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A NEW TECHNIQUE FOR FUNCTIONAL SURGERY OF THE NASAL VALVE AREA

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SUMMARY

Nasal valvular obstruction is a neglected and disregarded clinical entity in current practice.

Rhinomanometry and nasal endoscopy allow a better evaluation of the degree and the site of the stenosis.

The distinction between nasal valve and nasal valve area is fundamental in surgical practice.

Valvular disturbances are often induced or aggravated by rhinoplastic procedures due to scar tissue formation in the region of the nasal valve area and/or to excessive resection of supporting cartilaginous structures. Routine septal surgery is often followed by sequelae in the valve area structures.

The treatment of valvular disturbances is basically surgical. A systematic surgical approach should comprise the structures of the nasal valve area as well as the structures functionally related to it.

After a brief review of the techniques described in the literature, the authors present an original corrective technique for the valve area deformities, performed through the hemitransfixion incision.

This technique results from previous experience founded on Cottle's surgical philosophy. This technique assures the correction of the valve area deformities as well as the performance of surgical manoeuvres extended to the osteocartilaginous pyramid and the nasal cavities. It is therefore possible to properly correct the areas of resistance and to re-establish adequate functional relationships between the various parts.

INTRODUCTION

The surgical correction of deformities of the nasal valve requires a precise knowledge of the anatomy and physiology as well as the etiopathogenetic mechanisms of the abnormality.

Great confusion has prevailed for several years concerning the terminology related to the nasal valve. In 1830, Bell described "the narrowest part of the nose" (Bell's constriction). It was Mink (1903), who introduced the concept of the nasal

valve, indicating by this, the narrowest segment of the nose, which is the main site of nasal resistance. He placed the nasal valve between the caudal margin of the upper lateral cartilage and the nasal septum. He called this region ostium internum, a term by which Zuckerkandl (1882) had indicated the space between the septum and the lumen nasi, the latter being boundary between the bony and cartilaginous portions of the nasal wall.

Mink and Zuckerkandl thus defined two different regions by the same word. Bachmann and Legler (1972), using luminal impressions of the anterior section of the nose, concluded that the nasal portion with the smallest cross sectional diameter is not the ostium internum of Mink but the isthmus nasi (or ostium internum of Zuckerkandl).

This latter is partially delimited by the upper lateral cartilage but mostly by the soft tissues of the lateral nasal wall.

Bachmann and Legler presented a new definition of the nasal valve, consisting of the whole of the mobile lateral wall of the nose, which is the functional unit in the regulation of nasal resistance.

Bridger and Proctor (1970) localized the nasal valve within the region lying between the junction of the upper and lower lateral cartilages and pyriform aperture. They called this zone, which behaves as a Starling resistor, the flow-limiting segment (FLS). Haight and Cole (1983) confirmed the existence of the FLS and emphasized the role of the head of the inferior turbinates.

These anatomical and physiological considerations justify the concept of nasal valve surgery as surgery of an area involving several nasal structures. Surgery of the nasal valve has in recent years increasingly interested rhinologists and has achieved its own autonomy.

The authors present a functional surgical technique, based on Cottle's principles. Entirely performed through a hemitransfixion incision, it permits correction of the deformed valve as well as the, often concomitant, functional deformities of the nasal pyramid.

ANATOMICAL DESCRIPTION

According to Sulsenti (1974) and Kern (1978) it is necessary to distinguish between the nasal valve area and the nasal valve.

The former is delimited as follows:

a. Supero-laterally by the caudal edge of the upper lateral cartilage and laterally by fibro-fatty tissue joining it to the pyriform aperture ("empty triangle"), whose resistance is reinforced by the lateral extremity of the lower lateral cartilage (alar cartilage).
b. Inferiorly by the inferior margin of the pyriform aperture and the nasal spine.
c. Medially by the cartilaginous nasal septum.

The nasal valve is the specific slit-like passage made by the septum and the

upper cartilage: the latter is normally at an angle of 10 to 15 degrees to the septum.

