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**INDO AMERICAN JOURNAL OF  
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.1470633>Available online at: <http://www.iajps.com>**Research Article****RADIOLOGICAL FORCASTING AND ASSESMENT OF  
PERIODONTAL TISSUES AT THE END OF ORTHO-  
SURGICAL TREATMENT OF IMPACTED MAXILLARY  
CANINES****Mamedov Ad.A., Maclennan A.B., Morozova N. S., Kharke V.V., Timoshenko T.V.,  
Mazurina L.A., Skakodub A.A.**I.M. Sechenov Moscow Medical State University (Sechenov University); Department of  
Pediatric Dentistry and Orthodontics**Abstract:**

*Aim: The aim of this study is to evaluate the role of the pre-treatment radiographic assessment and the post-treatment periodontal status of intra-osseous impacted maxillary canines.*

*Material and Methods: A study population of 60 patients (76 canines) was evaluated at the end of the overall surgical-orthodontic treatment consisting of a combined surgical (flap) and orthodontic (direct traction to the center of the ridge) approach. The pre-treatment panoramic radiographs and CT scans were evaluated in order to assess location (palatal or labial), intra-osseous depth, thickness of overlying bone tissue. Periodontal tissues were evaluated after the treatment was finished. Pocket depth (PD) and keratinized tissue width (KT) were evaluated. Multilevel statistical analysis was used to evaluate post-treatment periodontal variables at patient, tooth and site levels.*

*Results: No significant differences in PD or KT were found at the end of surgical-orthodontic treatment with respect to age, gender, site of impaction or pre-treatment radiographic position of the impacted canine. The only statistically, but not clinically, significant difference (about 0.5 mm) was found for the KT that was greater for the palatally impacted canines than for the labially impacted ones.*

*Conclusions: Measured on the pre-treatment panoramic radiographs represent prognostic indicators for treatment planning of orthodontically re-positioned canines and are vital for evaluation before starting the treatment and determines the success of ortho-surgical treatment.*

**Key words:** *impacted canines, surgical-orthodontic treatment, periodontal tissues evaluation;*

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**INTRODUCTION:**

Orthodontic and surgical treatment can hardly be considered as a final stage of treatment in cases of impacted canines. Many authors describe the methods of the complex surgical (open access with delamination of the mucoperiosteal flap) and orthodontic (directed traction to the alveolar edge) treatment [1].

Similar tactic of treatment simulates the physiological mechanism of teeth eruption, ensures the correct position of the tooth in the dental arch and the normal formation of a healthy periodontal. Issues of the treatment prognosis of the impacted teeth is based on the study of the change in radiological analysis to determine the position of the tooth in the jawbones: depth of inclination, the tooth angulation, the distance from the occlusal plane, the possible interference with the roots of adjacent teeth [1,6].

This helps to describe the positions of the canines in the jawbones under the conditions of a mixed occlusion, to describe the subsequent implantation of the canines in a permanent occlusion. Radiographic signs correlate with the possibility of spontaneous eruption of impacted incisors [4,5].

In more recent studies, the same parameters were used to predict the treatment result of palataly impacted canines by extracting temporary and retaining (securing) space in the dental arch until the permanent is in the dental arch, and also in order to predict the time that orthodontic treatment will take to tract the permanent canine into the dental arch [9,10].

Thus, studies [7, 9] have shown that the position of impacted incisors and its relation to the adjacent teeth determine the lengthen of orthodontic treatment.

Nevertheless, the final criterion of success in the treatment of impacted teeth is determined by healthy periodontal tissues surrounding the tooth. Estimating of the periodontal state is described in studies of several authors who evaluated periodontal conditions depending on the combined surgical method (tunnel method) and orthodontic (traction to the alveolar process) used [3]. Also, positive results were observed when using a combined surgical technique of a closed flap for the prosthetic teeth, and an apically displaced flap for palpable labialy impacted canines [8].

Negative aesthetic results, as well as an increase in the mesio-labial pocket depth, a decrease in bone level, a decrease in the attached gingiva width, an extension of the dental crown are obtained with

orthodontic alignment and using the method of an open flap of the maxillary central incisors.

A five-year study of 80 patients [1] investigated the possible effect of the intraosseal position and inclination of maxillary canines on the periodontal state of these teeth at the end of treatment, showed that the measurements of the parameters on radiographic (a- angle, d- distance, s-sector) before treatment do not represent a prognostic indication of the periodontological status of orthodontically displaced maxillary canines.

