

# Effect of Clinical Aspects on Post-Endodontic Pain after Single-Visit RCT



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## Abstract

**Objective:** The purpose of this research is to evaluate the association of clinical issues such as sex, age, tooth group, preoperative pulpal diagnosis, preoperative pain, instrumentation, and irrigation type with post-endodontic pain.

**Materials and Methods:** One hundred and forty of 147 patients (76 women and 64 men) aged 18-65 years were incorporated in this research. Thirty-five of 140 teeth were selected to the four enlargement techniques. The study strategy included four experts; each expert prepared 35 teeth. Control group, TFA, WON and PTN groups received final flushing with 60C 17% liquid EDTA gently administered to the WL through a cold (60C) sterile metallic micro cannula attached to the Endovac system (Kerr Endo) for one minute. The root canals were then desiccated with sterile paper cones size #35 and filled at the same appointment. Gutta-percha cones

**Results:** No statistically significant difference ( $p > .05$ ) between the groups were founded regarding level or period of pain. The post-endodontic pain marks were analyzed 24 hours later in the four groups with a significant regression consequently. No statistically significant difference was seen between the 4 groups evaluated in the research in terms of analgesic consumption ( $p > .05$ ). In general, analgesic consumption was limited to the next 24 hours after RCT in all the groups evaluated. Nobody of the 140 patients stated acute pain or flare-ups during the phase of the research.

**Conclusion:** The result of this research suggests that the use of aids like intra-canal cryotherapy technique with negative pressure irrigation reduces post-endodontic pain. Clinical factors such as sex, age, tooth group, and the instrumentation technique does not affect the results. Previous factors as preoperative pain, and irrigation type, can affect the occurrence of pain.

**Keywords:** Flare Ups; Pain; Post-Endodontic Pain; Postoperative Pain

**Abbreviations:** RCT: Root Canal Treatment; WL: Working Length; AF: Apical Foramen; AP: Apical Patency; AC: Apical Constriction; VAS: Visual Analog Scale

## Introduction

Post-endodontic pain is a personal and subjective experience after root canal treatment (RCT) it is difficult to quantify and standardize. Pain management is indispensable in clinical procedures [1]. Endodontic pain contains a wide-ranging field which requests to be considered appropriately before arriving at a diagnosis. The patients widely fear pain of endodontic origin, accurate information of pain occurrence and strictness related with pulpal or periarticular illness and its decrease by RCT can change the attitudes of the patients, general dentists, endodontists, and other health care professionals [2]. Pain in

Endodontics includes a period time; previous, throughout, and subsequently RCT. Analyzing these limits also would help to choose the correct decision for treatment. During cleaning and shaping the canal, remains and irrigating solutions can be sent beyond the apex through RCT, and can lead to post-operative complications, such as intense pain or flare-ups. Therefore, adequate care of the working length (WL) can diminish the expulsion of remains through the apical foramen (AF) [3]. Numerous reports have presented that endodontic pain between two appointments can be due to preoperative pain, periapical lesions, fractured roots, retreatment cases. Pain after RCT can

also result from the exacerbation of chronic lesion [1,2] of a non-vital tooth, [3] previously treated teeth or related with a type of flare-up. Accumulation of material remnant in the final portion of the root is a typical occurrence that causes obliteration of the canal.

This situation can be prevented if patency of the AF is maintained [4]. Presently, maintaining apical patency (AP) is suggested thru RCT [5]. Apical patency is the action of using a tiny hand file to maintain the AF open. It is a method that keeps the apex free of remains [6]. A patency instrument is described as a tiny bendable K-file, which is used through the apical constriction (AC) [7,8]. The instruments employed to gain AP are often the same instruments primarily used to negotiate the canal [9]. To improve clean and shape the canal, has been proposed technique like the concept of balanced forces [10]. The benefits of Balanced forces are that it reduces the chance of a change of WL, decrease canal alterations and formation of apical ledges, [5] permits maintenance of the integrity of the AC, [11] and increase the palpable appreciation of the professional through RCT [8]. Great advances in mechanical procedures and metallic properties have led to the improve of plentiful methods with innovative designs in current years. However, all methods and tools existing to this time are related to some level of the expulsion of remains [12,13]. The model of one-file for canal shaping was presented in endodontics [14] with the promotion of Reciprocal (VDW, Munich, Germany) and Wave One™ (Dentsply Tulsa, Johnson City, TN) techniques. These metallic tools are made-up with a Ni-Ti alloy named M-Wire utilizing a novel thermal management procedure [15].

