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Original Study

Comparative evaluation of rotary and reciprocating single file systems on post-operative pain – a randomised controlled clinical trial

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ABSTRACT

Introduction

Post endodontic pain is intelligibly multifactorial, and the instrumentation procedure has been identified as a significant contributor. Debris and bacterial extrusion during chemo-mechanical preparation may be the cause of this, which exacerbates the inflammatory response and results in periradicular inflammation. Depending on the instrument design and instrumentation technique, the amount of extruded debris varies.

Aim

To compare and evaluate post-operative pain using rotary and reciprocating single file system

Methodology

Two groups of 27 reciprocating files (WAVEONE GOLD) and 27 rotary files, totaling 54 teeth, were created (One Shape). The entire root canal procedure was completed in a single appointment. VAS pain score was used to measure and evaluate post-operative pain at 6, 12, 24, 36, 48, and 72 hours.

Results

No discernible difference was found between the two groups' pre-operative mean pain levels when compared across various time periods (P>0.05). However, no significant difference in pain levels was found between the groups at 6, 12, 24, 48, or 72 hours after surgery.

Conclusion

In this investigation, there was no substantial difference in post-operative outcomes across the groups. The amount of pressure exerted on a tooth during cleaning and shaping with a single file is more than with a multiple file system, which will lead to post-operative discomfort. As the number of files decreases, debris extrusion decreases. Therefore, further research is required to fully understand the advantages and disadvantages of a single file system against numerous file systems.

***Keywords:** Root canal treatment, post-operative pain, Waveone gold, One shape*

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INTRODUCTION

The development of a suitable treatment plan, the application of knowledge of tooth anatomy and morphology (shape), and the performance of debridement, disinfection, and obturation of the complete root canal system are all necessary for the success of root canal therapy. The radicular gap was first sealed and obturated. Since neither a method nor a substance can create a barrier that is impermeable to moisture coming from the coronal or apical regions. Early prognostic studies suggested that failures were caused by insufficient obturation.[1] This demonstrates that inaccurate obturation solely reflects how well the cleaning and shaping were done. Inadequately obturated canals are frequently incompletely cleansed and shaped. The essential factors of a successful procedure are adequate cleaning, shaping, and creation of a strong coronal seal, with obturation being less critical for immediate success.[2]

Following root canal therapy (RCT), pain is an undesired but sadly frequent sensation that starts a few hours or days after the procedure and is always uncomfortable for both patients and clinicians. One of the most painful dental operations is reportedly root canal therapy. Less than 12% of patients suffered severe pain following RCT, with post-operative pain incidence reported to vary from 3% to 58%, mostly in the form of moderate discomfort.[3]

Chemical, mechanical, or microbial injuries to the periapical tissues that cause acute inflammation are some of the causes of postoperative pain. When a one-visit RCT was compared to a two-visit treatment, no discernible difference in post-operative pain was discovered. Mechanical variables, like over instrumentation or the extrusion of root-filling materials, have been linked to postoperative pain, indicating that root canal instrumentation and obturation procedures may have an impact on postoperative pain. The study's objective was to compare and assess post-operative discomfort using a reciprocating single file system and a rotary system.

MATERIALS AND METHODS

A thorough medical and dental history was gathered prior to the therapy. Age, sex, and tooth number were among the pre-operative details that were documented for each patient in the predesigned patient's chart. Informed consent was received from the willing patients who volunteered to participate in the trial after the therapy and study design were described to the qualified patients.

The 54 teeth were split into two groups at random. Depending on the endodontic file used, Group 1 (Waveone Gold) had n=27 and Group 2 (One Shape) had n=27. For all the chosen teeth, whether they were found in separate patients or the same patient, the endodontic files were randomly chosen using the envelope draw method. After administering local anaesthesia, a rubber dam was placed to isolate the tooth. An endo-access bur was used to open the access. The working length was measured using a #10 k File with the aid of an apex finder, and a periapical radiograph was utilized to confirm it. After the establishment of the glide path with the aid of the #20 K file, coronal enlargement was performed. After finalizing with the master cone radiograph following the cleaning and shaping the obturation were performed using the single-matched taper cone obturation technique and the AH plus sealer, depending on which group the patient was allocated to. After 6 hours, 12 hours, 24 hours, 48 hours, and 72 hours following surgery, VAS pain score was used to measure and evaluate postoperative pain.

