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ORIGINAL ARTICLE

# Closure of nasal septum perforations by bridge flaps

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**KEYWORDS**
Septoplasty;
Septum perforation;
Closure of the nasal septum;
Bridge flap

**Abstract**
*Introduction:* Treating nasal septum perforation is challenging from every point of view for patients who suffer from this condition. This article presents a general overview of this topic and describes an operative technique that very often enables closure of the perforation.
*Materials and methods:* A retrospective and descriptive study was performed on 92 patients who were surgically treated for nasal septum perforation. All patients were treated with the three-layer bridge flap technique for closure of the defect.
*Results:* In 98% of the patients, primary closure of the septum perforation was achieved immediately after removing the silicone sheets. The closure rate 18 months postoperatively was 93.8% (60 of the 64 patients who were examined postoperatively).
*Conclusions:* Success in closure of the septum perforation was greater than 90% with the 3-layer bridge flap technique. This technique can be performed using an endonasal approach and offers fewer complications in experienced hands. The limitation of this procedure is the height of the perforation.


**PALABRAS CLAVE**
Septoplastia;
Perforación septal;
Tabique nasal;
Colgajo en puente

**Cierre de las perforaciones del tabique nasal mediante colgajos «en puente»**

**Resumen**
*Introducción:* El tratamiento de las perforaciones del tabique nasal representa desde todo punto de vista un desafío para el paciente que sufra esta patología. En este artículo se expondrá una visión general del tema y se describirá una técnica quirúrgica, que ofrece con gran frecuencia la oclusión de la perforación.
*Material y método:* Estudio retrospectivo y descriptivo. Se llevó a cabo en 92 pacientes con defectos del tabique nasal. Se describen los detalles del procedimiento quirúrgico, por el que se llevó a cabo el cierre de la perforación del tabique nasal a través del colgajo en puente de 3 capas.

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*Resultados:* En un 98%de los casos hubo un cierre primario del defecto en el momento de retirar las láminas de teflón. La tasa de oclusión a los 18 meses postoperatorios fue de 93,8% (60 de 64 de los pacientes examinados en el postoperatorio).
*Conclusiones:* El cierre quirúrgico de los defectos del tabique nasal con colgajos «en puente» de tres capas obtiene un éxito superior al 90% La técnica es aplicable por vía endonasal y presenta pocas complicaciones en manos expertas. Las limitaciones de este método vienen dadas por la altura del defecto.


## Introduction

Nasal septal perforations represent a challenge in the treatment of patients suffering the consequences of this pathology. The formation of large crusts originating from mucus can frequently be observed, along with nasal obstruction, repeated epistaxis and even wheezing or pain. On the one hand, the surgical sealing of nasal septum defects is considered difficult and with an uncertain outcome. On the other hand, conservative treatments through the local application of different types of ointments and irrigations have a limited effectiveness. Lastly, alloplastic obturators ("septal buttons") are occasionally difficult to place, vary in tolerability and do not usually solve the mucus crust problem. They also cause chronic mechanical irritation that makes the defects larger in size. However, obturators are adapted to the exact lesion dimensions could be an alternative.

The real incidence rate of nasal septum defects is unknown. According to medical literature, 2/3 of cases are iatrogenic, which usually means that they are secondary to septoplasty or septorhinoplasty,[1] and less frequently due to cauterisation of haemorrhages.[2] Perforations with an idiopathic origin are also common. However, nasal trauma and inhalation of harmful substances are not frequent causes in Germany.

Scepticism surrounding surgical sealing is supported by the great variability of success rates obtained, between 30% and 100%, with different surgical techniques. After the Seiffert technique from 1936,[3] more than 40 methods for plastic reconstruction of nasal septum perforations have been published, such as unilateral or bilateral flaps by rotation or advancement, free grafts, inferior turbinate flap, buccal vestibule flap, endonasal advance flaps and frontal flaps, to seal especially large defects.[4]

The proposal of our new surgical technique joins the idea by Seiffert, with his "bridge" transplant,[3] and the idea by Seeley,[5] for bilateral endonasal mobilisation of the mucosa. This technique was developed and published by Schultz-Coulon.[6] The "secret" of the success of this surgical technique compared to other methods is that the reconstruction is always done in 3 layers, keeping the vascularization of the advance flap in mind (Figure 1). The sagittal irrigation of the flap is mainly conserved through branches of the greater palatine artery, especially in the flaps of the lower bridges, somewhat different in vertical rotation flaps.

