

## Fornix Reconstruction with Amniotic Membrane Transplantation: A Cosmetic Remedy for Blind Patients

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### Abstract

**Purpose:** Fornix contracture is an obstacle for fitting a prosthesis in blind or enucleated patients, and may lead to disfigurement and psychological issues. This study evaluates the efficacy of amniotic membrane transplantation (AMT) for fornix reconstruction with the aim of better retention of the ocular prosthesis.

**Methods:** This non-comparative interventional case series includes eighteen blind eyes with fornix deformity in which a cosmetic prosthesis could not be retained. Various causative factors included symblepharon, cyst formation and fornix shortening after enucleation. AMT was performed along with correction of symblepharon, cicatrix release, and excision of the cyst with or without anchoring sutures to reform the fornix.

**Results:** Mean fornix depth pre- and post-operation were  $3.72 \pm 0.69$  and  $7.13 \pm 0.81$  mm, respectively. Fornix deepening was achieved successfully in 15 cases (83.33%). Partial success was achieved in 1 case (5.66%); the remaining two cases (11.11%) were considered as failure despite repeat surgery. Both of these patients suffered from extensive symblepharon formation. Satisfactory results, i.e. formation of a deep fornix to hold the ocular prosthesis, could be achieved in 16 (89.99%) cases. There were no serious complications such as infection or graft rejection.

**Conclusion:** AMT can be a viable option for fornix reconstruction. It has a high success rate in subjects with blind eyes and moderate fornix shortening who are unable to retain an ocular prosthesis.

**Keywords:** Amniotic Membrane Transplantation; Fornix Reconstruction; Prosthesis; Shallow Fornix; Symblepharon

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### INTRODUCTION

A normal deep fornix creates a tear reservoir and provides full range of motility. Obliteration of the fornix may result in ocular surface failure due to dryness, lid margin keratinization, entropion, ptosis and restriction of ocular motility. An adequately deep fornix is very important to retain the prosthesis in a blind eye or an anophthalmic

socket. Inability to retain an ocular prosthesis due to fornix deformity adversely impacts the psyche of an individual and the cosmetic disfigurement affects their social and personal well-being. Shallowing of the inferior conjunctival fornix is one of the most common problems encountered in patients after enucleation. Other causes are symblepharon, cyst, granuloma formation, and excessive scarring with necrosis of conjunctival tissues.<sup>[1]</sup> All of these factors lead to deviation and malposition of the prosthesis producing an unsightly appearance. Successful reconstruction of the fornix requires stability and adequate fornix depth. This can be achieved by increasing the surface area with the use of grafts.

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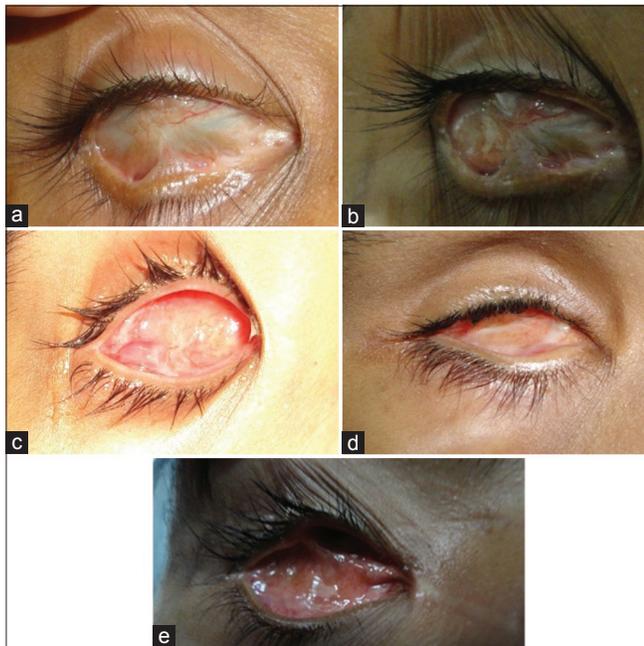
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Amniotic membrane (AM) has shown successful results in fornix reconstruction after symblepharon lysis in cicatricial pemphigoid, Stevens-Johnson syndrome, chemical burns, recurrent pterygium excision and contracted sockets.<sup>[2]</sup> AM has become more popular because of its favorable results in fornix and socket reconstruction. This material could be an ideal graft that is readily available and in abundance, without sacrificing the patients' own tissue. AM can be easily harvested, undergoes minimal shrinkage, is resistant to contraction, and has a short healing period with no donor site morbidity. These characteristics make the AM a suitable graft for fornix reconstruction.<sup>[2]</sup>

The current study evaluates the efficacy of amniotic membrane transplantation (AMT) for fornix reconstructing in blind or anophthalmic sockets where fornix shortening due to scar or symblepharon formation makes it difficult to wear an ocular prosthesis successfully.

