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Comparison of Working Length Loss In Manual Versus Rotary (Waveone) Preparation In Curved Canals; A Quasi-Experimental Study

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ABSTRACT

Objective: To compare the consistency of working length control in hand instrumentation and engine-driven rotary files Wave One by comparing their pre and post-instrumentation working lengths.

Study Design: Quasi-experimental study.

Place and Duration of Study: Armed Forces Institute of Dentistry, Rawalpindi Pakistan, from Jun to Dec 2019.

Methodology: A total of 90 mandibular first molars were selected. Two groups were drawn with 45 mesio buccal canals each. The First-Group was prepared with manual K-files, whereas the second group had rotary instrumentation using the WaveOne system. Pre and post-preparation working lengths were noted.

Results: The mean pre-operative (18.5±1.03mm) and post-operative (18.15±1.09mm) working lengths of manually prepared and WaveOne prepared canals (18.8±3.43mm and 18.7±3.25mm respectively) presented statistically significant loss of post-operative working lengths. The comparison of the two groups gives a statistically significant result in manual preparation, showing a greater loss of working length as compared to canals prepared with WaveOne rotary files.

Conclusion: Manual instrumentation causes a greater loss of working length by straightening the canal more than engine-driven WaveOne rotary files postoperatively.

Keywords: Endodontic instruments, Dentists, Dental instruments, Root canal preparation, Endodontics, Root canal therapy, WaveOne.

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INTRODUCTION

The primary goal of canal preparation is to eradicate the infected pulpal tissue and form a continuous tapered form while maintaining the apical foramen in its initial form and location.[1] A better outcome of a root canal treatment relies on the knowledge and insight of the morphological features of the root canal system and sustenance of accurate working length and the right curvature.[2,3]

The Wave One system is made of M wire fabricated with a special NiTi alloy.[4] This material has added benefits of elevated flexibility, upgraded fatigue resistance to cyclic forces, and a fast preparation time.6 These files are declared to be able to use only one instrument to prepare and clean the canals effectively.[5] Moreover, there are reports of minimised canal deformation incidences in curved canals due to their centring ability, thus allowing uniform three-dimensional tapering canal walls.[6,7]

Many studies have compared the capability of rotary NiTi and manual instruments in cleaning root canals and have confirmed that NiTi rotary systems are faster than hand instruments, eliminating problems during the preparation of curved root canals and thus resulting in better conservation of the tooth structure. Regarding the cleaning ability in permanent root canals, rotary NiTi instruments were better than hand files or yielded the same results.[8,9]

There are few studies analysing straightening of the canal after preparation, causing reduced working lengths.[10] The primary goal of this study was to investigate and assess the consistency of control of working length by juxta-positioning hand instrumentation and engine-driven rotary files (WaveOne) by comparing their pre and post-instrumentation working lengths.

METHODOLOGY

The quasi-experimental study was conducted at the Armed Forces Institute of Dentistry, Rawalpindi, Pakistan from Jun to Dec 2019 after approval by the ethical committee of the Armed Forces Institute of Dentistry (IRB number 905/Trg-ABP1K2). The sample size was calculated with the hypothesised percentage frequency of outcome factor in the population, which in this case is increased loss of working length in

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manual preparation) of 60% using OpenEpi sample size calculator.[10]

Inclusion Criteria: Patients with irreversible pulpitis, necrosis, periapical periodontitis, acute or chronic abscess, complicated crown fractures needing root canal therapy and patients needing elective endodontics of abutments for fixed prosthesis were included.

Exclusion Criteria: Non-salvageable teeth with poor prognosis, calcified canals, internal or external resorption and roots with less than 200 curvature or severely curved canals with more than 400 curvature were excluded.

Ninety mandibular first molars were selected from 90 patients in the Outpatient Department of Operative Dentistry. Radiographs were taken to check the curvatures. Informed consent was obtained from all the patients included in the study. Two groups, manual (Group-A) and WaveOne (Group-B) were drawn based on the mode of a preparation containing 45 teeth each.

A single operator performed all the canal preparations. A local anaesthesia block was given to the patients, and a rubber dam was applied for proper isolation. A round carbide bur was used for the access opening of the teeth. The cavity was de-roofed with straight carbide burs to remove any hindrance to the shaft of the placed files. Canals were negotiated using #10 and #15 files. The pre-instrumental working lengths were determined with an apex locator, counter-checked, and noted with a peri-apical digital radiograph in a mesial-distal direction with a paralleling technique. The reference points were determined with silicon stoppers and noted as well.

The canals of Group-A teeth received manual preparation using standardised technique starting from K-files ISO number 15, 20, 25 till 30. All these files were introduced till the end of the working length. Recapitulation was done intermittently after using every file to eliminate any debris packing in the apical third region of the tooth. In Group-B, the instrumentation was carried out with WaveOne engine-driven rotary files till the calculated pre-instrumental working length with small, primary, and medium files. During both procedures, sodium hypochlorite was used as an irrigant to flush out the debris and disinfect the chamber thoroughly. Upon completion of the root canal preparation, post-preparation radio graphs with number 30 K-file in mesial buccal canals of both the groups' molars were taken to measure the post-intervention working lengths and were verified with an apex locator. The pre-and post-working lengths were noted side by side, and their difference was calculated. The root canal procedure was completed by drying the canals with paper points, using Ca(OH) 2-based sealer and Gutta-percha of the corresponding sizes. The restoration was done, and patients were sent home with post-operative instructions and care.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. The Mean ± standard deviations of the pre and post-instrumentation for both groups were calculated, through paired samples t-test. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

Ninety mandibular first molars were selected from 90 patients in the Outpatient Department. The mean pre and post-operative working lengths of manually prepared canals were 18.5 ± 1.03 and 18.15 ± 1.09, respectively, which showed a statistically significant loss of working length after instrumentation. The mean working length of wave one prepared canals before and after instrumentation was 18.8 ± 3.43 and 18.7 ± 3.25, respectively, presenting a statistically significant loss of post-operative working length (Table-I). In the manual preparation, 36 mesio buccal canals differed in working length. Fifteen canals had 0.25mm, 17 had 0.5mm, and 4 had 1 mm reduction. Whereas in rotary, only 12 showed a difference, of which 4 had a 0.24 mm, and 8 had a 0.5 mm reduction in working lengths. The comparison of the two groups gave a statistically significant result regarding the loss of working length in manual preparation, depicting a greater loss of working length in manual compared to canals prepared with WaveOne rotary files (Table-II).

