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Experiences with the bridge-flap technique for the repair of large nasal septal perforations*

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SUMMARY

After a review of the literature a modified surgical method called "bilateral bridge-flap technique" for the closure of nasoseptal perforations is outlined. After an extensive elevation of mucoperichondrium and mucoperiosteum from the entire septum as well as from the nasal roof and the nasal floor bipedicle advancement flaps are created: on one side above the perforation by a longitudinal incision along the nasal roof, and on the opposite side below the perforation by a longitudinal incision along the lateral wall of the lower nasal meatus. In very large perforations it may be necessary to create two bridge flaps on each side, one below and the other one above the perforation. After bilateral closure of the mucosal defects the cartilaginous defect is entirely filled with an autogenous cartilage graft taken either from remainders of the septum or from the auricle or rib. Until now this method has been applied in 54 patients with nasoseptal perforations measuring between 0.3×0.5 cm and 2×5 cm. Forty-eight patients had a follow-up of more than six months; in 45 (93.75%) of these cases the procedure was successful. In the other six patients closure of the perforation could also be obtained, but they were excluded from the evaluation of the overall success rate because of their short follow-up. The essential characteristics illustrating this technique's reliability are: (1) the principally bilateral closure of the mucosal defects; and (2) the additional reconstruction of the cartilaginous septal defect with an autogenous cartilage graft only.

Key words: septal perforations, septel surgery, bilateral bridge flaps

INTRODUCTION

The surgical closure of large perforations of the nasal septum is one of the most difficult tasks in rhinosurgery, and most otorhinolaryngologists agree that in patients presenting a perforation without symptoms a surgical repair never should be attempted, because in case of a failure the post-operative situation of the patient may be worse than his situation before. However, many patients do have complaints like crust formation, whistling, and repeated haemorrhage and in these cases it is necessary to face this surgical challenge. Since Seiffert's first methodological proposals in 1936 – the unilateral bridge flap, the unilateral rotation flap and the pedicled flap from the lower turbinate – a large amount of ingenious techniques have evolved for surgical closure of nasal septal perforations, which roughly can be classified into seven categories:

1. *Uni- or bilateral rotation or transposition flaps* have been most widely used in multiple modifications by many authors (McGivern, 1940; Behrman, 1946; Berson, 1948; Cottle, 1961; Zaoli, 1964; Denecke and Meyer, 1967; Gollom, 1968; Meuser, 1968; Skolnik et al., 1969; Van Landeghem, 1971; Koburg, 1973; Osterwald, 1973; Seda, 1977; Converse, 1977; Rettinger et al., 1986). Unfortunately, these flaps can be applied in small and median perforations only and have a rather high tendency to develop suture dehiscences post-operatively, even when done bilaterally.

2. *Free fascia grafts* (Gerhardt, 1968; Skevas and Gosepath, 1975; Levine, 1980), *skin grafts* (Cottle, 1958), and *skin-cartilage composite grafts* (Walter, 1969; Kratz, 1973; Heermann, 1974; McCollough, 1976) are known to have a high failure rate even in small perforations. Post-operative results have been greatly improved by combining the free grafts with a unilateral rotation flap or bipedicle advance-

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ment flap (McCollough, 1976; Cottle, 1958; Fairbanks, 1970).

3. The *inferior turbinate flap* after Seiffert (1936) was favoured by Masing et al. (1980). Skolnik (1969) combined it with an opposite-sided transposition flap. We experienced this method as a difficult two- or even three-staged technique with rather poor long-term results and would not recommend it anymore.

4. The *oral vestibular flap,* which has been described by three different authors almost at the same time (Akyildiz, 1969; Dirlewanger and Meyer, 1969; Jeschek, 1969), also has the disadvantage of a two- or more-staged procedure. Hertig and Meyer (1969) modified this flap to a three-step method, in which a spoon-shaped distant flap from the oral vestibule with a piece of cartilage attached is first inserted into the septal perforation and than severed from its pedicle after the cartilage fragment, which is covered with mucous membrane on both sides, has grown into the septum. Nagel (1971) and Tardy (1977) took up Meyer's method recommending it for the closure of large perforations, especially. In our experience this procedure is a relatively reliable way to an effective perforation closure, but it is time-consuming, inconvenient for the patient, and not without risk for the symmetry of the upper lip and the nostrils.

