Original Article

Radiographic Comparison Between Shaping Ability of Reciprocating WaveOne Primary Files and Rotary ProTaper Gold Files in Curved Mesial Root Canals of Mandibular 1st Molars: An In Vitro Study

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ABSTRACT

Objective: The objective of this study is to evaluate the shaping capabilities of the ProTaper Gold Rotary file system and the WaveOne Gold Reciprocating file system in curved mesial root canals of extracted mandibular first molars, regarding the change in canal angle.

Study Design: Experimental Study (In-vitro)

Place and Duration of Study: This study was conducted at the department of Operative Dentistry, Sindh Institute of Oral Health Sciences, JSMU, Karachi from January 2020 to December 2022.

Methods: Total 60 extracted mandibular 1St molars teeth were included and divided into two groups. ProTaper Gold files (Dentsply Sirona, Switzerland) were used to shape Group 1 at the working length and group 2 was shaped with WaveOne Gold reciprocating files (Dentsply Sirona, Switzerland) according to manufacturer's instructions.

Results: Mean±SD of canal straightening (change in canal angle) was noted as 3.28±1.24 v/s 2.91±1.42 among WaveOne Gold Reciprocating file system vs the ProTaper Gold Rotary file system & p-value was found to be non-significant i.e. (p=0.286).

Conclusion: It is to be concluded that the shaping ability of Wave One Gold Reciprocating file system and the Pro Taper Gold Rotary file system in curved mesial root canals in extracted mandibular 1st molars was similar considering change in angle of canal. It will take more prospective, carefully monitored randomised studies to confirm the present findings.

Key Words: Mesial Root Canals, Pro Taper, Shaping Ability, Wave One

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INTRODUCTION

In endodontics, the most crucial stage is cleaning and structuring the root canal system. Preservation of integrity of canal during shaping is required to prevent unnecessary removal of root dentin that may weaken the tooth. In curved canals many iatrogenic errors for instance apical canal transportation, uncentered preparation, ledge formation or perforation can occur.[1, 2] Minimal change in canal shape is an important requirement with progression and advancement of filing systems. In comparison to conventional cleaning and shaping, NiTi rotary system has made major change in endodontics. Specially designed nickel titanium (NiTi) files helped the clinician to prepare curved canals more predictably as compared to conventional techniques. A new reciprocating single-file method recently came to light, promising to prepare canals with just one file and with a lower risk of contamination and instrument separation.[3]

Many studies have been conducted to determine the filing systems that produce less modifications in curved canals. Stringheta et al found no difference in shaping ability of Waveone Gold, Protaper Next, Reciproc and Prodesign Logic when studied on micro-computed tomography.[4] Few other studies that were conducted reached at a conclusion that all system (WaveOne, WaveOne Gold, ProTaper Gold, Reciproc, Mtwo,

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ProTaper Next, RaCe and BioRaCe) are similar in respect to centering ability and transportation and no significant differences were found regarding canal straightening.[5-8] Van der Vyver et al found WaveOne Gold better than Protaper Next in canal shaping.[1] The shaping ability of ProTaper and waveOne primary when compared in stimulated canal by few researchers concluded that waveone produce less modifications in canal.[9-10] When these different filing systems were compared in extracted teeth on CBCT, better result of Waveone than Protaper were seen.[11,12] Yet there are many researches that supports the better shaping ability of Protaper and found it better than Waveone in centering ability and transportation.[3,13-17]

The rationale of this study was to compare ProTaper gold and waveone filing system to aid in finding the best system to use in curved canal and preserve the canal's original shape. Studies that have been performed previously are giving mixed results and no conclusive statement has been achieved. Further studies are still required to find out better filing system in the curved canals.

METHODS

Sixty extracted mandibular 1st molars, with curved mesial canals, meeting the inclusion criteria (Curved mesial canals of mandibular 1st molar, fully formed roots, Angle range 20-30°), were selected from the collection of teeth obtained from the Oral Surgery Department of SIOHS, JSMU. As the teeth was extracted for caries, orthodontic or periodontal reasons, not specific for the study, so the Jinnah Sindh Medical University Institutional Review Board has granted the exemption Teeth was stored in 0.2% Thymol solution until use. Mesial root was sectioned and separated at cementoenamel junction from remaining tooth structure using diamond rotary cutting instrument (Mani, Tochigi, Japan). The #10 stainless steel (SS) K type file (Mani, Tochigi, Japan) was used to create the glide path. An initial digital radiograph (PSPIX2, ACTEON, SOPRO, France) was taken with #2 sensor (ACTEON, SOPRO, France) using 10# K type stainless steel file (Mani, Tochigi, Japan) at working length (figure#7). Teeth with angle range 20-30° were included in the study, as determined by Schneider method (figure#6). Teeth was then divided into two groups. ProTaper Gold files (Dentsply Sirona, Switzerland) were used to shape Group 1 at the working length and group 2 was shaped with WaveOne Primary reciprocating files (Dentsply Sirona, Switzerland) according to manufacturer's instructions. Canals were instrumented along with sodium hypochlorite irrigant 2.5% (Endosol, Pakistan) and EDTA 17% (Meta Biomed, Korea). After instrumentation, the specimens were scanned using a radiograph with #25 k type stainless steel file (Mani, Tochigi, Japan). Again, the angle was determined by Schneider method then change in canal angle was measured (figure#8). Data was entered in SPSS version 23 (SPSS Inc., Chicago, USA). With SPSS version 23, data analysis was carried out. Mean and Standard deviation of canal straightening (change in canal angle) were determined. To calculate the difference between the two groups, the T test was used. A statistically significant result was defined as $P<0.05$.

