

Full Thickness Skin Grafts in Periocular Reconstructions: Long-Term Outcomes

Deepa S. Rathore, M.B.B.S., M.S., M.R.C.Ophth, Swaroop Chickadasarahilli, M.B.B.S., M.R.C.Ophth., Richard Crossman, Ph.D., Purnima Mehta, M.B.B.S., M.S., M.R.C.Ophth., F.R.C.Ed., and Harpreet Singh Ahluwalia, M.B.B.S., M.S., M.R.C.Ophth., F.R.C.S., F.R.C.Ophth.

Department of Ophthalmology, University Hospital of Coventry and Warwickshire, Warwick Medical School, Clifford Bridge Road, Coventry, United Kingdom

Purpose: To evaluate the outcomes of eyelid reconstruction in patients who underwent full thickness skin grafts.

Methods: A retrospective, noncomparative intervention study of patients who underwent periocular reconstruction with full thickness skin grafts between 2005 and 2011.

Results: One hundred consecutive Caucasian patients were included in the study, 54 women and 46 men. Mean follow up was 32 months. Indications for full thickness skin grafts were excision of eyelid tumors (98%) and cicatricial ectropion (2%). Site of lid defects were lower lid (60%), medial canthus (32%), upper lid (6%), and lateral canthus (2%). The skin graft donor sites were supraclavicular (44%), upper eyelid (24%), inner brachial (18%), and postauricular (14%). Early postoperative complications included lower eyelid graft contracture (1%) and partial failure (1%). Late sequelae included lower eyelid graft contracture (4%) and hypertrophic scarring (23%). Of the 23 patients with hypertrophic scar, 21 achieved good outcomes following massage with silicone gel and steroid ointment and 2 had persistent moderate lumpiness. No statistically significant association was found between graft hypertrophy and donor site or graft size. As high as 95% of all patients achieved good final eyelid position. Good color match was seen in 94% and graft hypopigmentation in 6%. An association between hypopigmentation and supraclavicular and inner brachial donor site was found to be statistically significant.

Conclusions: Most patients (94%) achieved good eyelid position and color match. Majority (91%) of the early postoperative cicatricial sequelae can be reversed by massage, steroid ointment, and silicone gel application. Full thickness skin grafts have excellent graft survival rates and have minimal donor site morbidity.

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Full thickness skin grafts (FTSG) are composed of epidermis and dermis. When used in periocular reconstruction, they are usually harvested from several possible donor sites.

The periocular region is suited for skin graft as it has a rich vascular supply for capillary regrowth and collagen-producing fibroblasts, which help in graft adherence.^{1,2} FTSG has been widely used in eyelid reconstruction following tumor removal and cicatricial ectropion correction following surgery, trauma, and burns.^{1,2}

The authors evaluated the outcomes of eyelid reconstruction in patients who underwent FTSG.

METHODS

A retrospective case note analysis of all patients who underwent periocular reconstruction with FTSG between 2005 and 2011 was conducted. Data were collected on an Excel datasheet and analyzed both on the Excel datasheet and statistical package R.

The recipient sites included medial canthus, lower eyelid, upper eyelid, and lateral canthus. Various donor sites were used depending on the extent and location of the eyelid defect, tissue availability, and suitability. A template was used to harvest the grafts from the donor sites without attempting to oversize. All FTSG from remote donor sites like postauricular, supraclavicular, and inner brachial area underwent graft thinning. Grafts were secured with interrupted 7-0 silk sutures and or 7-0 Polyglactin 910 sutures (Vicryl).

Postoperative graft site dressing included a pressure dressing using paraffin gauze over the closed eyelids, a dental roll wrapped in paraffin gauze over the graft, and 2 to 3 eye pads taped with long-lasting adhesive tape. No conventional sutured bolster or eye ointment was applied over the graft site.

Donor site closure was carried out in 2 layers using 4-0 polyglactin 910 sutures and 6-0 Polypropylene or 5-0 Ethilon to skin. Donor sites were dressed with betadine spray and a dry adhesive dressing.

