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The influence of psychological factors on the frequency and perception of post-endodontic pain

Uticaj psiholoških faktora na učestalost i percepciju postendodontskog bola

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Abstract

Background/Aim. Post-endodontic pain (PEP) is associated with the presence of any uncomfortable feeling or sensitivity that occurs within a few hours or a few days after the endodontic treatment. The aim of this study was to evaluate the possible association between psychological factors and the frequency and perception of PEP. **Methods.** The study sample consisted of 140 patients with incisors, canines, or premolars indicated for root canal treatment (RCT) without periapical pathology. A single experienced endodontist was involved in the procedure, and the same clinical protocol was used for all the patients. Participants psychometric evaluation was done using the Depression Anxiety Stress Scale 21 (DASS-21). PEP levels were assessed using a Visual Analog Scale at different intervals (24, 48, and 72-hour intervals and after a week). **Results.** The presence of postoperative pain was reported in 63.6% of the respondents. The vast majority rated the pain intensity as mild, and the pain significantly decreased over evaluated time intervals. Participants who exhibited higher scores for depression, anxiety, and stress reported significantly higher pain intensity. The multivariate logistic regression analysis showed that tooth type ($p = 0.001$) and high anxiety score ($p = 0.035$) were directly associated with the occurrence of pain after therapy. **Conclusion.** Psychological factors, such as depression, stress, and anxiety, influenced pain perception after RCT treatment, and a high anxiety score was directly associated with the frequency of post-obturation pain.

Key words:
anxiety; depression; pain, postoperative; psychology; root canal therapy; stress, psychological; surveys and questionnaires.

Apstrakt

Uvod/Cilj. Postendodontski bol (PB) se opisuje kao neugodan osećaj ili bolna osetljivost koja se javlja u roku od nekoliko sati ili nekoliko dana posle endodontske terapije zuba. Cilj rada bio je da se proceni moguća povezanost između psiholoških faktora i učestalosti i opažanja PB. **Metode.** Uzorak studije činilo je 140 pacijenata čiji su sekutići, očnjaci ili premolari bili indikovani za lečenje kanala korena zuba (KKZ), bez prisustva periapikalne lezije. Terapijsku proceduru izvodio je isti terapeut, specijalista endodoncije, a identičan klinički protokol korišćen je za sve pacijente. Za psihometrijsku procenu korišćena je Skala stresa, anksioznosti i depresije (*Depression Anxiety Stress Scale* 21 – DASS-21). Intenzitet PB procenjivan je upotrebom Vizuelno analogne skale u različitm intervalima (24, 48 i 72 sata i nedelju dana kasnije). **Rezultati.** Prisustvo postoperativnog bola prijavilo je 63,6% ispitanika. Velika većina ispitanika ocenila je intenzitet bola kao blag, a bol se značajno smanjivao tokom ispitivanih vremenskih intervala. Učesnici studije sa ispoljenim višim stepenom depresije, anksioznosti i stresa prijavili su značajno veći intenzitet bola. Multivarijantnom logističkom regresionom analizom utvrđeno je da su tip zuba koji je lečen ($p = 0,001$) i visoki stepen anksioznosti ($p = 0,035$) bili direktno povezani sa pojavom bola posle terapije. **Zaključak.** Psihološki faktori, kao što su depresija, stres i anksioznost, uticali su na opažanje bola posle lečenja KKZ, a visok stepen anksioznosti bio je direktno povezan sa učestalošću pojave bola nakon terapije.

Ključne reči:
anksioznost; depresija; bol, postoperativni; psihologija; zub, lečenje korenskog kanala; stres; ankete i upitnici.

