

## EVALUATION OF POSTOPERATIVE PAIN FOLLOWING TREATMENT USING S-ONE PRO SINGLE NITI RECIPROCATION FILE AND ONE CURVE ENDODONTIC FILE SYSTEMS

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### ABSTRACT

Post endodontic pain is any degree of discomfort that develops after the start of root canal treatment. Post endodontic pain may be attributed to the employment of different types of movement patterns, the size of the apical preparation, the number of appointments and obturation operations, and the pre-operative conditions. The aim of the research is to assess the degree of discomfort encountered by patients following endodontic operations utilizing two distinct systems: the S-ONE Pro Single Niti Reciprocation file and the One Curve Endodontic file systems. Pain degree was measured using a Visual Analog scale to document pain intensity six hours pretreatment. Patients were allocated to two test groups. A group had endodontic treatment using the S-one pro reciprocating file. The second group was subjected to treatment using the One Curve Endodontic file. After receiving treatment, patients document their pain level after 6, 24, 48, 72, and 168 hours. Pain-relieving medication, ibuprofen 600 mg, was given to alleviate severe pain. No significant statistical difference was observed between groups as regarding postoperative pain degree, and painkiller consumption. However, S-ONE Pro Single Niti Reciprocation file was found to be related with lower postoperative pain compared to the complete sequence continuous rotating file. Nevertheless, both groups observed a statistically significant reduction in discomfort over time.

**KEYWORDS:** Postoperative Pain; Continuous Rotary; Reciprocation

### INTRODUCTION

The efficacy of endodontic therapy relies on the thorough mechanical preparation of the pulp area to remove tooth infection, and effective management of the patient's symptoms. Postoperative discomfort

is the most common reported symptom following root canal therapy. It is linked to periapical tissues inflammation. Approximately half of the individuals receiving root canal therapy suffer from post endodontic pain. <sup>[1,2]</sup>

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Pain is influenced by various factors, including age, sex, pre-treatment pulpal state, tooth type, and other factors such as microbiological and mechanical factors. The use of mechanical tools and irrigation during root canal preparation can lead to postoperative issues, including pain and edema. These complications probably occur because debris from the tooth, pulp tissue, germs, and irrigation solutions are pushed out to the surrounding periapical area. Such debris extrusion is probably the cause of periodontal inflammation, and can be attributed to endodontic file kinematics. Authors concluded that continuous motion resulted in reduced degrees of pain when compared to a reciprocating motion. The results can be attributed to factors as generated debris, being at its lowest with the utilization of continuous motion.<sup>[3,4]</sup> Meanwhile other research has showed that the reported pain level is higher when employing rotary motion instruments.<sup>[5]</sup>

The single-visit endodontic treatment offers several benefits, such as a reduced risk of complications, fewer surgical interventions, and eliminating the possibility of leaking between appointments through temporary restorations. Additionally, it requires less time and money, making it a more suitable option for individuals who frequently travel or have hectic schedules. Nevertheless, postoperative soreness remains a potential outcome even after a successful root canal procedure.<sup>[6]</sup>

One curve endodontic file\*, a heat-treated Ni-Ti file with a mutable cross-section specifically developed for one-time use, it exhibit remarkable flexibility and cutting efficacy while preserving the inherent structure of the tooth. the file's diverse cross-section enhances its ability to align itself in the apical third and eliminate debris in the coronal region. It allows comprehensive contouring of the entire canal, from start to finish, using only one file that reaches all the way to the apex. The benefits of utilizing the C-wire heat treatment include increased blade flexibility and higher resistance to separation.

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The final shape of the root canal adheres to the standards for efficient cleaning and shaping while preserving the natural canal anatomy.<sup>[13,14]</sup>

The S-one Plus Single NiTi Reciprocation File\*\*, is a very pliable single file that exceeds the elasticity of conventional single files. The variable pitch of the design enables effective and automated debris elimination coronally. The varying pitch design associated with S-section lead to the increase of cutting efficiency. This enables to enhance tooth preparation and optimize chip removal.

