Anophthalmic socket- A cosmetic dilemma

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Abstract
Anophthalmos is the absence of the globe and ocular tissues from the orbit. It can be congenital or acquired which is produced by destructive procedures like enucleation and evisceration. It affects the cosmetic appearance of the patient and can be particularly devastating psychologically. The anophthalmic socket has been associated with many complications such as discharge, entropion, ectropion, exposure or extrusion of the orbital implant, infection, migration of the orbital implant, contracted socket and ptosis. This article emphasises on the management of an anophthalmic socket and its complications such as a contracted socket in grownups.

Keywords Anophthalmic socket, Buccal mucosa, Contracted socket, Dermis fat graft, Implants.

Introduction
Anophthalmos is the absence of the globe and ocular tissues from the orbit. It can be congenital or acquired. The majority of cases of anophthalmos are seen following evisceration or enucleation. The unavoidable conditions leading to removal of the eyeball leaves behind an aesthetic question – management of an anophthalmic socket? With an exponential increase in the awareness amongst the patients now-a-days, providing a satisfactory cosmesis post disfiguring eye surgeries has become a challenge. At the time of evisceration or enucleation orbital implant is typically placed and an ocular prosthesis is fitted subsequently. The optimal time to achieve best functional and cosmetic results for anophthalmic socket is at the time of primary surgery. Evisceration is preferred over enucleation as it leads to less disruption of orbital anatomy, good motility of prosthesis and lower rate of migration, extrusion and resurgery.

Anophthalmic socket syndrome consists of enophthalmos due to orbital tissue shrinkage, deep superior sulcus, shallow fornix which is produced by destructive procedures like enucleation and evisceration. (Fig. 1) The anophthalmic socket has been associated with several complications including discharge, lid mal-positions, implant related complications such as extrusion, migration, infection or expulsion and the most dreaded being a contracted socket that requires meticulous surgical approach. The present study emphasise on all aspects of anophthamic socket.

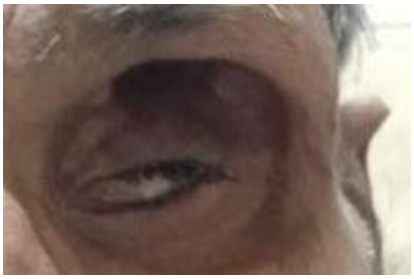

Fig. 1: Showing anophthalmic socket syndrome after evisceration

Causes of Anophthalmic Socket
The various causes of an anopthalmic socket are as follows:

1. As the presence of a healthy eyeball is necessary for the growth and development of the socket, congenital absence of the eyeball or microphthalmia may lead to formation of a contracted socket.
2. A poorly performed enucleation without the use of an implant especially in children in the growing age.
3. Delay in the use of a conformer or using conformer of an inappropriate size leads to forniceal shallowing and eventual formation of a contracted socket.
4. Excessive tissue loss due to fibrosis and laceration post trauma may predispose to a contracted socket formation.
5. Malignant conditions warranting the use of radio therapy like retinoblastoma in which post radiotherapy treatment can predispose to formation of contracted socket.

Sloughing of the conjunctiva and shortening of the fornices may occur as a result of infections of the either the socket or implant and may eventually lead to socket contraction.[1]

In order to maintain self confidence in a patient who has lost visual function all possible measures to maintain a "normal" look of the patient should be carried out to prevent devastating psychological side effects. An ideal ocular prosthesis that is natural looking is required. Medically, this means, normal eyelid and eyelash position and blinking pattern maintaining adequate symmetry with the healthy contralateral eye.

Various components of a functionally and aesthetically acceptable anophthalmic socket are as follows

1. A satisfactory central implant
2. An adequate, epithelium-lined socket
3. Eyelids of normal length, appearance and tone
4. Painless, noninflammed, well fitted prosthesis with volume restoration

All these factors enable good transmission of motility from implant to overlying prosthesis.

