

Anxiety and Changes in Physiological Parameters During Surgical Procedures for Removal of Impacted Mandibular Third Molars in Young Adults

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Abstract

Anxiety and fear of dental treatment accompany each dental procedure. Anxiety experienced by patients prior to surgical removal of impacted mandibular third molars has an effect on postoperative pain intensity and physiological cardiac parameters.

To assess the anxiety in young adult patients who are about to undergo surgery for removal of impacted mandibular third molars and the effect on patients' physiological parameters and postoperative pain intensity.

40 patients with bilaterally impacted mandibular third molars were studied. Anxiety reported using the STAI scale; physiological parameters; intensity of postoperative pain rated using a VAS were assessed. All participants in the study had an interview with a psychologist at the screening visit.

With regard to anxiety, in males (X_m before the first surgical procedure 34.42 ± 7.53 ; X_m before the second surgical procedure 30.00 ± 6.03), and in females (X_m before the first surgical procedure 37.64 ± 11.65 ; X_m before the second surgical procedure 34.43 ± 11.76 , respectively), there was a clear trend to a decrease in the total score for anxiety as a state before the second procedure, which is statistically significant in both sexes (paired t-test, $t = 2.13$, $p = 0.059$, in males and $t = 1.14$, $p = 0.263$ in females). In the second procedure, we found a significant moderate positive correlation between preoperative anxiety and postoperative pain at 6, 24, 48 hours in females ($r = 0.56$, $r = 0.41$ and $r = 0.45$, $p < 0.05$, respectively), but not in males.

Preoperative anxiety before removal of impacted mandibular third molars has an effect on the intensity of postoperative pain and heart rate, but not on the blood pressure and oxygen saturation.

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Introduction

Anxiety is an unpleasant emotional state, the causes of which are not clear, which is often accompanied by physiological changes in the body.¹ The most widely accepted concept of anxiety involves a complex pattern of behaviour associated with physiological stimulation which occurs in response to internal (cognitive and somatic) and external (environmental) stimuli, which patients may experience before or during dental treatment, or both.² According to the

American Psychiatric Association's definition, anxiety is "anticipation of a future concern", while fear is defined as a response to an actual or perceived threat.³

Anxiety and fear of dental treatment are an extremely important clinical problem, and they occur in 40-50% of the population.⁴ Dental fear or phobia has been ranked 4th in the ranking of the most common fears.⁵ Dental anxiety is more specific than general anxiety and it refers to the tendency to feel anxious during dental care.⁶ Dental anxiety is one of the conditions suffered by patients that complicates dentists' work in practice.⁶ Rizal MF et al⁷ in their study proved that successful management of anxiety during dental treatment could encourage children and their parents to maintain their oral health and could therefore enhance their quality of life.

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The importance of dental fear and dental anxiety is mainly associated with studies showing that they are among the barriers to regular dental visits⁸ and are a reason for dental avoidance and, therefore, poor oral health.⁹ Cohen et al.⁹ draw attention to the wider effects of dental anxiety on patients' general health and quality of life, finding adverse effects of anxiety on patients' sleep, social and personal relationships, coping with work, etc.

Dental anxiety is a complex phenomenon which depends on many variables. Factors which increase dental anxiety are personality characteristics, negative experiences with dental procedures in the past, family environment factors, as well as fear of pain and bleeding.¹⁰ Pain is often considered an etiological and, at the same time, supportive factor for dental anxiety.² Anxious patients experience more severe pain than non-anxious patients as a result of the same procedure.¹¹

Dental anxiety and fear of dental treatment increase the complexity of dental procedures.¹² Hermes D. et al.¹³ found in their study that anxiety levels were much higher before a surgical procedure compared to any other dental procedure. According to Kazancioglu HO et al.¹⁴ 60-80% of surgical patients in dental care experience anxiety before the surgical procedure itself. Patients undergoing surgical procedures in the field of oral and maxillofacial surgery (regardless of the procedure) show higher levels of anxiety than patients undergoing surgery in any other field of medicine.¹⁴ Tooth extraction is considered to be the most stressful procedure in dental care and this is the reason why it is at the top of the most frequently avoided procedures due to fear among patients.¹⁵ Some people fall ill only at the thought of a tooth extraction, and, therefore, this procedure is ranked in the top 5 of the most stressful procedures in dental practice.¹⁵ According to some literature sources, surgical removal of an impacted third molar is considered to be the most stressful surgical procedure in oral and maxillofacial surgery.¹⁶ Many authors believe that patients are horrified by this procedure.¹⁷

Objective

The objective of this study is to assess the anxiety in young adult patients who are about to undergo surgery for removal of impacted mandibular third molars and its effect on patients' physiological parameters and postoperative pain

intensity.

