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Lateral augmentation of the middle third of the nose with autologous cartilage in nasal valve insufficiency*†

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SUMMARY

Nasal valve insufficiency (NVI) is a troublesome clinical entity for both the patient and the otorhinolaryngologist. Aetiological factors include congenital and iatrogenic causes, trauma, aging. Pathology is frequently located in the middle third of the nose: the upper lateral cartilages (ULC) and the cartilaginous septum (CS). The nasal valve (NV) is the plane through the caudal edges of the ULC and the CS, and is part of a larger three-dimensional area called the nasal valve area (NVA). The NVA is considered to have the narrowest cross-sectional area of the entire airway. Between 1989-1992, 32 patients with nasal obstruction due to an incompetent nasal valve were surgically treated by lateral augmentation with autologous cartilage "spreader" grafts, placed between the CS and the ULC to widen the apex of the NVA. In all cases the open approach for rhinoplasty (OSR) was used. After a mean follow-up of 18 months, 27 patients were evaluated by a self-administered questionnaire, head-and-neck examination, nasal endoscopy, photography and video-documentation of the NVA. The patient's subjective opinion was used in the assessment of the surgical success. In 48% of the patients there was complete resolution of complaints. An overall improvement of nasal patency was seen in 81% of the cases. No major complications occurred. The indications, technique and results are presented.

Key words: external rhinoplasty, nasal valve graft

INTRODUCTION

Surgical treatment of nasal valve insufficiency (NVI) demands a thorough knowledge of nasal anatomy and physiology. Pre-operative analysis is essential to determine the cause and location of the nasal obstruction. The structures of the nasal valve area (NVA) should be carefully examined, and should include septal deviations, abnormalities of the pyriform crest, malformation of the nasal spine, deformities of the columella, the anterior aspect of the inferior turbinate, nasal mucosal swelling or hypertrophy due to infectious, allergic or non-specific stimuli. Collapse of the NVA may also occur due to an angle between the CS and the free caudal end of the upper lateral cartilages (ULC) of less than 10-15°, lack of rigidity of the ULC, and scarification after previous nasal trauma or surgery. Also with aging there is loss of tip projection and counter-rotation, influencing nasal patency.

Pre-operative assessment may include a patency test, suggested by Adamson (1991).

Surgical anatomy

The cartilaginous dorsum extends from the anterior septal angle cephalically to the osseo-cartilaginous junction, where it is overlapped by the nasal bones. This area ("K-area") is the center of support of the nasal roof. The ULC separate from the cartilaginous septum (CS) to end in free-curved margins in a variety of individual variations. Except for the distal end, the ULC fuse in the midline with the CS encased in the same perichondrial sheet. This forms a T-shaped construction which supports the nasal dorsum and contours the dorsum. Laterally, the junction with the pyriform aperture is formed by fibro-fatty tissue attachments. Accessory sesamoid cartilages are not uncommon in this area. Inferiorly, the caudal edge of the ULC tends to curl upwards ("retur-

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ning") and is overridden by the cephalic margin of the lateral crus of the lower lateral cartilages (LLC). Connective tissue between the ULC and the LLC forms the remaining part of this scroll region. The angle between the CS and the ULC increases from caudally to cranially.

Physiology

The NVA represent the narrowest part of the entire airway (Kern 1977, 1978, 1983; Sulsenti and Palma, 1989). The NVA widens and narrows under the influence of nasal musculature during respiration and should be considered a physiological phenomenon. It is thought to be beneficial because it tends to limit excessively high inspiration airflows that might exceed the ability of the nose to condition the incoming air. The capacity of the NV to withstand the transmural pressure prevents a collapse on inspiration. Tissue rigidity of the NVA and activity of the alar muscles are essential for this nasal function to be effective.

Aetiology

Rhinoplasty using traditional intercartilaginous incisions in combination with hemi- or transfixion incisions increases the chances of scar formation and blunting in the vicinity of the apex of the NV (Sheen 1975, 1978; Stucker and Smith, 1976; Goode, 1985; Adamson, 1987; Tardy, 1990). Transmucosal separation of the ULC and the CS or resection of the caudal border of the ULC will influence the NV (Converse, 1977; Courtiss et al., 1983; Peck, 1984). Dorsal hump removal which excises large amounts of ULC, inadequate infraction causing an "open roof" deformity or malposition of cartilage remnants will damage the NV (Sheen, 1978). Resection of large parts of the CS, as seen in the classic submucous septal resection, may produce a saddle nose deformity, a ballooning phenomenon and inward displacement of the ULC (Sulsenti and Palma, 1989). In general, the patient with a high bony-cartilaginous dorsum, short nasal bones, and long flaccid and weak ULC seeking primary rhinoplasty are prone to complications (Sheen 1984, 1988). Other factors are congenital, such as in the Caucasian with a narrow nose or age-related or traumatic injury.