## Material and method

This is a retrospective descriptive study. It was carried out with 92 patients (64 men and 28 women), between the ages of 22 and 68 (with a mean age of 51 years), who underwent surgery between July 2006 and July 2008 at the ENT department of *St. Elisabeth-Hospital*, *Kliniken der Ruhr Universität Bochum*, Germany. After that, an intermittent postoperative monitoring period of up to 18

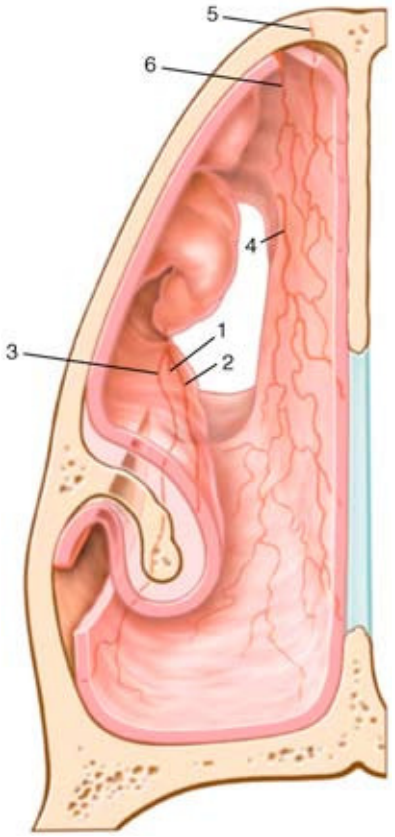


**Figure 1** Scheme of the endonasal mucosa irrigation. Irrigation is respected by the incisions described in the bridge-flap technique. 1: greater palatine artery; 2: alar branch anastomosis and labial artery; 3: posterolateral nasal artery; 4: descending palatine artery; 5: anterior ethmoid artery; 6: posterior ethmoid artery.

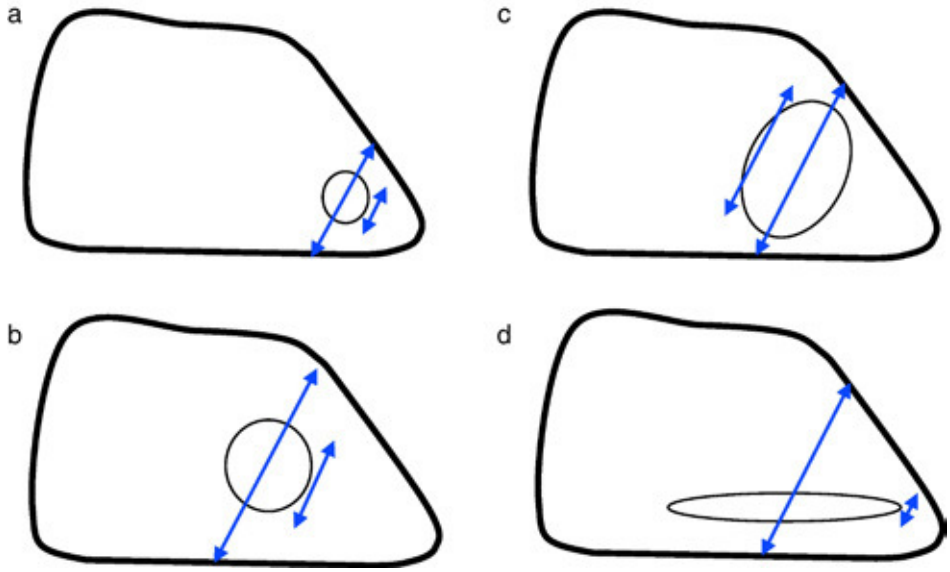


**Figure 2** Images a) and b) show graphs of a nasal septal defect, each with a different location. The condition for closure of the perforation through the bridge-flap technique is that the perforation size in its vertical height does not exceed more than half the height of the septum at the same level; this is because flaps will be mobilised cranially and caudally to the perforation. The possibility of operating (or estimation of the contrary) depends on perforation location and shape. Perforations larger in their sagittal perspective and smaller in their vertical one (c) would be inoperable; (d) would be easier to close, as long as the opposite.

months was maintained. A total of 64 patients attended this control. The remaining patients attended only the first control sessions, so they were not included in our final statistics. The distribution of septal defects was calculated according to their cause: iatrogenic (after septoplasty, septorhinoplasty, electrocautery of the septum, from epistaxis for example), posttraumatic, toxic and idiopathic. The size of the perforations was measured in their vertical and sagittal axes.

## Inclusion criteria

The vertical dimensions of the defect should not exceed half the height of the septum at that level (Figure 2). Patients experiencing problems such as crusts, nasal obstruction, repeated epistaxis, wheezing or pain.

## Exclusion criteria

Size of the perforations exceeding half the height of the nasal septum at that level; uninterrupted use of cocaine or other nasal toxic substances; severe concomitant diseases; Wegener's granulomatosis; practicing contact sports (e.g., boxing).

### Surgical principles

The preoperative examination included anterior rhinoscopy (Figure 3a) and endonasal endoscopy to discard the possibility of other concomitant pathologies. When chronic sinusitis is found it would be recommendable to solve it in a second operation. This surgery requires a standard set of instruments, as in septoplasty. In addition, a neurosurgical scalpel and a very thin needle holder are required for endonasal suture.