Material

40 patients with bilaterally impacted mandibular third molars subject to surgical removal, meeting the inclusion and exclusion criteria, were studied.

Inclusion criteria

Clinically healthy patients between 18 and 40 years of age with no evidence of pain in the area of the tooth to be extracted

Exclusion criteria

Pregnancy and lactation; patients with a history of head injury, seizures, neurological or psychiatric disorders; alcohol and drug abuse; women 5 days before and 5 days after their menstrual period in order to exclude the influence of hormonal factors on pain; a history of allergy to medications; acute inflammation in the area of the tooth to be extracted.

The subjects were males (n = 12), mean age 24.33 (SD = 4.40) years, and females (n = 28), mean age 23.50 (SD = 4.62) years.

Anxiety; and physiological parameters - heart rate, blood pressure, oxygen saturation; and intensity of postoperative pain were assessed.

Materials and methods

1. Clinical methods:

1.1 Screening interview for psychopathology - prior to their entry into the study, all patients underwent an introductory interview with a psychologist in order to exclude patients with mental disorders.

1.2 Measurement of physiological parameters, namely heart rate, blood pressure and oxygen saturation, before the surgical procedure, after extraction of the tooth from its socket, and after completion of the procedure, which was performed with a Riva-Rocci sphygmomanometer and a pulse oximeter.

2. Psychological methods:

2.1 Measurement of postoperative pain intensity using a VAS scale at postoperative hours 3, 6, 24, 48 and 72, respectively.

2.2 Anxiety assessment, which was carried out before each surgical procedure, for which the patients completed an adapted Bulgarian version of the State-Trait Anxiety Inventory (STAI).^{18,19} This questionnaire measures anxiety both as a personality trait and as an emotional state - the two main aspects of the

concept of anxiety. It contains two separate scales for measuring anxiety as a state and as a trait. *The S-anxiety scale (STAI - Form Y-1 State Anxiety)* has 20 statements, which, according to the instructions, assess how the respondents feel "right now," but it may also be used to evaluate how they felt at a particular time in the recent past and how they anticipate they will feel in a specific situation in the future. It evaluates: the feeling of danger, tension, nervousness and restlessness. *The T-anxiety scale (STAI - Form Y-2)* has 20 statements which, according to the instructions, assess how the respondents "generally feel". It is used to diagnose neuroticism, depression, in screening applicants for employment, etc. In this study, we report only the results of STAI - Form Y-1 State Anxiety.

3. Statistical methods:

The data was analysed using the statistical package IBM SPSS Statistics, version 22. A significance level of $p < 0.05$ was used for all tests. The following methods were used: descriptive statistics, t-tests - to determine whether there is a statistically significant difference between two variables in paired and independent samples, repeated measure ANOVA with Greenhouse-Geisser correction in the event of more than two "dependent variables" to increase the sensitivity of the analysis, and Bonferroni correction for all compared pairs; Shapiro-Wilk test - to measure the consistency between the empirical and theoretical distribution, Pearson's correlation coefficient - to determine whether there is a relationship between two ordinal scale variables; graphical analysis performed with MS Office 365 (Excel).

Surgical procedure

Surgical procedures were performed at a 2-week interval. Surgery to remove a mandibular third molar was performed using a standard technique. 4% solution of articaine hydrochloride (Septanest) was used for anesthesia, and only one carpule of the solution was administered to each patient in order to avoid the possibility of physiological parameters being affected by the anesthetic solution administered. After raising a triangular mucoperiosteal flap, the bone covering the tooth was removed, and if necessary, the tooth to be extracted was separated into

fragments. The next steps were dislocation and extraction of the tooth, smoothing of the bone edges, irrigation of the surgical wound with saline and placement of a surgical suture, which was removed on postoperative day 7.

Results

For the first procedure, the means of pain intensity reported in the sample ($n = 40$) differ statistically significant between the 5 different time points ($F(2.06, 10307.39) = 14.08, p = 0.000$). At hour 6 the pain intensity (49.49 ± 4.17 mm) (mean \pm error) is statistically significantly higher vs. all other time points - hour 3, 24, 48, 72 (32.55 ± 4.64 mm, $p = 0.002$, 29.09 ± 4.47 mm, $p = 0.000$, 25.50 ± 4.27 mm, $p = 0.000$, 18.61 ± 3.80 mm, $p = 0.000$, respectively). No correlation was found between the intensity of postoperative pain after the first procedure and the state of anxiety before the procedure. For the second surgical procedure, the means of pain intensity reported in the sample ($n = 38$) showed statistically significant differences between the 5 different time points ($F(2.03, 5240.53) = 8.27, p = 0.001$) with higher pain intensity at hour 6 (39.57 ± 4.94 mm) (mean \pm error) vs. all other time points - hour 24, 48, 72 (23.28 ± 4.37 mm, $p = 0.011$, 21.25 ± 4.18 mm, $p = 0.004$, 18.45 ± 3.93 mm, $p = 0.001$, respectively). In the second procedure, we found a significant moderate positive correlation between preoperative anxiety and postoperative pain at 6, 24, 48 hours in females ($r = 0.56, r = 0.41$ and $r = 0.45, p < 0.05$, respectively), but not in males.

