A New Technique for Reconstruction of the Nasal Dorsum

Underlay Autografting

Farahmand Sabeti, MD; Abbas Nadimi Tehrani, MD

This article presents a new surgical technique for reconstruction of the nasal dorsum following excisional rhinoplasty in patients with prominent humps. Reinsertion of the excised hump is not a new concept. Rather, underlay grafting of the resected hump was developed by modification of the Skoog technique, addressing the problem by salvaging the upper cartilaginous vault.

From the Departments of Otolaryngology–Head and Neck Surgery, Islamic Azad University (Dr Sabeti), and Tehran University of Medical Sciences (Dr Tehrani), Tehran, Iran.

RESULTS

Fifteen patients (12 women and 3 men) with prominent nasal humps underwent primary excisional rhinoplasty by the described operative technique. The age of the patients ranged from 18 to 38 years. After the initial study, the technique was used for an additional 10 patients whose follow-up period is still less than 18 months. All of the patients needed dorsal profile reduction exceeding 3 mm in the area of osteocartilaginous junction. In 8 patients, including 3 who did not undergo lateral osteotomies because of exceedingly narrow bony arch, the graft contained a slender osseous segment. In the remaining 7 patients the graft did not have any bony portion. Several other procedures such as septoplasty, tip surgery, or alar wedge resection were performed on most of them. After at least 18 months of follow-up, there was no incidence of immediate or late infection, hemorrhage, or displacement of the graft. None of the patients needed intraoperative or postoperative graft removal. Physical examination also showed no evidence of graft palpability, mobility, or resorption. There was no evidence of middle vault collapse, open roof, adhesion, or fibrosis of the skin and soft tissues. Smooth confluence of the bony and cartilaginous vaults was observed on frontal and lateral views. The curvature of the cartilaginous vault was preserved and ex-
OPERATIVE TECHNIQUE

Endonasal transcortilaginous incisions were made and united to a bilateral transfixion incision. The skin and soft tissues overlying the cartilaginous vault were elevated in a submucosuloaponeurotic plane by fine-pointed scissors. The perosteum over the median nasal bones was elevated using a Joseph elevator. Using an extramuscosal approach, the mucosa was reflected downward from the undersurface of cartilaginous and osseous vaults. At the anterior border of septum, this mucosal undermining was a few millimeters more than the designed resection of septum. The mucosal undermining extended inferiorly approximately twice the estimated distance of the dorsal reduction under the upper lateral cartilages and nasal bones (Figure 1). After cutting the defined portion of the cartilaginous hump with scissors or a No. 11 blade, the osseous hump was resected in continuity with the cartilaginous hump using a 12-mm osteotome. Then septoplasty or tip refinements were performed as outlined in the operative protocol. The excised hump, preserved in a gentamicin sulfate–containing isotonic sodium chloride solution, was then sculpted. Using a No. 15 blade, the resected septal part of the hump was removed with a fine blade (Figure 2). Special attention was paid not to thin excessively the 1- to 1.5-mm-thick septum intervening the upper lateral cartilage remnants. This septal part made an integrated single unit with the upper lateral cartilage remnants and was the essential ingredient of integrity and springlike action of the graft. After careful separation of the lateralmost portion of the upper lateral cartilage remnants attached to the undersurface of the osseous hump, the lateral border of the osseous hump was trimmed down to a slender triangular bony segment attached to the cartilaginous part of the graft with a fine bone cutter (Figure 2). Excessive thickness or convexity of the osseous part could be carefully rasped and flattened. Alternatively, the upper portion of the resected hump could be modified by first separating the cartilaginous vault completely from the undersurface of the bony hump, and then crushing the upper most portion of it by a small needle holder (Figure 2). Before inserting the graft and after confirming the adequate lowering of the dorsal profile, another 1 to 1.5 mm of anterior septum was resected to compensate for the graft thickness. By applying a thin Aufricht elevator, the dorsal skin and soft tissues were elevated. The graft was applied over the open roof, with the triangular bony fragment or the crushed upper part of the graft lying over the open bony roof. The caudal upper lateral cartilage remnants were then laid out and held lateral to the anterior border of the septum with a nontooth Atson forceps near the septal angle. The graft was fixed to the septum in this position by 1 or 2 nonabsorbable 5-0 horizontal mattress sutures in the caudal third. Mattress sutures automatically drove the lateral wings of the graft toward each other at an almost 120° angle slipping under the remaining upper lateral cartilage edges that were appropriately denuded of mucosa (Figure 3). If there was any suspicion of the exact underlying positioning of the graft, the lateral portions of the graft could be sutured deep to the upper lateral cartilages by fine absorbable sutures. After graft placement, low to high lateral osteotomies were made. The endonasal incisions were repaired and the nose was splinted.

