• Clinical Research •

Surgical outcome of a transposed lateral pendular flap for the reconstruction of medial and central lower lid defects

Yomna Amr Alahmadawy, Radwa Taher Elzanaty, Shaimaa Abdelsalam Arfeen

Department of Ophthalmology, Faculty of Medicine, Cairo University, Cairo 11562, Egypt

Correspondence to: Yomna Amr Alahmadawy. Department of Ophthalmology, Faculty of Medicine, Kasr Al Ainy School of Medicine, Cairo University, Cairo 11562, Egypt. Dr_y.alahmadawy@cu.edu.com

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Abstract

● **AIM:** To evaluate the outcome and the degree of patient satisfaction with the reconstruction of full-thickness medial and central lower lid defects using a pendular flap of the remaining lateral part of the lower lid.

● **METHODS:** Totally 20 patients with full thickness medial or central lower lid defects that could not be repaired by direct closure with or without cantholysis. A sliding full-thickness composite flap was created from the lateral part of the remaining lid to cover the defect. The posterior lamella of the induced lateral defect was repaired by either a periosteal flap alone or in combination with a free tarsal graft. Postoperative cosmetic and functional outcomes were evaluated.

● **RESULTS:** The mean age of the patients was 46.3±18.1y (20-70y). The defects ranged from 30%-80% of the lid width and resulted from the excision of lid tumors in 11 patients (55%) and from trauma in 9 (45%) patients. Postoperative complications included one case of lateral graft ectropion, 2 cases of lid retraction and 3 cases of marginal graft necrosis. Most of the patients had an acceptable final cosmetic outcome.

● **CONCLUSION:** Reconstruction of moderate-sized defects in the medial/central lower lid *via* a sliding flap yielded acceptable cosmetic and functional outcomes with high patient satisfaction. Large defects ≥50% of the horizontal length are at greater risk of complications. Reconstruction of medial defects by this technique was associated with a greater incidence of complications.

● **KEYWORDS:** lower lid defects; lateral pendular flap; reconstruction

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INTRODUCTION

Reconstruction of large eyelid defects, especially posttraumatic or post-tumor excision, poses significant challenges due to anatomical & structural complexities[1-3]. Multiple surgical procedures, which vary according to the size, location, and thickness of the defect, are available for lower eyelid defect repair[4-10]. Repairing medial and central lower lid defects is more difficult with limited options from surrounding flaps, which usually have different skin textures and colors, *e.g.*, glabellar flaps[1].

The Hughes flap has become a common procedure for lower lid reconstruction, yet it has some disadvantages. Different procedures were adopted to avoid some of the problems of the Hughes flap and to improve the outcome[11-12]. The use of pedicle flaps has been described in different studies where the flaps depend on the blood supply of the central pedicle. However, few studies have evaluated the advantages of using sliding flaps for large lower lid defects.

The aim of this work was to evaluate outcomes and patient satisfaction in full-thickness lower lid defect reconstruction using a sliding pendular flap technique.

PARTICIPANTS AND METHODS

Ethical Approval The study protocol was approved by the Institutional Research Ethics Committee of Cairo University (N-491-2023). The study and data collection conformed to all local laws and adhered to the principles of the Declaration of Helsinki. Informed consents were taken from all patients to publish their preoperative and postoperative photos for the aim of research work.

The medical records of all patients who underwent primary lid reconstructive surgeries between January 2020 and August 2023 were reviewed. Patients with medial or central lower lid defects that could not be repaired by direct closure after canthotomy or cantholysis, who completed at least 6mo of follow-up were included. We excluded patients with a history of previous lid surgeries.

Preoperative full ophthalmological examination was performed. Assessment of the lower lid included the following: size of the defect at the time of presentation or the presumed defect after excision of the lid mass was performed using a caliber and is expressed as a percentage of the horizontal length. Ocular surface assessment was performed by tear break-up time tests and corneal staining using fluorescent dye.