Comparing the mean pain intensities (paired t-test, $p = 0.007, n = 38$) measured at hour 6 after the first and the second surgical procedure we found a statistically significant difference. The intensity was significantly lower after the second intervention (39.57 ± 4.94 mm) compared to the first one (48.67 ± 4.27 mm).

The assessment of anxiety in both sexes showed that the mean scores did not exceed the means obtained in the Bulgarian normative sample, matched by age and educational level.¹⁹ With regard to anxiety, in males (X_m before the first surgical procedure 34.42 ± 7.53 ; X_m before the second surgical procedure 30.00 ± 6.03), and in females (X_m before the first surgical procedure 37.64 ± 11.65 ; X_m before the second surgical procedure 34.43 ± 11.76 , respectively), there was a clear trend to a decrease in the total score for

anxiety as a state before the second procedure, which is statistically significant in both sexes (paired t-test, $t = 2.13$, $p = 0.059$, in males and $t = 1.14$, $p = 0.263$ in females).

Riva-Rocci blood pressure measurements were performed before and after the surgery. In the first procedure, non-uniform distribution by systolic and diastolic blood pressure measured before the procedure, normal distribution by systolic blood pressure and non-uniform distribution by diastolic blood pressure were reported. The results of the measurements of systolic and diastolic blood pressure are presented in Table 1.

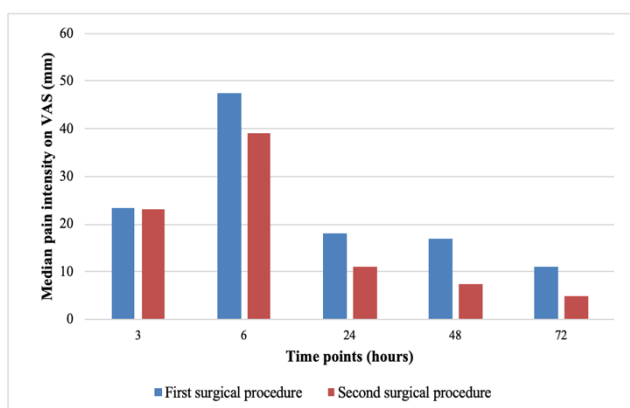


Figure 1. Dynamics of the mean pain intensity measured by VAS after the first and the second extractions.

	First procedure		Second procedure		p-value
	Mean	SD	Mean	SD	
Systolic BP before the procedure (mmHg)	118.82	12.33	115.00	11.68	$p = 0.016$
Diastolic BP before the procedure (mmHg)	75.97	9.13	75.92	8.69	$p = 0.972$
Systolic BP after the procedure (mmHg)	110.53	13.19	109.08	14.14	$p = 0.485$
Diastolic BP after the procedure (mmHg)	72.58	8.53	72.89	9.98	$p = 0.838$

Table 1. Mean blood pressure in the first and second surgical procedure.

The parameter oxygen saturation was measured using a pulse oximeter before the beginning of the surgical procedure, immediately after the extraction of the tooth from its socket, and after the end of the surgical procedure. With regard to this parameter, uniform distribution was not observed in any of the above measurements in both surgical procedures. The means of all measurements, which are presented in Table 2, are identical, without statistically significant differences.

The parameter heart rate, like oxygen saturation, was measured using a pulse oximeter before the beginning of the surgical procedure, immediately after the extraction of the tooth from its socket, and after the end of the surgical procedure. The distribution of this parameter was uniform in all measurements. (Table 3)

	First procedure		Second procedure		p-value
	Mean	SD	Mean	SD	
Saturation before the procedure	97.13	3.68	98.16	1.03	$p = 0.124$
Saturation after tooth extraction	98.11	1.20	98.00	1.16	$p = 0.639$
Saturation after the procedure	96.92	2.61	97.63	1.79	$p = 0.107$

Table 2. Mean oxygen saturation in the first and second surgical procedure.