Figure 1. Extent of mucosal dissection in different levels of the nasal framework: A, lower bony vault; B, upper cartilaginous vault; and C, lower cartilaginous vault. Note the extent of mucosal undermining under the upper lateral cartilages.

The peculiar anatomy of the nasal dorsum should be taken into consideration in any surgical procedure in dealing with reconstruction of nasal dorsum following excisional rhinoplasty. The nasal dorsum is a curved and arched structure that is widest in the rhinion area and narrowest in the intercanthal area and internal valve area of nose. Resection of a large hump and infracture of the lateral walls greatly reduce this difference in width, and the resulting open roof can never be closed completely (Figure 7). On the other hand, the upper cartilaginous vault normally has a curved and dome-shaped appearance that changes to a flatshaped structure in classic excisional rhinoplasty. Even using spreader grafts may not restore the natural contour over a flattened dorsum after resection of the hump. Rhinoplasty surgeons often experience satisfactory results by preserving the integrity of the nasal mucosa and avoiding excessive resection of the upper lateral cartilages and septum in patients with relatively small humps and average skin thickness. In fact, minimal reduction of the dorsum in the rhinion area reduces the medial tilt and movement of lateral walls after doing osteotomies and the remaining septum and upper lateral cartilages would retain much of their thickness and strength, greatly diminishing the incidence of edema of the middle vault area that lasted about 2 to 3 months. None of the patients reported any change in airway competence either during exertion or at rest, although objective assessment by rhinomanometry was not performed.
of middle vault collapse. On the other hand, patients requiring resection of a prominent hump frequently need some sort of graft to prevent middle vault collapse. Different surgical procedures have previously been applied to reconstruct the nasal dorsum.

REVIEW OF THE LITERATURE

Cottle, in 1954, was the first surgeon who proposed autografting the nasal dorsum after its excision; however, it was Skoog who performed it routinely in rhinoplasty operations. Cottle also introduced pushdown rhinoplasty, which did not solve dorsal convexity besides being a difficult procedure.3

In 1966, Skoog4 described a series of 19 patients who, based upon the Cottle concept, underwent nasal hump removal and reinsertion after trimming of the lateral borders and excising the septal remnant. He pointed out that after separating the septal remnant, the excised hump would invariably convert to a straight graft. He also emphasized that reinsertion of the dorsum would prevent a “surgical” appearing nose.4,5 Regnault and Alfaro6 applied Skoog’s technique extramucosally in a series of patients. By applying this technique, the graft was completely separated from the nasal cavity. The hump acted as a true autograft and theoretically would be revascularized. Skoog’s technique had some disadvantages. A large hump required intact removal; if considerable fractures occurred in its osseous part, it could not be used. The graft was occasionally unstable and mobile in some patients. The authors applied Skoog’s technique in some patients and noted undesirable postoperative excessive broadness of dorsum in most of them. The broadness probably has resulted from the strong tendency of the cartilaginous vault, being disconnected from the remaining nasal framework, to splay.

Daniel described another technique in which the nasal dorsum, while still attached to dorsal skin and soft tissues, was elevated by cutting the septum and upper lateral cartilages in predetermined locations. Based upon the previous measurements, the dorsal height was then reduced and finally the elevated roof was fixed on the new dorsum.7,9 He reported that the recapitulated roof could operate as a spreader graft and could camouflage the underlying irregularities. Daniel’s technique had the
same rationale as Skoog’s technique; however, the nasal dorsum was separated in a critical point from the nose and necessary refinements were performed not on the hump, but on the remainder of the nose. The technique, in addition to being useless if any significant fracture occurred in the bony hump, shared some disadvantages of Skoog’s technique. Furthermore, the surgeon could not manipulate the dorsal surface of the hump.