When evaluating a patient's pain, the most precise and dependable evidence of the presence and severity of pain is the patient's self-report<sup>[7]</sup>. Various methods can be used to assess pain, including quantitative and verbal rating measures as well as psychological evaluations. Pain scale primary function is the assessment of pain intensity and any fluctuations in its magnitude over a period<sup>[8]</sup>. In their study conducted in 2011, Hjerstad et al. discovered that patients prefer using the Numeric Rating Scale (NRS) as a tool for analyzing pain. This preference arises from the fact that the NRS simplifies the process of describing their discomfort.<sup>[9]</sup>

There is invariably a possibility of experiencing pain or discomfort. If any pain arises after surgery, it is essential to have a routine in place to effectively handle the suffering. NSAIDs are the preferred medication for reducing endodontic pain. Numerous studies confirm the effectiveness of NSAIDs for postoperative usage, provided there are no contraindications. At recommended dosages, ibuprofen is significantly more effective than acetaminophen in providing a substantial sensation of pain relief<sup>[11]</sup>. A dosage of 600 mg of ibuprofen has demonstrated a 76% reduction of post endodontic pain. Additionally, endodontic pain intensity is 96% lessened when combined with 1000 mg of acetaminophen.<sup>[12]</sup>

This study aims to compare post endodontic pain

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following single-session endodontic therapy using two distinct file systems: a reciprocating system and a continuous rotating system.

## PATIENTS AND METHODS

Research Ethics Committee of October 6 University granted an ethical approval for the current study. The study cohort comprised patients indicated for endodontic therapy. The study's methodology and purpose were clarified, and informed consent was obtained. Before commencing therapy, the medical and dental records of the patients were acquired, encompassing details such as gender, age, tooth, existence of any preoperative pain, and periapical condition. Each participant was limited to one tooth during the trial.

Only mandibular molars and premolars ( $\geq 18$  years) with radiographic evidence of periapical radiolucency with a negative sensitivity test were included in the study. Exclusion criteria were as following; Teeth that have not fully developed roots, teeth with root resorption, teeth that require retreatment of the root canal. Individuals who had previous health or oral issues that made them vulnerable throughout the experiment (those who were pregnant or breastfeeding), individuals who had used painkillers, antibiotics within the past 7 days, or individuals who needed significant prosthesis rehabilitation. Patients exhibiting widespread periodontal disease.

The Size of the sample was estimated assuming a distribution that is relatively normal. Using the G\*Power software\* using a 5% significance level, 95% statistical power (1-b), as reported by Xavier et al. (2021). The minimum requirement for the study was set at 14 samples, the sample size was set to be 20 for each group to account for participant attrition. [16,17]

Randomization was implemented to minimize biases and guarantee a fair allocation of patients.

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A list was produced randomly for each experiment setting. The treatment plan was securely sealed in an envelope by an independent body unaffiliated with the research intervention. The patients were not given any information regarding their designated group. The operator opened the sealed package upon assignment, the patient's name was documented on the patient's chart to aid in the legibility of data administration. [15]

A single operator conducted endodontic treatments in a single session. The teeth were isolated using a rubber dam. The patient was anesthetized utilizing 3.6 mL solution of 2% mepivacaine hydrochloride via an inferior alveolar nerve block. The decayed areas were removed. A glide path was established utilizing manual K-files #10, #15, and #20. The working length was established by employing the Root ZX II apex locator in conjunction with the K-type file that best suited in the root canal. Subsequently, Radiographic examination was conducted to confirm the results.

## Instrumentation Groups

**Group 1:** Rotational method (n = 20), The canal was prepared using a one-curve endodontic device. A limited amount of initial setup was conducted at a rotational speed of 300 Rpm / torque of 200 g/cm, following the instructions provided by the manufacturer. The instruments were passed down to their full working length. The instrument's flutes were regularly cleaned following each use. Each research patient was provided with a distinct set of files.

**Group 2:** Reciprocating procedure (n = 20), The teeth were prepared using the S-ONE Pro Single Niti Reciprocation file according to the instructions provided by the manufacturer. A limited amount of initial instrumentation was conducted utilizing a. The canal was meticulously enlarged to a diameter of 25/0.08 using a method that involved a deliberate and repetitive pecking motion mixed with a brushing motion. The instrumentation was carried out until the desired operating length was achieved. The instrument's flutes were cleaned after each use.

Each patient was provided with a distinct set of files. Teeth were irrigated with 5 mL of 17% EDTA for one minute, and then it was flushed out with 5 mL of 2.5% NaOCl.

Root canals were dried with aseptic paper points. Subsequently, AH-Plus endodontic sealer and a gutta-percha cone utilizing heated vertical condensation technique were used. The gutta-percha cones were carefully incised at the cemento-enamel interface using a heated tool. Occlusal reduction was performed as a post-treatment procedure in all cases in order to avoid postoperative pain.

