Three-Step Reconstruction of Complex Saddle Nose Deformities

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Objective: To evaluate a reproducible surgical technique for augmentation rhinoplasty of complex saddle nose deformities, which are characterized by substantial loss of nasal structural support and result in multiple nasal abnormalities.

Design: Case series and surgical outcome study.

Setting: Tertiary referral center.

Patients: A total of 43 patients (32 female and 11 male; mean ± SD age, 36 ± 12 years) with complex saddle nose deformities and extensive loss of nasal volume, shape, and support who underwent reconstructive surgery between 1997 and 1999.

Intervention: A standardized 3-step surgical procedure using autogenous costal cartilage.

Main Outcome Measures: Assessment of additional nasal abnormalities, graft recipient site conditions, postoperative complications, postoperative analgesic consumption, and subjective outcome assessed with a standardized telephone interview 2 years following surgery.

Results: Besides nasal abnormalities characteristic of complex saddle nose deformities, several additional nasal abnormalities were frequently encountered. Forty of the 43 patients had undergone previous septorhinoplasty, 26 of whom through multiple procedures. One transplant extrusion was recorded, which required revision surgery. In 8 patients, minor surgical corrections were performed. Nasal airflow was judged satisfactory or good by 30 of the 37 patients who were contacted by telephone and aesthetic appearance was considered good by 17, satisfactory by 10, and unsatisfactory by 10.

Conclusions: Three-step nasal reconstruction with costal cartilage is indicated in severe saddle nose deformities. It is a comparatively reliable surgical procedure yielding satisfying results even in patients with severe deformities and unfavorable recipient site conditions.

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A SIMPLE SADDLE NOSE DEFORMITY, which appears as a low nasal dorsum, is usually a consequence of reduced structural support secondary to surgery or trauma. Sufficient augmentation can be achieved by using cartilaginous dorsal onlay grafts harvested from the nasal septum or aural concha.1,2 In complex saddle nose deformities various additional abnormalities are encountered, including nasal hypoplasia; broad nasal radix, dorsum, and tip; epicanthal folds; low tip projection; retracted and short columella; rounded nostrils; and large nasal valve angle (ballooning) with secondary conchal hyperplasia (Figure 1A-C). Concomitant maxillary hypoplasia may further reduce the nasolabial angle and aggravate columellar retraction.3 Frequently, septal and conchal cartilage provide insufficient graft material to substitute for the structural losses in complex saddle nose deformities. In this case, autogenous (autologous) iliac crest bone, calvarian bone, and, as the first choice, costal cartilage are favorable grafts for augmentation rhinoplasty.1,2,4-8

As a consequence of the various abnormalities involved in complex saddle nose deformities, several structures of the nose need to be corrected, resulting in an intricate surgical procedure. To improve practicality of the complex surgical procedure, Rettinger9 has divided the course of surgery into 3 separate reconstructive steps, offering the surgeon a standardized technical principle. This article outlines details of surgical management and presents 2-year postoperative results in patients consecutively treated for severe saddle nose deformities using the 3-step reconstructive technique with autogenous rib cartilage.
METHODS

PATIENTS

Forty-three patients consecutively treated from 1997 through 1999 at the Department of Otorhinolaryngology of the University of Ulm School of Medicine were included in the study. For preoperative evaluation, a standardized protocol was used. Items of this protocol included etiology of nasal deformity, number and types of previous nasal surgical procedures, and types of additional nasal deformities. In all patients a 3-step reconstruction was performed as described by Rettinger.9 Additional surgical procedures were categorized as nasal septum correction, additional nasal tip graft, osteotomy, correction of deformed nasal alae, premaxillary implant, and correction of vestibular stenosis.

GRAFT HARVEST

The sixth rib served as graft material to compensate for nasal substance loss. Following harvest, the rib was longitudinally divided into 4 layers using the balanced-forces concept of Gibson and Davis.10 From the 2 medial layers, a septal graft, a dorsal nasal graft, and a columellar strut were sculptured. The remnants were used for a premaxillary implant or a shield-type tip graft, if required.

