Journal of Orthodontics, Vol. 29, 2002, 113–117

SCIENTIFIC SECTION

A cephalometric inter-centre comparison of growth in children with cleft lip and palate

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Abstract

Aim: To examine whether the treatment provided by the Mount Vernon Cleft Team produces craniofacial growth outcomes comparable with that of the Oslo Team.

Location: Mount Vernon Hospital, Middlesex, UK.

Design: A retrospective cephalometric investigation.

Subjects: Seventy-five Mount Vernon children and 150 Oslo children with complete unilateral or bilateral clefts of the lip and palate

Method: The subjects were matched for age, gender, and cleft type, and their radiographs were digitized. The radiographs from each site were grouped according to patient age (9–11 or 14–16) and cleft classification (bilateral/unilateral). Patients with associated craniofacial anomalies were excluded from the study.

Results: Of the four variables studied (SNA, SNPg, NGn, sNANsPG) significant differences in maxillary growth were noted for bilateral and unilateral cleft groups at 14–16 years of age. The soft tissue profile was significantly flatter in bilateral and unilateral Mount Vernon cases at 14–16 years. The craniofacial growth exhibited by the Mount Vernon patients demonstrated 3.9–5.1 degrees reduction in maxillary prominence with respect to the Oslo sample. The bilateral cases from Mount Vernon had greater anterior face heights at 14–16 years.

Conclusion: The treatment provided by the Mount Vernon Cleft team leads to a reduced maxillary prominence in children aged 14–16 years compared with the Oslo sample. This reduction is statistically significant in unilateral cleft lip and palate.

Index words: Cephalometry, inter-centre comparison, treatment outcome, unilateral and bilateral complete cleft lip and palate.

Received 3 May 2001; accepted: 3 October 2001

Introduction

It has been documented that children with repaired complete clefts of the lip and palate suffer adverse maxillary growth.[1] It appears that scarring produced by the primary surgical repair is a major aetiological factor.[2] Whatever the mechanism growth impairment becomes progressively apparent as patients reach maturity.[3] The Clinical Standards Advisory Group (CSAG), reported that compared with some centres in Europe, many aspects of cleft care in the UK are inadequate.[4] The Report suggested that there should be a common database made available for comparative audit studies on all cleft patients. Difficulties arise in comparing growth from samples of cases described in the literature, treated by different methods, due to potential biases. Thus, randomized controlled trials are the ideal in terms of research for comparing specific clinical methods. However, for obtaining an impression of the outcome of the overall package of care, including

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surgical protocols and proficiency, retrospective inter-centre studies are considered to be acceptable, providing certain criteria are met.[5] This study aims to compare the craniofacial growth of patients with unilateral and bilateral cleft lip and palate treated at Mount Vernon Hospital, Middlesex and Rikshospitalet, Oslo, Norway. It examines the hypothesis that craniofacial growth outcomes for children treated at the two centres are the same.

Materials and method

The study groups consisted of 150 patients with unilateral complete cleft lip and palate (UCLP), 50 from Mount Vernon and 100 from Oslo, and 75 patients with bilateral complete cleft lip and palate (BCLP), 25 from Mount Vernon and 50 from Oslo. Children with associated craniofacial anomalies were excluded from the study. Those with incomplete clefts and radiographs of poor quality were also excluded. The patients were divided into two groups aged 9–11 and 14–16 years. The Oslo and Mount Vernon Groups were matched for age, gender, and cleft type, and a description of the material is presented in Table 1. The resultant small numbers in the bilateral group decrease the power of the statistical comparisons. For this reason double matching was undertaken.

The Oslo protocol

Pre-surgical orthopaedics have never been performed in Oslo. The surgical protocol was as follows: patients with UCLP had lip closure (Millard technique) and hard palate closure using a single layer vomer flap at 3 months of age. Patients with BCLP had lip (straight line technique) and hard palate closure with a single layer vomer flap done in two stages, one side was closed at 3 months and the other at about 4–6 weeks later. The posterior palate was closed at 18 months using a modified von Langenbeck technique. All patients have had alveolar bone grafting in the mixed dentition. Secondary surgery was undertaken on an individual basis.

Table 1 Age, gender, and cleft types of groups.

Cleft type	Age group (years)	Mount Vernon		Oslo	
		Female	Male	Female	Male
UCLP	9–11	10	15	20	30
	14–16	10	15	20	30
BCLP	9–11	4	9	8	18
	14–16	5	7	10	14

The Mount Vernon protocol

Pre-surgical orthopaedics was not employed at Mount Vernon, but in babies with wider clefts a reduction in cleft width was encouraged using neonatal lip adhesion. This technique was introduced to the protocol in the late 1980s and has therefore been employed in some of the 10-year-old children studied. Patients with UCLP then had lip closure with the Millard approach and a vomer flap prior to 3 months of age.

