Original Article

Postendodontic pain in asymptomatic necrotic teeth prepared with different rotary instrumentation techniques

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Abstract

Objectives: to investigate the postendodontic pain in asymptomatic necrotic teeth prepared with different rotary instrumentation techniques after single-visit root canal treatment. **Materials and Methods:** A total of 60 single-rooted teeth with single root canal were treated endodontically. Teeth were divided randomly into four equaled groups (n = 15) according to instrumentation systems as follows: group I were shaped using ProTaper Universal (control group) (Dentsply/Maillefer, Ballaigues), group 2 were shaped with 2Shape (Micro-Mega) till TS2 (25.06), group 3 were shaped with XP-endo Shaper file (FKG Dentaire) till #30.04, and group 4 were shaped with Reciproc blue (VDW) till R25 (25.08). All groups were prepared according to manufacturer's instructions and obturated with lateral condensation technique. Pain levels were assessed by visual analog scale (VAS) and verbal evaluation of pain questionnaire after 6, 12, 24, 48 h, and 7 days of canal obturation. Data were then analyzed using Kruskal–Wallis and Mann–Whitney U tests at *P* value of 0.05. **Results**: Postendodontic pain started after 6 h of treatment with highest values and then decreased gradually until almost vanished after 1 week of treatment, with no significant differences in VAS among studied groups (ProTaper, 2 shape, XP endo Shaper, and Reciproc Blue) after 6,12, and 48 h of treatment. On the other hand, XP endo Shaper group, showed the lowest pain values after 24 h of treatment, and the highest pain values were found in 2 shape group after 1 week with significance ($P < 0.05$). **Conclusion**: Root canals prepared with XP endo Shaper resulted in the lowest pain levels after 24 h of treatment. Root canal preparation with 2Sshape rotary system resulted in the highest pain levels after 1 week of treatment.

Keywords: Asymptomatic, necrotic, pain, postendodontic, single-visit

Introduction

Postendodontic pain is defined as the sensation of discomfort after endodontic treatment and the degree of pain was reported in a range of 25%–40%,[1] and ranging from 1.5%[2] to more than 50%[3] of patients regardless of pulp and periradicular status. Postendodontic pain can be caused by several factors.[4] Inflammation may be produced by the extrusion of dentinal debris, pulp tissue, microorganisms, and irrigants to the periapical tissues during chemomechanical preparation.[5] Major advances in rotary instrumentation and metallurgy have led to the introduction of numerous systems with innovative designs in recent years. Nonetheless, all the preparation techniques and instruments available to date are still associated with some degree of extrusion of debris, which may cause postendodontic pain.[6] Crown-down technique is associated with less debris extrusion compared with other instrumentation techniques. Therefore, it is possible that early preflaring is associated with less

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debris extrusion and postoperative pain.[7] Most nickel-titanium engine-driven instrument systems extrude less debris than stainless steel K-files manipulated by hand, which has the potential to reduce the risk of postoperative discomfort.[8] ProTaper Universal (Dentsply/Maillefer, Ballaigues, Switzerland) is one of the conventional clockwise rotation multi-file rotary systems used since 2001, which prepares the root canals with six files: three shaping and three finishing files. A unique design element is the convex triangular cross-section and the varying tapers along the instruments.[9] 2 Shape (TS; Micro-Mega, Besancon, France) is a sequence with 2 shaping files in continuous rotation, it was launched in 2017, which have been heat-treated using the T Wire technology that according to the manufacturer, aims to improve both flexibility and cyclic fatigue resistance of the files. The latest generation of cross section (offset cross section) with triple helix produce perfect compromise between cutting efficiency and debris removal.[10] The XP-endo Shaper files (XPS; FKG Dentaire, La Chaux-de-Fonds, Switzerland) launched in 2016 are marketed to shape the root canals with one clockwise rotation instrument in 3D preparation concept. Its size is 30, 0.01 taper. XPS is manufactured using MaxWire (Martensite-Austenite Electropolishing-Flex, FKG) alloy.[11] Burklein and Schafer demonstrated that full-sequence rotary instrumentation was associated with less debris extrusion when compared with the use of reciprocating single-file systems.[12] Reciproc blue (VDW GmbH, Munich, Germany) launched in 2016 is a thermally treated nickel-titanium instrument, which is an improved version of the original Reciproc which works in (150:30) contra clockwise reciprocation motion.[13] It has an increased resistance to cyclic fatigue and a greater flexibility.[14] Su *et al.* found that the frequency of pain in patients after single-visit endodontic treatment was significantly lower than that in patients who received multiple-visit endodontic treatment.[15] The root canal treatment of tooth with necrotic pulp and apical periodontitis can be completed in single or multiple visits. Clinical studies demonstrated that patients generally tolerate and prefer single-visit root canal treatment[16] because of several advantages, such as reduction of operative procedures,[4] no inter-appointment leakage,[17] being less time consuming and more economical.[15] The aim of this *in vivo* study is to investigate the post-endodontic pain in asymptomatic necrotic teeth after single-visit root canal treatment prepared with different rotary instrumentation techniques.