Sheen presented a technique in 1983 that was based on using strips of septal cartilage along the anterior border of the septum to increase middle vault width following excision of the dorsum. This technique kept the upper lat-

Figure 4. Preoperative photographs (A, C, and E) of a 24-year-old patient with a large deviated nose and large skin sleeve. Postoperative photographs (B, D, and F) 2 years after hump excision, lateral osteotomies, and underlay grafting of dorsum. The smooth confluence of bony and cartilaginous vaults and the natural appearing dome-shaped middle vault is noted postoperatively.
eral cartilages farther from the septum, decreasing the like-
lihood of internal valve constriction. He recommended
middle vault reconstruction in all primary rhinoplasties that
included removing the cartilaginous vault. Sheen pointed
out that the main factor that should be restored was the
sufficient width of anterior septal border, which spread the
upper lateral cartilages. Although application of the spreader
grafts has been the dominant technique used by surgeons
to reconstruct the middle vault, the author’s experience has
been in accordance with Guyoran et al’s notification that
these grafts result in variable functional success while the
aesthetic outcome is often gratifying.10

Figure 5. Preoperative photographs (A, C, and E) of a 33-year-old patient with a high nose and relatively narrow bony base. Postoperative photographs (B, D, and F) 18 months after osteotomies and underlay grafting of dorsum.
McKinney and colleagues used a thin septal cartilage graft, which was sanded and shaped as a shield to close an open roof.\textsuperscript{11,12} It was claimed that the graft covered underlying irregularities, camouflaged any residual twist of septum, and acted as a spreader graft. The technique necessitated using a relatively long (about 35 mm) and wide portion of the vital septal cartilage.

Guyoran et al\textsuperscript{10} developed upper lateral splay grafts to reconstruct the natural confluence of upper lateral and septal cartilages in secondary rhinoplasty patients with

\textbf{Figure 6.} Preoperative photographs (A, C, and E) of a 25-year-old patient with a large nose and asymmetric bony walls. Postoperative photographs (B, D, and F) 18 months after hump excision, tip sutures and grafting, multiple osteotomies of the right side, and underlay grafting of dorsum. On the profile view, a small protuberance was noted that was due to inadequate lowering of dorsum to compensate for graft thickness.
middle vault collapse. The splay graft spanned the dorsal septum but was laid deep to the upper lateral cartilages. It was reported that the graft induced functional improvement in all of the patients operated on but could result in excessive widening of the caudal portion of the dorsum.

THE NEW TECHNIQUE: UNDERLAY AUTOGRAFTING OF DORSUM

The new surgical technique relies on using the patient’s excised hump for reconstruction of the nasal vault to prevent middle vault collapse and preserve the natural contour of the middle third of nose. The main difference of the present technique with the previous ones is the attempt to reconstruct the springlike T-junction of the upper lateral cartilages and septum in the upper cartilaginous vault and to prevent the occurrence of excessive broadness of dorsum.

Considering the functional anatomy, there is an important difference between the upper and lower cartilaginous vaults. McKinney et al demonstrated that the upper two-thirds of the cartilaginous vault consists of the upper lateral cartilages and septum as an integrated single unit, but in the lower third of the vault, the cartilages are usually separated from the septum and are only attached by fibrous connections. The upper cartilaginous vault gradually thickens and strengthens cephalically and variably extends under the nasal bones. The special anatomy of cartilaginous vault has important functional and aesthetic implications. The cartilaginous dorsum width naturally increases toward the rhinion area and the T-shaped spring-like upper cartilaginous vault takes on an arched, dome-like configuration (Figure 8). The spring inherent in the T-shaped junction splays out the upper cartilaginous vault under the bony arch (Figure 9). Separation or attenuation of the junction in the lower vault makes the nasal framework more collapsible by internal negative pressure and has a significant role in permitting the caudal border of upper lateral cartilages to act like a valve during inspiration and regulate the airflow through the nose (Figure 9). Guyoran et al reported that strengthening the upper cartilaginous vault by an underlying splay graft improved airflow through the internal valves postoperatively in secondary rhinoplasty patients suffering from middle vault collapse. Their study may support the contention that the spring of upper cartilaginous vault is the key element in the structural support of internal valves although Sheen has previously implicated anterior septal width in valve support.

