

# Influence of Endodontic Procedure on Postoperative Pain – Evidence from Systematic Reviews\*

## SUMMARY

*Pain control, during and after root canal treatment is one of the important issues in endodontic practice. Occurrence of pain after intervention often presents considerable distress to both patient and dentist. In many studies influence of different endodontic treatment factors on incidence of postoperative pain has been investigated. However, different and inconsistent results between studies and growth in number of published papers each year made professional updating and clinical-decision making challenging. Systematic reviews synthesized and combined data from relevant studies to find the answer to a research question providing the highest level of scientific evidence. Thus, their use may facilitate decision making in clinical practice. The aim of this article was to present results from systematic reviews about the influence of endodontic treatment on postoperative pain.*

**Key words:** Postoperative Pain, Root Canal Therapy, Systematic

**Jelena Krunic<sup>1</sup>, Irena Mladenovic<sup>2</sup>, Aleksandra Žuža<sup>1</sup>, Igor Radović<sup>1</sup>, Nikola Stojanović<sup>1</sup>**

<sup>1</sup> Department of Dental Pathology, Faculty of Medicine, University of East Sarajevo, Foca, Bosnia and Herzegovina

<sup>2</sup> Department of Oral Rehabilitation, Faculty of Medicine, University of East Sarajevo, Foca, Bosnia and Herzegovina

**REVIEW PAPER (RP)**

**Balk J Dent Med, 2019;121-125**

## Introduction

Pain control, during and after root canal treatment is one of the important issues in endodontic practice. Occurrence of pain after intervention often presents considerable distress to both patient and dentist, especially in situation where patient was symptom-free before the treatment. Any degree of pain that occurs after the endodontic treatment is defined as postoperative pain. According to the literature, its prevalence ranges between 3% and 58% of all endodontic patients<sup>1</sup>. A subset of postoperative pain characterized by a high degree of pain and/or swelling after treatment which require patients unscheduled visit for treatment is known as flare-up<sup>2</sup>.

Postoperative pain occurs as a result of acute periapical inflammation in response to mechanical, chemical and/or microbial injury of periapical tissues during the root canal treatment<sup>3</sup>. As a complex multifactorial process postoperative pain is influenced by many factors involving patient- and tooth-related factors as well as endodontic intervention. Many studies investigated influence of different procedural factors

during endodontic treatment on occurrence and intensity of postoperative pain including instruments design and instrumentation technique<sup>4,5</sup>, chemical irrigants and irrigation techniques<sup>6,7</sup>, intracanal medicaments<sup>8</sup>, number of visits<sup>9</sup>, and obturation material and techniques<sup>10</sup>. Considering inconsistent results from various studies, and growth in number of published studies each year, systematic reviews may help professionals in keeping up to date and facilitate clinical-decision making. Namely systematic reviews synthesize and combine data from relevant studies to find the answer to a research question, providing the highest level of scientific evidence<sup>11,12</sup>. Therefore, the purpose of this article was to present results from existing systematic reviews about the influence of endodontic treatment on postoperative pain and summaries available evidence.

## Overview of systematic reviews

The literature searches were performed in PubMed/MEDLINE and Cochrane Database of Systematic Reviews, until March 10, 2019. Systematic reviews related to pain after different root canal treatment

\*Note: The results of this paper were presented as a part of an invited lecture at the 24<sup>th</sup> BaSS Congress

procedures and references included in systematic reviews were searched. The search criteria included key words appropriate to the study (endodontic postoperative pain, postendodontic pain, endodontic treatment, root canal treatment). Studies were included if they were systematic reviews, published in English language only, and linked to postoperative pain related to root canal treatment.

