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Research Article

Dental Arch Dimensions in Patients with Isolated Maxillary Lateral Incisor Agenesis (Mlia)

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Received: February 15, 2021; **Published:** March 31, 2021

Abstract

Purpose: The objective of this study is to investigate the characteristics of dental arch dimensions in patients with isolated MLIA through comparing them with non-hypodontia control group and to compare the dental arch dimensions in UMLIA and BMLIA sub-groups.

Material and Methods: Dental casts were taken for 60 sex-matched patients, within an age range of 12 - 15 years, only affected by unilateral or bilateral congenital absence of maxillary lateral incisors, excluding third molars, in order to measure some of traditionally used parameters and new parameters which were developed and have not been studied before, and to be compared with non-hypodontia control sample. The significance test for the differences in arch dimensions between hypodontia and non-hypodontia subjects was performed using Student t-test.

Results: Intercanine width and anterior length of maxilla were significantly reduced in the patients compared with that of the controls, $p < .05$. Moreover, both parameters were significantly reduced in the patients with bilateral agenesis compared with those who had unilateral agenesis of upper lateral incisors, $p < .05$. The Incisive Depth (new parameter) and its two divisions were significantly reduced in the MLIA group compared with the control one.

Conclusion: This study concluded that the influence of MLIA appears exclusively in the anterior section of maxilla (premaxilla) to be narrowed and shorter compared with the control group and the development of the premaxillary section in both transverse and sagittal directions decreases along with diminished upper lateral incisor-number.

Keywords: *Agenesis; Arch Dimensions; Maxillary Lateral Incisor*

Introduction

The effects of congenital absence of teeth in general on arch dimensions have been investigated by limited number of researcher [1,2], although it is one of the most common developmental anomalies of human permanent dentition [3]. Maxillary lateral incisors are the first or second most commonly absent teeth [4-11] and because they have an obvious impact on facial aesthetics the demand for orthodontic treatment is high and orthodontists are still obsessed with this subtype of hypodontia. Although there are many researches and articles in

abundance all over the world revolving round the congenital absence of permanent teeth, yet researches handling isolated maxillary lateral incisors agenesis are still rare; this phenomenon has been studied in the context of congenital absence of teeth in general. Therefore, the objective of this study is to investigate the characteristics of arch dimensions in a group of Syrian adolescent patients with isolated MLIA to obtain a better understanding and more insight of this phenomenon.

Once the role of the incisors in the premaxillary development was finally recognized, the therapeutic options gained in accuracy and effectiveness. As long as the development and the growth of the premaxillae are not completed, the teeth represent for the nasal level of the face a capacity of expansion which requires to be presented [12].

Salmon., *et al*. [1] reported decreased arch widths and length; the arch is narrowed and shorter in a large French male group with missing and small maxillary lateral incisors after they measured only arch dimensions in the maxilla and evaluated only lateral incisors absence.

In a Turkish study, Celikoglu., *et al*. [2] investigated the prevalence, characteristics of tooth agenesis and arch widths in a group of Turkish patients seeking orthodontic treatment. They found that intercanine and intermolar widths were significantly reduced in the hypodontia group for both jaws compared with the control group (which was randomly selected from the group of non-hypodontia patients).

Materials and Methods

Dental casts were taken for both the affected sample which composed of 60 sex-matched governmental school children in Aleppo city - Syria, within an age range of 12 - 15 years, who were only affected by bilateral or unilateral congenital absence of maxillary lateral incisors-excluding third molars and who had permanent dentition- and the control sample which consisted of 21 non-hypodontia students who had normal occlusion criteria.

Measurement protocol

The following dental arch widths were determined according to Pont [13] (See figure 1):

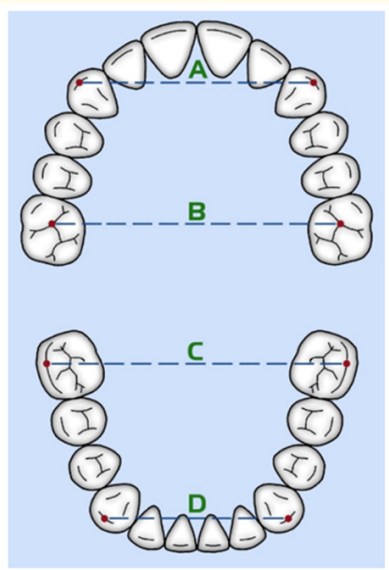

Figure 1: *Measurement of dental arch widths on models. (A) Maxillary intercanine width. (B) Maxillary intermolar width. (C) Mandibular intermolar width. (D) Mandibular intercanine width.*

- Upper and lower intercanine width: The distance between the cusp tips of the right and left canines.
- Upper intermolar width: The distance between the central fossae of the right and left first maxillary molars.
- Lower intermolar width: The distance between tips of the distobuccal cusps of the right and left first mandibular molars.

