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ARTICLE

Angular artery island flap for eyelid defect reconstruction

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ABSTRACT

Eyelid reconstruction is a challenging surgical procedure because of the special function and structure of the eyelids. There are various useful techniques which can be used to reconstruct eyelid defects. In this report, the authors aimed to present the clinical results of angular artery-based island flap for the repair of the full thickness eyelid defects. This presented series consists of eight patients with full-thickness eyelid defects. Oncologic resection was the reason for all of them. Five of the patients had lower eyelid defects and the other three had upper eyelid defects. Nasojugal angular artery-based axial flap was used in reconstruction in all patients. The inferior limit of the flap was the alar rim level in order to make the flap totally axial. A tunnel was created under the orbicularis oculi muscle in cases where the medial portion of the eyelids was left intact and healthy. Septal chondromucosal graft was used to repair posterior lamella of the eyelid. The follow-up period of the cases was from 12 months to 22 months, with a mean follow-up period of 16 months. There was only one patient with reconstructed upper eyelid needed flap defatting. There was no ectropion or wound healing problem observed during the follow-up period. This presented series shows that angular artery-based axial flap and septal chondromucosal graft combination is a simple and safe technique for both upper and lower eyelid full-thickness defect reconstruction. The donor site of this flap heals with an inconspicuous scar concealed in the nasojugal area.

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Introduction

Eyelid defects are mostly the result of trauma, tumor resections, and congenital defects. Reconstruction of eyelid defects is a challenging task for the surgeon since eyelids have peculiar anatomic structure and specialized function, providing protective coverage of the globes. The aesthetic role of the eyelids is also important in facial cosmesis [1]. Reconstruction should aim to optimize not only function but also aesthetic appearance.

There are many operative techniques defined in the literature for the reconstruction of the eyelids, but there is not any ideal reconstruction technique for all defects. Besides the horizontal, vertical, and depth dimensions of the defect, the availability of regional and distant tissue should be taken into account in reconstruction planning.

When a primary repair is not appropriate in full-thickness eyelid defects, various flaps are used. When enough lateral tissue mobility exists, Mustarde cheek rotation-advancement flap or Tenzel semicircular flap can be employed depending on the defect size [2,3]. Good color match and reliable vascularity are the advantages of these flaps. However, Mustarde flap needs wide dissection requirement for adequate mobilization and also it has, in the long term, the probability of ectropion resulting from wound contraction and the gravity. Tenzel flap has the risk of tissue fullness of the lateral lower eyelid, lateral canthal webbing, and symblepharon [4].

The absence of the ideal reconstruction method and increased patient expectations have led to seeking for alternative techniques for the reconstruction of full-thickness eyelid defects. Fabrizio et al. defined angular artery-based island flap for nasal reconstruction [5] and Tan et al. use this flap for eyelid defects in five patients [6]. In this report, we aimed to present the clinical results of angular artery-based island flap for the repair of the full thickness eyelid defects.

Patients and methods

This presented series consists of eight patients with full-thickness eyelid defects. Oncologic resection was the reason for all of them. Five of the patients had lower eyelid defects and the other three had upper eyelid defects. The age of patients ranged from 56 to 77 years with a mean age of 65. Total and subtotal full-thickness eyelid surgical defects were reconstructed with ipsilateral angular island flap and chondromucosal graft which was harvested from the nasal septum. Information regarding patients' characteristics are shown in Table 1. The report of this presented series follows the principles of the Declaration of Helsinki. Written consent was taken from the patients whose faces are shown in the figures.

Surgical technique

All operations were performed under general anesthesia with the patients in the supine position. Once the tumors were thoroughly examined and the excision borders were drawn, surgical resection was carefully carried out. All eyelid tumors were totally resected, leaving full-thickness eyelid defects. Ipsilateral angular artery-based island flaps were designed according to the defect location and size by using paper templates. The alar rim level was the inferior border of the flap where the flap harvesting started from. Incision deepened to the maxillary periosteum and dissection advanced subperiosteally to prevent angular vessels from

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inadvertent surgical damage since these vessels are very close to the periost. The lateral nasal artery was identified and coagulated on the medial side of the dissection. Subperiosteal dissection proceeded easily up to the medial palpebral ligament. As raising the flap, the angular vessels could be seen easily undersurface of the flap and the pedicle is released in a safe manner. After elevation of the flap, subcutaneous fat tissue was trimmed away while preserving the angular vessels under 2.5 magnifications. A tunnel was created under the orbicularis oculi muscle in cases where a medial portion of the eyelids was left intact and healthy.

