The influence of bilateral lower first permanent molar loss on dentofacial morfology – a cephalometric study

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Abstract

Objective: To evaluate cephalometric changes in patients with bilateral loss of lower first permanent molar teeth. **Methods:** Sixty-eight lateral radiographs of patients from private practices were analyzed. The sample was divided into two groups matched for age and gender: 34 individuals without loss (control group) and 34 presenting with bilateral loss of lower first permanent molar teeth (loss group). Patients who had lost teeth other than lower first molars, cases of agenesis and patients under 16 years of age were excluded from the sample. Only individuals who reported losing teeth at least 5 years earlier were evaluated. **Results:** It was found that bilateral loss of lower first permanent molars leads to smooth closure of GnSN angle ($P = 0.05$), counterclockwise rotation of the occlusal plane ($P = 0.0001$), mild decrease in lower anterior face height ($P = 0.05$), pronounced lingual tipping ($P = 0.04$) and retrusion of mandibular incisors ($P = 0.03$). Moreover, bilateral loss of lower first permanent molars did not affect the maxillomandibular relationship in the anteroposterior direction ($P = 0.21$), amount of chin ($P = 0.45$), inclination of upper incisors ($P = 0.12$) and anteroposterior position of maxillary incisors ($P = 0.46$). **Conclusion:** Bilateral loss of lower first molars can produce marked changes in lower incisor positioning and in the occlusal plane as well as a mild vertical reduction of the face.

Keywords: First permanent molar. Cephalometry.

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INTRODUCTION

Despite the vast scientific knowledge available concerning effective methods to prevent dental caries disease, epidemiological data on tooth loss show alarming rates in Brazil, especially in the low-income population.[2,8,9,15] Loss of lower first permanent molars not only contributes to these statistical data but has been identified as the most prevalent.[8,9]

Over the years literature has highlighted the importance of first permanent molars in occlusion. Their loss can lead to serious problems with remarkable clinical changes in the position of neighboring and antagonist teeth,[5,10,11] which may require orthodontic and rehabilitation treatment due to the complexity of the resulting malocclusion.

Several occlusal changes caused by missing first molars have been described in the literature. Second molars have been shown to migrate mesially into the posterior region of the dental arch,[5,11] while second premolars[5,6,11] and canines[10,11] drift distally. However, it is clear that the effects of lower first molar loss are not restricted to the posterior region as they seem to significantly influence anterior teeth, increasing the occurrence of diastemas[10] and midline shifts.[10,11] Few studies have sought to examine the effects of missing first permanent molars on the cephalometric pattern. These studies[1,12] showed spontaneous cephalometric changes in overbite and overjet and in incisor inclination after extraction of lower first permanent molars. A tendency was observed toward increased overjet and overbite in association with retroclination of lower incisors and protrusion of upper incisors, with relatively significant variation in these changes.[12] In most cases where overjet and overbite were normal, the overbite remained stable after extraction.[12] However, no evidence has been found to support the occurrence of changes in the vertical relationships of the face.[1]

MATERIAL AND METHODS

This study was developed through the analysis of 68 lateral cephalometric X-rays from routine orthodontic records. The sample was divided into two groups matched for gender and age: a control group (no loss), consisting of 34 radiographs, 8 men and 26 women, whose mean age was 19.5 years (16-26.2), and another group with bilateral loss of first permanent molars, consisting of 34 radiographs, 8 men and 26 women with a mean age of 24.6 years (16-36). Patients who had lost teeth other than the first molar, cases of agenesis and patients under 16 years of age were excluded from the sample.

Information regarding age and gender was collected directly from the patients' dental records. Despite the authors' efforts, it was not possible to accurately determine the time at which the molars were lost. The patients who were able to determine it reported having lost them at least 5 years earlier. Patients who reported a recent loss were excluded from the sample.

The radiographs were traced manually by one investigator and checked by another. The cephalometric measurements were made using the program Measurement and Cephalometric Tracing System (SMTC). Cephalometric landmarks and linear and angular measures were performed as outlined by Silva Filho et al.[13]

Random error was defined by Dahlberg's formula and systematic error was examined by the intraclass correlation test, duplicating measures in 20 randomly selected radiographs, 10 from each group. Student's t-test at 95% confidence was employed for statistical analysis of differences between groups.

RESULTS

Error analysis revealed a random error between 0.18 (1-NA) to 1.34 (Co-A) and systematic error (intraclass correlation) revealed an excellent correlation ($r=0.75$- 0.98, $p<0.001$) for all measures except Co-A, which exhibited a fair degree of correlation ($r= 0.68$, $p<0.01$).

