

Postoperative pain in patients following endodontic treatment by XP-endo Shaper files: A systematic review and meta-analysis

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Abstract

Context: Postoperative pain occurs in 25%–60% of patients following endodontic treatment. It can significantly impact a patient’s quality of life and requires timely management or, preferably, prevention.

Aims: The present systematic review was conducted aiming to analyze randomized controlled trials that compared postoperative pain in patients whose canals were shaped by XPS versus other endodontic file systems.

Materials and Methods: A systematic search was performed using key terms “postoperative pain” AND “XP-endo Shaper” across multiple databases to identify relevant randomized controlled trials. Details concerning the study design, endodontic preparation, XP-endo Shaper-related factors, and pain assessment were recorded. The risk of bias was calculated using the RevMan 5.3 software. Meta-analysis done using the random effects model which was represented using forest plots.

Results: Six studies evaluating a total of $n = 290$ samples of XP-endo Shaper file and other file systems each, respectively, were included in the final review and meta-analysis. The standard mean difference ranged from 0.8 to 2.88 with a mean of 1.04 (0.80–2.88) favoring other file systems. This signifies that the postoperative pain is on average 1.04 times more by other file systems as compared to XP-endo Shapers file although the difference was statistically nonsignificant ($P > 0.05$).

Conclusions: XP-endo Shaper has proven to be a relatively more efficient file system that effectively cleans and shapes the root canals, including those with difficult anatomy.

Keywords: Endodontic file systems; postendodontic pain; root canal treatment

INTRODUCTION

The primary objective of root canal therapy is to eliminate infected and necrotic tissues, ensuring a sterile and infection-free canal. While achieving a successful outcome is crucial, alleviating patient symptoms holds equal importance. Postoperative pain following endodontic treatment, is a common complication, occurring in approximately 25%–40% of cases and even higher (50%–60%)

in patients with periradicular conditions.^[1] Such pain can significantly impact a patient’s quality of life and requires timely management or, preferably, prevention.

One of the most important reasons for postoperative endodontic pain is the extrusion of infected dentin, microorganisms, and extrusion of irrigation solutions from the root apex during the chemomechanical preparation.^[2,3] This can lead to apical periodontitis where microbes left within the root canal system, or iatrogenic extrusion of bacteria and their by-products, infected debris, and/or irrigating solutions cause inflammation into the periapical tissue, becoming the primary cause of postendodontic pain.^[4]

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The initiation, level, and progression of pain may also vary according to various factors such as age, sex, pulpal and periradicular factors, preoperative pain, mechanical insult, and the implemented method for cleaning the pulp canals.^[5] Shaping the root canal in a manner that minimizes the extrusion of its content to the periapical tissues can limit the severity and prevalence of pain.

Advancements in file designs and metallurgy have led to efficient file systems that shape canals with irregular anatomy while reducing complications. XP-endo Shaper (XPS; FKG Dentaire SA, La Chaux-de-Fonds, Switzerland) is a single-file rotary instrument system produced from a MaxWire NiTi alloy that shows corresponding expansion and contraction at the body temperature, and the taper increases to 4%.^[6] XPS files are in the martensitic phase at room temperature, when placed into the canal at room temperature, they enter the austenitic phase (memorized shape).^[7] With an initial taper of 1%, the straight file assumes a serpentine shape which has the ability to touch most of the canal's walls and push out the envelope of movement and the files achieve a taper of 4% with ISO 30 diameter.^[8,9]

Several clinical trials have compared the effect of reciprocating and rotation kinematics on postoperative pain and reported conflicting results. It is, therefore, of importance to analyze the findings from these studies to ascertain the actual standing of XPS in terms of postoperative pain production as compared to other file systems. The present systematic review was conducted aiming to analyze randomized controlled trials that compared postoperative pain in patients whose canals were shaped by XPS versus other endodontic file systems.

MATERIALS AND METHODS

The study protocol was registered in the International Prospective Register of Systematic Reviews, PROSPERO (Registration ID: CRD42023433007). A systematic search was performed using key terms ("Postoperative pain" AND "XP-endo Shaper") across the following databases: MEDLINE (Ovid), PubMed, PubMed Central, Web of Science Citation Index Expanded (SCIEXPANDED), and Google Scholar. Only English language articles with full text were considered, encompassing various study types (randomized and nonrandomized clinical trials, case-control studies, and cross-sectional studies) except review articles, animal studies, case reports, case series, brief reports, and letters to the editor. Furthermore, cross-references of the articles included in the final analysis were also scanned for additional relevant articles. The PRISMA flowchart indicating the selection process of the studies for the present systematic review is depicted in Chart 1.

