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Rhinoplasty and Le Fort I Maxillary Osteotomy in Cleft Patients

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Introduction: Cleft patients often need orthognathic surgery to correct maxillary hypoplasia and rhinoplasty to correct nasal deformity. Rhinoplasty can be performed as a staged procedure after orthognathic surgery or simultaneously with maxillary osteotomy.

Aim: The authors evaluated need for and complications of staged and simultaneous rhinoplasties in patients with different cleft types undergoing maxillary osteotomy.

Patients and Methods: This retrospective study examined 99 (54 females) consecutive nonsyndromic patients with cleft lip/palate [23 bilateral cleft lip and palate (BCLP), 51 unilateral cleft lip and palate (UCLP), and 25 cleft palate (CP)] with a mean age of 17.8 (range: 11.5–45.3) years who had undergone Le Fort I maxillary advancement or bimaxillary osteotomy at the Cleft Palate and Craniofacial Center, Helsinki University Hospital, Finland, between 2002 and 2016. Medical charts were accessed through the hospital's archives and database.

Results: Of patients who underwent maxillary osteotomy, 45% (45/99) needed rhinoplasty (14 BCLP, 27 UCLP, and 4 CP). A significant difference ($P < 0.01$) existed in the need for rhinoplasty between different cleft types, those with BCLP and UCLP needing the most operations (60% and 53%). In 20 patients (20%), rhinoplasty was performed simultaneously with maxillary osteotomy, and in 25 patients (25%) in a second operation after osteotomy. The overall complication rate was 14%. No difference existed in complication rate in patients with or without simultaneous rhinoplasty.

Conclusions: Of cleft patients who underwent maxillary osteotomy, 45% needed rhinoplasty. Patients with BCLP and UCLP needed rhinoplasty most often. Staged and simultaneous procedures were almost equally common with similar complication rates.

Key Words: Cleft lip and palate, maxillary osteotomy, orthognathic surgery, secondary rhinoplasty

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Patients with cleft lip and palate (CLP) often require orthognathic surgery to correct maxillary hypoplasia, to establish optimal occlusion, and to gain better facial harmony. When planning maxillary osteotomy in patients with CLP, it is essential to also evaluate the nose. Maxillary osteotomy can accentuate nasal deformity and asymmetry, and an osteotomy without rhinoplasty may lead to an unsatisfactory result. Le Fort I maxillary advancement may elevate the nasal tip, leading to reduction of nasal length, increase in protrusion of the nasal tip, widening of the columellar angle, and increase in interalar width.[1,2]

Nasal deformity of patients with CLP is a complex functional and esthetic challenge. Nasal deformity is always associated with cleft lip, but its severity varies according to the type and original extent of the cleft. Despite skillful primary surgery, later rhinoplasty is often needed.[3–5] The need for and extent and timing of open rhinoplasty depends on several factors such as cleft type, nasal shape, asymmetry, obstruction, maxillary hypoplasia, and functional and esthetic wishes of the patient.

In patients with clefts and maxillary hypoplasia, it is essential to correct first the maxillary growth disturbance with orthognathic surgery. After correction of the skeletal discrepancy, the soft tissue revisions can be performed. For optimal functional and esthetic results, rhinoplasty should be delayed until facial growth is completed, and orthognathic correction has been performed. One possibility is to combine simultaneous maxillary osteotomy and rhinoplasty.

The advantages of a simultaneously performed rhinoplasty are better access during surgery and a reduced number of secondary operations.[6,7] Moreover, maxillary downfracture allows easier access to the septum and less incisions are required.[6,8,9] A limitation is the need for tube exchange during osteotomy.[6] In contrast, nasal correction after maxillary osteotomy in a second operation may have a more predictable outcome.[6] The staged procedure allows fine-tuning of the nose after the soft tissues have stabilized following osteotomy, thus giving better predictability in nasal position and morphology.[6] In addition, the operation is faster and there is less edema during rhinoplasty.[6]

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There is a paucity of literature in the field regarding the need for maxillary osteotomy and rhinoplasty and the complication rates between staged and simultaneous osteotomy and rhinoplasty in patients with clefts. One study from 2018, which examined 250 noncleft patients who underwent combined rhinoseptoplasty and bimaxillary surgery, reported an overall nasal procedure complication rate of 9.2%, whereas for isolated cosmetic rhinoplasty the rate was 6%.[10]

When planning orthognathic surgery for cleft patients with maxillary hypoplasia and crossbite, nasal esthetics and rhinoplasty are important aspects for both the operative surgeon and the patient. Major concerns include postoperative facial and nasal changes, possible need and timing of rhinoplasty, complications, and recovery from surgery. As the literature lacks information about orthognathic surgery and the need of rhinoplasty in patients with clefts, the aim of this study was to examine the need for and complications of staged and simultaneous rhinoplasties in patients with different cleft types undergoing maxillary osteotomy.

