The conjunctival tissue starts from the limbus and ends in the lid margin. According to the anatomic location, the conjunctiva can be subdivided into the bulbar and palpebral portions; palpebral conjunctiva can further be subdivided into tarsal and fornical portions. Under normal circumstances, the fornix is deep creating a tear reservoir for the formation of a tear meniscus. A normal, deep fornix also helps provide a full range of ocular motility when there is a natural, smooth contact between the lid and globe during the blink. Collectively, it helps maintain a stable tear film and a healthy ocular surface.

Obliteration or foreshortening of the fornix by a symblepharon due to scar tissue (cicatrix) may result in ocular surface failure. The pathogenic elements include: sicca due to the depletion of the tear flow and spread; blink-related microtrauma due to cicatricial entropion, lid margin/tarsal keratinization/scarring or misdirected lashes; exposure due to inadequate blinking and closure; entropion and ptosis; and restriction of ocular motility.

When symblepharon develops in the superotemporal fornix, severe sicca can develop by the blockage of the lacrimal gland. When symblepharon develops in the inferior fornix, nocturnal corneal exposure may further develop due to the loss of the Bell’s phenomenon during sleep.

Although there are diverse causes for developing symblephara, inflammation is invariably the common denominator. If uncontrolled, inflammation can progressively cause additional scarring worsening the symblepharon and fornix obliteration.

Depending on the location and severity of symblepharon, fornix obliteration can be pathogenic and even give rise to severe visual loss. In moderate to extreme situations, fornix obliteration may cause difficulties for contact/scleral lens insertion and wear; result in ankyloblepharon and socket contraction. All potential pathogenic elements of symblepharon are summarized in the table below.

**Table: Pathogenic Elements of Symblepharon**

<table>
<thead>
<tr>
<th>1. Causing Dry Eye</th>
<th>Obliteration of lacrimal excretory ductules</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Contributing to Dry Eye</td>
<td>Obliteration of tear meniscus, interference with lid blinking and closure</td>
</tr>
<tr>
<td>3. Causing Blink-related Microtrauma</td>
<td>Cicatricial entropion together with abnormal lid margins, tarsi and lashes</td>
</tr>
<tr>
<td>4. Causing Diplopia</td>
<td>Restriction of ocular motility</td>
</tr>
<tr>
<td>5. Causing Decreased Vision</td>
<td>Cicatricial ptosis and symblepharon extending to the cornea</td>
</tr>
<tr>
<td>6. Partaking in Ocular Surface Failure</td>
<td>Carrying uncontrolled inflammation</td>
</tr>
<tr>
<td>7. Interfering with Contact (Scleral) Lens Wear</td>
<td>Ankyloblepharon or socket contraction</td>
</tr>
</tbody>
</table>
For each symblepharon, the location is assigned by using “U: upper lid” or “L: lower lid”, and “N: nasal”, “M: middle” or “T: temporal”.

The severity is graded according to the following three parameters:

1. The shortest vertical length of symblepharon measured from the limbus to the lid margin of the foreshortened fornix. It is graded as “Mild” (Fig. 2A) if the length is greater than the palpebral conjunctiva, as “Moderate” (Fig. 2B) if the length is greater than the tarsal conjunctiva but shorter than the palpebral conjunctiva, or as “Severe” (Fig. 2C) if the length is shorter than the normal tarsal conjunctiva.

2. The longest horizontal width of symblepharon as compared to the length of the eyelid. It is graded as “Mild” if the width is less than 1/3 (Fig. 3A), as “Moderate” if the width is greater than 1/3 but less than 2/3 (Fig. 3B), or as “Severe” if the width is greater than 2/3 of the lid (Fig. 3C).

3. The severity and the location of the inflammatory activity of the symblepharon. The inflammatory activity is graded as “0” if absent (Fig. 4A), “1+” if mild (Fig. 4B), “2+” if moderate (Fig. 4C), or “3+” if severe (Fig. 4D) as judged by the vascularity and the presence or absence of whitish scar tissue. The location of most active inflammation is further specified as “L: limbal”, “F: fornical”, or “T: tarsal”.
Management

No treatment is needed if patients are asymptomatic and if clinical staging of symblepharon does not reveal any pathogenic potential. As stated above, a symblepharon can potentially be pathogenic if it obliterates the tear meniscus, the reservoir, or lacrimal secretion (leading to dry eye), induces blink-related microtrauma from the lid margin and misdirected lashes due to cicatricial entropion (inciting mechanical irritation), produces exposure keratopathy due to incomplete blink/closure or loss of Bell's phenomenon (punctuate/ulcerative keratopathy), restricts ocular motility (causing binocular diplopia) or impedes the comfort of contact/scleral lens wear (Table).

