Original article:

Efficacy and Safety of Fibrin Glue For Fixation of Limbal Conjunctival Autograft Following Pterygium Excision: A Prospective Clinical Study

Ankur Midha[1], Poonam Jain[2]

[1]Assistant Professor, Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan, India.
[2]Senior Resident, Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan, India.
Corresponding Author: Dr. Ankur Midha, Assistant Professor, Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan, India.
Date of submission: 10 September 2011, Date of acceptance: 17 November 2011

Abstract

Background: Pterygium is a common ocular surface disorder characterized by fibrovascular conjunctival growth extending onto the cornea, frequently associated with chronic ultraviolet light exposure. Surgical excision remains the treatment of choice for symptomatic or progressive pterygium; however, recurrence and postoperative discomfort continue to pose challenges. Limbal conjunctival autografting has significantly reduced recurrence rates, and the use of fibrin glue for graft fixation has been proposed as an alternative to sutures to improve surgical efficiency and patient comfort while maintaining safety.

Aim: To evaluate the efficacy and safety of fibrin glue for fixation of limbal conjunctival autograft following pterygium excision, with emphasis on operative time, postoperative complications, recurrence, and refractive outcomes.

Materials and Methods: This prospective clinical study included 50 patients undergoing pterygium excision with fibrin glue–assisted limbal conjunctival autograft fixation at Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan, India. Detailed preoperative evaluation included demographic data, sunlight exposure history, pterygium size assessment, visual acuity, keratometry, and slit-lamp examination. All surgeries were performed under local anesthesia, and operative time was recorded. Patients were followed postoperatively on day 1, day 7, day 15, day 30, month 3, and month 6 to assess symptoms, graft status, complications, recurrence, visual acuity, and keratometric changes. Final analysis was based on 46 patients who completed six months of follow-up.

Results: The study population showed a male predominance (62%), with most patients aged between 21 and 40 years. Larger pterygia (>3.5 mm) required significantly longer operative time compared to smaller lesions (29.42 ± 2.52 vs 26.68 ± 2.20 minutes; $P < 0.001$). Early postoperative symptoms such as pain, lacrimation, photophobia, and congestion were common but resolved rapidly. Graft-related complications were infrequent, with one graft loss and two cases of graft retraction. At six months, Grade III recurrence was observed in 2 patients (4.4%), while 73.9% showed no recurrence. Significant improvement in corneal curvature and astigmatism was noted postoperatively ($P < 0.001$).

Conclusion: Fibrin glue–assisted limbal conjunctival autograft fixation is a safe and effective technique for pterygium surgery, offering reduced operative time, minimal postoperative morbidity, and low recurrence rates with favorable refractive outcomes.

Key words: Pterygium; Fibrin Glue; Limbal Conjunctival Autograft; Recurrence; Corneal Astigmatism

INTRODUCTION

Pterygium is a common ocular surface disorder characterized by a triangular fibrovascular proliferation of bulbar conjunctiva that extends onto the cornea, most often nasally. It is frequently encountered in tropical and subtropical regions and is strongly associated with outdoor occupation and chronic environmental exposure. The condition is

