Postoperative pain in teeth endodontically treated by dental students, using manual and reciprocating techniques

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ABSTRACT
This study determined the frequency and/or intensity of postoperative pain and factors associated with such occurrence in endodontic treatments and retreatments performed by manual and reciprocating techniques, by undergraduate dental students at the Federal University of Pelotas. For that purpose, data were collected from the records of patients treated by last-term undergraduate students, in the period between January 2017 and July 2019, adding up to 182 treatments. Pain was recorded by the Numerical Pain Rating Scale (NPRS). The following predictive variables were considered in the outcome of postoperative pain: tooth, number of canals, symptoms, dental crown, indicated treatment and radiographic periapical index. The variables related to the treatments included the instrumentation techniques, number of sessions and apical limit of instrumentation. There was report of pain during treatment in 28% of records, while 11.5% did not report previous pain. In 149 cases (81.9%) included in this study there were no reports of postoperative pain, while mild pain was reported in 17 cases (9.3%), moderate in 6 (3.3%) and intensive in 10 (5.5%). In 67.4% of cases, the teeth were treated up to mark “0” of the apex locator, while in 32.6% the length was established at 1mm from this mark. There was no association between the type of treatment performed and the occurrence of postoperative pain (p=0.206). It was concluded that, among the evaluated factors, only the previous symptomatology was associated with higher frequency of postoperative pain.

1 INTRODUCTION
Endodontics acts in regions inaccessible to the human eye, demanding from professionals an accurate level of sensitivity, skill and experience, as well as a long learning curve for dental students1. Most Brazilian dental schools still use the instrumentation technique with manual files, which due to the complexity and need for high tactile sensitivity, contributes to a natural rejection of Endodontics2, consequently with low quality of endodontic treatment performed by recently graduated students and professionals3,4. The introduction of reciprocating movement in Dentistry courses opens a new educational perspective, leading professionals to achieve preparations with an excellent modeling pattern, even in more complex cases5, allowing even students with little experience to perform the treatment of more complex cases6.

In addition to the clinical and radiographic success, the postoperative comfort of patients is one of the desired factors when performing endodontic treatment or retreatment. In this context, the occurrence of postoperative pain is a relatively frequent problem for patients submitted to endodontic procedures and has been widely studied7-11. A systematic literature review7 evaluated studies on the prevalence of pain before, during and after endodontic treatment, with a mean prevalence of 24% and 11% after one and seven days, respectively. This results from a multifactorial process and is influenced by aspects related to the patient, the tooth to be treated and the dentist’s skills and interventions12.

Some technical factors have been shown to influence the occurrence of pain after root canal treatment, including insufficient instrumentation and/or obturation, outflow of irrigating solution, apical extrusion of debris and foraminal enlargement during root canal preparation13. The main causes related to postoperative pain include the extrusion of debris present in the root canal to the periapical tissues14,15. The amount of extruded debris and neuropeptides released in the periodontal ligament differ according to the instrumentation technique employed16, which has been related to the different levels of pain intensity and frequency reported by patients.

Thus, this study aimed to determine the frequency and/or intensity of postoperative pain and the factors associated with this occurrence in endodontic treatments and retreatments performed by manual and reciprocating instrumentation techniques, by undergraduate dental students at the Federal University of Pelotas (UFPel).

2 METHODOLOGY
Experimental design
This retrospective study surveyed information available on the medical records of patients treated by last-term dental students at the Dental School of UFPel, in the period between January 2017 and July 2019, approved by the Institutional Review Board (CAAE: 06198819.6.2001.5317).

The study included data from the anamnesis and clinical and radiographic exams of treated patients, pre- and postoperative pain levels. Data obtained from the medical records related to diagnosis, treatment and pain scales were tabulated and stored in a database.

Variables included in the study
The predictive variables for the outcome of postoperative pain were: tooth (dental group: anterior, premolars or molars), number of canals, symptoms (absent, absent with history or present), dental crown (intact, restored, carious, previously treated tooth), treatment indicated (vital pulp therapy, non-vital pulp therapy or retreatment) and radiographic periapical index (PAI) (1: normal periapical bone structure; 2:
small changes in bone structure, without
demineralization; 3: changes in bone structure,
with diffuse mineral loss; 4: apical periodontitis,
with a well-defined radiolucent area; 5: severe
apical periodontitis, with radiographic
characteristics of exacerbation). The variables
related to the treatment considered:
instrumentation technique (manual or
reciprocating), number of sessions (single,
2 sessions, 3 or more sessions) and apical
instrumentation limit (1 mm below mark “0” of
the apex locator – with or without patency, or at
mark “0” of the apex locator).

Endodontic treatment
All procedures were performed under
standardized conditions and under supervision by
an Endodontics professor.

