

Nasal stent fabrication involved in nasal reconstruction: Clinical report of two patient treatments

Michael D. Brooks, DMD,^a Alan B. Carr, DMD, MS,^b and Steven E. Eckert, DDS, MS^c
Mayo Graduate School of Medicine, Rochester, Minn

Total or near-total rhinectomy during tumor ablative surgery creates a large postsurgical defect. Surgical or prosthetic reconstruction may be considered. Surgical reconstruction of such a defect depends on support of the reconstructive tissues to prevent collapse. Without support, the esthetic results and airway patency are compromised. The purpose of this clinical report is to present the use of a nasal stent to support soft and hard tissues for the reconstruction of near-total rhinectomy in 2 patients. (J Prosthet Dent 2004;91:123-7.)

Management of neoplastic disease often involves surgical excision to achieve tumor-free margins in the residual tissue.¹ Tumors affecting the nose may necessitate a total or near-total rhinectomy, thereby creating a prominent midfacial defect. Surgical or prosthetic reconstruction is usually required; however, the prominent location and complexity of the anatomical configuration makes surgical reconstruction difficult. This situation is further complicated by the esthetic and functional demands in this site.

The face is the most noticeable of human characteristics and arguably the nose is its most prominent feature. Functions of the nose include the filtration, heating, and moisturizing of inspired air, as well as the functions of smell and taste. The nose is the only means of bringing warm humidified air into the lungs.² The combination of delicate tissues, refined bony and cartilaginous substructure, and subtle contours make it impossible to completely replace the natural nose. For this reason, compromises are necessary with any reconstructive effort. Complications of surgical reconstruction of the nose include constriction of the tissues inward, contraction of the tissues upward, and collapse of the tissues, leading to an unfavorable esthetic result.³ Moreover, the constriction and collapse of the involved tissues may lead to a loss of internal airway space, hindering respiratory function.

The normal anatomy of the nose can be described as having 3 component parts: an internal lining, a support structure, and an external lining. Reconstruction of the nose has also been compartmentalized into 3 units: cover, framework, and lining.^{4,5} Many surgical techniques have been reported in nasal reconstruction, in-

cluding lining flaps and rotational flaps to create internal and external linings, and cartilage grafts and autologous implants for the framework.^{4,6-9}

The most frequently encountered complication with nasal reconstruction is loss of lining.¹⁰ At one time, flaps used for nasal reconstruction typically lacked adequate vascularity to remain viable, resulting in an inability to maintain the cartilaginous graft. The advent of microvascular free flaps assisted in graft retention, because these use a secondary blood supply, creating an immediate vascular supply to the donor tissue.¹¹ However, collapse and contracture during healing still pose a challenge in maintaining the structural integrity of the reconstructed nose.

Burget and Menick¹⁰ reported that nasal support is best supplied at the time of soft tissue lining and cover construction. Support applied as a secondary procedure cannot compensate for what is lost to tissue shrinkage and scar contracture. Millard stated that the major function of the framework, referring to the framework of the nose created by bone and cartilage grafts, is to achieve and maintain profile and patency of the airway.¹² These authors agree that a codependency exists between the framework and lining that makes surgical reconstruction to achieve function difficult. The osteocartilaginous framework requires time to heal to be able to maintain form and structure of the nose, but without viable tissue, the osteocartilaginous graft cannot survive. Likewise, the lining graft depends on the osteocartilaginous graft to maintain form and structure while it heals.

On the basis of these observations, the need for an internal support mechanism was clearly identified. To accomplish this, a nasal stent was fabricated to act as an internal scaffold to support the graft and residual tissues, independent of those tissues. The purpose of the stent was to maintain internal airway patency and to prevent collapse and contracture of the donor tissues, while the stent was designed to allow easy removal on completion of healing.

^aResident, Department of Prosthodontics and Maxillofacial Prosthetics.

^bProgram Director, Advanced Prosthodontics.

^cAssociate Professor, Department of Dental Specialties.

Poster presentation at the 2002 American Academy of Maxillofacial Prosthetics meeting in Orlando, Fla.



Fig. 1. Lateral view of nasal stent for patient 1.

