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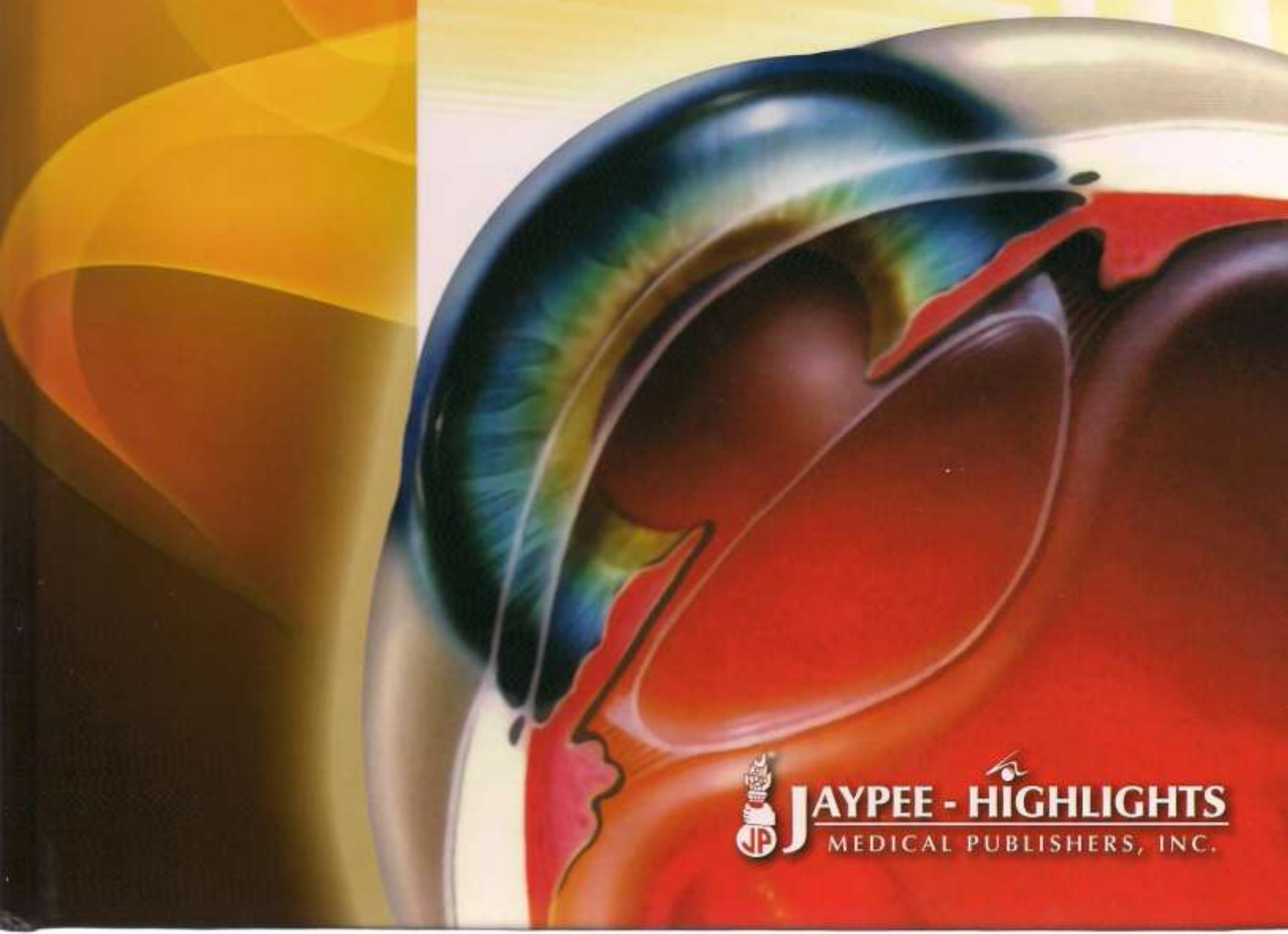
New Trends in Ophthalmology

Medical and Surgical Management



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Chapter 2

Pterygium Surgical Management

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Pterygium is one of the most frequent tropical and subtropical ocular conditions. Its prevalence ranges from 0.3 to 29%.[1,2] It is an acquired condition consisting of a triangular conjunctival thickening growing over the cornea. This benign condition may occasionally compromise vision and generally it has an unappealing appearance. When symptomatic, pterygium may behave as a foreign body causing recurrent inflammation.

Pterygium is named after the Greek word *Pterw* (wings), which describes its characteristic growth. It may appear in one or both eyes growing more frequently on the nasal side and seldom on the temporal side of the cornea. In such cases it develop on the nasal side as well. **(Figures 1 and 2).**

Risk Factors

Several pterygium predisposing factors have been reported. These include living near the Equator or sun exposure greater than 50% of the time during the first 5 years of life, as well as working close to reflective areas such as concrete. The chronic, concentrated effect of reflected light (ultraviolet B light, UV-B) on the cornea *(albedo)* entering through its temporal aspect and emerging or being focused nasally explains the more frequent nasal limbal location.[3,4,5] In addition to sunlight exposure and reflected UV-B light, the odds of developing pterygium are 36-fold higher among individuals living at latitudes under 30° during the early years of life when compared with those living at higher latitudes.[6,11] Protecting factors include wearing spectacles with UV filters and hats, and using solar protection.

In 1964, Jose I. Barraquer postulated a possible mechanism of progression from pinguecula to pterygium, consisting of an area of desiccation that might induce fibro vascular tissue growth.[12,13] Immunohistochemical studies have demonstrated the presence of tissue changes related to early mutations of the p53 gene resulting from chronic UV light exposure. These molecular alterations bring as a consequence an abnormal p53 product which results in activation of cellular apoptotic processes that

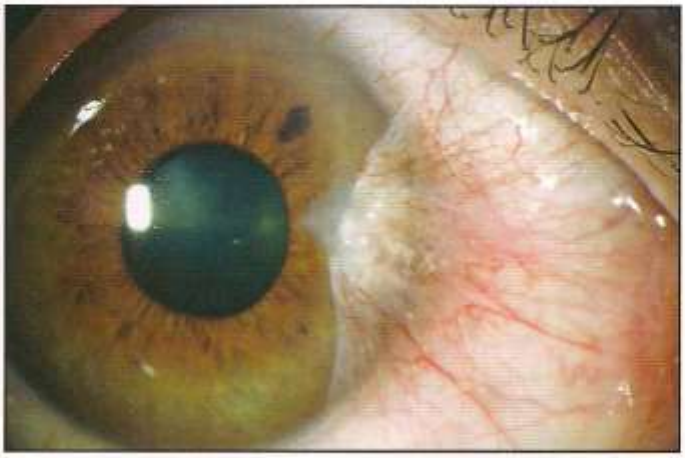

Figure 1. Nasal pterygium.

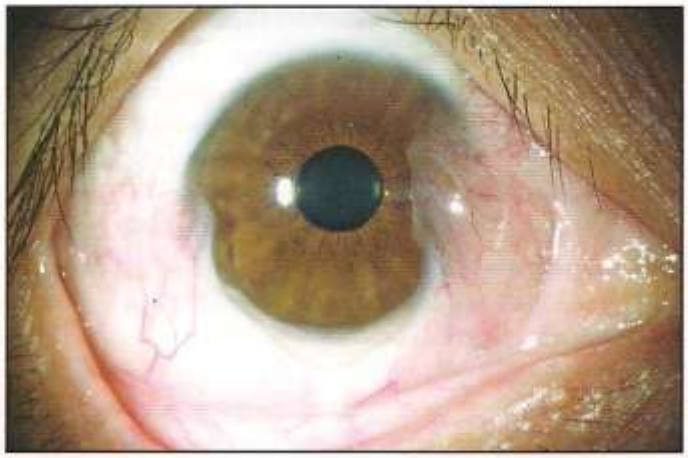

Figure 2. Nasal and temporal pterygium.

are p53 dependent. Epithelial basal stem cells (EBSC) behave aggressively invading the cornea through the basal membrane carrying conjunctival cells as well as newly formed vascular tissue.[7,8] According to this theory, modified migratory cells express an abnormal amount of p53 protein, vimentin, and an overproduction of transforming growth factor beta 1 (TGF-β1). These changes explain the subsequent increase of angiogenesis, activation of cytokines, collagenases and other proteases, as well as monocyte chemotaxis and fibroblast activation.[9]

Genetic or inherited factors known to increase the probability of developing pterygium include a damaged DNA repair mechanism. More recently, it has been suggested that hematopoietic and mesenchymal stem cells are involved in the development of pterygium fibro vascular component, while chemotactic factors, such as neurosensory peptide or substance P (SP), may work attracting stem cells from bone marrow.[10,11]

Other factors mentioned in the literature include dry eye, environmental factors, toxic foods, virus, etc. However, none of these risk factors have conclusively been proven.

