Three-dimensional laser scanner evaluatiion of facial soft tissue changes after Le Fort I advancement and rhinoplasty surgery: patients with cleft lip and palate vs patients with noncleftеd maxillary retrognathic dysplasia (control group)

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Title: THREE-DIMENSIONAL LASER SCANNER EVALUATION OF FACIAL SOFT-TISSUE CHANGES AFTER LEFORT I ADVANCEMENT AND RHINOPLASTY SURGERY: CLEFT LIP AND PALATE PATIENTS VS NON-CLEFTED MAXILLARY RETROGNATHIC PATIENTS (CONTROL GROUP)

Article Type: Original Research Article

Keywords: Cleft lip and palate, LeFort I osteotomy and secondary RSP, soft -tissue, three-dimensional surface laser scanner.

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Abstract: Objective: The aim of this study was to analyse the differences in facial soft-tissue changes, despite the same extent of upper jaw forward movement, between uCLP patients compared with non-CLP retruded maxilla patients, after LeFort I osteotomy and secondary Rhinoplasty.
Study design: Twelve patients with maxillary retrognathic dysplasia and nose deformity were divided in two groups: A (uCLP) and B (control) and compared on the basis of the same maxillary advancement. Cephalometry and 3D mean facial model of A and B was obtained before and after surgery. Linear/angular measurements were calculated.
Results: Upper vermilion and alar base remained unchanged in A but increased in B. In both groups, symmetry of the nasal base was improved and an increase of the sagittal projection of the lips was observed.
Conclusions: 3D analysis showed that surgical procedures, in uCLP, can provide a satisfactory aesthetic outcome but some differences are evident in comparison to control group.

Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology.

Editor-in-Chief Mark W. Lingen, DDS, PhD , Chicago, IL

Manuscript submission

I have enclosed the manuscript entitled: “Three dimensional laser scanner evaluation of facial soft tissue changes after Lefort I advancement and Rhinoplasty surgery: cleft lip and palate patients vs retrognathic-(control group)” for publication on the *Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology.*

The present study performed a 3D analysis of the differences in the facial soft-tissue changes after surgical treatment (LeFort I osteotomy and secondary Rhinoplasty surgery) in unilateral cleft lip and palate (uCLP) patients vs retrognathic patients with the same amount of bone correction.

3D analysis showed that surgical procedures, in uCLP adult patients, can provide a satisfactory aesthetic outcome but some differences are evident in comparison to control group. Therefore, further technical improvements are still possible.

Hereby I certify that the authors have participated actively in the writing of the manuscript and they approve to submit this version of the manuscript to the *Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology*.

This paper is unpublished and it is not under current consideration elsewhere.

There is no conflict of interest directly or indirectly for either authors.

Best regards.

Laura Verzé

June, 3, 2013

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Title: THREE-DIMENSIONAL LASER SCANNER EVALUATION OF FACIAL SOFT-TISSUE CHANGES AFTER LEFORT I ADVANCEMENT AND RHINOPLASTY SURGERY: CLEFT LIP AND PALATE PATIENTS VS NON CLEFT RETRUDED MAXILLA PATIENTS (CONTROL GROUP).

Dr Mark W. Lingen, DDS, PhD , Chicago, IL

Editor-in-Chief. *Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology.*

Dear Professor Lingen,

we thank the reviewers for their comments about our study that will help us to improve the level of our scientific communication.

We really appreciate the hard work of the reviewers and we agree that our paper needed some relatively minor recommendations.

We shall try to answer to reviewer's # 1 comments:

1. **"Non-cleft retruded maxilla patients":** This term was replaced with "non-clefted maxillary retrognathic patients", accepting your suggestion.
2. **"No primary rhinoplasty is performed":** the authors treated all the patients with current standard of care techniques. The phrase "no primary rhinoplasty is performed" intended that no further corrective rhinoplasty was performed. All patients underwent a primary cheilorhinoplasty therefore we edited the phrase in the Material and Methods Section P2 Lines 29-32.
3. **Discussion P2 Lines 53-54, P5 Lines 36-37:** we changed "defects" to "deformities".

4. **Discussion P3 Lines 38-39:** the sentence "the alar base width in CLP was bigger than in control pre-operatively" means that the alar base was wide and in the next paragraph we explained the reason of that "the nasal alar widening seems to be due to the release of the soft tissue attachment and muscle insertion". The term "bigger" was replaced with "wider and vertically increased" because we agree that this second statement is more understandable.
5. **Discussion P5 Lines 43-44:** the authors wrote the sentence "CLP patients had partially edentulous premaxilla…" because in four out six patients one or two frontal teeth were missing at the CLP side but we think that this should not altered the 3D facial morph. The sentence could be misunderstood so we decided to replaced it with "In addition, in some of the CLP patients, one or two frontal teeth were missing at the cleft side and this fact may contribute to reduce the upper lip support".

