

Evaluation of Postoperative Pain and Discomfort in Patients Undergoing Surgical Exposure of Impacted Maxillary Canines

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ABSTRACT

Objectives: The purpose of the retrospective study was to evaluate pain and discomfort related to surgical exposure according to initial localization of impacted maxillary canines.

Material and Methods: Pre-treatment cone-beam computed tomography (CBCT) data and discomfort evaluation questionnaire of 25 patients (17 female, 8 male), treated with combined surgical-orthodontic approach was analysed. The questions included: level of discomfort during surgery (0 to 10), level of pain (0 to 10) in the evening, one, two days and a week after surgery. CBCT analysis consisted of evaluation of impacted maxillary canines mesiodistal inclination, horizontal, vertical dislocation from alveolar process edge, labiopalatal localization and length of eruption path. To carry out research objectives a Spearman and interclass correlation coefficients, Mann-Whitney U test, Cohen's kappa coefficient were used. Level of significance was 0.05.

Results: Average level of discomfort during the procedure was 2.8 (SD 2.3). Pain level the evening after the surgery was the highest - 3.3 (SD 2.1) and decreased over the week. Pain level differed significantly between different days ($P < 0.001$). Neither labial or palatal location nor the unilateral or bilateral impaction had effect on the level of pain ($P > 0.05$). The results showed that pain during different stages of measuring as well as level of discomfort during surgical exposure did not differ statistically significantly depending on severity of impaction ($P > 0.05$).

Conclusions: There was no significant relation between the discomfort and the location of the impacted canine. Patient's gender or age did not have an impact on discomfort and pain.

Keywords: canine teeth; surgical procedure; pain perception; orthodontics.

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INTRODUCTION

Permanent canines are essential not only for aesthetics but also for static and functional occlusal relationship [1]. Impacted maxillary canines (IMC) is not a frequent condition, which affects approximately 2% of the population [2,3].

According to Grisar et al. [4] the most common type of bucco-palatal position of IMC is intra-alveolar with 54.3% of cases followed by palatal and vestibular with the frequency of 30.9% and 14.8% respectively. In other studies, palatal impaction of canines has been reported to occur more frequently (85%) than labial (15%) [5].

For patients with permanent dentition, combined surgical-orthodontic treatment is commonly used to resolve canine impaction [6]. However, this approach is complex due to prolonged duration of treatment, surgical involvement, and postoperative discomfort. This type of combined procedure involves the surgical opening of an impacted tooth and the use of a fixed orthodontic appliance to direct it to proper occlusion [7].

There are two surgical techniques to impacted teeth exposure: closed-eruption and open-eruption [8]. Closed-eruption technique includes using a flap and removing the bone to uncover the impacted tooth. Then the attachment with a chain is attached to the impacted tooth and the flap is sutured back, with the chain penetrating it [9]. Open-eruption technique involves removing the soft tissue and the bone to uncover the impacted tooth and leaving it in full view [10]. In the literature, both approaches are compared based on different aspects, such as the duration of the surgery [9,11], postoperative recovery [11,12], postoperative pain and discomfort [9,11,12], complications [9]. The results of those researches are contradictory.

No matter which approach is used to expose an impacted tooth, discomfort during surgery and postoperative pain during the healing process are expected [9]. Patients need to be fully informed about the procedures that will be performed during treatment, especially about the extent of pain and discomfort they cause [11].

These days a great number of studies focus on evaluating health related quality of life after various surgical procedures, including surgical uncovering of IMC [10,12-15]. Pain complaints are a common condition during orthodontic treatment, which directly affects patient satisfaction and quality of life. The need for surgical intervention in combined surgical-orthodontic treatment increases the fear of pain. Fear

of pain and long duration of orthodontic treatment are the reasons to decline treatment [16].

Numerous studies compare postoperative pain and patients' perceptions after closed and open techniques [9-12]. The conception of studies questionnaires answers establishes that after surgical exposure the pain is at the highest level on first day and pain regression is faster in closed eruption technique. Results from the studies suggest, that closed eruption technique ensures less postoperative discomfort, lower risk of infection [9] and, faster recovery rate [12]. However, the relation between localization of IMC and pain and discomfort has not been studied. The severity of impaction can be classified from simple to complex impaction, based on evaluation of radiographic parameters, thus it is important to analyse if the complexity of localization of IMC has influence on patient's perceptions after surgical exposure [17].

Therefore, the aim of this retrospective study was to evaluate pain and discomfort related to surgical exposure in relation to initial localization of impacted maxillary canines. The null hypothesis was that the discomfort during surgery and postoperative pain have a significant relation with the localization of the impacted tooth.

