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The influence of the Le Fort I osteotomy on nasal airway resistance

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SUMMARY

Pre- and postoperative rhinomanometric measurements were done on 13 patients by whom a Le Fort I osteotomy was performed. The claim that Le Fort I osteotomies may produce deleterious respiratory effects in the form of an increase in nasal airway resistance was investigated. The results are discussed.

INTRODUCTION

The Le Fort I osteotomy has become well established in orthognathic surgery in the treatment of maxillary hypoplasia and hyperplasia, and in the management of skeletal anterior open-bite as seen in the long-face syndrome (Figure 1).
Correction of these deformities often involves anterior, inferior or superior repositioning of the maxilla, especially in the posterior region in the long-face syndrome.
Previous investigations have shown both an objective and subjective improvement in nasal airway resistance in both normal and cleft palate cases (Warren et al., 1969; Hershey et al., 1976; Götzfried et al., 1984, 1988; Guenther et al., 1984; Turvey et al., 1984; Walker et al., 1988). Superior repositioning of the maxilla decreases the volume of the nasal cavity by elevation of the nasal floor. It would thus be anticipated that nasal airway resistance would be increased. The improvement noted has been explained on the basis of alteration in the nasal valve which represents the smallest cross-sectional area of the nasal cavity and thus the primary determinant of nasal airway resistance (van Dishoeck, 1965; Bridger et al., 1970; Turvey, 1980; Vig et al., 1981; Warren et al., 1987).
Many factors may influence nasal airway resistance preoperatively, and these include septal deviation, the character of the nasal mucosa, shape of the anterior nares, the presence of mucosal polyps or enlarged adenoids or turbinates.
This study was carried out to re-evaluate changes in nasal airway resistance following one-piece Le Fort I osteotomy.

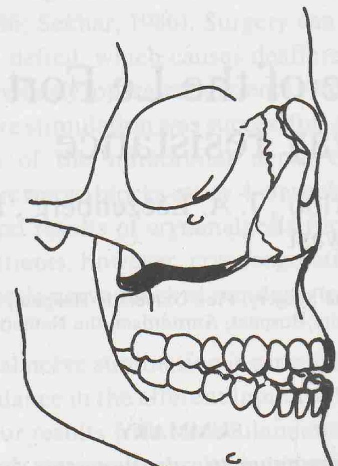


Figure 1. Osteotomy lines according to the Le Fort I technique.

MATERIALS AND METHODS

Thirty-three consecutive orthognathic patients were seen at the Free University Hospital of Amsterdam during the period March to August 1987. There were 21 females and 12 males, the age range was 17 to 41 years with a mean of 24 years. Twenty patients were treated by Le Fort I down fracture of which sixteen had a bimaxillary procedure. The remaining thirteen patients underwent a mandibular procedure only either a sagittal split or vertical ramus osteotomy and were used as the control group. Segmental procedures were not carried out in either group. Superior repositioning of the maxilla varied from 1 to 8 mm, and was performed in 15 patients. Inferior repositioning of 3 mm was performed on one patient. In the remaining three patients anterior repositioning to a maximum of 6 mm was carried out without a vertical component.

Prior to preoperative assessment of nasal airway resistance the patients were examined by an E.N.T. surgeon for the presence of septal deviation, spurs, enlarged turbinates as well as mucosal changes due to allergic rhinitis, vasomotor rhinopathy and other disorders. The examination was carried out without the use of a nasal decongestant, to minimize interruption in the normal nasal function. It has previously been shown that there is a normal physiological cyclical variation of the nasal mucosa which decreases the nasal lumina. This has been shown to alternate between each side of the nose such that mucosal enlargement may almost obstruct one airway whilst the other is in a secretive phase and thus unobstructed. The duration of this cycle ranges from 25 minutes to 4 hours with an average of 2½ hours (Heetderks, 1927; Stoksted, 1952, 1953; Brown, 1967).

