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Evaluation of the clinical efficacy of modified LSC transplantation plus BCL implantation in the treatment of pterygium

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Abstract

Objective To explore the clinical efficacy of modified limbal stem cell transplantation(Modified LSC transplantation) and bandage contact lens(BCL) implantation in pterygium surgery.

Methods A total of 479 patients with primary pterygium who were admitted to our hospital from March 2019 to March 2023 were randomly divided into three groups: the normal group (Group A: 89 patients), the control group (Group B: 195 patients), and the modified group (Group C: 195 patients). Each group received different intervention measures. Group A did not undergo surgical treatment and were required to follow up as outpatients. Group B received LSC transplantation combined with interrupted suturing plus BCL, whereas Group C received modified LSC transplantation combined with BCL. The degree of corneal irritation symptoms, wound healing and graft status under slit lamp, incidence and recurrence rate of complications, tear film rupture time, tear secretion test, intraocular pressure, ocular surface inflammation response(IL-1β, PGE2, TNF-α, VEGF), and visual quality were compared and analyzed at various time points after surgery.

Results Compared with those in the Group B, patients in the Group C experienced faster normalization of corneal epithelium recovery, fewer corneal irritation symptoms, and better wound healing. The break-up time (BUT) of the tear film at 1 week to 1 year postoperatively was significantly greater in the Group C than Group B, with values approaching those of Group A by 3 months ($P < 0.05$). The Schirmer test results revealed a similar trend to that of the BUT. Further analysis of intraocular pressure (IOP) at different time points revealed no significant differences among the three groups at postoperative Day 1. However, due to the use of corticosteroid eye drops postoperatively, IOP was greater in both the Group B(17.24 ± 2.12 mmHg) and Group C (17.02 ± 2.37 mmHg) than Group A (13.92 ± 1.57 mmHg) at 1 week. By 1 month, Group C had a lower IOP (15.77 ± 1.63 mmHg) than Group B(17.78 ± 2.41 mmHg). There were no significant differences in IOP among the three groups from 3 months to 1 year ($P > 0.05$). The ELISA results indicated that the expression levels of the ocular surface inflammatory factors IL-1β, TNF-α, PEG2, and VEGF in the Group C were lower than those in Group B from 1 week to 1 year post surgery. Under both natural light and

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low-light conditions (spatial frequency/6 cd), Group C had better best-corrected visual acuity and contrast sensitivity than Group B at 1 week to 1 year postoperatively. Additionally, Group C had lower corneal higher-order aberrations (including astigmatism, spherical aberrations, and total higher-order aberrations) and superior vision-related quality of life scores at 1 year postoperatively than Group B, with statistically significant differences ($P < 0.05$).

Conclusion Modified LSC transplantation combined with BCL implantation provided superior treatment outcomes for patients with pterygium, which was worthy of further clinical promotion.

Keywords Pterygium, Modified LSC transplantation, Bandage Contact Lens, Treatment efficacy

Introduction

Pterygium is an ocular surface disease characterized mainly by a wing-shaped growth of limbal and conjunctival tissue over the adjacent cornea [1]. Depending on the population studies, the prevalence of pterygium lies within the range of 1% to more than 30% [2]. According to a meta-analysis of 20 studies published in 2015, the pooled prevalence of pterygium is around 10%, and simple excisions leaving bare sclera lead to a high (38–88%) recurrence rate while the gold standard for pterygia surgery is about 8–12% [3]. Owing to the invasion of pterygium, normal corneal tissue is obscured, leading to irregular astigmatism and changes in higher-order aberrations on the corneal surface, resulting in varying degrees of visual quality decline [4]. Currently, surgery is the main treatment for pterygium, but due to mechanical damage to the corneal epithelium during surgery, patients experience symptoms such as photophobia, tearing, blurred vision, pain, and foreign body sensation [5]. In recent years, ophthalmologists have explored various grafting techniques (including conjunctival transplantation, amniotic membrane transplantation, and limbal stem cell transplantation) and surgical combined drug therapies (e.g., mitomycin) to reduce the recurrence rate of pterygium and improve postoperative discomfort in patients, especially with the application of biological amniotic membrane transplantation and limbal stem cell (LSC) transplantation. These methods significantly reduce the postoperative recurrence rate [6]. However, owing to the rich innervation of the ocular surface, which is sensitive to stimulation, LSC transplantation combined with interrupted suturing still results in significant irritation symptoms and even complications such as corneal ulcers and conjunctival granulomas [7]. Although Fibrin glue has been used to promote conjunctival healing after pterygium surgery, postoperative complications such as poor conjunctival healing and sclera exposure have limited its clinical applicability [8]. Research has shown that sutures at the wound site have significant effects on ocular surface inflammation, scar proliferation, tear secretion, and other conditions [9]. Therefore, this study, which is based on LSC transplantation, adopts a modified suturing technique combined with the bandage contact lens to discuss its clinical application effects from multiple perspectives, including the surgical success rate, ocular surface comfort, and visual quality. In this study, we aim to explore a more comfortable, safer, and more effective surgical treatment for pterygium.

Methods

Subjects

From March 2019 to March 2023, a total of 479 patients (right eye) who were admitted to our hospital with primary pterygium and met the inclusion and exclusion criteria were randomly divided into three groups: the normal group (Group A: 89 patients), the control group (Group B:195 patients), and the modified group (Group C:195 patients). Group A consisted of patients who were clearly diagnosed with primary pterygium but did not undergo surgical treatment and were required to follow up as outpatients. Group B received LSC transplantation combined with interrupted suturing plus the bandage contact lens implantation, whereas Group C received modified LSC transplantation combined with the bandage contact lens implantation. There was no statistically significant difference in gender(Group A: Male 47.67%; Group B: Male 48.39%; Group C: Male 46.92%) and age(Group A: 57.24±5.87 year; Group B: 58.37±5.49 year; Group C: 56.82±5.29 year;) among the three groups of patients included in the study. The patients we chose for pterygium were those with lesions invading the cornea by 3–5 mm to ensure surgical effectiveness. For lesions larger than 5 mm, we did not include them in the study. For patients who withdrew during the follow-up process, we included them in the new study under the same conditions.

