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Shaping Ability of Two Different Nickel-Titanium Rotary Instruments of Two Different alloys (In Vitro Study)

[1]Hassan Mohamed El Sayed Saleh, [2]Mohamed Mokhtar Nagy, [3]Tariq Yehia
[1]B.D.S Faculty of Dentistry
[2]Associate Professor of Endodontic, Faculty of Dentistry, Ain Shams University
[3]Lecturer of Endodontic, Faculty of Dentistry, Ain Shams University

Abstract
Background: *Root canal shaping is a crucial procedure in endodontic treatment that influences the subsequent steps of root canal disinfection and obturation. Each clinical situation is different and unique, but the final goal remains identical, which is to preserve the natural tooth functional, asymptomatic and achieve proper canal disinfection.*
Materials and Methods: *Forty human permanent mandibular first molars were selected with mature apices having angles of curvature of the mesiobuccal canals ranging between 20° to 40° degrees from the buccal view. Samples were randomly and equally distributed into two groups each of text according to the system used for mesiobuccal canal preparation Cone beam computed tomography was used to evaluate angle of canal curvature and dentin thickness pre and post instrumentation. Dentin thickness was measured at three different levels 3,6 and 9 mm from the apex at axial view using measuring tool.*
Results: *Results showed that there was no statistically significant difference between different groups regarding percentage of reduction of canal curve, canal transportation and canal centering.*
Conclusion: *Both systems one curve and Hyflex EDM maintained the canal terminus and coronal curvature and the original canal anatomy. There is no difference between one curve and Hyflex EDM groups regarding percentage of reduction of canal curve, canal transportation and canal centering.*

Keywords: *ONE CURVE, HyFlexEDM*

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I. Introduction

Root canal shaping is a crucial procedure in endodontic treatment that influences the subsequent steps of root canal disinfection and obturation. Each clinical situation is different and unique, but the final goal remains identical, which is to preserve the natural tooth functional, asymptomatic and achieve proper canal disinfection.

The preferred shape of the canal after mechanical shaping is a tapering funnel following the original shape and curvature of the canal, while keeping the original position of the foramen, and keeping it as small as practically possible. It is influenced not only by the clinician's experience, but also by the complexity of the root canal anatomy, as well as the clinician's armamentarium.

Nickel-titanium (NiTi) rotary endodontic instruments were introduced to facilitate instrumentation of curved canals. Ni-Ti instruments are superelastic and could flex far more than stainless steel instruments before exceeding their elastic limits. Technological advances led to dramatic improvements in the ability to shape root canals with fewer complications.

II. Materials And Methods

Materials

ONE CURVE™.

It is manufactured from heat-treated Nickel-Titanium alloy(C-wire). One Curve(OC) is a single-use, rotary file that enables shaping of the full length of the canal with a single instrument. the system is provided in three files one flare, one G and one curve. one flare size 25 taper .09 as an orifice opener enlarging the coronal portion. One G size 14 taper .03 as a glide path to reach the apex.one curve size 25 with taper .06 to shape the canal. One Curve is a single file system working with continuous rotation movement and produced by using different heat treatment procedures. OC is a new-generation root canal file, which was recently introduced to the market by manufacturer and is produced with C-Wire heat treatment technology. The manufacturer declares that this technology offers 33% faster root canal preparation in comparison to the reciprocating single-file systems and thus the clinicians would have more time for irrigation**.**

HyFlex® EDM

HyFlex EDM are 5th-generation NiTi rotary endodontic files fabricated using Electrical Discharge Machining (EDM) technology, which hardens the surface of NiTifile.***HyFlex EDM*** is provided as a pre-sterilized modular system that includes Shaping, GlidePath, OneFile, Orifice Opener, and Finishing files. ORIFICE OPENER size 25 taper 0.12

Glidepath Filesize 10 taper0.05 and OneFile size 25 variable taper and Variable Cross Section Design

Almost triangular cross section at top,Trapezoidal cross section in middle and Quadratic cross section at tip.0ptional HyFlex EDM Finishing Set 40/.04; 50/.03; 60/.02.