Surgical Technique All procedures were performed by one surgeon (Alahmadawy YA). In cases of lid tumors (Figure 1A), excision of the mass with a safety margin (3 mm) and frozen sectioning were performed in the same setting. Canthotomy and cantholysis were performed first to create a sliding full-thickness composite flap (skin, muscle, and tarso-conjunctiva) from the lateral part of the remaining lid. A subciliary incision approximately 3-4 mm below the lid margin was made to completely free the flap from the lower lid retractors and the orbital septum until adequate sliding could be achieved. The pedicle of the conjunctiva was left to keep the flap attached to its blood supply (Figure 1B). The lower border of the sliding lid was sutured to its new place on the remaining lower lid skin. The medial end of the sliding flap was sutured to the medial end of the defect in the case of central defects using vertical mattress suture 6/0 polyglycolic acid sutures (Figure 1C). In the case of medial defects, the sliding flap was sutured to the remnants of the medial canthal tendon or to the periosteum. The lateral new defect was closed. If the periosteal strip was able to reach the lateral edge of the remaining medial posterior lamella, then it was sutured with a 6/0 polyglycolic acid suture in a mattress fashion. The edge of the periosteal strip should be anterior to the posterior lamella.

In larger defects, the free tarsal graft from the ipsilateral upper lid was sutured medially to the free end of the pendular flap using 6/0 polyglycolic acid suture. This free tarsal graft was fixed and lengthened laterally by a periosteal flap from the periosteum overlying the zygomatic bone sutured together (Figure 1D).

The anterior lamella was reconstructed by the sliding skin of the Tenzel flap from the skin of the temple. If the lacrimal system was involved, intubation of the remaining part of the canaliculus was performed if feasible.

All surgical steps are diagrammatically represented in Figure 2.

Postoperative assessment included lid assessment for flap viability and final lower eyelid position. Lid retraction was assessed by marginal reflex distance 2 (MRD2) measured from the corneal light reflex to the lower eyelid margin.

The preoperative and early postoperative photos of the patients were shown to an oculoplastic consultant other than the authors; moreover, patients were called to visit the oculoplastic clinic for a recent follow-up where they were assessed. The final cosmetic outcome regarding the contour and margin integrity, the continuity of the lash line medially and centrally and the lid position was assessed by another oculoplastic consultant, and scoring was given according to a proposed scale.

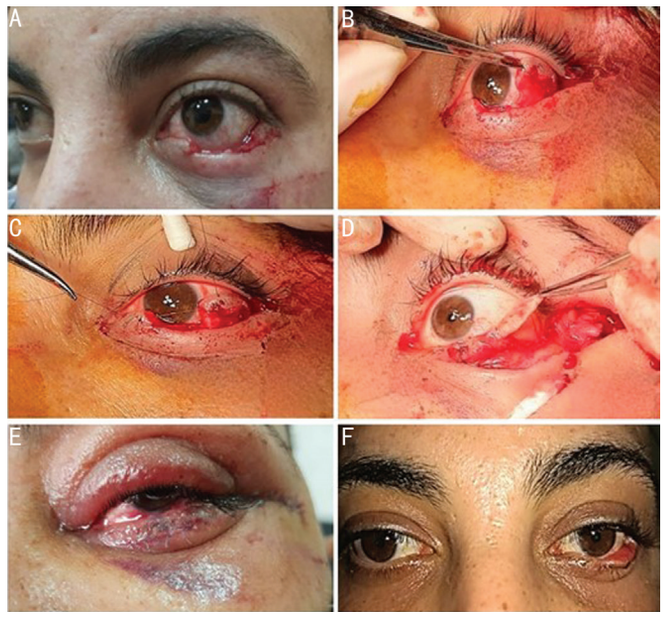

Figure 1 A patient with a large traumatic central defect A: Preoperative photo; B: A sliding flap is created based on a conjunctival pedicle; C: A flap is transposed medially and sutured to residual medial tissue; D: An extra tarsus graft is sutured medially to the transposed tissue and laterally to the periosteal flap; E: A good lid position and contour were achieved in the early postoperative period; F: Lateral graft ectropion in the same patient at the one-month follow-up.