There is also no significant difference in the pocket depth (PD) and the keratinized tissues width (KT), after the treatment, depending on the variables being investigated, such as sex, age, impaction area, radiographic position.

The objective of our study was to evaluate the radiographic background (parameters determined on the radiographic examination: location, thickness of the cortex, location related to the roots of adjacent teeth) before the treatment, and the periodontal conditions (presence / depth of periodontal pockets, bone loss, width of attached gingiva, length of coronal part) after the protocol of ortho-surgical treatment ends.

At the beginning of the study:

80 patients with unilateral or bilateral impacted maxillary canines, which were treated at the Department of pediatric Dentistry and Orthodontics of the FSAEI HE First State Medical University of Moscow. Named. Sechenov (Sechenov University). Of the total number of patients studied, 12 patients were not included in the study. The position of the canines did not allow direct traction to the center of the alveolar process. Six patients had a submucosal impacted canine in the labial side.

**At the end of the study:**

Of the 62 patients selected for the study, two were excluded from the statistical analysis. In one patient no canine movement was observed (ankylosis) as a result of which the treatment was not completed. And in one case, the treatment plan was supplemented with the removal of premolars.

As a result, 60 patients with unilateral or bilateral impacted maxillary canines were included in the study. 44 patients had a unilateral and 16-bilateral impacted maxillary canine.

**Establishing diagnosis**

The diagnosis of the impacted maxillary canines was

established clinically, after the maxillary canines were not erupted into the appropriate place in the physiologically defined terms. In most cases, a temporary canine was still in the dental arch.

In all 80 cases originally included in the study, the diagnosis was confirmed radiologically by the results of panoramic and/or cephalometric.

The studies were carried out on X-ray machines (3DLab and Picasso) where patients were sent to perform additional research methods after consultation with an orthodontist.

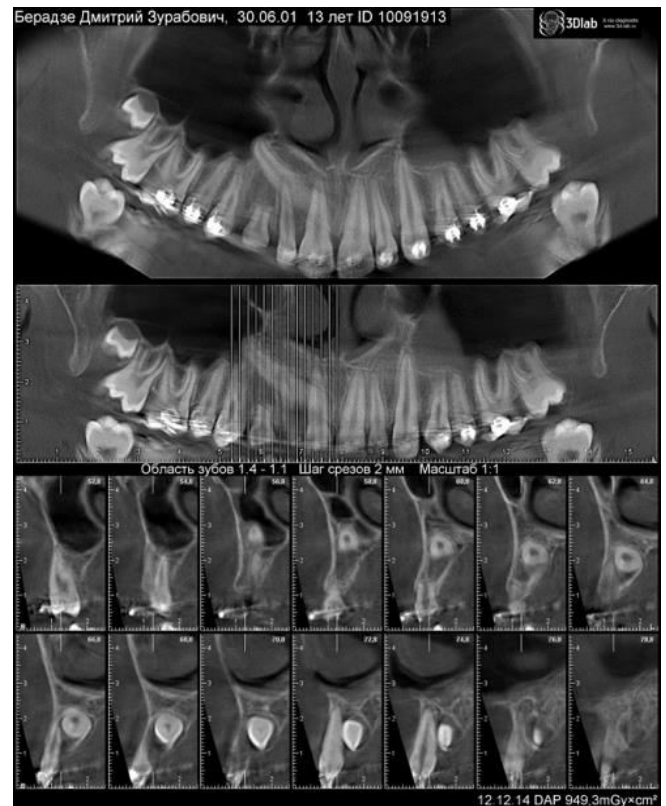
At the surgical treatment planning stages, a computer tomography of the desirable area was performed to determine the position of the coronal part of the impacted canine (labial or palatal), the thickness of the cortical layer. Fig. 1. X-ray examination of the patient before the surgical stage of treatment is necessary to assess the position of the impacted canine (labial or palatally), its relation to the roots of adjacent teeth, the volume of bone tissue above the crown of the impacted canine.

The following parameters were evaluated on the radiological photographs: location of the impacted canine, thickness of the cortical layer above it, its relation to the roots of adjacent teeth.

#### ***The protocol of complex ortho-surgical treatment***

All patients included in the study underwent standard ortho-surgical treatment. It included: the disclosure of impact teeth by surgical opening of periodontal flap, osteotomy over the crown of the impacted tooth, traction of the open canine toward the apex of the alveolar process.

The surgical protocol is performed by the same surgeon.