The inclusion criteria were as follows: (1) met the diagnostic criteria for pterygium, with the pterygium not extending to the pupillary margin; (2) had unilateral primary pterygium; and (3) were willing and able to adhere to follow-up visits.

The exclusion criteria were as follows: (1) Pseudopterygium; (2) history of corneal or conjunctival surgery or trauma; (3) concurrent dry eye, diabetes, or other immune-related diseases; and (4) pain sensitivity, anxiety, or other psychiatric disorders.

Surgical methods

Preoperative preparation and postoperative management were consistent between the two groups. All surgeries were performed by the same surgeon from Ziyang Hospital of West China Hospital, Sichuan University, under a microscope.

Surgical procedure

A conjunctival incision was made at the limbus level on the neck of the pterygium, and the conjunctiva was bluntly dissected from the pterygium. The conjunctiva was then incised toward the opposite side of the pterygium neck, and the pterygium was bluntly dissected and removed from the tail end. The neck of the pterygium near the head was inverted, and the proliferative tissue was dissected retrogradely (similar to capsulorhexis in cataract surgery) from the cornea, approximately 0.5 mm beyond the corneal margin, until the entire pterygium was excised. Any remaining proliferative tissue was checked, and minor cauterization was applied to any neovascularized areas. A conjunctival graft, which was slightly larger than the recipient bed and included limbal tissue, was harvested from the upper eye and transplanted to cover the exposed sclera where the pterygium was removed (ensuring that the limbal side of the graft was aligned with the limbus). In the Group B, the corneal graft was sutured to the limbus with two interrupted 10−0 sutures and then sutured to the conjunctival bed on the opposite side with two more sutures. Tobramycin and dexamethasone ointment were applied postoperatively, and the eye was bandaged. In the Group C, the graft was sutured to the limbus with two 10−0 sutures, but the graft was left unsutured on the opposite side and placed under the conjunctiva. A bandage lens was implanted into the conjunctival sac without requiring further dressing or bandaging. On the first postoperative day, the dressing was removed, and both eyes received tobramycin eye drops (four times daily) and sodium hyaluronate eye drops (four times daily). The bandage lens was removed after two weeks, and the conjunctival sutures were removed. Postoperatively, Group B was routinely treated with levofloxacin eye drops for two weeks (four times daily) and fluorometholone eye drops for four weeks (three times daily). The Group C was treated with levofloxacin eye drops for two weeks (four times daily) and fluorometholone eye drops for two weeks (three times daily).

Corneal Irritation symptom evaluation

Corneal irritation symptoms at various postoperative time points (1 day, 1 week, 1 month, 3 months, 6 months, and 1 year) were evaluated via the ocular comfort scoring method of Sancilio S [10] and the visual analog scale (VAS) [11]. Each discomfort symptom was given a score of 1 point, and the higher the score, the greater the degree of discomfort. A score of 0 indicates no discomfort; 1 indicated mild irritation symptoms; 2 indicated moderate irritation symptoms; 3 indicated severe irritation symptoms; and 4 indicated very severe irritation symptoms (as shown in the table below). The total possible score was 72 points, with higher scores indicating more severe corneal irritation symptoms.

Evaluation of corneal wound healing

The healing of corneal wounds at various postoperative time points (1 day, 1 week, 1 month, 3 months, 6 months, and 1 year) was assessed via fluorescein (FL) staining, as referenced from Chaidaroon [12]. The scoring criteria were as follows: no staining was scored as 0 points; scattered punctate staining or mild linear staining was scored as 1 point; a moderate amount of punctate staining with slight confluence was scored as 2 points; and dense punctate staining with confluence was scored as 3 points.

Determination of complications and recurrence rates

The occurrence of complications such as conjunctival cysts, symblepharon, corneal ulcers or scleral ulcers, and graft detachment was recorded as positive for complications. The recurrence rate was determined on the basis of the classification of postoperative outcomes of pterygium surgery reported by Prat [13], with the following four grades:

Grade 1: the operated area of the bulbar conjunctiva appeared normal;

Grade 2: no fibrous tissue proliferation but neovascularization tended to extend toward the cornea;

Grade 3: fibrous tissue proliferation begined, but it did not invade the cornea;

Grade 4: fibrous tissue proliferation had invaded the cornea; and.

Grade 4 was considered a recurrence.

Collection of clinical ocular surface data

At various postoperative time points (1 day, 1 week, 1 month, 3 months, 6 months, and 1 year), the following data were collected and recorded: anterior segment photographs, corneal fluorescein staining, tear film breakup time (BUT), Schirmer test results, and intraocular pressure.

Inflammatory response analysis

Tear samples were collected at various postoperative time points (1 day, 1 week, 1 month, 3 months, 6 months, and 1 year), and the levels of the ocular surface inflammatory factors IL-1β, PGE2, TNF-α, and VEGF were analyzed via ELISA.

