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Case Report

A Modified Continuous Suturing Technique for Amniotic Membrane Fixation after Chemical Corneal Injury: An Octagonal Graft

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Abstract

This case report aims to describe a modified continuous suturing technique for firm fixation of a human amniotic membrane graft in a patient with persistent epithelial defect (PED) after a chemical eye injury. As a result of this technique, the amniotic membrane (AM) was firmly fixed to the corneal surface with eight continuous and locked episcleral sutures that resembled an octagon graft. This technique was performed in a 14-year-old patient with PED after a chemical corneal burn. Three weeks after the surgery, the PED was completely healed. This simple continuous suturing technique can allow firm and stable fixation of AM grafts on the ocular surface in cases of PED after chemical burn. It may prevent early loss of the graft and facilitate corneal epithelial wound healing.

Keywords: Amniotic membrane transplantation, ocular surface diseases, persistent epithelial defect, octagonal suturing, corneal chemical burn

Introduction

Currently, human amniotic membrane (AM) transplantation has been accepted as an effective treatment option to promote the healing process in persistent epithelial defect (PED) after chemical burns.[1] AM acts as a basement membrane for epithelial regeneration due to its unique anti-inflammatory and anti-fibrotic nature.[2] Previous studies demonstrated that firm fixation of AM over the corneal surface provides a regenerative layer on the adhesion area, thereby facilitating both epithelial proliferation and migration.[3,4]

Over the years, numerous surgical techniques have been described for AM transplantation (AMT), including both sutured and sutureless methods.[1] Today, sutureless approaches with or without fibrin glue have gained popularity among surgeons due to their relative advantages, such as easy manipulation, shorter surgical time, and lack of suture-related complications.[5] However, it cannot exactly be stated that the sutureless technique should be the first choice for all AMT indications. AM grafts can be more mobile and lost earlier with suture-free fixation methods, possibly necessitating repeated AMT.[6] Moreover, this can be a disadvantage for PEDs because stable, firm, and long-lasting fixation of AM grafts on the ocular surface seem to facilitate epithelial regeneration in PED patients. To overcome these mentioned drawbacks, we describe a new and easily applicable continuous suturing technique for the stable and firm fixation of AM grafts in PEDs after chemical burns.

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Case Report

A 14-year-old patient presented to our clinic after experiencing an acute chemical injury to the left eye (exposure to 100% pure acetone). Standard emergent treatment was applied, including irrigation of the eye with a sterile saline solution. Uncorrected visual acuity was 0.9 and 0.5 Snellen lines in his right and left eye, respectively. Biomicroscopic examination showed conjunctival hyperemia, approximately 30-degree limbal ischemia at the nasal quadrants, a corneal epithelial defect with necrotic epithelium, and mild corneal stromal haze (Figure 1). Necrotic epithelial tissue was gently removed and medical treatment was administered, including topical antibiotic (moxifloxacin 0.5%, four times a day), topical steroid (dexamethasone 0.1%, six times a day), oral vitamin C, topical cycloplegic agents (cyclopentolate hydrochloride 1%, twice a day), and autologous serum-based eye drops (50%, five times a day). A therapeutic contact lens was fitted. Despite medical treatment, the total corneal epithelial defect persisted after one week and AMT was planned with the current continuous suturing technique.

In this surgical technique, a cryopreserved AM was used for transplantation as previously described.[1] First, peripheral corneal necrotic epithelium, if present, was gently removed. Then, a single AM layer was trimmed to size and was used to cover the entire corneal surface with the epithelial side up. The AM was circumferentially fixed to the episclera and the perilimbal conjunctiva using a non-absorbable continuous 10/0 nylon suture with one needle. First, the needle was inserted in the perilimbal area at 3 o'clock and passed through the AM, conjunctiva, and episcleral, in that order. The suture was then tied but not cut. The needle was passed parallel through to the limbus in each of eight sectors, and the knot was locked by passing the needle through the loop. The last knot was tied to the end of the first suture. In this way, eight knots were formed, resembling an octagon, which tightly fixed the AM to the entire corneal surface (Figure 2). At the end of the procedure, one drop of topical antibiotic was administered.

