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APPROACHES IN CONDUCTING PRIMARY PREVENTION OF TENDENCY OF MAXILLARY CANINE IMPACTION IN THE LATE MIXED DENTITION

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ABSTRACT:

Early diagnosis and prediction of potential maxillary canine impaction are of essential importance for the normal formation of dentition. **The aim** of this article is to present a protocol for primary prevention of potential maxillary canine impaction in the late mixed dentition. The diagnostic protocols include three methods of examination - anamnestic, clinical and radiological, and depending on the obtained results, the protocol for phase 1 of the late mixed dentition directs to three clinical preventive approaches of action. In phase 2 of the late mixed dentition, the clinical approaches are two, due to the approaching time of eruption of the canine and the need for immediate treatment measures. We believe that the most useful preventive interventions should take place during the early mixed dentition and phase 1 of the late mixed dentition. Early extraction of the temporary canine will lead to a change in the eruption path of the permanent canine – up righting and eruption in the normal position in the dental arch – if there is enough space

Keywords: impacted canines, primary prevention, mixed dentition, early extraction, temporary canine

INTRODUCTION

Early diagnosis and prediction of potential maxillary canine impaction are of essential importance for the normal formation of dentition. Abnormal eruption of the maxillary canine may be associated with root resorption of the central and lateral incisors or severe bone retention of the canine itself, leading to its extraction or surgical disclosure and orthodontic traction in the dental arch [1]. Early diagnosis of the impacted canine may reduce the treatment time, orthodontic treatment complications and the canine loss. [2]

Most of the authors [3, 4] suggest that temporary canine extraction should take place between 9 and 10 years of age, when the permanent canine begins to descend to the dental arch, while the temporary canine starts to resorb [5, 6].The angles studied by Kurol and Bjurklinare used as additional indicators, although there is no unified protocol for defining the tendency to canine impaction.

The aim of this article is to present a protocol for primary prevention of potential maxillary canine impaction in the late mixed dentition, similarly to the protocol, developed for the early mixed dentition [7]

The period of late mixed dentition includes two phases: phase 1, with erupted central and lateral incisors, maxillary first premolars and mandibular canines (average chronological age of 9-10 years) [8] and phase 2, with erupted maxillary canines, maxillary and mandibular second premolars and second molars (average chronological age of 10-11 years) [8].

Phase 1 of the period of late mixed dentition is close to and merging with the period of early mixed dentition. Frequently, the patients are diagnosed just at this stage and therefore, the clinical protocol involves the procedures, valid for the early mixed dentition; however, these procedures are enriched by additional indicators, due to the much stronger diagnostic value.

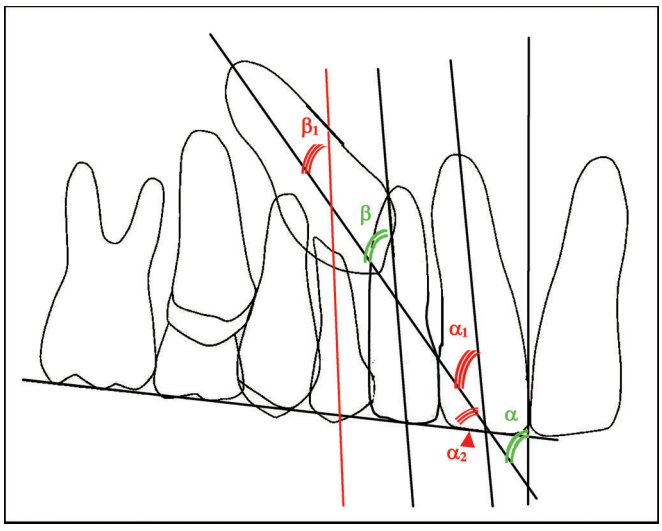
METHODS

The longitudinal retrospective study, conducted in a large cohort of patients with palatally displaced canines and a clinical group of patients with normal occlusal relationships and erupted teeth, enabled us to establish indicators that are of high statistical confidence for predicting potential canine impaction.