Table 1 Comparison of corneal irritation symptom scores between two groups of patients at different time points after surgery

Group	*N*	Postoperative 1 Day	Postoperative 1 Week	Postoperative 1 month	Postoperative 3 months	Postoperative 6 months	Postoperative 1 Year
Group B	195	23.47 ± 2.78	19.35 ± 1.92	16.77 ± 1.43	12.27 ± 1.92	11.98 ± 1.14	11.76 ± 1.26
Group C	195	22.94 ± 2.49	16.73 ± 1.85	13.35 ± 1.29	10.33 ± 1.58	10.12 ± 1.47	10.22 ± 1.17
T value	-	2.89	3.23	2.69	2.73	2.51	2.77
P value	-	0.158	0.001	0.013	0.02	0.037	0.043

Note: Group B = The control group; Group C = The modified group

Table 2 Comparison of corneal wound healing scores between two groups of patients at different time points after surgery

Group	*N*	Postoperative 1 Day	Postoperative 1 Week	Postoperative 1 month	Postoperative 3 months	Postoperative 6 months	Postoperative 1 Year
Group B	195	2.73 ± 1.27	2.32 ± 1.12	1.87 ± 0.96	1.25 ± 0.87	1.22 ± 0.92	1.24 ± 0.97
Group C	195	2.75 ± 1.19	1.78 ± 1.09	1.48 ± 0.87	1.14 ± 0.79	1.12 ± 0.83	1.09 ± 0.93
T value	-	8.92	7.84	9.34	8.54	8.18	7.94
P value	-	0.273	0.002	0.037	0.001	0.014	0.001

Note: Group B = The control group; Group C = The modified group

Visual quality analysis

Best corrected visual acuity (BCVA) was recorded via the LogMAR vision chart at various postoperative time points (1 day, 1 week, 1 month, 3 months, 6 months, and 1 year). Wavefront aberrations were assessed via the SCHWIND Keratron score, with each eye examined four times. The most ideal wavefront map was used to convert data into corneal wavefront aberration data via the ORK-CAM (Optimized Refraction Keratectomy) software system, which collected aberration data with a 6 mm pupil diameter. Additionally, vision-related quality of life was assessed via the National Eye Institute Visual Function Questionnaire-25 (NEI-VFQ-25) [14]. This questionnaire evaluates ten dimensions: near vision, distance vision, night vision deterioration, glare, reading fatigue, double vision, dryness, eye pain, surgical satisfaction, and others. Each dimension was scored with four response levels, namely, strongly disagree, disagree, agree, and strongly agree, with 0, 1, 2, or 3 points, respectively. The total score was calculated, with higher scores indicating worse vision-related quality of life. The scoring was completed independently by two physicians, and discrepancies between their results were resolved by the lead examiner.

Statistical methods

The data were processed via SPSS 20.0 statistical software. The minimum sample size achieved confidence level of 95%. Descriptive statistics are presented as the means ± standard deviations. Independent samples t tests were used for comparisons between different groups. A p value of less than 0.05 was considered statistically significant.

Results

Corneal irritation symptom evaluation

As shown in Table 1, there was no statistically significant difference in the corneal irritation symptom score between Group B and Group C on postoperative Day 1 ($P>0.05$). However, at postoperative time points ranging from 1 week to 1 year, the differences between the two groups were statistically significant. At each of these time points, the corneal irritation symptom scores in Group C were lower than those in Group B.

Corneal wound healing evaluation

As shown in Table 2, there was no statistically significant difference in corneal wound healing scores between Group B and Group C on postoperative Day 1 ($P>0.05$). However, at postoperative time points ranging from 1 week to 1 year, the differences between the two groups were statistically significant. At each of these time points, the corneal wound healing scores in Group C were lower than those in Group B.

Determination of complications and recurrence rates

In this study, the occurrence of complications such as conjunctival cysts, symblepharon, corneal ulcers or scleral ulcers, and graft detachment was recorded as positive for complications. As shown in Fig. 1, at 1 month after surgery, there was no significant conjunctival congestion in Group C patients while significant congestion was observed in Group B; At the same time, the haze were still visible at the corneal margin in group B, while the cornea and conjunctiva in group C had basically returned to normal at 3 months after surgery; Moreover, at the 1-year follow-up after surgery, conjunctival cysts were still visible in Group B(Fig. 1). The results revealed that the number of complications in Group B (11

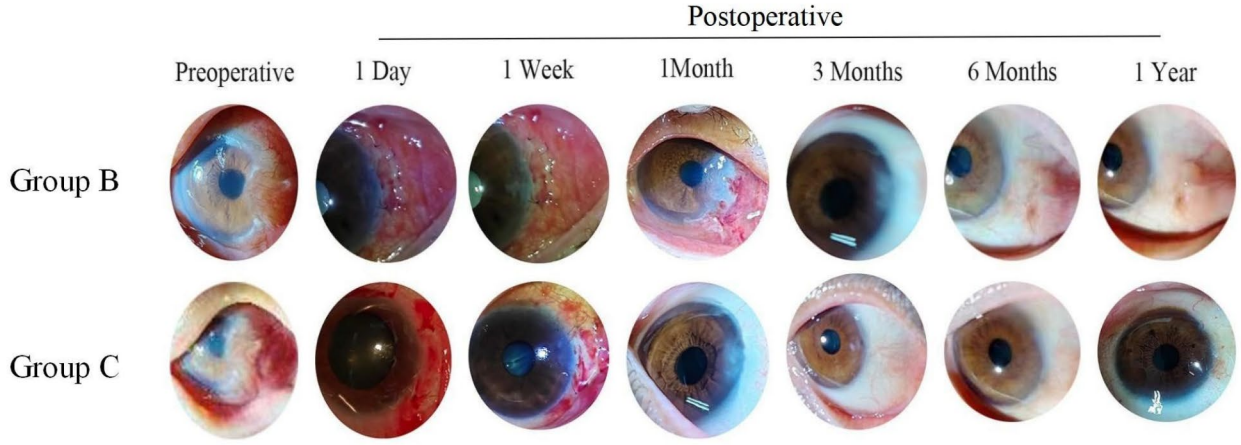

Fig. 1 Eye surface images of patients in the Group B and group C at different time points before and after surgery

Table 3 Comparison of postoperative complications and recurrence rates between two groups of patients one year after surgery

Group	Complication	Grade 1	Grade 2	Grade 3	Grade 4
Group B	11	131	34	18	12
Group C	4	158	21	10	6
P value	0.038	0.003	0.001	0.027	0.002

Note: Group B=The control group; Group C=The modified group

patients) was significantly greater than that in Group C (4 patients). Additionally, the number of cases of each grade of pterygium recurrence after surgery was significantly greater in Group B than in Group C. Thus, both the complication rate and the recurrence rate were significantly greater in Group B than in Group C($P<0.05$)(Table 3).