Firm fixation of the AM is demonstrated both in the slit-lamp photograph and optical coherence tomography (OCT) image of the anterior segment (Figure 3). The OCT image of the anterior segment also showed point-to-point adhesion of the

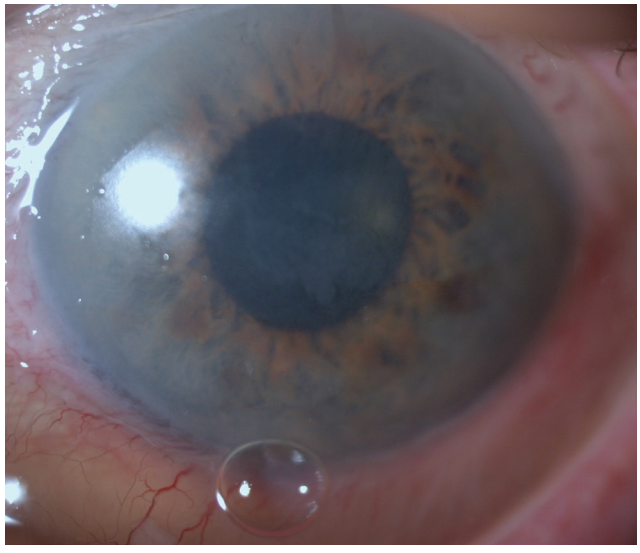

Figure 1. A biomicroscopic photograph of the patient at initial presentation after chemical corneal burn

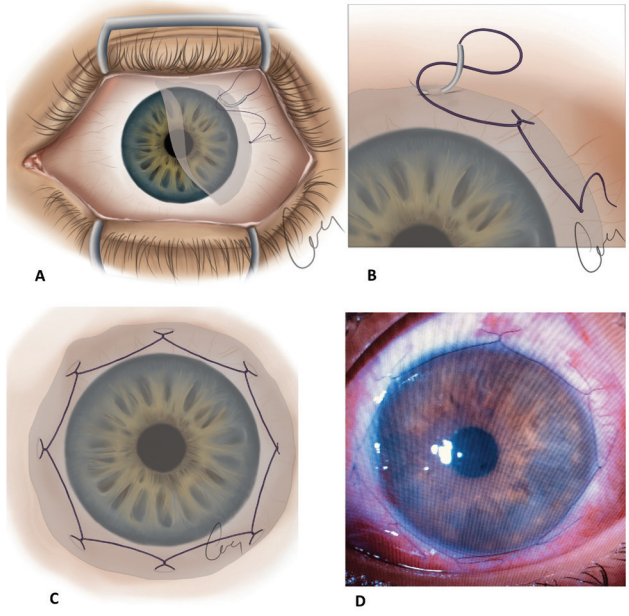

Figure 2. Illustrations showing the steps of the current continuous suturing technique (A-C) and an anterior segment photograph showing the final result (D)

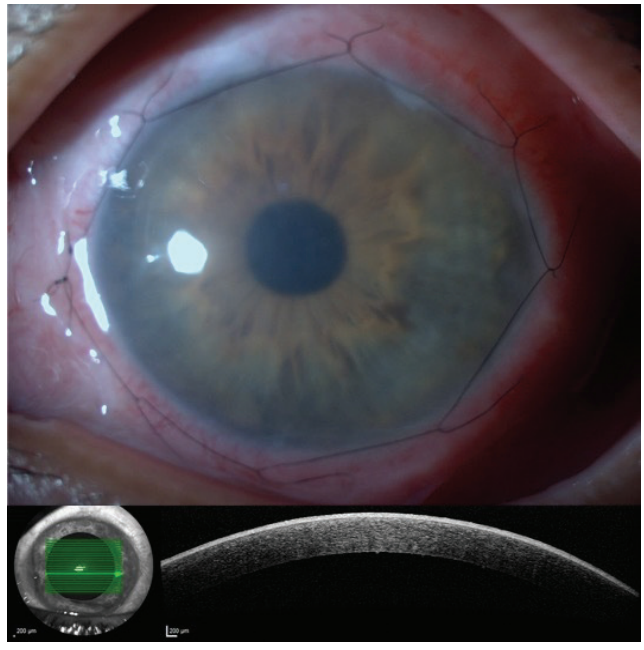

Figure 3. A biomicroscopic photograph (top panel) and anterior segment optical coherence tomography image (bottom panel) of the patient at 1 day after amniotic membrane transplantation

AM to the corneal surface. Three weeks after AMT, the corneal epithelium healed completely, and the remnants of the AM and sutures were removed. OCT imaging of the anterior segment confirmed the epithelial healing. Visual acuity was improved to 0.8 Snellen lines (Figure 4).

The patient's parent provided written informed consent to report this case.