Direction of facial growth and facial height

A comparative analysis of the GnSN angle, which defines the resultant vector of the antero-inferior growth of the mandible, showed a more smoothly closed GnSN angle (P=0.05) in the loss group (mean= 65.2°, SD=5.5°) compared to the control group (mean = 67.2°, SD = 3.8°).

The OclSN angle, which defines the occlusal plane from the cranial base, showed a mean of 12.6° (SD=6.6) in the control group, and 5.6º (SD=5.7°) in the loss group, demonstrating that bilateral loss of first molars causes a nearly 6º (P=0.0001) counterclockwise rotation of the occlusal plane.

The GoGnSN angle, which provides insight into the behavior of the mandibular base relative to the cranial base, showed a mean of 32.3° (SD= 5.0°) in the control group and 31.2° in the loss group (SD= 6.3), with no statistically significant difference (P = 0.21). However, LAFH, which is the linear expression of lower face height, where the mean value obtained for the control group was 70.8 mm (SD = 5.6 mm), and for the loss group, 68.6 mm (SD = 5.7 mm), revealed that bilateral loss of first molars causes a mild, statistically significant (P = 0.048) decrease in LAFH.

Anteroposterior maxillomandibular relationship

Comparative analysis between the control group and the group with bilateral loss of first molars revealed that the anteroposterior maxillo-mandibular relationship did not undergo significant change due to the loss.

Regarding NAP measure, which aids in qualifying maxillary protrusion in relation to total facial profile, its mean value in the control group was 5.1° (SD= 3.8°), and in the loss group, 4.4° (SD= 7.1º). This difference was not statistically significant (P = 0.39).

The SNA angle, which defines the position of the maxilla in relation to the cranial base, yielded a value of 83.6° (SD= 4.1°) in the control group, and 83.5º (SD= 4.2) in the loss group, with no significant difference (P = 0.49). A similar behavior was noted in analyzing the anteroposterior position of the mandible in relation to the skull base, which is obtained by means of the SNB angle. The mean value obtained in the control group was 79.8 ° (SD= 3.9°), and in the loss group, 80.2º (SD= 4.5°). This difference was not statistically significant (P= 0.34). As a result, there was no significant difference (P = 0.27) in ANB angle. Control group mean was 3.7° (SD = 3.0°) and loss group mean, 3.3° (SD = 3.0°).

When linear distances were analyzed for the A-N Perp line, which relates the maxilla to the cranial base, the control group achieved a mean value of 1.1 mm (SD= 4.3 mm), and the loss group, 0.53 mm (SD = 4.1 mm), this difference was not statistically significant (P = 0.28).

As regards the numerical expression of the size of the maxilla, obtained through the Co-A distance, the control group's mean value was 93.2 mm (SD = 5.1 mm) and the loss group's, 92.7 mm (SD = 5.8 mm), P = 0.34. The size of the mandible given by the Co-Gn line was found to be 120.9 mm (SD = 6.5 mm) in the control group, and 119.9 mm (SD = 6.8 mm) in the loss group, with no statistically significant difference (P = 0.13). Consequently, the maxillomandibular differential (Mm Diff), which is the difference between the CoGn and CoA measures, was statistically similar (P = 0.13) between the control group (mean = 27.6 mm, SD = 5.0 mm) and the group with bilateral loss of lower first molars (mean = 26.4 mm, SD= 4mm).

Dental pattern

Dental pattern results showed that the AIs angle, which reflects upper incisor inclination in the basal bone, exhibited no statistically significant difference between the control group (mean= 115.3°, SD= 13.3°) and the loss group (mean= 118.3°, D.P = 9.2°).

When comparing the axial inclination of upper incisors in the alveolar bone with the aid of 1.NA angle, the mean found in the control group was 24.4° (SD= 10.1), and in the loss group, 27.9° (SD= 9.8°), once again, this difference was not statistically significant (P = 0.12).

As regards the anteroposterior position of maxillary incisors in relation to their apical base, obtained by measuring 1-NA, the control group's mean was 7.3 mm (SD= 2.8 mm), and the loss group's, 7.2 mm (SD= 3.3 mm), indicating no statistically significant difference (P = 0.46).

