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Review Article

Artificial Eye - Boost to Life

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Abstract

A Contracted socket is a complication of an Anophthalmic socket which results in the inability to support prosthesis. Contracted socket defines absence of functional eyeball from orbit. In most of cases, its presence take a lot on person's confidence and make oneself very difficult to come out of psychological trauma and stress associated with it. Rehabilitation of these patients is of utmost importance to provide positivity and self confidence in these scenarios. Artificial Eye (Customized Ocular Prosthesis) acceptance is dependent on individual persona and multiple sitting approaches to satisfy the individual need. There are occasions to modify the socket by surgical intervention to fit the artificial prosthesis. This article was written to create basic understanding of artificial eye and its various steps of manufacturing and dispensing.

Keywords: Artificial Eye; Fornix Reconstruction; Customised Prosthesis; Evisceration; Enucleation

Introduction

A Contracted socket is a complication of an Anophthalmic socket which results in the inability to support a prosthesis [13]. Contracted socket defines absence of functional eyeball from orbit. It happens because of multiple reasons [Table 1]. In most of cases, its presence take a lot on person's confidence and also make one very difficult to come out of psychological trauma and stress associated with it. Rehabilitation of these patients is of utmost importance to provide positivity and self confidence in these scenarios.

It all depends on patient listening to understand the need and careful evaluation of socket and appropriate intervention. Intervention starts with clear and realistic procedural expectations and special emphasis in beginning that It requires multi-stage procedure.

SL No	Causes
1	Irradiation of the socket as after enucleation in some cases of retinoblastoma.
2	Severe socket infections
3	Faulty or non-wearing of the artificial eye
4	Keloid like mass formation in the socket
5	Tissue loss due to injury e,g., Bomb explosion, fight
6	Scarring of the conjunctiva due to various factors (allergy for ex.)
7	Possible prevention of Sympathic Ophthalmia

Table 1: Causes of Contracted Socket.

Materials and Methods

On background of current understanding of contracted socket management our cases were discussed and results were discussed and presented.

Results and Discussion

There are different classification systems of Contracted socket as convenience of management of contracted socket.

In 1980, Krisha., *et al*. proposed a unique grading system [14].

Grade 0	Socket is lined with healthy conjunctiva and has deep and well formed fornices.
Grade 1	Shallow lower fornix or shelving of the lower fornix (Figure 1)
Grade 2	Loss of the upper and lower fornices (Figure 2)
Grade 3	Loss of the upper, lower, medial, and lateral fornices (Figure 3)
Grade 4	Loss of all the fornices and reduction of palpebral aperture in horizontal and vertical dimensions (Figure 4)
Grade 5	Recurrence of contraction of the socket after repeated trials of reconstruction (Figure 5)

Table a

Figure a

Photo Courtesy: https://www.slideshare.net/MohammeAljodah/contracted-eye-socket reconstruction?from_action=save [17].

Guyuron in the series Advances in Ophthalmic Plastic and Reconstructive Surgery states the following [15].

Class I	These are the patients that only have insufficient lining of the eye socket, no enophthalmos, no soft tissue or bony deficiency of the orbit or periorbital area.
Class II	These patients have insufficient eye socket lining as well as deficiency in the soft tissue of the orbital content, so that even after the eye socket is successfully reconstructed the prosthetic eye will look enophthalmic.
Class III	These patients not only have deficiencies of the eye socket and orbital soft tissue, but are also deficient in growth of the periorbital tissues and bones.

Table b

An updated classification was proposed by Tawfik., *et al*. in 2009 [16].

Grade 1	Minimal or no actual contraction. Patients usually complain of inability to retain the prosthesis for a long time. Horizontal lid laxity is usually observed in these patients, with subsequent prolapse or retraction of the inferior fornix. Patients with an unusually large or anteriorly displaced implant also fall in this category.
Grade 2	Mild contracture of the inferior and/or the superior fornix. Patient either complains of inability to wear the prosthesis or may complain of a cosmetic disfigurement due to rolling-in of the upper and lower eyelid margin.
Grade 3	More advanced scarring than grade 2. Cicatrization generally involving the entire upper and lower fornices. Wearing the prosthesis is impossible.
Grade 4	Severe phimosis of the palpebral fissure both vertically and horizontally. Recurrent cases and irradiated sockets are also included in this category.

Table c

Surgical management (Table 2)

The goal of any Fornix reconstruction is to expand the fornices vertically and posteriorly to its form and function. This is achieved by excision of any symblepharon and reposition of adequate graft and flap to promote reepithelialisation and increase the space posteriorly. Management is always indivisualised and depends on two factors - 1. Severity and location of Symblepharon and 2. Amount of orbital volume.