clinically important because progressive lesions can induce irregular corneal astigmatism, ocular surface irritation, chronic redness, recurrent inflammation, and cosmetic concerns; when advanced, it may encroach on the visual axis and reduce visual acuity. The current understanding views pterygium not as a purely degenerative change but as an active, proliferative ocular surface process influenced by inflammation, extracellular matrix remodeling, and altered limbal barrier function.[1] Ultraviolet (UV) radiation is widely considered a major etiologic factor, acting through cumulative exposure that triggers oxidative stress and inflammatory mediators at the limbus. In clinical settings, patients with significant sunlight exposure—particularly those working outdoors—commonly present with earlier onset and more progressive disease. In addition to initiation of primary pterygium, UV exposure has also been implicated in recurrence, suggesting that both disease development and postoperative regrowth share environmental drivers that continue to operate after surgery if exposure persists.[2] Consequently, preventive strategies (protective eyewear, reduction of direct UV exposure) remain relevant even when surgical management is planned, and UV-related risk profiling is useful while counseling patients on prognosis. Surgical excision is the definitive treatment for symptomatic, visually significant, progressive, or cosmetically unacceptable pterygium. However, the main challenge after excision is recurrence, which is not merely a cosmetic failure but may return with greater fibrovascular activity and scarring. Traditional bare sclera excision is associated with high recurrence and has therefore been largely replaced by techniques that restore ocular surface integrity and reduce postoperative inflammation. Modern approaches aim to reconstruct the limbal-conjunctival interface and suppress fibrovascular proliferation by covering the scleral bed with tissue such as conjunctival autograft, conjunctivolimbal autograft, or amniotic membrane, with or without adjuvant agents. Among these, conjunctival autograft has become a preferred method because it is autologous, readily available, and restores conjunctival surface while lowering recurrence compared with bare sclera. Incorporation of limbal tissue in the graft (limbal conjunctival autograft/conjunctivolimbal autograft) is based on the concept that limbal stem cells and the limbal barrier help resist conjunctivalization and corneal invasion, thereby reducing the likelihood of fibrovascular regrowth. Techniques that include limbal components and meticulous removal of fibrovascular Tenon's tissue are therefore designed to address the biological basis of recurrence, not only the mechanical defect created by excision. Comparative clinical work has supported the advantage of limbal-conjunctival reconstruction in minimizing recurrence when weighed against other adjunctive options.[3] Despite these improvements, the method of graft fixation remains a practical determinant of surgical efficiency and postoperative comfort. Conventionally, autografts are secured with sutures, but suturing increases operative time and is frequently associated with postoperative foreign body sensation, pain, conjunctival inflammation, granuloma formation, and localized scarring. These suture-related issues can reduce patient satisfaction in the early postoperative period and may contribute indirectly to inflammation-driven recurrence in susceptible individuals. Accordingly, interest has grown in sutureless or reduced-suture techniques, including the use of tissue adhesives. Fibrin glue (fibrin sealant) is a biologic tissue adhesive that mimics the final stages of the coagulation cascade by combining fibrinogen and thrombin to form a stable fibrin clot. Its ophthalmic use has expanded

because it can provide rapid graft adherence, shorten operative time, and reduce suture-related discomfort. In pterygium surgery, fibrin glue–assisted grafting has been reported to simplify fixation, improve immediate postoperative comfort, and yield satisfactory anatomical outcomes while maintaining acceptable safety. A prospective comparison of fibrin glue versus sutures for conjunctival autograft attachment demonstrated that fibrin glue could reduce operating time and postoperative symptoms, supporting its role as a practical alternative to sutures in routine cases.[4] Similar experience has also been reported in conjunctival autograft procedures using commercially available fibrin adhesives, where fast application and reduced irritation were highlighted alongside favorable early outcomes.[5] At the same time, safe use of fibrin products requires awareness of theoretical concerns such as hypersensitivity reactions, cost considerations, and the very low but non-zero risks inherent to blood-derived products, depending on manufacturing and screening standards. Therefore, careful selection, aseptic preparation, and standardized technique are essential. Comprehensive ophthalmic reviews during this period summarized the expanding indications of fibrin glue and emphasized its utility for conjunctival graft fixation because it addresses key limitations of suturing while remaining generally well tolerated in clinical practice.[6] Given the continuing burden of pterygium in sunlight-exposed populations, the persistent concern of recurrence, and the need to enhance patient comfort without compromising safety, evaluating fibrin glue–assisted limbal conjunctival autograft fixation in a prospective framework is clinically relevant. Additionally, since recurrence is influenced by patient factors (age, environmental exposure), lesion characteristics (size, vascularity), and operative variables (tissue handling, operative time, graft stability), studies that document operative efficiency and postoperative outcomes together can better guide real-world practice. Comparative controlled data have also shown that limbal-conjunctival autograft–based strategies can achieve low recurrence with acceptable complication profiles when contrasted with antimetabolite-based approaches, reinforcing the importance of ocular surface reconstruction as the cornerstone of recurrence prevention.

