

Surgical Management of Pterygium

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ABSTRACT

Pterygium is a fibrovascular growth of the conjunctiva over the cornea that can cause ocular discomfort, decreased ocular motility and undesirable cosmetic appearance. Because of their high tendency to recur, several surgical techniques have been described for the surgical removal of pterygia that attempt to tackle with that issue. However, even the most successful procedures are associated with recurrence and several complication risks. This review strives to provide a compendium of available surgical procedures, graft attachment methods and adjuvant therapies so that one may make an informed decision on the management of pterygium.

Key words: Pterygium, recurrence, graft attachment, adjuvant therapy, excision, conjunctiva.

I. INTRODUCTION

Pterygium, a fairly common eye disorder, is a trigonal subepithelial growth of fibrovascular tissue extending from the bulbar conjunctiva, across the limbus and onto the cornea^{1,2,3,4}. Its name is derived from its resemblance with an insect's wing. There are multiple risk factors associated with the occurrence of this disorder such as older age, male gender, extended outdoor occupation, rural residence, alcohol consumption and sunlight exposure¹. Possible protective factors include the use of sunglasses and smoking¹. The progression of pterygium can result in decreased visual acuity (irregular astigmatism and pupillary axis blockage, if left unchecked), significant discomfort, restricted ocular motility, conjunctival hyperemia, foreign body sensation and tear buildup.^{1,2,5}

The high tendency of pterygia to recur is quite problematic and thus many studies have been conducted to find the prevailing risk factors associated with the recurrence. Young age, secondary pterygium, higher grade of corneal involvement, morphology (increased fleshiness) and untreated postoperative inflammation are the major risk factors of recurrence.^{6,7,8}

Indications for the surgical removal of pterygium are dependent on the size of pterygium, the presence of inflammation, patient discomfort and cosmetic appearance. An aggressive pterygium should be removed before it reaches the center of the cornea and causes pupillary axis blockage.⁴ With the excision of a pterygium, visual acuity is usually improved and astigmatism is reversed.^{9,10}

The plethora of available surgical procedures attests to the

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fact that there is no panacea when it comes to the successful treatment of pterygium. Ideally, the best treatment should have minimal recurrence rate, low chance of complications and good postoperative visual acuity and cosmesis.

II. EXCISION TECHNIQUES

Bare Sclera Technique

Bare Sclera Technique (BST) is one of the oldest to date techniques used for pterygium removal. In this method, the scleral area is left open post-operatively, allowing the surrounding conjunctiva to spontaneously heal the excised area, or it is sutured together, a variation of BST known as simple conjunctival suturing or primary closure. In modern practice, it is far from the ideal technique of choice due to its high recurrence rate, ranging from 38-88%.^{11,12,13,14,15,16} Because of that, it is most commonly used in tandem with adjuvant therapies to reduce the recurrence rate, such as Mitomycin C or 5-Fluorouracil, whose significance in pterygium surgery is going to be reviewed later on.

Conjunctival Autograft

A free conjunctival graft, commonly from the superior temporal conjunctiva, is used to cover the exposed sclera. It is fixated in place by the use of either sutures, fibrin glue or even autologous blood. Conjunctival Autograft has been described to have low recurrence rates, ranging from 3,7% with the use of fibrin glue and up to 20% with the use of sutures.^{7,8,9,17,18} Meiyani et al and Clearfield et al found that conjunctival autograft has a lower chance of recurrence than amniotic membrane transplantation for primary pterygium.^{18,19,20} Clearfield et al found that to be the case in recurrent pterygia as well. Complications from the conjunctival autograft are rare overall but they include graft edema, conjunctival inclusion cysts, dellen formation, tenon granuloma, irritation, conjunctival scarring, hyperemia and there have been some cases of induced necrotizing scleritis (SINS).^{11,21,22}

A modification of conjunctival autograft, called Pterygium Extended Removal Followed by Extended Conjunctival Transplant (P.E.R.F.E.C.T) initially introduced by Hirst, promises extremely low recurrence rates, 0,1% per 1000

patients, for both primary and recurrent pterygia as well as excellent cosmesis.^{17,23} Patients that were subjected to this technique report moderate pain post-operatively and some slight diplopia in extreme gaze, which persisted up to one week.^{17,23} Despite its steep learning curve, P.E.R.F.E.C.T provides near zero recurrence rates and excellent cosmetic appearance along with acceptable complication rates when compared with other available surgical techniques.