Inclusion and exclusion criteria

1. Population: Studies that compared postoperative pain after endodontic treatment with XP-endo Shaper to other file systems. Full-text available in the English language
2. Intervention: endodontic treatment with XP-endo System
3. Comparison: endodontic treatment with other file systems
4. Outcome: Postoperative pain after the use of XP-endo versus other file systems
5. Study design: Randomized and nonrandomized clinical trials, case-control studies, cross-sectional studies.

Data extraction

The extracted data included publication details (author, year, and country), study design, ethics, sample size, patient age, teeth involved, and inclusion/exclusion criteria. Also noted were compared file systems, pulp vitality test methods, randomization, and XP-endo Shaper-related factors: initial preparation, file specifications, irrigation, obturation, and restoration. Pain assessment scale, categories, and recording intervals per study were documented, alongside authors' conclusions. The quantitative outcomes comprised postoperative pain recorded using the respective methods for each study, while discomfort experienced by the patients was recorded as the secondary outcome. Studies that recorded postoperative pain irrespective of the scale and follow-up period were considered compatible for data analysis. The authors of the respective publications were mailed to retrieve missing data, if any [Tables 1 and 2].

Data synthesis

The qualitative data were tabulated in an MS Excel Sheet under appropriate headings. The traffic-light plots and summary plots were used to depict the risk of bias (ROB) across the included studies. The heterogeneity across measures of outcome for the included studies was generated in the form of a Begg's funnel plot. The quantitative data related to pain outcomes was subjected to meta-analysis using random-effects model which was represented using forest plots [Tables 1 and 2].

Risk of bias (quality) assessment

Methodological quality in included clinical trials and randomized studies was assessed using the Cochrane collaboration ROB-2 tool. Domains evaluated included random sequence generation, allocation concealment, blinding of personnel/equipment, blinding of outcome assessment, incomplete outcome data, selective reporting, and other biases through RevMan 5.3 software's (Hamilton, Ontario) questions. Studies were classified as low, moderate, or high risk based on domains, with low overall risk only if all had low risk. High risk was if one or more domains were high risk; moderate risk was for studies with uncertain or no high-risk domains.

