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Post-surgical effects on the maxillary segments of children with oral clefts: New three-dimensional anthropometric analysis

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ABSTRACT

This study aimed to use new three-dimensional (3D) anthropometric analyses to verify the post-surgical effects on the maxillary segments of children with unilateral cleft lip and palate. The sample was composed by digitized dental models of 60 children with unilateral complete cleft lip and alveolus (UCLA) and complete unilateral cleft lip and palate (UCLP). The impressions were taken before cheiloplasty (T1), after cheiloplasty (T2), and after palatoplasty (T3). The 3D anthropometric analyses of digitized dental casts were obtained through a specific software. Intragroup changes were applied paired *t* test and Wilcoxon test (UCLA group) and for the UCLP group, repeated-measures analyses of variance followed by the Tukey test. For intergroup analyses, an independent *t* test and Mann–Whitney test were used. The palatal dimensional changes of UCLA group showed that the distances I–C, I–T′, and I–T significantly increased after cheiloplasty ($p = 0.0002$, $p = 0.0007$ and $p < 0.0001$, respectively). In the UCLP group, the I–C′ distance statistically decreased in the post-surgical periods ($p < 0.0001$), while the I–T distance increased ($p < 0.0001$). The I–C distance increased after cheiloplasty ($p < 0.0001$). The I–T′ distance increased between T2 and T3 with statistically significant differences ($p = 0.0037$). The intergroup analysis of palatal development (T2-T1) showed that the distances I–C′ and I–T′ demonstrated a reduction of the dental arches growth of UCLP group compared with the UCLA group, with statistically significant differences. The new 3D anthropometric analysis showed that the development of the maxillary segments changed after surgical repair. The UCLP group demonstrated a reduction of the dental arches growth compared with the UCLA group.

1. Introduction

In dentistry, researchers use digital anthropometry to analyze the dental arch development of children with cleft lip and palate (CLP) undergoing reparative plastic surgeries such as cheiloplasty and palatoplasty (Sakoda et al., 2017; Falzoni et al., 2016; Jorge et al., 2016). These surgical procedures are indispensable methods for the anatomic and functional rehabilitation performed usually at 3 months (cheiloplasty) and 12 months (palatoplasty) of life (Freitas et al., 2012).

Surgery improves the physiological and psychological aspects of these children; however, the maxilla development is influenced not only by the characteristics of the congenital defects (Chiu et al., 2011; Zhang et al., 2015), but also by the surgical procedures carried out in early childhood (Falzoni et al., 2016; Shi & Losee, 2015; Zhang et al., 2015). The evidence of changed maxillary growth could be analyzed through dental casts with the benefit of performing a longitudinal following-up of the rehabilitative protocol (Fernandes et al., 2015) without exposure to ionizing radiation.

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The early analysis of palatal growth enables verifying how each cleft type behave after the surgical procedures (Sakoda et al., 2017) and can suggest the surgical technique and time most indicated for the correction of each cleft type, thus modifying rehabilitative protocols (Fernandes et al., 2015). This would ensure more appropriate growth, and consequently, harmony between esthetic and functional factors. Therefore, this study aimed to use new 3D anthropometric analyses to verify the post-surgical effects on the maxillary segments in children with unilateral cleft lip and palate.

2. Material and methods

This study was submitted to and approved by the Institutional Review Board regarding the ethical aspects. A total of 150 dental casts were obtained through the files of the Hospital for the Rehabilitation of Craniofacial Anomalies, University of São Paulo, Brazil (HRAC/USP). The rehabilitation protocol regarding lip repair was performed with Millard's technique around 3 months of age. Complete palate repair was performed with Von Langenback's technique around 12 months. Inclusion criteria were children of either sex with unilateral complete cleft lip and alveolus (UCLA) and unilateral complete cleft lip and palate (UCLP). Exclusion criteria were children with syndromes or those without complete dental documentation.

Sample size calculation considered the study of Harila et al. (2013) with a standard deviation of 1.83 mm. Considering the level of significance of 5%, test power of 80%, and the minimum difference to be clinically detected of 1.4 mm, the minimum sample size was 28 children. Thus, the study sample comprised 30 children with UCLA (12 boys and 18 girls) and 30 children with UCLP (17 boys and 13 girls). The dental casts of each child were obtained at the following periods: T1, before cheiloplasty (UCLA and UCLP groups); T2, after cheiloplasty (UCLA and UCLP groups); and T3, after palatoplasty (UCLP group).