**Fig. 1. X-ray examination of the patient before the surgical stage of treatment is necessary to assess the position of the impacted canine (labial or palatally), its relation to the roots of adjacent teeth, the volume of bone tissue above the crown of the impacted canine.**

Orthodontic protocol is performed by two orthodontists.



**Fig 2. Intra-oral pre-surgical photographic protocol**



**Fig 3. X-ray examination of the patient. Assessment of the position of the impacted canine**

The complex surgical treatment protocol is divided into the following phases:

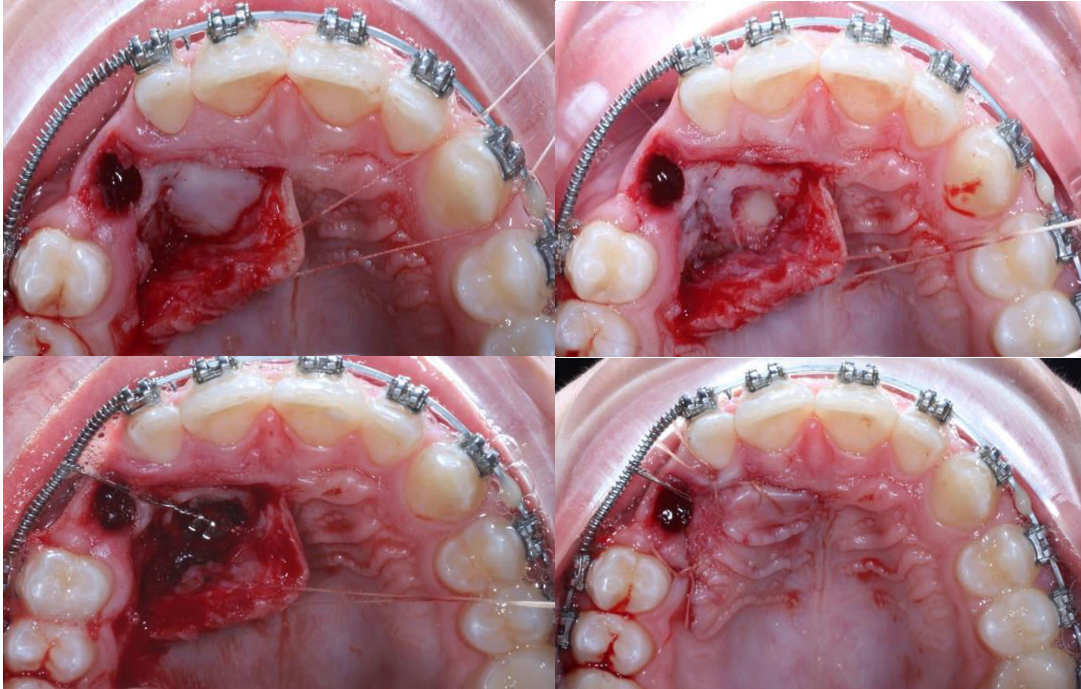
Phase 1. Initial orthodontic treatment:

Orthodontic tasks, associated with the impacted canines, as well as the creation of a place for the subsequent movement of the impacted canine, was carried out using edgewise techniques. Temporary canine was not removed before the beginning of the complex treatment.

Phase 2. Surgical opening and impacted tooth traction towards the apex of the alveolar arch:

Surgical technique: Under topical anesthetic "Topical Gel" and infiltration Sol. Ultracaini, 1.7 ml - 2% a

mesio-distal periodontal incision is made from the second incisor to the first premolar. The incision is prolonged accurately from the second incisor toward the projection of the impacted tooth to the middle palatal line. a full thickness mucoperiosteal flap is exfoliated. Impacted canine is visualized. Depending on the pre-operationally evaluated position and the thickness of bone tissue on the CT scan, we expected to see either the incisal edge of the canine, or its projection. The projection of the impacted canine crown was also determined by the quality of the bone tissue in the proposed field (usually pink color in the projection of the adjacent crown). bone osteotomy was performed by a round bur.



**Fig 4. Ortho-surgical treatment photo protocol in a patient with palataly impacted canines.**

On the coronal part, after the preliminary standard procedure, an orthodontic button with a slot, in which the ligature, is fixed.

The flap was put back into its original position. The wound is sewn with individual nylon sutures Vycryl 4-0. The ligature that emerges from under the flap is positioned in the middle of the alveolar margin and tied to the original orthodontic arch. Sutures were removed on the 10th day after the operation.