MATERIAL AND METHODS

Patients

The study was carried out at the Department of Orthodontics, Lithuanian University of Health Sciences, Kaunas, between July 1, 2021, to December 10, 2021. Bioethics permission was obtained from the Regional Biomedical Research Ethics Committee of Lithuanian University of Health Sciences (No. BE-2-65) to conduct a retrospective study.

All participants have read and signed informed consent form.

Selection criteria

The selection criteria for patients, which were all treated by the same experienced orthodontist (D.S.):

- Patients with diagnosed IMC.
- Treated by surgical-orthodontic approach.
- Presence of all teeth (except the third molars).
- Period of permanent occlusion, aged between 12 and 30 years.
- Good oral hygiene.
- No history of orthodontic treatment and no medical conditions that could impact the treatment.

- No alveolar bone atrophy or periodontal disease.
- Complete patient diagnostic and treatment records available including cone-beam computed tomography (CBCT) that was carried out before treatment, and a questionnaire completed by patients on pain and discomfort in the first week after surgery.
- Medical history data - patient's gender (female/male), patient's age at the time of surgery, surgical exposure side (palatal, buccal).
- Questionnaire, that collected information on the discomfort felt during the surgery and the pain felt on the first week after the surgical exposure of IMC, data.

Surgical procedure

All surgical procedures were done by same oral surgeon (D.S.). Standard non-extraction treatment with fixed appliances was used for initial alignment and space opening. After levelling and alignment, a rectangular stabilization arch-wire was used to maintain sufficient space in the impacted tooth area. Surgical uncovering of impacted canines was performed only when the space was adequate for canine alignment.

A muco-periosteal, envelope flap was elevated on the palatal or buccal surfaces, depending on exposure site. The layer of bone covering the canine crown was removed with either a curette if the bone was soft or a handpiece with a diamond bur if the canine was embedded deeply in the bone. The remaining primary tooth was removed during the same surgical procedure. No luxation of impacted tooth was performed. Then, attachment with a chain was bonded to the canine crown as ideally as possible. The flap was repositioned over the tooth. On the palatal side, a small hole was made in the gingival tissue over the canine crown, so the tooth will not have any impediment from the soft tissues to erupt. The open surgical defect was covered with a periodontal dressing (for one week) that was mechanically attached to allow healing.

Use of analgesic

All patients were given information with the recommendations of analgesic (paracetamol as first choice) according to the dosage recommendation. Rinsing with 0.12% chlorhexidine solution was prescribed two times daily postsurgery for 7 to 10 days. While filling the postoperative pain and discomfort questionnaire, patients were asked to respond about the sense of pain every day indicated before taking the analgesic, if necessary, to avoid full pain-relieving effect and distortion of results.

Questionnaire data

From each patient's confidential record, the following data was captured:

The questionnaire was given right after the surgery and all patients were instructed how to fill in it. The questionnaire included the following questions:

- The discomfort during surgery (a scale from 0 to 10, where 0 is no discomfort and 10 is the greatest discomfort).
- The pain in the evening the same day after intervention (a scale from 0 to 10, where 0 is no pain and 10 is the greatest pain);
- The pain on the second day,
- The pain on the third day,
- The pain on the week after surgery.

CBCT data collection

CBCT examination of the maxillofacial region was performed using a White Fox 3D CBCT scanner (Acteon Group; Rome, Italy). The CBCT scanner parameters were 105 kV, 9 mA, field of view = 150 x 130 mm. The CBCT scan consisted of 497 sections of 0.25 mm thickness for each patient. The dose-area product value was 11 dGy cm².

The patients' CBCT examination data were saved in the Digital Imaging and Communications Medicine (DICOM) file format and transferred to a secondary computer-assisted analysis program, White Fox Imaging 4.0 (Acteon Group; Rome, Italy). Analysis of the three-dimensional CBCT datasets was performed twice by same examiner. To test the reliability of the data, the agreement was calculated between the two sets of survey data. The intraclass correlation coefficient (ICC) was calculated for quantitative (scalar) data, and the Cohen's kappa (κ) coefficient for nominal data. The calculated correlation coefficients provide reasonable assurance that the data have been properly collected and are reliable. The interclass correlation coefficient in all cases more than 0.9, 95% confidence interval 0.987 to 1.000; $P < 0.001$, while $\kappa = 1.000$; $P < 0.001$ (data calculated identically twice).

CBCT analysis data included: side of canine impaction (right, left or bilateral), IMC mesiodistal migration, depth of the impaction, height of the impaction, the length of the IMC eruption path and labio-palatal localization (labial, palatal). If the bilateral impaction was diagnosed, the canine with worse position was only included in analysis.

