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Fabrication and Use of Custom-Designed Symblepharon Rings

ABSTRACT: *A symblepharon is a partial or complete attachment of the palpebral conjunctiva of the eyelid to the bulbar conjunctiva of the eyeball. A symblepharon ring is a device inserted over an eye during surgery, providing a physical barrier to inhibit the formation of this type of adhesion before its onset or after surgical lysis. This article describes the effectiveness and importance of using a custom-designed device as opposed to a generic item, in conjunction with a cryopreserved amniotic membrane graft when dealing with particular ocular traumas or disease. It will also describe the fabrication of such a device and, briefly, the aspect of inserting this ring with the sutured amniotic membrane graft for the best possible surgical outcome.*

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INTRODUCTION

An ophthalmic surgeon working with a patient suffering from a severe case like an ocular burn or a devastating syndrome, such as Stevens-Johnson syndrome (SJS), is likely to be faced with a socket requiring extensive conjunctival reconstruction. The severe inflammation associated with these conditions can permanently destroy the normal mucosal tissue of the ocular surface and eyelids, causing a future of severe dry eye issues and vision loss. The symblepharon ring provides a barrier between the affected tissues, stopping the occurrence of conjunctival adhesions and the effects of contracture. Amniotic membrane grafting over the affected cornea is currently practiced with great success. It promotes epithelial healing and is combined with the symblepharon ring for increased protection. In most instances, it can replace the use of an oral mucous membrane graft with greater chance of success. Instead of using a generic "off-the-shelf" device, which may or may not fit the contours of the eye or reach the depths of the fornices properly, a custom-designed ring can be fabricated by a trained ocularist to accommodate the special needs required of these sockets. The goal is to design a device that fits the needs of the socket rather than designing the socket to fit around the device.

There are multiple reasons for the formation of a symblepharon. Its severity is graded in three parameters: mild, moderate, and severe. This type of adhesion can occur with any conjunctival infection or allergy that results in conjunctival scarring. It can also form as a result of complications from disease (Figures 1 and 2) or trauma (Figure 3). The removal of the mild to moderate adhesion by the surgeon, coupled with the insertion of the symblepharon ring, will quite often be the difference between a patient's ability or

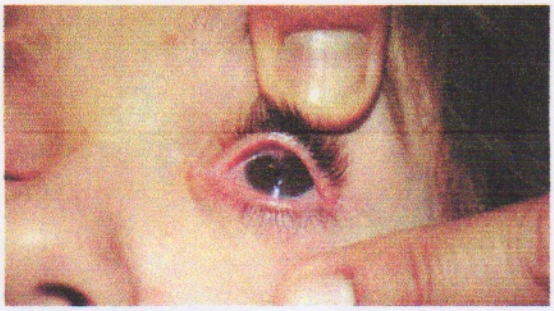

FIGURE 1 Symblepharon formation caused by graft vs. host disease.

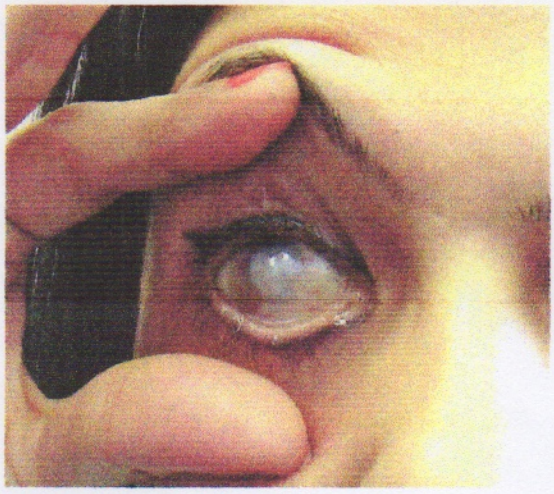

FIGURE 2 Vascularization of cornea post SJS.