History of surgical treatment of NVI

Surgical treatment of NVI is aimed at restoration of physiology, primarily by replacing deficient structures with identical tissue in their original position. This is preferably accomplished without undesirable effects on nasal aesthetics. Hinderer (1969), Tardy (1976), Tardy et al. (1985), Kern (1991), and Sulsenti and Palma (1989) emphasized the role of septal deviations in NVI and advocated the use of the traditional endonasal incisions. Surgical correction of the ULC was described by Cinelli (1941) and Fomon (1950). The rotation technique of the LLC was described by Rettinger and Masing (1981). The use of different types of grafts was advocated by Cinelli (1941), Fomon (1950), Walter (1969), Desprez and Kiehn (1975), Hurst (1978), Sheen (1984), Lapidot (1985), Goode (1985), Ochi and De Werd (1988), Jovanovic and Berghaus (1991), and Adamson (1991).

Spreader graft

Surgical treatment of NVI with lateral augmentation is a relatively unknown technique. Uni- or bilateral insertion of autologous cartilaginous grafts paramedian to the CS pushes the ULC in a lateral direction away from the CS, thus opening up the apex of the nasal valve (NV) and increasing the NVA. Originally the grafts were placed in a submucoperichondrial pocket exposed by the closed technique. However, precise placement and fixation are difficult (Sheen 1984, 1988). The open approach simplifies the placement of spreader grafts (Johnson and Toriumi, 1990).

Surgical exposure

A midcolumellar broken-line skin incision is connected with bilateral marginal incisions. After development of the columellar flap the nasal dorsal skin is elevated from the cartilaginous nasal skeleton. The caudal septum is exposed and superior bilateral mucoperichondrial flaps are elevated with an extension underneath the ULC, taking care not to tear the flaps (Figure 1). Cartilage is harvested from the CS, LLC or the ear. If no caudal septal pathology co-exists, cartilage can also be obtained by a posterior "Killian" incision, thus preserving tip support. A caudal and dorsal cartilage strut of at least 10–15 mm in width prevents columellar retraction, loss of tip projection or sagging of the dorsum (Figure 2).

Figure 1. Superior view on cartilaginous dorsum. The upper lateral cartilages, septal angle and caudal septum are exposed.

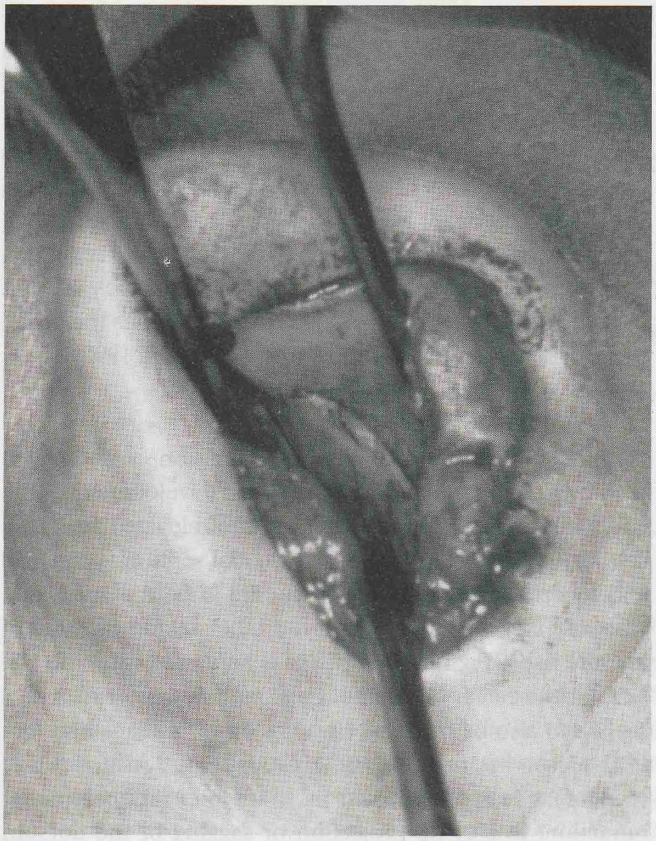


Figure 2. Septal cartilage is harvested, preserving a caudal and dorsal strut.