5. Several authors have apparently been able to treat nasoseptal perforations successfully with *plastic obturators* from Supramide (Link, 1951), Nylon (Meyer, 1964), Acrylic (Papangelou, 1969), and Silastic (Kern et al., 1977; Pallanch et al., 1982; Brain, 1980). We have seen three patients (1 female, 2 males) wearing Silastic obturators (3–12 months) inserted elsewhere. All three patients continued to complain about difficult breathing and crusting and showed considerable mucosal lesions at the rim of the perforation. Kridel and co-workers (1986) stated that Silastic buttons not only stop whistles and control bleeding, but also produce increased mucus, crusting and obstruction.

6. Seeley (1949) used *extensive mucoperichondrial elevation with mucosal advancement* successfully in one case, in another patient he combined the mucosal advancement with a reduction rhinoplasty. The latter technique was also recommended by Johnson (1968). The idea of extensive mucosal advancement also became the basic principle of the modified techniques of Denecke and Meyer (1967) and Meyer and Berghaus (1983).

7. The *bridge flap* after Seiffert (1936) was modified by Climo (1956) who in one patient with a large perforation applied a bilateral bridge flap achieving subtotal closure. Fairbanks (1970) presented another modification of the bridge-flap concept: with unilateral or bilateral bipedicle advancement flaps in combination with a fascial or pericranial autograft interposition he obtained a success rate of 95% (Fairbanks, 1980; 19 closures out of 20 patients). Apparently, other authors have been less successful with Fairbanks' method and, therefore, regard it as not reliable enough (Rettinger et al., 1986). Kratz (1973) used a similar technique (unilateral bipedicle advancement and a composite postauricular graft) in three patients successfully. Karlan et al. (1982) chose a gingivolabial approach and obtained successful closure by means of bilateral bipedicle advancement flaps and cartilage graft interposition in one patient, and in two others by means of a unilateral bridge flap in combination with a rotation flap on the opposite side. Kridel et al. (1986) reported a series of 22 cases of septal perforations up to 4 cm, operated on according to the method of Fairbanks utilizing an external septorhinoplasty approach with a success rate of 77%. In 1985 Younger and Blokmanis reviewed 90 nasal perforations operated on by local otolaryngologists; 27 *(sic!)* different surgical techniques were used, none of them being utilized significantly more frequently than others. The overall success rate was 46% and 47% in small and medium perforations, respectively, but only 25% in large perforations. The best results were obtained with bilateral flaps with autogenous interposing temporalis fascia, cartilage or bone (80% closures).

SURGICAL METHOD

On basis of the literature review and our own clinical experiences we expected the best results with modified bilateral bipedicle advancement flaps in combination with an autogenous cartilage graft. The basic principles of our bridge-flap technique have been outlined in detail elsewhere (Schultz-Coulon, 1989), but will be briefly summarized at this place (Figure 1). From a hemitransfixion incision the mucoperichondrium is elevated from the entire cartilaginous and bony septum on both sides; if the septum does not contain cartilage and/or bone anymore, the mucoperichondrial sheets of the septum are entirely separated. Additionally, on one side the mucoperiosteum is elevated from the floor of the nose and from the lateral wall of the lower nasal meatus over the entire length of the nasal cavity, and on the opposite side the mucoperiosteum is elevated from the nasal roof. Bridge flaps are then created on each side: on one side below the perforation at the nasal floor by a longitudinal incision along the lateral wall of the lower nasal meatus, and on the other side above the perforation by a longitudinal incision along the nasal roof. These bridge flaps are then drawn over the perforation like curtains and sutured with adsorbable material.

In more ventrally located perforations (i.e. near the nasal roof) the bilateral closure of the mucosa may be obtained more easily by utilizing bridge flaps from the nasal floor on both sides only (Figure 2). In very large perforations it may happen that the closure can not be achieved by only one bridge flap on either side. In these cases it is necessary and possible, to create two more bridge flaps at the opposite nasal floor and nasal roof, respectively (Figure 3A). If the ventro-caudal rim of a large perforation approaches the

A B

Figure 1. Bilateral bridge-flap technique, schematically. A: bipedicle advancement flaps are created on both sides; B: mucosal perforations have been closed and the cartilaginous defect has been filled with an autogenous cartilage graft.

