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Experimental Study / Deneysel Çalışma

Reconstruction of large nasal septal perforations with a three layer galeal pericranial flap: an anatomical and technical study

Geniş nazal septal perforasyonların üç katmanlı galeal perikranyal flep ile onarımı: Anatomik ve teknik çalışma

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Objectives: In this study, a modified surgical method was carried out to repair large nasal septal perforations with a galeal pericranial flap using endoscopic technique.

Materials and Methods: Six adult human cadavers were dissected by applying the classic open rhinoplasty technique. Large perforations were created in the septal cartilages. To repair the perforations, we prepared galeal pericranial flaps with supraorbital neurovascular pedicles and calvarial bone grafts under endoscopic visualization. The flaps were inserted between the upper lateral cartilages and folded into three layers. The flaps were sutured to the nasal mucosa with absorbable sutures. The length, the width, the size of the flaps and the perforations were measured using an electronic caliper and a flexible ruler.

Results: The mean length and width of the flap pedicles were measured as 26.8±5.1 mm (range 20 to 32 mm) and 19.3±2.6 mm (range 15 to 23 mm), respectively. In addition, the mean length and the width of the flaps were 54.1±4.9 mm (range 50 to 60 mm) and 51.6±7.8 mm (range 45 to 63 mm), respectively. All of the nasal septal perforations were repaired with a galeal pericranial flap.

Conclusion: The galeal-pericranial flap is well-vascularized and similar to the nasal mucosa for tissue thickness. Therefore, reconstruction with galeal-pericranial flaps can be an alternative surgical technique for repair of large nasal septal perforations.

Key Words: Calvarial bone graft; endoscopical technique; galeal pericranial flap; nasal septal perforation.

Amaç: Bu çalışmada, endoskopi tekniği ve galeal perikranyal flep kullanılarak değiştirilmiş cerrahi bir yöntem ile geniş nazal septal perforasyon onarımı yapıldı.

Gereç ve Yöntemler: Altı yetişkin insan kadavrası klasik açık rinoplasti tekniği uygulanarak diseke edildi. Septal kıkırdakta geniş perforasyonlar oluşturuldu. Perforasyonların tamiri için, endoskopik görüntüleme altında kalvarial kemik greftleri ve supraorbital nörovasküler pediküllü galeal perikranyal flepler hazırlandı. Flepler üç tabaka şeklinde katlanarak üst yan kıkırdakların arasına yerleştirildi. Flepler emilebilen dikişlerle nazal mukozaya dikildi. Fleplerin uzunlukları, genişlikleri ve perforasyon büyüklükleri, elektronik pergel ve esnek bir cetvel ile ölçüldü.

Bulgular: Flep pediküllerinin ortalama uzunluğu ve genişliği sırasıyla, 26.8±5.1 mm (dağılım 20-32 mm) ve 19.3±2.6 mm (dağılım 5-23 mm) idi. Buna ek olarak, fleplerin ortalama uzunluğu ve genişliği sırasıyla, 54.1±4.9 mm (dağılım 50-60 mm) ve 51.6±7.8 mm (dağılım 45-63 mm) olarak tespit edildi. Tüm nazal septal perforasyonlar galeal perikranyal flepler ile onarıldı.

Sonuç: Galeal perikranyal flep iyi vaskülarize ve doku kalınlığı açısından nazal mukozaya benzerdir. Bundan dolayı galeal perikranyal flepler ile rekonstrüksiyon, geniş nazal septal perforasyonların onarımında alternatif bir cerrahi teknik olabilir.

Anahtar Sözcükler: Kalvarial kemik grefti; endoskopik teknik; galeal perikranyal flep; nazal septal perforasyon.

