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Stabilité à long terme des ostéotomies de Le Fort I chez les patients opérés d'une fente labio-maxillo-palatine unilatérale.
Etude rétrospective de 54 cas pris en charge au CHU de Nantes

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INTRODUCTION.

Selon Veau et Delaire [1], il existe des mécanismes de croissance normaux chez les patients atteints d'une fente labio-palatine mais associés à des conditions anatomiques anormales. En découle une approche thérapeutique fonctionnelle qui respecte les mécanismes de croissance et restaure l'anatomie en préservant les fonctions. Cependant, il est admis que chaque correction chirurgicale est à l'origine d'une véritable iatrogénie responsable de l'hypomaxillie [2 3 4 5] dans le sens sagittal, vertical et transversal.

A ce jour, il n'existe pas de consensus dans la prise en charge chirurgicale des enfants porteurs d'une fente faciale. L'étude Eurocleft décrite par Shaw *et al* [6] rapporte en effet que sur 201 centres européens, il existe 194 protocoles différents. La variabilité des techniques chirurgicales primaires et des calendriers thérapeutiques rendent difficile l'analyse des causes de rétromaxillie[7]. De nombreuses améliorations ont été apportées et un grand nombre d'équipes est désormais sensibilisé à ces facteurs de risques (lambeaux vomériens [8], zones cruentées palatines [9 10], fermeture précoce de la fente alvéolaire [11], multiplicité des interventions sur le palais [12]…). Pour autant, environ 10 à 20 % des enfants opérés d'une fente présentent une classe III d'Angle par rétromaxillie nécessitant une prise en charge chirurgicale [13 14 15 16 17] .

Basée sur l'étude de l'équilibre mutuel des diverses structures osseuses du crâne et de la face, l'analyse architecturale et structurale cranio-faciale développée par Delaire, propose d'étudier successivement le crâne (voûte et base), le rachis cervical puis la face afin de diagnostiquer les dysmorphoses faciales. Son intérêt majeur est de proposer au chirurgien un équilibre facial théorique propre à chaque individu basé sur les rapports qu'entretient la face par rapport au crâne et à l'articulation cranio-rachidienne, susceptibles d'influencer la typologie faciale. L'analyse différentielle entre équilibres idéal et pathologique de la face permet ainsi de discerner les causes potentielles de la dysmorphose et de planifier l'acte chirurgical. La correction de la

dysharmonie dento-squelettique par le rétablissement d'une occlusion en classe I et l'amélioration de l'esthétique de la face est l'objectif de la chirurgie orthognathique. Cependant, la stabilité occlusale de l'ostéotomie de Le Fort, témoin de la restauration de l'équilibre morpho-fonctionnel, doit aussi être le but recherché par le chirurgien maxillo-facial.

Alors que dans la population générale, le pourcentage de dégradation sagittale des ostéotomies de Le Fort I est de 20% environ [18], les patients opérés d'une fente faciale présentent des risques de dégradations plus importantes (de 20 à 40% selon les études) [19] [20] [21]. Les études réalisées sur le sujet n'ont pas permis à ce jour d'établir un consensus concernant la prise en charge de cette dysmorphose séquellaire et la prévention des dégradations occlusales. En effet, la difficulté de la prise en charge vient du fait que les patients présentent le plus souvent de nombreux antécédents d'interventions. Les facteurs de risques peuvent être multiples et, dans la littérature nous retrouvons de nombreuses études évoquant la présence ou non de corrélations entre l'amplitude de dégradation et le type de chirurgie orthognathique (mono ou bimaxillaire) [22] [23] [24], ou encore le degré d'avancement per-opératoire [25] [21] [22] [26]. En effet, bien que certains auteurs ne retrouvent pas de corrélation significative entre degré d'avancée per opératoire et amplitude des dégradations post opératoires [27] [28] [24], d'autres études, plus récentes, concluent à un risque de dégradation plus important dans le cadre des grandes avancées per opératoires [22] [26] [21]. Cependant, le terme de grande avancée reste vague et aucune étude à notre connaissance n'a recherché une valeur seuil à partir de laquelle le risque de dégradation est majoré.

L'objectif de notre étude était donc d'évaluer la stabilité à 1 an des interventions d'ostéotomies de Le Fort I, dans une population large et homogène de patients opérés d'une fente labio-maxillo-palatine unilatérale (FLMP) au sein du service de chirurgie maxillo-faciale et stomatologie du Centre hospitalo-universitaire de Nantes.

INTRODUCTION.

According to Veau and Delaire [1], there are normal growth mechanisms in patients with cleft lip and palate (CLP) but associated with abnormal anatomical conditions. Consequently a functional approach that respects growth mechanisms and restores the anatomy while preserving functions is advocated. However, it is accepted that each surgical correction causes real iatrogenic consequences responsible for maxillary hypoplasia [2 3 4 5] in the sagittal, vertical and transverse directions.

To date, there is no consensus in the surgical management of children with facial cleft. The Eurocleft project of Shaw et al[6] relates in fact that among 201 European centers, there are 194 different protocols. The variability of the primary surgical techniques and therapeutic schedules makes it difficult to analyse the causes of maxillary retrusion [7]. Many improvements have been made and a large number of teams is now aware of these retromaxilly risk factors (vomerians flaps [8], palatal scarring [9 10], early closure of the alveolar slot [11], multiple interventions on the palate [12]…). However, about 10 to 20% of children operated of a cleft will present a class III malocclusion by maxillary retrusion requiring surgical treatment to correct dental and skeletal disharmony [13 14 15 16 17].

Based on the study of the mutual balance of various bone structures of the face and skull, the craniofacial architectural and structural analysis developed by Delaire, successively studies the skull (vault and base), the cervical spine and the face, to diagnose facial deformities. Its main interest is to provide the surgeon a theoretical facial balance, unique to each individual, based on ongoing relations between face and skull and the cranio-spinal articulation, that might influence facial typology. Differential analysis between ideal and pathological balance of the face makes it possible to discern potential causes of dysmorphosis and plan the surgery. The correction of dento-skeletal disharmony by restoring a Class I occlusion and the improvement of facial aesthetics are the main objectives of the orthognathic surgery.

However, occlusal stability of the Le Fort I osteotomy, reflecting the restoration of a morpho-functional balance, should also be the goal of maxillofacial surgeon.

While in the general population, the percentage of sagittal relapse in Le Fort I osteotomy is about 20% [18], patients operated for a facial cleft are at risk of more damage (20 to 40%) [19] [20] [21]. To date, studies on the subject have not allowed to establish a consensus regarding the management of this dysmorphosis sequelae and the prevention of occlusal relapse. Indeed, the difficulty of this therapeutic care is that patients have most often multiple attempts at palate repair. Risk factors may be multiple, and the literature reveals numerous studies citing the presence or absence of correlations between the amplitude of relapse and the type of orthognathic surgery (mono or bimaxillary) [22] [23] [24], or the degree of intraoperative advancement [25] [21] [22] [26]. Indeed, although some authors did not find a significant correlation between the degree of intraoperative advancement and the amplitude of postoperative relapse [27] [28] [24], other studies, more recent, concluded in a higher risk of relapse in the context of a major surgical advancement [22] [26]. However, major advancement isn't well defined, and to our knowledge, no study has sought a threshold value at which the risk of relapse is increased. The aim of our study was to evaluate the stability at 1 year of Le Fort I osteotomy in a large and homogeneous population of patients operated for unilateral cleft lip and palate (UCLP) in the maxillofacial surgery department of Nantes university Hospital.

MATERIAL AND METHODS.

This retrospective study included patients with UCLP, treated in the maxillofacial and stomatology surgery department of Nantes University Hospital and having benefited from a surgical Le Fort I osteotomy treatment, between 1993 and 2013. The patients were followed either from birth or secondarily as part of a recourse care. Inclusion criteria were:

- Patients operated for an unilateral cleft lip (UCL) or an unilateral cleft lip and palate (UCLP).
- Performing a Le Fort I osteotomy.
- Presence of a long term radiological follow-up (1 year), by preoperative profile radiographs (T0), immediate postoperative (T1) and late postoperative over 1 year [18 28 20]

Patients with radiographic follow-up of less than one year or with an incomplete radiographic case were excluded from the study

Le Fort I osteotomies were all performed in the Maxillofacial and Stomatology Surgery department of Nantes University Hospital. The main operator was Professor Mercier who realized almost 75% of the interventions.

The basic technique was not different from the osteotomy described by Bell [29], but there was a certain number of features:

The surgical approach could stay classic with a vestibular incision of a premolar to the other. In the case where a gingivoplasty was associated, the course on the side of the cleft would take the usual course of the gingivoplasty by a sulcular incision. In case of associated endomaxilly, a mobilization into two fragments could be achieved. When the alveolar bone graft had not been made before, it was performed during surgery using grafts collected on the operating site (chin, tibia, iliac crest).