CLINICAL REPORT

Adequate support, retention, and stability required extension of the stent into the nasal cavity to engage bony surfaces and residual turbinates. Because of the sensitivity of the nasal tissues, a direct impression was not possible. Instead, a wax pattern was fabricated, evaluated, and adjusted clinically. This allowed modifications to ensure that the stent approximated the size and contours of the internal structure of the nose. The design of the stent was a combined effort of the surgeon and the maxillofacial prosthodontist.

Wax (Set-Up Wax; Dentsply International, Inc, York, Pa) was selected for its handling properties and ease of use. When heated, set-up wax is malleable, allowing easy manipulation. Once cooled, it maintains structural integrity. The wax was shaped into cylinders approximately 0.5 cm in diameter. The cylinders were formed to the internal design with extension into the nasal cavity. The stent was invested in a type III dental stone (Coecal; GC America, Inc, Alsip, Ill) and laboratory plaster (Plaster no. 2; KerrLab, Orange, Calif) mix, boiled out, and converted into a clear acrylic resin (Hygenic Denture Resin; Hygenic Corp, Akron, Ohio) stent. The stent was carefully polished using pumice (Pumice; Great Lakes Orthodontics, Ltd, Tonawanda, NY) with a rag wheel and water. A high shine on the stent was created using a polishing paste (244-Blue; Kenda AG Dental Manufacturing, Vaduz, Liechtenstein) and a rag wheel to produce a smooth, uniform finish (Fig. 1). The stent was disinfected in an effort to reduce the risk of postsurgical infection caused by a foreign body. This was accomplished before the surgical reconstruction using a chemical disinfectant solution (Top-cide 60; Upland Research, San Mateo, Calif) in the operating room.

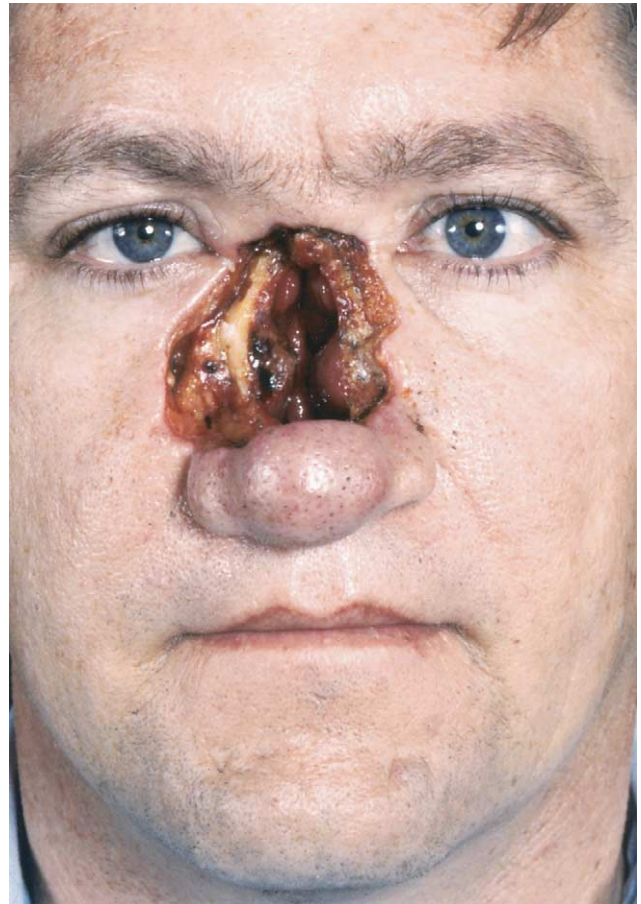


Fig. 2. Frontal view of patient 1 before reconstructive surgery.

Patient presentations

Patient 1 is a 42-year-old man with a biopsy-confirmed diagnosis of inverting papilloma. Resection was performed in 1998, during which time a small focus of squamous cell carcinoma was identified within the papilloma, resulting in the need for more extensive lateral rhinotomy. In November 2001, the patient developed a fullness and thickness in the skin near the lateral rhinotomy. Biopsy revealed a grade 2 (of 4)¹³ squamous cell carcinoma. Treatment consisted of near-total rhinectomy. The borders of the defect extended from the glabella superiorly to the frontal processes of the maxilla laterally. The bilateral ala and tip of the nose remained inferiorly (Fig. 2).