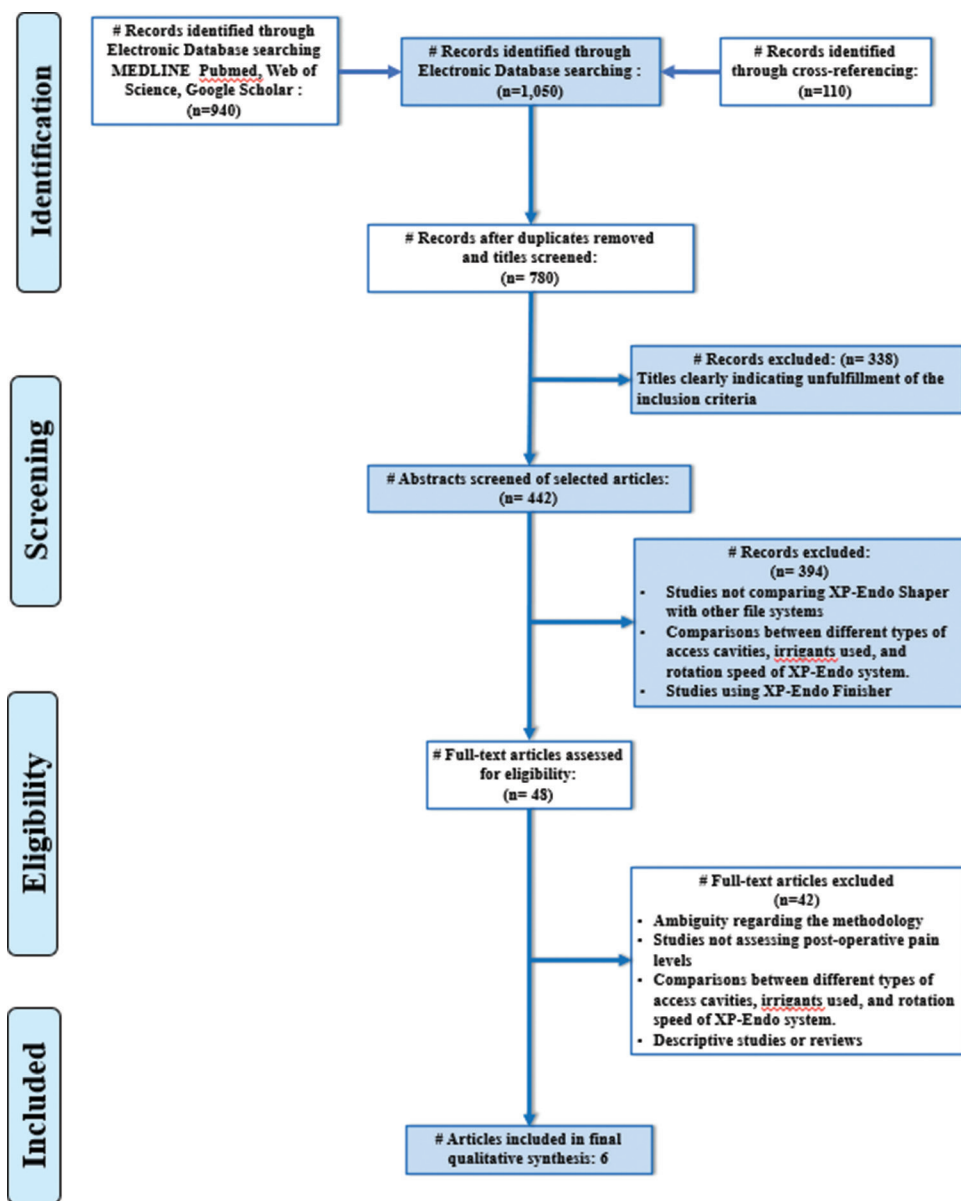


Chart 1: PRISMA flow diagram indicating the selection process of the articles in the present systematic review

RESULTS

A total of $n = 6$ studies were identified after careful evaluation of the identified articles by inclusion and exclusion criteria.^[10-15]

Assessment of methodological quality and risk of bias

All the included studies were largely comparable in methodological quality [Figure 1]. All the included studies had moderate-to-low ROB with all the respective domains. The highest ROB was seen for the blinding of participants and personnel (performance bias). Among the included studies, Al-Nahlawi *et al.* 2020 and Pawar *et al.* 2022 had a high ROB compared to all other studies.^[11,15]

Adigüzel *et al.* 2019 followed by Xavier *et al.* 2021 reported the lowest ROB.^[10,13] Domains of random sequence generation (selection bias); allocation bias (selection bias); selective reporting (reporting bias); and other biases were given at the lowest ROB by included studies while respected domains. The highest ROB was seen for blinding of participants and personnel (performance bias) followed by blinding of outcome assessment (detection bias) was given the highest ROB. The ROB in included studies through the Cochrane ROB-2 tool is depicted in Figure 2 as shown.

Synthesis of results

Six studies containing data on 580 ($n = 290$) samples, of which ($n = 290$) samples were evaluated by XP-endo Shapers file, and ($n = 290$) samples were evaluated by

