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EVALUATION AND COMPARISON OF POST OPERATIVE PAIN FOLLOWING ENDODONTIC TREATMENT PERFORMED BY ROTARY AND RECIPROCATING FILE SYSTEMS: AN IN VIVO STUDY

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Abstract-

Background- Postoperative pain is frequent complication of root canal treatment and can be influenced by preoperative status, treatment techniques and clinician experience. A new root canal instrumentation system, Pro Taper Next and Wave One Gold which employ varied file design and motion kinematics were selected in this study to evaluate the influence of motion kinematics for reduction of post operative pain.

Objectives – The main objective of this study was to evaluate and compare post operative pain following endodontic treatment performed by rotary and reciprocating file systems.

Material and Methods: A total of 60 patients with asymptomatic / symptomatic irreversible pulpitis between the ages of 25 and 40 were randomly assigned into 2 groups. Group I (n = 30) was instrumented with Protaper Next nickel-titanium file system, Group II (n = 30) was instrumented using Waveone Gold reciprocating system. All canals were instrumented and obturated within the same visit. The patients were asked to rate the severity of postoperative pain on a visual analogue scale at 6,12,24 and 48 hours. Data were analyzed using Student's t test, Paired t test and Chi square test. The level of significance was set at 0.05.

Results: The mean score for pain preoperatively was found to be highest for both the groups with no significant difference between them, Similarly no significant difference was found at 6 , 12 , 24 and 48 hrs .

Conclusions: Highest intensity of pain was observed at 6 h after the treatment, after which the pain intensity showed significant decrease by time with no significant difference in rotary and reciprocating file system groups.

Keywords: Pro Taper Next, Wave One Gold, Visual analog scale, Postoperative pain

Introduction

Root canal preparation is recognized as being one of the most important stages in endodontic treatment. For successful treatment necrotic tissue, microorganisms, and dentinal debris should be removed from the root canal system.[1]The aim of cleaning and shaping is to debride the intra-radicular contents and render the space suitable for obturation. Unfortunately, postoperative pain is still an unpleasant sensation that frequently occur after root canal treatment.[2]

Postoperative pain is defined as pain of any degree that occurs after initiation of root canal therapy and is caused mainly due to micro-organisms, extrusion of irrigant ,extrusion of debris containing necrotic tissue, microorganisms, pulpal fragments and dentine particles.. It is a frequent complication of root canal treatment and can be influenced by preoperative status, treatment techniques and clinician experience. Periradicular inflammation associated with apical extrusion of debris is one of the leading causes of postoperative pain.[3]

All root canal preparation techniques causes some degree of apical extrusion; however, the amount of extrusion may vary. Many factors are associated with apical extrusion of debris, including the irrigation protocol, the final apical size, the time spent on root canal instrumentation and the technique employed for it and the instrument design.[4] Advancements in rotary instruments have fastened the root canal procedures and resulted in less iatrogenic error. In recent times, a new root canal instrumentation system, Pro Taper Next [1]and Wave One Gold which employ varied file design and motion kinematics were introduced. The Pro Taper Next files operate in continuous rotary motion, and their center of mass or center of rotation is positioned off-center relative to the instrument's central axis of rotation. During rotation these files produce a mechanical wave which travels along the length of the working part of instrument. The offset design of this instrument improves flexibility in the working part of the instrument and minimizing the contact between the file and dentin.[5] Wave One Gold files are fabricated with M-Wire using an innovative thermal treatment process. The reciprocating motion require an initial rotation of the instrument in a counterclockwise direction, during which the instrument penetrates and cuts the dentin, and then a rotation in the opposite direction, during which the instrument is released.[6]

The incidence of postoperative pain has been a matter of concern even with the inception of advanced endodontic instruments While several in vitro studies have assessed the debris extrusion in different systems,[7,8] few have focused on the clinical outcome.[9] Based on these premises, the aim of this study was to evaluate and compare postoperative pain following endodontic treatment performed by rotary and reciprocating file systems.

Objectives – The main objective of this study was to evaluate and compare post operative pain following endodontic treatment performed by rotary and reciprocating file systems.

Material and methods-

This randomized clinical trial was carried out in the Department of Conservative Dentistry and Endodontics in Hitkarini Dental College And Hospital, Jabalpur and approval was taken from the ethical committee .All the patients were informed about the indications for endodontic treatment, the benefits and risks associated with treatment procedures.