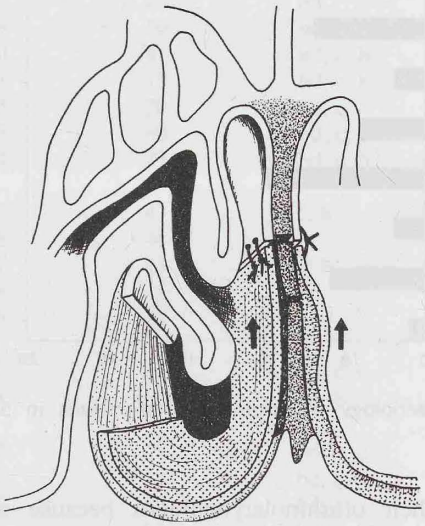

Figure 2. Bilateral bridge-flap technique, modified: bipedicle flaps have been advanced from the nasal floor only.

A B

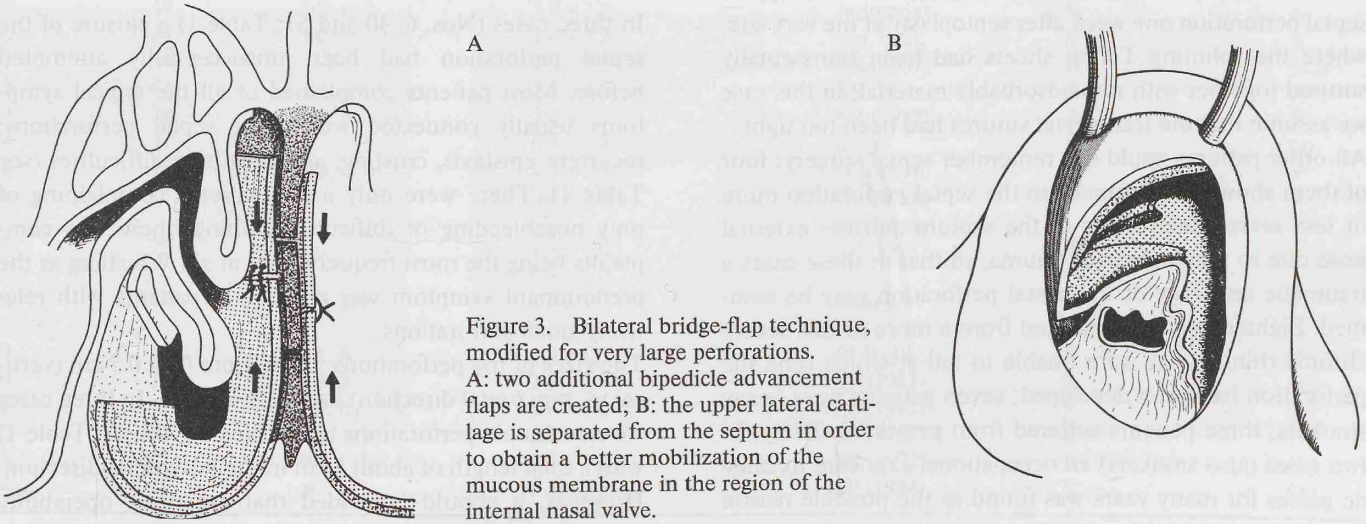

Figure 3. Bilateral bridge-flap technique, modified for very large perforations. A: two additional bipedicle advancement flaps are created; B: the upper lateral cartilage is separated from the septum in order to obtain a better mobilization of the mucous membrane in the region of the internal nasal valve.

internal nasal valve region, it may be additionally necessary to mobilize the upper lateral cartilages together with the attached mucous membrane. After an intercartilaginous incision on both sides the covering tissue is undermined and then the upper lateral cartilages are separated from the septum without cutting the mucosa (Figure 3B). However, if in cases with a post-operative septal perforation there is no intact septal cartilage left between the flaps, then opposing bipedicle flaps at the nasal roof should never be used, because otherwise a new perforation near the nasal dorsum may be created.

After the bilateral closure of the mucosal defects is completed the cartilaginous defect is filled with an autogenous cartilage graft taken either from the cartilaginous remainders of the posterior septum or, if septal cartilage is not available anymore, from the auricle or from the rib. Mucoperichondrial sheets and cartilage graft are adapted with fibrin glue; the reconstructed anterior septum is additonally splinted with Teflon sheets on each side, and the procedure is finished with bilateral package of the nasal cavity for about 3–4 days. The entire procedure is done under the operating microscope. After removal of the packages the nose is rinsed with physiological saline solution thrice a day and regularly treated with a soft fatty ointment.

RESULTS

Within the last five years we have applied the above-described technique in 54 patients, their ages ranging from 12 to 68 years. Age and sex distribution (Figure 4) show a remarkable predominance of male patients (40:14) with an age peak in the fifth decade.