HEDM, however, works with continuous rotation movement and is made of controlled memory (CM) by using the electronic discharging machining (EDM) technology. This method is based on shaping the file by melting and vaporizing the material through the electrical discharges. Electronic discharging machining technology was reported to give the file a crater-like appearance and an increased resistance to cyclic fatigue.

Methods

A-selection of samples:

Forty human permanent mandibular first molars were collected from the outpatient clinic of oral surgery department at Ain shams university with mature apices having angles of curvature of the mesiobuccal canals ranging between 20° to 40° degrees from the buccal view (according to the method described by Schneider)[(1)] used in this study. Teeth were cleaned from any calculus deposits with ultrasonic scalers, and then kept in 5.25% sodium hypochlorite for 30 minutes to remove any soft tissue and organic debris. Teeth were then stored in 0.9% normal saline until they were used. The selected molars were chosen to have mature apices without root defects or abnormal morphology.

B-Samples classification

Forty teeth were divided into two equal groups according to the instrument used.

- **Group OC (n=20):** preparation of the canals was made with one curve**.**
- **Group HEDM (n=20):** preparation of the canals was made with HyFlex EDM.

C-Preparation of samples:

1) Access cavities were prepared for all teeth using a high speed hand piece with round bur and tapered fissure bur. Teeth lengths were determined by introducing k-file size 10 into the canal till the tip of the file was seen flushing with the apex under magnification with loupes 4.0x. The working length was then calculated by subtraction of one mm from the tooth length. After length determination, file #10 followed by file #15 were used to ensure for canal patency. Irrigation was done using 5 ml of 2.5% sodium hypochlorite. The teeth were divided across 2 groups, where teeth in each group were mounted in 3 self-cured acrylic resin blocks to form a 10cm width X 10 cm depth acrylic block. All of the teeth are placed with the buccal side facing the front side of the block. After placing and fixing the teeth in acrylic resin blocks, pieces of guttapercha were placed at the corner of the acrylic resin block to determine the beginning of the teeth. The teeth were then scanned for pre-instrumentation images.

2) Pre-instrumentation imaging:

The acrylic block was placed on the chin support of CBCT machine standardization during imaging was achieved through adjusting the patient positioning lights as follows:

The seat height was adjusted to position the region of interest (ROI) vertically within the field of view (FOV). The upper light beam indicated the top of the FOV and the lower light beam indicated the bottom of the FOV. The sagittal light (Vertical front light) was positioned in the center of the FOV from sagittal direction so that it is in the center of the ROI. The lateral light (vertical side light) was positioned in the center of the FOV in the lateral direction so that it is in the center of the ROI. The lateral light (vertical side light) was positioned in the center of the FOV in the lateral direction so that it is in the center of the ROI. A scout view was obtained and adjustments were made to ensure that all samples were correctly aligned in the scanner according to adjustment light beam before acquisition. The machine is supplied with Amorphous Silicon Flat Panel Sensor with Cesium Iodide (CsI) scintillator, 0.5mm focal spot size, 14 Bit gray scale resolution, and operating at the following protocol for all the scans of the study. The tube voltage was 85 KVP, 15 mAsmilliamperes, with voxel size 0.125mm, the scanning time was 20 seconds and the field of view was 6 cm height * 8 cm diameter. After acquisition data were exported and transferred in DICOM format and downloaded via a Compact Disk (CD) to a personal computer for analysis, where, OnDemand 3d App software was utilized linear measurement.

3) Instrumentation

One curve (Group OC)

Initial penetration of the canal using #10 and #15 k files lubricated with EDTA for patency and to ensure glide path to full working length and canal patency confirmed with a size 10 k-file. Before instrumentation 5 ml of sodium hypochlorite was introduced in canal. One flare (#25 /.09) used with up and down motion without pressure in the coronal one third at operating speed of 300 rpm and torque 3 N.cm. Irrigation with 5 ml of NAOCL was performed 3 mm shorter than working length. One G (#14 /.03) used with up and down motion without pressure in the coronal one third at operating speed of 400 rpm and torque 1.5 N.cm. Irrigation with 5 ml of NAOCL was performed 3 mm shorter than working length. One Curve files at speed of 300 rpm, 2.5 N/cm torque according to manufacturer's instructions using direct downward movement in three waves till reaching the working length.

