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It is the impression of the authors that, although the overall frequency of septal perforations has decreased, the proportion of large defects has increased. Therefore, in addition to the methods for surgical treatment of small perforations, a particular description is given of a new procedure in which an extramucosal technique is used, which permits closure of even large perforations in a single session. Very large defects of more than about 2 cm in diameter can be closed most reliably with a three-step procedure using a pedicled flap from the oral vestibule.

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CLOSURE OF PERFORATIONS OF THE SEPTUM INCLUDING A SINGLE-SESSION METHOD FOR LARGE DEFECTS

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In the past few decades, the frequency of septal perforations has declined. This is probably related to the fact that one of the main causes of such defects, submucosal septum resection according to Killian,^{1,2} is becoming more and more infrequent. However, the condition has not been eliminated by the abandonment of this operative technique alone, because there are, of course, other mechanisms by which perforations of the septum occur. These will be mentioned briefly below. In addition, we refer to the excellent survey of this topic by Horst Ganz.¹

CAUSES OF SEPTAL PERFORATION

1. Congenital defects of the septum are extraordinarily rare according to studies by Ballenger and Peer (cited in reference 1).
2. Traumatically induced perforations of the septum are the most common and can be further subdivided as follows:

- (a) Facial macrotraumas that involve the septum, and undetected hematoma of the septum can lead to septal perforations. Septal microtraumas include nose picking, dry air, heat, and dust.²
- (b) Iatrogenic septum defects result from caustic agents and cauterization as well as from radiological and surgical tumor therapy. This category includes not only the above-mentioned submucosal septum resection according to Killian, which has been studied in more detail by Frey and Weinaug (cited in reference 1), but also every other improperly executed septal rhinoplasty. Finally, other therapeutic instruments, such as transnasal tubes and probes, can cause a perforation of the nasal septum.
- (c) Occupational causes, among which anorganic or toxic substances must be counted, are also microtraumatically active. They cause damage primarily to the cartilaginous part of the nasal septum, which is covered with a mucous membrane. Chrome can be mentioned as an example of the numerous substances which must be considered in this connection.

3. The third large group of causes of septal perforations is infection, wherein it is possible to differentiate between acute and chronic types.

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(a) Among the acute infections, perforation of the septum was most commonly caused in former times by scarlet fever (as a result of gangrene), followed by diphtheria, and, in rarer instances, typhus. More common now is the "banal" abscess of the septum, which, in principle, can occur as a result of any manipulation of the septum.

(b) Among the chronic infections, the so-called rhinitis sicca anterior (ulcus septi perforans) must be given particular mention. Heat, dry air, dust and other primarily physical agents of damage are seen as its causes.² Lues III leads to a connatal or inherited perforation, most commonly in the bony part of the nasal septum. It must be noted here that the saddle nose, which is a typical and well-known connatal phenomenon associated with lues, does not ordinarily appear until the third year of life. In contrast to the situation in lues, the bony septum is generally not affected in tuberculosis, which appears especially as a mucosal lupus of the nose.¹ Still to be mentioned is leprosy, which, especially in the lepromatous form, leads to a final stage similar to ozena.

4. Metabolic disorders, such as diabetes mellitus, for instance, are rare causes of perforations of the septum.
5. Tumors also frequently lead to such defects. The therapeutic measures applied in case of a "bleeding polyp" in Kiesselbach's area can easily lead to perforation.

SYMPTOMS OF SEPTAL PERFORATION

The indication for closure of such defects depends on the symptoms that trouble the patients. The holes in the rear bony part of the septum can usually remain untreated because they do not cause any inconvenience. On the other hand, symptoms worth mentioning as typical for perforations of the forward cartilaginous part of the septum are: itching; scab formation with impairment of breathing; putrid fetor and dryness of the nose; and recurrent epistaxis. Whistling noises can occur during breathing and even lead to difficulty in falling asleep; however, they occur only in defects that are located well forward, are very small, or have been reduced in size by scab formation.¹ Occasionally a septum perforation is bothersome because it is visible, especially, of course, when it leads to a deformity of the columella.