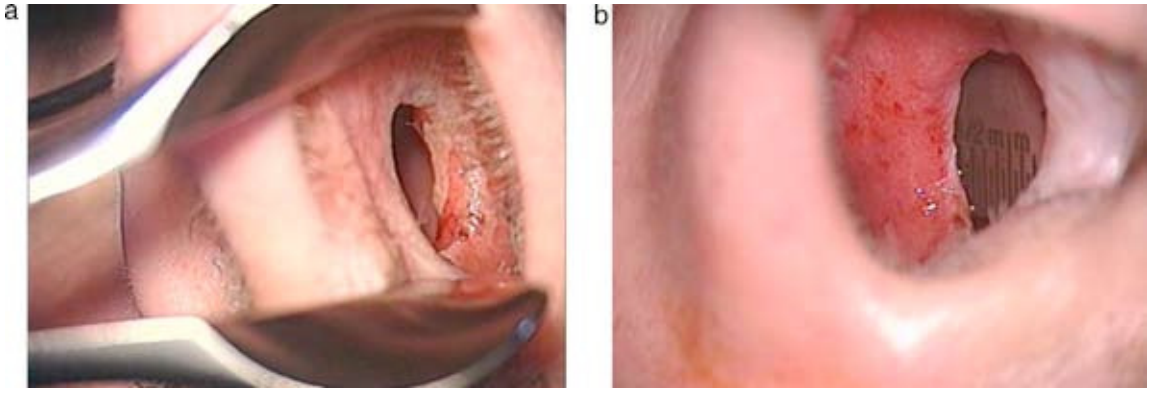


**Figure 3** a) Anterior rhinoscopy showing a nasal septum perforation. b) The defect is measured at the beginning of the operation.

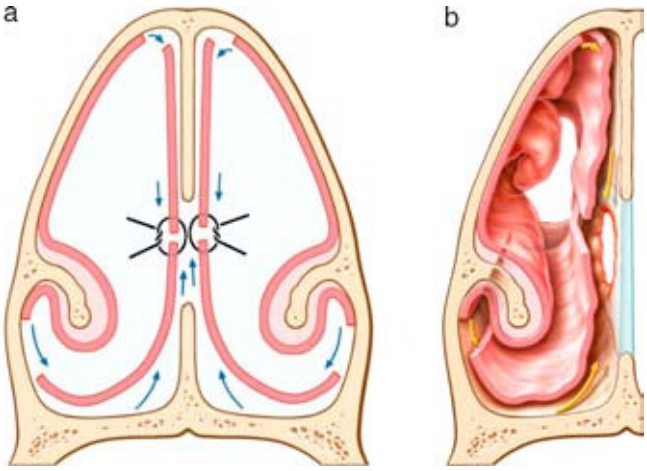


**Figure 4** Start of the bridge-flap technique. a) Cross section. b) 3D diagram.

Surgery is basically performed with a binocular microscope, with intermittent endoscopic control. A thorough nostril inspection is carried out at the beginning of surgery, while measuring the size of the defect (Figure 3b).

Figure 4 shows the mobilisation of the mucosa of the entire nasal septum and mucoperiosteum from the bottom of the nostril to the insertion of the inferior turbinate into the lateral nasal wall, where an incision is made to separate it. Consequently, the bottom bridge flap can be moved medially and upwards. This makes it possible to perform a bilateral suture of the mucosa without tension. The nasal septum defect is basically filled with autologous cartilage. If a larger defect of the nasal septum is present, there will be mobilisation and an additional incision in the nasal dome, so that the upper bridge flap can be moved medially and downwards. The possibility of moving bridge flaps allows us to adapt the mucosa without tension. The lateral area of the nose left uncovered by mucosa will scar without causing any functional problems.

**Surgical procedure details**

1. Hemitransfixion incision and submucosal preparation of the nasal septum ventrally and cranially to the defect.

Mobilisation is carried out ventrally and cranially to the defect up to the edge of the defect in the first incision of the mucosa, but without perforation (Figure 5). After anaesthetic infiltration, the cartilage is dissected through a hemitransfixion incision on the right side, as in Cottle-type septoplasty. A strictly subperichondrial preparation is carried out on both sides, continuing to the ventral part of the defect and ending cranially to it.

## Submucosal preparation of the bottom of the nasal cavity and caudal to the defect

The second step is to dissect the mucoperiosteum from the bottom of the nasal fossa on both sides (Figure 6a). To this end, the soft tissue lateral to the right philtrum is dissected from under the pyriform aperture to the bony part using the hemitransfixion incision. Contact with the bony part must be maintained during this dissection, so as to avoid perforating the mucoperiosteum. Above all, care must be exercised in the caudal part of the pyriform aperture, which often forms a spur at the junction with the bottom of the nostril (Figure 6b). After that, the same procedure is performed on the left side through the hemitransfixion incision.

Dissection is continued towards the vomer, medial and caudal to the mucoperichondrium defect.

The next step is medial dissection, in the direction of the vomer and the mucoperichondrium, caudal to the defect (Figure 7). The difficulty of this step increases if the vomer has been partially resected during previous surgery. During this step, it is a good idea to extract the quadrangular cartilage from the bottom of the nasal septum and to separate the fibres located laterally to the premaxilla with a sharp instrument.

