

Facial And Jaw Structures In Children Born With Cleft Lip And Palate: Effect Of The Timing And Protocol Of Surgery. A Narrative Review

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Abstract: Background: In children with cleft lip and palate, the face and jaws develop with a congenital tissue deficiency, and primary surgery may influence later growth. Objective: To summarise current evidence on facial and maxillary anthropometry in children with clefts and on the effect of the timing and protocol of primary surgery on facial growth, dental arch relationship and palatal morphology. Methods: A narrative review of three-dimensional anthropometric, dental-cast, cephalometric and morphometric studies was carried out, and quantitative data were extracted from the original publications. Results: In a study of 252 digitised dental models of children operated at 3, 5–6 or 8–10 months, children with later lip repair showed better growth of the dental arches by the age of 5 years, and the Attack index of the earliest group differed significantly from the others ($p < 0.0001$). In 66 children with unilateral cleft lip and palate, a favourable dental arch relationship was associated with female sex (OR 6.08), delayed palate repair (OR 4.77) and neonatal plates (OR 4.68), and a favourable palatal morphology with delayed palate repair (OR 9.76). A three-centre study found the palatal shape after one-stage repair closest to that of controls and after palatoplasty at about 36 months most deviant. Conclusion: Facial and maxillary growth after cleft surgery depends on the timing and protocol of surgery as well as on intrinsic factors; outcome data are partly contradictory, and surgical protocols should be evaluated with standardised three-dimensional and dental-arch indices.

Keywords: cleft lip and palate, cheiloplasty, palatoplasty, surgical timing, three-dimensional anthropometry, dental arch relationship, palatal morphology, maxillary growth.

Introduction

Cleft lip and palate is one of the most common congenital anomalies, occurring in about one in 700 live births, and its treatment requires a long multidisciplinary rehabilitation from infancy to adulthood [1]. The anomaly arises from disturbed development of the facial processes in early pregnancy and has a multifactorial aetiology involving genetic and environmental factors [2], so that the elements of the facial skeleton are formed with a morphological deficiency already before birth.

Cheiloplasty restores the anatomical integrity of the upper lip and the orbicularis oris muscle and changes the balance of muscle and soft-tissue forces acting on the maxilla [3]. Palatoplasty closes the palate and is essential for speech, but scar tissue may restrict growth of the maxilla in the sagittal and transverse directions. Multicentre comparisons have shown that facial growth and dental arch relationships differ considerably between treatment centres, and that the sequence and timing of surgery are among the most debated factors [4]. Anthropometric methods, including three-dimensional stereophotogrammetry and digitised dental casts, make it possible to measure these effects objectively. The aim of this review is to summarise current evidence on facial and maxillary anthropometry in children with cleft lip and palate and on the effect of the timing and protocol of cheiloplasty and palatoplasty on facial growth, the dental arch relationship and palatal morphology, in order to substantiate the choice of surgical and orthodontic strategies.

Materials And Methods

A narrative review of the literature was carried out. Publications were identified in the PubMed, Scopus and Google Scholar databases and in national journals using combinations of the keywords

“cleft lip and palate”, “cheiloplasty”, “palatoplasty”, “timing”, “three-dimensional anthropometry”, “dental arch relationship”, “Attack index”, “EUROCRAN index” and “palatal morphology”. Comparative studies of children with clefts and non-cleft controls, studies comparing surgical timing or protocols, three-dimensional facial and dental-cast analyses, multicentre outcome studies, systematic reviews and consensus documents published in English, Russian and Uzbek were included. For each study the design, the sample, the surgical protocol, the method of assessment and the main quantitative results were extracted from the original publication. Means, odds ratios, confidence intervals and p-values were reproduced without modification and presented in tables and figures. Because the studies differed in cleft type, age at assessment, surgical protocols and outcome indices, the evidence was synthesised descriptively, and the factors that influence maxillofacial growth were summarised in a conceptual scheme.