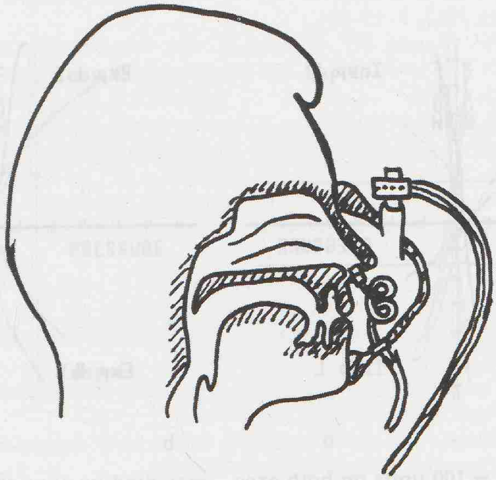


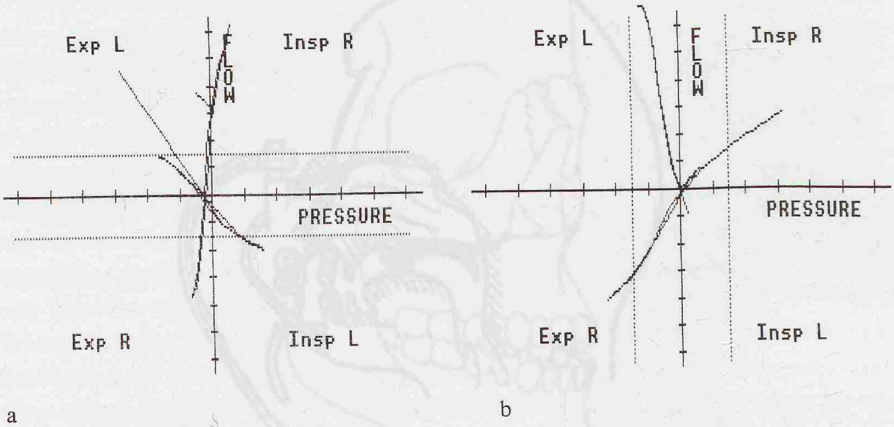
Figure 2. Passive anterior rhinomanometry.

To measure nasal airway resistance passive anterior rhinomanometry was employed (Williams, 1968; Cohen, 1969; Kortekangas, 1972; Bachmann and Nieder, 1978; Büsser and Schibli, 1978; Cole et al., 1980; Warren, 1984). Using a mask technique and a pressure nozzle placed to occlude one nostril it was possible to measure the pressure difference between the non-occluded nasal airway and the atmosphere. Flow was measured with the aid of a flow meter attached to the mask rather than the nose which would interfere with the shape of the nasal valve (Figure 2). The results of this technique were displayed on a rhinogram which demonstrates flow and pressure changes both on inspiration and expiration (Figure 3a). Each patient was assessed both pre- and postoperatively. The postoperative measurements were done 8–12 months after the operation.

RESULTS

In the control group apart the effects of the normal nasal mucosal physiological cycle there was no change in nasal airway resistance following the mandibular osteotomy alone (Figure 3a and b).

In the Le Fort I group 13 patients showed an improvement in nasal airways resistance, six patients showed no change and only in one patient there was a decrease in nasal airflow and an increase in nasal airway resistance (Table 1).



Scale: 1 Division = 100 units on both axes.

Figure 3. Rhinomanometric measurements showing the influence of the nasal cyclus on flow and pressure. a. preoperatively; b. postoperatively.

Table 1. Effect of type of maxillary repositioning on nasal function.

nasal function	maxillary repositioning			
	superior (n = 15)	superior and anterior (n = 1)	anterior (n = 3)	inferior (n = 1)
improvement	8	1	3	1
unchanged	6	0	0	0
deterioration	1	0	0	0

DISCUSSION

An improvement in nasal airway function following Le Fort I osteotomy was seen in 65% of the cases (an example is seen in Figure 4a and b). Only 5% showed an increase in nasal airway resistance probably due to post-operative septal deviation. In 30% of the cases nasal airway resistance was unaffected.

In those cases in which nasal airway resistance was reduced post-operatively the factors which may have produced this result include changes in position of the nasal septum, the nasal crest of the maxilla and the inferior turbinates. In all cases the height of the nasal septum was reduced to allow superior repositioning of the maxilla without producing deviation of the septum. Following extubation the septum was centralized using finger pressure in all but one of the cases. In none of the cases an inferior turbinectomy was carried out as it was felt that this procedure is only required when the amount of superior repositioning is of a larger magnitude.

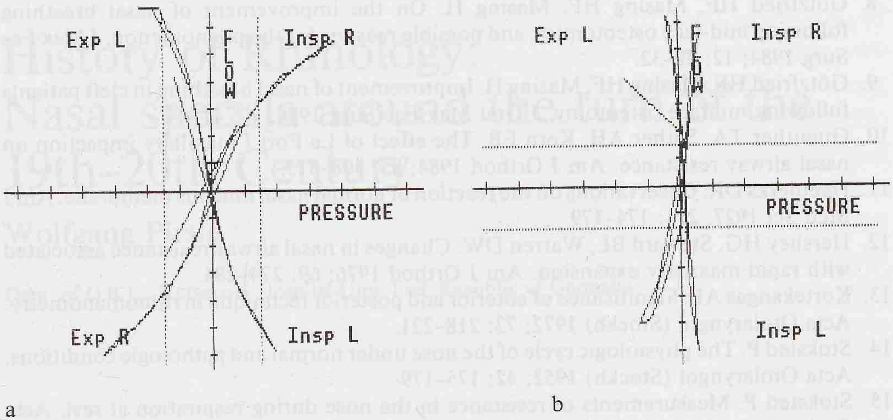


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Figure 4. Rhinomanometric measurements in a le Fort I patient showing the improvement of nasal airway function. a. preoperatively; b. postoperatively.