## Opening the mucosa around the perforation

Only after having carried out all of the previous steps to mobilise the surrounding mucoperiosteum is it time to make

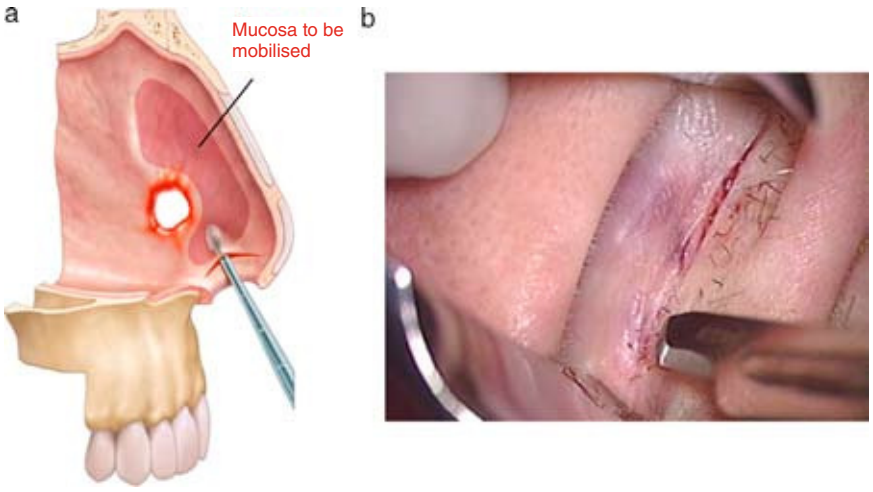


**Figure 5** Mucoperiosteum mobilisation, ventral and cranial to the defect. a) Scheme through the hemitransfixion incision. b) From the outside.

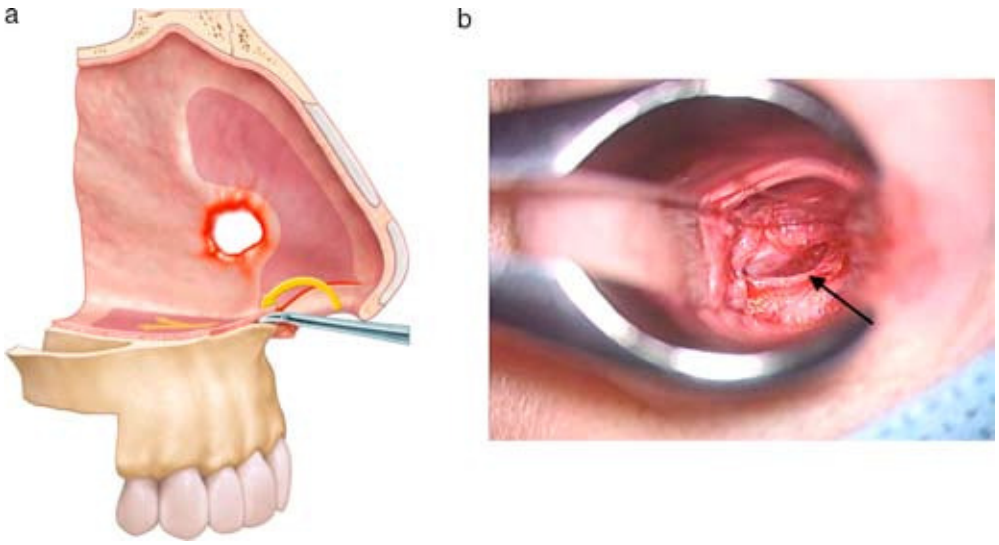


**Figure 6** Mobilisation of mucoperiosteum from the bottom of the nostril. a) After identifying the inferior edge of the pyriform aperture. b) From the outside, follow the arrow.

an incision medial to the defect mucosa with a neurosurgical scalpel (Figure 8). In this way, the mucosa of the right and left sides will separate completely, avoiding uncontrolled tearing of the mucoperichondrium and facilitating further suture. It is important to stress that the cartilage defect is frequently larger than the mucosal defect, which makes dissecting the mucous membranes that are joined together more difficult. For this step, it is possible to use a surgical scalpel with a fine or rounded blade. After mobilisation and complete separation of the mucous membranes towards the sphenoid ridge and the dorsal vomer edge, it is possible to resect or align both the cartilage and the bony part of the nasal septum.

## Incisions to release tension and mobilise the inferior bridge flap

To move the bridge flap towards the defect, it is necessary to perform incisions beneath the insertion of the inferior turbinate and, for large defects, it would also be necessary to make another incision in the nasal dome (Figure 9a). The incision of the inferior bridge flap requires the inferior turbinate to be medialized with the nasal speculum. The incision of the mucosa is carried out with a No. 15 scalpel from back to front, close to the lateral border of the pyriform aperture. Lastly, the bone mucoperiosteum is dissected (Figure 9b) so as to make the inferior bridge flap mobile.