Limbal Cell Pathophysiology

Limbal epithelial cells work as a functional and physical barrier that prevents migration of conjunctival epithelial cells over the corneal surface in the event of corneal epithelial defects. Damage to the limbus and subsequent defects or dysfunction of these cells may cause progression towards the cornea with release of growth factors, p53 and vimentin, followed by conjunctival epithelial overgrowth or conjunctivalization, vascularization, chronic inflammation, damage to the basal membrane and fibrosis. All these signs indicate a limbal defect.[14]

Clinically, a limbal defect is diagnosed as a loss of Vogt's limbal palisades. Preference for the nasal and temporal limbal conjunctiva is explained by the incidence of UV light on this area, weakening Vogt's palisades in the nasal and temporal areas, while the eyelids protect the superior and inferior areas.[15,16]

Signs and Symptoms

Pterygium may vary from symptomatic to completely asymptomatic. Patients usually report burning sensation, tearing, redness and eye soreness. Other symptoms include a foreign body sensation, itching and photophobia. These symptoms may be sporadic or constant and are usually caused by disruption of the tear film and the ocular surface. Patients may occasionally present with acute painful inflammation associated with ulceration of paralimbal corneal areas also known as Fuchs's pits or Dellen.

Extensive pterygia growing more than 4 mm over the cornea may decrease visual acuity, cause irregular astigmatism, or disturb the corneal anatomy and topography. A pterygium with large fibro vascular overgrowth may cause diplopia due to its restrictive effect on the extra ocular muscles.

Pterygium Anatomy

Three parts are usually found in pterygia:

- *Head or apex:* portion invading the cornea.
- *Limbal area:* adjoining the pterygium body.
- *Body:* fibro vascular tissue band spreading from the collarette and over the bulbar conjunctiva to the semilunar fold.
- *Stocker line:* Not part of the pterygium in itself, but a sign of chronicity. It is a brown-colored line around the head of the pterygium. It consists of intracellular iron deposit in the epithelial basal layer.[17,18,19]

Classification

According to its morphology, pterygium is classified as fleshy (thick and vascularized), atrophic (flat and translucid) or intermediate. Pterygium is also classified according to its corneal penetration depth: < 2 mm, 2-4 mm and > 4 mm, or based on the collarette size that describes the amount of limbal involvement.[19]

Surgical Management

Pterygium surgery has been performed for centuries with varied results. Generally, outcome has been poor except in cases treated with conjunctival and limbal-conjunctival autografts as reported decades ago by Gómez-Marquez [20,21] and Barraquer.[22] At present, the rate of recurrence after pterygium surgery followed by sutured limbal-conjunctival autograft has been reported to be as low as 2%.[23] This surgery is a typical example of the general principle of performing a wide surgical resection followed by an appropriate functional

and anatomic restoration. Neglect of this principle has resulted for decades, and continues to result, in multiple, incomplete or nonfunctional procedures that are not adequately reconstructive and fail as a successful treatment of the condition.

A proposed technique is a simple resection without a graft, a conjunctival sliding or any special drug, also known as *bare sclera technique*, proposed by D'Ombrain in 1948.[24] This procedure requires minimal surgical time. However, it may result in complications such as torpid postoperative course as the sclera becomes re-epithelized with risk of necrotizing scleritis,[29,30] scleral melting and perforation, and a highly aggressive recurrence pattern (up to 80%), making further procedures even more difficult.[25-28]

Bare sclera surgery associated with strontium-90 irradiation (also known as beta therapy) has been performed for several years.[30,31] The aim of this procedure is to reduce growth of immature or fast-growing tissue decreasing fibroblast proliferation and inducing an obliterating endarteritis of the newly formed surgical bed vessels, all in an attempt to preventing recurrences.

Results have and continue to be poor since radiotherapy induces immediate and long term ischemia (directly related to dosing) resulting in extremely thin necrotic scleral beds that may become easily infected in the early or late postoperative period, or even several years later(**Figure 3**).[32-34]

Simple (Primary) Closure Surgery consists of resection of the pterygium with primary closure of the surgical bed in an attempt to following the surgical principle of removing the lesion and reconstructing the surgical bed. This procedure eliminates some of the complications of the bare sclera technique such as scleral melting, infectious and necrotizing scleritis. It also reduces slightly the 37% recurrence rate previously reported.[35] However, this technique ignores limbal pluripotential cell (stem cell) physiology. Therefore, its anatomical and physiological results are poor and the recurrence rate is unacceptably high by current standards.[36]

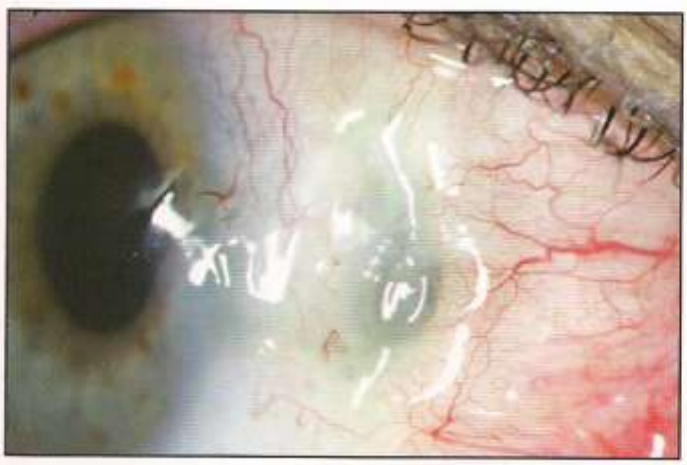

Figure 3. Chronic and progressive scleral thinning secondary to beta therapy performed several years earlier.

Sliding grafts have been used for several years. This technique consists of pterygium resection followed by rotation of a superior pediculated conjunctival flap that is vertically oriented and sutured 2 mm from the limbus. The aim of this procedure is to block the progression of conjunctival vessels from the resection edge, as well as to replace the conjunctival defect created with the resection, thus reducing bare sclera technique multiple complications. Additionally, it attempts to reverse perilimbal blood flow direction and to prevent horizontal vessels formation, which may invade the cornea, so that the vessels remain parallel to the cornea instead. Unfortunately, this is neither an anatomical nor a functional tissue reconstruction since it does not place stem cells in the limbus near the resection area. However, both aesthetic and functional results are better than in previously described procedures, and complication risk is lower. The technique is rarely used due to its high recurrence rate of up to 29%.[37,38]

In an attempt to reduce the high recurrence rate, use of antiproliferative and antiangiogenic drugs has been proposed more recently. These drugs prevent anomalous tissue growth towards the limbus and avoid pterygium recurrence. The use of a sponge soaked with Mitomycin C (MMC) at the end of the procedure[39] and MMC drops in the early postoperative period have been suggested.[40] However, this technique has not been considered reasonable since primary or secondary pterygium recurrence is caused by a defective or incomplete lesion resection, by an inadequate closure of the surgical bed, or by the absence of a free limbal-conjunctival autograft. If a free limbal-conjunctival autograft is not performed, limbal stem cells are not replaced and the use of antiproliferative drugs will have a merely local antivascular effect; however, the absence of a natural barrier against conjunctival proliferation and invasion increases the risk of recurrences. On the other hand, the combination of a free graft and antiangiogenic and antiproliferative drugs will have a greater or lesser effect on the limbal graft decreasing its

vitality and the chances of success, not only by means of direct toxicity but also by ischemia of the receptor bed. Several complications associated with these drugs have been reported such as scleral necrosis, corneal endothelial damage, iritis, scleral melting and cataracts, among others.[41, 42]

The use of drugs with anti-vascular endothelial growth factor (VEGF) effect, such as bevacizumab[43] and ranibizumab[44] has been suggested. Trial results are preliminary, but once again they try to inhibit vascular proliferation secondary to a poor surgical procedure, rather than trying to achieve the proper surgical technique making use of drugs unnecessary.