## METHODS

The study was conducted on 18 blind eyes of 18 patients aged 3 to 60 years. All eyes had obliterated fornices and were unable to retain the prosthesis. Various etiological factors were involved including symblepharon, cyst formation, and fornix shortening in deformed and enucleated eyes [Figure 1]. All patients underwent fornix reconstruction using AMT. Prior to surgery, fornix

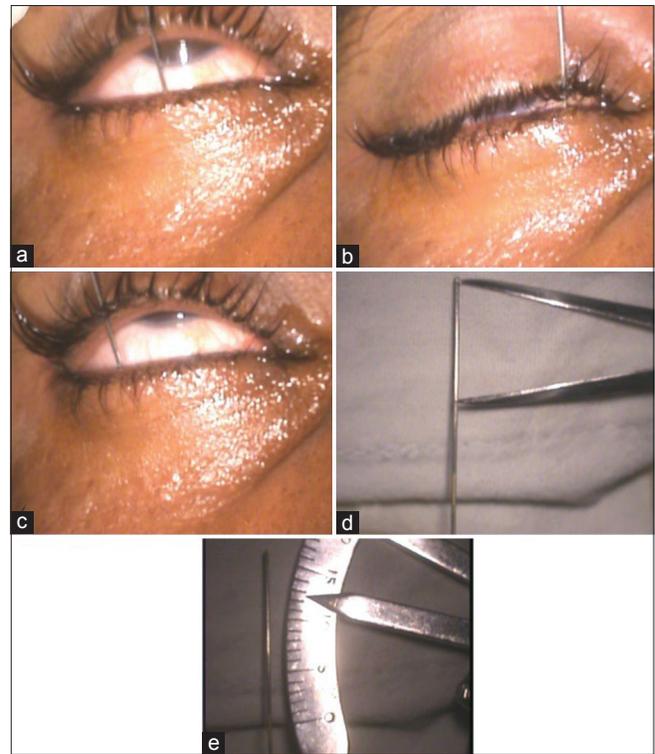


**Figure 1.** Preoperative appearance of representative cases of contracture and fornix shortening; Obliterated upper and lower fornix with symblepharon (a and b); shallow inferior fornix with granuloma formation (c); shallow inferior fornix (d); obliterated superior fornix with symblepharon formation (e).

depth was measured at different locations in both eyes using non-invasive, dull-edged fine stainless steel rods [Figure 2]. The required overall area and depth of the fornix was assessed by comparing measurements with that of the normal eye.

## Surgical Technique

Local anesthesia was preferred for cases with mild contracture and in cooperative subjects, but general anesthesia was given in subjects with excessive scarring and in younger or uncooperative patients. The subconjunctival scar tissue was dissected from the episclera along with excision of cysts and cicatricial tissues and symblepharon release, when necessary. The incision on the conjunctiva was given as close to the limbus as possible, so that the larger part of the conjunctiva was available to reconstruct the fornix. The free conjunctival flap was then recessed to the fornix. A layer of AM was applied to cover the exposed bare episclera. Epithelial side of AM was faced up. It was identified with the help of swab stick. The sticky part was stromal side and was kept towards the sclera. The size of the required AM varied from 5 mm to 11mm. Two patients with larger symblepharon required 9 and 11 mm AM grafts. Fornix depth as measured from the normal eye was taken into consideration to reform the



**Figure 2.** Pre-operative fornix depth measurement in the normal fellow eye: Measuring fornix depth at the center (a), medially (b), and laterally (c). Measuring the marked point on the stainless steel rod using calipers (d and e).

fornix. The required depth of the fornix was measured, and the fornical edge of the AM was anchored with sutures passing through the full thickness of the eyelid using 4-0 silk sutures. In cases with severe scarring, sutures were passed deep, up to the periosteum of the lower orbital rim. A bolster was applied on the skin side under the suture knot to prevent skin erosion. Adequately-sized conformers were placed in all the cases to prevent post-operative scarring and fibrosis. In cases with excessive dissection for severe scarring and improper lid closure, upper and lower lid sutures were placed and fixed to the opposite side (forehead and cheek) with adhesive tapes.

