Acta Odontologica Scandinavica, 2005; 63: 123–126

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Dental arches in six-year-old children with operated and unoperated submucous cleft palate and isolated cleft palate

ARJA HELIÖVAARA & JORMA RAUTIO

Cleft Center, Department of Plastic Surgery, Helsinki University Central Hospital, Helsinki, Finland

Abstract
The sizes of dental arches in 129 children with cleft palate were evaluated retrospectively from dental casts taken at the mean age 6.2 years (range 5.2–7.5). The material included 61 children with submucous cleft palate (SMCP) and 68 children with isolated cleft palate (ICP). Twenty of the children with SMCP were not operated on, while 41 had had surgical treatment, either palatal repair ($n = 16$, mean age at operation: 1.6 years, range 0.8–3.9) or pharyngeal flap (VPP) surgery ($n = 25$, mean age at operation: 4.5 years, range 2.6–6.2). In children with ICP, one-stage hard-palate and soft-palate closure had been done at the mean age of 1.5 years (range 1.0–2.1). Decreased maxillary intermolar widths were seen in children with SMCP after VPP, and especially after palatal repair. The children with ICP had the smallest maxillary dental arch widths. No significant differences were observed in the maxillary arch length or mandibular intermolar arch dimensions in children with SMCP or ICP. Surgery is associated with decreased maxillary intermolar arch widths in children with SMCP. Children with ICP had smaller maxillary dental arch widths than children SMCP.

Key Words: *Dental arches, isolated cleft palate, palatal repair, pharyngeal flap surgery, submucous cleft palate*

Introduction

Classic submucous cleft palate (SMCP) is identified by the triad of bifid uvula, notching of the posterior border of the bony palate, and palatal muscle diastasis [1]. Occult SMCP consists of only an abnormal levator muscle insertion into the posterior border of the palate [2]. Submucous cleft palates may be operated on if there is velopharyngeal insufficiency (VPI) or in rare cases because of prolonged problems with feeding or secretory otitis media. Although the estimated incidence of SMCP is roughly 1 : 1000, only 10% of patients may be symptomatic for VPI [3–5]. The surgical procedures for treating SMCP include palatal repair, pharyngeal flap with or without pushback, and intravelar veloplasty [2,3,6,7]. Optimally, surgery should achieve palatal and velopharyngeal closure with good speech and hearing without inhibition of growth or detrimental scarring.

There is still controversy about the type and timing of surgery as well as about the effect of surgery on growth. It has been difficult to prove that craniofacial growth in ICP is affected by the type of palatal repair [8–12]. The skeletal craniofacial morphology of 6-year-old girls with ICP and operated or unoperated SMCP is similar [13]. However, surgical treatment of SMCP with VPP in childhood has been shown to be associated with narrowing of the lower pharyngeal airway [14].

Palatal repair may affect palatal growth to some extent as the scar tissue in the palate may decrease dentoalveolar dimensions and alter occlusion [9,10,15,16]. Following VPP, a reduction in maxillary arch width at cuspids and molars and in arch length development has been documented [17]. There are no previous studies on dental arch dimensions in patients with SMCP. In children with ICP the sizes of dental arches in the primary, transitional, and permanent dentition have been reported to be smaller than in children who do not have clefts [18–21].

As surgery is considered to be related to the decreased maxillary dental arch widths in children with cleft palate, the purpose of this study was to evaluate the dental arch dimensions in children with operated

Correspondence: Arja Heliövaara, Cleft Center, Department of Plastic Surgery, Helsinki University Central Hospital, P.O. Box 266, FIN-00029 Hus, Finland. Tel: +358 9 471 87247. Fax: +358 9 471 87654. E-mail: arja.heliovaara@mbnet.fi

(Received 30 November 2004; accepted 26 January 2005)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.1080/00016350510019766

Table I. Comparability of the groups of children with submucous cleft palate (SMCP) and isolated cleft palate (ICP)

	SMCP	ICP	Total
No. of patients	61	68	129
Girls	29	38	67
Boys	32	30	62
Mean age (yrs)	6.2 (range 5.2–7.5)	6.2 (range 5.8–6.7)	
Type of operation			
No surgery	20		
Palatal repair	16	68	
Pharyngeal flap	25		
Mean age at operation			
Palatal repair	1.6 (range 0.8–3.9)	1.5 (range 1.0–2.1)	
Pharyngeal flap	4.5 (range 2.6–6.2)		

and non-operated submucous cleft palate. In addition, the aim was to compare the dental arch dimensions in the children with SMCP and ICP.