These indicators are as follows:

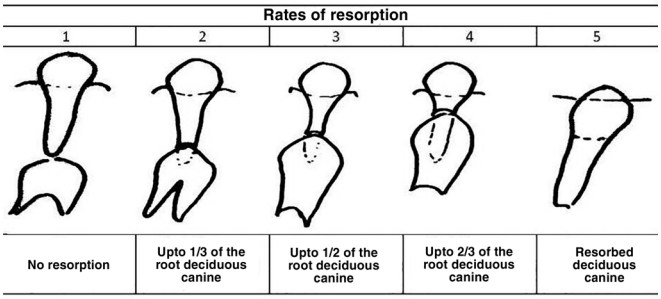
1. Angular indicators: angle β_1 (between axis 3/axis III), angleβ (between axis 3/axis 2), angleα_1 (between axis 3/axis 1) (Fig. 1)

Fig. 1.The method of Ericson and Kurol, complemented by the authors of this article



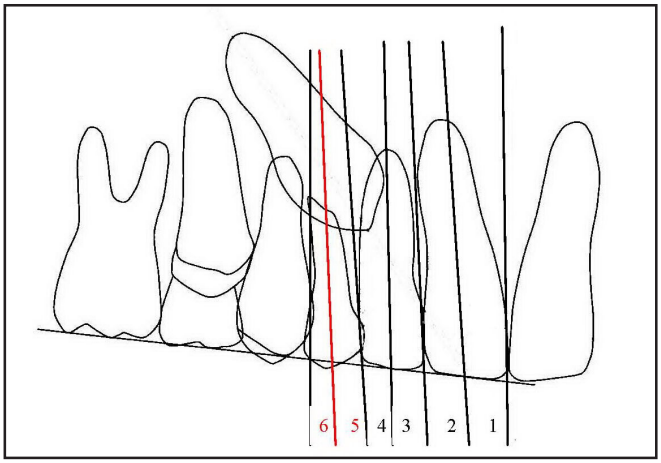
2. Degrees of resorption of the temporary maxillary canine (fig. 2)

Fig. 2. Degrees of resorption of the temporary upper canine, as per Tagguchi



3. Projection of the maxillary canine apex in the six sectors of OPG (fig. 3)

Fig. 3 The method of sector analysis of Ericson and Kurol, modified by the authors of this article



4. Position of the canine crown in the fields, defined by the two vertical and horizontal reference lines (Fig. 4)

Two horizontal and two vertical lines were constructed, thus determining two fields: the first one being distal to the axis of the lateral incisor (H_1 line) and the second one being mesial to the axis of the lateral incisor (H_1 line) and extending to the median line (H_2). The high erandmoremesial the location of the impactedcanineis, the worse is the prognosisforits arrangementinthe dentalarchand the prognosis for the adjacent teeth.

5. Projection of the canine germ in relation to Nl vertical line, as per the method of Arnautska and Krumova

The method, developed by us, includes identification of the most lateral point on *apertura piriformis* – point Nl – and construction of a vertical line, which passes through Nl and is parallel to the median line on the orthopantomography. Then, we assess the position of the canine crown in relation to the Nl vertical line by using a 4-degree scale, depending on the size of mesial intersection of the vertical line with the crown and root of the canine.(fig.5)

Fig. 4. Illustration of the canine position, as per the method of Zasciurinskiene [9]