THREE-STEP RECONSTRUCTION OF SADDLE NOSE DEFORMITIES

An external rhinoplasty approach was used in all patients. Remnants of the nasal septum and the anterior nasal spine were exposed between the medial crura (Figure 2A). The upper lateral cartilages were dissected from the nasal septum and septal remnants between the upper lateral cartilages were removed (Figure 2B).

In the first step of the surgical procedure, the nasal septum was reconstructed. The aim of septal reconstruction is to provide support for the nasal dorsal transplant and to reduce the abnormally wide nasal valve angle (ballooning). A balanced portion of the harvested costal cartilage was placed between the septal mucosal layers and between the upper lateral cartilages. It was fixed to the premaxilla and between the slightly

Figure 1. Complex pattern of irregularities in severe saddle nose deformity. A, Lateral view showing low dorsum, cartilaginous saddle, pseudohump, missing tip projection, short retracted columella, nasofacial angle less than 30°, and nasolabial angle less than 90°. B, Frontal view showing broad dorsum and broad base. C, Basal view showing rounded nostrils, a 90° angle between cheek and basis of ala, a short and broad columella, and an increased distance between the nasal domes. D, E, and F, Results 19 months after the 3-step reconstruction procedure using autogenous rib cartilage. The narrowing of the alar base was achieved without alar base resections; in addition to the standard procedure, a premaxillary transplant was used to camouflage maxillary hypoplasia.
Elevated upper lateral cartilages using mattress sutures (Figure 2C). The caudal edge of the septal transplant was reduced to reach the cephalic edges of the medial crura, leaving enough space to for the intercrural strut to be implanted later.

In the second step, the nasal dorsum was reconstructed. The second balanced portion of the costal graft was shaped like a flat rod. The dorsal transplant, which must reach from the nasal root to the lower edge of the septal transplant—covering the entire length of the nasal dorsum—was fixed to the periosteum of the nasal bone and the septal transplant (Figure 2D).

In the third step the columella, nasal tip, and base were reconstructed. A thin columellar strut was placed between the medial crura and loosely fixed to the nasal septal transplant with 2 sutures (Figure 2E). This hingelike connection to the septal transplant provides lateral mobility to the caudal parts of the nose. The base of the columellar strut was placed on the anterior nasal spine and fixed with a suture. Its dorsal end was fitted in the notched end of the nasal dorsal transplant. Finally, the medial crura were fixed to the columellar strut and the tip reconstructed by suturing the domes together above the columellar and dorsal transplant (Figure 2F).

**RESULTS**

From 1997 through 1999, a standardized 3-step reconstruction of complex saddle nose deformities using autogenous costal cartilage was performed in 43 of 886 major septorhinoplastic procedures. The mean±SD patient age was 36±12 years, 32 patients were female, 11 were male, the youngest was 16 years old, and the eldest was 71 years old. The main reason for surgery was impaired nasal function—mainly, nasal obstruction—in 32 patients and disturbing aesthetic appearance in 11 patients. The etiology of the saddle nose deformity was trauma in 28 patients, surgical failure in 5, congenital malformation in 6, and tumor in 1. In 3 patients, the etiology of the nasal deformity was unknown.

**PREOPERATIVE FINDINGS**

The typical abnormalities of severe saddle nose deformities were found in all patients, including broad nasal radix, dorsum, and tip; low tip projection; retracted and short columella; rounded nostrils; and large nasal valve angle. Of these 43 patients, 40 had undergone previous nasal sur-
gery and 26 had experienced more than 1 prior surgical treatment. In 9 patients, rib cartilage had already been transplanted to the nose. Additional abnormalities included nasal hypoplasia in 11 patients, lateral bony and cartilaginous nasal deviation in 10, abnormalities of the lower lateral cartilages and nasal dome in 11, severe septal deviations in 25, and septal perforations in 9.