We hope that these changes will fit the request of the reviewer and that our paper will be accepted for publication in the *Journal of Oral Surgery Oral Medicine Oral Pathology Oral Radiology*.

With regards.

Sincerely yours,

Laura Verzé, M.D.

***Statement of Clinical Relevance (max 40 words)**

Statement of Clinical Relevance. 3D analysis showed that surgical procedures, in uCLP adult patients, can provide a symmetric nasal base and a satisfactory facial profile but some differences remain in the post-operative frontal and profile views in uCLP patients, in comparison with the control group, indicating further technical requirement.

THREE-DIMENSIONAL LASER SCANNER EVALUATION OF FACIAL SOFT-TISSUE CHANGES AFTER LEFORT I ADVANCEMENT AND RHINOPLASTY SURGERY: CLEFT LIP AND PALATE PATIENTS VS NON-CLEFT RETRUDED MAXILLA PATIENTS NON-CLEFTED MAXILLARY RETROGNATHIC PATIENTS (CONTROL GROUP).

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Disclosure. Hereby I certify that there is no conflict of interest directly or indirectly for either authors.

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ABSTRACT

Objective: The aim of this study was to analyse the differences in facial soft-tissue changes, despite the same extent of upper jaw forward movement, between uCLP patients compared with non-CLP patients, after LeFort I osteotomy and secondary Rhinoplasty.

Study design: Twelve patients with maxillary retrognathic dysplasia and nose deformity were divided in two groups: A (uCLP) and B (control) and compared on the basis of the same maxillary advancement. Cephalometry and 3D mean facial model of A and B was obtained before and after surgery. Linear/angular measurements were calculated.

Results: Upper vermilion and alar base remained unchanged in A but increased in B. In both groups, symmetry of the nasal base was improved and an increase of the sagittal projection of the lips was observed.

Conclusions: 3D analysis showed that surgical procedures, in uCLP, can provide a satisfactory aesthetic outcome but some differences are evident in comparison to control group.

Keywords. Cleft lip and palate, LeFort I osteotomy and secondary RSP, soft -tissue, three-dimensional surface laser scanner.

Statement of Clinical Relevance. 3D analysis showed that surgical procedures, in uCLP adult patients, can provide a symmetric nasal base and a satisfactory facial profile but some differences remain in the post-operative frontal and profile views in uCLP patients, in comparison with the control group, indicating further technical requirement.

INTRODUCTION

Improvement of facial aesthetics is one of the primary objectives of modern orthognatic surgery; attractiveness is a major component of the self concept. The appearance of the face has been found to influence the social acceptance and psychological well being of the individual. In the literature, it has been reported that symmetrical body shape is a central cue for attractiveness.[1,2,3]

This fact allows the assumption of a potential disadvantage in the visual perception of patient with cleft lip and palate (CLP).[4]

The cleft malformation shows a variety of inter-individual shapes. Even when surgery was completed early in infancy and followed by therapeutic rehabilitation, adult patients with CLP show secondary deformities in the maxillary and nasal regions. These deformities may consist of defects that are unrepaired in primary surgery and distortions that devolop through growth or caused by residual scars. Clinical examination usually revealed upper lip scars from previous corrective plastic surgery, maxillary hypoplasia, difference in lip length and nasal deformities which can vary from almost invisible to catastrophic, mostly dependent on the severity and type of cleft[5] and on ability of cleft surgeon. Nose distortions include deviated columella, a depressed and deviated nasal tip, dislocation of the alar cartilage, webbing at the alar rim, flat and V- shaped nostrils, and scarring or fistulae of the nostril floor. These abnormalities are involved in all components of the nose, such as the facial skeleton, cartilage, muscle, skin, subcutaneous tissue and mucosal lining. [6-9]

There are many well-established surgical techniques to repair residual maxillary, lip and nose deformities in CLP adult patients. In all cases the aim of the therapy is to reach normal anatomy with symmetrical relations between the cleft and non-cleft sides.

Several cephalometric studies in cleft patients after surgery were conducted. The results of soft tissue changes have so far been interpreted with the aid of lateral cephalograms.[10] However in the lateral view structural comparison is limited in the medial plane and the asymmetries were not quantified.[11]

Analytical and objective three-dimensional (3D) laser scanner evaluation could help to quantify the post-operative soft-tissue changes.

To the best of the author's knowledge, no 3D laser scanner studies have been performed on the volumetric 3D soft-tissue changes after LeFort I osteotomy and secondary Rhinoplasty surgery (RSP) in unilateral CLP (uCLP) patients compared with a control group (~~non-cleft retruded maxilla~~ non-clefted maxillary retrognathic patients: non-CLP).

The aim of this study was therefore to analyse the differences in facial soft-tissue changes in uCLP patients who underwent LeFort I osteotomy and secondary RSP surgery compared with non-CLP patients who underwent the same extent of upper jaw forward movement and secondary RSP surgery.