Fuest et al and Ting et al used a femtosecond laser to create ultrathin grafts, in a technique called Femtosecond Laser Assisted Pterygium Surgery (FLAPS), producing excellent cosmetic appearance.^{24,25}

Limbal Conjunctival Autograft

Another variation of conjunctival autograft, limbal conjunctival autograft includes limbal tissue in the conjunctival graft which is then sutured over the denuded scleral area of the excised pterygium. It stems from the concept that limbal cells facilitate corneal epithelial healing and promote the reconstruction of normal anatomy of the affected area. They also serve as a barrier that inhibits conjunctival migration onto the cornea. Recurrence rate for limbal conjunctival autograft varies between 0% to 14,29%.^{12,26,27,28} Fibrin glue seems to be the better option than sutures in limbal conjunctival autograft surgery as it causes fewer recurrences and shorter operation time.²⁸ Complications of conjunctival limbal autograft are pannus formation, dellen and pseudopterygium.²⁵

M. F. al Fayed and Kheirkhan et al concluded that limbal conjunctival autograft has a lower recurrence rate than conjunctival autograft and as such is superior.^{9,27} Several meta-analysis studies show that limbal conjunctival autograft has a lower recurrence rate compared to amniotic membrane transplantation.^{14,15}

Conjunctival Flaps

A procedure that is also similar to the conjunctival autograft is the conjunctival flap. Part of the conjunctiva at the donor site is rotated or slid into position at the denuded scleral area. Kim et al concluded that mini-flap technique without the use of Mitomycin C had a lower recurrence rate (6,1%) than the conjunctival autograft without Mitomycin C (17,1%)²⁹. Ayser Dolar Bilge's research does not notice a lower recurrence rate between the 2 techniques but finds a statistically

significant lower operation time in the conjunctival flap group.³⁰ On the contrary, Alpay et al in their comparison of several surgical techniques for pterygium, reached the conclusion that conjunctival flaps have a higher recurrence rate (33,3%) than conjunctival autografts (16,66%).¹¹ Limbal sliding flap transplantation, described by Kurua et al, has a significantly lower recurrence rate (7,1%) than both primary closure (56%) and amniotic membrane transplantation (27,3%).¹⁰ Complications of patients undergone some form of conjunctival flap include hyperemia, post-operative cyst formation, photophobia and foreign body sensation.^{10,11,29}

Amniotic Membrane Transplantation

Another way to cover the denuded scleral area is by using an amniotic graft. Amniotic grafts have anti-inflammatory properties, they encourage epithelial growth, they suppress transforming growth factor-beta (TGF-beta) and fibroblast proliferation.^{13,31} Recurrence rates with amniotic membrane transplantation range between 14,5% and 27,3%, according to literature.^{15,32} Amniotic membrane transplantation provides a clear benefit with patients that have a scarred conjunctiva and patients with glaucoma that may need filtration surgery in the future.^{12,13} Several comparative studies have been conducting comparing amniotic membrane transplantation to various other available procedures. It is reported to have a higher rate of recurrences than conjunctival autograft, limbal conjunctival autograft and conjunctival flaps but lower compared to bare sclera technique.^{12,14,16,31,32} The use of fibrin glue instead of sutures in amniotic membrane has been linked with lower recurrences, inflammation, pain and discomfort.³³

H. Lin et al introduced a variation of P.E.R.F.E.C.T that uses an amniotic graft and is conjunctiva sparing, called Pterygium Extended Removal Followed by fibrin glue-assisted Amniotic Transplantation (P.E.R.F.A.M.T).³⁴ It reported a true recurrence rate of 6,6%, which is significantly lower than simple amniotic transplantation. It is associated with a number of complications such as postoperative pyogenic granuloma, transient diplopia, early detachment of the amniotic membrane, subamniotic membrane hemorrhage and steroid-induced glaucoma.³⁴