Inclusion Criteria

- Patients within the age group of 25-40 years
- Single rooted teeth with single canal (radiographically and clinically assessed)
- Asymptomatic / symptomatic irreversible pulpitis
- Absence of periapical radiolucency

Exclusion Criteria

- Non-vital tooth
- Periapical radiolucency

- Swelling or sinus tract formation
- Previous root canal treated teeth
- Teeth with difficult root canal anatomy curvatures > 30°,resorption ,radiographic evidence of calcification or open apices)
- Absence of occlusal contacts
- Medically compromised patients
- Severe periodontal disease

Experimental groups and intrumentation procedures-

All samples were randomly divided into 2 equal groups

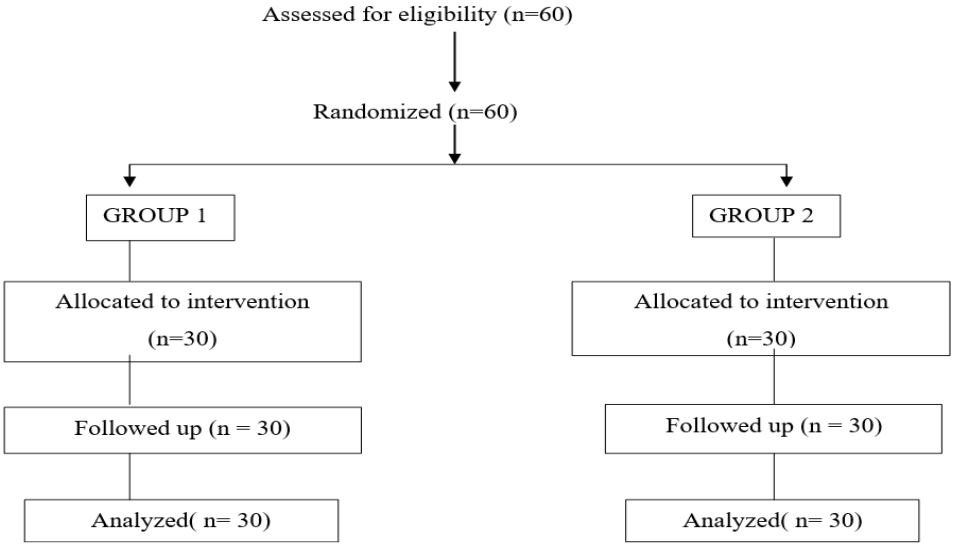
- GROUP 1= ProTaper next (Dentsply Sirona)
- GROUP 2= WaveOne Gold (Dentsply Sirona)

The minimum Sample size required was 30 teeth in each group .The aim and design of the study were explained to all the patients .After obtaining informed consent, preoperative pain scores using visual analog scale (VAS) (0–10mm)were recorded . Pulp vitality was diagnosed using thermal and electric pulp tester. After administering local anesthesia (2% lignocaine hydrochloride with 1:80,000 adrenaline) and rubber dam application,an ideal access opening was gained into the root canal system.

The apical patency of the canal was established using # 10 K- file .The working length was determined using an apex locator and confirmed radiographically. Cleaning and shaping of the root canals were done using ProTaper next (Dentsply Sirona) in rotary mode, whereas WaveOne Gold (Dentsply Sirona) in reciprocating mode with endomotor X-SMART® Plus (Dentsply Maillefer, Ballaigues,Switzerland). Torque and rotation speed were set individually as per the manufacturer's instructions. The master apical file tip size for both ProTaper next and WaveOne Gold was standardized at #25. The canals were irrigated between each file with 5 mL of 3% NaOCl. Prior to obturation, the canals were irrigated with 2mL of 17% ethylenediaminetetraacetic acid solution and a final flush was done with normal saline. The canals were later dried with paper points. A master cone radiographs was taken, and the root canals were obturated using gutta-percha and seal apex sealer by lateral compaction method.

No medications other than ibuprofen (400 mg), 6 hourly in the event of pain, was prescribed. Patients were contacted telephonically by the principal operator after 6, 12 , 24hours .The patient was recalled after 48 hours for post endodontic restoration. Postoperative VAS score was recorded after 6,12,24,48 hous.

PARTICIPANTS FLOW DIAGRAM



Statistical analysis -The recorded data was gathered and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). Kolmogorov Smirnov test was done to examine the normality of data. The results showed nonsignificant values which depicts that the data was found to be normal hence parametric tests were applied. For quantitative analysis of mean values of pain, Student's t test was used for intergroup comparison on the basis of treatments (comparison between rotary and reciprocating file system. For intragroup comparisons (between intervals for both the groups), Paired t test was applied. Qualitative data (intensity of pain) was compared using Chi square test. The level of significance was typically set at 0.05.