PATIENTS AND METHODS

From January 2010 to December 2011, 53 adults Caucasian patients with maxillary retrognathic dysplasia and varying degrees of nasal deformity underwent LeFort I osteotomy and secondary Rhinoplasty surgery (RSP) at the Division of Maxillofacial Surgery, San Giovanni Battista Hospital, University of Turin, Turin, Italy.

The criteria for inclusion in the present study were as follows: white males or females, adult age (> 18 years), skeletal class III (with maxillary retrognathic dysplasia, SNA< 82°±2°) and nasal deformity. All the patients underwent a similar surgical procedure, by the same surgeon, consisting of a maxillary advancement (standardized surgical treatment consisting of a LeFort I osteotomy) and RSP with or without grafts. Following maxillary stabilisation, a resorbable (2.0 Vicryl) oblique suture, performed intraorally with two symmetrical tension stitches between levator labii superioris alaeque nasi (LLSAN) of the right side and LLSAN of the left side, allowed a good control of alar flaring.

Patients with congenital syndromes or previous facial injuries, with incomplete clinical and radiologic records, and those who had not completed their post-operative follow-up were excluded from the study.

Twelve patients fulfilled inclusion criteria for the study and they were divided in two groups (Table I). Variables examined include: age, sex and deformity of the nose.

Group A: included 6 adult patients (4 women, 2 men) with complete uCLP (with no other associated malformations or distinctive features in the face such as piercing or tattoos); mean age 28.5 years, range 18-39 years. Three patients had a uCLP on the right side; the others (1 woman, 2 men) had a uCLP on the left side~~. Primary closure of the lip~~ Cheilorhinoplasty was conducted between the 6 and 9 months of age~~. No primary rhinoplasty was performed.~~ Closure of the hard and soft palates was done at 12 to 18 months of age. Three patients received a secondary alveolar bone graft between ages 10 and 13 years. In all patients, a fixed orthodontic appliance was placed to align the permanent teeth.

Group B (control): included 6 patients (4 women, 2 men), mean age 28 years, range 22-45 years. The patients of this group were selected on the basis of the same maxillary advancement of the patients in group A. None had distinctive features in the face such as piercing or tattoos. In all patients, a fixed orthodontic appliance was placed to align the permanent teeth. One out six also underwent mandibular setback to correct progenism.

Pre-operative patients' features and description of the surgical procedures are shown in Table I. The costal and auricolar cartilage grafts were used to support the nasal tip projection. The quadrangolar cartilage graft was used in patient no. 6 to reconstruct the left nasal alae.

Lateral (L) cephalometry and 3D facial surface data were obtained before (T0) and one year (T1) after surgery.

Informed consent was obtained from all participants. This study was performed in agreement with local institutional review board. We followed the Helsinki Declaration guidelines.

Cephalometric measurements

Lateral cephalograms were traced by one examiner using the software Dolphin 11.0 Premium (Dolphin Imaging, Chatsworth, CA, USA). Only SNA measurements were obtained to assess sagittal skeletal movements.

A subsample of 20 randomly selected radiographs were retraced and digitized 1 month later to calculate the systematic errors. All the measurements were compared between the two time sets by the paired t test. All the measurements presented no significant difference at retracing.

Facial scan and data processing

3D images of all subjects have been achieved at T0 and at T1. Surface data were acquired using a Head and Face Colour 3D Scanner (3030RGB; Cyberware, Inc., Monterey, California). Subjects were registered with the head in natural position (nhp), the eyes closed and teeth in occlusion. The acquired data was transferred to a graphics workstation for viewing and elaboration with Cyberware Echo software (Cyberware Inc., Monterey, California). The scanning method and the detailed protocol regarding how to reduce the artifacts was previously described.[12]

Scanned data arrays of the facial area were then firstly restricted and then reduced from around 160.000 to 30.000 points. Facial surface reconstruction, multiple scan alignment and measurements were carried out using Rapid Form 2004 software (INUS Technologies Inc., Seoul, South Korea).

Facial scans at T0 and T1 were pooled together by electronic surface averaging to obtain the mean facial model of uCLP patients (A) and control group (B), before (T0) and after treatment (T1); the rater was L.V. (Fig. 1). 3D average surfaces were constructed using the software Morphostudio (Biomodelling Solutions, UK) and a mesh framework algorithm based on nine anatomical landmarks.

Reference vertical (Y: midline through glabella; Y1: vertical plane through left endocanthion and perpendicular to X) and horizontal (X: through right and left endocanthion) planes were constructed on models.

Different linear and angular measurements of the mean faces were calculated for comparison of the T0 and T1 models using 10 landmarks taken from classical anthropometry. The landmarks were (Fig. 2-Table II): 1. enr, right endocanthion; 2. enl, left endocanthion; 3. alr, right alar crest point; 4. all, left alar crest point; 5. prn, tip of nose; 6. sn, subnasale; 7. chr, right cheilion; 8. chl, left cheilion; 9. ls, labialis superior; 10. stomation, sto. Differences of linear measurement greater than one millimeter and angular measurements superior to 3 grades were considered significant.