### **Instrumentation**

For root canal instrumentation hand instruments or engine driven nickel-titanium instruments can be used. Engine driven instruments can operate in continuous rotary and reciprocating motion. According to number of files used for instrumentations, engine driven instruments can be divided in single- and multiple-file systems. Different root canal instruments may produce different amounts of extruded debris<sup>13,14</sup>, affecting the postoperative pain incidence. Two recent systematic reviews and meta-analysis assessed influence of type of instruments on postoperative pain. According to Hou *et al.*<sup>15</sup> use of rotary instruments was related to lower incidence of postoperative pain in comparison to reciprocating instruments in single visit root canal preparation, but difference was not statistically verified. The authors further investigated difference in pain degree between two types of instruments and found that rotary instruments were associated with lower incidence of moderate and severe postoperative pain while reciprocating instruments were associated with higher incidence of mild postoperative pain. Sun *et al.*<sup>16</sup> compared incidence and intensity of postoperative pain between hand and rotary instruments, as well as between rotary and reciprocating instruments in single visit root canal treatment. According to review and meta-analysis results multiple rotary instruments contributed to significantly lower incidence and intensity of postoperative pain in comparison to hand files. When the types of hand instruments and shaping technique of rotary instruments were included in analysis, rotary instruments using crown-down technique were associated with lower incidence of postoperative pain than K-files. When rotary and reciprocating instruments were compared, multiple rotary instruments were associated with significantly lower incidence of postoperative pain, and may contribute to lower intensity of pain.

### **Working length/Foraminal enlargement**

It has been proposed that root canal preparation and obturation should be terminated within 1 to 2 mm of the radiographic root apex, in vital and non-vital teeth, including teeth with periapical lesion. In order to improve disinfection of apical part of root canal and facilitate healing of periapical lesions, foraminal enlargement was proposed. This means that apical preparation is terminated at apical foramen. However, foraminal enlargement may cause injury to the periapical tissue and extrusion of

infected debris leading to pain<sup>13</sup>. In systematic review and meta-analysis Borges Silva *et al.*<sup>17</sup> showed that foraminal enlargement was associated with significantly higher postoperative pain in the first, second, fourth, sixth and seventh day after treatment in comparison to conventional endodontic treatment of both necrotic teeth and teeth with apical periodontitis.

### **Apical patency**

Apical patency is a preparation technique in which the apical region of the root canal is maintained as free of debris and tissue remnants by insertion of K file size #10 or #15 1 mm longer than the working length, without binding and widening apical constriction. Despite advantages of apical patency concept, repeated passing of instrument beyond the apex can lead to inflammatory reaction in periapical tissue due to extrusion of infected debris secondary to mechanical instrumentation beyond the apical foramen<sup>13</sup>. Yaylali *et al.*<sup>18</sup> in recent systematic review of randomized controlled trial concluded that maintaining apical patency did not increase postoperative pain regardless of tooth vitality and number of visits. Moreover, apical patency did not cause flare-ups. In meta-analysis published shortly after previous, Abdulrab *et al.*<sup>19</sup> also concluded that apical patency was not associated with an increased incidence of postoperative pain after root canal treatment, as trend of less postoperative pain for apical patency teeth was observed. Furthermore, significantly more postoperative pain can be expected in no patency teeth than in teeth where apical patency was performed five days after intervention, but not after other days.

### **Irrigation**

In endodontic therapy range of antibacterial irrigating solutions are available: sodium hypochlorite (NaOCl), chlorhexidine (CHX), ethylenediaminetetra-acetic acid (EDTA), as well as recently developed combined irrigation solution, such as MTAD and QMiX. Root canal irrigation can be performed with either conventional manual syringe irrigation technique with needle or with different delivery and agitation techniques. Extrusion of chemically active solutions, secondary to debris, beyond the apex can result in postoperative pain<sup>13</sup>. Considering the influence of type of root canal irrigants on postoperative pain, Fedorowicz *et al.*<sup>20</sup> found from the underpowered studies that postoperative pain after root canal treatment is not influenced by irrigant solutions. Namely, incidence of postoperative pain did not differ between 5.25% NaOCl and 5.25% NaOCl combined with 3% hydrogen peroxide, and between 5% of NaOCl used alone or in combination with proteolytic enzyme. In the very recent systematic review and meta-analysis Decurcio *et al.*<sup>21</sup> assessed influence of different machine-assisted irrigation agitation methods on postoperative pain during root canal treatment. Authors found that use of agitation technique by ultrasonic or sonic devices and negative

apical pressure device reduced postoperative pain with respect to syringe needle irrigation at 24 and 48h after root canal treatment. Subgroup analysis showed similar effect of agitation techniques on postoperative pain when only teeth with symptomatic irreversible pulpitis, with moderate to severe preoperative pain, instrumented with rotary files, were analyzed.