During the last few years, the use of amniotic membrane in pterygium surgery has been suggested in an attempt to substitute a limbal conjunctival autograft for the preserved amniotic membrane graft.[45] This procedure is based on the capability of the amniotic membrane to act as a growth matrix for conjunctival epithelial cells repopulation, without the risks of the bare sclera technique. However, the recurrence rates are sill considerably higher[46] (up to 20%) than those of limbal conjunctival auto graft, which are either simple or on a matrix of amniotic membrane.

Limbal Conjunctival Autograft

In 1948, Jose I. Barraquer described the autograft technique and recommended free conjunctival grafts in cases of recurrent pterygia. His results were published in the Journal Estudios e Informaciones Oftalmológicas del Instituto Barraquer de Barcelona.[22] Similarly, Gomes-Marquez and Gama Pinto reported in the Archivos de la Sociedad Oftalmológica Hispanoamericana.[21]

The technique was successful. However, at that time many of the advances on corneal scleral limbus research were still unknown. A better understanding of physiopathology led to grafts that included 1 mm of the cornea, where the Vogt palisades with stem cells were supposedly located. Professor Jose Ignacio Barraquer presented some guidelines for the treatment of recurrent pterygium with limbal conjunctival grafts at the World Cornea Congress in 1964.[47] Professor Benito Strampelli recommended this treatment for severe cases of symblepharon secondary to chemical or physical burns or infectious or traumatic lesions. The technique is it still used in cases of primary and recurrent pterygium [48-54] **(Figure 4).**

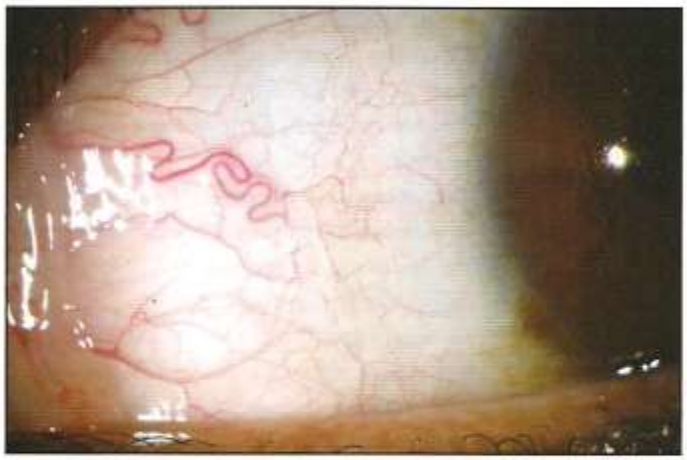

Figure 4. Pterygium with limbal conjunctival graft.

Graft Types

Conjunctival autografts can be procured by 3 different techniques, each one with precise indications.[49]

The first one is a *"free conjunctival graft up to the limbus"* which is routinely employed for the management of primary and non-complex recurrent pterygia. This type of graft includes the superficial conjunctiva over the limbal stem cells, but does not dig deep into the limbal niche.

The second one is a *"free limbal-conjunctival graft"* which is employed for the management of complex recurrent pterygia. This type of graft includes the limbal stem cells and is procured by dissecting deeper in the limbal area.

The third type of graft is the *"free conjunctival graft"* which can be procured from any area of the bulbar conjunctiva, and is used to cover large conjunctival defects away from the limbus.

Anesthesia

The following anesthetic technique is recommended: 3 drops of Tetracaine 1mg/ml are instilled before surgery. Afterwards, a small hole in the superior nasal quadrant of the conjunctival cul-de-sac is cut and 2 ml 1% Xylocaine are injected peribulbar.

Surgery under topical anesthesia is uncomfortable for the surgeon since the eye is free to move, and this problem will be greater in non-cooperative patients. Subconjunctival anesthesia induces great distortion of the tissue.

General anesthesia does not induce conjunctiva anatomical changes, however, it is riskier and hospitalization time is longer.

Autograft Technique

Pterygia Removal and Recipient Bed Preparation

The pterygium head is held with toothed forceps and is dissected with a surgical blade at its area of adherence to the cornea **(Figure 5)**. In cases of atrophic pterygia, lifting the head causes detachment of the head with the epithelium, leaving the Bowman membrane undamaged. In those with a very adherent head to the cornea or cornea-sclera junction, the plane is carefully dissected avoiding deep corneal cuts, irregularities or tissue loss, all of which will favor future recurrences. A safety margin of 1 to 2 mm of healthy limbal conjunctiva is dissected circumferentially around the pathology. After this, using Westcott scissors, two radial cuts are made into the bulbar conjunctiva, encompassing the diseased tissue and finally a parallel cut to the limbus is made into healthy conjunctiva in front of the plica semilunaris connecting the two previous radial cuts and removing the diseased tissue completely **(Figure 6)**. If the pterygium is resected from the body towards the head the resulting exposed sclera bed will be larger requiring a larger than necessary conjunctival graft. If the pterygium is large it should be removed with a triangular dissection, avoiding removing too much conjunctiva. Irregular resection borders should be prevented because they will not integrate properly with the conjunctival graft. Care should be taken not to leave anomalous tissue over the cornea or Tenon's capsule fragments on the sclera bed, as they will favor recurrences. The remaining anomalous corneal tissue can be leveled with an "aerorotor" as described by Reinoso and Barraquer [76, 77] many years ago. It is a high-speed drill used in odontology, with a flat-milling cutter covered with diamond dust. The aerorotor should be applied flat over the cornea and limbus until this area is evenly leveled **(Figure 7)**, while the assistant washes away any free epithelial cells from the exposed sclera bed to avoid the future formation of epithelial inclusion cysts. After this, a superficial hemostasis is done over the area adjacent to the cornea.

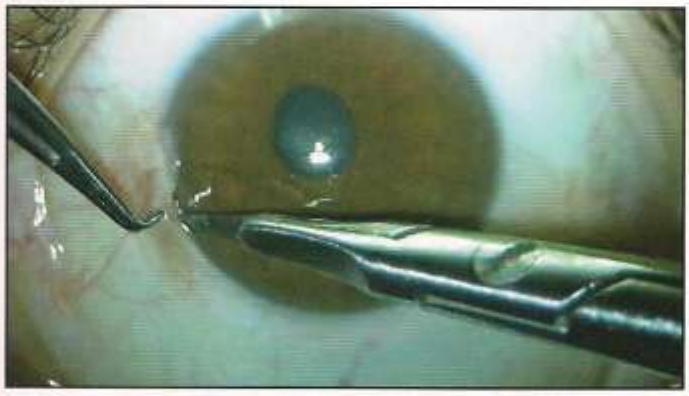

Figure 5. Blade resection of pterygium head.

