

Total Upper Eyelid Reconstruction with Modified Cutler-Beard Procedure Using Autogenous Auricular Cartilage

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ABSTRACT

Introduction: Malignant tumour in upper lid is a surgical challenge to oculoplastic surgeon. Full thickness defect created after removal of large tumour promptly treated with modified cutler beard procedure using autogenous auricular cartilage. Surgical procedure is two staged: In first stage, removal of the tumour followed by full thickness flap repaired; In second stage, opening the closed lid with lid margin repair. Post-operatively, there is good anatomical, functional and cosmetic restoration of the eyelid similar to the other eye.

Aim: To evaluate the efficacy of the modified Cutler-Beard procedure using autogenous ear cartilage for tarsal plate reconstruction in the repair of 70-100% upper eyelid defects.

Materials and Methods: This is a prospective, interventional case series of 16 patients over a period of three years. Patients with upper eyelid defects, secondary to removal of tumour, greater than or equal to 70% were included. Of these patients, those with lymph node involvement, distant metastasis, lower eyelid involvement, corneal infiltration or intra-orbital extension

were excluded. FNAC was done in all the cases. Created defect was measured in mm (length and width) and later expressed in percentage. Pre and Post-operative measurement of Levator Palpebrae Superioris (LPS) was done. Pre and Post-operative measurement of Margin to Reflex Distance (MRD1) were also noted.

Results: Upper eyelid recreation was successful in all patients without complications. Pre-operative LPS action ranged from 0-4 mm, while post-operative LPS action was 12-14 mm. Pre-operative MRD1 ranged from -4 millimeters to -1 mm, while post-operative MRD1 was +3 to +4 millimeters. The follow-up period ranged from six months to two years. Every patient had a successful upper eyelid reconstruction.

Conclusion: The modified Cutler-Beard procedure using an autogenous auricular cartilage graft is an effective procedure for repair of large upper eyelid defects, with acceptable functional and cosmetic results. Furthermore, it is particularly useful in resource-poor areas, due to lower cost than other available options.

Keywords: Choroid, Ciliary body, Coloboma, Levator palpebrae superioris, Ptosis

INTRODUCTION

Repair of full thickness defect created after removal of large tumour is the challenge to the eye surgeon. The goal of the treatment is to restore the normal anatomy, functional and cosmetic appearance of the patient. In addition, the use of a material to restore stability to the upper lid flap is of paramount to the functionality of the eyelid. Flaps without tarsal reconstruction have been studied and such grafts tend to have inadequate stability, with complications such as entropion [1].

Cutler and Beard described the first method of repairing a large upper eyelid defect [2]. Originally introduced in 1955, this procedure involves the creation of an advancement flap from the lower lid that includes skin, orbicularis muscle and conjunctiva. Notably, the flap excludes tarsal plate, as there is not enough tarsal plate in the lower lid to provide adequate tarsus functionality to both the upper and lower eyelids after the procedure [2]. Some years later, another study highlighted the general importance of recreating the anterior lamellae with use of skin and muscle rather than skin itself, given the need to maintain structure and provide good vascular supply. In addition, the study alluded to the fact that medial forehead and glabellar flaps, when used, provide an inferior skin source to replace delicate eyelid skin [3].

While the Cutler-Beard procedure represented a major advancement in the treatment of large upper eyelid defects, concerns about complications such as ectropion and lid shrinkage began to arise [4]. Oculoplastic surgeons started to experiment with grafts that included a tissue element to promote more stability to the upper eyelid flap. Allan Putterman described a composite upper eyelid graft using skin from the upper eyelid with the defect,

as well as tarsus, conjunctiva and skin taken from the opposite eyelid [5]. This procedure, however, included the unenviable manipulation and distortion of an intact upper eyelid. Nasal septal cartilage grafts have been used as a tarsal-conjunctival substitute with some success [6].

