

ORIGINAL ARTICLE

Cross-sectional evaluation of post-operative pain and flare-ups in endodontic treatments using a type of rotary instruments

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Abstract

Aim. The purpose of this clinical study was to evaluate the general incidence of post-operative pain and flare-ups in patients who were endodontically treated by two endodontics specialists using rotary instruments (Hero 642, Micro Mega, France) with the same treatment protocol. **Methods.** Records of 382 teeth belonging to 268 patients treated by two endodontics specialists during a 6-month period were kept and evaluated. Post-operative pain between treatment visits was categorized using a pre-established scoring system. Ninety-five patients were males, whereas 173 were females. **Results.** Pulpal necrosis without periapical pathosis was determined as the most common indication for endodontic treatment (21.7%) followed by irreversible pulpitis and re-treatment without periapical lesions (18.3%, 18.3%, respectively). The general prevalence of post-operative pain and flare-ups was determined as 8.1%, whereas cases that could be classified as real flare-ups which were severe and required an unscheduled visit (scores 2 and 3) comprised 3.4% of the cases. No statistically significant correlation was determined between gender and post-operative pain and flare-up ($p = 0.05$). There was a significant correlation between number of appointments and the presence of pain and flare-ups. Teeth undergoing multiple visits had a higher risk of developing post-operative pain and flare-ups compared to those with single appointments with a statistical significance ($p = 0.03$). **Conclusions.** Teeth with pre-operative pain were more prone to developing post-operative pain and discomfort with a statistically significant difference ($p = 0.02$). While no significant correlation was determined between tooth vitality and pain and flare-ups ($p = 0.5$), a statistically significant relationship existed between the presence of a periapical pathosis and post-operative pain and flare-ups. Cases with a periapical lesion had a higher risk of developing pain and flare-ups compared to those with no periapical involvement ($p = 0.0001$). Future studies may focus on the influence of rotary instrumentation systems in more specific groups of cases. Meanwhile; microbiological as well as psychological aspects of flare-ups are topics that warrant further investigation.

Key Words: *post-operative pain, flare-up, endodontic treatment*

Introduction

Post-operative pain following endodontic treatment has been defined as pain of any degree that occurs after the commencement of root canal therapy [1]. A flare-up, defined as a sub-set of post-operative pain, is characterized by the development of pain, swelling or both, which commences within a few hours or days after root canal procedures and is often of sufficient severity to require an unscheduled visit for emergency treatment [2]. It is an undesirable and distressing situation since it not only causes serious discomfort but may also disrupt the patient's confidence in the outcome of the treatment [3].

Various researches have been undertaken so far that examine the prevalence of post-operative pain, yielding different results [4–12]. It is difficult to draw a general conclusion relying on the varying results obtained from these researches. These conflicting results may be due to the differences in treatment protocols, as well as the days that patient records are taken.

There are various factors that have been reported as responsible for the occurrence of pain and endodontic flare-ups such as the number of appointments before the completion of the treatment, inter-appointment medication type, gender, age, the type of the tooth, presence of pre-operative

pain, pulpal and periradicular diagnosis, treatment protocol, irritants within the root canal space, apical debris extrusion and preservation of apical patency during root canal preparation [10]. Furthermore; patients' attitudes towards endodontic treatment may vary and these may constitute the impact of psychological factors on post-operative pain incidence. Fear of dentists, anxiety and apprehension were reported as factors that may affect patients' reaction thresholds and endurance [13]. In the meantime; there may be differences in patients' approaches towards endodontic treatment depending on the population investigated.

The science of endodontology has witnessed quite a number of innovations in recent years, one of which is the utilization of nickel-titanium rotary instruments. With the help of the rotary nickel-titanium instrumentation, excessive time consumption is prevented and endodontic procedures are completed more efficiently. Moreover, in some studies, it has been shown that crown-down instrumentation that allows the practitioner to reach the apical terminus gradually, starting from the coronal aspect of the root canal, significantly reduces the apically extruded debris, which is considered as one of the important etiological factors of post-operative pain and flare-ups [14]. The incidence of post-operative pain and flare-ups with rotary instrumentation systems engaging a crown-down technique isn't a topic that has been extensively studied. The purpose of the present study was to evaluate the general incidence of pain and endodontic flare-ups in cases treated by two endodontics specialists using rotary instruments with the same treatment protocol.