RESULTS

The questionnaire was completed by 17 men and 37 women, with a mean age of 51.92 ± 14.61 and 45.14 ± 14.05 years, respectively. 8 men and 19 women competed in Group I, while 9 men and 18 women took part in Group II. In statistical analysis, the Chi Square Test was employed.

Comparison of the mean pain levels experienced by the groups at various time points: There was no discernible difference (P>0.05) in the two groups' pre-operative mean pain scores at different time intervals. At 6, 12, 24, 48, and 72 hours after surgery, there was no substantial difference in pain levels across the groups. According to Tables 4 and 8, group II reported the highest mean pain (4.14 1.29) at 6 hours after surgery whereas group II experienced the lowest mean pain (0.22 0.42) at 72 hours.

Figure 1: Pre-op difference between Group A and Group B

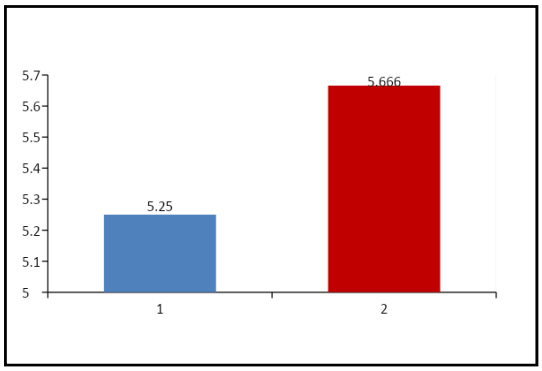


Figure 2: Post op pain scores in 6 hours between Group A and Group B

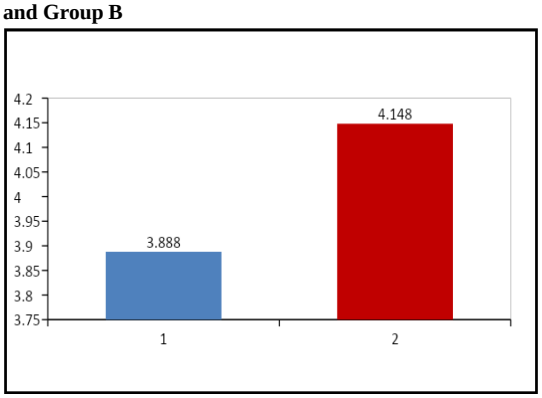


Figure 3: Post op pain scores in 12 hours between Group A and Group B

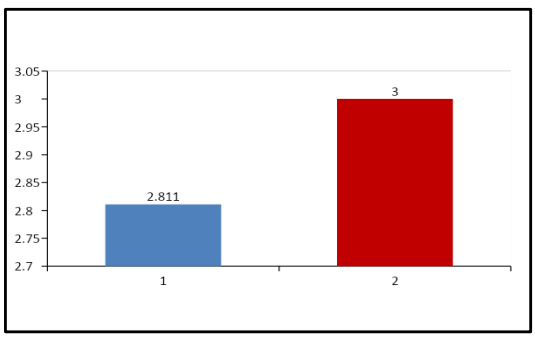


Figure 4: Post op pain between Group A and Group B on 24 hrs.

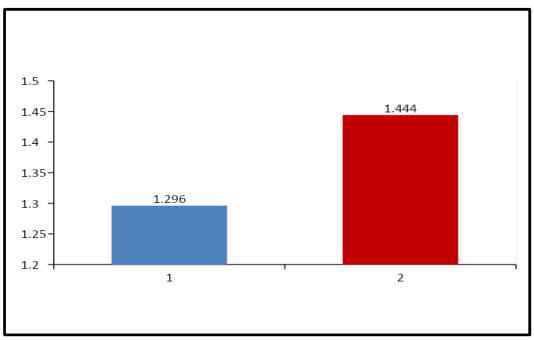


Figure 5: Post op pain between Group A and Group B on 48 hrs.