Regarding the anterior length of the jaws, the following dental arch lengths were determined according to Korkhaus [14] (See figure 2):

- Length of maxilla: Is defined as the perpendicular to the line connecting the lower most point of the transverse fissure of the first maxillary premolars, in the midsagittal plane. It is measured from the intersection of the two lines to the labial surface of the most anterior - positioned central incisor.
- Length of mandible: The anterior arch length is defined as the perpendicular distance from the most anterior labial surface of the central incisor to the line connecting the facial contact point between the left and right premolars.

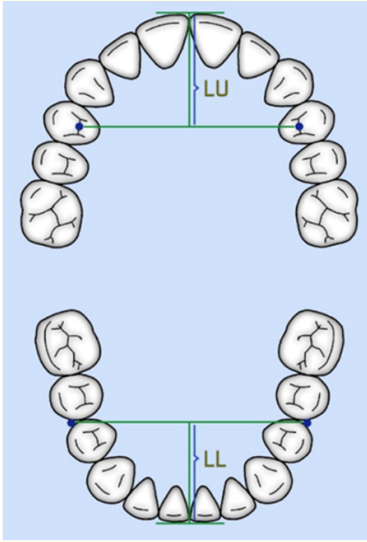

Figure 2: *Measurement of dental arch anterior length on models. (LU) Anterior length of maxilla. (LL) Anterior length of mandible.*

According to Talmant [12], maxillary incisors have an important role in the development of premaxillae through different stages of its development. Subsequently, its loss might influence the development of this section of maxilla in three dimensions. On this basis, some points were determined to study the effect of partial agenesis of maxillary incisors represented by lateral incisors agenesis. The parameters dependent on these points might allow investigating some dental arches characteristics in such cases. Moreover, these parameters will make researchers more accurate in determining the local defect resultant by the loss of maxillary lateral incisors, specifically in this section of the maxilla.

In other words, to investigate the influence of BMLIA or UMLIA in the length of premaxillary section, new parameters were developed and designed for the purpose of this research. As far as we are concerned, these parameters have not been included in any previously published study and they are derived from what have been nominated incisive depth (ID):

- Incisive depth (ID): The perpendicular constructed on the mid-palatal raphe at the posterior point of Incisive Papilla (IP) runs distal to the canines [15] (See figure 3). Hence, to measure ID, we measured the distance between IP and Incisive Edge (IE) at the point of its intersection with skeletal midline. In order to avoid the influence of maxillary central incisors' inclination and determined ID accurately regardless of the position of central incisors, we measured the distance between IP and Linguo - Gingival Margin (LGM) after constructing a perpendicular from LGM to the midline. Eventually, to determine the position of central incisors whether proclined or retroclined, we measured the distance between IE and LGM (See figure 4).

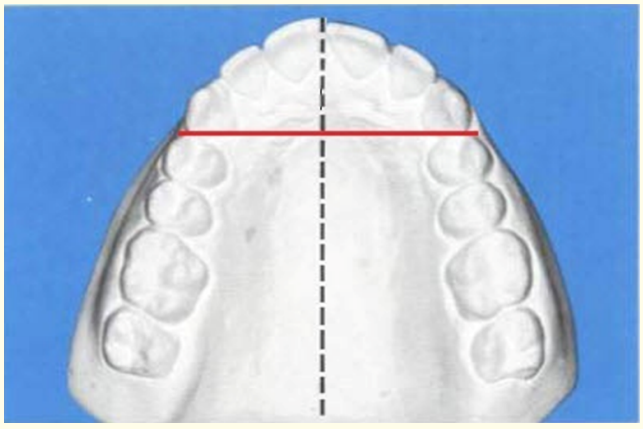

Figure 3: *Schmuth's Line. Note: From [15]. The broken line is the skeletal midline and the red one is Schmuth's line.*

