*Int. J. Oral Maxillofac. Surg. 2016; 45: 1309–1314*
http://dx.doi.org/10.1016/j.ijom.2016.05.013, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Research Paper
Imaging

# Three-dimensional evaluation of the alar cinch suture after Le Fort I osteotomy

**B. van Loon[1], L. Verhamme[2], T. Xi[2], M. J. J. de Koning[2], S. J. Bergé[2], T. J. J. Maal[2]**

[1]Department of Oral and Maxillofacial Surgery, St. Elisabeth Ziekenhuis, Tilburg, Netherlands; [2]Department of Oral and Maxillofacial Surgery, Radboud University Nijmegen, Medical Centre, Nijmegen, Netherlands

*B. van Loon, L. Verhamme, T. Xi, M. J. J. de Koning, S. J. Bergé, T. J. J. Maal: Three-dimensional evaluation of the alar cinch suture after Le Fort I osteotomy. Int. J. Oral Maxillofac. Surg. 2016; 45: 1309–1314.* 

*Abstract.* Orthognathic surgery has an influence on the overlying soft tissues of the translated bony maxillomandibular complex. Improvements in both function and facial appearance are the goals of surgery. However, unwanted changes to the soft tissues, especially in the nose region, frequently occur. The most common secondary change in the nasolabial region is widening of the alar base. Various surgical techniques have been developed to minimize this effect. The purpose of this study was to evaluate the changes in the nasal region due to orthognathic surgery, especially the alar width and nasal volume, using combined cone beam computed tomography (CBCT) and three-dimensional (3D) stereophotogrammetry datasets. Twenty-six patients who underwent a Le Fort I advancement osteotomy between 2006 and 2013 were included. From 2006 to 2010, no alar base cinch sutures were performed. From 2010 onwards, alar base cinch sutures were used. Preoperative and postoperative documentation consisted of 3D stereophotogrammetry and CBCT scans. 3D measurements were performed on the combined datasets, and the alar base width and nose volume were analyzed. No difference in alar base width or nose volume was observed between patients who had undergone an alar cinch and those who had not. Postoperatively the nose widened and the volume increased in both groups.

Key words: orthognathic surgery; Le Fort I osteotomy; alar; 3D; stereophotogrammetry; cone beam computed tomography scan.

Accepted for publication 17 May 2016
Available online 3 June 2016

Aside from skeletal changes, changes to the related soft tissues also invariably occur as a result of orthognathic surgery. Various studies have shown changes in the nasolabial morphology associated with the Le Fort I osteotomy,[1,2] especially an increase in alar width. A suturing method can be applied to prevent this increase in alar width. Reorientation of the displaced peri-nasal musculature and control of the alar base width is said to be possible with the use of an alar base cinch suture before incision closure.[3] The alar base cinch suture was originally described by Millard, who used this suture in patients with cleft lip undergoing nasal defect correction, and its use was later described in non-cleft patients.[4,5] Modified alar cinch suturing techniques have been developed to improve the narrowing effect and to simplify the execution of this technique. Studies describing the outcome of the suture in relation to postoperative alar width changes have reported contradictory results.[6–12]

The change in alar width has been studied anthropometrically,[9,13,14] two-dimensionally by means of photographs,[8,12] and three-dimensionally by means of cone beam computed tomography (CBCT) and computed tomography (CT).[7,10] Using two-dimensional (2D) techniques, data are possibly missed. As the human body is a three-dimensional (3D) entity, any change, whether from movement during facial expression or from surgery, happens in three dimensions.

The purpose of this study was to employ 3D techniques to evaluate the changes in the nasal region (inter-alar width and nose volume) occurring as a consequence of orthognathic surgery (Le Fort I osteotomy), with and without alar cinch suturing, in three dimensions.

## Materials and methods

### Patients

Patients (age >16 years) with maxillary hypoplasia who underwent a Le Fort I advancement osteotomy between 2006 and 2013 in the department of oral and maxillofacial surgery of a university medical centre in the Netherlands were included in this study. From 2006 to 2010, no alar cinch sutures were performed. From 2010 onwards, alar cinch sutures were performed because of the observed widening of the alar width in the first group of patients.

The following exclusion criteria were applied: missing preoperative or postoperative 3D photographs or CBCT scans, multi-segment Le Fort I osteotomy, anterior open bite cases, rhinoplasty surgery during or within 1 year after the Le Fort I osteotomy, and patients with accompanying craniofacial syndromes.