Postoperatively, oral antibiotic and analgesics were given to the patients for 7 days. The antibiotic-steroid drops and ointment, along with lubricating ointment was also prescribed for 2 weeks. At the end of this period, the dose of the steroid-antibiotic drops and ointment was gradually tapered over 2 months. However, lubrication was continued for 3 to 4 months. Conformers were left in place for 6-8 weeks. Regular cleaning of the conformer was instructed to the patients or their attendants. The patients were followed up regularly every week for a month and then every 15 days. After 3 months, patients were advised to have a prosthesis made. The follow-up period was between 8 months to one year. In the follow-up period, observations were made to record achievement of a deep fornix and any complications such as infection, graft rejection, contractures, fornix shortening, or recurrence of symblepharon.

Complete success was defined as restoration of an anatomically deep fornix with retention of the prosthesis, while partial success was defined when focal recurrence of scar and symblepharon occurred but it was still possible to retain a prosthesis. Failure was defined as recurrence of symblepharon or shallow fornix with failure to retain the prosthesis.

## RESULTS

A total of 18 patients, including 5 female and 13 subjects were operated. Mean age was  $19.33 \pm 12.35$  (3 to 60) years [Table 1]. Mean fornix depth pre- and post-operation were  $3.72 \pm 0.69$  and  $7.13 \pm 0.81$  mm, respectively. Complete success was achieved in 15 eyes (83.33%) with an adequate and deep fornix [Figure 3]; one eye developed a tag of symblepharon (partial success 5.66%), but no intervention was required as the prosthesis was well retained. Since the main aim was to retain the prosthesis and this was achieved in 16 eyes, the overall success rate was 88.99% [Figure 4].

Failure occurred in 2 (11.11%) eyes despite repeat intervention. In these cases, symblepharon was the underlying etiology which covered a larger surface area. AMT alone was not sufficient to achieve success and there was recurrence.



**Figure 3.** Post-operative results. Deep upper fornix (a), deep upper and lower fornices (b), deep fornix with an oversized conformer (c), deep fornices with a well-retained conformer (d).

## DISCUSSION

Contraction, shallow fornices and symblepharon in anophthalmic sockets or in blind disfigured eyes cause difficulty in using ocular prostheses and often pose a major aesthetic concern for the patient. Main factors leading to socket contracture include extensive loss of conjunctiva, deep scar formation, atrophy of orbital fat, and fornix contraction.<sup>[3]</sup> Successful reconstruction of the contracted socket requires a stable fornix with adequate depth by increasing the surface area with the use of grafts. Several graft materials such as oral mucosa, skin, dermis-fat, and hard palate mucosal grafts have been described for socket reconstruction. The major disadvantage of all the mentioned grafting procedures is the need to harvest tissue from another site of the same patient, where its availability may be limited. It also requires additional surgical skill, manipulation and instrumentation. Furthermore, once shrinkage and fibrosis of the socket begin, the patient may require repeat surgical interventions to maintain an adequate socket for the prosthesis.<sup>[4,5]</sup>

For mild contracture, several recent studies have described the use of AM as a substrate graft to allow the conjunctival epithelium to migrate and multiply over its surface.

There are limited reports on the use of AMT in oculoplastic and orbital surgery. Most have been aimed at fornix reconstruction or as a substrate for epithelialization of conjunctival defects for proper prosthesis fitting. AM can be used as a patch when epithelium is expected to grow beneath the membrane or as a graft when epithelialization is expected to grow over the membrane followed by incorporation into the host tissue.<sup>[6]</sup> A study by Tseng et al<sup>[7]</sup> showed the intraoperative application of mitomycin C (MMC) is an effective means to reduce chronic, deep-seated

**Table 1. Age, sex, etiology, degree of involvement of lids, preoperative fornix depth and achievement of fornix depth postoperatively**