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This study Presented as Oral Presentation at the 6th European Congress of Otorhinolaryngology Head and Neck Surgery, June 30 - July 4, 2007 Vienna, Austria *(Bu çalışma Altıncı Avrupa Otorinolarengoloji ve Baş Boyun Cerrahisi Kongresi'nde sözlü sunum olarak sunulmuştur 30 Haziran - 4 Temmuz 2007, Viyana, Avusturya).*

Nasal septal perforations are anatomical defects caused mainly by septoplasty, epistaxis treatment, cocaine abuse, trauma and nasotracheal intubation.[1-4] Nasal septal perforations are generally diagnosed incidentally during rhinological examination of asymptomatic patients. Symptomatic patients suffer from recurrent epistaxis, nasal obstruction, crusting, pain and whistling during inspiration and expiration.[1] These cases have been treated by different techniques depending on location and size of the perforation.[1-5] The surgical repair of perforations is commonly difficult and rarely successful. Therefore, many surgical techniques and their modifications have been developed and described in order to repair perforations and to control symptoms.

The galeal pericranial flap is a reliable, well vascularized and a versatile flap to reconstruct anterior skull base, orbital and paranasal sinus defects.[6-11] In the present study, we described a modified surgical repair technique to treat large nasal septal perforations with a galeal pericranial flap by using an endoscopic technique.

MATERIALS AND METHODS

Six adult human cadavers were dissected in this study. The heads of the cadavers in the supine position were elevated 20 to 30 degrees and turned 20 to 30 degrees to the right side. A classic open rhinoplasty incision was made. We created a large cartilage septal perforation. The size of the perforation was determined depending on the cartilage size of the nasi. Then, incision of a galeal pericranial flap was marked by coloured chisel (Figure 1). The nasal dorsum was dissected subperiostally to reach the glabella superiorly. The upper lateral cartilages were detached (Figure 2). An approximately 1 cm incision was performed from the radix nasi to the medial end of the eyebrow. A tunnel was created between the supraorbital rim to the upper lateral cartilages. Blunt dissection of skin from superior orbital rim to the hairline proceeded in the suprapericranial area by using 0 and 30 degree telescopes. The skin was elevated to separate it from the galea under endoscopic visualization (Figure 3). The suprabrow region was carefully dissected. In this region, the supratrochlear neurovascular bundle was identified and preserved. Then, a vertical incision was made on the galeal-pericranial layer and the resulting flap was extended to the hairline. After measuring the length of the flap pedicle, a 1 to 2 cm trichophytic incision was made on the hairline. An approximately 1 cm diameter external tabular part of the bone was also included by an osteotome in order to achieve a three-layer closure of the perforation (Figure 4). The flap was rotated to the detached upper lateral cartilages by inserting through the tunnel that was prepared earlier (Figure 2). The flap was inserted between the upper lateral cartilages and folded to form three layers (Figures 5, 6). The flap was then sutured to the nasal mucosa with an absorbable suture (Figure 7). The length, the width, the size of the flap and the perforation was measured using an electronic caliper and a flexible ruler.