Concerning the axial inclination of lower incisors in the alveolar bone, obtained with the 1.NB angle, the average found in the control group was 28.4° (SD = 7.9°), and the loss group, 23.2° (SD = 7.4°). This result indicates that the lower incisors are tipped lingually due to bilateral loss of lower first permanent molars (P = 0.004). This finding is confirmed by IMPA, where there was a marked lingual inclination of lower incisors in patients with missing first molars (P = 0.003), with control group mean equal to 94.6° (SD = 8.3°) and loss group mean of 89.4° (SD = 7.1°).

Regarding the anteroposterior position of lower incisors in relation to their apical base, measured by 1-NB, the control group's mean was 7.6 mm (SD= 2.3 mm) and the loss group's, 6.4 mm (SD= 2.6 mm). Moreover, a mild retrusion was found in the mandibular incisors of patients with missing first molars (P = 0.03).

Chin

Analysis of amount of chin through P-NB highlights a similarity between the control group (mean = 2.1 mm, SD = 2.8 mm) and the group with bilateral loss of first molars (mean = 2.0 mm, SD = 2.1 mm).

DISCUSSION

The literature has long discussed the key role played by first permanent molars in maintaining the morphology of the dental arches. The 50's and 60's saw the emergence of two orthodontic schools of thought. One of these argued that first molars were instrumental in determining a normal occlusion and therefore of paramount importance in maintaining incisal relationships. For this group of researchers[4,16] the loss of first permanent molars would lead to lingual collapse of lower incisors and increased overjet and overbite, as was indeed later confirmed by cephalometric studies.[12] Conversely, the other group contended that the loss of first molars produced no detrimental effect on incisal relationships.[3,7,14]

While little has been assessed regarding morphological changes in the dental arches arising from missing lower first permanent molars, almost nothing seems to have been reported regarding dentoskeletal changes resulting from these losses in facial morphology. Studies[1,12] have reported a tendency toward increased overjet and overbite associated with retroclination of the lower incisors

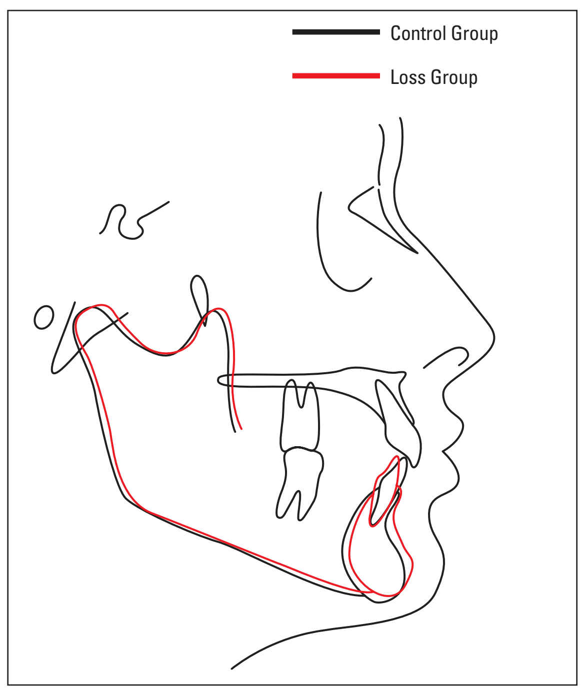

FIGURE 1 - Mean differences observed between the control group (black tracing) and the group with bilateral loss of lower first molar (red tracing).

TABLE 1 - Mean, standard deviation (SD), mean differences "t" and "P" values used to analyze differences between the control group and the group with bilateral loss of lower first molars.

