ORIGINAL ARTICLE

COMPARISON OF THE MEAN POST OPERATIVE PAIN AFTER MANUAL AND ROTARY INSTRUMENTATION FOR ROOT CANAL TREATMENT OF SINGLE ROOTED TEETH WITH IRREVERSIBLE PULPITIS

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Background: The rotary instruments are becoming a more common choice for both general dentists and endodontists. Trials are being conducted to assess their potential benefits, especially on post-operative pain. Therefore, the present study is aimed at recording the intensity of pain experienced by the patients after root canal procedure through `a rotary file system (Hyflex CM™) and comparing it with older techniques such as manual hand files (K-files) which are more commonly used. **Methods:** The current randomized clinical trial was conducted on 60 patients diagnosed with irreversible pulpitis. A patient who had taken an analgesic in the past 12 hours was excluded. A visual analogue scale (VAS) was used for recording the patient's pain readings. In the two intervention groups, rotary file systems and conventional manual K files were used for cleaning and shaping. **Results:** Pain readings in the two types of instrumentation techniques showed that there was a decrease in the pain level in both groups from the initial pain level. When comparing the two groups at different post-operative intervals (6hr,12hr,48hrs, and 1 week) it was found that there was statistically significantly less pain in the rotary group. (*p* values <0.05). **Conclusion:** The current study concludes that there was a significant difference in post-operative pain between manual and rotary Hyflex™ after the first visit of root canal therapy.

Keywords: Cleaning and shaping; Post-operative pain; Rotary endodontics; Root canal treatment

Citation: Sepah NG, Qureshi A, Khattak I, Ali MI, Iqbal A, Iqbal M. Comparison of the mean post operative pain after manual and rotary instrumentation for root canal treatment of single rooted teeth with irreversible pulpitis. J Ayub Med Coll Abbottabad 2024;36(4 Suppl 1):885–9.

DOI: 10.55519/JAMC-S4-12506

INTRODUCTION

There is a widespread misconception that root canal therapy is among the most painful dental procedures, and many patients experience postoperative pain anxiety. After receiving a root canal, postoperative discomfort has been observed to occur anywhere between 1.4% and 16% of the time.[1,2] Uncontrolled instrumentation, irrigant extrusion, intracanal medicaments, apical debris, missed canals, preoperative pain, and periapical pathosis are some of the major causes of postoperative pain and discomfort following root canal therapy.[3–5] Post-operative pain even after proper instrumentation can possibly be due to the apical extrusion of debris. Patients treated with some techniques for root canal treatment report more often with post-operative pain than with others. This is because some techniques tend to extrude more debris than others. However, this debate still continues as according to some studies, no association has been found between apical extrusion and post-operative pain.[6–9]

The contemporary approach to root canal treatment has been shifted towards engine-driven (rotary instrumentation) in the last decade.[10] It has been shown that most NiTi rotary instruments extrude less debris and irrigants than stainless steel hand k files, owing to their rotary action and Archimedes' screw effect.[6] When NiTi rotary instruments are combined with copious irrigation, less post-operative discomfort is experienced.[11] However, the incidence of postoperative pain following manual/hand instruments has been reported to be 0.25%[12], while for rotary instruments it is in the range of 1.68–2.4%[12,13]. HyFlex™ Controlled Memory NiTi file system is one example of rotary files that has been manufactured utilizing a unique process that controls the material's memory, making the files extremely flexible. These files are unlike other NiTi files in that they do not have shape memory. Due to the capacity to closely follow the anatomy of the canal, this lowers the possibility of ledging, transportation, or perforation in using this file system.[14–16]

As rotary instruments become a more common choice for both general dentists and endodontists. Studies have been conducted to compare manual and rotary in vivo studies for their clinical significance. T. Bita *et al*[1] in a clinical trial concluded that the difference in the mean

postoperative pain scores of the rotary group and the manual group was not significant (*P*=0.84). More than the file type, it seemed as though the crown-down manner of preparation affected the postoperative pain. In order to ascertain the impact of file type on postoperative pain, research should be carried out using the identical crown-down procedure in both groups. P. Domiano *et al.*[17] concluded that there was a significant difference between mean post-operative pain of rotary instrumentation (1.7) and manual instrumentation (2.7; $p<0.001$). The results of other studies on the topic state for clinicians to bear in mind that rotary endodontics will not guarantee a decline in post-operative endodontic pain.[18] A systemic review [19]even stated that there are only a few clinical trials comparing postoperative pain after the use of rotary and hand files. Especially with a specific "Crown down technique" assigned for all groups or with Hyflex CM ™ rotary files.

