ORIGINAL ARTICLE

Turk Endod J 2022;7(3):116–120
doi: 10.14744/TEJ.2022.46220

Post endodontic pain severity after single visit treatment using Twisted-File, TF-Adaptive, and TruNatomy file systems: A questionnaire-based observational study

Neslihan Yılmaz Çırakoglu, Olcay Özdemir

Department of Endodontics, Karabük University Faculty of Dentistry, Karabük, Türkiye

Purpose: This observational study aimed to evaluate post endodontic pain using Twisted File (TF), TF-Adaptive (TFA), and TruNatomy (TRN) files after a single visit root canal treatment.

Methods: A total of 150 healthy patients with asymptomatic maxillary or mandibular molar teeth identified for root canal treatment were allocated into three groups according to the instrumentation technique used: Group 1 (TF), Group 2 (TFA), and Group 3 (TRN) file systems were used in a single visit. The pain level after 72 h was questioned using a visual analog scale. Scores were analyzed using the Chi-square test with a significance value of $p< 0.05$.

Results: A significant difference was found between groups in terms of pain incidence ($p = 0.048$). In the pairwise comparison, there was no difference between Groups 1 and 2 (TF and TFA) ($p = 0.547$), and there was no difference between Groups 1 and 3 (TF and TRN) ($p = 0.201$). A significant difference was found between Group 2 (TFA) and Group 3 (TRN) in terms of pain incidence ($p = 0.007$).

Conclusion: All file systems used in the study caused post endodontic pain. When evaluating patients experiencing "no pain," the incidence of symptoms was higher with the TRN systems.

Keywords: Postoperative pain, post endodontic pain, TF-Adaptive, TruNatomy, Twisted File.

Introduction

Post endodontic pain is an uncomfortable, negative experience for the patient and may well affect the patient–clinician relationship. Despite the largest recorded pharmacological advances, postoperative pain after root canal treatment remains a major and common discomfort and unfortunately is highly unpredictable. It influences 2.5% to 60% of patients receiving endodontic therapy (1). Postoperative pain increases between 6 and 12 h after procedures. It arrives at a frequency of about 40% in 24 h and decreases to 11% one week after the treatment (2,3).

Postoperative pain after endodontic procedures is multicause and emerges from inflammation due to the periapical response to mechanical, chemical, and microbial extrusion to the periapical area during treatment (4). Various factors, such as gender, systemic health condition, the status of pulp and the periapical tissues, preoperative pain, apical patency, files for using preparation, the operator who performs the management, irrigation, irrigation activation, and obturation technique, may affect the post endodontic pain (5–8).

Cite this article as: Yılmaz Çırakoglu N, Özdemir O. Post endodontic pain severity after single visit treatment using Twisted-File, TF-Adaptive, and TruNatomy file systems: A questionnaire-based observational study. Turk Endod J 2022;7:00-00.

Correspondence: Neslihan Yılmaz Çırakoglu. Department of Endodontics, Karabük University Faculty of Dentistry, Karabük, Türkiye

Tel: +90 505 – 300 64 01 e-mail: neslihanyilmazcirakoglu@karabuk.edu.tr

Submitted: August 22, 2022 Revised: October 05, 2022 Accepted: October 07, 2022

Twisted File (TF) (Sybron Endo, Orange, CA, USA) is a triangular, continuous rotational Ni-Ti file system with three unique design features: R-phase heat treatment, metal bending, and special surface conditioning. These properties have been proven to increase instrument fracture resistance, provide greater flexibility, preserve the original canal center, and minimize canal transport (9).

An instrumentation motion called adaptive motion was introduced by SybronEndo (Orange, CA, USA), which uses both rotation and reciprocation features that can adapt to canal shape and dimensions during movement. This system aims to combine the advantages of both kinematics. According to the manufacturer, TFA motion uses a series of different angles that automatically change based on perceived intracanal stress (600°/0° to 370°/50°), aimed at optimizing efficiency and preventing errors. It has been reported that this kinematic rotational motion significantly increases the tool's resistance to fracture, reduces the screwing effect, and reduces the debridement that may be extruded apically. This system has a special motion that automatically adapts to instrumentation stress (10).