Of the symptoms mentioned as indications for surgery, particular emphasis should be placed on intense scab formation, recurrent bleeding, whistling noises, and deformity of the nose. Of course, a fresh traumatic perforation requires immediate treatment.

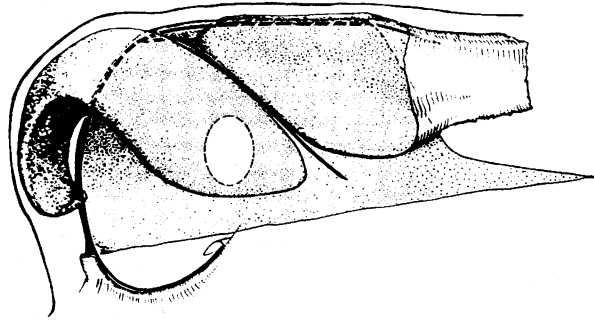
TREATMENT METHODS

Basically, the following choices of treatment are available.

1. Conservative therapy. Such treatment, which consists of the application of salves, etc., is indicated when an operation is contraindicated or refused by the patient.
2. Closure with obturators. This method, first proposed by Meyer and, independently, by Link in 1951, and later on by Papangelou (1969) and Von Dishoeck (1975), in which a button consisting of two plastic discs glued together in the middle is inserted into the defect, has been abandoned by us at the present time in favor of surgical procedures.³⁻⁶
3. Surgical enlargement of the defect. Although Ganz¹ lists some indications for this procedure, we see this measure at best as a last resort in case of a whistling defect, especially in a case in which the patient refuses a surgical closure. In this regard, it must be pointed out that surgical enlargement of the defect can give rise to new complaints, such as subsequent spontaneous increase in the size of the perforation, bleeding and fetor. As a matter of principle, we regard this method with extreme reservation.
4. Surgical closure of the perforation. In cases with the above-mentioned clinical symptoms, a total closure of the septal perforation will always be the goal to be strived for, and the surgical procedure chosen will be partly determined by the size of the defect.

SURGICAL TECHNIQUES

The extramucosal technique that we have been using routinely for years in all rhinoplasties⁷ is thereby so extraordinarily helpful that the procedure we used in previous years, in which local flaps were used for closure of small and medium sized perforations, is made superfluous in routine cases. This method, which we abandoned about five years ago, consisted in principle of mucoperichondrial flaps, one of which was cut from the area above the perforation, and one from the opposite side in the area below the perforation, and which were then pushed into place covering the



A



B

Figure 1. (A) Type of incision used for small perforations (B).

hole. Good reviews of such techniques can be found in Ganz¹ and Masing.²

In contrast, we now close small, medium sized, and even large perforations of the septum using variations of the extramucosal technique designed to fit the individual situation.

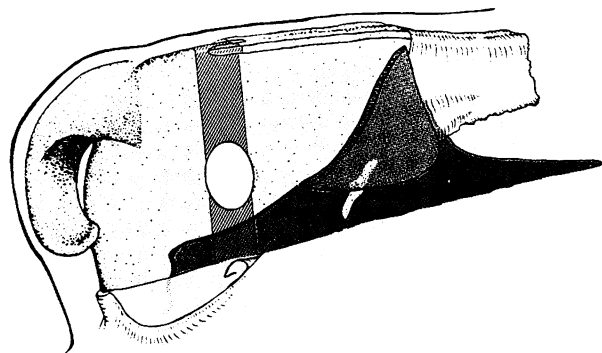
Small Defects. In closing small defects, it is sufficient to mobilize a large area of the mucoperichondrium coupled with the use of adaptation sutures free of tension. To make this possible, the transfixion incision is first extended downward running parallel to the lower edge of the apertura piriformis along the floor of the nose to the meatus nasi inferior and then upward somewhat under the concha inferior on the lateral nasal wall. On the other hand, an extension of the incision upward and dorsal leads beneath the roof of the nose to the lower edge of the upper lateral cartilage and then along this to the area of the limen nasi, so that this incision corresponds to the intercartilaginous incision (Fig. 1).

