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Iam so grateful to all staff members and staff of Endodontics Department, Faculty of Dental Medicine, Cairo, Boys Al-Azhar University and those who assisted me in initiation and completing this study.

Dedicatio

This work is dedicated to;
my parents souls, my wife and children and my brother and sisters the kindest people in the whole world.
No words can describe my gratitude to them

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Introduction

Postoperative pain is unpleasant sensation of the patient that may occur shortly after root canal treatment. It may last for a few hours or days. Postoperative pain after nonsurgical root canal has been reported to range from approximately 3% to more than 50 % [1- 4].

Unfortunately, the patient may develop postoperative pain as a result of microbial, mechanical or chemical injury to the periapical area during root canal treatment. Regarding microbial injury, forcing the debris that is loaded with microorganism and their necrotic byproduct beyond the apex may lead to serious complication with resultant postoperative pain [5]. On the other hand, mechanical injury to the periapical area as result of over instrumentation when using traditional instrument may irritate the periapical tissue with development of postoperative pain very shortly following root canal treatment. Also, extrusion of the irrigating solutions or intracanal medicaments may induce inflammatory response to the periapical tissues with resultant postoperative pain [6,7].

The key role to reduce postoperative pain after root canal treatment is to avoid debris, irrigants and medicaments extrusion beyond the apex and to avoid over instrumentation of the periapical tissues. Unfortunately, some sort of postoperative pain is still evident after root canal treatment that may need pain killer [1,8].

On the other hand, activation of the irrigating solution may reduce the microbial biofilm inside the root canal system that indirectly may reduce postoperative pain[9,10]. Furthermore, the instrumentation motions either continuous

rotation or reciprocation may be one of the predisposing factors that induce postoperative pain [11,12,].

Recently, new technology has been advocated in the manufacture of NiTi wire aiming to enhancing the performance of the rotary endodontic files. For instance in 2015, XP endo shaper was claimed to reduce postoperative pain by cleaning and shaping the root canal system in a three dimension pattern [13]. More recently, the 2Shape rotary system was introduced with innovative T wire technology giving a large clearance space in order to provide a decrease in debris extrusion as claimed by the manufacturer [14].

However, Little research have been done to evaluate the incidence of postoperative pain after root canal instrumentation using different rotary files and Reciprocating files. Furthermore little research has been done to evaluate the incidence of postoperative pain in relation to activation of the irrigating solution inside the root canal system.

REVIEW OF LITRTURE

SECTION OUTLINE:

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Review of literature

2.1 : Mechanism of pain:

It is common known that the perception of dental pain is due, to an inflammatory reaction that involves different molecular mechanisms. Peripheral pain mechanisms associated with odontogenic painful conditions are overall similar to the mechanisms observed in all other body parts. These similarities include the type of sensory neurons involved as well as the different molecules that play a role in these processes (e.g., receptors, channels, transmitters, and intracellular signaling effectors responsible for the transduction, modulation, and propagation of peripheral stimuli) [(15)]. The pain signal is conducted via thin fibers containing unmyelinated C-fibers and myelinated A- fibers of primary sensory neurons to secondary order neurons in the spinal cord and finally to the cortex via a relay in the thalamus [(16).]

2.2 : Methods of evaluation of postoperative pain:

Since pain is a subjective experience and difficult to standardize, so using pain scales helps to quantify pain intensity and guide treatment decisions. Although many pain assessment scales exist, it has been shown that the Visual Analog Scale (VAS)**,** Numeric Rating Scale (NRS), Verbal Rating Scale (VRS) are the most commonly used measures of pain intensity in adults to facilitate communication

between health care providers and patients [17]. Postoperative pain following single visit root canal therapy was evaluated in a study where the postoperative pain assessment was done after 24 hours, 48 hours and finally after one week by asking the patients about present or absence of pain. They concluded that 90% of the patients showed no or little postoperative pain.

The use of these scales in assessment of the effects of analgesics on pain were suggested in a study which compared between both VAS and VRS in assessment of the effects of analgesics on pain, they concluded that VRS scale is more valuable than VAS, since the people don't express the same feeling by the same words, but on the other hand a research conducted showed a different results that opposed this finding. It has been reported that VAS was more valuable than VRS in assessment of the effect of analgesics on pain [18].

An interesting study was held in Cairo University which was concerned with the management of endodontic pain with nonsteroidal anti-inflammatory agents. Root canal therapy were completed in three visits and the patients were instructed to take nonsteroidal anti-inflammatory medication if they experienced pain between visits, finally patients were instructed to rate the experienced postoperative pain using NRS. It was concluded that the use of nonsteroidal anti-inflammatory reduced postoperative pain [19].

A study was performed to compare post-obturation pain experienced following

one visit and two visits root canal treatment. Post-obturation pain was assessed using Verbal Descriptive Scale modified from VRS. They found that there was no difference in incidence of post obturation pain between the two groups[20].On the other hand, these findings were not coincided with the findings reported by another research that also compared postoperative pain experienced following one visit and two visits root canal treatment VAS was-used for pain assessment. They found that patients underwent two visits root canal therapy experienced more postoperative pain than patients received single visit root canal therapy[21].

2.3: Incidence of postoperative pain:

Root canal treatment is usually associated with postoperative pain, this pain may last from a few hours to a few days and it remains to be an unpleasant experience for both the patients and clinician [22].

2.4: Factors that affecting incidence of postoperative pain:

The progression of postoperative pain following endodontic therapy depends on many factors such as ; history of preoperative pain, use of medication, condition of the pulp whether it is vital or necrotic, performing endodontic treatment in either single or multiple visits, Instrumentation technique, obturation material and obturation technique [23]. Apical extrusion of debris to the periradicular tissues during root canal treatment was recently reported to be one of the possible factors related to the occurrence of postoperative pain and inflammation [24].

2.2.1: Effect of number of visits:

An early study evaluated postoperative pain following single visit root canal treatment. Postoperative pain assessment was done after 24 hours, 48 hours and after one week by asking the patients about presence or absence of pain. They concluded that 90% of the patients showed no or little postoperative pain [25].

Other study evaluated the incidence of postoperative pain after single visit root canal treatment of asymptomatic pulpal necrosis in single rooted teeth. The selected teeth were included in the study and randomly assigned in to two groups regarding the number of visits required to accomplish root canal treatment. It has been found that there was no difference in the incidence of postoperative pain between single visit and multiple visits [26].

Additionally the incidence of postoperative pain after single and two vists root canal treatment of permanent molars with vital or non-vital pulp was evaluated. Postoperative pain assessment was done using VAS at 6, 12, 24, and 48 hours after root canal treatment. They found that there was no difference in the incidence of postoperative pain between single and two visit root canal treatment [27].

2.4.2 : Effect of the irrigating solutions;

The effect of the use of various endodontic irrigant on inter-appointment pain was evaluated in a study where the authors found out that there was no relationship between the inter-appointment pain and the type of irrigant used [28].

A research was performed to evaluate the levels of post-operative discomfort after cleaning and shaping of root canals using two protocols for removal of smear layer. At random, canals were cleaned and shaped with one of the following

protocols; group I 5.25%NaOCL was used as the root canal irrigant and 17% EDTA was used to remove smear layer for 1 minute followed by a 5-ml rinse of 5.25%NaOCL). Group II, (1.3%NaOCL was used as root canal irrigant and smear layer was removed by placing MTAD in the canals for 5 minutes). Pain was recorded using a modified VAS at 6, 12, 18, and 24 hours and one week. They found no significant difference in the pain degree between the two groups[29].

The effect of two different root canal irrigation solutions (2% chlorhexidine & 5.25 % NaOCL) after cleaning and shaping were examined in a study in order to determine the level of postoperative pain where the results showed that significant difference in the pain level between two groups only at 6 hours post-operatively. It was concluded that more pain was present in irrigation using 5.25%NaOCL when compared to that in teeth irrigated using 2% chlorhexidine solution[30].

A study was performed to compare postoperative pain after irrigation with Vibringe versus a conventional needle where it has been found that the incidence and intensity of postoperative pain experience following conventional needle irrigation or use of a sonically activated irrigation device on teeth with non-vital pulps and a single root canal were not significantly different[31].

2.4.3 : Effect of the irrigation and activation methods:

The level of post-operative pain after using Max-i-Probe and Endo-Vac was assessed in anterior and premolar teeth. The teeth were randomly assigned into two

groups. In the first group (n=55) procedures were performed by (max-i-probe). The second group (n=55) procedures were performed by (Endo-vac). The result showed that the post-operative pain decreased with the use of negative apical pressure device in comparison with conventional needle irrigation. It was concluded that the negative apical pressure irrigation system Endo-Vac was safer than the conventional syringe[32].

A research was conducted to compare the postoperative level of pain occurrence after root canal therapy using different irrigation protocol. It was concluded that the Safety Irrigator resulted in significantly less post-operative pain than subsonic Endo Activator and conventional needle irrigation[33].

Furthermore a study was conducted to evaluate the postoperative level of pain after activation of irrigants using Endo Activator with conventional needle irrigation during root canal treatment. It was concluded that the activation of irrigants using Endo Activator could be considered an effective method for reducing postoperative pain [34].

Another study evaluated the incidence of postoperative pain after canal preparation of open teeth using two irrigation regimes. The pain experienced was categorized under mild, moderate, severe or none. Results showed that 3 out of 36 patients (8%) had mild discomfort following the use of Solvent irrigant and paste. In the SISC group, 10 out of the 32 patients (31%) complained of pain ranging from moderate discomfort to severe pain with associated swelling of soft tissues. It was concluded that incidence of post-operative pain was high when the root canals of open teeth were not medicated [35].