Mesiodistal migration of IMC

The mesiodistal migration of the IMC were established from CBCT axial plane trigonometric analysis based on the study by Bonetti et al. [18], by capturing the main radiographic parameter: the mesial canine crown cusp position, evaluated by the migration sectors (1 to 5) (Figure 1). Sectors of mesiodistal crown position of IMC:

- 1 = the position of the incisive cusp of the impacted canine corresponds to the position of the deciduous absent canine;
- 2 = the position of the incisive cusp of the impacted canine is localized between the distal part and the midline of the lateral incisor;
- 3 = the position of the incisive cusp of the impacted canine is localized between the mesial part and the midline of the lateral incisor;
- 4 = the position of the incisive cusp of the impacted canine is localized between the distal part and the midline of the central incisor;
- 5 = the position of the incisive cusp of the impacted canine is localized between the mesial part and the midline of the central incisor.

Eruption path length

To evaluate the actual eruption path length of

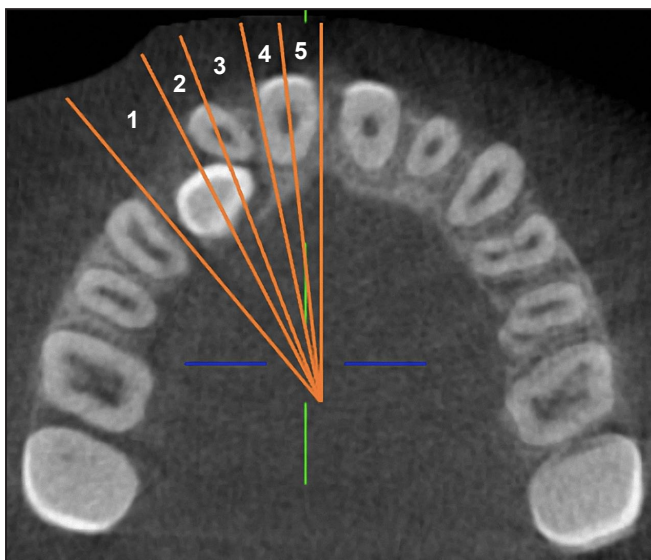


Figure 1. Sectors of mesiodistal crown position of impacted maxillary canines on CBCT axial plane:
 1 = corresponding to the position of the deciduous absent canine.
 2 = localized between the distal part and the midline of the lateral incisor.
 3 = localized between the mesial part and the midline of the lateral incisor.
 4 = localized between the distal part and the midline of the central incisor.
 5 = localized between the mesial part and the midline of the central incisor.

the IMC, the methodology of Schubert et al. [19] was used, which is primarily based on the simplified calculation of the expected regular canine position on CBCT.

The traversed horizontal (x) and vertical (y) movement components of the impacted canine tip was quantified until alignment in an axial (x) and sagittal (y) CBCT plane as sides of a rectangular triangle and the eruption path length (d, measured in mm) was determined by the Pythagoras theorem ($d^2 = x^2 + y^2$) (Figure 2).

The predicted position of the canine tip point after orthodontic tooth alignment was determined based on three auxiliary lines constructed in the impacted canine region of the CBCT.

- Line 1 - shortest distance between the lateral incisor and the first premolar at the approximal contact height area
- Line 2 - a perpendicular line from the midpoint of line 1 to the tangent of line 3 - defines the final position of the canine tip after alignment
- Line 3 - tangent line from the lateral incisor incisive to the tip of the first premolar buccal cusp. This line crossed two directive points: A - the point of first premolar buccal cusp tip and B - the point of lateral incisor incisive tip.

The intersection point of lines 2 and 3 was defined as the expected ideal position of the canine tip endpoint (d) after the alignment. Thus, the eruption path length (d) of the impacted canine is measured as the distance

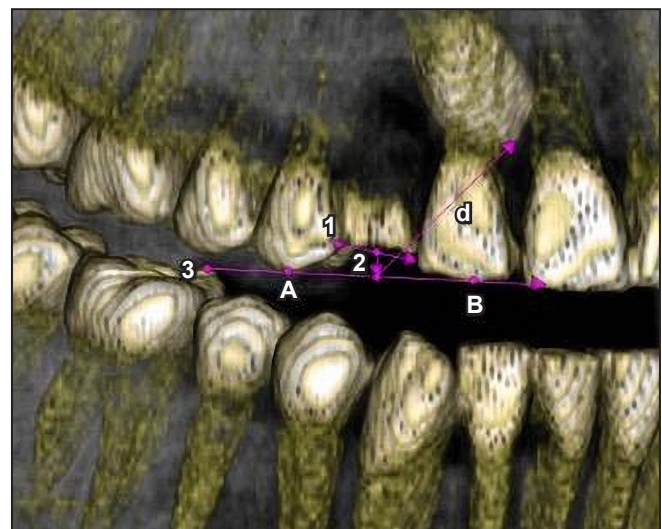


Figure 2. Evaluation of actual eruption path length (d) on three-dimensional CBCT.
 (A) the point of first premolar buccal cusp tip; (B) the point of lateral incisor incisive tip; (1) shortest distance between the lateral incisor and the first premolar at the approximal contact height area; (2) a perpendicular line from the midpoint of line 1 to the tangent of line 3 defines the final position of the canine tip after alignment; (3) tangent line from the lateral incisor incisive to the tip of the first premolar buccal cusp.

between the actual crown tip and the predicted correct position of the crown as constructed in the three-dimensional model. This calculation is based on the Pythagoras theorem.

