AMNIOTIC MEMBRANE TRANSPLANTATION WITH A MODIFIED OCULAR SURFACE RING: A SUTURELESS OCULAR SURFACE RECONSTRUCTION TECHNIQUE

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INTRODUCTION

Human amniotic membrane has been used in the management of ocular surface diseases. The usefulness of amniotic membrane has been attributed to its anti-inflammatory, anti-fibrotic, and anti-vascularization effects and also to its ability to enhance epithelial healing.

Symblepharon is one of the most challenging problems of ocular surface diseases and can result in restriction of ocular motility, inadequate blinking, entropion, ptosis and secondary harmful effects on the ocular surface, including the cornea. It can be caused by problems such as chemical burn, Stevens-Johnson syndrome, ocular cicatricial pemphigoid, and dry eye.

Symblepharon rings are commonly used in the prevention of symblepharon formation. The ring exhibits beneficial effects by reducing scarring and keeping the eyelids away from the damaged ocular surface. In this study, a novel surgical technique for amniotic membran transplantation (AMT) with a modified ocular surface ring (MOSR) using a feeding tube is described in cases of severe ocular surface diseases.

CASE PRESENTATION

The patients underwent placement of the amniotic membrane and modified symblepharon ring implantation to treat the ocular surface diseases. In cases with symblepharon, lysis of symblepharon and all adhesions were performed, followed by AMT onto the entire ocular surface with the MOSR implantation. In cases with limbal stem cell deficiency, limbal stem cell transplantation was also performed, followed by AMT with MOSR.

AMT with MOSR procedure

The surgical technique is shown in detail in video 1, video 2, Fig. 1, and Fig.2. The modified ring was formed using the custom dimension of each eye using a feeding tube. After adjusting the length of the tube by positioning the fornices, it was cut from the marked point. The feeding tube opening was enlarged using a forceps to insert the other end, and then the ends were nestled to form the MOSR. A large piece of amniotic membrane graft was prepared to cover the entire cornea, conjunctiva, fornix, and palpebral conjunctiva. The amniotic membrane graft was spread onto the ocular surface and eyelid, with the epithelial side facing down. The MOSR was gently placed on the amniotic membrane graft in the palpebral aperture. The MOSR held using a forceps was first pushed into the inferior fornix, followed by pushing into the superior fornix. The excess membrane was trimmed at the lid margins. Postoperatively, the patient first received topical moxifloxacin, topical loteprednol etabonate 0.5%, artificial tear eye drops, autologous serum eye drop, and followed by regulated according to ocular condition of patient.

RESULTS

Six eyes of 6 patients with severe ocular surface diseases who underwent AMT combined with MOSR were analyzed retrospectively. Additionaly, symblepharon release was applied in two eyes and limbal stem cell transplantation was performed in three eyes. Postoperatively, complete epithelialization was achieved without symblepharon formation. The demographic information and clinical data of the patients are summarized in Table 1.

DISCUSSION

Severe ocular surface diseases such as chemical burns and ocular cicatricial diseases can lead to severe ocular morbidites, including symblepharon formation and limbal stem cell loss. Maintenance or restoration approaches for ocular surface management are very important to prevent loss of vision or to perform sequential surgical treatment, including keratoplasty and keratoprosthesis. It has been reported that early intervention with AMT in severe ocular surface diseases such as Stevens–Johnson syndrome and acute chemical burns leads to better long-term results.[1,2]

The amniotic membrane is usually sutured onto the ocular surface using running or interrupted sutures for fixation.[3] However, the placement of sutures inflicts trauma to the ocular surface with prolonged operative time, and hence technical skills are required for an effective suture placement. AMT with MOSR does not require any sutures and eliminates several problems resulting from sutures, such as subconjunctival hemorrhage, infection due to sutures, tissue necrosis, foreign body reaction, and irritation. Using AMT with MOSR relieves patient symptoms and decreases surgical time.