Proceeding from this incision, the mucoperichondrium is separated from the septal cartilage over a large area. Then, the mucoperiosteum of the nasal floor is also detached as far as the lower nasal meatus. Finally, the external skin over the upper lateral cartilage is mobilized. This can now be separated at its base in full length from the cartilaginous septum so that the result of the procedure up to this point is a hose-like structure

consisting of mucoperiosteum and mucoperichondrium with the attached upper lateral cartilage. The perforation located therein has collapsed due to the elimination of tension.

The same principle is followed in the other nasal cavity. To mobilize the mucoperiosteum, an incision can be made along the lower edge of the lateral nasal wall extending deep into the bony cavity, but the anterior ethmoidalis artery must not be damaged. The loosely adjoining edges of the perforations in the mucoperiosteum can then be freshened and, following adaptation, sutured.

To reduce the size of the actual cartilage defect in the lamina quadrangularis, we basically use two different methods, depending on the location and nature of the perforation. If the hole does not lie too far to the rear, below and with its greatest diameter perpendicular to an imaginary line on the floor of the nose, we perform resections of cartilage strips above and below the edges of the perforation parallel to its largest diameter (Fig. 2). As a result of this procedure, the lamina quadrangularis is divided into two parts: the forward part can be fully mobilized and pushed backward and upward against the second part (Fig. 3). This alone effects a decrease in the size of the perforation, which can be further closed by inserting a piece of the resected cartilage. To avoid recession of the columella, the other strip of cartilage can be attached to the forward edge of the septum. If the largest diameter of the perforation is parallel



A



B

Figure 2 (A and B). Strip resection for reducing the size of a small defect.

to an imaginary sagittal line at the floor of the nose, then it is possible, using the same procedure, to remove strips of cartilage in front of and behind the perforation, lengthening the maximum diameter. In this way, an upper septal plate is separated from a lower. The upper plate can be pushed down onto the second half after mobilization at the dorsum of the nose. The perforation, which becomes smaller due to this procedure, can now be closed further by inserting a strip of cartilage. It must be remembered that, in this procedure, it is also necessary to lower the bony framework of the nose.

If the perforation is located lower and farther back (which is more rare) so that the procedure described cannot be used, another method can be helpful for closure of the cartilaginous defect. With this method, after removal of a small strip of cartilage between the lower edge of the perforation and the crista maxillaris or vomer, the lamina quadrangularis and the mucoperichondrium are rotated into or across the defect from both sides (Fig. 4). This requires a rotation of the mucoperichondrium and the triangular cartilage on both sides toward the front and downward, whereby the forward lower edge of the upper lat-

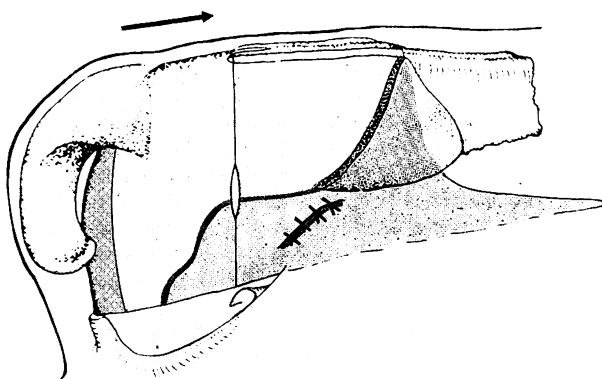


Figure 3. Reduction of the size of the defect by displacement of the septum cartilage and closure of the perforation in the mucoperiosteum.