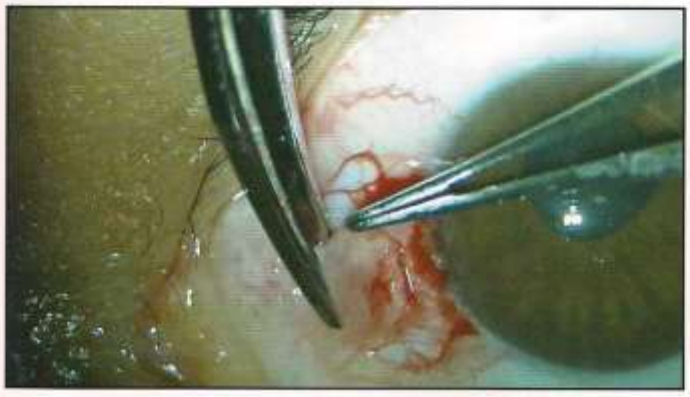

Figure 6. Scissors resection of pterygium body.

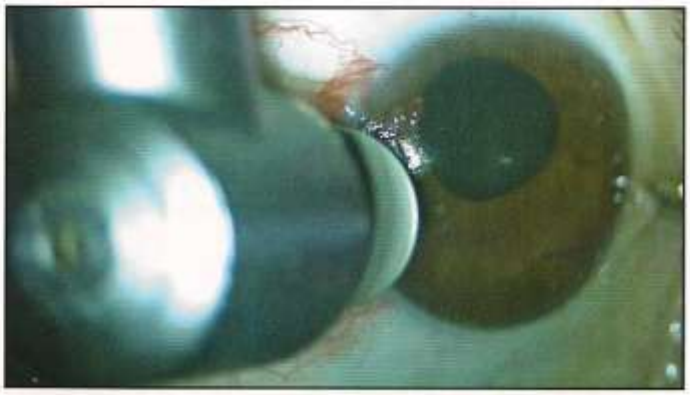

Figure 7. Leveling of corneal and limbal surface.

Graft Procurement, Alignment and Suture

The conjunctival graft is procured from the superior bulbar conjunctiva, including a varying amount of limbus according to the previously described types of grafts, preferably measuring carefully with a caliper in order to get the precise match with the exposed scleral bed. After this, the bulbar conjunctiva is sectioned accordingly with Wescott scissors in a square fashion up to the limbus. This is achieved by making two radial and one horizontal cuts towards the cul de sac connecting the two previous cuts **(Figure 8)**. At this point the dissected conjunctiva is turned over the cornea (still adhered at the limbus) exposing its stromal side, and then the remaining Tenon's fibers are resected with toothed forceps and Wescott scissors **(Figures 9, 10)**. Once the graft is free from Tenon's fibers, it is returned to its normal anatomical position and sectioned at the limbus with fine scissors **(Figure 11)**. The two graft limbal corners are grasped with fine forceps and positioned over the exposed sclera bed, limbus to limbus, epithelial side up **(Figure 12)**. It is then sutured with 10-0 Nylon: first the two limbal stitches, including the graft-episclera-receptor conjunctiva, then the two squares towards the caruncle, including conjunctiva-conjunctiva, and after this, as many in-between stitches as the surgeon deems necessary to secure the graft. Finally a stitch is placed at the center of the graft, anchoring it to the underlying episclera **(Figure 13)**.

Donor Site Closure

The donor site is closed by descending from the superior cul de sac to the free conjunctival border and anchoring it to the episclera at the superior limbus with two 10-0 nylon stitches, one at each corner. The exposed superior scleral bed should not be left open as it will induce Tenon's capsule inflammation and slow healing. **(Figures 14 and 15)** We use no antimetabolites such as MMC, either during or after surgery.

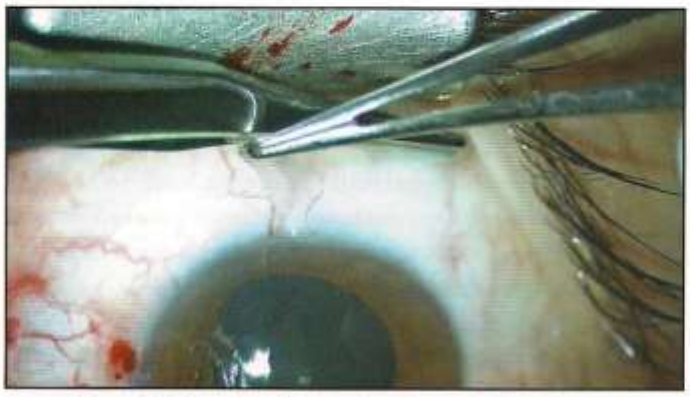

Figure 8. Superior bulbar conjunctiva graft procurement.

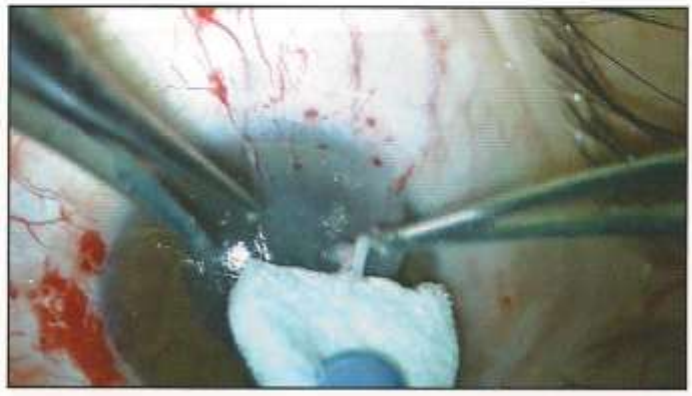

Figure 9. Dissection, cleaning and resection of Tenon's fibres in the graft.

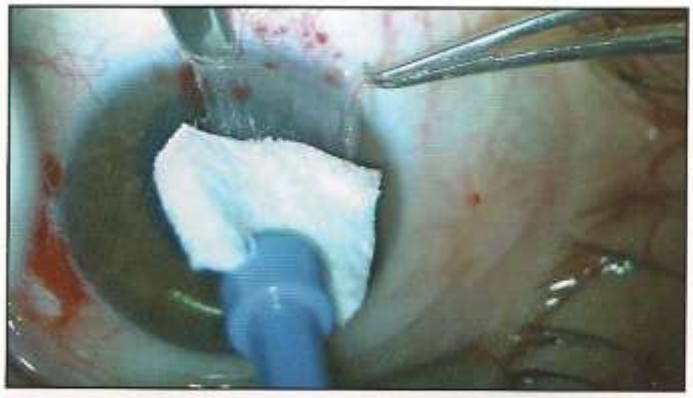

Figure 10. Resection of Tenon's fibres adherent to the superior limbus with crescent blade.

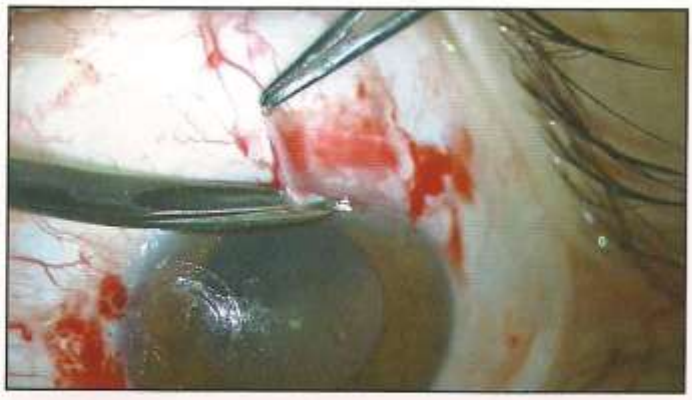

Figure 11. Superior limbal graft resection with scissors.

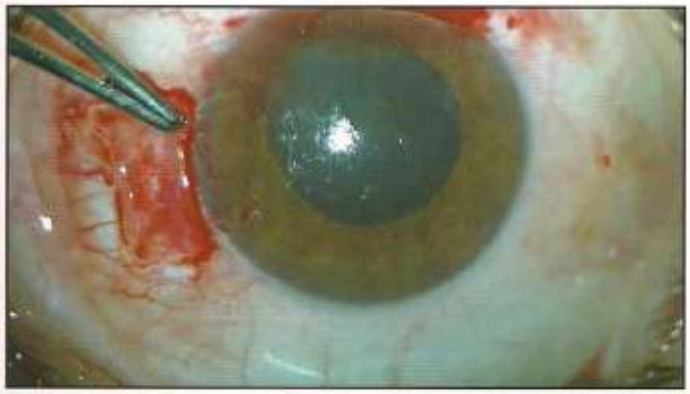

Figure 12. Placement of the conjunctival graft on the receptor bed.