Results

The mean score for pain, standard deviation, and standard error was calculated for preop, 6-,12-,24- and 48-hrs time interval (Table 1) (Figure1).Data were analyzed by Student's t-test for comparison between rotary and reciprocating file system based on mean scores for pain. Test results showed that mean values preoperatively were found to be highest for both the groups (Rotary file system: 5.07±0.91 and reciprocating file system: 4.93±1.08) with no significant difference between them (p=0.607).Similarly no significant difference was found at 6 hrs (p=0.759), 12 hrs (p=0.770), 24 hrs(p=0.439) and 48 hrs (p=0.093) with mean values for rotary are 4.7333±.78492, 4.5333±.93710, 4.1333±.68145 and 2.2333±1.25075 respectively and for reciprocating it is 4.6667±.88409, 4.4667±.81931, 4.0±.64327 and 1.8±.61026 respectively.

For intragroup comparisons (between intervals for both the groups), Paired t test was applied. The level of significance was typically set at 0.05. (Table 2, Figure 2)and (Table 3, Figure 3) explain about the comparison between different intervals for rotary and reciprocating file system on the basis of mean pain values. Test results showed there was no significant difference between pre op and 6 hrs,6 hrs and 12 hrs.Significant difference was found between preop and 12 hrs and also between 12 hrs and 24 hrs. Highly significant difference (p=0.001) was found between preop and 24 hrs, preop and 48hrs, 6 hrs and 24 hrs, 6 hrs and 48hrs , 12hrs and 48 hrs as well as between 24 hrs and 48 hrs respectively.

The qualitative data (intensity of pain) was compared using Chi square test between rotary and reciprocating file system. (Table 4) and (Figure 4) showed majority of the patients in preoperative and 6hrs visit had moderate pain with no significant difference between the 2 groups. The trend was same at 12 hours and 24 hours with majority of the patients had moderate pain in both the groups .At both the interval the p-value was found out to be 1.000. But at 48 hours the trend changed to majority of the patients with mild pain in both the groups. For rotary group 27 participants (90%) had mild pain and for reciprocating all the participants showed mild pain (100%). None of the participants showed severe pain at 48 hours after procedure.

Table 1: Comparison between mean values of pain between rotary and reciprocating file system.

Interval	Group	Mean	Standard deviation	Standard error	t-value	p-value
Preop	Rotary	5.0667	.90719	.16563	0.518	0.607
	Reciprocating	4.9333	1.08066	.19730		
6 hours	Rotary	4.7333	.78492	.14331	0.309	0.759
	Reciprocating	4.6667	.88409	.16141		
12 hours	Rotary	4.5333	.93710	.17109	0.293	0.770
	Reciprocating	4.4667	.81931	.14958		
24 hours	Rotary	4.1333	.68145	.12441	0.779	0.439
	Reciprocating	4.0000	.64327	.11744		
48 hours	Rotary	2.2333	1.25075	.22835	1.705	0.093
	Reciprocating	1.8000	.61026	.11142		

Figure 1: Comparison between mean values of pain between rotary and reciprocating file system.