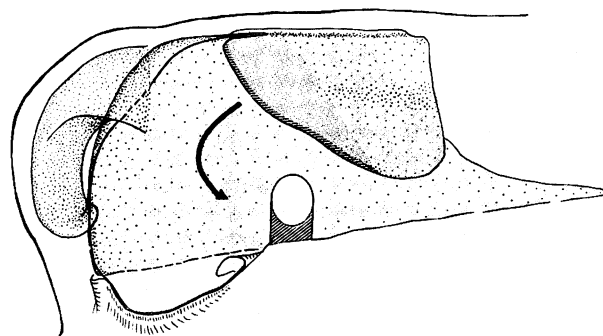


Figure 4. Rotation of the mucoperichondrium.

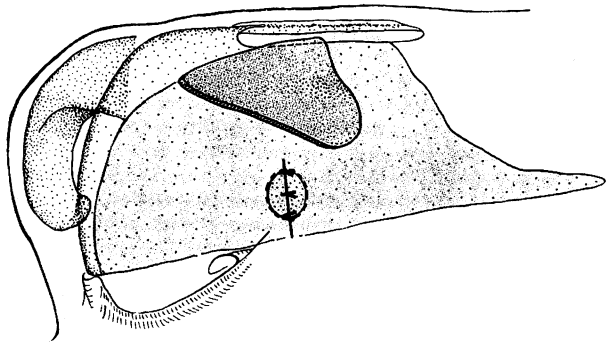


Figure 5. Closure of the perforation; the anterior edge of the upper lateral cartilage is shortened.

eral cartilage now reaches into the nasal cavity and becomes bothersome because it decreases the size of the lumen. Therefore, the upper lateral cartilage should be clearly shortened at the forward edge on both sides (Fig. 5). Thereafter, the mobilized and newly relocated flaps are attached with mattress sutures to the inner lining of the nose and additionally supported by tamponade.

For all the procedures mentioned, the access, especially for suturing, can be eased by separating one or both of the wings of the nose, and possibly the columella as well, from the skin of the lip and cheek and temporarily folding them upward and backward (Fig. 6). At the end of the operation, they can be folded back down and sewn in place. If suturing is done carefully, the results of such auxiliary incisions are usually not visible.

Defects up to 2 cm. The extramucosal technique is especially valuable in the treatment of perforations of up to 2 cm in diameter because it permits their closure in a single session. In contrast to the total number of septal defects, these large perforations have become relatively more common in the past few years. Therefore, it seemed of particular interest to work out a single-session method for closure of such perforations.

To do justice to the unusual extent of such perforations, we begin the operation in this case on one side with an incision, the course of which corresponds to that of the hemitransfixion incision, but starts at a substantially greater distance from the edge of the septum, so far forward that it is located in the skin of the columella, only a few millimeters behind the nasal orifice (Fig. 7). The further course of the incision then corresponds to that already described above, i.e., the incision ex-

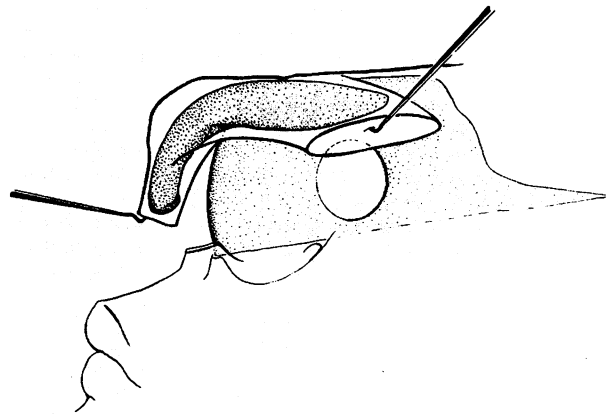


Figure 6. Folding-up of the wings of the nose and columella to facilitate access to the septum.

tends to the rear and upward as an intercartilaginous incision and then downward parallel to the lower edge of the apertura piriformis at the floor of the nose, then extends to the lateral nasal wall. Where the incision passes beneath the dome of the wing, care must be taken to avoid damage to the cartilage.

