

Position and Eruption of Permanent Maxillary Canines in Cases of Maxillary Lateral Incisor Agenesis in Mixed Dentition

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Objective: Assess whether the permanent maxillary canine (MC) has a natural tendency to erupt mesially in children with maxillary lateral incisors agenesis (MLIA), compared to children without agenesis. **Study design:** This retrospective, observational, cross-sectional study consisted of children between 5 and 12 years old divided into three groups: the first group with unilateral MLIA, in which an intraindividual analysis was performed, the second group presented bilateral MLIA, and the third group with patients without agenesis. These last two groups were matched for comparison interindividual, being paired by sex and maturation of the MC. **Results:** The canine position in the horizontal sector showed a clear mesial positioning of the MC on the agenesis side in individuals with unilateral MLIA (group 1) when compared with the counter lateral side; and in individuals with bilateral MLIA (Group 2) compared with control Individuals without agenesis (group 3). Even with the maintenance of this deciduous tooth in the dental arch, the MC keeps its tendency to mesial eruption. **Conclusion:** There is a greater tendency for mesial angulation of the maxillary canine in patients with MLIA, regardless of the presence or absence of deciduous lateral incisor.

Keywords: maxillary lateral incisor agenesis, maxillary canine, eruptive path.

INTRODUCTION

Maxillary lateral incisors agenesis (MLIA) leaves the dentist facing a complex problem because of the position that those teeth assume during the smile and the occlusal function. This anomaly frequently arises in orthodontic clinical practice. The early detection and diagnosis of this dental malocclusion is essential to assess the patient and determine the most appropriate treatment plan.¹

The maxillary lateral incisor (MLI) is a critical guide in the eruption of permanent maxillary canine (MC).^{2,3} The MC starts its eruptive path initially with an accentuated mesial inclination. Before the eruptive process, the dental MC follicle is positioned above the premolar follicle and delimited by the mesial maxilla piriform aperture.⁴

In the Portuguese population the prevalence of MLIA is 1.3%, being more frequent in females and more unilateral, often associated with the contralateral microdontia.⁵

Early diagnosis of MLIA can be done through some direct and indirect signals, while family history may also indicate the problem.^{6,7} However, accurate diagnosis of hypodontia requires dental, clinical, and radiographic examination to differentiate whether the tooth absence is due to extraction, inclusion, or congenital absence.

The literature suggests that the orthodontic movement of adjacent teeth through the edentulous alveolar ridge can develop appropriate alveolar bone dimensions without the use of regenerative procedures.⁸⁻¹⁰ As the tooth moves along the alveolar ridge bone is deposited correcting dimensional deficiencies. According to some authors,^{9,11,12} if the permanent lateral incisor is congenitally absent, mesial MC eruption in the space of the lateral incisor is advised. In the case of an opening treatment option, the canine can then be orthodontically moved distally to develop a space of an appropriate size capable of receiving an implant without grafting.¹³

The main objective of this study was to analyze the permanent MC position in mixed dentition in children with MLIA compared to children without agenesis by hypothesizing that there is a natural tendency to a canine mesialization that would simplify and help increase successful treatment of MLIA, whether in the choice of the closing or opening of the space.

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MATERIALS AND METHOD

The sample population in this retrospective, observational, cross-sectional study consisted of the clinical records of children between 5 and 12 years old that were retrieved from the archives of the University Institute of Health Sciences, between 1993 and 2013.

Clinical records were excluded if the children had syndromes or associated systemic disease with bone injuries or associated jaw defects and if the permanent canine was erupted. An analysis of the clinical records was performed and the sample was divided into three groups: Group 1—Individuals with unilateral MLIA; Group 2—Individuals with bilateral MLIA; and Group 3—Individuals without agenesis.

The same investigator performed the tracing and measurements with paper superimposed on panoramic radiographs. An intra-observer error measurement was calculated, performing a new tracing and measurement on 20 randomly selected radiographs two weeks after the first assessment. A second investigator performed the same procedure and this data was used to calculate the inter-observer error measurement. The following variables were analyzed:

- Gender and age of the individual;
- In group 1 and 3, the morphological classification of the lateral incisor microdontia was done according to Proffit.⁸ The maxillary lateral incisor was considered microdontic when its mesiodistal size was smaller than the lower lateral incisor (data confirmed in the clinical file).

The panoramic radiograph measurements were performed to verify the MC position and inclination in the horizontal and vertical planes, relative to the average and infraorbital line.