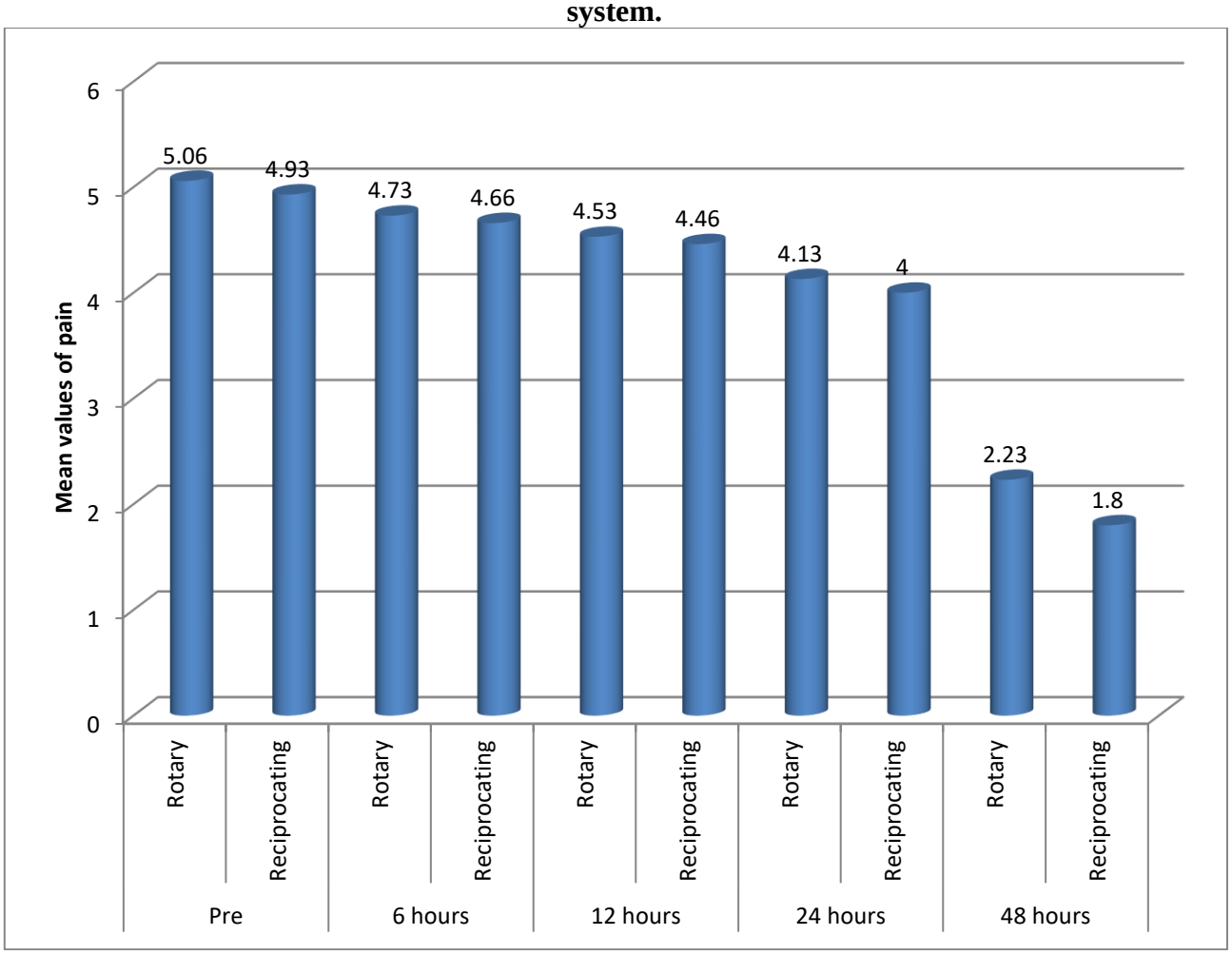


Table 2: Comparison between different intervals for rotary file system on the basis of mean pain values.

Intragroup comparison	Mean difference	Std. deviation	Std. error mean	t-value	p-value
Preop & 6hrs	.333	.922	.168	1.980	.057
Preop & 12hrs	.533	1.137	.208	2.570	.016*
Preop &24 hrs	.933	.868	.159	5.887	.001**
Preop &48 hrs	2.833	1.464	.267	10.599	.001**
6 hrs& 12 hrs	.200	.551	.101	1.989	.056
6 hrs&24 hrs	.600	.675	.123	4.871	.001**
6hrs& 48 hrs	2.500	1.503	.274	9.111	.001**
12hrs&24 hrs	.400	.770	.141	2.845	.008*
12hrs&48 hrs	2.300	1.489	.272	8.460	.001**
24 hrs&48 hrs	1.900	1.322	.241	7.871	.001**

Figure 2: Comparison between different intervals for rotary file system on the basis of mean pain values