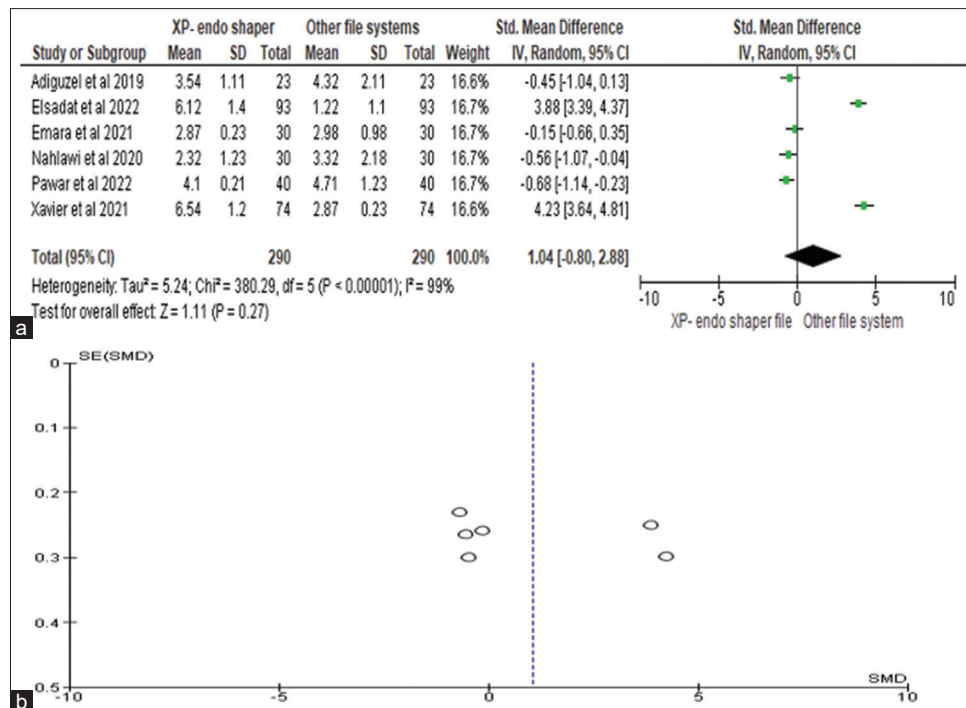


Figure 1: (a) Forest plot showing XP-endo shaper file with other file systems with regards to the postoperative pain (b) Begg's Funnel plot with 95% confidence intervals demonstrating asymmetric distribution with the presence of systematic heterogeneity of individual study compared with the standard error of each study, indicating presence of publication bias

other file systems for the postoperative pain as an outcome. The standard mean difference is 1.04 (0.80–2.88) and the pooled estimates favor other file systems. This signifies that the postoperative pain is on average 1.04 times more by other file systems as compared to XP-endo Shapers file and this difference is not statistically significant ($P > 0.05$) which implies that both are more or less equal. By employing the random effect model the I^2 statistic showed 99%, the heterogeneity for τ^2 was 5.24, χ^2 being ($P < 0.0001$), and the overall effect for Z value being 1.11 ($P = 0.27$).

Funnel plot showing asymmetric distribution with the presence of systematic heterogeneity of individual study compared to the standard error, showing the presence of publication bias in the meta-analysis.

DISCUSSION

Complete debridement of the pulpal tissue along with eradication of the microorganisms present in the pulpal canal to the maximum possible extent is the chief objective of root canal treatment. One of the most frequent complications following a root canal treatment is postoperative pain. This pain significantly impacts patients' quality of life, trust, and confidence in the endodontist. The present systematic review, thus, aimed to analyze randomized controlled trials comparing postoperative pain in XPS-shaped canals to other systems. The goal is to

assess XPS's position and its postoperative pain compared to other files.

Postoperative pain varies in younger and older patients.^[16] Included studies commonly had subjects aged 18–65 years. The inclusion of young adults would be more rational as a significant portion of the patients in the routine clinics is comprised this population. Comparison of pain levels in a population with a wide range of ages would confound the results. Pain being a subjective finding, in the present review, there is no evidence that there is any age predilection for pain threshold being higher or lower in patients of different age groups.

The preoperative pulpal and periapical conditions have an effect on postoperative pain.^[17] Azim *et al.* and Bassam *et al.*, in their studies, have reported that postoperative pain and flare-up in teeth with pulpal necrosis are more common than those with vital pulps.^[18,19] This review's studies included teeth needing endodontic therapy, mostly with mild or no periapical issues. Within the limitations of this review, there seems to be no confounding effect of the preoperative clinical conditions, and hence the variations in pain in these studies must be attributed to the instrumentation system and technique used.

Apical debris extrusion affects microbial-host balance, causing inflammation or lesion exacerbation.^[20] Debris