Materials and methods

In this study, records of 382 teeth belonging to 268 patients treated by two endodontics specialists during a 6-month period were evaluated. Data were obtained by recording information belonging to patients whose endodontic treatments were completed by these specialists. Ninety-five male (35.4%) and 173 female (64.6%) patients were included in the study. The main focus of the study was the evaluation of the incidence of post-operative pain and flare-ups. Before the study, the specialists came to a consensus about the clear definition of endodontic pain and flare-ups by scoring their individual cases not included in the study and a scoring was established to define the type of pain and discomfort experienced by patients between appointments. In case discrepancy was observed between the practitioners, a consensus was reached by discussion. A special chart was designed for the recording of the data. The following scorings were assigned to the treated teeth in terms of pain and

flare-ups based on a system similar to that developed by Fava [6]:

1. No symptoms between visits.
2. Mild-to-moderate pain which could be alleviated by regular medication.
3. Severe signs of pain that required an unscheduled visit.
4. Severe pain accompanied by intra-oral or extra-oral swelling.

During the study, variables such as patients' ages, gender, tooth numbers, initial diagnosis, number of appointments and the duration of the overall treatment were recorded.

While evaluating post-operative pain, information regarding the initiation of the flare-up (the day of onset), its duration and type were also included.

Initial diagnosis of the treated teeth was classified and described as follows:

1. *Deep carious lesions*: Lesions extending to the pulp chamber without any symptoms of pulpitis; however, requiring root canal treatment due to extensive pulpal exposure. The pulp is vital and there is no periapical radiolucency.

2. *Irreversible pulpitis*: Cases exhibiting symptoms of irreversible pulpitis by clinical and radiologic examination. The pulp is vital and there is no periapical radiolucency.

3. *Pulpal necrosis*: Cases with a non-vital pulp but intact periradicular tissues based on clinical, vitalometric and radiologic examination.

4. *Acute apical abscess*: Acute cases with a necrotic pulp, periradicular pathosis as well as swelling by clinical and radiologic examination.

5. *Chronic apical periodontitis (Granuloma)*: Asymptomatic cases with necrotic pulp and a periradicular pathosis by radiological examination.

6. *Chronic apical abscess*: Cases with a necrotic pulp, periradicular pathosis and a sinus tract formation by clinical and radiologic examination.

7. *Retreatment*: Teeth with previous endodontic intervention with no periradicular pathosis by anamnesis, clinical and radiologic examination.

8. *Prosthetic purposes*: Teeth without any pulpal or periradicular pathosis; however, with the necessity of a prophylactic endodontic intervention due to prosthodontic reasons (e.g. requirement of extensive tissue removal during root canal treatment that will result in pulpal exposure).

The endodontics specialists who participated in the study followed a very similar treatment protocol during the performance of their endodontic treatments. Meticulous care was taken to follow contemporary principles of endodontic care. At the university clinic where the study was performed, the utilization of rotary intra-canal instruments (Hero 642, MicroMega, France) is a commonly adopted treatment protocol. The basic feature of this system is that it utilizes a crown-down approach

until the working length. Initially a 0.06 taper instrument is used until 1/2 or 2/3 of the working length with a rotational speed of 300–600 rpm. Then a 0.04 taper instrument is introduced until working length minus 2 mm. Finally, a 0.02 taper instrument is used until the working length. Care was taken to confirm apical patency without causing damage to the periapical tissues.

