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Scleral Repair by Biodegradable Collagen Implant in Strabismus Surgery

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Authors' contributions

This case study was carried in collaboration between both authors. Author MMH performed the surgery and followed up the case with the needed investigations and photographs and suggested the hypothesis of the case study. He wrote the protocol and the first draft of the manuscript. Author IMH managed the literature searches and the language supervision. Both authors read and approved the final manuscript.

Article Information

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Case Study

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ABSTRACT

Aim: To evaluate biodegradable collagen implant as a patch for scleral defect.
Case Presentation: A 3 years old girl was subjected to scleral rupture during lateral rectus (LR) advancement for correction of consecutive esotropia. A scleral defect accidentally occurred with uveal exposure of an area 4x6 mm posterior to the original insertion of the lateral rectus muscle The defect was covered by a patch of biodegradable collagen matrix (CM) implant Ologen™ (Aeon Astron Europe B.V., Leiden, The Netherlands) measuring 12 mm diameter x 1mm thickness. Conjunctiva was meticulously closed over it. A follow up of 1 year was performed regarding ocular alignment and globe integrity which was assessed by slit lamp, fundus examination, photography and B-scan ultrasonography (U/S).
Results: Both eyes remained aligned. Scleral defect was well covered, healed by the collagen implant which was incorporated in the surrounding scleral tissues. During postoperative follow up, no uveal exposure and intact retina (no retinal breaks) were detected.
Discussion and Conclusion: Scleral rupture is a potential serious problem that can be managed by patching with collagen matrix biodegradable implant before closing the conjunctiva.

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Keywords: Scleral rupture; biodegradable collagen implant; scleral repair; Ologen implant.

1. INTRODUCTION

Scleral thinning is a well reported complication following pterygium excision, retinal detachment repair, systemic vasculitis, high myopia, or trauma. In rare cases, it results in staphyloma formation, scleral perforation, and uveal exposure. Reinforcement of thin or perforated sclera is necessary, especially when the choroid is exposed to prevent prolapse of ocular contents and secondary infection. Various types of homografts and allografts have been used in this situation, but none has been uniformly accepted. Scleral graft has many intrinsic advantages in this scenario as it is readily available from donor eyes, can be easily preserved for months and is strong, flexible, and easy to handle. Sclera has a natural curvature allowing it to neatly blend with host sclera. However, the biggest advantage is that it is avascular and is well tolerated with little inflammatory reaction. On the other hand, failure of scleral homografts has been reported owing to lack of vascularization with resultant necrosis and sloughing [1].

The sclera is thinnest just posterior to the four recti muscles insertions. This area is the site for most muscle surgeries, especially for recession procedures. Therefore, scleral perforation is always a risk during eye muscle surgery [2].

1.1 Presentation of the Case

A three years old girl presented to us with right consecutive esotropia (ET) measuring 30 PD following an over recession of lateral rectus muscle (LR) 9 mm (as mentioned in a medical report) to treat an intermittent exotropia few months ago. A face turn to the right was noticed indicating a severe weakness of LR mimicking LR palsy.

Advancement of LR 5 mm was planned for surgical correction of the current situation. The patient underwent the surgery under general anesthesia after informed consent from her parents.

The first intraoperative manoeuver was a forced duction test to exclude restrictive strabismus; that was negative. Surgical exploration started with a wide fornix based periotomy of the conjunctiva to expose the area of original insertion. The sclera was very thin at this area with a bluish discoloration due to the proximity of uveal tissues (Fig. 1a). After proper isolation of LR and separation from inferior oblique muscle, LR was advanced 5mm to a point 11 mm from the limbus. Once LR was sutured to the sclera by vicryl 6/0 sutures, rupture of the thin scleral tissue occurred accidentally while manipulating the eye and uveal exposure of was encountered (Fig. 1b).

As the complication occurred, a scleral graft was not available. A biodegradable collagen matrix (CM) implant (Ologen^{TM}) measuring 12 mm diameter x 1mm thickness was available. It was used to cover the scleral defect and conjunctiva was meticulously closed over it using vicryl 8/0 stitches (Figs. 1c, d).

Dilated fundus examination was done at the end of the procedure and there was no retinal breaks nor vitreous hemorrhage, nor choroidal complications. A combination of dexamethasone and tobramycin eye drops was prescribed 5 times a day with lubricating gel 4 times a day for two weeks and systemic antibiotic for one week.

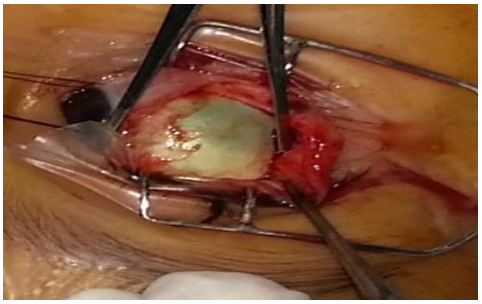
2. RESULTS

In the follow up visits, two challenges were to be assessed; the first was ocular alignment and the second was stability of the treated scleral defect by slit lamp examination, photography, fundus examination and B-scan U/S.