INTRAOPERATIVE AND POSTOPERATIVE COURSE

In addition to the surgical procedure described, lateral and transversal osteotomies were performed in 10 patients, bony hump removal in 10 patients, and additional corrections of the nasal ala and tip also in 10, in whom additional aural cartilage was used. No intraoperative complications were encountered; particularly, no vessel, nerve, or pleural injury occurred during rib harvest. All patients received 50 mg of diclofenac sodium at the end of surgery. No additional pain medication was administered in 25 patients. During the entire postoperative course, 7 patients took 50 to 250 mg, 4 patients took 300 to 500 mg, 5 patients took 550 to 1000 mg, and 2 patients took more than 1000 mg of diclofenac sodium. During the postoperative course, 12 complications were observed. There were 2 minor chest wound infections; 2 nasal wound infections; 6 minor infections of the nose presenting as transient reddening, swelling, and pain; and 6 other minor complications including synchia, transient swelling of the columna, and transient septal hematoma. There was 1 extrusion of the nasal dorsal transplant following infection and 2 patients experienced persistent mucosal swelling. Revision surgery was performed in 1 patient, and in 8 patients minor corrections such as smoothing of the nasal dorsum or fixation of a mobile dorsal transplant under local anesthesia became necessary.

COMMENT

Septal or conchal cartilage is easily available, causes minor donor site morbidity, and suffices to compensate for substance losses at the nasal dorsal area in most simple and complex saddle nose deformities. Some patients with severe complex saddle nose deformities and substantial loss of nasal cartilage require more graft material for reconstruction; in this tertiary referral center for aesthetic and functional nasal surgery, rib cartilage was considered necessary for nasal reconstruction in fewer than 5% of major septorhinoplastic procedures.

Our results indicate that the 3-step reconstructive procedure with rib cartilage was performed in a selected group of patients who had poor preoperative recipient site conditions. Of these 43 patients, 40 had undergone previous nasal surgery and in a majority of them, it has been at least the second revision procedure. Frequently, remnants of previous implants with concomitant foreign body reaction were encountered. Blood supply was often impaired, and, due to scarring and the scarceness of available skin, considerable contraction had to be expected during the postoperative course. In these unfavorable recipient site conditions, the amount and stability of conchal cartilage were considered insufficient to achieve a long-lasting satisfying result. Moreover, preoperative analysis revealed several deformities in addition to the typical abnormalities associated with severe nasal saddling. These included severe deviations of septal remnants and/or septal perforations, a laterally deviated nose, dysmorphic alar cartilages and domes requiring additional conchal cartilage grafts, and severe nasal hypoplasia. Besides, maxillary hypoplasia requiring a premaxillary implant was frequently encountered. As a consequence, the median time needed for the surgical procedures was 2.9 hours. Unfavorable recipient site conditions and the duration of surgery may explain the rate of minor infections and wound-healing problems encountered in this patient group. Since minor contamination of the transplant may result in sustained release of microorganisms at the recipient site, amoxicillin and clavulanic acid were given for 5 days postoperatively.

The central problem of complex saddle nose deformities is the loss of septal height, which causes a pattern of nasal deformities (Figure 1). The correction of these problems requires an intricate reconstructive procedure. It seems reasonable to divide a complex surgical procedure in several single steps, performed one after the other in a logical order of procedure. The 3-step reconstruction proposed by Rettinger provides a reliable surgical approach to complex saddle nose deformities that can be managed by a regularly skilled rhinologic surgeon.

The stable septal graft placed during the first surgical step supports the nasal dorsal transplant and prevents later depression of the reconstructed nasal dorsum because of contraction of the skin and scar tissues. The at-

### Responses of 37 Patients to a Telephone Questionnaire 2 Years After Surgery

<table>
<thead>
<tr>
<th>Item</th>
<th>Answers (No.)</th>
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<tbody>
<tr>
<td>Nasal patency</td>
<td>Good (14), acceptable (14), insufficient (8), unspecified (1)</td>
</tr>
<tr>
<td>Sense of smell*</td>
<td>Better (3), unchanged (29), worse (3), unspecified (2)</td>
</tr>
<tr>
<td>Warping of cartilage</td>
<td>None (22), minor (8), severe (4), unspecified (3)</td>
</tr>
<tr>
<td>Dry mucosa and crusting</td>
<td>None (14), minor (9), severe (12), unspecified (3)</td>
</tr>
<tr>
<td>Nasal paresthesia</td>
<td>None (18), minor (7), severe (11), unspecified (1)</td>
</tr>
<tr>
<td>Pain</td>
<td>None (0), minor (30), severe (5), unspecified (2)</td>
</tr>
<tr>
<td>Duration of pain†</td>
<td>&lt;1 Week (30), &lt;3 months (2), &gt;3 months (3), unspecified (2)</td>
</tr>
<tr>
<td>Cosmetic results‡</td>
<td>Good (16), acceptable (10), insufficient (19), unspecified (1)</td>
</tr>
</tbody>
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*As compared with the preoperative state.
†At the donor site.
‡Overall impression.
tempt to gain too much height with the septal transplant may later cause the transplant to slip off the maxillary crest, impair blood supply of the nasal dorsal skin, and result in a short nose with an oversized nasolabial angle (gain of height at the expense of length). Moreover, the domes may then not be sutured together above the dorsal transplant, resulting in a broad, bifid nasal tip. If the achievable height with the septal transplant seems insufficient, the later use of a shield-type tip graft is advised.