Beginning at the incision at the edge of the columella, the skin of the lateral columella and the septum membranaceum must be dissected with the utmost care and caution and must not be perforated. For this purpose, we recommend the use of magnifying glasses. When the dissection has reached the forward edge of the septum, the mucoperichondrium of the nasal septum is peeled off, as are the mucoperiosteum of the floor of the nose and bony cavity, along with the external skin over the upper lateral cartilage (Fig. 8). Then the upper lateral cartilage can be separated at its base from the septum, at which point the perforation located in the mucoperichondrium

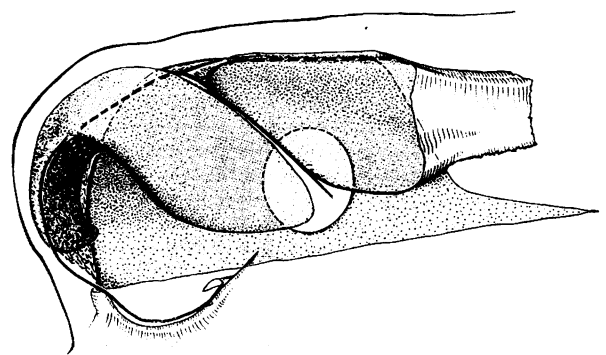


Figure 7. Type of incision used for larger perforations (up to 2 cm).

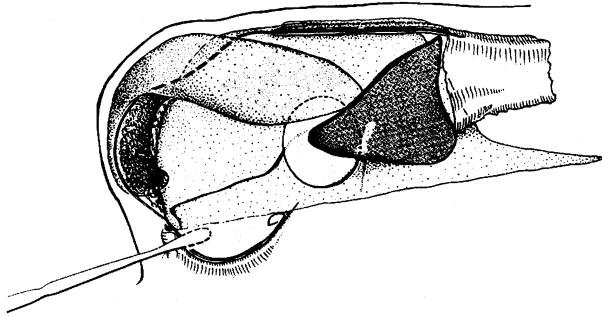


Figure 8. Preparation of the mucoperichondrium. Note the collapse of the perforation of the mucous membrane.

narrows automatically to a slit as the mucous membrane collapses (Fig. 9).

On the other side, the procedure is basically the same, but with the important difference that the vertical course of the incision before the edge of the septum corresponds to that of a hemitransfixion incision (Fig. 10). Care must be taken not to create a defect connecting the two nasal vestibules. On this side too, the edges of the perforation in the mucoperichondrium adapt of themselves after mobilization.

After freshening the edges of the defect in the cartilage, it can be closed by a cartilage transplant (Fig. 11), which can be taken without any danger from, for example, the dorso-caudal part of the septum—easily accessible at this point in the

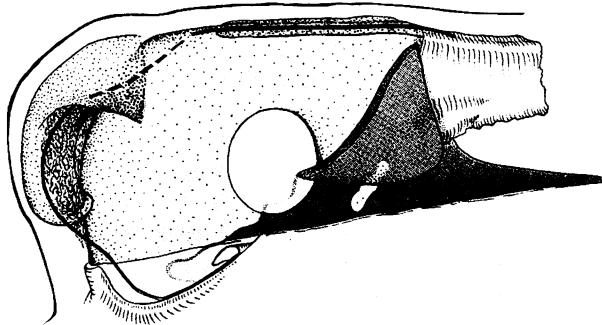


Figure 9. The preparation of the mucoperichondrium is finished.

operation. It is also possible to cut around a segment of cartilage in the area beneath the edge of the perforation and rotate it into the defect.