Results

Facial anthropometry in children with clefts. Before surgery, children with unilateral cleft lip have significantly lower philtral height, lip height, lip length and columella height on the cleft side and larger nostril and nasal sill widths than age-matched controls ($p < 0.001$) [5]. After repair, three-dimensional studies show persistent asymmetry of the nasal base, a thinner upper vermilion [6] and a wider, flatter upper lip compared with non-cleft children [7]. In adolescence, children with clefts show maxillary retrusion and posterior rotation of the jaws on lateral cephalograms [8]. The facial and jaw structures thus remain under the influence of both the congenital deficiency and the treatment throughout growth.

Timing of cheiloplasty. The effect of the timing of lip repair was studied on 252 digitised dental models of children with cleft lip and palate divided into three groups according to the age at cheiloplasty: 3 months (50 models), 5–6 months (50 models) and 8–10 months (26 models), with models obtained before lip repair (T1) and at the age of 5 years (T2) [9]. Linear segment lengths, areas and the Attack index were analysed. At T1 the group operated at 3 months had significantly smaller arch segments than the group operated at 5–6 months; at T2 several segment lengths differed between the groups, the growth of the I–C' segment differed significantly between the earlier groups and the group operated at 8–10 months ($p = 0.0003$), and the Attack index of the group operated at 3 months differed significantly from the other groups ($p < 0.0001$) (Table 1). The authors concluded that children operated later showed better growth and development of the dental arches.

Table 1. Effect of the timing of lip repair on dental arch dimensions at the age of 5 years (3D analysis of digitised models)

Group	Age at lip repair	Models	Main finding
G1	3 months	50	Smaller segments at T1; Attack index differed from G2 and G3 ($p < 0.0001$)
G2	5–6 months	50	Larger anterior segments at T1 than G1 ($p = 0.0004$ – 0.0346)
G3	8–10 months	26	Different I–C' growth from G1 and G2 ($p = 0.0003$); better arch development

Note: T1 – before lip repair; T2 – age 5 years. Data of Rando et al. (2024).

Timing and protocol of palatoplasty. The timing of palate repair and the overall protocol also influence the result. In a cross-sectional study of 66 Italian children with complete unilateral cleft lip and palate aged 10.1 ± 2.9 years, 20 of whom were treated by a one-stage protocol and 46 by a staged protocol with delayed palate repair, the dental arch relationship and palatal morphology were graded with the EUROCRAN index [10]. In multiple logistic regression, a favourable dental arch relationship was associated with female sex, delayed palate repair and the use of a neonatal plate, while delayed palate repair was the only factor associated with a favourable palatal morphology (Figure 1).

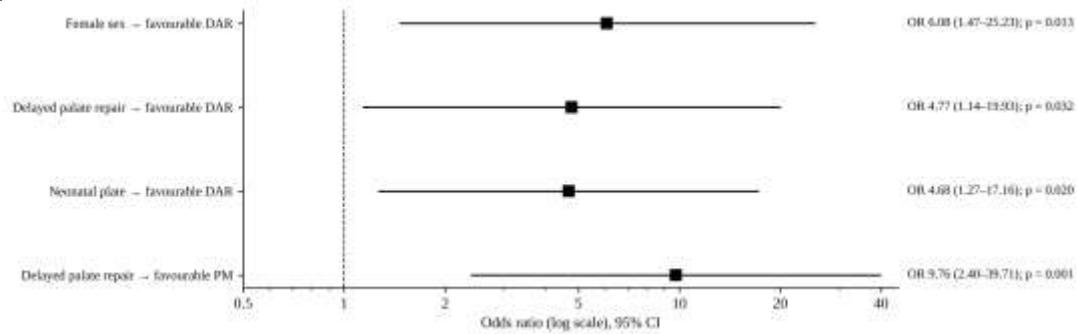


Figure 1. Factors associated with a favourable dental arch relationship (DAR) and palatal morphology (PM) in children with unilateral cleft lip and palate (odds ratios with 95% CI; data of Defabianis et al., 2023)

Contradictory evidence. Other studies, however, report different results. A three-centre study using geometric morphometrics of maxillary casts compared children treated by one-stage repair (Warsaw, $n = 53$), by two-stage repair with palatoplasty at about 11 months (Bratislava, $n = 16$) and by two-stage repair with palatoplasty at about 36 months (Prague, $n = 24$) with 60 non-cleft children [11]. All groups differed significantly from each other and from the controls; the palatal shape of the one-stage group was closest to that of the controls, whereas the group with late palatoplasty deviated most (Figure 2). In 28 patients with unilateral cleft lip and palate operated with neonatal lip repair and palatoplasty at about 7 months, the intercanine distance and dental arch length were significantly shorter than in 30 controls at both 5 and 10 years ($p < 0.001$), whereas the intermolar distance did not differ, and the mean 5-year-olds' index and GOSLON score were 2.46 and 2.89, respectively [12].