Furthermore, endodontic apex locators (Raypex, Densply, Maillefer, Switzerland) were also available for the establishment of the working lengths. Confirmation of the working lengths was determined by combining radiographic findings with those obtained by apex locators. Apex locators were used until 1 mm short of the working length. During the preparation of the root canals, irrigation was performed with sufficient amounts of 2.5% sodium hypochlorite. Should the treatment be performed in multiple visits, a pure calcium hydroxide paste, Pulpdent (Pulpdent Corporation, Watertown, MA, USA) was utilized for intra-canal medication. Root canal obturation was accomplished by using a cold lateral condensation technique that combined gutta-percha points with AH Plus® (AH Plus Densply, DeTrey, Konstanz, Germany) sealer using finger spreaders. Confirmation of the adequacy of root fillings was done by periapical radiographs.

The patients were instructed to call the practitioners in case they experienced painful episodes between appointments or after root canal obturation. They were questioned about the type of pain or discomfort they experienced between appointments. In cases where the patients suffered from mild-to-moderate pain, analgesics such as NSAIDs or acetaminophen were prescribed for the alleviation of symptoms. When severe cases were encountered, the patients were called to the clinic for emergency interventions. Root canals were not completed unless the patients were completely free of symptoms. Patient follow-ups were continued from the initiation of root canal treatment until 1 week after obturation.

Statistical analysis

The relationship of different parameters with inter-appointment flare-ups was evaluated by the chi-square test. A confidence level was set at 0.05.

Results

Records of 382 teeth belonging to 268 patients were included in the study. Ninety-five (35.4%) patients were males, whereas 173 (64.6%) were females.

Table I presents the distribution of teeth according to tooth types. Mandibular first molars comprised the highest proportion of teeth to be treated in the study.

Table I. Distribution of teeth according to their types.

| Tooth type | <i>n</i> | % |
|-------------------|----------|-------|
| <i>Maxillary</i> | 213 | 55.76 |
| Central incisors | 26 | 12.21 |
| Lateral incisors | 26 | 12.21 |
| Canines | 26 | 12.21 |
| First premolars | 32 | 15.02 |
| Second premolars | 33 | 15.49 |
| First molars | 38 | 17.84 |
| Second molars | 28 | 13.15 |
| Third molars | 4 | 1.88 |
| <i>Mandibular</i> | 169 | 44.24 |
| Central incisors | 5 | 2.96 |
| Lateral incisors | 4 | 2.37 |
| Canines | 17 | 10.06 |
| First premolars | 20 | 11.83 |
| Second premolars | 27 | 15.98 |
| First molars | 65 | 38.46 |
| Second molars | 30 | 17.75 |
| Third molars | 1 | 0.59 |

In Table II, the initial diagnosis of the treated teeth is presented. Pulp necrosis (without periapical pathosis) was the most common indication (21.7%) for endodontic treatment, followed by irreversible pulpitis (18.3%) and re-treatment (without periapical pathosis) (18.3%).

The majority of the endodontic treatments (55.8%) were completed in two appointments; 42.1% of the cases were completed in a single visit. Only eight cases (2.1%) necessitated three appointments for the final completion of endodontic treatments.

Table III presents the general incidence, day of onset and type of inter-appointment pain. Thirty-one (8.1%) of the examined teeth developed post-operative pain and flare-ups in general. The majority of pain and flare-ups commenced during the first

Table II. Distribution of teeth according to initial diagnosis.

| Initial diagnosis | <i>n</i> | % |
|---|----------|------|
| 1. Deep carious lesions with pulpal exposure | 45 | 11.8 |
| 2. Irreversible pulpitis | 70 | 18.3 |
| 3. Necrosis without periapical pathosis | 83 | 21.7 |
| 4. Acute apical abscess | 6 | 1.6 |
| 5. Chronic apical periodontitis | 47 | 12.3 |
| 6. Chronic apical abscess | 22 | 5.8 |
| 7. Re-treatment without apical pathosis | 70 | 18.3 |
| 8. Prosthetic purposes (vital teeth treated for prosthetic reasons) | 39 | 10.2 |