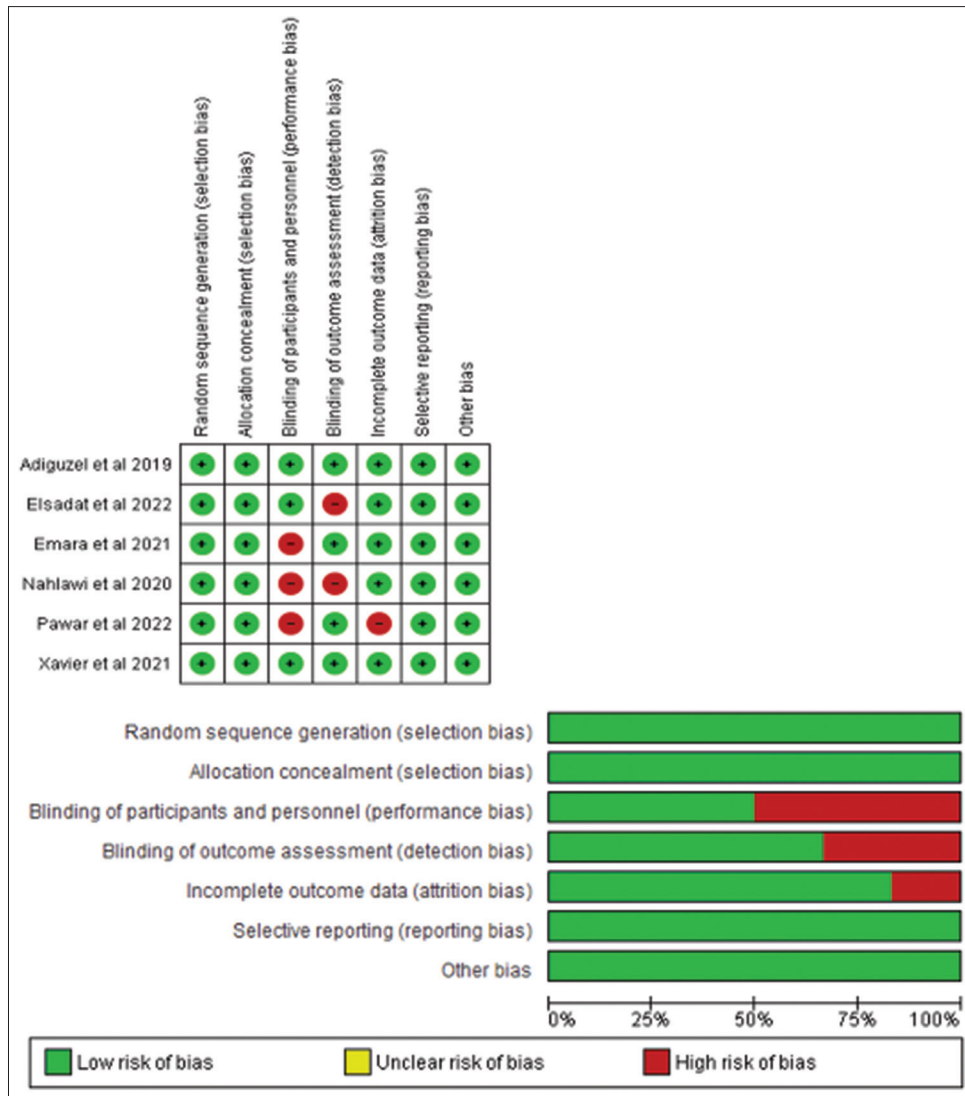


Figure 2: Risk of bias summary: Review authors’ judgments about each risk of bias item for each included study

amount links to postoperative pain. All instrument systems lead to some extrusion.^[21] Despite new techniques and improved tools, no method is debris-extrusion-free. Owing to recent advances in production methods and metallurgy, it became possible to manufacture systems offering easier and faster instrumentation.^[21] XP-endo Shaper (XPS; FKG Dentaire SA, La Chaux-de-Fonds, Switzerland) is one such continuous rotary single-file system that employs a thermomechanically treated nickel-titanium alloy. XPS files are in the martensitic phase at room temperature because of their aluminum content and get converted into the austenitic phase (memorized shape) when entering the canal at body temperature during preparation. The small core of the XPS-endo file grants the file flexibility, cyclic fatigue resistance, as well as elimination of the coronal debris effectively.^[22-24]

Loureiro *et al.* found continuous rotary motion caused more pain than reciprocation postendodontic treatment.^[25]

The difference was linked to extrusion depending on the method. However, Tanalp and Güngör and Uzun *et al.* found rotary less painful with less debris extrusion due to preflaring^[26,27] reciprocating versus rotary effects on pain conflicted, maybe due to varied systems’ properties and designs.

In this review, XP-endo files were compared with 2Shape, iRace, F-One blue, SAF, Reciproc blue, and WaveOne Gold systems. XP-endo showed less pain versus Rec Blue, 2-shape, iRace. Al-Nahlawi *et al.*^[11] noted the lowest pain with XPS due to reduced debris extrusion and periapical irritation.