Table 1 Postoperative lid scoring scale

Assessment criteria	Unsatisfactory	Satisfactory
Lid position	0	1
Lash line	0	1
Lid margin contour and integrity	0	1

Score 3: Excellent cosmesis; Score 2: Moderate cosmesis; Score 1: Fair cosmesis; Score 0: Bad cosmesis.

Lid position and the lash line were assessed as follows: lid position was given a score of 0 in cases of entropion, ectropion, or lid retraction. The lash line was given a score of 0 if there was loss of lashes or discontinuity of the line. Lid margin contour and integrity were scored as zero if there was any irregular margin or notching (Table 1).

Patient satisfaction was assessed postoperatively after at least 6mo of follow-up using a visual analogue scale (VAS). This scale includes a vertical line and two accompanying faces at its inferior and superior ends, representing complete dissatisfaction and full satisfaction, respectively. The patient signs the point on the line that matches his/her level of satisfaction with the final cosmetic outcome. The scores ranged between 0 and 10.

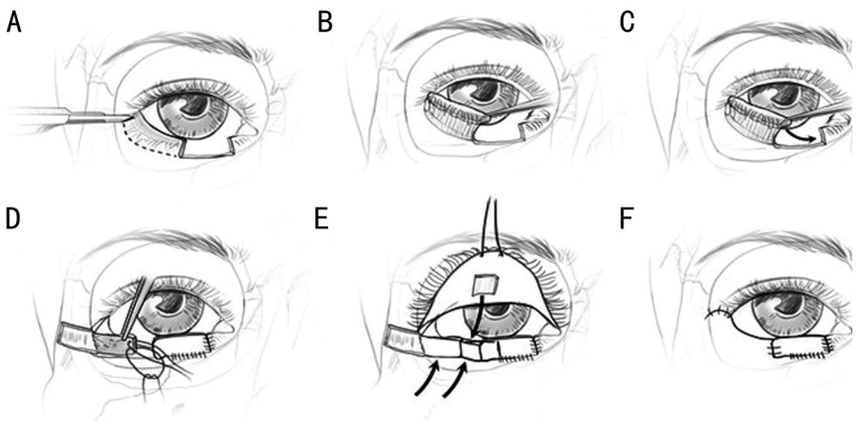

Figure 2 A diagrammatic illustration of the surgical steps A: Canthotomy, cantholysis, and subciliary incision; B: A sliding flap is created based on a conjunctival pedicle; C: A flap is transposed medially and sutured to residual tissue; D: A periosteal flap is created and sutured to a transposed flap; E: An extra tarsus graft is used for large defects; F: A rotational Tenzel flap is created to reconstruct the anterior lamella of the lateral defect.

The data for the last follow-up were coded and entered into the Statistical Package for Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). The quantitative data are presented as the means and standard deviations, and the categorical data are presented as frequencies (counts) and relative frequencies (percentages).

RESULTS

The medical records of 97 patients who underwent reconstructive lid surgery between January 2020 and August 2023 were reviewed. Twenty-seven patients fulfilled the inclusion criteria. Only 20 patients who agreed to participate in the final assessment by a consultant were included in the study. The demographic data of the patients are included in Table 2.

Nine patients were presented with medial defects (45%) while 11 patients had central defects (55%). Eleven patients (55%) underwent reconstruction using a sliding flap together with a periosteal flap only in whom the size of the defects ranged from 25% to 50% (mean: 37.8%±7.2%). Nine patients (45%) required an additional free tarsus graft sutured to the periosteal flap in whom the defect sizes ranged from 45% to 80% (mean: 60.77%±11.1%). Type of defects, technique of repair and complications are summarized in Table 3.

Intraoperative intubation was performed in two trauma patients and only one tumor patient in whom the medial end of the canaliculus could be detected after excision of the tumor and was exteriorized on the surface. The mean postoperative MRD2 measurements were 5.325±0.63 (range: 4-7) mm.

In the medial defect group, those who underwent repair with only a periosteal flap (6 patients), two patients (33.3%) developed postoperative retraction secondary to dehiscence of the medial canthal suture which was further complicated by lagophthalmos in one of them. The defect size in these patients was 45% and 42% respectively, both patients required repair by canthopexy.

