

Primary dermis fat graft as orbital implant after evisceration

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Abstract

Aims: Orbital implants allow for cosmesis and volume replacement of an eviscerated eye. Alloplastic orbital implants are associated with potential complications, including exposure and extrusion. Dermis fat graft offers the advantages of its relative availability and autologous nature. This study aimed to provide evidence for dermal fat graft as a safe and stable orbital volume replacement following ocular evisceration.

Methods: This prospective case series involved the placement of dermis fat graft harvested from the paraumbilical area of the patient's abdomen into the eviscerated scleral shell with the dermis sutured to the sclera and covered by conjunctiva. At 6 weeks postoperatively, patients received an ocular prosthesis. The volume of the dermis-fat grafted globe was measured at 1 month and 9 months postoperatively by plain magnetic resonance imaging of the orbit. Postoperative exophthalmometry was performed with the prosthesis in place at 1 and 9 months. A numerical satisfaction scale score was obtained from patients 9 months postoperatively.

Results: Eight patients underwent ocular evisceration and dermis fat graft implant. Six patients completed the study. The dermis fat-grafted globe showed a reduction of mean (standard deviation) of 1.92 (1.31) ml after

9 months ($p = 0.028$, Wilcoxon signed rank test). Clinical exophthalmometry showed a mean difference (standard deviation) of 2.14 (0.9) mm compared with the fellow eye after 9 months ($p = 0.083$, Wilcoxon signed rank test). Mean satisfaction score was 6.5 (range, 5 to 8).

Conclusions: Dermis fat graft is a viable alternative to alloplastic implants as a primary orbital implant following ocular evisceration. Despite the reduction in volume and clinical enophthalmos over time, it is a safe implant without significant complications. Dermis fat graft may be particularly useful for a subset of patients at risk of exposure or extrusion from alloplastic implants.

Key words: Adipose tissue; Eye enucleation; Orbital implants; Prostheses and implants; Transplantation, autologous

Introduction

Smith and Petrelli¹ first described the use of autogenous dermis fat grafts as a secondary implant following extrusion. As a primary implant, the use of dermis fat graft has been described following ocular enucleation.² Despite the success of alloplastic implants, autogenous graft as an orbital implant should not be discounted, as complications arising from alloplastic implants such as exposure and extrusion have been reported. In particular, exposure rates of porous implants after evisceration and enucleation range from 2 to 10%.^{3,4} Hence, this study revisits dermis fat graft as a

primary orbital implant given its autologous nature and relative availability. In contrast to previous studies, this study examines dermis fat graft implants in eviscerated orbits. The radiological outcome of the dermis fat graft is traced over time so that an improved understanding of fat absorption can be gained.

Methods

The study was approved by the ethics committee review board of the Hospital Authority, Hong Kong, in accordance to the Declaration of Helsinki. Informed consent was obtained from all patients prior to entry in the study. Inclusion criteria included patients who had a painful blind eye from infective causes or terminal glaucoma who were indicated for evisceration. Exclusion criteria included patients with known ocular malignancy, previous abdominal surgery, or prior evisceration and implant. Patients were recruited between August 2008 and August 2009. Eight consecutive patients who met the inclusion criteria were recruited and six patients completed the study.

All procedures were performed under general anesthesia. Evisceration was performed commencing with a 360° peritomy followed by a limbal incision with a 15° blade as described by Chen.⁵ The cornea was excised using corneal scissors. The uvea was separated from the sclera and the uveal contents were removed followed by an absolute alcohol rinse. Hemostasis was achieved by cold saline packing and monopolar cautery. Radial posterior sclerectomies were performed as described by Stephenson,⁶ whereby the sclera is cut in between the horizontal and vertical recti muscles in an anteroposterior direction beginning anteriorly at the equator and extending to the optic nerve posteriorly (**Figure 1**).⁶

The dermis fat graft was harvested from the paraumbilical region as described by Bonavolontà et al.⁷ A 20-mm horizontal incision was made in the paraumbilical area. The dermis was excised with the diameter of the fat ball measuring 20 mm, and underlying fat to a depth of 25

mm to obtain a cylindrical shape. Following hemostasis, the paraumbilical wound was closed with 5-0 prolene sutures. The dermis was trimmed to fit the scleral opening and the fat portion of the dermis-fat graft was placed into the scleral shell. Intraoperative Hertel exophthalmometry was performed to ensure that there was a small degree of overfilling to eviscerated orbit. The aim was for a 2-mm proptosis for the dermis fat graft implant. The dermis was sutured to the sclera by using 5-0 ethibond. The conjunctiva was closed with 6-0 vicryl sutures, and a conformer was placed over the conjunctiva into the fornices. The ocular wound was dressed with a pad and bandage for 3 days postoperatively. The abdominal wound from where the dermis fat graft was harvested was examined and the sutures were removed 1 week postoperatively. At 6 weeks postoperatively, the patient received an ocular prosthesis.