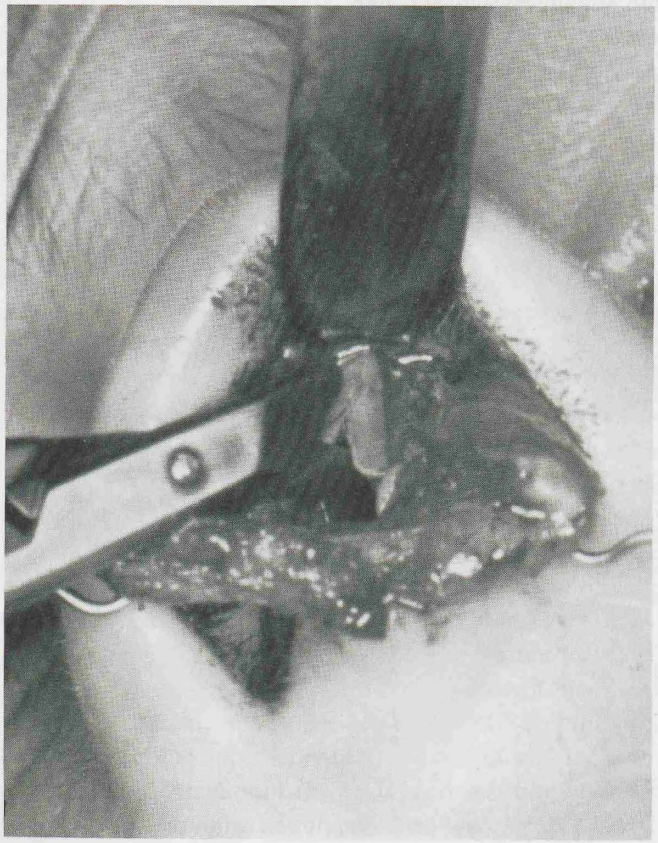


Figure 3. Converse scissors are used to dissect the upper lateral cartilages and the nasal septum.

A stick-shaped graft is carved with an average measurement of 18×1.5×3 mm. Sometimes longer, broader or even double grafts are demanded. A bony graft, derived from the bony nasal septum, may be useful to restore an overly-collapsed bony nasal bridge. Alternatively, the spreader graft can be placed so as the cephalic portion extends into the bony pyramid and supports a collapsing nasal bone. The caudal end of the ULC are identified and preserved. The ULC are sharply dissected from the dorsal edge of the CS (Figure 3). The length of the grafts is measured, designed and inserted between the dorsal edge of the CS and the medial border of the ULC (Figures 4A-B). A 5×0 vicryl suture with a P-3 cutting needle is used to fix three layers at the desired position parallel to the septum with a mattress-suture technique (Figures 5A-B). Dorsal refinement finishes the procedure. All other rhinoplasty manoeuvres can be executed at the same time.