Among those who underwent free tarsal grafting (3 patients), one patient (33.3%) had lateral graft ectropion one month postoperatively and required a lateral tightening procedure; a procedure like lateral tarsal strip together with shortening of the previously fashioned periosteal flap (Figure 3). Another patient developed marginal tarsal graft necrosis that required no intervention and had an irregular contour (defect size 65%).

Table 2 Patient demographic data and clinical characteristics *n* (%)

Items	Data
Age (y), mean±SD (range)	46.3±18.1 (20-70)
Sex (males)	13 (65%)
Systemic diseases	
DM	2 (10%)
HTN & heart diseases	1 (5%)
Etiology	
Tumors (total)	11 (55%)
BCC	10 (90.9%)
SCC	1 (90.09%)
Trauma (total)	9 (45%)
Dog bite	1 (11.1%)
Falling	1 (11.1%)
Sharp instrument	2 (22.2%)
Gun shot	1 (11.1%)
Car accident	4 (44.4%)
Size of defect, %, mean±SD, (range)	46.8±14.5 (30-80)
Follow up months, mean±SD (range)	10.94±4.5 (6-24)

DM: Diabetes mellitus; HTN: Hypertension; BCC: Basal cell carcinoma; SCC: Squamous cell carcinoma.

Table 3 Type of defect, technique of repair and complications

Parameters	Medial defect	Central defect
No. (%)	9 (45%)	11 (55%)
Size of defect (%)	44.2±12.2 (33-65)	51.4±15.6 (30-80)
Age in years, mean±SD (range)	45.8±19.9 (20-70)	46.7±15.6 (18-70)
Type of repair		
Periosteal flap only, *n* (%)	6 (66.6)	5 (45.5)
Size of defect (%)	38.3±8.27 (25-50)	37.8±5.6 (30-46)
Periosteal flap and graft, *n* (%)	3 (33.3)	6 (54.5)
Size of defect (%)	56.6±8.4 (45-60)	62.8±11.7 (50-80)
Complications, *n* (%)	4 (44.4)	2 (18.1)

For central defects, all those who had only a periosteal flap showed no complications. Two patients with large central defects (75% and 80%) who required additional tarsus grafts developed postoperative marginal graft necrosis, one of whom ended with an irregular lid contour and mild lid retraction (Figure 4). The other patient had lateral graft ectropion at 1mo despite achieving good contour early postoperatively (Figure 1E, 1F), but neither had lagophthalmos, and no further intervention was needed.

Preoperative corneal examination revealed that three trauma patients (15%) had inferior punctate keratopathy secondary to exposure, while none of the tumor patients had corneal abnormalities. The signs of exposure keratopathy disappeared completely postoperatively and did not appear in any of the new patients.

Regarding the final cosmetic outcome, the mean average postoperative score was 2.65±0.43 (range: 2-3). The patients' satisfaction score, assessed using a visual analog scale, was 7.25±2.2 (range: 3-10). No cases have encountered any postoperative ocular discomfort.

DISCUSSION

The goal of eyelid reconstruction is to restore the anatomical and functional structure of the eyelid together with an aesthetically acceptable appearance. Reconstruction of large medial and central lower lid defects is more complex[13-17].

For medial defects, the complexity of the medial canthal anatomy and the presence of the nasolacrimal cavity, the difference in skin texture and color of the available flaps and grafts might lead to a poor match for lid skin[18-19].

In the case of central defects, the available options for reconstruction of the posterior lamella are mainly bridging flaps or free tarsus grafts. The skin can also be compensated by free grafts or flaps from the periocular region, which may be deficient, especially in trauma cases.

Classically, those patients are either candidates for Hughes flaps with free skin grafts or free tarsal grafts with skin flaps. Hughes flaps, however, have several disadvantages. It is a two-stage surgery in which the eye is closed for at least 2wk. Loss of lashes at the site of the flap is of aesthetic concern. Persistent postoperative hyperemia was reported and was attributed to the reversed orientation of the tarsal plate within the reconstructed lower eyelid. In addition, postoperative upper eyelid retraction has been reported in 19% to 32% of patients. Moreover, it is more difficult to use it in medial defects as the tarsus becomes thinner and weaker medially[20-25].