A contracted socket is essentially a socket in which prosthesis of an adequate size cannot be fitted. Socket contraction being the most common complication of an anophthalmic socket is characterised by granulation tissue formation, loss of fornices and scarring.[2] Several histopathological changes include conjunctival metaplasia, inflammatory cell infiltration, keratinization and reduction in the goblet cell count.[3]

Primary surgical procedure like evisceration/enucleation should be performed meticulously in preventing socket contracture. A conformer must be placed post operatively which can be replaced after 6 weeks by prosthesis of adequate dimensions.

Proper evaluation of a contracted socket should include eyelid position and tension, status of socket lining, position of prosthesis. Various other associated abnormalities that need to be assessed are fibrous bands, symplepharon formation, granulomas, anophthalmic ptosis, entropion, eyelid laxity and ectropion. The contracture can be graded according to severity and various classifications are used for it.

Grading of Socket Contraction: A surgical reconstruction approach is primarily based upon the amount of socket contraction which may be graded as follows:

Grade I- shallow lower fornix or shelving of the lower fornix. The lower fornix gets downward sloping shelf that pushes the lower lid down and out preventing the retention of an artificial eye.

Grade II- lost upper and lower fornix.

Grade III- lost upper, lower, medial and lateral fornices.

Grade IV- loss of all fornices and reduction in the palpebral aperture in the horizontal and vertical dimensions

Grade V- recurrence of contracted socket even after repeated trials of reconstruction.[4]

Mild contracted socket includes grade I and II, moderate includes grade III and severe involves all cases in which all fornices are involved along with phimosis of the palpebral aperture. Malignant contracted socket is a term reserved for the condition where severe contracted socket is associated with bony contraction.[5]

Before instituting a definitive therapy, it is imperative to identify and eliminate any factor that may further precipitate contracture formation.

Proper dissection should be performed at the time of the initial procedure and as much conjunctiva and tenon's capsule should be preserved during enucleation. A secured closure of all the layers over the implant without superior displacement of the inferior fornix should be carried out. Any rough or ill-fitting prosthesis should be avoided as this accentuate granulation tissue and symblepheron formation. Any source of chronic infection should be identified and treated appropriately. Oversized prosthesis may migrate and hence a proper estimation of the size of prosthesis in accordance with the fellow eye should be carried out before attempting a surgical reconstruction.[6]

Various types of Orbital Implants: The main aim after the removal of the eyeball is maintenance of the orbital volume. The volume of an enucleated eyeball lies somewhere between 7-9 ml and this deficit is corrected using an orbital implant. A prosthesis used over an orbital implant restores a maximum of about 4.2 ml.[7] Orbital implants can be classified into various types depending upon the time of placement (primary or secondary), depending on the source (artificial and natural) and depending on the material (porous or non-porous). Currently in ophthalmological practice the various implants used are methyl methacrylate sphere, hydroxyapatite implant, Guthoff orbital implant, conformer dressed in the skin graft or dermis fat graft.[8]

Nonporous Implants: These are solid implants and does not allow fibrovascular ingrowth (Acrylic, Methylmethacrylate, Silicone). (Fig 2a, b) These are economical and less chances of extrusion but have decreased motility and can migrate.

Methyl Methacrylate Sphere: It is a subtype of a non-porous orbital implant which is most commonly used in surgical practice to restore lost volume. By its placement in the scleral pocket it restores good ocular volume and motility. Careful assessment of the size should be made as too big implant can be expulsed. The suturing preferably should be done in two layers again in order to prevent loosening of sutures and ultimate expulsion of the implant.[9]

The risk of expulsion can be minimised by placing the implant in the muscle cone behind the scleral pocket after performing a posterior sclerotomy. Extraocular muscle integrity is required to ensure adequate motility.[10]

Silicone Spheres: These are non-porous implants similar to acrylic but more pliable.