The patient was followed up at 1 day, 1 week, 1month, 6 months and 1 year.

Proper ocular alignment and orthophoria were obtained throughout this period and no more face turn was noticed.

There was a hyperemic conjunctiva over the CM implant at the first day up to one week, which gradually resolved at the end of first month (Fig. 2a.) to be nearly similar to adjacent conjunctiva after 3 months (Fig. 2b) with minimal injection after 1 year (Fig. 2c). CM was incorporated in the surrounding tissues. There was no evidence of any uveal prolapse throughout the follow up visits. Fundus examination was free of any retinal breaks. B-scan U/S revealed covering of the scleral defect by the CM implant which was incorporated in the surrounding sclera (Figs. 3a, b).



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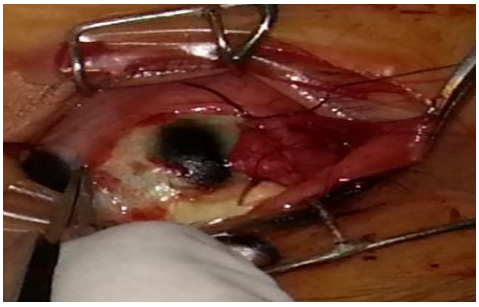

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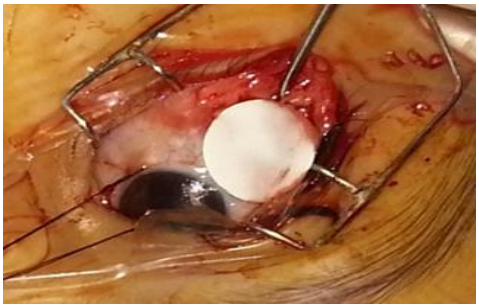

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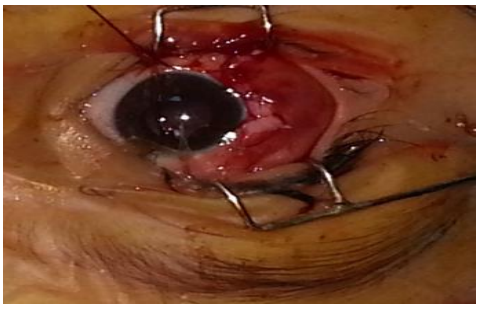
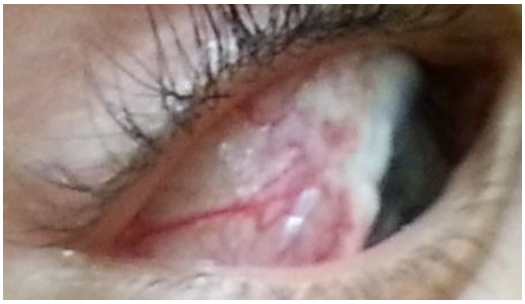


(d)

Fig. 1. a) Thin scleral tissues near the original insertion, b) Scleral defect and uveal exposure, c) CM covering the scleral defect, d) Conjunctiva closed at the end of the surgery



(a)

(b)

(c)

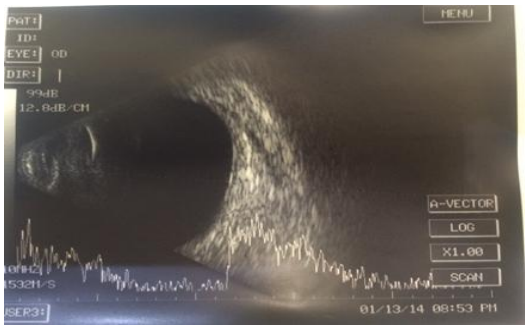
Fig. 2. a) CM after 1 month, b) CM after 3 months, c) CM after 1 year

3. DISCUSSION

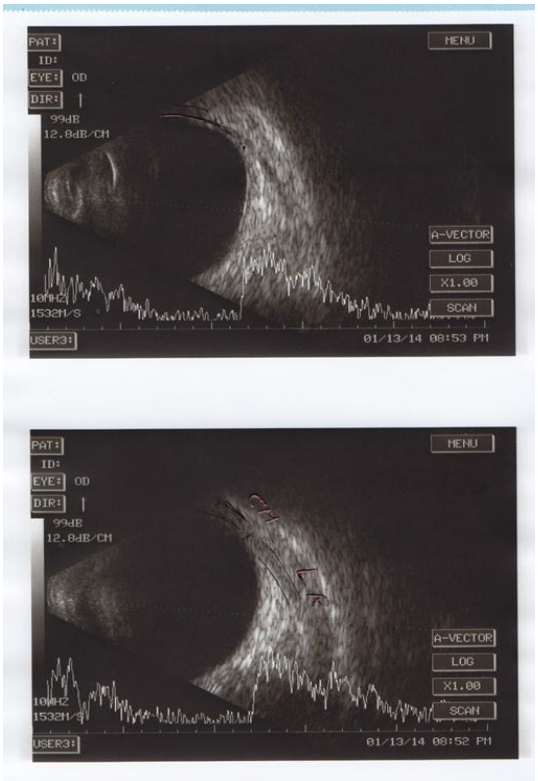
Human homograft and autograft techniques are commonly employed to manage ocular diseases that compromise the tectonic stability of the eye . Traditionally, sclera was used as a graft in cases of scleromalacia with impending rupture, scleral ectasias, or traumatic scleral dehiscence [3].