Impaction depth and height

To determine the depth of the canine impaction, the correct position of IMC is first measured by taking additional trigonometric measurements on the CBCT projections (Figure 3). Using the methodology of Schubert et al. [19], a position is found in the coronal and axial projections of the CBCT where the coronal (Figure 3A) and axial (Figure 3B) plane passes through the buccal cusp tips of the first upper premolars. In this axial projection, the visible arrow strand is shifted so that it crosses the middle of the incisal edge of the upper lateral incisor on the impacted canine side (Figure 3B). Thus, the axial plane is shifted to be tangent to the incisal edge in the lateral projection of the CBCT (Figure 3C); this vertical position is marked as an auxiliary line using the measuring tool (Figure 3D, line 1). Returning to the axial projection (Figure 3E) and, using the measuring tool, the auxiliary line z was conducted,

connecting the first premolar buccal cusp tip and the distal edge of the upper lateral incisor (Figure 3F, line z). In coronal plane, we then shifted the axial plane in vertical direction to the estimated approximal contact point location one-third of the crown height below the central fissure (Figure 3G). On the new axial projection, the midpoint between the mesial first premolar point and the distal lateral incisor point is identified and marked with the measuring tool (Figure 3H, point v). This axial projection is then shifted vertically until the tip of the impacted canine crown is seen and the sagittal plane is then shifted onto the tip of the canine (Figure 3I). The correct tangential position of the axial plane on the tip of impacted canine is then applied to the corresponding sagittal plane (Figure 3J). Returning to the axial plane (Figure 3K, segment x), the tip of impacted canine crown is connected to the previously marked central point within the auxiliary line z to calculate the length x of the horizontal component of the canine motion. In the corresponding sagittal plane, the length of the vertical component y of the canine motion is calculated by measuring the distance between the tangent line drawn through the tip of impacted canine (Figure 3L, line 2) and the previously drawn parallel auxiliary line (Figure 3L, segment y).