Hyflex EDM (Group HEDM)

Initial penetration of the canal using #10 and #15 k files lubricated with EDTA for patency and to ensure glide path to full working length and canal patency confirmed with a size 10 k-file.

Before instrumentation 5 ml of sodium hypochlorite was introduced in canal. ORIFICE OPENER (#25 /.12) used with up and down motion without pressure in the coronal one third using an endo motor at operating speed of 400 rpm and torque 2.5 N.cm. Irrigation with 5 ml of NAOCL was performed 3 mm shorter than working length. Glidepath Filesize 10 taper0.05 (#10 /.05) used with up and down motion without pressure in the coronal one third at operating speed of 300 rpm and torque 1.8 N.cm. Irrigation with 5 ml of NAOCL was performed 3 mm shorter than working length. OneFile (#25/~) at speed of 400 rpm, 2.5 N/cm torque according to manufacturer's instructions using direct downward movement in three waves till reaching the working length.

4) Post instrumentation imaging:

All the samples were be scanned with CBCT and the images were stored for post-instrumentation measurements.

D-Methods of evaluation

1. Evaluation of angle of curvature:

Comparison between pre and post instrumentation CBCT images was made to determine the change in the angle of curvature before and after instrumentation according to Schneider method. The Schneider's method involves making a point at the level of canal orifice. A straight line was drawn from point (A) to point (B), a third point (c) was made at the apical foreman and a line was drawn from this point to (b). The angle formed by the intersection of the lines was measured as the canal curvature. The angle formed at the pre-instrumentation image was compared to the post-instrumentation one.

Percent of reduction of canal curvature was calculated according to following equation:

$$\frac{pre\ instrumentation\ measurement - post\ instrumentation\ measurment}{pre\ instrumentation\ measurement} x100$$

The greater the percentage the more change happened.

2-Evaluation of canal centering:

Remaining dentine thickness for both the groups is the shortest distance from the canal outline to the closest adjacent root surface was measured at each three levels 3, 6 and 9 mm in a mesio distal direction and bucco lingual direction.

According to **Gambill *et al*** **[2]** the mean centering ratio indicates the ability of the instrument to stay centered in the canal. This ratio was calculated for both the groups at each level using these two equations:

For dentin thickness, OnDemand3d App software was employed to superimpose preoperative and postoperative scans, hence guaranteeing measuring dentin thickness at the exact level. Fusion module was used to superimpose the postoperative scan over the preoperative one, where automatic registration performed by the software. Superimposition sequence was repeated for each group individually. After fusion of pre-operative and post-operative scans, at any plane, both scans were being reconstructed at the same layer. For measuring dentin thickness, the apex of a tooth was located, and then, three vertical lines of lengths, three, five and seven millimeters, were drawn from the apex upwards. Axial levels assigned for recording dentin thickness were decided by the end of each of these three lines. At each axial image dentin thickness at mesial, distal, buccal and lingual aspects of the canal lumen were measured at both scans simultaneously. The procedures were repeated at the three axial levels for each tooth. The same technique was utilized to measure the root curvature using Schneider method, where preoperative and postoperative scans of theeach tooth were viewed at the sagittal view to measure curvature at both scans.

Statistical analysis:

Numerical data were explored for normality by checking the data distribution, calculating the mean and median values and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data showed parametric distribution so; it was represented by mean and standard deviation (SD) values. Intergroup comparisons were done using independent t-test, while intragroup comparisons were done using one-way repeated measures ANOVA followed by bonferroni post hoc test. The significance level was set at $p \leq 0.05$ within all tests. Statistical analysis was performed with IBM® SPSS® Statistics Version 26 for Windows.