### **Intracanal medication**

Different intracanal medicaments are used during endodontic treatment to improve disinfection, facilitate healing and prevent or reduce postoperative pain. Anjaneyulu and Nivedhitha<sup>22</sup> investigated effectiveness of calcium hydroxide as intracanal dressing in reducing the postoperative pain, and found that calcium hydroxide was not effective. However, when used in combination with other intracanal medicaments (chlorhexidine, camphorated monochlorophenol) its effectiveness in reducing postoperative pain can increase.

### **Obturation**

Several materials and techniques have been recommended for filling of root canals after chemomechanical debridman. Sealer composition and root canal filling methods may influence incidence of postoperative pain<sup>13,23</sup>. In meta-analysis Peng *et al.*<sup>24</sup> investigated outcome of root canal filling with warm gutta-percha (thermomechanical compaction, thermoplasticized injectable gutta-percha obturation, ultrasonic condensation of gutta-percha, and solid-core carry insertion technique) in comparison to cold lateral condensation, and found that incidence of postoperative pain was similar between the two groups, although the overextension was seen more frequent in the former technique. The results of systematic review and meta-analysis of Wong *et al.*<sup>25</sup> indicate that postoperative pain of core-carrier obturation was comparable with that of cold lateral condensation in day 1 and 7 days after intervention. Moreover, no significant difference in the technical quality of root canal filling (overfilling or adequate adaptation) was found between techniques.

### **Number of visits**

Endodontic treatment in a single visit, especially of infected teeth, is still controversial because it has been introduced as alternative to the conventional approach in multiple visits. Pain and other complications may influence adoption of single-visit approach. There were many systematic reviews published in the literature up to date investigating influence of number of visit not only on endodontic outcome but also on postoperative pain. In systematic-review with meta-analysis Figini *et al.*<sup>26</sup> found no significant difference in postoperative pain up to 72h and one week after treatment between single- and multiple-visit root canal treatment, although one week postoperative pain was less common after multiple-

visit treatment. None of patients had persistent pain at one month. In addition, frequency of swelling was less common in multiple-visit than in single visit treatment, but difference did not reach significance. When necrotic teeth were analyzed only, incidence of pain remained insignificant, although pain was less common after single-visit treatment. Sathorn *et al.*<sup>1</sup> in systematic review also indicated no significant difference in prevalence of postoperative pain/flare-up between single- and multiple-visit root canal treatment. In systematic review with meta-analysis Su *et al.*<sup>27</sup> investigated endodontic treatment in single or multiple visits of infected necrotic root canals only. Authors reported that prevalence of short-term postoperative pain (up to 72h) was significantly lower in single-visit treatment; incidence of medium-term postoperative pain (7 to 10 days) was not significantly different between two treatment approaches, but appeared slightly lower in single-visit treated teeth. In addition, none of patients reported longer-term of postoperative pain after one month. Wong *et al.*<sup>28</sup> showed that both single and multiple-visit treatment induce similar postoperative complications, including pain. Updating the review of Figini *et al.*<sup>26</sup>, Manfredini *et al.*<sup>29</sup> found no significant difference in postoperative pain up to 72h hours, one week and 18 months as well as in prevalence of flare-up or swelling after root canal treatment between participants treated in single or multiple visit, although patients undergoing single-visit treatment may experience a higher level of pain at one week after treatment. Similar results were obtained when subgroups analyses were performed regarding tooth diagnosis (vital or necrotic teeth). Schwendicke and Göstemeyer<sup>30</sup> found that risk for postoperative pain or long-term complications were not related to number of treatment visits. However, risk for flare-up was significantly higher after single-visit in comparison to multiple-visit treatment. Moreira *et al.*<sup>12</sup> in overview of systematic reviews concerning endodontic treatment in single and multiple visits found slightly lower incidence of postoperative complication in single visit treatment of teeth with necrosis, and apical periodontitis, with level of evidence qualified as high for this clinical approach.