METHODS

Patients

This retrospective study examined 99 nonsyndromic patients (54 females and 45 males) with cleft lip/palate (Supplemental Table 1, http://links.lww.com/SCS/F681). All patients had undergone Le Fort I maxillary advancement or bimaxillary osteotomy for correction of maxillary hypoplasia with or without staged or simultaneous rhinoplasty to correct nasal deformity. Osteotomies and rhinoplasties were performed at the Cleft Palate and Craniofacial Center, Helsinki University Hospital, Finland, between 2002 and 2016. The initial data comprised 100 patients, but 1 patient was excluded due to temporomandibular joint endoprosthesis.

All patients had their primary and secondary cleft surgery done in the same cleft center by the same cleft team. None of the patients had had nasoalveolar molding. The lip closure was done according to the modified Millard method for unilateral cleft lip and palate (UCLP) patients and modified Mulliken method for bilateral cleft lip and palate (BCLP) patients. During the lip closure, nose repair was performed according the principals presented by McComb.[11] No open rhinoplasties were performed for babies. All patients with UCLP and BCLP had had bone grafting of the alveolar cleft, and all patients had been given orthodontic treatment.

The data from rhinoplasties, osteotomies, and associated complications were collected from medical records. Only complications requiring surgical treatment were recorded. The χ^2 test was used in statistical analyses.

Surgical Methods

Osteotomies

The osteotomies were grafted with bone grafts from the iliac crest and fixed with Leibinger Wurzburg miniplates or Matrix Orthognathic Synthes (DePuy Synthes) miniplates. Prefabricated interocclusal splints were used during the operation, but these were removed immediately afterwards. In postoperative orthodontic treatment, intermaxillary elastics were used individually for minor corrections of intercuspidation. The osteotomies were performed by 4 senior cleft surgeons.

Rhinoplasties

All (secondary) rhinoplasties were performed openly. Indication for secondary cleft rhinoplasty was cleft-related nasal aesthetics and/or nasal airway obstruction. Cartilage grafts (septum, ear/rib cartilage) were used for structural support, to improved tip definition and to augment dorsum of the nose. In this study, we use the term rhinoplasty synonymously with open secondary rhinoplasty that occurs after of facial growth is mainly completed.

RESULTS

Osteotomies

Of the 99 patients, 72 (73%) underwent only Le Fort I osteotomy and 27 (27%) underwent simultaneous sagittal split osteotomy. At the time of osteotomy, the mean age of all patients was 17.8 (range: 11.5–45.3) years. Details of patients by cleft type, sex, and age at osteotomy are given in Supplemental Table 1 (http://links.lww.com/SCS/F681). Because of severe maxillary hypoplasia with functional, esthetic, and/or social difficulties, 6 patients (2 BCLP and 4 UCLP) of this osteotomy series had early maxillary osteotomies during growth. The mean age of these patients was 12.9 (range: 11.5–14.0) years.

Rhinoplasties

Of the patients who underwent maxillary osteotomy (n = 72) or bimaxillary osteotomy (n = 27), 45% (45/99) needed rhinoplasty [14 BCLP, 27 UCLP, and 4 cleft palate (CP)]. In 20 patients (20%), rhinoplasty was performed simultaneously with maxillary osteotomy at a mean age of 18.1 (range: 14.8–27.3) years. In 25 patients (25%), rhinoplasty was done in a second operation on average 23.9 months after osteotomy at a mean age of 19.0 (range: 14.9–24.3) years. No rhinoplasties were performed simultaneously with the early osteotomies. In all patients with bimaxillary surgery, rhinoplasty was done separately. Two of the patients who had either simultaneous (1 UCLP) or staged rhinoplasty (1 UCLP), had had an earlier rhinoplasty before the osteotomy. Also, 2 of the patients who underwent maxillary osteotomy without rhinoplasty had had and earlier rhinoplasty before the osteotomy (2 BCLP).