Patients were provided with a pain assessment scale, ranging from 0 to 100. They were instructed to record their pain levels at specific time intervals (6, 24, 48, 72, and 168 hours) following the treatment. This was done to monitor and manage any severe pain that the patients might have experienced. Additionally, The rescue treatment referred to is the ibuprofen regimen, which was established by Menhinick et al. in 2004. The participants were instructed to document their compliance with the prescribed analgesic medicine, including the number of tablets taken and the duration of treatment needed to manage the pain.

Statistical analysis was conducted using SPSS 25.0. The results were reported as the average and SD. The mean VAS scores were compared before and after at different intervals. The chosen significance level for each test was 5%.

RESULTS

Table 1 displays demographic and clinical data of patients in both groups. No significant difference in the average age, distribution of genders, and tooth type (p > 0.05) was reported. The mean VAS scores for both study groups at different follow up points are shown in Table 2.

No significant correlation was reported as regarding the degree of postoperative pain and gender and age (P>0.05).

Average VAS values of all the groups tested decreased significantly (p < 0.05) with time. Both instrumentation groups showed the highest average postoperative pain scores at 6 hours, followed by a considerable decrease over time. (Figure 2). After six hours of the treatment, the average VAS score of Group 1 was observed to be significantly greater than that of Group 2, and a similar trend was observed for other time intervals.

TABLE (1): Patients demographic data for both study groups.

Variable	Group 1		Group 2		p-value
	Mean	SD	Mean	SD	
Age	35.5	7.43	36.4	5.72	0.253
<b>Gender</b>					
Male	12	60%	9	45%	0.421
Female	8	40%	11	55%	
<b>Tooth</b>					
Premolar	12	60%	12	60%	1
Molar	8	40%	8	40%	

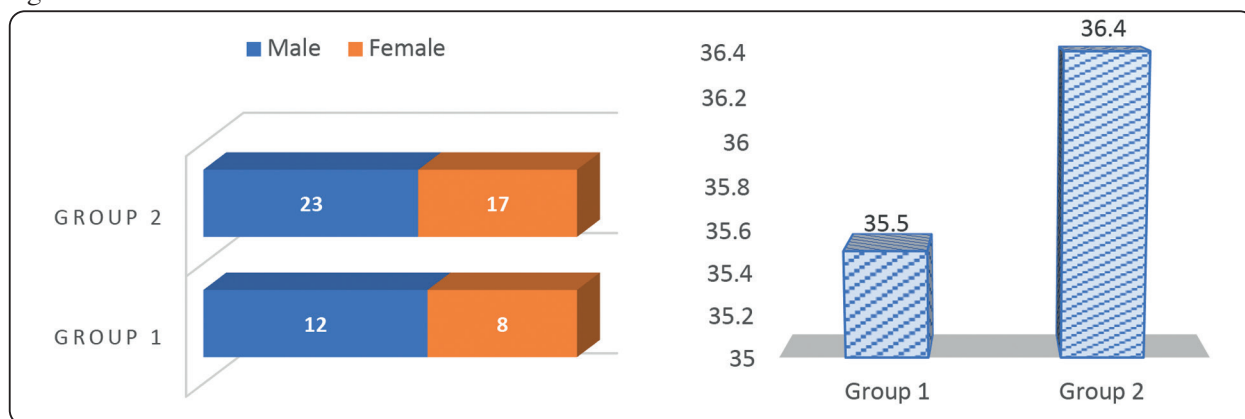


Fig. (1) A graph showing Baseline Demographic data of the study groups

TABLE (2): Comparison of VAS Scores for both study groups

Follow up	Group 1		Group 2		t-value	p-value
	Mean	SD	Mean	SD		
Pretreatment	49.98	8.755	49.465	10.427	0.169	0.867
6 H	37.455	5.62	27.315	5.496	5.769	≤ 0.001*
24 H	19	4.23	15.55	4.442	2.515	0.016*
48 H	10.1	2.049	7.95	1.317	3.947	≤ 0.001*
72 H	7.15	2.159	5.4	1.667	2.869	0.007*
168 H	0.4	0.681	0	0	2.629	0.012*
F-value	327.586		244.994			
p-value	≤ 0.001*		<0.001*			