Moreover a study was conducted to evaluate the efficacy of ultrasonic hand pieces, subsonic hand pieces, irrigating needle and probes. Results revealed that

the Max-i-probe was the most effective instrument used to clear dye from the simulated canals in both the mandibular and maxillary positions [36].

Postoperative pain was evaluated in chronic periapical periodontitis. The patients were randomly assigned into three groups. The treatment for group A used M two Ni-Ti rotary instrument combined with ultrasonic irrigation of a 2.5% NaOCL solution. The group B used the same instrument combined with ultrasonic irrigation of an active silver ion antibacterial solution. The group C used the same instrument combined with syringe irrigation of a 2.5% NaOCL solution.

The single-visit root canal treatment with a Ni-Ti rotary instrument combined with ultrasonic irrigation for elderly patients with chronic periapical periodontitis achieved short and long-term efficacy and stability[37].

Moreover the effect of continuous ultrasonic irrigation on postoperative pain in mandibular molars with non-vital pulps was evaluated in a study where the patients were randomly allocated to one of the two groups, continuous ultrasonic irrigation (CUI) and syringe irrigation (SI) .The CUI group received irrigant activation using a Pro ultra Piezo flow ultrasonic needle as the final irrigation protocol, while in the SI group; the final irrigation was performed using 27 gauge needles. They reported that CUI had significant lower level of postoperative pain when compared to syringe irrigation on the first day. At 24 hours, pain prevalence was 41.4%. CUI had a lower incidence of pain (31.4%) as compared to the SI group (51.4%), but the difference was not significant [38].

2.4.4 : Effect of the instrumentation techniques:

A research evaluated the incidence of post obturation pain related to root canal treatment of asymptomatic non-vital maxillary central incisor teeth that were treated in one visit using two different manual root canal preparation techniques; Step-back and Step-down and to determine the relationship, if any between post obturation pain and root canal preparation technique. Patients were asked to categorize the experienced postoperative pain according to; No pain, slight pain, moderate pain and finally severe pain. They found that there was no difference in the incidence of post obturation pain was found between the two instrumentation techniques[(39)].

Another study evaluated the incidence and intensity of postoperative pain and periapical inflammation after endodontic treatment with two different instrumentation techniques (rotary crown down technique using Twisted File system TF and reciprocating single file technique using Reciproc instrument[)]. All root canal treatment was done in single visit and postoperative pain assessment was done 72 hours after the root canal treatment using VAS. They found that patients in Reciproc group showed the highest postoperative pain score compared to patients in TF group [(40)].

Moreover a study evaluated the influence of three different instrumentation techniques (rotary technique using Twisted File system TF, reciprocating single file technique using Wave One instrument and combination of continuous rotation and reciprocation using TF adaptive system) on the incidence of postoperative after endodontic treatment. They found that patients in Wave One group showed the highest postoperative pain score among the three groups [(41)].

Postoperative pain after instrumentation with a reciprocating system and different irrigating solutions was evaluated in patients requiring root canal treatment on single rooted teeth with non-vital pulp, they found that there was no difference in the incidence of postoperative pain in both groups[42].

The effect of two continuous rotary (Protaper & TF) and one reciprocating file system (Wave One) on the incidence of postoperative pain after single visit endodontic treatment was also assessed where all root canal treatments were achieved in single visit. Postoperative pain was assessed after 72 hours following the root canal treatment using VAS. They concluded that Wave One resulted in maximum postoperative pain experienced by the patients [43].

Furthermore a research was conducted to study the incidence of postoperative pain using single file reciprocating system (Reciproc) and full sequence rotary system (Protaper universal). They found that there was no difference in postoperative pain between Reciproc and Protaper [44].

The effect of two different rotary instruments (Race and Protaper) on postoperative pain in teeth with asymptomatic irreversible pulpitis were studied on mandibular first and second molars They found that there were no significant differences in the postoperative pain reported between the two groups [45].

While the incidence of postoperative pain after using two reciprocating systems (Reciproc and Wave One) and a continuous rotary system (Protaper Next) was also evaluated in patients with vital teeth indicated for root canal treatment that were randomly assigned in to three groups according to type of instrument used. They found that reciprocating systems and the continuous rotary system were found to be equivalent in regard to the incidence of postoperative pain[46].

2.4.5 : Effect of the debris extrusion:

One of the first papers published that dealt with the assessment of apical extrusion of debris when using the ProTaper F2 file in reciprocation motion utilized the use of the Protaper F2 file in reciprocating motion and compared it to the ProTaper universal system in continuous rotation to prepare mesial roots of mandibular molars. The results showed that there was no difference between the Protaper F2 used in reciprocation motion and the protaper universal system used in continuous rotation[47].

The first research conducted to evaluate debris extrusion using rotary instruments was performed by comparing conventional filing using K-files with a step-back technique and Profile series 29 taper 0.04 in straight canals. They found that filing with the step-back technique to the apical foramen resulted in more debris extrusion [48].

On the contrary another study compared the ProTaper universal system, the Profile series 29 taper 0.04 and Step-back technique using K-flexofile in terms of apical extrusion of debris in mesiobuccally canals of human mandibular molars. They found that there was no significant difference between the groups [49].

Moreover, another study compared the Protaper universal and the Revo-S rotary files with the Self-Adjusting File (SAF) and the Reciproc reciprocating file 20 when preparing mandibular premolars for the assessment of the apically extruded debris. It has been found that there was no significant difference between all of the files [50].

Another interesting study was conducted to evaluate the effect of glide path creation on the amount of debris extrusion apically when preparing curved canals

using single-file systems. Glide path was utilized prior to preparing curved mesial roots of mandibular molars using Reciproc R25, Wave One Primary and One Shape. They found that One Shape extruded significantly less debris than both Wave One and Reciproc [51].

Furthermore, a research compared the ProTaper Universal, Wave One, and Revo-S when preparing straight root canal for the assessment of the apically extruded debris. It was reported that Revo-S system was associated with significantly less debris extrusion compared to ProTaper and Wave One [52].

2.4.6 : Effect of the obturation techniques:

Incidence of postoperative pain following the use of different sealers in immediate root canal filling was evaluated in a study performed on vital single or multirooted teeth with irreversible pulpitis were included in the study; all canals were mechanically prepared and then obturated by four different sealers in a single visit (Iodoform, Oxpara root canal cement, Endomethasone, AH26). Patients were called 3, 7, and 30 days after treatment and questioned concerning the degree of discomfort they had experienced after the obturation. They found that there was no difference in the incidence of postoperative pain between the four sealers [53].

A study was performed to compare the incidence of postoperative pain after one-visit root canal treatment on teeth with vital pulps using three different obturation techniques (cold lateral compaction, Thermafil technique and Backfill- Thermafil technique. Assessment of postoperative pain after 2 and 6 hours, and 1, 2, 3, 4, 5, 6 and 7 days were using VAS. They found that the Patients whose teeth

were filled with Thermafil showed higher levels of discomfort than patients whose teeth were filled using any of the other two techniques[54].

2.4.7 : Effect of analgesics:

Postoperative pain may by intense in the first 48 hours until it subsides after 3-7 days. Relive of pain is often more important to the patients than the success of the endodontic treatment. The pain relive due to endodontic treatment is rarely immediate and complete [55].

Postoperative analgesics are often required to relive pain after treatment. Long acting anesthetic act by blocking impulse propagation through the peripheral nerves [56].

Non-steroidal anti-inflammatory drugs (NSAIDS) relieve pain by preventing the release of inflammatory mediators from the peripheral nervous system, while opioids control pain by acting on the central nervous system[57]. Analgesics have been proposed to control postoperative pain after root canal treatment. Each has its own mode of action and side effects. Many authors have suggested the use of combined drugs for better control of postoperative pain[58] .

A study compared the effect of ibuprofen versus ibuprofen/acetaminophen on postoperative endodontic pain in symptomatic patients with a pulpal diagnosis of necrosis and an associated periapical radiolucency having moderate to severe postoperative pain. They found that there was decrease in pain levels and analgesic use over time for the ibuprofen and ibuprofen/acetaminophen groups. There was no statistically significant difference between the two groups[59].

The effect of ibuprofen to an ibuprofen/acetaminophen combination in managing postoperative pain following root canal treatment where tested on patients experiencing moderate to severe pain. The patients were administered a single dose of either placebo, 600mg ibuprofen or 600mg ibuprofen and 1000 mg of acetaminophen. Patients recorded pain intensity following treatment on a VAS and a baseline four-point category pain scale as well as pain relief every hour for the first 4 hours then every 2 hours thereafter for a total of 8 hours. It was concluded that the combination of ibuprofen with acetaminophen was more effective than ibuprofen alone for the management of postoperative endodontic pain. There was no significant difference between the placebo and the ibuprofen[(60)].

Moreover The efficacy of two different oral analgesic combinations on postoperative pain following root canal preparation in teeth with irreversible pulpitis were evaluated in patients who were diagnosed with irreversible pulpitis in anterior teeth or premolars. They were divided randomly into 3 groups , the 2 experimental groups received a single dose of either ibuprofen or paracetamol or diclofenac sodium and paracetamol combination, while the control group received placebo medication, immediately after the first appointment where the pulp was extirpated and canals were fully prepared. The intensity of pain was recorded using VAS and Verbal Descriptor Scale (VDS) preoperatively and at 6, 12 and 24 hours postoperatively. They concluded that at 6, 12, and 24 hours postoperatively, the intensity of pain was significantly lower in experimental groups than in placebo group. Diclofenac sodium and paracetamol combination was more effective than ibuprofen and paracetamol combination[(61)].

Another study evaluated the efficiency of paracetamol alone and in combination with three different NSAIDs for control of post-endodontic pain. It was found that IP-group (ibuprofen/paracetamol) had the most pain reduction, followed by DP-group (combined diclofenac K/paracetamol), then MP-group, followed by P-group, whereas Pib-group had the least pain reduction [(62)].