The lowering of the maxillary tray was cautious and gradual. The continuity between the palatal fibromucosa and the nasal mucosa was sectioned. A possible residual cleft palate could thus be closed.

The mobilization of the maxilla was performed after pterygomaxillary disjunction, rugination of the nasal plane to the rear edge of the nasal cavity bone, release of the scar tissue in the velopterygoïdian region and cautious release of the posterior palatine pedicles

Osteosynthesis was achieved by titanium plates of 0.6 mm thickness at the canine pillars and / or by steel wire. This was performed after placing an occlusal splint preserved or not postoperatively.

Depending on the importance of the sagittal gap, on the existence of a lateromandibuly and on the indications of the architectural and structural analysis, a mandibular surgery (backward mandibular sagittal split osteotomy (SSO), Vertical subsigmoid osteotomy (VSO) of Caldwell-Letterman) could be associated.

An intermittent maxillomandibular fixation with elastics was recommended after surgery for 6 weeks, associated with a mixed diet. The orthodontic treatment, prior to surgery; was reconducted 6 weeks after surgery.

Our study focused on radiographic analysis of the population using profile cephalograms. The radiographs were made with the same radiology apparatus at 73kV and 40mA/s (Siemens, Erlangen, Germany).

The preoperative analysis of profile radiographs (T0), immediate postoperative (T1), and one year postoperative (T2) was performed by the study of four bone and dental landmarks. The coordinates of these points were manually defined on a tracing paper in an orthonormal landmark (Figure 1), described by Nimeskern [30] and defined by the lines C1 (corresponding to the x-axis: top line of the skull base of Delaire's cephalometric analysis (clinoid point Cl' (middle of the line Cla-Clp)– point M) [31] et C0 (corresponding to the y-axis : line C0 perpendicular to the line C1 through the clinoid point Cl').

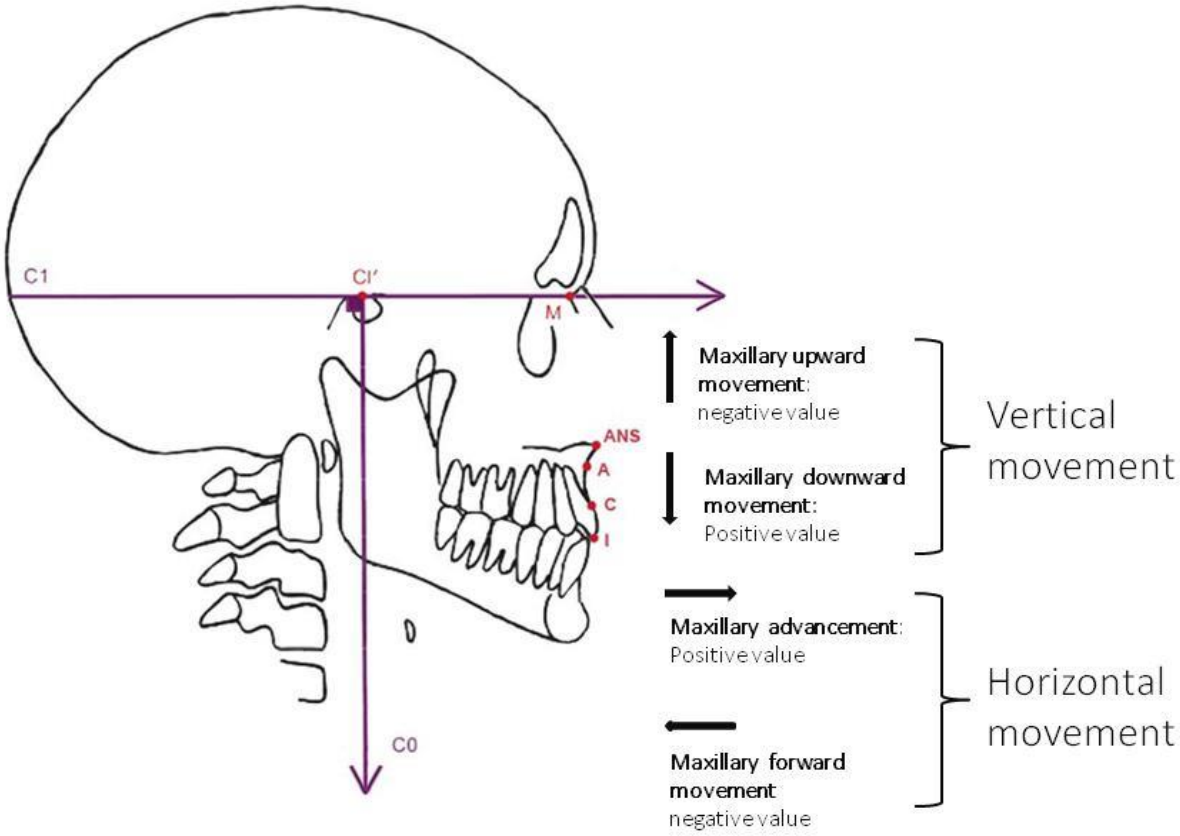

Figure 1 : schema of orthonormal landmark and studied movements, from the profile cephalogram. C1 corresponding to the x-axis: upper line of the skull base of Delaire's cephalometric analysis (clinoid point Cl '- the point M, fronto-nasal, fronto-maxillary and maxillo-nasal sutures union)[31] and C0 corresponding to the y-axis: C0 line perpendicular to C1 through the clinoid point Cl'. Points studied [32] [24] ANS: anterior nasal spine / A : subspinale point, deepest point on the anterior contour of the maxillary alveolar arch / C : the lowest edge of the maxillary alveolus of the central incisor, prosthion / I lower point of the maxillary central incisor

The analysis of cephalometric data and the evaluation of the surgical treatment's stability were obtained by collecting the coordinates of points ANS, A, C, et I in the same fixed orthonormal landmark (C1 ; C0) for each patient during the different periods of the study (T0, T1, T2).

The radiographic layer superposition method, proposed by Björk [33], was used. Measurements were performed preoperatively (T0), in immediately after the operation (T1), and one year later (T2), and then compared with each other. The change in position of each point was studied as to quantify dento-skeletal and maxillary movements, to evaluate the amplitude of the horizontal and vertical surgical displacements (evaluated by the difference between immediate postoperative data and preoperative data) and the long term stability results (quantified by the difference

between the data at different postoperative periods: immediate postoperative, and one year postoperative).
Relapses were studied in percentage loss relative to intraoperative movement. For the horizontal movements, it mainly concerned the percentage of advancement loss. For the vertical movements it mainly concerned the percentage of the downward and upward movements loss.

Quantitative values were compared by a Student t-test (if the pre-test of Shapiro-Wilk showed a normal distribution, and $n \geq 30$) or a Mann and Whitney test ($n < 30$ or non-Gaussian distribution). Qualitative values were compared using a Chi square test or an exact test of Fisher.

The correlation between continuous variables was examined by the linear correlation coefficient of Spearman.

The correlation analysis on the subgroup was examined by a Student test for substantial groups (normally if $n>30$, but as the variables had a normal distribution, the test was applied for $n>10$), otherwise the non-parametric Wilcoxon test was carried out.

The determination of a threshold value of advancement was obtained by recursive partitioning for points ANS, A, C and I.

The level of significance was set at $p <0.05$.

To test the reproducibility of the measurements, the points ANS, A, C, I à T0, T1, T2 were recorded manually and systematically by two different examiners for all patients included in the study. The same measurements were repeated twice by the two examiners at more than two months apart. Thus, the feasibility of this study was therefore able to be measured by the Dahlberg formula [34] (Standard Error: $(SE) = \sqrt{(\sum d^2 / 2n)}$ where d is the difference between the two measurements and n the number of double measurements) thereby determining the random error associated with the method of analysis. The reproducibility of the random error is important

because it determines the differences between the 2 metric measurements and the acceptability of these differences.

The measurements reliability was assessed by an intraclass correlation coefficient (ICC). The interpretation of reproducibility was judged on the following scale:
If ICC>0.8 = excellent
If ICC between 0.6-0.8 = good
If ICC between 0.4-0.6 = moderate
If ICC<0.4 = bad

RESULTS.

As represented in table 1, there was an excellent reproducibility of the analysis method for the intraoperative vertical and sagittal movements, for the four points studied (ICC>0,8 for the inter- and intra-examiner analysis).

Table 1: Analysis of the reproducibility of the analytical method for studying the intraclass correlation coefficient (ICC) formed between the two measurements of each examiner (ICC intraexaminer 1 and 2) and between one of the measures of the two examiners (ICC interexaminer). Values in bold correspond to steps having good to excellent reproducibility.

