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Free Flaps Reconstruction after Orbital Exenteration: A Single Centre Case Series

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Abstract

Introduction: Orbital exenteration is a disfiguring procedure that leaves a large defect. Free flaps are increasingly widely used to fill this. We report our single centre series of free flap reconstruction, which adds to the literature base on flap choice and potential complications.

Methods: A retrospective single centre consecutive case series of twenty patients who has an orbital exenteration and free flap reconstruction.

Results: The surgical indication was malignant tumour with orbital involvement in all 20 cases. The rectus abdominis flap was most commonly used (10/20, 50%). Anterolateral thigh and radial and ulnar forearm were also used. Flap failure occurred in 1/20 (5%) of cases. Flap necrosis (1 case), flap infection (1 case) and haematoma (3 cases) all required intervention but the flap survived. At last follow up (mean 57 months follow up) 8/20 (40%) patients were alive.

Discussion: Free flaps are an effective way of reconstructing exenteration defects. They have a low likelihood of failure and relatively quick recovery time. The choice of flap for different defects and the cosmetic rehabilitation options are discussed.

Keywords

Exenteration, Orbital, Free flap, Reconstruction, Rectus adominis, Anterolateral thigh, Ulnar forearm, Radial forearm, Complication

Introduction

Orbital exenteration is the surgical removal of the orbital contents including the eyeball. It is used for treatment or palliation of extensive tumours that are invading the orbit and occasionally for other conditions such as severe periocular necrotising fasciitis and orbital mucormycosis.

A total exenteration is the excision of the entire orbital contents including the globe, the periorbita (the periosteum of the orbit) and the eyelids. Tumours that invade other surrounding tissues require extended exenteration, for example of the sinuses, orbital and cranial bones or the cranial cavity and brain [1]. Other variations have been developed to improve the cosmetic outcome and post-surgical prosthetic options, such as eyelid sparing and globe sparing exenteration.

Exenteration leaves a large orbital defect. This can be left to granulate [2]. Alternatively, various reconstructive options are employed to expedite recovery, improve cosmetic outcomes and increase prosthetic options. These include split-skin grafts, local or pedicled flaps such as the forehead flap, the temporalis fascia flap and various free flaps. Free flaps are increasingly widely used, as they can provide a large volume of tissue to fill big defects and their tissue components can be tailored to the defect and the reconstructive goals. Commonly used free flaps include the radial forearm, rectus abdominis, anterolateral thigh, lateral arm flap, latissimus dorsi, gracilis and the scapula flap [3-9].

Orbital exenteration defects are both uncommon and challenging reconstructive sites. There is great variation in the choice of flap and a paucity of data on the potential complications and outcomes. We report our single centre series of free flap reconstruction for orbital exenteration.

Methods

This retrospective case series includes all patients who had orbital exenteration with a free flap reconstruction at the Royal Adelaide Hospital between 2002 and 2014. All patients were followed up for between 6 months and 6 years. Parameters investigated included the indication for exenteration, type of reconstruction and the surgical

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Table 1: Tumour histological subtype and location of primary.

Tumour/Location of primary	Number of Cases
Squamous cell carcinoma	
Skin	
Forehead	6
Eyelid	3
Unknown	1
Sinus	
Ethmoid	1
Maxillary	1
Basal cell carcinoma	
Skin	1
Malignant melanoma	
Sinus	
Ethmoid	1
Maxillary	1
Blue cell naevus	1
Adenoid cystic carcinoma of the maxillary sinus	1
Sebaceous cell carcinoma of the upper eyelid	1
Salivary duct carcinoma	1
Adenocarcinoma	1

Table 2: Origin of free flaps used for the different exenteration defects.

Classification of Exenteration/Flaps Used/Defect	Number of Cases
Type 1: Exenteration alone	
Radial forearm	2
Ulnar forearm	1
Rectus abdominis	1
Type 2: Exenteration without entry to the cranial cavity	
Rectus abdominis	
Maxillectomy	2
Zygoma and maxillary sinus	1
Maxillectomy, ethmoidectomy and partial rhinotomy	1
Maxillectomy, sphenoid mucosa, coronoid process, hard palate	1
Maxillectomy and ethmoidectomy	1
Anterolateral thigh	
Frontal bone (orbital rim)	1
Maxillectomy, ethmoidectomy, lateral orbital wall, inferior turbinate, temporal coronoid process	1
Radial Forearm	
Lateral orbital wall	1
Frontal bone and sinus	1
Ulnar forearm	
Frontal sinus, medial orbital wall, nasal bone, wide excision of forehead skin	1
Type 3: Exenteration with entry to the cranial cavity	
Rectus abdominis	
Maxillectomy, sphenoid sinus mucosa, frontal lobe	1
Maxillectomy, cranial floor	1
Forehead skin and dura excision (via craniotomy)	1
Anterolateral thigh	
Zygoma, partial nasal bone and frontal lobe resection	1
Frontal bone of orbital roof, frontal lobe dura	1

complications and outcomes. All the data for these parameters was ascertained by case note review. The data was stored and analysed in Microsoft Excel.