Adigüzel *et al.* found XPS-endo yielded less pain than REC Blue and iRC. Smaller size and taper of XPS contributed.^[10] Emara *et al.* noted XPS caused less pain versus iRace due to fewer files, shorter preparation time, and potentially less amount of apical extrusion.^[12]

Table 1: Data extraction/synthesis

Author	Sample size	Teeth used	Comparison between	Randomization	Inclusion criteria	Exclusion criteria	Pulp vitality tested by
Adigüzel <i>et al.</i> ^[10]	69 3 groups (n=23 each)	First or second mandibular tooth with asymptomatic necrosis but no periapical pathology	XP-endo Shaper (XPS; FKG Dentaire SA, La Chaux-de-Fonds, Switzerland), iRace (iRC; FKG Dentaire SA) and Reciproc Blue (REC Blue; VDW, Munich, Germany) files	Color-coded bags	Patients aged 21–65 years, first or second mandibular molars with asymptomatic necrosis with no periapical pathology	Participants with periapical lesions, abscesses or cellulitis at the relevant tooth, those with a medical treatment history or those having undergone root canal treatment for the relevant tooth	Thermal and electric pulp tests, followed by palpation, percussion and periodontal charting
Al-Nahlawi <i>et al.</i> ^[11]	60	Single-rooted teeth	ProTaper Universal, (Dentsply/Maillefer, Ballaigues 2 Shape (MicroMega) XP-endo Shaper file (FKG Dentaire) Reciproc blue (VDW)	Sequential	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	Teeth without good apical constriction, such as wide or open apex Resorption and large apical lesions (more than 5 mm) Lower anterior incisors	Cold vitality test with the use of electric pulp testing device (Parkell, Farmingdale, NY, US)
Emara <i>et al.</i> ^[12]	60 (2 groups, 20 each)	Single-canalled mandibular premolars with necrotic pulps	XP-endo Shaper and iRaCe	Computer software - random sequence of numbers	Mandibular premolars with single oval root canals and necrotic pulps, and with (smaller than 3 mm) or without periapical radiolucency	Pregnant women If analgesics or antibiotics were taken during the past 12 h Teeth that did not have a normal occlusal contact on verification using an articulating paper, association with acute periapical abscess, >5 mm periodontal pockets, greater than grade I mobility, alveolar bone loss exceeding 50%, and nonrestorable teeth	Both thermal test and electrical pulp tests (Denjoy DY310 Dental Pulp Tester; Denjoy, Henan, China)
Xavier <i>et al.</i> ^[13]	148 (2 groups, 74 each group)	Maxillary or mandibular molar or premolar	WaveOne Gold (WOG; Dentsply Sirona, Ballaigues, Switzerland) and XP-endo Shaper (XPS; FKG Dentaire, La Chaux-de-Fonds, Switzerland)	Dark boxes containing 74 tokens (32 red and 32 green) picked randomly by assistant	Vital teeth (normal pulp diagnosis) No symptoms Maxillary or mandibular molar or premolar Indication for conventional endodontic treatment for prosthetic purposes	Nonvital teeth Apical periodontitis Endodontic retreatment Symptomatic/asymptomatic irreversible pulpitis Root resorption Immature/open apex Root canal in which patency of the apical foramen could not be established Patients refusing to participate in the study Patients whose teeth had issues precluding single-visit treatment Patients using some type of medication during the 7 days before the procedure Patients with signs of systemic infection Patients allergic to local anesthetic agents Patients with any uncontrolled systemic disease	positive cold test (Endo Ice; Coltene/Whaledent Inc, Cuyahoga Falls, OH)

Contd...

Table 1: Contd...

Author	Sample size	Teeth used	Comparison between	Randomization	Inclusion criteria	Exclusion criteria	Pulp vitality tested by
Elsadat <i>et al.</i> ^[14]	93	Mandibular first molars	XP-endo shaper and F-One file	Research randomizer software (www.randomizer.org)	Male, literate patients, age range between 20 and 25 years old, suffering from acute pulpitis without apical periodontitis related to the first mandibular molar	Teeth with aberrant morphology (calcified canals, teeth showing root dilacerations, open apices, root fractures, roots curvature more than 30°), patients with necrotic teeth or teeth showing acute or chronic abscesses, patients with periodontal diseases, or with any systemic diseases, patients took medication 12 h before the diagnostic visit	Electric pulp tester
Pawar <i>et al.</i> ^[15]	120 (3 groups, 40 patients each)	Mandibular first molars	XP-endo shaper sequence, full-sequence self-adjusting file, and manual K-files	Computer-generated simple randomization method (www.random.org)	Patients diagnosed with symptomatic irreversible pulpitis with or without clinical signs of apical periodontitis, with fully formed mature roots and an absence of periapical lesion, with respect to maxillary and mandibular first molars	Nonvital teeth, cases of previous endodontic retreatment, second and third molars, and intentional root canal treatment periapical radiolucent lesion, root resorption, immature/open apex, root caries, and gross decay that were considered nonrestorable as well as teeth with mobility and complex anatomy Patients who had taken medication in the 12 h before the operation, such as analgesics or nonsteroidal or steroidal anti-inflammatory drugs, pregnant and breastfeeding patients, patients with any uncontrolled systemic disease, and patients younger than 18 or older than 65 years	A cold test (Endo-Ice; Hygienic, Akron, OH, USA), and an electric pulp test