Moreover another research compared the effect on pain relief between on demand versus regular prescription of ibuprofen after single-visit root canal treatment in the teeth with irreversible pulpitis. Patients' in-group 1 received a single dose of 400 mg ibuprofen and a rescue bag of the same medication to be used if they felt pain and needed further medication. Patient's in-group 2 received the same medication as group 1 patients after treatment and they were also provided with a prescription to use 400 mg ibuprofen every 6 hours for at least 24 hours. It was found that there was no significant difference in pain felt by the patient's in-group 1 and 2 at either 24 or 48 hours after treatment. Patient's in-group 2 used significantly more medication compared with patient's in group 1[(63)].

Furthermore a research had studied the analgesic effect of ibuprofen and gabapentin on the post-endodontic pain in patients requiring root canal treatment, those patients were randomly divided into two groups. The ibuprofen group received 800 mg ibuprofen 1 hour before the treatment and 400 mg at 6, 12, and 24 hours after the treatment procedure, and the other group received 600 mg gabapentin 1 hour before the treatment and 300 mg at 6, 12 and 24 hours after treatment. Patients recorded the intensity of pain on VAS before treatment and every hour for the 6 hours after taking the medication and then every 6 hours. It

was reported that the analgesic effect of gabapentin was significantly higher than ibuprofen in 12, 24, and 48 hours after analgesic intake. It has been also shown that both medicines had a significant analgesic effect. Gabapentin had greater analgesic effect on the sample group until 48 hours when compared with ibuprofen[64].

Aim of the study

The aim of this study was to evaluate postoperative pain in mandibular first molar after using files with different metallurgy and different motions include, XP endo shaper, 2Shape files and Reciproc blue with or without irrigant activation. The null hypothesis stated that there is no difference in the incidence and intensity of postoperative pain following instrumentation with any of the three instruments.

Patients and methods

Section outline:

4.1 Selection of the patient.

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4.5.5 Obturation.

4.6 Postoperative pain assessment.

4.7 Statistical analysis of the data.

Patients and Methods:

4.1. Selection of the patients:

Out of 90 patients, 60 male healthy patients aged between 18 to 35 years old that need root canal treatment for their mandibular first molar were selected from the outpatient endodontic clinic at the Faculty of Dental Medicine, Al-Azhar University, Boys, Cairo to be included in this Randomized clinical study.

4.1.1. Clinical and radiographic examination:

History from all patients including, past and present medical and dental histories followed by chief complain collection were taken. Extra oral examination was done to detect any extra oral swelling and/or presence or absence of sinus tract. This was followed by intraoral examination including soft and hard tissue visualization, palpation of the periapical area, vertical and horizontal percussion, mobility test, probing test and vitality test of the selected tooth. Radiographic examination using 2 periapical radiographs from different angulations was done to confirm presence of 4 canals independent in each molar and to confirm absence of apical periodontitis.

4.1.2. Preoperative pain assessment:

Following clinical and radiographic examination of the patients, preoperative pain assessment of the patients selected teeth with acute pulpitis was done by the operator according to a scale modified from the modified verbal Descriptor scale (VDS)(Table (1)) described by Mathias Haefli [(65)]. The scale consists of a scoring system that describe list of adjectives describing different level of pain including, no pain (score 0), mild pain (score2), moderate pain (score 4), strong pain (score 6), severe pain (score 8), worst pain (score 10). The operator

marked the adjective which fits the pain intensity according to the patient own words figure (1). The odd numbers represent the intermediate pain intensity among the main pain levels. Following preoperative pain assessment the patients were selected according to a specific inclusion and exclusion criteria as follows:

-Patients with a score level (4-6) were included in the study

-patient with certain level of education.

While the following patients were excluded from the study as:

-Medically compromised patient.

- Patients that taking analgesics in the last 12 hours before treatment

-Patients outside the included pains score range.

- Patient outside the selected age range.

-Teeth with periodontal disease.

-Teeth with necrotic pulp and periapiacal pathosis.

-Teeth with abnormal morphology.

Table (1) Scoring system with list of adjectives describing different level of pain intensity:

Score	Pain Intensity	Description
0	No Pain	The involved tooth felt to be normal
2	Mild Pain	The involved tooth with low pain intensity with no need to take analgesics.
4	Moderate Pain	The involved tooth with higher pain intensity than mild pain but it is tolerable with or without Non-Steroidal Anti Inflammatory Drugs (NSAID).
6	Strong pain	The involved tooth with pain intensity that disrupts sleep and need (NSAID) Analgesics.
8	Severe Pain	The involved tooth with pain intensity that disrupt normal activity (eat, walking, sport activity etc.) and/ or sleep with no effect of (NSAID) administration.
10	Worst Pain	The involved tooth with pain intensity that disrupts normal activity and/or sleep with manifestation of general symptoms (fever, general weakness) with need to antibiotic and narcotic analgesic administration.

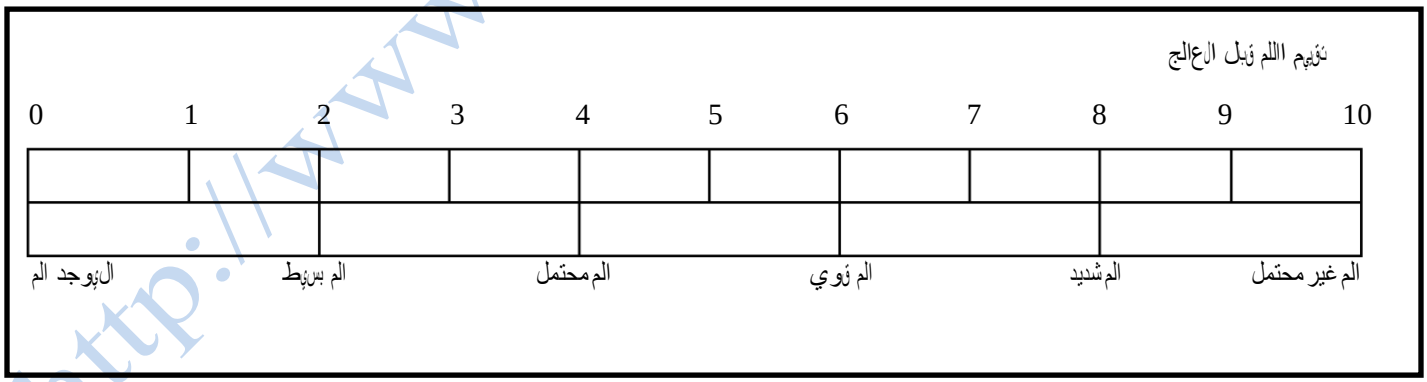

Figure (1) preoperative pain assessment from that was filled by the operator.

4.2. Patient consent:

Patient that were selected to be included in the study, have signed a written informed consent after exploring all steps of the study (figure 1).

جامعة الازهر
كلية طب الاسنان (بنين- القاهرة)
قسم علاج الجذور

إقرار

أقرانا..... الموقع ادناه بتاريخ.....علي موافقتي الصريحه على صيغه هذا الاقرار كالاتي:

١.أنه قد تم توضيح الخطة العلاجيه المقرره لي من قبل الطبيب المعالج وقد قبلتها كما هي.

٢. أنني اوافق على ادراج حالتي ضمن الخطه البحثيه للطبيب المعالج.

٣.أن كل مايخصني من سجلات تشخيصيه والاشعات الخاصه بي قبل واثناء وبعد العلاج هي ملك القسم وتحت تصرف الطبيب المعالج ويمكن استخدامها بدون إذن مسبق منى في اي ملتقى علمي او للنشر في المجلات العلميه.

٤. أنه يجب على احترام المواعيد المحدده لي وتعليمات الطبيب القائم بالعلاج وفي حاله عدم استكمال العلاج فإنني اتحمل المسؤليه عن ذلك.

٥.أتعهد بأنني سأحافظ على الصحه العامه والعنايه بالاسنان.

المقر بما فيه

العمر/

رقم التليفون/

اسم الطبيب المعالج/

Figure (2) A photograph showing patient consent.

4.3 Grouping 0f the patients.

Prior to single visit root canal treatment of th patients' teeth, grouping was done as follows (Table 2),

Group A1B1: Instrumentation using XP endo Shaper with activation using XP endo finisher.

Group A1B2: Instrumentation using XP endo Shaper with traditional side vented needle irrigation.

Group A2B1: Instrumentation using 2Shape files with activation using XP endo finisher.

Group A2B2: Instrumentation using 2Shape files with traditional side vented needle irrigation.

Group A3B1: Instrumentation using Reciproc Blue with activation using XP endo finisher.

Group A3B2: Instrumentation using Reciproc Blue with traditional side vented needle irrigation.

4.4. Randomization of the patients:

Besides grouping of the patients' teeth, each patient was taken a number from 1 to 60 for preoperative randomization using Research Randomizer software (www.randomizer.org) to be blindly selected for each group (figure 2).

(Table2): Grouping of the patients.