SURGICAL ANATOMY AND ETIOPATHOGENESIS OF THE MAIN DEFORMITIES

Correct surgery requires an accurate knowledge of the anatomical relationships between the nasal valve area and the surrounding structures.
Abnormalities of the bony cartilaginous dorsum, the lobule or the vestibule have to be corrected concomitantly to the valvular deformities to achieve a complete functional recovery.
The upper lateral cartilages are fused to the septal cartilage, and are encased in a common perichondrial sheath. They have the same embryological origin and constitute a single three-winged cartilage complex.
Superiorly and laterally, the upper lateral cartilages extend beneath the distal border of the nasal bones. The junctions between the nasal bones, the upper lateral cartilages, the septal cartilage and the perpendicular plate of the ethmoid constitute the K area, which is the center of support of the nasal roof.
Laterally, the junction with the pyriform aperture is formed by fibro-fatty tissue ("empty triangle") and is deprived of firm supporting structures. This zone is the weak point of the external lateral wall of the nose, where collapse occurs during forced inspiration. Lateral cartilages may vary in shape, size and elasticity; sometimes these variations, particularly at the lateral edges of the lower lateral cartilages, may facilitate collapse at the empty triangle, which is an area frequently involved in rhinoplastic surgical procedures.
Inferiorly, the caudal edge of the upper lateral cartilage tends to curl upon itself upwards and outwards ("returning") and is overlapped by the cephalic margin of the lateral crus.
"Returning" is a normal anatomical finding insuring elasticity of the nasal lateral wall and preventing early inspiratory collapse. It is also cosmetically relevant. This is why it is removed almost systematically in surgical shortening of the nose, in aesthetic reduction rhinoplasty. In the case of functional surgery, anatomical features of the caudal margin (sagging, twisting, thickening, depression, excessive length) are to be carefully defined in the surgical plan. For this reason, a thorough perichondrial elevation must always precede any cartilage modelling.
The intercartilaginous space is filled with connective fibres constituting a veritable aponeurosis, "the superior cul-de-sac", which is a membraneous recess of considerable functional importance. The flexibility of the intercartilaginous joint must be maintained; the freedom of movement of the lobule in relation to the valve depends upon this and it is fundamental for good respiration. In spite of what has been described in several anatomy books, the sesamoid cartilages, whose larger axis is parallel to the edges of the lateral cartilages (Jost et al., 1973), lie at the junction between the upper and lower lateral cartilages. The sesamoids

seem to result from the plicature and subsequent rupture of the primitive lateral cartilage, as is observed in the human embryo and the embryo of other animal species (Takahashi et al., 1971).

The relationship between the septum and the inferior medial part of the upper lateral cartilage is of great importance.

Here, the upper lateral cartilages are very thin and are separated from the septum by a cleft in a reverse-V shape; this lack of continuity allows the upper laterals to follow the respiratory movements.

The several anatomical variations of the lower lateral cartilages must also be taken in account (Zelnik and Gingrass, 1979). The upper surface of the lateral crus bulges, whereas its cephalic margin forms a scroll which curves medially in many subjects: this gives the lateral crus its outer convexity which is more pronounced along its superior portion. The scrolls of the two lateral cartilages stand upon each other but curve in opposite directions. This, and the loose fibrous tissue between the scrolls, enable the lateral crus to pivot and slide up and down. The lateral crus extends towards the pyriform margin, sometimes touching the bony margin.

Anatomical deformities of the vestibular baffles (Cottle, 1955), which vary with ethnic origin and age, may also severely affect valve function (Bridger, 1970). Dislocations of the caudal margin of the septum, abnormalities in the height, shape and thickness of the pyriform crest, dysmorphisms of the nasal spine, columellar deformities and obstructing scars lead to an increase in the inspiratory negative pressure sufficient to overcome the physiological forces opposing the collapse of the lateral wall of the nose.

In addition to anatomical deformities, disturbances of the nasal dilator muscles may cause alterations of the valve function (May et al., 1977).

A clear classification of the nasal valve abnormalities has been presented by Kern (1978). The most frequent cause of valvular pathology is, from an etiopathogenetic point of view, post-traumatic sequelae involving the structures constituting the nasal valve area. Where injury occurs in early childhood, abnormal cicatricial retraction and growth disturbances of the cartilaginous structures may result. In these cases, a physiological surgical technique, performed correctly at a later age, may remove the causes of these abnormalities, normalizing respiration and the growth of the involved structures. In adult life, valve troubles are often iatrogenic, resulting from inappropriate surgical removal of upper and/or lower lateral cartilages. A fixed collapse of the valvular region sometimes occurs, due to incorrect infracture of the nasal bone. In other cases the valve is obstructed by scar tissue, as a result of poorly performed incisions or excessive removal of skin and/or mucosa. Subcutaneous resection of the septum may also lead to valvular complications. Postoperative saddling of the cartilaginous vault is a common finding after Killian's operation: the width and elasticity of the valve are distorted by

cicatricial traction pulling the caudal margin of the upper lateral cartilages down towards the nasal spine.

The complexity of the problem demonstrates the insufficient objectivity of routine nasal examinations as a means of arriving at precise diagnostic conclusions. Computerized rhinomanometry, optimized with particular equipment and techniques (Sulsenti and Palma, 1985), and nasal endoscopy, provide reliable data for better diagnosis (grade, site and nature of the nasal stenosis) and surgical management.

SURGICAL METHODS

The purpose of a systematic surgical approach to the nasal valve area is the correction of structural deformities of the area as well as of the structures functionally related to it.

The best method is the prevention of damages secondary to surgical manoeuvres. Overlooked by classical septal surgery or sacrificed by some aesthetic surgical operations, the valve should, on the contrary, be modelled by functional surgical techniques based on a minimal number of incisions, on as limited undermining as possible, avoiding extensive removal of the supporting structures and preserving the mucocutaneous lining.

The technique proposed by Hinderer (1970) consists of the correction of the septal deformities through a hemitransfixion incision, whereas the valve is approached through an intercartilaginous incision.

Kern (1978) reproposed the two approaches mentioned before, taking particular care in the treatment of scars of the valve area.

There are numerous techniques for correcting the alar collapse and the incompetence of the upper lateral cartilages (Hill, 1918; Cinelli, 1941; Fomon et al., 1950; O'Connor et al., 1967; Walter, 1976).