The ætiology of septal perforations was most probably iatrogenic in 31 cases (Figure 5): in 30 patients the medical history revealed previous septal surgery *alio loco,* which according to intra-operative findings obviously had been performed according to the method of Killian (submucosal septal resection) in 22 cases, and after the method of Cottle (septoplasty) in seven cases; in two out of these 30 patients a septorhinoplasty had been done before. One patient was seen in our hospital (case No. 25; Table 1), who developed a septal perforation one week after septoplasty at the very site, where the splinting Teflon sheets had been transseptally sutured together with non-adsorbable material; in this case we assume that the transseptal sutures had been too tight.

All other patients could not remember septal surgery: four of them showed additionally to the septal perforation more or less severe deformities of the septum and the external nose due to previous nasal trauma, so that in these cases a traumatic aetiology of the septal perforation may be assumed. Eighteen patients suffered from a more or less severe chronic rhinitis, but were unable to tell at which time the perforation had been developed; seven patients were heavy smokers; three patients suffered from perennial allergy. In two cases (also smokers) an occupational exposure to caustic gasses for many years was found as the possible reason for the chronic rhinitis; six other patients reported repeated

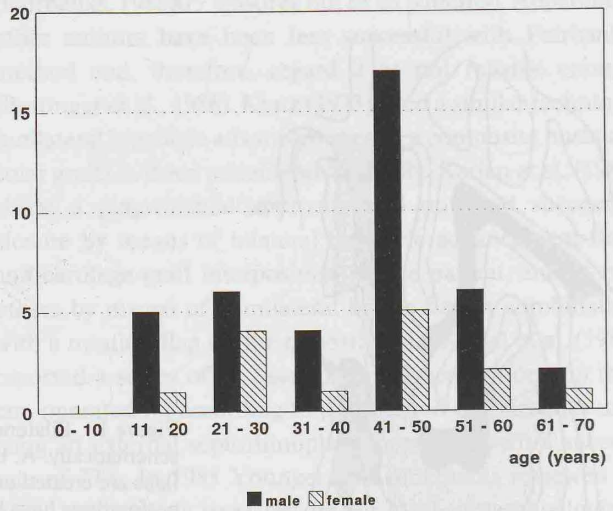

Figure 4. Age and sex distribution of 54 patients with a nasoseptal perforation.

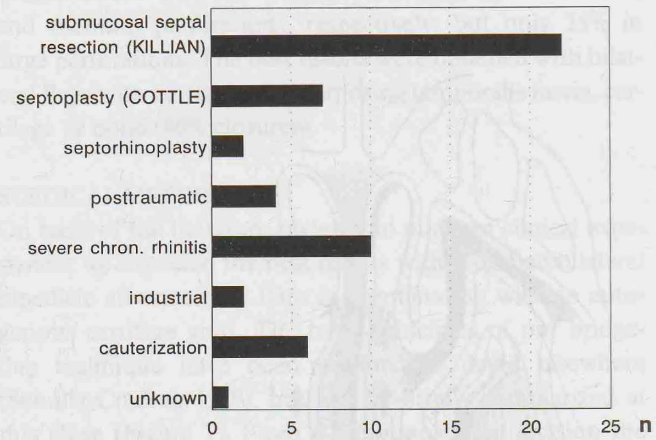

Figure 5. Probable aetiology of nasoseptal perforations in 54 cases.

cauterization by their otorhinolaryngologist because of recurrent epistaxis and thought that cauterization would have caused the perforation. There was one patient (case No. 38; non-smoker) without any pathological findings in his medical history or on admission.

In three cases (Nos. 6, 40 and 51; Table 1) a closure of the septal perforation had been unsuccessfully attempted before. Most patients complained of all the typical symptoms usually connected with large septal perforations: recurrent epistaxis, crusting, and breathing difficulties (see Table 1). There were only a few patients complaining of only nosebleeding or difficult breathing, these two complaints being the most frequent ones at all. Whistling as the predominant symptom was noted in 5 patients with relatively small perforations.