Analysis of BUT, Schirmer, and intraocular pressure at different postoperative time points

As shown in Fig. 2, on postoperative Day 1, there was no statistically significant difference in BUT values between Group B (4.87±1.32) and Group C (5.14±1.18). However, at postoperative time points ranging from 1 week to 1 year, the BUT values in Group C were greater than those in Group B, and by 3 months post surgery, the BUT values in Group C stabilized and approached those of Group A. The differences were statistically significant ($P<0.05$). Additionally, the Schirmer test results showed a similar trend to that of the BUT. Further analysis of IOP changes at different time points revealed that on postoperative Day 1, there was no statistically significant difference in IOP among the three groups. However, due to the use of corticosteroid eye drops postoperatively, the IOP was greater in both Group B(17.24±2.12 mmHg) and Group C (17.02±2.37 mmHg) than in Group A (13.92±1.57 mmHg) at 1 week post surgery. By 1 month post surgery, the intraocular pressure in Group C (15.77±1.63 mmHg) was lower than that in Group B(17.78±2.41 mmHg). From 3 months to 1 year post surgery, there were no statistically significant differences in IOP among the three groups ($P>0.05$).

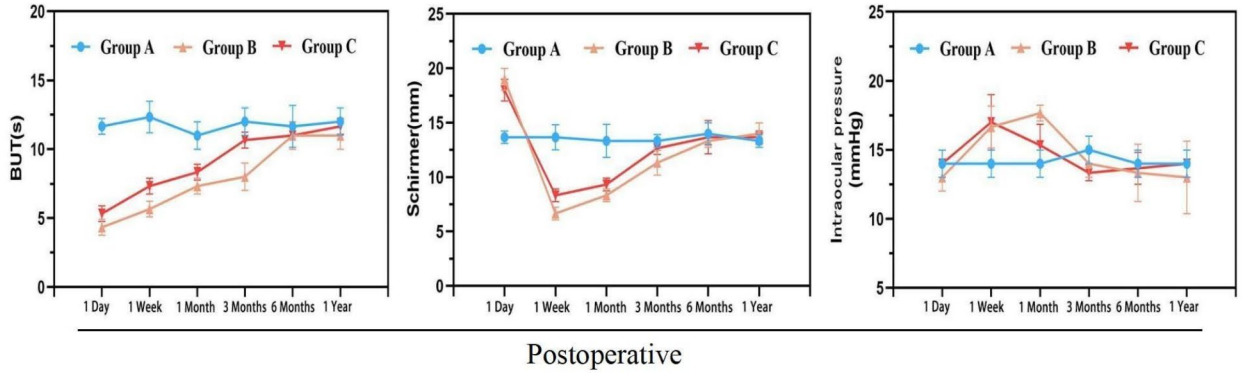

Fig. 2 Data analysis of BUT, Schirmer and intraocular pressure of patients at different time points after surgery
Note: Group A=The normal group; Group B=The control group; Group C=The modified group

Ocular surface inflammatory response analysis at different postoperative time points

As shown in Fig. 3, compared with those in Group A, the concentrations of IL-1β, PGE2, TNF-α, and VEGF were significantly greater in both Group B and Group C at 1 day, 1 week, 1 month, and 3 months postoperatively ($P<0.05$). However, at 6 months and 1 year postoperatively, there were no statistically significant differences in these inflammatory markers among the three groups ($P>0.05$). On postoperative Day 1, there was no statistically significant difference in the IL-1β, PGE2, TNF-α, or VEGF concentration between Group B and Group C($P>0.05$). Nevertheless, at 1 week, 1 month, and 3 months after surgery, Group C presented significantly lower levels of these inflammatory markers than did Group B ($P<0.05$).

Visual quality analysis

Analysis of best corrected visual acuity (BCVA) at different postoperative time points

This study revealed that the best corrected visual acuity (BCVA) was lower in both Group B and Group C than in Group A on day 1, 1 week, and 1 month postoperatively. On postoperative Day 1, there was no statistically significant difference in BCVA between Group B and Group C ($P>0.05$). However, from 1 week to 1 year after surgery, the BCVA in Group C was consistently better than that in Group B. By 3 months after surgery, the BCVA in Group C had stabilized and was better than the preoperative value(Table 4).

Contrast Sensitivity Analysis

The study revealed that under both natural lighting conditions and low light conditions (spatial frequency/6 cd), there was no statistically significant difference in contrast sensitivity between Group B and Group C on postoperative Day 1 ($P>0.05$). However, at 1 week and 1 month postoperatively, the contrast sensitivity in Group C was