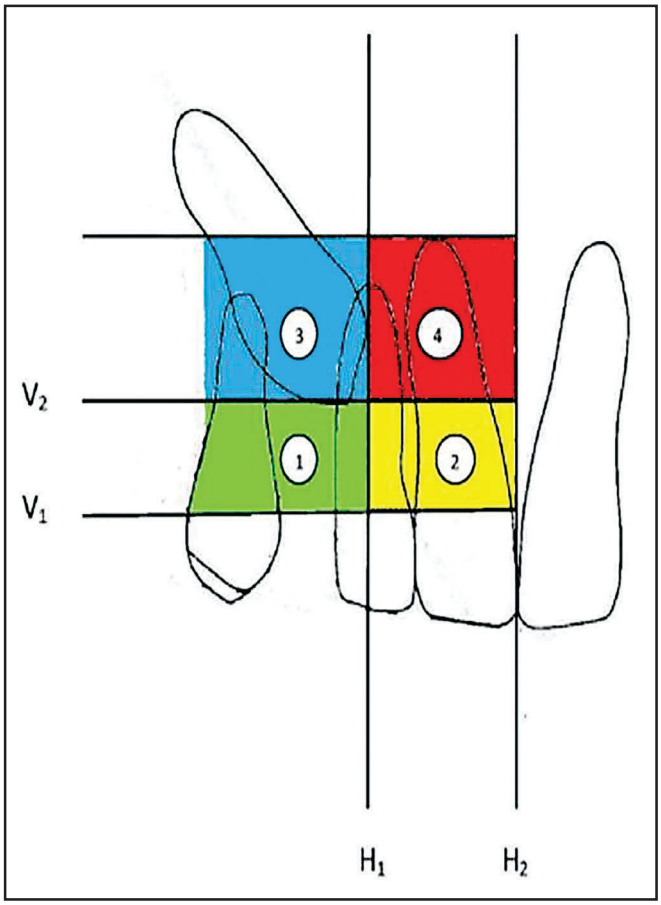
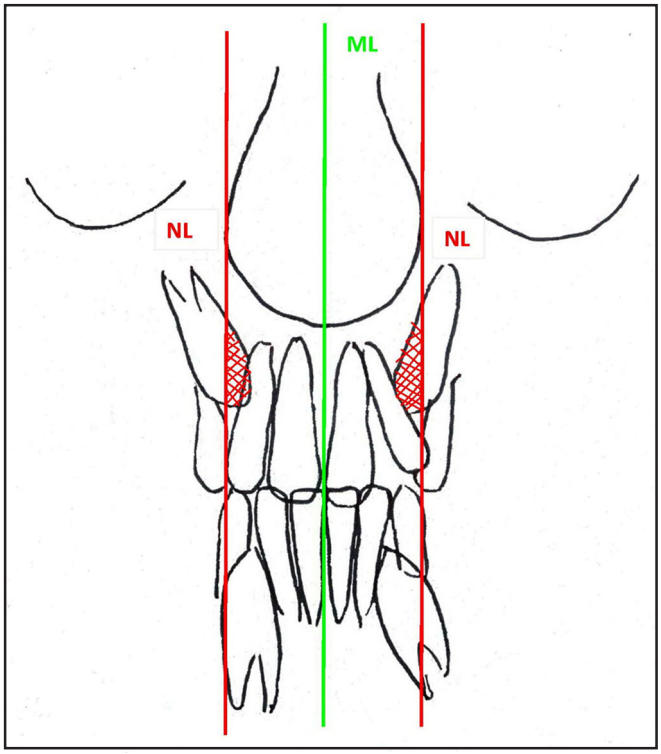


Fig. 5. Relationship between N1 vertical line and the crown of the permanent canine germ



Scale of the relationship between N1 vertical line and the crown of the permanent canine:

Degree 1: the canine crown does not intersect N1
Degree 2: 1/2 of the canine crown intersects N1
Degree 3: the whole canine crown intersects N1
Degree 4: the canine crown and root intersect N1

RESULTS AND DISCUSSION

The diagnostic protocols, developed by us, include three methods of examination - anamnestic, clinical and radiological, and depending on the obtained results, the protocol for phase 1 of the late mixed dentition directs to three clinical preventive approaches of action (fig. 6). In phase 2 of the late mixed dentition, the clinical approaches are two, due to the approaching time of eruption of the canine and the need for immediate treatment measures. (fig. 7)