The wax pattern for the stent was fabricated as previously described. Clinical trial of the stent confirmed approximation to the internal structure of the nose. Support was gained from the frontal bone and residual nasal bone superiorly, and from the superior surface of the maxilla inferiorly. Retention and stability were obtained by extending the periphery of the wax pattern to engage between the middle and inferior turbinates, and be-



Fig. 3. Frontal view of patient 1 with nasal stent in position.

tween the inferior turbinate and the floor of the nasal cavity bilaterally (Figs. 3 and 4).

Patient 2 is a 65-year-old man with a biopsy-confirmed grade 4 (of 4)¹³ squamous cell carcinoma. In 1999, the patient underwent a near-total rhinectomy. The superior surface of the defect was defined by the nasion extending laterally to the frontal processes of the maxilla. The defect extended inferiorly to the philtrum, leaving only remnants of the ala bilaterally (Fig. 5). The patient successfully used a silicone nasal prosthesis retained with skin adhesive with satisfactory esthetic results for 2 years. Difficulties with retention and maintenance of the prosthesis because of the patient's active lifestyle led him to pursue surgical reconstruction. The stent was fabricated in a similar manner as described; however, modifications were made as a result of experience gained from the treatment of patient 1.

For patient 1, a slight posterior shift of the stent was noted, most likely caused by the weight of the graft tissues. To combat this effect in patient 2, external support was gained from extension of the prosthesis through the apertures with bracing extensions that rested upon the upper lip. This prohibited movement posteriorly into the nasal cavity and assisted in maintaining and supporting the nasal apertures. In addition, the extensions between the middle and inferior turbinates were eliminated. This left a superior support onto the frontal bone and bilateral extensions onto the nasal floor inferiorly. Finally, a space was made in the anterior portion of the stent to allow grafted bone to form a columellar strut (Fig. 6).

Surgical procedure

Both patients received similar surgical procedures. A radial forearm fasciocutaneous free flap was harvested. The facial artery and vein were identified and anastomosed to the artery and vein of the donor tis-



Fig. 4. Lateral view of patient 1 with nasal stent in position.

sue. The nasal stent was inserted and the flap was sutured over it to form the internal lining of the nose. Osteocartilaginous rib was harvested and shaped to form a nasal dorsum and columellar strut. The free flap was folded onto itself after de-epithelialization of 1 end, and the lateral surface was sutured over the cartilaginous graft to form the external lining of the nose.

After appropriate healing, the nasal stent was segmented intranasally and removed through the apertures. Revision surgeries involved removal of the external lining free flap and debulking of the internal lining free flap. A paramedian forehead flap was used to replace the outer lining. In addition, calvarial bone was grafted and plated on the dorsal portion of the osteocartilaginous rib graft because of resorption of the original graft in patient 1.

DISCUSSION

Postsurgical follow-up time was limited to 14 and 10 months for patients 1 and 2, respectively. In both patients, the stent helped to establish internal airway space and supported the form of the graft and residual

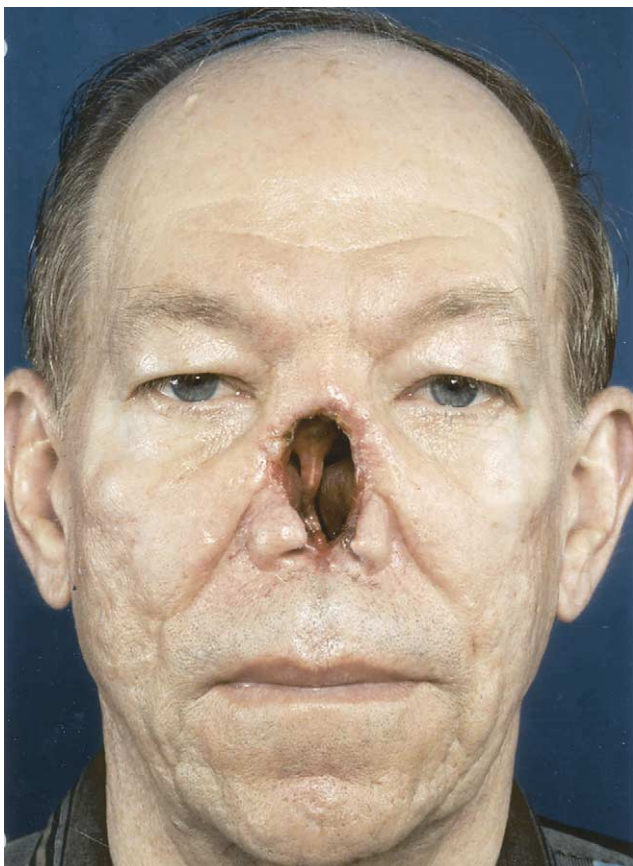


Fig. 5. Frontal view of patient 2 before reconstructive surgery.