Activation or traditional irrigation / Rotary instrument used (A)	Activation using XP endo finisher (B1)	Traditional side vented Needle irrigation (B2)	Total
XP endo shaper (A1)	A1B1	A1B2	20
2Shap files (A2)	A2B1	A2B2	20
Reciproc Blue (A3)	A3B1	A3B2	20
Total	30	30	60

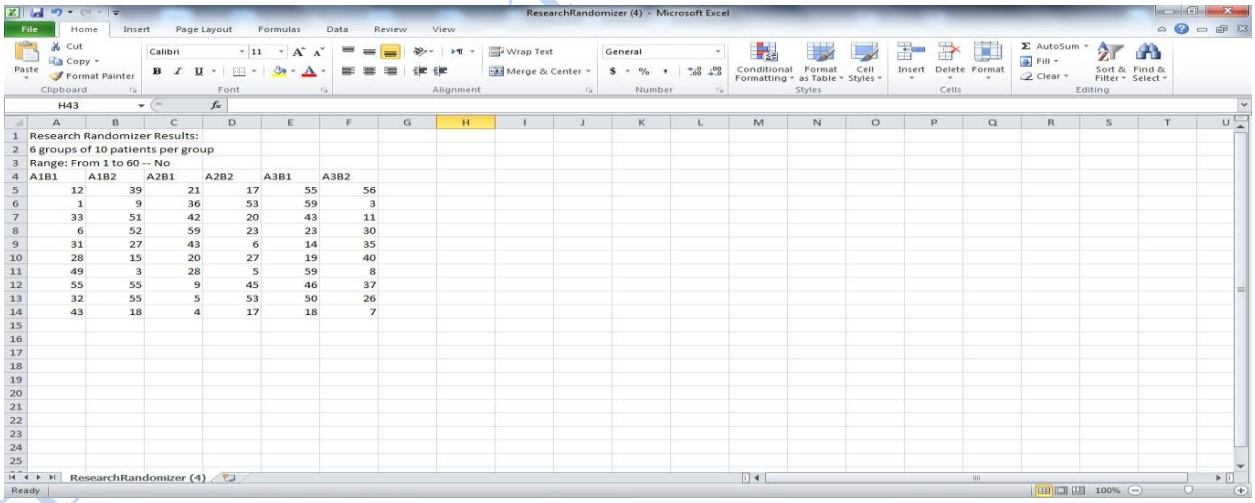

Figure (3) A photograph showing the exported excel sheet for Randomization of the patients from the Research Randomizer software.

4.5. Single visit treatment protocol:

Root canal treatment of the selected patients was done in single visit.

4.5.1. Anaesthetization of the patient and isolation of the field:

The local anesthesia solution administrated using lidocaine 2% adrenaline 1:80.000 (Septodent, Lignospan) through 27 gauge long needle mounted in dental syringe(inferior alveolar block without supplemental injection). The working field was isolated using rubber dam.

4.5.2. Access cavity preparation and tooth rebuilding:

Removal of decay and old restoration if present was carried out using round bur mounted on contra angle high speed handpeice (NSK MACH-LITE XT Japan) with coolant. The access cavity was accomplished using round bur size 2 to deroof the pulp chamber followed by complete deroofing using Endo Z bur (Dentsply, Maillefer) and finishing the cavity walls with tapered fissure bur. Locating the root canal orifices was done using K file size 8 in concomitant with irrigating the access cavity using 3 ml of 5.25% sodium hypochlorite (NaOCL)(calix- USA).Tooth rebuilding if there was missing axial wall/walls was accomplished using resin modified glass ionmer filling glass ionmer (3M ESPE) after application of matrix and band and occluding the root canal orifices with sterile Teflon strips .Following GI setting, the matrix and band were removed with finishing of the glass ionmer filling and adjusting the occlusal table of the tooth to be free of occlusion

.Reopening the access cavity with removal of Teflon strips while providing straight line access to all root canals was accomplished.

4.5.3: Cleaning and shaping (A):(Figure (3))

Establishing glide path of the canals using K files size 8, 10 and 15 in a watch winding motions in concomitant with working length(WL) determination using electronic apex locater (ROOT ZX I, JMORITA, Japan) was done. For those canals in which size 15 K file was loose before rotary instrumentation, the tooth was excluded from the study and the patient was replaced with another one according to the inclusion criteria of the study. The working length of all root canals was confirmed using 2 periapical radiographs from different angulation. In concomitant with glide path, irrigation of the root canals was accomplished with 2ml of NaOCL 5.25% using double side vented needle (Patterson Dental Supply) mounted on 5ml leur locker syringe.

The patients were divided into 3 main groups (n=20) according to the instrumentation system used as follows:

Group A1B2: (Instrumentation using XP endo shaper):

The root canals in this group were prepared using XP Endo shaper (FKG Dentaire SA, La Chaux-de-Fonds, Switzerland). It is a rotary NiTi single file made of MaxWire alloy with 0.01 initial taper. It has a six cutting edges booster tip (BT). By continuous rotation motion, the file expands once inside the root canal to achieve 0.04 taper with gradual increase in its tip diameter up to size 30 as claimed by the manufacturer. Instrumentation was done according to the manufacturer instruction as follows:

Removing the XP Endo shaper file from its sterile blister pack to be mounted in a contra-angle handpeice that was attached to a torque limited control motor (Traus-Korea). The speed was adjusted to be 800 rpm with 1 NCm torque. The working

length on the file was adjusted for each canal using rubber stopper to be 0.5 mm shorter than the (WL). Prior to root canal instrumentation, Irrigation of each root canal with 2ml of 5.25%Naocl while floating the pulp chamber with the NaOCL followed by inserting the file tip inside the root canal before starting the rotation. As the shaper file tips proceed into the root canal, switching on the rotation motion was done. The file is working in an up-and-down motion proceeding up to two thirds of each root canal. Confirming the apical patency for each root canal using size 10 K file in concomitant with irrigation of each root canal with 2ml of 5.25% NaOCL was done. Continuing root canal instrumentation with XP endo shaper to the full (WL) using the same protocol as previously mentioned. Once the working length was reached, applied 5 more up-and-down strokes over the entire working length of each root canal. Further apical patency for each root canal was done using size 10 k file in concomitant with further irrigation with 2ml of 5.25%Naocl was done. Confirming the apical diameter of the preparation was accomplished using size 30 K file. For those canals in which the apical preparation lacks an apical stop with size 30 K file, the tooth was excluded from the study and the patient was replaced with another one according to the inclusion criteria. Irrigation of each root canal using 2ml of 17% Ethelene diamine tetracytic acid (EDTA) (calixe-Dharma USA) was accomplished.

Group A2B2: (Instrumentation using 2Shape files):

The root canals in this group were prepared using 2shape system **(**Micro Mega, France) it is a rotary NiTi multi files system made of T-Wire alloy. Two files were used in the study, TS1 (25/0.04 taper) and TS2 (25/0.06 taper). Both files have asymmetrical cross section with 25 mm standard instrument length. Instrumentation was done according to the manufacturer instruction as follows:

Removing the 2 shape files from its sterile blister pack to be mounted in a contra-angle handpeice that was attached to a torque limited control motor. The speed was adjusted to be 400 rpm with 2.5 NCm torque. The working length on the file was adjusted for each canal using rubber stopper to the full working length. Prior to root canal instrumentation, Irrigation of each root canal with 2ml of 5.25%Naocl while floating the pulp chamber with the NaOCL was accomplished. Inserting the TS1 file in rotation motion into the root canals in a progressive up and down movement till reach the full working length followed by confirming apical patency for each root canal using size 10 K file in concomitant with irrigation of each root canal with 2ml of 5.25%Naocl was done. Inserting the TS2 file in rotation motion was done as previously mentioned with TS1 file. Further apical patency and irrigation with 2ml of 5.25% NaOCL was done. Confirming the apical diameter of the preparation was accomplished using size 25 K file. For those canals in which the apical preparation lacks an apical stop with size 25 K file, the tooth was excluded from the study and the patient was replaced with another one according to the inclusion criteria. Irrigation of each root canal using 2ml of 17% (EDTA) was accomplished.

Group A3B2: (Instrumentation using Reciproc Blue file system):

The root canals in this group were prepared using Reciproc blue R25 file (VDW, Germany). It is a rotary NiTi single file made of M-Wire alloy with diameter of 0.25mm with a taper of .08 over the first apical 3 millimeters. It has a specific s-shaped cross section, the variable taper and the cutting angles. The instrumentation was done according to the manufacturer instructions as follows:

Removing the Reciproc blue instrument from its pack to be mounted in a contra-angle handpeice that was attached to torque limited control motor (TRAUS,Korea)

with pre adjusted reciprocal program for Reciproc blue file. The length on the file was adjusted for each canal using rubber stopper to be two third of the full working length. Irrigation of each root canal with 2ml of 5.25%Naocl while floating the pulp chamber with the NaOCL was accomplished. Inserting the R25 instrument in pre adjusted reciprocating motion into the root canal in a slow in-and-out pecking motion 1-2 mm in depth till reach two third of each root canal. Confirming the apical patency for each root canal using size 10 K file in concomitant with irrigation of each root canal with 2ml of 5.25%Naocl was done. Continuing root canal instrumentation with Reciproc blue to the full working length using the same protocol as previously mentioned. Further apical patency and irrigation with 2ml of 5.25% NaOCL was done. Confirming the apical diameter of the preparation was accomplished using 25 K file. For those canals in which the apical preparation lacks an apical stop with size 25 K file, the tooth was excluded from the study and the patient was replaced with another one according to the inclusion criteria. Irrigation of each root canal using 2ml of 17% (EDTA) was accomplished.

4.5.4. Irrigant activation versus further irrigation (B) Table (2):

Each main group (A1, A2&A3) was further divided into 2 subgroups (B1&B2) according to whether the irrigating solution was activated using XP endo finisher or further irrigation using traditional side vented needle irrigation was accomplished. Activation of the sodium hypochlorite irrigating solution was done using the same protocol in sub groups (A1B1, A2B1&A3B1).