### Pre- and postoperative 3D documentation

A CBCT scan (i-CAT 3D Imaging System; Imaging Sciences International Inc., Hatfield, PA, USA) was used to acquire bony tissue information. A 3D stereophotogrammetry camera setup (3dMD System; 3dMD LLC, Atlanta, GA, USA) was used to capture 3D photographs of the face. The 3D photographs were generated from six 2D photographs taken simultaneously (four grey-scale photographs and two full-colour photographs). A polygon light pattern was projected onto the four grey-scale photographs. Based on this pattern and its deformed image, a 3D photograph was reconstructed.[15]

A full field of view extended height CBCT scan was acquired preoperatively and at 1 year postoperative. 3D photographs were acquired directly preoperative and at 1 year postoperative.

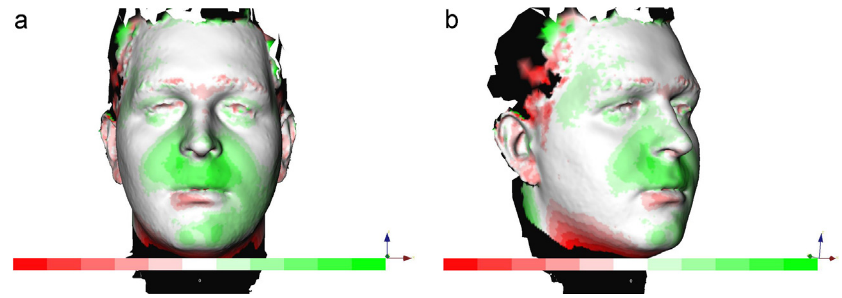


*Fig. 1.* Distance kit indicating the differences between the preoperative and postoperative 3D soft tissues. The range of the colour histogram is −5 mm to 5 mm.

### 3D measurements

The method described previously by this research group was used to evaluate the hard tissue maxillary changes and the soft tissue nasal changes.[16] Briefly, both the CBCT and the 3D photographs were taken in natural head position and habitual occlusion.[17] 3D models were created and aligned using voxel-based matching in Maxilim software (Maxilim version 2.2.2.1; Medicim NV, Mechelen, Belgium).[18,19] A surface-based matching procedure for the preoperative and postoperative 3D photographs was performed in five steps, as described in a previous study.[20] A distance map was created on the matched 3D photographs, indicating the soft tissue changes (Fig. 1). Finally a modified 3D cephalometric analysis was performed (Table 1).[21] From this analysis, the inter-alar width and planes lining the nose were acquired (Fig. 2). The planes indicated the region of interest (ROI). The volumes of the left and right sides of the nose were calculated from this ROI.

*Table 1.* Definitions of the landmarks and planes used in the analysis.

| Landmark | Abbreviation | Description |
|---|---|---|
| Alare (left) | al(l) | Left alare, most lateral point on the left alar contour |
| Alare (right) | al(r) | Right alare, most lateral point on the right alar contour |
| Cheilion (left) | ch(l) | Left cheilion, point located at the left labial commissure |
| Cheilion (right) | ch(r) | Right cheilion, point located at the right labial commissure |
| Nasion | n | Nasion, the midpoint of the frontonasal suture |
| Subnasale | sn | Subnasale, midpoint on the nasolabial soft tissue contour between the columella crest and the upper lip |
| **Plane** | | **Description** |
| Median plane | | The median ($z$) 3D reference plane is computed through the pupil reconstructed point and as a plane perpendicular to the horizontal ($x$) and the vertical ($y$) 3D reference planes |
| Horizontal plane | | The horizontal ($x$) 3D reference plane is automatically computed as a plane 6.6° below the canthion–superaurale line, along the horizontal direction of the natural head position and through the pupil reconstructed point translated 77.2 mm more posteriorly |
| Vertical plane | | The vertical ($y$) 3D reference plane is computed as a plane perpendicular to the horizontal ($x$) 3D reference plane and along the horizontal direction of the natural head position |
| Lateral left nasal plane | | A plane through landmarks ch(l) and al(l) and perpendicular to the vertical plane |
| Lateral right nasal plane | | A plane through landmarks ch(r) and al(r) and perpendicular to the vertical plane |
| Upper nasal plane | | A plane through landmark n and parallel to the horizontal plane |
| Lower nasal plane | | A plane through landmark sn and parallel to the horizontal plane |