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Orbital Contracture Repair Using the Radial Forearm Free Flap: A Nine and Ten Year Follow-up

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Abstract

Introduction: Orbital contracture is a severe cicatricial process within the enucleated orbit prohibiting the use of an ocular prosthesis and often requires socket expansion procedures. We hypothesize that the RFFF provides stable long-term expansion of the contracted orbit and allows for continued ocular prosthesis use without the accumulation of keratin debris.

Methods: A retrospective chart review was performed at the University of Iowa Hospitals and Clinics.

Results: Two subjects with orbital contracture were identified. Both had previously undergone tissue graft orbital expansion and failed. RFFF reconstruction was performed without complication. Nine and 10 years after reconstruction both patients maintain well-formed sockets without contracture recurrence. Both subjects were able to use an ocular prosthesis without keratin debris accumulation.

Conclusions: The radial forearm free flap provides durable, long-term orbital expansion that definitively corrects orbital contraction and is not associated with adverse consequences such as the accumulation of keratin debris.

Keywords

Orbital contracture, Socket contracture, Radial forearm free flap

Introduction

Orbital contracture is a severe cicatricial process that occasionally occurs in the enucleated eye socket. Orbital contracture results in the inability to retain an ocular prosthesis as a result of decreased orbital volume. While the exact etiology is unclear, this process may be associated with tissue injury caused by a poorly fit ocular prosthesis, chronic infection, trauma, or radiation. Initial management strategies attempt to expand the socket using tissue grafts such as dermis, mucosa, or skin grafts. However, the process is often progressive and recalcitrant to subsequent volume expansion procedures. When these augmentation procedures fail, a vascularized tissue transfer may be the next best option [1].

The radial forearm free flap (RFFF) is a versatile and reliable reconstructive tool used frequently in head and neck surgery [2]. Its use in the repair of orbital contracture has been previously described [3-5]. There have been concerns regarding keratin debris shed from the RFFF collecting in the expanded socket causing a cavity care issue that could limit the use of an ocular prosthesis. Accumulation of keratin debris over time could also result in inflammation or an infection. We hypothesized that the RFFF is a viable reconstructive option after standard orbital expansion procedures have failed in the contracted socket. Additionally, we believe keratin debris accumulation is not a concern and does not complicate ocular prosthesis use.

Material and Methods

A retrospective chart review was performed at the University of Iowa Hospitals and Clinics. Subjects diagnosed with orbital contracture after enucleation were identified. Subjects whose treatment were recalcitrant to conventional fornix expansion with various graft procedures (i.e., palate/buccal mucosa, skin, dermis, fat) and required microvascular free tissue transfer were selected. Patient demographics, etiology of enucleation, prior surgical history, operative notes, and follow-up visit information were collected and analyzed.

Surgical technique

Surgical preparation of the contracted orbit was prepared first. The contracted conjunctival lining that is present within the orbit is identified. It is divided equally to provide a palpebrum for the upper and lower lids. Supraperiosteal dissection is performed for the remainder of the bony orbit and all soft tissues are removed to back to the orbital fissures creating a soft tissue defect where the microvascular skin paddle will be placed. Recipient vessels are identified preferably in the preauricular area using the superficial temporal system or in the neck (facial vessels) which may require a vein graft. A subcutaneous tunnel is then created for passage of the pedicle from the orbit to the recipient vessels.

A template of the orbital defect is fabricated and transposed to the

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forearm 1 cm proximal to the volar wrist crease and centered upon the radial artery. The flap is then elevated in a standard suprafascial technique under tourniquet. Once harvested with maximal pedicle length, the flap is circumferentially inset in the orbit conjunctival defect. A small amount of the orbital rim should be removed to ensure that the vascular pedicle is not compressed as it exits the orbital defect to enter the facial subcutaneous tunnel. The vascular pedicle is then passed through the subcutaneous tunnel to the recipient vessels and an end-to-end vascular anastomosis is performed. In both cases, the donor site defect was small and a local skin advancement flap was used to close the donor defect. For larger defects, a skin graft might be necessary at the donor site to cover the flexor tendons however this was not encountered in this study.