The watch-winding motion comprises an initial turning of the device in an anticlockwise way, during which the file enters and cuts the dentin, after that a sequence in a clockwise way, meanwhile the file is liberated. Most of the systems generate extrusion to some level; however, the volume of extrusion may vary [16,17]. Some other factors may disturb the occurrence of post-endodontic pain when AP was conserved in concordance to when it was not [18]. One of the unproven details for not operating AP is the probable passage of remains throughout the AF, a clinical situation associated with post-endodontic pain [12]. Some other studies indicated that conserving AP would not generate postoperative complications, requiring it is reasonably made with other clinical aids [19]. The purpose of this research is to evaluate the association of clinical issues such as sex, age, tooth group, preoperative pulpal diagnosis, preoperative pain, instrumentation, and irrigation type with post-endodontic pain.

### Materials and Methods

This study was completed at the Universidad Autónoma de Baja California, Facultad de Odontología, Tijuana, México. The review board accepted the study and was managed in agreement with ethical codes (including the World Medical Association Declaration of Helsinki). Four certified endodontists

qualified in the processes, aids, and methods investigated took part in this project. The endodontists selected tracked a pre-established method for the Balanced Force technique, TFA, Wave One™, and Protaper Next instrument systems. The inclusion limitations were nonappearance of radiographic proof of apical inflammation and identification of irreversible pulpitis recognized by the positive reaction to thermal tests.

The principal author completed thermal pulp test, and four endodontists recognized radiographic procedures. Clinical necessities were established as follow:

- i. The needs of the investigation were spontaneously accepted.
- ii. Patients must be in physical and emotional wellbeing.
- iii. Only vital teeth were selected.
- iv. Positive thermal stimulation with EndoIce (Hygenic Corp, Akron, OH).
- v. Enough coronal structure.
- vi. No endodontic treated teeth.
- vii. Any drug used seven days' previous the study.

Exclusion parameters were: Endodontic treated teeth, pregnancy, No patient's consent, patients younger than 18 years. Necrotic teeth and teeth with periapical injury, root resorption, undeveloped apex, or a root canal with severe curvature (>38o) rejected also. The subsequent records were collected in clinical archives. Accumulating dental record and doing digital radiography, periodontal assessment, percussion, and cold test established the judgment of vital tissue. The diagnostic results were evaluated by relating the tooth's reaction versus an adjacent tooth with the same vital condition. The occurrence or nonexistence of pre-operative pain (yes/no) was noticed. Teeth (posterior/anterior) and location (superior/inferior) were also added.

### Patient Selection

One hundred and forty of 147 patients (76 women and 64 men) aged 18-65 years were incorporated in this research (Figure 1). Sample size estimation was accomplished, rendering with a system for this particular objective (Cochran's method, 1986). Therefore, the 35 teeth distributed to each group were acceptable to approve an elemental sample. All patients contributed with maxillary or mandibular posterior or front teeth chosen for a standard RCT for prosthetic reasons identified with vital pulps. Patients rejecting to join the research, those with issues with single-visit RCT, those consuming a specific kind of medicine such as painkillers or NSAIDs, and participants with some unrestrained systemic ailment were excluded too. All applicants were knowledgeable of the aims and plan of the research, and printed permissions and patient consent form for this study was obtained before their addition.