For the mobilisation of the superior bridge flap, it is necessary to perform an incision in the nasal dome, although this procedure requires extreme care in order not to sever the nasal valve. Next, the same procedure is carried out on the left side.

## Endonasal suture

Only after having performed all the steps in the dissection can the suture of the mucous membrane of the defect be carried out on both sides. Vicryl 5-0 is usually used with a thin "T-F" needle. To facilitate endonasal suture, a previously-moulded Teflon sheet is temporarily placed

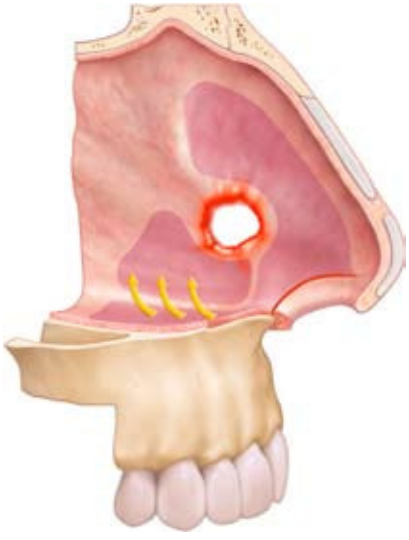

**Figure 7** Mobilisation of mucoperiosteum from the bottom of the nostril, caudal to the defect.

**Figure 8** Incision of the edges of the mucosa, medially to the perforation by the neurosurgical scalpel.

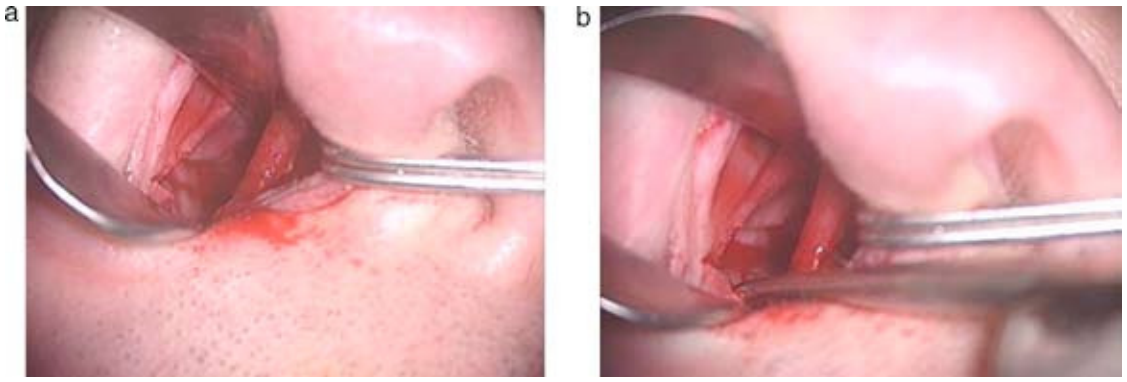


**Figure 9** a) Sagittal incision of the mucoperiosteum below the insertion of the inferior turbinate. b) Displacement of the mucosal for the mobilisation of the bridge flap.

between the mucous membranes on the left and right sides, to suture their respective sides. These Teflon sheets avoid the accidental suture of both sides of the mucosa and are also a visual aid due to their contrasting colour (Figure 10). A small needle holder (Karl Storz, ref. 515117) facilitates the endonasal suture, which is started on the left side. With the first mattress suture, the needle must be relocated after each stitch to avoid tearing the mucoperichondrium. For this same reason, simple stitches should not be performed. Mattress stiches evert the mucosa towards the nasal cavity. The resulting irregularities will spontaneously flatten after a few weeks. The knot should be made carefully so that the bridge flaps are brought closer gradually (Figure 11, Figure 12). In this way, tearing of the mucous membranes and sutures is avoided. The number of mattress sutures depends on the size of the defect. In most cases, two stitches are enough. On the second stitch, the edges of the defect can be sutured directly, without relocating the needle. For the suture of the defect on the right side, the Teflon sheet is changed to the right nasal fossa (Figure 13a). To facilitate the suture of the right side, this should be done from the interseptal space, with the surgeon repeating the same movements as on the left side (Figure 13b). The Teflon sheet should protect the mucous membrane of the septum of the inferior turbinate. Consequently, the edges of the defect on the right side will be inverted. No disadvantages have been observed with respect to the eversion of the mucosa on the left side.

**Figure 10** The placement of the Teflon sheet in the interseptal space will prevent accidental suturing of the right side with the left.

### Preparation of the cartilage perichondrium, adaptation to the defect and fixation of the quadrangular cartilage

To close the defect in three layers, it is necessary to fill the cartilage defect with a cartilage graft. Auricular or costal cartilage (and, more rarely, from the dorsal septum) is used, depending on the size of the defect. The reattachment of the rest of the quadrangular cartilage to the periosteum of the nasal spine is very important because it provides the projection of the nasal tip and keeps the cartilage of the nasal dorsum from descending. Dislocation of the transplant (Figure 14) can be avoided by suture in the quadrangular cartilage.