A significant difference ($\chi^2 = 12.1053$, $P < 0.01$) emerged in the need for rhinoplasty and maxillary osteotomy between different types of clefts, those with BCLP needing the most operations (60%). The need for rhinoplasty in patients with UCLP was 53% and CP 16% (Supplemental Table 2, http://links.lww.com/SCS/F681). Most of the patients with BCLP (8/14, 57.1%) and UCLP (16/27, 59.3%) had subsequent rhinoplasties in a second operation after osteotomy, whereas most patients with CP (3/4, 75%) had simultaneous rhinoplasties. The number of rhinoplasties by cleft type and sex are given in Supplemental Table 3 (http://links.lww.com/SCS/F681). All 4 surgeons performed both simultaneous and staged rhinoplasties. Three patients (2 UCLP, 1 BCLP) underwent later minor surgical corrections to nose with fat grafts to achieve more aesthetic outcome.

The staged rhinoplasties (n = 25) were performed on average 23.9 (range: 4.5–76.2) months after osteotomy, 14.1 (range: 6.1–34.0) months in patients with BCLP (n = 8) and 29.8 (range: 4.5–76.2) months in patients with UCLP (n = 16). One patient with CP underwent primary rhinoplasty 7 months after osteotomy. One patient with UCLP who had had a simultaneous rhinoplasty with maxillary osteotomy underwent a secondary rhinoplasty 15 months postoperatively (Fig. 1).

Complications

Thirteen patients had altogether 14 complications after osteotomy. Ten complications occurred after maxillary and 4 after bimaxillary osteotomy. Among rhinoplasties, there was only 1

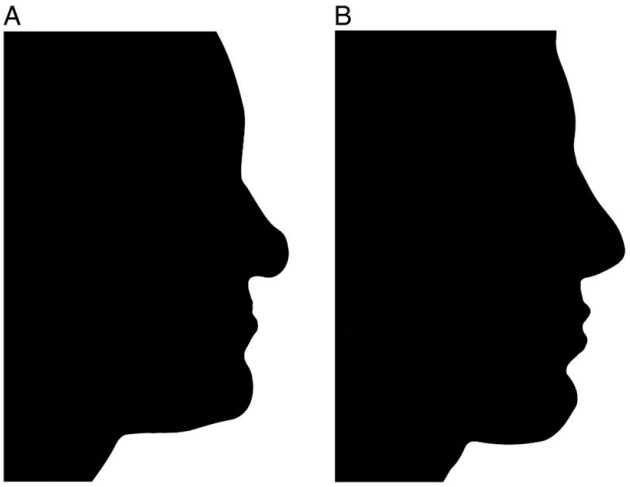

FIGURE 1. A black colored lateral facial photograph of a patient with unilateral cleft lip and palate preoperatively (A), and postoperatively (B) after maxillary osteotomy and simultaneous rhinoplasty and a later secondary staged rhinoplasty.

complication, when 1 patient with UCLP needed removal of prominent graft material from the nose. Osteotomy complications requiring surgical treatment are shown in Supplemental Table 4 (http://links.lww.com/SCS/F681). Three patients (2 BCLP, 1 CP) had the osteotomy complication after simultaneous rhinoplasty (complication rate 15%) and 4 patients (3 BCLP, 1 UCLP) after staged procedure (complication rate 16%). The difference between osteotomy complications between simultaneous and staged procedures is statistically nonsignificant ($\chi^2 = 0.0085$). Seven patients (3 UCLP, 4 CP) who had complications after osteotomy did not undergo rhinoplasty at all. One patient with BCLP sustained a burn to her collum from diathermy during osteotomy surgery.

DISCUSSION

Need for Osteotomy and Rhinoplasty

A significant proportion (14%–75%) of patients with clefts undergo orthognathic surgery.[12] The rates vary between institutions and cleft types. The need is highest for patients with BCLP, with a rate of 30.0% to 71.0%.[13–18] For patient with UCLP, the corresponding proportion is 15.6% to 50.4%.[13–15,17–19] and for patients with CP 0% to 13.2%.[13,15,17,20]

According to this study, a significant proportion (45%) of cleft patients needing osteotomy also required additional rhinoplasty. The need was greatest in patients with the most extensive clefts, that is, those with BCLP and UCLP (60% and 53%), and smallest in those with CP (16%). This is hardly surprising as patients with BCLP and UCLP often have the most pronounced secondary deformities in maxillary and nasal regions.

