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Dental arches in submucous cleft palate: Comparison of six-year-old boys with unoperated submucous cleft palate, with operated cleft of the soft palate, and without a cleft

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Abstract

Objective. To evaluate the dental arch dimensions in 6-year-old boys with unoperated submucous cleft palate (SMCP), and to compare their dental arch dimensions with those of boys without clefts and boys with clefts of the soft palate (CP). ***Material and methods***. The sizes of dental arches in 97 boys were compared retrospectively from dental casts taken at a mean age of 6.4 years (range 5.2–8.4). The material included 34 boys without clefts, 30 with unoperated SMCP, and 33 with CP. In children with CP, palatal closure had been done by the pushback technique at a mean age of 1.5 years. ***Results***. The dental arch dimensions of the boys with SMCP were similar to those of boys without clefts, except for a decreased maxillary arch length. There was no difference in maxillary arch length between the boys with SMCP and those with CP. The boys with CP had smaller maxillary and mandibular dental arch widths than the boys without clefts and with SMCP. There were no differences in the number of boys with permanent incisors between the three groups. ***Conclusion***. Six-year-old boys with unoperated SMCP have similar dental arch dimensions as boys without clefts, except for a decreased maxillary arch length.

Key Words: *Dental arch dimensions, isolated cleft palate, submucous cleft palate (SMCP)*

Introduction

The sizes of maxillary dental arches in cleft palate (CP) patients can be influenced by several factors, including type and extent of the cleft, gender, type and timing of surgery, and skill of the surgeon. Whereas clefts of the soft palate are operated on in early childhood, the majority of children with submucous cleft palate (SMCP) may not require surgical treatment [1]. SMCPs may require surgery in the presence of velopharyngeal insufficiency (VPI) or, more seldom, because of prolonged problems with feeding or with secretory otitis media. The estimated incidence of SMCP is roughly 1:1000, but only 10% of patients may have symptoms of VPI [1–3]. Palatal repair, pharyngeal flap with or without pushback, and intra-velar veloplasty have been used for the surgical treatment of SMCP [2,4–6].

Palatal surgery can cause morphological alterations during growth, but evaluation of the roles of the intrinsic growth deficiency associated with cleft-ing, functional adaptations and growth disturbance caused by surgery on dentofacial growth is complicated. It has been difficult to prove that the type of palatal repair affects craniofacial growth in patients with CP [7–10]. Operated and unoperated patients with CP demonstrate great similarity in craniofacial morphology [11], but their morphology differs from that of patients without clefts and from those with other cleft types [12]. Children with SMCP and CP have similar craniofacial morphology, although the children with SMCP have thicker maxillary and mandibular soft tissues [13].

However, palatal surgery may affect palatal growth and alter occlusion, as the scar tissue may decrease dentoalveolar dimensions [7,8,14,15]. Surgical treatment of SMCP has been shown to be associated with decreased maxillary inter-molar arch widths in 6-year-old children compared to children with SMCP without surgery [16]. In children with CP, the sizes of dental arches in the primary, transitional,

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and permanent dentition have been reported to be smaller than in children without clefts [17–20].

In patients with clefts, anomalies in the number of teeth, in the size and shape of teeth, and in the eruption of teeth are common. This may also affect the dental arch dimensions. The prevalence of hypodontia in the permanent dentition of children with SMCP [21] and CP [22,23] is higher than in children without clefts. Abnormalities in the shape and size of deciduous and permanent teeth in children with CP are common [23], and smaller tooth size is a constant finding [23,24]. Delayed tooth formation of the permanent dentition has also been reported; in 251 Finnish children with isolated CP, the mean delay was 0.7 years [23].

To our knowledge, no previous comparisons have been made of dental arch dimensions between patients with unoperated SMCP and patients without clefts. The purpose of this study was to evaluate the dental arch dimensions in 6-year-old boys with unoperated SMCP and to compare their dental arch dimensions with those of boys without clefts and boys with operated clefts of the soft palate.

Material and methods

The study group comprised 97 Finnish boys; 34 without clefts (mean age 6.3 years, range 5.5–7.3), 30 with unoperated SMCP (mean age 6.6 years, range 5.2–8.4), and 33 with cleft of the soft palate (mean age 6.3, range 5.8–7.9).

SMCP

The boys with SMCP had attended the Cleft Palate and Craniofacial Center at the Department of Plastic Surgery of the Helsinki University Central Hospital between 1980 and 2000. In all patients, diagnoses of SMCP were verified at the Cleft Center either clinically or by nasopharyngoscopy. The children with SMCP who had had surgical treatment, palatal repair, or pharyngeal flap surgery were excluded from the study. However, five of the boys with SMCP needed operations to improve speech after the study casts had been taken. Hospital records until 2005 were used to collect data of the need for operation to treat VPI after the evaluation at 6 years of age.