Rotary systems are not used commonly in practice by the dentists in public sector health facilities and comparing them with older techniques such as manual hand files which are more commonly used as presented by an extensive national survey by Bhatti *et al*[20] will provide evidence for future considerations. The phobia of post-operative endodontic pain is a major reason for patients deferring or deterring endodontic therapy. The present study is therefore aimed at assessing association between post-operative pain and the file techniques used then it can be a help for clinicians in their evidence-based practice, ultimately benefiting the community.

MATERIAL AND METHODS

The current randomized clinical trial was conducted on the patients presenting to the Department of Operative Dentistry and Endodontics, Rehman College of Dentistry, Peshawar. The duration of the study was from December 2022 to December 2023. Once ethical committee approval from the institute was taken (EC.Ref.No:20-07-015) participant recruitment began. The trial was registered in the Iranian Registry of Clinical Trials (IRCT2030713058771N1). Patients were given informed consent and a detailed explanation of the study and procedure. Randomization of the subjects into two groups was done by concealed lottery method and was non-blinded. The patient had the option to withdraw at any given time. A sample size of 30 subjects in each group and a total of 60 were calculated with the help of WHO software with the following assumptions: Confidence interval = 10%, power of test = 80%, population means pain in rotary Group-1=20.14, population mean pain in manual group[1] =23.31, population standard deviation[1]=3.94 and 3.89 respectively. The sampling technique used was non-probability consecutive sampling (Figure-1). Inclusion criteria were patients of both genders of age between 20–50 years, incisors and canines with irreversible pulpitis, and periodontally sound teeth and teeth that had no radiographic changes on periapical radiographs. Exclusion criteria were patients who had taken an analgesic of any sort 12 hours before the procedure, teeth with root resorption, and patients who could not understand the proforma/ numeric pain scale.