Fig. 6. Lateral view of nasal stent for patient 2 including modifications.

tissues, thereby improving the final esthetic results. Collapse and contraction of the grafted tissues were prevented, whereas maintenance of the nasal aperture was provided by the stent.

Although the stent maintained airway patency and acted as an internal scaffold during tissue healing, the procedure did not eliminate other challenges associated with surgical reconstruction of the nose. The use of a free flap maintains tissue vascularity but adds internal and external bulk to the reconstruction, regardless of nasal stent intervention. In addition, the stent itself partially blocked normal nasal airflow during its use in the initial healing phase. Finally, the stent could not prevent some degree of distortion of the nose because of contraction and collapse. This was observed during the secondary surgical procedures when the stent was already removed (Figs. 7 and 8).

The stent improved the outcome of the nasal reconstruction by maintaining the form and structure of the grafted tissue, as well as maintaining airway patency. Its use did not reduce the number of surgical procedures involved in the nasal reconstruction; however, it did not

create the need for additional surgery. A portion of the original osteocartilaginous graft for patient 1 resorbed, necessitating a secondary surgery to augment the dorsum of the nose with a calvarial bone graft. Modifications were made to the stent for patient 2 to improve stability and support. Perhaps the benefit of the improved stent helped to eliminate the need of additional surgery for patient 2.

SUMMARY

With the advent of microvascular surgical techniques, the potential for more favorable surgical reconstruction of the nose is eminent. The difficulties in achieving acceptable esthetic results are obvious. Maintenance of appropriate contours is difficult as the tissues undergo cicatricial changes associated with healing. One method to aid in maintaining tissue form through the use of an intranasal stent was presented. Routine prosthetic techniques were adapted for use in this situation to assist in achieving short-term goals of the reconstructive team.

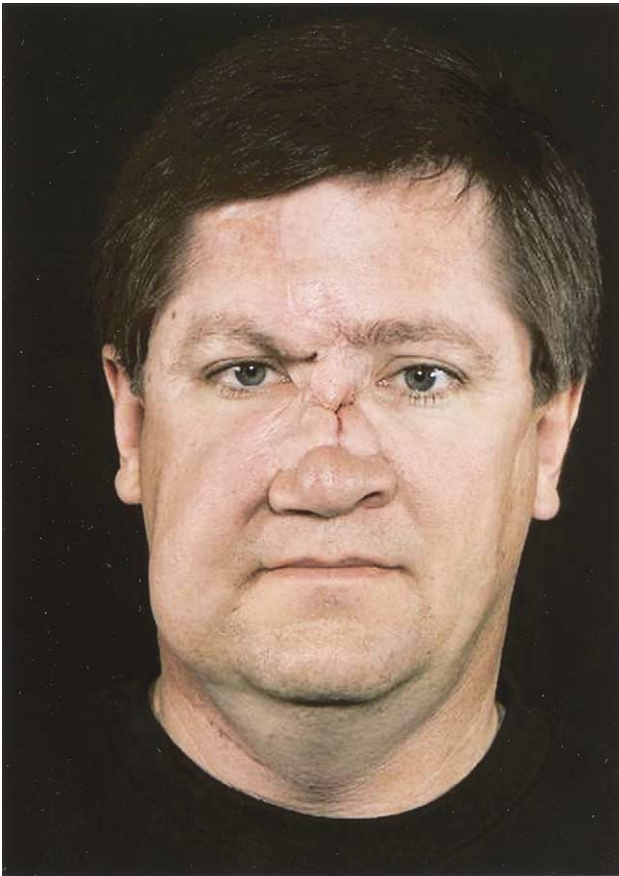


Fig. 7. Frontal view of patient 1 after reconstructive surgery.