Materials and Methods

Study design

Randomized Controlled Trial was used, with blind assessment technique. After obtaining ethical approval (01/2/2018). Before starting the treatment procedures, all participants were informed about the nature and objectives of the study, along with obtaining a written consent. Participants were also not aware of the study group that they were belonging to. Before starting the study sample, 10 pilot *in vitro* and 10 *in vivo* samples were performed to master the use of rotary instrumentation to ensure the correct study steps.

Inclusion and exclusion criteria

Selected patients were in good health with no general diseases and pregnancy. Patients used antibiotics or analgesics just before endodontic treatment were excluded. Cold vitality test with the use of electric pulp-testing device (Parkell, Farmingdale, NY, US) were used preoperatively to confirm pulp necrosis in all teeth. Only nonvital, necrotic teeth were included in the study. Accepted teeth for this study were with the following criteria:

- Nonvital asymptomatic teeth.
- Single-rooted single canal teeth (radiographically and clinically assessed).
- Ability for isolation with rubber dam.
- Restorable teeth.
- Initial apical size 0.10–0.15#.
- Ability to fill the root canals in single-visit treatment.

Exclusion criteria

- Teeth without good apical constriction, such as wide or open apex
- Resorption and large apical lesions (more than 5 mm).
- Lower anterior incisors

Treatment procedures

After isolation and access opening, canals of all teeth were prepared using four different instrumentation systems, irrigated with 5.25% NaOCl and 17% ethylene diamine tetraacetic acid (EDTA), and obturated with gutta-percha and sealer using lateral condensation technique. For all teeth an initial manual glide-path with stainless steel k-files up to size #15 was performed. The teeth in group 1 (n = 15) were shaped using ProTaper Universal (control group) (Dentsply/Maillefer, Ballaigues, Switzerland) till F2 (25.08), group 2 (n = 15) were shaped with 2 Shape (TS; Micro-Mega, Besancon, France) till TS2 (25.06), group 3 (n = 15) were shaped with XP-endo Shaper file (XPS; FKG Dentaire, La Chaux-de-Fonds, Switzerland)#30.04, and group 4 (n = 15) were shaped with Reciproc blue (VDW GmbH, Munich, Germany) R25 (25.08. all groups were prepared according to manufacturer's instructions. All canals were shaped, cleaned, and obturated in a single-visit by lateral condensation technique with resin-based sealer (Adseal; Meta- Biomed, Korea lot: ADS1505151) and gutta-percha cones taper 4% (Meta-Biomed, Korea lot: GE1102078).

Upon completion of RCT, a periapical radiograph was carried out to ensure the accuracy of root canal obturation. Then each tooth was restored temporarily with a glass ionomer restoration for 1 week (Kavitan plus SpofaDENTAL, Czech Republic, lot: 2481885-1).

Randomization

Regardless of the treated included case in the study, and without informing the patient of which group the treated tooth was belonging to, the first treated case was for the first group, the second was for the second group, and the third case was for the third group, and so on.

