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CLINICAL NOTES

Is wire osteosynthesis obsolete for fixation of Le Fort I osteotomies?

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In the literature, there are many reports about the skeletal stability of the maxilla after Le Fort I osteotomies. Most of the reports concern the stability of the upper jaw in cases in which the jaw was fixed with wire osteosynthesis in combination with postoperative rigid maxillomandibular fixation (MMF); in other, more recent reports, the jaw was fixed with rigid internal fixation without consecutive postoperative rigid MMF.

The introduction of miniplates rapidly convinced many maxillofacial surgeons to abandon wire osteosynthesis, partly for the sake of avoiding the complications and discomfort linked to postoperative MMF but mostly because of the more predictable skeletal stability for most surgical movements. Yet rigid fixation posed new problems, not the least of which is that with rigid fixation there is postoperatively less possibility of correcting occlusal errors by means of intermaxillary elastics.

This study evaluated the stability obtained with wire osteosynthesis for stabilization of the maxilla after Le Fort I osteotomy *without* postoperative rigid MMF. This is better for postoperative respiratory security, dental hygiene, and patient comfort. Wire osteosynthesis is much cheaper than rigid internal fixation, which is relevant in developing countries and in some health care systems.

MATERIAL AND METHODS

In this prospective clinical study, 34 of 40 consecutively operated patients were involved. Six patients were excluded, 3 because of incomplete data sets and 3 for various other reasons (incomplete dental arches, postoperative condylysis, application of postoperative rigid MMF). None of the remaining 28 female and 6 male patients (average age, 22 years; range, 16-38 years) had cleft lip and palate deformity, craniofacial syndromes, or previous facial skeletal trauma. The maxillary surgical movements were limited to intrusions and advancements, the maximum being 8 mm. Postoperative rigid MMF was not applied, and there were no complications during or after surgery. In each of 12 cases the Le Fort I osteotomy was combined with bilateral sagittal splitting of the mandible, and in each of 22 patients an additional genioplasty was performed.

Surgical technique

The Le Fort I osteotomy was performed as described by Obwegeser,[1] with complete mobilization of the maxilla. The maxilla was repositioned after MMF over a position splint. On each side, three 0.4 steel wires were used for osteosynthesis; they were situated lateral to the piriform aperture, below the infraorbital foramen, and along the zygomatic buttress. There was direct bone contact in the paranasal area and at the zygomatic buttress. The remaining bone gap was filled with bone removed at the osteotomy site, chin bone, or lyophilized bone.[2] Training elastics were inserted 2 to 3 days postoperatively for a period of 2 to 4 weeks. Bilateral sagittal splits were stabilized by means of 3 bicortical position screws on each side.

Method of investigation

Cephalograms taken preoperatively, immediately postoperatively, and 1 year postoperatively were analyzed. The examined landmarks were the points A, ANS, and PNS (Fig 1). The cephalometric points were

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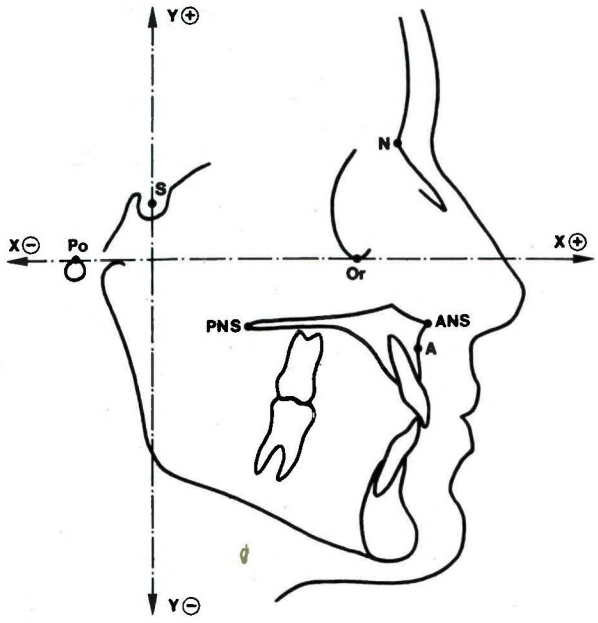


Fig 1. Cephalometric landmarks and reference axes X and Y.

plotted on a Numonic digitizer with an error magnitude of 0.25 mm and analyzed by means of the Zurich cephalometric anal-ysis system (Department of Orthodontics, Dental School of the University of Zurich). The total method error was maximally 0.4 mm for the reference points and 0.6 mm for the examined points. The surgical movements and the relapse seen 1 year postoperatively were calculated.