Sl. No	Type of Defect	Treatments	Additional Procedures
1	Minimal or Mild contracture with or without posterior lamellae shortening	Z-plasty, Local Conjunctival Flap,	Horizontal Lid tightening procedures Weis procedure
2	Moderate Contracture	Buccal Mucosal Graft, Amniotic Membrane Graft	
3	Volume Loss	Dermis Fat Graft	Hard Palate-Dermis Fat Graft
4	Severe Contracture	Space Occupying (Silicon/Poly-ethylene) Allograft materials fixed to orbital rim	Rotational or Microvascular Free flaps

Table 2: Surgical Management Options of Contracted Socket.

Surgical consideration

It's highly desirable to understand the conjunctival fornix dimension to provide comfort, stability and facial aesthetics to ocular prosthesis. The normal socket has superior and inferior fornix of 8-10 mm from Superior and inferior limbus respectively while Temporal scleral show is usually 12-14 mm including fornix from temporal limbus and medial scleral show only measures 7 mm from medial limbus (Figure b). Even after Conjunctival socket reconstruction, increasing size of Conformers are used to increase to adequate fornix size.

Conformer made of acrylic, placed inside orbit helps to support the growth of eye socket and bones in the face and requires sometime serial increasing sizes to maximise the fornix space (Figure c).

Figure b: Conjunctival cul-de-sac dimension.

Figure c: Ocular Shell Acrylic Conformers.

Conformers are used during healing for about 6 weeks to find appropriate conjunctival fornices and muscle tone during healing process. Thereafter ocular shell prostheses are given preferably Customized or Ready-stock.

Our results

Figure d: Grade II socket; 60 year old Saint with inability to use his old prosthesis because of shallow fornix. Fornix reconstruction was done with Buccal Mucosal graft and allowed to heal with increasing conformer size and later was satisfied with Custom-made ocular Prosthesis. (Surgeon - Dr Ajeet Kr Dwivedi; www.sedh.org).

Figure e: Grade IV socket; 35 year old female in with narrow palpebral fissure and shallow vertical and horizontal fornices. Fornix reconstruction was done with Buccal Mucosal graft and allowed to heal with increasing conformer size and later was satisfied with Ready-made (Stock) ocular Prosthesis (Surgeon – Dr Ajeet Kr Dwivedi; www.sedh.org).

Ocular prosthesis

An ocular prosthesis is important tool in rehabilitation of such patients. An ocular prosthesis is an artificial substitute for an eviscerated and enucleated eye. An Orbital prosthesis [11,12] is required in cases of exenterated eye.

A prosthesis which adapts well improves the psychological state of the patient and also increases the patient's confidence level and the aesthetic value.

Ocular Prosthesis can be either Ready-made (Stock) and Custom-made [7]. Custom made prosthesis has several advantages over Stock one as below-

- Better Mobility
- Even distribution of pressure due to equal movement thereby reducing incidence of ulceration
- Improved fit
- Comfort and adaptability
- Improved Facial contours and aesthetics
- Increased tissue health because of reducing potential stagnation spaces at tissue-prosthesis interface [7].

There are different stages of Custom-made prosthesis development once patient decide about it. It requires at least 2-3 visits of a patient to have satisfied facial aesthetics and comfort.

- Ocular Impression (Table 2)
- Double Layer Cast
- Wax Pattern Retrieval
- Wax Pattern try in
- Processed Sclera (Clear Acrylic)
- Processed Sclera try in.
- Pupil marking
- Corneal drawing and Painting/3D stock Painted Cornea/Iris disk match
- Final Finishing and Policing
- Dispensing and Training.

Patients are usually called on Day 0 for Ocular Impression, Day 3 for Processed Sclera/Wax try in and Pupil marking/Corneal drawing and Day 5 for final dispensing of Ocular Prosthesis. Pupil Marking/C and Final dispensing can be done on Single day in special cases.

Ocular impression techniques

- External Tray Impression Technique (Taylor., *et al.* [8] with Irreversible Hydrocolloids)
- Modified Impression Technique (Cain [9]. Allen and Webster [10] technique with Ophthalmic Alginates)
- Siloxane Impression Technique

1	Irreversible Hydrocolloids
2	Ophthalmic Alginates
3	Tissue conditioners
4	Polyvinyl Siloxane impression materials
5	Dental Impression waxes e.g. Korecta wax No 4 and Iowa wax

Table 3: Impression materials used in Ocular Impression.

Figure f: Customized Ocular Shell Prosthesis via Siloxane Impression Method (Photo courtesy - Dr Nitu Dubey, www.sedh.org).

Conclusion

Custom-made Ocular prosthesis after appropriate management of Contracted socket is ideal and rewarding for patient future life and gives immense satisfaction to surgeon to help someone to lead their lives with new energy and goals. Careful assessment, patient expectation and realistic solution options with custom-made prosthesis is key to success.

Conflict of Interest

No conflict of interest was present among authors.

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