Each patient received instructions on how to use a questionnaire for the numeric and verbal evaluation of pain/discomfort. The questionnaire contained a 10-cm (100 mm) visual analog scale (VAS) to assess discomfort/pain after 6, 12, 24, 48 h and 7 days of canal obturation [Figure 1].

The patient has to mark the area on the VAS that corresponds with the amount of felt pain as the 0 refers for no pain, and the 100 degree refers for unbearable pain. The distance between the beginning of the scale 0 and the patient's pain mark was measured using a roller and the VAS value by millimeters was recorded. For verbal evaluation of pain/discomfort, the patients were asked to record the pain on the same questionnaire as follows: 0: no pain, 1: slight pain, 2: moderate pain, and 3: severe pain. Patients were contacted on phone to remind them about registering pain according to different periods. In case of severe or unbearable pain, or when patients ask to take sedatives, patients were allowed to take antiinflammatories like ibuprofen 400 mg, or acetaminophen, or both according to pain severity, and verbal along with VAS reading was recorded for the corresponding period and other pain reading after sedatives application were excluded from the study. The questionnaires were completed and delivered after 1 week of canal obturation at the session of restoring the teeth, which was done using the composite (Nexcomp, Meta-Biomed, Korea lot: 0120) as the final restoration. The data were then inserted to a personal computer and analyzed using the Statistical Package for the Social Sciences (SPSS) 25.0 computer software by using Kruskal–Wallis and Mann–Whitney U tests for comparing among the study groups; *P* value of 0.05 was considered statistically significant.

Results

Study sample consisted of 60 single-visit RCTs for patients aged between 19 and 62 years old. Study sample was divided into four equal distinct groups (ProTaper Universal (control), 2 Shape, XP-endo Shaper, Reciproc blue groups) [Figure 2]. VAS or verbal pain values are illustrated in Figures 3 and 4.

The results of this study showed highest increase of pain levels after 6 h of treatment, and then decreased gradually in the following monitoring periods until almost vanished after 1 week.

VAS pain values after 6 h were (28.33), (23.47), (14.33), and (14.33) for Protaper, 2Shape, XP endo Shaper, and Reciproc Blue systems groups, respectively. Mean rank of verbal pain degree values after 6 h were (38.43), (33.07), (25.87), and (24.63) for Protaper, 2Shape, XP Endo Shaper, and Reciproc Blue systems groups, respectively. Measured pain values decreased remarkably in XP endo Shaper group along the monitoring periods more than any other group. VAS pain values were: (14.33), (2.33), (0), (0), and (0) after 6, 12, 24, 48 hours, and 7 days of treatment, respectively. The results of this study showed almost complete correspondence between verbal and VAS pain values, so we list only the VAS results analysis.