The re-distribution of remaining tarsus, whether in the upper or lower eyelid, has been explored as a means of re-establishing the stability to an upper eyelid defect. Leone describes a tarsal-conjunctival advancement flap utilizing lower lid tarsus to fill upper lid defects, but the clear disadvantage of possible lower eyelid instability issues persists in this technique [1]. Kersten et al., describe the use of a rotational upper eyelid tarsal flap for upper eyelid defects, but this procedure is effective only if the eyelid defect is small enough that adequate tarsus remains for a flap to bridge the defect [6]. Jordan et al., described the advancement of a tarsoconjunctival flap, but only in cases in which at least 3 mm of central upper eyelid tarsus remains [7]. In 1997, Yaqub and Leatherbarrow described a technique of using autogenous auricular cartilage as an upper eyelid tarsal substitute in patients with entropion, with good results [8]. Holloman used Achilles cadaver tendon as a tarsal substitute with successful recreation of the upper eyelid and no complications, but the burden of cost and possibility of disease transmission complicate this technique [9]. In addition, in developed countries, bioengineered tarsal substitutes have been utilized, such as tarSys™ [10]. While there is not yet of a plethora of literature evaluating tarSys™, one recent case report recounts two instances in which a foreign body giant cell reaction to tarSys™ necessitated graft removal [10]. Other surgical options have also been advocated for large upper eyelid

defects, including glabellar flaps and Fricke's flaps for anterior lamellae reconstruction, as well as mucous membrane grafts for posterior lamellae replacement. These procedures have significant drawbacks, particularly the utilization of thick skin as an eyelid skin substitute, resulting in poor cosmetics and functionality [11-15].

In general, the modified Cutler-Beard procedure has been advocated for repair of large upper eyelid defects, with various materials used to impart stability to the eyelid. Cartilage has been advocated as a tarsal substitute in different situations with success, but has not been studied specifically as a tarsal substitute in combination with modified Cutler-Beard procedures to correct large upper eyelid defects. In this study, we describe a technique of using autogenous ear cartilage as a means of imparting stability to the traditional Cutler-Beard flap to repair upper eyelid defects greater than 70%.

MATERIALS AND METHODS

This was a prospective, interventional case series of 16 patients over a period of three years. The study was started from January 2012 in Regional Institute of Ophthalmology Medical College Calcutta, India Consent was obtained from each patient for surgical procedure.

Inclusion criteria of this study were tumour in the upper eyelid (malignancy confirmed by fine-needle aspiration cytology) and upper eyelid defects of 70-100% after removal of the tumour [Table/Fig-1]. Patients with involvement of local lymph nodes; distant metastasis in the liver, lung or brain; associated lower eyelid involvement; gross corneal infiltration; or-intra-orbital extension were excluded.

Six patients were male, and ten patients were female. Patient age ranged from 60-86-years. Each patient had an upper eyelid defect created by removal of a large malignant tumour. All investigators adhered to the principles outlined in the Declaration of Helsinki. In addition, the Institutional Ethics Committee at the Medical College of Kolkata, in Kolkata, India, approved the study.

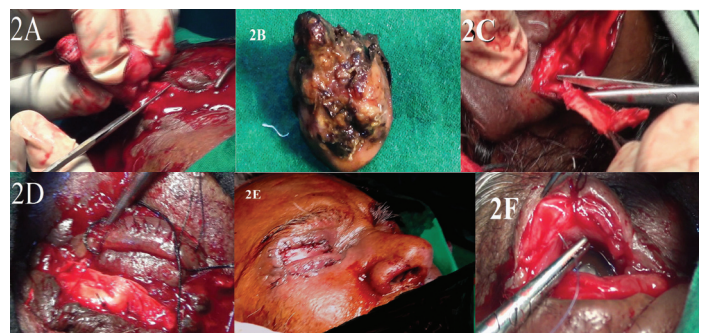
Regarding surgical procedure, the upper eyelid tumour was excised, with a minimum of 4 millimeter of gross macroscopic healthy margins horizontally and vertically, leaving a rectangular eyelid defect. This prevents the post-operative recurrence of the malignancy. Whatever the tumour size and e.g., oval, round, triangular, always made the defect rectangular with cancer free margin. Intraoperative measurement of width and length of created defect express in percentage. Defects ranged from 70-100% that was used to determine the requirement of auricular cartilage support of tarsal plate replacement. Length of the created defect determined the tarsal plate replacement and width is for how much advancement flap negotiate below the bridge flap. A lower eyelid rectangular flap was then made by making a full-thickness horizontal incision two millimeters below the lower tarsal