Table III. Distribution of teeth according to the presence of inter-appointment pain and flare up, pain and flare-up onset time and flare-up type.

| | | <i>n</i> | % |
|---|--------------------------|----------|------|
| Presence of inter-appointment pain and flare-up | Absent | 351 | 91.9 |
| | Present | 31 | 8.1 |
| Flare-up time (day of onset) | 0 | 351 | 91.9 |
| | 1 | 22 | 5.8 |
| | 2 | 8 | 2.1 |
| | 3 | 1 | 0.3 |
| Flare-up type | No pain | 351 | 91.9 |
| | Mild-moderate pain | 18 | 4.7 |
| | Severe pain | 9 | 2.4 |
| | Severe pain and swelling | 4 | 1 |

day following endodontic treatment (5.2%). When the type of inter-appointment pain and flare-up was evaluated, the majority of the symptomatic teeth were identified as having mild-to-moderate symptoms classified as 0 or 1 (4.7% of the overall painful cases). Nine teeth (2.4%) were associated with severe flare-ups classified as 3 and four teeth (1%) were associated with pain accompanied by extra-oral swelling classified as 4. Overall; cases with severe pain which required an unscheduled visit that could be characterized as real flare-ups comprised 3.4%.

When a correlation was drawn between patient ages, gender and post-operative pain and flare-up, no statistically significant difference was noted (Table IV) ($p = 0.853$ and 0.199 , respectively).

The relationship between tooth vitality, pre-operative pain, presence of an apical pathosis, number of appointments and post-operative pain and flare-ups is presented in Table V. Among the diagnosis indicated, deep carious lesions, irreversible pulpitis and prosthetic purposes were regarded as vital cases; whereas pulpal necrosis, acute apical abscess, chronic apical periodontitis (granuloma), chronic apical abscess and re-treatment cases were regarded as non-vital. No statistically significant difference was noted between tooth vitality and the presence of post-operative pain or flare-up ($p = 0.5$). While classifying teeth as such, acute apical abscesses, chronic apical periodontitis and chronic apical abscesses were categorized as teeth with periradicular pathology, whereas the remaining cases were regarded as without periradicular pathology. Statistical analysis revealed a significant difference between the presence of periapical pathology and post-operative pain and discomfort ($p = 0.0001$). This was also true for cases with scores 2 and 3 that required an unscheduled visit. Teeth with pre-operative discomfort and pain developed inter-appointment pain and flare-up more frequently and

the difference was statistically significant ($p = 0.022$). Teeth with multiple appointments had a higher risk of pain and flare-ups with a statistically significant difference ($p = 0.034$).

Discussion

Although contemporary endodontic treatment can be pain free during the procedure, patients may still experience some pain and discomfort after the appointment. Hargreaves et al. [15] drew attention to the significance of pain in endodontic therapy indicating that the terms root canal and pain are considered synonymous even in the 21st century. The authors further indicated that every clinician who provides endodontic therapy had to deal with this misconception and the clinician's skill is often primarily judged by the success or failure of pain control.

A survey of the literature reveals different rates reported in terms of flare-up cases and it has been indicated that the rates reported in the literature range between 1.4–16% [10]. Alves [10] evaluated the incidence of flare-ups (requiring emergency intervention) in 408 cases seen by students attending a specialization course and determined the overall rate of flare-ups (requiring unscheduled visit) as 1.71%, which is slightly lower than the 3.4% obtained in the present study. The differences may be attributed to the variabilities between the two studies, such as the rotary instrumentation techniques used. Their results were similar to those of the present study in the sense that teeth with periapical radiolucencies were more prone to developing inter-appointment flare-ups. This issue has been confirmed by a number of other researches as well [7,8,11,16].