Results

The case notes of 20 consecutive patients that underwent exenteration with a free flap reconstruction were reviewed. The average age at the time of surgery was 69 years (range 48-84 years) and 14/20 (70%) patients were male. The indication for surgery was a malignant tumour in all cases, of which the primary was skin in 8 (40%) patients, sinus in 7 (35%) patients, orbit in 3 (15%) patients, salivary gland in 1 (5%) patient and unknown in 1 (5%) patient (Table 1). The majority of tumours (11/20, 55%) were squamous cell carcinomas. These predominantly arose from the skin of the forehead and eyelid. In 10 (50%) cases the exenteration was required for recurrent tumour and for first presentation in the other ten. The tumour was present in the orbit in all of the cases, and in 12 (60%) patients the orbital bones were also involved. Exenteration surgery was performed between 2 weeks and 9 months after orbital tumour invasion was diagnosed (average 11 weeks) except in one patient with a squamous cell carcinoma who had the surgery 5 years after the initial orbital invasion. The extent of the surgery was: exenteration alone in 4 cases extended with bony resection but without entry to the cranial cavity in 11 cases (of which 2 cases had eyelid sparing surgery) and extended with entry to the cranial cavity in 5 cases (Table 2). The flap reconstruction was immediate in all cases. The rectus abdominis flap was the most commonly used free flap for reconstruction (10/20 cases), followed by the anterolateral thigh flap and radial forearm (both 4/20 cases). An ulnar forearm flap was used in two cases. Of the 10 rectus abdoiminis flaps, 9 were harvested as myocutaneous flaps and one was a pure muscle flap which was covered externally with a full thickness skin graft. The skin paddle of the flap was folded to reconstruct the lateral nasal wall and palate with a de-epithelialised bridge to the external skin component in 7 cases. Two cases had no cutaneous defect and the skin component of the flap was used for internal lining. The ipsilateral facial artery and commitant vein were used as the recipient vessels in 17/20 cases and the internal jugular vein/superficial thyroid artery in the other three cases. Vein grafts were only necessary in one case. All rectus abdominis flap donor sites were closed primarily and seven cases received an on-lay synthetic mesh for reinforcement of the fascial repair. One ALT donor site could be closed primarily with a rhomboid flap, whereas the remaining cases were covered with a split thickness skin graft (SSG). All forearm flap donor sites were covered with fenestrated SSG. No patients had prosthesis coupling devices inserted at the time of surgery or in subsequent surgical procedures. To the best of our knowledge all surviving patients wore simple 'black' patches although most have been discharged from the care of our tertiary hospital.

Major complications were uncommon (3/20, 15%). There was one complete failure of a rectus abdominis flap (total flap failure rate 1/20, 5%), which necessitated secondary reconstruction with a free latissimus dorsi myocutaneous flap. This patient subsequently died of hospital acquired pneumonia 5 months post-exenteration. There were two other major early complications: one case of flap necrosis requiring skin grafting, and one flap infection requiring drainage. Three flaps showed vascular compromise from a haematoma in the first 48 hours postoperatively, which required evacuation and a further flap with venous congestion that was successfully treated conservatively with leech therapy.

In 17 patients (85%) the tumour margins were not clear and perineural invasion was present in 12 (60%) patients. Two of three patients with clear margins had SCCs and the other BCC; the other 17 patients had either cavernous sinus other areas of the cranial cavity, extratumoral perineural inasion or sinus spread too extensive to be fully excised. Radiotherapy had been used prior to exenteration in two patients (50 and 54 greys respsectively). In both cases, radiotherapy was used for recurrent squamous cell carcinoma after previous extensive excision. Post-operative radiotherapy was used in 14 (70%) cases (range 20 greys to 60 greys) for patients with incomplete clearance of SCC (7 cases), melanoma (2 cases), BCC, salivary duct carcinoma, sebaceous gland carcinoma, adenocystic carcinoma and adenocarcinoma (1 case each). Radiotherpay was not used in the one case in which the flap failed. Post-operative chemotherapy was used in 6 (30%) patients (4 with SCC and 2 with melanoma) for palliation of metastatic disease. Post-operatively patients stayed in hospital for between 3 and 43 days (mean 13.1). At the last follow-up 8 (40%) patients were alive. The surviving patients had been followed up for a mean of 57 months (range 9-147). The 12 patients who died survived a mean of 16 months post evisceration (range 5-33).

Discussion

Exenteration leaves a large soft tissue and often bony defect. A

free flap fills the defect at the time of surgery, which may expedite the recovery time and reduce post-operative complications.