However, contradictory to the above finding, XPS-endo caused more pain than WaveOne Gold and SAF, as seen in studies conducted by Xavier *et al.* and Pawar *et al.* studies.^[13,15] XPS's uncontrolled dimensional change at body temperature could harm PDL, increasing pain. XPS's swaggering motion at 800 rpm could cause turbulence in the irrigant, elevating debris extrusion with dentin shavings, and possibly causing more pain.^[28,29]

XPS and iRace systems effectively reduced bacterial levels in infected canals with no pain difference.^[12] WOG caused less pain than XPS, with pain rating as mild.^[13] XPS and F-One showed similar pain levels.^[14] SAF caused less pain than XP-endo Plus.^[15] Thus, the XP-endo Shaper single-file system can be an effective tool that could limit the unpleasant occurrence of postoperative pain.

Other factors that might influence the amount of extruded debris and subsequent postoperative pain include the

operator performing the procedure, the irrigation used, and the materials and techniques used for obturation. Therefore, these factors need to be standardized as much as possible to avoid any confounding of the results.^[30] To eliminate inter-clinician differences, one operator conducted all procedures. Thus, standardized irrigation and condensation would not impact pain across the included studies.

Singh and Garg, in their clinical trial, reported that the incidence of pain after the single-visit endodontic treatment was less than that observed after the multiple-visit endodontic treatment.^[31] Therefore, a single-visit treatment approach was adopted by all the authors in this systematic review to rule out the potential influence of intracanal medication or other factors triggering pain.

In a 2011 systematic review, Pak and White found peak postoperative pain early after root canal treatment.^[32] Pain

Table 2: Data extraction/synthesis

Author	Local anesthesia	Initial prep	Irrigation	Obturation	Restoration	Pain assessment	Pain categories	Recording intervals	Conclusive findings
Adıgüzel et al. ^[10]	IANB with 1:100,000 epinephrine (Ultracain DS Forte; Sanofi-Aventis) and 4% arti-caine	#10 manual K-files (VDW)	5.25% NaOCl and 17%	Cold lateral compaction method	Resin-modified glass-ionomer and a nano-hybrid composite resin	VAS	No pain (0), mild pain (1–3), moderate pain (4–6) and severe pain (7–10)	24-, 48- and 72-h and 1-week	For all the periods, the minimum level of postoperative pain was observed in the XPS group and the maximum level in the REC Blue group. The XPS group exhibited less postoperative pain than the REC Blue group at 24- and 48-h intervals. iRC system and XPS and REC Blue systems were found to be similar in terms of postoperative pain severity.
Al-Nahlawi et al. ^[11]	Not provided	#15 manual k-files	5.25% NaOCl and 17%	Lateral condensation technique with resin-based sealer and Gutta-Percha cones taper 4%	Glass ionomer restoration for 1 week (Kavitan plus SpofaDENTAL, Czech Republic, lot: 24818851)	VAS	Questionnaire as follows: 0: No pain, 1: Slight pain, 2: Moderate pain, and 3: Severe pain	6, 12, 24, 48 h, and 7 days	No significant differences in VAS among studied groups (ProTaper, 2 shape, XP endo Shaper, and Recipro 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. XP-endo Shaper significantly reduced the incidence (at 6, 12, and 24 h) and severity (at 6, 12, 24, and 48 h) of postoperative pain compared with iRaCe rotary files. Both instrumentation systems succeeded in significantly reducing bacterial levels in primary infected root canals with no significant difference between them.
Emara et al. ^[12]	1.8 mL of 2% Mepivacaine HCl with 1:100,000 epinephrine (Mepecaïne-L; Alexandria Company for Pharmaceuticals and Chemical Industries, Alexandria, Egypt)	Not provided	2.5% sodium mL of 2.5% sodium hypochlorite and EDTA gel	Modified single cone technique with 40, 0.04 Gutta-Percha and a resin-based root canal sealer	Core-build up composite resin	Modified VAS	None (0); 2, Mild (1–3); 3, Moderate (4–6); 4, Severe (7–10)	6, 12, 24 h and daily for 5 days	Both instrumentation systems succeeded in significantly reducing bacterial levels in primary infected root canals with no significant difference between them. The WOG system caused less postoperative pain than the XPES system, the average pain at the assessment times was classified as mild in both groups. Short-term postoperative pain (24–72 h) can be expected after the use of the systems tested, but it is absent after 7 days.
Xavier et al. ^[13]	4% articaine and epinephrine (1:100,000 [Septanest; Septodont, Saint-Maur-des-Fosses, France])	Kfile ISO #15 (Dentsply Sirona)	2.5% sodium hypochlorite and 17% EDTA	Single cone technique using AH Plus epoxy resin sealer and the Gutta-Percha cone	Resin-reinforced glass ionomer filling (Riva Light Cure; SDI, Victoria, Australia)	VAS	No pain (0), mild pain (1–3), moderate pain (4–6), and severe pain (7–10)	24, 48, and 72 h and 7 days	The highest pain scores were recorded after 6 h in both groups; the severity of pain was observed to decrease significantly between 6 h and 72 h. Both XP-endo shaper and F-One blue files showed nearly the same amount of postoperative pain over time.
Elsadat et al. ^[14]	LA administered but materials used and concentration not provided	#15 K-file	5.25% NaOCl and 17% EDTA and saline	Cold lateral compaction technique	Glass ionomer filling material	VDS	Not provided	6, 24, 48, 72 h and 7 days	The highest pain scores were recorded after 6 h in both groups; the severity of pain was observed to decrease significantly between 6 h and 72 h. Both XP-endo shaper and F-One blue files showed nearly the same amount of postoperative pain over time.