Axial cross sections through prn, sn and ls and sagittal cross sections were also obtained (Fig. 3-4).

RESULTS

Cephalometric measurements

The L Cephalometric measurements showed a maxillary advancement between 5 to 8 mm (mean 6.33 mm) in each group (Table I).

Facial scan and data processing

The comparison between A and B revealed that uCLP patients had a shorter and more round face than non-CLP subjects, in both T0 and T1 (Fig. 1).

In frontal view, a vertical increase of the upper vermilion and lengthening of the alar base width were evident in B. At T0, the alar base width in A was bigger than in B and was unchanged at T1; in A also the upper vermilion remained unchanged. In both groups, symmetry of the alar forms were improved at T1 (Fig. 1).

In profile view, both in A and B, an improvement of the orbito-maxillary-zygomatic sulcus and increase of the sagittal projection of the lips were observed; at T1, a successfully projected nasal tip was noticed more in B than in A (Fig. 1).

Table II showed different linear and angular measurements of the mean faces at T0 and T1. Measurements at T0 and T1 documented that the major post-surgical changes in A and B were in upper lip and nose. At T0, al_r- al_l in A was greater than in B, at T1 this measurement significantly decreased in A. Normalization of the nasal alae were evident in B, reduced but still noticeable asymmetry of the alar was observed in A (al_{r-l}-prn). At T0, the al point of the two sides demonstrated vertical asymmetry, significantly improved at T1; al_{r-l}- X was greater in B than in A both at T0 and T1. Prn-Y in A showed that surgery allowed an improvement of deviation of the tip of nose on the symmetry axis. After treatment, the distance of the ls from sto was increased in B, demonstrating lengthening of the upper vermilion.

In A prn-sn-ls° significantly increased and was larger than in B either at T0 or T1. The distance between prn and the horizontal axis (prn- X) is longer in B vs A and was unchanged at T1.

Increase of the sagittal projection of the lips was also evident, in particular in B, with lengthening of the ls- Y_1.

Axial cross sections through prn, sn and ls clearly demonstrated a post-op displacement of facial soft tissue in B greater than in A; reduced, but still noticeable deviation of the tip of nose on the symmetry axis (Y) was observed in A (Fig. 3). Sagittal sections illustrated a refinement of the naso-labial sulcus in A and increase sustain of the upper lip in B (Fig. 4).

DISCUSSION

The impairment of maxillary growth resulting in retrusion of the maxilla is a frequent finding in CLP adult patients. To correct these dento-facial deformities, orthognathic surgery may therefore be indicated. [13]

A maxillary advancement with a Le Fort I osteotomy is the most common orthognathic procedure. In the literature, the frequency of indications for a Le Fort I osteotomy in uCLP patients varies from 22% to 48.3%.[14-17] CLP children often have midfacial growth deficiency, with a a characteristic concave profile. This generally increases during adolescence. [18] For a few authors, these growth disturbances are intrinsic to the cleft itself, as it was observed in children who were never operated on for their cleft. [19-21] Instead, for many authors, maxillary growth deficiency is mainly iatrogenic in nature and a consequence of the primary surgical repair of the palate. [22-23]

CLP adult patients can also show secondary nasal deformities.

Recently, primary rhinoplasty has been highlighted for the management of patients with uCLP and these techniques have been shown to clearly improve the results of the nasal deformity and overall symmetry. [24-26]

However, definitive rhinoplasty may still be necessary as the child grows.

The goal of the secondary treatment of uCLP deformities is to achieve naturally balanced nasal forms with an adequately projected nasal tip and a repositioning of retrognathic maxilla. Because a uCLP involved more or less inherent tissue ~~defects~~ deformities in the lip and nose, the secondary correction does not always achieve the level of the healthy frontal/profile configuration. Many rating systems for nasal deformity have been established and used worldwide. [27, 28]

Recent developments in computer technology have facilitated the more accurate and objective 3D characterization of facial forms of CLP patients. [29, 30]

Laser surface scanning has been reported as a reliable and accurate method for identifying cranio-facial surface landmarks. [12, 31, 32]

Previous studies on the 3D laser scanner analysis of the morphologic changes of the nose and lips after a Le Fort I osteotomy, in non-CLP patients, were conducted. The authors observed that the labial changes were mainly due to the movements of the jawbone. The nasal morphology changes after a Le Fort I osteotomy and consists mainly of widening of the nasal alae caused by the release of the muscle insertion and their retraction. This change resulted not to be influenced by the direction of the maxillary movement. [33]

To date, very limited evaluation of facial morphology changes, after orthognathic surgery in CLP adult patients in comparison to non-CLP subjects, were performed with 3D analysis. [10, 11] McCance et al. [10] measured the 3D soft-tissue changes in a group of adult patients with various forms of clefts following orthognathic surgery to correct jaw disproportion. The cleft patient groups were also compared to a control group of normal adults with skeletal and occlusal Class I relationships and average facial heights, before and after surgery. A previous 3D soft-tissue evaluation of facial morphology changes after rapid maxillary expansion and Delaire Facemask, in CLP children and the class III malocclusion patients among the groups, were described. [11]

The present study attempted to determine the soft-tissue changes in uCLP adult patients who underwent LeFort I advancement and Rhinoplasty surgery, by comparing the 3D mean facial model (A) at T0 and T1 and also comparing A with a 3D mean facial model B (control group without CLP), who underwent the same bone displacement.