| Number | Age | Sex    | Status of operated eye             | Involved eyelid | Depth of fornix   |          |                      |                               |
|--------|-----|--------|------------------------------------|-----------------|-------------------|----------|----------------------|-------------------------------|
|        |     |        |                                    |                 | Preoperative (mm) |          | 2 months F/U (mm)    | 6 months F/U (final F/U) (mm) |
|        |     |        |                                    |                 | No affected       | Affected |                      |                               |
| 1      | 7   | Male   | Empty socket                       | LL              | 9                 | 5        | DF 7                 | DF 7                          |
| 2      | 26  | Male   | Empty socket                       | UL              | 8.5               | 4        | DF 7.5               | DF 7.5                        |
| 3      | 11  | Male   | Phthisis                           | LL              | 9                 | 3        | DF 6.5               | DF 6.5                        |
| 4      | 12  | Male   | Phthisis                           | LL              | 8.5               | 4.5      | DF 7                 | DF 7                          |
| 5      | 03  | Female | Cystic eye ball                    | BL              | 8                 | 3        | Focal symblepharon 7 | Partial success 7             |
| 6      | 15  | Female | Shallow fornix with granulation    | LL              | 9                 | 4        | DF 8                 | DF 8                          |
| 7      | 10  | Male   | Phthisis                           | LL              | 8                 | 4.5      | DF 8                 | DF 8                          |
| 8      | 18  | Female | Empty socket                       | BL              | 8.5               | 3        | DF 7.5               | DF 7.5                        |
| 9      | 28  | Male   | Empty socket with symblepharon     | BL              | 9                 | 2.5      | SF 5                 | SF with symblepharon 5        |
| 10     | 20  | Male   | Empty socket                       | LL              | 9.5               | 4        | DF 8                 | DF 8                          |
| 11     | 12  | Female | Ant staphyloma with symblepharon   | LL              | 8.5               | 3.5      | DF 7                 | DF 7                          |
| 12     | 22  | Male   | Empty socket                       | LL              | 8                 | 4        | DF 8                 | DF 8                          |
| 13     | 23  | Male   | Total vascularized corneal opacity | BL              | 8.5               | 3.5      | DF 7.5               | DF 7.5                        |
| 14     | 60  | Female | Eviscerated SF                     | LL              | 8                 | 4.5      | DF 7                 | DF 7                          |
| 15     | 14  | Male   | Phthisis SF                        | LL              | 7.5               | 3        | DF 7                 | DF 7                          |
| 16     | 25  | Male   | Shallow fornix with cyst           | LL              | 8.5               | 4        | DF 7.5               | DF 7.5                        |
| 17     | 17  | Male   | Enucleated SF                      | LL              | 9                 | 4        | DF 7.5               | DF 7.5                        |
| 18     | 25  | Male   | Symblepharon                       | BL              | 8.5               | 3        | Recurrence 5.5       | SF with symblepharon 5.5      |

F/U, follow-up; UL, upper lid; LL, lower lid; BL, both lids; DF, deep fornix; SF, shallow fornix



**Figure 4.** Final outcome. A1 and B1 show pre-operative blind eye and empty socket with fornix deformity, A2 and B2 showing 1-month post-operative condition with conformers in place, A3 and B3 showing 2 months post-operative situation with deep fornix, A4 and B4 showing 6 months postoperative outcomes of patients A and B, respectively.

conjunctival inflammation, thereby helping AM to restore a deep fornix after symblepharon lysis. MMC was not used in our series because most of our cases had mild to moderate contracture and a good probability

of success without adjunctive agents. Lukáts<sup>[8]</sup> used a silicone sphere as an expander for widening and deepening severely contracted conjunctival sacs. In our series, conformers were used in all patients to prevent

scarring and fibrosis. Lee et al<sup>[9]</sup> used a subciliary approach to fix the conjunctival fornix to the periosteum immediately posterior to the inferior orbital rim in patients with anophthalmic, shallow inferior fornices with sufficient conjunctiva but loose attachment of the fornix to the underlying tissue, causing shallow fornices. In our study, sutures were passed from the periosteum only in cases with severe scarring. Poonyathalang et al<sup>[10]</sup> described 10 cases of fornix reconstruction where socket contraction prevented fitting of a prosthesis. A total of 80% achieved successful fitting following reconstruction. Similar results were achieved in 18 eyes in our study. Our complete success rate was 83.33%, and overall success rate (including the single case of focal recurrence with good retention of the prosthesis) was 88.99%. Based on our results, the limitation of using AMT is when the symblepharon covers a large surface area and this technique is not successful (11.11%).

In summary, AMT is a simple and safe method for fornix reconstruction in blind and disfigured, or enucleated sockets; it provides effective deepening of the fornix to retain the ocular prosthesis. A successful outcome can be achieved by selectively deploying cicatrix lysis, symblepharon release, and fornix reconstruction with AMT along with or without anchoring sutures.

### Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

### Conflicts of Interest

There are no conflicts of interest.

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