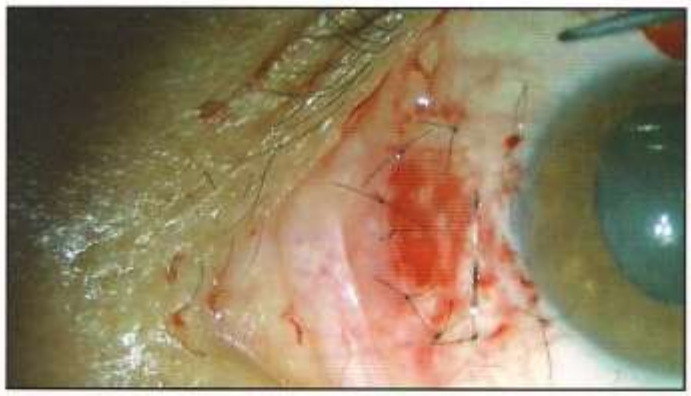

Figure 13. Anchoring suture.

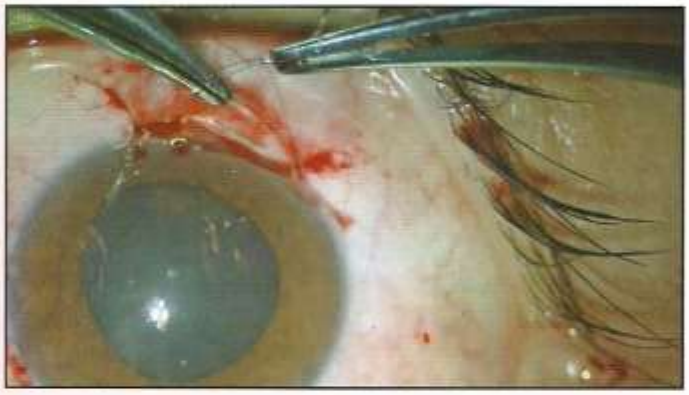

Figure 14. Donor site closure.

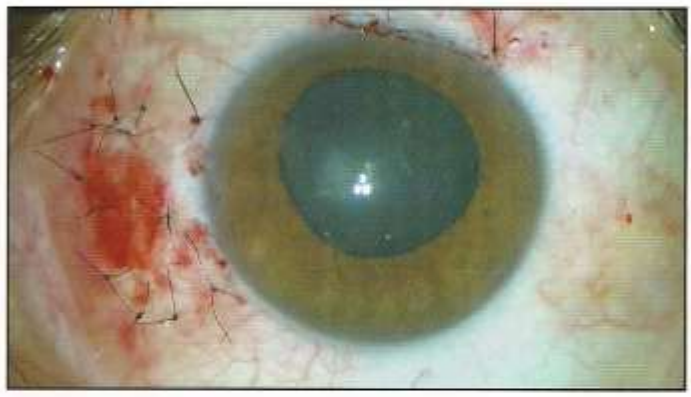

Figure 15. Immediate result of pterygium surgery.

Postoperative Management

Immediately after surgery, cycloplegic, steroid and antibiotic drops are instilled. A compressive eye patch is placed in order to reduce graft edema. Topical treatment is started on the next day after removing the patch, with anti-inflammatory drops (dexamethasone or prednisone) 5 times a day during 12 days, topical antibiotics 5 times a day, and lubricant or artificial tears around the clock during 15 days tapered thereafter. The patient is provided with an ocular shield to be used at night, to protect the graft and prevent involuntary rubbing during sleep. Another form of protection is using sunglasses for wind, dust and sun protection. The stitches are removed under the slit lamp 8 days after surgery.

Recurrences are symptomatically managed with anti-inflammatory drops and lubricants. New procedures for recurrences should not be performed prior to six months from the initial surgical procedure.

Limbal Conjunctival Autografts Complications

Fuchs' Pits[49,53] also known as Dellen, are associated with corneal surface irregularities caused by removal of pathological conjunctival tissue with the blade or the aerorotor, leaving the cornea surface uneven, or when graft edema is present in the postoperative period causing a desiccated area at the limbus or the cornea. Fuchs' pits may favor pterygium recurrences, and when they last longer than 48 hours, they attract growth factors that stimulate fibro vascular proliferation. Graft edema can be managed by performing several incisions on the graft and placing a compressive patch during 24 to 48 hours. Patches are indicated in pits and should be maintained

until the limbus is normalized. Increasing the frequency of lubricant drops and ointments is also recommended **(Figure 16)**.

Inverted Graft: this complication occurs when the graft is placed upside-down with the Tenon side upwards and the graft epithelial side is in direct contact with the episclera. Tenon fibers can be seen on the ocular surface of the eye. Differential diagnosis is made by instillation of a fluorescein drop that stains the Tenon's side of the graft. If the complication is diagnosed early the graft can be re-positioned. Otherwise, the graft should be replaced.[49]

Subconjunctival Hemorrhage: this complication occurs when a small vessel breaks while suturing and no hemostasis is performed. It may also occur in anticoagulated patients who did not suspend their medication, hypertensive patients, or after Valsalva maneuvers in patients with vascular fragility. Bleeding may cause irregularities of the graft-limbus junction and subsequent formation of Fuchs' pits. Fresh, extensive hemorrhages can be managed by performing several incisions on the graft allowing draining **(Figure 17)**.

Other Complications

Grafts bigger than the receptor bed may slide over the cornea. Grafts may also be too small from the beginning or shrink after sutured if Tenon was not properly removed when procuring them. When the graft is too tense, suture dehiscence may occur and expose the Tenon. Debris from the pterygium head on the cornea may attract growth factors that will induce fibrosis and recurrences. Limbal leveling with the aerorotor releases material from the epithelial cells and remnants of fibrous tissue that should be removed with cellulose sponge towards the cornea; otherwise, epithelial remnants may remain under the graft and cause inclusion cysts.

Cornea perforations are infrequent but may appear after multiple procedures following recurrences. Perforations are usually caused by an inadequate use of the blade or the aerorotor. Corneal tissue loss associated with pterygium surgery may induce astigmatic changes. Abscesses are infrequent and usually disappear after removing the suture and administering topical antibiotics.

Symblepharon is infrequent and secondary to multiple recurrences probably caused by inadequate surgical procedures. Severe retraction of the rectus muscle may cause double vision or diplopia.

Tenonitis is caused by Tenon exposure while obtaining the graft. Local inflammation improves when the epithelium extends over the donor bed. Healing is associated with a tight adherence of the conjunctiva to the underlying bed.

Granuloma is a complication occurring when the stitches break and the graft retract, or when the donor site is not properly closed. They may also appear near the caruncle when the graft shrinks after rupture of the stitches when the graft is too tense. These pyogenic granulomas should be treated medically with anti-inflammatories and, if they persist, they should be removed **(Figure 18)**.

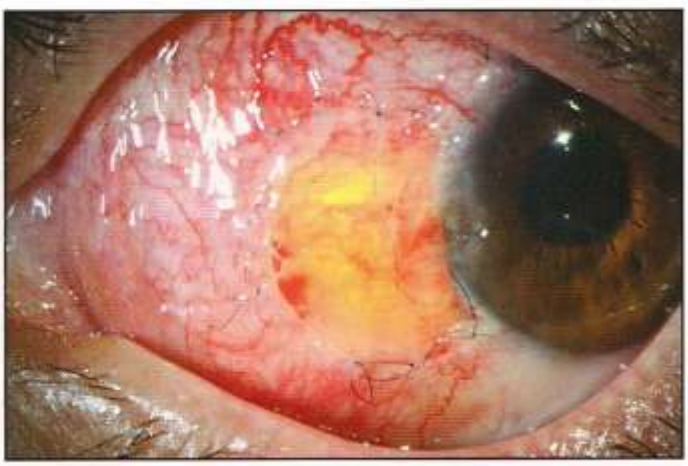

Figure 16. Graft edema and Fuchs' pit.