Patients with symptoms caused by pathogenic symblepharon should be treated to avoid potential blindness. The treatments start with conventional therapies including frequent lubrication using artificial tears or ointment, punctal occlusion, bandage contact lens (if not contraindicated), scleral lens, and periodic epilation. Systemic immunosuppressive measures should also be initiated for active inflammation in mucous membrane pemphigoid.

If the above measures fail to achieve the desired effects or cannot be instituted (e.g., lens insertion), even if the inflammatory activity is successfully controlled by systemic immunosuppression in the case of mucous membrane pemphigoid, surgical procedures including symblepharon lysis and fornix reconstruction become necessary. This Guide describes our proposed surgical methods, which include intraoperative application of mitomycin C (MMC) and sutureless transplantation of cryopreserved amnion graft.

Supplies

- Cryopreserved amniotic membrane: AMNIOGRAFT® purchased from Bio-Tissue, Inc. by calling their toll free phone number 1-888-296-8858. For product information, visit www.biotissue.com.

<table>
<thead>
<tr>
<th>Catalog #</th>
<th>AMNIOGRAFT® Sizes</th>
<th>Actual Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG-2520</td>
<td>A</td>
<td>2.5 x 2.0 cm</td>
</tr>
<tr>
<td>AG-2015</td>
<td>B</td>
<td>2.0 x 1.5 cm</td>
</tr>
<tr>
<td>AG-3535</td>
<td>C</td>
<td>3.5 x 3.5 cm</td>
</tr>
<tr>
<td>AG-1510</td>
<td>D</td>
<td>1.5 x 1.0 cm</td>
</tr>
</tbody>
</table>

- For sutureless surgery, use fibrin glue: TISSEEL VH (Vapor Heated) fibrin glue (1.0 mL, part # 921028) purchased from Baxter Biologics by calling their toll free phone number 877-TISSEEL (877-847-7335). For product information, visit www.advancingbiosurgery.com/us/products/tisseel/. We prefer to use the two components separately, each with a special needle provided without dilution, instead of combining them via the provided DUPLOJECT.

NOTE: The ophthalmic use of fibrin glue is considered “off label”.

- 7-O Polyglactin sutures: Vicryl purchased from Ethicon Inc., Johnson & Johnson, Somerville, NJ.
- For severe/moderate cases, 4-O black silk sutures are also needed
Surgical Techniques

In general, the surgical approach is formulated based on the severity of symblepharon according to the grading system described above. In principle, the grading of the vertical length affects the necessity of using anchoring sutures to the lid skin and/or additional transplantation of oral mucosal graft; the grading of the horizontal width affects the size of conjunctival autograft (if possible), oral mucosal graft or cryopreserved amnion graft; and the grading of location and severity of the inflammatory activity affects the site and the duration of intraoperative application of MMC.

Key Surgical Steps

Anesthesia: Topical anesthesia with 2% lidocaine gel under intravenous sedation is preferred for mild cases. General anesthesia is preferred for moderate to severe cases in which traction sutures to open the eyelids without a speculum, more extensive excision, an oral mucosal graft, or anchoring sutures are required.

Preparation of the Eye: After standard prep and drape of the eye, a speculum is inserted for mild cases. In moderate to severe cases, one 4-O black silk suture is placed at each lid margin as a traction suture to open the eye if the speculum cannot be inserted (Fig. 5). Several drops of non-preserved 1:1000 epinephrine (Hospira, Inc., Lakes Forest, IL) are applied on the entire ocular surface to achieve vasoconstriction for subsequent hemostasis.

Incision, Traction Suture and Excision of Cicatrix: Circumlunar incision (like peritomy) starts from the perilimbal region between the normal conjunctiva and the beginning of the symblepharon (Fig. 6). Relaxing incisions are made extending toward the fornix along the border of symblepharon (Fig. 7). A traction suture made of double-armed 7-O polyglactin (Vicryl, Ethicon Inc., Johnson & Johnson, Somerville, NJ) is placed near the exposed bulbar sclera, and the eye is rotated opposite to the vertical axis of symblepharon, allowing better exposure of symblepharon and subsequent excision of cicatrix (Fig. 8).