MATERIALS & METHODS

This prospective clinical study was carried out in the Department of Ophthalmology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan (India) and included 50 outdoor patients undergoing pterygium excision with limbal conjunctival autograft fixation using fibrin glue. Written informed consent was obtained from every participant prior to enrolment, and all patients underwent a detailed systemic and ocular history followed by a comprehensive ophthalmic evaluation.

Patient selection was based on predefined criteria. Individuals were considered eligible if they had primary pterygium or recurrent pterygium, with corneal encroachment greater than 2 mm, belonging to the age group of 20–50 years, and having either progressive or stationary disease. Patients were excluded if the corneal involvement was less than 2 mm, if they were younger than 20 years or older than 50 years, if the lesion was old and atrophic, or if they were one-eyed. Cases with associated conjunctival pathology or infection involving the conjunctiva, lids, or lacrimal apparatus were not included. Patients with systemic comorbidities or conditions predisposing to poor healing or bleeding—such as bleeding disorders, diabetes mellitus, hypertension, uremia, and connective tissue disorders—were also excluded. Preoperative assessment emphasized both disease

characterization and baseline ocular status. History taking specifically documented episodes of redness, pain, diplopia, duration of disease, occupational exposure (with particular attention to outdoor activity and sunlight exposure), family history of pterygium, and any prior surgical intervention. Ocular examination included unaided and best-corrected visual acuity (Snellen), refraction and retinoscopy wherever feasible, slit-lamp biomicroscopy (including measurement of pterygium size horizontally and vertically, and assessment of vascularity, corneal haze/grey opacity, and Stocker's line when present), ocular motility assessment, fluorescein staining to detect punctate epithelial involvement, keratometry using Javel-Schiotz keratometer to document pterygium-induced astigmatism, and posterior segment evaluation with direct ophthalmoscopy.

All surgeries were performed under local anaesthesia using peribulbar block with 0.5% sensoricaine (2 ml) and 2% xylocaine (4 ml), supplemented by facial block with 0.5% sensoricaine (1 ml) and 2% xylocaine (3 ml). Operative time was recorded for each case from the placement of the lid speculum until its removal at completion, to evaluate the procedural efficiency of fibrin glue fixation. After adequate aseptic preparation, the eye was painted with betadine and draped, and a lid speculum was applied.

For graft fixation, commercially available fibrin sealant (ReliSeal™, Reliance Life Sciences) was used. The sealant system included freeze-dried human fibrinogen, freeze-dried human thrombin, aprotinin solution, and sterile water for injection, along with syringes, needles, and a dual-chamber applicator. The fibrinogen component was reconstituted with aprotinin solution, gently swirled until fully dissolved, warmed in a 37°C water bath for 10 minutes, and then aspirated into a sterile syringe. Thrombin was reconstituted with sterile water, gently agitated, and aspirated into another sterile syringe. Both syringes were mounted onto the applicator to allow simultaneous delivery through the mixing chamber and blunt application needle, ensuring aseptic handling throughout.

The pterygium was excised using standard technique. The conjunctival portion was ballooned with 0.5 ml of 2% lidocaine with adrenaline to assist dissection and minimize bleeding. The pterygium head was shaved from the cornea using a Bard-Parker No. 15 blade, with keratectomy initiated slightly anterior to the pterygium head to include approximately 0.5 mm of uninvolved cornea, ensuring complete removal and a smooth corneal surface. The body was dissected free from the conjunctival undersurface using spring scissors, removed in one piece, and the conjunctival edges were trimmed leaving an approximately 3 mm bare scleral area. Bleeding episcleral vessels were controlled using wet-field cautery.

A limbal conjunctival autograft was harvested from the superotemporal bulbar conjunctiva, considering the limbal stem cell richness of this region. After rotating the eye inferomedially for exposure, the donor area was outlined with gentian violet to obtain an oversized graft with an additional 1.0 mm in both length and width relative to the recipient bed. Subconjunctival lidocaine with epinephrine was injected to provide haemostasis and facilitate a thin dissection plane. The graft was dissected as thinly as possible with Westcott scissors, minimizing Tenon's tissue. The epithelial surface was marked with gentian violet to prevent inversion, and the graft bed was dried before application of the reconstituted fibrin sealant. The graft was positioned immediately, maintaining correct limbal-to-limbal orientation, and carefully apposed to recipient conjunctival margins. A drying period of approximately 5 minutes was allowed before administering a subconjunctival

injection of gentamicin and dexamethasone away from the graft site. After removing the lid speculum, patients were asked to blink to confirm graft stability and mobility, followed by antibiotic ointment application and eye patching for 24 hours. The reconstituted sealant preparation was typically utilized for approximately 5–6 patients as per operative practice.