III. Results

In this chapter results of shaping ability are presented in three parts:

1) Canal curvature
2) Canal transportation (BL &MD)
3) Centering (BL&MD)

Table (1): Mean ± standard deviation (SD) of measurements of root canal curvature for different groups

Time	Root canal curvature (mean±SD)		p-value
	OC	HEDM	
Pre-operative	21.24 ± 6.34	20.92 ± 5.57	**0.869 ns**
Post-operative	19.69 ± 5.64	19.51 ± 4.55	**0.916 ns**
p-value	**0.074ns**	**0.137ns**	

* significant ($p \leq 0.05$) ns; non-significant ($p>0.05$)

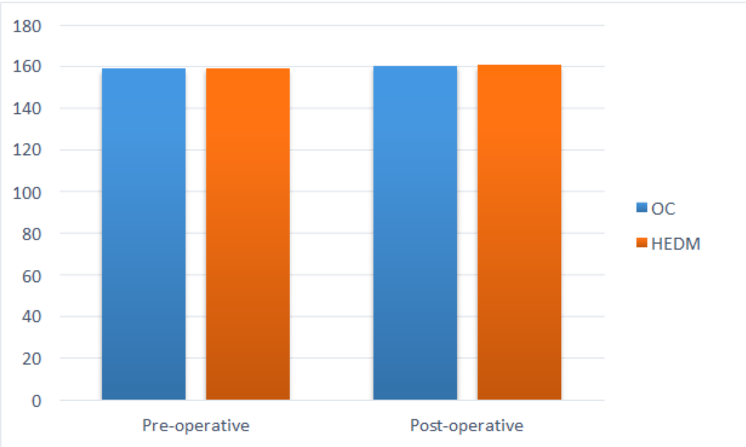

Figure (1): Bar chart showing average measurements of canal curvature for different groups

Table (2): Mean ± standard deviation (SD) of centering ratio (bucco lingual) for different groups

Section	Centering ratio (mean±SD)		p-value
	OC Group	HEDM Group	
3 mm	0.24±0.21	0.35±0.27	**0.147 ns**
6 mm	0.37±0.27	0.27±0.25	**0.253 ns**
9 mm	0.35±0.27	0.28±0.29	**0.407 ns**
p-value	**0.289ns**	**0.567ns**	

*; significant ($p \leq 0.05$) ns; non-significant ($p>0.05$)

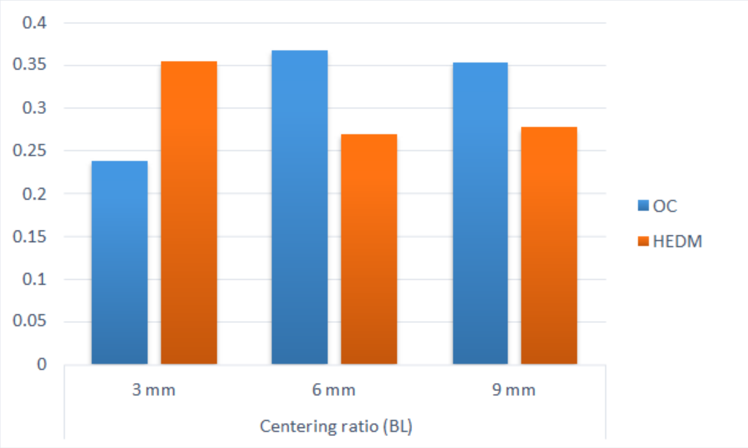

Figure (2): Bar chart showing average centering ratio (bucco lingual) for different groups

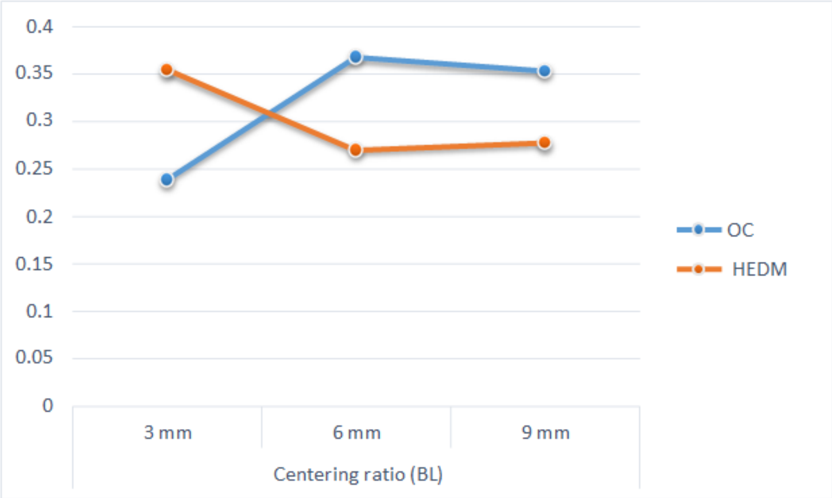

Figure (3): Line chart showing average centering ratio (BL).