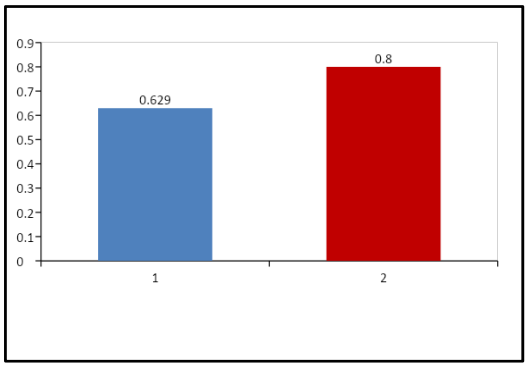
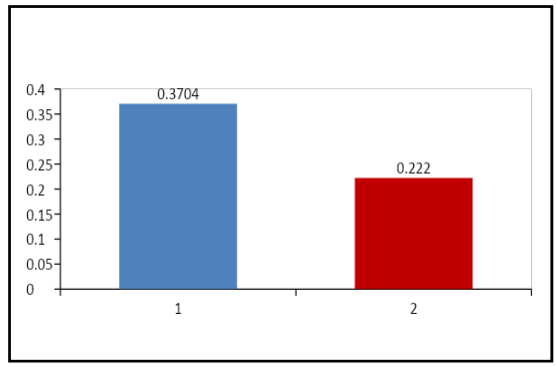


Figure 6: Post op pain between Group A and Group B on 72 hrs.



There was no statistically significant difference in pain between the groups I & II for post-operative period of 6, 12, 24, 48 and 72 hours respectively. (Table 4,5,6,7 and 8)

Table 1: Comparison of pre op pain score between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Pre op pain score	Group A	5.259	1.754	-.4074	-0.997	.335
	Group B	5.666	1.754			

Independent t test-

Table 1 depicts the mean pre op pain between the groups. The difference was not found to be significant statistically (p value≥0.05).

Table 2: Comparison of post op pain score – 6 hours between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Post op pain score – 6 hours	Group A	3.888	1.050	-.2592	-0.809	.860
	Group B	4.148	1.292			

Independent t test

Table 2 depicts the mean post op pain at 6 hours between the groups. The difference was not found to be significant statistically (p value≥0.05).

Table 3: Comparison of post op pain score – 12 hours between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Post op pain score– 12 hours	Group A	2.811	1.564	-.18519	-.463	.853
	Group B	3.000	1.358			

Independent t test

Table 3 depicts the mean post op pain at 12 hours between the groups. The difference was not found to be significant statistically (p value≥0.05).

Table 4: Comparison of post op pain score – 24hrs between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Post op pain score – day 1	Group A	1.296	1.353	-.1481	-.433	.917
	Group B	1.444	1.154			

Independent t test

Table 4 depicts the mean post op pain on day 1 between the groups. The difference was not found to be significant statistically (p value≥0.05).

Table 5: Comparison of post op pain score – 48hrs between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Post op pain score – day 2	Group A	.629	.883	-.1481	-.646	.775
	Group B	.778	.800			

Independent t test

Table 5 depicts the mean post op pain on day 2 between the groups. The difference was not found to be significant statistically (p value≥0.05).

Table 6: Comparison of post op pain score – 72hrs between the groups

	Groups	Mean	Std. Deviation	Mean difference	t value	p value
Post op pain score – day 3	Group A	.3704	.687	.1481	.953	.072
	Group B	.222	.423			

Independent t test

Table 6 depicts the mean post op pain on day 3 between the groups. The difference was not found to be significant statistically (p value≥0.05).

DISCUSSION

The effectiveness of cleaning, shaping, and obturation as well as the level of discomfort experienced after surgery all contribute to the success of endodontic therapy. The subjective aspect of this evaluation and the inherent difficulty in quantifying pain are two of the key flaws encountered while evaluating post-operative pain.[4,5] Extrusion of debris from the root canal caused by instrumentation results in discomfort. This randomized controlled clinical trial's goal was to assess the variations in post-operative discomfort brought on by single file rotary and reciprocating file systems. According to age, the patients were distributed at random (18-75 years). 54 patients in total received treatment at the baseline evaluation for post-operative pain at 6, 12, 24, 48, and 72 hours. Each group's post-operative pain was recorded and evaluated using a VAS scale.