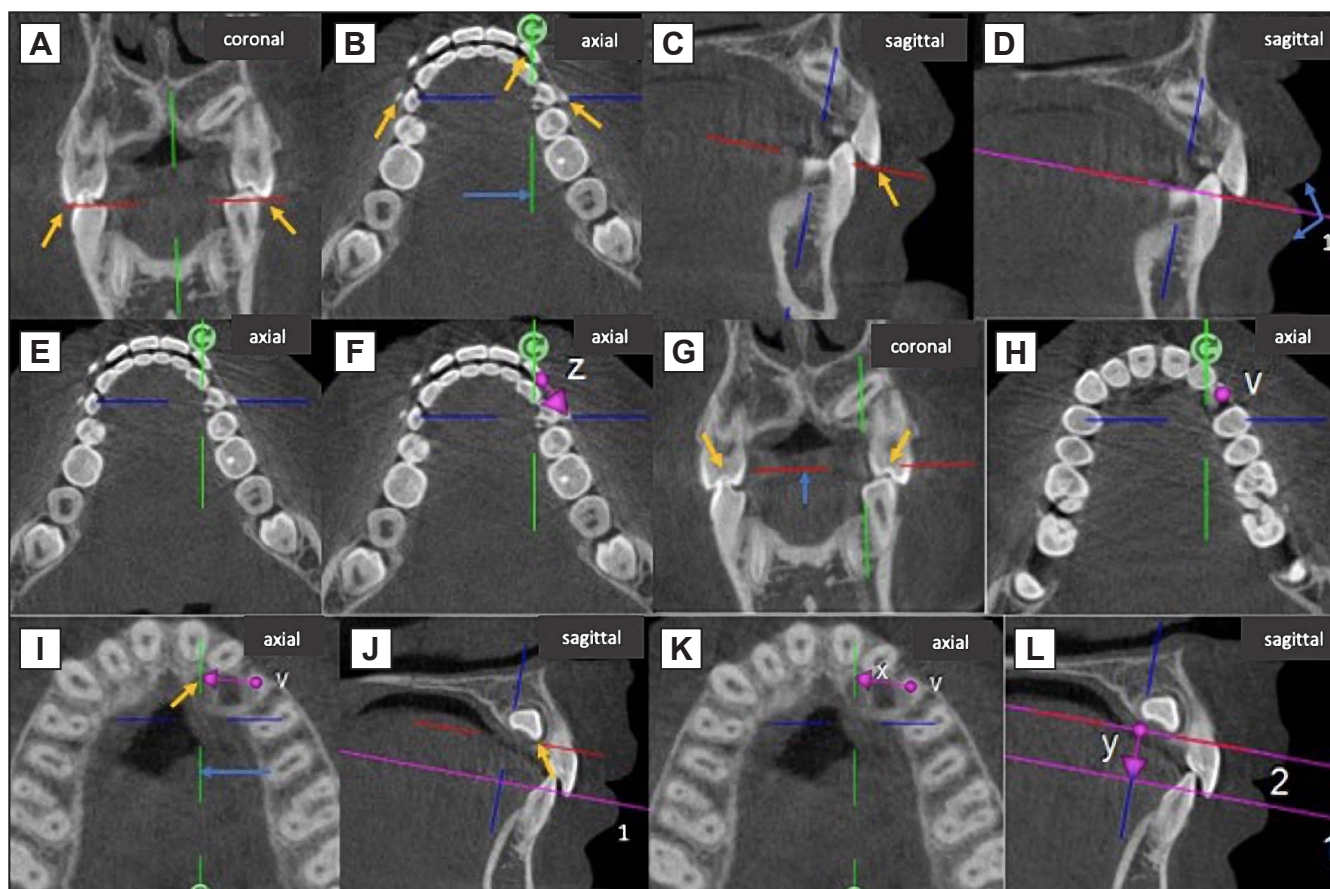


Figure 3. Evaluation of impacted maxillary canines (IMC) depth (x) in axial plane and IMC height (y) in sagittal plane of the CBCT. A = coronal; B = axial; C = axial; D = sagittal; E = axial; F = axial; G = coronal; H = axial; I = axial; J = sagittal; K = axial; L = sagittal.

The impacted canine depth is calculated as the distance of the canine dislocation in the horizontal direction to the physiological position of the tip of the canine tooth, and is equal to the value x . This horizontal component of the impacted canine movement, x , forms the side of a right triangle in the axial three-dimensional plane of the CBCT.

The impacted canine height is calculated as the distance of the canine dislocation in the vertical direction to the physiological position of the tip of the canine and is equal to y . This vertical component of the impacted canine movement, y , forms the side of a right triangle in the sagittal three-dimensional plane of the CBCT.

Labio-palatal localization

The labio-palatal localization of the IMC is assessed in the CBCT axial plane by comparing the position of the impacted canine crown in relation to the adjacent teeth and the centre of the dental arch. The localization of the canine crown was captured on two positions:

- Labial position - the impacted canine crown is deployed to the labial-vestibular side in relation to the adjacent teeth and the centre of the dental arch.
- Palatal position - the impacted canine crown is deployed to the palatal side in relation to the adjacent teeth and the centre of the dental arch.

Sample size calculation

Sample size was estimated based on the prevalence of IMC [20]. The minimum prevalence of IMC was 0.92%. To reach the confidence level of 95% with the 5% margin of error, a minimum of 15 teeth were required.

Statistical analysis

The relationship between discomfort and pain and the localization of the impacted canines, patient age, and gender was investigated using IBM® SPSS® 24 Statistical analysis software (IBM Corp.; Armonk, New York, USA). In order to assess the relationship between patients' age and perceived discomfort and pain, a non-parametric Spearman correlation coefficient was calculated. The discomfort and pain in different groups of impacted tooth localization was assessed by non-parametric Mann-Whitney U test. To assess agreement of CBCT findings, the ICC was calculated for quantitative (scalar) data and the Cohen's kappa coefficient for nominal data. Parametric data were expressed as mean and standard deviation

(M [SD]).

The value of $P < 0.05$ was considered statistically significant.

RESULTS

Twenty five patients (17 female and 8 male) underwent surgical exposure of IMC. Mean age of the patients was 15 (2.3) years old (range 12 to 21).

Out of 25 patients, 6 patients (24%) had labial impaction of maxillary canines and 19 patients (76%) had palatal impaction. In 19 (76%) patients impaction was unilateral, and 6 (24%) patients had bilateral impaction.

Regarding mesiodistal migration, 3 (12%) IMC matched the location of deciduous canine, 2 (8%) IMC localized between distal part and midline of lateral incisor. The majority of IMC (8 [32%]) occlusal cusp localized between the midline and longitudinal part of lateral incisor. 6 (24%) cusps of IMC localized between lateral incisor and longitudinal part of central incisor, also 6 (24%) IMC cusps localized between the midline and longitudinal part of central incisor.