Introduction

Endodontic treatment (ET) is considered a kind of microsurgical procedure that requires great precision in a narrow space of root canals with limited direct-view access. The term "post-endodontic pain" (PEP) is a condition associated with the presence of any uncomfortable feeling or sensitivity that occurs within a few hours (hrs) or a few days after the ET [1]. The prevalence of postoperative pain (PP) reported in different studies varies from 13.1% to 64.7%. This wide variance was attributed to the study type (prospective or retrospective), sampling method, different kinds of assessing and defining

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PP concerning different criteria, preoperative diagnosis, or the time point when the pain was recorded [2]. The pain intensity can range from mild to intensive or severe, and it can last one day or sometimes several weeks. Patient dissatisfaction can sometimes be dominantly caused because of the occurrence of PP. Besides that, the occurrence of pain could be an indicator of some kind of pathology, and even more, may raise doubts about the long-term treatment success [3]. Previous studies evaluated common factors that could influence the occurrence of discomfort and pain after the ET. The most frequently investigated factors were inadequate instrumentation, apical extrusion of infected debris, irrigation solutions or intracanal dressing, missed canals, presence of traumatic occlusion, preoperative pain or periapical pathology, number of visits, etc. [4].

The International Association for the Study of Pain defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" [5]. Later on, a more complete definition occurred, which included psychological, noxious transmission, and a very important modulatory component. By this definition, pain is "an unpleasant sensation associated with actual or potential tissue damage and mediated by specific nerve fibers to the brain, where its conscious appreciation may be modified by various factors" [6]. In general, pain presents an experience that is subjective and influenced by various factors, such as personality, behavior, and physical and psychological factors, and is, therefore, difficult to quantify and standardize [7]. Previous studies have demonstrated that emotional states, such as fear, anxiety, depression, or stress, can modulate human pain reactivity. Anxiety refers to agitation, impatience, irritability, or difficulty relaxing. Stress is characterized by tension, which is persistent, by a tendency to overreact to stressful events, and by a low threshold of becoming frustrated or upset. Depression is characterized by a low level of positive affect (lack of energy, dysphoria, anhedonia, and hopelessness). Dental fear and dental anxiety represent strong negative feelings related to different dental treatments and may result in the worsening of dental health by interfering with patients' compliance. Previous painful experiences and anxious episodes regarding dental procedures could also be related to the reported pain [6, 8]. However, there is still a lack of studies that investigate the role of anxiety and depression on pain perception concerning ET [9].

The aim of this study was to evaluate the possible association between psychological factors and the frequency and perception of PEP.

Methods

Study population

The participants were selected from the Department of Dentistry, Community Health Center in Ljig, Serbia, between February and June 2023. The study was performed following the ethical principles for medical research involving human subjects stipulated by the Declaration of Helsinki and approved by the institutional Ethics Committee (protocol No. 191/2023, from February 21, 2023). Oral and written informed consent was obtained from all participants.

G*Power 3.1 software (Heinrich Heine University, Dusseldorf, Germany) was used to determine the sample size, with the power set at 80% and the alpha level at 0.05. The mean and standard deviation (SD) values were taken from a previous study conducted by Çiçek et al. [10]. The sample volume was determined to be at least 109 participants.

The inclusion criteria for the study were the following: systemically healthy patients over 18 years of age who could understand the use of the pain scale, with incisors, canines, or premolars indicated for root canal (RC) treatment (RCT), diagnosed with symptomatic or asymptomatic irreversible pulpitis or pulp necrosis (with normal periapical tissues) and those which required RCT due to prosthetic reasons. The exclusion criteria were: patients under 18 years of age, pregnancies, contraindications for RCT due to systemic disease, immunosuppressed patients, reported intolerance to nonsteroidal anti-inflammatory drugs, patients with pacemakers, conditions which require antibiotic prophylaxis, reported medication with an anti-inflammatory or analgesic agent before treatment, patients undergoing orthodontic treatment, teeth with periodontal disease or periapical pathology, internal and external resorption, teeth with open apices, RC retreatment, calcified or extremely narrow canals, teeth with severe RC curvature or anatomic abnormalities, cases of inadequate obturation after treatment (inhomogeneous filling, short fillings, apical extrusion of obturation material). The final study sample was 140 after the exclusion of patients who did not meet the criteria.