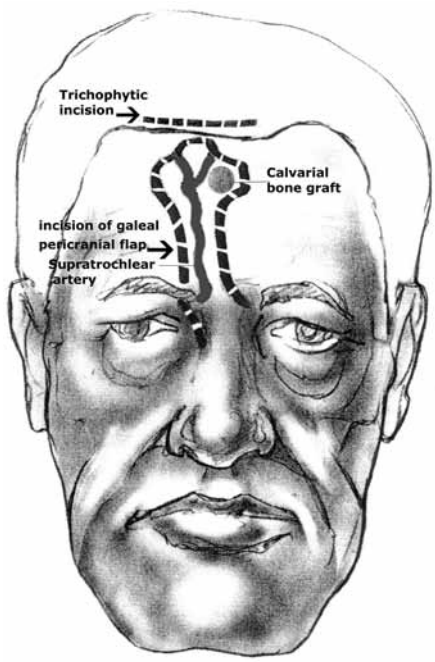

Figure 1. *Incision of galeal pericranial flap.*

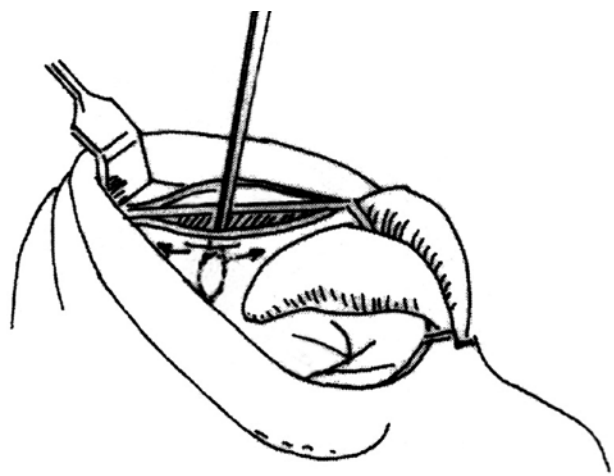

Figure 2. *Elevation between upper lateral cartilages.*

Figure 3. *Elevation between skin and galea under endoscopic visualization.*

RESULTS

We applied the method, which was described in this manuscript to six adult cadavers. The mean lengths of the nasal bones and the septal cartilages were 21.8±3.8 mm (range 17-28 mm) and 33.7±6.1 mm (range 25-43 mm), respectively (Table 1). The size of the perforations depended largely on the mean lengths of the septal cartilages. The mean lengths of the superior vertical, inferior vertical, anterior sagittal and posterior sagittal portions of the perforation were measured as 22.5±2.7 mm (range 20-25 mm), 17.8±3.1 mm (range 15-22 mm), 24.2±3.7 mm (range 20-30 mm) and 23.5±3.1 mm (range 20-28 mm), respectively (Table 1; Figure 8). The flaps had to be prepared in sufficient size for reconstruction of the perforations. In our case, the mean lengths of the galeal-pericranial flaps were 54.1±4.9 mm (range 50-60 mm). Furthermore, the mean lengths and the widths of the pedicles of the flap were measured

Figure 5. *The flap is inserted between upper lateral cartilages.*

Figure 4. *The flap become three-layer including approximately 1 cm diameter external tabular part of bone.*

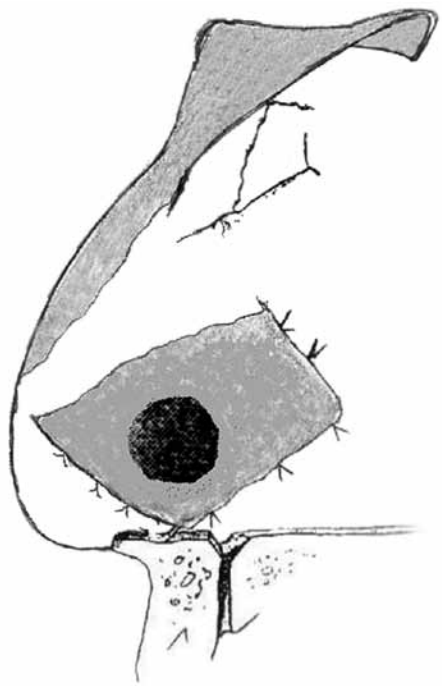

Figure 6. *Between upper lateral cartilages, the flap is inserted and sutured to nasal mucosa.*

Figure 7. *The flap is sutured to the nasal mucosa.*

as 26.8±5.1 mm (range 20-32 mm) and 19.3±2.6 mm (range 15-23 mm), respectively. The widths of the flaps were important for reconstruction of the perforation as well. The mean length of the wide part of the flaps was 28.5±3.3 mm (range 26-35 mm) and the width of the upper, middle and lower 1/3 of the flaps were 47±7.2 mm (range 40-60 mm), 51.6±7.8 mm (range 45-63 mm) and 57.5±8.8 mm (range 50-70 mm), respectively (Table 1; Figure 9). The mean vertical and sagittal diameters of the bone grafts were measured as 15.8±2 mm (range 15-20 mm) and 10.8±2 mm (range 10-15 mm), respectively (Table 1).