TruNatomy (TRN) (Dentsply, Maillefer, Ballaigues, Switzerland), a continuous rotational Ni–Ti file system, has a characteristic feature that is dependent on the sliding shaping ability, and the manufacturer has declared flexibility and fatigue-resistance due to its special off-center parallelogram cross-section design with heat treatment. These files preserve the dentinal structure due to the regressive taper, geometry, and slenderized pattern (11,12).

This observational study aimed to evaluate the incidence of pain after single-visit treatment with TF, TF-Adaptive (TFA), and TRN file systems, which have various motion kinematics during instrumentation. The null hypothesis tested was that there is no difference between the incidence of pain after treatment with different file systems.

Materials and Methods

This study design was approved by the local committee of ethics (protocol number: 2020/331). For the study, 150 patients identified for primary root canal treatment were included and observed for postendodontic pain. The inclusion criteria were permanent molar teeth (lower and upper) with asymptomatic irreversible pulpitis and no periapical lesion and patients between 20 and 50 years of age with no medical history. The exclusion criteria were previous root canal treatment for the related tooth, taking any medication in the last 12 h, pregnancy, complex anatomy (roots with more than 25° of curvature), any root resorptions, calcifications, immature tooth structure, periodontal disease, presence of periapical lesions, preoperative pain, sensitivity to percussion, swelling, and a sinus tract.

Before initiating treatment, signed informed consent was obtained, and a list of information was collected from each patient regarding age, gender, tooth number, and location (Table 1). Patients were divided into three groups (TF, TFA, and TRN, n = 50) by a blind independent observer according to the root canal instrumentation technique. To eliminate operator-dependent effects, all treatment procedures were performed by another endodontist experienced in all instrumentation techniques.

After isolation with a rubber dam, access cavity preparation was performed under local anesthesia. The working length was determined using an apex locator device (VDW Gold, VDW, Munich, Germany). The root canals were prepared according to the recommended instructions of manufacturers as follows:

- Group 1: Twisted File (Sybron Endo, Orange, CA, USA) was used at the working length using an endodontic motor (VDW Gold, VDW, Munich, Germany) at 500 rpm and 2 N cm with continuous rotation. The preparation of root canals was completed with TF (25/0.04).
- Group 2: Twisted File-Adaptive (Sybron Endo, Orange, CA, USA) files were used at the working length with the adaptive motion on the Elements endodontic motor (Axis/SybronEndo, Coppell, TX, USA). The preparation of root canals was completed with an SM1 (20/0.04) file.
- Group 3: TruNatomyTM (Dentsply, Maillefer, Ballaigues, Switzerland) orifice modifier (#20, 0.08), glider (#17, 0.02), small (#20, 0.04) files used with an endodontic motor (VDW Gold, VDW, Munich, Germany) at 500 rpm and 1.5 N cm torque with continuous rotation.

All root canals were irrigated with 5% NaOCl and 17% EDTA for smear layer removal and dried. For narrow canals, such as mesial (lower) and buccal (upper), the single cone technique was used. Palatal (upper) and distal (lower) ones were obturated using gutta-percha and a resin-based sealer with a cold lateral compaction method.

The questionnaire evaluation of postendodontic pain was performed 72 h after the first appointment by one liberated observer (13). The pain history after treatment was questioned using a 4-point visual analog scale (VAS), confirmed in earlier research (14):

- No pain
- Mild pain: noticeable but not irritating pain that needed no analgesics
- Moderate pain: discomfort but tolerable pain
- Severe pain: difficult to endure

The statistical analysis was conducted using SPSS 19.0 software (SPSS, Inc., Chicago, IL, USA) and Statistical Software (Statistical Software Version, Version 17.3.1. Minitab, Inc. USA). Descriptive statistics were obtained in terms of frequency and percentage. The Chi-squared test was used for binary comparison. The significance level was determined at a value of $p< 0.05$.

Results

When evaluating patients experiencing "no pain," the incidence of symptoms was higher with the TRN system. When evaluating patients experiencing "severe pain," the incidence of symptoms was higher with the TFA file system. The scores are presented in Table 2.

A significant difference was found between groups in terms of pain incidence ($p = 0.048$). In the pairwise comparison, there was no difference between Groups 1 and 2 (TF and TFA) ($p = 0.547$), and there was no difference between Groups 1 and 3 (TF and TRN) ($p = 0.201$). A significant difference was found between Group 2 (TFA) and Group 3 (TRN) in terms of pain incidence ($p = 0.007$).