The defect of the posterior lamella of the eyelid is measured to determine the composite chondromucosal graft dimensions. Killian incision was performed on the ipsilateral side of the septum to harvest chondromucosal graft. To avoid septal perforations, the contralateral mucoperichondrial flap should not be damaged. Composite chondromucosal graft was harvested in needed dimensions. The chondromucosal graft was adapted in such a way that mucosal side faced with the bulbar conjunctiva. The edges of the septal cartilage of the graft were attached with two 6/0 polyglycolic acid interrupted sutures to the tarsal remnants or lateral and medial canthal tendons. The donor site of the chondromucosal graft is left with nasal packing to heal by second intention. The flap was placed in front of the chondromucosal graft. The flap donor site can be easily closed primarily after hemostasis.

Results

The follow-up period of the cases was from 12 months to 22 months, with a mean of 16 months. The average operation time was about 70 min, including oncologic resection. There were no early complications such as infection, hematoma, corneal irritation, or wound dehiscence in any patient. All flaps survived completely (Figures 1–3).

There was no ectropion, flap contraction or donor site morbidity during the follow-up period. Reconstructed eyelids functioned well. Cosmetic outcomes were satisfactory in terms of color and texture match in all patients, but three of the patients complained flap bulkiness and one of them underwent reoperation after 6 months for the complaint of the level of his upper eyelid. The flap was trimmed and the patient was satisfied with the elevated upper lid level (Figure 4). There were not any problems encountered in the follow-up of the other five patients. The linear donor site scars were inconspicuous in the nasojugal area.

Table 1. Patient Summaries.

Patients	Age/sex	Eyelid	Flap size (mm)	Pathology	Follow up (month)	Complications
1	77/M	Upper	36x27	BCC	12	–
2	74/M	Upper	30x17	BCC	22	Flap bulkiness
3	56/F	Lower	33x24	SCC	20	Flap bulkiness
4	60/M	Lower	28x23	BCC	18	–
5	57/M	Lower	32x22	BCC	17	Flap bulkiness
6	64/M	Upper	35x26	BCC	12	–
7	72/M	Lower	37x24	BCC	14	–
8	65/F	Lower	32x19	BCC	14	–

BCC: basocellular carcinoma; SCC: squamous cell carcinoma.

Discussion

Full-thickness eyelid defects should be reconstructed in two planes as the posterior and anterior lamellae together. To nourish the reconstructed eyelid, at least one lamella should have an intact blood supply, thus, the two planes should be the combination of two flaps or a flap and a graft.

For the posterior lamella reconstruction of the eyelids, tarsoconjuntival flaps from the opposite eyelids have been used [7,8]. But these techniques require eyelid closure for at least two weeks and a second procedure. This is a difficulty especially for the elderly [9]. Several different one stage techniques have been defined to overcome this difficulty. Custer and Neimkin reconstructed posterior lamella by sliding a tarsal flap and anterior lamella with a rhomboid skin flap. They used their technique in small to medium size, shallow lower lid defects. They reported satisfactory functional recovery [10]. Skippen et al. used lateral-based full-thickness advancement flap in patients with a minimum 25% lateral lower eyelid intact tissue for medial advancement [11]. Lemaître et al. reconstructed full-thickness eyelid defects with upper eyelid myocutaneous flap and nasal chondromucosal graft combination in 25 patients. They reported that their cosmetic result was satisfactory in all patients and no further surgery was performed [12]. Eser et al. used a malar myocutaneous bridge and nasojugal flaps and septal chondromucosal graft for the reconstruction of the full-thickness lower eyelid defects in seven patients. They observed mild scleral show in two cases [13]. These reports reveal that full-thickness eyelid defects can be reconstructed by using a one-stage procedure.