Although the results of our 3D analyses should be interpreted with caution because of the relatively small sample size, several conclusions from our data seem to be warranted.

It is well known that the morphology of the soft tissues, such as the nose and lips, as well as the maxilla, changes after a Le Fort I osteotomy. They have been reported as a flattening and thinning of the upper lip, expansion of the nose, and antero-superior movement of the nasal tip.[34, 35]

Baek et al. [36] compared the treatment outcomes and relapse between maxillary advancement surgery with LeFort I osteotomy (group 1) and maxillary distraction osteogenesis (group 2) in 25 patients with cleft lip and palate with maxillary hypoplasia. They founded that the nasal-labial angle increased more in group 2 than in group 1. In addition, the forward movement of the upper lip and nasal tip was significantly greater in group 2. These findings supported the results in the study of Chua and Cheung. [37]
However, there are few reports that evaluated the form of these soft tissues three-dimensionally.

In our study, the alar base width in CLP ~~was bigger~~ was wider and vertically increased than in control pre-operatively and was reduced at T1 (Fig. 1, Table II). This finding is consistent with previous results in the literature[7, 38], instead the upper vermilion remained unchanged. This is probably because it is more difficult to detach tissues when there are previous scars.

Otherwise, lengthening of the alar base width and a vertical increase of the upper vermilion were evident in B (Fig. 1, Table II). The vertical increase of upper lip in B is positive and probably due to the V-Y closure. The nasal alar widening seems to be due to the release of the soft tissue attachment and muscle insertion. Once released from the bone, muscles such as zygomaticus major, levator labii superioris, levator labii superioris alaeque nasi, and nasalis give rise to lateral retraction, thus resulting in alar widening.

To prevent nasal alar widening and labial flattening after the maxillary osteotomy, alar cinch suture and V-Y closure are conceptually good procedures. However, although these procedures were performed, some reports, as well as this study, state that several millimeters of widening of the nasal alae were still observed. [7]

The reasons may include insufficient sutures under general anesthesia with nasal intubation and the short duration of tensile strength of the threads. For the aim of tightening up the nasal alae, some tools such as an external fixator may be effective. Subspinal Le Fort I osteotomy may be another solution for this problem. [39]

An improvement of symmetry of the alar forms, both vertically and horizontally, were observed in both groups. A normalization of the position of the tip of nose in the center of the face was observed in A (Table II). These effects may be attributed to the closed rhinoplasty which allowed the reshaping of the alar cartilage, columella and nasal dorsum.

In profile views, an increased support of the lips ~~were~~ was shown to a greater degree in B than in A (Fig. 1- 4). Though a significant normalization of soft-tissue profiles was generally observed in A, residual ~~defects~~ deformities were documented in the post-operative upper lip and tip of nose projection (Fig. 1). This could be explained by the fact that patients with CLP had scar contractures which prevented the correct soft-tissues countering. In addition, ~~CLP patients had partially edentulous premaxilla so the upper lip was without support from the teeth.~~ in some of the CLP patients, one or two frontal teeth were missing at the cleft side and this fact may contribute to reduce the upper lip support.

The main limit of this study is the small sample. More experience and further long-term follow-up studies are needed to evaluate a much larger patient population with better control over the variables.

In conclusion, 3D analysis performed in this study showed quantitative outcomes on the secondary treatment of uCLP nose/lip/maxilla deformities. Our surgical procedures can provide a symmetric nasal base and a satisfactory facial profile but some differences remain in the post-operative frontal and profile views in uCLP patients, in comparison with the control group.

Precise correction of secondary deformities in CLP adult patients still appears a challenging task in maxillofacial surgery, and further technical improvements are still possible.

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LEGENDS TO ILLUSTRATIONS

Figure 1: Mean facial model of uCLP patients (A) and control group (B) at T0, T1.

Figure 2: Demonstration of 10 facial landmarks taken from classical anthropometry employing 3D analyses.

Figure 3: Axial sections of the 2 superimposed shells (T0: green; T1: red) at different levels passing through prn, sn, ls. A: mean facial model of uCLP patients; B: mean facial model of control group.

Figure 4: Sagittal sections of superimposed shells (T0: green; T1: red). A: mean facial model of uCLP patients; B: mean facial model of control group.