The distance between the tip of canine cusp to the midline was considered to evaluate the MC position in the horizontal plane.

A technique adapted from Ericsson and Kuroi¹⁴ that divides the front part of the dental arch in three sectors (Figure 1) was used:

- H1 sector—located between the midline (between the interproximal space of the central incisors and the midpoint of interradicular space between the same teeth) and the long axis of the central incisor;
- H2 Sector—situated between the long axis of the central incisor and the axis of the lateral incisor (or on the side of agenesis until the middle of the empty space between the central incisor and the present adjacent tooth);
- H3 Sector—situated between the long axis of the lateral incisor and the axis of the first premolar (or first deciduous molar).

To evaluate the canine position in the vertical plane (Figure 2), a modified Power and Short¹⁰ technique was used to refer to the cusp tip of the canine included. The root portion (the tooth zone below the bone crest) of the central incisor was divided into three equal parts, with reference to the occlusal plane (located between the mesial cusp of the first molar and the incisal edge of the central incisor).¹⁵⁻¹⁷ This lead to defining the V1 Sector in the apical; the V2 Sector in the middle third of the root zone incisor adjacent to the tip of the canine cusp; and the V3 Sector in the occlusal third.

Figure 1. Horizontal location of the canine; Reference lines: (1) between the midline and the long axis of the central incisor; (2) between the long axis of the central incisor and the axis of the lateral incisor (or on the side of agenesis until the middle of the empty space between the central incisor and the present adjacent tooth); (3) between the long axis of the lateral incisor and the axis of the first premolar (or first deciduous molar).

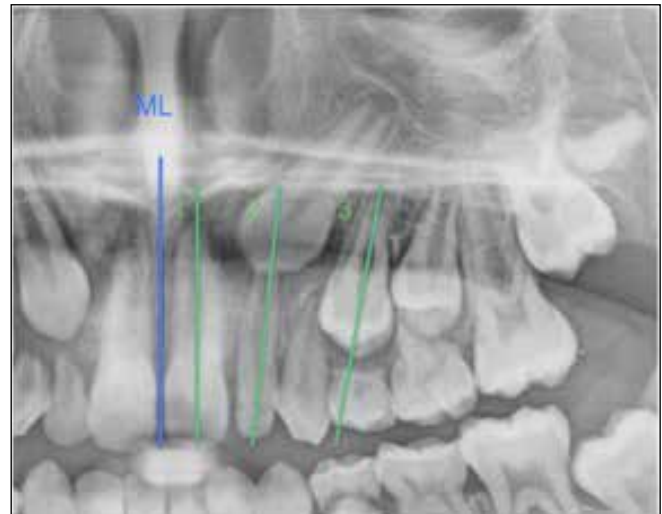
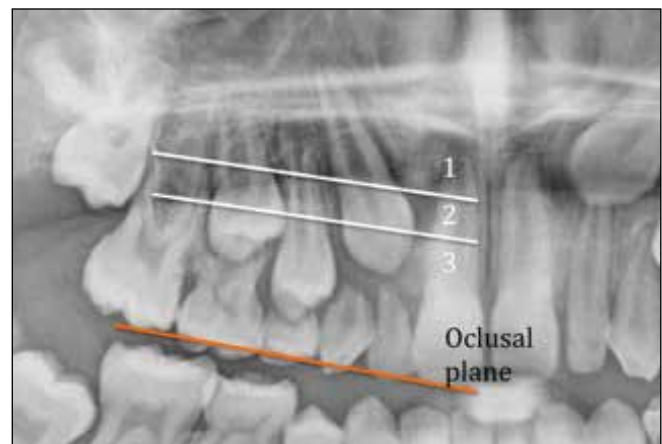


Figure 2. Vertical location of the canine cusp; Reference lines that divide the root (below the bone crest) of central incisor into three equal parts: (1) apical third; 2- middle third; 3- occlusal third.



Thereafter, the angle of the canine was measured following the methods proposed by Bjerklin and Kuroi, modified by Fernandez *et al*¹⁸, and by Ericson and Kuroi.¹⁴ As shown in Figure 3, the modified method proposed by Bjerklin and Kuroi¹⁴ measures the external angle formed by the permanent canine axis and a straight line that passes through the infraorbital points. As shown in Figure 4, the method proposed by Ericson and Kuroi¹⁴ measures the angle formed between the axis of the canine and the midline.