IV. Discussion

The goal of root canal therapy is to remove the infected pulp and to prevent or resolve apical periodontitis through proper cleaning, shaping, disinfection and sealing of the root canal system. Schneider stated that the most important phase of endodontic treatment is cleaning and shaping of the root canal system. Besides other anatomical variations root canals are rarely straight and have a varying degree of curvature along their length, hence the instruments used for cleaning and shaping them can become stressed as the degree of curvature increases. [(1)]

Root canal instruments have evolved over time, from annealed piano wire instruments made by Fouchard in 1746, to the use of Nitinol orthodontic wire to fabricate endodontic files by Walia et al in 1988. Now a days, there are numerous rotary NiTi file systems available. [(3)]

Rotary NiTi instruments are manufactured with various tapers that facilitate achievement of a continuously tapered funnel shape canal preparation. These instruments have been shown to be well suited for use in curved root canals. [(4,5)].

The purpose of this study was to compare the shaping ability of different Nickel Titanium rotary file systems of different alloys regarding canal curvature, canal centering ability and canal Transportation.

One Curve and HyFlex EDM were chosen in this study because they are single file systems working with continuous rotation movement and produced by using different heat treatment procedures. OC is a new-generation root canal file, which was introduced to the market by manufacturer and is produced with C-Wire heat treatment technology. The manufacturer declares that this technology offers 33% faster root canal preparation in comparison to the reciprocating single-file systems and thus the clinicians would have more time for irrigation.

HEDM is made of CM by using EDM technology. This method is based on shaping the file by melting and vaporizing the material through the electrical discharges. EDM technology was reported to give the file a crater-like appearance and an increased resistance to cyclic fatigue. [(6,7)]

In this study, human natural teeth were used. Human teeth have the privilege of simulating clinical conditions as irregular root canal anatomy, variable degrees of curvature and dentine Also, having a concave distal surface makes them more susceptible to strip perforation. [(8)] Human mandibular permanent teeth were preferred than the simulated resin acrylic blocks, as the latter do not reproduce the anatomic variations and the micro hardness of the dentinal walls inside the root canals.

The angle of curvature of the mesio buccal canals were measured using Schneider's method. Many previous studies have used the Schneider's method for the determination of root canal curvature as it showed reliability and accuracy. [(9,10)]

A variety of methodologies have been used to evaluate the shaping ability of endodontic instruments, including simulated root canal models, decalcification techniques, sectioning techniques, and radiographic comparison, but the limitations of these techniques have led researchers to look for new methods that can produce more accurate results. [(11)]

CBCT is a three-dimensional imaging system. CBCT overcomes most of the limitations accompanied by conventional radiography like two-dimensional imaging, anatomic super imposition and image distortion. CBCT produces clear images with higher resolution, therefore useful tool in assessment of canal shaping and canal anatomy. [(12)]

Micro–computed tomography (micro-CT) is a powerful tool for ex vivo evaluation of root canal morphology because it is accurate as anatomic sectioning. It enables analysis of volume changes, cross-sectional shape, taper, and proportion of prepared surface by matching reconstructed sample volumes of preoperative and postoperative canal systems. [(13)]

CBCT can be as accurate as micro-CT in the assessment of several morphological features of extracted human permanent teeth; however, there are some exceptions related to the more detailed morphological aspects. Voxel size likely influences the ability to detect these features, though the different aspects of exposure setting used in studies components may be confounding factors. CBCT may be considered for the assessment of root canal morphology ex-vivo. [(14)]

The use of CBCT provide non-aggressive 3D information from the preoperative and postoperative images of the cross-section of root canal at different levels that can also be easily superimposed in 3D facilitates the evaluation of the significant parameters of root canal preparation. [(15)]

For evaluation of canal curvature, centering and transportation the levels (3, 6, 9mm) were selected from apex towards coronal, representing the apical, middle and coronal levels of the root canal respectively [(2,16,17)] This allowed the evaluation of the curvature, transportation and centering ability of the tested rotary file systems at different root levels.

