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# A cephalometric intercentre comparison of patients with unilateral cleft lip and palate at 5 and 10 years of age

Filomena Del Guercio*, Maria Costanza Meazzini*, Giovanna Garattini**, Alberto Morabito***, Gunvor Semb**** and Roberto Brusati*
*Department of Maxillo-Facial Surgery, University of Milan, Regional Center for CLP, Departments of **Orthodontics and ***Biomedical Statistics, San Paolo Hospital, Milan, Italy and ****Oslo Cleft Team, Department of Plastic Surgery, National Hospital, Norway

SUMMARY The aim of this study was to evaluate any differences between the craniofacial growth of unilateral cleft lip and palate (UCLP) patients who underwent surgery in the Milan CLP centre with those from the Oslo CLP centre at 5 and 10 years of age.

The Milan sample comprised 88 UCLP patients (60 males, 28 females) at 5 years of age and 26 patients (17 males, 9 females) at 10 years of age all operated on by the same surgeon. The Oslo sample consisted of 48 UCLP patients (26 males, 22 females) aged 5 years and 29 patients (20 males, 9 females) aged 10 years treated by four different surgeons. Lateral cephalometric radiographs obtained for both samples were analysed and angular measurements and ratios were calculated both for the hard and soft tissues. Statistical analysis was undertaken with an unpaired *t*-test.

At 5 years of age, there were neither sagittal nor vertical hard tissue differences between the two groups. With regard to the soft tissues, only the naso-labial angle showed a statistically significant difference (Milan greater than Oslo by 5 degrees, $P < 0.01$). At 10 years of age, both SNA and ANB differences were larger in the Oslo group than in the Milan group, >2.6 degrees, $P < 0.01$ and >2.9 degrees, $P < 0.001$, respectively.

At 5 years of age, the Milan UCLP sample had the same maxillary protrusion as the Oslo group, while at 10 years of age, the Milan sample were slightly less protruded than the Oslo group.

## Introduction

Numerous cephalometric studies (Ortiz-Monasterio *et al.*, 1966; Huddart, 1969; Da Silva Filho *et al.*, 1992; Capelozza Filho *et al.*, 1996) on cleft lip and palate (CLP) patients have shown that maxillary growth in operated CLP patients is often restricted three-dimensionally.

However, no consensus has been reached as to the cause of this growth inhibition. Surgical treatment is viewed as the variable most influencing craniofacial growth (Ross, 1987; Shaw *et al.*, 1992).

It is still controversial as to which type of surgical repair most negatively influences growth. Some authors (Bardach and Mooney, 1984; Kapuçu *et al.*, 1996; Capelozza Filho *et al.*, 1996; Huang *et al*., 2002) consider lip closure as the most important factor responsible for maxillary growth restriction, while others palatal surgery (Ross, 1987; Liao and Mars, 2005).

Secondary bone grafting is carried out usually before the eruption of the canines or, in some centres, before the eruption of the permanent maxillary lateral incisors (Eldeeb *et al.*, 1986; Bergland *et al.*, 1986; Lilya *et al.*, 2000). According to Semb (1988), secondary bone grafting after 8 years of age does not have any adverse influence on antero-posterior or vertical maxillary growth, while Enemark *et al.* (1987) and Daskalogiannakis and Ross (1997) report a negative influence on vertical growth when bone grafting is performed before 10–11 years of age.

The iatrogenic effect of surgical repair, on the other hand, has been shown to be strongly linked to the experience of the surgeons and their surgical skill (Shaw *et al.*, 1992).

Intercenter studies allow for comparison between different surgical protocols applied in different centres in order to define the protocol from which the best results in terms of growth, dental occlusion, and aesthetics can be obtained (Shaw *et al.*, 1992).

The results for the Oslo centre have been previously compared with other European centres and maxillary growth of the subjects has been shown to be among the best in Europe (Molsted *et al.*, 1992).

The Milan surgical protocol consists of lip, nose, and soft palate repair at 4–6 months of age (Brusati and Mannucci, 1992) and early secondary gingivoalveoloplasty (ESGAP) at 18–36 months of age during hard palate repair. Pre-surgical orthopaedics are performed in 60 per cent of patients. The Milan ESGAP seems to allow for excellent ossification (no necessity for secondary bone grafting), but at this time, it is not possible to determine its influence on maxillary growth (Meazzini *et al.*, 2007).