Pressure dressing on graft site was left for 3 to 5 days and then health of the graft assessed with sutures removed a week later. Following suture removal, rehabilitation included scar massage with steroid ointment and silicone gel if indicated and was titrated based on response. Subsequent follow up was based on the graft appearance.

The parameters recorded were patient identification number, age, sex, indication for FTSG, FTSG size (longest dimension), primary surgical procedure, adjuvant procedures, second procedure, donor sites (upper eyelid, postauricular, supraclavicular, and inner brachial), and follow-up period.

The primary outcome measures were FTSG host site complications, which included early postoperative complications (within 2 weeks) such as dehiscence, necrosis, infection, bleeding, partial/complete graft failure and ectropion, and late postoperative complications, such as graft hypertrophy, cicatricial ectropion, and hypopigmentation, and donor site complications such as infection and wound dehiscence. The secondary outcome measures included postoperative eyelid position, graft color match, and cosmesis. The degree of color match was assessed between the FTSG and the surrounding skin. This

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Address correspondence and reprint requests to Deepa Rathore, M.B.B.S., M.S. M.R.C. Ophth, Department of Ophthalmology, University Hospitals of Coventry and Warwickshire, Clifford Bridge Road, Coventry, CV2 2DX, United Kingdom. E-mail: deeparathore4@gmail.com

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was assessed by the clinician and recorded as either hypopigmented, adequate, or good.

All statistical analyses were carried out using the statistics package R (v 2.13.0).

The study complied with the policies of the local institutional review board and adhered to the principles of the Declaration of Helsinki.

RESULTS

The study included 100 consecutive Caucasian patients who underwent eyelid reconstruction using FTSG between 2005 and 2011. There were 54 women and 46 men. Mean (standard deviation) age 75 (± 13) years (range 29–95 years). Ninety-eight patients (98%) had FTSG following periocular tumor excision and 2 patients (2%) had FTSG for correction of cicatricial ectropion. The mean follow up was 32 months (range 8–60 months) and median was 29 months.

The most common recipient site was lower eyelid in 60 (60%), followed by medial canthus in 32 (32%), upper eyelid in 6 (6%), and lateral canthus in 2 (2%) (Table 1).

The commonest donor site was the supraclavicular region in 44 patients (44%) followed by upper eyelid in 24 (24%), inner brachial in 18 patients (18%), and postauricular in 14 (14%) (Table 1). Size of the skin grafts ranged from 8 mm to 25 mm in maximum dimensions with a mean of 15 mm, SD ± 4.6 mm and median of 15 mm.

Early postoperative complications were seen in 2 patients (2%). One patient had lower eyelid medial ectropion and needed corrective surgery. One patient (1%) had partial graft failure (area of graft ischemia) and underwent local debridement in outpatients following which it resolved completely within 3 weeks (Table 2).

Late postoperative complications were seen in 27 patients (27%). Twenty-three patients (23%) had graft hypertrophy and 4 (4%) had cicatricial ectropion of lower eyelid (Table 2). All patients were advised massage with steroid cream and silicone gel.

Of the 23 patients with graft hypertrophy, 21/23 (91%) resolved (Fig. 1) with mild residual lumpiness and 2/23 (9%) had persistent moderate lumpiness. The commonest location for hypertrophy were lower eyelid in 14/60 (23%) followed by medial canthus in 7/32 (22%), upper eyelid in 1/6 (17%), and lateral canthus in 1/2 (50%). Among the patients with graft hypertrophy, the donor sites included postauricular 5/14 (36%), supraclavicular 11/44 (25%), eyelid 5/24 (21%), and arm 2/18 (11%). A χ^2 test was employed to determine whether graft hypertrophy was significantly more or less common for any donor site. The p value was 0.831, indicating no statistically significant difference between any of the donor sites. In the group of patients with graft hypertrophy, the mean graft size was 15 mm (ranging from 8 mm to 19 mm, median 15 mm), which was similar to the mean graft size of the group with no complications.