RESULTS

In this in-vitro experimental study, 60 extracted teeth total—30 in each of the WaveOne and ProTaper groups—were used to compare the shaping ability of the ProTaper Gold Rotary file system and the WaveOne Gold Reciprocating file system in curved mesial root canals of extracted mandibular first molars (in terms of change in canal angle). The results were analysed as follows: Mean ± SD of canal straightening (change in canal angle) in WaveOne group was 3.28±1.24 with C.I (2.81----3.74) and ProTaper group was 2.91±1.42 with C.I (2.37----3.44) as presented in TABLE 2.

Mean±SD of canal straightening (change in canal angle) was noted in 3.28±1.24 v/s 2.91±1.42 between WaveOne Gold Reciprocating file system vs the ProTaper Gold Rotary file system & p- As indicated in TABLE 3, the value was determined to be non-significant, or p=0.286.

Table No. 1: Comparison of Canal Angle Before Canal Preparation Between Groups n=60

		n	Minimum	Maximum	Mean	±sd
GROUP	Wave One	30	21	29	25.3	2.3
	Pro Taper	30	22	29	24.6	1.97

n= number of canals

Table No. 2: Descriptive statistics of canal straightening (change in canal angle) n=60

Change		n	Minimum	Maximum	Mean	±sd	95% C. I
GROUP	Wave One	30	1	5.5	3.28	1.24	2.81----3.74
	Pro Taper	30	0.5	5.0	2.91	1.42	2.37----3.44

n= number of canals

Table No. 3: Comparison Of Canal Straightening (Change In Canal Angle) Between Groups N=60

Group	Change in Canal Angle		P-value.*
	Mean	±sd	
Waveone (n=30)	3.28	1.24	0.286
Protaper (n=30)	2.91	1.42	