		ICC Intra examiner 1	ICC Intra examiner 2	ICC Inter examiner
SURGICAL MOVEMENT				
Sagittal	ANS	**0.802**	**0.79**	**0.644**
	A	**0.926**	**0.949**	**0.947**
	C	**0.947**	**0.904**	**0.942**
	I	**0.928**	**0.947**	**0.956**
Vertical	ANS	**0.806**	**0.878**	**0.745**
	A	**0.828**	**0.876**	**0.863**
	C	**0.864**	**0.911**	**0.906**
	I	**0.941**	**0.869**	**0.935**
RELAPSE				
Sagittal	ANS	0.389	0.519	0.353
	A	0.383	0.424	0.535
	C	**0.666**	0.497	0.56
	I	**0.761**	**0.726**	**0.758**
Vertical	ANS	0.459	**0.815**	0.344
	A	0.494	**0.627**	0.52
	C	**0.676**	**0.772**	**0.642**
	I	**0.745**	**0.876**	**0.729**

Regarding postoperative sagittal relapses, the reproducibility of ANS was moderate to bad (ICC from 0,389 to 0,519 in intra-examiner) and bad (ICC=0,353) for the inter-examiner analysis. This landmark therefore appeared less relevant because too variable. It was thus not selected for the study of relapses secondary to osteotomy.

Regarding the radiological measurements of relapses, the reference points A, C and I are still relevant, as the ICC is moderate to good for the points A and C, and then good to excellent for the point I.

Furthermore, the Dahlberg formula was applied to the different measures inter- and intra- examiner, allowing to find a metric difference of about one centimeter between analysis. (intra examiner: mean 0,89mm, standard deviation 0.19 mm, minimum 0.67 mm, maximum 1.25 mm and inter examiner mean 1.02 mm, standard deviation 0.16 mm , minimum 0.82, maximum 1.36 mm). The analysis method was thus considered reliable.

Between 1993 and 2013, 65 osteotomies Le Fort I (LFI) were performed at Nantes University Hospital, among patients operated for UCL or UCLP. There was a non-significant male prevalence (53.8%), a preponderance of the cleft lip and palate form (93,84%) on the forms without cleft palate (6,16%), as well as the congenital form (90,77%) on the syndromic form. Almost half of the patients (49.23%) were treated in the context of care recourse. Among these patients, the mean age at first consultation was 15.08 years.

Among the 65 LFI performed in patients operated for UCL or UCLP, 54 patients had a complete clinical and radiological follow-up at 1 year after surgery (Table 2). Among them, 53.70% were supported in the context of care recourse, and the primary surgery and sometimes the interceptive surgery had not been performed in our service. The mean age at the time of care recourse was 14.4 years.
The number of palatal interventions averaged 3,04 ± 1,23 (1 - 8). Eight patients had a history of orthognathic surgery prior to the LFI osteotomy: 6 genioplasties, 1 Le Fort I osteotomy (procedure performed at the age of 12 in 1983 as part of care recourse) and 1 backward mandibular SSO. In this last case, the patient was taken care as care recourse following a relapse of his surgery.

Table 2: study population data. UCLP: unilateral cleft lip and palate / UCL : unilateral cleft lip. Among palatal interventions, were counted the different times of velar closure, cleft palate closure, intravelar veloplasty, pharyngeal flap.

Sexe: female/male, n (%)	28 (51,85) / 26 (48,15)	p=0,7855
Cleft type: UCLP/ UCL, n(%)	51 (94,44) / 3 (5,56)	p<0, 05
Syndrome: yes/no, n(%)	4 (7,40) / 50 (92,59)	p<0,05
Dental status		
Lateral agenesis: yes/no, n(%)	30 (55,56) / 24 (44,44)	p=0,4142
Lateral space: maintained/closed, n(%)	46 (85,19) / 8 (14,81)	p<0,05
Presence of prior extraction: yes/no, n(%)	39 (72,22) / 15 (27,77)	p=0,0011
Care recourse		
Care recourse /follow up from birth, n(%)	29 (53,70) / 25 (46,30)	p=0,5862
Age of care recourse (years), mean ± standard deviation (min-max)	14,40 ± 9,98 (0,5 - 45)	
Surgical calendar		
First intervention age (month), mean ± standard deviation (min-max)	5,7 ± 1,94 (0,2-9)	
Preoperative pharyngoplasty		
yes/no, n(%)	22 (40,74) / 32 (59,26)	p=0,1736
Age (years), mean ± standard deviation (min-max)	7,05 ± 2,86 (5 - 16)	
Alveolar bone grafting		
yes/no, n(%)	31 (57,41) / 23 (42,59)	p=0,2763
Age (years), mean ± standard deviation (min-max)	10,93 ± 6,51 (1 - 33)	
Number of palatal interventions , mean ± standard deviation (min-max)	3,04 ± 1,23 (1 - 8)	
Previous orthognathic surgery		
isolated genioplasty, n(%)	6 (11,11)	
Le Fort I + genioplasty, n(%)	1 (1,85)	

Results about per operatory and postoperatory surgical treatments are listed in Table 3. Among the 24 Le Fort 1osteotomies with several fragments, one patient underwent a Le Fort I osteotomy in 3 fragments. The Le Fort I osteotomy in 2 fragments were sometimes more or less spontaneous through the residual alveolar cleft (n=13), and in that case bone grafting was performed in the same time.

Among the 17 bimaxillary osteotomies, there were 9 mandibular SSO (8 backward movements and 1 advancement), 6 recentering unilateral SSO, 1 vertical subsigmoid osteotomy associated with a controlateral SSO and one subapical osteotomy.
Among the 35 patients who did not receive any alveolar bone grafting (ABG), 11 showed no ABG history in childhood and 24 patients had benefited of one.
There was a majority of postoperative long-term containment (70,37%). Two patients had a Delaire's mask during a year postoperative. These patients were supported in care recourse with a significant hypomaxilly on the horizontal plan (11.25 mm and 8,4mm advancement despite a concomitant backward SSO for this last, and on the vertical plan (2.5mm and 5.2mm of downward movements respectively).

Table 3 : Intra-operative and post-operative surgical treatment of Le Fort I osteotomy (SSO : Sagittal split Osteotomy; VSO : Vertical subsigmoid osteotomy ; MMF : maxillo-mandibular fixation

Age (years), mean ± standard deviation (min-max)	18,8 ± 5,2 (14 – 45)	
Le Fort I:		p=0,4142
- Several fragment/ one-piece, n(%)	24 (44,44) / 30 (55,56)	
Associated surgery:		
-Bimax osteotomy: yes/no, n(%)	17 (31,48) / 37 (68,51)	p=0,065
SSO: unilateral/bilateral, n(%)	6 (11,54) / 9 (16,67)	
VSO + SSO, n(%)	1 (1,85)	
Subapical osteotomy,n(%)	1 (1,85)	
-genioplasty, n(%)	35 (64,81)	
-alveolar bone grafting, n(%)	19 (35,19)	
Fixation:		p<0,001
- plates/ wires, n(%)	49 (90,74) / 5 (9,26)	
Post operative treatment		
-occlusal splint,n(%)	33 (61,1)	
-MMF, n(%)	54 (100)	
-Long-term contention: yes/no, n(%)	38 (70,37) / 16 (29,63)	p=0,0028
stellite, n(%)	27 (50)	
Palatal plate,n(%)	10 (18,51)	
Delaire's mask,n(%)	2 (3,70)	

The results in terms of surgical movement and postoperative relapse are summarized in Table 4.

Different degrees of relapses were observed between points A, C and I. Thus, in the vertical direction (downward or upward movements), the point I then the point C appeared more at risk of relapse. In the sagittal direction, the point A was the point the more at risk of relapse (20,1%).

The majority of patients (n=51) had an horizontal relapse less or equal to 2 mm at the point A. Surgical advancements of the 3 patients with more than 2 mm of relapse were 5,5 mm, 7,5 mm and 9,75 mm.

Tableau 4 : Surgical movement and relapse after one year follow up. n = sample size / SD = Standard Deviation

	landmarks	n	surgical movement	relapse
			mean (mm) ± SD (min/max)	mean (mm) ± SD / % relapse
advancement	A	51	4,2 ± 3,0 (0,25/ 11,25)	-0,8 ± 1,0 / 20,1
	C	50	4,4 ± 3,0 (O,75/ 15)	-0,7 ± 1,0 / 15,6
	I	49	4,0 ± 3,1 (0,25/ 14,25)	-0,5 ± 1,4 / 12,4
downard	A	26	2,0 ± 1,9 (0,25/ 7)	-0,6 ± 1,2 / 28,4
	C	30	2,1 ± 2,1 (0,25/ 7)	-0,6 ± 1,5 / 29,9
	I	29	2,3 ± 1,9 (0,25/ 8,25)	-0,8 ± 1,4 / 35,6
upward	A	27	-2,3 ±2,3 (-0,25/ -11,25)	0,2 ± 1,2 / 7,0
	C	22	-2,7 ±2,5 (-0,25/ -9)	0,5 ± 1,2 / 16,7
	I	21	-2,9 ±2,6 (-0,25/ -9,75)	0,8 ± 1,4 / 27,6

There was a significant correlation ($p<0,05$) between the degree of advancement of the maxilla and the degree of long term relapse (Figure 2) for the three points A, C and I.