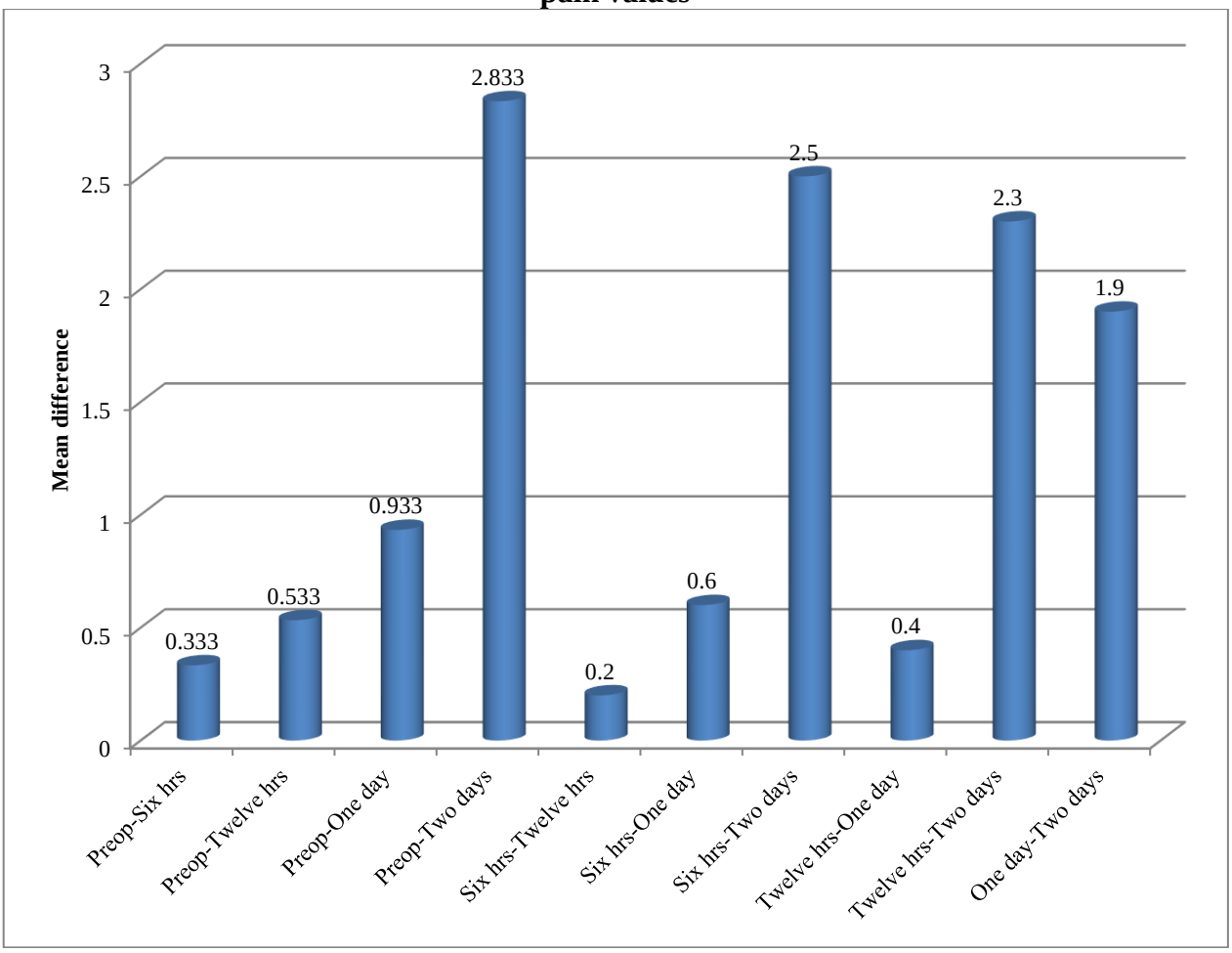


Table 3: Comparison between different intervals for reciprocating file system on the basis of mean pain values.

Intragroup comparison	Mean difference	Std. deviation	Std. error mean	t-value	p-value
Preop & 6hrs	.267	.868	.159	1.682	.103
Preop & 12hrs	.467	1.042	.190	2.454	.020*
Preop &24 hrs	.933	.980	.179	5.215	.001**
Preop &48 hrs	3.133	1.137	.208	15.099	.001**
6 hrs& 12 hrs	.200	.610	.111	1.795	.083
6 hrs&24 hrs	.667	.844	.154	4.325	.001**
6hrs&48 hrs	2.867	.900	.164	17.455	.001**
12hrs&24 hrs	.467	.776	.142	3.294	.003*
12hrs&48 hrs	2.667	.922	.168	15.837	.001**
24 hrs&48 hrs	2.200	.714	.130	16.868	.001**

Figure 3: Comparison between different intervals for reciprocal file system on the basis of mean pain values.

