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ORIGINAL INVESTIGATION

Primary replacement for the management of exposed orbital implant

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ABSTRACT

Purpose: We present a series of primary orbital implant replacement for cases of implant exposure to describe our experience of this one-staged surgical approach.

Methods: This study reports on a one-stage technique which involved the removal of the exposed implant or dermis fat graft (DFG) and insertion of a secondary (replacement) in the same procedure, with a variety of materials, including autologous tissue. Re-exposure in a socket where a DFG was placed was defined as a new defect in the newly epithelialized conjunctiva or dehiscence of the dermis-conjunctiva junction. All cases of primary replacement for the management of exposed orbital implant, porous and non-porous, were included, even when there were clinical signs suggestive of infection. The primary outcome was the rate of re-exposure, requiring additional surgical procedures. Infection following primary replacement was a secondary outcome.

Results: Seventy-eight patients had primary replacement for the management of an exposed orbital implant. 6.4% had re-exposure at a mean follow-up of 49.7 months (9.1% for ball implants and 4.5% for DFG). The rate of exposure was higher in those with prior signs of infection than those without (8% vs. 3.6%). Re-exposure occurred in 4.5% of cases with DFG implantation, 4.3% of cases with non-porous implants and in 20% of cases with porous implants.

Conclusion: Primary replacement for management of exposed orbital implant, porous and non-porous, has a high rate of successful outcome even in cases with presumed or confirmed infection.

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Anophthalmic socket; orbital implant exposure; primary replacement

Introduction

Orbital implants, porous and non-porous, have a reported extrusion rate of 0–44%.[1–4] Implant exposures may occur with any type of implant or at any time following surgery and may lead to implant infection, extrusion or explantation.[5] There are many factors predisposing to implant exposure, many of which are related to surgical technique. These include tension on the wound, inadequate or poor closure techniques, implant location and the use of surgical adjuncts such as insertion of a motility peg.[3,6–8] Other factors include infection, mechanical or inflammatory irritation from the irregular surface of a porous implant and or delayed ingrowth of fibrovascular tissue with subsequent tissue breakdown.[5]

Orbital implant exposure can cause chronic discharge from the socket and discomfort. Spontaneous closure of the conjunctival defect has been reported in 7–16% of cases.[1] Various tissues can be used to repair the defect, but if these fail, one option is to remove the implant and leave the socket empty for a period (typically a few weeks to a few months) to allow inflammation and infection to be treated or resolve, before a further operation to place a secondary implant (a two-stage approach).[9–17] However, some surgeons advocate primary implant replacement, i.e. the removal of the exposed implant and insertion of a secondary (replacement) in the same procedure either in all cases or in the absence of clinical or microbiological evidence of infection (a one-stage approach).[18–20] This practice obviates the need for a second operation, which may facilitate faster rehabilitation and may preserve conjunctival tissue. However, there is little data on the outcomes and in particular if it is associated with a high rate of re-exposure or persistent orbital inflammation or infection.[18–20]

Materials and methods

This international, multi-centre study is a retrospective observational case series, evaluating the outcomes of primary orbital implant replacement. The primary

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outcome was the rate of re-exposure of the implant or dermis fat graft (DFG) requiring additional surgical procedures. Re-exposure in a socket where a DFG was placed was defined as a new defect in the newly epithelialized conjunctiva or dehiscence of the dermis–conjunctiva junction. Infection following primary replacement was a secondary outcome. Other secondary outcomes were to identify other factors that may influence the outcome such as pre-operative purulent discharge, infection, type of replacement implant material and medical comorbidity. Data was collected from the orbital services of The Royal Victoria Hospital, Belfast, The Royal Victorian Eye and Ear Hospital, Melbourne, St. James University Hospital, Leeds, Vancouver General Hospital, Vancouver and The Sussex Eye Hospital, Brighton. All cases of primary replacement for the management of exposed orbital implant from 2006 to 2016 were included, including replacement with autologous tissues such as dermis fat. The decision on what type of material of ball implant to use and re-implant, or to use a DFG, lay with the individual surgeon. The maximum volume of ball implant that could be covered was selected and the maximal fill of dermis fat was used.