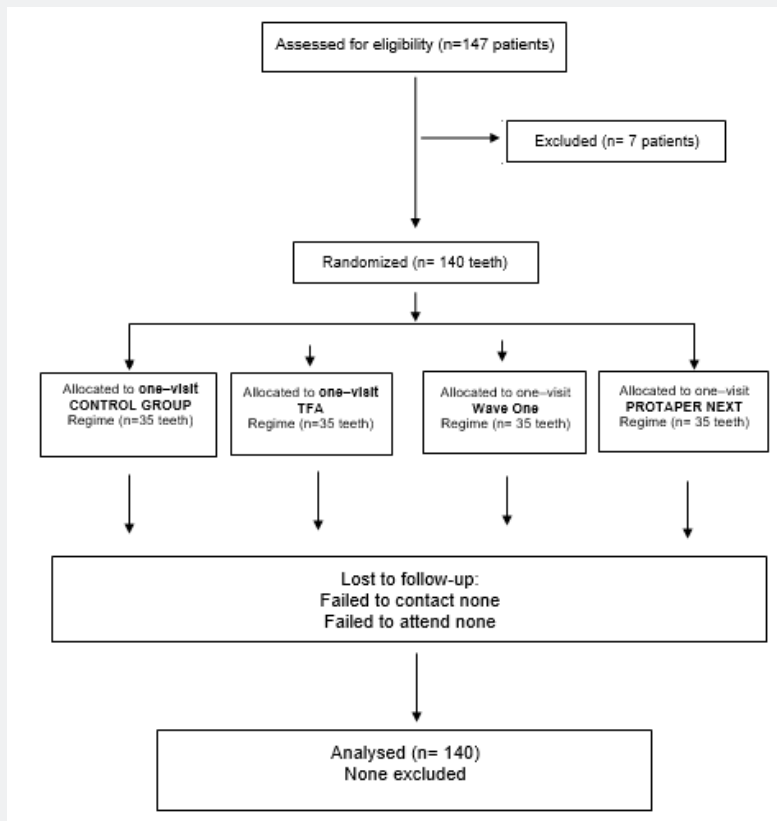


Figure 1: Flow diagram of the progress of phases of the study.

Table 1: Distribution by group of teeth.

Clinical features	Control Group (CG) n=35	Twisted FA (TFA) n=35	Wave One™ (WON) n=35	Protaper Next (PTN) n=35	Total 140
Female	19 (54.28)	19 (54.28)	19 (54.28)	19 (54.28)	76 (54.28)
Male	16 (45.71)	16 (45.71)	16 (45.71)	16 (45.71)	64 (45.71)
Maxillary teeth	21 (15.17)	21 (15.17)	21 (15.17)	21 (15.17)	84 (60.71)
Incisors and canines	1 (2.85)	2 (5.71)	1 (2.85)	1 (2.85)	5 (3.57)
Bicuspid	4 (11.42)	4 (11.42)	3 (8.57)	4 (11.42)	15 (10.71)
Molars	16 (45.71)	15 (42.85)	17 (48.75)	16 (45.71)	64 (45.71)
Mandibular teeth	14 (40)	14 (40)	14 (40)	14 (40)	56 (40)
Incisor and canines	1 (2.85)	0	1 (2.85)	1 (2.85)	3 (2.14)
Bicuspid	3 (8.57)	3 (8.57)	1 (2.85)	2(5.71)	9 (6.42)
Molars	10 (28.57)	11 (31.42)	12 (34.28)	11 (31.42)	44 (31.42)

p= 0.05

Table 2: Distribution by group of teeth.

Gender	Female n (%)	76	(54.28)
	Male n (%)	64	(45.71)
Type of teeth	Mandibular molars n (%)	44	(31.42)
	Mandibular premolars n (%)	9	(6.42)
	Mandibular anterior n (%)	3	(2.14)
	Maxillary molars n (%)	64	(45.71)

	Maxillary premolars n (%)	15	(10.71)
	Maxillary anterior n (%)	5	(3.57)
Pre-operative pain	Asymptomatic n (%)	73	(52.14)
Diagnosis	Symptomatic n (%)	67	(47.85)
	Acute pulpitis	67	(47.85)
	Chronic pulpitis n (%)	73	(52.14)

### Random Selection

Thirty-five of 140 teeth were selected to the four enlargement techniques. The study strategy included four experts; each expert prepared 35 teeth (Tables 1 & 2).