Psychological status evaluation

The evaluation of the participant's psychological status was done using the Depression, Anxiety, and Stress Scale (DASS)-21, translated into the Serbian language. This scale represents the short version of the original 42-item DASS, created by Lovibond and Lovibond [11], and has been widely used for screening the symptoms of depression, anxiety, and stress (DAS) at different levels. The questionnaire contains 21 statements, divided into three subscales containing seven statements and measuring the three dimensions of negative emotional states – depression (DASS-D), anxiety (DASS-A), and stress (DASS-S). A 4-point Likert scale ranging from 0 ("does not apply to me at all") to 3 ("applies to me most of the time or always") was used to categorize the answers for each statement. The final score was calculated after multiplying the sum of 7 scores of each subscale by 2. The score for the three subscales was classified as normal, mild, moderate, severe, or extremely severe, as recommended by the original authors of the DASS-21. This scale was previously validated on the general adult population and student population in Serbia [12, 13].

Root canal treatment procedure

A single operator, an experienced endodontics specialist, performed all the diagnostic and treatment procedures to minimize or eliminate treatment individual variability be-

tween different operators. The same standard evidence-based protocol (shaping, cleaning, and filling the RC system) was used for all cases included in the study in order to standardize the ET. Before the treatment, local anesthesia with 2.5 mL of 2% lidocaine containing 40 mg/2 mL + 0.025 mg/2 mL adrenaline (Galenika a.d., Belgrade, Serbia) was administered. The working field was isolated using the rubber dam, and the round diamond burs were used to perform the access cavity. A modified step-back technique with Nickel-Titanium (NiTi) K-Files (FKG Dentaire, La Chaux-de-Fonds, Switzerland) was used for instrumentation. The coronal third of RC was shaped using Gates-Glidden drills (#1, 2, and 3) (Dentsply Maillefer, Ballaigues, Switzerland), and the working length was determined using an electronic apex locator (DPEX III, Guilin, Guangxi, China). The RCs were prepared to a master apical size of 40/0.02, the step-back technique was done with K-Files 45–55/0.02, and the depth of insertion was reduced by 1 mm. The irrigation was done using 2.5% sodium hypochlorite (NaOCl) (i-dental, Siauliai, Lithuania) with a 27-G needle, inserted 2 mm short of the working length between each file. The same volume of irrigant was used during each treatment. To remove the smear layer after RC preparation, approximately 3 mL of 17% ethylenediaminetetraacetic acid (i-dental, Siauliai, Lithuania) was used. The polymeric calcium hydroxide RC sealer (Sealapex™, Sybron-Kerr, Romulus, MI, USA) and the lateral compaction method were used for obturation at the same visit. In the case of multi-visit treatment, temporary RC filling was done using calcium hydroxide paste (Calxyl®, OCO Präparate GmbH, Dirmstein, Germany). A post-treatment radiograph was taken immediately after treatment to evaluate the quality of RC obturation.

Postoperative pain assessment

The occurrence and pain intensity after ET were evaluated using a Visual Analog Scale (VAS) at 24, 48, and 72-hour intervals and after a week. According to this scale, the pain level was numerically recorded in the range of 0–10. The participants were asked to indicate, on the scale, the point on the line that represents the intensity of pain at a given moment. The following VAS classification was used: 0 – no pain, 1–3 – mild pain, 4–6 – moderate pain, and 7–10 – severe pain. The operator explained to the patients in detail how to use the visual scale, and during the intervals, the patients were called by phone and asked to fill in the PP questionnaire.

Statistical analysis

For the analyses, the statistical software SPSS v20.0 (IBM Inc, USA) was used. Descriptive statistics for baseline demographic and clinical features were expressed as numbers and percentages for all categories. DASS-21 and VAS scale scores were expressed as percentages, with mean, SD, and minimum and maximum values. The analysis of the intensity of PP for the evaluated time intervals was performed using the Friedman test ($p \leq 0.05$). An Independent *t*-test was used to evaluate the difference in PEP intensity (mean ± SD) among DASS-21 categories at predetermined time points, at the significance level of $p \leq 0.05$. Evaluation of the association between the incidence of PEP and different variables at the subject level was done using logistic regression. First, univariate unconditional logistic regression analysis was performed, with each variable as an independent and the presence of PEP as a dependent variable. After that, the multivariate logistic analysis was performed, including only the variables with significant correlation as independent variables. The strength of association was presented by odds ratio with a 95% confidence interval at the significance level of $p \leq 0.05$.