Patients with BCLP also had lip adhesion where clefts were wide, followed by straight-line closure and vomer flap. The posterior palate was closed at 4–12 months using the Wardill–Kilner pushback. Alveolar bone grafting was undertaken prior to completion of root formation of the maxillary canines. At Mount Vernon too, secondary surgery was undertaken on an individual basis.

Oslo was chosen as the reference centre because it has a large database, which meant that double matching could be undertaken. This study design would increase the statistical power of the comparison.[6] A total of 50 unilateral cleft children were analysed and comparisons made with 100 Oslo children. A group of 25 bilateral cleft children were analysed and compared with 50 Oslo views. The landmarks used were the following:

- Gn Gnathion: the lowest point on the mandibular symphysis.[7]
- N Nasion: most anterior point of the frontonasal suture.[7]
- Pg Pogonion: most prominent point of the chin.[7]
- S Sella: centre of the bony crypt known as the sella turcica.[7]
- A A Point: deepest point on the anterior contour of the upper alveolar arch.[7]
- sN Soft tissue nasion: the deepest point on the frontonasal contour.[8]
- AN Apex nasalis: the most anterior point on the tip of the nose.[9]
- sPG Soft tissue pogonion: the most anterior point on the soft tissue profile of the chin.[10]

For linear measurements the distance measured was divided by the magnification factor for each unit to allow direct comparison. All cephalograms were digitized by one individual (MJG).

Forty radiographs were digitized a second time 2 weeks later to enable the cephalometric measurement error of the operator to be calculated (Table 2).

This paper seeks to examine the following four variables that were chosen to give a broad overview of

sagittal, vertical, and soft tissue growth for clinical use. Soft tissue ANB was not employed as the study is retrospective, and it was felt that soft tissue B point may be affected by open or closed lip posture.

- Sella–nasion-A point (maxillary position)
- Sella–nasion-pogonion (mandibular position)
- Nasion–gnathion (anterior facial height)
- Soft tissue nasion–apex nasalis–soft tissue pogonion (soft tissue facial convexity)

Results.

Student *t*-tests were used to compare the two samples. The results as mean values, standard deviations, confidence intervals, and *P*-values are tabulated in Tables 3–6.

Table 2 Cephalometric measurement error.

Variable	95% CI half-widths
SNA	1.81
SNPg	2.00
NGn	1.72
sNANsPG	3.33

No significant differences were found in the prominence of the mandible (SNPg) for unilateral or bilateral cleft groups. The 15-year-old bilateral cases showed significant differences in facial heights (NGn). Maxillary prominence (SNA) was significantly reduced in 15-year-olds with unilateral ($P < 0.0001$) cleft children under the care of the Mount Vernon team. The 15-year-old bilateral cleft lip and palate cases also showed a reduction in maxillary prominence. This reduction cannot be considered significant ($P = 0.0243$) in view of the multiple comparisons made**.** The soft tissue profile was similar in the 10-year-old group for unilateral cases but tended to be flatter amongst 15-year-old unilateral cases ($P = 0.0021$), and also in 10- and 15-year-old bilateral Mount Vernon patients.

Discussion

Clinical audit in cleft care should ideally include the inter-related outcomes of facial growth, nasolabial appearance, dental arch relationships, speech, hearing, and burden of care, and can be achieved in a number of ways:

1 Comparisons of records of cohorts of consecutive cases from different centres as in the Eurocleft and Scandcleft studies.[11–17]. To some extent this approach allows prospective planning for standardized record collection and blinded panel analysis to minimize analysis bias.
2 Comparison (preferably blinded) of the records of one centre with an archive of consecutive matched cases from another[6,18] and as proposed in the establishment of a European reference archive.[19]
3 Comparison of a team's records with an agreed set of normative values.[20]
4 Comparison with published reports already in the literature. This last method is probably the least reliable.[3]

This study has analysed the practice of one cleft centre over a 20 year period under the care of one cleft team. The numbers reported are small despite the fact that the centre has been one of the busier cleft units in the UK, and has had an organized and committed team approach for many years. The collection of longitudinal data, however, requires extreme rigour and depends not only on the cleft team members, but also on other members of staff, such as dental technicians, secretaries, and others involved in the storage and filing of information within a hospital. These difficulties, together with patients and their families moving area during the long treatment period, makes record collection extremely difficult. The Oslo cohort was chosen as this represents a centre with an established database that has been used in a number of previous inter-centre comparisons.

The Mount Vernon cohort was assessed for facial growth at ten and fifteen years of age as this relates to the recommendations made by the Clinical Standards Advisory Group (CSAG) for milestone records.

