

ORIGINAL ARTICLE

Association between psychological factors and pain perception in patients with symptomatic irreversible pulpitis during endodontic treatment

ABSTRACT

Aim: To investigate the association of pain perception of inferior alveolar nerve (IAN) block injection and access cavity preparation with psychological factors in patients undergoing endodontic treatment.

Methodology: In this observational study, out of 208 patients who had lower molar with symptomatic irreversible pulpitis, 165 patients completed the study. Psychological factors comprising anxiety, depression and personality traits were evaluated by Hospital Anxiety and Depression scale and short form of NEO Five-Factor Inventory. Procedural pain comprising needle insertion and anesthesia solution deposition during IAN block injection as well as access cavity preparation was rated based on the Heft-Parker visual analog scale. Binary logistic regression was used to determine odd ratio (OR) with 95% confidence interval (CI).

Results: The mean (standard deviation) age of patients was 34.63 (12.42) in which, females comprised 72.7% (n=120). Considering the psychological factors, the anxious and depressed individuals constituted 38.8 % and 32.7% of the participants, respectively. By adjusting the socio-demographic factors, depression score during needle injection and anesthetic solution deposition were the risk factors for higher levels of pain (OR=1.12; 95% CI=1.03_1.29 and OR=1.13; 95% CI=1.05_1.32 respectively). Among the personality traits, just neuroticism at needle insertion and anesthetic solution deposition associated with higher levels of pain (OR=1.11; 95% CI=1.02_1.28 and OR=1.09; 95% CI=1.01_1.20 respectively).

Conclusions: Coupling with the effect of physiological aspects (depression and neuroticism) on the perception of pain at the needle insertion and anesthetic solution during IAN block injection, a multidisciplinary effort both by dentists and by psychologists might improve dental services for some patients.

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Received 2020, July 17

Accepted 2020, September 3

KEYWORDS anxiety, depression, pain, psychology, root canal therapy

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Peer review under responsibility of Società Italiana di Endodonzia

[10.32067/GIE.2021.35.01.02](https://doi.org/10.32067/GIE.2021.35.01.02)

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Introduction

Perceptions of pain related to dental treatment may be varied not only by procedural issues, but also by many environmental and psychological factors (1-4). Gender, age, education, anxiety, fear, depression (2, 3) as well as former experiences, expectancy level of control (1) are some of the factors which may affect the perceptions of pain in dental setting. Dental-related anxiety, which is likely to affect 10 % of people, is one of the chief impediments for dental treatment and can adversely affect the patient-practitioner interaction (5). Likewise, depression, a psychiatric condition that harms behavioral patterns, satisfaction and temper over the time, is related to a wide-range of dental diseases (6) and may be associated with dental pain (3, 7). However, the role of anxiety and depression on the pain perception has not been comprehensively studied in the field of Endodontology.

Although the effect of personality traits, behavioral patterns affecting the way of thinking about oneself and the surroundings, on the dental belief (8) and dental anxiety (9, 10) have been evaluated, the role of personality characters in pain perception still remains a mystery in the field of dentistry.

Owing to lack of evidence regarding association among psychological factors, particularly personality characters with perception of pain in the field of Endodontology, the present study aimed to investigate the association of anxiety, depression and personality traits with pain perception during inferior alveolar nerve (IAN) block injection and access cavity preparation for patients with symptomatic irreversible pulpitis undergoing endodontic treatment.

Materials and Methods

This observational study was performed from January, 2016, to January, 2017. 208 patients attending the Department of Endodontic at Dentistry School, Isfahan University of Medical Sciences, who had at least one mandibular molar tooth with

symptomatic irreversible pulpitis entered the study. Inclusion criteria included participants being able to complete the questionnaires, no sign of periodontal disease or apical radiolucency (except periodontal ligament widening), no history of allergic reaction and systemic diseases that contraindicate lidocaine injections, no medication history that may alter pain perception or interact with lidocaine. Exclusion criteria included confronting a necrotic pulp after access cavity preparation and no sign of successful anesthesia after 15 minutes.

The study was performed after ethical and scientific approval of the Regional Bioethics Committee of Isfahan University of Medical Sciences (IR.MUI.REC.1395.3.375). This research was done in complete agreement with the World Medical Association Declaration of Helsinki. Information about this study was given to patients in waiting room and they were asked to sign the informed consent. In order to maintain the privacy of the patients and confidentiality of the research, questionnaires were given to them in sealed packs.