Postoperative care was provided on an outpatient basis. Patients were discharged the same day with pad bandage and received oral antibiotics and systemic non-steroidal anti-inflammatory drugs for three days. Follow-up was planned on postoperative day 1 and subsequently at day 3, day 10, day 30, day 90, and day 180. At each visit, safety and efficacy parameters were systematically assessed, including symptoms (pain, congestion, lid swelling, photophobia, blepharospasm), visual acuity with refraction where feasible, slit-lamp examination to document graft status and complications (chemosis, subconjunctival haemorrhage, conjunctival cyst, granuloma, congestion), corneal and scleral integrity, anterior chamber reaction/iritis, ocular motility, fluorescein staining, and keratometric changes. Recurrence was graded as Grade 0 (normal appearance), Grade 1 (fine episcleral vessels up to limbus without fibrous tissue), Grade 2 (fibrous tissue in excised area not invading cornea), and Grade 3 (fibrovascular tissue invading cornea). Out of the 50 operated cases, 2 patients did not attend follow-up beyond 3 months and 2 additional patients did not return at 6 months; therefore, final evaluation and results were based on 46 patients, while the study enrolment comprised 50 cases.

RESULTS

The gender distribution and mean age of the study population are shown in Table 1. Of the 50 patients enrolled, 31 (62.0%) were males and 19 (38.0%) were females, indicating a male predominance among patients undergoing pterygium surgery. The mean age of male patients was 35.22 ± 8.96 years, while that of female patients was 31.10 ± 8.55 years.

Table 2 depicts the distribution of patients according to history of exposure to sunlight. A majority of patients, 39 out of 50, reported significant exposure to sunlight, whereas only 11 patients did not have such exposure.

The preoperative size of the pterygium and its distribution by sex are summarized in Table 3. Pterygium size less than 3.5 mm was observed in 31 patients (62.0%), while 19 patients (38.0%) had pterygium size greater than 3.5 mm. Among males, a larger proportion had pterygium size greater than 3.5 mm compared to females (16 males versus 3 females). This association was found to be statistically significant ($\chi^2 = 4.986$, d.f. = 1, $P < 0.05$), indicating that males were more likely to present with larger pterygia, possibly due to greater sunlight exposure and outdoor occupational activities.

Operative time in relation to pterygium size is presented in Table 4. The mean operative time for pterygia measuring less than 3.5 mm was 26.68 ± 2.20 minutes, whereas for pterygia larger than 3.5 mm it was 29.42 ± 2.52 minutes. The difference in operative time was highly significant ($P < 0.001$), demonstrating that larger pterygia required longer surgical time due to increased tissue dissection and graft manipulation. The overall mean operative time was 27.72 ± 2.68 minutes, highlighting the efficiency of fibrin glue–assisted limbal conjunctival autograft fixation.

Postoperative adverse effects and complications observed during follow-up are detailed in Table 5. On the first postoperative day, common complaints included pain (15 patients), lacrimation (30 patients), photophobia (16 patients), and

conjunctival congestion (45 patients). Subconjunctival hemorrhage was noted in 9 patients and chemosis in 4 patients. Fluorescein staining was positive in all cases on day 1, indicating epithelial healing response. These early postoperative symptoms gradually subsided over subsequent visits. By day 7, only a small number of patients reported pain, lacrimation, and photophobia, while congestion and subconjunctival hemorrhage showed marked reduction. By day 15 and day 30, most symptoms had resolved, with only minimal congestion or resolving hemorrhage in a few cases.