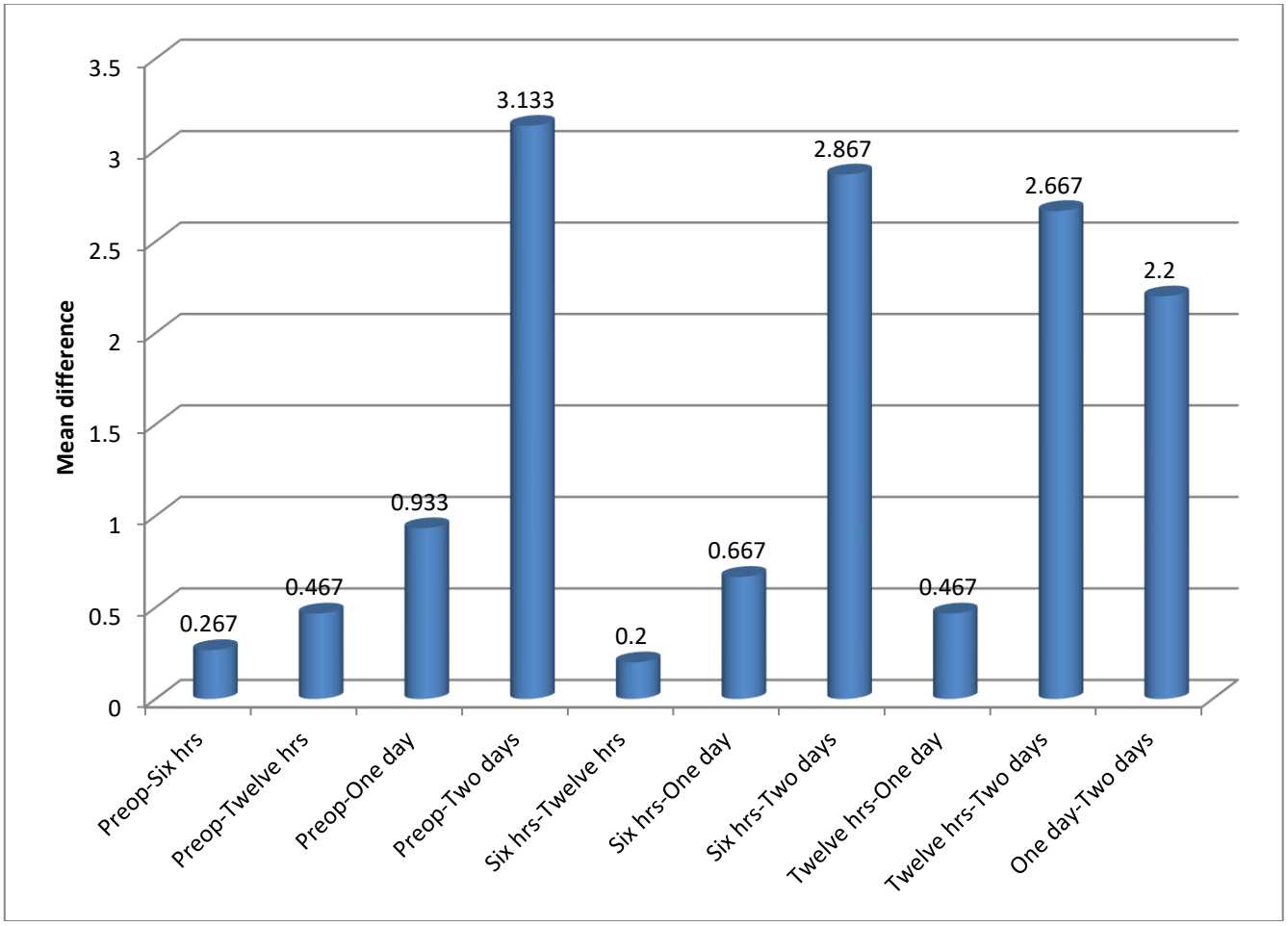
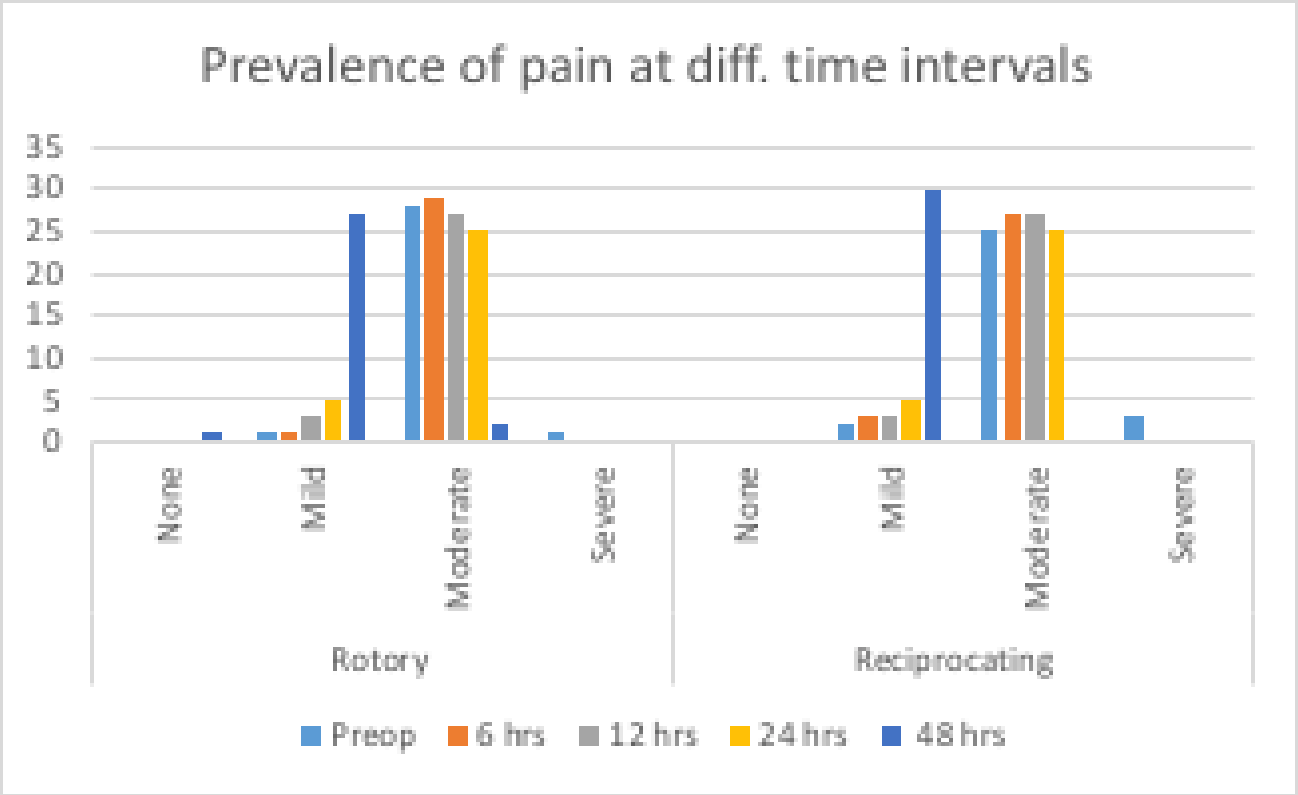


