European Journal of Orthodontics 31 (2009) 64–67
doi:10.1093/ejo/cjn068
Advance Access publication 5 November 2008

The effect of Delaire cheilorhinoplasty on midfacial growth in patients with unilateral cleft lip and palate

Rosario Rullo, Gregorio Laino, Marisa Cataneo, Nicoletta Mazzarella, Vincenzo Maria Festa and Fernando Gombos
Department of Odontostomatological, Orthodontical and Surgical Sciences, Second University of Naples, Italy

SUMMARY The aim of this research was to evaluate the effect of the Delaire surgical technique on the midfacial morphology in a group of subjects with a congenital unilateral cleft of lip and palate (UCLP), prior to orthodontic treatment. Thirty-five UCLP (15 left and 20 right) patients (16 males and 19 females, mean age 7.03 ± 0.9 years; age range 8.7–5.0 years), treated for the correction of congenital malformation, were retrospectively selected. Analysis of midfacial growth was undertaken on lateral cephalograms, and the data were compared with reference values (Ricketts analysis). A Mann–Whitney ranked sum test was used to detect significant differences between the findings and reference values. $P \leq 0.05$ was considered as significant.

The results demonstrated a retropositioning of both the maxilla and mandible (SNA and SNB $P < 0.01$) and increased mandibular development (Go–Me distance). Vertically, there was a trend to a posterior rotation of the mandible ($P < 0.01$), resulting in a hyperdivergent profile. This trend was confirmed by the increase in SpA–SpP/Go–Me ($P < 0.05$). In agreement with previous studies, the effects of surgical closure of a cleft lip might be responsible for excessive maxillary retropositioning with a downward rotation.

Introduction

Orofacial clefts are congenital malformations characterized by an incomplete shaping of those structures that separate the nasal from the oral cavity (i.e. lip, alveolus, hard and soft palate) and can affect the right, left, or both sides. These malformations are one of the most common anomalies in man with an average incidence of 1 to 2:1000 live births (Carinci *et al.*, 2000, 2003). A complete unilateral cleft lip and palate (UCLP) generally results in asymmetry of the midface; the lack of continuity in the perilabial musculature through the midline contributes to a malpositioning of the underlying osseous structures (i.e. pre and emi-maxilla), which are often underdeveloped and displaced on the affected side (Markus and Delaire, 1993; Smith *et al.*, 1995; Rullo *et al.*, 2006).

Many surgical techniques for cleft repair have been described, but the main aim of the treatment is the establishment of good function, aesthetics, and development of the facial skeleton (Schultes *et al.*, 2000). Notwithstanding this, it is often reported that the effects of surgical closure of a cleft lip, especially in subjects with a unilateral cleft, produce doubtful results due to excessive maxillary retrusion and downward rotation (Schultes *et al.*, 2000; Shi *et al.*, 2001; da Silva Filho *et al.*, 2003). A number of authors (Joos, 1995; Smith *et al.*, 1995; Rullo *et al.*, 2006) have stressed the importance of careful reconstruction of the orbicularis oris muscle, and, in general, of the perinasal mimic muscles, in order to induce adequate midface development through growth. The aim of this study was to evaluate the effect of the Delaire surgical technique on midface morphology in a group of UCLP patients prior to orthodontic treatment.

Subjects and method

Thirty-five patients (16 males and 19 females, mean age 7.03 ± 0.9 years; range 8.7–5.0 years), with a non-syndromic complete UCLP (15 left and 20 right), were selected for the study from consecutive patients who underwent surgery from 1999 to 2002, carried out by one surgeon (RR) at the Dental Clinic of the Second University of Naples, Italy.

All patients had undergone the same primary surgical protocol: the first operation was performed between 4 and 6 months of age for functional reconstruction of the nasolabial area, in accordance with the philosophy of the functional cheilorhinoplasty technique of Delaire (Markus and Delaire, 1993; Webb *et al.*, 2001). Subsequently, a functional closure of the soft palate was undertaken (Markus *et al.*, 1993) between 10 and 12 months of age, and, finally, a gingivo-alveoloplasty (Smith *et al.*, 1995) and hard palatoplasty (Markus and Delaire, 1993; Markus *et al.*, 1993; Horswell and Pospisill, 1995; Anastassov and Joos, 2001) was performed between 12 and 36 months of age. None of the patients had received primary orthopaedic treatment within the first weeks of life or alveolar bone grafting during the primary surgical period, independent of cleft width. Patients, who had commenced orthodontic treatment at the time of the study, were excluded from the sample.