### Treatment Procedure

For each procedure, two carpules of Mepivacaine Hydrochloride 2% with Levonordefrin 1:20,000 (Septodont, Cambridge, Ontario, Canada) was administered. In circumstances in which additional anesthesia was required, intraligamental Mepivacaine 2% was administered. After absolute isolation, the tooth was sanitized with 5.25% NaOCl. Cavity access was performed by using # 331 bur (Dentsply International, York, PA), with high-speed and water cooling during the procedure. 5.25% NaOCl was used to clean the coronal cavity. The canals were evaluated with #10 K-type hand files (Flex-R® files, Moyco/Union Broach, York PA, USA). The standard procedures involved the following steps: Access was gotten; Smear Clear™ (Kerr Endodontics, Orange, CA) lubricant was administered at the entry of the canals. WL was first obtained with a #10 k-file and the Root ZX locator (J Morita, Irvine CA, USA), following by subtracting 0.5 mm from the measurement, which was estimated with the assistance of a metallic ruler. With digital radiographic confirmation (Schick Technologies, NY, USA). A glide path to the WL was then established.

Pulpal cavity was dried with a sterilized cotton pellet. Lubricant was positioned at the entry of canals (i.e., measurements were made along humid canals). A #15 file attached to Root ZX apex locator was used to calculate WL. WL was calculated with #20 and #25 files, respectively. If there was no arrangement among measures gotten by using the three files, the dissimilar data was reevaluated. If discrepancy continued, the measure conveyed with the thicker file was designated. WL was confirmed with a digital radiograph. In the event of dissimilarity between radiographic and electronic quantities, the last was designated. For the control group (CG), Balanced Force technique was employed. Canals were prepared and enlarged with hand Flex-R® files (Moyco/Union Broach, York PA, USA). The canals were enlarged using a #40 instrument for tinny or curved canals and a #55 file for wide canals. Gates-Glidden burs (Dentsply Maillefer) sizes #1 - #3 were employed at the two-thirds of the root.

For mechanical enlargement, the rotary files were employed with a micro motor (Elements Motor, Sybron Endo, Glendora

CA,USA). Spin and revolution were established individually for each rotary file system employed. Twisted file adaptive, Wave One™ and Protaper Next instruments were employed in continuous brushing rotary motion and reciprocating mode correspondingly. Dentinal remains were removed from the instrument using a gauze, continuously to the next instrument change or after 3-4 in-and-out (pecking) movements allowing to the manufacturer's commendations. Each canal was flushed with 2.5mL 2.5% NaOCl. Irrigation was accomplished using a 27-G needle (Max-I-Probe; Tulsa Dental, York, PA) through access and a 31-G Navi Tip needle (Ultra dent Products Inc, South Jordan, UT) when getting the WL after each Ni-Ti file insertion.

- a) Group TFA: SM1 (size 20, .04 taper) and SM2 (size 25, .06 taper) files were used consecutively with a single meticulous motion agreeing to the manufacturer's instructions.
- b) Group WON: For the Wave One™ group, a file (25.08) was used to prepare narrow, straight, and curved canals, and a file (40.08) was used for large and wide canals.

Three in-and-out motions were used with lengths not beyond 3 mm in the three segments of the canal until reaching the estimated WL.

- c) Group PTN: For the Pro Taper Next group, Sx files, X1, and X2 (Pro Taper Universal system; Dentsply, Ballaigues, Switzerland) were used for preflare and preparation of thin and curved canals and X3 and X4 (40/.06) for preparation of wide canals up to the WL. The instruments were operated using a continuous rotary brushing motion at a speed of 300 rpm.

