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A nasal prosthesis for treatment of nasal airway obstruction

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SUMMARY

Surgery is not always the best approach for immediate resolution of nasal airway problems. In some instances, surgery may be deferred, unnecessary, contraindicated or frankly refused by the patient. For some of these patients, the use of a simple intranasal prosthesis to enhance the passage of air through the nasal valve region is beneficial. Five patients meeting these criteria were fitted with a prosthesis and carefully evaluated pre- and postinsertion with rhinomanometry. Other situations are discussed where such a prosthetic device might be helpful.

The rhinoplastic surgeon traditionally approaches functional nasal problems as a surgical challenge to improve the airway while preserving or enhancing appearance. Employing prosthetic devices to accomplish this is not often considered. This is in part because patients find prostheses a nuisance and also because of the implication of the surgeon's inadequacy.

Compromise of the nasal airway is a troublesome complaint which is not always resolved with surgery. The most constricted portion of a nasal airway is the nasal valve region where airflow is regulated by the variable engorgement at the anterior ends of the turbinates and the acute angle aperture at the junction of the caudal ends of the upper lateral cartilage and septal cartilage. As rhinoplastic surgeons have become increasingly aware of the importance of the nasal valve area, airway problems are often approached more directly. This region remains vulnerable to inappropriate assessment, misplaced incisions, and injudicious resection of supportive structures.

In a number of specific instances, surgery is not the ideal answer to resolution of nasal valve compromise. Patients who have had bad results from previous nasal surgery may for a number of reasons refuse further nasal operations. In other patients, surgery may be considered unnecessary or even contraindicated. A third group may well require surgery, but because of more immediate concerns, correction of the airway may need to be delayed, deferred, or staged. For these groups of patients, it is possible to offer symptomatic relief with a simple intranasal prosthesis designed to support the soft tissues in the nasal valve area.

MATERIALS AND METHODS

Of the ten patients to whom use of an intranasal prosthesis was proposed, three refused, two were not compliant, and five are included in this study group. Two of these studied patients had refused further surgery, one had a temporary facial paralysis, and in the remaining two surgery was electively delayed. Each patient underwent a complete otolaryngological examination, alternative forms of management were described, and measurements taken for fitting the device. They were then evaluated using rhinomanometry with and without the prosthesis in place.

The prosthesis

The nasal prosthesis employed consists of two rings and two struts (Figure 1). The material consists of 20 gauge stainless steel wire and cadmium-free silver solder. The larger outer ring is designed to be large enough so that it cannot easily traverse the nasal valve area and fall retrograde into the nose. The passive pressure of the lateral vestibular wall along with some local drying of the nasal mucosa tends to keep it firmly in place avoiding motion and excoration.

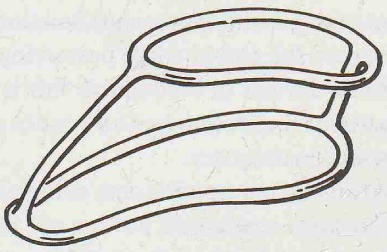

Figure 1. Sketch of prosthesis showing rings and supporting struts.

The prosthesis can be easily inserted and removed by the patient. First, the vestibular skin is moistened by compressing the lateral wall against the septal mucosa while exhaling. The top ring is then inserted being sure that the bent strut is located caudad and the concave aspect of the rings adjacent to the septum. The little finger is then used to gently push the prosthesis inward until the bottom ring cannot be seen. With minor adjustments, the wearer can position the prosthesis in the vestibule so that it feels comfortable and so that easy breathing is achieved. In proper position, the small ring should be located in the plane of the nasal valve area (Figure 2). To remove the prosthesis the device can be easily loosened by moistening the vestibule with water and gently pulling it out with the thumb and little finger.