#### Phase 2. Orthodontic traction

Orthodontic traction of the impacted canine consisted of a double archwire technique with the aim of directing the impacted tooth into its position, which has been created in the dental arch.

#### Phase 3. Next orthodontic treatment

In this phase, the tooth was aligned in the dental arch, correcting the tooth rotation is the next possible procedure. After the active orthodontic treatment ends, a retainer is needed.

Assessment of the periodontal tissues condition after the end of treatment.

After the completion of ortho-surgical treatment(end of phase 3), the periodontal tissues condition of the relocated impacted canines was assessed. The

assessment of the periodontal tissue was carried out by a single dental surgeon, who performed all the surgical steps, which are included in the study.

The following parameters were evaluated:

- (1) Pocket Depth (PD) was measured in 6 points: mesio-buccal, medial-buccal, distal-buccal, mesio-lingual, medial lingual, distal-lingual for each displaced tooth.
- (2) Keratinized tissue width (KT) from the gingival margin to the muco-gingival junction was measured in the mesial position of the buccal side of the crown of the tooth. The keratinized gingiva and alveolar mucosa were identified using Lugol solution.
- (3) Gingiva Recession (GR), if existed, in the middle of the buccal surface of the tooth crown.

#### RESULTS:

62 patients were included in the study. Excluded from the statistical analysis - 2. One patient did not present canine movement (ankylosis) as a result, the treatment was not completed. And in the other case, the treatment plan was supplemented with the premolars removal.

For the statistical analysis, 60 patients with unilateral or bilateral maxillary canines' impaction were included in the study. Of these, 49 are men and 11 are women between the ages of 12.8 and 17.9. 76

impacted canines were managed using one standard surgical technique, always performed by a single surgeon. In the study, 44 patients had a unilateral impacted canine and 16-bilateral impacted maxillary canines.

All 76 impacted canines were successfully moved and placed into the dental arch. None of the patients presented significant complaints during the treatment. None of the patients lost an orthodontic button attached to the impacted tooth. Only in one case did the patient lose the ligature from the attached orthodontic button.

In this case, we were forced to go for a re-operation and lift the mucosa-periosteal flap again. Ligature was fixed onto the orthodontic button. After this procedure, the traction process was resumed.

The treatment was continued and successfully completed. The duration of the total complex ortho-surgical treatment (process 1-3) was a total of (24.2 +/- 5.22) months. The duration of the second phase (from the moment of activation of the traction mechanism to the eruption of the canine tip) was 7.89 +/- 3.21 months.

**Table 1. Descriptive statistics of multi-level tables used in the study**

Variable	Unit of observation	Average	Standard deviation	spreading
Age	In years	14,8	6,04	12,8-17,9
The total treatment period (Phases 1, 2, 3)	In months	24,2	5,22	12-40
Orthodontic (traction) period (Phase 2)	In months	7,89	3,21	4-12

Variable	Frequency	%
Right-sided Impression	49	56
Left-sided impaction	21	44
Palatal impaction	47	73
Labial impaction	13	22

Age: at the beginning of the impacted toothtraction.

Total treatment period: duration of the general period of ortho-surgical treatment (Phases 1, 2, 3)

Orthodontic (traction) period (Phase 2)

**Table 2. Multilevel tables for examining the depth of the periodontal pocket at the level of the patient, tooth and the area of study**

Index	calculation	Standard Error	p-parameter
Intersection point	1,11	0,14	
<i>At patient level</i>			
Age	0,00	0,00	0,3173
Sex	-0,04	0,06	0,4343
<i>At the tooth level</i>			
Impaction (unilateral / bilateral)	0,07	0,05	0,1976
Side (right / left)	0,01	0,03	0,6617
Location (palatal / labial)	0,09	0,05	0,0943
<i>At the studied area level</i>			
position Measurement	0,61	0,03	<0,0001

Age: at the beginning of traction of the impacted tooth

Sex: male - 1; female - 0

Impaction: unilateral- 1; bilateral - 0

side: right - 1; left - 0

Location: palatal - 1; labial-0

Position measurement: inter-proximal area - 1; labial or palatal region - 0

**Table 3. Multilevel tables of the study of the keratinized gingivathickness at the patient's level, tooth and location.**

Index	calculation	Standard Error	p-parameter
Intersection point	4,92	0,50	
<i>At patient level</i>			
age	- 0,02	0,02	0,4949
sex	- 0,17	0,19	0,4830
<i>At the tooth level</i>			
Impaction (unilateral / bilateral)	- 0,20	0,17	0,2440
Side (right / left)	- 0,05	0,10	0,6526
Location (palatal / labial)	0,45	0,19	0,0149