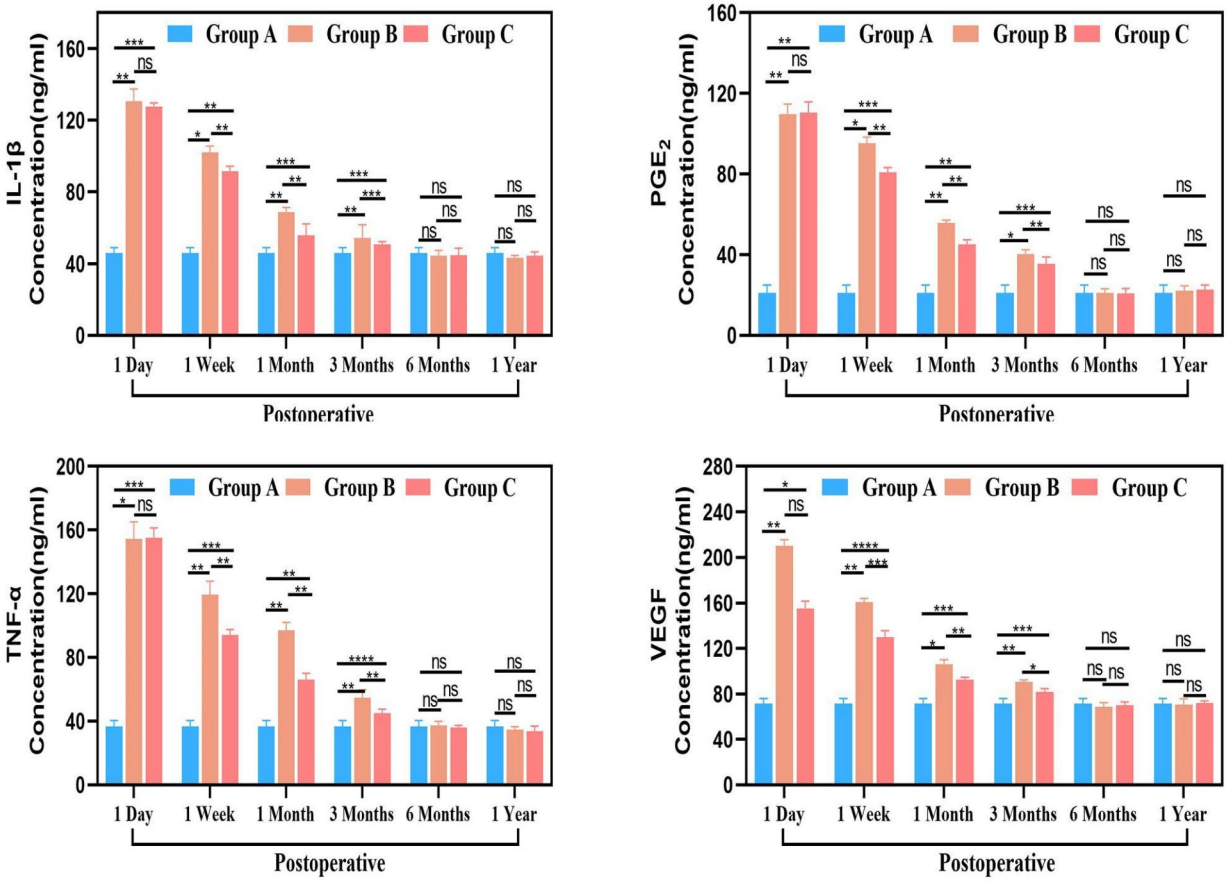

Fig. 3 Analysis of ocular surface inflammation response in three groups of patients at different postoperative time points
Note: Group A = The normal group; Group B = The control group; Group C = The modified group

Table 4 Analysis of optimal corrected visual acuity for three groups of patients at different postoperative time points

Group	*N*	Postoperative 1 Day	Postoperative 1 Week	Postoperative 1 month	Postoperative 3 months	Postoperative 6 months	Postoperative 1 Year
Group A	0.41 ± 0.13	0.39 ± 0.12	0.42 ± 0.11	0.40 ± 0.13	0.42 ± 0.09	0.41 ± 0.11	0.42 ± 0.11
Group B	0.37 ± 0.15	0.22 ± 0.08	0.28 ± 0.12	0.31 ± 0.07	0.35 ± 0.11	0.45 ± 0.12	0.47 ± 0.08
Group C	0.39 ± 0.14	0.24 ± 0.11	0.31 ± 0.09	0.35 ± 0.08	0.47 ± 0.12	0.51 ± 0.09	0.54 ± 0.12
F value	68.34	72.34	43.42	48.23	39.73	41.05	48.45
P value	0.481	0.317	0.013	0.001	0.007	0.019	0.031

Note: Group A = The normal group; Group B = The control group; Group C = The modified group

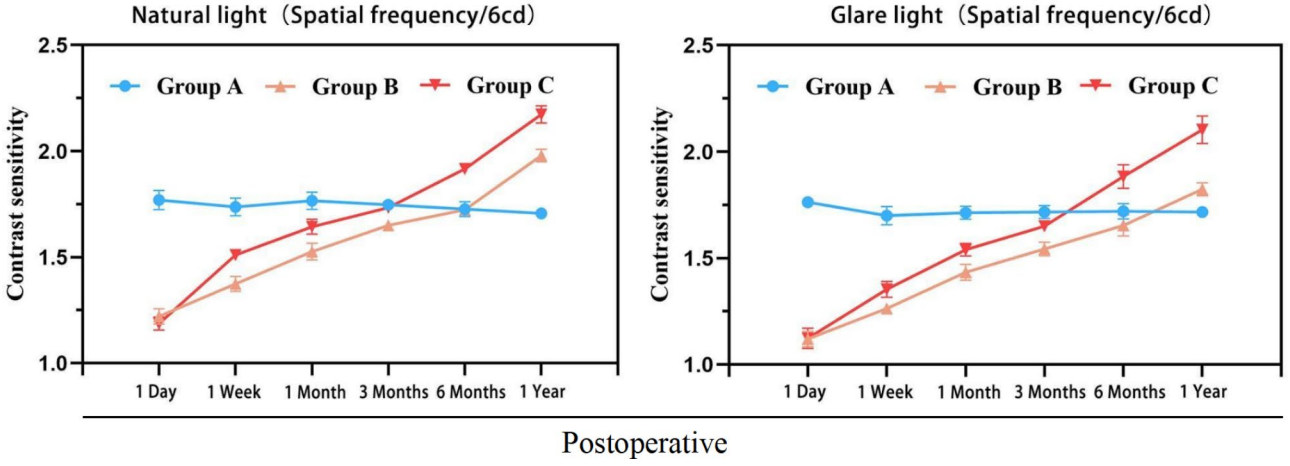

Fig. 4 Sensitivity analysis of three groups of patients at different postoperative time points under natural and low light conditions with a spatial frequency of 6 cd
Note: Group A = The normal group; Group B = The control group; Group C = The modified group