Material and methods

The patients comprised 129 Finnish children with cleft palate (61 with submucous cleft palate and 68 with isolated cleft palate) who had attended the Cleft Center, Department of Plastic Surgery, Helsinki University Central Hospital during 1980–1995. In all patients, diagnoses of submucous cleft palate were verified in the Cleft Center either clinically or by nasopharyngoscopy. Patients with combined clefts or syndromes were excluded, as were the children with SMCP who had undergone two operations: first palatal repair and, subsequently, pharyngeal flap surgery ($n=25$). In addition, the ICP patients with secondary operations were excluded. The comparability of the groups is given in Table I.

Twenty of the children with SMCP were unoperated, and 41 had had surgical treatment. The techniques for surgical treatment consisted of either palatal repair ($n=16$, mean age 1.6 years, range 0.8–3.9) or pharyngeal flap surgery ($n=25$, mean age 4.5 years, range 2.6–6.2). Palatal operations were earlier done using the Veau–Wardill–Kilner V-Y pushback operation or the Cronin modification with additional mucosal flaps from the floor of the nose ($n=11$) [22], and after 1992 using Bardach [23] two-flap palatoplasty ($n=3$) or Mendoza [24] minimal incision palatopharyngoplasty ($n=2$). For pharyngeal flap surgery, superiorly based flaps were used; in the first two cases Sanvenero-Rosselli, and later modified Honig superior pharyngeal flap with palatal pushback ($n=23$) [22]. One patient underwent fistula closure.

The patients with ICP were grouped into two subgroups according to extent of cleft at birth. Fifty-four of the patients had clefts of the hard and soft palate while 14 had clefts of the soft palate only. The severity of the cleft was classified from hospital records before primary surgery. In ICP patients one-stage hard-palate and soft-palate closure had been done at the mean age of 1.5 years (range 1.0–2.1 years) using the Veau–Wardill–Kilner V-Y pushback operation ($n=52$) or the Cronin modification ($n=16$). As no significant difference in dental arch dimensions was found between the ICP patients with hard and soft palate clefts and soft palate clefts alone, the ICP groups were pooled for further analysis. Neither the patients with ICP nor the patients with SMCP had received orthodontic treatment.

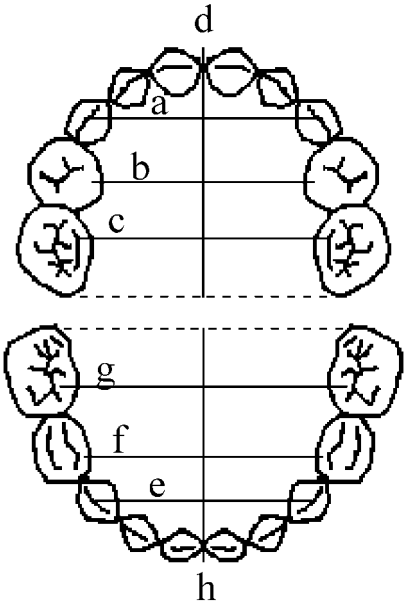

Figure 1. *Maxillary dental arch measurements*: (a) Intercanine width: distance between cusp tips of the upper deciduous canines. (b) 1st intermolar width: distance between the mesiolingual cusps or centers of the corresponding facets of the upper deciduous 1st molars. (c) 2nd intermolar width: distance between the mesiolingual cusps or centers of the corresponding facets of the upper deciduous 2nd molars. (d) Upper dental arch length: distance between a line at a tangent to the labial surfaces of the upper central incisors and a line connecting the distal margins of the upper deciduous 2nd molars. *Mandibular dental arch measurements*: (e) Intercanine width: distance between cusp tips of the lower deciduous canines. (f) 1st intermolar width: distance between the mesiolingual cusps or centers of the corresponding facets of the lower deciduous 1st molars. (g) 2nd intermolar width: distance between the mesiolingual cusps or centers of the corresponding facets of the lower deciduous 2nd molars. (h) Lower dental arch length: distance between a line at a tangent to the labial surfaces of the lower central incisors and a line connecting the distal margins of the lower deciduous 2nd molars.

Alginate impressions of maxillary and mandibular dental arches were taken at the Cleft Center at the 6-year-old check up. The measuring methods and points are those reported by Moorrees [25] and are shown in Figure 1. The measurements were taken with a sliding digital caliper (Mitutoyo) by the senior orthodontist. Deciduous maxillary molars were missing in two patients, while deciduous mandibular molars were missing in 6 patients. Two measurements were taken for 24 patients, and Student's *t*-test showed that there were no significant differences between the two

Table II. The means, standard deviations, and *p*-values of dental arch measurements in *t*-test between children with SMCP without surgery (A), with pharyngeal flap surgery (B), with palatal repair (C), and children with ICP (D). Distances are reported in millimeters