Average eruption path length in the palatal group was 14.52 mm and, in the labial, - 16.86 mm ($P > 0.05$).

Impaction depth in palatal and labial IMC groups was 10.06 mm and 3.55 mm respectively ($P > 0.05$). Impaction height in the palatal group was 11.93 mm, in the labial - 15.93 mm ($P > 0.05$).

The evaluation of the questionnaire data shows that patients score the pain they experience on the first evening after the intervention with the highest scores, and the scores of the pain experienced gradually decrease over time. The level of discomfort experienced by patients during the intervention averaged 2.8 points out of 10 (2.3). Pain level the evening after the surgery was 3.9 (2.1), on the second day (PO2) - 2.8 (2.7), the third day (PO3) - 1.7 (2.2), a week after (PO7), the average pain level was 0.5 (0.8) (Table 1). Comparison of pain scores at different stages of measurement by the Friedman criterium showed that the mean ranks of pain scores at different stages of measurement were statistically significant ($\chi^2 [3] = 47.681; P < 0.001$).

The impact of patient's sex and age on the discomfort and pain

The impact of patients age and localization of impacted tooth on the discomfort and pain was evaluated using a non-parametric Mann-Whitney U test. Comparison of the discomfort and pain

Table 1. Numeral characteristics of scores experienced by patients in the evening, the second, the third day and one week after surgical exposure of Impacted maxillary canines

	Mean (SD)	Min; max
Discomfort during surgical procedure	2.8 (2.3)	0; 9
Pain the evening after the procedure (POD1)	3.9 (2.1)	0; 10
Pain the day after the procedure (POD1)	2.8 (2.7)	0; 8
Pain the third day after the procedure (POD3)	1.7 (2.2)	0; 8
Pain a week after the procedure (POD7)	0.5 (0.8)	0; 3

POD = postoperative day; SD = standard deviation.

experienced by patients on different days in the male and female groups showed that the discomfort and pain experienced did not differ statistically significantly by patient gender ($P > 0.05$) (Table 2). A non-parametric Spearman correlation coefficient was calculated to assess the association between patients' age and perceived discomfort and pain. The analysis showed that discomfort during surgical procedure and pain after the intervention on different days were not statistically significantly related to age ($P > 0.05$).

The impact of the localization of impacted tooth on the discomfort and pain

Discomfort and pain in different labio- palatal localization groups were evaluated using nonparametric Mann-Whitney U test. The test showed that discomfort and pain experienced by

the patients at various stages of the measurement after the intervention are not statistically significantly related to the localization of the impacted tooth ($P > 0.05$; $P > \alpha$). A comparison of mean discomfort and pain scores in the impacted tooth groups is presented in Table 3.

Spearman correlation coefficient was used to determine if height, depth of impaction, and eruption path length of IMC had any effect on discomfort during surgical procedure and pain after the surgery. Result showed that impaction height, depth, eruption path length were not statistically significantly related to discomfort and pain ($P > 0.05$)

Discomfort during surgery and postoperative pain evaluation dependence on the side of retention was evaluated using Mann-Whitney U test. Calculations exhibited that neither discomfort during surgery, nor pain was affected by impaction being unilateral or bilateral ($P > 0.05$; $P > \alpha$) (Table 4).

Table 2. Comparison of discomfort during surgery and postoperative pain at different stages in male and female groups

	Female (n = 17)			Male (n = 8)			Mann-Whitney U test; P-value
	Mean	Median	Min; max	Mean	Median	Min; max	
Discomfort during surgery	2.9	3	0; 9	2.5	2	0; 6	U = 65.1; P = 0.711
Pain in the evening after intervention	4.3	4	0; 10	3.1	2.5	1; 6	U = 41.5; P = 0.124
Pain the day after intervention	2.8	1	0; 8	2.8	2	1; 5	U = 75.5; P = 0.669
Pain the third day after intervention	1.8	1	0; 8	1.6	1	0; 5	U = 70; P = 0.932
Pain a week after intervention	0.5	0	0; 3	0.6	0.5	0; 2	U = 80; P = 0.511

Table 3. Comparison of discomfort during surgery and postoperative pain experienced by patients in the labial and palatal localisation groups

	Labial (n = 17)			Palatal (n = 8)			Mann-Whitney U test; P-value
	Mean	Median	Min; max	Mean	Median	Min; max	
Discomfort during surgery	3.5	3	1; 9	2.6	2	0; 6	U = 47; P = 0.555
Pain in the evening after intervention	4	3	2; 7	3.9	4	0; 10	U = 57.5; P = 1.000
Pain the day after intervention	3	1.5	0; 8	2.7	2	0; 8	U = 55.5; P = 0.926
Pain the third day after intervention	3	2	0; 8	1.3	0	0; 6	U = 33; P = 0.138
Pain a week after intervention	0.7	0	0; 3	0.5	0	0; 2	U = 56.5; P = 0.975