Results

The present study included 140 participants of both genders over 18 years of age (mean age 39.23 ± 14.38, range 18–68). ET was conducted on 92 single-rooted and 48 double-rooted teeth. The demographic characteristics of the study population are presented in Table 1.

Table 1

Baseline demographic and clinical features

Variable	Values
Age, years	
18–40	80 (57.1)
41+	60 (42.9)
Gender	
female	60 (42.9)
male	80 (57.1)
Tooth	
single-rooted	92 (65.7)
double-rooted	48 (34.3)
Dental arch	
upper	102 (72.9)
lower	38 (27.1)
Preoperative pain	
asymptomatic	32 (22.9)
symptomatic	108 (77.1)
Pulpal vitality	
vital	116 (82.9)
necrotic	24 (17.1)

All values are expressed as numbers (percentages).

The results of the evaluation of participants' psychological indicators using the DASS-21 for each category (mean values, SDs, and score range) are presented in Table 2.

Table 2

DASS-21 scores of the study sample

Parameter	Mean ± SD	Range
Depression	5.74 ± 7.12	0–32
Anxiety	6.56 ± 7.56	0–30
Stress	11.03 ± 10.03	0–42
Total	23.27 ± 23.43	0–98

DASS-21 – Depression Anxiety Stress Scale-21; SD – standard deviation.

Normal scores for the DASS-21 subscales were obtained among the largest number of respondents (77.1%, 65.7%, and 68.6%, respectively), while 5.0%, 10.7%, and 8.6%, respectively, exhibited severe or extremely severe scores (Figure 1).

The presence of PP 24 hrs after obturation was reported in 63.6% of the respondents. The vast majority rated the pain intensity as mild, and only two respondents rated it as moderate 24 hrs after obturation. The intensity of PP significantly decreased over evaluated time intervals ($p < 0.001$). The frequency and intensity of PEP at predetermined time intervals are presented in Table 3.

The results of the comparison of post-obturation pain (POP) intensity among DASS-21 categories revealed that participants with moderate to severe scores in three categories reported significantly higher pain intensity at predetermined time points, except in the depression category after 72 hrs (Table 4).

The occurrence of POP was associated with tooth type ($p = 0.002$), high depression ($p = 0.042$), anxiety ($p = 0.005$),

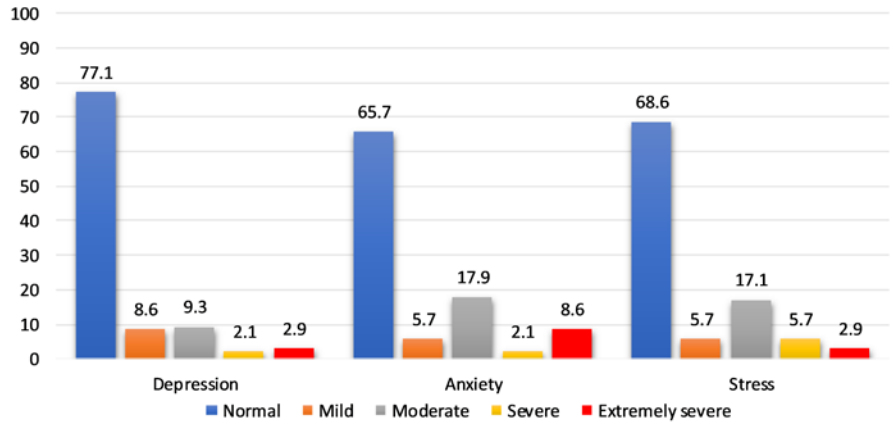

Fig. 1 – Distribution of the study participants according to the DASS-21 categories. DASS-21 – Depression Anxiety Stress Scale-21

Table 3

Frequency and intensity of post-endodontic treatment pain at predetermined time intervals

Time (intervals)	F	I	χ^2	*p*
After				
24 hrs	89 (63.6)	1.31 ± 1.19 (0–4)	121.76	< 0.001
48 hrs	68 (48.6)	0.59 ± 0.67 (0–2)		
72 hrs	20 (14.3)	0.14 ± 0.35 (0–1)		
7 days	4 (2.9)	0.03 ± 0.17 (0–1)		

F – number (percent) of participants who reported post-endodontic treatment pain; I – intensity of post-endodontic pain given as mean ± standard deviation (minimum-maximum) according to the Friedman test.