III. GRAFT ATTACHMENT METHODS

Fibrin Glue vs Sutures

Grafts can be attached to the surrounding conjunctiva and to the bare sclera by either sutures or fibrin glue. Sutures, either absorbable (vicryl) or non-absorbable (nylon) represent the more traditional approach, with fibrin glue steadily gaining more prominence as new data arise. Fibrin glue creates an adhesive fibrin network that keeps the graft in place.³⁵ Fibrin glue is associated with less recurrences, faster operation times, lower inflammation and post-operative discomfort all the while having comparable complication rates with sutures.^{8,28,33,35} Disadvantages of fibrin glue usage include relatively high cost compared to sutures, dislocation of the graft and the possibility of infection, even if such a case is yet to be reported in ophthalmic use.^{34,35,36}

Autologous Blood

Autologous blood is a novel graft attachment method that can present as an alternative to fibrin glue. Blood is collected on the eye and, through clotting, adheres to the graft. Autologous blood does not offer the same level of graft retraction as either sutures or fibrin glue. It is superior to sutures when it comes to operation times but lagging behind fibrin glue.^{37,38}

IV. ADJUVANT THERAPIES

Mitomycin C

Mitomycin C is an alkylating agent, inhibiting DNA synthesis. Furthermore, it inhibits RNA and protein synthesis and it has been used systemically as an anticancer therapy.¹¹ In pterygium management, it can be used before, during and after the operation with favorable outcome. It reduces recurrence rates when used adjuvantly with another procedure, such as bare sclera, conjunctival autograft, limbal conjunctival autograft and amniotic membrane transplantation.^{14,25,39,40,41} However, that is not always the case since studies have shown that intraoperative use of mitomycin C following bare sclera technique has a higher recurrence rate than conjunctival autograft and limbal conjunctival autograft without the use of mitomycin C.¹⁵ Since mitomycin C is such a potent cytotoxic agent, it should be used sapiently. Several serious complications have been reported with the

use of mitomycin C, such as punctate keratitis, corneal and scleral melting, iritis, chemosis and sudden onset of mature cataract.^{40,41}

5-Fluorouracil

5-Fluorouracil (5-FU) is a pyrimidine analogue that inhibits DNA synthesis and acts on the S phase of the cell cycle. 5-FU is inferior to mitomycin C as it produces higher recurrence rates and an unsatisfactory cosmesis with excessive vascularization.^{39,42}

β -radiation

β -radiation is one of the oldest adjuvant therapies used in pterygium management. A radioactive plaque is sutured onto the sclera post-operatively and kept there until the desired dose is achieved. Recurrence rates of β -radiation range from 0% to 50%.^{43,44} Complications include scleromalacia, scleral necrosis and ulcerations.⁴⁴

Anti-VEGF: Bevacizumab and Ranibizumab

Fibrovascular proliferation plays an important role in the pathogenesis and recurrence of pterygia. Vascular Endothelial Growth Factor (VEGF) is increased in pterygium formation.⁴⁵ Bevacizumab and Ranibizumab are two of the anti-VEGF agents that have been evaluated for their usefulness against pterygium development and recurrence. Several studies have been conducted but none have yet to provide solid proof about the efficacy of those agents.^{42,45,46}

Further research is required in order to clarify their role, if any, in pterygium management.

V. CONCLUSION/DISCUSSION

It can be safely stated that there is no unanimity on the best procedure for the treatment of pterygia. However, it is safe to state that older techniques, such as bare sclera and primary closure, are being outperformed by newer techniques. Conjunctival autograft, conjunctival flaps and amniotic membrane transplantation boast better results with lower recurrence rates and fewer complications. Among them, conjunctival autograft, particularly with its variations, seems to be pulling ahead in terms of recurrence rates but amniotic membrane transplantation has an advantage when the conjunctiva needs to be preserved either for future operations or due to past scarring. The use of fibrin glue is becoming increasingly more frequent as it leads to lower complication and recurrence rates compared to sutures. Adjuvant therapies, such as mitomycin C and 5-Fluorouracil, play an important role in pterygium surgery but should be used with prudence due to various adverse effects.

The performing surgeon must take into account the data available from literature, the patients' needs and expectations, the accessibility of resources and equipment

Technique

Recurrence Rate

Bare Sclera	38 - 88%
Conjunctival Autograft	3,7 - 20%
P.E.R.F.E.C.T	0,1%
Limbal Conjunctival Autograft	0 - 14,29%
Conjunctival Flaps	6,1 - 33,3%
Amniotic Membrane Transplantation	14,5 - 27,3%
P.E.R.F.A.M.T	6,6%

as well as his/her own experience and familiarity with the available treatment options when choosing the most suitable one.

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