For point A, the recursive partitioning method enabled to highlight the 7 mm advancement threshold for which postoperative relapse was significantly greater. Thus, 7 mm advancement or more (n = 12, mean = 1.00 ± -1,67mm) in this series was at risk of significantly greater postoperative relapse ($p = 0.008$) than advancement lesser than 7 mm (n = 42, mean = 0.88 ± -0,60mm).

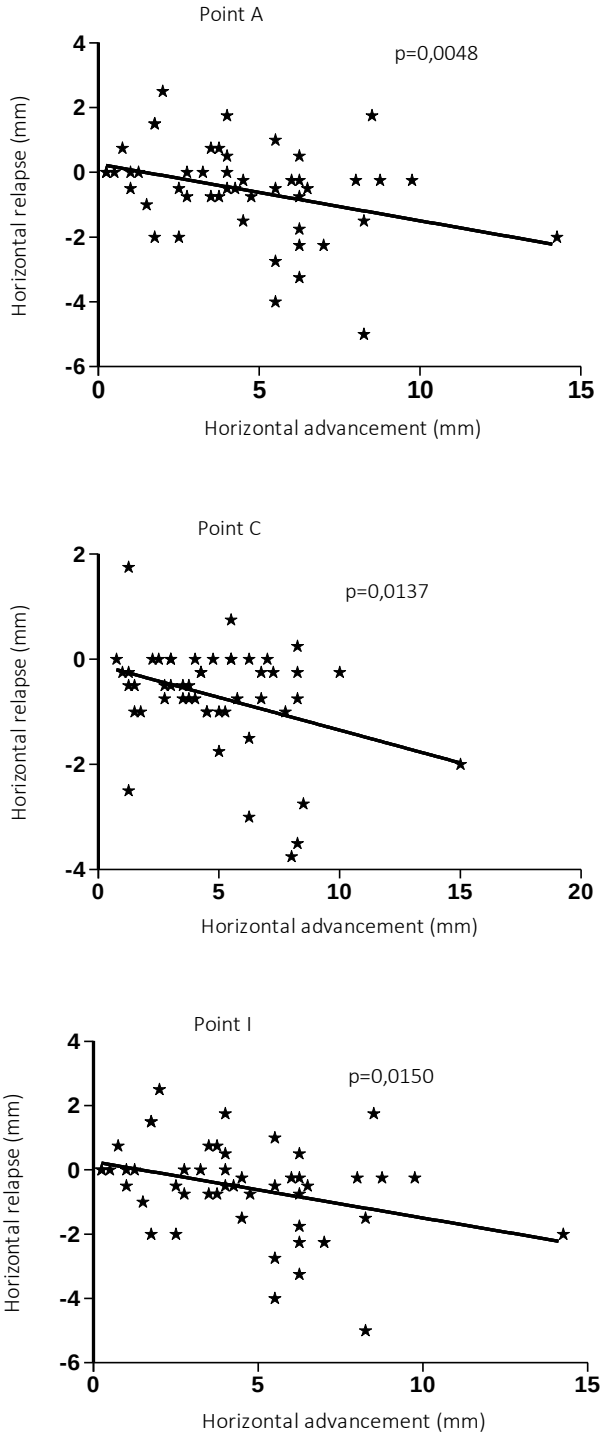

Figure 2: Relation between horizontal surgical advancement and relapse after 1 year. Negative values are backward movement and positive values are forward movement.

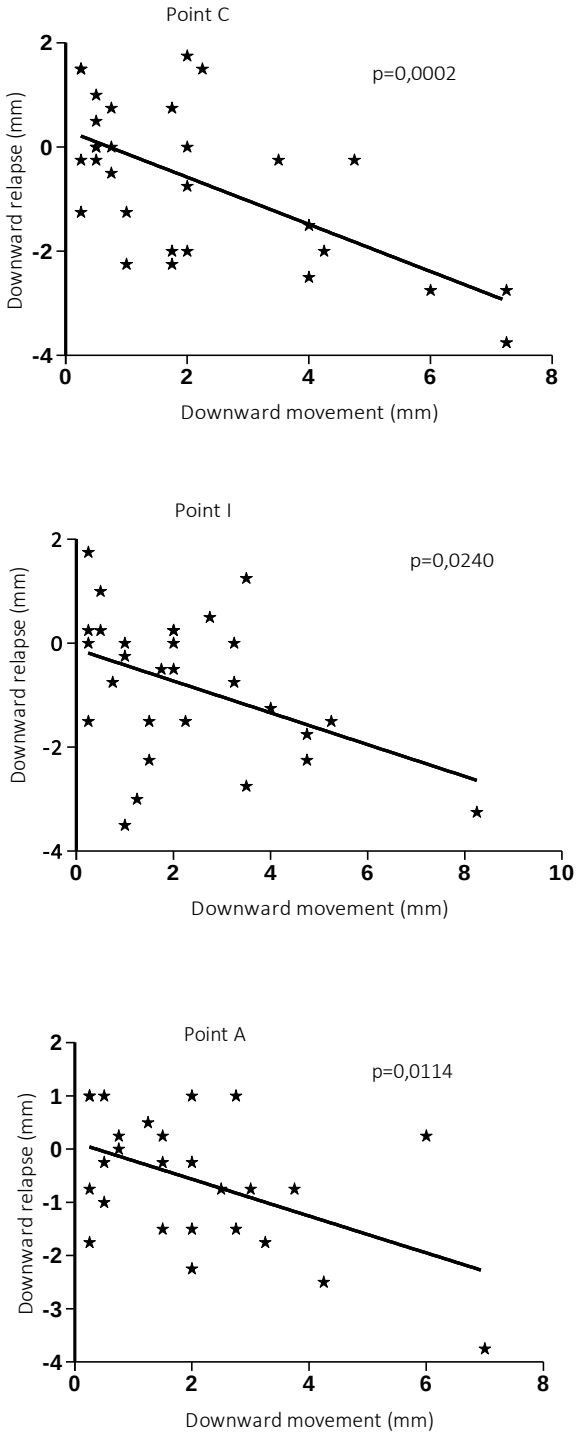

Figure 3: relation between vertical downward surgical displacement and relapse after 1 year. Negative values are superior movement and positive values are inferior movement.

The study of the vertical surgical movements showed a significant difference. As evidenced by the linear regression lines in Figure 3, there was a significant

correlation ($p<0,05$) between the downward surgical movements and relapse for the points A, C and I.

There was, thus, an increased risk of relapse with the degree of downward movement. No significance was found for the surgical upward movements ($p>0,05$).

There was no significant correlation ($p>0,05$) between the different subgroup analysis (sex, age at surgery, UCLP or UCL, care recourse, age at the primary time, previous pharyngeal flap, space of the lateral incisor maintained, tooth extractions prior to surgery, number of prior palatine interventions, Le Fort I osteotomy with several fragments, bimaxillary surgery, maxilla-mandibular fixation).

Forty eight patients showed no complications (local and velopharyngeal) postoperatively. Seven local complications were found without the need to repeat the surgery. Among them, there were two recurrent palatal fistula, 2 aseptic nonunion, 3 surgical site infections.

Ten patients presented with a deterioration of velopharyngeal status of which 6 have been fixed by a pharyngeal flap and 1 by intravelar veloplasty (IVV) associated with a posterior nasopharyngeal lipostructure. Of these 10 patients, three patients had no phonation disorder preoperatively, 4 patients had mild to moderate hypernasality and 2 patients had an important hypernasality.

DISCUSSION.

The aim of our study was to evaluate the stability at 1 year of Le Fort I osteotomy of patients operated for unilateral cleft lip and palate (UCLP) in Nantes University Hospital. Relapse amplitudes on sagittal and vertical planes were low (< 0,8 mm on average) but were correlated with degree of intraoperative advancement. Thus the threshold value of 7 mm of advancement was associated with a significantly higher risk of relapse at 1 year. The number of patients included and the methods of validation of measures used, makes in our opinion, the originality and value of this study. However, there were several limitations to the evaluation and comparison analysis. The study population was very heterogeneous in terms of surgical timing, scarring sequelae, associated procedures with the osteotomy and pre- and postoperative orthodontic care. Moreover, this analysis was made difficult by the use of reference points corresponding to bone sites remodeled by the surgical procedure, including the ANS point [32].

Furthermore, the reference points C (lowest edge of the maxillary alveolus of the central incisor, prosthion) and I (lower point of the central incisors) respectively correspond to alveolar and dental reference points. In our study, there was less relapse in these two points, probably due to the alveolo-dental compensation of the postoperative orthodontic movements. Indeed, in order to compensate the backward dental relapse, orthodontists could procline the anterior maxilla teeth attempting to maintain a post-operative class I relationship. The study of purely bone relapse seemed more relevant by using point A [35 21 36 22].