The sizes of the perforations varied from 0.3×0.5 cm (vertical vs. horizontal direction) up to 2.8×3.4 cm. In three cases we saw double perforations (cases Nos. 17, 29, 47; Table 1) with a total length of about 5 cm in the horizontal direction. However, it should be added that regarding operability these measurements have to be seen first in relation to the

Table 1. Clinical data of 54 patients with a nasoseptal perforation (abbreviations: bd: breathing difficulties; c: crusting; b: epistaxis; w: whistling; SR: submucosal septal resection after Killian; SP: septoplasty after Cottle; al. rh.: allergic rhinitis; chron. rh.: chronic rhinitis; rep. caut.: repeated cauterization; traum.: traumatic; A: cartilage graft from the auricle; S: cartilage graft from the septum; R: cartilage graft from the rib; r.p.: re-perforation). Cases Nos. 49–54 have been excluded from the statistical evaluation of the overall success rate, because of a follow-up period of less than six months.

No.	age	complaints	size of perforation (cm)	aetiology	cartilage graft	success
1	45	bd; c; b; w	0.5 × 0.5	SR (1987)	A	+
2	52	bd; c	2 × 2	SR (1954)	S	+
3	32	bd; b	1 × 1	SR (1976)	S	+
4	12	bd	1 × 1.5	traum.	A	+
5	31	bd; c	1 × 1.5	chron. rh.	S	+
6	23	bd; b	1.8 × 2.2	chron. rh.	S	+
7	44	bd; c; b	1.2 × 1.8	chron. rh.	S	+
8	21	bd; c; b	1.5 × 1.5	chron. rh. industrial	S	+
9	47	bd; b	1.2 × 1.2	SR (1976)	A	+
10	49	bd	0.9 × 0.9	al. rh.	S	+
11	37	bd; c	2.2 × 2.0	SR (?)	S	+
12	29	bd; b	2.5 × 3.2	SR (1979)	S	+
13	24	w	1.0 × 0.8	SR (1982)	S	+
14	23	bd; c	2.8 × 3.4	SR (1988)	A	+
15	50	bd; c; w	0.8 × 1.1	SR (1966)	S	+
16	43	bd; c	1.7 × 2.2	SR (1972)	S	+
17	62	bd; c; b	1.9 × 3.2 0.5 × 1.1	SR (1955)	S	+
18	25	bd	1.5 × 1	chron. rh.	A	+
19	50	bd; c; b	1 × 1	chron. rh.	S	+
20	41	bd; c; b	1 × 1.5	SR (?)	A	+
21	18	bd; c; b	1.6 × 1.8	chron. rh.	S	+
22	20	bd; c	1.2 × 1.3	SP chron. rh.	R	r.p.
23	60	bd; c; b	1.2 × 1.2	SR (1967)	A	+
24	27	bd; c; b	1 × 1.5	chron. rh. rep. caut.	S	r.p.
25	43	c; b	1 × 1	SP (1988)	A	+
26	44	b	1 × 1	SR (1988)	S	+
27	43	c; b	1.5 × 1.6	traum.	S	+
28	46	bd	1.8 × 2.0	traum.	S	+
29	44	c	1.8 × 1.5 1.2 × 1.5	RhP (1982, 1985, 1988)	R	+
30	14	bd; c; b	1.5 × 1.5	chron. rh.	S	+
31	68	bd; b	1.1 × 1.2	chron. rh. rep. caut.	S	+
32	59	bd; c; b	2.9 × 3.2	SR (?)	A	+
33	48	bd; c; b	1.5 × 1.6	SR (1967)	A	+
34	63	bd; c	1.1 × 1.3	SR (1954)	S	+
35	52	bd; c; b	2.6–3 × 2	al. rh.	R	+
36	54	bd; b	1.5 × 1.5	al. rh. rep. caut.	S	+
37	43	bd	2.8 × 3.3	SR (?)	A	+
38	59	bd; b	1.6 × 1.8	?	S	+
39	49	bd; c; b	2.0 × 3.2	industrial	S	+
40	34	bd; b	1.0 × 1.2	rep. caut.	S	+
41	54	c; b	1.5 × 1.5	SR (1967)	A	+
42	51	bd; c	1.5 × 3.5	SR (?)	A	+
43	28	bd; b	2.0 × 1.5	SR (1982)	A	+
44	31	w	0.7 × 0.7	al.rh.	S	r.p.
45	18	bd; c; b	1.5 × 1.6	chron. rh.	S	+
46	15	b	0.5 × 1.0	chron. rh. rep. caut.	S	+
47	28	bd	1.5 × 2.0 0.5 × 1.0	SP (1991)	R	+
48	44	bd; c; b	1.6 × 1.7	traum.	S	+
49	41	bd; b	1.5 × 1.5	RhP (1972)	R	(+)
50	30	bd; b	2.0 × 3.5	SP (1982)	R	(+)
51	43	bd; b	2.0 × 2.0	SP (1991)	R	(+)
52	44	bd; c; b	2.0 × 3.0	SP (1968)	R	(+)
53	48	bd; c; b	2.5 × 3.5	SR (1972)	R	(+)
54	41	w	0.3 × 0.5	SP (1984)	S	(+)