In patients with lower eyelid cicatricial ectropion secondary to contracture of graft, 3/5 (60%) had corrective surgery, 1/5 (20%) had

TABLE 1. Donor and recipient sites for full thickness skin grafts in periocular area

Site	Present Study (N = 100)	Leibovitch et al. (N = 397)	Bush et al. (N = 35)
Donor Site			
Supraclavicular	44%	44.6%	25.71%
Upper eyelid	24%	20.9%	65.71%
Postauricular	18%	16.6%	2.85%
Arm	14%	1.3%	0%
Preauricular	0%	2.5%	5.71%
Recipient Site			
Lower eyelid	60%	28%	54.28%
Medial canthus	32%	66.5%	22.85%
Upper eyelid	6%	5.5%	2.85%
Lateral canthus	2%	0%	8.57%

TABLE 2. Complications of full thickness skin grafts in periocular area

Complications	Present Study (N = 100)	Leibovitch et al. (N = 397)	Bush et al. (N = 35)
Hypertrophic scar	2 (2.2%)	28 (7%)	4 (11%)
Contracture + ectropion	4 (4.4%)	5 (1.2%)	1 (3%)
Infection	0 (0%)	4 (1%)	No comments
Hematoma	0 (0%)	3 (0.75%)	No comments
Partial failure	1 (1%)	8 (2.01%)	0 (0%)
Complete failure	0 (0%)	1 (0.25%)	0 (0%)
Intervention rate	3%	9%	3%

improvement with minimal residual medial ectropion (Fig. 2), and 1/5 (20%) deceased. The donor sites in this group were eyelid 3/24 (13%), inner brachial 1/18 (6%), and supraclavicular 1/44 (2%) and. A χ^2 test was used to determine whether contracture of graft was significantly more or less common for any donor site. The p value was 0.202, indicating no statistically significant difference between any of the donor sites. In the group of patients with graft contracture, the mean graft size was 15 mm (ranging from 10 mm to 21 mm, median 15 mm), which was similar to the mean graft size of the group with no complications.

Good eyelid position was seen in 95 patients (95%). With regard to color match, information was available in 94 patients. Good color match was seen in 88/94 (94%) and graft hypopigmentation in 6/94 (6%) (Table 3). The donor sites in which graft hypopigmentation was seen were supraclavicular 4/44 (9%) and inner brachial in 2/18 (11%).

To explore a possible relationship between grafts taken from donor sites away from the face and graft hypopigmentation, the supraclavicular and inner brachial donor sites were combined into 1 group, as were the eyelid and postauricular sites, creating a 2 \times 2 contingency table with entries based on donor group and on whether hypopigmentation was observed. The Fisher exact test was then applied (due to the small sample size and the 2 \times 2 contingency table), resulting in a p value of 0.038. Hence, a statistically significant association was found between supraclavicular and inner brachial donor sites and graft hypopigmentation. This method was replicated for consideration of contracture of graft and for graft hypertrophy, resulting in p values of 0.808 and 0.647, respectively.

Statistical analysis was performed to identify association between the variables (age, sex, recipient and donor site, FTSG size) and postoperative complications (partial or complete graft failure, graft infection, acute bleeding/hematoma, graft hypertrophy, and graft contracture). These tests are summarized below.

Age was not found to be normally distributed using a Shapiro-Wilks test ($p = 0.001$), and so median ages were compared using the Mann-Whitney U test. No significant difference was found between those with and without complications as a group ($p = 0.369$).

Sex was compared against complications using the Fisher exact test. No significant relationship was found when considering all complications simultaneously ($p = 0.834$) or separately (p values 0.679, 0.805, 0.495, 1).

Sites were compared against complications using the χ^2 test. No significant relationship was found for recipient site when considering all complications simultaneously ($p = 0.599$).

Similarly, for donor site, no significant relationship was found when considering all complications simultaneously ($p = 0.831$).

FTSG size was found to not be normal using a Shapiro-Wilks test ($p = 0.0003$), and so median sizes were compared using the Mann-Whitney U test. No significant relationship was found when considering all complications simultaneously ($p = 0.249$) or separately (p values 0.150, 0.116, 0.863, 0.564).