Cartilage grafts obtained from various sites are often used (Cinelli, 1941; Gurney, 1941; Fomon et al., 1950; Sherman, 1956; Hage, 1965; Desprez and Kiehn, 1975; Hurst, 1978; Lapidot, 1985; Goode, 1985).

The rotation technique of the lower lateral cartilages (Rettinger and Masing, 1981) is particularly interesting: the adequate mobilization and upward shifting of the lateral crus strengthens the "empty triangle" which is the area where the external lateral wall of the nose most easily collapses.

Tardy's technique (1976) displays physiological properties: through an intracartilaginous incision, a semilunar segment from the cephalic margin of the lateral crus is removed in order to leave a complete S-shaped strip. The cul-de-sac is therefore adequately modified without depriving the nasal wing of cartilaginous support; the deformities of the caudal margin of the upper lateral cartilages are corrected and any excess connective tissue removed. The nasal valve is opened up by the dynamics of the tip and the cartilaginous vault: the former is pulled upwards, whereas the latter is pushed downwards.

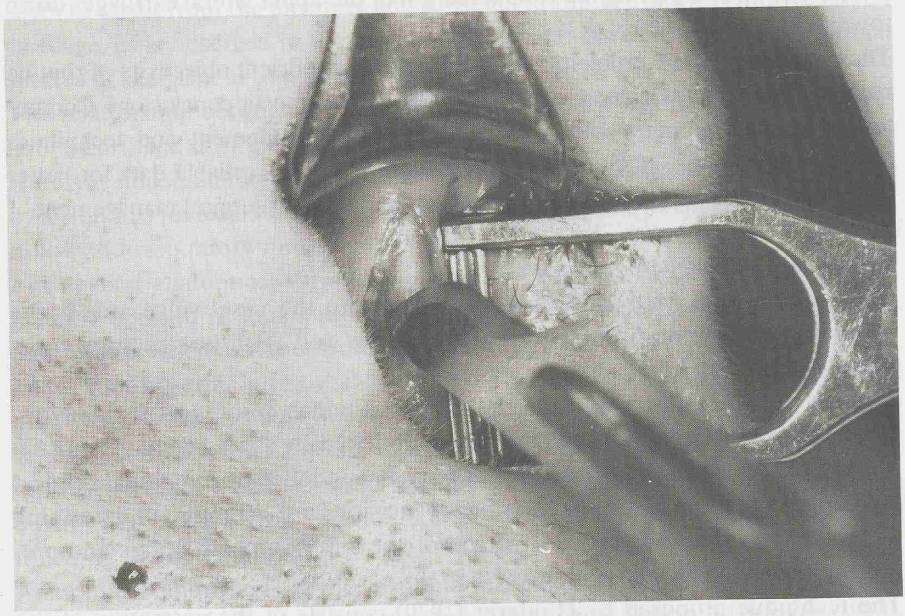

Figure 1. Hemitransfixion incision.

Figure 2. Undermining of the columellar foot and formation of the magic plane.

There are, therefore, many surgical techniques available for correction of the nasal valve; the right choice is, however, not always easy.
Critical analysis of the limitations of the various available techniques, consistent application of the principles of Cottle's surgical philosophy and exploitation of its operative potentialities, have led the authors to develop a technique for nasal valve area surgery entirely performed through a hemitransfixion incision.

AUTHORS' TECHNIQUE: SURGICAL STEPS

The basic surgical steps are those of the Maxilla-Premaxilla approach to septum surgery (Cottle, 1958), summarized as follows:

1. hemitransfixion incision (Figure 1):
2. left anterior tunnel;
3. magic plane more or less extended according to needs (Figure 2);
4. inferior tunnels;
5. fourth posterior tunnel;
6. if needed, anterior right tunnel;
7. union of the tunnels;
8. inferior and posterior chondrotomy;
9. correction of the septal deformities both cartilaginous and bony.

A great variety of corrective surgical manoeuvres are then possible:

- The execution of a "drainage tunnel" (undermining through the hemitransfixion incision, via columella-space in between domes-dorsum) allows redistribution of the dorsal skin, freeing it from pre-existing abnormal tension (Figures 3 and 4).
- All the structures constituting the valve area (septum, upper laterals, empty triangle, pyriform aperture, inferior nasal spine) can be visualized and approached through the hemitransfixion incision (Figures 5 and 6). When the septal cartilage presents complex deviations or is irregularly shaped, the method of removal-reposition of the septal structures (Sulsenti, 1976) becomes mandatory. Only this approach allows complete visualization of the cartilaginous vault. The upper lateral cartilages are thus properly appraised: morphological abnormalities (length, shape, thickness, adherence), irregularities in the "returning", asymmetries of both sides. It is then possible to perform, through a subperichondrial approach, adequate correction under visual control, and avoid the common mistakes (excessive or defective removal, asymmetric modelling), which are responsible for unpleasant aesthetic changes (Figures 7, 8 and 9).