Lateral cephalograms, obtained with the same radiographic machine for each patient, were digitized, by

computer, by one examiner (MC). Midfacial growth was evaluated with a computerized cephalometric analysis (OrthoCAD Cadent Limited, Carlstadt, New Jersey, USA), and the obtained data were compared with reference values (Ricketts, 1982), in order to determine the possible influence of Delaire primary surgical correction of UCLP on midfacial growth. The craniofacial variables evaluated are shown in Table 1. The Ricketts reference values were provided by the software and were matched for age and gender with the selected sample.

For the study of occlusal relationships, both the cephalograms and a clinical evaluation were used for each patient; in particular, overjet was defined as the horizontal overlap of the incisors. This was measured by means of a periodontal probe from the labial surface of the most anterior lower central incisor to the labial surface of the most anterior upper central incisor, parallel to the occlusal plane. Overjet was considered positive if the upper incisor was in front of the lower incisor and negative if the lower incisor was in front of the upper incisor.

Overbite was defined as the vertical overlap of the incisors when the posterior teeth were in contact. It was assessed on the upper central incisors by means of a periodontal probe and was considered positive when the incisors overlapped vertically and negative if they were vertically separated.

If an open bite was present (negative overbite), a single measurement was performed between the edge of the lower central incisor and that of the upper central incisor (Ciuffolo *et al.*, 2005).

Statistical analysis

In order to determine the reliability of the method, 10 radiographs were randomly selected and digitized twice using the same software, 1 month later, by the same examiner (MC). The error of the method (S_i) was calculated using the formula: $S_i = \sqrt{\left(\sum d^2 / 2n\right)}$, where d is the difference between the first and second measurements and n is the number of double determinations (Sadeghianrizi *et al.*, 2005). The greatest errors were 0.6 degrees for all angular and 1.04 mm for all linear measurements.

A Mann–Whitney signed-rank test (Sigma Stat Software, San Jose, California, USA) was used to determine statistically significant differences between the analyzed parameters and the cephalometric reference values. $P \leq 0.05$ was considered statistically significant.

Results

Sagittal variables

Cephalometric analysis showed an overall reduced cranial base length (N–Ba). The anterior cranial base (S–N) was shorter in UCLP patients compared with standard values, even though there was an apparent progressive growth increase between 9 and 12 years of age (data not shown). Evaluation of SNA and SNB demonstrated a retropositioning of both the maxilla ($P = 0.008$) and mandible ($P < 0.001$; Figure 1a). Moreover, ANB showed a skeletal Class I relationship between the two arches. Go–Me distance appeared increased in the study sample compared with the reference values (Figure 1a).

Table 1 Mean values, standard deviation (SD), and value ranges of the unilateral cleft lip and palate (UCLP) group, for linear and angular craniofacial variables compared with reference values of Ricketts analysis, according to age.

Measurments	UCLP			Ricketts reference values
	Mean	SD	Range	
Sagittal				
SNA (°)	78.36	4.34	68.0/83.3	82 ± 2
SNB (°)	75.5	3.31	67.1/80.1	80 ± 2
ANB (°)	3.35	3.0	0.3/7.5	2 ± 2
Go–Me (mm)	61.3	5.17	52.7/66.1	59.9 ± 4.7
Vertical				
S–N/Go–Me (°)	37.7	4.9	25.1/43.8	35 ± 3
SpA–SpP/Go–Me (°)	29.4	5.58	19.3/38.0	26 ± 1
Occlusal plane/Go–Me (°)	17.96	5.23	10.3/25.9	16 ± 1
Dentoskeletal				
Upper incisor/SpA–SpP (°)	90.34	7.2	73.9/101.7	109 ± 5
Lower incisor/Go–Me (°)	83.94	6.07	71.8/91.7	90 ± 5
First molar/S–N (°)	28.48	5.01	19.3/34.5	34.5 ± 1.12
Occlusal				
Molar relationship	1.34	1.57	−1.0/4.4	3 ± 3
Canine relationship	1.37	1.70	−1.2/2.8	2 ± 0.7
Overjet (mm)	0.4	2.9	−5.7/4.3	2 ± 2
Overbite (mm)	0.28	2.73	−5.3/3.8	2 ± 2

Vertical variables

Go–Me/S–N showed an increase ($P < 0.001$) in the UCLP subjects, compared with the standard values (Figure 1b). This finding marked a trend to a postero-inclination of the mandible in the UCLP group, with a prevalence of a hyperdivergent profile. This trend was confirmed by the increase ($P = 0.03$) in SpA–SpP/Go–Me (Figure 1b).