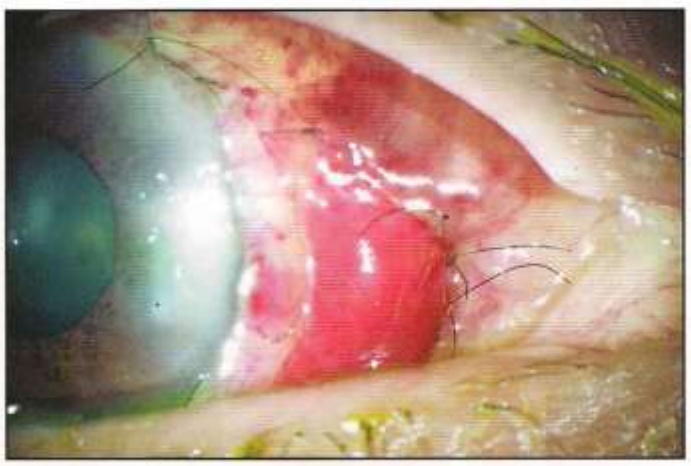

Figure 17. Subconjunctival haemorrhage under the graft.

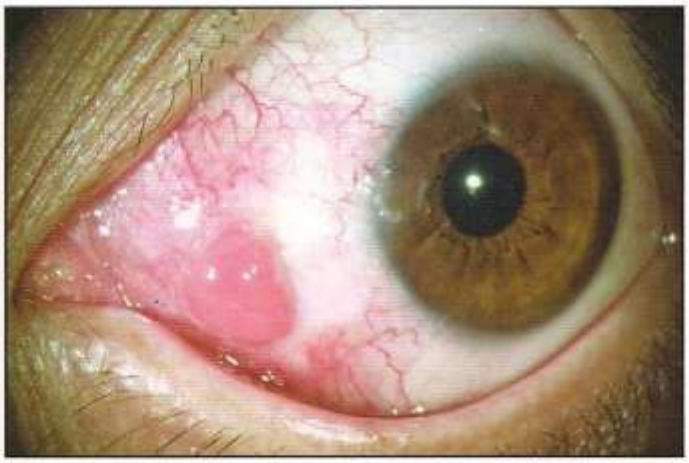

Figure 18. Postoperative granuloma.

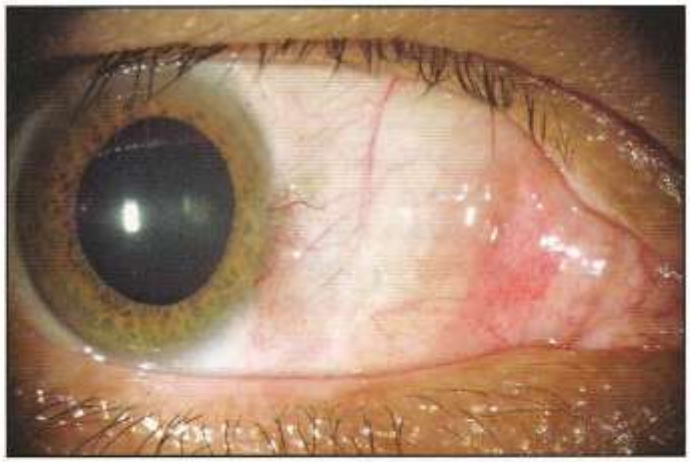

Figure 19. Central recurrence of pterygium.

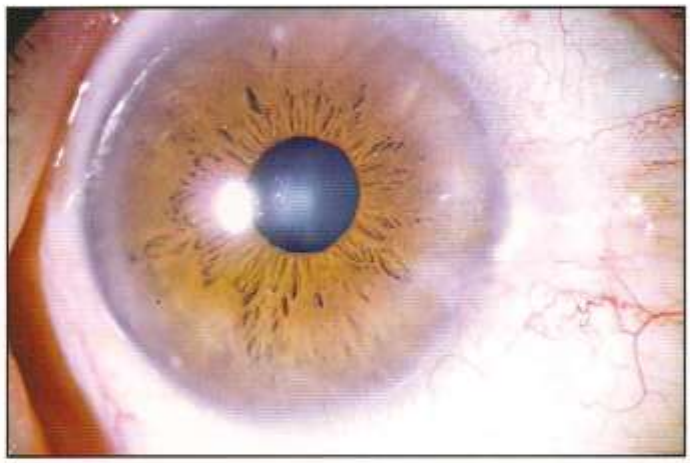

Figure 20. Peripheral recurrence of pterygium.

Recurrence

The recurrence rate following autologous limbal conjunctival or limbal graft is low, around 5% in expert hands, according to reported results, including patients with secondary pterygia.[23,48,49,57,58,59]

Recurrence pattern may change with the type of surgery. Lesions treated by simple conjunctival autograft progress more frequently over the center of the cornea, whereas those treated by limbal grafts are more frequent near the edges **(Figures 19** and **20)**. The former are probably secondary to limbal irregularities or Fuchs' pits while the latter are caused by an insufficient limbus-to-limbus contact. Recurrences should be treated at least 6 months after the prior surgery.

Complete Resection Technique with Limbal-Conjunctival Autograft Variations

Amniotic Membrane

A stromal matrix and a single layer of epithelial cells form the human amniotic membrane. The basal membrane of this epithelium is composed by collagen IV, V and laminin.[60] This tissue is avascular, antiangiogenic, does not express histocompatibility antigens[61] and provides an adequate matrix for the growth of fibroblasts, producing transforming growth factor beta, among others. It has an anti-adherent effect and facilitates the migration of epithelial cells and adhesion of basal epithelial cells, inducing epithelial differentiation and preventing epithelial apoptosis, restoring the proper conjunctival epithelial phenotype and suppressing fibroblast apoptosis.[62] In other words, amniotic membrane transplantation is not only a transplantation of epithelial growth matrix but also a bio-active transplantation.

The composition of amniotic epithelial basal membrane is very similar to that of the conjunctival epithelial basal membrane.[60] Therefore, it is easily and rapidly incorporated into the ocular surface after transplantation. It is an effective matrix for the growth and cellular expansion of the conjunctival epithelium.

For the aforementioned reasons, amniotic membrane transplantation on the surgical bed of removed pterygia may provide a healthy and effective growth matrix in those cases that require a wide

conjunctival resection or when the availability of donor conjunctiva is limited, as in the case of multiple recurrences **(Figures 21 A-C)** or simultaneous, large nasal and temporal pterygia. A small limbal conjunctival graft is placed over this amniotic membrane. The graft needs to be sutured to the patient's conjunctiva by at least one of its three non-limbal edges in order to preserve vascular supply and assuring survival. This surgical technique works nicely, permitting large conjunctival resections that can be later repopulated from a small limbal conjunctival autograft, expanded in vivo on an amniotic membrane.[63] The amniotic membrane implant should be properly spread, with its epithelial side facing upwards covering the episclera bed completely, its edges introduced under the conjunctival resection border. Its four edges are sutured with nylon 10-0 stitches to conjunctiva and episclera. The limbal conjunctival graft is sutured on the amniotic membrane in the usual way with nylon 10-0 taking care that it is adequately spread (but not tense) to prevent tears from dissecting it from the underlying amniotic membrane. In these cases nylon 10-0 stitches used to suture the conjunctival graft to the amniotic membrane and episclera are not removed on the 10th day but approximately 3 weeks after the surgery, in order to achieve a better stability and reduce the risk of detachment. It should be noted that the eyes might require a few extra weeks before they look aesthethically satisfactory. However, three months after surgery they look not differently from eyes managed with simple limbal conjunctival autografts.