DISCUSSION

Periocular region is a favorable FTSG recipient area by virtue of its high vascularity. The usual donor sites for harvesting

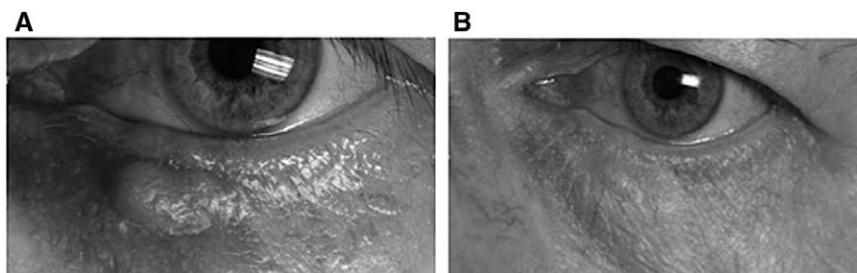


FIG. 1. **A**, Early skin graft hypertrophy and **(B)** Postmassage resolution of hypertrophy.

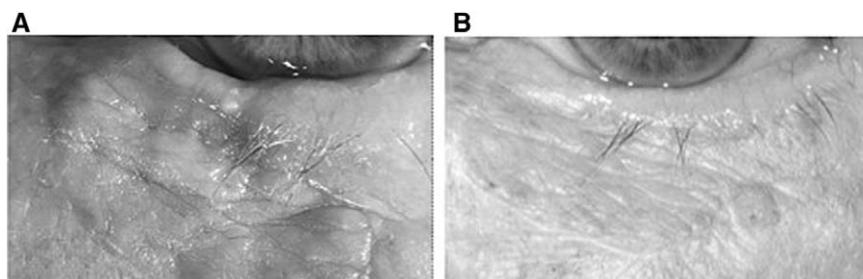


FIG. 2. **A**, Graft contracture with irregular surface and **(B)** Postmassage resolution with good color match.

TABLE 3. Outcomes of full thickness skin graft in periocular area

Outcomes	Present Study (N = 100)	Bush et al. (N = 35)
Eyelid position	Good position: 95% Ectropion: 5%	97% 3%
Color match (N = 94)	Good color match: 94% Hypopigmentation: 6%	85% No comments
Cosmesis	Good cosmesis: 87% Slightly thickened: 2% Ectropion: 5% Hypopigmentation: 6%	No comments 11% No comments No comments

FTSG for the periocular area are upper eyelid, preauricular, postauricular, neck, clavicular, supraclavicular, and inner brachial area. Different sites yield different graft thickness.¹⁻³

The early complications seen in the first 2 weeks are mainly bleeding with hematoma formation beneath the graft, infection, or seroma formation. These complications may prevent graft adherence to the underlying wound bed, prolong the ischemic phase, compromise the graft's vascular supply, and result in graft failure. Late complications seen by 3 months are cicatricial ectropion and graft hypertrophy and contracture. The long-term complications are mainly cosmetic or functional and result from color and texture mismatch, and hyper or hypopigmentation.¹⁻³

In this series of 100 cases, there was no hematoma formation, infection, or complete graft failure. One patient showed signs of partial graft failure, which resolved following debridement.

Graft contracture results due to unopposed action of elastic fibers, resulting in variable degrees of shrinkage. The factors influencing shrinkage are mainly elasticity of the donor site and graft thickness.^{1,2} Graft contraction is believed to be more prominent as the thickness of the graft decreases.^{3,4} Stephenson et al.⁵ found that in the presence of infection, the graft contracted to almost half the initial size, and in cases where there was no infection, the graft contracted by one-third. In addition, more

contraction occurred in grafts placed in the nasal and periorbital areas compared with the temple and scalp.

In this study, there were only 5 cases of significant graft contracture (5% of all patients). Although the majority of the contracture cases occurred in lower eyelid (5 cases out of 60), this was not statistically significant and was explained by the relatively higher number of lower eyelid defects treated (60%). Leibovitch et al.⁶ had majority of cases with contractures and ectropion involving the medial canthus and lower eyelid. Bush et al.⁷ have also reported mild contractures in their study however no site has been implicated.

Like Stephenson et al. and Leibovitch et al., who found no significant difference in graft contraction between the different donor sites for FTSG harvesting, the authors found that though the eyelid donor site (3 out of 5 cases) was associated with graft contracture, it was not statistically significant. Eyelid skin is thin and this would explain the association with contracture.