In patients with UCLP, the maxilla may be laterally displaced and hypoplastic, and the orbicularis oris muscles can cause asymmetric unopposed pull.[21] Together with the lack of support from the hypoplastic bony maxilla, they cause the septum to deviate to the noncleft side.[21] The nasal tip is blurry and there is obliquity of the alar facial angle.[22] In the bilateral case, the nasal septum is usually midline but deviated caudally to the less involved side of the possible lip asymmetry, the columella is distorted, and the tip projection is blurry.[21,22] Le Fort I osteotomy in cleft patients may affect the base of the nose, as it reduces the depth of the nasal aperture, leading to increased interalar width, decreases the columellar length and nasal tip projection, elevates the nasal tip, and decreases the nasolabial angle.[22,23] Previous studies in noncleft populations have shown that interalar widening is the most consistent effect on the nasolabial region of maxillary advancement.[24]

Timing of Osteotomy and Rhinoplasty

In this study, 45% of patients underwent osteotomy and rhinoplasty simultaneously and 55% as a staged procedure. All operating surgeons performed both procedures. However, simultaneous rhinoplasty was most common in patients with CP (75.0%), while staged rhinoplasty was most common in patients with BCLP (57.1%) and UCLP (59.3%). The staged procedures were used mostly for patients with the most extensive clefts who usually have severe nasal deformities and nasal asymmetries already before the osteotomy. The staged procedure allows fine-tuning of the nose after the soft tissues have stabilized post-osteotomy, better predictability in nasal position and morphology, shorter length of procedure, less edema around the nose during rhinoplasty, and no need for tube exchange during the procedure.[6,8] Unfavorable changes in the nasal profile during large maxillary movements constitute challenges for the waiting period when the operations are not done simultaneously. Disruption of the nasal support structures during osteotomy is also a challenge in simultaneous procedures.

Preoperatively, the simultaneous procedure allows the surgeon to plan and manipulate all components of the nasomaxillofacial tissues at once. Perioperatively, the simultaneous procedure gives better visibility and access during rhinoplasty.[7] Moreover, unsatisfactory nasal outcome after orthognathic surgery can be improved immediately. Postoperatively, the simultaneous procedure requires anesthesia only once and is therefore less burdensome for the patient.[6] Combining the procedures might at least in theory have financial benefits with only one surgery event required.

Deferring rhinoplasty until skeletal maturity avoids the need to anticipate changes to nasal structures as a result of maxillary movements. Early efforts to correct nasal deformity before the age of osteotomy may also cause suboptimal outcome with later corrections.[4] Possibly, the amount of maxillary advancement during osteotomy could also affect the timing of rhinoplasty, as large advancements or maxillary rotations can make it more difficult to predict the final position of the nasal base and other structures on the nose of the patient with a cleft.

In our patients, the rhinoplasty was done at a mean age of 18.6 (range: 14.8–27.3) years. Deferring rhinoplasty to late adolescence or adulthood probably also influenced our relatively low re-rhinoplasty rate (2%). Only 1 patient with UCLP who underwent simultaneous rhinoplasty and osteotomy needed later secondary rhinoplasty.

Complications

It has been stated that patients with clefts undergoing orthognathic surgery do not have higher risk for short-term complications than those without clefts.[25] The overall complication rate in this study was 14% (14 complications in 13 patients). This is in line with a previous systematic review reporting a complication rate of 12.76% in 1003 patients with CLP but also higher complication rate of 35.3% have been reported.[26,27] In our study, no difference in complication rate was present in patients with or without simultaneous rhinoplasty. The complication rate of osteotomy without simultaneous rhinoplasty procedure was 16% (4 complications), and the complication rate of osteotomy with simultaneous rhinoplasty was 15% (3 complications).

Complications after orthognathic surgery in patients with CLP are similar to those in patients without cleft.[26] The typical additional complications in orthognathic surgery in cleft patients include failure of preexisting palatal fistula, velopharyngeal impairment, closure failure of preexisting alveolar fistula, gingival recession, tooth root damage, failure of premaxillary stabilization, and neurosensory defect in the region innervated by the inferior alveolar nerve or lingual nerve.[26–28] In this study, velopharyngeal impairment was not counted as a complication, because Le Fort I osteotomy can affect velopharyngeal function in cleft patients. At risk are patients who present borderline or more severe velopharyngeal incompetence preoperatively.[29] However, in our cleft material the amount of maxillary advancement does not affect the velopharyngeal function.[30] The most important factors in reducing complications in Le Fort I osteotomy are careful patient selection, surgical planning, and selection of surgical technique.[31] In addition, patients with clefts should be informed preoperatively that they might have to undergo additional speech surgery after maxillary osteotomy[30]

We did not record any major complications such as thrombosis or pulmonary embolism. There were also no records of postoperative intranasal bleeding requiring nasal packing or reoperation and no respiratory distress requiring operations. The overall complication rate of rhinoplasties was 2%, and the revision rhinoplasty rate was also 2%, showing an overall low rate. All our nonrevisional rhinoplasties were performed openly.

Strengths and Limitations

This is a retrospective study of a governmentally supported national center. Strengths of the study include almost 100 patients with clefts who were operated on by 4 experienced senior surgeons from the same cleft center. In addition, primary and secondary cleft surgery were done in the same center. In contrast, the patients varied about type of cleft and techniques of primary and secondary surgery.