Hand and rotary files were employed in just one tooth (single use) and then excluded. AP was conserved through all the procedures used by using a #10 K-type file at WL. After the instrumentation phase, the pulp chamber was rinsed with 1 mL 2.6% NaOCl, agitated ultrasonically. Ultrasonic activation was done using an Irrisafe ultrasonic 20.00 tip (Satelec, Merignac, France) at 50% power of the Mini Endo ultrasonic unit (Kerr Endo) to place the tip 3 mm from the WL for 30 seconds per canal. Then, TFA, WON and PTN groups received final flushing with 60C 17% liquid EDTA gently administered to the WL through a cold (60C) sterile metallic micro cannula attached to the Endovac system (Kerr Endo) for one minute to eliminate the smear layer and reduce post-endodontic pain. A repeat of WL was established again by using EAL as describe before using #35, #40, and # 45 files. The root canals were then desiccated with sterile paper

cones size #35 and filled at the same appointment. Gutta-percha cones (Dentsply Maillefer) were laterally condensed with #20 nickel-titanium spreaders (Dentsply Maillefer) and Sealapex® sealer (Sybron Endo Endodontics, Orange, CA). Entrance openings of anterior teeth were etched and repaired with Fuji IX (GC Corp, Tokyo, Japan). For posterior teeth, a rebuilding was placed with the same method. Finalized the RCT patients received instructions on how to use a 10-cm visual analog scale (VAS) to record post-endodontic pain. After that this score was transferred to a numerical value between 0 and 10 and a verbal scale (none, mild, moderate, intense and unbearable).

**Statistical Analysis**

Patients were advised of the probable occurrence of pain for days after RCT and received a survey form to be completed and returned two days after. In it, they proof the occurrence or nonappearance of post-endodontic pain, its period and level of distress rated as follows: mild pain: any discomfort that does not require treatment; moderate pain: pain that demands and is comforted with painkillers; and severe pain: any pain that is not calmed with treatment (analgesics). One hundred and thirty-four of the 140 surveys were returned correctly responded and, in the date, requested. Of these, 31 belonged to the control group, 35 to TFA group, 35 to WON group and 34 to PTN group. Rests of the 140 were received one day after and were included in the data analysis.

Outcomes of groups TFA, BF, WON and REC associated to existence (yes/no), level (slight, moderate, severe), and interval (days) of post-endodontic ache were evaluated, focusing to diagnostic factors: condition of tooth (all vital), manifestation or absence of pre-operative pain, group of teeth (molar/premolar or anterior), or location (Maxillary, Mandibular). Outcomes were examined using SPSS 22.0 with the Chi-Square for the presence of post-endodontic pain, and Mann-Whitney U test.

**Results**

The clinical structure of the participants is shown in Table 1. The average age of the 140 participants recorded in this project was 34 years. No statistically significant difference ( $p > .05$ ) between the groups were founded regarding level or period of pain (Table 3). The post-endodontic pain marks were analyzed 24 hours later in the four groups with a significant regression consequently. No statistically significant difference was seen between the 4 groups evaluated in the research in terms of analgesic consumption ( $p > .05$ , Table 4). In general, analgesic consumption was limited to the next 24 hours after RCT in all the groups evaluated. Nobody of the 140 patients stated acute pain or flare-ups during the phase of the research (Tables 3 & 4). In situations with the informed occurrence of pre-operative pain, periods of post-endodontic pain were considerably more. There was no statistically significant difference ( $p > .05$ ) among the groups: CG, TFA, BF, WON and PTN concerning techniques about to the occurrence of the post-endodontic pain experience (Table 3).

**Table 3:** Kruskal/Wallis test applied to the post-endodontic pain results for the groups Control group,

Instrumentation Technique	n	Mean	Standard Deviation
Pain after 24 h			
Control Group	35	.45	.63
Twisted File Adaptive	35	.67	.64
Wave One™	35	.5	.63
Protaper Next	35	.67	.74
Pain after 48 h			
Control Group	35	.18	.33
Twisted File Adaptive	35	.16	.45
Wave One™	35	.17	.32
Protaper Next	35	.16	.45

Twisted file adaptive, Wave One™ and Pro Taper Next.

P value= 0.05

**Table 4:** Distribution of teeth by Randomization Factors.

24 Hrs. After	Control Group (CG) (n = 35) (%)	Twisted file adaptive (TFA) (n = 35) (%)	Wave One™ (WON) (n = 35) (%)	Protaper Next (PTN) (n = 35) (%)	Total (n = 140)
Quantity					
None	29 (82.85)	34 (97.14)	34 (97.14)	34 (97.14)	131 (93.57)
One tablet	2 (5.71)	1 (2.85)	1 (2.85)	2 (5.71)	6 (4.28)
Two tablets	2 (5.71)	0	0	0	2 (1.42)
Three tablets	1 (2.85)	0	0	0	1 (0.71)

## Group of Teeth

No statistically significant differences were encountered between groups about occurrence, grade, or length of post-endodontic pain among anterior and posterior teeth.