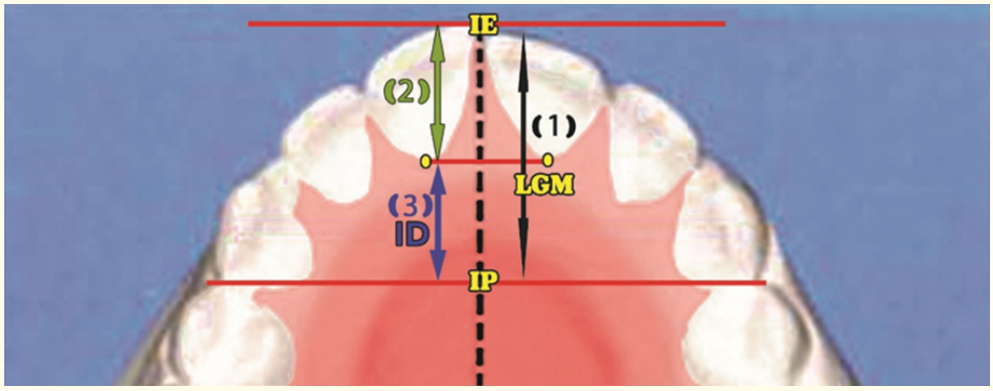

Figure 4: *Incisive depth.*

Note: All these parameters were specifically designed for this research.

(1) ($\overline{IE - IP}$) The distance between incisive edge and incisive papilla

(2) ($\overline{IE - LGM}$) The distance between incisive edge and linguo-gingival margin

(3) ID = ($\overline{LGM - IP}$) The distance between linguo-gingival margin and incisive papilla.

Since incisive foramen which forms the posterior border of premaxilla is identified based on lateral cephalometric radiograph, we have resorted to Schmuth Line in identifying Incisive Papilla on dental casts in order to avoid the students extra exposure to radiation after diagnostic panoramic one.

In summary, we think that the most important advantages of the new proposed method are:

- It can be used regardless of the influence of central incisors' inclination.
- Ensure less exposure to radiation.

Measurement techniques

All the length measurements of subjects' dental casts were carried out by measuring grid according to Schmuth which is accurate to 0.5 mm (since length measurements are perpendicular distances). Whereas width measurements which are linear distances were made on the models using digital caliper (IOS 4" digital caliper, Houston- USA) accurate to .01 mm.

Reliability of measurement

In order to calculate the measurement error, (10) randomly selected dental casts were simultaneously remeasured by another researcher and by the same researcher after four weeks of the initial measurement. The method error for inter and intra - examinations was calculated by using Cronbach's alpha coefficient which was within the range (0.942→1). This value indicates that the reliability of all measurements is very high.

Statistical analysis

Student t-test was to compare between the independent samples and to measure the significant difference between the means of the quantitative parameters. The statistical significance level was established at $p < .05$. Descriptive statistics were also used to measure the means and the standard deviations. All descriptive and comparative statistical analyses steps were performed using the IBM SPSS-version. 22 and Minitab-version. 16 software packages.

Results

The maxillary intercanine width of the MLIA group was reduced by 5.84 mm compared with that of the control sample; statistically, this is found to be a highly significant difference; $p < .05$. Whereas there were no statistically significant differences between the two groups in all of the mandibular intercanine width and intermolar widths of both jaws; $p > .05$.

Regarding anterior dental arch length, we found that there was no statistically significant difference between anterior length of the mandible in MLIA and control groups. In contrast, we found the anterior length of maxilla in the MLIA group was significantly shorter and reduced by 1.86 mm compared with that of the control group; $p < .05$. Also, we found the (IP - IE, IP - LGM (ID) and IE - LGM) distances were shorter in the MLIA group compared with those of the control group and reduced by 1.91 mm, 1.25 mm and .67 mm respectively. Statistically, these differences are highly significant; $p < .05$ (See table 1).

Dental arch Widths and Lengths (mm)	Control group N = 21 subjects		MLIA group N = 60 subjects		
	Mean	SD	Mean	SD	P Value
Upper intercanine width	33.85	1.74	28.01	3.08	.000
Lower intercanine width	25.52	1.91	25.45	2.41	.899
Upper intermolar width	46.47	1.88	45.53	3.16	.204
Lower intermolar width	46.52	2.08	46.70	3.05	0.80
Length of maxilla	17.52	1.03	15.66	1.99	.000
Length of mandible	15.09	1.13	14.71	1.61	.326
IP - IE	11.33	.96	9.42	1.16	.000
IP - LGM	3.69	.87	2.44	.76	.000
IE - LGM	7.64	.57	6.97	.83	.001

***Table 1**: Mean dental arch widths and lengths of MLIA and control groups.*

When the same comparison was made between the UMLIA and BMLIA subgroups, we found that there were significant differences between the two subgroups for three measurements.