Flap success rates

In the present series, 95% of the flaps survived. This is a similar to other series of orbital exenteration free graft series in which graft survival rates of 87-97% are reported [7-12]. Reported risk factors for flap failure include pre-operative radiotherapy, cardiovascular disease, hypercoagulable states and long operating time [13,14]. However there were no flap failures in the present series in the patients in which the site had been irradiated pre or post-operatively. There were no specific risk factors in the one flap failure in the present series.

Reconstructive options

Exenteration defects can heal with satisfactory results by secondary intention; granulation tissue fills the defect over several months creating a reasonably shallow defect that can relatively comfortably accommodate prosthesis [2]. When compared to using a flap, the operation is much quicker and less technical expertise is required, but the recovery is much slower, and frequent changes of dressing are required.

When a flap is used, a number of considerations must be addressed: 1) size and composition of the defect, 2) recipient vessels and required flap pedicle length for microvascular anastomosis, especially in cases of previous surgery including neck dissections, post radiotherapy or vascular disease 3) donor site availability and morbidity, (4) functional and aesthetic reconstructive goals, including reconstruction of nasal or oropharyngeal components and possible fitting of prosthesis and (5) need for tumour treatment, particularly surgical or radiotherapeutic.

Several different flaps were used in the present series. The rectus abdominis musculo-cutaneous flap was the most common. It has excellent and consistent vascularity and allows a large amount of tissue to be harvested. However, it is reported as potentially causing significant donor site morbidity including abdominal scarring, hernias/'bulge' and respiratory difficulties [15,16]. There are no recorded hernias in our series, but we cannot exclude this having been managed at other centres after having been discharged from our care. Previous abdominal surgery or pre-existing pulmonary dysfunction may preclude the use of this flap. No donor site-related complications were observed in our series. One rectus abdominis flap failed, although there is no indication that the failure related to the type of flap. In our series, large defects were predominantly filled with rectus abdominis flaps. The degree of shrinkage of these large flaps cannot be accurately predicted and there is a risk of damage to perforator vessels if aggressive debulking is done at the time of the primary surgery. Therefore these flaps are left large and accordingly two required debulking.

Five patients were successfully treated with forearm-based flaps. Whereas both the radial and ulnar forearm flaps are highly reliable and provide excellent contour and lining, they are less suitable for large three-dimensional defects, for example after exenteration with maxillectomy, which requires additional soft tissue bulk. However, these flaps can leave conspicuous donor sites and larger flaps may heal slowly or poorly. There has been a reported morbidity of resection of one of the arteries supplying the hand [17,18]. However, these complications did not occur in the present series. The antero-lateral thigh flap has become a workhorse flap for head and neck, including skull base reconstructions [19]. Its size can be tailored to any defect and it can be harvested both as a purely fascio-cutaneous flap or including a portion of vastus lateralis muscle to obliterate dead space as required. Further advantages are its long pedicle and low donor site morbidity, which can either be closed primarily or covered with a split thickness skin graft.

Survival rate and palliation

Orbital exenteration is a radical and disfiguring procedure and is therefore mainly used for aggressive tumours. However, these cases often have tumour spread that is too extensive for surgery alone, for example involving the cavernous sinus and elsewhere in the cranial cavity, deep extratumoral perineural invasion or major areas of the deeper sinuses, which explains the high rates of incomplete clearance. Such tumours invariably have a high mortality rate: 55% in the present study. However, orbital exenteration has an important role in palliation in these cases as it can prolong life and avoid the potential debilitating symptoms of uncontrolled orbital tumour growth, such as proptosis with exposure causing a blind, painful eye.

Cosmetic rehabiltation

Tumour clearance or debulking in palliative cases is the primary consideration in orbital exenteration. However, despite the disfiguring surgery, the cosmetic outcome is important and should be considered pre-operatively. The simplest option is a black 'pirate' patch and many patients favour this for its simplicity and comfort. If a prosthesis is desired, it can either be retained with a 'simple' mounting method, e.g. adhesive or spectacle mounting, or can be mounted (typically with a either a pin and socket or a magnetic button) on an osseointegrated device [20,21]. Osseointegration usually requires additional surgical procedures, which may not be suitable for some patients. None of the patients in our series had an osseointegrated device due to local surgeon preference.

This study is limited by the retrospective nature of the data collection. However, this large series of free flaps for the reconstruction of extenterations adds important further data to the literature on the possible flap reconstructions and potential complications.

Conclusion

Free flaps are a safe and reliable method of repairing the large defect created by orbital exenteration. Complete flap failure rates are low and minor complication rates are within an acceptable range and have little to no impact on the convalescence time. This single centre series has found that although minor complications do occur, overall flap failure rates and flap morbidity are low. Furthermore the recovery time is significantly faster and less arduous than allowing the defect to heal by secondary intention.

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