The edges of the perforation in the mucoperichondrium, which become loosely adapted spontaneously, are freshened and closed with 5-0 sutures. Likewise, the other incisions in the mucoperichondrium and in the skin of the columella and vestibule are sewn with interrupted sutures of 4-0 or 5-0 nylon (Fig. 12). If dorsal displacement of the mucoperichondrium results in too much tension after final suture of the edge of the columella (danger of "hidden columella"), then the loss of skin material can be compensated for by a retroauricular skin transplant. So far, we have not seen any postoperative "hidden columella" in patients who have undergone surgery with this method. We have been using the extended method for three years, and have found nothing more than a single slight recidivous perforation in a total of 16 cases (Fig. 13). We successfully closed this remnant perforation one year later using the same techniques.

Defects Larger than 2 cm. If the diameter of the perforation exceeds 2 cm, so that an attempt at surgical closure is not very promising even with this method, then we must fall back upon another, substantially more complicated method, which was first mentioned in 1969 by Hertig and Meyer⁸ as Meyer's method, and described again by Meyer in 1972.⁹ In 1971, this procedure was



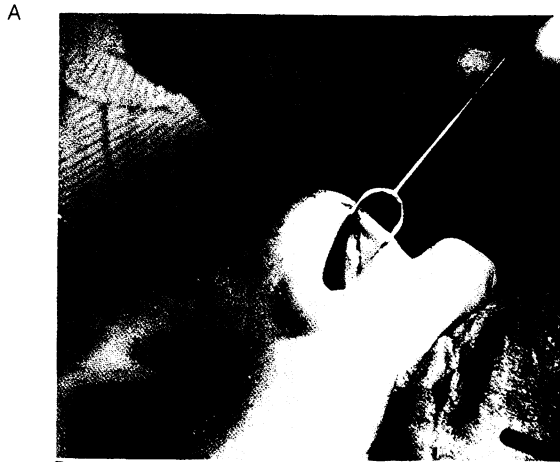
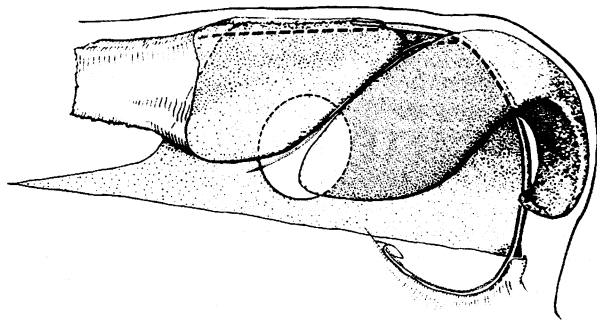


Figure 10 (A and B). Type of incision used on the opposite side.

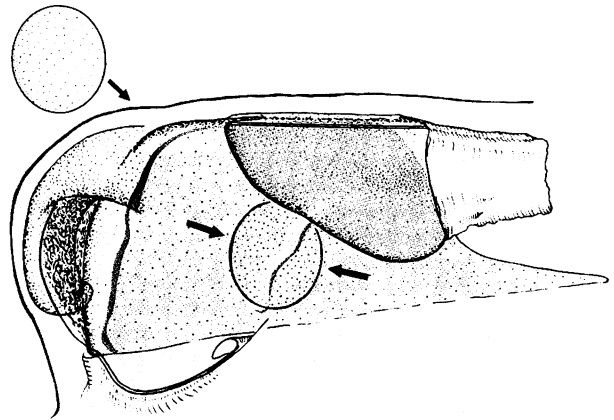
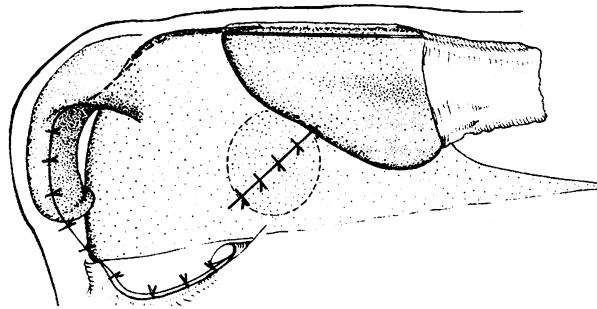


Figure 11. Closure of the cartilage defect by placement of a cartilaginous graft; readaptation of the mucoperichondrium.