The Oslo CLP team use a different surgical protocol including lip closure (Millard procedure) at 3 months of age with hard palate repair by a one-layer vomer flap without any pre-surgical orthopaedics, and posterior palate closure at 18 months of age according to von Langenbeck (Semb, 1991). The alveolar cleft is repaired with a bone graft between 8 and 11 years of age (Bergland *et al.*, 1986).

The objective of this study was to determine whether there is any difference between the craniofacial growth of unilateral cleft lip and palate (UCLP) patients treated in the Milan CLP centre and those patients from the Oslo CLP centre at 5 and 10 years of age.

## Subjects and methods

The Milan 5-year-old sample comprised 88 consecutively treated UCLP (60 males, 28 females) non-syndromic patients, with an average age of 5 years 1 month, all operated on by the same surgeon, and the 10-year-old sample 26 consecutively treated UCLP (17 males, 9 females) non-syndromic patients, with an average age of 9 years 10 months, all operated by the same surgeon. None of the subjects were omitted from the sample because of missing records or other reasons. All patients were Caucasian and of Italian origin.

The Oslo 5-year-old sample comprised 48 consecutively treated UCLP (26 males, 22 females) non-syndromic patients with an average age of 5 years 9 months and 29 consecutively treated UCLP (20 males, 9 females) non-syndromic patients, with an average age of 10 years treated by four different surgeons. All subjects were Caucasian of Norwegian origin.

Lateral cephalometric radiographs were obtained for both groups at 5 and 10 years of age. The radiographs (Figure 1) were traced by one trained operator (FDG).

The parameters evaluated on the lateral radiographs are listed in Table 1. Linear measurements were not compared as absolute values, as it was not possible to calculate the radiographic magnification obtained with different machines, since the technical parameters were not reported.

### Statistical analysis

An unpaired *t*-test was used to determine any differences between the two samples. The same experienced operator retraced, after an interval of 1 month, 25 blindly selected radiographs to avoid bias linked to groups. Method error analysis was carried out using the formula of Dahlberg (1940). For all variables, the measurement error was less than 3 per cent of the total variance. Furthermore, systematic error was estimated with a one-sample *t*-test, while random error was evaluated through the coefficient of reliability as suggested by Houston (1983).

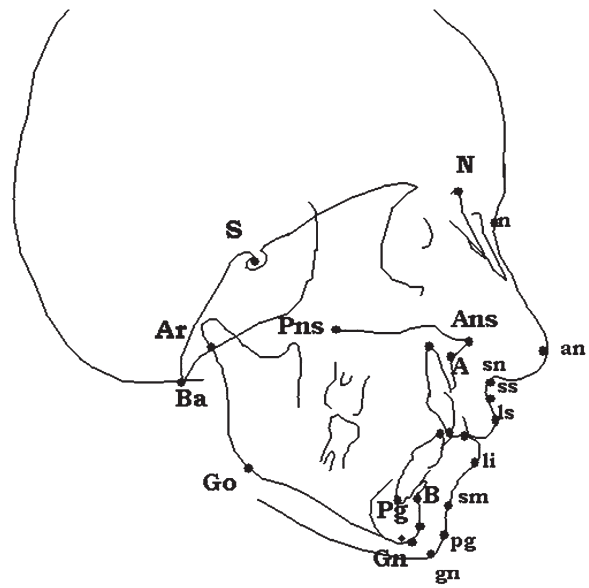


**Figure 1** Skeletal and soft tissue landmarks measured on the lateral cephalometric radiographs. S (sella) midpoint of the fossa hypophysealis; Ba (basion) most postero-inferior point of the clivus; Ans (anterior nasal spine) most anterior point of antero-posterior profile of the upper jaw; Pns (posterior nasal spine) most posterior point of the bony palate; N (nasion) anterior point at the fronto-nasal suture; Point A deepest anterior point in the concavity of the anterior maxilla; Point B deepest anterior point in the concavity of the anterior mandible; Pg (pogonion) the most projecting point in the contour of the chin; Ar (articulare) intersection of a line along the posterior border of the mandible and the inferior border of the basilar occipital bone; Go (gonion) intersection between a line bisecting the posterior and inferior borders of the mandible and the contour of the chin; Gn (gnathion) point of intersection between the contour of the chin and a line bisecting the inferior border of the mandible and a line passing through N and Pg; n (nasion) most posterior point at the fronto-nasal suture level on the soft tissues; an (anterior nasalis) tip of the nose on the soft tissues; sn (subnasalis) point of intersection between the base of the nose and upper lip on the soft tissues; ss (subspinale) most posterior point in the anterior concavity of the upper lip on the soft tissues; sm (supramentale) most posterior point in the anterior concavity of the lower lip; pg (pogonion) most anterior point of the mandibular profile in the mental region on the soft tissues; (gnathion) most inferior point of the mandibular profile in the mental region on the soft tissues; ls (labiale superioris) most projecting point, on the frontal plane, of the upper lip; li (labiale inferioris) most projecting point, on the frontal plane, of the lower lip.