Fig. 2 (a) Acrylic non porous spheres and (b) Silicone spheres

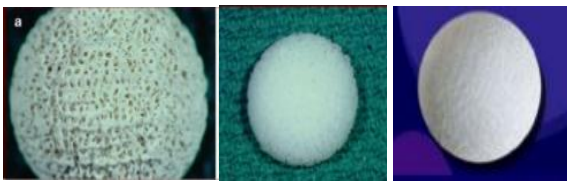

Fig. 3: (a) Porous hydroxyapatitie (b) Porous synthetic polyethylene, (c) Aluminium oxide bioceramic implant

Porous Implants: These are implants with numerous pores or channels that allows fibrovascular growth (Hydroxyapatite, synthetic polyethylene, aluminium oxide)(Fig. 3a,b,c)

Hydroxyapatite Implant: It is usually used post enucleation which was approved for usage in 1989. Originally it was obtained from natural occurring substances such as coral made up of complex calcium phosphate. It was a new face of the porous integrated orbital implants with interconnected pores facilitating the formation of fibro-vascular mesh within the orbital cavity and secure attachment with the extraocular muscles.[11] Advantages mainly includes diminished risk of expulsion and provision of good motility. In addition, a peg can be placed that can be connected to a prosthesis that provides excellent motility. However, its use has now been contraindicated in the elderly, immunocompromised and after local radiotherapy due to the risk of infection, pyogenic granuloma formation, conjunctival thinning and long term orbital pain due to its abrasive surface.[12] High surgical cost is another major drawback for its use.

Synthetic porous Polyethylene (MEDPOR): It is porous type of plastic, well tolerated by orbital soft tissue, nonabrasive surface so can be used with or without wrapping material. Extraocular muscle can be directly sutured on to its surface.

Aluminium Oxide Bioceramic Implant: This is porous and inert. Human fibroblasts and osteoblasts proliferate more rapidly than hydroxyapatite showing this is more biocompatible. It is light weight with uniform pore size and excellent pore interconnectivity. A protein coating is formed after insertion prevents the implant from being recognised as foreign body and its inert nature minimises socket inflammation.

Guthoff Orbital Implant: It combines the advantages of a hydroxyapatite implant and the methyl methacrylate implant sphere. Primarily comprising of two areas, the posterior half is methyl methacrylate and the anterior half is hydroxyapatite, with four grooves for suturing the extra ocular muscles. Unfortunate drawbacks being the unaffordable cost and lack of long term studies describing its benefit over the traditionally used implants.[13]

Integrated Implant: This refers to the implants that can be directly coupled to overlying prosthetic eye with a peg system. A peg is a motility coupling post made of titanium and permits direct coupling of implant movements to an overlying prosthesis. Pegs can be inserted within sleeves that are drilled into anterior aspect of implant. As there is a small break in the overlying conjunctiva through which the peg protrudes that's why these are known as partially exposed integrated implants.

Non- integrated Implant: An implant that has been placed within the anophthalmic socket that has no connection with the overlying prosthetic eye. There is a closed, smooth, uninterrupted conjunctival surface completely covering the implant. These are also known as buried non-integrated implant.

Quasi-integrated Implant (Buried integrated or Indirectly Integrated Implant): An implant that has been placed in socket with a closed, uninterrupted conjunctival surface completely covering implant that has an irregular anterior surface allowing indirect coupling (quasi-integration) of implant to overlying modified prosthesis (Allen, Iowa, Universal MEDPOR Quad implant) (Fig. 4). Recently designed magnetic coupling systems may also be classified as quasi-integrated implant.