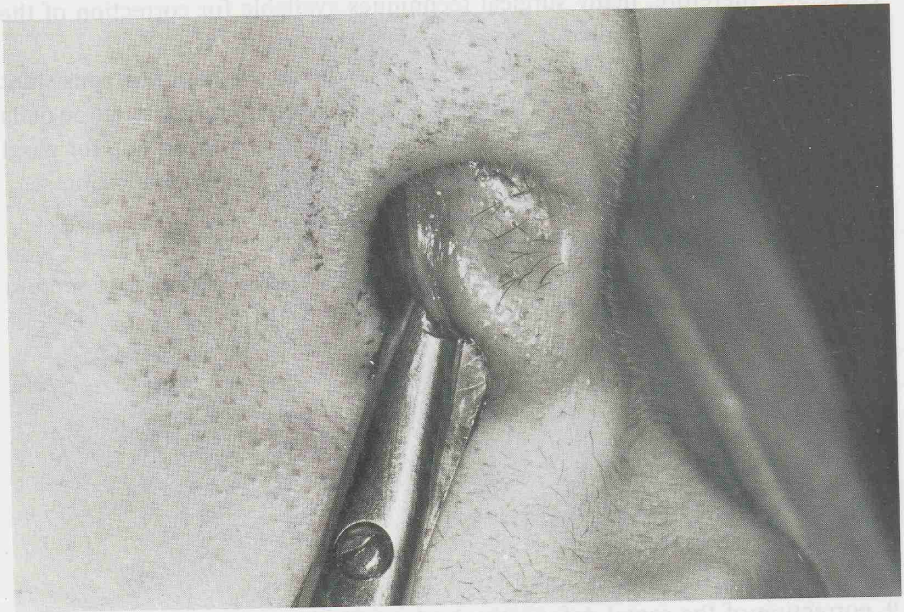

Figure 3. Drainage tunnel.

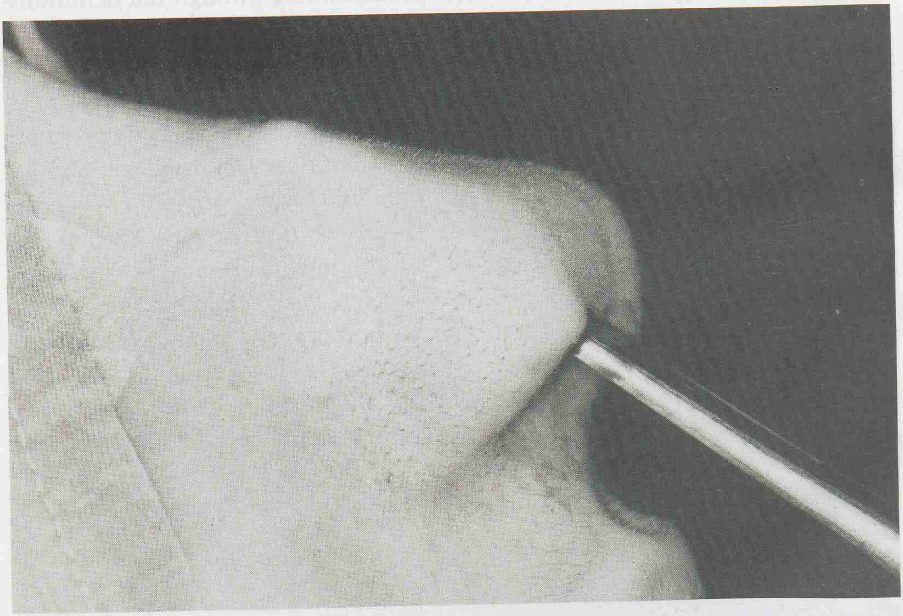

Figure 4. Undermining of the drainage tunnel through the columella, over the cartilaginous and bony vault.

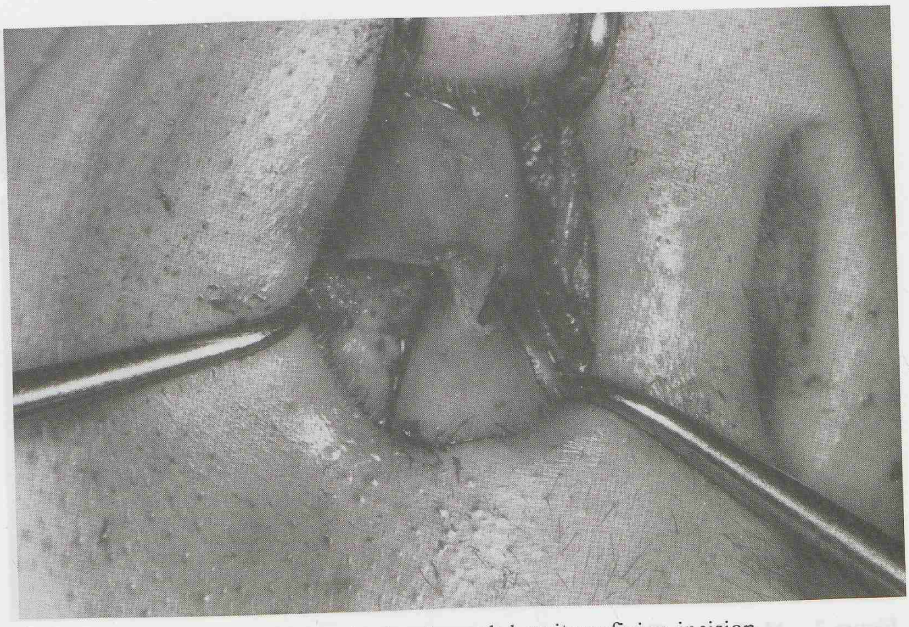

Figure 5. Exposure of the nasal valve through hemitransfixion incision.