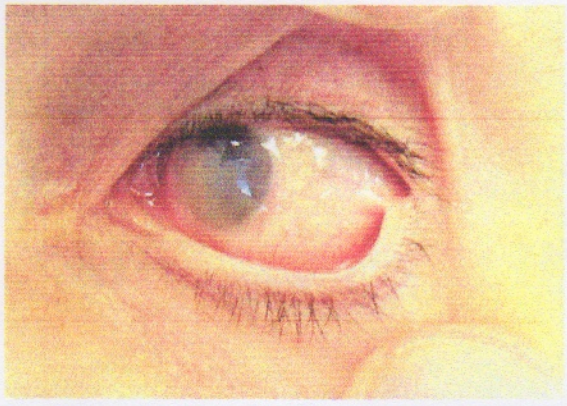

FIGURE 3 Symblepharon caused by trauma, unable to wear scleral shell prosthesis.

inability to retain an ocular prosthesis (Figures 3, 4, and 5). In a severe and often life-threatening case where a patient is suffering from SJS, toxic-epidermal necrolysis syndrome (TENS), or a thermal/chemical burn, vision can easily be compromised because of extensive tissue damage, cicatricial epithelial and subconjunctival scarring within the socket. The destruction of the corneal limbal stem cells can lead to vascularization and thickening of the corneal epithelium producing severe vision loss.[1] The eyelid margins and cilia are often involved. These patients can suffer from diplopia, exposure keratopathy, trichiasis, keritinization of the ocular surface, distichiasis, and complete loss of the tear function. Also, severe dry eye and photophobia are likely to be permanent. Symblepharon rings are often used during the acute phase of SJS and TENS to stop the adherence of opposed conjunctival surfaces. Unfortunately, the symblepharon ring alone cannot prevent the destruction of the normal mucosal tissue associated with these severe cases.

FABRICATION OF CUSTOM RINGS

A generic symblepharon ring is of uniform shape, normally round or oval and indicative of a healthy globe and socket. A custom-designed device can be made to deal with the abnormal anatomy of a compromised socket. Designing these custom rings requires a physical examination of the globe and socket prior to surgery (Figure 6). As an alginate impression cannot be taken because of the nature of the ocular surface; the size and shape are based on physical evaluation only. Consultations are likely to be in the hospital; therefore, a camera, measuring tool, and note-taking device are needed. Detailed photographs with measurements should be sent to the ocularist if a consultation is not possible. Measurements of the socket are recorded and should be photographed for future reference (Figure 7). Curvatures of the globe and depth of the fornices need to be observed, noted, and photographed. It is important to note that the apertures in these sockets are often much smaller than expected.

A series of rings should be built based on the configuration of the globe; normally three to four rings will suffice. The surgeon should be given multiple options for the best fit based on the least invasive surgical procedure. A variety of base shapes from the ocularist's office can be modified to suit the size and shape needed. Shapes

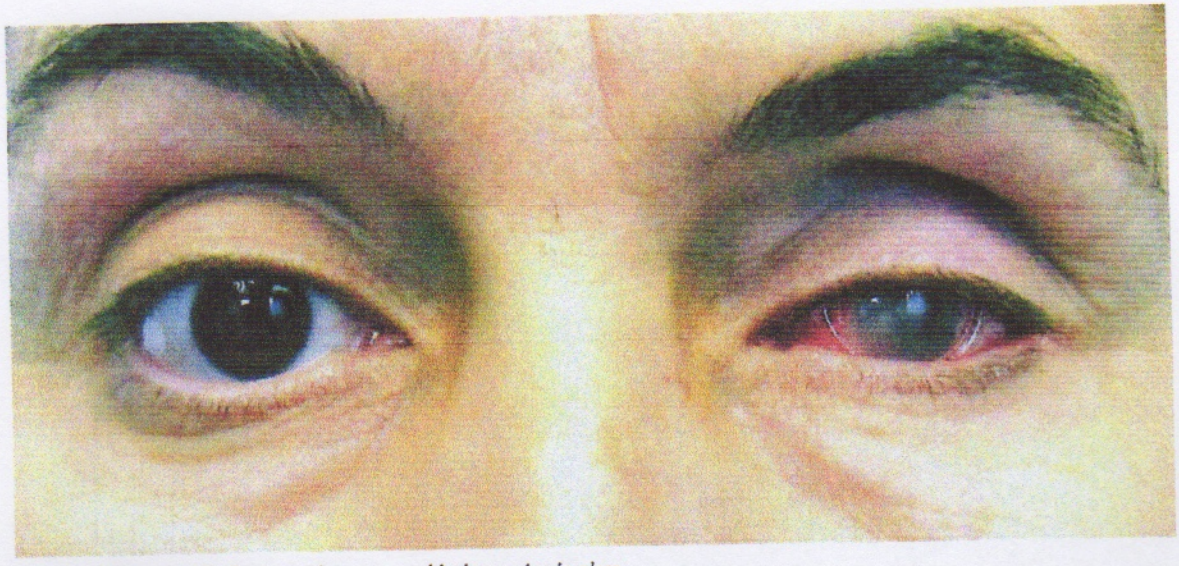

FIGURE 4 Removal of adhesion and custom symblepharon ring in place.