In view of the analysis reproducibility and reliability of measurement methods, only points A, C and I were taken into account in the study of the stability at 1 year. Despite an intraclass correlation index moderate to good for the reproducibility of postoperative relapse measures, the metric difference calculated by the Dahlberg formula reported a random error of the millimeter.

The radiological follow-up of our study was 12 months postoperative. This follow-up duration was chosen for two reasons: First post-operative damage are commonly described as unlikely to worsen after twelve months postoperative [24] [21] [28], as the majority of vertical and horizontal relapses occur respectively 3 to 6 months postoperatively. Secondly, the choice of a one year period allowed to limit the number of patients lost to follow-up. In Chua *et al*. study [36], presenting a 5 year follow-up, we observed indeed close to a third lost to follow-up 3 years after the surgery.

In this study, no correlation was found between age at surgery and relapse amplitudes. As all patients were over 15 years at the time of surgery, this study seemed to confirm the interest of achieving the Le Fort I osteotomy near the end of growth, and not during puberty or the ante-pubertal period. A too early intervention could indeed promote relapse mainly because of the continued mandibular growth [37]. In Cheung *et al.* study [24] that does not advocate for maxillomandibular postoperative fixation, results at six weeks showed relapse of about 5% in the sagittal direction and 15% in the vertical direction. For Hirano *et al.*[21] who realise a maxillomandibular fixation of 6 weeks, postoperative relapse starts after this blocking period. In our study, means of postoperative contention started, in accordance with Hirano *et al.,* with an intermittent maxillomandibular fixation with elastics, associated with an occlusal splint for 6 weeks postoperative. Once the orthodontic treatment finished, the long-term containment could be achieved by wearing a palatal plate or stellite. We found only two cases of postoperative treatment by Delaire's mask. To our knowledge, no study discusses the role of long-term postoperative containments means, the interest of Delaire's masks during LFI with major advancement, apart from occlusal corrections by slight elastic traction.

It is commonly accepted that Le Fort I osteotomy relapses in patients operated for a cleft lip and palate are more important than in the general population. Indeed, while the results of post-operative relapses varies between 20 and more than 30% in osteotomy of CLP, Hoffman *et al.*[38] relate in their literature review 7 to 18% of Le Fort osteotomy relapse in the general population.

Likewise, in Hochban *et al.* study [26], on Le Fort I osteotomy relapse in 31 patients with 14 operated of CLP during childhood, a significant difference was found between the group operated of a facial cleft and the group without a cleft, as relapse amplitudes were more important in the group operated of a cleft. Our study confirms these published data with a relapse rate for horizontal movements of 20,1%.

Regarding intraoperative vertical movements, results in the literature are sometimes difficult to compare. Indeed, in the case of UCLP where hypomaxillia is theoretically tridimensional (vertical, horizontal, transverse), some teams only realize osteotomies with downward maxillary movement. A downward movement corrects vertical hypomaxillia and, by mandibular counter clockwise rotation, reduces the movement of maxillary advancement necessary to restore the class I occlusion. This theoretical operative movement does not take into account the particularities of the individual on the clinical and architectural plan. An important maxillary advancement can be source of an anterior vertical excess resulting in an excessive and unsightly gingival uncovering. Our study included in fact 27 osteotomies with intraoperative maxillary ascension.

Chua *et al.* [36] and Hirano *et al*. [21], who differentiate ascension and lowering movements of the maxilla, have observed more important relapse during the lowering of the maxilla than during its ascent. This has also been observed in our study, as a gradual re-ascension of the maxilla reached, in average, at point A, 0,6 mm (28,4%) at 1 year for an initial average lowering of 2mm, whereas ascents seemed stable. As a matter of fact, Hirano *et al*. advise to realize an over-correction of about 2 mm in case of maxillar lowering.

The meta-analysis by Saltaji realized in 2012 from 10 studies on the stability at 1 year after Le fort I osteotomy for facial cleft [20], allows to highlight the present study (Table 5). Among these 10 studies, only 5 were comparable to our study in terms of relapse assessment criteria (angular measurements for one [39], or study population). Kumar *et al*. [40], Chua *et al*. [36], and Ayliffe *et al.* studies [41] report the results of relapse in patients operated of uni- and bilateral CLP without distinguishing between the two. Yet, Hirano *et al.* study [21] found significantly more important postoperative relapse for bilateral than unilateral clefts.

Table 5: Main studies assessing the magnitude of horizontal and vertical relapse of point A in the UCLP (according Saltaji [20]) (MMF : maxillo-mandibular fixation). § Missing data

Horizontal Dimension						Vertical Dimension	
Authors, Year	Sample size	Fixation	Postoperative follow up (month)	Mean movement, mm	Mean Relapse, mm (%)	Mean movement, mm	Mean Relapse, mm (%)
Thongdee and Samman, 2005	30	Plates	12 to 66	5.64	1,77 (31,46)	4.40	2,25 (52,27)
Heliövaara et al, 2001	40	Plates	12	3,9	0,8 (20,5)	4,5	1(22,2)
Hirano and suzuki, 2001	42	Plates and MMF	18 to 102	-§	-(19,1)	-§	-§
Posnic and Dagys, 1994	35	Plates	12	6,9	1,6 (23)	2,1	1,2(21)
Daimuaruya et al, 2010	7	Plates	12	5,8	1,6 (25,5)	3,3	1,7(50,4)
Our study	54	Plates and MMF	12	4,2	-0,8 (20,1)	-upward: 2,3 -downward: 2,0	-upward: 0,2(7) -downward: 0,6(28,4)

We haven't found any correlation between the relapse amplitude and the type of surgery performed (Isolated Le Fort I or maxillo-mandibular osteotomy) in accordance with Thongdee *et al.* [22], Hirano *et al.* [21] and Posnick et Dagys studies [23]. In our experience, maxillo-mandibular surgery can be necessary in case of mandibular retrusion associated to maxillar retrusion, or in case of mandibular deviation (usually functional by forward mandibular sliding but rarely to compensate for a major maxillar advancement, which could explain the absence of correlation found.

Similarly, our results on the stability of single or multi-pieces Le Fort I osteotomy were similar to Watts *et al.* [42] on 30 UCLP with a one year follow-up, concluding to

the existence of similar sagittal and vertical relapses, regardless of the type of osteotomy.
In accordance with Heliövaara *et al.* [32], Posnick *et al.* [23],and Eskenazi *et al.* studies [27] no significant difference was found between relapse amplitudes and the realisation or not of a preoperative pharyngeal flap.
A specific analysis was realized between the group of patients followed since birth and those from care recourse. No significant difference was found for post-operative relapse amplitudes between the 2 groups. The age of primary surgery for patients followed since birth was 6,3 months and 4,38 months for those from a care recourse. The populations of the two groups were comparable in terms of number of palatal interventions prior to the osteotomy (with an average of 2,93 for the group followed since birth and 2,92 for the care recourse group), in terms of presence or not of a pharyngeal flap, and in terms of advancement average in the 2 groups (respectively 3,85 mm for the care recourse group and 4,54 mm for the group followed since birth).

Our study found 10 patients with phonation damage after Le Fort I osteotomy. There was no correlation between the degree of advancement and the worsening of a postoperative phonatory disorder. Heliövaara *et al.*[43] studied 37 patients with a facial cleft operated by a Le Fort I osteotomy with an average advancement of 4.7mm. There was no significant radiological change of the oropharyngeal airway, length of soft palate, or position of hyoid bone, but the nasopharyngeal airway presented changes correlated to the degree of intraoperative advancement.

On the phonatory level, Chua *et al.* study [37] concluded to a great variability of phonatory postoperative disorders depending on the preoperative status, the degree of intraoperative advancement, and on an individual response that the surgeon can hardly expect.

In a literature review, Chanchareonsook *et al.*[44] believe that patients with a real risk of decompensation after surgery are those with small imperfections before surgery. For the rest, the impact of the degree of intraoperative advancement on the velopharyngeal function was not obvious. The authors recommend to re-evaluate the velopharyngeal insufficiency at 1 year postoperative, as to retain or not the indication

of a pharyngeal flap. A phonatory improvement on the articulatory level and hypernasality may indeed appear six months after the osteotomy.

Since the late 90s and based on the principles of Ilizarov [45] distraction regenerated bone, many teams use extra-oral and intra-oral distractors for the treatment of major retrusion of the maxilla. Unlike the classic Le Fort I osteotomy, the osteogenic distraction (DO) consists in the performing of an osteotomy without mobilizing the maxillar. An extra-oral or intra-oral distractor is placed during surgery as to mobilize progressively the maxillary bone according to the desired vector. This technique would limit the postoperative retractions phenomena observed after conventional osteotomies, by stretching progressively the soft tissues, which is not possible in conventional orthognathic surgery.