Results

Case 1

Subject #1 is a 46-year-old female with a history of a right choroidal melanoma. Therapy included enucleation with placement of a 20 mm Medpore implant followed by post-operative fractionated stereotactic radiation therapy to a total dose of 60 Gy. The subject experienced several wound healing complications after radiation and required hyperbaric oxygen therapy. The ocular prosthesis required removal secondary to orbital contracture. Over a 2 year period, 7 orbital volume expansion procedures using grafts (dermal/fat = 4, oral mucosa = 3) were performed. Despite multiple interventions, the subject developed persistent socket contracture limiting the ability to maintain an ocular prosthesis. Due to persistent contracture, a RFFF reconstruction for orbital expansion was performed without complication. The subject had successfully used an orbital prosthesis for 9 years without further interventions. The subject recently passed from recurrent metastatic disease (Figure 1).

Case 2

Subject #2 is a 37-year-old female with a history of a retinoblastoma diagnosed as a child. The subject underwent enucleation and post-operative radiation therapy over 30 years prior to consultation. After successfully maintaining an ocular prosthesis for most of her adult life, the subject subsequently developed contracture and was unable to retain an ocular prosthesis. One dermal fat graft expansion was performed and was unsuccessful. The subject then underwent a successful RFFF reconstruction for orbital expansion. Postoperatively, the subject has successfully maintained an orbital prosthesis for 10 years without complication or further intervention.

Discussion

Orbital contracture is a rare process in which scarring of the enucleated socket results in the loss of the upper and lower lid fornix and thus the potential space for an ocular prosthesis. Orbital contracture causes the orbit to appear depressed and limits or eliminates the ability to maintain an ocular prosthesis.

Treatment of orbital contracture requires an expansion of the contracted socket. Many techniques using tissue grafts, including dermal, fat, mucosal (nasal and oral) membrane and skin grafts have all been well described with similar outcomes [6-12]. However, orbital contracture recurrence is common and often requires multiple interventions before an ocular prosthesis can be permanently retained. In our study, initial attempts were made to expand both subjects contracted sockets with conventional grafting techniques. A variety of grafts were used including skin, mucosal membrane and/or dermal fat grafts. One subject underwent 7 failed graft procedures and the second subject had 1 failed procedure. A RFFF was used after one failure in the second patient due to the severity of the re-contracture.

The RFFF was first described in head and neck reconstruction in 1981 [2]. Its durability, ease of harvest, reliable blood supply, and long pedicle make it an ideal flap for socket augmentation. The success rate of this fasciocutaneous flap is very high and exceeds 95% in most studies. Li et al. has the largest series using this technique to reconstruct the contracted socket and demonstrated good results in 22 patients. However, long-term follow-up was limited [1]. Other fasciocutaneous flaps have also been used in orbital expansion with similar success [13].

Complications at the RFFF donor site are low and typically involve minor wound healing problems over the forearm tendons that can be managed with local wound care. Other described donor site complications include decreased grip and pinch strength, skin graft loss, and sensory changes [14-17]. With meticulous technique during flap harvest [18-20] and during closure [21], donor site complications can be minimized. In the study by Lutz, 54% of participants experienced radial sensory nerve dysaesthesia, however, this dysaesthesia improved over time [22]. In the present case series there were no wound healing complications.

A multitude of flaps have been described for orbital reconstruction in patients with orbital contracture [14]. The authors prefer use of the RFFF for its thin pliable skin flap that easily fits the small orbital defect. Flap harvest is quick with a consistent blood supply. Additionally, the