Table 4

Difference of post-endodontic treatment pain intensity among DASS–21 scale categories at predetermined time points

Time-point	Depression		*t*	*p*
	normal/mild	moderate/severe		
After				
24 hrs	1.13 ± 1.09	2.25 ± 1.12	4.2204	< 0.001*
48 hrs	0.50 ± 0.62	1.00 ± 0.65	3.3094	<0.005*
72 hrs	0.13 ± 0.34	0.20 ± 0.41	0.7849	0.4339
7 days	0.00 ± 0.00	0.20 ± 0.41	5.4380	< 0.001*
	Anxiety			
	normal/mild	moderate/severe		
24 hrs	1.00 ± 1.02	2.03 ± 1.17	5.1371	< 0.001*
48 hrs	0.40 ± 0.57	1.00 ± 0.64	5.4380	< 0.001*
72 hrs	0.08 ± 0.27	0.30 ± 0.46	3.4798	< 0.001*
7 days	0.00 ± 0.00	0.10 ± 0.30	3.3094	< 0.005*
	Stress			
	normal/mild	moderate/severe		
24 hrs	1.08 ± 1.08	1.92 ± 1.18	3.9342	< 0.001*
48 hrs	0.42 ± 0.57	1.00 ± 0.68	4.9873	< 0.001*
72 hrs	0.08 ± 0.27	0.33 ± 0.48	3.9713	< 0.001*
7 days	0.00 ± 0.00	0.11 ± 0.32	3.5797	< 0.001*

For abbreviation, see Table 2. Values are expressed as mean ± standard deviation.*significant at $p < 0.05$ (Student's *t*-test).

Table 5

Association between the incidence of post–endodontic treatment pain and different variables

Variable	Presence of PEP n (%)	Logistic regression analysis					
		univariate			multivariate		
		OR	95% CI	*p*-value	OR	95% CI	*p*-value
Gender							
female	35 (58.3)	0.674	0.34–1.35				
male	54 (67.5)	1		0.266			
Age, years							
18–40	54 (67.5)	1.484	0.74–2.97				
41+	35 (58.3)	1		0.266			
Preoperative pain							
symptomatic	60 (62.0)	0.743	0.32–1.72				
asymptomatic	22 (68.7)	1		0.489			
Pulpal vitality							
vital pulp	71 (61.2)	0.526	0.19–1.42				
necrotic	18 (75.0)	1		0.206			
Tooth							
single root	50 (54.3)	0.275	0.12–0.63		0.232	0.09–0.55	0.001*
two roots	39 (81.2)	1		0.002*	1		
Dental arch							
upper	69 (67.6)	1.882	0.88–4.02				
lower	20 (52.6)	1		0.103			
Visits							
single	26 (54.2)	0.544	0.26–1.12				
multiple	63 (68.5)	1		0.097			
DASS-21 Depression							
normal/mild	72 (60.0)	0.265	0.07–0.95		0.345	0.05–2.29	0.271
moderate/severe	17 (85.0)	1		0.042*	1		
DASS-21 Anxiety							
normal/mild	56 (56.0)	0.270	0.11–0.67		0.205	0.05–0.89	0.035*
moderate/severe	33 (82.5)	1	0.19–0.74	0.005*	1		
DASS-21 Stress							
normal/mild	60 (57.7)	0.329	0.13–0.82		0.616	0.09–3.91	0.607
moderate/severe	29 (80.5)	1		0.017*	1		

***significant at $p < 0.05$; OR – odds ratio; CI – confidence interval; PEP – post-endodontic pain. For other abbreviations, see Table 2.**

and stress ($p = 0.017$) scores after conducting univariate unconditional logistic regression analysis. The multivariate logistic regression analysis revealed that only tooth type ($p = 0.001$) and high anxiety score ($p = 0.035$) had a direct link with the occurrence of POP (Table 5).