	SMCP						ICP				
	A		B		C		D		A/B	A/C	A/D
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*p*-value	*p*-value	*p*-value
Maxilla											
Intercanine	28.2	2.0	27.2	2.3	27.1	2.3	27.1	1.9	0.154	0.150	**0.034**
Intermolar (1st)	29.0	2.2	27.9	2.3	27.3	2.1	26.2	2.1	0.144	**0.032**	**0.000**
Intermolar (2nd)	34.0	2.5	32.5	2.8	31.9	2.4	31.3	3.0	**0.048**	**0.023**	**0.000**
Arch length	26.1	2.8	25.3	1.5	25.9	1.8	26.7	1.5	0.123	0.659	0.313
Mandible											
Intercanine	23.1	1.9	22.4	1.7	22.6	1.7	21.8	1.8	0.223	0.409	**0.011**
Intermolar (1st)	25.1	2.2	24.5	1.6	25.2	2.1	24.6	1.9	0.321	0.865	0.370
Intermolar (2nd)	29.1	2.5	28.2	1.7	28.9	2.0	28.0	2.1	0.207	0.786	0.108
Arch length	23.6	1.9	23.2	1.7	23.3	1.6	23.7	1.6	0.476	0.675	0.828

measurements. Student's *t*-test was used in the statistical analysis.

Results

The results are given in Table II. Surgery is associated with decreased maxillary intermolar arch widths in children with SMCP. Decreased maxillary intermolar widths were seen in children with SMCP after VPP and especially after palatal repair. The children with ICP had the smallest maxillary dental arch widths. No significant differences were observed in the maxillary arch length or mandibular intermolar arch dimensions in SMCP and ICP.

Discussion

Factors that may influence the size of maxillary dental arches in cleft palate patients include the type and timing of surgery, the skill of the surgeon, and the type and extent of the cleft. A major finding of this study was that both palatal repair and pharyngeal flap surgery were associated with decreased widths of maxillary dental arches in children with SMCP when compared to those without surgery. The fact that all patients were operated on at the Cleft Center adds validity to the comparison. On the other hand, the material of this preliminary study is small (although it was collected over 15 years), and different surgical methods had been used. In earlier studies on adult patients with ICP no difference has been found in dental arch dimensions between the Veau–Wardill–Kilner technique and the Cronin modification [15]. These techniques leave an area of denuded bone close to the alveolar process which is later covered by scar tissue. In the newer tecniques by Mendoza and Bardach, the amount of scar tissue is reduced. Jakobsson [9] has reported wider maxillary dental arches in 8-year-old children with ICP after abandonment of pushback palatal repair. According to Karsten et al. [16] the width of the upper arch in children with ICP at 5 years of age was narrower in the Veau–Wardill–Kilner group when compared to the minimal incision technique described by Mendoza. They also found that scar tissue and pits of the palate were more frequently found in the Veau–Wardill–Kilner group. The majority of the patients of the present paper were operated on using pushback techniques, but five patients had been operated on by minimal incision techniques. All VPP patients had had superiorly based pharyngeal flaps.

The age for surgical correction of SMCP depends on the diagnosis of the velopharyngeal inadequacy and therefore nearly always occurs later than the time for preferred treatment of patients with overt cleft palate [6]. In fact, many submucous clefts may remain undiagnosed into and through adulthood. This paper suggests that superior pharyngeal flap with palatal pushback may cause less maxillary arch constriction than palatal repair in children with SMCP. However, the SMCP children with VPP had been operated on at the mean age of 4.5 years, whereas the SMCP children with palatal repair had been operated on at the mean age of 1.6 years. It is thus possible that growth would later change the situation. According to Keller et al. [17], the cleft children who had undergone VPP between ages 5 and 7 years demonstrated a significant reduction in both arch width (at cuspids and molars) and arch length development compared to the control sample following VPP. In their longitudinal study, superiorly based flaps were used and patients were followed until 11 years of age.

Submucous cleft palate is anatomically a milder form of overt cleft palate. SMCP can therefore be expected to be associated with larger maxillary arch widths than ICP. The extent of the palatal cleft at birth is of importance for the dental arch widths in adult patients with ICP, whereas the reports in children with ICP are conflicting [9,19,20]. Maxillary dental arch dimensions have been found to be smallest in patients with complete clefts compared to patients with incomplete or soft palate clefts [15]. In smaller palatal clefts, not only might the amount of scar tissue be less, the scar line might also run further away from the dental arch [19]. On the other hand, patients with

larger clefts are most likely to have additional palatal operations, which may further increase scar formation. In this study, the ICP patients with additional operations and the SMCP patients with two operations were excluded.

Palatal repair and velopharyngeal flap surgery were associated with decreased maxillary intermolar arch widths in children with SMCP. However, it is obvious that when evaluating the long-term effect of surgery in SMCP, speech and nasopharyngeal function should also be included. Children with ICP had smaller maxillary dental arch widths than children SMCP.