Values marked with \*Denotes statistically significant difference; Significant(P≤0.05)

TABLE (3): Comparison of Mean Analgesic Intake at different time points

Time	Group 1		Group 2		t-value	p-value
	Mean	SD	Mean	SD		
6 H	0.9	0.553	0.7	0.733	0.975	0.336
24 H	0.8	0.523	0.4	0.503	2.466	0.018*
48 H	0.6	0.681	0.3	0.47	1.622	0.113
72 H	0.1	0.308	0	0	0.154	0.154
168 H	0	0	0	0	0	1
F-value	14.69		8.609			
p-value	<0.001*		<0.001*			

Values marked with \*Denotes statistically significant difference; Significant(P≤0.05)

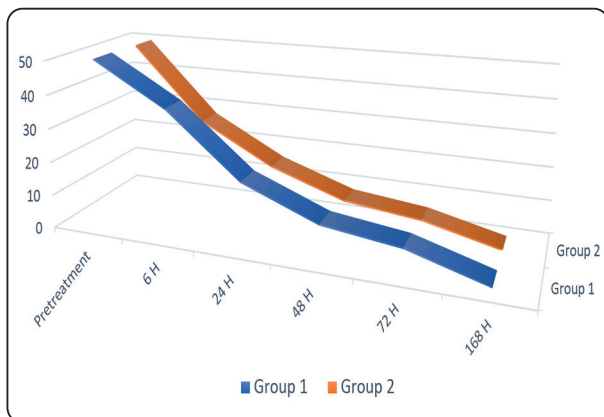


Fig. (2) VAS scores across six timepoints for the two experimental groups.

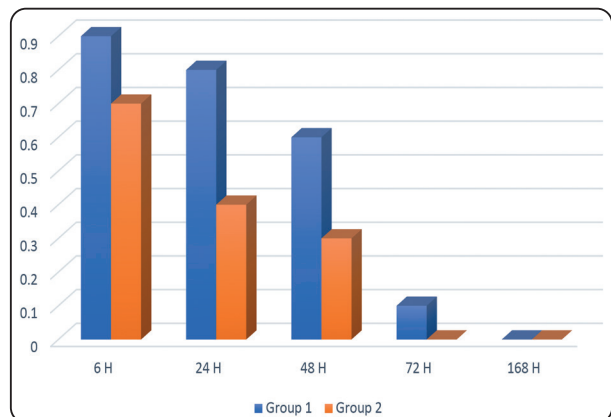


Fig. (3) Graph showing Analgesics intake across six timepoints for the two groups.

## DISCUSSION

Effective management of postoperative pain following non-surgical endodontic intervention is crucial. Literature reports a range of pain incidence estimates, ranging from 3% to 58%. Several factors, including preoperative discomfort, pulpal state, and patient-specific factors, impact the perception of postoperative pain. Establishing a correlation between pain occurrence and its likely origin is particularly difficult due to the subjective nature of pain assessment. Consequently, several approaches have been employed to assess and reduce postoperative pain. These factors encompass various aspects such as effective communication with the patient regarding the procedure and its aftereffects, utilization of NSAIDs, reducing occlusal forces, minimizing the number of instruments used, employing cross-sectional design, employing specific instrument techniques, and considering kinematic motion. These factors have a direct or indirect impact on the amount of debris that is extruded during the procedure, and consequently, influence the occurrence of postoperative pain.<sup>[18]</sup> A one-session endodontic treatment was conducted, potentially impacting postoperative discomfort. Treatments conducted in a single session generally result in reduced pain levels.<sup>[19,20]</sup> The reduced occurrence of this can be attributed to prompt sealing. The barrier stops the medicine from flowing through and reduces the need for frequent instrumentation and irrigation, hence decreasing irritation to the periradicular tissues. Recent studies suggest that the success rates of one or multiple-session root canal treatments are similar for infected teeth.<sup>[21]</sup>

The study found no correlation between postoperative discomfort and the gender of the individuals, which is consistent with prior research findings. Nevertheless, certain researchs have indicated that women encounter elevated degrees of postoperative pain.<sup>[22]</sup>

The study included only individuals who had not taken painkillers within the preceding 7 days, as prior use of anti-inflammatory medicines has been shown to significantly decrease postoperative pain.<sup>[23,24]</sup>

Glennon et al. reported that the postoperative pain intensity was greater in molar teeth compared to anterior and premolar teeth. The cause could be attributed to the proliferation of canals and the intricacies of their anatomical structure.<sup>[25]</sup>