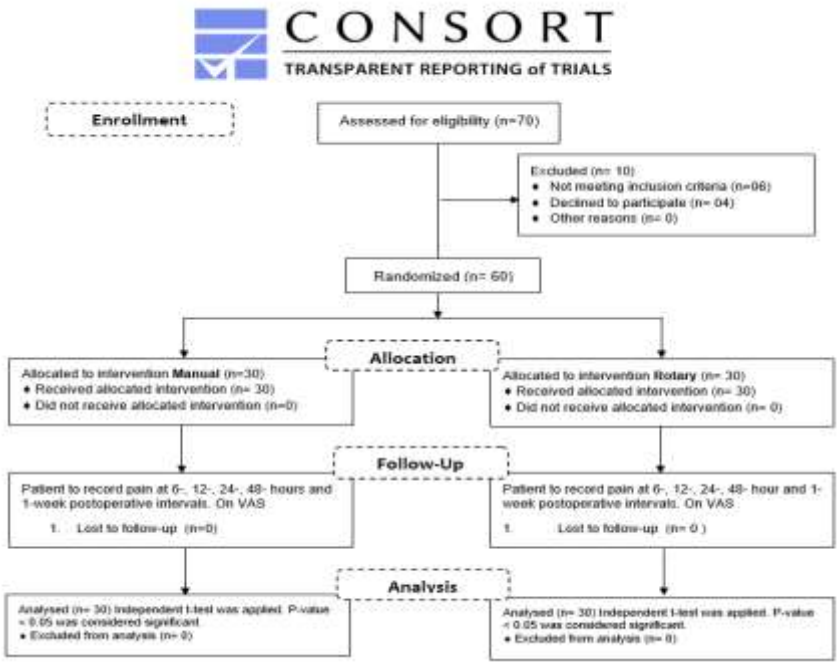

Figure-1: Consort flow diagram

Patients fulfilling the inclusion criteria were asked to record their initial pain score on the visual analog scale[21] (VAS, 0–10 cm) by markings on the line and this was taken as a baseline. All the participants were treated by one clinician in order to decrease interpersonal variability in the endodontic procedure. The patient subject was administered local anaesthesia with 2% lidocaine with 1:100,000 epinephrine 1.8 ml (Medicaine®.Inj, HuonCo.Ltd, Korea). Rubber dam was applied for isolation purposes. The crown-down technique of preparation was followed in both manual and rotary instrumentation groups. Access cavity was made and a pulpectomy procedure was performed. The working length was determined with a size 10 K-file (Dentsply Maillefer, Ballaigues, Switzerland) with an apex locator (Root ZX, J. Morita, Kyoto, Japan) and verified by digital radiography. In both groups, the working length was decided to be left 0.5–1 mm shorter than the radiographic apex. During this procedure, regular irrigation was done with sodium hypochlorite solution (Parcan®.Sol, Cedex50 France) between instrumentation. In the manual instrumentation group, the cleaning and shaping of the root canals was done by NiTi K-files. In the rotary instrumentation group cleaning and shaping of the root canals was done by Hyflex CM ™(COLTENE/Whaledent AG, Switzerland) rotary system. In order to keep an equal apical diameter, the final apical preparation in both groups was kept similar. The patients were instructed to record their pain on a VAS at 6-,12-,24-, 48-hour, and 1-week postoperative intervals. The patient was recalled after 01 weeks and the pain score was noted on the pain scale. Root canal treatment was completed by the same dentist where obturation of the root canals was done followed by restoration of the tooth.

Data was entered into SPSS version 21.0. Mean and standard deviation were evaluated for numerical variables like patients' mean post-operative pain score. Frequency and percentage were evaluated for the patient's gender. An Independent sample *t*-test was applied to compare the mean post-operative pain between the two groups. *p*-value<0.05 was considered significant.

RESULTS

Out of the total participation 60, 26 (43.33%) were female and 34 (56.67%) were male. (Table-1) Comparison of pain in the two types of instrumentation techniques shows that there was decrease in the pain level in both the groups from the initial pain level *i.e.* 7.47 to 0.71 and 7.82 to 0.57. When comparing them at various time points showed that only the initial pain between manual and rotary instrumentations was not statistically significant (p=0.29). The mean pain value at 6 hours in manual group was 4.62±0.76 while in rotary group was 3.47±0.66 and the difference was statistically significant (p<0.001). The mean pain at 12 hours, in manual group the mean pain value was 2.72±0.32 and for rotary 2.23±0.16 and statistically significant (p<0.001). Similarly at 48 hours and after one week in rotary group mean pain values were lower than manual group and all of these differences were statistically significant (p<0.001). The details are given in Table-2.

Table-1: Frequency of Genders

Variable	Characteristic	*n* (%)
Gender	Female	26 (43.33)
	Male	34 (56.67)

Table-2: Values of pain in the two types of instrument groups at various times are compared

Characteristic	Manual, N=30[1]	Rotary, N=30[1]	*p*-value[2]
Initial pain	7.49 (1.32)	7.82 (1.05)	0.29
6hr pain	4.62 (0.76)	3.47 (0.66)	<0.001
12hr pain	2.72 (0.32)	2.23 (0.16)	<0.001
48hr pain	1.69 (0.17)	1.41 (0.27)	<0.001
1week pain	0.71 (0.17)	0.57 (0.30)	0.021

[1]Mean (SD) [2]Two sample *t*-test

DISCUSSION

The purpose of the current study was to compare the effect of two different canal preparation techniques i.e. manual K file and rotary Hyflex™ on post-operative pain. The first finding of the study was that irrespective of the groups there was an overall decrease in pain value from the baseline to 01-week post-operative interval. This has already been concluded by previous literature that root canal therapy is the primary treatment of choice with teeth diagnosed with irreversible pulpits for pain and prognosis of tooth.[22,23] Now that it is established that a root canal will decrease the pain, further advancement in the topic was to assess which method of root canal preparation would significantly reduce the post-operative pain further.