The root canals were prepared using one of
the following techniques: manual (crown-down
technique with stainless steel manual
instruments) or reciprocating (WaveOne Gold or
Reciproc systems, following the manufacturer's
instructions). Irrigation during biomechanical
preparation was performed with 2.5% sodium
hypochlorite (NaOCl) and 17% ethylenediamine
tetraacetic acid (EDTA) for 3 to 5 minutes at
completion of preparation. In cases requiring
more than one session, intracanal calcium
hydroxide dressing was used. Obturation was
performed by the single cone technique of the
WaveOne Gold or Reciproc systems, or gutta-
percha lateral condensation technique in case of
manual instrumentation.

Pain assessment
The presence and intensity of pre- and
postoperative pain was assessed by the
Numerical Pain Rating Scale (NPRS) validated
to Portuguese language¹⁷. The NPRS consists of
a scale of 11 points, often presented in closed
boxes in increasing order of whole numbers from
left to right from 0 to 10, in which the extreme
points mean “no pain” for 0 and “worst pain
imaginable” for 10. The participants were asked
to mark with an “x” the only number that best
represented the pain intensity. The scale was
applied at different times: at the first consultation
during complete clinical examination and
anamnesis; after biomechanical preparation and
placement of intracanal dressing (if treatment
was not completed); and after root canal
obturation.

On the first consultation, after complete
clinical examination, the patients were asked
about the intensity of pain of dental origin in the
last 48 hours (preoperative pain), being
instructed and asked to record the number
corresponding to the pain intensity on the scale.
After completion of this consultation, the patients
received a printed scale and were instructed to fill
it at home concerning the presence and intensity
of symptoms in the first 24 and 48 hours after
each clinical session. When there was no face-to-
face consultation, the patients were contacted by
telephone at preestablished times. For statistical
purposes, the numerical data referring to
postoperative pain were categorized as 0 =
absent; 1 to 4 = mild pain; 5 to 7 = moderate pain;
8 to 10 = severe pain).

Data analysis
Statistical analysis was performed using
the software SPSS v. 22.0 (SPSS Inc, Chicago,
IL). Descriptive analyses were performed on data
related to the teeth included in the study and- pre
and postoperative pain indices, besides
association tests between variables and the
endodontic outcome.

3 RESULTS
The frequency and intensity of
postoperative pain and its association with the
main variables analyzed is described in table 1.
During the evaluation period, 182 endodontic treatments were completed by last-term dental students. In 149 (81.9%) no pain was reported in any of the postoperative periods, while mild pain was reported in 17 cases (9.3%), moderate in 6 (3.3%), and intense in 10 (5.5%). Of the total cases, 57 (31.1%) were teeth with vital pulp, 88 (48.4%) teeth with necrotic pulp and 37 (20.3%) were cases of retreatment.

A total of 54 patients (28%) reported pain during treatment, while 21 (11.5%) reported previous pain. The presence of pain in the 48h before the initial consultation, either during treatment or before, showed statistically significant relationship (p<0.000) with the report of postoperative pain of any intensity.

In 132 (72.5%) cases, the students chose to use reciprocating instruments for root canal preparation and in 46 (25.3%) conventional manual instruments were used. The instrumentation technique employed did not interfere with the occurrence of postoperative pain, and similar rates of mild, moderate or severe pain were reported for teeth instrumented by manual and reciprocating techniques (p=0.733).

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Table 1. Frequency of postoperative pain and its association with the main variables evaluated