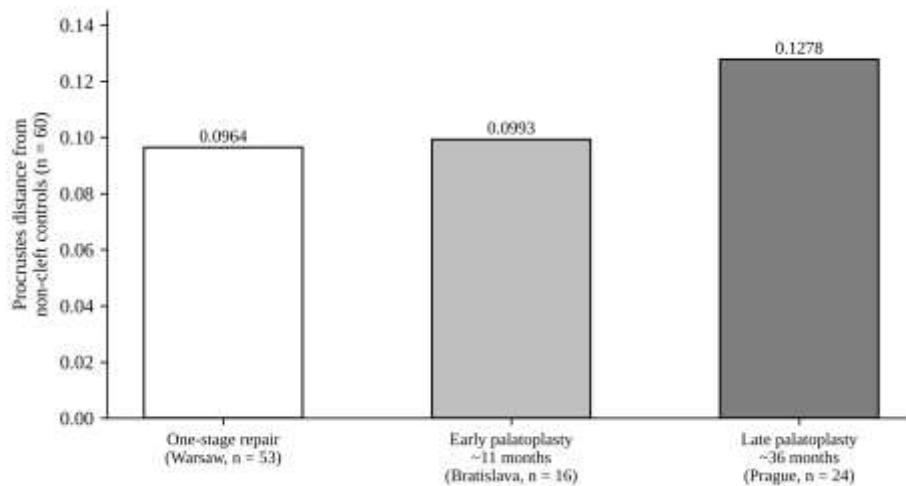


Figure 2. Deviation of palatal shape from non-cleft controls after different surgical protocols (Procrustes distances; data of Petrova et al., 2023)

Table 2. Studies on the effect of surgical timing and protocol on maxillofacial growth

Study	Sample	Protocols compared	Main result
Rando et al., 2024	252 models of children with CLP	Lip repair at 3, 5–6 and 8–10 months	Later lip repair – better arch development at 5 years
Defabianis et al., 2023	66 UCLP, 10.1 years	One-stage vs delayed palate repair	Delayed palate repair, female sex and neonatal plate – favourable outcome
Petrova et al., 2023	93 UCLP, 60 controls	One-stage; palatoplasty at 11 or 36 months	One-stage closest to controls; late palatoplasty most deviant
Novakova et al., 2024	28 UCLP, 30 controls	Neonatal lip repair, palate at 7 months	Shorter intercanine distance and arch length at 5 and 10 years

Note: CLP – cleft lip and palate; UCLP – unilateral cleft lip and palate. Compiled by the authors.

Conceptual scheme. The factors that influence the development of the facial and jaw structures in children with clefts, as identified in the reviewed studies, are summarised in Figure 3. They include intrinsic factors (tissue deficiency, cleft type and width; sex), the timing and sequence of surgery, the surgical technique and the use of orthopaedic and orthodontic measures, which together determine the growth of the maxilla and are reflected in facial anthropometry, the dental arch relationship and palatal morphology.