DISCUSSION

Reconstruction of nasal septal perforations presents a complex technical challenge for otolaryngologists since both sides of nasal mucosa and cartilage are absent and the perforation needs to have all three layers repaired. Although, in the literature, there are many procedures proposed to reconstruct nasal septal perforations, success rates for large perforations are generally low.[1-5] When the perforation size exceeded 2 cm, lower success rates have been reported in previous studies.[1-12]

The pericranial-galeal flap has been used for closure of anterior skull base defects, medial orbital defects and frontal sinus obliteration.[6-11] The main vessels of this flap are the supratrochlear, supraorbital and superficial temporal vessels.[6] The pericranial-galeal flap consists of periosteum and loose connective tissue.[8] This flap is well-vascularized, versatile, reliable, thin and pliable.[6-11] The calvarial bone graft can also be harvested attached to this flap.[7] In the literature, there is only one case report that used the pericranial flap for reconstruction of a large nasal septal perforation.[5] They used the bicoronal approach in order to harvest the pericranial flap. The bicoronal incision is not visible and has no cosmetic problem.

Table 1. Sizes of nasal septal perforations and galeal-pericranial flaps

	Cadavers no.						
	1	2	3	4	5	6	Mean+SD
Lengths of the nasal bone (mm)	20	20	17	28	24	22	21.8±3.8
Lengths of the septal cartilage (mm)	30	32	43	25	35	37	33.7±6.1
Size of cartilage defect (mm)							
A	25	20	30	20	25	20	24.2+3.7
P	25	20	28	20	23	25	23.5+3.1
S	20	20	25	20	25	25	22.5+2.7
I	15	15	20	15	22	20	17.8+3.1
Galeal pericranial flap (mm)							
A	60	45	50	40	42	45	47+7.2
B	63	47	60	45	45	50	51.6+7.8
C	65	50	70	50	50	60	57.5+8.8
D	20	18	23	15	20	20	19.3+2.6
E	26	27	35	28	28	27	28.5+3.3
F	24	23	20	32	32	30	26.8+5.1
G	50	50	55	60	60	50	54.1+4.9
The bone graft (mm)							
Vertical diameter	20	15	15	15	15	15	15.8+2
Sagittal diameter	10	10	15	10	10	10	10.8+2

SD: Standard deviation.

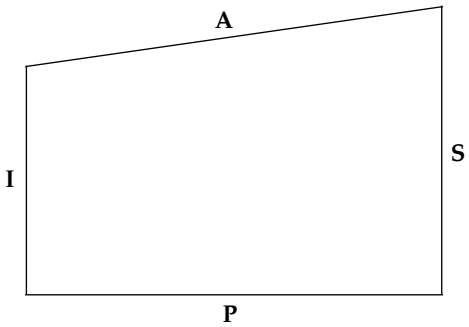

Figure 8. *Design of the perforation on nasal septal cartilage. The mean lengths of the inferior vertical (I), superior vertical (S), anterior sagittal (A) and posterior sagittal (P) of the perforation.*

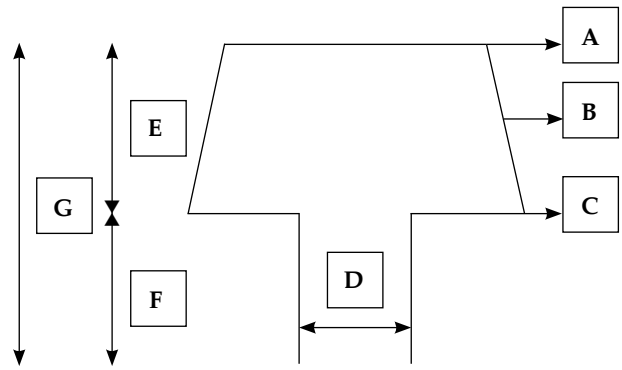

Figure 9. *Design of flap. The mean width of the upper (A), middle (B), lower (C) and length (E) of the wide part of the flap. The mean width (D) and length (F) of the pedicle of the flap. The mean length of the galeal-pericranial flap (G).*