The decision of the reconstruction technique for full-thickness eyelid defect depends on various factors including the size of the

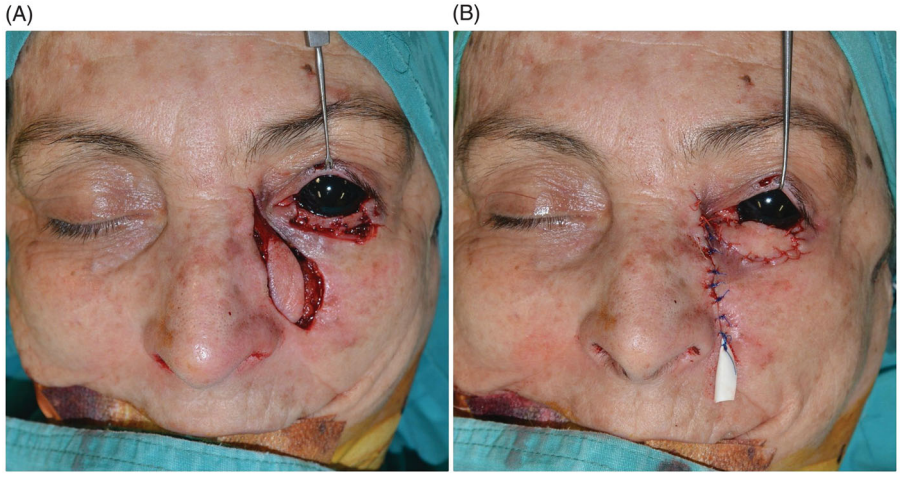

Figure 1. Full thickness lower lid defect after oncologic resection and the angular flap (A) and the flap insetting for lower lid reconstruction (B).

defect, the amount of adjacent tissue laxity, and the surgeon preferences. Also the presence of a scar can hinder performing a common technique. Therefore, several different techniques should be in the armamentarium of a surgeon. Nasojugal area is an appropriate donor area for the flaps to be used in the repair of the eyelid defects due to its proximity to the eyelids and inconspicuous scar marks. This presented series showed that the angular artery-based island flap could be a good option in the repair of eyelid defects.

Fabrizio et al. defined retroangular flap and used for nasal reconstruction [5]. Ascari-Raccagni and Baldari reported the use of retroangular flap for nasal tip defects repair [14]. Tan et al. use retroangular flap for different facial area defects. Anatomically, the angular artery is defined as the terminal branch of the facial artery [15]. In these mentioned studies, the angular artery was accepted as the continuation of the facial artery and the flap was assumed to be nourished by reverse flow. Therefore, the term 'retroangular' was logical for this consideration. Based on this flow dynamic, Vayvada et al. stated that superiorly based nasolabial flap can be planned more superiorly than the classic one and used it for lower eyelid reconstruction in 10 patients [16]. Tatar et al. also used the same flap in 11 eyelid defect repair [17].

However, different descriptions of the course of the angular artery have been reported. Kim et al. reported that the angular artery was not the terminal branch of the facial artery in more than half of the cases [18]. Koh et al. revealed that the facial artery terminated as the angular artery in 36.3% of 91 specimens [19]. Niranjan reported that facial artery ended as the angular artery in 68% of 25 British specimens [20]. By examining 284 hemi-faces, Loukas et al. detected that the facial artery terminated as the angular artery in 51.4% of the cases, in the others it ended as the superior labial or lateral nasal artery or as a simple rudimentary branch [21].

Figure 2. The appearance of the patient in Figure 1 after 12 months later.

All these studies show that angular artery is a continuation of facial artery in only half of the cases. Hou et al. examined 22 hemi-faces and found that the angular artery was constantly present in their specimens and it originated from an ophthalmic or infraorbital artery in about 64% of the specimens [22]. Based on the findings of these mentioned studies, the flow was not reversed at least half of the cases so the term 'retroangular flap' is not appropriate. The flap can be named as angular artery axial flap instead.

In cases where the angular artery is not a continuation of the facial artery, the nasolabial region would be a randomly nourished area if it is included in the flap. Since secondary intention can lead to lid margin retraction and irregularity, it is important to prevent flap tip necrosis or tissue sloughing. These types of complications can be avoided by raising the flap completely axial even flap defatting is performed. Therefore, in this presented series, the flap was planned to be completely axial and the alar rim level was chosen as the inferior limit of the flap in order not to include any randomized area to the flap. This differed this flap design from that of the mentioned reports from Vayvada et al. and Tatar et al. [16,17].

Iida et al. used the retroangular flap with an exteriorized pedicle to prevent pedicle from compression or undue tension, but this maneuver needs secondary intervention. Tan et al. reported that when the subcutaneous tunnel is large enough and the pedicle is appropriately long there will be no blood flow disturbances for the flap. In our presented series, there was not any circulation problem in four cases in whom the pedicle was tunneled subcutaneously.