## Results

### Five years of age

*Hard tissue variables*. Sagittal dimensions. There was no significant difference in maxillary prominence, although in the sagittal jaw relationship, there was a statistically significant difference between the Milan and Oslo UCLP samples (Table 1). There was no significant difference in cranial base angulation ($P > 0.05$).

Vertical dimensions. There was no significant difference in palatal inclination. Craniomandibular, intermaxillary, and mandibular angles were significantly larger in the Milan UCLP sample ($P < 0.001$).

*Soft tissue variables*. There was no significant difference in the sagittal protrusion of the upper lip, while the sagittal

**Table 1** Hard and soft tissues measurements at 5 and 10 years of age for the Milan and Oslo unilateral cleft lip and palate patients.

| | | Milan | Oslo | Mean difference |
|---|---|---|---|---|
| SNA | 5 years | 79.8 (4.1) | 80.5 (3.9) | −0.7 |
| | 10 years | 75.4 (3.7)** | 78.0 (3.6)** | −2.6 |
| S–N–Ans | 5 years | 84.1 (4.1) | 83.7 (4.0) | 0.4 |
| | 10 years | 80.5 (3.8) | 82.2 (3.9) | −1.7 |
| S–N Pns–Ans | 5 years | 11.2 (4.6) | 10.1 (3.6) | 1.1 |
| | 10 years | 11.8 (3.8)* | 9.4 (4.1)* | 2.4 |
| SNB | 5 years | 74.6 (3.2) | 74.4 (2.9) | 0.2 |
| | 10 years | 75.4 (3.4) | 75.1 (3.6) | 0.3 |
| S–N–Pg | 5 years | 74.6 (3.2) | 74.3 (3.0) | 0.3 |
| | 10 years | 76.4 (3.7) | 76.0 (3.4) | 0.4 |
| S–N Go–Gn | 5 years | 38.4 (4.4)*** | 35.5 (4.3)*** | 2.9 |
| | 10 years | 37.7 (4.4) | 36.3 (3.9) | 1.4 |
| Ar Go–Gn | 5 years | 135.4 (4.8)*** | 129.4 (4.0)*** | 6.0 |
| | 10 years | 132.7 (4.7) | 131.5 (4.5) | 1.2 |
| ANB | 5 years | 5.2 (3.3)* | 6.4 (2.9)* | −1.2 |
| | 10 years | −0.0 (3.1)*** | 2.9 (2.7)*** | −2.9 |
| Pns–Ans Go–Gn | 5 years | 27.5 (4.8)** | 25.3 (4.5)** | 2.2 |
| | 10 years | 26.1 (5.0) | 26.8 (5.2) | −0.7 |
| N–A–Pg | 5 years | 170.9 (6.7)*** | 167.5 (5.7)*** | 3.4 |
| | 10 years | 182.4 (7.0)*** | 176.0 (5.4)*** | 6.4 |
| LFH/TFH | 5 years | 60.13% | 60.13% | 0.0% |
| | 10 years | 56.8%*** | 58.3%*** | −1.5% |
| Ba–S–N | 5 years | 128.4 (4.9) | 128.5 (5.5) | −0.1 |
| | 10 years | 130.1 (5.1) | 128.9 (5.0) | 1.2 |
| Ba–S–Pns | 5 years | 60.7(5.3)*** | 64.4(5.6)*** | −3.7 |
| | 10 years | 59.7 (5.0) | 58.6 (4.6) | 1.1 |
| S–n–ss | 5 years | 85.0 (4.0) | 84.9 (3.5) | 0.1 |
| | 10 years | 87.3 (4.2) | 89.5 (3.1) | −2.2 |
| S–n–sm | 5 years | 78.9 (3.4) | 78.1 (2.6) | 0.8 |
| | 10 years | 81.2 (4.2)*** | 78.0 (2.5)*** | 3.2 |
| ss–n–sm | 5 years | 6.0 (2.6)* | 7.0 (2.0)* | −1.0 |
| | 10 years | 3.6 (2.8)*** | 6.1 (2.2)*** | −2.5 |
| ss–n–pg | 5 years | 5.5 (2.8) | 5.9 (2.3) | −0.4 |
| | 10 years | 3.9 (1.8)*** | 5.6 (1.9)*** | −1.7 |
| n–sn–pg | 5 years | 167.1 (6.0) | 167.8 (4.9) | −0.7 |
| | 10 years | 171.2 (6.4) | 167.9 (3.6) | 3.3 |
| A–N–ss | 5 years | 5.3 (3.3) | 4.4 (3.3) | 0.9 |
| | 10 years | 12.3 (2.5) | 12.3 (2.6) | 0.0 |
| an–sn–ls | 5 years | 127.7 (10.0)** | 123.0 (10.5)** | 4.7 |
| | 10 years | 119.2 (10.6) | 118.1 (12.7) | 1.1 |