Comparisons were made between monomaxillary procedures (n = 14) and bimaxillary procedures (n = 20) and between cases with mainly maxillary advancement (n = 15) and cases with mainly maxillary intrusion (n = 19).

The Wilcoxon matched pairs signed rank test was used to compare surgical and postoperative movements. Correlation between surgical moves and relapse tendencies was analyzed with a simple regression test. Results were considered statistically significant when $P \leq .05$.

RESULTS

The mean advancement in A was 3.6 ± 2.4 mm, with a mean relapse 1 year postoperatively of 0.4 ± 1.1 mm (Table I). The mean vertical surgical displacement was an intrusion of 0.6 ± 2.6 mm. Postoperatively, there was a further significant intrusion of 0.7 ± 1.2 mm. Similar patterns were seen in ANS. The mean surgical intrusion in PNS was 2.2 ± 2.7 mm, with a postoperatively ongoing intrusion of 0.2 ± 1.2 mm. There was a significant positive correlation between surgical intrusion and horizontal relapse in A.

Table I. Mean horizontal and vertical changes (with standard deviations) for all cases

	Surgical move		*Relapse 1 y postoperatively*	
	x	*y*	*x*	*y*
All patients (N = 34)				
A	3.6 ± 2.4	–0.6 ± 2.6	–0.4 ± 1.1	–0.7 ± 1.2
ANS	3.8 ± 2.3	–0.5 ± 2.8	–0.5 ± 1.2	–0.8 ± 1.2
PNS	3.9 ± 2.4	–2.2 ± 2.7	–0.4 ± 1.4	–0.2 ± 1.2

+, Movement in anterior or inferior direction; –, movement in posterior or superior direction.

Table II. Mean horizontal and vertical changes (with standard deviations) in monomaxillary procedures and bimaxillary procedures

	Surgical move		*Relapse 1 y postoperatively*	
	x	*y*	*x*	*y*
Monomaxillary (n = 14)				
A	3.7 ± 2.7	0.9 ± 2.4	–0.1 ± 1.0	–0.9 ± 1.1
ANS	4.1 ± 2.5	1.2 ± 2.6	–0.2 ± 1.2	–1.0 ± 1.2
PNS	4.2 ± 2.6	–1.8 ± 2.9	–0.1 ± 1.2	–0.2 ± 1.0
Bimaxillary (n = 20)				
A	3.5 ± 2.3	–1.6 ± 2.2	–0.6 ± 1.2	–0.5 ± 1.2
ANS	3.7 ± 2.2	–1.6 ± 2.2	–0.7 ± 1.2	–0.6 ± 1.2
PNS	3.7 ± 2.3	–2.6 ± 2.6	–0.6 ± 1.5	–0.2 ± 1.3

+, Movement in anterior or inferior direction; –, movement in posterior or superior direction.

Comparison between the monomaxillary and bimaxillary groups showed a similar advancement, with a horizontal relapse in A of 0.1 ± 1.0 mm in the monomaxillary group and 0.6 ± 1.2 mm in the bimaxillary group (Table II). The postoperatively ongoing intrusion in the ANS was more important in the monomaxillary group (1.0 ± 2.6 mm) than in the bimaxillary group (0.6 ± 1.0 mm). PNS remained equally stable in both groups (postoperatively ongoing intrusion of 0.2 mm).

Comparison between cases of mainly advancement and cases of mainly intrusion showed significant differences for surgical displacement and relapse (Table III). In the advancement group, the mean horizontal surgical displacement was stable (0.2 ± 1.2 mm in the same direction as the mean advancement of 5.4 ± 2.3 mm), whereas the mean surgical extrusion of 0.2 ± 1.2 mm was followed by a postoperative intrusion of 1.0 ± 1.0 mm. The intrusion group had a horizontal relapse of –1.0 ± 0.9 mm, for a mean advancement of 2.4 ± 1.7 mm and a relative vertical stability with postoperative intrusion of –0.3 ± 1.3 mm after a surgical intrusion of –2.6 ± 1.7 mm. PNS showed a similar postoperative intrusion.