used to create impressioning trays are ideal for the fabrication of symblepharon rings, and these existing templates can be duplicated and modified as needed. The amount of clearance or vault over the cornea is based on a physical evaluation of the patient's orbit. The aperture, or corneal opening of the ring, is drilled approximately 13 millimeters to 14 millimeters in diameter. It is imperative that this aperture be rounded

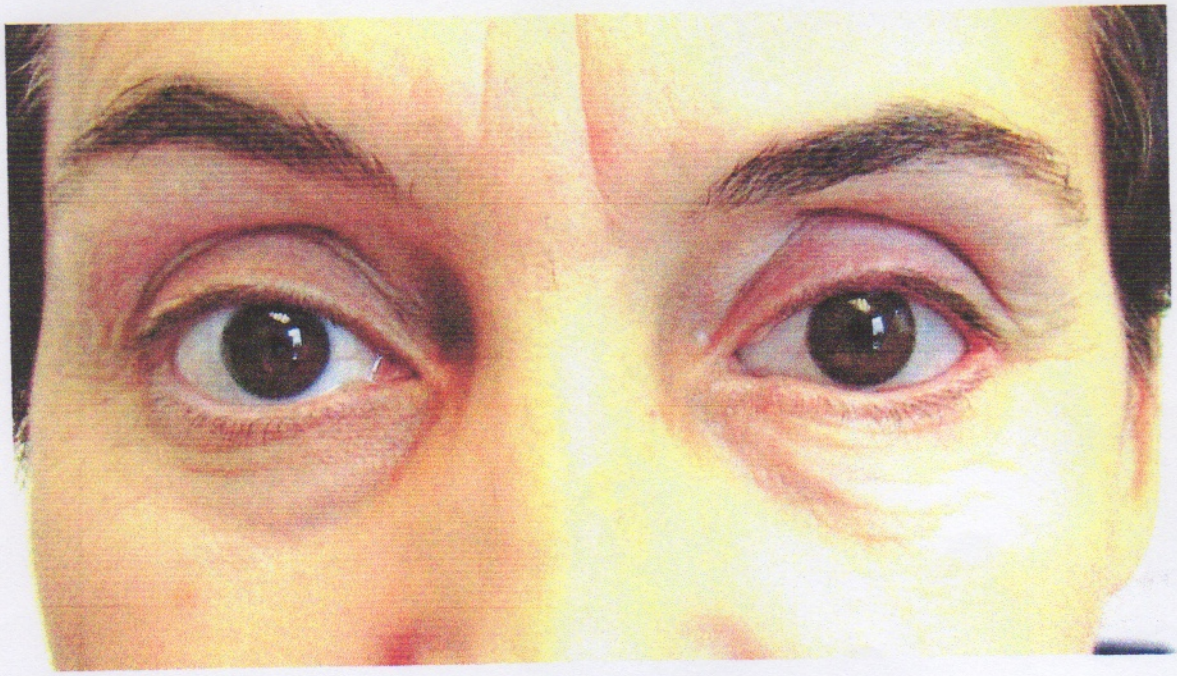

FIGURE 5 Patient successfully wearing scleral shell.

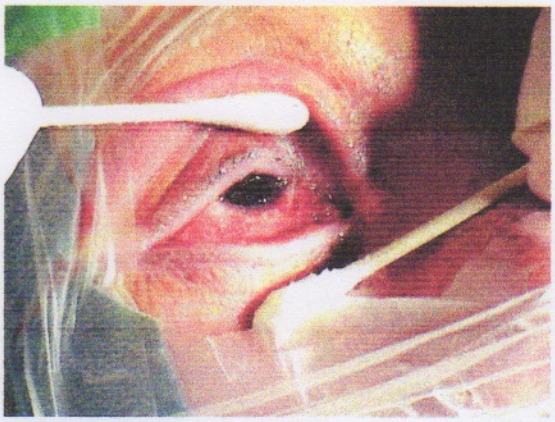

FIGURE 6 Physical evaluation.