A



Figure 12. After suturing, the closure of the perforation is complete.

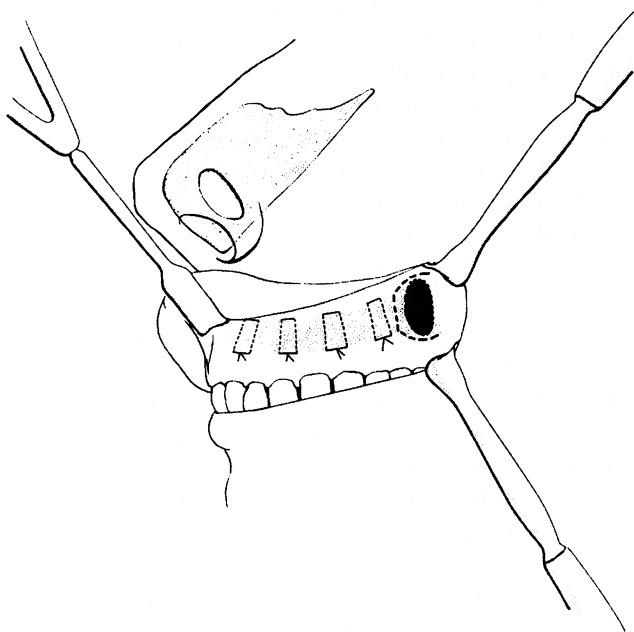


A



B

Figure 13. Septum before (A) and after (B) closure of the perforation.



A



B

Figure 14 (A and B). Oral vestibular flap for very large defects.

also taken up by Nagel¹⁰ and in 1977 by Tardy.¹¹ It is 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 perforation and then severed from its pedicle after the cartilage fragment, which is covered with mucous membrane on both sides, has grown into the septum.

The surgical procedure consists of the following individual steps:

1. Preparation of the distant flap in the mucous membrane of the oral vestibule. The flap, which will later consist of a pedicle and a piece of cartilage covered on both sides with mucous membrane, is begun in the gingivolabial or gingivobuccal fold of the oral vestibule, directly next to the frenulum above the upper row of teeth. The cartilage is taken from the external ear, which does not result in any substantial deformity. It is then sewn into a pouch of submucosal tissue in the oral vestibule (Fig. 14). Next to this, another flap is cut in the mucous membrane. This flap, however, retains a medial pedicle and is folded under the already existing cartilage-mucous-membrane pouch, so that the cartilage is now covered by mucous membrane on both sides. The defect resulting from the removal of this mucous membrane flap is closed with a simple suture. Between the frenulum and the main part of the distant

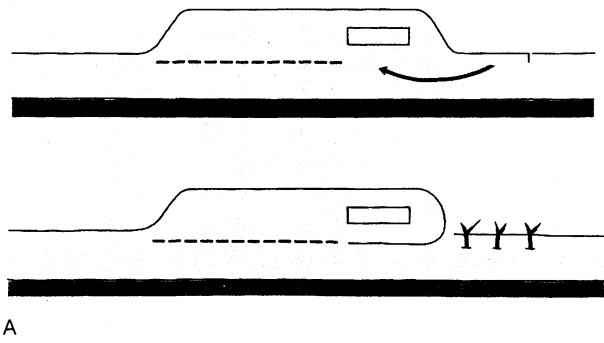


Figure 15. Schematic drawing of the distant flap in cross-section (A) and incision for inclusion of cartilage and for lining the flap (B).