Graft-related complications were infrequent. One case of graft loss was observed on day 1, and graft retraction or gaping was noted in two patients during early follow-up. One patient developed a conjunctival granuloma by day 15, which was managed appropriately. No cases of symblepharon, scleral thinning, or corneal thinning were observed. Recurrence was not detected in the early postoperative period; however, one patient developed recurrence by the third month, and a total of two patients showed recurrence by the end of six months.

Table 1: Gender distribution and mean age (N = 50)

Gender	n (%)	Mean age (years) ± SD
Male	31 (62.0)	35.22 ± 8.96
Female	19 (38.0)	31.10 ± 8.55
Total	**50 (100.0)**	—

Table 2: Sunlight exposure history (N = 50)

Exposure to sunlight	n
Present	39
Absent	11

Table 3: Preoperative pterygium size distribution (corneal encroachment) by sex (N = 50)

Size (mm)	Male n (%)	Female n (%)	Total n (%)
<3.5	15 (30.0)	16 (32.0)	31 (62.0)
>3.5	16 (32.0)	3 (6.0)	19 (38.0)
Total	**31 (62.0)**	**19 (38.0)**	**50 (100.0)**

Statistical note: $\chi^2 = 4.986$; d.f. = 1; **P < 0.05**

(males showed a significant association with larger pterygia >3.5 mm).

Table 4: Operative time according to pterygium size (N = 50)

Operative time (minutes)	<3.5 mm (n = 31) Mean ± SD	>3.5 mm (n = 19) Mean ± SD	P-value	Significance
Mean ± SD	26.68 ± 2.20	29.42 ± 2.52	<0.001	HS

Table 5: Postoperative adverse effects and complications over follow-up

(Day 1 to Day 30: N = 48 as recorded; Month 3: N = 48; Month 6: N = 46)

Parameter	Day 1	Day 7	Day 15	Day 30	Month 3	Month 6
Pain	15	2	0	0	0	0
Lacrimation	30	5	2	0	0	0
Photophobia	16	2	0	0	0	0
Congestion	45	40	10	2	0	0
Chemosis	4	1	0	0	0	0
Subconjunctival hemorrhage	9	8	5	0	0	0
Fluorescein stain positive	50	1	0	0	0	0
Graft retraction/gaping	0	1	1	0	0	0
Graft loss/slip	1	0	0	0	0	0
Conjunctival cyst / granuloma	0	0	1	0	0	0
Symblepharon	0	0	0	0	0	0
Recurrence	0	0	0	0	1	2 (1+1)

DISCUSSION

In the present study, males constituted 62.0% (31/50) and females 38.0% (19/50), and a substantial proportion reported significant sunlight exposure (39/50; 78%), supporting the established environmental contribution of ultraviolet exposure in pterygium. Moran *et al* (1984) demonstrated a strong positive correlation between climatic UV radiation and pterygium prevalence, which aligns with the predominance of exposed individuals observed in our cohort.[7] Most patients in our series belonged to the 21–40-year age group (72%) with male predominance, suggesting that working-age populations with outdoor activity constitute a major surgical burden. Fernandes *et al* (2005), in a large long-term outcomes analysis, similarly reported male predominance and highlighted that males and patients below 40 years had a greater propensity for recurrence; in contrast, our clinically significant (Grade III) recurrence at 6 months remained low (2/46; 4.4%), suggesting favorable short-term outcomes with fibrin glue–assisted limbal conjunctival autografting in a largely young adult cohort.[8] Preoperatively, 38% (19/50) of eyes had pterygium size >3.5 mm, and males were significantly more likely to present with larger lesions (16 males vs 3 females; $P < 0.05$). This finding is clinically relevant because lesion severity has been linked with recurrence risk in the literature. Tan *et al* (1997) emphasized the importance of lesion characteristics (notably "fleshiness") as a recurrence risk factor—particularly when bare sclera excision is used—reporting recurrence of 61% after bare sclera compared with 2% after conjunctival autografting for primary pterygium; our practice of autografting with fibrin glue likely contributed to minimizing high-grade recurrence despite a meaningful proportion of larger lesions.[9] Operative duration in our series increased significantly with lesion size: 26.68 ± 2.20 minutes for <3.5 mm versus 29.42 ± 2.52 minutes for >3.5 mm ($P < 0.001$), indicating that larger pterygia required additional surgical handling even with glue fixation. Koranyi *et al* (2004) reported substantially shorter procedure times with fibrin glue (9.7 minutes) compared with sutures (18.5 minutes, $P < 0.001$); the longer absolute times in our series likely reflect