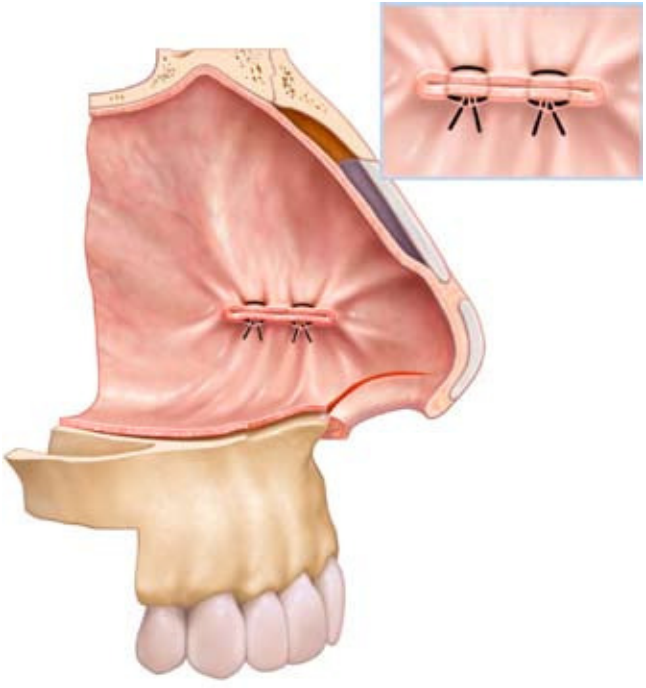

**Figure 11** Mattress stitches in the closure of the perforation mucosa.

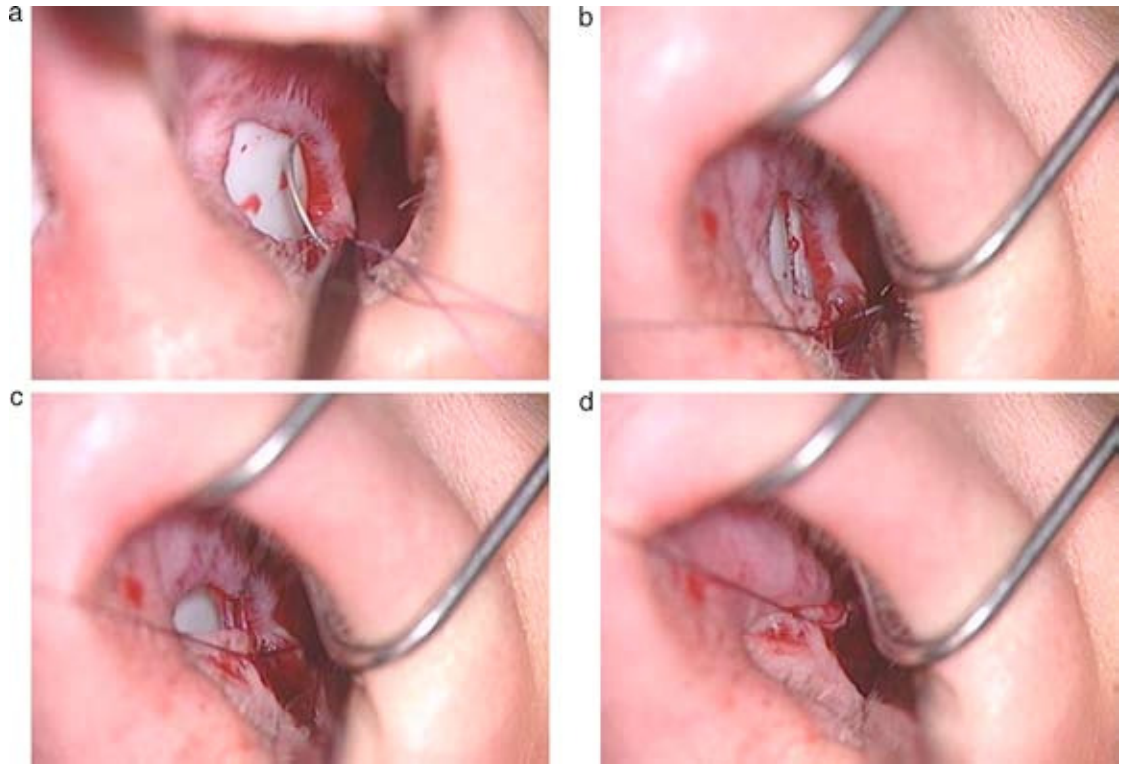


**Figure 12** a-d) Implementation of the mattress stitches on the left side, with careful and slow approach of the bridge flap for the adaptation of the mucosa without tension.

### Use of fibrin glue

Fibrin glue is applied to the mucoperichondrium and bridge flaps to avoid a septal haematoma and also to improve bridge flap adaptation and fixation. Compression is then quickly applied over both sides of the septum with the aid of two nasal specula, for approximately 5 minutes.