The exact mechanism for graft hypertrophy is not fully understood, and it probably represents an aberration in the process of wound healing, which includes cell proliferation, inflammation, and increased synthesis of cytokines and extracellular matrix proteins. This may be a similar process to that of hypertrophic scars and keloids formation.⁸ Leibovitch et al.⁶ had a majority of graft hypertrophy in medial canthus 26 (6.5%).

In this series, the commonest donor site causing hypertrophy was postauricular followed by eyelid, supraclavicular, and inner brachial, but no statistically significant difference was found ($p = 0.647$). To the best of the authors' knowledge, no other studies on periorbital FTSG have commented on donor site in relation to graft hypertrophy.

Various treatment options to reduce hypertrophic scarring include observation, pressure dressing, massage, silicone gel sheets, pulsed dye laser treatment, intralesional corticosteroids, dermabrasion, and laser CO₂ resurfacing.⁸⁻¹⁰ The authors found most of their patients had significant resolution following massage with silicone gel and steroid ointment.

Color mismatch and pigmentation differences are generally temporary and improve gradually, but may, on occasion, be permanent and require interventions like dermabrasion or laser resurfacing.^{1,2} In this series, the donor sites like supraclavicular

and inner brachial that are away from the face were found to have had an increased association with hypopigmentation and were statistically significant ($p = 0.038$).

Ninety-five percent of the cases achieved good eyelid position similar to 97% in Bush's series. Good color match was seen in 94% similar to that in Bush et al.⁷ (85%).

None of the patients in this series were documented to have donor site morbidity such as wound dehiscence, infection, and unacceptable scars.

This study also demonstrates that suturing bolsters to the FTSG in the periocular region is not required, as reported by Bush et al.⁷ in their series of 47 FTSG cases. This technique of postoperative dressing achieves compression and immobilization of the graft similar to what is achieved by bolsters. Any complications were not observed secondary to graft nonadherence in this series. Graft size had no effect on postoperative sequelae.

CONCLUSION

In this large series of Caucasian patients, FTSG have minimal donor site morbidity with excellent graft survival rates with most patients achieving good eyelid position and color match.

Upper eyelid donor site was associated with increased incidence of graft contracture though not statistically significant. Early hypertrophy and contracture in FTSG is not uncommon, although no statistically significant association was found between either donor site or graft size. The vast majority can be reversed with early initiation of topical anticicatricial agents along with digital massage.

Best color match was achieved with FTSG harvested from facial skin (e.g., eyelid, postauricular) compared to nonfacial donor sites (supraclavicular and inner brachial), which also revealed a statistically significant relationship with hypopigmentation.

REFERENCES

1. Johnson TM, Ratner D, Nelson BR. Soft tissue reconstruction with skin grafting. *J Am Acad Dermatol* 1992;27:151–65.
2. Ratner D. Skin grafting. From here to there. *Dermatol Clin* 1998;16:75–90.
3. Valencia IC, Falabella AF, Eaglstein WH. Skin grafting. *Dermatol Clin* 2000;18:521–32.
4. Rudolph R. The effect of skin graft preparation on wound contraction. *Surg Gynecol Obstet* 1976;142:49–56.
5. Stephenson AJ, Griffiths RW, La Hausse-Brown TP. Patterns of contraction in human full thickness skin grafts. *Br J Plast Surg* 2000;53:397–402.
6. Leibovitch I, Huilgol SC, Hsuan JD, Selva D. Incidence of host site complications in periocular full thickness skin grafts *Br J Ophthalmol* 2005; 89: 219–22.
7. Bush K, Cartmill BT, Parkin BT. Skin grafts in the periocular region without a bolstered dressing. *Orbit* 2012;31:59–62.
8. Tredget EE, Nedelec B, Scott PG, et al. Hypertrophic scars, keloids and contractures. The cellular and molecular basis for therapy. *Surg Clin North Am* 1997;77:701–30.
9. Moran ML. Scar revision. *Otolaryngol Clin North Am* 2001;34: 767–80, vi.
10. Alster T. Laser scar revision: comparison study of 585-nm pulsed dye laser with and without intralesional corticosteroids. *Dermatol Surg* 2003;29:25–9.