	First procedure		Second procedure		p-value
	Mean	SD	Mean	SD	
Heart rate before the procedure (beats/min)	93.03	17.79	94.63	16.57	$p = 0.633$
Heart rate after tooth extraction (beats/min)	88.00	15.52	83.05	13.60	$p = 0.041$
Heart rate after the procedure (beats/min)	87.11	11.04	83.58	12.74	$p = 0.109$

Table 3. Mean heart rate in the first and second surgical procedure.

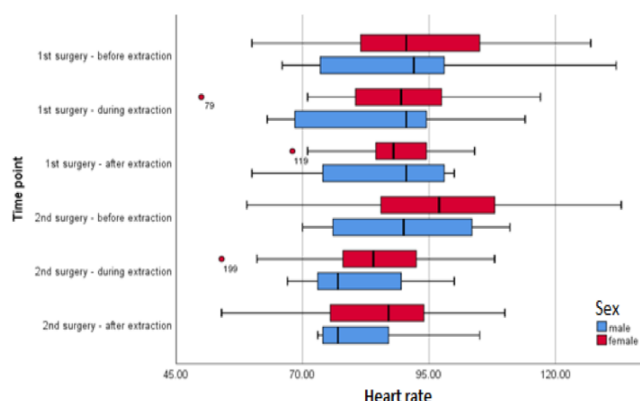


Figure 2. Comparative characteristics of the mean heart rate in males and females.

The results which show the distribution of the studied parameters in both sexes are presented in Fig. 2, 3 and 4. They clearly demonstrate that the mean heart rate in females was higher than in males, except for the heart rate reported after the first surgical procedure, where the mean was higher in males. The results of blood pressure measurements

show that the mean values at all time points were higher in males than in females.

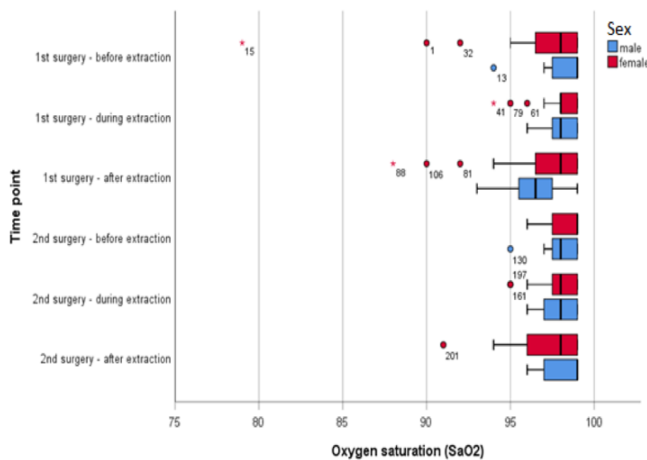


Figure 3. Comparative characteristics of oxygen saturation in females and males.

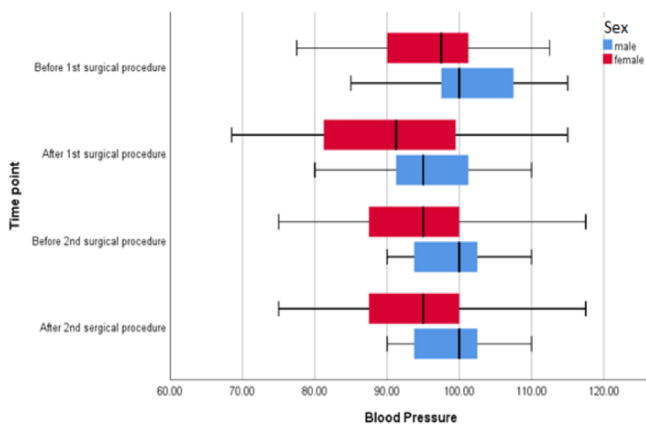


Figure 4. Comparative characteristics of mean blood pressure in males and females.

Discussion

Anxiety and fear of dental treatment are an extremely important clinical problem, and they occur in 40-50% of the population⁴ with 60-80% of surgical patients in dental care experiencing anxiety before the surgical procedure itself.¹⁴ Our results show that the anxiety was greater in the first compared to the second surgical procedure. These results are in accordance with those obtained by other authors. Krause K. et al.²⁰ in 2011 conducted research on how dental anxiety associated with third molar extraction affects regional cerebral blood flow. Sixteen patients were examined who had their both mandibular third molars extracted at two-week intervals. MRI was performed before and after each surgical procedure. Anxiety was assessed using the STAI

scale at the beginning of each visit. The results show that patients had markedly higher levels of anxiety before the first surgical procedure compared to the levels before the second procedure, and compared to previous control levels. Anxiety levels are associated with a significant increase in cerebral blood flow in the areas of the posterior insula, amygdala and hypothalamus. The authors conclude that anxiety is an important component in the multifaceted pain experience.