The obtained results were compared intra-individuals in Group 1 and inter-individuals in Groups 2 and 3, pairing these last two groups based on the root maturation of the MC, thereby evaluating whether there were any differences in the MC position in MLIA case. The data regarding qualitative variables are presented as absolute frequency and quantitative variables are presented as mean and standard deviation.

To assess the existence of dependence between two qualitative variables, the Chi-square test was used. Monte-Carlo method was used when the conditions for the use of Chi-square test were absent. The Q Cochran test was used to test counts or ratios of two paired samples.

To compare quantitative variables, parametric tests were used (t test for independent and t test samples for paired samples) when the assumptions for these tests were satisfied. The assumptions to use parametric tests include verifying the normal distribution of the variables (Shapiro-Wilk test) and homogeneity of variance (Levene test). When the assumptions were not fulfilled, nonparametric tests were performed.

The significance level was set at $\alpha=0.05$. All analysis were performed with SPSS Software® (v.20; SPSS Inc., Chicago, IL).

Ethical approval was guaranteed by the Ethics Committee from Instituto Universitário de Ciências da Saúde, CESPU.

RESULTS

From the panoramic analyzed radiographs, 56 cases presented MLIA. Of these, 28 (50%) had unilateral MLIA and 28 (50%) had bilateral MLIA. Of the 28 unilateral agenesis cases, it was found that contralateral had microdontia in 10 cases (35.7%). Information regarding the presence of IL deciduous was also collected and was found in 34 MLIA cases (60.7%), including 18 cases in Group 1 (the side affected by MLIA) and 16 in Group 2.

When performing intra individual analysis, i.e. in cases with unilateral MLIA, for angulation of the MC regarding infraorbital plan and midline (Figure 5), no statistically significant differences were found. However, an analysis of the graphs showed a greater angulation tendency to the side of MLIA. An analysis of the canine position on the horizontal sector in cases of unilateral agenesis showed significant differences, i.e. the MC was more mesialized on the side of agenesis (sector 2) than on the side of the presence of the MLI (sector 3), i.e. there was a clear mesial positioning of the MC on the agenesis side (Table 1). Regarding the analysis of the vertical sector, there was an equitable

Figure 3. Measurement of the external angle formed between the long axis of the maxillary canine (MC) and the line connecting the infraorbital point (line Or).

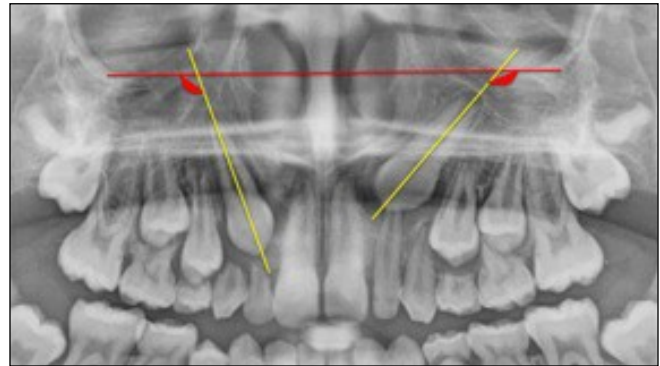


Figure 4. Measurement of the angle between the long axis of the maxillary canine (MC) and mean line.

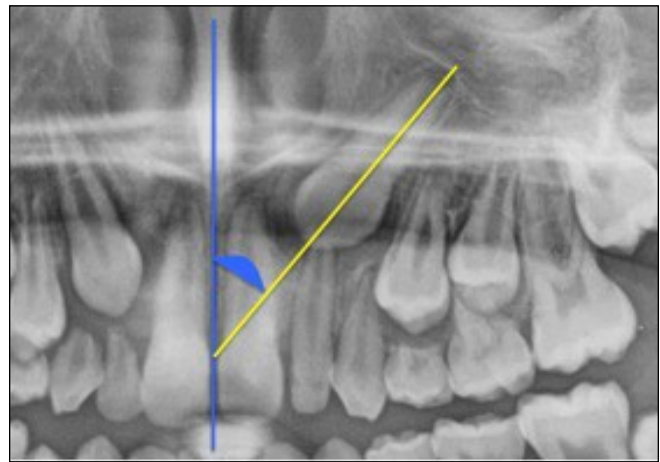


Table 1. Canine position in the horizontal plane on the side of agenesis versus side of the lateral incisor presence.