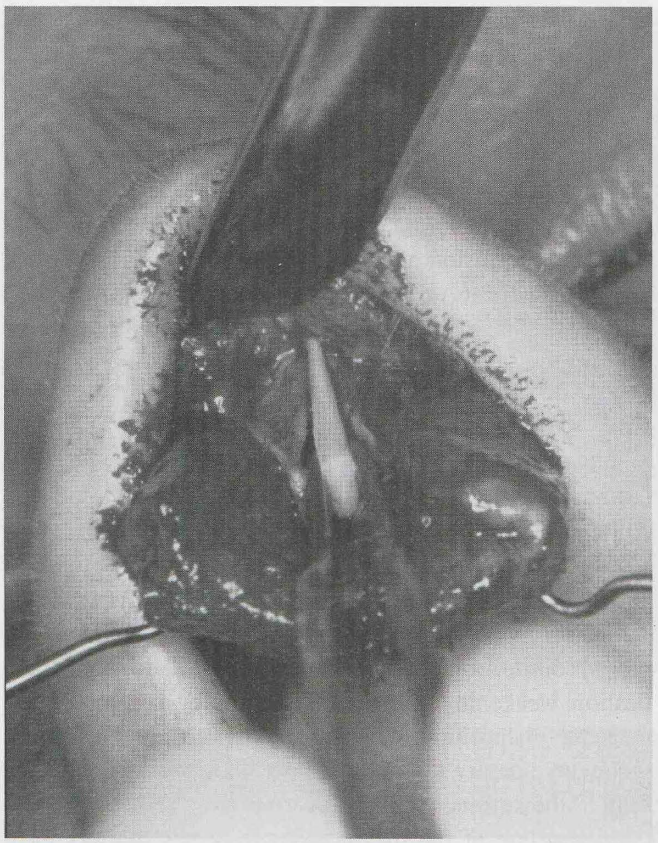
MATERIAL AND METHODS

We retrospectively reviewed 130 consecutive rhinoplasty patients and selected 32 patients with NVI, all of them operated on by the senior author (TDZ) between 1989 and 1992. The patients were admitted for surgery after routine head-and-neck examination, nasal endoscopy and photography, video-documentation of the NVA, standard rhinoplasty photography and assessment of nasal mucosal pathology as seen in allergic or non-allergic rhinitis. Selection criterion was a persistent, severe nasal obstruction due to a nasal valve collapse which interfered with daily activities, even after nasal decongestion with a vasoconstrictor. Patients with caudal septal deviations or rhinitis were excluded from the study. The assessment sheet was studied to determine pre-operative complaints and objective findings related to the middle third and the NVA. The worksheet was studied to determine the aesthetic and reconstructive techniques used. The main criteria used to evaluate the result included: (1) patient's satisfaction; (2) post-operative appraisal by the surgeon and an independent researcher; and (3) comparison of pre- and post-operative photographs and video-documentation.

RESULTS

Thirty-two patients with an average age of 40 years (range: 18-65 years) suffering from NVI underwent surgery for the middle third pathology. There were 20 males and 12 females. The Cottle sign was positive in all cases. In addition, introduction of a ring curette at the apex of the NVA, which pushes the caudal end of the ULC in superlateral direction, provided subjective improvement of nasal patency. History revealed previous nasal surgery in 66% of the patients (Table 1). The pre-operative symptoms are listed in Table 2. The external approach was used to expose the cartilaginous skeleton. Donor material was harvested from the CS in 75%, conchal ear cartilage in 19%, and from LLC in 6%.

Thirty-two patients with NVI but without caudal septal deviations were augmented with spreader grafts (62%) or



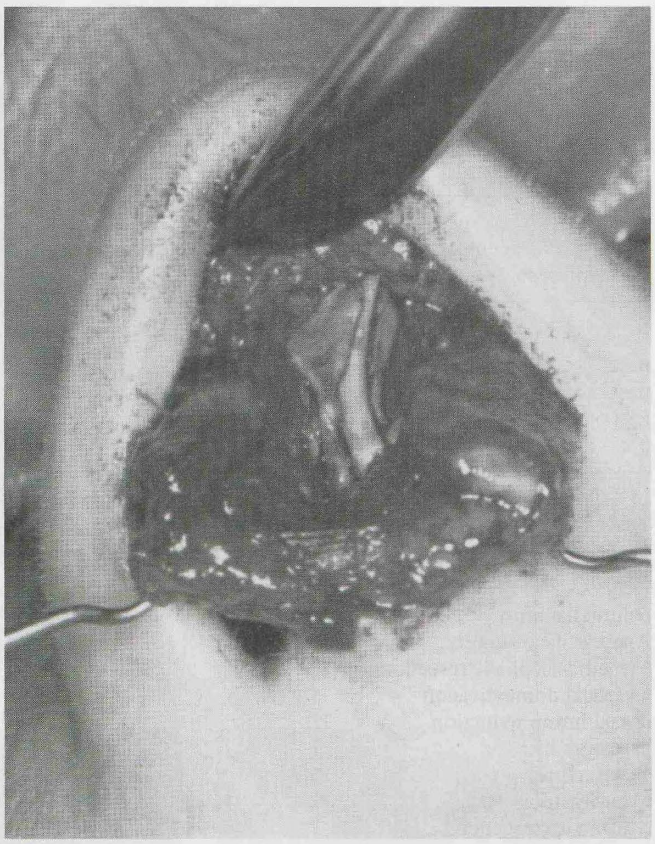
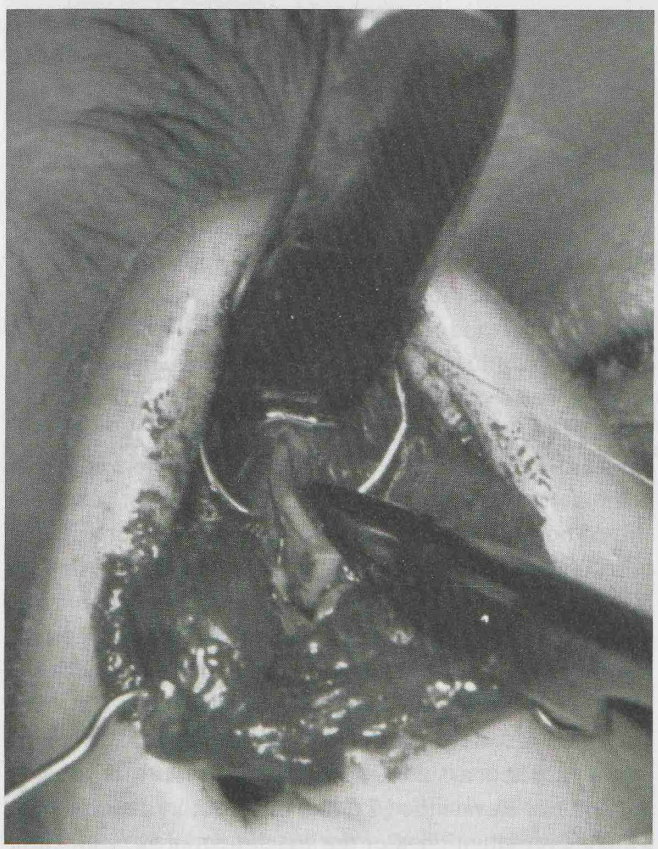