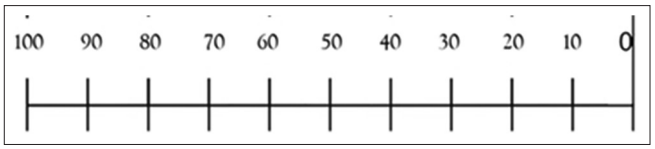

Figure 1: Visual analog scale used to assess pain in the study

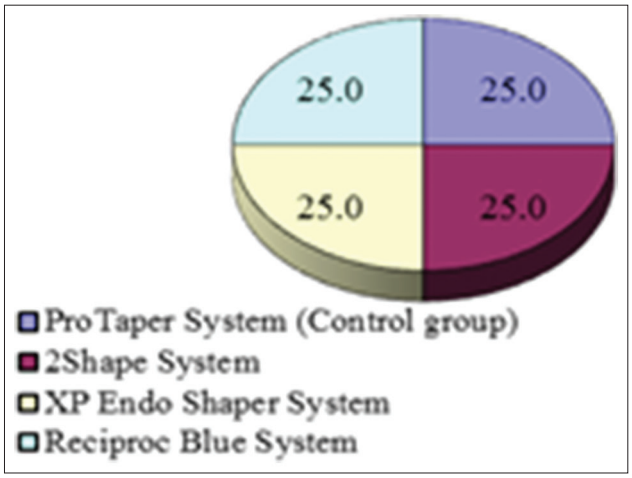

Figure 2: Percent of sample distribution according to instrumentation technique

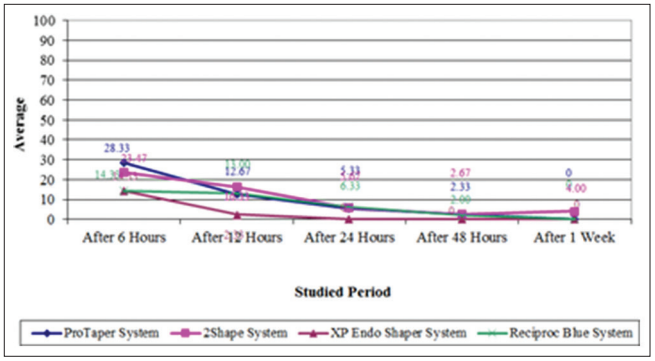

Figure 3: Average of VAS pain values according to the studied group and the studied period

Statistical analysis

A Kruskal-Wallis Test was applied to know if there were significant differences in VAS Pain values among the study groups as shown in Table 1.

P-values were greater than 0.05 after 6, 12, and 48 h, so, at the confidence level of 95% there were no significant differences in VAS Pain values after 6, 12, and 48 h of treatment among the studied groups in the studied sample. *P* values after 24 h and after 1 week were lower than 0.05, so, at the confidence level of 95% there were significant differences inVAS pain values after 24 h and after 1 week of treatment among at least two of the four studied groups. A Mann–Whitney U test was applied to know if there were significant pairwise differences between study groups as shown in Table 2.

P-values were lower than 0.05 when comparing in VAS Pain after 24 h among XP endo Shaper system group and all the

other studied groups, and when comparing in VAS pain after 1 Week among 2Shape system group and all the other studied groups, so, we can conclude that at the confidence level of 95% there were significant differences in VAS pain among the sub-mentioned studied groups. Referring to the according mean values we conclude that: VAS pain values after 24 h in XP endo Shaper system group were lower than those of all the other studied groups, VAS pain values after 1 week in 2 Shape system group were greater than those of all the other studied groups in the studied sample. All other *P* Values were greater than 0.05, so, at the confidence level of 95% there were no significant differences in VAS pain values amongn the according subgroups in the sample.

Discussion

The most important objective of root canal therapy is total tissue debridement and to minimize the number of microorganisms in root canal system followed by 3D obturation of the prepared space.[18] Postoperative pain is a frequent complication associated with root canal treatment, especially during apical instrumentation of tooth with preexisting periradicular inflammation objectives.[19] Prevalence of postoperative pain after endodontic treatment has been reported to range from 1.5%[2] to more than 50%.[3] According to the study results, we notice that the postendodontic pain started after 6 h of treatment with highest values, and decreased gradually until almost vanished after 1 week of treatment, with no significant differences in VAS among the studied groups (ProTaper, 2shape, XP endo Shaper, and Reciproc Blue) after 6, 12, and 48 h of treatment. This could be attributed to the possible irritation of the periapical area due to endodontic treatment that caused the local inflammatory response, which leads to this postendodontic pain that vanished after recovery of the periapical area. These results were in agreement with those of Siqueira and Barnett, [20]Al-Nahlawi *et al.*, [21]and Kherlakian D *et al.*[22]

This study results were in contrary with Gambarini *et al.*[23] who found that reciprocation movement of rotary file resulted in more VAS pain values comparing with forward rotation. But in their study the reciprocating movement was used through Wave One Gold rotary system instead of Reciproc Blue used in this study, and they also evaluated postendodontic pain in necrotic posterior teeth (premolars and molars) not single canal single rooted teeth as in this study, and these could explain the difference in results between the two studies. The correspondence between VAS pain values and verbal pain degrees insure the accuracy of pain measurement records, and these two methods of obtaining pain values done together are important to avoid the possible weakness in the results from only one method. The 10-cm scale measurement pain values in the VAS methods will give more data variety, so it was listed in the study instead of verbal pain degree values. It was