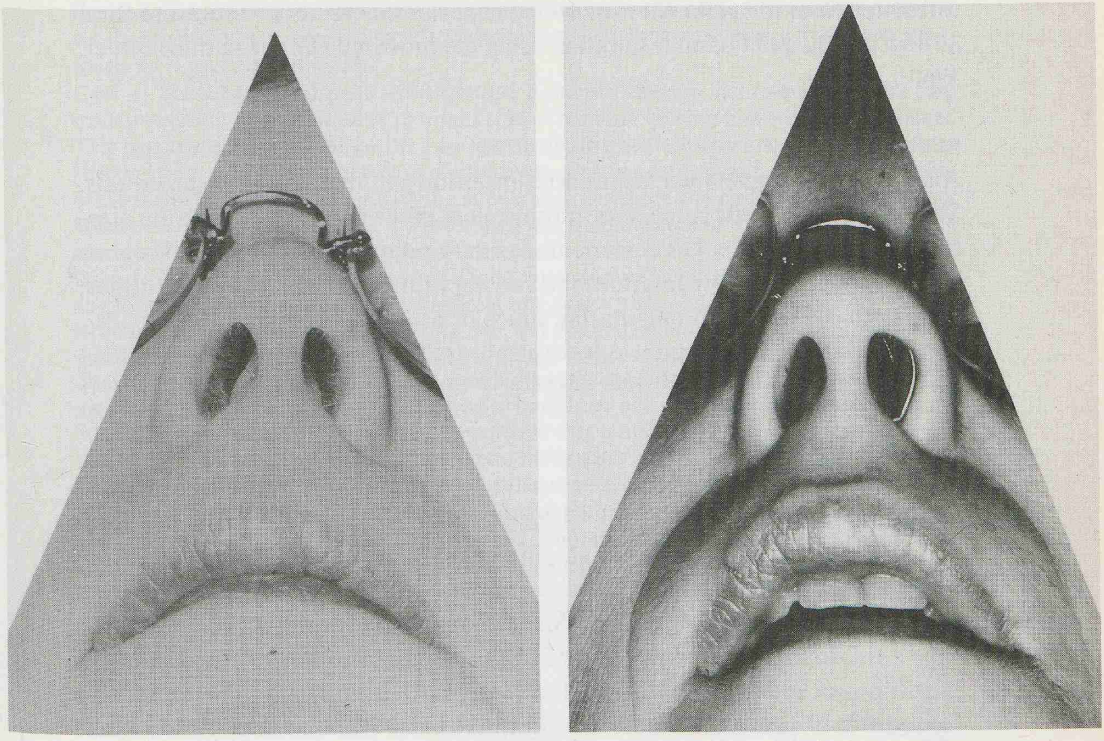

Figure 2. Case Number 3 is shown with alar collapse due to loss of facial muscle tone (LEFT) and with prosthesis in place to restore nasal airway (RIGHT). Note caudal ring in nasal vestibule and cephaled ring at nasal valve region.

Rhinomanometry technique

Nasal airflow was obtained with a pneumotachograph (Sanborn Model 651-267M) fitted with a molded rubber nose piece and coupled to a differential pressure transducer (Stratham Model PM-197). Care was taken not to press the nose piece against the unoccluded naris. Intraoral pressure was obtained by means of a single polyethylene catheter (ID: 1.75 mm; OD: 2.5 mm; Length: 38.0 cm) positioned in the middle of the vocal tract. The catheter was coupled to a pressure transducer (Stratham PM131TC). The tip of the catheter was occluded, but there were side holes near the tip to sense static pressure.

The inspiratory and expiratory waveforms were measured and the peak nasal airflows (V_n) and peak intraoral air pressures (P_o) were calculated. Peak volumes were expressed in liters/second (L/sec) for nasal flow and centimeters of water (cm H_2O) for intraoral air pressure. Pressure was calibrated against a water manometer and airflow was calibrated against a rotometer. Nasal airway resistance was

calculated from the parameters of averaged peak intraoral air pressure and nasal airflow during quiet nasal respiration using the modified Ohm equation (Butler, 1960).

RESULTS

All five patients developed facility with insertion and removal of the prosthesis. They noted immediate subjective improvement of the nasal airway with the prosthesis in place and this was documented with rhinomanometry. In those patients in whom symptoms were intermittent, varying with nasal cycle or head positions, the prosthesis was worn only during times of peak symptoms.