In the present study, special care was taken to follow a similar treatment approach. However, it is practically impossible to standardize treatments performed by two different practitioners. Furthermore, there is no means by which the impact of individual differences can be calculated. On the other hand, a definite consensus was made both in armamentarium to be utilized as well as the techniques chosen during root canal preparation and obturation. In multiple-visit cases, root canals were not obturated until the patients were completely free of symptoms, therefore, no severe post-obturation pain was reported that could be characterized as flare-up. Although the majority of multiple-visit cases were completed in two appointments with a 1-week time interval, some cases required a longer time elapse either due to the persistence of symptoms or the delay in patients' attendances due to personal reasons.

Different researchers attempted to determine the incidence of pain and flare-ups. Fox et al. [17] controlled 247 endodontically treated teeth in terms of pain 1, 2 and 7 days following endodontic treatment. The authors recorded a pain incidence of 62%,

Table IV. Distribution of teeth according to age and gender and relationship with pain and flare-up.

| | | Flare-up (-) | | Flare-Up (+) | | <i>p</i> | OR (95% CI) |
|--------|--------|--------------|--------|--------------|--------|----------|------------------|
| Age | <30 | 59 | 16.80% | 4 | 12.90% | 0.853 | |
| | 31-50 | 142 | 40.50% | 13 | 41.90% | | |
| | >51 | 150 | 42.70% | 14 | 45.20% | | |
| Gender | Male | 119 | 33.90% | 7 | 22.60% | 0.199 | 1.75 (0.73-4.20) |
| | Female | 232 | 66.10% | 24 | 77.40% | | |

45% and 11% 1 day, 2 days and 7 days following endodontic treatment, respectively. They also added that there was a positive correlation between gender and the presence of a periapical lesion and inter-appointment pain. The results of the present investigation found no result in favor of a specific gender. Genet et al. [18] found the incidence of ‘flare-ups’ as 30% in a study they performed on 1204 patients. Post-operative pain and discomfort were more frequently reported in re-treatment cases performed in teeth with periradicular lesions. In the present study, re-treatment cases with a periapical lesion were categorized under the group of periapical pathologies to which they belonged, rather than classifying them as those of Genet et al. We preferred to name these cases under the periapical lesion category to which they belonged. Instead, the term ‘re-treatment’ was used only for those cases that required a repetition of root canal treatment with intact periapical tissues to outnumber the periapical lesion factor and assessing only the effect of the re-treatment intervention process. On the other hand, combining the two situations may be assessed in future studies evaluating post-operative pain that specifically focus on re-treatment.

Al-Negrish and Hababbeh [19] evaluated the presence of flare-ups among patients in a military hospital. The root canals were shaped according to the step-back technique and filled using the lateral condensation method. The authors determined the incidence of flare-ups in asymptomatic non-vital incisors as 11.6 and 3.6% after 2 and 7 days, respectively.

There are studies that aim to evaluate pain incidence in root canal treatments performed in single and multiple visits. Oginni and Udoe [20] emphasized that there is a higher incidence of flare-ups in single visit cases compared to multiple ones. Yoldaş

et al. [21] evaluated the frequency of flare-ups in single and multiple visit cases. The authors concluded that intra-canal medication performed in two visits significantly reduced flare-up incidence, especially in re-treatment cases. Eleazer and Eleazer [22] compared one visit and two visit endodontic treatment. They determined an advantage for the one-visit group in terms of flare-ups, which is consistent with the results of the present study. However, their study group consisted of necrotic molars, whereas the investigated teeth in the present study consisted of a combination of different diagnosis. Consequently, different results can be obtained if only necrotic teeth are included. Imura and Zuolo [8] and de Andrade Risso [12] also reported a positive correlation between flare-ups and pre-operative pain, which is also in agreement with the results obtained in the present study.

Extrusion of debris into periradicular tissues has been described as one of the major etiological factors leading to flare-ups. In asymptomatic periapical lesions, there is a balance between infecting microorganisms and periapical tissues. However, bacteria and toxic products may be introduced to the periapical tissues. In such cases, the periradicular tissues are confronted with more amounts of irritating agents than regular and the balance between irritating agents and host response may be temporarily disrupted. An acute response ensues to regain the balance [2]. Although care was taken to minimize any sort of apical irritation, it is practically impossible to avoid apically extruded debris completely, regardless of the instrument utilized. Although the practitioners involved in the study were experienced practitioners and extreme care was taken to avoid such occurrences, mishaps are still likely to occur.