n= number of canals

*Applied Independent t-test

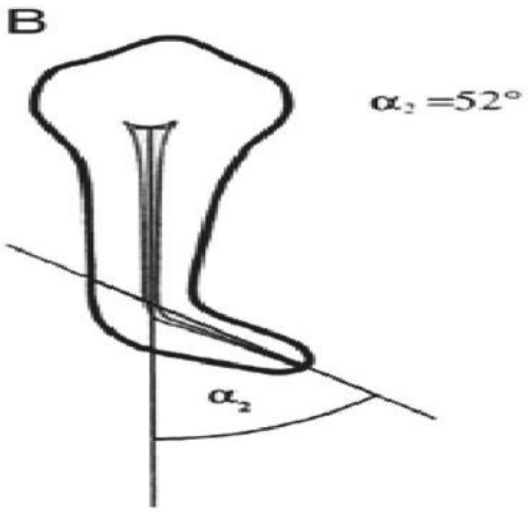

Figure No. 1: Schneider method of measuring canal angle

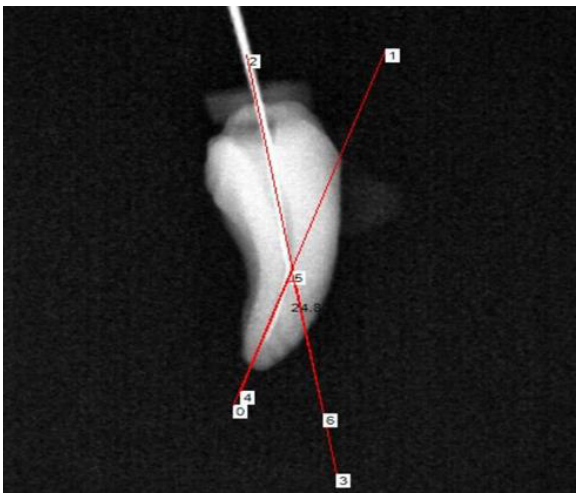

Figure No. 2: Initial Radiograph measuring canal angle

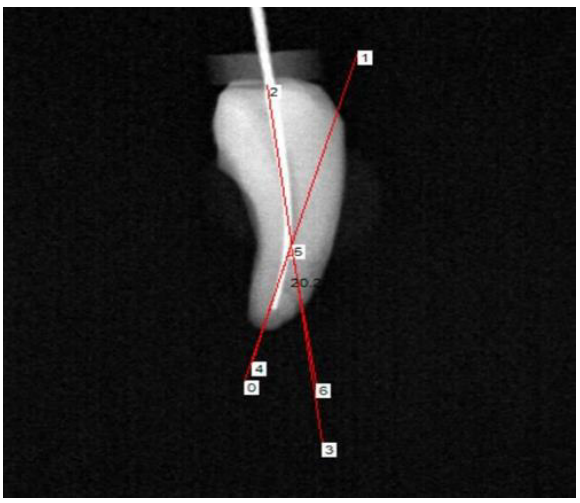

Figure No. 3: Radiograph after instrumentation measuring angle of canal

DISCUSSION

The ensuing root canal disinfection and obturation are directly impacted by canal shaping, one of the most essential phases in endodontic treatment. A root canal which is properly prepared should maintain the canal's original outline and have a constantly tapering funnel shape.[18] These aims are usually difficult to attain because of the very variable root canal architecture and canal curvature, especially when shaping significantly curved canals.[1] Curved root canal mechanical preparation remains challenging, nevertheless, due to typical issues such the rigidity of the instruments used for canal preparation, and hidden canal curvatures in two-dimensional radiography.[1]

Compared to the manually operated stainless steel files that were previously in use, the nickel-titanium (NiTi) alloy known as Nitinol has made endodontic practice more effective in terms of quality, accuracy, speed, and risk reduction..[4] This is because NiTi files are more flexible, better resistant to fracture, and have a shape memory effect.[4] When compared to stainless steel hand instruments, the usage of nickel titanium devices has decreased operator fatigue and increased the success rate of root canal therapy. As a result, a variety of engine-driven dental systems with NiTi tools of various shapes and sizes are now on the market. Since their initial debut, advancements have been achieved in alloy processing, design, and rotation motion. The most recent stage NiTi equipment for root canal preparation are reciprocating single-file systems. Yared proposed a reciprocating motion based on a balanced force approach, and it was recommended to prepare curved root canals with a single F2 ProTaper device in a reciprocating motion.[19] This has been demonstrated to be equally effective at cleaning surrounding root canals as the entire ProTaper system. It is claimed that reciprocating single-file systems can reduce the risk of cross-contamination and instrument failure while completely preparing root canals with just one instrument.[19]

Little information has been made available so far on the reciprocating file's shaping capabilities. To evaluate the qualities of these novel files, thus, a comparison between these single file systems and known rotational multi-file NiTi systems must be made.

Abdulrahman Abdullah et al. investigated the shaping abilities of the ProTaper Gold and WaveOne Gold systems in artificial S- and L-shaped canals in an in vitro study. In summary, WaveOne Gold outperformed ProTaper Gold in shaping capabilities, exhibiting fewer aberrations in the canal and quicker canal preparation. The findings indicated that a significantly significant difference in preparedness was found.[20]

Yuan et found that degree of canal straightening (change in canal angle) was higher in WaveOne Primary group that is 13.11±2.86% compared to ProTaper Next group that is 10.86±3.31%.[5] A study by Yoo Y, et al found that mean for WaveOne as 3.74±0.45 and 2.94±0.66 for ProTaper.[12] In present study, mean canal straightening (change in canal angle) was noted in 3.28±1.24 v/s 2.91±1.42 between WaveOne Gold Reciprocating file system vs the protaper Gold Rotary file system & P-Value (p=0.286) was determined to be non-significant.

In contrast to what we found, V Pathak et al.'s study sought to determine how well four single-file systems could shape the extremely curved MB root canals of mandibular first molars. Canal straightening was assessed by measuring the curvature of the canal both before and after Shaping. The results revealed that while F360 and OneShape continuous files successfully preserved the original curvatures, WOG and WO reciprocating files significantly straightened the canals. A statistical investigation verified the noteworthy distinctions in the ways the file systems affected the curvature of the canal.[21]

We selected mandibular mesiobuccal roots from first molars because their curvatures are usually quite unusual. Schneider's approach was used to evaluate the angle of curvature, which was set at 20 to 30°. The American Association of Endodontists (AAE) considers 25 to 30° to be a moderate degree of curvature, meaning that it can produce results for a wide range of patients. One potential weakness of the current study is that, as it was conducted on extracted teeth in vitro, root canal preparation cannot be directly compared to an in vivo setting. Furthermore, different outcomes in root canal shape may arise from the angulation of the teeth that are present in the oral cavity. To provide endodontists reliable recommendations, more evaluations of the evaluated brands' clinical performance in vivo are necessary. To understand how the patented advanced metallurgy processing of WaveOne Gold and ProTaper Gold system affects its qualities, further research into the metallurgy and mechanical properties along with clinical usage of these systems is necessary.

CONCLUSION

It can be concluded that, when taking into account changes in canal angle, the shaping abilities of the ProTaper Gold Rotary file system and the WaveOne Gold Reciprocating file system in curved mesial root canals of extracted mandibular first molars were comparable. Additional well-controlled and prospective randomized trials are needed to confirm the present findings.

Author's Contribution:

Concept & Design of Study:	Sudesh Kumar
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Revisiting Critically:	Sudesh Kumar, Yawar Ali Abidi
Final Approval of version:	Sudesh Kumar

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