Figure
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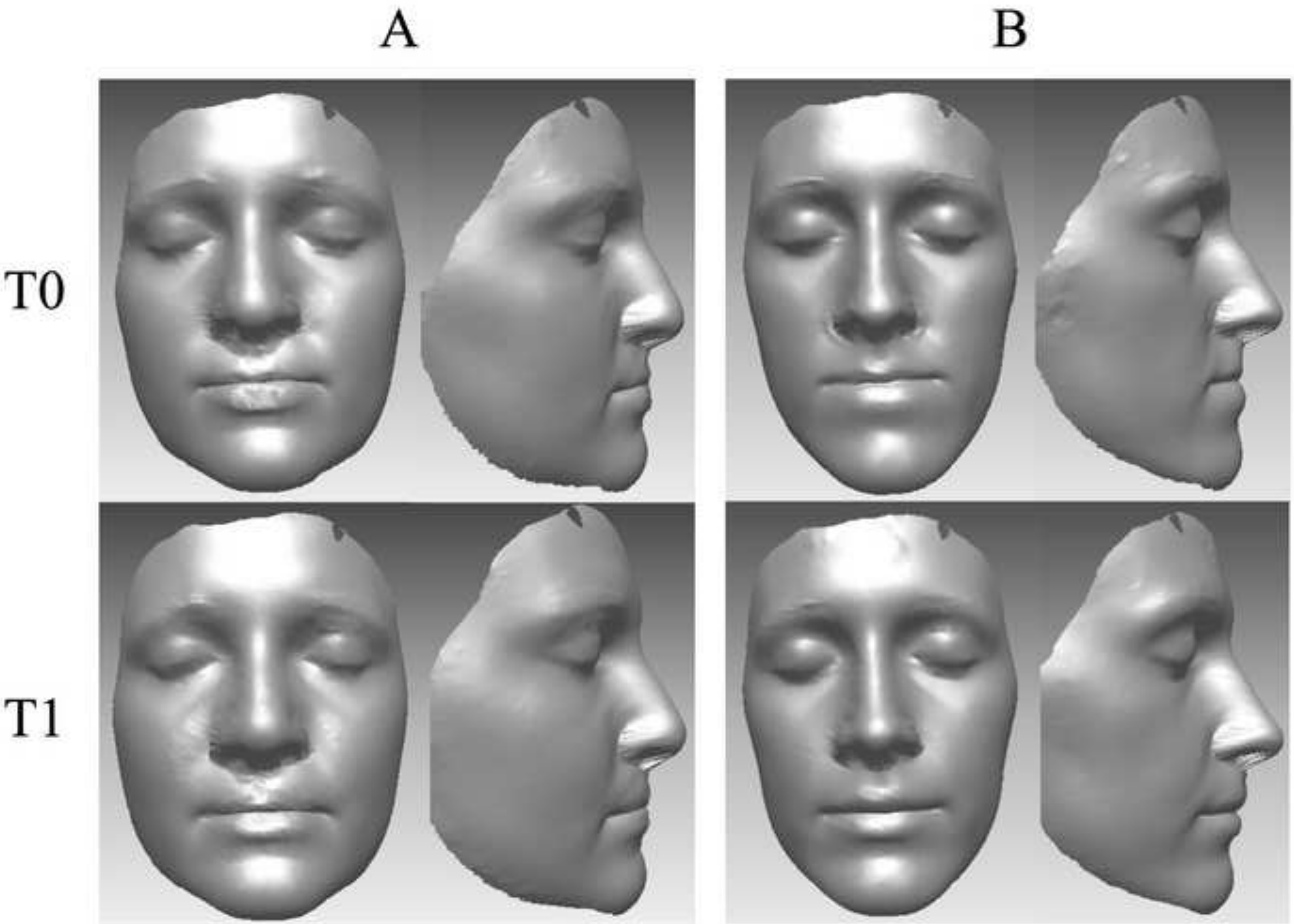