There are various potential complications of the eyelid reconstruction, including ectropion, marginal notching, symblepharon, and local infection. Ectropion has been reported the most common problem, being 2.5–7% of the cases [23]. In the late postoperative period, gravity, flap bulkiness, and wound contraction can cause ectropion in reconstruction techniques which use inferolateral tissue such as Mustarde technique. Since the axes of this presented flap were oriented parallel to the lid margin, wound

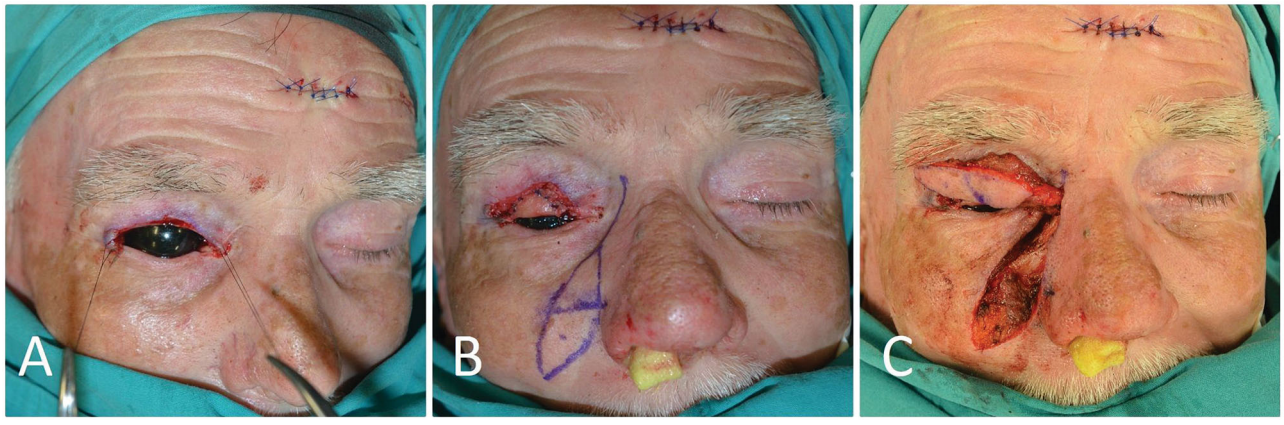

Figure 3. Full thickness upper lid defect after oncologic resection (A); posterior lamellar reconstruction with septal chondromucosal graft and the design of the angular flap (B); the flap transposed (C).

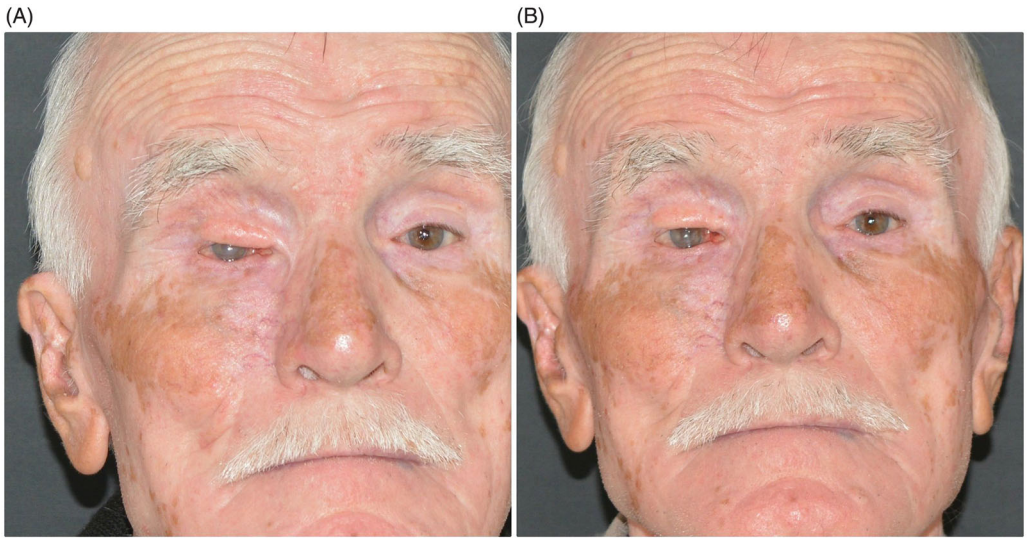

Figure 4. The appearance of the patient in Figure 3, 6 months later. The descending upper lid of the patient made an obstacle in his field of vision (A); after defatting operation, the lid level elevated (B).

contraction did not produce ectropion. Vayvada et al. stated that involutional laxity of the flap can be another factor for ectropion and posterior lamella restoration with semi-rigid skeletal component might prevent ectropion occurrence [16].