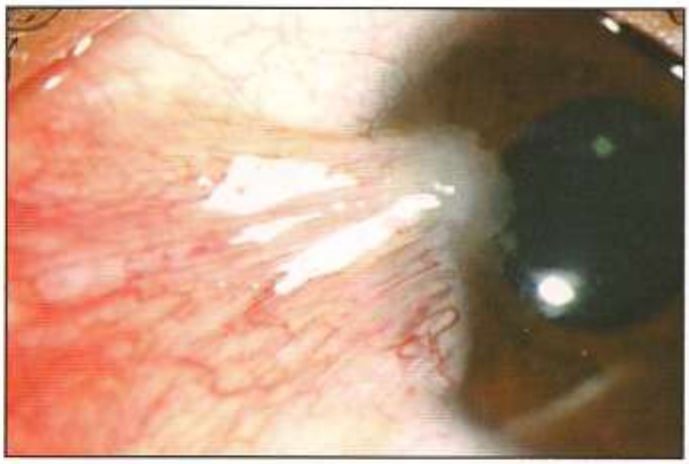

Figure 21A. Third recurrence of nasal pterygium in a patient with previous surgery for temporal pterygium and nasal and temporal pterygium in the fellow eye. Consequently, healthy, non-disturbed conjunctiva for limbal-conjunctival autograft is scarce.

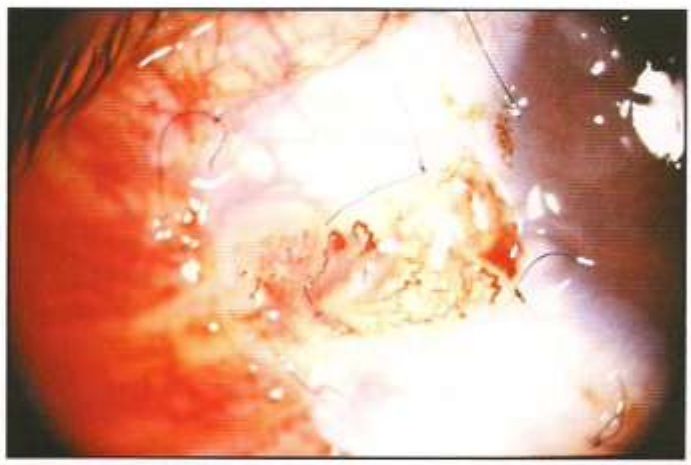

Figure 21B. Early postop period (5 days). Notice the extense amniotic membrane covering the scleral bed and on top of it the small limbal-conjunctival graft.

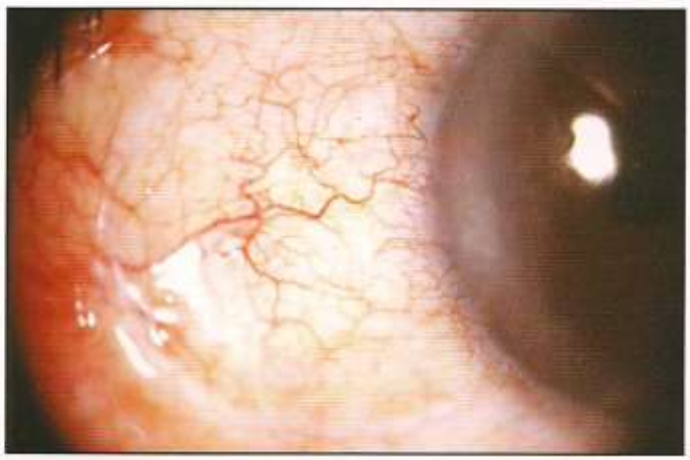

Figure 21C. Three months after surgery.

Tissue Adhesive

Pterygium resection followed by autologous limbal-conjunctival graft with tissue adhesive has been the focus of research for several years.[64, 65] The purpose of this procedure is to reduce surgical time, increasing the procedure efficiency given the worldwide changes in health concepts and reimbursement, and reducing patients' annoyance associated with stitches and long postoperative follow-up. This procedure is very useful among those patients who cannot remain as required in the city where they were operated for stitches removal. With this technique patients may return to their residency in half the time. The glue most frequently used for this purpose is fibrin (Tissucol©, Baxter AG, Vienna, Austria). This glue is presented in two components. The first contains fibrinogen and aprotinin and the second

contains calcium chloride and thrombin. Thrombin is presented in two different concentrations, 4 IU and 500 IU, to allow for an accurate adjustment of the preparation coagulation speed (thrombin 4 IU forms clot more slowly, taking about 20 seconds, whereas thrombin 500 IU forms a clot in 5 seconds).

The procedure is essentially the same as in conventional surgery with stitches, involving pterygium resection, removal of underlying Tenon, limbal polishing, episclera hemostasis and limbal conjunctival graft. However, the graft size should be somewhat bigger in order to prevent postoperative tractions that might detach the graft and cause pyogenic granulomas.

Immediately before the graft is placed on its bed, a combination of fibrinogen-aprotinin and calcium chloride-thrombin is placed in similar proportion on the edge of the conjunctival incision and the graft is placed and maintained in contact with the receptor edge with atraumatic forceps during 5 or 20 seconds (depending on the thrombin concentration) **(Figures 22 A-C)**. Afterwards, the donor bed is closed by applying both components on the juxtalimbal sclera, then descending and maintaining bulbar conjunctiva in place as long as is required by the concentration of thrombin. Reported recurrence rates are between 5.3% [66] and 14%.[67] In our opinion, recurrence incidence with glue vs. stitches[22A] is still unacceptably high and we believe this technique should be improved before it becomes an established procedure that can be regularly offered to our patients. [23, 67]

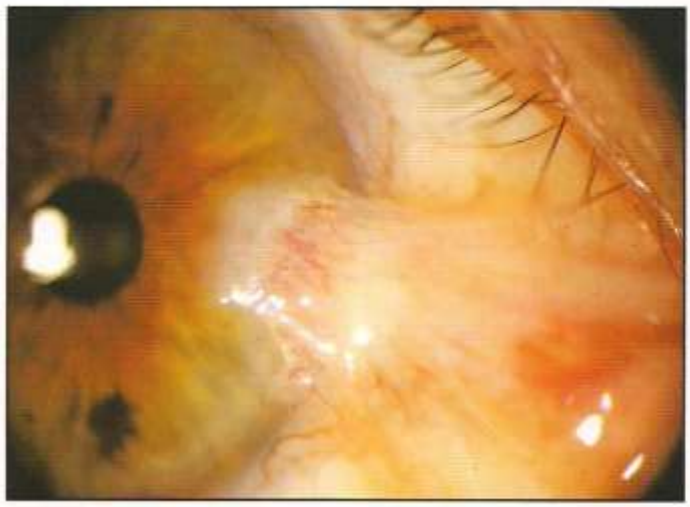

Figure 22A. Nasal pterygium in a 45 years old man.

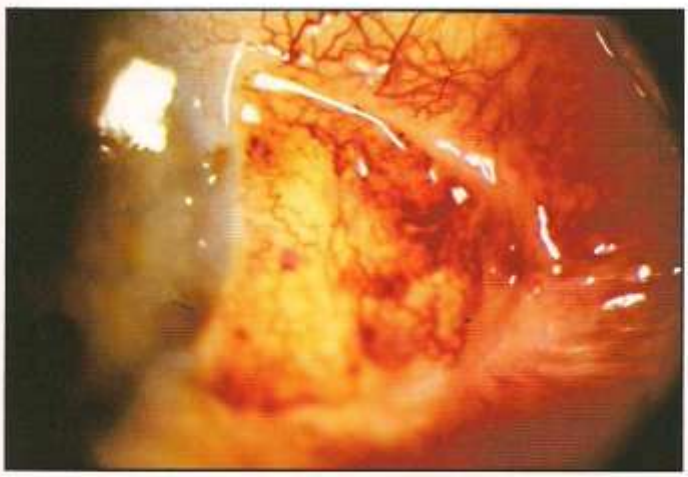

Figure 22B. Eight days after surgery. Notice moderate graft edema.