Demographics and clinical data were collected from patient records including patient age and sex, duration of follow-up, diagnosis leading to eye removal, surgical technique for primary eye removal (evisceration versus enucleation), size and material of primary implant, time until implant exposure, clinical features of infection, size and material of replacement implant, variations in surgical technique to reduce re-exposure, rate and timing of re-exposure. Any additional surgery prior to the remove/replace procedure was recorded. The values are shown as mean ± standard deviation. χ^2 test was used for comparison of non-parametric data. $p < 0.05$ was considered statistically significant. The study adhered to the tenets of the Declarations of Helsinki. Institutional board approval for the study was obtained via the Belfast Health and Social Care Trust's Standards, Quality and Audit department.

Results

Demographics

There were 78 patients who had primary replacement for the management of an exposed orbital implant included in the study whose demographics are listed in Table 1.

Table 1. Patient demographics.

Number of patients	78	
Gender		
Male	41	53%
Female	37	47%
Mean age (years)	43.0 ± 20.9	
Age range (years)	5–90	
Indication for eye removal		
Trauma	41	53%
Infection	8	10%
Glaucoma	4	5%
Tumour	4	5%
Other	10	13%
Unknown	11	14%
Eye removal		
Enucleation	29	37%
Evisceration	49	63%
Median implant size (mm)	18	
Range of implant size (mm)	14–22	
Implant material		
Acrylic	28	36%
Coral	19	24%
Aluminium oxide	4	5%
Porous polyethylene	24	31%
Titanium mesh	1	1.3%
Glass	1	1.3%
Unknown	1	1.3%
Mean area of exposure (mm^2)	51	
Mean time to exposure (months)	78 ± 122.7	
Prior socket surgery	14	18%
Mean follow-up (months)	49.7 ± 51.7	
Range follow-up (months)	1–106	

Initial exposure

The mean time to initial implant exposure was 68.1 ± 104 months in the enucleation group and 94.9 ± 149 months in the evisceration group. Discharge or bleeding from the exposed area or socket was present in 51/78 (65%) patients. Swabs from the socket were taken for microbiological sampling in 28/50 (56%) of patients with signs suggestive of infection (purulent or bloody discharge). In 19/28 (68%) of these swabs, a variety of bacteria were cultured.

Ball implants

The material of the exposed/removed implant was exchanged with a material of similar type (either porous or non-porous) in 23/33 (70%) of cases. The implant material type was changed (from porous to non-porous or vice versa) in 10/33 (30%) of cases. The replaced median size of the implant was unchanged at 18 mm. In 28/33 (85%) of cases, a more posterior location of implant or opening of posterior tenons capsule was described. Re-exposure occurred in 3/33 patients (9.1%) with an orbital implant. The mean time to re-exposure was 55 ± 77.4 months (3–144 months) in cases of orbital implant, porous or non-porous. In 2/3 (67%) patients, re-exposures occurred in cases of porous implants and in 1/3 (33%) in cases of non-porous implants. Signs of infection were present in 2/3 patients (66%).

One-third (33%) cases that re-exposed had a swab taken, which cultured Staphylococcus *aureus*. The rate of re-exposure was higher in those with prior signs of infection (purulent or bloody discharge) than those without (11.1% vs 6.7%). In 1/4 (25%) of those with positive

cultures, suggesting colonization, who all had clinical signs suggestive of infection, there was no re-exposure. One patient had diabetes (33%) (2/30 implants without diabetes did not re-expose (7%)). One patient had a pegged implant (33%). No immunosuppressed patients received a replacement ball implant.