In this study, the authors adopted the idea of "like for like reconstruction" by using residual lid tissues and converting medial and central defects to lateral defects. This allows feasible reconstruction of the anterior lamella of the newly formed lateral defect due to the abundance of skin from the surrounding area, *e.g.*, from the upper lid by the Tripier flap or skin of the temporal region by the Tenzel flap. The availability of a periosteal flap also represents an efficient option for reconstruction of the posterior lamella[23].

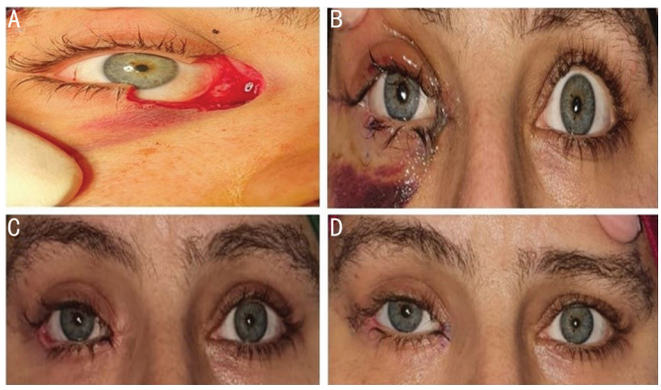

Figure 3 A large medial defect after basal cell carcinoma excision A: Preoperative photo; B: A periosteal flap with a free tarsus graft were used with good postoperative lid position and contour; C: Lateral graft ectropion developed at 1mo postoperative; D: After correction by lateral tarsal strip.

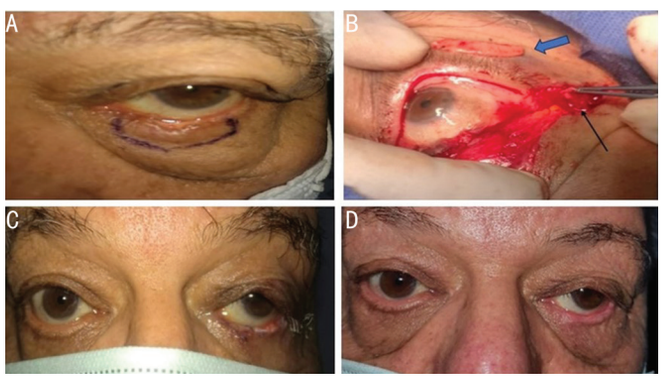

Figure 4 A large central lid defect after basal cell carcinoma excision A: Marking excision site of lower lid basal cell carcinoma; B: Fashioning a tarsus graft (blue arrow) and a periosteal flap (black arrow); C: Marginal graft necrosis one-month postoperative; D: Irregular lid contour.

Reconstruction using a periosteal flap was first designed by Smith to replace the lateral canthal tendon[26]. In 1985, Weinstein *et al*[27] extended the strip to reconstruct the posterior lamella, as was adopted in our case series. The periosteal flap keeps the lower eyelid in the desired position, maintains the upward curve, and supports the eyelid in general.

In our cohort, we encountered some complications while using free grafts in large defects, more than 50% of the horizontal length, such as marginal necrosis and lateral graft ectropion.

The occurrence of marginal necrosis might be explained by the defective vascularity required for graft survival because the graft was sutured between an extended periosteal flap and transposed lid tissue with a narrow conjunctival pedicle. We conclude that suturing flaps to the native lid tarsus provides a more stable vascular supply and hence better healing than

suturing flaps to a graft, as the "flap to flap is better than flap to graft to flap!".

As regarding lateral ectropion, previous studies recommended that at least the medial half of the tarsus should be preserved while using a periosteal flap for repair. Using it for larger defects was associated with ectropion, eyelid sagging, cosmetic deformity, and poor function because the periosteum is less rigid than the tarsus so can't guarantee a good canthal support for the graft against gravity. It is also advisable to suture the periosteal flap to an intact native tarsus whenever possible to enhance adherence[13,26]. An extended periosteal flap beyond the need for canthal support mostly played a role in weakening the support of the reconstructed lid. We assume that in large defects, if a smaller periosteal flap is fashioned just to act as lateral canthal support, as was first designed by Smith and Nesi[26], this might decrease the incidence of lateral ectropion.