Posterior lamellar grafts can be prepared from the nasal septum, ear cartilage, buccal mucosa, hard palate mucosa, and periosteal flaps [8,11,24,25]. Each type of graft has its specialties. While auricular cartilage graft procedure has minimal or not any donor site morbidity, it lacks mucosal layer for conjunctival reconstruction [26]. Palatal grafts and nasal septal chondromucosal grafts, by contrast, have their own mucosal covering. Although hard palate can provide appropriate tissue for posterior lamella reconstruction, donor site can be problematic. Open palatal wound and discomfort at donor site can cause feeding difficulties, especially for the elderly patients [27]. On the other hand, septal chondromucosal graft procedure is also associated with the possibility of complications. Septal perforation and hemorrhage are potential complications [26]. Therefore meticulous dissection and careful hemostasis should be performed during graft harvesting. There are several reports stating that posterior lamella reconstruction by using septal chondromucosal grafts provide good eyelid stability and esthetic outcome in the late postoperative period [25,26,28]. In this presented series, posterior lamella reconstruction was made by using septal chondromucosal graft and there was no septal perforation or hemorrhage complications in our patients.

Besides ectropion, flaps bulkiness can cause aesthetic and functional problems, especially in the reconstructed upper eyelid. Three of our patients complained about the feeling of weight and fullness, and one of them had a low level of the upper eyelid. His complaints improved following flap debulking procedure. Actually, flap bulkiness was seen in three of the first five patients. After that experience, flap defatting was performed more rigorously and then none of the patients complained flap bulkiness. This result considered that defatting is a safe procedure for the angular flap, especially performed under loop magnification, since it is a totally axial flap.

A similar problem that may be encountered in eyelid reconstruction is the trapdoor effect. It probably arises mainly from venous and lymphatic outflow impedance. Island flaps may be at particular risk of the trapdoor effect because they have small pedicle diameter relative to their size. Various surgical strategies have been proposed to minimize this effect, such as fastening the flap base down to the defect bed, and diminishing flap size relative to the defect size [29]. Especially, when it occurs on the upper eyelid, the trapdoor effect can engender functional and cosmetic problems. We considered that besides defatting, the width of the flap should be kept as little as possible, especially, in upper lid reconstruction to minimize trapdoor effect in case it occurs.

The use of the angular artery-based island flap in eyelid reconstruction has some limitations. Harvesting of this flap is technically demanding and requires meticulous dissection compared to common techniques such as the Tenzel semicircular flap. Although defatting is safe, it is very difficult to reconstruct fine, the delicate structure of the upper eyelid with this flap. Also, this flap needs a graft procedure for the reconstruction of posterior lamella in full-thickness eyelid defect repair.

Although the sample size is small, this presented series shows that angular artery-based axial flap is a simple and safe technique for both upper and lower eyelid defect reconstruction. Flap defatting is a safe procedure when needed. Donor site heals with an inconspicuous scar concealed in the nasojugal area.

Disclosure statement

The authors declare that they have no conflict of interest.

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References

[1] Yousefiazar A, Hassanzadazar M. A new technique for reconstruction of medium-sized eyelid defects (a modification of tessier nasojugal flap). Facial Plast Surg. 2018;34:657–662.

[2] Mustardé J. Major reconstruction of the eyelid: function and aesthetics considerations. Clin Plast Surg. 1981;8:367.

[3] Tenzel RR, Stewart WB. Eyelid reconstruction by the Semicircle Flap Technique. Ophthalmology. 1978;85:1164–1169.