Cleft palate

The boys with clefts of the soft palate had attended the Cleft Palate and Craniofacial Center between 1980 and 1993. The extension of the cleft was classified from hospital records before primary surgery. Primary surgery 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 ($n=19$) or the Cronin modification ($n=14$). Children with secondary operations were excluded, as well as all children with CP and SMCP who had combined clefts or syndromes. None of the children had received orthodontic treatment.

Boys without clefts

The group of boys without clefts was collected from the normative Finnish database at the University of Helsinki, Department of Orthodontics.

Alginate impressions of maxillary and mandibular dental arches of the cleft children were taken at the Cleft Palate and Craniofacial 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 dental casts were measured with a

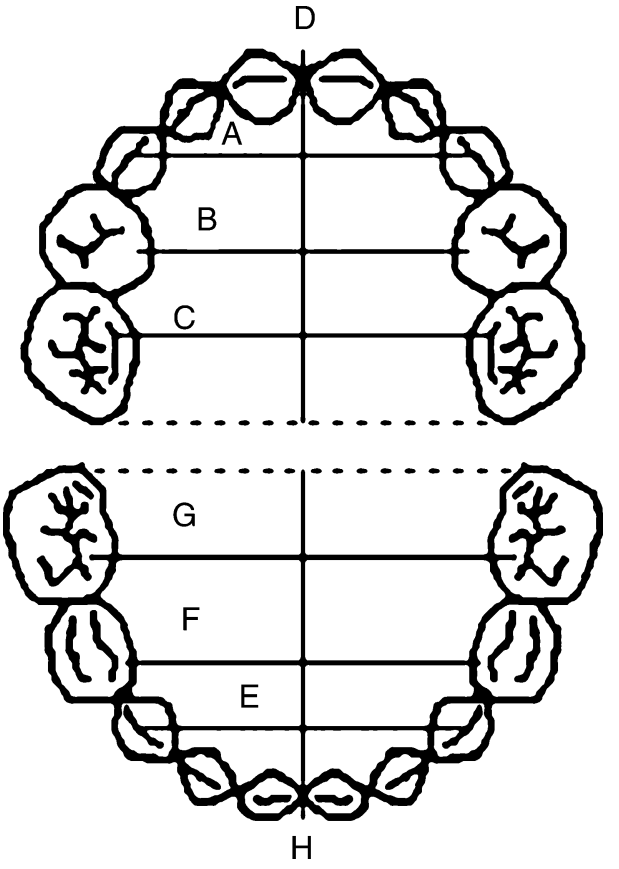

Figure 1. *Maxillary dental arch measurements:* A. Inter-canine width: Distance between cusp tips of the upper deciduous canines. B. 1st inter-molar width: Distance between the mesiolingual cusps of the upper deciduous 1st molars. C. 2nd inter-molar width: Distance between the mesiolingual cusps of the 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. Inter-canine width: Distance between cusp tips of the lower deciduous canines. F. 1st inter-molar width: Distance between the mesiolingual cusps of the lower deciduous 1st molars. G. 2nd inter-molar width: Distance between the mesiolingual cusps 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.

sliding digital caliper (Mitutoyo®) by one senior orthodontist. Double measurements were taken for 24 patients, and Student's *t*-test showed that there were no significant differences between the two measurements. Student's *t*-test was also used to compare the dental arch dimensions. The number of permanent incisors and the number of missing teeth (exfoliated, extracted, and congenitally missing) were calculated. In cases with missing teeth, the dental arch dimensions that could not be properly measured were excluded. A chi-square test was used to compare the number of patients with permanent incisors in the three study groups. Test statistics with *p*-values equal to or less than 0.05 were considered statistically significant.

The research protocol was approved by the Ethics Committee of the Medical Faculty of Helsinki University.

Result

The results are presented in Tables I and II. The dental arch dimensions of the boys with SMCP were similar to those of the boys without clefts, except for a decreased maxillary arch length. There was no difference in the maxillary arch length between the boys with SMCP and those with CP. The boys with CP had smaller maxillary and mandibular dental arch widths than those without clefts and with SMCP.

There were no significant differences between the numbers of boys with one or more maxillary or mandibular permanent incisors among the three study groups (Table II). Most missing deciduous teeth ($n=6$) were observed in the SMCP group (1 upper 1st molar, 1 lower canine, 3 lower 1st molars, and 1 lower 2nd molar). Three of the boys without clefts had missing deciduous teeth (1 upper canine, 1 upper 1st molar, and 1 lower 2nd molar). In the CP group, 2 deciduous missing teeth were observed (1 upper 1st molar and 1 upper 2nd molar).

Discussion

A major finding of this study was that the maxillary dental arch widths in boys with unoperated SMCP were similar to those in boys without clefts. It seems that without surgical treatment there is no severe growth disturbance or reduction in maxillary arch widths in children with SMCP. According to a previous study [16], 6-year-old children with SMCP have decreased maxillary inter-molar widths after velopharyngeal surgery, and especially after palatal pushback repair, when compared with the SMCP children without surgery.