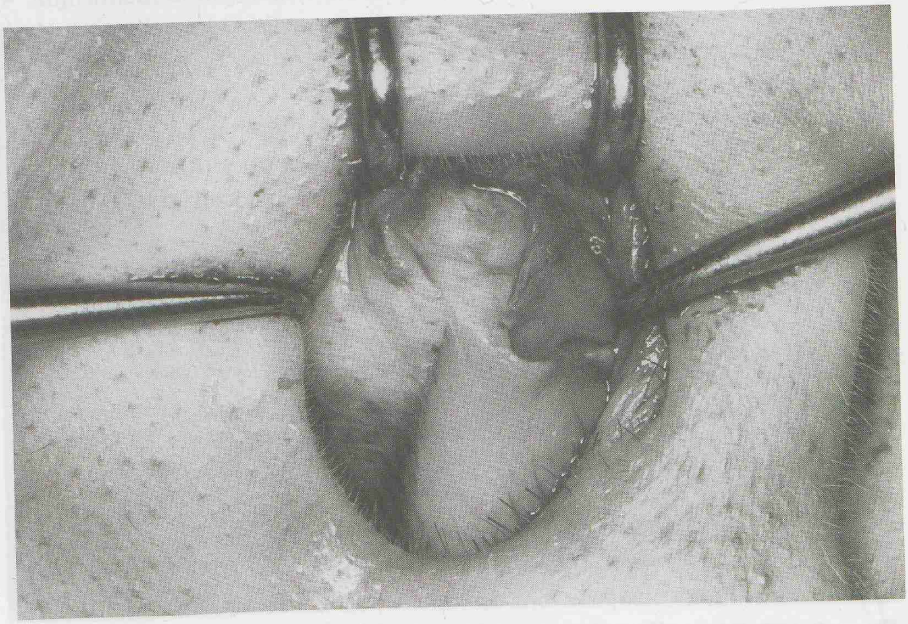

Figure 6 Exposure of the returning.

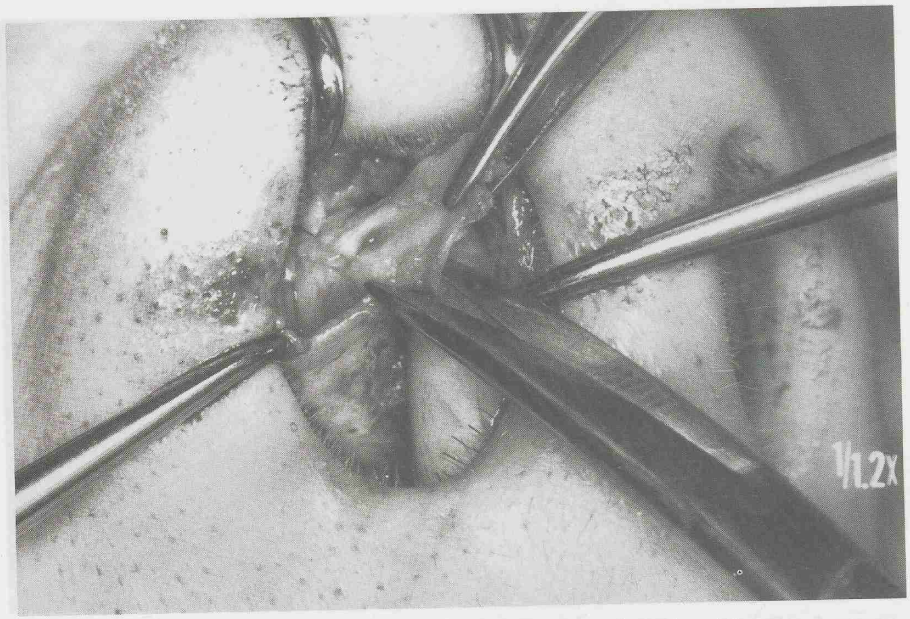

Figure 7. Modelling of the caudal end of the right upper lateral cartilage.