Regarding the effect on canal curvature both groups showed non-significant difference. The highest mean value was found in OC, while the least mean value was found in HEDM. This is because of HEDM based on 'Controlled memory' which retain their shape in curved canals and do not possess the 'Spring back action', in contrast to the classical 'Shape memory' one. One curve also based on 'Controlled memory'. The file that is manufactured from heat-treated Nickel Titanium alloy (C. Wire). The manufacturer claims, this file has a unique manufacturing technique that implemented by MICRO-MEGA for developing a controlled memory NiTi files that can be pre-bend for easier instrumentation of the root canal and elimination of difficulties. And the Hyflex EDM with a variable taper but one curve with a constant taper 0.06. And this is in contrast with Gomaaet al (2021)[(18)] study which showed that At the canal terminus and coronal curvature, OC and HEDM caused significantly less canal transportation than PTN, with no significant differences between OC and HEDM .

Al-Asadi, et al (2018) [(19)] compared shaping ability between Hyflex EDM, Reciproc blue and One Shape they found that At 3 mm there was a significant difference among the group in the BL direction and the HEDM groups how the highest centering ratio values and the data revealed no significant difference at the other levels. [(8)] It is worth noting that both OC and One Shape have approximately design features despite their different alloy types).

Regarding to canal transportation, the highest value was found in OC group while the least in HEDM group.

This can be a result of the variable quadratic cross section at the tip of the HEDM which enable the file to progress in the root canal .

On the other hand, at 9mm from the apex highest value was found in HEDM group while the least in OC group. this can be a result of the taper of the one flare (.09) smaller than the taper of the orifice opener of HEDM (.12) while having the same size 25. this is agreed with Bal et al(2021)[(20)] that showed no significant difference between the apical transportation values of one curve, Hyflex EDM and wave one gold groups in MD direction and BL direction at all level apical, middle and coronal.

In Al-Asadi et al (2018) [19] study At 3 mm, the results showed that there were no significant differences among Hyflex EDM, Reciproc blue and OneShape groups regarding the canal transportation. This could be attributed to thae fact that all the tested systems have a non-cutting tip; which functionally work as a guide to allow easy penetration with minimal apical pressure, and the standardized master apical file size. While at At 6 mm there was a significant difference among the groups regarding canal transportation and this may be due to two factors; first, the tooth related factors as this region represents the beginning of curvature where the file flexesand bends. Second factor is the file related factors, which includes to the design of the file such as cross section, taper, and metallurgy. [8]

V. Conclusion

Both systems one curve and Hyflex EDM maintained the canal terminus and coronal curvature and the original canal anatomy. There is no difference between one curve and Hyflex EDM groups regarding percentage of reduction of canal curve, canal transportation and canal centering.

References

[1]. **Schneider S.** A comparison of canal preparations in straight and curved root canals. Oral surg, Oral med, oral path. 1971 1; 32(2):271-5.

[2]. **Gambill J, Alder M, Carlos E.** Comparison of nickel-titanium and stainless steel hand-file instrumentation using computed tomography. J Endod. 1996 1; 22(7):369-75.

[3]. **Azad, Akash&Chokshi, Shraddha& Shah, Shashin&Pandya, Mihir& Patel, Soham&Vaidya, Rupal.** Comparative Evaluation of the Shaping Ability of Nickel Titanium Rotary Instruments in curved canals, Protaper Next vs Twisted File an In-Vitro Study.J Res Adv Dent 2017; 6:1s:250-258.

[4]. **Peters O.** Current challenges and concepts in the preparation of root canal systems: a review. J Endod. 2004; 30(8):559-67.

[5]. **Hülsmann M, Peters O, Dummer P.** Mechanical preparation of root canals: shaping goals, techniques and means. Endodontic Topics. 2005; 10(1):30-76.