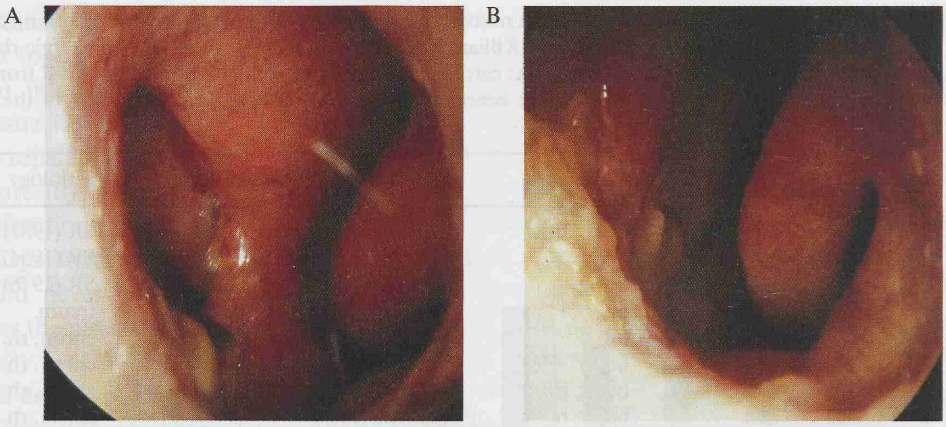

Figure 6. Nasoseptal perforation of 1.5 cm in a 13-year-old boy. A: pre-operative endoscopical view from the left side; B: post-operative result.

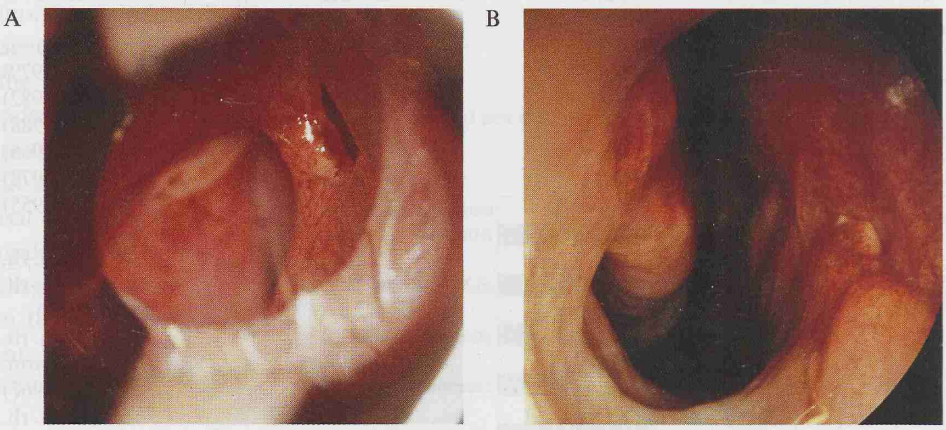

Figure 7. Nasoseptal double perforation (5 cm) in an adult male patient (53 years). A: pre-operative endoscopical view from the left side; B: post-operative result, endoscopical view from the right side.

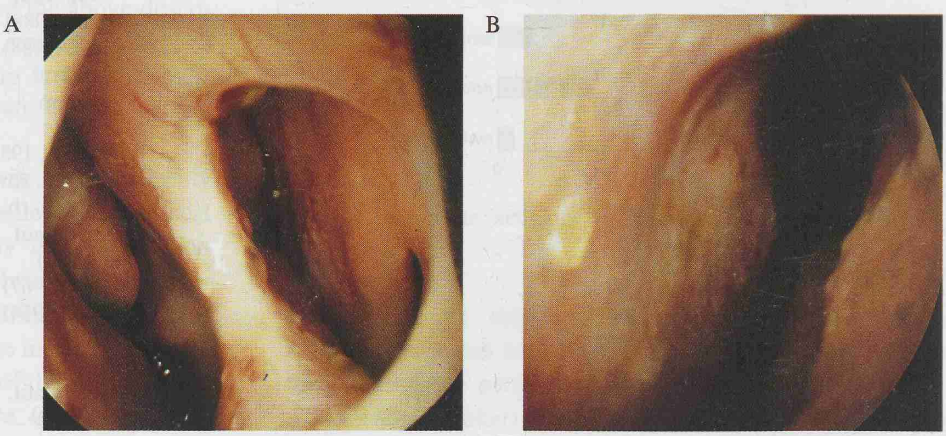

Figure 8. Large nasoseptal perforation (2.5 cm) in a 33-year-old female patient. A: pre-operative endoscopical view from the right side; B: post-operative result (from the right side).