The dental casts were digitized (Scanner 3Shape R700 Scanner, Copenhagen, Denmark) (Sakoda et al., 2017; Falzoni et al., 2016; Jorge et al., 2016) and the anthropometric analyses were performed by the software of a stereophotogrammetry system (Mirror Imaging Software, Canfield Scientific Inc., Fairfield, NJ, USA) in the Laboratory of Functional Anatomy of the Stomatognathic System, University of Milan, Italy (Céron-Zapata et al., 2016; De Menezes et al., 2016). Anatomic landmarks and anthropometric measurements were: I–C (anterior inter-segment distance: interincisor point to the point of eruption of the primary canine of the greater segment); I–T (anterior-posterior inter-segment distance: interincisor point to tuber of the greater segment); I–C′ (anterior intra-segment distance: interincisor point to the point of eruption of the primary canine of the lesser segment); and I–T′ (anterior-posterior intra-segment distance: interincisor point to tuber of the lesser segment) (Fig. 1 A–B). All measurements were performed by a trained and calibrated examiner as in previous studies (Falzoni et al., 2016; Jorge et al., 2016; Sakoda et al., 2017; Fuchigami et al., 2017; Shetty et al., 2017).

All statistical analyses were performed with GraphPad Prism software (Prism 5 for Windows, version 5.0; GraphPad Software, Inc.) with a level of significance of 5%. The intra-examiner error was analyzed through repeated-measures analysis 15 days after the first measurements in one-third of the sample, randomly selected. To analyze the systematic and casual error, a paired t test and Dahlberg's formula were respectively used. Data distributions were verified for all variables; for normally distributed values, means and standard deviations were calculated, and inferential parametric tests were used. Otherwise, medians, interquartile amplitudes and non-parametric tests were used. To verify the intragroup changes in the UCLA group, a paired t test and Wilcoxon test were applied. In the UCLP group, repeated-measures analysis of variance followed by the Tukey test were applied. The intergroup comparisons used an independent t test and the Mann–Whitney test.

3. Results

The median ages (in years) of the children were verified at all study periods. In UCLA group, the median ages were 0.29 and 1.74 respectively at T1 and T2. The median ages of UCLP group were 0.29 (T1), 1.08 (T2), and 2.25 (T3). To assess reproducibility, the intra-examiner error was analyzed, and showed no statistically significant differences in the repeated-measures analysis ($p > 0.05$).

The palatal dimensional changes of the UCLA group showed that the distances I–C, I–T′, and I–T significantly increased after cheiloplasty (Table 1). In the UCLP group, the I–C′ distance statistically decreased in the post-surgical period, while the I–T distance increased. The I–C distance increased after cheiloplasty, with statistically significant differences. The I–T′ distance increased between T2 and T3 with statistically significant differences (Table 2). Table 3 displays the intergroup analysis of palatal development (T2-T1) and shows that the distances I–C′ and I–T′ demonstrated a reduction of the dental arch growth in th e UCLP group compared with the UCLA group, with statistically significant differences (Table 3).

4. Discussion

Currently, digital anthropometric analysis is a viable alternative to conduct studies to verify the development of the dental arches in children with cleft lip and palate undergoing reparative surgical procedures (Carrara et al., 2016; Falzoni et al., 2016; Sakoda et al., 2017). The 3D measurements can verify the differences between children with and without congenital orofacial anomalies

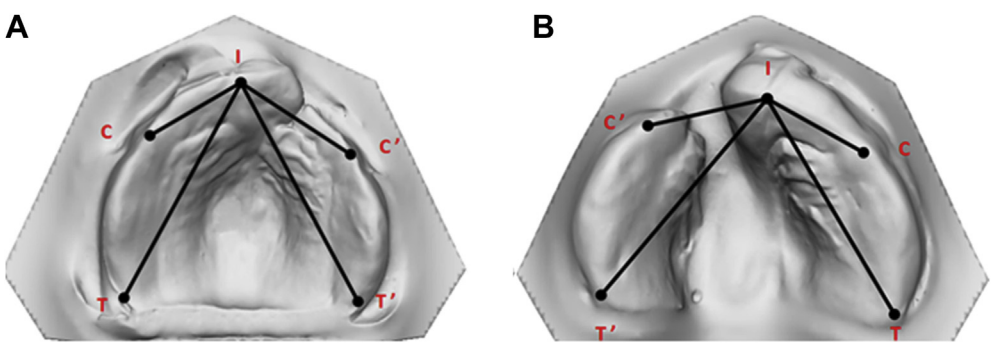

Fig. 1. (A, B) Anatomic points of dental arches. (A) Dental arch of unilateral complete cleft lip and alveolus (UCLA). (B) Dental arch of unilateral complete cleft lip and palate (UCLP).

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