Discussion

This observational study aimed to evaluate post endodontic pain after the preparation of multi-rooted teeth with TF, TFA, and TRN file systems using various kinematics during instrumentation. The result of this study was limited to showing the effect of kinematics and TF used with rotation and TFA used with adaptive combined motion showed similar results in terms of VAS pain scores. In addition, when evaluating patients experiencing no pain, TF and TRN systems using the same rotational kinematics presented significantly better results. Therefore, the null hypothesis was partially rejected. With consistency, Gambarini et al.,(13) Özdemir et al., (15) and Comparin et al. (16) reported that there is no clinical difference between reciprocation, adaptive, and rotary motion concerning post endodontic pain after endodontic treatment and retreatment. The possibility of apical extrusion is the nature of the root canal treatment, which is not only a solution but also debris, microorganisms, and medicaments. Extruded material may cause inflammation of the periapical tissue, postoperative pain, and flare-up at various intensities (17). Although there is no consensus on the effect of kinematics on apical debris extrusion, file structure, cross section, surface properties, cutting angle, and conicity may affect the amount (18–21).

Table 1. Demographic information of treated and observed patients

	Twisted File (n = 50)	Twisted File-Adaptive (n = 50)	TruNatomy (n = 50)
Gender			
Female	40%	45%	35%
Male	60%	55%	65%
Age			
Mean	37.6	32.15	39.25
Range	21–48	20–45	23–50
Localization			
Maxilla	24	27	25
Mandibula	26	23	25

Table 2. Number of patients experiencing pain according to severity, mean pain scores according to the number of individuals, and standard deviations

File system	Mean	SD	No pain	Mild	Moderate	Severe
Twisted File (TF)	10.6	11.5	16	18	14	2
TF Adaptive (TFA)	12.3	16.3	11	17	18	4
TruNatomy (TRN)	5.2	9.7	26	15	9	–

SD: Standard deviation.

TruNatomy (Dentsply Sirona, Maillefer, Ballaigues, Switzerland), a recently introduced heat-treated Ni–Ti file system using a rotary motion, has been developed with higher flexibility, allowing the file to be precurved when needed. This off-centered preparation system has a parallelogram cross-section design that is 0.8 mm of Ni–Ti wire instead of 1.2 mm found in most other variable tapered instruments (22). Van der Vyver et al. (11) reported that TruNatomy instruments maintain their structural integrity via geometry, slim design, regressive tapers, and heat treatment. To the best of our knowledge, no study evaluating the TRN system and other systems in terms of postoperative pain has been reported in the literature. However, the extrusion of infected debris from the apex to the periapical area is one of the major reasons for discomfort and post endodontic pain. Recently, many studies on apical debris extrusion have shown that TRN causes less apical extrusion than many systems (23–26). Consistent with the previous results, the TRN system was found to cause less postoperative pain. This situation may be explained by the fact that this file system performs preparation more conveniently for the original anatomy, resulting in less debris and therefore less debris extrusion compared with other files used in this study.

An instrumentation motion called TF-Adaptive®, which combines continuous rotation and reciprocation, was introduced to advance the benefits of reciprocation motion while diminishing the disadvantages and was developed to dispatch the debris coronally. This unique movement can automatically adapt to instrumentation stresses. Previously, the adaptive instrumentation technique was reported to

reveal similar post-endodontic pain when compared with other instrumentation techniques (13, 27). Similarly, TF and TFA files caused similar post-endodontic pain from the point of view of both kinematics and the instruments.

Endodontic treatment can be conducted in single or multiple appointments. Many studies have indicated that single-visit root canal treatment is more acceptable and preferable by patients and clinicians (14,28,29). Its benefits include less time consumption, reduction in the number of clinical processes, and no inter-appointment leakage problems due to temporary fillings. Recently introduced instrumentation techniques and instruments have increased the rate of root canal treatment in a single visit by reducing the treatment time and visit (27,30). Besides, it was reported that the extrusion of the irrigant to the periapical area was more prominent in the disruption of apical constriction (31). Moreover, Özdemir et al. (32) reported that exaggerating the number of appointments may affect the probability of apical irrigation solution overflow. Therefore, the treatment in a single visit was preferred for the methodology design.