With the assistant grabbing the tip of the symblepharon, the cicatrix, which consists of scar and thickened fibrovascular tissue included in the Tenons capsule, is dissected away from the epithelial tissue of the symblepharon and amputated at the base using scissors near either the fornix or the tarsus (Fig. 9A-9C). This step invariably results in further recession of the symblepharon epithelial tissue to the fornix, leaving a larger bare bulbar sclera. The epithelial lining tissue is intentionally saved for reconstructing the palpebral conjunctiva. The thoroughness of cicatrix removal can be judged by the free motility of the globe under the traction suture.
**Key Surgical Steps**

**Intraoperative Application of Mitomycin C:** With the exception of cases without inflammation, nearly all symblephara need intraoperative application of 0.04% MMC delivered via soaked sponges. The MMC sponges are inserted at the base where cicatrix is amputated (Fig. 10, arrow marks the inserted sponge). The duration of MMC application depends on the severity of inflammatory activity. For those graded as 3+, MMC is applied for 5 min; for those graded as 2+, MMC is applied for 4 min; and for those graded as 1+, MMC is applied for 3 min. During incubation, the inserted sponge is covered by the recessed symblepharon tissue. The traction suture helps pull the bulbar sclera away from being exposed to the MMC sponges. Periodically dry the bulbar sclera with a dry Weckcell sponge. After incubation, the sponges are removed and counted, and the contact area is thoroughly rinsed with BSS (half a bottle).

**For Mild Symblepharon-Transplantation of Cryopreserved Amnion Graft Alone:**

For mild cases (judged by the vertical length measured from the limbus to the lid margin of the foreshortened fornix), the recessed symblepharon conjunctiva is large enough to be used to cover the entire palpebral conjunctiva (Fig. 11, after removing the cicatrix in gray, the original host conjunctiva in green in the preoperative scheme (Fig. 11A) is recessed in the postoperative scheme (Fig. 11B) and contiguous with cryopreserved amnion graft denoted in black). First, attach the recessed conjunctiva to the palpebral area using fibrin glue with the two components applied separately. The remaining bare bulbar sclera is covered with cryopreserved amnion graft also using fibrin glue as follows.

Peel the amnion graft from the nitrocellulose filter paper and lay it down on the defect with the sticky, stromal surface down to cover the entire bare sclera. Use 0.12 forceps to flip half of amnion graft onto the other half to allow half of the stromal surface to face upwards (Fig. 12A). Apply the thrombin (watery, colorless) solution to the bare sclera adjacent to the folded graft (Fig. 12B). Then apply the fibrinogen (viscous, tawny) solution on the stromal surface of folded graft (Fig. 12C). Flip the graft back on the sclera and a muscle hook is used to spread the fibrin glue into an even and thin layer under the amnion graft (Fig. 12D). These steps are repeated for the other half of the amnion graft to cover the entire sclera. Check the graft edges using 0.12 forceps to make sure they are secure. If not, apply small drops of both components to secure any loose areas. Trim off any excess membrane graft and fibrin gel to make the graft flush with the conjunctival edge.

If sutures are used instead, 10-O nylon sutures are placed interruptedly to secure the amnion graft to the limbal and bulbar sclera, while 8-O Vicryl sutures are placed interruptedly to secure the recessed conjunctival tissue over the amnion graft with episcleral bites parallel to (but not perpendicular to) the forniceal line.
**Key Post-Operative Points**

After surgery, all patients should receive ointment containing 0.3% tobramycin and 0.1% dexamethasone (Alcon Laboratories, Inc., Fort Worth, TX) nightly for 1 week and 1% prednisolone acetate eye drops (Allergan Inc., Irvine, CA) four times a day with tapering in 3–4 weeks. Sutures should be removed within 1-2 weeks. Postoperative exams should be scheduled for 1 day, 1 week, 6 weeks, and 3 months, and every 3 months thereafter. At the routine postoperative examination, changes in the patient’s symptoms should be recorded and photos should be taken.