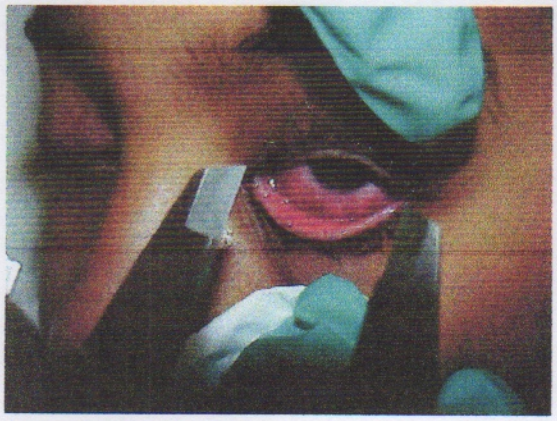

FIGURE 7 Measuring the aperture.

and smooth with absolutely no sharpness. This corneal opening must exceed the diameter of the limbal blend and should be tapered so as not to impinge on the ocular tissue. The surgeon can request the placement and amount of stabilizing suture or graft placement

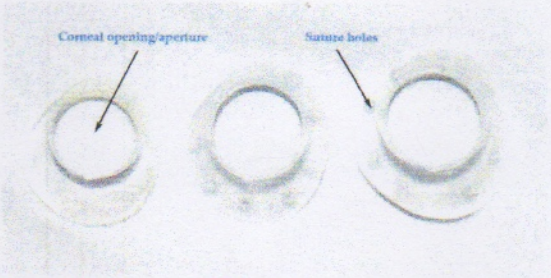

FIGURE 8 Custom symblepharon rings.

holes required (Figure 8). The finished symblepharon rings should be sent to the hospital well in advance of surgery to be properly sterilized. Please note that when dealing with a severe case, such as SJS, the custom rings will have to be completed and delivered very quickly; therefore, having templates available to work with is recommended.

USE OF AMNIOTIC MEMBRANE IN CONJUNCTION WITH CUSTOM SYMBLEPHARON RINGS

Oral mucous membrane is commonly used to wrap symblepharon rings. This membrane is very functional in the rehabilitation of difficult, contracted sockets having volume and conjunctival deficits. However, in situations where the cornea is still viable or in SJS where the mucous membrane is compromised, amniotic membrane is likely more effective and quite possibly the only choice. Transplantation of amniotic membrane is known to be highly efficient in both promoting re-epithelialization and suppressing inflammation.[2] Depending on its orientation, it can provide a new basement membrane that promotes healing and will ultimately reduce scarring and pain of the ocular surface. Even though buccal mucosa is a stronger tissue and easier to use, it requires a secondary donor site, causing it to be a much more invasive procedure. In the case of a patient with SJS/TEN, this type of graft would not be possible when considering the deterioration of mucous membrane within the body. The amount of tissue required also makes the buccal graft problematic, as it may be difficult to harvest enough membrane to cover the expanse of the symblepharon ring.

The following is a basic procedural rundown of inserting the custom symblepharon ring with the amniotic membrane graft. Under anesthetic and following symblepharon lysis, the ring is inserted into the socket for sizing, prior to attaching the membrane (Figure 9). The ring must be tested to ensure there is proper clearance over the cornea. It is beneficial to have multiple curvatures, sizes and corneal openings available. The amniotic membrane is carefully placed over the posterior surface of the symblepharon ring and wrapped around onto the anterior rim (Figure 10). The membrane is always sutured to the ocular surface with its epithelial side up and the mesenchymal