In 2016, Tanidir AN et al.⁵ conducted a study which found that patients' awareness of the upcoming surgery for removal of an impacted third molar resulted in a reduction of anxiety about the upcoming procedure. This fact was confirmed by other teams.^{14,21} In line with the above studies, our patients showed lower anxiety after the experience gained in the first surgical procedure, which could be explained by the subjective assessment of experiences during the procedure and the attitude towards the forthcoming new procedure.

The obtained results show that postoperative pain assessed using a VAS was more severe after the first surgical procedure. Authors working on the problem believe that anxiety can be used to predict postoperative pain.^{22,23,24} Mobilio N. et al.²⁵, in their study, found that dental anxiety did not have a significant effect on postoperative pain levels. Lago-Méndez L. et al.²⁶ found that patients with higher levels of anxiety experienced more pain in the postoperative period, especially in the first 5 postoperative days, which is in accordance with our findings in males after the second procedure. Our results show that young males are more likely to "reconstruct" the memory of dental pain over time.

Sakamoto E. et al.²⁷ analysed the information in the literature regarding the relationship between anxiety and postoperative pain in the field of oral and maxillofacial surgery and found that preoperative anxiety increases the pain intensity. Although the mechanism is not completely clear, anxiety is thought to have an effect at the central nervous system level by suppressing descending pain inhibitory systems, thus intensifying pain perception. In conclusion, the authors believe that measures should be taken to reduce preoperative anxiety, thus reducing the intensity of acute postoperative pain and preventing it from turning into refractory

chronic pain, i. e. not forming a traumatic memory of pain.

We believe that studies of dental pain and anxiety are needed, which should differentiate between cognitive, emotional and physiological factors²⁸, including attitudes towards dental surgery, in order to more fully understand the mechanisms of dental anxiety in young adult males and females.

When analysing blood pressure results, higher mean values of both systolic and diastolic blood pressure were observed before the procedure compared to the values measured after the surgery. When comparing the values before the first and before the second, as well as after the first and after the second surgical procedures, lower means in the second procedure were reported. We did not find differences in the levels of oxygen saturation in the two procedures. Heart rate measured after extraction of the tooth from its socket and after the end of the procedure was higher in the first compared to the second surgical procedure. An exception is the heart rate measured before the second surgical procedure, which was higher than that measured before the first surgical procedure. This correlates with the higher anxiety levels measured prior to the second procedure compared to those measured prior to the first procedure. With regard to the heart rate before the first procedure, we found higher values in females than in males, which corresponds to greater anxiety in females. Based on our results, we can conclude that anxiety affects heart rate, but not blood pressure and oxygen saturation.

Some authors have found that patients' emotional state affects their ability to cope with certain situations and can cause psychosomatic symptoms such as higher heart rate, elevated blood pressure, tremor, dizziness and even difficulty breathing.^{29,30} Here it is important to note that emotional states are characterised by high variability over time. Based on our results, we cannot report a correlation between the state of anxiety and blood pressure and oxygen saturation due to the peculiarities of the design of this study - the presence of a time interval between the assessment of anxiety and the measurement of physiological parameters. This is the time interval in which a neuroimaging study was performed, which will be reported elsewhere. In a similar study, Alemany-Martínez A. et al.³¹ found that changes in physiological parameters

during surgery for removal of a mandibular third molar were within normal limits and were due to the anxiety and stress associated with this procedure.

Hollander MHJ et al.⁴ studied dental anxiety associated with third molar extraction and the resulting changes in heart rate. The highest heart rate values were reported during the interruption of the procedure, during the incision and the alveolotomy. Based on their study, the authors conclude that the intensity and course of anxiety associated with third molar extraction follow a specific pattern, with the lowest levels of anxiety before and immediately after surgery, and the highest levels observed on interruption of the procedure and during a substantial part of it.

Our results regarding the correlation between sex and heart rate and blood pressure (lower heart rate and higher blood pressure in males compared to females) are confirmed by other authors.^{4,27}

Conclusions

Preoperative anxiety, accompanying surgical procedures for removal of impacted mandibular third molars, results in an increase in the intensity of postoperative pain. Regarding the change in physiological cardiac parameters, greater preoperative anxiety correlates with higher heart rate before the start of the surgical procedure, but does not affect blood pressure and oxygen saturation. Patients' awareness before the surgery and the individual experience gained from the surgical procedure are factors which modify anxiety and intensity of postoperative pain, and are of paramount importance during surgery.

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Declaration of Interest

We declare no conflict of interests.

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