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**Key Surgical Steps**

**For Moderate Symblepharon-Transplantation of Cryopreserved Amnion Graft and Anchoring Sutures:**

For moderate cases (judged by the vertical length measured from the limbus to the lid margin of the foreshortened fornix), there is enough recessed symblepharon conjunctiva to cover the tarsal area but not large enough to cover the entire palpebral area. (Fig. 13, after removing the cicatrix in gray, the original host conjunctiva in green in the preoperative scheme (Fig. 13A) is recessed in the postoperative scheme (Fig. 13B) and contiguous with cryopreserved amnion graft denoted in black, and is secured to the tarsus by an anchoring suture in red). The recessed conjunctiva is attached to the palpebral area by anchoring a double armed 4-O black silk suture to the edge and securing it to the skin with a bolster made of 25 gauge butterfly tubing (Fig. 14A-C). One such anchoring suture is needed per quadrant. The remaining bare sclera and bare palpebral area is covered by cryopreserved amnion graft using the following steps.

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**For Severe Symblepharon-Transplantation of Cryopreserved Amnion Graft, Anchoring Sutures, and Oral Mucosal Graft/Conjunctival Graft:**

For severe cases (judged by the vertical length measured from the limbus to the lid margin of the foreshortened fornix), there is not enough of the recessed symblepharon conjunctiva to cover the tarsal area (Fig. 16, after removing the cicatrix in gray, the original host conjunctiva is recessed and contiguous with an oral mucosal graft in brown and with cryopreserved amnion graft denoted in black,
and secured by an anchoring suture in red as shown in the postoperative scheme (Fig.16B). Therefore, it is necessary to obtain a free cell-containing graft to substitute the tarsal conjunctiva. A conjunctival autograft is the natural choice if it is available from the same eye or the fellow eye. However, if it is not available, an oral mucosal graft from the mouth is the alternative. The size of conjunctival autograft or oral mucosal graft depends on the width of symblepharon.

To obtain an oral mucosal graft, the oral cavity is opened with two towel clamps and the oral mucosa is prepared with beta-iodeine. Submucosal injections of 2% lidocaine with epinephrine are given using a 30 gauge needle. An incision is made into the oral mucosa with a superblade (Fig. 17A) and the free graft is dissected off with scissors (Fig. 17B), and soaked in gentamicin solution. After trimming off the stromal fat, the oral mucosal graft is sutured to the recessed conjunctiva with interrupted 8-O Vicryl sutures at each corner. The graft is attached to the tarsal plate with fibrin glue (Fig. 18A) and then further secured to the palpebral area by anchoring a double armed 4-O black silk suture to the edge of the mucosal graft and secured to the skin with a bolster made of 25 gauge butterfly tubing (Fig. 18B). One anchoring suture is needed per quadrant. The remaining bare sclera and bare palpebral area is covered with cryopreserved amnion graft in the same manner as described for moderate cases.

**Tarsorrhaphy:** To minimize the eye exposure for severe cases where a large bulbar sclera is covered by cryopreserved amnion graft, it is advised that the eye is closed with 4-O black silk suture passing through the bolster (Fig. 19).

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### Literature Summary

Traditionally, fornix reconstruction involves symblepharon lysis and cicatrix removal followed by measures taken to prevent readhesion (reformation of symblepharon). The efforts toward latter include insertion of conformers, silicone rubber sheets, or plastic. It is also believed that these measures can postpone but not prevent regrowth of symblepharon. To augment the success, transplantation of such tissues as a pedicle graft from skin, and full-thickness mucous membrane graft have been attempted to prevent symblepharon reformation.

A conjunctival autograft is the best free graft option for reconstruction when there is enough healthy conjunctival tissue available. Tseng et al first showed that cryopreserved amnion grafts can be considered as an alternative substrate for conjunctival surface reconstruction during the removal of large conjunctival lesions, scars or symblepharon. Using sutures to anchor cryopreserved amnion graft, 5 of 16 eyes (31%) showed partial success or failure due to persistent host conjunctival inflammation.

Prabhasawat and Tesavibul noted a success rate of 54% in 13 eyes with symblepharon. Katircioglu et al reported that 1 of 6 eyes (17%) with chemical burns failed because there was no healthy host conjunctiva before surgery. Oberhansli and Spahn reported that 8 of 48 eyes (17%) failed to achieve a deep fornix due to progressive retraction.

Solomon et al introduced anchoring sutures to achieve 12 of 17 eyes (71%) success in fornix reconstruction. The remaining failed cases had underlying causes such as autoimmune disorders or recurrent pterygium.