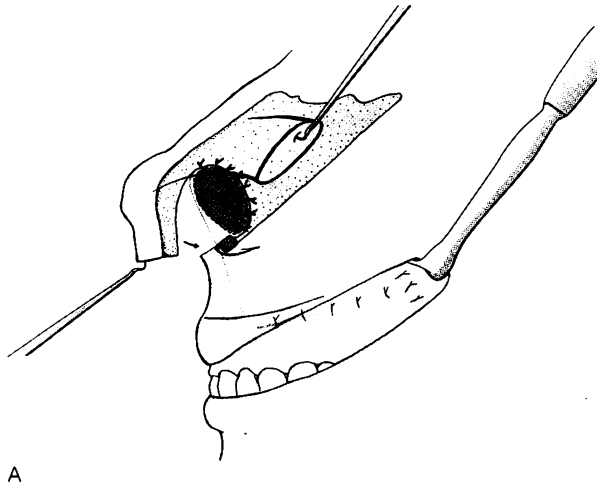


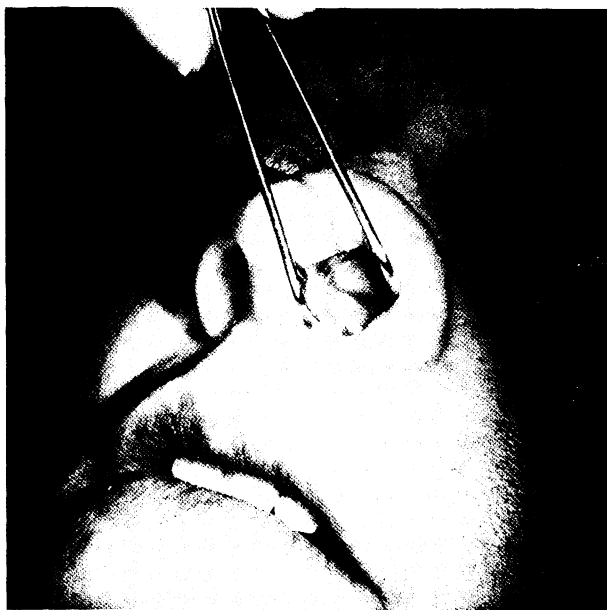
Figure 16. Transfer of the flap into the defect (A and B); suturing brings the detached columella back into place (C).



A



B



C

Figure 17. Septum before (A) and after (B and C) closure of the perforation by oral flap (with detachment of both alar bases).

flap, which is constructed in this manner, the pedicle is prepared by molding a longish horizontal roll of tissue using interrupted incisions and mattress sutures (Fig. 15).

2. After 3 to 5 weeks, during which time the cartilage and the mucous membrane flap grow in, a roughly spoon-shaped flap can be cut and fed into the nasal cavity and to the septum through a tunnel which has been constructed beginning at a point in front of the floor of the nose and next to the spina nasalis anterior. This is the second surgical step. The site of removal is sewn with 4-0 nylon sutures. It is helpful to sever and fold up not only the two

wings of the nose, but also the base of the columella, so that the cartilage fragment covered with mucous membrane on both sides can be sewn into the perforation without any problem. The incision chosen for this purpose extends to the forward lower edge of the perforation, so that the portion of the septum located in front of the defect is raised along with the columella, and the perforation is opened wide. If the mucous membrane on both sides of the flap is now sewn to the local mucous membrane, the columella and the ventral portion of the septum are automatically brought back into their original position (Fig. 16). Thereaf-

ter, the columella is again sutured at the philtrum.

3. This new situation is again left for 3 to 5 weeks. Then the third step can be carried out without the patient's being admitted to the hospital, and the separation of the pedicle can be performed under local anesthetic. At the same time, the normally necessary thinning out of the three-layered graft can be done.

This method, which we have used successfully since its first description, is always our method of choice for very large perforations. Due to the good prospects of success and the substantial postoperative improvement in the situation of the patient, we consider this relatively complicated and time-consuming operation suitable and reasonable in selected cases (Fig. 17).

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