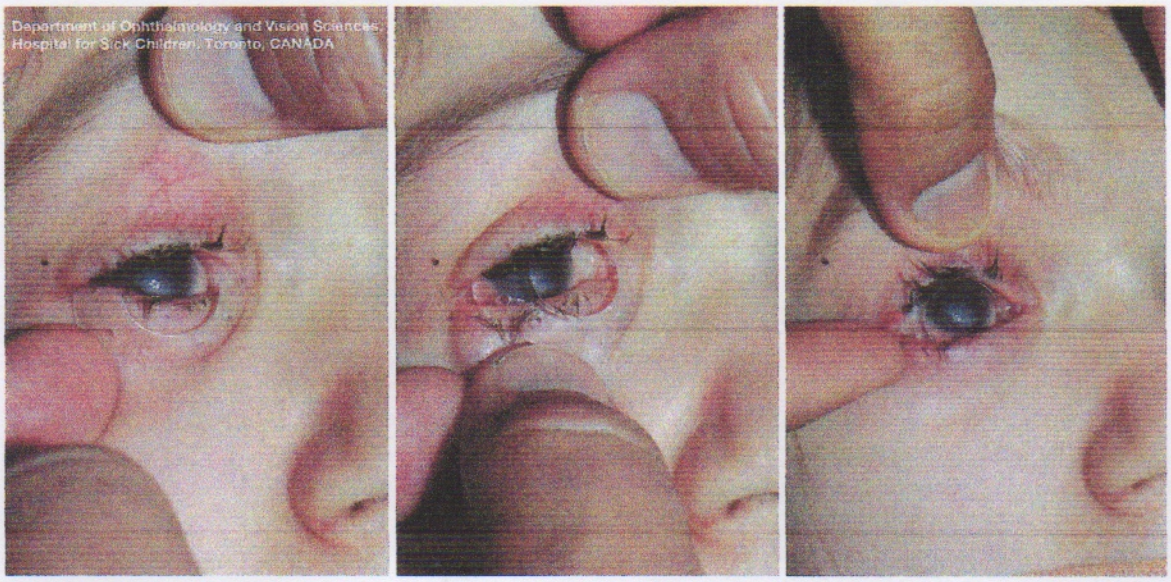

FIGURE 9 Pre-op insertion of the symblepharon ring.

surface in contact with the eye to facilitate adherence of the membrane to the ocular surface.[3]

This procedure is a very delicate as amniotic membrane is difficult to work with because of its consistency. The membrane is then sutured via the drilled placement holes (Figure 11). The ring is inserted into the socket, and the membrane is neatly placed over the affected cornea and sutured into the socket superior and inferiorly (Figure 12).

The ring will then become an integral part of the healing process, decreasing the effects of contracture of the fornices and keeping the conjunctival surfaces of the eye and eyelid well apart from one another (Figure 13).

CONCLUSION

The use of a properly constructed symblepharon ring in conjunction with the cryopreserved amniotic membrane can prevent a lifetime of eye-related issues for patients suffering from some of the most severe ocular surface diseases. The custom symblepharon ring is a

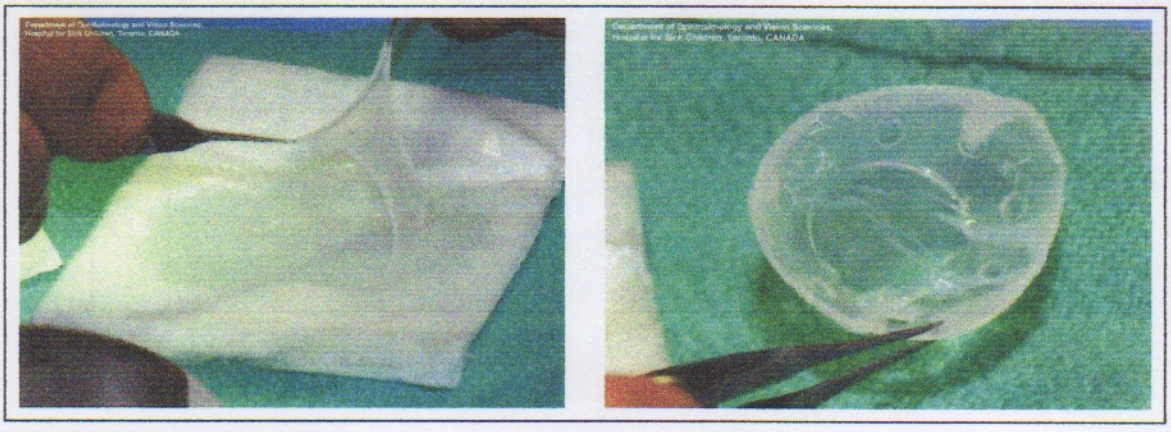

FIGURE 10 Application of membrane.