Table 4: Prevalence of pain at diff. time intervals

Time Interval	Groups	Pain Category				P-value
		No Pain N(%)	Mild N(%)	Moderate N(%)	Severe N(%)	
Pre Operative	Rotary	0(0)	1(3.33)	28(93.34)	1(3.33)	0.472
	Reciprocating	0(0)	2(6.67)	25(83.33)	3(10)	
6 h	Rotary	0(0)	1(3.33)	29(96.67)	0(0)	0.612
	Reciprocating	0(0)	3(10)	27(90)	0(0)	
12 h	Rotary	0(0)	3(10)	27(90)	0(0)	1
	Reciprocating	0(0)	3(10)	27(90)	0(0)	
24 h	Rotary	0(0)	5(16.67)	25(83.33)	0(0)	1
	Reciprocating	0(0)	5(16.67)	25(83.33)	0(0)	
48 h	Rotary	1(3.33)	27(90)	2(6.67)	0(0)	0.206
	Reciprocating	0(0)	30(100)	0(0)	0(0)	

Figure 4: Prevalence of pain at diff. time intervals



Discussion

Endodontic therapy is designed to manage pain and eliminate infection from teeth. Pain is a personal and subjective experience, that involves activation of peripheral nociceptors. It is a combination of nociceptor signals with emotional and cognitive elements that makes pain a multidimensional experience . Postoperative pain after the root canal treatment is basically unpreventable.[10] Although major advances in rotary instrumentation and metallurgy have led to the introduction of numerous systems with innovative designs and kinematics in recent years, Rotary instruments are commonly used as they shape the canals easily, quickly, and more predictably with less incidence of canal transportation and apical extrusion of debris when compared with stainless steel hand files.[11,12]

A new kinematics, instrument's alternating motion in clockwise(instrument releasing direction) and counter-clockwise directions (cutting direction), has been suggested for NiTi instruments to produce different stress points along length of the canal wall and file instrument during canal shaping , which might show fewer dentinal crack formation and excellent instrument's fracture resistance.[13]

In this study we have used ProTaper Next files to evaluate the influence of variable taper along the length of the file in causing postinstrumentation discomfort. The offset design of the PTN rotary files along with its swaggering motion in the canal could have enhanced the augering of debris out of the canal coronally rather in the apical direction.[14] WaveOne GOLD reciprocating files were selected in this study to evaluate the influence of motion kinematics for reduction of post operative pain and the metallurgical advancements of a gold thermal treatment which gives the file its distinctive gold finish producing a super-elastic NiTi file.[15]

Pain is known to be a highly subjective with fluctuating experience. Different scales and methods have been used to evaluate postoperative pain. The VAS scale was selected due to its ease of use, validity, and reliability in measuring pain.[16]

Root canal treatment could be offered in single or multiple visits. The single-visit endodontic treatments have become popular in recent years In the present study, the root canal treatment was

completed in a single visit with its advantages such as reduction in the number of operative procedures, lesser time, relatively inexpensive, and decreased overall postoperative pain .[17]

Few etiologic factors are attributed to post endodontic pain including history of preoperative pain, inadequate root canal debridement, hyperocclusion, periapical disease, and extrusion of infected debris into the periapical tissue. It can be stated that all instrumentation techniques were associated with debris extrusion during chemo-mechanical preparation of the root canals, that could be reduced using accurate irrigation , instrumentation limited to the confines of the root canal, and use of different endodontic files and their kinematics.[18] To investigate the effect of instrumentation technique on the postoperative pain, the irrigation and root canal obturation techniques were standardized in all cases.