differences in surgical workflow (including meticulous keratectomy, limbal graft preparation, and standardized intraoperative steps), while still demonstrating the expected trend of efficiency and the size–time relationship.[10] Early postoperative symptoms in our cohort were common but rapidly self-limiting: on day 1, pain was reported by 15 patients, lacrimation by 30, photophobia by 16, and congestion by 45; by day 7 these symptoms reduced markedly (pain 2, lacrimation 5, photophobia 2), and by day 30 only minimal congestion persisted (2). Bahar *et al* (2006) similarly found that fibrin glue significantly reduced operative time (16 minutes vs 20 minutes) and was associated with significantly less pain and irritation-related symptoms in the early postoperative period, supporting our observation that patient comfort improves quickly after glue-assisted fixation with limited ongoing inflammation.[11] Graft-related events were infrequent in the present study: one graft loss on day 1, graft retraction/gaping in two patients early in follow-up, and one granuloma by day 15, with no symblepharon, scleral thinning, or corneal thinning recorded. Karalezli *et al* (2008) reported partial graft dehiscence in 2/25 (8%) in the fibrin glue group (successfully reattached), indicating that minor graft edge instability can occur even with glue but is usually manageable; our low frequency of graft-related complications is consistent with this safety profile and supports the procedural reliability of fibrin glue fixation when meticulous graft sizing and adequate drying time are ensured.[12] With respect to refractive outcomes, our data demonstrate meaningful corneal normalization after surgery: the steep meridian keratometry decreased from 45.40 ± 2.06 D to 44.17 ± 1.41 D (mean change 1.23 ± 1.55 D, $P < 0.001$), and mean corneal astigmatism reduced from 1.92 ± 1.80 D to 0.78 ± 0.84 D (mean change 1.14 ± 1.46 D, $P < 0.001$). Yagmur *et al* (2005) similarly demonstrated significant improvement in topographic indices and reported a reduction in topographic astigmatism from 4.65 ± 3.02 D to 2.33 ± 2.26 D ($P = 0.003$), supporting the concept that pterygium induces measurable corneal distortion that improves after excision with ocular surface reconstruction.[13] At final follow-up (6 months; N = 46), Grade III recurrence occurred in 2 patients (4.4%), while 73.9% remained Grade 0; lower-grade vascular or fibrous regrowth without corneal invasion (Grades I–II) was observed in 10 patients (21.7%), emphasizing the importance of defining recurrence endpoints when comparing studies. Prabhasawat *et al* (1997) reported recurrence rates of 14.8% (all pterygia) in one group at ~11 months, and 4.9% (all pterygia) in another group at ~23 months, illustrating that recurrence varies by technique and follow-up duration; our low Grade III rate (4.4%) is comparable to lower recurrence benchmarks reported with more definitive ocular surface reconstruction approaches, though longer follow-up would be necessary to evaluate late recurrences beyond six months.[14]

CONCLUSION

Pterygium excision with fibrin glue–assisted limbal conjunctival autograft fixation is a safe and effective surgical technique with the advantages of reduced operative time, minimal postoperative discomfort, and low complication rates. The procedure demonstrated favorable anatomical stability with a low rate of clinically significant recurrence and meaningful improvement in corneal curvature and astigmatism. Early postoperative symptoms were mild and self-limiting, and graft-related complications were infrequent. These findings support the use of fibrin glue as a reliable alternative to sutures for limbal conjunctival autograft fixation in pterygium surgery.

