.

Also the result shows that hyflex file has more canal centering than Wave one and One shape files and this is may be due HyFlex® CM™ NiTi files have been manufactured with a unique process that controls the material's memory, making the files extremely flexible. [23]. This increases the ability of the file to follow the anatomy of the canal very closely, and reduces the risk of ledging, transportation and perforation.[23]. Also in the sequence of HyflexCM have a taper of .04 and OneShape of .06, whereas Wave One is characterized by a taper of .08 over the first 3 mm from the tip.

Wave one and one shape have less canal centering and more canal transportation than other files of this study this may be due to canthe increased taper over the first 3 mm, may result inless flexibility than the other files of the same tip size. This result in most instruments tended to straighten especially the apical curvature of S-shaped canals is corroborated by several studies [23,24,25].

Also the result of this study showed that group A(wave one)has more canal transportation than group B(oneshape)at (D2,D3,D5) and that's mean in the apical and slight middle part and less canal transportation at(D9,D8) and that's mean in the coronal part and that may be due that the WaveOne is characterized by a taper of .08 over the first 3 mm from the tip. This observation can be explained by the increased taper at the tip region of this instrument. Because of its greater taper over at the first 3 mm, they appear to be less flexible than the other files of the same tip size. This finding may cause the most instruments tended to straighten especially the apical curvature of S-shaped canals is corroborated by several studies [23,24,25], Also the use of the controlled memory wire (CM alloy) exerted a positive effect on the shaping effects, because in a previous studydone by Berroughs JRet al ,2013 [22], Typhoon rotary files with CM wire (DS Dental, Johnson City, TN) showed satisfactory results when enlarging S-shaped canals. And that's why we have less canal transportation in the coronal part.

Also group A (wave one) has more canal transportation than group C(hyflex) at most points(D5,D6,D7,D9,D10). And also more canal transportation than group D (TRUShape) at(D2,D3).and that's because of its more taper result in more ridgedfile than the other files.

From the results we can conclude that group B (one shape), has less canal transportation than group C(hyflex) at(D1,D3) that's mean in the apical part , and more canal transportation than group C at(D5,D10) , means in middle and coronal part. Also groupB has less canal transportation than group D (trushapefile) at (D1,D2) that's mean in the apical part, and more canal transportation than group D at (D4,D5) which means in the middle part . this may due to that one shape file is more flexible causing less canal transportation than all other tested files of this study in the apical part and more ridged in the middle and coronal partand that's may be due to its alloy and its fabrication.

Also the results showedthat group C(hyflex), has more canal transportation than group D (Trushape file), at (D0,D6,D7,D8,D9,D10), and that may be due to the unique S shape file with 32%less transportation and more preserving tooth structure.

Alsotheresults of this study showed that the group D And group C both have less canal transportation in 0 acessange than +45 and -45 acess angle and group A and B have no significant difference between 0 and -45or +45 acess angle. This mean that both Hyflexfile and Trushapefile are not fixed files ,they changed their shape so they canaffected on canal centering transportation by changing access angles while Wave one file and Trushapefile are more fixedfiles their shape show no change during instrumentation thus show no affect with changing access angles .

The Wave one instruments are designed to work with a reverse cutting action. All instruments have a modified convex triangular cross-section at the tip end and a convex triangular cross-section at the coronal end .This design improves instrument flexibility overall. The tips are modified to follow canal curvature accurately. The variable pitch flutes along the length of the instrument considerably improve safety .While The One shapefilehas three different cross-section zones. The first zone presents a variable 3-cutting-edge design. The second, prior to the transition, has a cross-section that progressively changes from 3 to 2 cutting edge .

Guided down the glide path by 3 cutting edges, One Shape®'s flexibility assures a perfect respect to the original canal path and curvature. n One Shape®'s variation of cross-sections offers an optimal cutting action in 3 zones of the canal. n The variable pitch of One Shape® reduces instrument screwing effects. n ABC (Anti Breakage Control) is a safety bonus: the instrument will unwind to cutting edges. The last (coronal) is provided with 2 cutting edges.[26]

True shape unique S-shape design, allowing it to conform to areas of the canal larger than the nominal file size. This creates an envelope of motion that better disrupts biofilms for improved 3D conforming difference. The S-shape While Hyflexfile has variable Cross Section Design Almost triangular cross section at top, Trapezoidal cross section in middle, Quadratic cross section at tip.

5. Conclusion

Instrumentation by Trushape file has less canal centering value as compared withall other groups of this study at most measuring point, while instrumentation by Hyflex file has less canal centering value as compared with other groups at all measuring points.Also the results showed that 0^0 access angle has less canal centering values than with (+45^o and -45^o) access angles in most instrument types of this study. The results of this study reveled that the canal transportation in canal instrumented by Wave one file has less values as compared with other groups at most measuring points. Also the groups with (0^o) access angle has less canal transportation ascompared groups with (+45^{o}and -45^o)access angles. Also the results showed that the groups with (+45^o) access angle has less canal transportation as compared with groups with (-45^o) access angle. at most measuring points.

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