However, the patient has a risk for hair loss and exposure of the bicoronal scar tissue. Besides, temporal branches of the facial nerves and some sensory branches of the supraorbital nerves can be damaged during blunt dissection (i.e., nasal dorsum area dissection). Scalp necrosis is also a potential complication in patients who have received radiation therapy previously.[8] Therefore we modified the surgical repair to treat large nasal septal perforations with a three-layer pericranial-galeal flap by using endoscopic technique. An open rhinoplasty approach is necessary for this technique. A small incision near the eyebrow is adequate for preparing the flap. Furthermore, if cutting the flap pedicle is necessary, this incision may be useful to obtain a thinner pedicle after the vascularization period. When preparing the flap, the surgeon needs to be careful during dissection of the supratrochlear and supraorbital neurovascular bundle. Three layer closure of the perforation is the most important advantage of this technique. Cartilage (autograft or allograft) can be selected instead of calvarial bone. In this situation, a second trichophytic incision is avoided. Passing the flap with calvarial bone into the nasal cavity through a tunnel of radix nasi can be difficult because of the rigidity of the attached calvarial bone to the flap. By dividing the bone graft into two or three parts, insertion of the flap can be achieved. We described the sizes and the lengths of the flaps as well. Our measurements, taken on cadavers, are adequate to harvest galeal-pericranial flaps and to reconstruct large perforations since live tissue is more elastic than cadaver tissue. Previous studies did not give any measurements for preparing flaps. Another advantage of this technique is the protection of all intact nasal mucosa since extranasal tissue is transferred to the nasal cavity.

The three layer galeal-pericranial flap is a reliable method with low morbidity for the closure of the large nasal perforations. This flap is similar to the nasal mucosa for tissue thickness. Therefore, reconstruction with galeal-pericranial flaps can be an alternative technique for the repair of large nasal septal perforations.

REFERENCES

1. Newton JR, White PS, Lee MS. Nasal septal perforation repair using open septoplasty and unilateral bipedicled flaps. J Laryngol Otol 2003;117:52-5.
2. Heller JB, Gabbay JS, Trussler A, Heller MM, Bradley JP. Repair of large nasal septal perforations using facial artery musculomucosal (FAMM) flap. Ann Plast Surg 2005;55:456-9.
3. Kridel RW. Septal perforation repair. Otolaryngol Clin North Am 1999;32:695-724.
4. Schultz-Coulon HJ. Three-layer repair of nasoseptal defects. Otolaryngol Head Neck Surg 2005;132:213-8.
5. Paloma V, Samper A, Cervera-Paz FJ. Surgical technique for reconstruction of the nasal septum: the pericranial flap. Head Neck 2000;22:90-4.
6. Donath A, Sindwani R. Frontal sinus cranialization using the pericranial flap: an added layer of protection. Laryngoscope 2006;116:1585-8.
7. Rodrigues M, O'malley BW Jr, Staecker H, Tamargo R. Extended pericranial flap and bone graft reconstruction in anterior skull base surgery. Otolaryngol Head Neck Surg 2004;131:69-76.
8. Noone MC, Osguthorpe JD, Patel S. Pericranial flap for closure of paramedian anterior skull base defects. Otolaryngol Head Neck Surg 2002;127:494-500.
9. Smith JE, Ducic Y. The versatile extended pericranial flap for closure of skull base defects. Otolaryngol Head Neck Surg 2004;130:704-11.
10. Newman J, Costantino P, Moche J. The use of unilateral

pericranial flaps for the closure of difficult medial orbital and upper lateral nasal defects. Skull Base 2003; 13:205-9.
11. Leatherbarrow B, Watson A, Wilcsek G. Use of the pericranial flap in medial canthal reconstruction: another application for this versatile flap. Ophthal Plast Reconstr Surg 2006;22:414-9.
12. Vuyk HD, Versluis RJ. The inferior turbinate flap for closure of septal perforations. Clin Otolaryngol Allied Sci 1988;13:53-7.