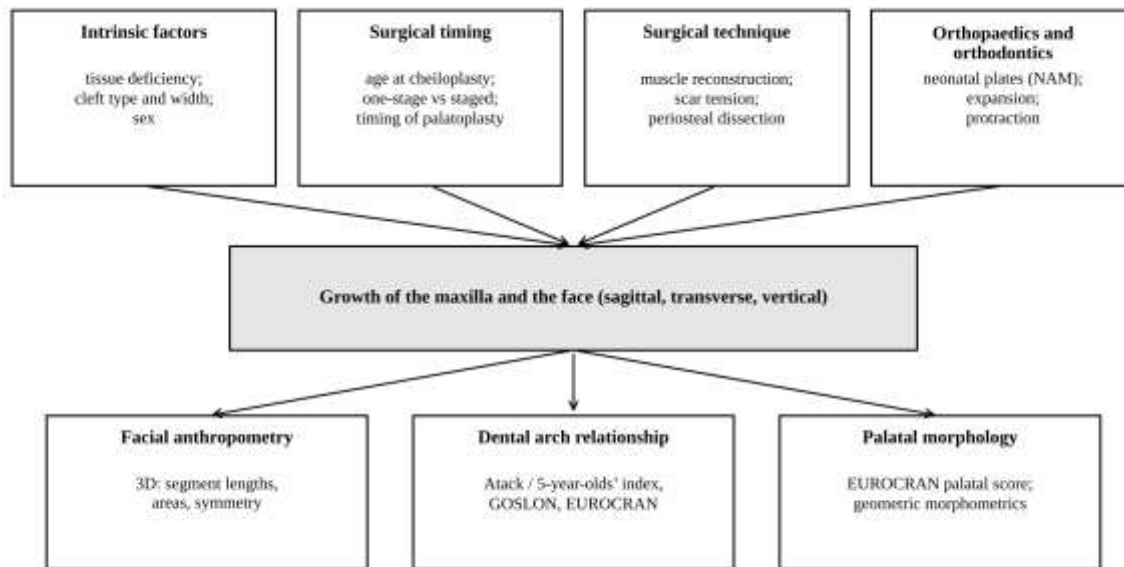


Figure 3. Factors influencing the growth of facial and jaw structures in children with cleft lip and palate and methods of outcome assessment

Discussion

The reviewed studies confirm that the structures of the face and jaws in children with clefts are affected both by the congenital deficiency and by surgical treatment, and that their growth can be measured objectively with three-dimensional anthropometry, dental-cast indices and morphometrics. The effect of surgical timing, however, is not uniform. Studies from Brazil and Italy suggest that later lip repair and delayed palate repair favour the development of the dental arches, which is consistent with the view that early surgical scarring restricts maxillary growth. In contrast, the three-centre European study found the best palatal shape after one-stage repair and the worst after very late palatoplasty, and patients with neonatal lip repair in the Czech study still had narrower and shorter anterior arches at 10 years. These differences reflect not only timing but also differences in surgical technique, surgeon experience, cleft severity, orthopaedic support and outcome measures, which explains why multicentre comparisons remain essential.

For clinical practice, timing cannot be chosen on the basis of growth alone, because delayed palate repair may compromise speech development, and the optimal protocol must balance facial growth, speech and psychosocial factors. The association of neonatal plates and female sex with better dental arch relationships indicates that orthopaedic support and individual growth potential should be considered when planning treatment and follow-up. Early orthodontic interception of transverse deficiency and crossbite is recommended in children with growth disturbances [13], although the evidence for long-term benefit of early treatment in the general population is inconsistent [14], and national studies in Uzbekistan emphasise the importance of early orthodontic treatment of children with clefts [15].

The review has limitations. The included studies are mostly retrospective or cross-sectional, use different indices and age groups and come from different countries, which limits direct comparison. Prospective multicentre studies with standardised three-dimensional anthropometric and dental-arch assessment are needed, including in cleft centres of Uzbekistan.

Conclusion

In children born with cleft lip and palate, the facial and jaw structures develop under the combined influence of the congenital tissue deficiency and surgical treatment, and three-dimensional anthropometry, dental-cast indices and morphometric analysis show persistent asymmetry of the nose and lip and deficiency of the anterior maxillary arch; the timing and protocol of cheiloplasty and palatoplasty, together with sex and the use of neonatal plates, are associated with the dental arch relationship and palatal morphology, but the published evidence is partly contradictory, with some studies favouring later lip and palate repair and others one-stage repair. It is recommended that surgical protocols in cleft centres be chosen with a balanced consideration of facial growth and speech, that outcomes be documented at standard ages with three-dimensional anthropometry and indices such as the 5-year-olds' index, GOSLON and EUROCRAN, that neonatal orthopaedics and early orthodontic follow-up be included in the rehabilitation programme, and that prospective multicentre studies of surgical timing be carried out in Uzbekistan.

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