Figure 4A–B. Spreader graft is placed between the dorsal edge of the septum and medial border of the upper lateral cartilages.



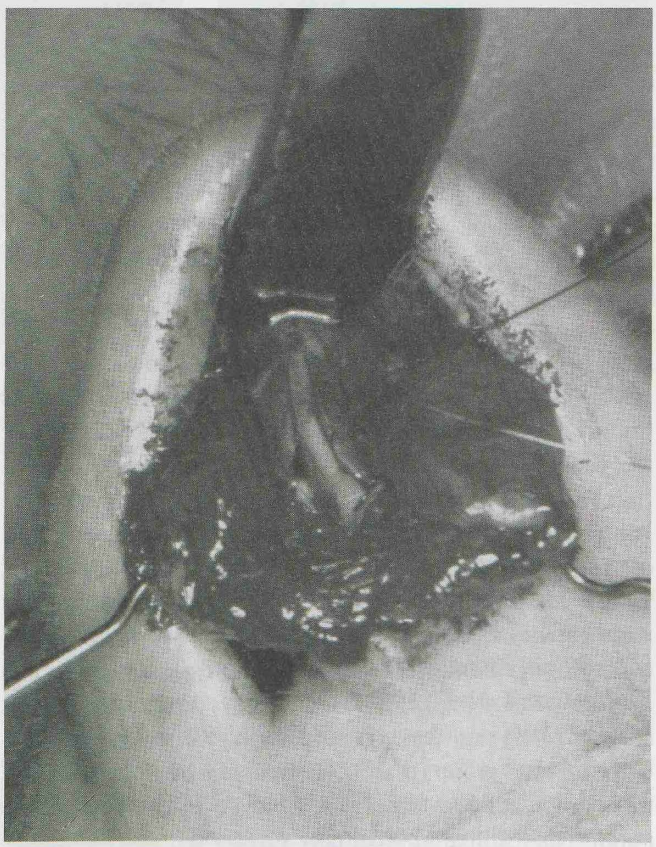


Figure 5A–B. The graft is meticulously sutured in place, taken care to avoid dorsal irregularities.

Table 1. Previous surgery (n=21; 66%).

	n	%
nasal septum	17	81
turbinate	7	33
rhinoplasty	6	28

Table 2. Pre-operative (N1) and post-operative (N2) symptomatology, and resolution (%) of symptoms (n=27).

	N1	N2	%
nasal obstruction	27	14	48
nasal aesthetics	11	2	82
loss of smell/taste	9	3	66
pharyngitis	10	5	50

Table 3. Adjuvant procedures (n=32).

	n	%
columellar strut	23	71
Alar cartilage surgery:	17	53
* (medio-)cephalic resection	12	37
* vertical dome division	5	16
dorsal hump reduction	12	37
osteotomies:	7	21
* in-fracture	6	19
* out-fracture	1	3
* turbinate resection	3	9

Table 4. Nasal obstruction (n=27).

	n	%
improvement	22	81
unchanged	4	15
worsened	1	3
* free of symptoms	13	48

columellar struts (23%) to retain tip projection. Others had tip surgery (17%) consisting of either (medio-)cephalic resections and/or vertical dome divisions and resuturing to obtain tip rotation (12%) or tip refinement (5%). In Table 3 the adjuvant procedures performed are listed.