References

1. Solomon AS. Pterygium. Br J Ophthalmol. 2006;90(6):665–666. doi:10.1136/bjo.2006.091413. Available from: https://pubmed.ncbi.nlm.nih.gov/16714259/
2. Fallah MR, Golabdar MR, Amozadeh J, Zare MA, Moghimi S, Fakhraee G. Transplantation of conjunctival limbal autograft and amniotic membrane vs mitomycin C and amniotic membrane in treatment of recurrent pterygium. Eye (Lond). 2008;22:420–424. doi:10.1038/sj.eye.6702657. Available from: https://pubmed.ncbi.nlm.nih.gov/17159974/
3. Uy HS, Reyes JMG, Flores JDG, Lim-Bon-Siong R. Comparison of fibrin glue and sutures for attaching conjunctival autografts after pterygium excision. Ophthalmology. 2005;112:667–671. doi:10.1016/j.ophtha.2004.08.028. Available from: https://pubmed.ncbi.nlm.nih.gov/15808260/
4. Marticorena J, Rodríguez-Ares MT, Touriño R, Mera P, Valladares MJ, Martinez-de-la-Casa JM, et al. Pterygium surgery: conjunctival autograft using a fibrin adhesive. Cornea. 2006;25(1):34–36. doi:10.1097/01.ico.0000164780.25914.0a. Available from: https://pubmed.ncbi.nlm.nih.gov/16331038/
5. Panda A, Kumar S, Kumar A, Bansal R, Bhartiya S. Fibrin glue in ophthalmology. Indian J Ophthalmol. 2009;57(5):371–379. doi:10.4103/0301-4738.55079. Available from: https://pubmed.ncbi.nlm.nih.gov/19700876/
6. Ari S, Caca I, Yildiz ZO, Sakalar YB, Dogan E, et al. Comparison of mitomycin C and limbal-conjunctival autograft in the prevention of pterygial recurrence in Turkish patients: a one-year, randomized, assessor-masked, controlled trial. Curr Ther Res Clin Exp. 2009;70(4):274–281. doi:10.1016/j.curtheres.2009.08.004. Available from: https://pubmed.ncbi.nlm.nih.gov/24683237/
7. Moran DJ, Hollows FC. Pterygium and ultraviolet radiation: a positive correlation. Br J Ophthalmol. 1984;68(5):343–346. doi:10.1136/bjo.68.5.343. Available from: https://pubmed.ncbi.nlm.nih.gov/6712914/
8. Fernandes M, Sangwan VS, Bansal AK, et al. Outcome of pterygium surgery: analysis over 14 years. Eye (Lond). 2005;19:1182–1190. Available from: https://www.nature.com/articles/6701728
9. Tan DT, Chee SP, Dear KB, Lim AS. Effect of pterygium morphology on pterygium recurrence in a controlled trial comparing conjunctival autografting with bare sclera excision. Arch Ophthalmol. 1997;115(10):1235–1240. Available from: https://pubmed.ncbi.nlm.nih.gov/9338666/
10. Koranyi G, Seregard S, Kopp ED. Cut and paste: a no suture, small incision approach to pterygium surgery. Br J Ophthalmol. 2004;88(7):911–914. Available from: https://pubmed.ncbi.nlm.nih.gov/15205236/
11. Bahar I, Weinberger D, Gaton DD, Avisar R. Pterygium surgery: fibrin glue versus Vicryl sutures for conjunctival closure. Cornea. 2006;25(10):1168–1172. Available from: https://pubmed.ncbi.nlm.nih.gov/17172892/
12. Karalezli A, Kucukerdonmez C, Akova YA, Altan-Yaycioglu R, Borazan M. Fibrin glue versus sutures for conjunctival autografting in pterygium surgery: a prospective comparative study. Br J Ophthalmol. 2008;92(9):1206–1210. doi:10.1136/bjo.2008.139600. Available from: https://pubmed.ncbi.nlm.nih.gov/18621797/

13. Yagmur M, Ozcan AA, Sari S, Ersoz TR. Visual acuity and corneal topographic changes related with pterygium surgery. J Refract Surg. 2005;21(2):166–170. Available from: https://pubmed.ncbi.nlm.nih.gov/15796222/
14. Prabhasawat P, Barton K, Burkett G, Tseng SCG. Comparison of conjunctival autografts, amniotic membrane grafts, and primary closure for pterygium excision. Ophthalmology. 1997;104(6):974–985. Available from: https://pubmed.ncbi.nlm.nih.gov/9186439/