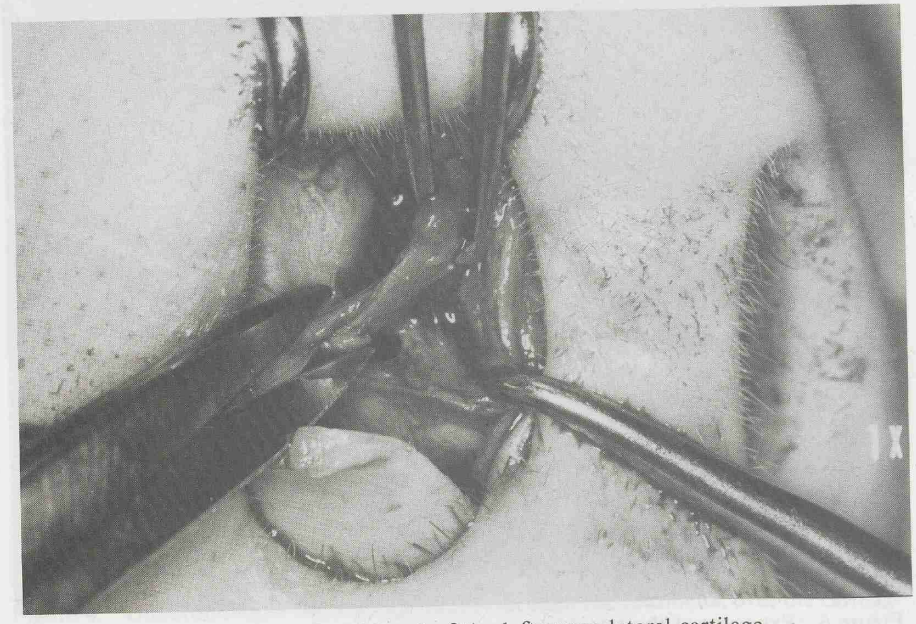

Figure 8. Modelling of the caudal end of the left upper lateral cartilage.

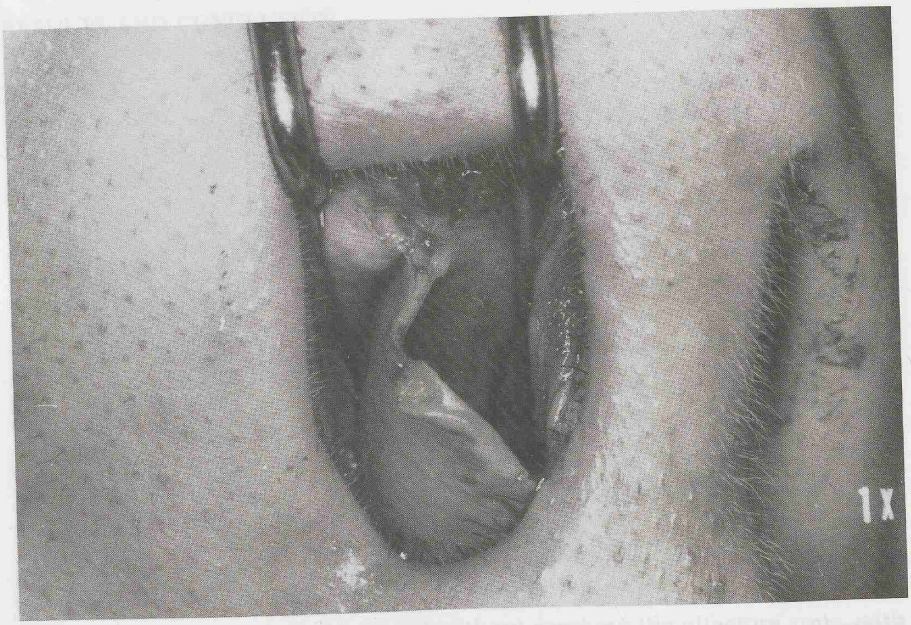

Figure 9. Corrected valve area.

This approach allows:

- Adjustment of the amplitude of the cul-de-sacs by retrograde undermining of the lower lateral cartilages.
- The possibility of adequately placing various types of grafts (septal cartilage, conchal cartilage etc.) in order to sustain or reconstruct the valve.
- The possibility of modifying the position of the lateral crus with respect to the pyriform aperture, then strengthening the empty triangle and reducing the abnormal collapsibility of this key area.

Besides these procedures, devoted to correcting the valve abnormalities, the hemitransfixion incision also makes possible the performance of all the surgical measures needed for functional correction of other nasal areas:

- The possibility to approach the K-area to the bony vault, in order to carry out changes in shape and position of the nasal pyramid, which normalize the direction and pressure of the air currents (Figures 10 and 11).
- Performance of the lateral osteotomies without further incisions in the vestibular skin.
- The possibility of modifying the shape, size and position of the nostrils through extension of the magic plane and through appropiate sutures.
- Correction of columellar abnormalities and adequate modification of the nasolabial angle (emptying of columella, intracolumellar graft etc).

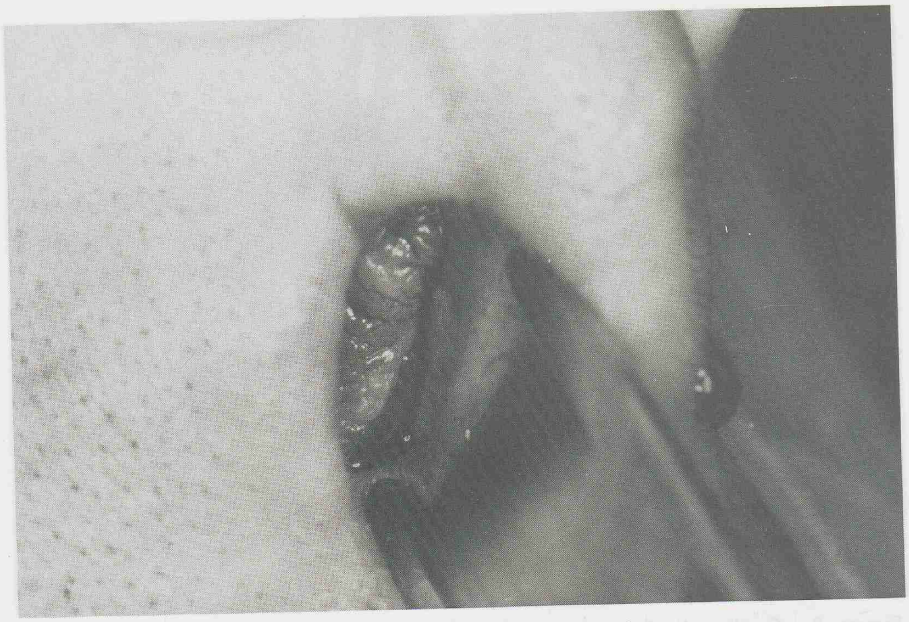

Figure 10. Introduction of Cinelli chisel for hump removal.