Table 4. Comparison of discomfort during surgery and postoperative pain experienced by patients in different sides of impaction

	Unilateral (n = 19)			Bilateral (n = 6)			Mann-Whitney U test; P-value
	Mean	Median	Min; max	Mean	Median	Min; max	
Discomfort during surgery	3	3	0; 9	2.2	2	0; 6	U = 44; P = 0.437
Pain in the evening after intervention	3.6	3	1; 7	5	5	0; 10	U = 79.5; P = 0.156
Pain the day after intervention	2.2	1	0; 8	4.8	6.5	0; 8	U = 80.5; P = 0.138
Pain the third day after intervention	1.6	1	0; 8	2.2	2	0; 6	U = 70; P = 0.437
Pain a week after intervention	0.4	0	0; 3	0.8	1	0; 2	U = 78; P = 0.198

The impact of IMC mesiodistal migration on patients' discomfort and pain was measured using nonparametric Kruskal-Wallis test. The results showed that pain during different stages of measuring as well as level of discomfort during surgical exposure of IMC did not differ statistically significantly depending on mesiodistal inclination of IMC ($P > 0.05$).

DISCUSSION

This prospective study analysed patients' perceptions of discomfort during surgical exposure of IMC and postoperative pain during recovery in order to enhance the knowledge on IMC features that could determine discomfort and pain. Nowadays, patients take interest in details regarding the surgical procedure and what to expect during recovery. The closed flap technique was used specifically with the intention of reducing pain and impairment for patients [9] as well as faster healing time [12,13]. However, in palatal impaction cases the procedure was modified and after the flap replacement, a small hole was made in the gingival tissue over the canine crown which was covered with a periodontal dressing for one week. Chapokas et al. [21] suggest that palatally impacted canines should always be exposed with an open technique. Open exposure does not require an orthodontist to bond an attachment to the crown of the impacted canine, thus the surgical duration differs on 30.9 (10.1) minutes for open compared with 37.7 (8.4) min for the closed-eruption technique [11]. Although Björksved et al. [9] did not find a statistically significant difference in surgery duration in two groups. On the other hand, closed exposure is more advantageous than open because patients have a faster recovery time from postoperative pain [12,22] as well as lesser chance of complications in cases of bilateral impaction [9].

Different studies in the literature compared pain and recovery related to surgical technique used for surgical exposure of IMC [8,9,11,12,14,22].

Evaluating pain perception on these two techniques, Gharaibeh and Al-Nimri [11] prospective study of 32 patients (mean age 17.6 [2.4] years) revealed that pain perception in closed eruption of palatally impacted canines may be similar to open technique because of the oedema of sutured flap over the chain and the application of acid to etch the enamel of the uncovered canine. Nevertheless, severe pain lasted longer in the open eruption group (until second postoperative day [POD2]) than in closed eruption group (until first postoperative day [POD1]) [11]. Otherwise, Chaushu et al. [12] study had reached a slower pain reduction. In the closed-eruption group, median recovery time from severe pain was significantly shorter in the closed-eruption group (POD 3 versus 5; $P = 0.01$). Likewise, Björksved et al. [9] in a randomised study with 119 patients (mean age 13.4 [1.46] years) concluded that patients in the open exposure of palatally impacted canines group experienced more pain and impairment compared to the closed group. Thus, there is no evidence which surgical technique is better regarding postoperative pain. The most frequently mentioned discomfort factors at operation were injection, drilling and sewing [9].

The studies which aimed to evaluate postoperative discomfort or pain of exposure of impacted teeth, use resembling format of numeral pain scale from 0 to 10 [11-14] or VAS scale [9] that indicated mild (1 to 3), moderate (4 to 7), and severe (8 to 10) pain during the period of seven days after the surgery. Results of present study show that the pain level was at its highest in the evening after the procedure (mean 3.9 [SD 2.1]) and decreased over time (POD7 mean 0.5 [SD 0.8]). The average pain level was never severe, however in separate cases the indicated pain reaches the limit of severe pain. The similar trend of postoperative pain regression was found in other studies [10-14] and in a systematic review, where the average mean for postoperative pain in closed eruption group was 3.9 score [8]. Nevertheless, Gharaibeh and Al-Nimri [11] noted, that 10 of 32 patients (31.25%) of patients refer pain as severe on

the first day after the surgery, and the percentage of patients reporting severe pain reduced to 6% on the second day. Such discrepancy could arise because of difference in surgical procedure and different study samples.