	H1	Horizontal plane in addition to the presence of the lateral		Total
		H2	H3	
Horizontal plane on the side of agenesis	H1	1	0	1
	H2	0	2	18
	H3	0	0	9
Total		1	2	25

distribution among different sectors on the side of the presence of the MLI. On the MLIA, there was a predominance of the V3 sector that is a more occlusal position (Table 2).

In the inter individuals analysis (bilateral MLIA vs. control group), the average values of Or angles from teeth 13 and 23 showed a higher angulation of MC in patients with agenesis, and these data were statistically significant for the second quadrant (Figure 6). The results concerning the midline were similar, with a greater angle in the MC, this being statistically significant in the second quadrant (Figure 7). Results of the comparison of the MC position for the horizontal sectors clearly showed a tendency to MC mesialization in MLIA cases. With respect to the vertical plane, the inferential statistical analysis did not affirm that the distribution of the canine position of the classification depends on the group (Table 3).

Table 2. Canine position classification in the vertical plane on the side of agenesis versus side of the lateral incisor presence.

V1	Vertical plane in addition to the presence of the lateral			Total	
	V2	V3			
Vertical plane on the side of agenesis	V1	4	0	0	4
	V2	4	5	0	9
	V3	1	5	9	15
Total		9	10	9	28

Figure 5. Or and Me angles in patients with unilateral maxillary lateral incisors agenesis on the side of agenesis versus side of the lateral incisor presence. All values are means, with a confidence interval of 95%.

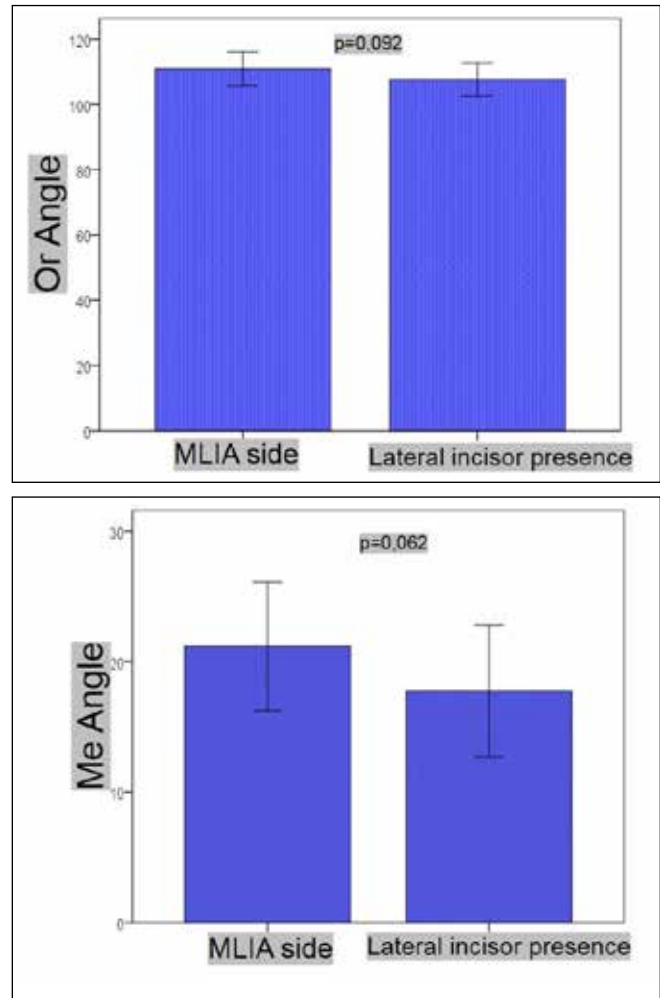


Figure 6. Average Or Angle of (A) tooth 13 and (B) tooth 23 in patients with bilateral agenesis patients vs. without bilateral agenesis (control group). All values are means, with a confidence interval of 95%.