All eligible patients with the history of pain were tested with a Frisco spray (ad-Arztbedarf GmbH, French, Deutschland) and Gentle Pulse electrical pulp tester (Parkell Inc., Farmington, NY), to confirm symptomatic irreversible pulpitis diagnosis.

Using the standard IAN block injection (11), a cartridge of 2% lidocaine hydrochloride with 1:80,000 epinephrine (Darou Pakhsh, Tehran, Iran) with 27-gauge 1¼-inch needle (Septoject, Septodont, Saint-Maur-des-fosses cedex, France) attached to an aspirating syringe (Aspirating Dental Injection Syringe, Novocol Ontario, Canada) was administered for each patient. All IAN blocks were injected at the same manner and location by an endodontist (A.Kh). 0.2 mL of anesthetic solution was deposited during the advancement of needle toward the bone at 1cm higher than occlusal plan. After contacting needle to the bone, it was drawn back for 1 mm and after negative aspiration, the rest anesthetic solution was deposited in 60 seconds. The second IAN block was immediately

**Table 1**

Socio-demographic characteristics, psychological variables and level of pain of study population (n=165)

Variables	Mean (SD)	Frequency (%)
Age	34.63 (12.42)	
Educational year	11.72 (4.21)	
Gender		
Female		120 (72.7)
Male		45 (27.3)
Marital status		
Married		111 (67.3)
Widow		1 (0.6)
Divorced		7 (4.2)
Single		44 (26.7)
Type of tooth		
First molar		93 (56.4)
Second molar		49 (29.7)
Third molar		23 (13.9)
Depression score	6.18 (3.21)	
Depressed individual		54 (32.7)
Anxiety score	6.83 (3.40)	
Anxious individuals		64 (38.8)
NEO Five Factor Inventory		
Neuroticism	22.15 (3.44)	
Extraversion	28.56 (5.77)	
Openness	25.19 (6.76)	
Agreeableness	29.94 (5.49)	
Conscientiousness	31.37 (6.51)	
Level of pain at T1		
Low		102 (61.8)
High		63 (38.2)
Level of pain at T2		
Low		96 (58.2)
High		69 (41.8)
Level of pain at T3		
Low		113 (68.5)
High		47 (28.5)

Abbreviations: T1, time of needle insertion; T2, time of anesthetic solution deposition; T3, time of access cavity preparation.

Pain according to Heft-Parker visual analog scale.

injected again using second cartridge in the same manner.

If the lip numbness was not obtained within 15 minutes after the injection, the block would be considered missed and patients dismissed and reappointed. In cases with profound lip numbness achievement, the tooth would be tested again with cold spray to confirm pulp anesthesia. Then access cavity would be prepared (12). Socio-demographic factors, depression and

anxiety, personality traits, and pain perception of participants were obtained by questionnaires. Socio-demographic factors including age, gender, educational years and marital status (widowed, divorced, married or unmarried) were recorded. The Hospital Anxiety and Depression scale comprising two subscales, each of which included seven items which were ranked according to a four-point rate was used for measuring the participants' anxiety and depression. Each subscale had a range from 0 to 21 and scores equal or higher than 11 were considered as clinically anxious and depressed (13, 14). To study personality traits, the short form of NEO Five-Factor Inventory scale which is made of 60 questions (12 items for each personality) was used and each question was scored from 1 for agreeing strongly to 5 for disagreeing strongly (15). If a score of each personality trait was higher than the median, the patient would be associated with that trait. The five personalities studied in this questionnaire were extraversion; neuroticism; agreeableness; openness to experience; conscientiousness.

Before the procedure, the patients were instructed to rate pain at three phases of procedure; needle insertion, anesthetic solution deposition as well as access cavity preparation according to the 170-mm Heft-Parker visual analogue scale (HPS) (16). This scale was rated 0 to 54-mm and 55 to 170-mm corresponding with low pain and high pain respectively (17). The needle insertion and anesthetic solution deposition pain were recorded immediately after injection. In addition, after the access cavity was prepared, the pain of entering the dentin was recorded.