DFG

An autologous DFG was used in 44/78 (56%) of cases. A maximum fill of DFG was described. Re-exposure occurred in 2/44 patients (4.5%) with a DFG. The mean time to re-exposure was 10.5 ± 12.0 months (2–19 months) in cases of DFG. Signs of infection were present in both patients. The rate of re-exposure was higher in those with prior signs of infection (purulent or bloody discharge) than those without (6.5% vs 0%). In 16/16 (100%) of those with positive cultures, suggesting colonization, who all had clinical signs suggestive of infection, there was no re-exposure. There were no cases of re-exposure in patients with a systemic cause of immunosuppression as compared to a rate of 6.8% (3/44) in patients with no systemic immunosuppression. In 1/2 (50%) of those who re-exposed, there had been prior socket surgery between removal of the eye and this primary replacement.

Overall

Overall, re-exposure occurred in 5/78 patients (6.4%) after primary replacement (Table 2). The rate of re-exposure was higher in those with prior signs of infection (purulent or bloody discharge) than those without (8% vs. 3.6% (p = 0.444)). All cases of re-exposure occurred in patients who had an enucleation initially. Re-exposure occurred in 2/44 (4.5%) of cases where a DFG was used 1/23 (4.3%) of cases where non-porous implants (acrylic) where used and in 2/10 (20%) where porous implants (1 coral, 1 porous polyethylene) were used (p = 0.178).

Management of re-exposure

The management of cases of re-exposure are shown in Table 3. Case 1 had removal of residual polyethylene mesh, not removed with the original implant at the time of the primary replacement surgery, causing a central defect in the DFG. A new 16 mm non-porous ball implant was placed. Case 2 had re-suturing of a central defect in the DFG which did not heal spontaneously following over a few weeks. Case 3 had exposure occurring around the edge of a motility peg hole associated with a porous implant. The peg was removed and covered with a scleral cap and conjunctival flap. Case 4 occurred in a non-porous implant and case 5 in a porous implant. Both had removal of the exposed implant and a DFG placed.

Discussion

We report on the exposure of implants and primary replacement with a variety of materials including autologous tissue, performed even when there were clinical signs suggestive of infection which in our series included a purulent or bloody discharge from the socket in addition to the presence of an exposed implant. Infection of porous implants is a rare complication that may be difficult to control without implant removal.[21–25] Factors predisposing to infection include conjunctival dehiscence with implant exposure, poor or delayed vascular ingrowth secondary to chronic illness, such as diabetes or vasculopathy, chemotherapy, radiation therapy, prior socket reconstruction or delayed fibrovascular ingrowth within a host scleral shell with no portals for vascular ingrowth.[21–25] Initial symptoms and signs are not always indicative of implant infection. For example, recurrent discharge may indicate implant infection, but is also a common problem for some anophthalmic patients without an infectious process. The constellation of socket findings including persistent mucopurulent discharge, despite antibiotic coverage, recurrent pyogenic granuloma (indicative of implant exposure) and/or socket discomfort or tenderness aggravated by touching the implant, should raise one's suspicion for an implant infection.[21–25] Recurrent pyogenic granulomas are often an indicator of small conjunctival dehiscence with underlying porous implant exposure.[21–25] These areas of tissue breakdown may allow entry of the causative bacteria before complete implant vascularization occurs within the first six months following surgery. Alternatively, bacterial colonization of the implant may occur during surgical implantation, despite air–fluid exchange of the implant in an antibiotic solution prior to implant placement. The eyelid margin is the most likely source of surgical infection, and as the bacteria within the implant multiply and migrate to the surface, a conjunctival dehiscence occurs as well as a pyogenic granuloma. Once the infection becomes loculated, the pyogenic granulomas are the likely sites where bacteria migrate from within the implant to the conjunctival surface, explaining the persistent conjunctival inflammatory reaction, despite the topical application of numerous antimicrobial drops.[21–25]

There are a number of potential advantages to primary replacement for exposed orbital implant. The ability to manage the problem with one surgical procedure is appealing to the patient and for the surgeon may enable preservation of conjunctival tissue which is advantageous, should further surgery be necessary in the future. Another advantage of a one-stage approach is the improved cosmetic satisfaction for the patient, as there is likely to be less time when they look volume

Table 2. Characteristics of cases of re-exposed orbital implant.