After an average follow-up of 18 months (range: 5-36 months) 27 patients were evaluated after completion of a self-administered questionnaire. An overall subjective improvement of nasal patency was seen in more than 88% of the patients. In four patients (10.8%) no changes occurred. In one patient nasal breathing was worse after surgery. Almost 50% of the patients appeared to be completely free of symptoms (Table 4). On a success rating scale of 1-10 (1: bad; 5: reasonable; 10: perfect) an average improvement in nasal patency of 4.1 was noted. Pre-operatively, there was an average judgement of 2.3 (range: 1-5). Post-operatively, the average was 6.4 (range: 1-10). Subjective results in primary surgery (n=9) and revision surgery (n=18) were compared with the total group (n=27). The most favourable improvement on nasal breathing was achieved in the first group (88%). The result after secondary surgery scored 77% improvement. An overall improvement was seen in 81.4%.

The overall aesthetic result was appreciated by all patients but three. Only 23% of the patients were aware of the columellar scar. In two cases a single-sided minor irregularity was noted, due to overriding skin edges. No columellar scar revision was required. Other complications related to the open approach were not seen. A septal haematoma was aspirated by needle drainage. Graft resorption or displacement and protrusion of permanent suture material were not seen. In Figures 6A-H a case is presented, with a schematic operation plan depicted in lateral and anterior-posterior direction.

DISCUSSION

Small alterations in the vicinity of the NVA after surgery or trauma may have immediate and disproportionate effects. Although the effect of cosmetic rhinoplasty on nasal patency can be minimized by meticulous surgery and profound knowledge of nasal anatomy and physiology (Berry, 1981; Adamson 1990), nasal surgery sometimes results in tip ptosis, counter-rotation, saddling of the nasal dorsum, scarification, weakening of the nasal skeleton by excision of cartilage, or malposition of different parts of the nose. Before secondary surgery the nasal history should be "read" carefully in the correct sequence in order to establish complete understanding of the dysfunction. Only few authors have reported on the possible values of lateral augmentation of the nose with spreader grafts in selected cases as a method of prevention or reconstruction for NVI (Sheen, 1984; Johnson and Toriumi, 1990; Adamson, 1991). No previous study has evaluated the use of spreader grafts. Lateral augmentation is studied most purely in those patients with NVI based on congenital, developmental and age-related factors, after excluding those with septal deviations and turbinate hypertrophy. This study was designed to determine the effect of spreader grafts on clinical symptoms related to impaired nasal breathing, nasal cosmesis and activities of daily living within this patient selection.

Standarized pre- or post-operative evaluation of nasal patency is difficult, because the present methods of measuring still fail to provide reproducible results. The physiology of the nose is influenced by many rapidly changing factors, such as nasal cycle, allergen exposition, environmental factors, mucosal inflammation, and stress. The available nasal airway evaluation techniques, e.g computerized rhinomanometry, have been improved during the last years, but still do not solve the above-mentioned problem of variation of parameters. Acoustic rhinometry for assessement of the NVA is a promising new technique, but the equipment is not yet commercially available. A relatively simple home office method is the "Adamson nasal patency test": The patient is asked to describe the patency of each nostril, based on a scale of 0 (no patency at all) to 10 (perfect patency). Then a small probe or ring curette is used to sequentially elevate the LLC and the ULC, i.e. to attempt to simulate the situation after the attachment of an onlay cartilage graft to strenghten the collapsing LLC, or a spreader