### Sealing of the hemitransfixion incision, placement of the Teflon sheets and nasal block

The hemitransfixion incision is closed with isolated stitches. After having completely controlled the sutures of the mucosa (Figure 15), a Teflon sheet is placed in each nasal fossa and fastened with a transfixing suture. Next, a nasal block in the form of splints smeared with Vaseline is put in place.

### Postoperative control

The Vaseline splints are removed after 2 days and the Teflon sheets after 7 days. Patients receive perioperative antibiotic prophylaxis, generally with cefazolin. Athorough treatment must be followed during the postoperative period, applying nose ointment, while trying to avoid resecting the mucus crusts at the level of the sutures with instruments. Sutures are resorbable and should not be resected.

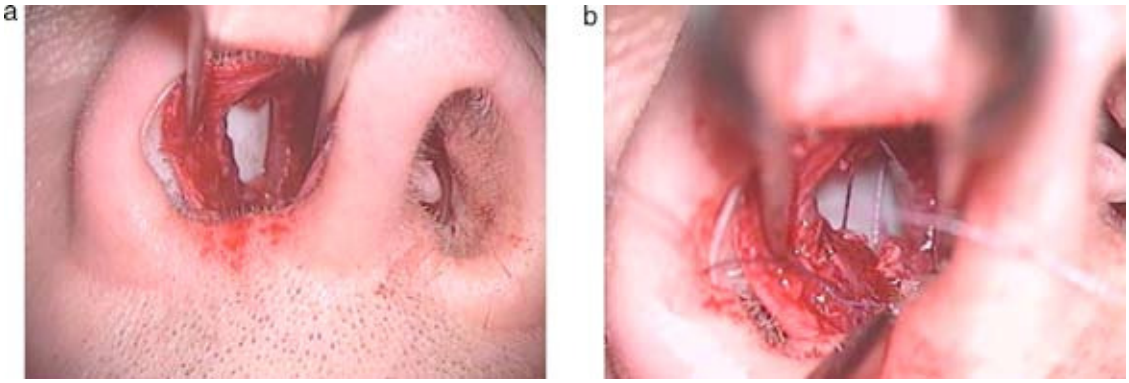


**Figure 13** a) Mucosa on the right side. b) Silicone sheet on the right side.

**Figure 14** Placement of auricular cartilage in the septal defect. The curvature of the cartilage is corrected by repeated incisions on it.

## Results

Our experience with this method includes 92 patients, all of whom underwent surgery during the period from July 2006 to July 2008 at the ORL department of *St. Elisabeth- Hospital, Kliniken der Ruhr Universität Bochum*, in Germany.

The distribution according to cause of nasal septum perforation was as follows:

- Iatrogenic: 61 (66.3%)
- Idiopathic: 27 (29.3%)
- Posttraumatic: 3 (3.2%)
- Cocaine consumption: 1 (1.08%). This patient was included because he had suspended cocaine use for good many years before.

Four patients with mild saddle nose underwent a procedure combining septal defect closure with rhinoplasty. In 2 cases of severe posttraumatic saddle nose, a correction was made with a costochondral graft. The rate of primary closure of the nasal septum defect (at the time when the Teflon sheets were removed) was 98% (90 of the 92 patients). The rate of obstruction at 18 months was 93.8%(60 of the 64 patients who attended postoperative control sessions). The remaining 28 patients were excluded from the study, as they did not attend the postoperative controls for the entire 18 months.

Perioperative complications recorded were rare: 1 haematoma of the nasal septum and 2 cases of suture dehiscence.

Regarding perforation sizes, they were between 0.7 and 2.8 cm at the vertical axis, with a mean of 2.1 cm, whereas on the sagittal axis the perforations measured between 0.8 and 3.5 cm with a mean of 2.4 cm.

## Discussion

Schultz-Coulon[2,6] reported the highest number of patients monitored after interventions using this technique, with over 400 cases in which the complete closure of the septal defect was achieved in 92.5%. According to this author, recurrences, when they appeared, were smaller than the original defects and caused less discomfort. In addition, after a reasonable time, this process could be repeated to attempt total closure of the remaining defect. Some of the reasons for recurrences of the defect were haematomas of the nasal septum, postoperative infections (periostitis on the nasal dorsum) or trauma.

An interesting fact is that our 3 cases with postoperative complications were not related to those cases where there was recurrence of nasal septum perforation. That is, both the haematoma and the suture dehiscence resolved spontaneously without causing any more lesions to the mucous membranes of the nasal septum. Therefore, the cause of perforation recurrence in the 4 patients could not be explained.

Performing the bridge-flap technique successfully depends mostly on defect location and size. Posterior defects are difficult to suture through the endonasal route. Fortunately, defects in the dorsal septal part are rare, either because they are uncommon or because they cause less discomfort, thus not making the patients seek medical help.