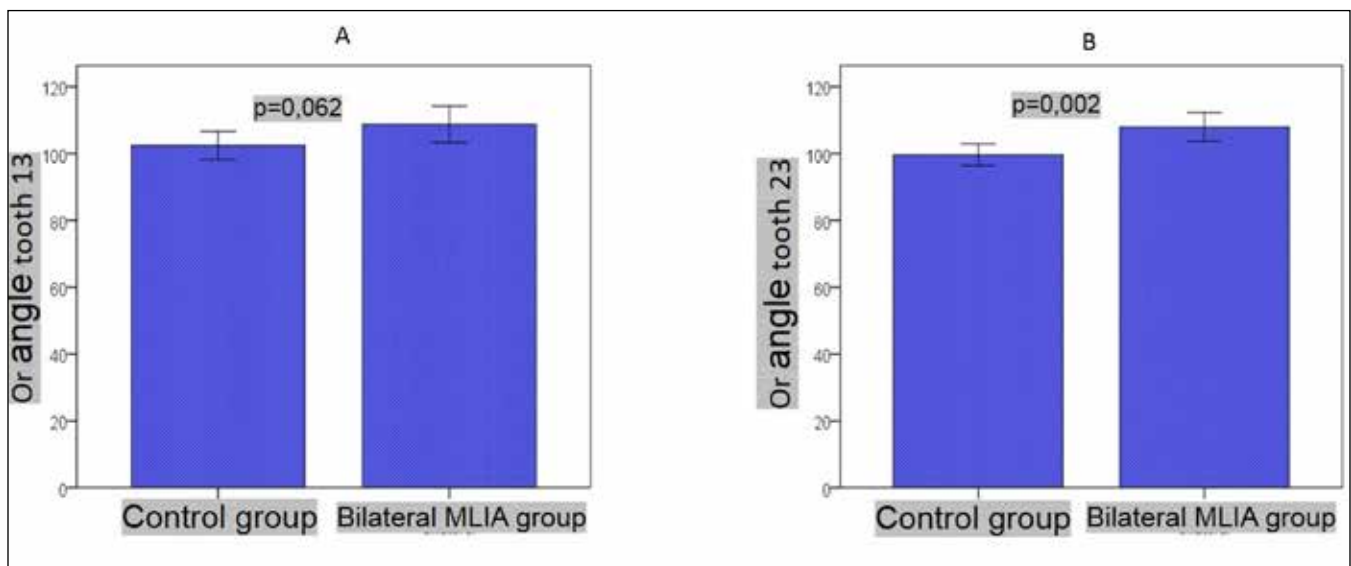


Figure 7. Average Me Angle of (A) tooth 13 and (B) tooth 23 in patients with bilateral agenesis patients vs. without bilateral agenesis (control group). All values are means, with a confidence interval of 95%.

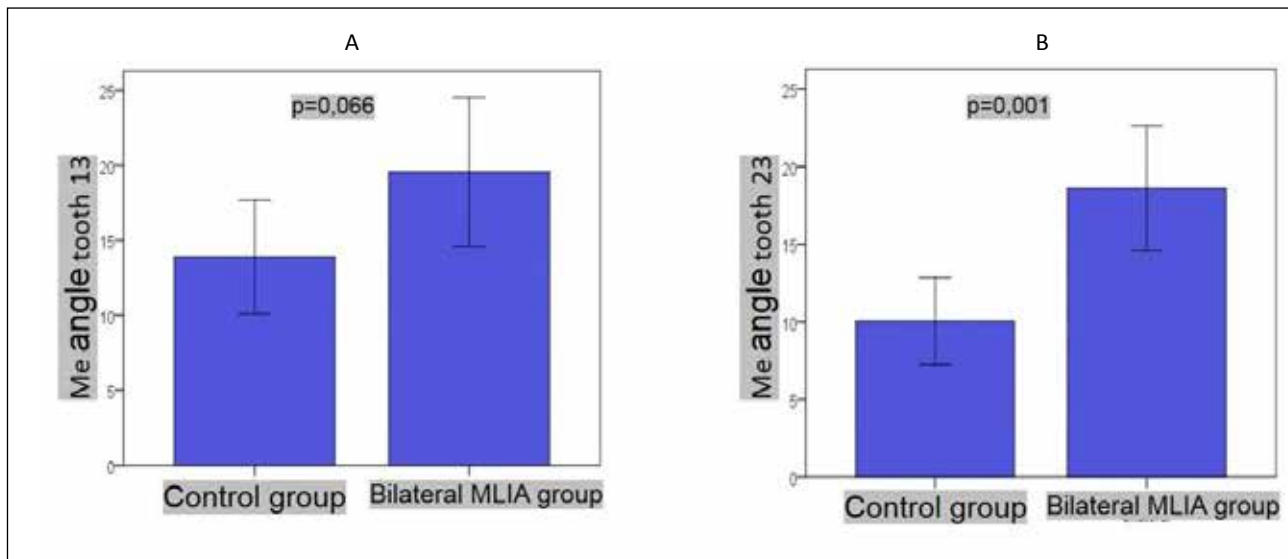


Table 3. Canine position of the rating in the vertical and horizontal planes of teeth 13 and 23 in the group of patients with bilateral agenesis and the control group. The values shown here are the absolute frequencies.