Many other tissues and synthetic materials have been added to the ever expanding list of reconstructive materials. Still no material has been found to be universally acceptable. Varied success has been reported with the use of sclera

grafts. There are obvious advantages with the use of sclera, the only criticism is that it may become involved in the ongoing necrotic process or being avascular may melt. Tectonic corneal lamellar grafting to preserve globe integrity in cases of scleral melting after pterygium surgery was tried in case of deficiency of scleral graft . Split thickness dermal grafts have been shown to provide tectonic support in certain unusual circumstances as in cases of previous conjunctival scarring [4].



(a)



(b)

Fig. 3. B-scan U/S

They have the disadvantage of being cosmetically unacceptable and unsuitable for use in infective cases and of undergoing extensive vascularization [3]. Dermal grafts and numerous other tissues such as fascia lata, periosteum, and cartilage require an additional surgery and thereby have the potential to add morbidity [1].

Ologen is an artificial porcine extracellular matrix, which is made of atelocollagen cross-linked with glycosaminoglycan. It is a biodegradable scaffolding matrix that induces a regenerative wound-healing process in the absence of antifibrotic agents.It is designed to prevent episcleral fibrosis and subconjunctival scarring and minimize the random growth of fibroblasts, instead promoting their growth through the pores in the matrix. This implant is found to be biodegradable within 90–180 days [5].

Ologen has been widely used in different glaucoma surgeries as wound healing modulator as well as in other indications including oculoplasty, ocular surface reconstruction, pterygium excision and strabismus surgery [6].

When stimulated by wounding, the episclera migrates down the scleral wound supplying vessels, fibroblasts and activated macrophages. The healing of the sclera differs from that of the cornea in that the collagen fibers are randomly distributed, not laid down in orderly lamellae and the principle glycosaminoglycan is dermatan sulphate rather than the keratin sulphate and chondroitin sulphate present in the cornea. The sclera is avascular and acellular. If the uvea is also damaged, uveal fibrovascular tissue may enter the scleral wound. The result is a scar with a dense adhesion between uvea and sclera [7].

Indolent episcleral fibrosis produces adense coat around an extrascleral foreign body such as a scleral buckle [8].

In a research work by Rosentreter to study the reaction of the subconjunctival tissue and the histopathologic findings in explanted Ologen Implant, Ologen matrices and scar tissue were explanted in revision surgery in case of failed trabeculectomies or after glaucoma drainage device surgery. Histological sections were studied by hematoxylin-eosin (HE) staining. Further immunohistochemic stainings were performed for α-smooth muscle actin (α-SMA),

fibronectin (FN), collagen III (COL3) and CD68 [9].

In case of failed trabeculectomies, HE staining of the explanted Ologen revealed an invasion of fibroblasts into the implant. The implants were enclosed by a collagenous pseudocapsule and surrounded by a loose connective tissue. α-SMA staining showed an accumulation of myofibroblasts predominantly in the ologen implant, whereas COL3 was mainly detected at the border area of the implant and the pseudocapsule around the implant.

Immunohistochemistry for FN showed an intensive staining inside the implant and at the pseudocapsule [9].

In case of explanted ologen implants after glaucoma drainage device sugery, a pseudocapsule of three layers of different density was found. Staining for α-SMA indicated an accummulation of myofibroblasts in the middle layer of the pseudocapsule and in the ologen implant. Staining for COL3 showed no signal in the inner layer next to the drainage device, however, a strong staining in middle and outer layer, and a weak signal inside the Ologen. FN was detected with a very strong signal in the implant and in the inner layer of the pseudocapsule. Staining for CD68 revealed macrophage activity inside the Ologen implant.These data denoted that Ologen implants seem to induce the expression of FN and α-SMA. Inside the CM implant macrophage activity was shown. The subconjunctival tissue responds to the implantation of a CM implant with a scarring reaction [9].

The use of Ologen in our case as a patch for the scleral defect was a not a planned step. No scleral grafts were available, CM was available in the facility for glaucoma procedures. The previous data from Rosentreter together with the way the sclera heals support the efficacy of Ologen use and its incorporation into the surrounding tissues to be able to cover the scleral defect and prevent further complications [9].

This was supported clinically as well by the early vascularity over the implant and the lack of uveal prolapse or retinal breaks. B-scan U/S findings confirmed this.

4. CONCLUSION

Scleral rupture is a potential serious problem that can be managed by patching with collagen matrix biodegradable implant before closing the conjunctiva. Using the matrix biodegradable implant in further cases would be useful for more consolidation of the concept. It may be a good choice in the lack of scleral grafts especially in areas with deficient eye banking.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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