Table 5 Analysis of corneal aberrations in three groups of patients before surgery (including coma, spherical aberration, and total higher-order aberration)

Higher order aberration types	Group A	Group B	Group C	T value	*P* value
Spherical aberration	0.32 ± 0.07	0.29 ± 0.08	0.31 ± 0.11	38.42	0.473
Coma	0.21 ± 0.07	0.19 ± 0.09	0.22 ± 0.10	42.12	0.191
Total higher-order aberration	0.47 ± 0.11	0.51 ± 0.12	0.49 ± 0.09	48.28	0.328

Note: Group A = The normal group; Group B = The control group; Group C = The modified group

greater than that in Group B. By 3 months post surgery, the contrast sensitivity in Group C was comparable to that in Group A, with no statistically significant difference ($P>0.05$). Furthermore, from 6 months to 1 year post surgery, the contrast sensitivity in Group C was significantly greater than that in both Group A and Group B($P<0.05$)(Fig. 4).

Corneal aberration analysis

As shown in Table 5, there were no statistically significant differences in preoperative corneal aberrations (including astigmatism, spherical aberrations, and total higher-order aberrations) among the three groups ($P>0.05$). On postoperative Day 1, there were no statistically significant differences in corneal aberrations between Group B and Group C ($P>0.05$). However, from 1 week to 3 months postoperatively, both in Group B and Group C showed a decreasing trend in corneal aberrations, with a more pronounced decrease in Group C. At 3 months through 1 year post surgery, the number of corneal aberrations in Group C was significantly lower than that in Group A(i.e., the nonsurgical group) ($P<0.05$)(Table 6).

Vision-related quality of life questionnaire scores

The results of this study indicated that there were statistically significant differences in vision-related quality of life scores among the three groups at 1 year postoperative ($P<0.05$). The scores for distance vision, near vision, night vision, reading fatigue, glare, double vision, dry eye, eye pain, and surgical satisfaction were all lower in both Group B and Group C than in Group A, with Group C having the lowest scores(Table 7).

Discussion

There are several important findings in this study: (1) The Modified LSC transplantation plus BCL implantation can effectively reduce the inflammatory expression of IL-1β,

Table 6 Comparative analysis of corneal aberrations (μ m) in three groups of patients at different postoperative time points

Higher order aberration types	Postoperative	Group A	Group B	Group C	T value	*P* value
spherical aberration	1 day	0.45 ± 0.13	0.78 ± 0.18	0.82 ± 0.07	67.23	0.417
	1week	0.46 ± 0.11	0.69 ± 0.12	0.64 ± 0.08	58.47	0.001
	1month	0.48 ± 0.12	0.55 ± 0.13	0.47 ± 0.09	63.45	0.003
	3months	0.47 ± 0.08	0.47 ± 0.11	0.33 ± 0.11	59.81	0.041
	6months	0.45 ± 0.11	0.48 ± 0.09	0.34 ± 0.08	68.42	0.039
	1year	0.48 ± 0.09	0.46 ± 0.11	0.32 ± 0.07	56.19	0.002
Coma	1 day	0.67 ± 0.19	0.85 ± 0.23	0.81 ± 0.07	74.24	0.183
	1week	0.69 ± 0.12	0.79 ± 0.17	0.73 ± 0.06	69.53	0.001
	1month	0.65 ± 0.11	0.69 ± 0.09	0.65 ± 0.09	72.37	0.019
	3months	0.62 ± 0.08	0.65 ± 0.12	0.59 ± 0.07	64.82	0.031
	6months	0.64 ± 0.09	0.61 ± 0.11	0.55 ± 0.10	78.81	0.001
	1year	0.67 ± 0.11	0.64 ± 0.07	0.57 ± 0.08	69.45	0.001
Total higher-order aberration	1 day	0.73 ± 0.19	0.92 ± 0.27	0.93 ± 0.11	38.23	0.374
	1week	0.79 ± 0.15	0.87 ± 0.17	0.83 ± 0.09	43.97	0.002
	1month	0.75 ± 0.14	0.79 ± 0.13	0.78 ± 0.13	37.16	0.001
	3months	0.78 ± 0.09	0.75 ± 0.11	0.72 ± 0.10	45.83	0.007
	6months	0.79 ± 0.08	0.77 ± 0.09	0.68 ± 0.12	40.77	0.035
	1year	0.77 ± 0.11	0.72 ± 0.13	0.69 ± 0.13	39.04	0.001

Note: Group A = The normal group; Group B = The control group; Group C = The modified group

Table 7 Comparison of Visual Related Quality of Life scores among three groups of patients one year after surgery

Rating content	Group A	Group B	Group C
Near vision	0.72 ± 0.25	0.70 ± 0.23	0.63 ± 0.19
Distance vision	0.42 ± 0.11	0.37 ± 0.12	0.34 ± 0.11
Decreased night vision	0.83 ± 0.35	0.71 ± 0.24	0.62 ± 0.31
Reading fatigue	0.47 ± 0.11	0.38 ± 0.13	0.31 ± 0.09
Glare	0.91 ± 0.26	0.78 ± 0.17	0.65 ± 0.21
Fringe	0.64 ± 0.13	0.51 ± 0.11	0.37 ± 0.09
Dry eye	0.83 ± 0.19	0.67 ± 0.15	0.43 ± 0.16
Ophthalmodynia	0.71 ± 0.22	0.38 ± 0.11	0.24 ± 0.08
Other	0.38 ± 0.11	0.34 ± 0.08	0.27 ± 0.11
Surgical satisfaction	3.34 ± 1.23	2.76 ± 1.17	2.23 ± 1.04
Total score	6.92 ± 2.38	4.75 ± 1.96	3.48 ± 1.57

Note: Group A = The normal group; Group B = The control group; Group C = The modified group

PGE2, TNF-α, and VEGF, thus promoting wound healing, reducing corneal irritation symptom, and lowering the postoperative complications and recurrence rates in pterygium surgery; (2)From the perspectives of BUT, Schirmer, intraocular pressure and other data, the Modified LSC transplantation plus BCL implantation is more secure for ocular surface safety; (3)The Modified LSC transplantation plus BCL implantation can achieve better visual recovery and visual quality, thereby enhancing patients' satisfaction and quality of life with the surgery.