The DO can be interceptive, it means to be performed before puberty. In this indication, Harada *et al.* [46] recommend the realization of an over-correction of the advancement to compensate the catching up phenomena of the mandibular growth. However, many centers perform the intervention at the end of growth, as the interceptive DO should stay occasional, in case of maxillomandibular shift greater than 10 mm [47] and/or if psychosocial impact on the child and/or severe sleep apnea syndrome by maxillary retrusion [35].

These indications have to be balanced with the occlusal results obtained, the psycho-social impact [48] and the possible complications linked to the DO [49] [50] [48]. In a study on the rotation of the occlusal plan after intra oral DO, extra oral DO and conventional surgery, Viwattanatipa *et al.*[51] have observed a greater occlusal relapse with intra oral DO (90,70% for the group intra-oral DO and 63,9% for the group LFI and 29,28% for the group extra-oral DO). This greater relapse in the intra oral DO group could be linked, according to the authors, with the orthodontic correction of a posterior gap by counterclockwise rotation of the mandibular plan at the end of treatment by intra-oral DO.

Despite the existence of numerous studies that compare conventional orthognathic surgery and DO in terms of tridimensional stability, the choice between conventional Le Fort I osteotomy and DO is to date non-consensual. Rachmiel *et al.* [52] have

compared post-operative relapses of 17 LFI et 19 DO. They recommend the realization of a LFI at the end of growth only in case of small advancements, as DO is preconized for mild to great advancements. However, no threshold value is mentioned. Chua *et al.* study [37] compared the post operative stability of 25 LFI and 20 DO in patients operated for a facial cleft and who had a retrusion of maxilla requiring a correction by advancement of 4 to 10 mm. Small advancements <4 mm (surgical correction by LFI) and great advancements >10 mm (surgical correction by DO) were excluded of the study. They concluded in a better stability of the DO and thus preconized the realization of the Le Fort I osteotomy only in case of retrusion of maxilla inferior to 4 mm. In our study, we have set evidence of a linear correlation between the degree of intra operative advancement and the relapse amplitude. The threshold value of advancement leading to a postoperative relapse significantly greater was 7 mm. Moreover, only 12 patients required an advancement superior to 7 mm, with an average of horizontal relapse of 1,67 mm. only 3 patients showed a relapse superior to 2 mm. For Proffit *et al.* [53], a relapse inferior to 2 mm is considered as clinically unsignificant.

Thus, although our study osteotomy in a large and homogeneous population of 54 patients operated for UCLP, has demonstrated a significantly increased risk of relapse for advancements superior to 7 mm, they remain under 2 mm and are thus clinically insignificant in 75% of cases (9 patients on 12). These results suggest that the Le Fort I osteotomy retains its place as part of the management of the dentofacial deformity of UCLP, including in the case of major retromaxilly (Fig. 4).

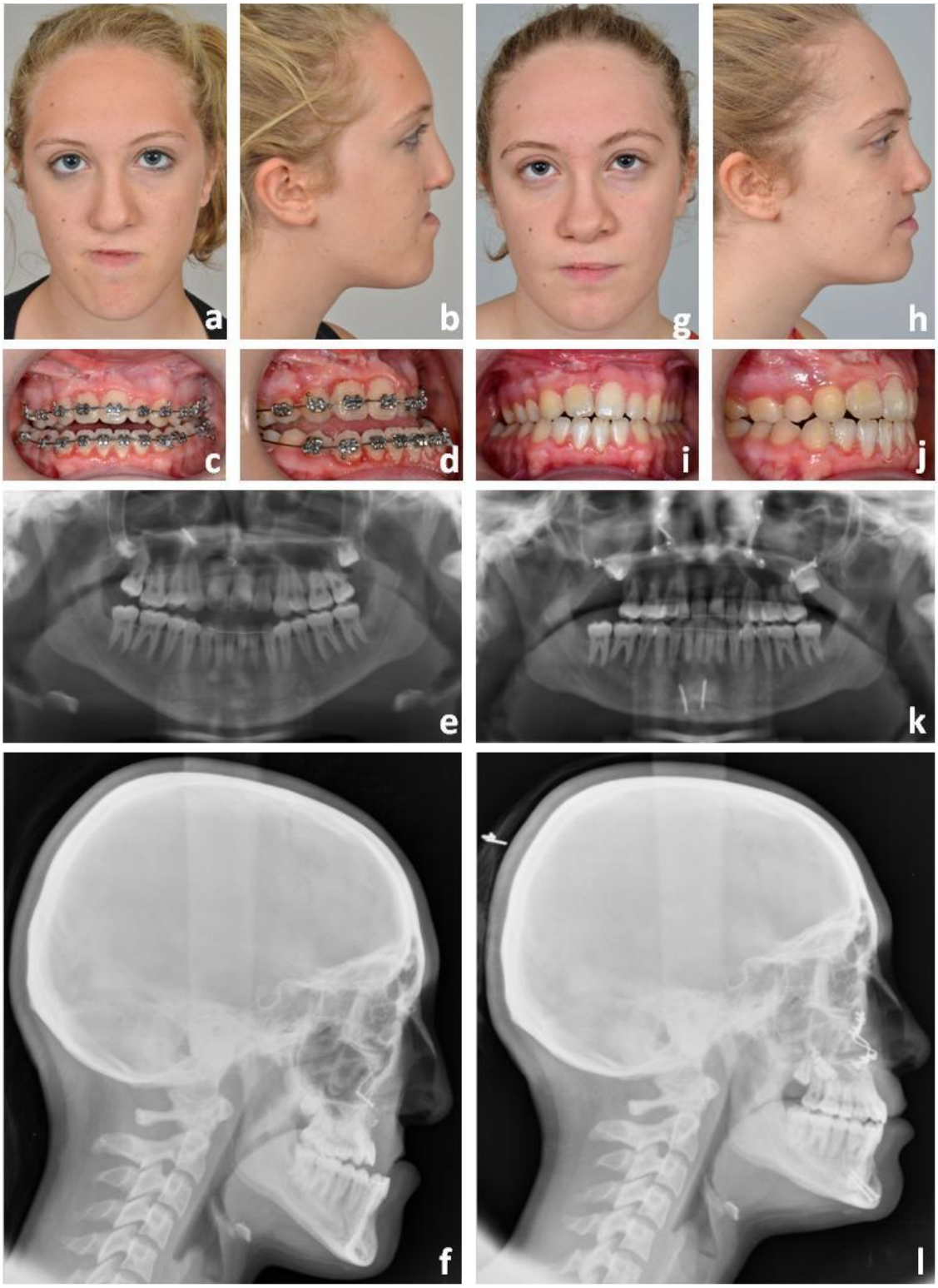

Figure 4: Right UCLP patient followed at Nantes University Hospital since the age of 13 years and with major retrusion of maxilla and a facial vertical excess from symphyseal origin. Dentally, 12 is absent (space of lateral incisive closed) and 14-24 previously extracted. The LFI osteotomy combined with a genioplasty was performed at 16. The maxillary advancement to point A was 11.25 mm (degradation at 1 year = 1.75mm) associated with a vertical downward movement of the maxilla (2.5 mm to 1 year degradation = 1.75mm). The images a, b, c, d, e, f corresponding to the pre-operative clinical and radiological data. Images g, h, i, j, k, l corresponding to postoperative ones at 1 year. (operator: Dr PERRIN)

DISCUSSION.

L'objectif de cette étude était d'évaluer les résultats de stabilité à 1 an des interventions d'ostéotomies de Le Fort I réalisées au sein du service de chirurgie maxillo-faciale et stomatologie du Centre Hospitalo-Universitaire de Nantes. Les amplitudes de dégradations dans le plan sagittal et vertical étaient faibles (< 0,8 mm en moyenne) mais étaient corrélées au degré d'avancée per-opératoire. Ainsi, la valeur seuil de 7 mm d'avancée était associée à un risque significativement plus élevé de dégradation à 1 an post opératoire. Le nombre de patients inclus et les méthodes de validation des mesures utilisées font à notre sens l'originalité et la valeur de cette étude.

Il existait cependant plusieurs limites associées à l'évaluation et à la comparaison des analyses. La population étudiée était très hétérogène en terme de calendrier chirurgical, de séquelles cicatricielles, de gestes associés à l'ostéotomie et de prise en charge orthodontique pré- et post-opératoire. De plus, cette analyse a été rendue difficile par l'utilisation de points de repères correspondant à des sites osseux remodelés après la procédure chirurgicale, notamment le point ENA [32].