Figure 11. Normalization of the profile.

RESULTS AND CONCLUSION

The proposed technique has been used for 13 years in more than 2000 patients presenting with valvular problems.

Constant clinical application of rhinomanometry and rigid or flexible endoscopy enabled the authors to accurately evaluate indications and limitations of this approach, and to objectively appreciate the results (Figures 12a, b).

The authors consider this technique offers several advantages:

1. Only one incision (hemitransfixion) reduces scar tissue formation.
2. Sequential exposing manoeuvres, i.e. "magic plan" and "drainage tunnel", carried out through the hemitransfixion incision, permit inspection and handling of all nasal structures, both internal and external.
3. The subperichondrial exposure, extended from the septum both to the upper laterals, beneath and over the cartilaginous vault, and to the lower laterals, permits direct exposure, mobilization and modelling of the caudal margin of the upper laterals as well as of the cephalic margin of the lobular cartilages preserving the fibrous structures of the cul-de-sacs.
4. Convenient shortening of the nose does not impair the resilience of the lobule.
5. Deviations in area 3 are corrected without reaching the olfactory zone, with reduced risk of synechiae, which are often present after traditional surgery.
6. Placement of grafts without contact with the nasal cavities avoids infection and subsequent reabsorption of graft material.

This technique demands, however, a thorough knowledge of the topographic and surgical anatomy of the nose, as well as sufficient surgical experience. When the surgeon has become familiar with the technique, he is increasingly able to combine it with many surgical procedures. The technique, in good hands, permits refined modelling not only of the nasal valve, but also of the nasal cavities and the pyramid. As it does not impair physiology, it can be used at the various stages of life. It allows normal growth of the nasal structures in children and takes into account the decreased tissue elasticity in the elderly.

The statistical evaluation of the rhinomanometric data obtained with the computerized rhinomanometer with integrated electronic mask (Sulsenti and Palma, 1985), are presented in another publication. The preliminary results (patients' opinion, nasal inspection and rhinomanometric findings) of this technique are extremely favourable.

Patient: male, aged 47.
History: 12 years ago nasal trauma, bilateral nasal obstruction, mainly on the right side. Oral respiration. Sore throat, snoring.
Nasal examination: septal deviation on the right side, at area 2, with valve stenosis. Slight narrowing of left nasal vestibule.
Endoscopy: Right: dry, dystrophic mucosa on the anterior part of the septum. Nasal cavity beyond valve area cannot be investigated.
Left: congested inferior turbinate. Enlargement of the anterior tip of M.T. meati. No pathological changes.

pressure	75	150	300	Pa
inspiratory flow right	51	112	186	cc/sec
inspiratory flow left	215	338	0	cc/sec
total respiratory flow	266	450	–	cc/sec
ratio	4.22	3.02	0.00	
increase of flow right	120	66		%
increase of flow left	57	0		%

resistance	insp.	exp.
right (150 Pa)	1.30	0.80
left (150 Pa)	0.43	0.37
Total	0.32	0.25

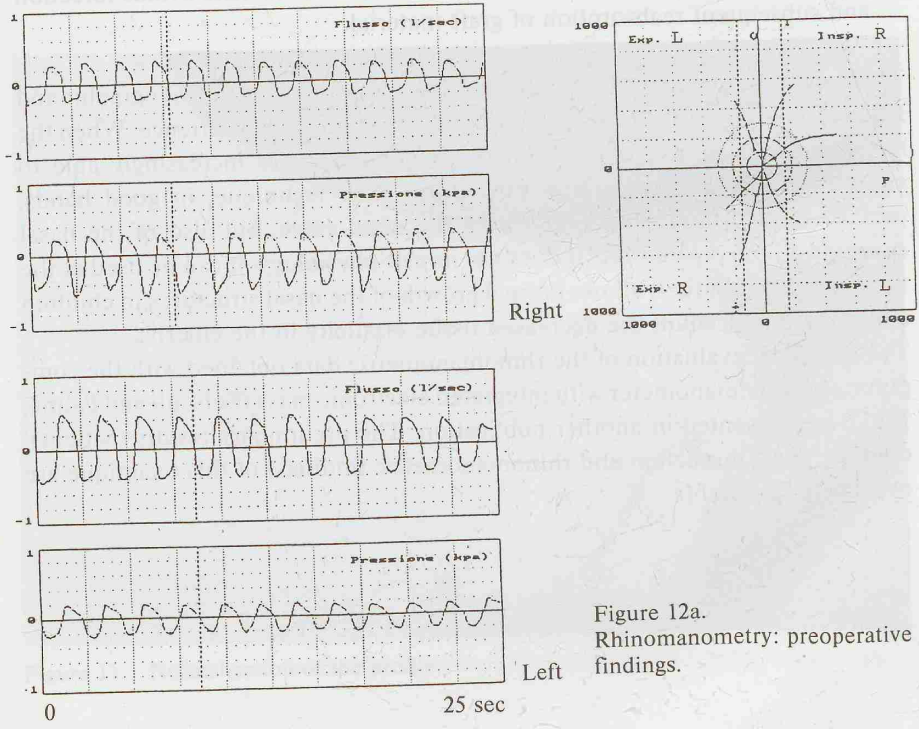

Figure 12a.
Rhinomanometry: preoperative findings.