One of the key points when deciding whether to carry out the closure or not is the size of the defect in its vertical axis, because the superior and inferior bridge flaps must necessarily be moved and adapted without tension. This was demonstrated in our study, where the closure of perforations was successful in defects up to 3.5 cm at their

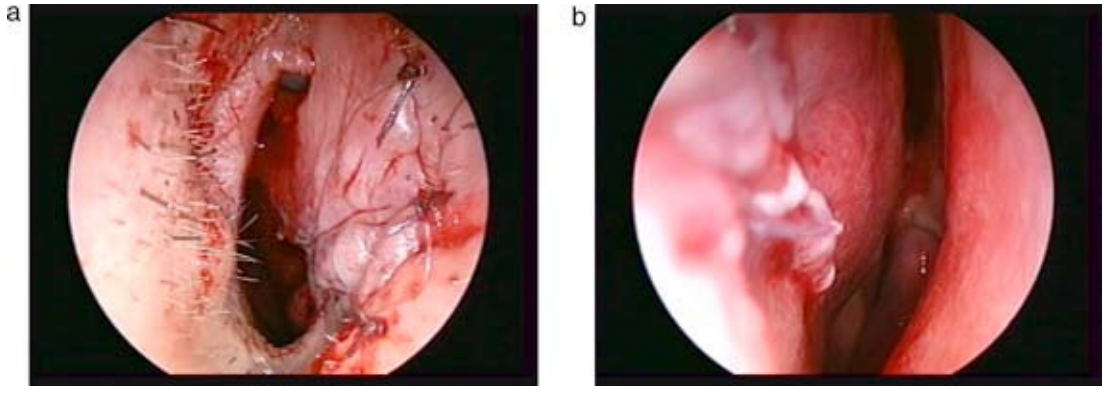


**Figure 15** Endonasal endoscopy for the verification of the suture on the right side (a) and the left side (b).

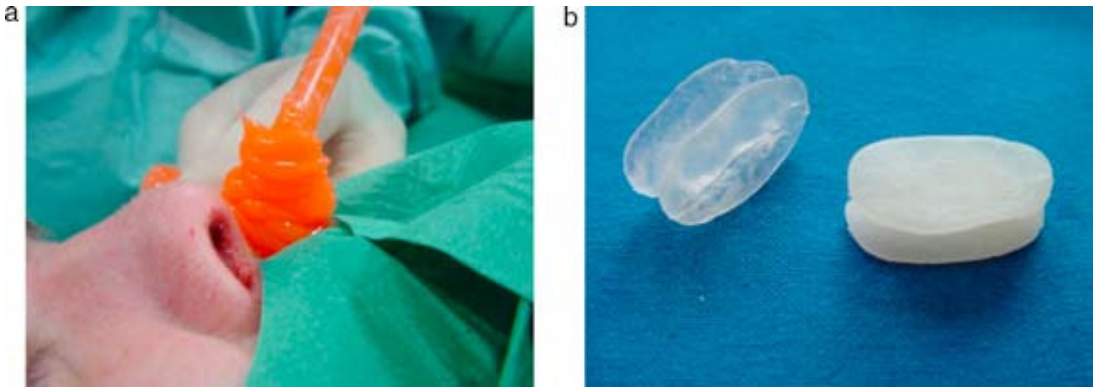

**Figure 16** a) Elaboration of an endonasal mould with silicone-based material. b) Individually-tailored silicone sealant (Figures 16 a and b were used with the permission of Mathias Schneider, anaplastologist, Epitheseninstitut Schneider, Zweibrücken, Germany).

sagittal axis; however, in the vertical axis, 2.8 cm was the maximum. Consequently, it can be established as a general rule that this technique can be performed safely when the vertical dimension of the defect is not more than half the height of the nasal septum at that same level.

Considering the high success rate in all defects, surgical closure can be recommended if the mentioned criteria are met. Given that the size of untreated defects tends to increase over time, it is preferable to not postpone surgery unnecessarily, because otherwise it could reach the size limit that makes this technique not recommendable.

The possible exceptions or contraindications of this surgery should be considered individually, such as, for example, the frequent inhalation of harmful substances (use of cocaine), practicing contact sports (e.g., boxing) and the presence of comorbidities (such as Wegener's granulomatosis).

A therapeutic alternative for large subtotal defects would be the frontal flap.[7]

The manufacture of obturators is, at present, unsatisfactory, although there is an alternative in which a silicone obturator is adapted. In this case a mould of the interior of the nasal fossa is taken (Figure 16a). A replica obturator can be created from this mould with soft silicone that will adapt perfectly to the dimensions (Figure 16b), and insertion is performed under general anaesthesia. The results with obturators, not comparable to those with "septal buttons", are generally good as they do not produce irritations of defect edges when dislocating, sneezing or breathing. However, long-term studies are still necessary.[8]

## Conclusion

Surgical sealing of nasal septum defects with 3-layer bridge flaps obtains a success rate higher than 90%. The endonasal approach can be applied in this technique, which presents few complications in expert hands. The limitations to this method stem from the height of the defect.

Individually-tailored obturators as well as front flaps can be alternatives for subtotal defects.

## Conflict of interest

The authors declare no conflict of interest.

## Acknowledgements

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