The nasal dorsal transplant is placed during the second surgical step to give the nasal dorsum its final height and contour and to fill a residual saddle in the nasal dorsum. In addition, the nasal tip can be advanced anteriorly and caudally during that step, if needed. The dorsal transplant, which offers little stability, is not sufficient to withstand the powerful scar contraction seen in complex saddle nose deformities unless it is supported by a stable septal transplant. The nasal dorsal transplant must fit nicely on the underlying tissues to avoid seesawing or lateral instability. If the latter is encountered, it is commonly due to bony humps, which should be removed.

In the third surgical step, a crural strut is attached to the anterior edge of the septal transplant to form a somewhat laterally flexible nasal tip, normalize the nasolabial angle, provide tip projection and protection, and correct a retracted columella. The strut should be thin to avoid broadening of the columella. Finally, the domes are sutured together over the dorsal implant and the incisions are closed.

Advantages and disadvantages of various transplant and implant materials have recently been reviewed. Tissue properties of autogenous costal cartilage, such as consistency, flexibility, ease of sculpturing, low immunogenity, and resistance to absorption and extrusion resemble those of septal cartilage, making costal cartilage particularly suitable for nasal augmentation compared with iliac crest or calvarian bone. However, graft warping, difficult rib carving in older patients with calcifications, and donor site morbidity are the major disadvantages of rib cartilage. To reduce donor site morbidity, careful subperichondral preparation of the rib is essential. In this patient group, 2 minor chest wound infections that healed with oral antibiotic treatment were the only complications of rib harvesting.

Most reliable data on clinical and functional outcomes of a surgical procedure are obtained when the patient comes to a follow-up examination, and patient satisfaction and quality-of-life issues are commonly assessed through mailed questionnaires or telephone interviews. Advantages of a telephone survey over a mailed questionnaire include high response rates, lower rate of missing response rates to single items, improved validity because the patient can ask the interviewer for clarifications, and speed of investigation. Bias due to incomplete telephone coverage has been found negligible in several studies. In this study, 85% of the patients were successfully contacted and major nonrespondent bias is therefore unlikely. The responses reflect the severity of the preoperative nasal deformity and patient history. The high rate (33%) of nasal mucosal dryness, for example, is due to multiple surgical procedures in most cases, and the elevation of the nasal dorsum, which results in tension of the nasal skin, may explain the 30% rate of nasal skin paresthesia. Seven patients retrospectively complained of severe early postoperative pain at the donor site, but they were not administered postoperative pain medication because they had not reported their complaints during their hospital stay. It thus seems advisable to administer a standardized pain therapy regimen to all patients rather than to administer pain medication on demand.

Moreover, it seems advisable to correct unrealistic expectations about aesthetic results in patients with extensive saddle nose deformities who have undergone several prior surgical procedures. Approximately 25% of the patients were not satisfied with the result, but they had been in a postoperative course for more than 1 year and had extensive scar contraction. However, as a rule, minor corrective surgery such as smoothing of the nasal dorsum or straightening of the columella suffices to achieve a satisfactory result (Figure 1C-F).

In conclusion, augmentation rhinoplasty in patients with severe saddle nose deformities requires sufficient and stable graft material to withstand the postoperative contraction due to scar tissue. Autogenous rib cartilage is considered the best material currently available to achieve this task. Dividing the complex reconstructive procedure into 3 single steps performed one after the other in a logical order facilitates the surgery and aids in achieving more predictable results.