Par ailleurs, les points de repères C (rebord crestal ou prosthion) et I (bord sécant des incisives supérieures) correspondent respectivement à des points repères alvéolaire et dentaire. Dans notre étude, il existait une dégradation moindre de ces deux points, probablement due à la compensation alvéolo-dentaire des mouvements orthodontiques post-opératoires. En effet, afin de prévenir ou corriger une éventuelle récidive croisé d'articulé antérieur, une vestibuloversion du secteur incisivo-canin pouvait être entreprise en post opératoire. L'étude de la dégradation purement osseuse nous a donc semblé plus pertinente en utilisant le point A [35 21 36 22].

Au vue de l'analyse de reproductibilité et de fiabilité des méthodes de mesures, seuls les points A, C et I ont été pris en compte dans l'étude de la stabilité à 1 an post opératoire. Malgré un indice de corrélation intraclasse moyen à bon pour la reproductibilité des mesures de dégradation postopératoires, la différence métrique

calculée par la formule de Dahlberg ne rapportait une erreur aléatoire que de l'ordre du millimètre.

Le suivi radiologique de notre étude était de 12 mois post opératoire. Cette durée de suivi a été retenue pour deux raisons : premièrement les dégradations post opératoires sont communément décrites comme étant peu susceptibles de s'aggraver après douze mois post opératoires [24] [21] [28], la majorité des dégradations verticales et horizontales se faisant respectivement dans les 3 et 6 mois post opératoires. Deuxièmement, le choix d'un délai d'un an permettait de limiter le nombre de patients perdus de vue. Dans l'étude de Chua *et al*. [36], présentant un suivi à 5 ans, on observait en effet près d'un tiers de patients perdus de vue à 3 ans de l'intervention.

Il n'a pas été observé dans cette étude de corrélation entre l'âge à la date de l'intervention et l'amplitude de dégradation. La totalité des patients ayant plus de 15 ans au moment de l'intervention, cette étude semble confirmer l'intérêt de réaliser l'ostéotomie de Le Fort I vers la fin de croissance, et non en période pubertaire ou anté-pubertaire. Une intervention trop précoce risquerait en effet de favoriser la dégradation des résultats notamment à cause de la poursuite de la croissance mandibulaire[37].

Dans l'étude de Cheung *et al.* [24] qui ne préconise pas de blocage maxillo-mandibulaire post-opératoire, les résultats à six semaines montraient des dégradations de l'ordre de 5% dans le sens sagittal et 15% dans le sens vertical. Or, pour Hirano *et al.*[21] qui réalise un blocage maxillo-mandibulaire de 6 semaines, la dégradation post opératoire débute après cette période de blocage. Dans notre étude, les moyens de contention postopératoires débutaient, en accord avec Hirano *et al.,* par un blocage maxillo-mandibulaire intermittent, par élastiques, associée à une gouttière d'intercuspidation maximale pendant 6 semaines post opératoires. Une fois le traitement orthodontique terminé, la contention à long terme pouvait être réalisée par le port d'une plaque palatine ou d'un stellite. Nous n'avons retrouvé que deux cas de traitement post opératoire par traction sur masque. A notre connaissance, dans aucune étude n'est discutés le rôle des moyens contentions post opératoires à long terme, l'intérêt des tractions sur masque lors des grandes

avancées de LFI, en dehors des corrections occlusales par traction élastique légère ou plaque palatine [39] [36].

Il est communément admis que les dégradations des ostéotomies de Le Fort I chez les patients opérés d'une FLMP sont plus importantes que dans la population générale. En effet, alors que les résultats des dégradations post opératoires varient entre 20 et plus de 30% dans le cadre des ostéotomies sur FLMP, Hoffman *et al.*[38] ne rapportent dans leur revue de la littérature que 7 à 18% de dégradations des ostéotomies de Le Fort dans la population générale.

De même, l'étude d'Hochban *et al.* [26], portant sur la dégradation des ostéotomies de Le Fort I chez 31 patients dont 14 opérés d'une FLMP dans l'enfance, rapporte une différence significative entre le groupe opéré d'une fente faciale et le groupe sans fente, les amplitudes de dégradations étant plus importantes dans le groupe opéré d'une fente. Notre étude, retrouvant un taux de dégradation pour les mouvements horizontaux de 20,1%, confirme les données publiées.

Concernant les mouvements verticaux per opératoires, les résultats de la littérature sont parfois difficilement comparables. En effet, dans le cadre des FLMP où l'hypomaxillie est théoriquement tridimensionnelle (verticale, horizontale, transversale), certains auteurs ne réalisent que des ostéotomies avec abaissement du maxillaire. Un abaissement corrige l'hypomaxillie verticale et, par autorotation mandibulaire, diminue le mouvement d'avancée maxillaire nécessaire afin de rétablir l'occlusion de classe I. Ce mouvement opératoire théorique ne prend cependant pas en compte les particularités de l'individu sur le plan clinique et architectural. Une avancée importante du maxillaire peut être à l'origine d'un excès vertical antérieur qui se manifeste par un découvrement gingival excessif et disgracieux. Notre étude comportait de fait 27 ostéotomies avec ascension maxillaire per opératoire.

Chua *et al.* et Hirano *et al*., qui différencient mouvements d'ascension et d'abaissement du maxillaire, observent des dégradations plus importantes lors de l'abaissement du maxillaire que lors de son ascension. C'était aussi le cas dans notre étude, où une ré-ascension progressive du maxillaire atteignait en moyenne au point A 0,6 mm (28,4%) à 1 an pour un abaissement initial moyen de 2mm tandis

que les ascensions semblaient stables. Aussi, Hirano *et al*. conseillent-ils de réaliser une sur-correction d'environ 2 mm en cas d'abaissement maxillaire.

La méta-analyse de Saltaji réalisée en 2012 à partir de dix études traitant de la stabilité à 1 an au moins des ostéotomies de Le Fort I pour fente faciale [20], permet de mettre en relief la présente étude (Tableau 5). Sur les 10 études rapportées dans cette méta-analyse, seules 5 étaient comparables à notre étude en terme de critères d'évaluation de la dégradation (mesures angulaires pour l'une [39] ou de population d'étude. Les études de Kumar *et al*.[40], Chua *et al*.[36], et Ayliffe *et al.*[41] rapportent en effet les résultats de dégradation de patients opérés de FLMP uni- et bilatérales sans les distinguer. Or, l'étude d'Hirano *et al.* [21] retrouvaient des résultats de dégradation post-opératoire significativement plus importants pour les fentes bilatérales que pour les fentes unilatérales.

Nous n'avons pas retrouvé de corrélation entre l'amplitude de dégradation et le type de chirurgie pratiquée (ostéotomie de Le Fort I isolée ou maxillo-mandibulaire) en accord avec les études de Thongdee *et al* [22], Hirano *et al*. [21] Posnick et Dagys [23]. Dans notre expérience, la chirurgie maxillo-mandibulaire peut être nécessaire en cas de rétromandibulie associée à la rétromaxillie, ou en cas de latéro- ou promandibulie (le plus souvent fonctionnelle par proglissement mandibulaire), mais rarement pour compenser une avancée maxillaire majeure, ce qui pourrait expliquer l'absence de corrélation retrouvée.

De même, nos résultats sur la stabilité des ostéotomies de Le Fort I mono ou pluri-fragmentaire sont similaires à ceux de Watts *et al.* [42] sur 30 FLMP unilatérale avec un suivi à un an, qui concluent à l'existence de dégradations similaires, sagittales et verticales entre les deux groupes.

Tableau 6:Principales études évaluant l'amplitude de dégradation sagittale et verticale du point A dans les FLMP unilatérales (d'après Saltaji [20]) (BMM : Blocage maxillo-mandibulaire). § Données manquantes

Horizontal Dimension						Vertical Dimension	
Auteurs, Année	population	ostéosynthèse	Suivi postopératoire (mois)	Mean mouvement, mm	Moyenne dégradation, mm (%)	Moyenne mouvement, mm	Moyenne dégradation, mm (%)
Thongdee et Samman, 2005	30	Plaques	12 à 66	5.64	1,77 (31,46)	4.40	2,25 (52,27)
Heliövaara et al, 2001	40	Plaques	12	3,9	0,8 (20,5)	4,5	1(22,2)
Hirano et suzuki, 2001	42	Plaques et BMM	18 à 102	-§	-(19,1)	-§	-§
Posnic et Dagys, 1994	35	Plaques	12	6,9	1,6 (23)	2,1	1,2(21)
Daimuaruya et al, 2010	7	Plaques	12	5,8	1,6 (25,5)	3,3	1,7(50,4)
Notre étude	54	Plaques et BMM	12	4,2	-0,8 (20,1)	-ascension 2,3 -abaissement 2,0	-ascension 0,2(7) -abaissement 0,6(28,4)

En accord avec les études de Heliövaara *et al.* [32]., Posnick *et al.* [23], et Eskenazi *et al.* [27] aucune différence significative n'a été retrouvée entre les amplitudes de dégradation et la réalisation ou non d'un lambeau pharyngé pré opératoire.