Conclusions

As a result, similar results between TF and TFA file systems in terms of post endodontic pain severity may indicate that the kinematic properties of the file systems do not play a decisive role. In addition, it can be concluded that the structural and metallurgical properties of the TRN file system enable it to remove less dentin and create a more conservative shape, the result of which is the reduction of post endodontic pain. As there is a lack of evidence, further research is needed.

Authorship Contributions: Concept: N.Y.Ç.; Design: N.Y.Ç.; Supervision: N.Y.Ç.; Materials: N.Y.Ç., O.Ö.; Data: O.Ö.; Analysis: N.Y.Ç.; Literature search: N.Y.Ç., O.Ö.; Writing: N.Y.Ç., O.Ö.; Critical revision: N.Y.Ç.

Source of Funding: None declared.

Conflict of Interest: None declared.

Ethical Approval: The study protocol was approved by the Karabük University Clinical Research Ethics Commitee (date: date: 05.11.2020, protocol no: 2020/331).

Informed consent: Written informed consent was obtained from patients who participated in this study.

References

1. Sathorn C, Parashos P, Messer H. The prevalence of postoperative pain and flare-up in single- and multiple-visit endodontic treatment: a systematic review. Int Endod J 2008; 41: 91–9.
2. Iqbal A. The factors responsible for endodontic treatment failure in the permanent dentitions of the patients reported to the College of Dentistry, the University of Aljouf, Kingdom of Saudi Arabia. J Clin Diagn Res 2016; 10: ZC146–8. [CrossRef]
3. Iranmanesh F, Parirokh M, Haghdoost AA, Abbott PV. Effect of corticosteroids on pain relief following root canal treatment: a systematic review. Iran Endod J 2017; 12: 123–30.
4. Genet JM, Hart AA, Wesselink PR, Thoden van Velzen SK. Preoperative and operative factors associated with pain after the first endodontic visit. Int Endod J 1987; 20: 53–64.
5. Sun C, Sun J, Tan M, Hu B, Gao X, Song J. Pain after root canal treatment with different instruments: A systematic review and meta-analysis. Oral Dis 2018; 24: 908–19.
6. Nagendrababu V, Gutmann JL. Factors associated with postobturation pain following single-visit nonsurgical root canal treatment: A systematic review. Quintessence Int 2017; 48: 193–208.
7. Ng YL, Glennon JP, Setchell DJ, Gulabivala K. Prevalence of and factors affecting post-obturation pain in patients undergoing root canal treatment. Int Endod J 2004; 37: 381–91. [CrossRef]
8. Abdulrab S, Rodrigues JC, Al-Maweri SA, Halboub E, Alqutaibi AY, Alhadainy H. Effect of apical patency on postoperative pain: a meta-analysis. J Endod 2018; 44: 1467–73. [CrossRef]
9. Marzouk AM, Ghoneim AG. Computed tomographic evaluation of canal shape instrumented by different kinematics rotary nickel-titanium systems. J Endod 2013; 39: 906–9. [CrossRef]
10. Gambarini G, Gergi R, Naaman A, Osta N, Al Sudani D. Cyclic fatigue analysis of twisted file rotary NiTi instruments used in reciprocating motion. Int Endod J 2012; 45: 802–6. [CrossRef]
11. van der Vyver PJ, Vorster M, Peters OA. Minimally invasive endodontics using a new single-file rotary system. Int Dent–African Ed 2019; 9: 6–20.
12. Riyahi AM, Bashiri A, Alshahrani K, Alshahrani S, Alamri HM, Al-Sudani D. Cyclic fatigue comparison of TruNatomy, Twisted File, and ProTaper Next rotary systems. Int J Dent 2020; 2020: 3190938. [CrossRef]
13. Gambarini G, Testarelli L, De Luca M, *et al*. The influence of three different instrumentation techniques on the incidence of postoperative pain after endodontic treatment. Ann Stomatol (Roma) 2013; 4: 152–5. [CrossRef]
14. Lohbauer U, Gambarini G, Ebert J, Dasch W, Petschelt A. Calcium release and pH-characteristics of calcium hydroxide plus points. Int Endod J 2005; 38: 683–9. [CrossRef]
15. Özdemir O, Hazar E, Koçak MM, Koçak S, Sağlam BC. Evaluation of postoperative pain after using different file systems: a randomized clinical study. Cumhuriyet Dent J 2019; 22: 292–8. [CrossRef]