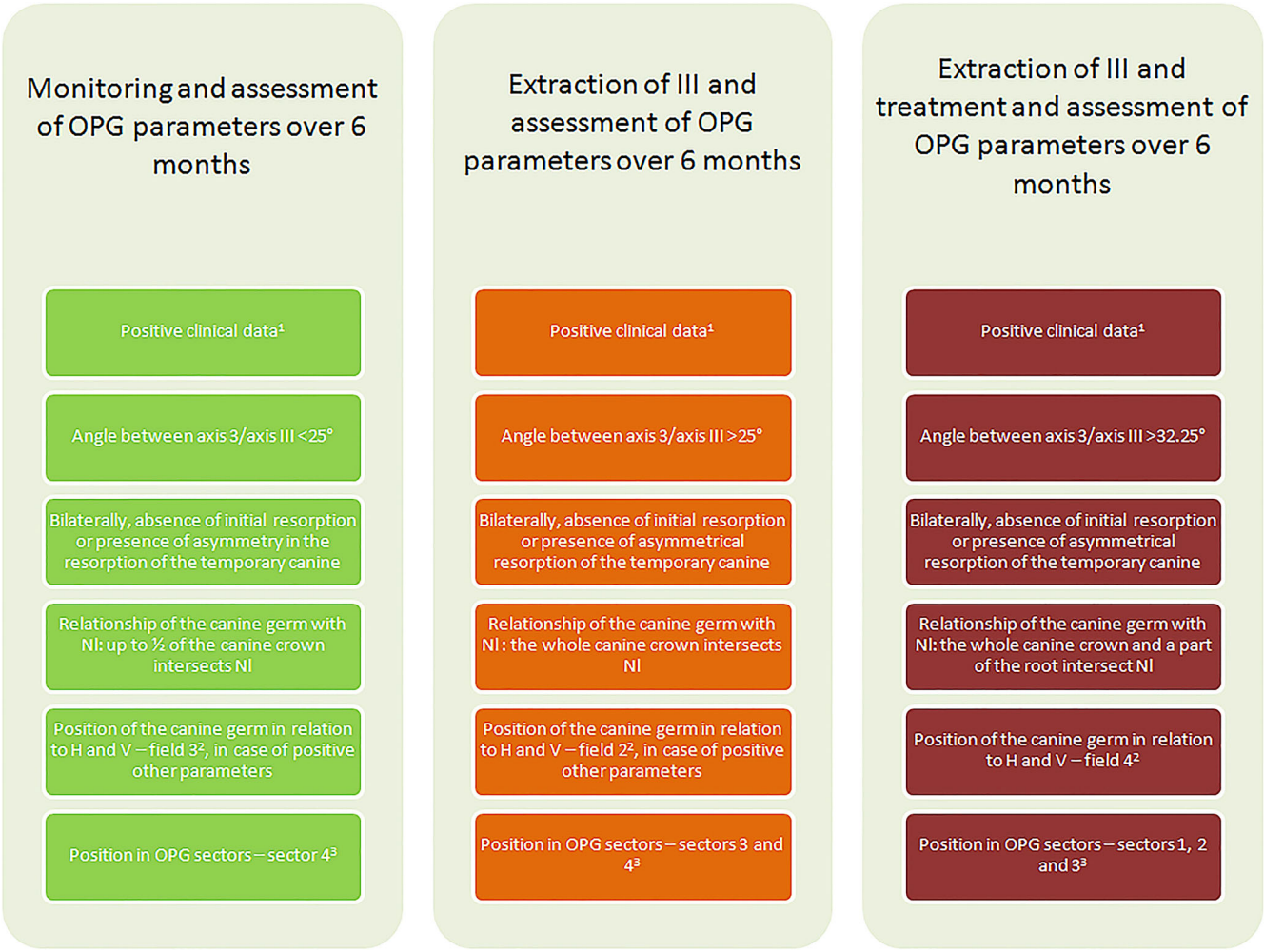
The anamnesis includes data collection from the mother on the time of temporary teeth eruption, the time of exfoliation, problems with eruption and familial history. An important indicator is the presence of impacted canines in relatives with horizontal (brothers, sisters and cousins) or vertical (mother, father, grandparents, aunts and uncles) family relationships. The presence of an impacted tooth inany of the relatives may be a serious indicator of a genetically determined canine impaction, requiring early prevention. This is the main indicator of potential impaction in children under 10 years of age, and shows the need for further radiological assessmentfor the purposes of diagnosis and initiation of prophylaxis [10].

The clinical examination aims at detecting abnormal eruption, persisted temporary teeth, impaired occlusal relationships. During palpation, a lack of vestibular bulge in the area over the roots of the temporary canine and the lateral incisor is sought. If smooth or even a slightly concave surface is established after the age of 8.5 years, this is an indicator of abnormal eruption path of the canine and requires a radiological examination. The position of the lateral incisor is also assessed.

Upon positive clinical examination results, we proceed to examining the OPG, whenever it refers to a single or a group of indicators.

Assessment of OPG parameters in phase 1 of the late mixed dentition (fig. 6)

Fig. 6. Protocol for phase 1 of the late mixed dentition



In phase 1 of the late mixed dentition,a comprehensive assessment of the degree of temporary canine root resorption, angle ß1, the intersection of N1 vertical line with the canine crown, the position of the canine crown apex in fields 2 or 4, according to the horizontal and vertical lines, and the position of the canine crown apex mesially to field 4, according to the method, modified by us, are needed for achieving high predictive accuracy.The indicators listed above are complemented by the lack of vestibular bulge and data for familial aggravation.