Fig. 4: Showing quasi-integrated implants (Allen)

Dermis Fat Graft: The risk of expulsion and migration posed by artificial grafts can be altogether eliminated by the use of autologous material in an anophthalmic socket. The dermis fat graft due to its excellent biocompatibility has been advocated for use in congenital anophthalmia, contracted socket or after expulsion of artificial orbital implants. It has two components: fat to restore orbital volume and dermis that provides vascular support to the graft. The dermis fat graft can be harvested from the hip or groin area free from any skin infection and without the presence of any hair with enough fat panicle. Desired graft diameter runs between 20-24mm with an average thickness of about 20mm. Large grafts run the risk of central necrosis due to ischemia and compression and on the other hand small grafts lead to under correction. The major disadvantage of this graft lies in its atrophy, which is a physiological, however which is accelerated in case of poorly vascularised or injured grafts.[14]

Conformer Enveloped in skin Graft: This helps in dealing with situations of severely contracted sockets where it is impossible to recover extra ocular muscle. This is the best possible option to restore the orbital volume within the socket. A biconvex conformer may be used when volume is diminished or a convex concave one can be used in case of retracted fornices. (Fig. 5) The skin graft is usually harvested from the inner aspect of the upper arm which should ideally be hairless. Disadvantages are poor aesthetic correction and hence this should be employed in cases where no other option is suitable for socket reconstruction.

Various options for Reconstruction of Contracted Socket: A mild contracted socket is characterised by shortening of the posterior lamina of the lids due to which resultant entropion is developed but the fornices are not lost completely. There is shortening of the inferior fornix but prosthesis is still retained. Lash entropion may occur. In such a case the surgery plan includes transverse blepharotomy with marginal rotation. If the contracted socket co-exists with a significant lid laxity, horizontal lid shortening is done in addition to the marginal rotation. Localized symblepharon & fibrous bands can be managed by Z-plasty or V-y plasty. In cases where these two procedure meet with failure, an attempt to place a scleral or cartilage graft is made to lengthen the posterior lamina of the lid. Therefore, these measures can be safely employed for the surgical correction of a contracted socket with adequate fornices.[5]

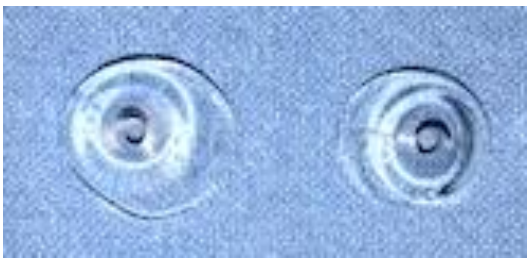

Fig. 5: Showing conformer

In moderate socket contraction both inferior & superior fornices are shortened in which inferior fornix is of greater importance. Signs & symptoms of moderate socket contraction are inability to retain prosthesis, poor motility of prosthesis, non-closure of eye, loss of normal lid fold, persistent discharge and irritation, enophthalmos with posteriorly displaced prosthesis if associated volume loss. When there occurs shortening of the fornices with prolapse of the graft the open method for fornix repair is adopted. Patients experience spontaneous prolapse of the inferior aspect of the prosthesis, especially in upgaze. Repair is done by performing a lateral tendon procedure along with a fornix reconstruction. Management: modification of prosthesis can be tried initially by trying a smaller prosthesis. If this is not possible, surgical management includes adequate scar excision and mucous membrane grafting (MMG) to increase the surface area of the socket. Lip or buccal mucosa is preferred (40-50% excess of the defect created after dissection of conjunctiva). Conformer is placed at the end and replaced by artificial eye later. Amniotic membrane grafting (AMG) can be used as a substitute for MMG because of easy availability, lack of donor site morbidity, antifibroblastic activity and antimicrobial activity.[15] In desperate cases, orbital /spectacle prosthesis is the only option.

In moderate to severe contractures the socket is first assessed as moist or dry as the surgical remedies for the both differ.

Moist Socket Reconstruction: Full thickness MMG are superior to partial thickness MMG which are more susceptible to shrinkage and contracture. Full thickness mucous membrane may be obtained from oral mucosa, cheeks and lips (which is the most common site), hard palate, prepucial skin or the skin of the labia. The graft size should ideally be about 50 percent larger to allow for subsequent contracture formed during healing. It should be harvested before the procedure to enable antibiotic bath before placing it over the surgical site. The conjunctiva is incised across the entire horizontal width and extensive dissection is performed releasing the conjunctiva from the scarred tissue. The free mucous membrane graft is placed and sutured with 6-0 vicryl sutures to the pre-existing conjunctiva posteriorly and the palpebral conjunctiva anteriorly. A conformer is left into the socket to maintain the graft and usually left in place for a couple of weeks till healing takes place.[16]