The dental pulp is removed during endodontic therapy or root canal therapy, and the tooth's root canals are then shaped, cleaned, and sealed. The total alleviation of pain is one of the key goals of root canal therapy. The precise reasons for discomfort after root canal therapy have not been well reported. Root canal therapy can be finished in a single visit or across many. To ensure a straightforward, consistent treatment strategy and prevent the probable influence of intracanal medication, single-visit endodontic treatment was adopted. According to Su et al.[6], the incidence of discomfort following a single endodontic visit was lower than that reported following a multi-visit endodontic procedure. Single visit for endodontic treatment has been linked to an increase in post-operative discomfort and flare-up rates, although other research have shown no correlation between these two factors.

Extrusion of microorganisms, materials, or dentin debris into the periradicular area has been shown to cause inflammation and may be related to flare-ups and post-operative pain. As a result, forcing these irritants into the area causes inflammation, the severity of which depends on the quantity and quality of the extruded debris. The intensity of the response will increase with the amount of extruded debris.[7] Patients may suffer post-operative discomfort differently depending on the instrumentation approach used because of changes in the amount of debris extrusion and neuropeptides produced by C-type nerve fibres found in the periodontal ligament.[8] The difference shown, according to some authors, may be caused by variations in the cutting-edge, taper, design, cross section, configuration, tip type, flexibility, usage concept, alloy type, kinematics, quantity of files utilized or cutting efficacy.[9]

To remove or reduce interpersonal variability in the treatment processes, just one clinician carried out all the treatments. In each of these groups, the post-operative pain score at 6 and 12 hours was considerably greater than at 24, 48, and 72 hours. Pak and White conducted a systematic review in 2011 and found that the early stages following root canal therapy were when post-operative discomfort was at its highest level. According to many authors reports, the incidence of post-operative discomfort in the first 24 hours was 40%, which further reduced in the next 48 hours, and was found to be less than or equal to 11% on the seventh day.[9,10] According to Burklein and Schafer, reciprocating instruments extruded more debris than rotary ones do.[11] However, some authors have reported that using reciprocating systems does not result in a larger extrusion of apical debris. [12,13]

When compared to root canal preparations carried out by convention full-sequence rotary systems, post-operative discomfort following root canal therapy using reciprocating tools is not related with greater pain. Cruz Junior et al demonstrated that the Reciproc system's apical extrusion was not clinically significant.[14] Other research demonstrates that, when compared to a rotary Ni-Ti crown down instrumentation approach employing Twisted Files, the reciprocating single-file technique results in a further substantial inflammatory reaction and discomfort.[15] A lower releasing angle and a greater cutting angle combine to create the reciprocation movement. When the releasing angle is used, the file moves apically. Debris is thereby pushed apically rather than being removed at the releasing angle. The WaveOne file thereby functions as a piston to moves material further than the apical foramen.

In addition, the WaveOne method uses a single-file system with a greater taper (usually 0.08 taper, size 25). Without first enlarging the coronal, these instruments are used. The length of the file comes into touch with the canal wall as a result, increasing the quantity of debris that is produced. Additionally, the reciprocating file's cutting ability is significantly lower than continuous rotation, and it also removes less debris. As a result of the debris becoming caught in the flutes, frictional stress, and torque demand increased.[16] In comparison to a file having a centred mass and axis of rotation, a file with an offset design delivers additional cross-sectional area for improved cutting, packing, and pushing debris out of a canal. Because of the abundance of intra-blade debris that is stuck between the cutting flutes over the active area of a file, many instruments frequently breaks. The likelihood of lateral compacting debris and obstructing the root canal system anatomy is often reduced by offset file designs.