Dentoskeletal variables

The upper and the lower central incisors were retroclined (Figure 1c), a finding confirmed by the reduction in both the upper incisor/bispinal plane angle ($P < 0.001$) and lower incisor/mandibular plane angle ($P = 0.002$), when compared with normal values. The first molar was in a distal position compared with the S–N line (Figure 1c).

Occlusal variables

The molar relationship showed a prevalence to a Class I occlusion in the selected sample ($P < 0.001$; Figure 1d).

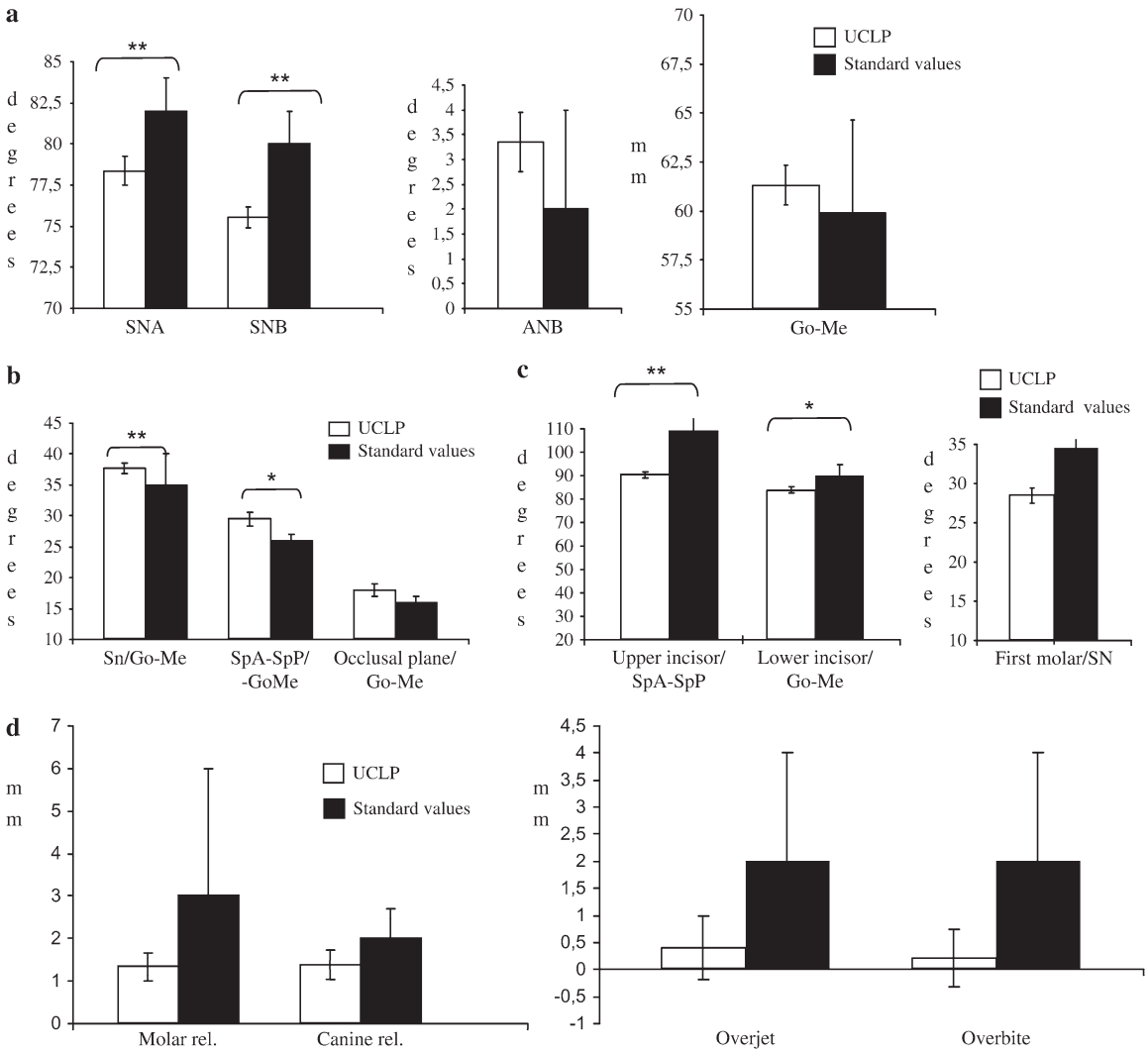

Figure 1 The mean ± standard deviation for sagittal (a), vertical (b), dentoskeletal (c), and occlusal variables (d) in unilateral cleft lip and palate (UCLP) patients compared with reference standard values of Ricketts' analysis. Statistically significant differences between the UCLP and reference values were calculated with Mann–Whitney ranked sum test. *$P \leq 0.05$; **$P \leq 0.01$.

Overbite showed a prevalence to an open bite ($P = 0.002$; Figure 1d). Moreover, overjet showed a high variance (range −5.7 to 4.3 mm) even if not statistically significant.

Discussion

The aim of this study was to investigate how the reconstruction of a UCLP, using Delaire's functional cheilorhinoplasty, could influence growth of the midface.

Surgical lip repair, in UCLP patients, may have a bone-remodelling effect on the maxilla (Liao and Mars, 2005), and the forces released by surgery are able to influence maxillary morphology more than genetic factors (da Silva Filho *et al.*, 2003) The reconstruction of a unilateral cleft lip, using Delaire's functional cheilorhinoplasty, should have an influence on growth of the midface. In fact, Markus and Delaire (1993) pointed out the importance of careful rebuilding of the orbicularis oris, and, in general, of the perilabial muscles, in order to obtain a positive growth-inducing effect on the maxilla and anterior palate (Delaire *et al.*, 1977; Joos, 1995; Markus and Precious, 1997).

Previous studies, however, have shown that surgical reconstruction of this facial malformation seems to negatively guide the development of the maxilla. In fact, closure of the lip and alveolar cleft could result in a reduction of midface development (Normando *et al.*, 1992; Kapucu *et al.*, 1996; Schultes *et al.*, 2000; da Silva Filho *et al.*, 2003; Corbo *et al.*, 2005; Dogan *et al.*, 2006; Velemínská *et al.*, 2006), especially in unilateral malformations. The present results agree, to a certain extent, with those authors. In particular, SNA showed, in the present sample, a retropositioning of the maxilla compared with standard values ($P = 0.008$; Figure 1). The more common findings, as previously reported (Normando *et al.*, 1992; Kapucu *et al.*,