Dental arch widths and lengths (mm)	UMLIA group N=30 subjects		BMLIA group N=30 subjects		
	Mean	SD	Mean	SD	P Value
Upper intercanine width	29.93	1.68	26.10	2.99	.000
Lower intercanine width	25.96	2.37	24.93	2.37	.097
Upper intermolar width	46.16	2.79	44.90	3.43	.124
Lower intermolar width	47.23	2.82	46.16	3.22	.178
Length of maxilla	16.30	1.74	15.03	2.05	.013
Length of mandible	15.03	1.51	14.40	1.67	.130
IP - IE	9.68	1.02	9.16	1.26	.087
IP - LGM	2.68	.66	2.20	.79	.013
IE - LGM	7.00	.79	6.94	.88	.815

***Table 2**: Mean dental arch widths and lengths of UMLIA and BMLIA subgroups.*

- The upper intercanine width in the BMLIA subgroup was significantly reduced by 3.83 mm compared with that of the UMLIA subgroup, $p < .05$.
- The anterior length of maxilla was significantly shorter in the BMLIA and reduced by 1.27 mm; $p < .05$.
- The IP - LGM (ID) distance was shorter in the BMLIA and reduced by .48mm, which is also statistically considered significant; $p < .05$ (See table 2).

Discussion

Some studies found differences in dental arches dimensions between patients with tooth agenesis and controls [1,2]. Salmon., *et al*. [1] measured only arch dimensions in the maxilla and evaluated only MLIA, they reported decreased arch width and length; the maxilla is narrowed and shorter in the group with MLIA. On the other hand, Celikoglu., *et al*. [2] found that intercanine and intermolar widths were significantly reduced in the hypodontia group for both jaws compared with the control group. The results of the present study are quite consistent with those of the study of Salmon., *et al* [1]. However, the present study is more profound and specific; we found that only intercanine width and anterior length of maxilla are significantly reduced, whereas, no significant differences in maxillary intermolar width and in all measurements of the mandible; i.e. the influence of MLIA appears exclusively in the anterior section of the maxilla (premaxillary section) to be narrowed and shorter compared with the control group, which does not agree with the results of the study of Celikoglu., *et al*. [2] where the influence of hypodontia appeared obviously in the whole dental arch for the both jaws.

The explanation for this inconsistency could be due to the variation in sampling techniques; the sample of the study of Celikoglu., *et al*. [2] included all forms of hypodontia, whereas the present study sample included only the subjects with isolated MLIA.

More specifically, it was found that the IE - IP distance with its two parts in the subjects of affected sample is significantly reduced compared with the controls ($p < .05$), although the difference between the anterior length of maxilla and this distance in the group with

MLIA is not significantly different compared with that of the control sample. This most likely indicates that the lack of length of the anterior length of maxilla in the group with MLIA is at the expense of the length of premaxillary section.

Also, it was found that the distance IE - LGM is significantly reduced in the sample with MLIA compared with the control sample ($p < .05$). This significant difference is due to the position of the central incisors in MLIA sample; which indicates that they are retroclined.

Moreover, the IP - LGM distance in the patients is significantly reduced compared with the controls ($p < .05$), which apparently reveals that the shortness of the premaxillary section is not only due to the retroclination of the central incisors, but also at the expense of the incisive depth (ID) which is represented by IP - LGM distance.

Having made the same comparison between UMLIA and BMLIA subgroups, it was found that there are significant differences between them for three measurements: upper intercanine width, anterior length of maxilla, and IP - LGM (ID) distance; these measurements are significantly reduced in the BMLIA subgroup. The significant difference of the third measurement indicates that lack of length of the anterior length of maxilla is exclusively at the expense of IP- LGM (ID) distance, while the first two measurements apparently reveal that the development of the incisive bone or premaxillary section in both transverse and sagittal directions decreases along with diminished upper lateral incisor-number and that do support the hypothesis of Talmant [12] when he attributed an important motor role to the maxillary incisors in the development of the premaxillary and facial envelope.

Unfortunately, we could not compare some of the aforementioned results of the present study, regarding dental arch measurements, with previous studies because, to our knowledge, these parameters (IP - IE, IP - LGM (ID) and IE - LGM) were especially developed for this study and have not been included in any previously published study. Nevertheless, these parameters are very specific and important to realize the role of maxillary lateral incisors and resultant defect caused by their loss.

Conclusion

This study concluded that only the maxilla is affected by MLIA, and the influence of MLIA appears exclusively in the anterior section of maxilla (premaxilla) to be narrowed and shorter compared with the control group. Furthermore, lack of length of the anterior length of maxilla in the group with MLIA is not only at the expense of premaxilla length, but also as a result of central incisors' retroclination. Moreover, the development of the premaxillary section in both transverse and sagittal directions decreases along with diminished upper lateral incisor-number.

Acknowledgement

This work would not have been accomplished without the support and cooperation between the Faculty of Dentistry-University of Aleppo, Syria, and the Faculty of Dentistry-University of Kiel, Germany.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Volume 20 Issue 4 April 2021