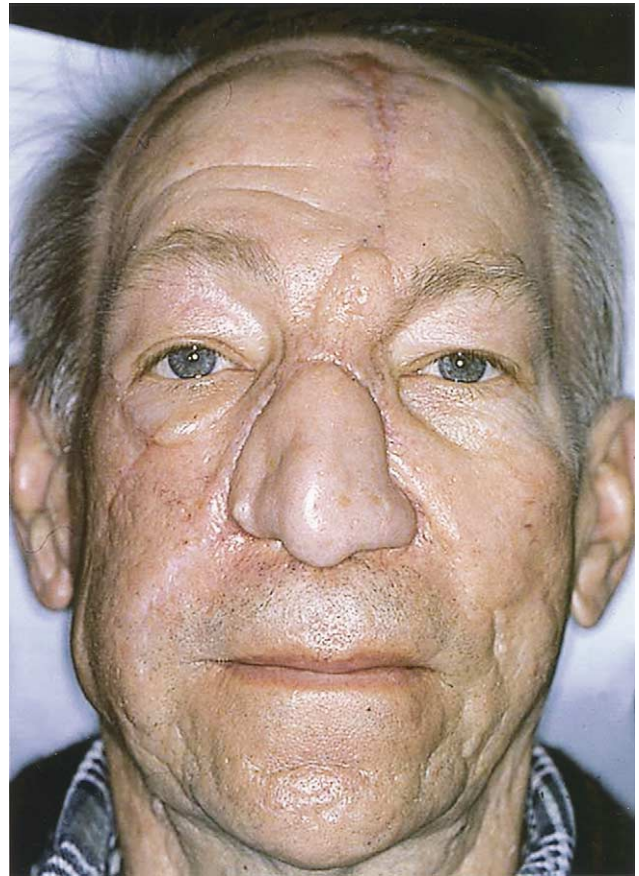


Fig. 8. Frontal view of patient 2 after reconstructive surgery.

REFERENCES

1. Johnson JT. Management of advanced cancers of the external nose. *Oncology* 1993;7:73-7.
2. Des Jardins T. *Cardiopulmonary anatomy and physiology*. 4th ed. New York: Delmar Learning; 2002.
3. Burget GC, Menick FJ. Nasal support and lining: the marriage of beauty and blood supply. *Plast Reconstr Surg* 1989;84:189-202.
4. Converse JM. *Reconstructive plastic surgery*. Vol 2. 2nd ed. Philadelphia: Saunders; 1977.
5. Ko SE, Fine L, Robinson JE. Total rhinoplasty or prosthesis? *J Prosthet Dent* 1980;44:74-6.
6. Burget GC, Menick FJ. The subunit principle in nasal reconstruction. *Plast Reconstr Surg* 1985;76:239-47.
7. Gillies H, Millard DR Jr. *The principles and art of plastic surgery*. Vol 1. Boston: Little, Brown; 1957.
8. Millard DR. Reconstructive rhinoplasty for the lower two-thirds of the nose. *Plast Reconstr Surg* 1976;57:722-8.
9. Romo T, Scalfani AP, Jacono AA. Nasal reconstruction using porous polyethylene implants. *Facial Plast Surg* 2000;16:55-61.
10. Burget GC, Menick FJ. Nasal reconstruction: seeking a fourth dimension. *Plast Reconstr Surg* 1986;78:145-57.
11. O'Brien BM. *Microvascular reconstructive surgery*. London: Elsevier Health Sciences; 1977.
12. Millard DR. Total reconstructive rhinoplasty and a missing link. *Plast Reconstr Surg* 1966;37:167-83.
13. Broders AC. The microscopic grading of cancer. *Surg Clin North Am* 1941;21:947.

Reprint requests to:
 DR MICHAEL D. BROOKS
 MAYO CLINIC
 200 FIRST ST SW
 ROCHESTER, MN 55905
 FAX: (507) 284-8082
 E-MAIL: brooks.michael@mayo.edu

0022-3913/\$30.00
 Copyright © 2004 by The Editorial Council of *The Journal of Prosthetic Dentistry*.

doi:10.1016/j.prosdent.2003.11.001