Case 1: This 28-year-old engineer (S.R.: co-author and designer of prosthesis) experienced difficulty breathing through his nose since childhood. The problem was greater on the left side and varied with nasal cycle. He was found to have a deviated septum with an impaction in area 2 and a tendency for the nasal alae to collapse on the left side during respiration. In 1974 and again the following year, the patient underwent attempts at restoration of the airway with septoplasty. Following these procedures he remained symptomatic and because of progressive concern, he was prompted to study the nasal airway, and developed a simple prosthesis for resolution of these symptoms. He experienced subjective improvement, and rhinomanometry revealed a dramatic decrease in nasal airway resistance with the prosthesis (Figure 3).

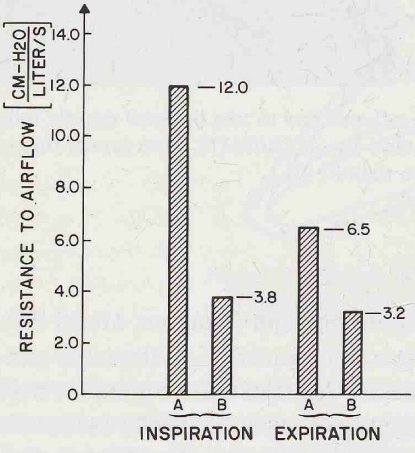

Figure 3. The changes in nasal airway resistance in all cases were similar to that in the first patient depicted here. This graph shows the change in nasal airway resistance achieved with the prosthesis, with A indicating nasal resistance prior to placement and B showing resistance with the prosthesis in place.

Case 2: Also undergoing two septoplasty procedures, this 31-year-old male continued to complain of right nasal obstruction. He demonstrated septal deviation with area 2 impaction on the right but also some collapse of the lower cartilagenous vault with inspiratory effort. He too experienced subjective and objective improvement with the prosthesis and refused further surgery.

Case 3: This 43-year-old female executive was noted to have difficulty breathing following resection of a left facial nerve neuroma and cable nerve graft. The difficulty was due to collapse of the left naris with routine inspiratory effort and this was accentuated when lying down on the right side. With the prosthesis in place (Figure 2), breathing was improved in

the upright and she had loss of airway compromise when turned on her right side. Over a six-month period she regained facial tone and found it no longer necessary to wear the prosthesis so it was discontinued.

Case 4: This 67-year-old male with multiple basal cell cancers had microscopically controlled excision of a lesion over the right side of his nose leaving him with a large defect. This was managed surgically with a composite graft which underwent some subsequent stricture with scarring and decrease of the airway. Further surgery was deferred largely because the patient was satisfied with the appearance and there was concern about recurrent facial cancers developing. After the prosthesis was tried the patient was totally satisfied and elected not to proceed with any further surgery.

Case 5: This 70-year-old lady required a total rhinectomy and postoperative radiation therapy for treatment of a squamous cell carcinoma of the nose and adjacent maxilla. Reconstruction was initiated with a large scalp flap, but delayed healing and postoperative wound infections precluded progressing rapidly through stages of thinning and structural formation to facilitate restoration of the airway. During this time of transition, the prosthesis was helpful in establishing a temporary airway.

DISCUSSION

Nasal prostheses can be an integral part of the armamentarium for approaching problems of nasal airway obstruction particularly when this involves the area of the nasal valve. Rhinologic surgeons are becoming increasingly aware of the importance of the nasal valve region in determining nasal airway resistance. This is evident in part by increasing attention addressed to management of the caudal septum in septoplasty and septorhinoplasty procedures. There is increasing recognition that rhinoplasty can compromise the functional integrity of the nose. It has long been apparent that injudicious resection of alar cartilage can result in severe airway compromise due to alar collapse (Goldman, 1950). Recent anatomical studies have demonstrated that the routine management of the osteocartilagenous vault may further compromise the narrowest portion of the airway necessitating compensatory surgical maneuvers (Ford, 1984). Creative surgical approaches to correct undesirable constrictions of the nasal valve have been described by Kern (1977) and Sheen (1984) and such approaches offer satisfactory solutions for most patients.