The instrument systems utilized in this study were based on a close match in terms of tip size of the instruments to maintain standardization and to rule out the effect of varying tip diameters on postoperative pain.[19] The WL and type and amount of irrigating solution were controlled as these factors may influence the debris extrusion which might affect the periodontal ligament response.[20] Thus, efforts were made to decrease the over preparation by controlling the WL using apex locator and radiographic verification in all cases. The irrigant extrusion was limited by using side-vented irrigation needles to deliver the irrigants to the apex safely and effectively.[21]

The primary aim of this study was to compare the post instrumentation pain on using rotary and reciprocating file system at different intervals. In this study, mean values preoperatively were found to be highest for both the groups (Rotary file system: 5.07±0.91 and reciprocating file system: 4.93±1.08) with no significant difference between them .This is similar to the study done by Mollashahi et al.[22] which showed no significant difference between Reciproc and OneShape groups in terms of pain after endodontic treatment. This may occur due to the instrumentation kinematics which had no impact on intensity of postoperative pain

During the root canal treatment, the pain and/or swelling that may occur between appointments or after root canal treatment is considered a serious complication.[23] Microorganisms may pass from the infected root canals to the periradicular tissues through the infected debris, causing an imbalance between microorganisms and the human immune system, resulting in increased inflammation.[24] Any injury to the periapical tissue during root canal treatment promotes more intensive secretion of endogenous chemical mediators associated with inflammation and pain , such as prostaglandins, serotonin, leukotrienes, histamine and bradykinin.[25,26] The pain associated with periradicular inflammation due to debris extrusion may also be attributed to substance P and calcitonin gene-related peptide which activates G protein-coupled receptors on nociceptors, leading to the activation of neurons, and these neuropeptides can cause peripheral sensitization characterized as hyperalgesia, allodynia, and spontaneous pain. Furthermore, central sensitization is initiated by a barrage in C-fiber inputs with sufficient intensity and duration.[27]

There are differences of beliefs on the impact of the reciprocating and continuous systems on apical extrusion. Although in this study ,the reciprocal and rotational instrumentation techniques caused similar incidence and intensity of post-operative pain .However ,the reciprocal technique demonstrated slightly lower pain scores than rotational technique without any significance.This finding may be explained by differences in the kinematics of these 2 systems i.e the cross-section of the WOG file is a parallelogram, and only one cutting edge in contact with the canal wall. Along the active part of the instrument, there is a constant helical angle of 24°. The additional space around the instrument also provides space to auger debris removal. The WOG file has roundly tapered and semi-active guiding tip .In addition, WOG is a single-file system unlike PTN; requiring minimum instrumentation and hence less extrusion of debris.[28]

The present study compared postoperative pain following endodontic treatment performed by rotary and reciprocating file system at different intervals. There was statistically no significant differences between Preop and 6 hrs as well as between 6 hrs and 12 hrs. A significant reduction in postinstrumentation pain was observed between preop and 12 hrs also between 12 hrs and 24 hrs . Highly significant difference was found between preop and 24 hrs, preop and 48 hrs, 6 hrs and 24

hrs, 6 hrs and 48hrs, 12 hrs and 48 hrs as well as between 24 hrs and 48 hrs .This might be explained due to the initiation of tissue inflammation response resulting from debris extrusion and stimulation of nociceptors of c-fibers found in the periodontal ligaments that were stated to reach its maximum level at 12 hours postoperatively. Also there was significant decrease in pain scores at 24 and 48 hours compared to each other and to all other tested intervals. This could be explained due to subsiding of inflammatory response and the ongoing process of normal healing .[29]

The severity of postoperative pain was observed to decrease gradually at all the time intervals, after the root canal treatment in both the groups. Pak et al [30] reported that the highest level of postoperative pain was observed in the early phase after root canal treatment. The postoperative pain incidence was reported to be 40% in the first 24 hours, to decrease significantly in the first 48 hours, and to be 11% or less on the 7th day. Similar results were also attained in the present study.

The factors in the post operative pain can be microbial and nonmicrobial.In the present study adequate care was taken to avoid nonmicrobial causes such as over-instrumentation or irrigant that could be extruded into the periapical area . The microbial factors include apical extrusion of debris and insufficient instrumentation , of which only the difference in debris extrusion could have arisen as a factor in this study. Nevertheless, the amount of postoperative pain induced by instrumentation are important to enable the operator to reduce discomfort to their patients.[31]

Conclusions-

Within the limitations of this study, the following conclusions were drawn:

- Highest intensity of pain was observed at 6 h after the treatment, after which the pain intensity showed significant decrease by time in rotary and reciprocating file system groups.
- No significant difference was found between Rotary file system and reciprocating file system groups in terms of pain after endodontic treatment.

However, further investigations with additional in-vivo tests are desirable in order to evaluate effect of instrumentation techniques on the incidence and intensity of postoperative pain.

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