Case	Gender	Indication for eye removal	Primary eye removal	Age at time of explantation	Time to exposure (months)	Signs of infection	Swab	Material explanted implant	Peg	Implant size (mm)	Material primary replacement	Implant size (mm)	Change implant location	Diabetes	Time to re-exposure (months)
1	F	Trauma	Enucleation	51	132	Y	N	Acrylic	N	Unknown	DFG	N/A	Nil	N	19
2	F	Trauma	Enucleation	33	136	Y	N	Unknown	N	Unknown	DFG	N/A	Nil	N	2
3	M	Trauma	Enucleation	19	36	N	N	Acrylic	Y	18	Coral	20	More posterior	N	144
4	F	Unknown	Enucleation	30	6	Y	N	Coral	N	20	Acrylic	16	More posterior	N	3
5	F	Endophthalmitis	Enucleation	54	18	Y	*S. aureus*	Coral	N	18	Porous polyethylene	18	More posterior	Y	18

Y = "Yes". N = "No". N/A = "Not applicable"

Table 3. Management of cases of re-exposure of orbital implant.

Case	Time to re-exposure (months)	Management of re-exposure	Diabetes	Follow-up duration (months) post-ball replacement
1	19	Removal of residual vicryl mesh and new ball implant (16 mm)	N	52
2	2	Re-suturing of central defect in DFG	N	34
3	144	Peg removed, debrided, scleral cap and conjunctival flap	N	264
4	3	DFG	N	Unknown
5	18	DFG	Y	75

Y = "Yes"' N = "No"

deficient (sunken) and are unable to wear a prosthesis. Primary replacement may enable a faster rehabilitation process, facilitating an earlier return to using a prosthetic eye, negating a period between surgeries where the socket is empty and the patient is unlikely to be able to wear a prosthesis. With this technique, we can limit the psychological impact of being without a painted prosthesis facilitating a faster return to work and other social activities.[26–29]

A small number of studies with small numbers of patients and short follow-up report on the success rate and complications of a one-stage technique demonstrating safety of this approach.[18–20] Some of these studies focused on implants of a specific material whilst others excluded cases with co-existing infection. Bi et al. report on 21 patients with one-stage primary replacement for management of "complicated" implant, with all replaced with a hydroxyapatite implant. At 6 months average follow-up, they reported no implant exposures but reported one case of recurrent conjunctival fistula thought to be due to chronic infection.[18] Toft et al. reported on 24 patients with one-stage primary replacement for the management of an exposed orbital implant. At 25 months mean follow-up, they reported no re-exposures.[19] Lee et al. reported on four patients with simultaneous primary replacement for the management of an exposed orbital implant with both a ball implant and a DFG. At 27 months follow-up, no patients had re-exposure.[20] We report on the exposure of implants and primary replacement with a variety of materials including autologous tissue, performed even when there were clinical signs suggestive of infection. The overall re-exposure rate is low (6.4%) with a longer mean follow-up (49.7 months).

Traditional approaches to the management of an exposed implant include vaulting the posterior surface of the prosthesis, muscle, conjunctival, tarsal and periosteal flaps, amniotic membrane, patch grafts and a two-stage approach to implant removal and replacement.[9,10,30,31] Both approaches have high reported rates of re-exposure of the orbital implant. Sagoo et al. reported four patients in whom orbital implant exposure was managed with a temporalis fascia patch graft. At 16 months mean follow-up, the re-exposure rate was 25%.[11] Turner et al. reported 13 patients in whom orbital implant exposure was managed with a temporoparietal fascial graft. At 9.5 months mean follow-up, they report graft failure in 15% of cases.[12] For two-stage techniques, Salour et al. reported on eight patients who underwent a two-stage surgical technique with initial closure then either mucosal or DFG. At 13 months follow-up, there were no re-exposures.[13] Kim et al. reported on four patients who underwent a two-stage repair with dermis fat and then re-implantation with 4 months between procedures. 50% of these had infection initially. At a mean follow-up of 20.3 months, there were no re-exposures.[14]