Visual Analog Scale ranging was chosen due to its established reliability. The primary rationale for selecting this extensive scale was to ensure that even the most subtle discomfort experienced by patients could be accurately measured and scored. The study findings demonstrate a significant reduction in patients' pain levels across all groups following a 72-hour period. Furthermore, in the initial phases following the randomized controlled trial (RCT), patients may encounter a form of postoperative pain. Mild pain is a frequent outcome even with proper execution of root canal therapy, and so it should be anticipated.<sup>[26]</sup>

Neelakantan et al. found that using Reciproc single-file systems instead of One Shape rotational single-file systems leads to reduced postoperative discomfort in mandibular molars.<sup>[27]</sup>

Kherlakian et al. conduct a prospective randomized clinical experiment that looked at how postoperative pain was treated and how much pain medication was taken. They found that there was no significant difference between the reciprocating systems and the continuous rotating systems. The results of our study contradict the conclusions of a randomized clinical trial conducted by Nekoofar et al. In their research, it was shown that patients who underwent treatment with the ProTaper Universal rotary system had considerably lower levels of postoperative pain compared to patients treated with the Wave One reciprocating system. The variability in the research findings can be attributed

to variations in the types of teeth involved (teeth with irreversible pulpitis versus vital teeth), the choice of irrigating solution (chlorhexidine versus sodium hypochlorite), and the specific technique employed during reciprocating instrumentation.<sup>[28]</sup>

The use of standardized and controlled movements in this study may have helped to minimize the presence of leftover fragments or protrusions, hence potentially minimizing the likelihood of experiencing pain. Overall, reciprocating instrumentation systems demonstrate a notable reduction in postoperative pain and the need for analgesic medication compared to continuous instrumentation systems. While the specific cause was not examined in this study, it is possible that it is related to the kinematics of the instruments. Additional investigation is required to ascertain the precise factors contributing to this phenomenon.

The results of prior studies exhibit a contrast, highlighting the need to acknowledge that findings from a single clinical study cannot be universally applied. To comprehensively explore the limitations and advantages of instrument systems, future research with bigger sample numbers is needed. The study was constrained by the small sample size and the inherent subjectivity of pain, making it challenging to measure accurately. Another potential constraint of the study was the disparity in design between the two file systems. The average pain experienced by all groups in this study was highest within the initial 24 hours, followed by a notable decrease in pain ratings at the succeeding observation time periods of 48 hours, 72 hours, and 7 days. Pak and White's systematic review research conducted in 2011 yielded similar results. The study indicated that the incidence of pain was 40% within the first 24 hours, but decreased significantly thereafter, particularly during the first 2 days. The discomfort peaked at 11% after 7 days. Ng et al.<sup>[30]</sup>

The lack of blinding by the operator was one of the study's limitations. Nevertheless, the occurrence

of a significant bias is improbable. The participants were chosen at random to minimize selection bias. The patients were kept unaware of the approach, minimizing the influence of performance bias. The Visual Analog Scale (VAS) was used to examine the data provided by the patients, taking into account the differences in pain thresholds among participants.

The current study has many limitations that make standardization in clinical investigations problematic. Given the subjective nature of pain, individuals possess varying pain thresholds. Consequently, different instances of pain may not be employed to establish a benchmark for the VAS scores. Furthermore, variations in tooth structure impact the duration of dental procedures, thus influencing the level of discomfort experienced after the surgery. Further clinical trials should include a variety of clinical scenarios, such as non-essential teeth and instances requiring retreatment. Furthermore, the assessment of instrumentation systems in non-surgical root canal therapy should involve multiple visits to thoroughly understand their possible effects.

## CONCLUSIONS

Individuals suffering symptoms of irreversible pulpitis accompanied by apical periodontitis experienced less intense and shorter-lasting posttreatment discomfort when the S-ONE Pro Single Niti Reciprocation File was used, as compared to the One Curve rotary device. The specific cause of this phenomena was not assessed; nonetheless, it is likely attributed to the kinematics of the instruments. The utilization of reciprocation movement offers a more dependable and secure approach for the preparation of root canals, leading to a decrease in postoperative pain. The utilization of this strategy may result in a decrease in the necessity for patients to consume painkillers. Additional investigation is necessary to clarify the precise factors contributing to this phenomenon.

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