Une analyse spécifique a été réalisée entre le groupe de patients suivis depuis la naissance et ceux issus d'un recours. L'analyse n'a pas retrouvé de différence significative d'amplitudes de dégradations post opératoires entre les deux groupes. L'âge du premier temps chirurgical chez les patients suivis depuis la naissance était de 6,3 mois et ceux issus d'un recours était de 4,38 mois. Les populations des deux groupes étaient comparables sur le plan du nombre d'interventions palatines préalables à l'ostéotomie (avec une moyenne de 2,93 pour le groupe suivi depuis la naissance et 2,92 pour le groupe recours), de la présence ou non de lambeau

pharyngé, et de la moyenne des avancées dans les deux groupes (respectivement, 3,85 mm pour le groupe recours et 4,54 mm pour le groupe suivi depuis la naissance).

Notre étude retrouvait 10 patients présentant une dégradation phonatoire après ostéotomie de Le Fort I. Il n'existait pas de corrélation entre le degré d'avancement et la présence d'une aggravation des troubles phonatoires post opératoires. Heliövaara *et al.*[43] a étudié 37 patients porteurs d'une fente faciale et opérés d'une ostéotomie de Le Fort I avec une avancée moyenne de 4,7mm. Il n'existait pas de changement significatif sur le plan radiologique concernant la filière oropharyngée, la longueur du palais mou et la position de l'os hyoïde, mais avec cependant, une filière nasopharyngée présentant des changements corrélés au degré de l'avancée per opératoire. Sur le plan phonatoire, l'étude de Chua *et al.* [37] concluait à une grande variabilité des troubles phonatoires post opératoires dépendant du statut pré-opératoire, du degré d'avancement per-opératoire, et d'une réponse individuelle que le chirurgien peut difficilement prévoir.

Dans leur revue littérature, Chanchareonsook *et al.* [44] estiment que les patients présentant un réel risque de décompensation en post opératoire sont ceux qui présentent de petites imperfections avant l'intervention. Pour le reste, l'impact du degré d'avancement per opératoire sur la fonction vélopharyngée n'apparaissait pas évident. Les auteurs préconisent de réévaluer l'insuffisance vélopharyngée à 1an post opératoire, afin de retenir ou non l'indication d'un lambeau pharyngé. Une amélioration phonatoire, sur le plan articulatoire et du nasonnement peut en effet apparaître à 6 mois de l'ostéotomie.

Depuis la fin des années 90 et se basant sur les principes d'Ilizarov [45] de « la régénération en distraction », plusieurs équipes utilisent les distracteurs extra- et intra-oraux pour le traitement des rétromaxillies majeures. Contrairement à l'ostéotomie classique de Le Fort I, la distraction ostéogénique (DO) consiste à réaliser une ostéotomie sans mobiliser le maxillaire. Un distracteur intra ou extra oral est mise en place en per opératoire afin de mobiliser le maxillaire progressivement selon le vecteur souhaité. Cette technique permettrait de limiter les phénomènes de rétractions post-opératoires constatées après ostéotomies classiques, en étirant

progressivement les tissus mous, ce qui n'est pas possible en chirurgie orthognathique conventionnelle.

La DO peut être interceptive, c'est-à-dire réalisée avant la fin de la puberté. Dans cette indication, Harada *et al* [46] recommande de réaliser une sur-correction de l'avancée afin de compenser le phénomène de rattrapage par la croissance mandibulaire. Cependant, de nombreux centres réalisent l'intervention en fin de croissance, la DO interceptive devant rester occasionnelle, en cas de décalage maxillo-mandibulaire supérieure à 10 mm [47] et/ou avec retentissement psychosocial de l'enfant et/ou syndrome d'apnée du sommeil sévère par rétrusion maxillaire [35].

Ces indications sont par ailleurs à pondérer par rapport aux résultats occlusaux obtenus, au retentissement psycho-social [48] et aux possibles complications liées à la DO [49] [5048]. Dans une étude portant sur la rotation du plan occlusal après DO intra-orale, DO extra-orale et chirurgie conventionnelle, Viwattanatipa *et al.*[51] ont observé une dégradation occlusale plus importante en cas de DO intra-orale (90,70% pour le groupe DO intra-oral 63,9% pour le groupe CO et 29,28% pour le groupe DO extra-oral). Cette dégradation plus importante dans le groupe DO intra-oral pouvait selon les auteurs être en lien avec la correction orthodontique d'une béance postérieure par rotation antihoraire du plan mandibulaire en fin de traitement par DO intra-orale.
Malgré l'existence de nombreuses études comparant chirurgie orthognathique conventionnelle et DO en termes de stabilité tridimensionnelle, le choix entre ostéotomie de Le Fort I conventionnelle et DO n'est à ce jour pas consensuel. Rachmiel *et al.* ont comparé les dégradations post-opératoires de 17 LFI et 19 DO. Ils recommandent de réaliser une LFI en fin de croissance seulement en cas de petites avancées, la DO étant préconisée pour les moyennes à grandes avancées. Cependant, aucune valeur seuil n'est mentionnée. L'étude de Chua *et al.* [37] comparait la stabilité post opératoire de 25 LFI et 20 DO chez des patients opérés d'une fente faciale et présentant une rétromaxillie nécessitant une correction par avancée de 4 à 10 mm. Les petites avancées <4 mm (correction chirurgicale par LFI) et les grandes avancées >10 mm (correction chirurgicale par DO) étaient exclus de l'étude. Ils concluaient à une meilleure stabilité de la DO et ne préconisait donc la réalisation de l'ostéotomie de LFI qu'en cas de rétromaxillie de moins de 4 mm. Dans notre étude, nous avons mis en évidence une corrélation linéaire entre le degré

d’avancée per-opératoire et l’amplitude de dégradation. La valeur seuil d’avancée entrainant une dégradation post-opératoire significativement plus importante était de 7 mm. Par ailleurs, seuls 12 patients ont nécessité une avancée supérieure à 7 mm, avec une moyenne de dégradation horizontale de 1,67 mm. Seuls 3 patients présentaient une dégradation de plus de 2 mm. Selon Proffit *et al.* [53], une dégradation de moins de 2 mm est considérée comme cliniquement non significative.

Ainsi, bien que notre étude ait mis en évidence un risque de dégradation significativement plus important lors des avancées de plus de 7 mm, celles-ci restent de moins de 2 mm et donc non cliniquement significatives dans 75% des cas (9 patients sur 12). Ces résultats tendent à démontrer que l’ostéotomie de Le Fort I conserve sa place dans le cadre de la prise en charge des dysmorphoses dento-squelettique séquellaire d’une FLMP unilatérale, y compris en cas de rétromaxillie importante(Fig.4).

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Stabilité à long terme des ostéotomies de Le Fort I chez les patients opérés d'une fente labio-maxillo-palatine unilatérale.
Etude rétrospective de 54 cas pris en charge au CHU de Nantes

ABSTRACT.

The stability of the osteotomy Le Fort I to postoperative year was evaluated retrospectively in 54 patients undergoing unilateral cleft lip and palate. The horizontal and vertical relapse were analyzed on profile cephalograms performed preoperatively, at immediate postoperative, and one year. At point A, the mean advancement during surgery was 4.2 mm with a relapse of 0.8 mm (20.1%). The mean downward movement was 2.0 mm (n = 26) with a relapse of 0.6 mm (28.4%). The mean upward movement was 2.3 mm (n = 27) with a deterioration of 0.2 mm (7%). An 7mm advancement corresponded to the threshold value beyond which relapse appeared significantly greater with however clinically insignificant degradation. The osteotomy Le Fort I retains his place in the treatment of maxilla retrusion of unilateral CLP.

La stabilité des ostéotomies de Le Fort I à un an post-opératoire a été évalué, de manière rétrospective sur 54 patients opérés d'une fente labio-maxillo-palatine unilatérale. Les dégradations horizontales et verticales ont été analysées sur les téléradiographies de profil réalisées en préopératoire, en post opératoire immédiat, et à un an. Au point A, l'avancée maxillaire moyenne au cours de l'ostéotomie était de 4,2 mm avec une dégradation de 0,8 mm (20,1%), l'abaissement moyen était de 2,0 mm (n=26) avec une dégradation de 0,6 mm (28,4%), et l'ascension moyenne était de 2,3 mm (n= 27) avec une dégradation de 0,2 mm (7%).Une avancée de 7 mm correspondait à la valeur seuil au-delà de laquelle la dégradation apparaissait significativement plus importante avec cependant des dégradations cliniquement non significatives. L'ostéotomie de Le Fort I conserve sa place dans le cadre de la prise en charge des rétromaxillies d'une FLMP unilatérale.

MOTS-CLES
Cleft lip and palate, Le Fort I osteotomy, relapse tendency, maxillary advancement