### **Overall clinical implications**

Postoperative pain is undesirable complication of root canal treatment. It can be affected by preoperative (patient and tooth) and procedural factors during the endodontic intervention. Knowing the risk factors may be of great help in clinical practice in order to identify patients with increased risk, and to conduct measures to reduce postoperative pain. This study highlights the evidence from systematic reviews about influence of procedural factors on postoperative pain occurrence. The relevant systematic reviews integrated into one document may help in clinical decision making and providing pain-free outcome. According to present results preparation

of root canal with hand instruments, or reciprocating files of engine driven instruments, performing foraminal enlargement, and use of conventional syringe irrigation technique during root canal treatment may increase risk for postoperative pain. On the other hand, procedural factor such as performing apical patency, although did not have significant impact, may decrease incidence of postoperative pain. Considering the influence of number of visit on postoperative pain, data do not able one to draw clear conclusion.

## Conclusions

According to available evidence from systematic reviews it can be concluded that the use of hand instruments, or reciprocating files of engine driven instruments, performing foraminal enlargement, and conventional syringe irrigation technique during root canal treatment may increase risk for postoperative pain. However, more well-controlled studies with representative sample size are needed to gain the evidence about the influence of other endodontic factors on postoperative pain, in addition to influence of patient- and tooth-related factors.

## References

- Sathorn C, Parashos P, Messer H. The prevalence of postoperative pain and flare-up in single- and multiple-visit endodontic treatment: a systematic review. *Int Endod J*, 2008;41:91-99.
- Walton R, Fouad A. Endodontic interappointment flare-ups: a prospective study of incidence and related factors. *J Endod*, 1992;18:172-177.
- Genet JM, Hart AA, Wesselink PR, Thoden van Velzen SK. Preoperative and operative factors associated with pain after the first endodontic visit. *Int Endod J*, 1987;20:53-64.
- Çiçek E, Koçak MM, Koçak S, Sağlam BC, Türker SA. Postoperative pain intensity after using different instrumentation techniques: a randomized clinical study. *J Appl Oral Sci*, 2017;25:20-26.
- Shokraneh A, Ajami M, Farhadi N, Hosseini M, Rohani B. Postoperative endodontic pain of three different instrumentation techniques in asymptomatic necrotic mandibular molars with periapical lesion: a prospective, randomized, double-blind clinical trial. *Clin Oral Investig*, 2017;21:413-418.
- Farzaneh S, Parirokh M, Nakhaee N, Abbott PV. Effect of two different concentrations of sodium hypochlorite on postoperative pain following single-visit root canal treatment: a triple-blind randomized clinical trial. *Int Endod J*, 2018;51(Suppl 1):e2-e11.
- Yılmaz K, Tüfenkçi P, Adıgüzel M. The effects of QMix and EndoActivator on postoperative pain in mandibular molars with nonvital pulps: a randomized clinical trial. *Clin Oral Investig*; 2019 doi: 10.1007/s00784-019-02856-6.
- Samir Abouelenien S, Mohamed Ibrahim S, Gameel Shaker O, Mohamed Ahmed G. Evaluation of postoperative pain in infected root canals after using double antibiotic paste versus calcium hydroxide as intra-canal medication: A randomized controlled trial. *F1000Res*, 2018;7:1768.
- Wong AW, Tsang CS, Zhang S, Li KY, Zhang C, Chu CH. Treatment outcomes of single-visit versus multiple-visit non-surgical endodontic therapy: a randomised clinical trial. *BMC Oral Health*, 2015;15:162
- Kandemir Demirci G, Çalışkan MK. A prospective randomized comparative study of cold lateral condensation versus core/gutta-percha in teeth with periapical lesions. *J Endod*, 2016;42:206-210.
- U.S. National Library of Medicine. National Institutes of Health. HTA 101: Glossary. Systematic review. Available from: <https://www.nlm.nih.gov/nichsr/hta101/ta101014.html>, Accessed in 2019 (Feb 1).
- Moreira MS, Anuar ASN, Tedesco TK, Dos Santos M, Morimoto S. Endodontic treatment in single and multiple visits: an overview of systematic reviews. *J Endod*, 2017;43:864-870.
- Siqueira JF Jr, Barnett F. Interappointment pain: mechanism, diagnosis and treatment. *Endod Topics*, 2004;7:93-109.
- Gkampsesi S, Mylona Z, Zarra T, Lambrianidis T. Assessment of apical extrusion of debris during endodontic retreatment with 3 rotary nickel-titanium retreatment systems and hand files. *Balk J Dent Med*, 2016;20:22-28.
- Hou XM, Su Z, Hou BX. Post endodontic pain following single-visit root canal preparation with rotary vs reciprocating instruments: a meta-analysis of randomized clinical trials. *BMC Oral Health*, 2017;17:86.
- Sun C, Sun J, Tan M, Hu B, Gao X, Song J. Pain after root canal treatment with different instruments: A systematic review and meta-analysis. *Oral Dis*, 2018;24:908-919.
- Borges Silva EA, Guimarães LS, Küchler EC, Antunes LAA, Antunes LS. Evaluation of effect of foraminal enlargement of necrotic teeth on postoperative symptoms: a systematic review and meta-analysis. *J Endod*, 2017;43:1969-1977.
- Yaylali IE, Demirci GK, Kurnaz S, Celik G, Kaya BU, Tunca YM. Does maintaining apical patency during instrumentation increase postoperative pain or flare-up rate after nonsurgical root canal treatment? A systematic review of randomized controlled trials. *J Endod*, 2018;44:1228-1236.
- Abdulrab S, Rodrigues JC, Al-Maweri SA, Halboub E, Alqutaibi AY, Alhadainy H. Effect of apical patency on postoperative pain: a meta-analysis. *J Endod*, 2018;44:1467-1473.
- Fedorowicz Z, Nasser M, Sequeira-Byron P, de Souza RF, Carter B, Heft M. Irrigants for non-surgical root canal treatment in mature permanent teeth. *Cochrane Database Syst Rev*, 2012;CD008948.
- Decurcio DA, Rossi-Fedele G, Estrela C, Pulikkotil SJ, Nagendrababu V. Machine-assisted agitation reduces postoperative pain during root canal treatment: a systematic review and meta-analysis from randomized clinical trials. *J Endod*, 2019;45:387-393.