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

interlip relationship in the Milan group was significantly smaller than in the Oslo sample (Table 1). Naso-labial angle was larger in the Milan UCLP sample and the difference was statistically significant ($P < 0.01$).

### *Ten years of age*

*Hard tissue variables*. Sagittal dimensions. There was a significant difference in maxillary prominence and in sagittal jaw relationship between the Milan and Oslo samples ($P < 0.01$; Table 1). The Oslo UCLP sample was more protruded than the Milan sample at the dentoalveolar level, although there was no difference in the protrusion of anterior nasal spine.

Vertical dimensions. There was no significant difference in any of the vertical dimensions.

*Soft tissue variables*. The sagittal relationship was significantly less favourable in the Milan UCLP sample compared with the Oslo UCLP sample ($P < 0.001$; Table 1).

## Discussion

The results of the present study showed no differences in maxillary protrusion at 5 years of age between the two groups.

These data confirm cephalometrically the findings obtained using the 5-year yardstick by Flinn *et al.* (2006), where the 5-year-old dental arch relationship of patients from three different centres (Oslo, Norway; Milan, Italy; and Lancaster, Pennsylvania, USA) were compared. The results showed that between the three centres there were no statistically significant differences, even though the protocols differed.

In this study, the Milan sample showed a more divergent mandibular pattern and a more open gonial angle than the Oslo sample, demonstrating a different pattern of mandibular growth. Semb (1988) reported that after bone grafting there was a tendency towards posterior rotation of the mandible. Furthermore, Trotman *et al.* (1996) found that in patients who had undergone primary grafting, the mandibular growth pattern was different from the non-grafted group with a clockwise rotation of the mandible. ESGAP might therefore explain the difference in mandibular rotation. This apparent mandibular compensation which differentiated the Milan sample from the Oslo sample at 5 years of age was not significant at 10 years of age. A possible explanation might be that by 10 years of age, most of the Oslo sample had undergone secondary bone grafting.

The present results show that at 10 years of age, the Oslo sample was significantly more protruded at the maxillary dentoalveolar level than the Milan sample, although, there was no difference in protrusion of anterior nasal spine. Soft tissue differences confirmed a larger upper lip protrusion for the Oslo sample. At present, there is no explanation for this dentoalveolar growth difference at 10 years of age. The improved growth of the Oslo group compared with the Milan sample might be related to the different surgical protocols. Intrinsic racial differences might also be a confounding factor. Although there are cephalometric studies on the Norwegian population (El-Batouti *et al.*, 1994; Axelsson *et al.*, 2003), no data exist on craniofacial growth of Italians. There is a great variability in the Italian race due to Spanish and Austro-Hungarian domination in Northern Italy and Swedish domination in Southern Italy, but no studies have analysed this variability. Certainly, long-term data will be needed for a more definitive conclusion.

## Conclusions

At 5 years of age, the Milan UCLP group appears to have the same maxillary protrusion as the Oslo sample, while at 10 years of age, the Milan UCLP sample appears to be slightly less protruded when compared with the Oslo group.

### Address for correspondence

Filomena Del Guercio
Via Sartirana 1
Bollate
Milano 20021
Italy
E-mail: filomena.delguercio@libero.it

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