Table 1: Kruskal-Wallis Test results to know if there were significant differences in VAS pain values among study groups according to the studied period

Studied Period	Chi Square	d.f.	*P*	Significant Diff
After 6 h	6.209	3	0.102	No
After 12 h	6.739	3	0.081	No
After 24 h	11.234	3	0.011	YES
After 48 h	3.458	3	0.326	No
After 1 week	16.062	3	0.001	YES

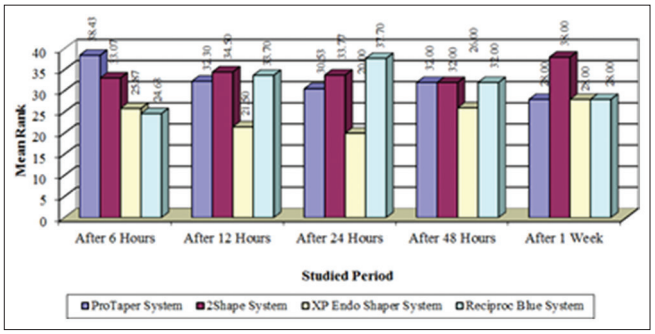

Figure 4: Mean ranks of verbal pain degrees according to instrumentation technique and studied period

Table 2: Mann-Whitney U Test results to know if there were significant pairwise differences on VAS pain after 24 h and after 1 week among studied groups

Studied variable = VAS pain						
Studied Period	**Instrumentation Technique (I)**	**Instrumentation Technique(J)**	**Mean Difference (I-J)**	**U**	***P***	**Significant Diff.?**
After 24 h	2 Shape	Reciproc Blue	-0.67	106	0.771	No
		XP endo Shaper	5.67	60	0.003	YES
		ProTaper	0.33	102	0.620	No
	Reciproc Blue	XP endo Shaper	6.33	45	0.001	YES
		ProTaper	1.00	93	0.374	No
	XP endo Shaper	ProTaper	-5.33	75	0.017	Yes
After 1 week	2Shape	Reciproc Blue	4.00	75.0	0.016	Yes
		XP endo Shaper	4.00	75.0	0.016	Yes
		ProTaper	4.00	75.0	0.016	Yes
	Reciproc Blue	XP endo Shaper	0	112.5	1.000	No
		ProTaper	0	112.5	1.000	No
	XP endo Shaper	ProTaper	0	112.5	1.000	No

noticed from the study results that in XP endo Shaper group, postendodontic pain presented with lowest values after 24 h of treatment compared with other groups. It is possible that the 3D preparation new concept applied in XP endo Shaper produces less amount of debris extrusion beyond the apex, the fact that will reduce periradicular irritation resulting in less pain compared with traditional preparation concept found in Protaper Universal, 2Shape, and Reciproc Blue rotary systems. These results were in agreement with Uslu G *et al.* and another study.[24,25]After one week of treatment pain disappeared in all groups except for 2 Shape rotary system group, and this resulted in significant difference. This could be explained that the offset cross-section and flutes design (Triple Helix) of this new system is pushing more debris beyond the apex producing more postendodontic pain compared with other systems. And as this system is a new system (launched in 2017), we did not find any study in the literature up till now dealing with postendodontic pain using 2 Shape system to compare with this study results.

Clinical significance

The outcome of this study indicates that the use of the new 3D preparation XP endo Shaper rotary system reduces postendodontic pain.

Study limitations

We think that if we used larger groups sample size, the results will be more accurate to obtain more reliable pain measurement records.

Conclusions

Within the limitations of this study we can conclude the following:

- Pain after endodontic treatment reaches the highest levels after 6 h, and then decreased until almost vanished after 1 week of treatment.
- Root canal preparation with XP endo Shaper rotary system resulted in the lowest pain levels after 24 h of treatment.
- Root canal preparation with 2 Shape rotary system resulted in the highest pain levels after 1 week of treatment.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published anddue efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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