Discussion

The final goal of RCT is to maintain the tooth, but this treatment among patients is frequently associated with some extent of pain before, during, and after the treatment. The multifactorial nature of pain perception is well known, and the expression of pain is related to the person's biology and psychology. Therefore, a better understanding of patients' psychological aspects, their anticipation, and their ability to cope with the dental procedure associated with pain could increase patients' confidence and contribute to the improvement of their level of care. In this regard, one should not only consider the individual perception of the treatment but also take into account the impact of the negative social connotations associated with the treatment [14].

The evaluation of participants' psychological status in this study was done using the DASS-21, which is widely used, and it turns out that it presents a model that can successfully recognize and separate symptoms related to DAS. It has been translated and adapted in a large number of countries on all continents and applied in different linguistic and cultural communities [15]. DAS mean values in the present study, as well as the percentages of participants with at least moderate levels for three categories (14.3%, 28.6%, and 25.7%, respectively), were very similar to the results from a recent study in Serbia, among dental students [13]. It should be mentioned that higher levels of DAS were recorded in the other study among the general adult population of Serbia. However, those results could be considered as expected, given the timing of the study, which was almost immediately after declaring the state of emergency due to the COVID-19 pandemic and after the residents of Serbia spent a month in lockdown [12].

The gold standard for measuring pain intensity is patient self-assessment. VAS was used in the present study to measure the level of pain after ET. In 1969, Aitken was among the first to discuss the measurement of feelings using VAS, and today, the VAS scale is widely used for measuring psychosocial subjective phenomena [16]. It is highly responsive, it does not burden the patients too much, it is

fairly simple, easy to manage the administration, and solved quickly. The presence of PP was reported by 63.6% of respondents in the present study. This incidence can be considered high, even though it should be mentioned that there is an extremely wide range of results in the literature regarding the frequency of PEP, probably due to the differences in pain assessment methods and definitions of pain, different inclusion criteria, different techniques used for ET, different quality assessment, the difference in host-related factors, as well as whether potentially present microbiological or iatrogenic factors were taken into account [17]. The reasons for this high percentage of reported PP could be due to the participants' individual perceptions or the fact that the manual RC instrumentation technique was used in the present study, which is commonly considered a significant factor. This outcome can be possibly associated with the results of previous studies that reported reduced periapical extrusion of infected debris in the case of rotary NiTi instrumentation [18]. It should be mentioned that there are studies that reported less frequency of pain when the modified step-back technique was used compared with the reciprocal and rotational techniques [10]. Pain intensity in the present study was low, namely around 1 or 2 points on the VAS scale. The pain reached its peak overall up to 24 hrs after the treatment, and the intensity significantly decreased over evaluated time intervals. Previously conducted studies reported the same results [10, 19, 20].

POP intensity at predetermined time points was significantly higher among participants of the present study with moderate to severe scores for DAS in comparison to ones with normal or mild scores. Maggirias and Locker [21], in their research, confirmed the important role of psychological factors in pain perception. It has already been proven that the cognitive component must be considered when evaluating the presence of pain and assessing its intensity, taking into account recall of previous experiences and learning. Anxiety and depression can also affect the perception of pain [22]. In the medical literature, depression has been extensively studied as a predictor of PP, as well as a correlation between depression and the patient's assessment of VAS and pain [23]. However, there are conflicting conclusions. In dentistry, depression has not been widely explored as a predictor for PP. Yang et al. [24], in their study, found that participants with diagnosed depression reported greater levels of pain related to ET. Khademi et al. [9] evaluated the pain perception during RCT of patients diagnosed with symptomatic irreversible pulpitis and the potential influence of psychological factors. The results indicated that neuroticism traits and depression were associated with higher pain levels. Nevertheless, the authors concluded that in spite of the introduction of certain models, the direct association remained uncertain. The association between high levels of stress and conditions related to increased orofacial pain levels, such as bruxism, is well-established [13]. A recent study demonstrated that stress can modulate pain perception and the other way around, indicating the bidirectional association. However, the difference between acute and chronic stress should be emphasized because acute stress can even affect a reduced perception of pain, while, on the contrary, chronic stress can affect an increased perception over time. The authors of the study concluded that increased exposure to stress may represent an increased risk for more pronounced pain perception [25]. There is a lack of literature data regarding the potential influence of stress on the occurrence and perception of PEP. In the research by Sana et al. [26], a significant correlation was recorded between pain and stress, and it has been concluded that increased stress levels before ET have increased procedural pain perception during and after treatment.