Barabino et al used the same approach together with systemic immunosuppression and reported 100% success rate in 9 eyes with mucous membrane pemphigoid for the first 16 weeks of follow up. A small area of symblepharon returned in 4 eyes (44%) in 28 weeks.

Recently, Tseng et al added the intraoperative application of MMC to the subconjunctival space in the fornix to the above procedure and reported that all 18 eyes (100%) regained a deep fornix and continuous tear meniscus, but 3 of 12 eyes (25%) with motility restriction showed recurrence of partial motility restriction. Most notable was a combination of transplantation of cryopreserved amnion graft, anchoring sutures and intraoperative application of MMC which achieved a deep fornix in all 6 eyes with prior mucous membrane graft. Nava-Castaneda et al also confirmed that additional use of intraoperative MMC significantly enhanced the success of transplantation of cryopreserved amnion graft.


**References:**

**FAQs:**

- **When is the best time to perform symblepharon lysis and fornix reconstruction?**
  
  In general, the surgery is best performed when the eye is quiet. Taking chemical burns as an example, symblepharon lysis and fornix reconstruction are already at the chronic stage when there is no ongoing active inflammation. For the same reason, it is better to wait for 6 months if the eye has failed from the first attempt of fornix reconstruction.

- **Why is it necessary to use intraoperative MMC?**
  
  If the preoperative evaluation does not reveal any inflammatory activity in the area of symblepharon and the patient’s underlying disease is not active, it is not necessary to use MMC at all. Unlike conjunctival autograft, cryopreserved amnion graft does not contain any live cells. Therefore, the healing depends on the migration of host cells into the membrane. The chronic inflammation in the host tissue surrounding the symblepharon, if not treated with MMC, may still retain its "malignant and abnormal" phenotype, and upon invasion into the membrane may continue to develop a cicatrix. That is why it is necessary to use MMC to suppress this abnormal phenotype and active inflammation in order to enhance the aesthetic outcome. It should be noted that MMC is applied subconjunctivally, but not onto the bare sclera, to avoid any side effects.

- **Why is it necessary to use conjunctival autograft or oral mucosal graft in severe cases?**
  
  In severe cases, there is a significant shortage of epithelial tissue between the lid margin and the limbus. The remaining conjunctival tissue is not sufficient to cover the tarsal conjunctiva, let alone to regenerate the entire fornix. For this reason, a small epithelium-containing tissue such as conjunctival autograft or oral mucosal graft is needed to provide the epithelial source. This free graft can help recover the entire region with the help of an amnion graft. The oral mucosal graft is more ideal to resurface the tarsal conjunctiva while the amnion graft is more ideal to resurface the bulbar conjunctiva.

- **Why is it necessary to place any anchoring sutures during fornix reconstruction?**
  
  After symblepharon lysis and the removal of any cicatrix, the recessed conjunctival tissue will readily collapse to contact the bare bulbar sclera, leading to recurrent formation of symblepharon. Therefore, it is important to anchor it to the palpebral tissue plane so that the subconjunctival fibrovascular tissue will point toward the orbital space instead. With the close apposition by the amnion graft to the epithelial edge, epithelial tissue, but not fibrovascular tissue, will grow onto the membrane.

- **How do you handle Limbal Stem Cell Deficiency (LSCD) in conjunction with symblepharon?**
  
  Before tackling the LSCD issue, it is important to control and correct any scarring and inflammation related to the symblepharon. Therefore, in general, it is better to perform symblepharon lysis and fornix reconstruction before treatment for LSCD because there will be a more favorable environment to treat LSCD when the eye is quiet. For some cases, symblepharon is contiguous with the pannus extending onto the corneal surface in the region where there is LSCD. If LSCD is partial, i.e., the other limbal region still contains healthy limbal stem cells, transplantation of cryopreserved amnion graft can be extended to cover the corneal surface after superficial keratectomy to remove the pannus. Frequently, this approach will also result in restoration of the limbus in this region. However, if LSCD is diffuse and total, it is best not to remove the pannus from the corneal surface during the symblepharon lysis and fornix reconstruction. The LSCD is best left to the second stage when transplantation of limbal stem cells by either conjunctival limbal autograft (from the fellow eye) or keratolimbical allograft (from the cadaver) is contemplated.