Activation of the irrigating solution using XP-Endo Finisher (B1):

Prior to dryness and obturation of the root canal system, each roots canal in sub groups (A1B1,A2B1&A3B1) were activated using XP endo finisher utilizing

4ml of 5.25% NaOCL in each root canal. XP endo finisher was used according to the manufacturer's instruction as follows:

The instrument was removed from the sterile blister pack to be mounted into a contra-angle hand-piece that was previously attached to a torque limited control motor where the rotational speed was adjusted to 800 rpm while torque was adjusted to 1Ncm. The rubber stopper was then adjusted to the working length by the aid of a plastic tube. Cooling the file inside its pack was done using a cold spray (Ethyl Chloride. Spray, Walter Ritter Pharmaceutica. Germany) followed by removal of the covering tube while the file in a rotation mode. The motor was then turned off immediately after removal of the file from the covering tube. Concomitantly each root canal was irrigated with 2 ml of 5.25% NaOCL irrigating solution using sterile disposable syringe with side vented 27gauge needle placed to 1 mm short of the working length. The XP-endo Finisher was then inserted into the root canal of the tooth while straight and once its tip was inside, the motor was turned on. The file was used in an up and down gentle motion for 30 seconds followed by its removal from the canal while it's still in rotation. Irrigation with 2ml of 5.25% (NaOCL) for each canal for further activation using XP endo finisher file . Final irrigation with 4ml of normal saline solution for each canal as a final rinse was accomplished.

Further irrigation (B2):

Prior to dryness and obturation of the root canal system, each root canal in sub groups (A1B2, A2B2&A3B2) was further irrigated using 2ml of 5.25% NaOCL for 1 minute followed by final rinse with 4ml of normal saline solution

4.5.5 Obturation of the selected teeth:

Dryness of the root canals, that were prepared using XP endo shaper, were accomplished using 30/0.04 taper paper point. While dryness of the root canals, that were prepared using either 2Shape rotary system or Reciproc blue reciprocating system, were accomplished using 25/0.04 taper paper points. Checking the master cone for each root canal was done using visual and tactile tests with confirmation using periapical radiographs. Obturation was done using lateral compaction technique using master cones 30/0.04(XP endo shaper group) and 25/0.04 (2Shape and Reciproc blue groups) with accessory cones 20/0.02 taper in combination with Resin based sealer (Ad seal, Korea). Painting each root canals with resin sealer was done by the aid of 25 sterile K file followed by placement of the master gutta percha cone. A suitable size finger spreader was used followed by placement of accessory gutta percha cones in concomitant with spreader placement till complete canal obturation. Cutting off the gutta percha cones at the level of the canal orifices was done using hot condenser with vertical compaction of the gutta percha using suitable size plugger to allow for coronal seal of each root canal. A temporary coronal restoration was done using glass ionmer resin filling till finalization the coronal restoration after 72 hours. A postoperative radiograph was done to confirm the obturation quality and presence or absence of sealer puff. The teeth that showed sealer puff were excluded from the study and the patient was replaced with another one according to the inclusion criteria of the study.

4.6 : Postoperative pain assessments:

At the end of the visit and prior to patient dismiss the operator motivated the patient how to use modified VDS by describing each level of pain intensity within the scale. Patients were given a copy of the Arabic modified VDS and asked to mark the level of pain intensity felt postoperatively after 12, 48 and hours. Postoperative assessment was collected by from the patient after 72 hours when final coronal restoration was done (Figur4). The patients were instructed to take 600 mg ibuprofen on demand (5 patients on group A3B2). Prior to statistical analysis of the data the patient's eligibility for the study was drawn in (figure 5).

4.7 : Statistical analysis of the data:

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, dura showed non-parametric distribution.

Mann-Whitney was used to compare between two groups in non-related samples. Kruskal Wallis test was used to compare between more than two groups in non-related samples. Friedman test was used to compare between more than two groups in related samples. Wilcoxon was used to compare between two groups in related samples.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

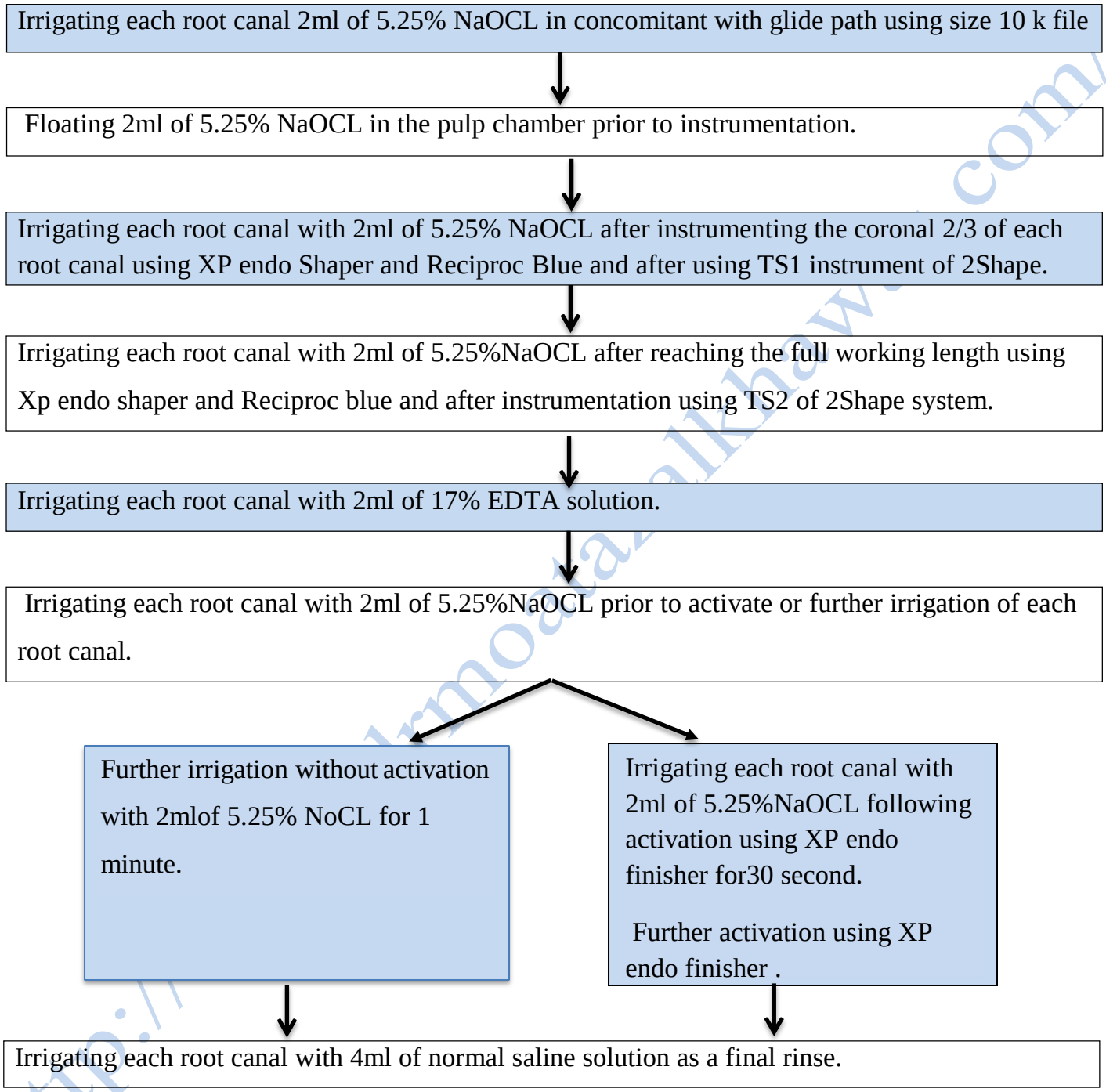

Figure (4): Schematic representation showing the irrigating protocol of each root canal throughout the study.

(A)

0	ال ّوجذ الن	الضزس طبِعً وًّشار لو بالزهز **0**
2	الن بسِط	الضزس ًّسبب الن بسِط لفحزه هن الوقث وال ًّلزم اخذ ادوٌّ هسكنو وًّشار لو بالزهز **2**
4	الن هححول	الضزس ًّسبب الن هححول سواءا باسحخذام ادوٌّ هسكنو او ال وًّشار لو بالزهز **4**
6	الن قِوي	الضزس ًّسبب لو الن وًّودي الى السحِقاظ هن النوم وًّلزم اخذ هسكن وًّشار لو بالزهز **6**
8	الن ذذ	الضررزس ًّسربب الرن رذًّذ وًّرودي الرى عرذم السرحالاعو للنروم وال الثشرالو الِورهِرو ه رل اال رل والورش رِ والزاضو وًّحاج الى ادوٌّ هسكنو وًّشار لو بالزهز **8**
00	الن غِز هححول	الررو السرحالِن النروم وال الثشرالو الِورهِرو هرن ظضرور اعرزِ ١ عاهرو ه رل الحروري وضعف عام وًّلزم اخذ هضاد حِوي هن ادوٌّ هسكنو وًّشار لو بالزهز **01**
	الرقِام الفِذٌة	جزهز لوسحوًّات الن هحوسالة بِرن هسحوًّات اللن الزئسة

جقِِن االلن بعذ 12 ساعو

(B)

0	1	2	3	4	5	6	7	8	9	10

اليوجد الم — الم بسِيط — الم محتمل — الم قوي — الم شديد — الم غير محتمل

جقِِن االلن بعذ 48 ساعو

(C)

0	1	2	3	4	5	6	7	8	9	10

الِيوجد الم — الم بسِيط — الم محتمل — الم قوي — الم شديد — الم غير محتمل

جقِِن االلن بعذ 72 ساعو

(D)

0	1	2	3	4	5	6	7	8	9	10

الِيوجد الم — الم بسِيط — الم محتمل — الم قوي — الم شديد — الم غير محتمل

Figure (5) Arabic modified VDS that given to the patient prior to his dismiss including description of pain levels (A) and pain assessment after 12 hours (B), 48 hours (C) and 72 hour (D).