There have been very few reports of prostheses being used for correction of such problems (Davenport, 1981). This is partly due to a preference for surgical cure by patient and surgeon. Patients also tend to find prostheses inconvenient and threatening to their self-image.

In certain instances, there is need for an alternative to surgery and the prosthesis offers a simple, inexpensive technique with minimal inconvenience. There appear to be at least three major categories of problems which are best served by the use of a prosthesis and the patients presented in this study are representative of these groups.

Group 1 consists of patients who refuse surgery either through exaspiration from multiple procedures, low level of expectation and/or fear of surgery. This group is

exemplified by the first two cases presented. In some instances the low level expectation is warranted by the degree of complexity of the problems such as excessive scarring, loss of osseo-cartilagenous support, and soft tissue loss. In group 2 are patients for whom surgery is either unnecessary or contraindicated. In the third case presented, surgery was certainly unnecessary because of the temporary nature of the patient's facial paralysis. Patients experiencing paralysis secondary to cerebro-vascular accident or other temporary paralysis problems would be similar candidates. There are also patients with minimal symptomatology which is intermittent such as allergic patients or patients with exaggerated nasal cycle symptoms who may only require intermittent correction such as could be offered with a prosthesis. Certainly where surgery would be contraindicated due to systemic disease, bleeding diathesis, or physiologic age, another alternative to surgery is attractive. Group 3 may designate a final group where a prosthesis might be beneficial; these patients require delay of surgery but are symptomatic enough to warrant some form of immediate management. The fourth case presented is an example where deferral of surgery was a patient preference and also allowed a longer period of observation for recurrent cancer. Patients who have a great deal of cicatricial stenosis following microscopically-controlled excision of cancer with healing by secondary intention may be other good candidates for temporary stenting. Case 5 demonstrates the use of the prosthesis as a short interim measure during ongoing staged nasal reconstruction to supply an airway by supporting soft tissues lacking osteocartilagenous superstructure and prior to defatting procedures. Some patients may wish to defer surgery but would like to experience the sensation of an improved airway to improve their motivation and this could be provided with a prosthesis. In the other instances deferral might be appropriate to facilitate an optimal result. For example, in the pediatric age group, it is often preferable to wait until the cartilages are better developed. In some instances the airway might be sufficiently compromised as to render the patient more susceptible to upper and lower respiratory disease. The use of a prosthesis would offer a simple interim solution for such problems.

Although application of the nasal prosthesis for inadequate nasal patency is limited, there does appear to be subjective and objective evidence in the patients evaluated indicating the efficacy of this approach. Where benefits are appreciated by patients there is generally good compliance. The surgeon is afforded the luxury of deferring surgery to a more optimal time in many instances which may facilitate a better surgical outcome ultimately and also eliminate the need for surgery in some borderline cases. The prosthesis described is simple to construct and seems to be well tolerated by the patients. It is lightweight and fits snugly in anatomical position without producing ulceration. Insertion and removal does not require unusual dexterity and is quickly learned by the patients. Although there is little question that appropriate surgical correction is the management of

choice for most structural nasal structive problems, alternative measures such as the use of a nasal prosthesis allow the otorhinologist flexibility in the management in some of these difficult problems.

RÉSUMÉ

La chirurgie n'est pas toujours la meilleure façon d'aborder les problèmes du passage de l'air par le nez. Il y a des cas où la chirurgie pourrait être inutile ou contre-indiquée; où il vaudrait mieux différer l'intervention chirurgicale; où le patient la refuse franchement.

Pour certains d'entre eux l'emploi d'une simple prothèse intranasale pour améliorer le passage de l'air à travers la région de la valve nasale est utile.

Chez cinq patients remplissant ces critères une prothèse a été posée, la situation avant l'insertion et après ayant été soigneusement évaluée à l'aide de rhinomanométrie. Les auteurs donnent d'autres situations dans lesquelles un tel mécanisme pourrait être efficace.

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