In our study, patients who mostly developed postoperative retraction were those with medial defects >40% secondary to dehiscence of the medial canthal suture unlike those of central defects, this matches previous results reporting that autogenous free tarsus grafting represents an effective reconstructive procedure with a good healing outcome if sutured directly to the edge of the lid tissue remnants in central defects[28-30]. The complications associated with the medial defects in our series could also be explained by the long distance of flap transposition. This might result in kinking of the conjunctival vessels of the flap pedicle.

The concept of shifting the defect was discussed before with various techniques. Lateral repositioning or shifting of the defect was described by Perry and Allen[31], who transposed the native posterior lamella medially in central and medial defects. In their technique, the anterior lamella was repaired using a myo-cutaneous advancement flap rather than the rotational Tenzel flap. We believe that these rotational flaps counteract the negative effect of gravity and might prevent postoperative lid retraction. These authors reported postoperative complications in 29% of the patients, which was comparable to our findings (30%). These complications included misdirected lashes, granulomas, hypertrophic scars, ectropion, small areas of symblepharon and kinks of the upper lid free tarsal graft donor site.

Similarly, Galindo-Ferreiro *et al*[32] reported the use of this technique for repairing large lower lid defects. Their technique differs from ours in that dissection extends beyond the edge of the lateral orbital bone. These authors reported complications in 2 patients with 70% and 75% defects, respectively. There was one patient with early medial dehiscence and one patient with mild ectropion.

In the assessment of the postoperative results, we attempted to evaluate the patient objectively by using a scoring system to evaluate the success of the surgical technique, which revealed acceptable results. The surgeon's perception of success may differ from that of the patient. Therefore, assessing patient satisfaction should be one of the major outcomes sought[29]. The preservation of the lash line together with the use of skin of a similar nature to cover the defect plays a major role in the final cosmetic appearance of the lid and patient satisfaction. Patients themselves can vary from one to another given apparently similar functional outcomes. This difference depends on the age, sex and etiology of the lid defect. Patient satisfaction is not affected by minor postoperative complications due to low expectations after tumor excision or major trauma also due to absence of any symptoms of ocular discomfort.

Our technique is theoretically more indicated for medial defects due to the inadequacy of the Hughes flap. However, our cohort reported better results for central defects 50% or less in size.

Another limitation of this technique is that it is a lengthy technique, which may limit the advantage of being a one-stage surgery. Technically, this procedure is even more difficult when used to reconstruct large medial defects. Although the Hughes technique is a 2-stage technique, the simple 2nd stage of cutting the flap under local anesthesia is considered a minor procedure. Furthermore, this technique cannot avoid the risk of upper lid complications when harvesting large grafts for large defects. In addition, some have suggested that one potential advantage of the Hughes procedure is the upward traction it exerts on the reconstructed eyelid, acting as an in-situ frost suture to guard against postoperative lid retraction. It also controls the final position of the lower eyelid margin at the time of graft division (second stage). These benefits are absent when a free tarsal graft is used[28]. Additionally, the loss of lashes in older patients with large defects with already faint residual lashes might not be bothersome.

The results of our study are being limited by its retrospective nature together with the small sample size, so further prospective comparative studies with larger sample size could be conclusive.

In conclusion, reconstruction of medial/central lower lid defects *via* this technique yielded acceptable cosmetic and functional outcomes and high patient satisfaction. Patients with defects ≥50% of the horizontal length are at greater risk of complications. Better results were obtained in reconstructing central defects. The proper selection of the patient considering the site, the size of the defect and the patient's expectations are highly important when considering the technique. Further studies with larger sample sizes and prospective designs are recommended for better evaluation of this technique.

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Data Availability: Upon request from the corresponding author.

Conflicts of Interest: Alahmadawy YA, None; **Elzanaty RT,** None; **Arfeen SA,** None.

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