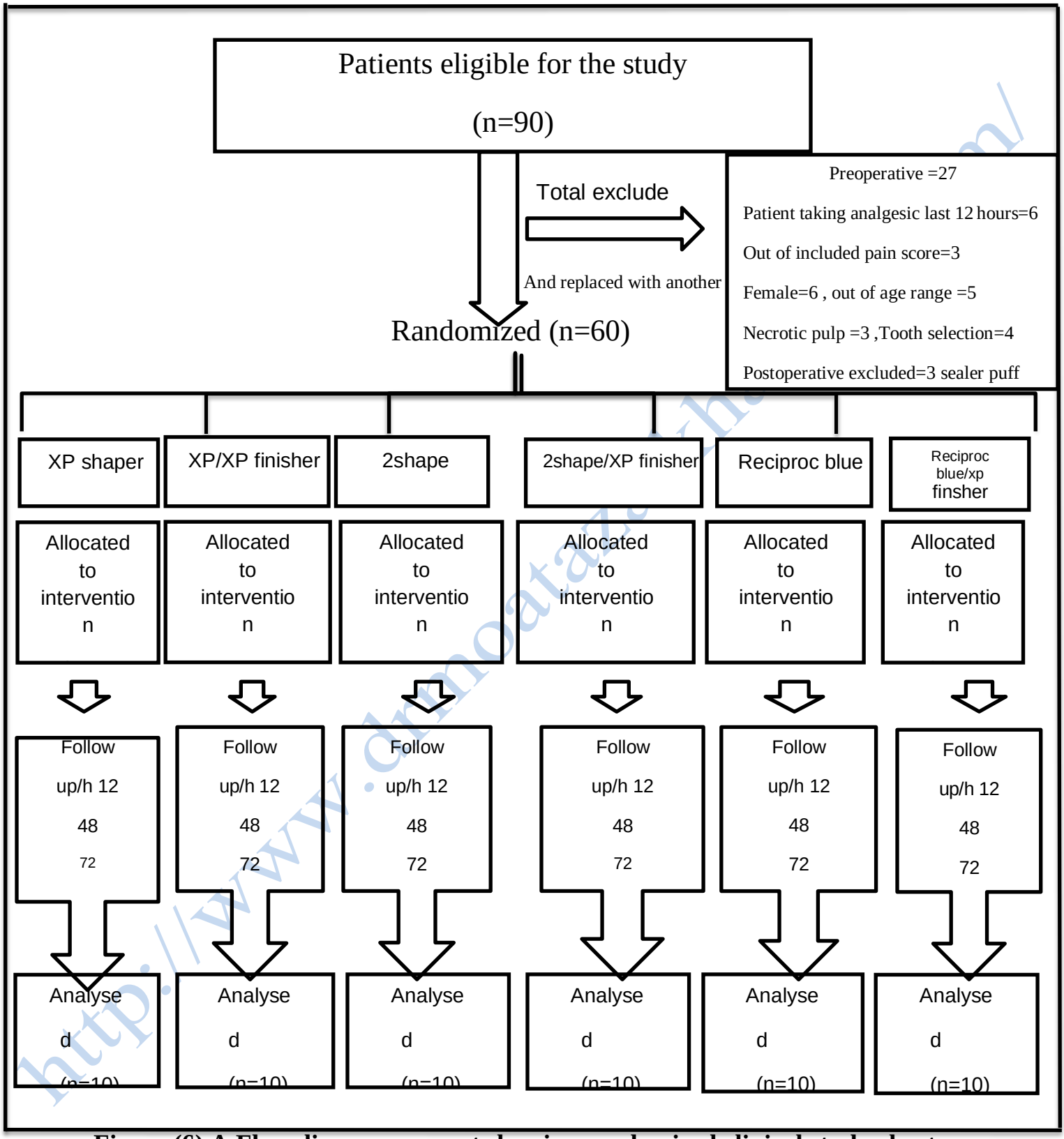

Figure (6) A Flow diagram consort showing randomized clinical study chart

Results

Section outline:

5.1 Evaluation of postoperative pain among all groups in each time interval:

5.1.1 Preoperative.

5.1.2 postoperative after 12 hours.

5.1.3 postoperative after 48 hours.

5.1.4 postoperative after 72 hours.

5-2) Evaluation of postoperative pain at different time intervals in each group:

5.2.1 XP shaper file.

5.2.2 XP shaper/XP finisher files.

5.2.3 2Shape files.

5.2.4 2Shape /XP finisher files.

5.2.5 Reciproc blue files.

5.2.6 Reciproc blue/ XP finisher files.

5-3 Evaluation of postoperative pain for each rotary/reciprocating system with/without activation using XP finisher file:

5.3.1 When using XP shaper files.

5.3.2 When using 2Shape file.

5.3.3 When using Recioroc blue file.

Results

5-1 Evaluation of postoperative pain among all groups in each time interval:

Data in this section was statistically analyzed using Kruskal Wallis test that was used to compare between more than two groups. Mann-Whitney was used to compare between two groups.

5.1.1 preoperative :

The results showed that the highest mean pain score value was recorded with XP shaper/ XP finisher group (5.40±0.84) followed by XP shaper (5.20±0.90), 2shape /XP finisher (5.0±0.99), Reciproc blue / XP finisher (5.10±0.88), 2shape (4.90±0.99) groups while the lowest mean score pain value was recorded with Reciproc blue (4.0±0.99) group with no significant difference among all groupsP value=0.819.

5.1.2 postoperative after 12 hours:

The result showed that the highest mean pain score value was recorded with Reciproc blue (7.10±0.88) that showed statistically significant difference with each of Reciproc blue / Xp finisher (5.80±0.79), 2shape / XP finisher (5.10+1.20), XP shaper (4.80+1.23), XP shaper / XP finisher (4.70±0.67) groups, while the lowest mean pain score value was recorded with 2shape (4.20±1.40) group that showed statistically significant difference with other groups. P value<0.001.

5.1.3 postoperative after 48 hours:

The result showed that the highest mean pain score value was recorded with Reciproc blue (6.70±1.06) group that showed statistically significant difference with each of Reciproc blue/Xp finisher file (4.30±0.67), 2shape (3.90±1.37), XP shaper / XP finisher (3.80±0.92), 2shape / XP finisher (3.80±0.63) groups, while the lowest mean pain score value was recorded with XP shaper (3.60+0.70) group that showed statistically significant difference with other groups. P value=0.001.

5.1.4 postoperative after 72 hours:

The result showed that the highest mean pain score value was recorded with Reciproc blue /XP finisher (3.00±0.82) group that showed statistically significant difference with each of Reciproc blue (2.90±0.88), 2Shape / XP finisher (2.80±0.79), XP shaper (2.30±1.06), XP shaper / XP finisher (2.30±0.48) group, while the lowest mean pain score value was recorded with 2shape (1.50±1.58) group that showed statistically significant difference with other groups. P value=0.024.

Table (3) : The mean, standard deviation (SD) values of pain score of different groups in different time periods.

Variables	Pain							
	Pre		After 12 hours		After 48 hours		After 72 hours	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
XP	5.20 [a]	0.92	4.80 [bc]	1.23	3.60 [c]	0.70	2.30 [abc]	1.06
XP with XP finisher	5.40 [a]	0.84	4.70 [c]	0.67	3.80 [bc]	0.92	2.30 [bc]	0.48
2Shape	4.90 [a]	0.99	4.20 [c]	1.40	3.90 [bc]	1.37	1.50 [c]	1.58
2Shape with XP finisher	5.00 [a]	0.94	5.10 [bc]	1.20	3.80 [bc]	0.63	2.80 [ab]	0.79
Reciproc	4.90 [a]	0.99	7.10 [a]	0.88	6.70 [a]	1.06	2.90 [ab]	0.88
Reciproc with XP finisher	5.10 [a]	0.88	5.80 [b]	0.79	4.30 [b]	0.67	3.00 [a]	0.82
p-value	0.819ns		<0.001*		<0.001*		0.024*	

Means with different l letters in the same column indicate statistically significance difference. *; significant ($p<0.05$).

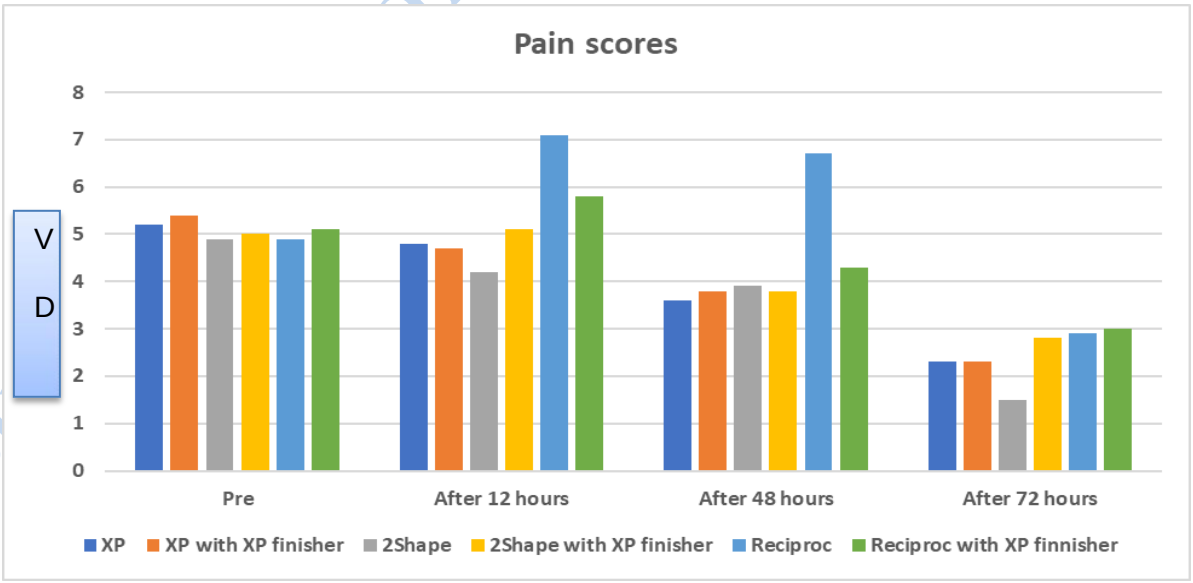

Figure (7): Bar chart representing pain score for different groups in different time period.