For describing continuous variables, mean with standard deviation (SD) was used. Comparison between groups' means was performed by t-test. Association between pain perception and psychological factors was analyzed with the use of a binary logistic regression test. Corresponding confidence interval (CI) of 95% was used for reporting odd ratio (OR). The dependent variable was the level of pain (low/high) and the independent variables were socio-demographic factors including sex,

Table 2
Comparison of mean (SD) of psychological variables between levels of pain perception (low or high) at different time of intervention

	Level of pain at T1			Level of pain at T2			Level of pain at T3		
	Low	High	P-value ²	Low	High	P-value ²	Low	High	P-value ²
Depression score¹	5.98(2.19)	6.88(2.26)	0.04	5.74(2.29)	6.78(2.80)	0.04	6.20(3.29)	6.26(3.22)	0.94
Anxiety score¹	6.75(4.71)	6.91(3.92)	0.82	6.66(4.01)	6.94(4.68)	0.69	6.19(4.56)	7.16(4.44)	0.74
NEO Five Factor Inventory¹									
Neuroticism	21.05(2.04)	23.74(3.17)	0.04	21.21(3.30)	23.46(3.69)	0.03	22.37(4.55)	22.64(3.43)	0.78
Extraversion	28.59(5.56)	28.57(6.14)	0.98	28.71(5.76)	28.33(5.81)	0.71	28.78(5.83)	27.37(5.34)	0.21
Openness	25.22(6.07)	25.15(5.28)	0.93	25.88(4.72)	26.62(4.80)	0.37	25.52(5.01)	24.51(4.76)	0.26
Agreeableness	30.36(6.83)	29.80(5.70)	0.64	29.90(5.80)	29.90(5.04)	0.91	30.45(5.51)	29.56(5.35)	0.28
Conscientiousness	32.36(6.89)	30.78(6.83)	0.15	31.68(6.61)	30.93(6.40)	0.49	31.42(6.82)	30.79(5.66)	0.59

Abbreviations and notes: SD, standard deviation; T1, time of needle insertion; T2, time of anesthetic solution deposition; T3, time of access cavity preparation. ¹Mean (SD), ²t-test.

Pain according to Heft-Parker visual analog scale.

age, educational and marital status as well as depression (yes/no), anxiety (yes/no) and personality traits (yes/no). Analysis was performed using SPSS, version 21 (IBM Corp, Armonk, NY) and $P < 0.05$ was considered as the level of significance.

Results

A total of 208 individuals were eligible to be included in this study. The profound lip numbness was not achieved in 17 patients, 2 teeth were diagnosed as partially necrotic pulp after access preparation, and 24 patients failed to fill the questionnaires completely (participants who failed to answer more than 10% of questions). Finally, the mean (SD) age of 165 patients who completed the study was 34.63 (12.42) years ranging from 19 to 70 years. Females comprised 72.7% ($n=120$) of the sample. The distributions of anxious and depressed individuals were 38.8% and 32.7%, respectively. Based on HPS, 41.8%, 38.2%, and 28.5% of patients reported high levels of pain for anesthetic solution deposition, needle insertion, and access cavity preparation respectively (Table 1).

Higher levels of pain at needle insertion and anesthetic solution deposition phase were associated with depression score and

neuroticism traits ($P < 0.05$, t-test). There was no association between higher pain of access cavity preparation with any psychological factors ($P \geq 0.05$, t-test, Table 2).

After adjusting the socio-demographic factors, binary logistic regression model demonstrated that by increasing a unit of depression score, the odd of pain perception at high level would be 1.12 and 1.13 times greater during needle injection and anesthetic solution deposition respectively (OR=1.12; 95% CI=1.03_1.29 and OR=1.13; 95% CI=1.05_1.32 respectively). Moreover, neuroticism during needle insertion (lower median VS. upper median: OR=1.11; 95% CI=1.02_1.28) and during anesthetic solution deposition (lower median VS. upper median: OR=1.09; 95% CI=1.01_1.20) were the risk factors associated with feeling higher levels of pain (Table 3).

Discussion

The etiology, persistence and perception of pain, which is common in dental environment, is a multifaceted agenda (18). Beside the neurobiological aspects of pain perception, many psychological factors comprising attention, feeling either positive or negative, social interaction and

**Table 3**

Estimated odds ratio from binary logistic regression model predicts the probability of level of pain (low or high) at T1, T2 and T3 as a dependent variable of psychological variables in 165 patients undergoing endodontic treatment