[4] Miller EA, Boynton JR. Complications of eyelid reconstruction using a semicircular flap. Ophthalmic Surg. 1987;18: 807–810.
[5] Fabrizio T, Savani A, Sanna M, et al. The retroangular flap for nasal reconstruction. Plast Reconstr Surg. 1996;97: 431–435.
[6] Tan O, Atik B, Ergen D. The retroangular flap revisited. Dermatol Surg. 2007;33:1343–1349.
[7] Cutler NL, Beard C. A method for partial and total upper lid reconstruction. Am J Ophthalmol. 1955;39:1–7.
[8] Hughes WL. Total lower lid reconstruction: technical details. Trans Am Ophthalmol Soc. 1976;74:321–329.
[9] Leibovitch I, Selva D. Modified Hughes flap: division at 7 days. Ophthalmology. 2004;111:2164–2167.
[10] Custer PL, Neimkin M. Lower eyelid reconstruction with combined sliding tarsal and rhomboid skin flaps. Ophthalmic Plast Reconstr Surg. 2016;32:230–232.
[11] Skippen B, Hamilton A, Evans S, et al. One-stage alternatives to the Hughes Procedure for reconstruction of large lower eyelid defects: surgical techniques and outcomes. Ophthalmic Plast Reconstr Surg. 2016;32:145–149.
[12] Lemaître S, Lévy-Gabriel C, Desjardins L, et al. Outcomes after surgical resection of lower eyelid tumors and reconstruction using a nasal chondromucosal graft and an upper eyelid myocutaneous flap. J Fr Ophtalmol. 2018;41: 412–420.
[13] Eser C, Kesiktaş E, Gencel E, et al. Total or near-total lower eyelid defect reconstruction using malar myocutaneous bridge and nasojugal flaps and septal chondromucosal graft. Ophthalmic Plast Recons Surg. 2016;32:225–229.
[14] Ascari-Raccagni A, Baldari U. The retroangular flap used in the surgery of nasal tip defects. Dermatol Surg. 2004;30: 1131–1137.
[15] Gray HSS. Gray's anatomy: the anatomical basis of clinical practice. Edinburgh (Scotland): Churchill Livingstone Elsevier; 2008.
[16] Vayvada H, Menderes A, Tan O, et al. Total lower eyelid reconstruction using paranasal flap. J Craniofac Surg. 2006; 17:1020–1026.
[17] Tatar S, Yontar Y, Özmen S. Superiorly based nasolabial island flap for reconstruction of the lateral lower eyelid. Turk J Med Sci. 2017;47:1673–1680.
[18] Kim YS, Choi DY, Gil YC, et al. The anatomical origin and course of the angular artery regarding its clinical implications. Dermatol Surg. 2014;40:1070–1076.
[19] Koh KS, Kim HJ, Oh CS, et al. Branching patterns and symmetry of the course of the facial artery in Koreans. Int J Oral Maxillofac Surg. 2003;32:414–418.
[20] Niranjan NS. An anatomical study of the facial artery. Ann Plast Surg. 1988;21:14–22.
[21] Loukas M, Hullett J, Louis RG, et al. A detailed observation of variations of the facial artery, with emphasis on the superior labial artery. Surg Radiol Anat. 2006;28:316–324.
[22] Hou D, Fang L, Zhao Z, et al. Angular vessels as a new vascular pedicle of an island nasal chondromucosal flap: anatomical study and clinical application. Exp Ther Med. 2013; 5:751–756.
[23] Rubin P, Mykula R, Griffiths RW. Ectropion following excision of lower eyelid tumours and full thickness skin graft repair. Br J Plast Surg. 2005;58:353–360.
[24] Marcet MM, Lau IHW, Chow S. Avoiding the Hughes flap in lower eyelid reconstruction. Curr Opin Ophthalmol. 2017; 28:493–498.
[25] Rajabi MT, Bazvand F, Hosseini SS, et al. Total lower lid reconstruction: clinical outcomes of utilizing three-layer flap and graft in one session. Int J Ophthalmol. 2014;7: 507–511.
[26] Suga H, Ozaki M, Narita K, et al. Comparison of nasal septum and ear cartilage as a graft for lower eyelid reconstruction. J Craniofac Surg. 2016;27:305–307.
[27] Wearne MJ, Sandy C, Rose GE, et al. Autogenous hard palate mucosa: the ideal lower eyelid spacer? Br J Ophthalmol. 2001;85:1183–1187.
[28] Altuntas Z, Uyar I, Findik S. Our clinical experiences in lower eyelid reconstruction. Turk J Plast Surg. 2018;26:2.
[29] Rajak SN, Huilgol SC, Murakami M, et al. Propeller flaps in eyelid reconstruction. Eye. 2018;32:1259–1264.