Contd...

Table 2: Contd...

Author	Local anesthesia	Initial prep	Irrigation	Obturation	Restoration	Pain assessment	Pain categories	Recording intervals	Conclusive findings
Pawar <i>et al.</i> ^[15]	2% lidocaine 1:80,000 (epinephrine) (Lidayn, Dr. Dentaids, Kolkata, India)	#15 K-file	3% sodium hypochlorite	Lateral compaction technique using a resin-based sealer and a Gutta-Percha master cone	Sterile dry cotton pellet and hydraulic temporary restorative material followed by permanent restoration (material not provided) in 15 days	VAS	No pain (level A, 0–24 mm), mild pain (level B, 25–49 mm), moderate pain (level C, 50–74 mm), and severe pain (level D, 75–100 mm)	6, 24, 48, and 72 h	The full sequence SAF instrumentation resulted in less postoperative pain than the XP-endo Plus protocol, while manual instrumentation with K-files resulted in the highest postoperative pain

VAS: Visual Analog Scale, VDS: Verbal Descriptor Scale, SDI: Southern Dental Industries, EDTA: Ethylene diamine tetracetate, IANB: Inferior alveolar nerve block

was 40% within 24 h, dropping significantly within 48 h. Adigüzel *et al.*^[10] and Xavier *et al.*^[13] confirmed similar trends. Elsadat *et al.*^[14] noted the highest pain scores at 6 h, decreasing notably from 6 to 72 h. Al-Nahlawi *et al.*^[11] found XP-endo Shaper treated patients had the lowest pain at 24 h compared to other files.

This review implies XP-endo Shaper can effectively minimize postoperative pain. However, considering file features and its metallurgy, caution in extrapolation is needed. Meta-analysis showed other files cause 1.04 times more pain on average than XP-endo Shaper, but this lacks statistical significance ($P > 0.05$). Very high heterogeneity was observed in the outcomes recorded across the various studies included in the review, making the findings of the meta-analysis questionable, constituting a possible drawback of the present systematic review.

The clinical implication of the present systematic review is that the XP-endo Shaper single-file system can be an effective tool that could limit the unpleasant occurrence of postoperative pain and match the performance of conventional multiple files rotary systems for effective root canal disinfection even in canals difficult to prepare by the other file systems. The lower level of postoperative pain in canals treated by XPS may be attributed to its smaller size and taper which reduce the amounts of extruded debris.

CONCLUSIONS

XP-endo Shaper has proven to be a relatively more efficient file system for cleaning and shaping root canals, including those with difficult anatomy. The system minimizes debris extrusion to some extent which leads to lesser postoperative pain following endodontic treatment as compared to other file systems. Findings from studies reported by various authors that were included in the present systematic review have found supportive evidence for these statements. Our meta-analysis revealed that across all the studies, while patients treated with XP-endo Shaper had a lesser incidence of postoperative pain, the

difference between other file systems was not of statistical significance.

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Conflicts of interest

There are no conflicts of interest.

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