LIU [15] reports that as the pterygium advances into the cornea, it can cause corneal astigmatism and higher-order aberrations, leading to a decline in visual acuity and visual quality. Besides, postoperative pain is a common symptom, with some patients requiring oral pain medications for relief. Mechanical damage during surgery, exposure of corneal nerves, and the production and stimulation of inflammatory factors can result in varying degrees of discomfort [16–18]. Romano [19] reports that fibrin glue may result in less recurrence and may take less time than sutures for fixing the conjunctival graft in place during pterygium surgery, but for patients with large lesions of pterygium, this method may result in poor conjunctival flap healing after surgery. Corneal bandage lenses made from silicone hydrogels offer high oxygen permeability, which promote corneal epithelial cell regeneration and enhance the repair rate of corneal wounds. Additionally, corneal bandage lenses provide excellent mechanical protection and act as a barrier, covering exposed trigeminal nerve branches and corneal suture lines. This coverage helps prevent direct friction of eye surface tissues due to eye movements, reducing the infiltration of inflammatory cells into the corneal stroma and thus assisting in the healing of corneal wounds [20, 21].

Mangan MS [22] indicates that wound contraction or horizontal eye movements can lead to instability of autologous conjunctival flaps, and bandage lenses help stabilize these flaps. Sutures in the bulbar conjunctiva can lead to foreign body sensation, suture reactions, lid-to-eye adhesion, or graft rupture. Excessive suturing can exacerbate inflammatory responses on the eye surface, increasing the postoperative recurrence rate of pterygium [23, 24]. Studies suggest that corneal epithelial damage repair occurs in three stages: (1) a lag phase where cell proliferation is minimal, but receptor and cell matrix protein synthesis is active; (2) cell migration; and (3) cell proliferation, adhesion, fixation, and the repair of tight junctions

between cells [25, 26]. Research has shown that wearing a bandage lens after pterygium excision can stabilize the regenerating corneal epithelium, potentially shortening the epithelial repair time and promoting corneal epithelial recovery [27]. In this study, compared with LSC transplantation combined with interrupted suturing plus the bandage contact lens implantation, we used modified LSC transplantation combined with bandage contact lens for pterygium treatment, the modified group had faster corneal epithelial recovery, fewer corneal irritation symptoms, better wound healing, and a significantly lower incidence of complications and recurrence.

Corneal surface inflammation is a major factor in the recurrence of pterygium. Studies have shown that inflammatory cytokines such as IL-1β, TNF-α, PGE2, and VEGF play significant roles in the development and progression of pterygium. Excessive suturing of conjunctival flaps leads to an exacerbation of ocular surface inflammation during wound healing, resulting in prolonged use of local anti-inflammatory drugs in postoperative patients, discomfort such as conjunctival scarring and dry eye syndrome. Therefore, inhibiting the expression of IL-1β, TNF-α, PGE2, and VEGF can significantly reduce the recurrence rate after pterygium surgery [28, 29]. In our study, we collected tear samples from patients to analyze inflammatory responses at different postoperative time points. The results revealed that from 1 week to 1 year after surgery, the levels of the inflammatory factors IL-1β, TNF-α, PGE2, and VEGF were lower in the modified group than in the control group. Moreover, this study demonstrated that the IOP was greater in both control and modified group due to the use of corticosteroid eye drops at early postoperative period. However, by the reason of the fact that the postoperative duration of corticosteroid eye drops in the modified group was only half that of the control group, so the IOP in the modified group was lower than that in the control group by 1 month post surgery. These findings indicate that the modified group experienced less inflammation, better tear film stability, and potentially reduced local corticosteroid use, which could lower the risk of postoperative elevated intraocular pressure and cataract development [30, 31].

Wavefront aberrations are important indicators of visual quality. Wavefront aberrations include low-order aberrations such as myopia, hyperopia, and regular astigmatism, as well as high-order aberrations such as spherical aberrations, coma, and secondary aberrations. Pterygium, by infiltrating the corneal edge or even obscuring the pupil, increases higher-order aberrations, leading to reduced visual quality [32–34]. Our study used modified LSC transplantation combined with bandage contact lens implantation for pterygium treatment. The results showed that the modified group had better best-corrected visual acuity (BCVA) than did the control group. Additionally, under both natural and low-light conditions (spatial frequency/6 cd), the modified group presented superior contrast sensitivity. The number of corneal aberrations (including coma, spherical aberration, and total high-order aberrations) in the modified group was lower than that in the control group and even lower than that in the patients who did not undergo surgery. Furthermore, the modified group had better vision-related quality of life scores at 1 year postoperatively than did the control group. These results suggest that the modified LSC transplantation combined with bandage contact lens implantation can effectively reduce common postoperative symptoms such as blurred vision, eye discomfort, dryness, foreign body sensation, and even headache, which significantly improves postoperative visual quality.

The shortcomings of this study lie in the small number of included cases and the limited follow-up time. The intervention effect of wearing sbandage contact lens on surgical treatment of pterygium, as well as its impact on recurrence rate, need to be further explored by expanding the sample size and extending follow-up time. In the following experiments, we will further expand the surgical sample size, compare and analyze the application effect of this surgical method combined with mitomycin C, as well as the differences between it and amniotic membrane transplantation surgery. We will also analyze the effect of using corneal epidermal growth factor eye drops in combination.