Recently, several sutureless amniotic graft implantation procedures have been described. The Prokera ring (Bio-Tissue, Inc, Doral, FL) is an FDA-approved device that consists of a cryopreserved amniotic membrane circle clamped into a dual polycarbonate ring. However, it has a relatively high cost. Liang et al created a modified symblepharon ring using a polymethylmethacrylate ring to apply the amniotic membrane for patients with ocular chemical burns.[4] They showed that sutureless AMT using MOSR had better efficacy than the conventional sutured AMT in the treatment of acute ocular burns.

Symblepharon formation is one of the most challenging problems of severe ocular surface diseases. Various procedures have been evaluated to prevent symblepharon formation, such as the conformer or conventional symblepharon ring combined with AMT. Commercially available amniotic bandage tissues such as the Prokera ring cover just the corneal and limbal surfaces, leaving the deep fornix unreachable, and fail to prevent symblepharon formation. AMT with MOSR procedure expands the effective coverage of the amniotic graft to the entire ocular surface, including the cornea, bulbar conjunctiva, fornices, and palpebral conjunctiva, and prevents significant ocular surface scarring and symblepharon formation. When compared with other options, the MOSR is an inexpensive and an easily accessible option. It can also be customized for each individual. As the MOSR is placed into fornices, it does not cause any cosmetic view. Central aperture of the MOSR allows oxygen and drops to reach the ocular surface, and examination of the ocular surface during the postoperative period. Postoperatively, the MOSR can be easily removed from the ocular surface in the office room.

CONCLUSION

This study demonstrated a simple, effective, and safe technique using AMT combined with MOSR for ocular surface rehabilitation without the need for suturing. This modified technique is economically advantageous and may be an alternative to conventional symblepharon ring or other sutureless AMT techniques.

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TABLES

Table 1. The demographic information and clinical data of the patients

Case no	Age/ sex	Ocular surface disease	Surgery	Follow-up (Mo)	Last visit Results
1	13/F	Chemical burn, large stem cell loss	AMT+MOSR	2	No symblepharon, no epithelial defect
2	30/F	Symblepharon	Symblepharon release+AMT+MOSR	4	No symblepharon recurrence
3	50/M	Chemical ocular burn, limbal stem cell loss	Limbal stem cell tx+AMT+MOSR	9	No symblepharon, no epithelial defect
4	62/F	Symblepharon	Symblepharon release+AMT+MOSR	6	No symblepharon recurrence
5	40/M	Severe chemical ocular burn, limbal stem cell loss	Limbal stem cell tx+AMT+MOSR	6	Lid deformation, entropion, no epithelial defect, no symblepharon
6	35/M	Severe chemical ocular burn, 360^{o} limbal stem cell deficiency with conjunctivalization, corneal opacity	Limbal stem cell tx+AMT+MOSR	3	no epithelial defect, no conjunctivalization and limbal stem cell deficiency, but corneal stromal opacity remain

F:Female, M:Male, Mo: Month, AMT: amniotic membrane transplantation, MOSR: modified ocular surface ring, Tx:Transplantation, PK: Penetrating Keratoplasty

FIGURES

Figure 1.

Preparation of the MOSR. A: A feeding tube; B: the adjustment of the tube length by positioning the fornices; C:Cutting of the feeding tube from the marked point; D: Enlargement of the feeding tube opening using a forceps; E: Nestling of the tube ends to form the MOSR; F: Apparance of the formed MOSR

Figure 2.

Implantation of the MOSR in a patient with severe ocular chemical burn (case 1). A: Covering the entire ocular surface with a large piece of amniotic membrane graft; B: Positioning of superior part of the MOSR in the superior conjunctival fornices above the amniotic membrane graft; C: Positioning of inferior part of the MOSR in the inferior conjunctival fornices and medial canthus above the amniotic membrane graft; D: Appearance of the ocular surface after the MOSR implantation; E: Trimming of the excess amniotic membrane at the lid margins.

VIDEOS

Video 1.

(Case 1). Amniotic membran transplantation with a modified ocular surface ring (MOSR) in a patient with severe ocular chemical burn.

Video 2.

(Case 6). Conjunctival limbal autograft implantation, amniotic membran transplantation with a modified ocular surface ring, and simple limbal epithelial transplantation from a cadaveric donor in patient with severe limbal stem cell deficiency secondary to ocular chemical burn.