All magnetic resonance imaging (MRI) was done by the 1.5 Tesla Siemens Symphony MRI system (Siemens, Erlangen, Germany) with an 8-channel head coil. Axial T1 spin echo and T2 turbo spin echo slices of 2 mm thick were obtained. The volumes of the post-evisceration globe, with the primary dermis fat graft and ocular prosthesis in place, and the contralateral orbit were measured on the Vitrea 2 workstation (Vital Images Inc., Minnetonka, MN, USA) by a single radiologist. The dermis fat-containing globe and the contralateral globe were first segmented by outlining the region of interest with a freehand drawing tool in each slice of the image. The volumes were calculated by the workstation using the volume measurement tool.

The volume of the dermis fat graft was measured at 1 and 9 months postoperatively by plain MRI of the orbit. Hertel exophthalmometry was performed with the prosthesis in place at 1 and 9 months postoperatively (**Figure 2**). A self-rated numerical satisfaction scale score for cosmetic satisfaction was obtained from each patient. A score of 1 to 4 was considered unsatisfactory, a score of 5 to 7 was considered satisfactory, and a score of 8 to 10 was considered very satisfactory.

Results

Eight patients were recruited into the study and six patients completed the study. The two patients who did not complete

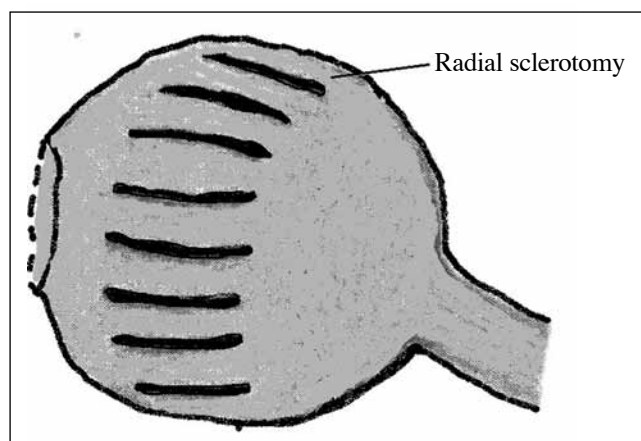


Figure 1. Diagram showing radial anteroposterior sclerectomies based on Stephenson's technique.⁶



Figure 2. Right eye with dermis fat graft and ocular prosthesis at 9 months postoperatively.

the study defaulted the MRI of the orbit after the first MRI at 1 month. A summary of patients' demographics and indications for evisceration are presented in the **Table**.

All patients had comorbidities; one patient had sepsis following pneumonia, three had diabetes mellitus, two had hypertension, one had ischemic heart disease and chronic renal failure, and one had giant cell arteritis and was taking oral prednisolone at the time of the study.

The mean (standard deviation [SD]) volume of the dermis fat-inserted globes at 1 month was 3.83 (1.77) ml and at 9 months was 1.96 (1.33) ml. There was a mean (SD) reduction of 1.92 (1.31) ml ($p = 0.028$, Wilcoxon signed rank test). Exophthalmometry showed a mean difference (SD) between the normal and dermis fat-inserted globe of 1.71 (1.25) mm at 3 months. At 9 months postoperatively, the difference was 2.14 (0.9) mm ($p = 0.083$, Wilcoxon signed rank test).

The mean numerical satisfaction scale score was 6.5 (range, 5-8) at 9 months postoperatively.

There were no major adverse events related to the periumbilical fat harvest site in all patients. Clinical examination showed good integration of the bulbar conjunctiva to the dermis in all patients. There was no fat extrusion from the epidermis. No hair growth from the dermis, conjunctival cysts, or pyogenic granuloma were noted. All patients were followed up for 1 year after the procedure. No adverse effects occurred in the long term. No conjunctival scarring, shallow fornices, or post-enucleation socket syndrome were noted 1 year after the procedure. Following the initial ocular prosthesis fitting, no patients required a second fitting at the time of this manuscript submission.

Discussion

The use of dermis fat graft to reconstruct an anophthalmic

socket was first described by Smith and Petrelli in 1978.¹ The use of dermis fat graft as a primary orbital implant after enucleation has been previously reported.^{2,3} Dermis fat grafts have also been reported as a secondary implant following exposure or extrusion of alloplastic implants.⁵ Our series investigates the use of dermis fat graft as a primary implant after evisceration and aims to trace the radiological outcome of the implant.