5-2 Evaluation of postoperative pain at different time intervals in each group:

Data in this section was statistically analyzed using Fredman test that was used to compare between more than two groups. wilcoxon was used to compare between two groups.

5.2.1 XP endo shaper file;

The result showed that the highest mean pain score values were recorded at preoperative (5.20±0.92) and 12 hours postoperative (4.80±1.23) intervals with no significant different between them. Both groups of preoperative and 12 hour's postoperative intervals groups showed statistically significant difference than, 48hours postoperative (3.60±0.70) intervals. The lowest pain score value was recorded at 72 hours (2.30±1.06) intervals that showed significant difference with other groups. P value<0.001 .

5.2.2 XP shaper/Xp finisher group:

The result showed that the highest mean pain score value was recorded at preoperative (5.40±0.84) group that showed statistically significant difference with 12 hours postoperative (4.70±0.67) intervals, 48 hours postoperative (3.80±0.92) intervals. The lowest mean pain score value was recorded at 72 hours postoperative (2.30±0.48) intervals that showed significant difference with other groups. (*p value* < 0.001).

Table (4) : The mean, standard deviation (SD) values of pain score of different XP groups.

Variables	XP			
	Without XP		With XP	
	Mean	SD	Mean	SD
Pre	5.20 [a]	0.92	5.40 [a]	0.84
After 12hrs	4.80 [a]	1.23	4.70 [b]	0.67
After 48hrs	3.60 [b]	0.70	3.80 [c]	0.92
After 72hrs	2.30 [c]	1.06	2.30 [d]	0.48
p-value	<0.001*		<0.001*	

Means with different l letters in the same column indicate statistically significance difference.
*; significant ($p<0.05$) .

5.2.3 2Shape group:

The result showed that the highest mean pain score value was recorded at preoperative (4.90±0.84) group that showed statistically significant difference with 12 hours postoperative (4.20±0.67) intervals, 48 hours postoperative (3.90±1.37) intervals. The lowest mean pain score value was recorded at 72 hours postoperative (1.50±1.58) interval that showed significant difference with other groups. (*p value* < 0.001).

5.2.4 2Shape / Xp finisher group:

The result showed that the highest mean pain score values were recorded at 12 hours (5.10±1.20) intervals and preoperative (5.00±0.94) group with no significant difference between them. Both 12 hours and preoperative groups showed statistically significant difference with 48hours (3.80±0.63) intervals. The lowest pain score value was recorded at 72 hours (2.80±0.79) intervals that showed significant difference with other groups. ($p<0.001$).

Table (5): The mean and standard deviation (SD) values of pain score of different 2Shape groups.

Variables	2Shape			
	Without XP		With XP	
	Mean	SD	Mean	SD
Pre	4.90 [a]	0.99	5.00 [a]	0.94
After 12hrs	4.20 [ab]	1.40	5.10 [a]	1.20
After 48hrs	3.90 [b]	1.37	3.80 [b]	0.63
After 72hrs	1.50 [c]	1.58	2.80 [c]	0.79
p-value	<0.001*		<0.001*	

Means with different l letters in the same column indicate statistically significance difference. *; significant ($p<0.05$) .

5.2.5 Reciproc blue group:

The result showed that the highest mean pain score values were recorded at12 hours (7.10±0.88) intervals that showed statistically significant difference with 48 hours (6.70±1.06) intervals, preoperative (4.90±0.84) group. The lowest mean pain score value was recorded at 72 hours (2.90±0.88) intervals that showed significant difference with other groups. (*p value* < 0.001).

5.2.6 Reciproc blue / Xp finisher group:

The result showed that the highest mean pain score value was recorded at 12 hours (5.80±1.23) intervals showed statistically significant difference with preoperative (5.10±0.88) group and 48hours (3.60±0.70) interval. The lowest mean pain score value was recorded with 72 hours (2.30±1.06) interval with significant difference with other groups. ($p < 0.001$).

Table (6) : The mean, standard deviation (SD) values of pain score of different Reciproc blue groups.

Variables	Reciproc blue			
	Without XP		With XP	
	Mean	SD	Mean	SD
Pre	4.90 [b]	0.99	5.10 [ab]	0.88
After 12hrs	7.10 [a]	0.88	5.80 [a]	0.79
After 48hrs	6.70 [a]	1.06	4.30 [b]	0.67
After 72hrs	2.90 [c]	0.88	3.00 [c]	0.82
p-value	**<0.001***		**<0.001***	

Means with different l letters in the same column indicate statistically significance difference. *; significant ($p<0.05$) .

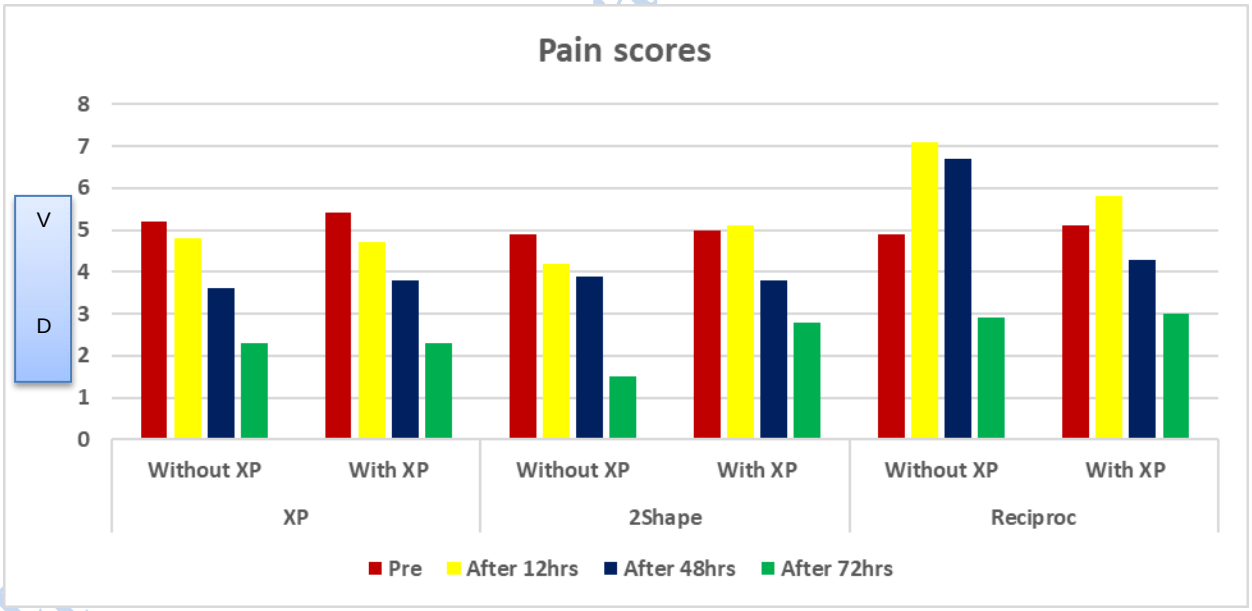

Figure (8): Bar chart representing pain score for different groups.

5-3 Evaluation of postoperative pain for each rotary/reciprocating system with/without activation using XP endo finisher file:

Data in this section was statistically analyzed using Mann Whitney test.

5.3.1 When using XP endo shaper rotary system:

The higher mean pain score value was recorded in XP shaper/XP finisher (4.05±1.38) group, while a lower mean pain score value was recorded in XP shaper file group (3.98±1.49) with no significant difference between them. P=0.848

5.3.2 When using 2Shape rotary system:

The higher mean pain score value was recorded in 2Shape/XP finisher (4.18±1.30) group, while a lower mean pain score value was recorded in 2Shape (3.63±1.84) group with no significant difference between them. P=0.240.

5.3.3 When using Reciproc blue reciprocating system:

The higher mean pain score value was recorded in Reciproc blue (5.40±1.92) group, while a lower mean pain score value was recorded in Reciproc blue/XP finisher (4.55±1.30) group with significant difference between them. P=0.024.

Table(7): The mean, standard deviation (SD) values of pain score of different groups.

Variables	Pain score					
	XP		2Shape		Reciproc	
	Mean	SD	Mean	SD	Mean	SD
Without XP	3.98 [a]	1.49	3.63 [a]	1.84	5.40 [a]	1.92
With XP	4.05 [a]	1.38	4.18 [a]	1.30	4.55 [b]	1.30
p-value	0.848ns		0.240ns		0.024*	

Means with different l letters in the same column indicate statistically significance difference. *; significant ($p<0.05$) .