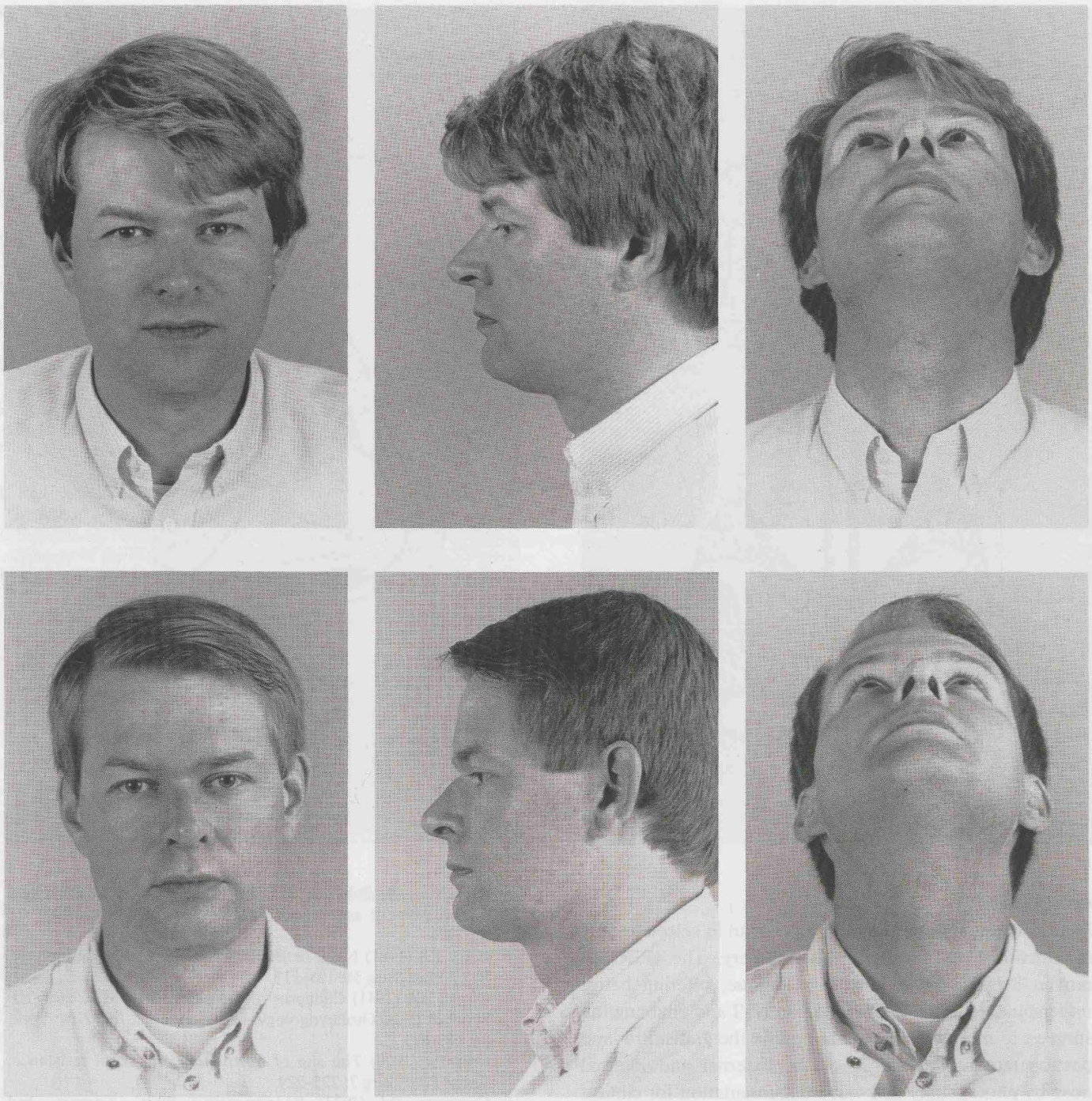
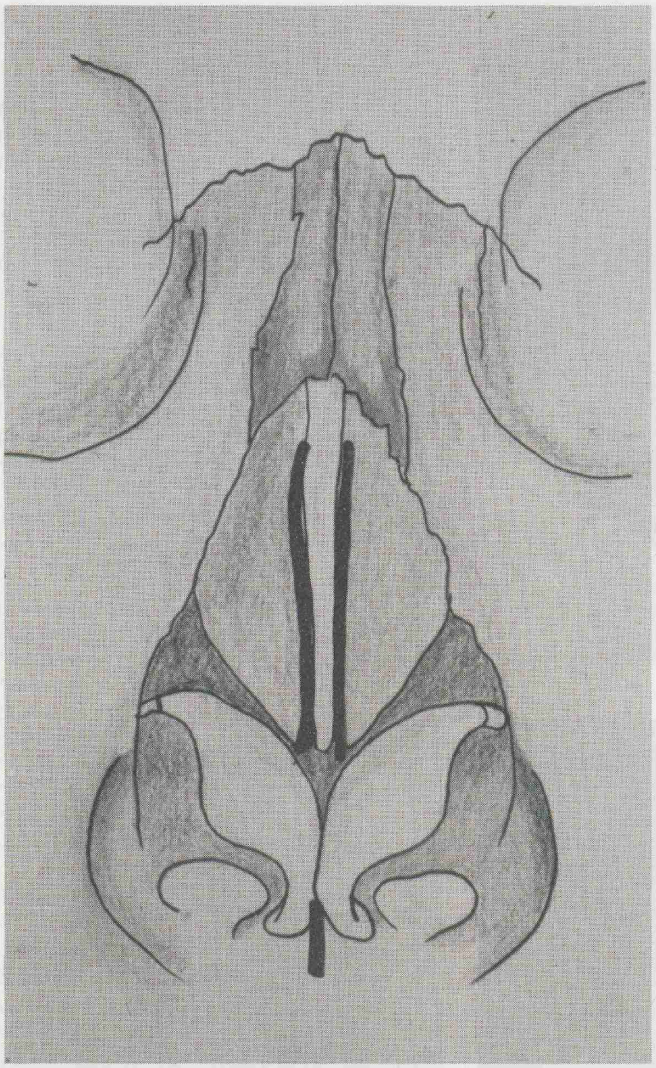