Patient: male, aged 47.
History: control (10 months) after surgery for septum, valve and pyramid. Concomitant surgical decongestion of left inferior turbinate.
Nasal examination: straight septum, normal size and shape of nasal valves.
Endoscopy: no pathological findings.

pressure	75	150	300	Pa
inspiratory flow right	286	407	0	cc/sec
inspiratory flow left	292	441	0	cc/sec
total respiratory flow	578	848	–	cc/sec
ratio	1.02	1.08	0.586	cc/sec
increase of flow right	42	0		%
increase of flow left	51	0		%

resistance	insp.	exp.
right (150 Pa)	0.36	0.37
left (150 Pa)	0.34	0.35
Total	0.18	0.18

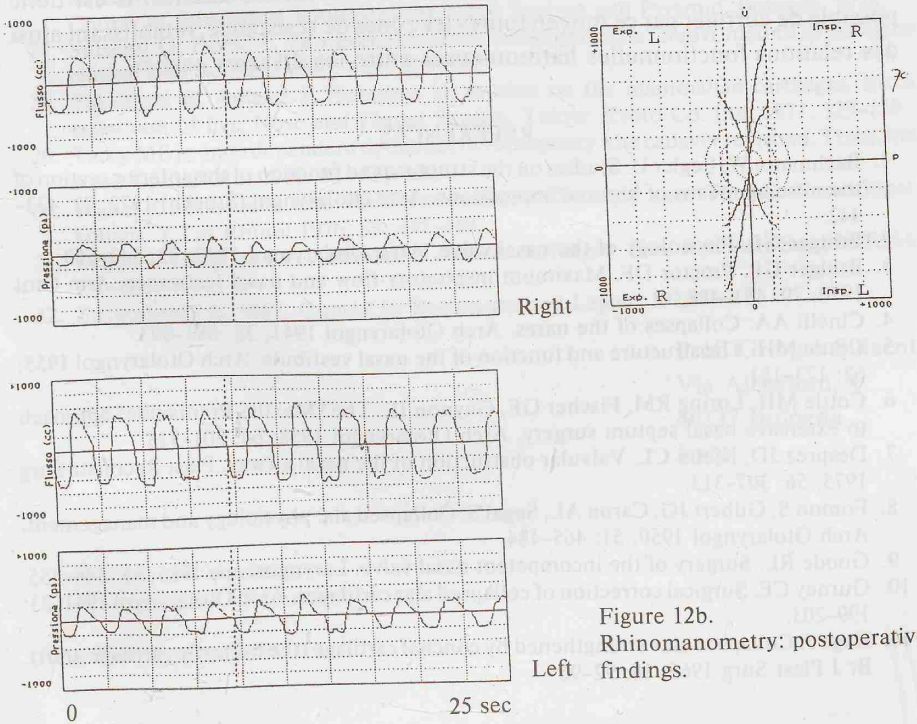

Figure 12b.
Rhinomanometry: postoperative findings.

RÉSUMÉ

L'obstruction de la valve nasale est une entité clinique qui est négligée et méconnue en pratique courante.

La rhinomanométrie et l'endoscopie nasale ont permis de mieux évaluer le degré et la localisation de la sténose. La distinction entre valve nasale et région de la valve nasale est fondamentale en pratique chirurgicale.

Les troubles valvulaires sont souvent provoqués ou aggravés par des pratiques rhinoplastiques. Il peut s'agir de formation de tissu cicatriciel dans la région de la valve nasale ou d'une excision excessive des structures cartilagineuses de support. La chirurgie du septum selon la technique de Killian est celle qui présente le plus souvent des séquelles au niveau des structures valvulaires.

Le traitement des troubles valvulaires est avant tout chirurgical. L'approche chirurgicale systématique doit comprendre toutes les structures de la région de la valve nasale et/ou celles qui y sont fonctionnellement associées. Après une brève revue des techniques chirurgicales décrites dans la littérature, les auteurs présentent une technique originale de correction des déformations valvulaires à l'aide de l'hémitransfixion.

Cette technique résulte du développement d'expériences antérieures basées sur la philosophie chirurgicale de Cottle. Elle permet non seulement la correction des déformations de la région de la valve nasale, mais également une chirurgie étendue à la pyramide ostéocartilagineuse et aux cavités nasales. Il est donc possible de corriger par ce moyen toutes les zones de résistance, rétablissant ainsi des relations fonctionnelles harmonieuses entre les diverses parties.

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