References

[1] Calnan J. Submucous cleft palate. Br J Plast Surg 1954;6: 264–82.

[2] Kaplan EN. The occult submucous cleft palate. Cleft Palate J 1975;12:356–68.

[3] Bagatin M. Submucous cleft palate. J Maxillofac Surg 1985; 13:37–8.

[4] Garcia Velasco M, Ysunza A, Hernandez X, Marquez C. Diagnosis and treatment of submucous cleft palate: a review of 108 cases. Cleft Palate J 1988;25:171–3.

[5] Weatherley-White RCA, Sakura CY Jr, Brenner LD, Stewart JM, Ott JE. Submucous cleft palate. Its incidence, natural history, and indications for treatment. Plast Reconstr Surg 1972;49:297–304.

[6] Gosain AK, Conley SF, Marks S, Larson DL. Submucous cleft palate. Diagnostic methods and outcomes of surgical treatment. Plast Reconstr Surg 1996;97:1497–509.

[7] Åbyholm FE. Submucous cleft palate. Scand J Plast Reconstr Surg 1976;10:209–12.

[8] Bishara SE. Cephalometric evaluation of facial growth in operated and non-operated individuals with isolated clefts of the palate. Cleft Palate J 1973;10:239–46.

[9] Jakobsson OP. Repair of isolated cleft palate. A comparison of one- and two-stage surgery by dental arch measurements, cephalometry, and speech analysis. Acta Univ Upsal 1990;236.

[10] Jonsson G, Thilander B. Occlusion, arch dimensions, and craniofacial morphology after palatal surgery in a group of children with clefts in the secondary palate. Am J Orthod 1979;76:243–55.

[11] Normando AD, da Silva Filho OG, Capelozza Filho L. Influence of surgery on maxillary growth in cleft lip and/or palate patients. J Craniomaxillofac Surg 1992;20:111–8.

[12] Palmer CR, Hamlen M, Ross RB, Lindsay WK. Cleft palate repair: comparison of the results of two surgical techniques. Can J Surg 1969;12:32–9.

[13] Heliövaara A, Ranta R, Rautio J. Craniofacial cephalometric morphology in six-year-old girls with submucous cleft palate and isolated cleft palate. Acta Odontol Scand 2003; 61:363–6.

[14] Heliövaara A, Ranta R, Rautio J. Pharyngeal morphology in children with submucous cleft palate with and without surgery. Eur Arch Otorhinolaryngol. In press.

[15] Heliövaara A, Pere A, Ranta R. One-stage closure of isolated cleft palate with the Veau–Wardill–Kilner V to Y pushback procedure or the Cronin modification. II. Height, weight and comparison of dental arches. Scand J Plast Reconstr Hand Surg 1994;28:55–62.

[16] Karsten A, Larson M, Larson O. Dental occlusion after Veau–Wardill–Kilner versus minimal incision technique repair of isolated clefts of the hard and soft palate. Cleft Palate Craniofac J 2003;40:504–10.

[17] Keller KB, Long RE Jr, Gold ED, Roth MD. Maxillary dental arch dimensions following pharyngeal-flap surgery. Cleft Palate J 1988;25:248–57.

[18] Athanasiou AE, Mazaheri M, Zarrinia K. Longitudinal study of dental arch dimensions in hard and soft palate clefts. J Pedod 1987;12:35–47.

[19] Friede H, Persson EC, Lilja J, Elander A, Lohmander-Agerskov A, Soderpalm E. Maxillary dental arch and occlusion in patients with repaired clefts of the secondary palate. Influence of push back palatal surgery. Scand J Plast Reconstr Hand Surg 1993;27:297–305.

[20] Hellqvist R, Ponten B, Skoog T. The influence of cleft length and palatoplasty on the dental arch and the deciduous occlusion in cases of clefts of the secondary palate. Scand J Plast Reconstr Hand Surg 1978;12:45–54.

[21] Nyström M, Ranta R, Kataja M. Sizes of dental arches and general body growth up to 6 years of age in children with isolated cleft palate. Scand J Dent Res 1992;100:123–9.

[22] Millard DR. Cleft craft. The evolution of its surgery III. Boston: Little, Brown; 1980.

[23] Bardach J. Cleft palate repair: two flap palatoplasty, research philosophy, technique and results. In: Bardach J, Morris HL, editors. Multidisciplinary management of cleft lip and palate. Philadelphia: W. B. Saunders; 1990. p 352–65.

[24] Mendoza M, Molina F, Azzolini C, Ysunza Rivera A. Minimal incision palatopharyngoplasty. A preliminary report. Scand J Plast Reconstr Hand Surg 1994;28:199–205.

[25] Moorrees CFA. The dentition of the growing child. Cambridge, MA: Harvard University Press; 1959.