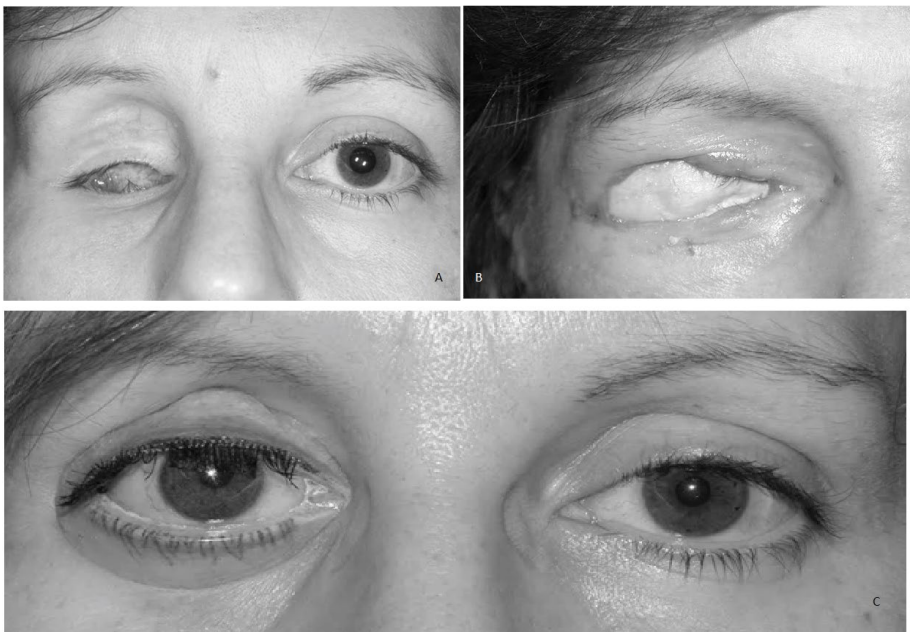

Figure 1: Patient #1- (A) Preoperative socket contracture (B) Initial postoperative result after radial forearm free flap socket expansion (C) 9 year follow-up with ocular prosthesis in place.

skin paddle does not contract facilitating maintenance of the orbital cavity. Further, the long pedicle length allows for some flexibility in selection of recipient vessels and the large caliber vessel allows for easy anastomosis. When compared to the lateral arm flap, the RFFF is thin and does not require a second procedure for removal of excess subcutaneous tissue. The radial forearm flap is more pliable and easier to fold into the small cavity. The lateral arm flap requires careful dissection to avoid sensory nerve injury [14]. The anterolateral thigh flap has similar disadvantages to the lateral arm flap when compared to the RFFF in that it would require a second debulking procedure. Even when a small flap is harvested, the anterolateral thigh flap can leave a residual contour deformity at the donor site [16,23]. The thoracodorsal artery perforator (TDAP) flap is another option and has the advantage of a less noticeable scar when compared to the RFFF. Dissection of the TDAP is more technically complicated making flap harvest time significantly longer than the RFFF [24]. Additionally, use of the TDAP may require patient repositioning. Further, patient size may preclude use of this flap. Other options such as the pedicled postauricular fasciocutaneous island flap or the temporal superficial artery skin flap are limited by size and mobility, making them less optimal to completely reconstruct the contracted orbit [14]. Overall, the RFFF is a pliable thin flap with a predictable vascular pedicle allowing for reliable orbital reconstruction in a single stage.

One concern with the use of skin bearing tissue, such as the RFFF, to expand the contracted socket is the accumulation of keratin debris in the orbital fornices. If debris was allowed to accumulate, it could result in inflammation or infection and complicate the use of an ocular prosthesis. Additionally, chronic infection could predispose to recurrence of the contracture. In our experience, keratin debris accumulation has not been noted in either subject. Both subjects had excellent results after RFFF orbital expansion and no further expansion procedures were required. Both subjects completed reconstruction with an ocular prosthesis and were able to retain the use of the prosthesis long-term. There were no complications associated with use of the RFFF reconstruction in this study.

Conclusion

Orbital contracture is an uncommon condition that results in the inability to retain an ocular prosthesis after enucleation and reconstruction. Conventional grafting procedures are the first-line treatment; however, they are often unsuccessful in the long term, limiting the use of an ocular prosthetic. The RFFF is an excellent option when grafting procedures have failed and long-term follow-up demonstrates no issues with keratin debris accumulation in the orbit.

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