[Table/Fig-1]: Preoperative image of sebaceous cell carcinoma involving the entirety of the right upper eyelid.

plate, followed by two vertical full-thickness incisions at the medial and lateral borders of the tarsal plate. The tarsus was dissected from this flap and left to maintain structure in the lower eyelid [Table/Fig-2a,b]. This flap was then advanced into the upper lid defect. It was then split into anterior lamellae (skin and orbicularis muscle) and posterior lamellae (conjunctiva and capsulopalpebral ligament). The remaining upper eyelid was then divided into its own anterior lamellae (skin, orbicularis muscle, and orbital septum) and posterior lamellae (conjunctiva and aponeurosis of the levator palpebrae superioris muscle). The posterior lamellae of the flap and upper eyelid were secured together with interrupted 5-0 polyglactine sutures, creating a cartilage bay [2,8,11].

A vertical incision was then made in the back of the pinna on the ipsilateral side of the upper eyelid defect, and a wedge of cartilage was removed [Table/Fig-2c]. The size of the ear cartilage was measured to appropriately replace the tarsus defect in the upper eyelid. The incision was closed with interrupted 5-0 black silk sutures. The graft was then implanted into the cartilage bay made earlier by attachment of advancement flap posterior lamellae with upper eyelid posterior lamellae, and was secured with 5-0 polyglactine sutures [Table/Fig-2d]. The anterior lamellae from the advancement flap were then secured to the anterior lamellae of the upper eyelid, sandwiching the autogenous ear cartilage [Table/Fig-2e]. This bridge flap was maintained for three months. When incised, the bridge flap was maintained with convexity downwards to carefully construct the lid margin, which ideally should be smooth to properly maintain corneal integrity and tear film. The lower lid margin was then smoothed and secured [Table/Fig-2f]. Each patient was examined and photographed at every post-operative visit, with patients followed from six months to two years post-operatively. [Table/Fig-3,4] showed another case of total upper eyelid reconstruction with modified cutler-beard procedure using autogenous auricular cartilage.



[Table/Fig-2]: Steps of operation autogenously auricular cartilage grafted in upper lid replacing tarsal plate by modified cutler Beard procedure. 2a&b) Tumour mass is excised with 4mm healthy margin creating a quadrangular defect in upper lid; 2c). Elliptical auricular cartilage excised from the back of the ear pinna; 2d) Elliptical auricular cartilage fixed on posterior laminae bay, made of upper lid and lower advancement flap; 2e) Quadrangular upper lid created defect filled up by similar advancement flap where auricular cartilage being sandwiched by anterior lamellae and posterior lamellae of upper and lower advancement flap; 2f) In 2nd stage after two and half month there is opening of the lid with creation of upper lid margin.



[Table/Fig-3]: Post-operative lid opening and closure of right upper eyelid of patient who underwent modified Cutler-Beard procedure with auricular cartilage graft.

RESULTS

Six patients were male, and ten patients were female. Patient age ranged from 60-86-year-old. Sixteen patients underwent the two stage modified Cutler-Beard procedure with autogenous auricular cartilage in the repair of large upper eyelid defects after tumour



[Table/Fig-4]: Pre and post-operative image of total upper eyelid reconstruction with modified cutler-beard procedure using autogenous auricular cartilage.

resection. In this study, half of the patients had a 100% lid defect, which require total tarsal plate replacement by autogenous auricular cartilage while the other half of patients had a 70-90% lid defect. It was treated with partial replacement of tarsal plate by auricular cartilage. Pre-operative Levator Palpebrae Superior (LPS) action ranged from 0-4 mm, while post-operative LPS action was 12-14 mm. Pre-operative Margin-to-Reflex Distanced (MRD1) ranged from -4 millimeters to -1 mm, while post-operative MRD1 was +3 to +4 millimeters [Table/Fig-5].