On the panoramic radiograph, the degree of temporary canine resorptionis assessed by using thescale, modified by us (Fig. 2). If the resorption of the temporary canine root is missing on the OPG and especially, if the resorption is unilateral or initial, but significantly different in the left and right dental arches, further criteria for assessing the eruption path of the permanent canine should be considered. If the resorption is presented as the only symptom,a 6-month orthopantomography monitoring of temporary canine resorption and permanent canine eruption should be considered.

We measure the value of *angle* β_1 (axis 3/axis III) (Fig. 1); if *angle* $\beta > 25°$ in phase 1 of the late mixed dentition, immediate preventive measures are required to change the path of canine movement.

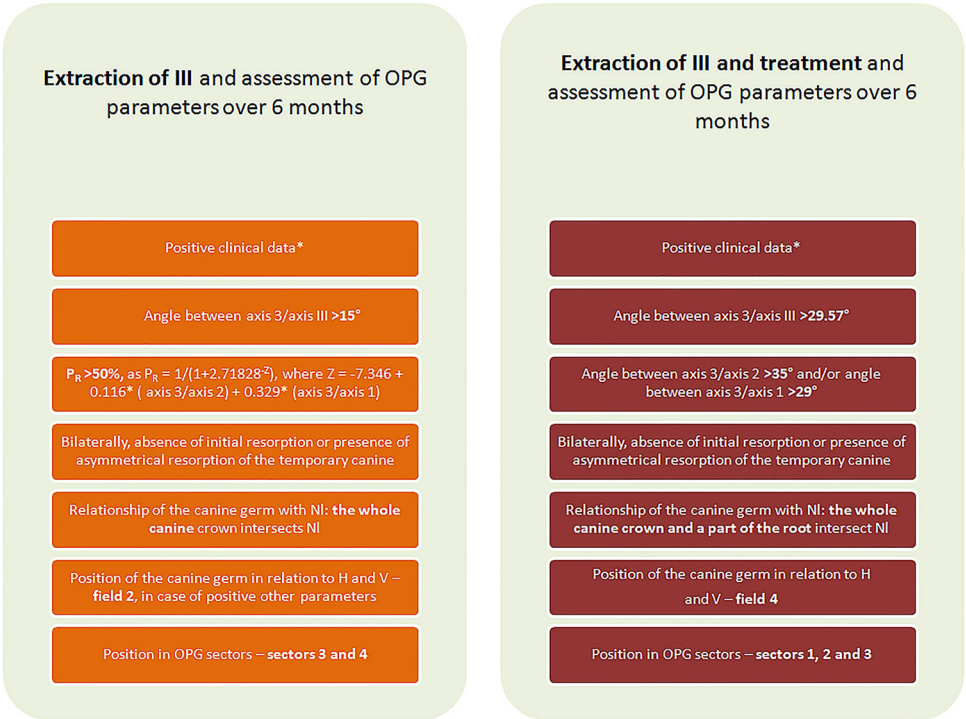
We assess the position of the crown apex of the canine germ in relation to the sectoral determination on the orthopantomography as per the method of Ericson and Kurol, modified by us (Fig. 3). Any position of the crown apex of the canine germ in sector 4 is a sign of palatal impaction, in the case of positive angular indicators for impaction. Any position of the crown apex of the canine germ in sectors 1 to 3 is a reliable sign of palatal impaction, even in the case of absent positive angular indicators for impaction.

Additionally, we assess the position of the permanent canine apex according to the method of Zasciurinskiene (Fig. 4). If the canine apex passes mesially to the axial axis of the lateral incisor, thus positioning in field 4, this is a reliable sign of canine impaction. If the canine apex is positioned in field 2, the probability of impaction is very high, but however, requiring the comprehensive assessment of the other indicators.

We assess also the position of the canine germ in terms of the degree of its intersection with N1 vertical line, according to the method developed by us (Fig. 5). Any intersection of N1 vertical line with the whole canine crown or the canine crown and root is a reliable sign of palatal impaction, in the case of positive angular indicators for impaction.