Discussion

In this paper, we presented a new continuous suturing technique for AMT in PEDs after chemical burns. We believe that this technique offers many advantages over previous methods.[7] Mainly, the octagonal suture shape provides excellent peripheral support to the AM in all limbal quadrants circumferentially. Accordingly, the AM adhered firmly to the entire corneal surface and was less affected by eyelid movements. This technique may shorten corneal epithelialization time, avoid the risk of graft detachment, and may extend AM graft survival. Traditional suturing methods employ 12- to 16-bite running or interrupted sutures.[7,8,9] Regarding the AMT, an excessive number of sutures requires more episcleral bites, increasing surgical time, intraoperative bleeding risk, postoperative inflammation, and patient discomfort.[1,7,8,9] In the technique described here, we used eight easily performed sutures in AM fixation to reduce suture-related complications. Despite the limited number of bites, the AM was anchored firmly due to the advantageous suture configuration. Several studies reported that sutureless techniques using the fibrin-based tissue adhesive ProKera (Bio-Tissue, Miami, FL, USA) or the self-adhesive AM graft AmbioDisk (Katena Products Inc, Parsippany, NJ, USA) can be regarded as an effective option for AMT.[10] The short operation time and easy application with local anesthesia are the main reasons for the popularity of sutureless methods. However, graft cost and mobility (which may mean that repeated applications are needed) are the main disadvantages of the technique.[11,12] Moreover, in sutureless surgery there is potential for a space to form between the posterior layer of the AM and the ocular surface due to the mobility of the graft. Inflammatory cells, infective agents, and cell debris can accumulate in this space and impair the healing process.

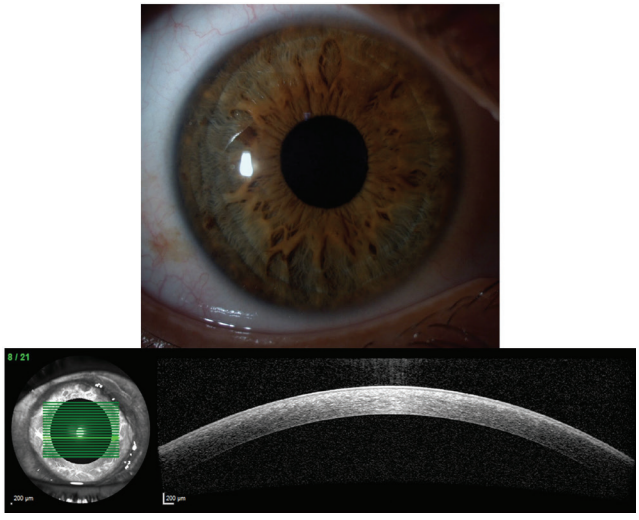

Figure 4. A biomicroscopic photograph (top panel) and anterior segment optical coherence tomography image (bottom panel) of a patient 3 weeks after AM transplantation. Photographs demonstrated complete epithelial corneal wound healing

AM: Amniotic membrane

With the current technique, the AM graft is tightly attached to the corneal surface and immobilized by the eight knots, providing stable fixation of the AM to the ocular surface for a longer time. This new continuous suturing technique requires fewer tissue manipulations and offers the advantages of low cost and a quick and surgeon-friendly application. The AM graft tightly covers the entire corneal surface with a wider point-to-point adhesion area. This can facilitate and accelerate corneal epithelial wound healing. Although sutureless methods seem to be the first choice for AMT according to many corneal surgeons, this does not mean that sutured methods should be abandoned. We think that sutured methods should still be performed as the first choice for some indications. The current technique can be regarded as an effective option, especially in cases with impaired corneal epithelium. In the present case, we used this suturing technique with a single AM layer in a patient with chemical burns. However, the current technique can safely be performed with a multi-layered AM in different conditions such as corneal ulcers and neurotrophic keratopathy.

This simple method provides point-to-point AM-corneal surface adhesion in cases of PEDs after chemical burns. In this way, the AM can act as a regenerative layer for healing. With this firm and long-lasting fixation of the AM to the corneal surface, epithelial regeneration can be facilitated and accelerated. This method can also provide rapid closure of the wound in severely chemically injured eyes, and further interventions, such as limbal stem cell transplantation, can be done much earlier. Although the use of sutures seems to be the main limitation of the current technique, we believe that it provides rapid and effective epithelial regeneration in PEDs after chemical burns with the advantage of a simple application. However, further comparative studies with a large number of cases and with a long follow-up period are necessary to reach a definitive conclusion.

Ethics

Informed Consent: Obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.B., E.S.S., Concept: M.B., E.S.S., Design: E.S.S., M.B., C.Y., Data Collection or Processing: E.S.S., M.Ö.K., Analysis or Interpretation: E.S.S.,

Literature Search: E.S.S., Writing: E.S.S.

Conflict of Interest: No conflict of interest was declared by the authors.

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