## Post-Endodontic Pain Associated with the Arch

In maxillary teeth, differences among groups were not statistically relevant concerning occurrence, level, or length of post-endodontic pain. In mandibular teeth, post-endodontic pain was significantly lengthier (P .016; Table 3) than maxillary teeth.

## Discussion

Pain is tough to comprehend and measure especially when it occurs unexpectedly in patients. The main inconvenience in learning pain and anxiety is the participant's special assessment and its dimension. For this objective, scheduling the evaluation form has to be entirely understood by patients. In this project, a simple categorization was monitored in the feedback procedure with three classes: minor, modest, and acute. Pre-operative pain is a predictor of post-endodontic pain [20]. Teeth with irreversible pulpitis were allocated for this investigation and were performed RCT in one-visit to avoid any the probable effect of intracanal medication or other issues causing pain and the involucrate teeth in the four groups were released of any early occlusal points after RCT so that improper painful occlusion would not interrupt the results. In this research, the correct measure of WL during RCT was furthermore crucial. WL was calculated with an EAL device and corroborated with an X-ray film. Root ZX locater was employed due its precision has been recognized in two clinical scenarios. [21-24]. As recommended by Herrera et al. [25], electronic WL dimension was cyclic after coronal and middle thirds shaping.

When endodontists associate radiographic analysis and digital root canal measurements, sometimes results do not match. In the time of discrepancy between both sizes, the electronic calculation would be selected, [26-28] as occur in this research. In an early study [29] was demonstrated that the length of the file employed to preserve AF open varied. A size #10 file was used to conserve working length in this research. Managing major measurements to maintain AP can produce damage to surrounding tissues, hard control in complete RCT. All of these circumstances influence the manifestation of aching. Pushing of endodontic files outside the AF can impulse a variety of toxic products to the neighboring tissues, which can produce pain [30]. Georgepoulou et al. [31] demonstrated a significant incidence of pain if, through the enlarging canal procedure, instruments, or material were involuntarily placed outside the AF instead of keeping them inside the canal. In our research, there is no over instrumentation, working length was maintained in all cases. Nevertheless, AP does not appear to be related to post-endodontic pain in vital condition because of its control during RCT [32].

Moreover, Torabinejad et al. [33] detailed that unintentional over-passage of the instrument, it can happen while calculating WL, does not affect the incidence of post-endodontic pain. Our method was similar to them because likely we employed only thin files to establish the WL. This study supports our results in that apical overextension does not generate post-endodontic pain. Though, it varies from our research in that they did not maintain AP during all the RCT Siqueira et al. [34] discovered the little occurrence of flare-ups subsequent RCT in teeth with necrotic tissue or teeth with the previous RCT if AP was conserved. They identified that maintenance of AP does not affect post-endodontic pain. This condition did not happen in our research because only manage vital teeth. In our study, we reduce the variation in the processes following practices based on suggestions by authors and producers. Clean and shape actions were performed on root segments using brushing, and reciprocating movements individually followed final flushing with cold 60C 17% EDTA gently delivered to the WL using a cold (60C) sterile metallic micro cannula attached to the Endovac supported in an early scientific report [35-37]. Clinical factors studied as sex, age, tooth group, instrumentation, and irrigation type does not affect the success of the treatment only the preoperative pulpal diagnosis and preoperative pain can modify the prognosis of the study.

## Conclusion

The result of this research suggests that the use of intra-canal cryotherapy technique with negative pressure irrigation reduces post-endodontic pain after single-visit RCT. Clinical factors such as sex, age, tooth group, and the instrumentation technique don't affect the results. Previous factors as preoperative pain, and irrigation type, can affect the occurrence of pain.

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