The follow-up period ranged from six months to two years. Every patient had a successful upper eyelid reconstruction. There were no infections, wound dehiscence, cartilage exposure, or wound necrosis in any patient. There was no incidence of ectropion, entropion, lid retraction, lid malposition, ptosis, or lid shrinkage. In this study, regarding created defect out of 16 cases three had 100% defect, four cases were 90% or above, two case were 80% or above, five case were 70% or above. But, all the cases need cartilage support for upper lid recreation. In this series of cases bandage contact lens was applied post-operatively in all the patient. All patients initially had ocular surface irritation due to eyelid margin suture; however, by four months, all patients had adequate eyelid function with a healthy ocular surface. None of the patients required a second surgical procedure. The modified Cutler-Beard flap and autogenous auricular cartilage used for

tarsal reconstruction retained good architecture, stability, mobility, functionality, and cosmesis through the entirety of the follow-up period.

DISCUSSION

As previously described, there are numerous procedures in the literature discussing the repair of complex upper eyelid defects, all with their respective advantages and drawbacks. However, no studies to date have reported the use of the modified Cutler-Beard procedure with autogenous ear cartilage in the reconstruction of large upper eyelid defects (>70%) after tumour excision. This case series highlights the successful use of this technique in the reconstruction of large, often difficult to repair, upper eyelid defects.

All of the patients did well in this case series following the modified Cutler-Beard procedure using autogenous ear cartilage for tarsal reconstruction. We support this procedure due to its unique advantages. The upper eyelid reconstruction provided excellent functionality with good levator function, allowing adequate clearance of the pupil for good vision. Further, none of the patients in the study had resultant upper or lower eyelid entropion, ectropion, lid shrinkage, lid malposition, or ptosis.

A previous study reporting the use of auricular cartilage in the upper eyelid also showed no post-operative complications or additional surgery, this study, however, included graft implantation in the upper eyelid for entropion repair, rather than a Cutler-Beard procedure for eyelid defects. As for cosmetic results, autogenous post-auricular cartilage classically has excellent results. The donor site itself is located in a discrete area, one cannot visualize without manipulation of the ear. The experience of multiple institutions, including both at our own and others throughout the world, highlights the excellent cosmetic results at the donor and recipient site in post-auricular graft usage [8,9,11,16].

Wang explored the clinical effect of the pedicled lower lid-sharing flap for full-thickness reconstruction of the upper eyelid [17]. On 18-month follow-up period, no recurrence, lagophthalmos, hypertrophic scar, or bulky appearance was noted in any of the patients. Aesthetic results for the upper eyelid were obtained for all patients. Similar results were seen in our study. On follow-up for 2 years, every patient had a successful upper eyelid reconstruction.

On the contrary, Saito reviewed 50 cases of malignant periorbital tumour that were treated surgically from 1992 to 2010 [18]. For the upper eyelid, switch flap from lower lid was performed in 11 out of 14 patients those defects exceeding 50% of the horizontal

S.No	Age	Sex	Original Diagnosis	Created defect (mm) (Length + Width)	(%)	Pre-Op LPS action (mm)	Post-op LPS action	Pre-op MRD	Post-op MRD	Follow up in months
1	75	M	SqCC	30 + 18	$30 \div 32 \times 100 = 93.7$	0	14	-4	+4	24
2	78	M	SeCC	32 + 22	$32 \div 32 \times 100 = 100$	0	13	-4	+3.5	18
3	80	M	SeCC	30 + 20	$30 \div 32 \times 100 = 93.7$	0	12	-4	+3	16
4	74	M	SeCC	26 + 14	$26 \div 32 \times 100 = 81.2$	2	13	-2	+4	20
5	76	M	SeCC	24 + 12	$24 \div 32 \times 100 = 75$	0	13	-2	+4	21
6	68	M	SeCC	23 + 12	$23 \div 32 \times 100 = 71.8$	3	14	-1	+4	6
7	74	F	SeCC	32 + 24	$32 \div 32 \times 100 = 100$	0	13	-4	+3	10
8	68	F	SeCC	25 + 14	$25 \div 32 \times 100 = 78.1$	2	13	-2	+3	16
9	86	F	SeCC	32 + 18	$32 \div 32 \times 100 = 100$	0	12	-4	+3	24
10	70	F	SeCC	24 + 12	$24 \div 32 \times 100 = 71.8$	2	13	-2	+4	24
11	72	F	SeCC	28 + 18	$28 \div 32 \times 100 = 97.5$	2	13	-2	+4	20
12	71	F	SeCC	23 + 12	$23 \div 32 \times 100 = 71.8$	2	13	-2	+4	14
13	68	F	SeCC	24 + 12	$24 \div 32 \times 100 = 75$	4	14	-1	+4	24
14	70	F	SeCC	27 + 13	$27 \div 32 \times 100 = 84.37$	3	14	-2	+4	24
15	80	F	SeCC	30 + 20	$30 \div 32 \times 100 = 93.7$	0	14	-4	+4	24
16	82	F	SeCC	30 + 24	$30 \div 32 \times 100 = 93.7$	0	13	-4	+4	24