	Group						P
	Control (n=19)			Patients with bilateral agenesis (n=28)			
	S1	S2	S3	S1	S2	S3	
Horizontal plane of tooth 13	0	1	18	0	23	5	<0.001
Horizontal plane of tooth 23	0	1	18	0	21	7	<0.001
Vertical plane of tooth 13	2	9	8	5	11	12	0.747
Vertical plane of tooth 23	2	10	7	4	14	10	0.930

DISCUSSION

Hypodontia, particularly MLIA, is an anomaly that arises relatively frequently in orthodontic clinical practice. Because of its great involvement in facial aesthetics, understanding and identifying this anomaly is essential to forming the most successful therapeutic approach.^{1, 19, 20}

If a permanent lateral incisor is congenitally absent, it is advised that the permanent canine erupt mesially in the space of the lateral incisor. Even in cases when opening the space is an option, the canine is moved orthodontically distally to develop a space with an appropriate dimension, accomplished by receiving an implant without bone graft.^{9, 11, 12} The present research was intended to contribute to the clarification of this issue, hypothesizing that there is a natural tendency to a canine mesialization that would simplify and help increase successful treatment of MLIA, whether in the choice of closing or opening the space.¹³

This tendency was demonstrated in the presence of MLI deciduous in the same side of agenesis. All the cases that present MLI deciduous clearly show a tendency to MC mesialization. It can therefore be assumed that even with the maintenance of this deciduous tooth in the dental arch, the MC maintains its tendency to mesial eruption, and therefore there is no need for deciduous tooth extraction to promote the MC eruption in mesial position. Thus, the deciduous lateral incisor should only be extracted when it shows physical obstruction to the eruption of the MC or when the canine is very close to the line of the arch and not as canine mesial eruption promoter. We can thus minimize the aesthetic consequences inherent to the early extraction of the deciduous lateral incisor and can extract it as late as possible, close to the canine eruption in the oral cavity.

When the treatment option is closing the space corresponding to MLIA, this tendency to the MC mesial eruption becomes important not only for sealing the space, but

also because it will promote mesial eruption of distal teeth, leaving the patient with a Class II occlusion. This eruption of the entire arch in the Class II relationship will facilitate and reduce the orthodontic treatment time to mesialize the posterior sector. This tendency for a Class II relation in MLIA cases was observed in some studies.¹⁶ Each case, however, must be analyzed individually. In some cases, the orthodontist should create a treatment plan programming sequential extractions in the support zone from the deciduous canine to the second deciduous molar (when the correspondent permanent tooth is still in a position higher in the bone and at least half of the root is formed), thus causing the eruption of permanent first molars in a Class II position and promoting the spontaneous closing of the existing spaces due to lack of MLI, subsequently reducing the need for complex treatments.

In cases when programmed extractions can be performed, the professionals have to be conscious of the coexistence of other malocclusions. For example, in a nine year-old patient with a Class I (or Class III) relation, the extraction of the temporary maxillary canine and lateral incisor may allow an advance of the posterior teeth when combined with the temporary loss of the second molars to help this advancement. However, in a severe Class II, extractions should be done with additional caution because they can curb the anterosuperior sector growth or facilitate the advancement of the posterior sector, making it impossible to fix (blocking central incisor retrusion).^{1, 21}

The information in the literature reveals that in cases when the MLIA treatment option is opening or closing the space, MC mesial eruption is advantageous.^{22, 23} In the case of opening the space, several studies advocate that the mesial canine eruption promotes an increased bone in thickness MLIA zone. Thus, the MC eruption should always be oriented to occur with a mesial direction, often having to resort to early extraction of deciduous MLI to promote mesial eruption. Thus, the problems arising from the lack of bone in the area of agenesis can be minimized, and consequently lessen the implications of an implant placement after the end of growth. In addition to achieving an improved physiology, the need for bone graft prior to an implant placement is reduced.²⁴

CONCLUSION

There is a greater tendency for mesial position and more angulation of the MC in MLIA when compared to the presence of the maxillary lateral incisor, regardless of the presence or absence of deciduous lateral incisor. This tendency highlights the advantage of increasing the bone thickness in cases when the treatment option is opening or closing the space. It also demonstrates that there is no need for premature extraction of the lateral incisor and deciduous canine, minimizing the aesthetic problems inherent to the permanent lateral incisor agenesis itself.

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