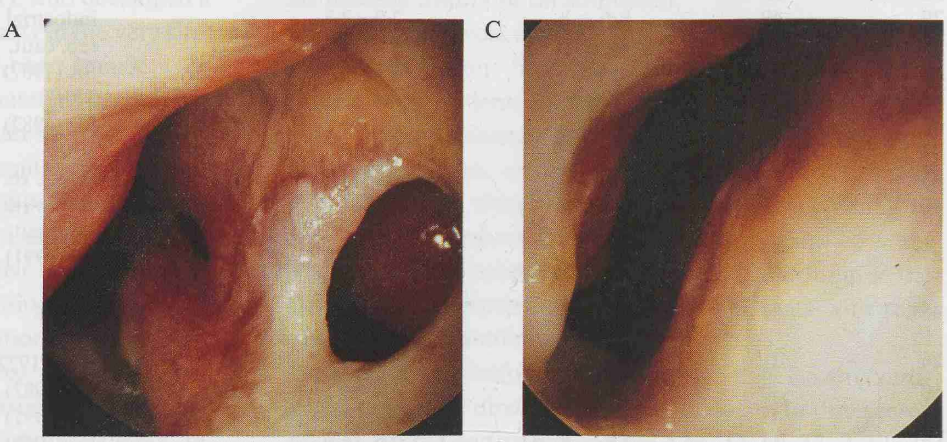

Figure 9. Iatrogenic nasoseptal double perforation with severe saddle nose in a 36-year-old female patient. A: endoscopical view from the right side; C: post-operative endoscopical view from the right side.

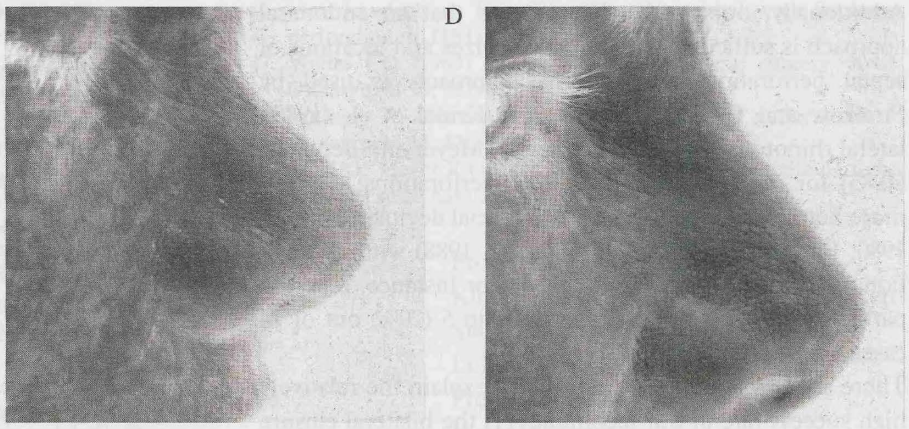

Figure 9. (continued) B: saddle nose after two rhinoplasties *alio loco;* D: post-operative result after implantation of an autogenous rib cartilage graft.

size of the nose, and secondly on the basis of the individual medical history. For instance, the closure of a 15-mm perforation in a 13-year-old boy (Figure 6) with still a relatively small nose is much more difficult than that of a huge double perforation (Figure 7), measuring about 5 cm in the anterior-posterior and 2 cm in the vertical direction, in an adult patient with a large nose offering enough mucous membrane in the nasal cavities for sufficient bilateral bipedicle advancement flaps. Another example: the 2.5-cm perforation of unknown origin in a young female (Figure 8), not operated on her normally sized nose before, is to be managed easier than the double perforation in a severe iatrogenic saddle nose in a 44-year-old female patient (Figure 9), who had had one septoplasty and two rhinoplasties before, performed by three different surgeons. In this case the closure of the two septal perforations had to be combined with an augmentation of the nasal dorsum by implantations of an autogenous rib cartilage graft as well as with refilling almost the entire septum with rib cartilage.