The peculiar dome-shaped structure of middle vault also provides the nose with maximal inner space and maximal tension on the skin (Figure 10). This is why excision of the dorsum induces a greater increase in the skin sleeve than what is expected from dorsal height reduction.

Underlay autografting of dorsum has been applied using a closed rhinoplasty technique, although graft placement could be obviously more convenient should an open approach be used. Graft sculpting was similar to the Skoog technique with a few important differences. The hump was not excised more than the desired reduction of

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**Figure 7.** Excision of a prominent hump (A) and infracture of lateral walls to close the open roof greatly diminishes the difference of dorsal width in the rhinion, intercanthal, and valve regions (B).

**Figure 8.** Schematic representation of a cross section of the upper, middle, and lower cartilaginous vault (A, B, and C) and the corresponding levels of the excised hump (D, E, and F). Note that the hump lies completely flat, which could be compared with the freeing of a spring.
ingly narrow, high noses did not undergo lateral osteotomies. The results and the low rate of complications indicate the new technique to be predictable and reliable. In addition, the present technique has several advantages. First, positioning of the graft incorporates it to the nasal framework and splays the upper lateral cartilages to avoid middle valve collapse. Second, the graft is predominantly invisible and its lateral borders could not be identified on inspection or palpation. Third, it may provide the surgeon more safety in doing lateral osteotomies in patients with relatively narrow bony bases (Figure 5). This is also true in patients with short nasal bones and wide bony bases. The patient need not necessarily have a very large hump and the procedure could be accomplished in any patient who need at least 3-mm dorsal reduction in rhinion area. The underlay positioning of the graft camouflages any asymmetry of the lateral cartilaginous wall resection and inevitable fine irregularities of dorsal septum. It also provides maximal dimensions to the nasal framework, opposing skin thickening and deformity. The technique does not obligate septal surgery for graft harvest and vital septal cartilage is spared.

The disadvantages of the technique are as follows: First, many surgeons may be unfamiliar with the technique. Second, since the hump is necessarily excited as a single unit and preserved temporarily out of the patient’s body, inadvertent loss of it might occur. Third, the technique does not correct a wide or asymmetric dorsum. Finally, long-term follow-up of this technique is not yet available.

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Corresponding author and reprints: Farahmand Sabeti, MD, No. 19, Unit 6, First Alley, Behrooz Street, Mohseni Square, Mirdamad Street, Tehran, Iran (e-mail: drsabeti64@yahoo.com).

Figure 9. Schematic representation of the nasal framework. The cartilaginous vault could be compared with a springlike plate (A), which is restricted by its connections to the bony arch (B). C, Breakage of the T-junction in the lower vault renders it a compressible valve-like structure. D, The condition that results from classic excisional rhinoplasty.

Figure 10. Cross sections of a tent model for upper cartilaginous vault structure to demonstrate the effect of different vault shapes on the available inner space and tension on the drape. Model corresponds to an operated-on nose by excision of dorsum and infracture of lateral walls (A), to the reconstruction of dorsum by spreader grafts (B), and to an unoperated-on nose or reconstruction by underlay grafting (C).

dorsal profile and the upper lateral remnants of the hump were not trimmed. Marked lateral trimming of bony hump was done after careful freeing of its lateral borders over the cartilaginous dorsum (Figure 3). In 7 patients the graft was sculpted by completely removing the bony segment, preserving the cartilaginous dorsum and crushing its cephalic portion. The latter procedure enabled us to use the excised hump despite inadvertent fractures of the osseous portion. Both procedures yielded almost equally satisfactory postoperative results. On palpation, however, the group having the graft with a small bony segment showed better coverage of the bony roof. Three patients with exceedingly narrow, high noses did not undergo lateral osteotomies. The graft also worked well in them by a suitably covering the open roof and maintaining airway competence.

REFERENCES