A limitation is subjectivity in indications for rhinoplasty. In addition, no cephalometric analyses were performed, and the amounts of maxillary movements were not evaluated. The extent of maxillary movement and rotation could have influenced the incidence and timing of rhinoplasty. We did not have a possibility to measure patient satisfaction after the procedures or possible changes in nasal function. Le Fort I osteotomy and simultaneous septoplasty are effective for the relief of nasal airway obstruction in patients with UCLP.[32] Moreover, a preliminary study found that nasal obstruction of cleft patients with class III occlusions improved after distraction-mediated Le Fort I without concomitant intranasal interventions.[33]

CLP and its associated maxillary and nasal deformities can have both psychosocial and functional long-term impact. Patients with clefts often are most dissatisfied with their nasal appearance, and their parents share this concern.[34] Rhinoplasty may have a significant effect on self-esteem and the overall quality of life, as shown by Roosenboom et al[35] in their study with 33 patients with cleft lip with or without cleft palate 1 year after secondary rhinoplasty. Patients' subjective outcomes following secondary cleft rhinoplasty tend to be positive with a high satisfaction rate, and 94% to 100% of patients would undergo the procedure again.[35,36]

CONCLUSIONS

Of the cleft patients who underwent maxillary osteotomy, 45% needed rhinoplasty. The frequency of rhinoplasty was highest in patients with BCLP (60%) and UCLP (53%). Staged and simultaneous procedures were almost equally common with similar complication rates.

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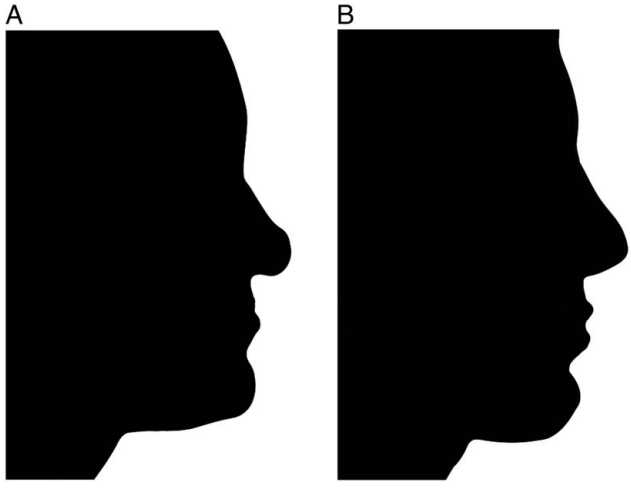

SUPPLEMENTAL DIGITAL CONTENT: TABLES

Supplemental Table 1. Patients by cleft type, gender, and age at osteotomy.

Cleft type	Males	Females	Mean age (range)	Total
BCLP	11	12	17.9 (12.7 – 27.3)	23
UCLP	27	24	17.5 (11.5 – 28.1)	51
CP	7	18	18.3 (13.8 – 45.3)	25
Total	45	54	18.34 (15.3 – 19.5)	99

Supplemental Table 2. Number (%) of patients who required rhinoplasties by cleft type.

Cleft type	Total	Needed rhinoplasty (N/%)	Simultaneous rhinoplasty (N/%)
BCLP	23	14 (60.1)	6 (42.9)
UCLP	51	27 (52.9)	11 (40.7)
CP	25	4 (16)	3 (75.0)
Total	99	45 (45)	20 (44.4)

Supplemental Table 3. Rhinoplasties divided by cleft type and gender.

	Rhinoplasty / No rhinoplasty			
Cleft type	**BCLP**	**UCLP**	**CP**	**All cleft types combined**
Gender				
Male	**7** 4	**10** 17	**1** 6	**18** 27
Female	**7** 5	**17** 7	**3** 15	**27** 27

Supplemental Table 4. Osteotomy complications leading to surgical treatment according to cleft type and information about when the complication occurred (**simultaneous** + staged procedure).

COMPLICATION	**CLEFT TYPE**			
	BCLP	**UCLP**	**CP**	**Total**
Removal of prominent osteosynthesis Material	4 (**1**+3)	1 (1)	4 (**1**)	9 (**2**+4)
Problem with intraoral wound healing	1 (**1**)	1	1	3 (**1**)
Burn from diathermy to neck	1 (1)			1 (1)
Postoperative bleeding		1		1
Total complications with this cleft type / All patients with this cleft type	6/23 (**2**+4)	3/51 (1)	5/25 (**1**)	14/99 (**3**+5)