Hard palate grafts are superior due to presence of both mucosal layer along with a fibrous collagen matrix. Additionally, they are easily harvested and cause minimum shrinkage and a short healing time. It may be difficult to harvest sufficient amount of graft to reconstruct a large area.[17]

The use of MMG along with hard palate grafts may be employed as an alternate approach to the reconstruction of moist contracted sockets.

Amniotic membrane can also be used instead of mucosa. It has less incidences of morbidity, shows faster recovery rates and no formation of contracture. It is easily available and had an effective cost benefit ratio.[18]

Dry Socket Reconstruction: In such cases the socket is lined with a split thickness skin graft. This split thickness skin graft can be obtained from the inner aspect of the thigh. The dermis fat graft is used to correct the conjunctival and volume deficit in the contracted socket. It is an autologous implant and consists of de-epithelialized epidermis with adjacent subcutaneous fat tissue. The graft is obtained from the upper outer quadrant of gluteal region as this is not a weight bearing area and there is no risk of damaging the sciatic nerve. The surgical site is prepared by performing a conjunctival incision from the caruncle extending horizontally to the lateral canthus. The

conjunctiva is mobilised via dissection and space to accommodate the graft is created. Gentle pressure is kept on the graft in order to prevent the orbital fat and issue from desiccating out. The graft is then sutured to the conjunctiva using 6-0 vicryl sutures. A conformer is put into place at the end of the procedure and the socket is closed for 2-3 days after instilling antibiotic and steroid solution in the socket.

Dermis fat grafts reportedly produce good cosmetic and functional results with minimum contracture formation and maintaining good orbital vascularity. This procedure is the procedure of choice when both increased surface area and volume are desired.

Scarred and contracted sockets are most difficult to reconstruct. Although autologous dermis fat grafts are usually effective, they still carry a 30 percent chance of atrophy of at least half of the graft volume due to loss of a vascular bed. Therefore, using a pedicle flap into the orbit as a vascular bed along with a dermis fat graft may increase the graft survival and also fill additional volume of the socket.[19]

A temporalis muscle graft supplied by the superficial temporal artery is an ideal choice. The most common adverse effects associated with this technique include alopecia at the donor site, blood loss, hematoma formation and a slight depression over the temporal area.[20]

Other abnormalities that need to be evaluated and corrected along with socket contraction are as follows

Lash margin Entropion: It occurs due to contracture of fornices or cicatricial changes at lash margin. It is managed by tarsal rotation procedure or MMG.

Anophthalmic Ectropion: It results from poor prosthesis or lower lid laxity and can be managed by less bulky prosthesis correction in initial phase. Lower id laxity can be corrected by lower lid tightening at either the lateral or medial canthal tendon depending on its amount. Correction of eyelid retraction can be corrected by inferior rectus recession and MMG in inferior fornix.

Anophthalmic Ptosis: It results from superotemporal migration of implant, cicatricial tissue in upper fornix, damage to levator or its nerve, ptosis may be secondary to enophthalmos or volume deficiency and lower lid laxity. Mild ptosis can be management of the prosthetic modification or fasanella servat procedure.

Moderate ptosis can be corrected by leavator tightening and frontalis suspension but results are less satisfactory.

Conclusion

Loss of one eye due to any reason is devastating for the patient at any age. The patient not only loses binocular vision but suffers also changes in the perception of self that can lead to anxiety and depression. Eye contact is an important part of interpersonal interaction and therefore is essential for the patient to have a more natural looking prosthesis similar to the other eye. Anophthalmic socket surgery is no longer just the replacement of a diseased eye with an orbital implant, it carries along with itself a more psychological and cosmetic importance. Hence, the choice of implant should be based on surgeon's comfort level as well as patient's affordability.

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