The follow-up period from the operation to the last rhinological examination varied from 2 months to almost 6 years. In the cases Nos. 49–54 the follow-up period has been less than 6 months up to now. Therefore, these cases were not considered for the subsequent evaluation of the overall success rate, in spite of the fact that in all 6 cases a closure of the septal perforation could be obtained until now. In 45 (93.75%) of those 48 patients being followed for longer than 6 months the procedure was successful.

Three patients (cases Nos. 22, 24 and 44) developed a re-perforation in spite of an intra-operatively complete bilateral closure. In two of these cases extremely nervous behaviour of the patient during the post-operative phase is regarded as the most probable reason for the failure: both patients did not tolerate their nasal package, and removed it by themselves on the first post-operative day, already blowing and manipulating their noses all day. In one of them – a 20-year-old woman (case No. 22) – we attempted the closure in a second operation, but were again not successful. The other patient (case No. 24) has refused a second operation until now. The third patient (case No. 44) showed a completely normal post-operative course; when she was discharged from the hospital one week after the operation, her septal perforation appeared to be well-closed on both sides, but eight weeks later she had developed a very small (0.1×0.1 cm) re-perforation. It may be worth noting that all three failure cases suffered from chronic rhinitis, but did not know the actual reason of the septal perforation.

Regarding post-operative complications, we saw bleeding in 2 cases on the 6th and 8th post-operative day, respectively. In both cases a re-package of the nose was required; in spite of these measurements the perforations healed well. No further complications were seen in the whole series.

Healing time varied remarkably between 4 to 12 weeks, apparently dependent upon the individual condition of the nasal mucosa. In cases with a rather normal mucosal aspect the time interval until complete healing lasted about 4–5 weeks only, but patients with symptoms of a chronic rhinitis showed prolonged healing times up to 12 weeks. Several patients developed on one side, or even both sides, a mucosal dehiscence 8-10 days post-operatively, but then showed secondary healing over the surface of the interposed cartilage graft.

DISCUSSION

Until now the main problem of the surgical repair of nasal septal perforations – especially of large ones – has been the high failure rate. As mentioned before, Yonger and Blokmanis (1985) reported an average failure rate of around 75% in cases with large perforations.

Our results (a success rate of 93.75% after a follow-up period of more than 6 months up to 6 years) are comparable with those of Fairbanks (1980; success rate: 95%), but it has to be taken into consideration that in the latter study 18 of 20 patients showed perforations smaller than 3 cm in one direction and only two patients with a 3-cm perforation. Our series of 54 patients contain 12 cases with perforations equal to or greater than 3 cm (up to 5 cm) in one direction. Our experiences show that the modified bridge-flap technique with an cartilage graft is able to close even large septal perforations up to 5 cm, although it should be stressed that not the absolute but only the relative size of a septal perforation determines operability.

Additionally, our results demonstrate that an endonasal approach is sufficient for all operable sizes and locations of septal perforations. An external approach as used by Strelzow and Goodman (1978) and Kridel et al. (1986), lateral rhinotomy as recommended by Meyer and Berghaus (1983) for difficult cases with large perforations, or even more heroic techniques such as mid-facial degloving (Brain, 1980; Karlan et al., 1982; Romo et al., 1988) with all additional hazards – Romo et al. (1988), for instance, reported partial stenosis of the nasal vestibule in 5 (20%) out of 24 cases – are apparently not necessary.

There are two issues that in our view explain the relatively high success rate of our technique: (1) the bilateral closure of the mucoperichondrial perforation with wide, well-nourished "bridge"-flaps allowing the closure of the mucoperichondrial sheets without tension; and (2) refilling the cartilaginous defect with autogenous cartilage is certainly a *conditio sine qua non,* because in case of a post-operative dehiscence the mucous membrane can heal spontaneously over an autogenous graft only. As mentioned earlier we observed several patients showing secondary healing and development of a post-operative mucosal dehiscence, which slowly healed over the surface of the cartilage graft. Without the interposed cartilage all these patients would have developed a re-perforation most probably, and our failure rate would have been considerably higher.

In summary, bilateral mucosal closure and the exclusive use of autogenous cartilage for the reconstruction of the cartilaginous septum are the essential characteristics of this technique. In spite of the disadvantage that the procedure is relatively time-consuming – on average one needs 2–3 h – we think that the remarkable reliability of this technique justifies its further application.

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