Varying extruded debris and neuropeptide amounts might be produced by different instrumentation approaches, which would account for the reported variations in postoperative pain intensity. Although several canal instrument systems have been created, despite variations in design, cross-sectional structure, and application techniques, all show some degree of debris extrusion. Even with careful working length management, material extrusion via the apical foramen cannot be totally avoided.[17]

The rotary instruments are developed with both symmetrical and asymmetrical rotary motions. Asymmetrical rotary instruments have their centres off-centre from the main axis of rotation of the instrument. The length of the working portion of the instrument tends to move in a wavelike pattern during rotation, reducing contact between the dentin and file. In this scenario, rotary instruments may be able to generate less debris build up with cleaner canals than reciprocating instruments. Basically, the reciprocating action is linked to an initial counterclockwise rotation, allowing the device to break through, and cut the dentin. The instrument can then be disengaged with a further rotation in the reverse direction.[18] Furthermore, the utilization of the irrigation procedure as well as the kinematics are both factors that state that reciprocating instruments produced more debris.[19]

Studies conducted in vitro have revealed that reciprocating techniques can lead to higher debris extrusion or buildup in the root canal than rotary systems, most likely because of the reciprocating instrument's reversing motion. [20] However, another in vitro investigation found that employing the reciprocating system resulted in reduced apical extrusion of bacteria. However, in vitro results might not generalize to clinical situations.

Nickel-titanium (NiTi) Rotary files show less debris extrution than hand files made of stainless steel. There have been more rotational and reciprocal NiTi devices introduced recently. According to reports, both single-file reciprocating systems (i.e., Wave One and Reciproc instruments) and continuous rotary systems (i.e., ProTaper and M two instruments) were equally successful at removing cultivable bacteria and endotoxins from mostly infected root canals.[21] In contrast to reciprocal instrumentation, constant rotary instrumentation creates a channel for the clearance of dentinal debris from the root canal, hence lowering apical extrusion of debris and the intensity of post-operative discomfort. The advantage of reciprocal instrumentation was correlated with reduced post-operative discomfort than rotational instrumentation in a clinical randomised study with 624 patients.[22] This study found inconsistent results when rotary and reciprocating systems were compared for post-operative pain, however numerous studies found reciprocation to result in severe post-operative pain.

A recent systematic review revealed contradictory findings, but it also indicated that reciprocating instruments tended to extrude more dentine debris than rotary instruments. Using rotary vs. reciprocating instruments for single-visit root canal preparation, a recent meta-analysis of a few studies examined the post-operative pain, and it revealed no differences in the methods' pain incidence.[23]

The mechanical movement wave propagates down the stretch of the instrument's operating component while it rotates, limiting contact between the dentin and file. In such instances, rotary files produce cleaner canals by assuring lower levels of debris accumulation than reciprocating devices do. Comparing the quantity of files

needed for root canal preparation is another aspect to consider. In the apical area, it is shown that the number of files increases the production of debris and the level of manipulation. Using more tools to get to the working length might result in increased extrusion and post-operative discomfort.

According to previous studies, reciprocal files produce more debris extrusion than rotary files. Reciproc instruments produced more debris extrusion during retreatment processes than Mtwo R instruments, according to Lu et al.[24] In mandibular molar teeth having necrotic pulps, Shokraneh et al. examined the degrees of post-operative discomfort after using three separate instrumentation techniques.[25] When compared to root canal procedures utilizing the ProTaper Universal hand files and rotary system, they found that the WaveOne technique produced considerably lower levels of post-operative discomfort. They credited this to the quantity of contaminated material extruded from the apex.

More research with bigger sample sizes are necessary to further evaluate the limitations and gains of these two methods with relation to pain following endodontic therapy, since it must be emphasized that the findings of a single clinical report cannot be applied to all clinical instances.

Conversely, regarding retreatment time, the NiTi rotary files were faster than the hand files.

CONCLUSION

In this investigation, there was no discernible difference in post-operative outcomes across the groups. New endo files are continuously added, and older systems are upgraded. Since then, attention has been directed to novel manufacturing techniques and various distinctive characteristics, such as varying cross-section over the length of the working area of the file. The amount of pressure placed on a tooth during cleaning and shaping with a single file is greater than with a multiple file system, which will lead to post-operative discomfort. As the number of files decreases debris ejection decreases. Future studies should compare the pain symptomatic patients feel during root canal preparation utilizing single file reciprocating and rotating devices.

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Conflicts of interest - Nil

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