Table V. Relationship between pulpal status, periapical status, pre-operative pain and number of appointments with post-operative pain and flare-up.

| | | Pain and flare up (-) <i>n</i> = 351 | | Pain and flare up (+) <i>n</i> = 31 | | <i>p</i> | OR (95% CI) |
|------------------------|-----------------------------|--------------------------------------|--------|-------------------------------------|--------|----------|-------------------|
| Pulpal status | Non-vital | 205 | 58.40% | 23 | 74.19% | 0.454 | 2.04 (0.89-4.70) |
| Periapical status | Periapical pathosis present | 59 | 16.81% | 16 | 51.61% | 0.0001 | 5.28 (2.47-11.26) |
| Pain | Pre-operative pain + | 15 | 4.27% | 16 | 51.61% | 0.022 | 2.49 (1.19-5.24) |
| Number of appointments | Multiple appointments | 197 | 56.13% | 24 | 77.42% | 0.034 | 2.68 (1.12-6.38) |

Flare-ups should also be evaluated in a microbiological point of view. Specific bacteria have been held responsible of painful periradicular inflammation such as *P. Endodontalis*, *Provotella* species, *T. denticola*, *T. forsyntia*. *F. Nucleatum*, *Provotella* and *Porphyromonas* species were also frequently isolated from 'flare-up' cases [23]. Furthermore, Herpes viruses were also reported as causative agents in the releases of cytokines by host defense cells. It was also suggested that symptoms may arise in cases where periradicular lesions are infected by Epstein Barr and/or human cytomegalovirus [24]. Slots et al. [25] also drew attention to the possibility of flare-ups initiated by active Herpes viruses in periradicular lesions. The aforementioned studies suggest that detailed microbiological analysis is essential to provide valid conclusions about microbiological aspects of flare-ups.

The psychological factors associated with flare-ups were not taken as a primary criterion in the present investigation. However; it is true that fear and anxiety towards dental procedures are among factors that trigger patients' pain thresholds and reactions. Moreover, pain and discomfort thresholds may exhibit individual differences. Previous painful experiences may also have influence on the severity of post-operative responses. Also, mutual communication between the patient and the practitioner may have influence on patients' reactions towards endodontic procedures, which again is debatable in the present study where the treatments were performed by two practitioners whose behavioral approaches may somehow differ.

Although rotary instrumentation techniques seem to cause a relatively smaller amount of pain, pain and discomfort between appointments remains to be a challenging problem in endodontic treatment. Because it is a multi-factorial problem, flare-ups should be focused in a number of aspects. The present investigation gives a general overview of inter-appointment pain incidence when rotary instruments engaging crown-down instrumentation are utilized. Detailed research on a more specific group of cases will certainly help enlighten our knowledge on this clinical dilemma. Meanwhile, there is recently a tendency for manufacturing systems with the capacity to reach apical terminus with only a single instrument, for responding to the demand of completion of the endodontic procedure in as little time as possible by dental practitioners. Also, reciprocating type of rotary systems has started to gain more attention recently, that are specifically designed for a more controlled type of approach to the apical terminus. Studies evaluating these systems in terms of post-operative pain and flare-up prevalence will also be complementary in assessing the clinical outcomes of innovative methodologies.

Within the limitations of this study, it can be concluded that the overall incidence of inter-appointment pain or flare-up was ~ 8.1% among teeth that had

undergone endodontic treatment using Hero 642[®] rotary instrumentation systems with a crown-down approach. Of the treated cases 3.4% were characterized as real flare-ups which required an unscheduled visit. Post-operative pain using rotary systems is definitely a topic that warrants further investigation with the inclusion and comparison of different methodologies to suggest strategies for the prevention for this undesirable and distressful condition, both for the patient and the dental practitioner.

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