22. Anjaneyulu K, Nivedhitha MS. Influence of calcium hydroxide on the post-treatment pain in endodontics: a systematic review. *J Conserv Dent*, 2014;17:200-207.
23. Dalopoulou A, Economides N, Evangelidis V. Extrusion of root canal sealer in periapical tissues - report of two cases with different treatment management and literature review. *Balk J Dent Med*, 2017;21:12-18.
24. Peng L, Ye L, Tan H, Zhou X. Outcome of root canal obturation by warm gutta-percha versus cold lateral condensation: a meta-analysis. *J Endod*, 2007;33:106-109.
25. Wong AW, Zhang S, Li SK, Zhang C, Chu CH. Clinical studies on core-carrier obturation: a systematic review and meta-analysis. *BMC Oral Health*, 2017;17:167.
26. Figini L, Lodi G, Gorni F, Gagliani M. Single versus multiple visits for endodontic treatment of permanent teeth. *Cochrane Database Syst Rev*, 2007;CD005296.
27. Su Y, Wang C, Ye L. Healing rate and post-obturation pain of single- versus multiple-visit endodontic treatment for infected root canals: a systematic review. *J Endod*, 2011;37:125-132.
28. Wong AW, Zhang C, Chu CH. A systematic review of nonsurgical single-visit versus multiple-visit endodontic treatment. *Clin Cosmet Investig Dent*, 2014;6:45-56.
29. Manfredi M, Figini L, Gagliani M, Lodi G. Single versus multiple visits for endodontic treatment of permanent teeth. *Cochrane Database Syst Rev*, 2016;12:CD005296.
30. Schwendicke F, Göstemeyer G. Single-visit or multiple-visit root canal treatment: systematic review, meta-analysis and trial sequential analysis. *BMJ Open*, 2017;7:e013115.

**Conflict of Interests:** Nothing to declare.

**Financial Disclosure Statement:** Nothing to declare.

**Human Rights Statement:** None required.

**Animal Rights Statement:** None required.

**Received on August 29, 2019.**

**Revised on September 1, 2019.**

**Accepted on September 10, 2019.**

Correspondence:

Jelena Krunic  
Department of Dental Pathology  
Faculty of Medicine, BiH  
e-mail: jelena.krunic@ues.rs.ba