	T1	T2	T3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Depression score	1.12 (1.03_1.29)	1.13 (1.05_1.32)	1.01 (0.93_1.11)
Anxiety score	1.01 (0.98_1.10)	1.02 (0.91_1.07)	1.01 (0.92_1.10)
NEO Five Factor Inventory			
Neuroticism			
Lower median	Ref	Ref	Ref
Upper median	1.11 (1.02_1.28)	1.09 (1.01_1.20)	1.02 (0.94_1.09)
Extraversion			
Lower median	Ref	Ref	Ref
Upper median	1.00 (0.94_1.06)	0.99 (0.93_1.07)	0.93 (0.85_1.00)
Openness			
Lower median	Ref	Ref	Ref
Upper median	1.00 (0.91_1.10)	1.07 (0.97_1.18)	0.99 (0.89_1.13)
Agreeableness			
Lower median	Ref	Ref	Ref
Upper median	1.01 (0.94_1.08)	1.01 (0.94_1.08)	1.00 (0.93_1.08)
Conscientiousness			
Lower median	Ref	Ref	Ref
Upper median	0.98 (0.95_1.09)	1.00 (0.94_1.06)	1.00 (0.94_1.07)

Abbreviations: CI, Confidence interval; OR, Odd ratio; T1, time of needle insertion; T2, time of anesthetic solution deposition; T3, time of access cavity preparation.

The outcome variable: level of pain at T1, T2 and T3 (low=0 and high=1). Adjusted based on age, gender and type of tooth.

seeing the other agony may modify it in dental setting (19).

Notwithstanding controversies with respect to the role of psychological factors of patient in pain perception in dental environment, the present study demonstrated that depression and neuroticism trait were risk factors for feeling higher levels of pain at either needle insertion or solution deposition. The consequence of depression on the feeling of pain in dentistry has not been thoroughly understood yet. Although pain perception after dental implant insertion was not modified by the level of depression of patients (20), the post-operative oral sugary pain was found to be influenced by depression and distress (3).

Moreover, the Korea National Health and Nutrition Examination Survey revealed

that depressed individuals indicated higher dental related pain, particularly allied to pulpitis (7).

Similarly, the present study also indicated the depression score influenced the pain at two stages of injection.

These contrary findings related to the association between depression and pain perception may be attributed to different methodologies and time of measuring pain or as well as diverse dental procedures. Notably, although some models were introduced to explain the co-occurrence of pain and depression, the direct relation remained uncertain (7).

In general, contrary findings observed about the impact of anxiety on pain perception in dental setting mostly concluded the anxiety may alter the dental-related pain (1, 2, 18, 20-23). Notably, in the field

of Endodontology, a moderate association between pain level and anxiety were found (24) the main sources of which were cognitive conditioning and parental pathways (25). The present study also indicated that the anxiety was not a risk factor for pain perception at any phase, which was different from previous studies due to the different dental procedures, population, scale and time of pain rating (2, 21). Considering the high rate of dental anxiety in dental setting, endodontists should know how to recognize and manage anxious patients. Both subjective and objective check would benefit a dentist to recognize an anxious patient and consequently apply psychology intervention or medication administration or multifaceted approaches (26).

It is worthy to mention that even the use of anxiety control protocols alone may not always result in endodontic pain avoidance. The present study discovered that just neuroticism characteristic is associated with both needle insertion and solution deposition pain during the IAN block injection. Feinmann et al. (27) determined, beside anxiety, neuroticism was a risk factor for feeling higher levels of post-operative pain in patients undergoing minor dental surgery. On the other hand, Abu Alhaija et al. (28) reported personality traits did not affect patients' way of thinking about orthodontic therapy and pain. A critical review also revealed the modest association of neuroticism with pain, predominantly with regard to alteration of chronic pain (29), which may be attributed to the fact that neuroticism is correlated with the trait of harm avoidance (30). Additionally, personality parameters may act as moderators for the dental beliefs, fear and anxiety in dental setting (8), hence may cause pain perception indirectly. Above all, the neuroticism traits may be related to the pain perception in dental setting, more studies are recommended. The use of a self-administered questionnaire for assessing pain without examining any biomarkers, not evaluating other socio-demographic factors as well as merely investigated the procedural pain can be considered as limitations of the present study.

Conclusions

Depression and neuroticism might be related to higher levels of pain perception at needle insertion and solution deposition during IAN block injection. Therefore, bearing in mind the physiological aspects of pain during endodontic treatment, promoting awareness of endodontists about the identification and managing of physiological factors related to pain as well as informing them about the appropriate time to refer their patients suffering from high pain to psychologists is encouraged to improve dental services.

Clinical Relevance

Depression and neuroticism were associated with a higher level of pain perception during the inferior alveolar nerve block administration.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Acknowledgements

This study was taken from a postgraduate thesis and was financially supported by Isfahan University of Medical Sciences (#395378).

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