1996; Corbo *et al.*, 2005; Dogan *et al.*, 2006; Velemínská *et al.*, 2006) are a significant degree of maxillary retrusion and downward rotation in UCLP patients when compared with non-cleft subjects (Normando *et al.*, 1992; Kapucu *et al.*, 1996). This finding has also been attributed to the tissue defect in the proximity of the cleft (Shi *et al.*, 2001).

Regarding dental relationships, a reduced prevalence of normal occlusion has often been reported in literature, with almost the same distribution of Angle Class II and III relationships (Schultes *et al.*, 2000), while, in the present sample, an occlusal Class I molar relationship was found in the majority of the patients ($P < 0.001$; Figure 1d).

The palatal inclination of the upper incisors (Figure 1c), that locked the lower incisors in linguoversion (Corbo *et al.*, 2005), could be due to an excessive moulding effect, consequent to the force established by the rebuilding of perilabial muscular ring. Moreover, the hyperdivergence found in the present sample, as indicated by the increase of S–N/Go–Me ($P < 0.001$; Figure 1b), could result in the development of a Class III relationship during the peak period of growth because of the inability of the posterior maxilla to control the mandibular position.

Conclusions

The findings of the present study are in agreement with the literature (Normando *et al.*, 1992; Kapucu *et al.*, 1996; Schultes *et al.*, 2000; Shi *et al.*, 2001; da Silva Filho *et al.*, 2003; Corbo *et al.*, 2005; Dogan *et al.*, 2006) which recognize the failure of cleft surgical restoration alone, in obtaining satisfactory results in the therapy of UCLP. Apart from the good aesthetic results obtained with this surgical protocol (Rullo *et al.*, 2006), a multidisciplinary approach to this pathology is necessary to improve the final results, and post-surgical orthopaedic–orthodontic treatment has to be considered as an essential phase of the UCLP treatment.

Address for correspondence

Rosario Rullo
Via de Crecchio 6
80138 Napoli
Italy
E-mail: rosario.rullo@unina2.it

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