As in the present study, the retrusive maxilla of UK patients compared with those of some other North European centres has been observed before.[4,6,13,18,21,22] In this study the differences may be attributable to the earlier timing of surgery or to differences in surgical protocol, i.e. the use of the Wardill–Kilner pushback. The maxillary prominence of the 10-year-old Mount Vernon children compares well with the Bristol UCLP patients of the same age.[18] It has also been suggested that there are differences in the craniofacial growth of Norwegian and British children.[23]

Conclusions

The results demonstrated in this study show that there are no significant differences in facial profile and A–P

Table 3 Mean values, standard deviations, confidence intervals, and *P*-values for 10-year-olds (UCLP).

10 year UCLP	Mean MVH ($n = 25$)	SD MVH	Lower 95%CI	Upper 95%CI	Mean Oslo ($n = 50$)	SD Oslo	Lower 95%CI	Upper 95%CI	Difference	*P*-value
SNA (°)	76.03	3.923	74.616	77.444	77.5	3.56	76.488	78.512	–1.47	0.0906
SNPg (°)	74.80	4.105	73.320	76.280	76.03	2.94	75.194	76.866	–1.23	0.1465
NGn (mm)	103.44	7.615	100.694	106.186	105.04	5.68	103.426	106.654	–1.6	0.3113
Convexity (°)	139.33	6.288	137.063	141.597	139.50	3.60	138.447	140.523	–0.17	0.8900

Table 4 Mean values, standard deviations, confidence intervals, and *P*-values for 15-year-olds (UCLP).

15 year UCLP	Mean MVH ($n = 25$)	SD MVH	Lower 95%CI	Upper 95%CI	Mean Oslo ($n = 50$)	SD Oslo	Lower 95%CI	Upper 95%CI	Difference	*P*-value
SNA (°)	72.08	4.467	70.263	73.924	77.23	4.18	76.042	78.418	–5.15	<0.0001
SNPg (°)	76.72	4.679	74.789	78.651	78.04	4.17	76.855	79.225	–1.32	0.2375
NGn (mm)	116.52	8.469	113.024	120.016	116.81	7.93	114.556	119.064	–0.29	0.8869
Convexity (°)	139.84	8.060	136.513	143.167	134.13	4.63	132.814	135.446	+5.71	0.0021

Table 5 Mean values, standard deviations, confidence intervals, and *P*-values for 10-year-olds (BCLP).

10 year BCLP	Mean MVH ($n = 13$)	SD MVH	Lower 95%CI	Upper 95%CI	Mean Oslo ($n = 26$)	SD Oslo	Lower 95%CI	Upper 95%CI	Difference	*P*-value
SNA (°)	78.13	6.589	74.481	81.779	79.75	3.235	78.443	81.057	–1.62	0.3824
SNPg (°)	74.73	5.099	71.906	77.554	74.83	3.96	73.230	76.430	–0.10	0.9483
NGn (mm)	104.87	6.452	101.297	108.443	106.23	6.015	103.80	108.66	–1.36	0.5097
Convexity (°)	138.17	7. 372	134.087	142.253	134.48	4.048	132.831	136.129	+3.69	0.0873

Table 6 Mean values, standard deviations, confidence intervals, and *P*-values for 15 year olds (BCLP).

15 year BCLP	Mean MVH ($n = 12$)	SD MVH	Lower 95%CI	Upper 95%CI	Mean Oslo ($n = 24$)	SD Oslo	Lower 95%CI	Upper 95%CI	Difference	*P*-value
SNA (°)	73.23	5.72	70.289	76.171	77.20	4.68	75.224	79.176	–3.97	0.0243
SNPg (°)	75.97	4.281	73.769	78.171	76.85	4.647	74.888	78.812	–0.88	0.5352
NGn (mm)	115.36	5.35	112.609	118.111	110.09	9.665	106.009	114.171	+5.27	0.0322
Convexity (°)	136.86	8.686	132.394	141.326	133.95	4.423	132.082	135.818	+2.90	0.2178

position of the maxilla or mandible as measured on lateral cephalograms for either unilateral or bilateral cleft lip and palate patients between the Mount Vernon sample and the Oslo sample at 10 years.

Patients at age 15 years with UCLP and BCLP treated at Mount Vernon had flatter facial profile, and reduced maxillary prominence compared with a matched group of patients treated by the Oslo team. This difference was significant in the unilateral cleft lip and palate patients ($P < 0.0001$).

Acknowledgements

The authors would like to thank Marie Pinkstone, Cleft Coordinator, for her assistance with data collection and the Restoration of Appearance and Function Trust (RAFT) for their support.

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