DISCUSSION

On the basis of studies reporting good stability obtained with wire osteosynthesis and MMF for similar surgical moves,[3-5] an acceptable skeletal stability could be expected. Advancements of 8 mm cover corrections of most dysgnathias, because in major class III malocclusions stability is significantly better for combined maxillary and mandibular surgery, splitting the necessary correction over surgical movements in both jaws. In maxillary extrusions wire osteosynthesis should not be used because it leads to unstable results.[6-8]

For the 2 osteosynthesis systems, similar stability results have been reported in monomaxillary procedures. Teuscher and Sailer[3] noted a mean relapse of 0.4 mm 1 year postoperatively after a mean maxillary advancement of 7.0 mm, stabilized with wires and MMF. Between 1 and 5 years postoperatively, only small changes averaging less than 0.5 mm were noted.[3] In 15 cases with a mean maxillary advancement of 8.8 ± 1.0 mm stabilized with miniplates, Hoffman and Moloney[9] reported a mean relapse 1 year postoperatively of 0.6 ± 0.3 mm. Other studies could not present equally good results after maxillary advancement.[10,11] However, several reports showed comparable mean relapse values for the 2 osteosynthesis systems.[5,12-15]

The mean results of the group with mainly advancement are comparable to the results obtained with rigid fixation. On the contrary, in cases of mainly intrusion there was a constant posteriorly oriented relapse correlated with the amount of intrusion. In this combination of surgical moves, overcorrection splints should be made. Van Sickles and Richardson[16] advocate this also when miniplates are used; in their opinion, maxillary intrusion alone is very stable and only small hardware is needed to stabilize the maxilla. This was also the case in our series, but with a constant tendency toward additional postoperative intrusion of approximately 1 mm in the anterior maxilla; in contrast, the postoperative maxilla remained stable. This loss of vertical dimension is compatible with the mechanics of the wire osteosynthesis, which allows upward movements causing mobility at the healing site, with ensuing bone resorption. Even when miniplates were used, this mobility was detected in the anterior maxilla until 1 year postoperatively.[17]

Another way of assessing postoperative stability is to count the numbers of cases with postoperative motions less than 2 mm and more than 2 mm, as this is considered the critical value for skeletal relapse.[4] Horizontal relapse exceeding 2 mm was seen in 6 cases; vertical relapse exceeding 2 mm was seen in 7 cases (20.6%) in ANS and in 2 cases in PNS (5.9%). This coincides with the findings of a comparative study on the stability of

Table III. Mean horizontal and vertical changes (with standard deviations) in mainly maxillary advancement and mainly maxillary intrusion

	Surgical displacement		*Relapse 1 y postoperatively*	
	x	*y*	*x*	*y*
Advancement (n = 15)				
A	5.4 ± 2.3	0.2 ± 1.9	0.2 ± 1.3	−1.0 ± 1.0
ANS	5.5 ± 2.1	0.2 ± 2.3	0.0 ± 1.6	−1.1 ± 1.0
PNS	5.6 ± 2.2	−0.1 ± 1.5	0.1 ± 2.0	−0.1 ± 2.0
Intrusion (n = 19)				
A	2.4 ± 1.7	−2.6 ± 1.7	−1.0 ± 0.9	−0.3 ± 1.3
ANS	2.7 ± 1.6	−2.6 ± 1.5	−1.0 ± 0.9	−0.4 ± 1.3
PNS	2.6 ± 1.5	−3.9 ± 2.1	−0.9 ± 1.2	−0.2 ± 1.0

+, Movement in anterior or inferior direction; −, movement in posterior or superior direction.

Le Fort I osteotomy for maxillary advancement stabilized with wires and miniplates.[18] The comparison of the mean values suggested improved stability with rigid fixation, but statistical analysis showed no significant difference. However, in the group with wire osteosynthesis, 3 cases showed postoperative change of more than 2 mm; in the group with miniplate fixation this occurred in 1 case.

The standard deviations seen in our series have a greater range than those mentioned in most studies on rigid fixation. This illustrates that the use of miniplates leads to more homogenous postoperative motion patterns with a better individual predictability.

Wire osteosynthesis has been abandoned because it does not provide a predictable skeletal stability for all surgical movements and because of the major disadvantages of the accompanying postoperative rigid maxillomandibular fixation. This study shows that with restrictions on direction and amplitude of the surgical movement, wire osteosynthesis results in acceptable skeletal stability without the application of postoperative rigid maxillomandibular fixation. The main disadvantages are worse individual predictability of skeletal stability and a need for extra time for its application in comparison with plating, especially when wires or thin bone structures break. The main advantages are the extreme low cost and the possibility of performing minor skeletal corrections by means of intermaxillary elastics, which facilitates postoperative settling of the occlusion.

Although miniplates are the treatment of choice for osteosynthesis in orthognathic surgery, wire osteosynthesis of Le Fort I osteotomies is not obsolete. Rather, it is a valid alternative that offers considerable advantages in specific indications, on the condition that in bimaxillary cases rigid osteosynthesis be applied in the mandible. Wire osteosynthesis is thus a valuable tech-

nique and may still have a role to play in the daily practice. Especially when plate fixation of the maxilla is not available for financial reasons, surgeons should not refrain from performing these procedures.

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