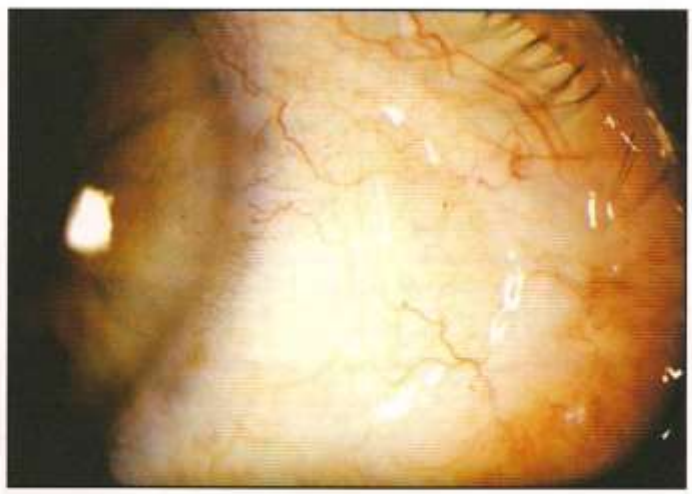

Figure 22C. Three months after surgery.

Differential Diagnosis

Pseudopterygium: this is a fibro vascular proliferation that originates from scarred bulbar conjunctiva and spreads obliquely over the cornea. It is usually secondary to inflammatory conditions such as fibrotic conjunctivitis, chemical burns, peripheral keratitis, trauma, etc. The lesion may appear in any limbal quadrant and progress over the cornea without adhering to the corneoscleral surface. Occasionally, it may develop a wide edge over the corneal surface. Other associated elements, such as corneal vascularization or pannus, may appear in those cases secondary to chemical burns. Occasionally pseudopterygium may be secondary to contact lens use **(Figure 23)**.

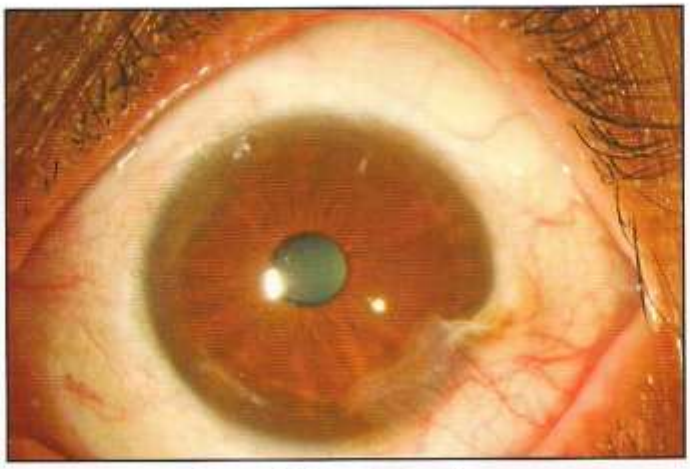

Figure 23. Pseudopterygium.

Bening Tumors

- *Limbal dermoid tumors* are congenital tumors formed by elements of different origin from that of the tissue where they appear (in this case, corneo-scleral limbus). They are also known as choristomas and are frequently located in the inferior temporal limbal quadrant. They appear as a solid, elevated, white-pinkish mass with smooth and well - defined edges. They may contain hair, sweat and sebaceous glands, cartilage, adipose tissue or tear glands, in a matrix of collagenous tissue with a stratified squamous epithelium in its surface due to its embryological origin **(Figure 24)**.[68,69]

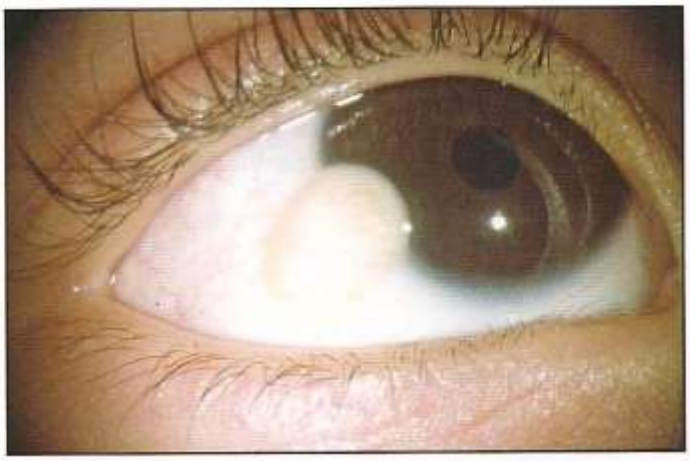

Figure 24. Limbal dermoid.

- *Papillomas:* this histopathological term refers to tumors with specific morphology, with cauliflower or finger-like appearance. They are frequently lobulated with a central vessel. Conjunctival papillomas can have neoplastic or viral etiology. The neoplastic lesions are epithelial squamous tumors with low risk of malignization, more frequent in adults, and are mainly secondary to UV radiation. There is a strong association between human papilloma virus (HPV) type 6 and 11 and the development of dysplastic conjunctival papillomas in adults. Viral papillomas are more frequent in children, are located anywhere over the conjunctival surface and are not associated with dysplasia.
- *Nevus:* nevi are circumscribed lesions with a variable degree of pigmentation that may be located in the limbus. One third of the nevi are not pigmented. They generally appear during childhood, but may appear in adulthood as well. They may grow during the second decade of life and induce an inflammatory response with redness and prominent vascularization that should not be considered cancerigenous.
- *Actinic Keratosis:* is a white-yellowish tumor that is frequently associated with whitish overlying shell (leukoplakia) of variable size that is more frequently found in the exposed areas of the bulbar conjunctiva near the limbus, especially in the nasal area. They are related to sun exposure and considered to be premalignant.

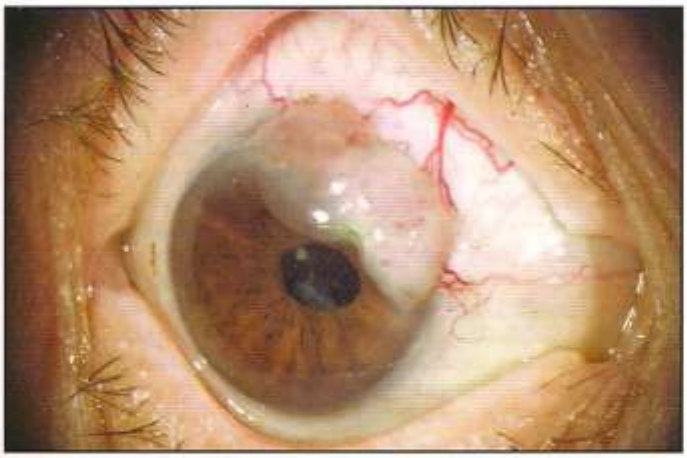

Figure 25. Ocular surface neoplasm.

- *Ocular Surface Neoplasms:* this term includes variable degrees of dysplasia, in situ carcinoma and conjunctival epidermoid or squamous cell carcinoma **(Figure 25)**. Ultraviolet exposure is the most important risk factor. It generally appears around the sixth decade of life. It has also been observed in young patients with immune suppression and xeroderma pigmentosum. Intraepithelial dysplasia and carcinoma in situ usually appear among elderly patients as gelatinous masses, generally in the limbus. In case of growth, they usually acquire an exofitic, cauliflower-like appearance. They are usually unilateral and in one single location, and if untreated, they may evolve into invasive squamous cell carcinoma. They are considered pre-malignant lesions.
- *Epidermoid or squamous cell carcinoma* may appear as a gelatinous mass with its own vascularization or as leukoplakic lesion, usually invading the limbus and spreading through the surface of the cornea. This lesion tends to spread superficially. Treatment consists of resection with safety margin. It may infrequently invade the eyeball and/or the orbit; in those cases, treatment consists of enucleating or anterior exenterating the orbit.

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