Age: at the beginning of traction of the impacted tooth

Sex: male - 1; female - 0

Impaction: unilateral- 1; bilateral - 0

side: right - 1; left - 0

Location: palatal - 1; labial-0

Position measurement: inter-proximal area - 1; labial or palatal region – 0

#### **Assessment of the periodontal tissues condition:**

**Pocket Depth (PD):** The depth of the PD was 1.87 + 0.48 mm, the multilevel model shown in Table 2, does not show a significant difference in age and sex of patients at the level of the patient's study. Also, there were no significant differences for unilateral or bilateral impaction, right or left side, buccal or labial position of the canine at the level of tooth examination.

However, at the level of the region under study, in the intra-proximal region, the depth of the PP was deeper by 0.46 mm than in the buccal lingual region of the study ( $p < 0.0001$ )

**Keratinized Tissue Width (KT):** The thickness of the keratinized gingiva is in average 3.89 + 1.13 mm. The multilevel model shown in Table 3, does not show a significant difference for the age and sex of patients at the level of the patient's study, there were no significant differences for unilateral or bilateral impaction, right or left side, buccal or labial position of the canine.

At the level of tooth examination, the KT, as the model of the study showed, is 0.41 mm thicker in the replaced canines, which were palataly impacted: a statistically significant difference was obtained ( $p < 0.0149$ ).

**Gingival Recession (GR):** Recession of the gingiva was observed only in one patient (0.5 mm) on one impacted canine after the end of complex ortho-surgical treatment.

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#### **DISCUSSION:**

With insufficient effectiveness of measures aimed at preventing delayed eruption, a complex surgical and orthodontic treatment has been shown to move the latent teeth into the dental arch.

The purpose of our study was to assess the condition of periodontal tissues of displaced impacted maxillary after using the complex ortho-surgical protocol to treat the retention of maxillary, and to assess the radiographic background for predicting the time and success of treatment.

In our study, the surgical protocol component was always performed by one surgeon using the same surgical technique, aimed at moving the impacted canine into its physiological position, i. E. and the region of the apex of the alveolar process of maxilla. This technique of detachment of the mucosal-periosteal flap allows to ensure the physiological volume of the gingiva in the region of the displaced canine after the end of orthodontic treatment.

The results of our study showed that in displaced canines the depth of the PD is on average  $< 2$  mm, and the average thickness of the keratinized tissue is 4.5 mm. Only one patient had gingival recession  $< 1$ mm; At the end of the treatment, we found no significant difference in the depth of the PD and thickness of KT related to age and sex at the patient's level, as well as the location of the impaction and the data of position of the impacted tooth on radiological examinations.

The only statistically significant but not clinically relevant indicator is the data obtained by us that the thickness of the KT for the palataly located canine

teeth was greater by (0.5 mm) than for the labially located canine, which moved to the dental arch.

Similar data were obtained by researchers who studied the thickness of the keratinized gingiva in the retouched canines after ortho-surgical treatment, and in spontaneously erupted [8]. The researchers did not find a statistically significant difference between the main group and the controlled group. The thickness of the KT was 1 mm larger in spontaneously erupted canines than in the displaced orthodontically.

It should be noted that most dental surgeons use only panoramic radiographics or sighting intraoral images to plan and determine tactics and surgical access when planning the surgical stage of ortho-surgical complex treatment. We believe that this study does not provide a full-fledged planning of the surgical protocol of disclosing the impacted tooth. Performing a CT scan of the area of interest allows you to accurately assess important parameters, such as: location, thickness of the cortex, its relation to the roots of adjacent teeth. These parameters determine the success of the surgical protocol of treatment.

From a clinical point of view, the evaluation of radiological images of the impacted canines and subsequent ortho-surgical complex protocol of treatment described above, leads to positive results in each individual clinical case, excluding only a few cases of ankylosis of impacted canines. So, we exclude two patients, in whom we observed ankylosis in impacted maxillary canines during the treatment.

In conclusion, we note that the use of the parameters, which are determined on pre-operational radiographic, for the purpose of predicting the results of impacted canines treatment is not always appropriate, and does not give the possibility of predicting the treatment results in the section of periodontal health of displaced impacted canines. The study of parameters such as: location, thickness of the cortex, location related to the roots of adjacent teeth in computed tomography images of the important area is clearly necessary for planning and success of the surgical aspect of ortho-surgical complex treatment.

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