	Control group (n = 34)		Bilateral loss group = 34)		Difference Mean	t-value	p-value
	Mean	SD	Mean	SD			
Facial growth direction							
GnSN	67.2°	3.8°	65.2°	5.5°	2.0°	1.64	0.05 *
Ocl SN	12.6°	6.6°	6.9°	5.6°	5.7°	3.83	0.0001 **
GoGnSN	32.3°	5.0°	31.2°	6.3°	1.1°	0.80	0.21 (ns)
LAFH	70.8 mm	5.6 mm	68.6 mm	5.7 mm	2.2 mm	1.60	0.048 *
NAP	5.1°	6.9°	4.4°	7.1°	0.7°	0.39	0.39 (ns)
Max-mand rel. A-P							
SNA	83.6°	4.1°	83.5°	4.2°	0.1°	0.02	0.49 (ns)
SNB	79.8°	3.9°	80.2°	4.5°	-0.4°	-0.39	0.34 (ns)
ANB	3.7°	3.0°	3.3°	3.0°	0.4°	0.58	0.27 (ns)
A-N perp	1.1 mm	4.3 mm	0.53 mm	4.1 mm	0.57 mm	0.56	0.28 (ns)
CoA	93.2 mm	5.1 mm	92.7 mm	5.8 mm	0.5 mm	0.38	0.34 (ns)
CoGn	120.9 mm	6.5 mm	119.9 mm	6.8 mm	1.0 mm	1.09	0.13 (ns)
Mm Diff.	27.6 mm	5.0 mm	26.4 mm	4.0 mm	1.2 mm	1.10	0.13 (ns)
Dental Positioning							
Ais	115.3°	13.3°	118.3°	9.2°	-3.0°	-1.07	0.14 (ns)
1.NA	24.4°	10.1°	27.9°	9.8°	-3.5°	-1.18	0.12 (ns)
1-NA	7.3 mm	2.8 mm	7.2 mm	3.3 mm	0.1 mm	0.09	0.46 (ns)
1.NB	28.4°	7.9°	23.2°	7.4°	5.2°	2.74	0.004**
1-NB	7.6 mm	2.3 mm	6.4 mm	2.6 mm	1.2 mm	1.90	0.03 *
IMPA	94.6°	8.3°	89.4°	7.1°	5.2°	2.75	0.003**
Chin							
P-NB	2.1 mm	2.8 mm	2.0 mm	2.1 mm	0.1 mm	0.10	0.45 (ns)

ns = non-significant.
* P<0.05.
** P<0.01.

12 to 18 months after the loss of lower first permanent molars.

The findings of this study corroborate the results of previous studies,[1,11,12] which showed a marked influence of bilateral loss of lower first permanent molars on the positioning of lower incisors (Table 1, Fig 1). Cephalometric evaluation comparing the two groups—control and loss—shows that the bilateral loss of lower first permanent molars causes an approximate 5° retroclination of lower incisors both in terms of 1.NB, which assesses the angulation of lower incisors through a craniomandibular reference, and IMPA, which assesses the positioning of mandibular incisors relative to the mandibular plane. However, the group cross-sectional analysis used in this study did not disclose any changes in the positioning of the upper incisors, which confirms the clinical data of Normando et al[10] and diverges from the longitudinal cephalometric data[12] that point to an increase in the protrusion of upper incisors one year after the loss of lower first permanent molars.

It seems reasonable to believe, however, that the influence of bilateral loss of lower first permanent molars, although on a smaller scale, is not confined only to the anteroposterior position of lower incisors (Fig 1). The group with bilateral loss also displayed changes in several measures that make up the vertical analysis of the face. Table 1 portrays a slightly decreased lower anterior face height (LAFH) in the loss group, substantiated by a decrease in the GnSN angle and a counterclockwise rotation of the occlusal plane. Although these cephalometric data do not lend support to previous studies,[1] they reinforce the common clinical evidence regarding the loss of vertical dimension that results from bilateral loss of first permanent molars.

Evidently, from a scientific point of view, a confident study of the influence of tooth loss on dentoskeletal development should be conducted by means of a longitudinal evaluation. However, ethical requirements render the adoption of this methodology impossible, leaving to investigators only those evaluations of a cross-sectional nature, along with the obvious disadvantages of working with two samples composed of different individuals. In the present investigation several measures were adopted in order to make it as reliable as possible, among which one should highlight the use of patients with no potential for growth and matched for age and gender.

Another point to be discussed focuses on the fact that cephalometric studies generally use as control group subjects with normal occlusion. In this study, the sample that comprised the group with missing first permanent molars was not obtained through an epidemiological survey in a random population, but rather from a dental office sample. It is reasonable to believe that if a patient seeks orthodontic treatment, they probably present with an occlusal problem. Therefore, in order to obtain a control group that could be different from the experimental group in terms of the variable of interest, i.e., bilateral loss of lower first permanent molars, a control sample was used which consisted of individuals who sought orthodontic treatment without, however, having lost any teeth.

CONCLUSIONS

The following conclusions can be drawn based on the results of this study:

1. Bilateral loss of lower first permanent molars did not affect the anteroposterior maxillomandibular relationship, the dental pattern of the upper dental arch or the chin.
2. Bilateral loss of lower first permanent molars can interfere with the direction of growth, leading to a counterclockwise rotation of the occlusal plane, and a mild decrease in lower face height, and with the dental pattern of the lower arch, resulting in a steep lingual inclination and a mild retrusion of lower anterior teeth.

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