16. Comparin D, Moreira EJL, Souza EM, De-Deus G, Arias A, Silva EJNL. Postoperative pain after endodontic retreatment using rotary or reciprocating ınstruments: a randomized clinical trial. J Endod 2017; 43: 1084–8. [CrossRef]
17. Oginni AO, Udoye CI. Endodontic flare-ups: comparison of incidence between single and multiple visit procedures in patients attending a Nigerian teaching hospital. BMC Oral Health 2004; 4: 4. [CrossRef]
18. Ahmad MZ, Sadaf D, MacBain MM, Merdad KA. Effect of mode of rotation on apical extrusion of debris with four different single-file endodontic instrumentation systems: Systematic review and meta-analysis. Aust Endod J 2022; 48: 202–18. [CrossRef]
19. Caviedes-Bucheli J, Castellanos F, Vasquez N, Ulate E, Munoz HR. The influence of two reciprocating single-file and two rotary-file systems on the apical extrusion of debris and its biological relationship with symptomatic apical periodontitis. A systematic review and meta-analysis. Int Endod J 2016; 49: 255–70. [CrossRef]
20. Western JS, Dicksit DD. Apical extrusion of debris in four different endodontic instrumentation systems: A meta-analysis. J Conserv Dent 2017; 20: 30–6. [CrossRef]
21. Silva EJ, Carapiá MF, Lopes RM, *et al*. Comparison of apically extruded debris after large apical preparations by full-sequence rotary and single-file reciprocating systems. Int Endod J 2016; 49: 700–5. [CrossRef]
22. Dentsply Sirona, TruNatomy Brochure. Available at: https://www.dentsplysirona.com/en/explore/endodontics/trunatomy.html. Accessed July 5, 2022.
23. Yılmaz Çırakoglu N, Özbay Y. Apically extruded debris associated with ProTaper Next, ProTaper Gold and TruNatomy systems: An in vitro study. J Dent Res Dent Clin Dent Prospects 2021; 15: 30–4. [CrossRef]
24. Falakaloglu S, Yeniçeri Özata M, İriboz E. Apically extruded debris and irrigants during root canal instrumentation with TruNatomy and ProTaper Gold rotary file systems. G Ital Endodon 2021; 35: 38–43.
25. Mustafa R, Al Omari T, Al-Nasrawi S, Al Fodeh R, Dkmak A, Haider J. Evaluating ın vitro performance of novel nickel-titanium rotary system (TruNatomy) based on debris extrusion and preparation time from severely curved canals. J Endod 2021; 47: 976–81. [CrossRef]
26. Predin Djuric N, Van Der Vyver P, Vorster M, Vally ZI. Comparison of apical debris extrusion using clockwise and counter-clockwise single-file reciprocation of rotary and reciprocating systems. Aust Endod J 2021; 47: 394–400.
27. Plotino G, Grande NM, Testarelli L, Gambarini G. Cyclic fatigue of Reciproc and WaveOne reciprocating instruments. Int Endod J 2012; 45: 614–8. [CrossRef]
28. Sathorn C, Parashos P, Messer HH. Effectiveness of single- versus multiple-visit endodontic treatment of teeth with apical periodontitis: a systematic review and meta-analysis. Int Endod J 2005; 38: 347–55. [CrossRef]
29. Inamoto K, Kojima K, Nagamatsu K, Hamaguchi A, Nakata K, Nakamura H. A survey of the incidence of single-visit endodontics. J Endod 2002; 28: 371–4. [CrossRef]
30. Kim HC, Kwak SW, Cheung GS, Ko DH, Chung SM, Lee W. Cyclic fatigue and torsional resistance of two new nickel-titanium instruments used in reciprocation motion: Reciproc versus WaveOne. J Endod 2012; 38: 541–4.
31. Tinaz AC, Alacam T, Uzun O, Maden M, Kayaoglu G. The effect of disruption of apical constriction on periapical extrusion. J Endod 2005; 31: 533–5. [CrossRef]
32. Özdemir O, Hazar E, Koçak S, Sağlam BC, Koçak MM. The frequency of sodium hypochlorite extrusion during root canal treatment: an observational clinical study. Aust Dent J 2022 Jun 16, [Epub ahead of print] doi: 10.1111/adj.12924. [CrossRef]