Dermis fat grafts have the advantages of relative abundance and light weight. For the same volume, a dermis fat graft is lighter than silicone or hydroxyapatite implants. To simulate the anterior curvature of the globe, we have adopted a technique by Putterman modified from Smith and Petrelli to create a dome-shaped dermis fat graft by creating 4 small base-out triangles sutured with vicryl (**Figure 3**).^{1,8} With the anterior convexity present, the prosthesis can be lighter and thinner centrally and extend more deeply into the fornices. In addition, the dermis fat graft was harvested as a cylindrical shape with the fat portion flared out so that the diameter of the fat is slightly larger than the diameter of the dermis cap. The elongated cylindrical shape of the fat also allows for an overfilled volume within the eviscerated scleral shell as fat atrophy was anticipated.

Previous reports have documented the harvest of dermis fat from the gluteal area,⁹ hip region,¹⁰ inner thigh,¹⁰ and arm¹¹;

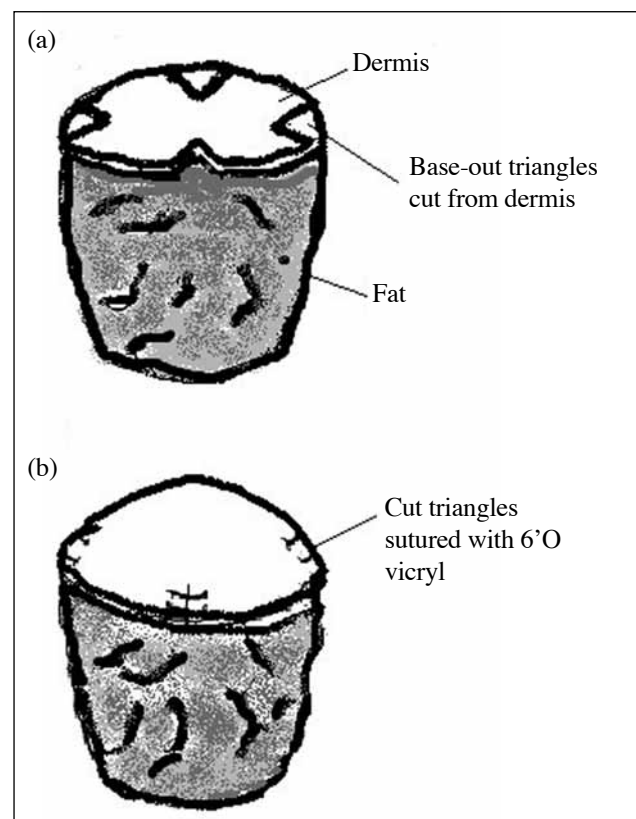


Figure 3. Diagrams showing (a) base-out triangle cuts based on Putterman's technique, and (b) dome-shaped dermis fat graft after the triangle cuts were sutured based on Putterman's technique.⁸

Table. Summary of patient demographics and indications for evisceration.	
Demographics / indications	No. of patients (unless otherwise stated)
Age (years)	
Mean	66
Range	58-83
Sex	
Male	6
Female	2
Laterality	
Left	7
Right	1
Indication for evisceration	
End-stage glaucoma	3
Endophthalmitis	5

in this study, a modified technique described by Bonavolontà et al⁷ was adopted, whereby the periumbilical dermis fat is harvested. The dermal fat layer in the periumbilical area is abundant. Moreover, the area is relatively hair-free compared with the gluteal region, and the dermis has a thickness sufficient to be resistant to severe reabsorption and can become vascularized with the surrounding conjunctiva once implanted.

This case series is the first to use MRI to document the radiological changes of orbital dermis fat. The T1 hyperintense signal of the dermis fat graft on MRI allows for visibility of the dermis fat graft within the eviscerated globe.