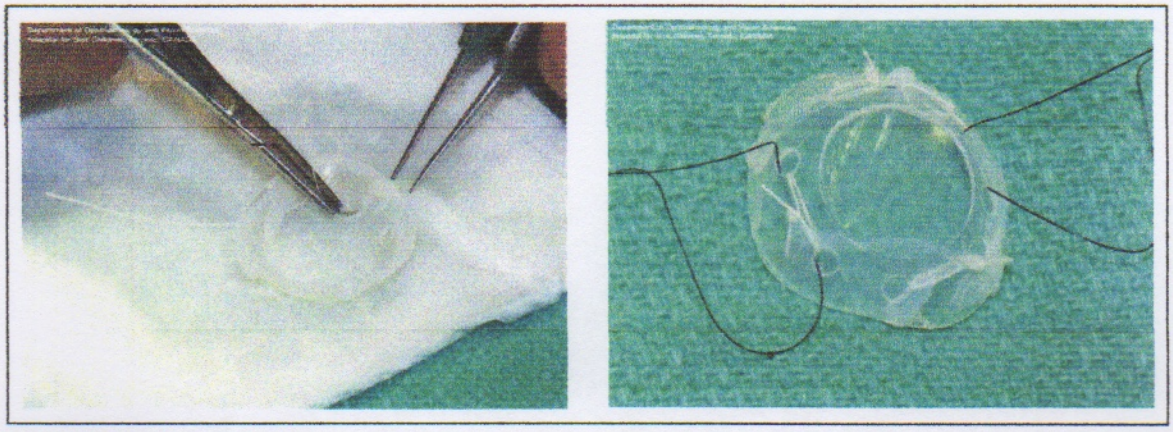

FIGURE 11 Suturing of graft to ring.

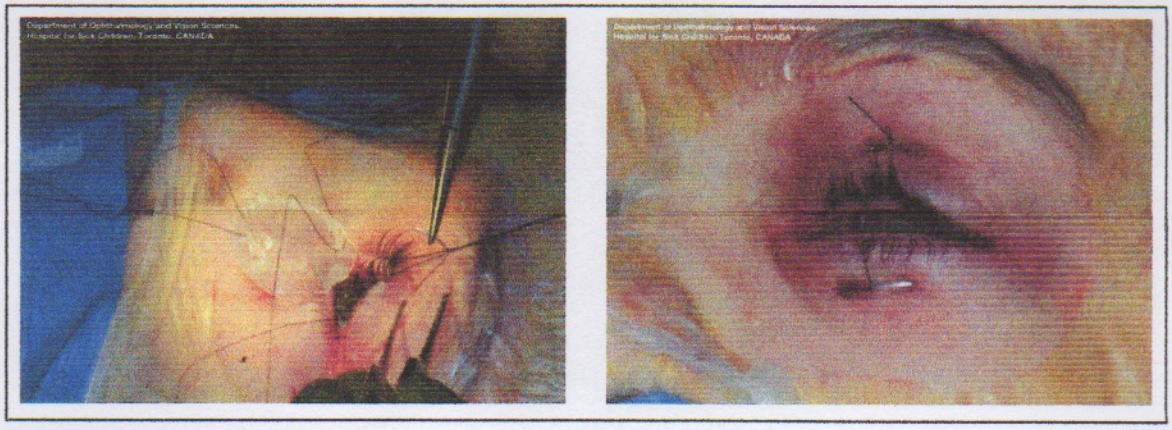

FIGURE 12 Surgical insertion and completion.

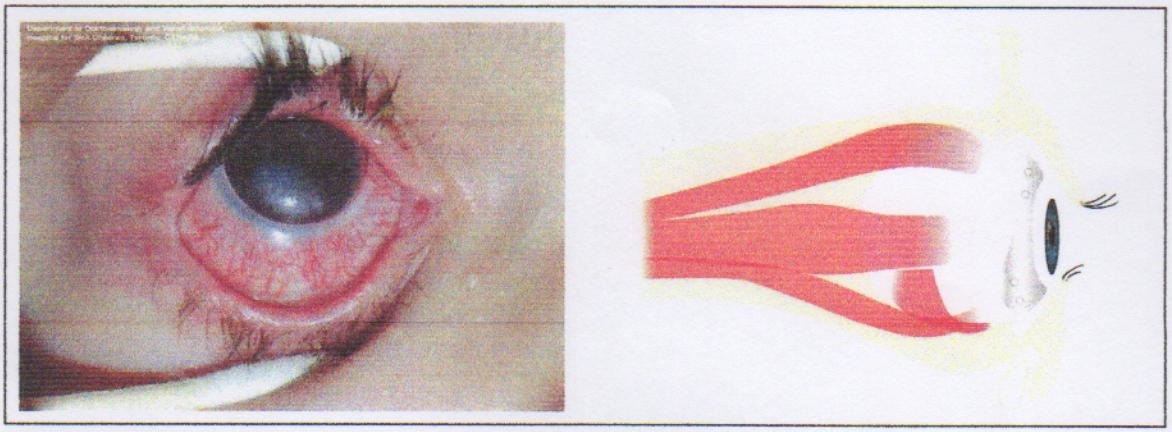

Figure 13 Symblepharon ring in place post-op.

simple tool that can offer both surgeon and patient a better chance of successful socket reconstruction using the talents of the trained ocularist.

ACKNOWLEDGMENTS

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