In the present study as described in the results, there was a statistically significant difference between the methods of canal preparation at all the postoperative time intervals, i.e., 6th hour, 12th hour, 24th hour, 48th hour & 1 week. Results showed that in the rotary group of patient's post-operative pain was significantly perceived less in comparison to the manual method of preparation. Literature shows that many clinical trials concur with our findings.[17] A very recent study by Attaullah *et al* in Egypt concluded that patients operated on with rotary

preparation techniques had less postoperative pain than patients prepared with manual preparation techniques.[24] In their description of the endodontic procedure, they explained that for the "glide path" they even used rotary glide path files as compared to conventional K files. The justification for this given in the study was that initial scouting and path file use can be a major source of apical debris migration. The formation of acute inflammation associated with periapical tissues as a result of a mechanical, chemical, or microbial insult has been proposed as the mechanism behind post-endodontic discomfort.

One of the key elements influencing post-operative discomfort, according to theory, is apical debris extrusion. Hence assessment of preparation methods that cause apical debris extrusion from the apical foramina should be determined as well.[25,26]

In the current study as distributed in the procedure details, the crown-down preparation method was conducted in both manual and rotary groups of participants. The significance of this is highly important. Previous literature has presented that the "Crown down Technique" causes less extrusion of debris into the periapical tissue.[23,27,28]

This effect is not solely because of the technique's steps but also because of a better maintenance of the working length throughout the preparation procedure. Hence by selecting the "Crown down Technique" in the present study for both groups, we removed a bias based on a controllable variable.[23]

In recent literature, we can also find many studies that concluded that there was no statistically significant difference in post-operative pain between the manual and rotary techniques[1–30]. The study by T. Bita *et al*[1] included participants with asymptomatic irreversible pulpitis. As these patients were already without symptoms like pain, they should be the best inclusion to asses' post-operative pain. But firstly obtaining such a sample size is very difficult.

Patients will only give consent to a root canal procedure on symptomatic teeth. Secondly incidence of asymptomatic irreversible pulpitis is also less in comparison to symptomatic irreversible pulpitis.[31] Thirdly root canal treatment is a clinical procedure so its implications need also be assessed on a frequent clinical presentation as to a rare one. As the purpose of evidence-based dentistry is the guidance of the clinician for the interest of the patient.[32] These investigations are challenging since postoperative pain is subjective and varies on the patients' cultural, personal, and financial backgrounds. Since measuring pain is challenging by nature, the individuals in the current study were given acceptable explanations of postoperative pain and VAS. Most respondents are able to rate the intensity of their pain and are familiar with the VAS technique. VAS is regarded as a legitimate and trustworthy method for assessing pain alleviation[33]. In this situation, variables like age, gender, tooth type, and pulp status of the two study groups were matched. The fact that endodontic procedure procedures were carried out by a single operator also allowed all technique-and operator-related factors to be controlled. The only variations were the instrumentation approach and file type used in the two different groups.

In the present study, we choice chose the multi-visit endodontics procedure as to single visit. The reason to do so was that even Cochrane Reviews like the one presented by Manfredi *et al*[34] had concluded. That although there was no statistical difference between post-operative pain in single visit versus multi-visit endodontics. Studies showed patients who only have one visit may have a little higher frequency of oedema and significantly more analgesic use recommended to them. The rotary system selected in this study was Hyflex CM™, justification for this was that we chose the system which would cause the minimum extrusion of apical debris. In comparison to the systems available locally, we selected the Hyflex™. As, literature based on in vitro study designs stated that "The WaveOne™ and ProTaper™ rotary instruments, produced significantly more debris compared with Hyflex CM™ rotary instruments".[35]

CONCLUSION

This study highlights significant difference in post-operative pain between manual and rotary Hyflex™ after the first visit of root canal therapy, where there was less post-operative pain in the rotary group.

AUTHORS' CONTRIBUTION

Nida Gul Sepah[1], Asim Qureshi[2], Imran Khattak[3], Muhammad Izaz Ali[4], Azhar Iqbal[5], Mahnoor Iqbal[6]

NGS: Conceptualization, data collection, write-up. AQ: Write-up, literature search, study design. IK: Data analysis, interpretation, proof reading. MIA: Interpretation, write-up. AI: Proff reading, literature search, write-up. MI: Data interpretation, data collection, proof reading.

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Submitted: September 20, 2023	*Revised: October 5, 2024*	*Accepted: December 2, 2024*

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