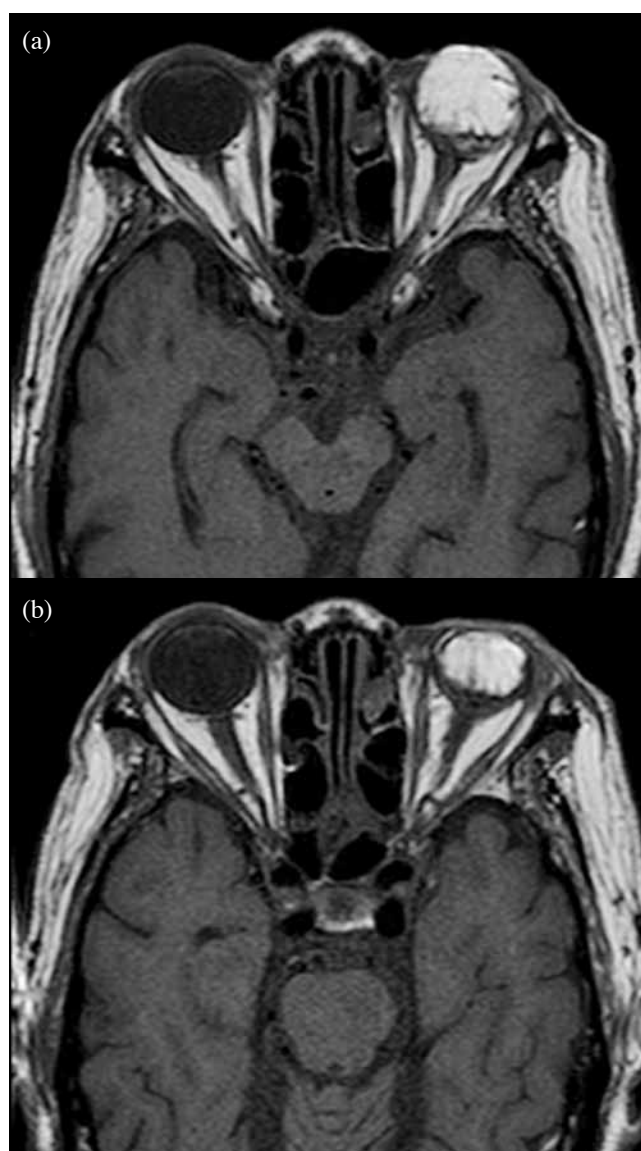


Figure 4. T1-weighted axial magnetic resonance images of (a) the orbits at 1 month postoperatively showing the T1 hyperintense signal of the dermis fat within the scleral shell of left globe, and (b) the same patient at 9 months postoperatively showing shrinkage of the dermis fat in the left globe. There is a marked decrease in the size of the T1 hyperintense signal in the posterior part of the eviscerated globe suggesting liquefaction of fat.

By measuring the volume of the T1 hyperintense signal of the dermis fat, the dermis fat graft volume within the globe is readily determined. The initial MRI volume measurement point at 1 month postoperatively was chosen so that any early postoperative tissue edema would have likely subsided to avoid confounding the fat implant volume measurement. A mean reduction of 1.92 ml in globe volume within 9 months was noted and, assuming an average adult globe volume of 7 ml, this was a mean reduction in globe volume of 27%. Smith et al¹² reported in their series of 118 patients that most fat grafts used as a primary implant after enucleation atrophied by 25%, while up to 30 to 40% absorption takes place after secondary implantation or from severely contracted sockets as a result of severe chemical injuries.¹³ The orbital MRI scans from this series showed that the reduction in volume was largely a result of fat atrophy, and the percentage reduction is consistent with the findings from Smith et al's series.¹² With a statistically significant reduction in volume, clinical enophthalmos occurred in 3 patients in this series. Moreover, despite intense effort to place as much fat as possible into the orbit, it is likely that the initial dermis fat-filled globe volume was less than that of a normal globe as air and fluid spaces between the sclera and fat were likely to be present. It is also likely that some degree of phthisis occurred before evisceration. Even so, no patient in this series required a regrant at 1 year postoperation.

Comparison of the MRI scans of these patients shows that the reduction in volume was largely from the posterior part of the globe, indicating that fat atrophy accounted for the volume reduction (**Figure 4**). The dermis fat graft adopts a more conical shape over time. The anterior part representing the dermis maintained an anteriorly curved configuration over the course of 9 months. It is likely that the blood supply from the anterior ciliary circulation maintained the viability of the dermis as it was well-integrated with the conjunctiva, as evidenced clinically (**Figure 5**). Furthermore, the posterior radial sclerectomies were likely to have aided vascularization of the adipose tissue from the posterior sclera. However, it is uncertain to what extent, if any, of integration of the fat



Figure 5. Integration of the dermis with the sclera and overlying conjunctiva at 3 months postoperatively.

portion of the fat graft with orbital fat occurred. If integration occurred, a hyperintense signal on T1 imaging would be expected along the sites of the radial sclerotomies, but this was not clearly defined on MRI. No obvious scarring was noted in the interface between the dermis fat and posterior sclera. In a future study, additional measures such as exogenous vitamin E, glucose, and insulin soaking of the dermis fat may be used to maximize fat survival. The range of extraocular movements may also be documented to gauge the motility of the dermis fat graft.

This study showed that dermis fat graft as a primary

implant is a safe procedure. Even after endophthalmitis, the placement of dermis fat graft into the scleral shell rendered volume replacement without further infection. Dermis fat integration occurred in patients with medical comorbidities. Patients who are at risk for alloplastic implant exposure from poor wound healing may benefit from this procedure.

Acknowledgment

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