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Absent</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>p value</th>
</tr>
</thead>
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<tr>
<td><strong>Instrumentation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>46(100)</td>
<td>36(78.3)</td>
<td>6(13)</td>
<td>2(4.3)</td>
<td>2(4.3)</td>
<td>0.733</td>
</tr>
<tr>
<td>Reciprocating</td>
<td>132(100)</td>
<td>110(83.3)</td>
<td>11(8.3)</td>
<td>4(3)</td>
<td>7(5.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Tooth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>72(100)</td>
<td>64(88.9)</td>
<td>3(4.2)</td>
<td>2(2.8)</td>
<td>3(4.2)</td>
<td>0.135</td>
</tr>
<tr>
<td>Premolar</td>
<td>40(100)</td>
<td>32(80)</td>
<td>4(10)</td>
<td>2(5.0)</td>
<td>2(5.0)</td>
<td></td>
</tr>
<tr>
<td>Molar</td>
<td>69(100)</td>
<td>52(75.4)</td>
<td>10(14.5)</td>
<td>2(2.9)</td>
<td>5(7.2)</td>
<td></td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vital pulp therapy</td>
<td>57(100)</td>
<td>44(77.2)</td>
<td>5(8.8)</td>
<td>3(5.3)</td>
<td>5(8.8)</td>
<td>0.206</td>
</tr>
<tr>
<td>Non-vital pulp therapy</td>
<td>88(100)</td>
<td>75(85.2)</td>
<td>7(8.0)</td>
<td>2(2.3)</td>
<td>4(4.5)</td>
<td></td>
</tr>
<tr>
<td>Retreatment</td>
<td>37(100)</td>
<td>30(81.1)</td>
<td>5(13.5)</td>
<td>1(2.7)</td>
<td>1(2.7)</td>
<td></td>
</tr>
<tr>
<td><strong>Initial symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Absent</td>
<td>107(100)</td>
<td>97(90.7)</td>
<td>8(7.5)</td>
<td>1(0.9)</td>
<td>1(0.9)</td>
<td>0.000</td>
</tr>
<tr>
<td>Present</td>
<td>54(100)</td>
<td>36(66.7)</td>
<td>6(11.1)</td>
<td>3(5.6)</td>
<td>9(16.7)</td>
<td></td>
</tr>
<tr>
<td>Previous pain</td>
<td>21(100)</td>
<td>16(76.2)</td>
<td>3(14.3)</td>
<td>2(9.5)</td>
<td>0(0.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Initial PAI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>91(100)</td>
<td>75(82.4)</td>
<td>8(8.8)</td>
<td>4(4.4)</td>
<td>4(4.4)</td>
<td>0.484</td>
</tr>
<tr>
<td>2</td>
<td>29(100)</td>
<td>24(82.8)</td>
<td>3(10.3)</td>
<td>0(0.0)</td>
<td>2(6.9)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>27(100)</td>
<td>24(88.9)</td>
<td>1(3.7)</td>
<td>1(3.7)</td>
<td>1(3.7)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>32(100)</td>
<td>24(75.0)</td>
<td>5(15.6)</td>
<td>0(0.0)</td>
<td>3(9.4)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3(100)</td>
<td>2(66.7)</td>
<td>0(0.0)</td>
<td>1(33.3)</td>
<td>0(0.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Number of sessions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single session</td>
<td>110(100)</td>
<td>95(86.4)</td>
<td>6(5.5)</td>
<td>2(1.8)</td>
<td>7(6.4)</td>
<td>0.541</td>
</tr>
<tr>
<td>2 sessions</td>
<td>58(100)</td>
<td>43(74.1)</td>
<td>9(15.5)</td>
<td>3(5.2)</td>
<td>3(5.2)</td>
<td></td>
</tr>
<tr>
<td>3 or more session</td>
<td>14(100)</td>
<td>11(78.6)</td>
<td>2(14.3)</td>
<td>1(7.1)</td>
<td>0(0.0)</td>
<td></td>
</tr>
</tbody>
</table>

* χ² test

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locators, which allowed 122 (67.4%) cases to be treated until mark “0” of the apex locator, cleaning the entire length of the root canal. The instrumentation limit used, either at mark “0” of the apex locator or 1 mm below this measurement, did not influence the occurrence of postoperative pain (p=0.729).

There was no association between the occurrence of pain and the dental group treated, even though there was a higher percentage of mild or moderate pain in molars and premolars (p=0.135). Also, the number of canals was not associated with higher occurrence of postoperative pain (p=0.235).

The frequency and intensity of postoperative pain varied according to the treatment performed: there was no pain in 44 (77.2%) cases of vital pulp therapy, 75 (85.2%) cases of non-vital pulp therapy and 30 (81.1%) retreatments; however, there was no statistically significant association between the treatment performed and the occurrence of postoperative pain (p=0.206). There was no association between the condition of the dental crown at the moment of treatment (restored, previously treated, carious, intact), the initial PAI or the number of sessions required for treatment completion with the occurrence of postoperative pain (p>0.05).

4 DISCUSSION

This study aimed to determine the frequency of postoperative pain and the factors associated with this occurrence in patients who received endodontic treatment performed by undergraduate students. Due to the subjective and multifactorial nature of pain, many difficulties can arise in the assessment of postoperative pain levels and in controlling the several confounding factors involved.

For pain assessment, an attempt was made to turn a phenomenon that is essentially subjective and subject to high individual variability into something objective, highlighting the complexity of measuring results related to pain assessment. The present study used the NPRS to measure pre- and postoperative pain; this scale is one of the most used tools for this evaluation in clinical procedures, previously validated for Portuguese language.

Pain after root canal treatment can be related to variable causes. However, one of the predictive factors for its occurrence seems to be the inflammation caused by debris extruded into the periapical tissues. Even though the literature indicates that the manual technique seems to extrude greater amount of debris than the reciprocating technique, the present study did not observe any significant difference in postoperative pain between the different instrumentation techniques (manual and reciprocating). In disagreement with this result, several studies have shown a higher occurrence of postoperative pain when manual instrumentation is used, compared to mechanical instrumentation. These results can be assigned to the fact that, in the present study, the crown-down manual technique was used, while most studies demonstrating a higher occurrence of postoperative pain in cases treated by manual techniques used the step-back technique. In the step-back technique, there is a tendency that the instrument may act as an embolus, directing debris and forcing their extrusion through the apical foramen, probably worsening the periapical inflammatory condition and consequently the pain.