[Table/Fig-5]: Patient Lid Measurements.

SqCC – Squamous cell carcinoma

SeCC – Sebaceous cell carcinoma

LPS – Levator palpebrae superioris muscle

MRD – Margin to reflex distance

length. He concluded that 72% of major complications were associated with reconstruction of larger defects in upper eyelid, as it is extremely difficult to obtain good results in the patients with large upper eyelid defects.

This study is particularly unique in that it was performed in Calcutta, India. In the area with middle to low socioeconomic groups with limited access to donor grafts and expensive synthetic tissue substitutes, the options for repair of very large eyelid defects are few and can be particularly daunting. Achilles tendon grafts cost around \$1400, while donor sclera is approximately \$650. As for tarSys™, one 1 cm x 4 cm piece of tarSys™ costs \$385.10. Moreover, aside from cost itself of biologic grafts, one must also consider the increased failure rates of such grafts. For example, in a study of anterior cruciate ligament repair using allografts and autografts, allografts were 7.7 times more likely to fail than autografts [19]. The necessitation of removal of implanted tarSys™ grafts in two cases was previously discussed. Failure rates of allografts and synthetic material simply cannot compare to success rates of autografts [20]. As for tarSys™, while there is not yet a plethora of literature studying the material, one recent case reports recounts two instances in which a foreign body giant cell reaction to Tarsys necessitated graft removal [10,16]. Failure rates of allografts and synthetic material simply cannot compare to success rates of autografts. This is the most effective procedure, with lower failure rates, and lower cost, the modified Cutler-Beard procedure with auricular cartilage graft is advantageous in both wealthy countries and those with limited resources.

Finally, the challenges of screening donor tissues thoroughly in certain areas of the world further complicate this issue. If using an autograft, there is no chance of transmission of communicable diseases, as there is no donor tissue involved. Screening for donor tissue infection, including hepatitis B, hepatitis C, and HIV, is expensive and less common in the developing world. The only way that these scenarios can be entirely avoided is by use of autograft, rather than donor, tissue when possible. One minor disadvantage of our technique is that there exists a second surgery site, given that the cartilage graft is autogenous. However, as evidenced above, as cartilage is taken from behind the ear and closed in simple fashion, there is an almost non-existent cosmetic or functional defect. Further as evidenced by this and previous studies, there are no significant functional deficits in the donor flap site of the lower eyelid [21,22].

LIMITATION

In certain condition this procedure is not fruitful. When the malignancy had distal metastasis or local lymph node involved confirmed by biopsy. The patient having upper lid malignancy may involve the lower lid and in case lid malignancy enter into the orbital cavity.

CONCLUSION

The modified Cutler-Beard procedure with autogenous ear cartilage for tarsal reconstruction is an acceptable procedure for repair of eyelid defects of 70-100%. In addition to providing satisfactory cosmetic results, it is safe and cost-effective. The procedure's

efficacy, cost-effectiveness and low complication rates can make it advantageous everywhere, whether in countries with unimpeded access to varied tissues options, or in those with infrastructures that limit such availability.

Surgery of one of the cases can be accessed on the below mentioned Video link for better understanding- <https://youtu.be/Z13wHf9Y0w8>.

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