Factors predisposing to implant exposure include tension on the wound, inadequate or poor closure techniques, infection, mechanical or inflammatory irritation from the irregular surface of the porous implant, and/or delayed ingrowth of fibrovascular tissue with subsequent tissue breakdown.[5] Another risk factor for implant exposure that is not often appreciated by ophthalmic surgeons is improper seating of the porous implant. Porous implants have a rough surface and drag tissue inward as they are placed into the orbit; this "Velcro®" effect makes implantation technically more demanding.[6] Insertion with a tissue glide and/or implant wrap may help avoid the posterior drag of anterior tissue.[6] The overlying tissue may be closed successfully over the implant, but with time the tissues dragged inward may try to return to their original relaxed position – a natural restitution of tissue (Cactus syndrome).[6] As this occurs, a gradual migration of the implant anteriorly with progressive conjunctival thinning and eventual tissue breakdown over the anterior implant surface (exposure) occurs.[6]

As outlined above, another risk factor is infection.[21–25] One perceived disadvantage of primary replacement is the insertion of a new implant, either artificial or autologous, into a potentially infected environment, with the concern that this may lead to a higher rate of re-exposure compared to a two-stage technique. Although the rate of re-exposure was slightly higher in patients with signs suggestive of infection (8% vs. 3.6%), the difference was not statistically significant and both are considered low given that the rate of exposure following primary implant placement has been reported as 0–44%.[1–4] Additionally, the low rate of re-

exposure in cases with confirmed bacterial colonization on a swab from the socket (5%) further adds to the safety of this one-stage approach.

The choice of what material of implant to use when managing a further implant exposure is a difficult one for the surgeon. There is limited evidence to guide the decision aimed at reducing the risk of further re-exposure. In our study, the highest rate of re-exposure occurred where a porous implant was used as the replacement implant (20%) as compared to a DFG (4.5%) or a non-porous implant (4.3%). Whilst this was not a statistically significant difference, it correlates with the higher proportion of primary exposures seen in porous implants, 60% vs. 39%, in non-porous implants. Perhaps when considering primary replacement of an exposed orbital implant, the surgeon may choose to avoid a porous implant with preference being given to either a non-porous implant or an autologous DFG. Pegging is a known risk factor for orbital implant exposure and was a contributing factor in one case who re-exposed.[7] The proportion of patients having had prior socket surgery was similar in both groups who re-exposed and did not re-expose (20% vs. 18%) and there were low rates of diabetes and systemic immunosuppression in both groups.

We present data on a large number of patients who had primary replacement for the management of an exposed orbital implant, porous and non-porous, with a moderate length of follow-up (49.7 months). This is the largest number of patients reported having a one-stage surgical approach, with a longer follow-up period. We acknowledge a number of limitations of this study. As a retrospective case series, there is scope for bias in patient selection. Operations were performed by multiple surgeons across multiple sites and variations in surgical techniques may influence the re-exposure rate. There was limited microbiological evidence to support the possibility of infection suggested by clinical signs, with just over half of patients having microbiological sampling performed. There was no histopathological testing of the removed ball implants in this series as has been previously reported.[32]

Conclusions

Primary replacement for management of exposed orbital implant has a high rate of successful outcome, even in cases with presumed or confirmed infection. It reduces the need for multiple operations and negates a period of time between operations with no implant or prosthesis, and poor cosmesis. Porous implants may also have a higher incidence of re-exposure.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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