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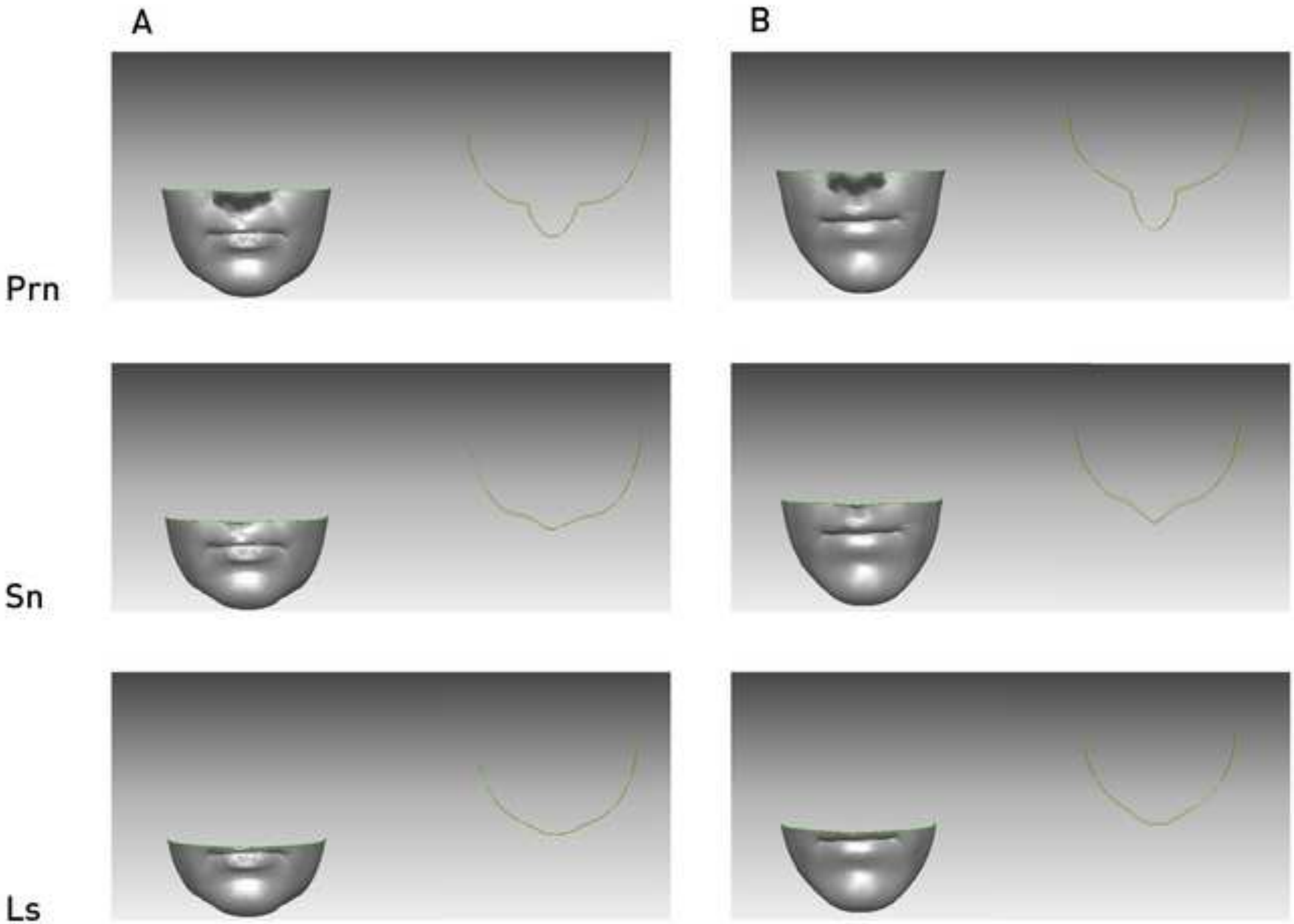