On the other hand, the maxillary arch length of the boys with SMCP in the present study was smaller than in the boys without clefts, but similar to that of the boys with CP. No difference has been reported in the maxillary arch length between the operated and unoperated children with SMCP [16]. The length of the maxillary dental arch in SMCP may be shorter because of the growth deficiency associated with clefting. Although we measured purely dental dimensions, it is possible that the decreased length of the maxillary dental arch is associated with the decreased length of the hard and soft palates. In a cephalometric study of SMCP [5], in nearly all cases (90%) hard palate length was less than average for age, but was within one standard deviation. The soft palate length was short by two standard deviations in 75% of cases, and short by one standard in 90%. Wheatherley-White et al. [3] reported that there was relative shortness, poor mobility, and weakness of the soft palate in patients with SMCP. Length, thickness, and muscular integrity of the soft palate are important when speech is evaluated and velopharyngeal closure is inadequate.

Smaller stature, smaller head size, and retarded skeletal maturity have been found in patients with cleft lip and palate [12]. A shortcoming of our study was that the body size of the children was not known. However, Nyström et al. [20], when studying the

Table I. The means, standard deviations (SD), and *p*-values of dental arch dimensions in *t*-tests among boys without a cleft (NC), boys with submucous cleft palate (SMCP), and boys with cleft of the soft palate (CP). Distances are reported in millimetres (*$p<0.05$; **$p<0.01$; ***$p<0.001$)

	NC		SMCP		CP		NC/SMCP	SMCP/CP	NC/CP
	Mean	SD	Mean	SD	Mean	SD	*p*-value	*p*-value	*p*-value
Maxilla									
Inter-canine width	29.9	2.5	29.1	2.1	27.8	2	0.213	*	***
1st inter-molar width	30.3	2.6	30.1	2.1	27.3	2.4	0.709	***	***
2nd inter-molar width	34.7	2.6	34.9	2.8	31.3	2.7	0.770	***	***
Arch length	29	1.7	27.2	1.9	26.8	1.8	***	0.680	***
Mandible									
Inter-canine width	24	1.8	24.2	2.1	23.2	1.7	0.581	*	*
1st inter-molar width	26.6	2	26.1	1.6	24.9	2	0.365	*	**
2nd inter-molar width	30.4	2.1	29.9	1.7	28.6	2.2	0.343	*	***
Arch length	25.5	1.5	25.4	2.3	25.3	1.8	0.809	0.788	0.788

Table II. Number (%) and chi-square values of chi-square test of boys with one or more permanent maxillary or mandibular incisors in the groups without a cleft (NC), with submucous cleft palate (SMCP), and with cleft of the soft palate (CP)

	NC	SMCP	CP	χ^2 (df = 2)
Maxilla				
Permanent incisors	11/34 (32.5%)	11/30 (36.5%)	7/33 (21%)	1.941 ns
Mandibula				
Permanent incisors	17/34 (50%)	13/30 (43.5%)	16/33 (48.5%)	0.300 ns

size of dental arches and general body growth in Finnish children with CP up to 6 years of age, concluded that body size differed less from the non-cleft sample than the size of dental arches. In another study [26], children with CP from birth to 12 years were studied using the current Finnish relative height and weight standards. The body size for CP was nearly average, and extent of the cleft at birth did not appear to affect general body growth. The fact that all children of the present study were boys increases the validity of the comparison. However, the age range was widest in the SMCP group.

In small dental arches, crowding may cause incisors to erupt more palatinally or lingually than they do when space is available in the dental arch. According to Moorrees [25], the arch length in children without clefts increases markedly in the maxilla and slightly in the mandible during emergence of the central incisors. In the present study, no significant differences were found in the number of maxillary or mandibular permanent incisors between the study groups. Thus, the short maxillary dental arch length in boys with SMCP and CP could not be explained by retarded dental development.

It was to be expected that the children with CP had the smallest dental arch widths. The children of this study were all operated on by pushback techniques. Both the method and timing of the palatal closure have since been changed in Finland. Wider maxillary dental arches have been reported in 8-year-old children with CP after abandonment of push-back repair [7] and in 5-year-old children with CP operated on by the newer minimal incision techniques described by Mendoza, when compared to those operated on using the Veau-Wardill-Killner technique [15]. Furthermore, impairment of the nasal airway [27], early feeding difficulties, and recurrent infections are typical of children with isolated CP. Mouth-breathing in children causes a reduction in the size of both maxillary and mandibular arch widths [28,29]. Also, sucking habits may cause a reduction in maxillary arch width [28] and affect dental arch lengths by changing the incisor inclination. In the present study, however, habits could not be investigated retrospectively.

As the children of the present study were only 6 years old, it is possible that growth may later change the situation. It is also noticeable that only children with diagnosed SMCP are treated at the Cleft Center, whereas children with SMCP who are free of symptoms may remain undiagnosed even into and through adulthood. In addition, the material on the children with SMCP was small, although it was collected over 20 years.

To conclude, without surgical treatment there was no severe growth disturbance or reduction in maxillary arch widths in children with SMCP. However, maxillary arch length in boys with SMCP and in boys with CP was similar.

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