Chaushu et al. [10,12,13] evaluated patients' perceptions after the exposure of impacted teeth comparing both surgical techniques. However, they investigated not only maxillary canines but also other impacted maxillary teeth. In postoperative study out of 29 patients (mean age 16 [2.8] years), treated with closed-eruption method, 27.6% of the patients reported severe pain on first postoperative day [13]. Authors concluded that recovery time of three days is expected after surgical exposure of maxillary teeth by obvious severe pain reduction (27.6%, 13.8% and 3.4%), however prolonged period of severe pain is associated with longer surgery time (> 30 minutes) [13]. In comparison, the other study conducted by same authors explored recovery times after open-eruption surgical technique and showed that expected recovery time is longer than when using closed eruption technique - 5 days compared to 3 days. Also, the need for bone removal tends to prolong the period of pain [10].

The present study results show mild discomfort during surgical procedure (2.8 [2.3]). Only one study evaluated the discomfort during surgical procedure [9] and recorded even less discomfort (value of 7 to 8 in VAS scale from 1 to 100).

Present study showed that the discomfort and pain experienced by patients did not differ statistically significantly by patient gender or age ($P > 0.05$), although the study consisted of a larger percentage of female patients (68% female, 32% male). The other studies presume that lower percentage of male sample explains gender differences in the occurrence of maxillary canine impaction and the greater need for orthodontic treatment among females [9-12]. The Chaushu et al. [9] study established that females reported delayed recovery regarding pain (POD 5 versus POD 2.5; $P = 0.01$), which oppose this study results. Likewise in contrast to findings of the present study, Hauspy [14] found a difference in reporting pain according to age. The results of this study displayed that younger patients (younger than 16 years old) report more severe pain than older patients (50% and 37.5% respectively). In addition, in studies the direct dependence has been observed between the use of analgetic and a pain relief, which contributes to patient's comfort [9-14].

The present study was aimed to find a relation between pain and the initial localisation of IMC. Speculation was, that for deeper impaction and

bilateral impaction greater discomfort is anticipated. Regarding localisation of IMC, our study concluded that neither labio-palatal localisation, nor the height or depth of impaction had a significance on discomfort during surgery or postoperative pain. For the study of a similar nature, the impacted teeth localization was evaluated using orthopantomography [10]. Chaushu et al. [10] study (30 patients, mean age 14.8 [2.7] years) has captured the impacted tooth labio-palatal localization (buccal, palatal, middle of the alveolar crest) and height of impaction (cervical, middle and apical location). The study established that the recovery did not differ significantly for tooth location and height of impaction [10]. As mentioned earlier, the need for bone removal prolonged recovery time (POD 6 versus POD 3; $P = 0.05$) [10].

The impaction being unilateral or bilateral did not have a significant impact on pain and discomfort during the week after the surgery. Even though the pain in the evening after intervention and the second, the third day and the week after intervention was higher in bilateral cases group, the difference was not statistically significant ($P > 0.05$). Considering complications, Björksved et al. [9] revealed a similarity in both open and closed exposure groups in cases of unilateral impaction, however in bilateral cases, severe complications such as swelling, and bleeding were more common. Although a study conducted by Hauspy [14] displayed different results - the recovery time was significantly longer in bilateral exposure group ($P = 0.021$) and the pain level was higher during recovery ($P = 0.037$). The study confirmed that the mean value for pain the fourth post-operative day was 3 in the bilateral exposure group, versus 2 in the unilateral exposure group. While in this study on the third day pain mean level was lower: rated as 2 in bilateral and 1 in unilateral groups. No studies in literature were found to compare our results regarding other IMC localisation parameters such as impaction depth, eruption path length and inclination of IMC. Our findings concluded that mentioned parameters did not have a statistically significant impact on discomfort during surgery or postoperative pain. The hypothesis was denied: discomfort during surgery and postoperative pain are not related with the localization of the impacted tooth. The limitation of the study could be small sample size. Even though the study sample was sufficient according to sample size calculation, when patients were categorized, the amount of subject was inconsiderable. Another limitation was underestimated psycho-emotional status of patients evaluating the postoperative pain and discomfort, because pain sensitivity is very person related.

Meanwhile, the study purpose was not to associate the patient's pain scale levels with psycho-emotional condition. Even though, an additional questionnaire on emotional well-being would clarify the results of the study. The last limitation was no record of amount of analgesic consumed, because patients must have assessed sense of pain every specified day before taking the analgesic. Only recommendation of same analgesic and dosage was offered. Further studies with larger sample size and capturing wider range of data are required for more accurate results.

CONCLUSIONS

1. The pain level the evening after intervention was

rated the highest and decreased gradually over time.

2. There was no significant relation between the discomfort and the location of the impacted tooth.
3. Patient's gender or age did not have an impact on discomfort and pain.

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The authors report no conflicts of interest related to this study.

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