Table-I: Comparison of Pre and Post Instrumental Mean Working Lengths of Manual and WaveOne Rotary Preparation (n=90)

Method	Pre-Operative Working Length (Mean ± SD)	Post- Operative Working Length (Mean ± SD)	*p*-value
Manual (mm)	18.5±1.03	18.1±1.09	<0.001
Rotary (mm)	18.8±3.43	18.7±3.25	<0.001

Table-II: Comparison of Loss of Working Length of Manual and WaveOne Rotary Preparation (n=90)

Method	Loss of Working Length (Mean ± SD)	*p*-value
Manual (mm)	0.36 ± 0.27	<0.001
Rotary (mm)	0.11 ± 0.2	

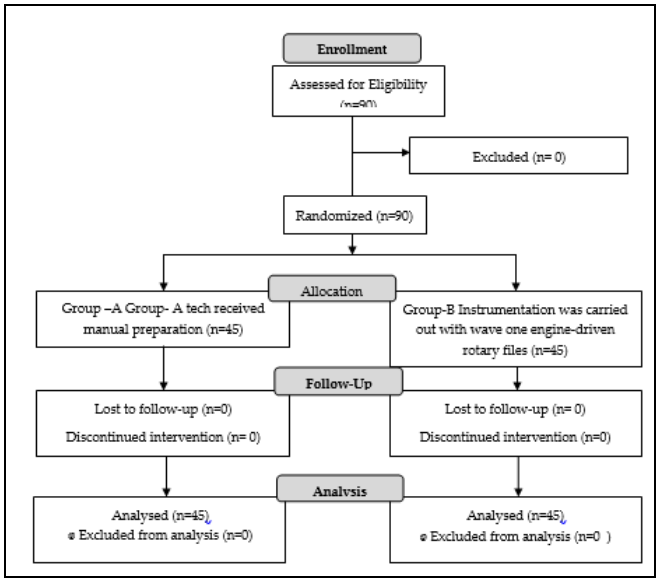

Figure: Patient Flow Diagram (n=90)

DISCUSSION

Maintenance of working length is still a challenging task in clinical practice. The preparation and instrumentation of a root canal are demanding due to decreased tactile sensation, invisible operating site and sparse room for instrument manoeuvre. Moreover, a small discrepancy in the working length while preparing the canal is a chief consideration in evaluating the execution of that armamentarium.[11]

Despite the technique used to determine the working length, keeping uniformity of that measurement throughout the track of endodontic treatment and obturating till the wanted length is critical.[12] This is especially relevant in the case of curved canals.[13] The working length should be 0.5 to 1 mm short of the major foramen, confined to apical constriction. The apical constriction can be described as the area of maximum constriction in the canal, and the approximate interval from the foramen to the constriction is about 0.5 millimetres.[14] One experimental trial postulated that only 46% of the teeth had a classical apical constriction that, too, differed in relation to the apical foramen.[15]

With the arrival of the nickel-titanium rotary instrumentation, the root canal treatment has been revolutionised by minimising the operator's exhaustion, the period needed to complete the preparation and reduced iatrogenic errors related to the root canal instrumentation, enabling the clinicians to attain more effective and foreseeable canal preparation.[16] Walia *et al*. analysed Nickel-titanium (Ni-Ti) instruments for the first time in 1988 by manufacturing a triangular cross-section of 15-size orthodontic wire from Ni-Ti alloy material. Upon observation, it was found that these Nitinol Files are superior to stainless steel files due to greater elastic flexibility and fracture resistance in torsion motions.[17]

Working length discrepancy is one of the reasons for post-treatment disease, making it necessary to keep the obturating material within the limits without impinging on the periapical tissues.[18] Krajczar *et al*. in Hungary conducted a similar study as ours on 40 extracted teeth. He found a statistically significant difference between manual and rotary preparations (Mtwo) with the hand instruments group stipulating a propensity towards shortening the original working length with a mean of 0.2 mm.[9] Our study showed comparable results with a statistically significant loss of working length in rotary instrumentation as compared to hand filing. Another study conducted on 148 molars with canal preparations with various rotary instruments like Profile, Protaper, and K3 demonstrated significant losses of working lengths.[13] A Pakistani study conducted by Ahmad *et al*. on 40 teeth also confirmed that the working length was better maintained by rotary (Protaper) as compared to manual instrumentations with a 0.007 p-value in pre-post working lengths with manual and rotary preparations.[8]

This is a unique study with limited data comparing post-operative lengths using manual and WaveOne systems. To our knowledge, this is the first study of its kind, indigenously. However, further large multi-centre studies are required to generalise the results. The limitation of this study is its simple convenience sampling and single-centre nature.

CONCLUSION

Within the study's limitations, it is concluded that manual instrumentation causes a greater loss of working length by straightening the canal than one-driven WaveOne rotary files.Postoperatively, keeping the shape of the canal intact results in fewer chances of extrusion of obturating materials and adequate length control.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MA & MH: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

LA & SI: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AY & DR: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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