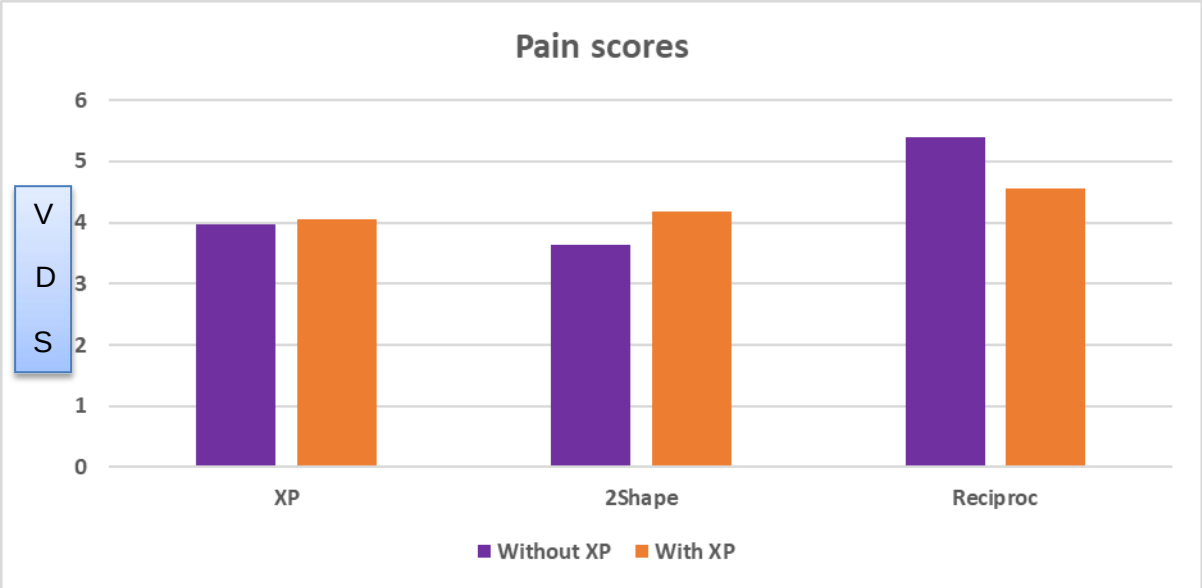

Figure (9): Bar chart representing effect of XP finisher usage on pain score values.

Discussion

Although postoperative pain following root canal treatment does not last long but sometimes is announcing to the patient due to microbial, mechanical and chemical irritation to the periapical tissues [66,67]. Other factors such as age, gender, preoperative pain, periapical status, tooth type and its location in maxilla or mandible may affect the degree of postoperative pain [2,68].

This study evaluated the effect of using 3 different instrumentation systems (XP Shaper, 2Shap and Reciproc blue), with/without irrigant activation using XP endo finisher on the postoperative pain after single visit treatment of teeth with irreversible pulpitis.

Male patients aged 18-35 years were selected in the study to decrease the effect of hormonal changes that are usually associated with female patients while keeping similar patient response within the selected age range [69,70].

Patients who had teeth with irreversible pulpitis were included to eliminate the effect of the periapical status of the affected teeth while those that had systemic diseases, taking analgesic in the last 12 hours before treatment or those that had teeth with periodontal disease, apical periodontitis and teeth with abnormal morphology were excluded to ensure that no other pain sources or drug interaction could interfere with pain result [71 -73].

Postoperative pain has been more frequently reported in the mandibular posterior teeth (42%) in comparison with maxillary posterior teeth (26%) due to thick cortical mandibular plate that allows for the accumulation of exudates and increasing the intra-periapical pressure that produces pain [74 -76].

Lidociane 2% local anesthetic agents with adrenaline 1:80.000 has been used due its medium acting effect that does not affect the result of postoperative pain [77].

Single visit appointment was preferred over multiple visits in order to avoid the inter appointment contamination and bacterial growth resulting in pain especially with leakage underneath the temporary filling. [78,79] .

Different scales and methods have been used to assess postoperative pain. The current study used the modified verbal descriptive scale (VDS) to measure the intensity of postoperative pain; this scale is easily understood by patients and is a simple and reliable way that has been used worldwide in several studies [61,80].

The working length (WL) was determined by electronic apex locator because of its high accuracy then confirmed by the radiograph, this greatly confines the instrumentation within the root canal system [81,82].

Creation of a glide path and canal patency prior to and during instrumentation of the root canals respectively were done to minimize extrusion of debris outside the apical foramen with decreasing the risk of postoperative pain [83 -86].

Sodium hypochlorite irrigating solution was used due to it has broad antibacterial activity and organic matter dissolution ability. While using EDTA 17% irrigating solution was due to its ability in removing the inorganic content of the smear layer which accumulates as a result of the mechanical cleaning and shaping [87 -90].

Obturation was done using lateral compaction technique due to it has less effect on postoperative pain compared to warm vertical compaction beside its availability and simplicity. Cold lateral compaction technique was done utilizing cold gutta percha point and resin based root canal sealer due to its insolubility in tissue fluid, high adhesion to dentin, good radiopacity and hermetic sealing . Different research concluded that the treatment outcome including postoperative pain is not significantly affected by the type of sealer [91 - 95].

Assessment of pain intensity was carried preoperatively and postoperatively after 12, 48, and 72 hours. These intervals were chosen as 12- h was after instrumentation enough to allow the anesthetic solution effect to completely disappear. Finally 48 hours and 72 hours intervals where chosen because it usually represent the period of the maximum peak of pain [96,61,54,].

The non-steroidal anti -inflammatory drugs, ibuprofen was selected because most investigations on the postoperative pain have used ibuprofen. Moreover ibuprofen is effective for treating acute pain and inflammation related to endodontic treatment, rapidly absorbed and metabolized by the liver [5, ,97- 99].

In the present study, the highest pain levels were recorded with Reciproc blue than XP shaper and 2Shape groups at different time intervals (12, 48 and 72 hours postoperative). This finding is in agreement with Oubaid, Mehdi,[100] and Nekoofar et al[101] who found that postoperative pain level was significantly lower in patient treated with the rotary systems than those treated with reciprocating system. Alternatively, the present study was In contrast with the results found by Kherlakian et al **[46]** and Revals et al [44]. They reported that no significant difference in postoperative pain levels between rotary and reciprocating motions.

The significant difference in the present study may be attributed to the extrusion of debris, as reciprocating motion is responsible for extruding higher amount of debris than rotary motion, due to reciprocating motion is formed by a wider cutting angle and smaller releasing angle, while rotating in the releasing angle direction, the flutes did not remove debris rather than push it apically [102].

On the other hand, XP Shaper and 2Shape groups showed lower postoperative pain level than Reciproc blue group which may be due to their continuous rotation motions with less debris extrusion beside the 2Shape has asymmetrical cross section with 2 main cutting edge and 1 secondary edge that augments removal of debris from inside root canal while XP Shaper has a snake movement while expanding and contracting during relatively long strokes, may improve touch on the canal walls [103,13].

Additionally 2Shape group showed lower postoperative pain than XP shaper group as the 2Shape is a multi-file [104] system with less apical diameter (0.25mm) while Xp shaper single file system with larger apical diameter(0.30mm) . Also, the difference may be attributed to the difference in metallurgy between both rotary systems as the friction to the canal wall make the Max wire alloy of XP endo shaper more expandable by temperature raising inside the root canal leading to pushing more debris outside the apex in compare with T wire alloy of 2Shape rotary system that has a standard apical diameter and tapper.

Regarding activation of the irrigating solution, the results showed dramatically decrease in postoperative pain level when XP finisher was used following root canal instrumentation using Reciproc blue file on the other hand, XP finisher did not significantly decrease the postoperative pain levels following root canal instrumentation using XP shaper and 2shape groups. This may be

attributed to greater canal taper when instrumentation with Reciproc blue (0.08 taper) in compared with that XP shaper (0.04 taper) and 2shape (0.06 taper) rotary systems. The greater canal taper allows for better debris removal especially from the apical third of the root canals that were instrumented with Reciproc blue reciprocating file. These results are agreement with Leoni et al.[(105)] who found that XP-endo Finisher instrument were associated with significantly lower levels of accumulated hard tissue debris(AHTD) compared with conventional irrigation and the modified SAF system protocol and disagreement with Kfir A et al [(106)]who found that Rotary file followed by XP-endo Finisher file extruded significantly more debris than a full-sequence SAF system.The difference between them may attributed to difference in methodology. However the results of the present study rejected the null hypothesis that there was no significant difference among all groups.

Summary

This randomized clinical trial was conducted to evaluate and compare the postoperative pain after single visit treatment with 2shape, XP shaper and Reciproc blue with /without activation of irrigation with XP finisher file in patient with symptomatic irreversible pulpitis.at 12, 48 and 72 hours after treatment using a VDS.

Out of (90) 60 healthy male patients with acute pulpitis on lower first molar teeth without periapical radiolucency were randomized into six groups; group 1 were treated by XP shaper file with traditional irrigation, group 2 were treated by XP shaper file with activation of irrigation by XP finisher file, group 3 were treated by two shape file with traditional irrigation, group 4 were treated by two shape file with activation of irrigation by XP finisher file, group 5 were treated by Reciproc blue with traditional irrigation and group 6 were treated by Reciproc blue with activation of irrigation by XP finisher file.

Patients of all groups were followed up at intervals; 12 hours after procedure, 48 and 72 hours. Postoperative assessment was done according to VDS.

Results of the study showed that the highest mean pain score value was recorded with Reciproc blue at all intervals while activation of the irrigating solution , the results showed dramatically decrease in the postoperative pain level when XP finisher was used following root canal instrumentation using Recioproc blue.

Conclusions

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

1- All of the tested rotary and reciprocating instruments induce postoperative pain with variable levels.

2-Reciproc blue reciprocating file induces postoperative pain than XP endo shaper and 2Shape continuous rotation systems.

3- Activation of the irrigating solution using XP endo Finisher file is effective in reducing postoperative pain when using Reciproc blue reciprocating system.

4-Activation of the irrigating solution does not affect postoperative pain when both of XP endo Shaper and 2Shape continuous rotation systems were used.

5- Postoperative pain decreases with time in all tests groups.

Recommendations

With the limitation of this study, the following recommendations were drawn:

1-Activation of the irrigating solution is highly recommended to decrease postoperative pain especially when reciprocating motion was used for instrumentation.

2- Further research should be done to compare the levels of postoperative pain when using different reciprocating files with different reciprocating ranges in association with activation of the irrigating solution.

3- Further research should be done to evaluate the effect of activation time when using both of reciprocation and continuous rotation motions.

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