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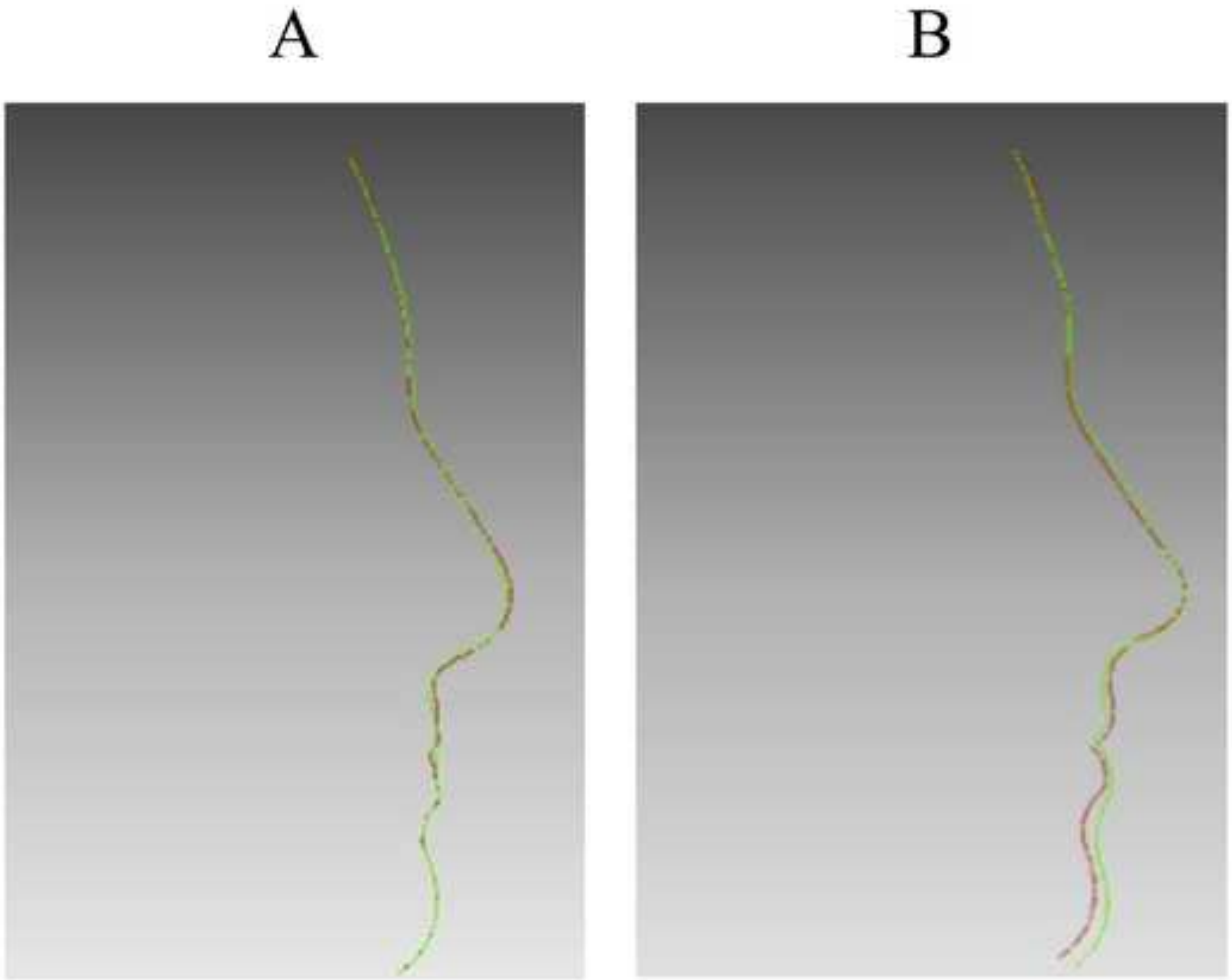

Table

Table I. Patients involved in the study.

A (uCLP)							B (Control)						
					Surgery							Surgery	
Patient	CLP side	Sex	Age	Deformity of the nose	LeFort I (Advancement mm)	RSP	Patient	Angle	Sex	Age	Deformity of the nose	LeFort I (Advancement mm)	RSP
1	right	F	18	b, c	**5**	B, +	1	III	F	24	b, e	**5**	A, C, E
2	right	F	35	a, d, e	**5**	C, E	2	III	F	22	e	**5**	A, C, +
3	right	F	18	c, e	**6**	B, D	3	III	F	22	c, e	**6**	C, E
4	left	F	39	d	**7**	‡	4	III	F	45	e	**7**	C, E
5	left	M	20	b, d	**7**	†	5	III	M	23	e	**7**	C, D
6	left	M	21	b, d, e	**8**	A, B, C,E	6	III	M	32	e	**8**	A, C, E

Abbreviations: u**CLP**: unilateral cleft lip and palate.

Deformity of the nose. **a**: deviated columella; **b**: depressed and/or deviated nasal tip; **c**: wide nasal ala; d: flat and v-shaped nostril; **e**: hump.

RSP: Rhinoplasty surgery. †: costal cartilage graft; ‡: auricular cartilage graft; +: quadrangular cartilage graft. **A**: symmetrizing of alar cartilages ;

B: basal osteotomy; **C**: hump; **D**: septum; **E**: tip of the nose (upward rotation).

Table

Table II. Point to point distances of the landmarks considered.

			A	B
Frontal view	al_r-al_l	T0	35.22	31.10
		T1	**33.62**	32.06
	al_r-prn	T0	24.19	25.30
		T1	**22.32**	**23.19**
	al_l-prn	T0	27.53	22.09
		T1	**25.90**	22.18
	al_r-X	T0	36.53	40.21
		T1	37.02	**44.69**
	al_l-X	T0	38.11	44.27
		T1	37.10	**45.57**
	prn-Y	T0	1.60	0.97
		T1	**0.53**	0.87
	sn-ls	T0	11.08	12.39
		T1	11.92	12.24
	ch_r-ch_l	T0	51.20	52.89
		T1	50.38	53.01
	ls-sto	T0	3.18	5.64
		T1	3.27	**7.39**
Lateral view	prn-sn-ls °	T0	134.05	133.05
		T1	**137.54**	133.47
	prn-X	T0	32.98	37.64
		T1	32.10	37.23
	ls-Y_1	T0	38.64	38.56

	T1	39.52	**40.08**

The values are in millimetres (or degrees for angles).

A: uCLP patients; **B**: control group. **X**: horizontal reference plane; **Y**: vertical reference plane through glabella; **Y1**: vertical plane through left endocanthion and perpendicular to X; **r**: right; **l**: left.

(Differences of linear measurement major of 1 mm and angular measurements superior to 3 grades were considered significant and highlighted in bold).