The literature addressing the association between the pulp condition and the occurrence of postoperative pain still provides inconsistent data. Several studies report that the pulp condition contributes to postoperative pain, while others do not. However, the present results demonstrated significant association between the initial symptoms and the occurrence of postoperative pain, which agrees with results...
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previously reported in the literature\textsuperscript{23,36,37}. Patients who have pain before endodontic treatment already have some degree of inflammation of the pulp and/or periapical tissues, and after root canal preparation and obturation, even if anti-inflammatory drugs are used, the inflammation and consequently the pain is gradually reduced, justifying the results described.

It was also observed that the dental group did not influence the postoperative pain, although it has been reported that molars are most likely to present postoperative pain\textsuperscript{38}. This association is probably due to the fact that molars present a more complex anatomy, with a greater number of canals and more pronounced curvatures, as well as anatomical variations that can contribute to the maintenance of uncleaned walls and consequently persistent infection and tissue inflammation, even after biomechanical preparation\textsuperscript{37-40}.

The number of sessions of endodontic treatment did not influence the postoperative pain in this study, which agrees with previous studies, which indicate that the result of endodontic treatment in a single session or in several sessions was similar concerning the occurrence of pain, without flare-ups and complications\textsuperscript{41-43}. However, the available literature is also controversial regarding these results. Some authors mention a lower rate of postoperative pain in endodontic treatments performed in a single session\textsuperscript{44-45}, while others report a lower rate of postoperative pain in multiple sessions\textsuperscript{46-47}. The lower rate of postoperative pain in root canal treatment in a single session could be assigned to immediate filling, thus avoiding the passage of drugs, repeated instrumentation and irrigation. In addition, endodontic treatment in a single session could also prevent the occurrence of pain resulting from reinfection of the root canals as a result of bacterial penetration through an unsatisfactory provisional restoration\textsuperscript{48}.

The rates of postoperative pain were relatively low in the present study. This may be associated with the operators who performed the endodontic treatments, who were undergraduate students. Previous studies\textsuperscript{12,49} indicate lower prevalence of postoperative pain in endodontic treatments performed by undergraduate students compared to graduate students. Such findings cannot be directly explained and should consider the limitations of the present study, that included multiple operators, which can imply a great variation in relation to other studies.

5 CONCLUSION

The results of the present study showed no association between postoperative pain in teeth endodontically treated by undergraduate students and the instrumentation technique used, either manual or reciprocating. Among the factors evaluated, only previous symptomatology was associated with a higher frequency and intensity of postoperative pain.

RESUMO

Dor pós-operatória em dentes tratados endodonticamente por estudantes de Odontologia, utilizando técnicas manual e reciprocante

O objetivo do presente estudo foi determinar a frequência e/ou intensidade de dor pós-operatória e os fatores associados a esta ocorrência em tratamentos e retratamentos endodônticos realizados pelas técnicas de instrumentação manual e reciprocante, por estudantes de graduação em Odontologia da Universidade Federal de Pelotas. Para tal, utilizou-se informações dos prontuários de pacientes atendidos por estudantes do último ano de graduação, no período compreendido entre janeiro de 2017 e julho de 2019, totalizando 182 tratamentos. A dor foi registrada por meio da Escala de Avaliação Numérica da Dor (EAND).
Considerou-se como variáveis preditivas no desfecho de dor pós-operatória: dente, número de canais, sintomas, coroa dentária, tratamento indicado e índice periapical radiográfico. Como variáveis relativas aos tratamentos, técnica de instrumentação, número de sessões e limite apical de instrumentação. Havia relato de dor no momento do tratamento em 28% dos prontuários, enquanto 11,5% não reportaram dor prévia. Em 149 casos (81,9%) incluídos neste estudo não foi relatada a ocorrência de dor pós-operatória, enquanto dor leve foi relatada em 17 casos (9,3%), moderada em 6 (3,3%) e intensa em 10 (5,5%). Em 67,4% dos casos dos dentes foram tratados até a marcação 0 do localizador apical, enquanto em 32,6% o comprimento foi estabelecido a 1mm desta marcação. Não houve associação entre o tipo de tratamento realizado e a ocorrência de dor pós-operatória (p=0,206). Conclui-se que, entre os fatores avaliados, apenas a sintomatologia prévia apresentou associação com a maior frequência de dor pós-operatória.


**REFERENCES**


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