Gender, tooth type, preoperative pain, single/multiple visits, irrigants, and their activation, different medications, instrumentation technique, obturation material and techniques, and the vitality of the pulp were some of the factors that were related to the incidence of PEP in different literature. The conclusion from the literature review was that this condition is multifactorial. Time presents an important factor in the evaluation of PEP, and different factors are interdependent and interrelated [27]. Multiple logistic regression models in the present study revealed that only tooth type and high anxiety score were associated with the occurrence of POP. The significant association with the tooth type is probably expected and might be due to the canal anatomy complexity and increased number of canals in double-rooted teeth. Moreover, the chairside time could be influenced by the difference in teeth anatomy, which could also affect PP [28]. Except for the fact that a larger number of RCs and canal anatomy complexity increases the risk that some of the potentially significant factors exert their influence on the occurrence of intraoperative and PEP, the differences between short and long treatments could be confounded by tooth type. The possible explanation could be the progressive decrease of the anesthetic effect, together with the increase of the patient's anxiety as the intervention extended [29]. Glennon et al. [30] reported a higher level of PP after the ET of molars in comparison with anterior and premolar teeth, with the explanation that debridement is more difficult due to the complexity of the RC system or the simple fact that a larger number of RCs increases the possibility of postoperative complications. The relationship between pain and anxiety before, during, and after dental treatment has already been reported in the literature. The nature of the relationship is dynamic, resulting from the correlation between expected and perceived pain [31]. Studies have also reported that higher levels of pain after dental treatment were recorded among participants with higher scores on dental anxiety and pain scales [6]. In their study, Wu et al. [31] found that the important factor for anxiety and post-treatment pain reduction after emergent ET of teeth with symptomatic irreversible pulpitis was the level of pain relief expectation before the treatment. A positive correlation between the experienced pain and dental anxiety among patients with irreversible pulpitis was also reported by Dou et al. [32], while Murillo-Benítez et al. [33] found that during RCT, moderate or intense levels of intraoperative pain were more than twice as likely felt by anxious patients. Likewise, it should be noted that there were studies that indicated that anxiety was not a significant factor for pain perception at any phase of ET [9].

The present study has some limitations. The sample size matched the calculation performed before starting the research, but it is not large enough for generalizing the findings of the study. A single operator performed all the treatments using the same clinical protocol for all the patients, all in order to minimize or eliminate intraoperative factors important for the treatment outcome. However, previous studies presented some differences concerning the incidence and intensity of PEP dependent on different instrumentation techniques, irrigation agents and techniques, or obturation techniques and sealer types [1, 34, 35]. Bearing in mind that the results of the present study indicated a significant association of PEP with tooth type, further studies should be conducted, divided into different groups (with a single canal and with two or more canals) for comparison. The sample included both vital and nonvital teeth. Although the presence of different pulp pathology could affect the occurrence and intensity of PEP, the authors decided to form the sample without classification into individual diagnoses, relying on the results of previous studies, indicating that the effect of the pulp vitality remains inconclusive [27, 36]. Further on, socially desirable answers cannot be completely avoided in the case when the participants complete the questionnaires on their own [37]. Likewise, a single instrument (VAS scale) was used to measure the intensity of pain. Although it is widely used and results in high rates, some authors claim that PP intensity can be more precisely measured when more than one scale is used in order to compare the relationships between each intensity scale and obtain a more accurate measure [19].

Conclusion

The results of the present study indicated that psychological factors, such as depression, anxiety, and stress, had an influence on pain perception after the RCT. Among evaluated psychological factors, a high anxiety score was significantly associated with the occurrence of post-obturation pain. Additional studies need to be done in the future, bearing in mind the lack of evidence regarding the association between psychological factors and personality characteristics with the perception of pain in the field of endodontology.

Conflict of interests

The authors declare no conflict of interest.

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