[6]. **Pedulla E, Lo Savio F, Boninelli S, Plotino G, Grande N, La Rosa G, Rapisarda E.** Torsional and Cyclic Fatigue Resistance of a New Nickel-Titanium Instrument Manufactured by Electrical Discharge Machining. J Endod 2016; 42:156-159.

[7]. **Yılmaz K, Uslu G, Özyürek T.** Effect of multiple autoclave cycles on the surface roughness of HyFlex CM and HyFlex EDM files: an atomic force microscopy study. Clin Oral Investig 2018; 9:2977-2980.

[8]. **Avina Paranjpe B.** A micro-computed tomography-based comparison of the canal transportation and centering ability of ProTaper Universal rotary and WaveOne reciprocating files. Quintessence Int. 2014;45(2):101-8.

[9]. **Gergi R, Rjeily JA, Sader J, Naaman A.** Comparison of canal transportation and centering ability of twisted files, Pathfile-ProTaper system, and stainless steel hand K-files by using computed tomography. J Endod. 2010 1; 36(5):9047.

[10]. **Versiani M, Pascon E, de Sousa C, Borges M, Sousa-Neto M.** Influence of shaft design on the shaping ability of 3 nickel-titanium rotary systems by means of spiral computerized tomography. Oral Surgery, Oral Med, Oral Pathol, Oral Radiol, and Endod. 2008; 105(6):807-13.

[11]. **Stavileci M, Hoxha V, Görduysus Ö, Tatar I, Laperre K, Hostens J, Küçükkaya S, Muhaxheri E.** Evaluation of Root Canal Preparation Using Rotary System and Hand Instruments Assessed by Micro-Computed Tomography. *Med Sci Monit Basic Res*. 2015;21:123-130

[12]. **Meena N and Kowsky R.** "Applications of Cone Beam Computed Tomography in Endodontics: A Review". Dentistry 04.07 (2014): 2-9.

[13]. **Pasqualini D, Alovisi M, Cemenasco A, Mancini L, Paolino D, Bianchi C, Roggia A, Scotti N, Berutti E.** Micro-Computed Tomography Evaluation of ProTaper Next and BioRace Shaping Outcomes in Maxillary First Molar Curved Canals. J Endod. 2015; 41(10):1706-10.

[14]. **Borges CC, Estrela C, Decurcio DA, PÉcora JD, Sousa-Neto MD, Rossi-Fedele G.** Cone-beam and micro-computed tomography for the assessment of root canal morphology: a systematic review. Braz Oral Res. 2020;34: e056.

[15]. **NurB G, Ok E, Altunsoy M, Aglarci OS, Colak M, Gungor E.** Evaluation of the root and canal morphology of mandibular permanent molars in a south-eastern Turkish population using cone-beam computed tomography. Eur J Dent. 2014; 8(2):154–59.

[16]. **van der Vyver P, Paleker F, Vorster M, de Wet FA.** Root Canal Shaping Using Nickel Titanium, M-Wire, and GoldWire: A Micro-computed Tomographic Comparative Study of One Shape, ProTaper Next, and WaveOne Gold Instruments in Maxillary First Molars. J Endod. 2019; 45(1):62-67.

[17]. **Xu X, Eng M, Zheng Y.** Comparative study of torsional and bending properties for six models of nickel-titanium instruments. Int Endod J. 2001;34(8):372-5.

[18]. **Gomaa M, Osama M, Badr A.** Shaping ability of three thermally treated nickel-titanium systems in S-shaped canals. Aust Endod J 2021.

[19]. **Al-Asadi A, Al-Hashimi R.** In-vitro Assessing the Shaping Ability of Three Nickel-Titanium Rotary Single File Systems by Cone Beam Computed Tomography. International Journal of Medical Research & Health Sciences, 2018, 7(2): 69-74

[20]. **Bal E, Gunes B, Bayrakdar I.** Comparison of root canal shaping ability of different heat-treated NiTi single files: a micro-CT study. Quintessence Int. 2021 Oct 1; 0(0):2-11.

1Hassan Mohamed El Sayed Saleh, et. al. "Shaping Ability of Two Different Nickel-Titanium Rotary Instruments of Two Different alloys (In Vitro Study)." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(10), 2022, pp. 62-68.