We suggest the following protocol for phase 2 of the late mixed dentition: (fig.7)

Fig. 7. Protocol for phase 2 of the late mixed dentition



The clinical examination protocol in phase 2 of the late mixed dentition follows the same sequence as in the earlier dentition. The radiographic data investigate the same parameters, but because of the advanced eruption of the permanent teeth, there are some peculiarities. When the temporary canine is exfoliated, we cannot use $\hat{a}_1$ angle, which is why, for this phase, we examine the angle of the axis of the canine germ against the axes of the central and lateral incisor.

As a result of the statistical analysis of the data, an equation was obtained, which includes the angles between the axis of the canine and the axis of the central and lateral incisor; it allows the calculation of the approximate percentage probability for canine impaction[11]. This equation is as follows:

P_R (probability for canine impaction) = $1 / (1 + \mathbf{e}^{-z})$, whereas

$z = -7.346 + 0.116 \times b + 0.329 \times \alpha_1$

e = 2.71828 (Neper's constant)

The values of angle β (axis 3/axis 2) and $anglea_1$ (axis 3/axis 1) are measured on the panoramic roentgenography, as the angle between the axis of the permanent canine and the axis of the central and the lateral incisor, respectively, are substituted in the equation for Z.

The probability for impaction is determined by the value of P_R. If the value of $P_R > 0.05$, the probability of impaction is greater than 50%, while in the case of P_R of up to 0.1, the probability of impaction approximates 100%.

In the case of existing temporary canine, we will use the value of *angle* β_1 only. If the temporary canine is missing, we will use the equation with *angle* β *and angle* α_1. This equation is also not universal, because in many cases, canine impaction is accompanied by hypodontia of the lateral incisor and therefore, we cannot use the equation. The other radiographic parameters are similar to those in phase 2 of the late mixed dentition.

The data obtained from the clinical and radiologic examinations are compared with those in the protocol for phase 1 and phase 2 of the early mixed dentition, proposed by us, and the patient is referred for one of the preventive measures, appropriate for the respective dentition. In the case of positive clinical data, but absence of radiographic evidence of impaction, the patient should be followed-up and after 6 to 12 months, should be re-assessed in terms of the orthopantomography parameters. This applies to phase 1 of the early mixed dentition, because in phase 2, the normal eruption is pending and the deviation showsimpaired canine eruption and the need of immediate measures.

In the case of positive data from the analysis of panoramic roentgenography, the patient should be referred to an orthodontic specialist for undertaking preventive measures. These include:

- extraction of the temporary canine and radiographic monitoring over six months, for following-up the progression of the canine. If there is no improvement within 1 year after the extraction, active treatment should be started, associated with space creating for the impacted canine or with maintaining the space without allowing mesial eruption of the first permanent premolar.

- if there is no space in the dental arch for the normal eruption of the canine, it is necessary, in addition to the extraction, to consider anappliance for creating of such a space. The selection of thetreatment appliance depends on the diagnosis and clinical assessment of the orthodontist.

We believe that the most useful preventive interventions should take place during the early mixed dentition and phase 1 of the late mixed dentition. Early extraction of the temporary canine will lead to a change in the eruption path of the permanent canine – uprighting and eruption in the normal position in the dental arch – if there is enough space [3, 12, 13].

After obtaining the results and establishing a tendency of canine impaction, we proceed to extraction of the temporary canine and when there is enough space in the dental arch, to maintenance of the position of the first premolar and prevention of its medialization. In the case of physiological eruption, the canine is in contact with the root of the premolar and therefore, retains itsspace by the time of its natural eruption that follows about 2 years after the eruption of the first premolar.

If the fourth tooth has already erupted, we apply radiologic monitoring over six months, to follow-up the eruption of the canine, and if there is no change within 1 year, weproceed to initiation of active therapeuticinterventions, associated with shaping of the dental arch and preparation of enough space for positioning the canine.

If there is no place for the permanent canine, we should extract the temporary canine and initiate treatment for creatinga space by distalization of the lateral segment and shaping and maintaining a place until the eruption of the permanent canine.

CONCLUSIONS

In many cases, early extraction of temporary canines may lead to closure of the space, due to the chronologically earlier eruption of maxillary first premolars and their potential medialization, due to the slower eruption of the higher-situated canines. This calls for differentiation of the cases requiring early extraction of the temporary canine, in order to improve the direction of canine eruption. This uncompleted discussion on the specific indicators that ultimately direct towards extraction of the temporary canine, made us study in details the path of eruption of palatally impacted canines and develop protocols for research and preventive actions in cases of suspected canine impaction.

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