The interalar distance was restored to the pre-operative value using an transalar suture, thus the size of the anterior nares was unaltered. However, the only factor which is altered which may affect nasal airway resistance is the nasal valve.

CONCLUSION

65% of Le Fort I osteotomy cases presented demonstrate an increase in nasal airflow and a subsequent reduction in nasal airway resistance. In the majority of these cases there was a superior repositioning of the maxilla. There is therefore no support to the claim that Le Fort I osteotomies may produce deleterious respiratory effects in the form of an increase in nasal airway resistance.

REFERENCES

1. Bachmann W, Nieder Th. Der klinische Wert der Rhinomanometrie. Lar Rhinol 1978; 57: 379–383.
2. Bridger GP, Proctor DF. Maximum nasal inspiratory flow and nasal resistance. Am Otolaryngol 1970; 79: 481–488.
3. Brown EA. The measurement of the resistance of the nasal passages to the movement of air "II". Rev Allergy 1967; 21: 852–857.
4. Büsser ER, Schibli A. Rhinomanometrie, Methodik und Normalwerte. Dtsch Med Wschr 1978; 98: 719–723.
5. Cohen BM. Nasal airway resistance and the effects of bronchodilator drugs in expiratory airflow disorders. Respiration 1969; 26: 35–46.
6. Cole P, Fastag O, Niinimaa V. Computer-aided rhinometry. Acta Otolaryngol (Stockh) 1980; 90: 139–142.

7. Dishoeck, HAE van. The part of the valve and the turbinates in total nasal resistance. Int Rhinology 1965; 3: 19–26.
8. Götzfried HF, Masing HF, Masing H. On the improvement of nasal breathing following mid-face osteotomies, and possible reasons for the phenomenon. J Max Fac Surg 1984; 12: 29-32.
9. Götzfried HF, Masing HF, Masing H. Improvement of nasal breathing in cleft patients following midface osteotomy. J Oral Max Fac Surg 1988; 17: 41–44.
10. Guenther TA, Sather AH, Kern EB. The effect of Le Fort I maxillary impaction on nasal airway resistance. Am J Orthod 1984; 85: 308–315.
11. Heetderks DR. Observations on the reaction of normal nasal mucous membrane. Am J Med Sci 1927; 231: 174–179.
12. Hershey HG, Steward BL, Warren DW. Changes in nasal airway resistance associated with rapid maxillary expansion. Am J Orthod 1976; 69: 274–284.
13. Kortekangas AE. Significance of anterior and posterior technique in rhinomanometry. Acta Otolaryngol (Stockh) 1972; 73: 218–221.
14. Stoksted P. The physiologic cycle of the nose under normal and pathologic conditions. Acta Otolaryngol (Stockh) 1952; 42: 175–179.
15. Stoksted P. Measurements of resistance in the nose during respiration at rest. Acta Otolaryngol (Stockh) 1953; Suppl 109: 143–158.
16. Turvey TA. Management of the nasal apparatus in maxillary surgery. J. Oral Surg 1980; 38: 331–335.
17. Turvey TA, Hall DJ, Warren DW. Alterations in nasal airway resistance following superior repositioning of the maxilla. Am J Orthod 1984; 85: 109–114.
18. Vig PS, Sarver DM, Hall DJ, Warren DW. Quantitative evaluation of nasal airflow in relation to facial morphology. Am J Orthod 1981; 79: 263–272.
19. Walker DA, Turvey TA, Warren DW. Alterations in nasal respiration and nasal airway size following superior repositioning of the maxilla. J Oral Max Fac Surg 1988; 46: 276–281.
20. Warren DW. A quantitative technique for assessing nasal airway impairment. Am J Orthod 1984; 86: 306–314.
21. Warren DW, Duany LF, Fischer NW. Nasal pathway resistance in normal and cleft lip and palate subjects. Cleft Palate 1969; 6: 134–140.
22. Warren DW, Hinton VA, Pillsbury HC, Hairfield WM. Effects of size of the nasal airway on nasal airflow rate. Arch Otolaryngol Head Neck Surg 1987; 113: 405–408.
23. Williams HL. The history of rhinometry in North America. Int Rhinology 1968; 6: 34–49.

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