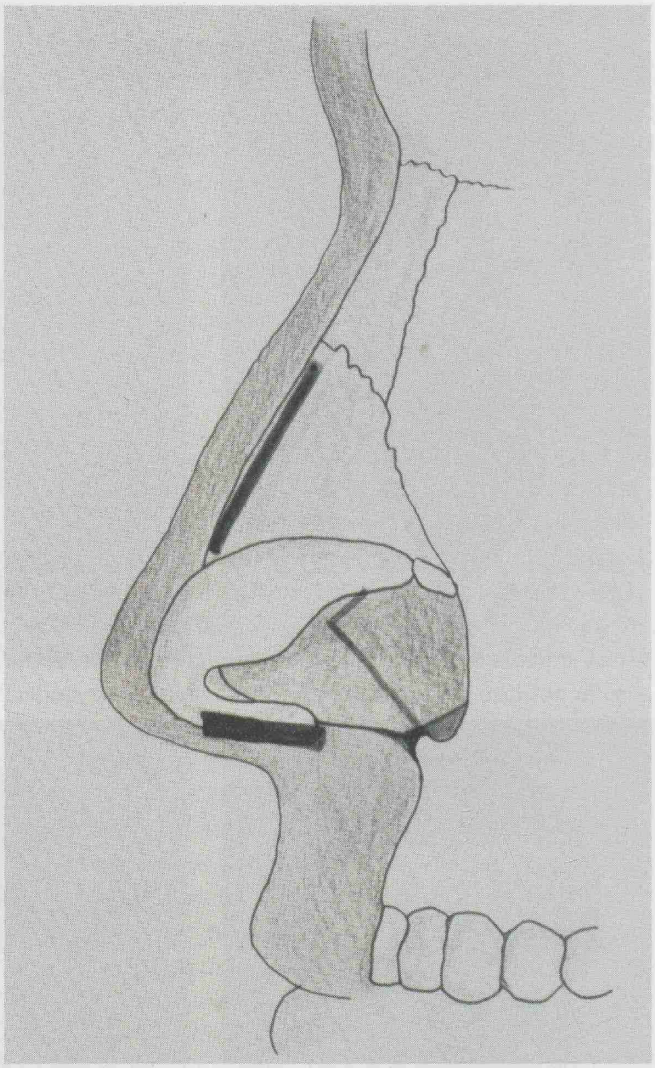
Figure 6A–H. Thirty-four-year old male with impaired nasal breathing due to a bilateral nasal valve insufficiency, caused by a collapse of the middle third of the nose, short nasal bones, thin weak upper lateral cartilages. An open approach was used to insert bilateral spreader grafts and a columellar strut derived from the nasal septum. Note the broadening of the middle third of the nose. (A–C: pre-operative frontal, lateral and basal views; D–F: one-year result; G–H: surgical plan).

graft to strengthen a collapsing ULC. The patient is asked again to describe their nasal patency using a number. This is repeated after surgery.

In this study nine patients without previous surgery or trauma were included in the study. In all but one subjective improvement of an average of 4.8, varying from 1–9 (on a scale of 1–10) was seen. Those patients with nasal surgery (18%) and/or nasal trauma (3%) had acceptable results as well.

The technique of choice for reconstruction depends on the surgeon's personal preferences and experience. The open approach in septorhinoplasty (OSR) has brought new perspective to the surgical treatment of NVI. The OSR enables the surgeon to intraoperatively assess the cause of the obstruction, as it relates to existing anatomical pathology (Goodman, 1978, 1981; Wright and Kridel, 1981; Anderson et al., 1982; Adamson, 1987; Mayer and Fleming, 1988; Zijlker and Vuyk, 1990). The extramucosal access to the NV is facilitated with the OSR, minimizing further tissue damage. The ability to secure the grafts with sutures is an added benefit to OSR.





CONCLUSION

Lateral augmentation of the nose is useful in selected cases in functional and aesthetic nasal surgery. The OSR has proven itself to be a reliable technique, offering better understanding of pathophysiology in NVI and enabling the surgeon to more precisely place and fix the grafts. Pre- and post-operative visualization of the external and internal nose by photography and video-documentation for clinical and medico-legal reasons is mandatory.

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