Conclusion

In summary, the clinical use of modified LSC transplantation combined with bandage contact lens implantation for pterygium patients results in better therapeutic outcomes. This approach effectively reduces corneal irritation symptoms, alleviates pain, promotes corneal wound healing, and decreases the recurrence rate of pterygium. Additionally, this surgical method improves postoperative visual quality and warrants further promotion and research.

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Author contributions
Ying Li were responsible for the study concept and design. Liyan Gong did the data and project management. Linxia Meng was responsible for conceptualisation, funding acquisition, data acquisition. Xiao Wang and Xiaoding Yang interpreted the data and drafted the manuscript. Tao Li was responsible for writing the article.

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Data availability
The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study adhered to the tenets of the Declaration of Helsinki and Malaysian Guidelines for Good Clinical Practice (GCP). This study protocol was reviewed and approved by the Ethics Committee of The Ziyang Central Hospital(no.20210231). A signed written informed consent was obtained from all patients prior to enrolment. The authors affirmed that human research participants provided informed consent for the publication of their data.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Zhang XQ, Wu Y. Acupoint Massage plus recombinant bovine basic fibroblast growth factor Ophthalmic Gel and Limbal Stem Cell Transplantation on Visual Quality, corneal refraction, and aesthetic outcome in patients with Pterygium[J]. Evid Based Complement Alternat Med. 2022;14:7103496.
2. He S, Wu Z. Biomarkers in the occurrence and development of pterygium[J]. Ophthalmic Res. 2022;13:1–12.
3. Liu L, Wu J, Geng J, et al. Geographical prevalence and risk factors for pterygium: a systematic review and meta-analysis[J]. BMJ Open. 2013;3:e003787.
4. Trinh T, Mimouni M. Outcomes of ipsilateral simple limbal epithelial transplantation, tenonectomy, mitomycin and amniotic membrane transplantation for treatment of recurrent pterygium[J]. Cornea. 2021;40(1):43–7.
5. Gumus K, Erkilic K, Topaktas D, et al. Effect of pterygia on refractive indices, corneal topography, and ocular aberrations[J]. Cornea. 2011;30:24–9.
6. Gupta VP, Sanghi S, Rohatgi J et al. Outcomes of preoperative intrapterygial injection of mitomycin C for pterygium excision with and without inferior conjunctival flap[J]. Oman J Ophthalmol. 2019;12:171.
7. Leila Ghiasian, Bijan Samavat, Yasaman Hadi. Recurrent Pterygium: A Review[J]. J Curr Ophthalmol. 2022;33(4):367–378.
8. Fernando Quadros Costa, Ricardo Quadros Costa, José Bonifácio Barbosa, et al. Pterygium Surgery with Conjunctival Autograft Fixation Using Bipolar Electrocauterization[J]. Eur J Ophthalmol. 2021;31(3):1458–1462.
9. Phit, Upaphong. Kessara. Inadvertent filtering bleb due to extracapsular cataract extraction wound reopening after mitomycin C use: a case report[J]. J Med Case Rep. 2023;17(1):57.
10. Sancilio S, Di SS. Curcuma longa is able to induce apoptotic cell death of Pterygium-Derived Human Keratinocytes[J]. BioMed Res Int. 2017;14(2):2956597.
11. Chaidraroon W, Isipradti S, Upaphong P, et al. A randomized controlled trial to manage postoperative ocular pain after pterygium excision with conjunctival autograft transplantation with a single application of 2% sodium hyaluronate[J]. Pain Res Manag. 2022;13(2):1–8.
12. Prat D, Zloto O, Ben AE, et al. Therapeutic contact lenses vs. tight bandage patching and pain following pterygium excision: a prospective randomized controlled study[J]. Graefe's Archive Clin Exp Ophthalmol. 2018;256:2143–8.
13. Lim L, Lim EWL. Therapeutic contact lenses in the treatment of corneal and ocular surface diseases-A review[J]. Asia-Pacific J Ophthalmol. 2020;9:524–32.
14. Liu YC, Ji AJS. Femtosecond Laser-assisted Preparation of Conjunctival Autograft for Pterygium Surgery[J]. Sci Rep. 2020;10(1):2674.
15. Liu YC, Devarajan K. Optical coherence tomography angiography for evaluation of reperfusion following Pterygium Surgery[J]. Am J Ophthalmol. 2019;6:24–9.
16. Song P, Chang X, Wang M, et al. Variations of pterygium prevalence by age, gender and geographic characteristics in China: a systematic review and meta-analysis[J]. PLoS ONE. 2017;12(3):e0174587.
17. Fonseca EC, Rocha EM, Arruda GV. Comparison among adjuvant treatments for primary pterygium: a network meta-analysis[J]. Br J Ophthalmol. 2018;102:748–56.
18. Schrader S, Wedel T, Moll R, et al. Combination of serum Eye drops with Hydrogel Bandage Contact Lenses in the treatment of persistent epithelial Defects[J]. Graefe Arch Clin Exp Ophthalmol. 2006;244:1345–9.
19. Romano V, Cruciani M, Conti L, et al. Fibrin glue versus sutures for conjunctival autografting in primary pterygium surgery. Cochrane Database Syst Rev. 2016;12(12):CD011308.
20. Zhang X. Acupoint Massage plus recombinant bovine basic fibroblast growth factor Ophthalmic Gel and Limbal Stem Cell Transplantation on Visual Quality, corneal refraction, and aesthetic outcome in patients with Pterygium[J]. Evidence-Based Complement Altern Med. 2022;5:124–9.
21. Sun YC, Inamoto Y, Wang RK, et al. The Disposable Bandage Soft Contact lenses Therapy and Anterior Segment Optical Coherence Tomography for Management of Ocular graft-versus-host Disease[J]. BMC Ophthalmol. 2021;21:271.
22. Mangan MS, Tekcan H. Efficacy of Bandage Contact lenses Versus Eye patching in early postoperative period of Müller's muscle-conjunctival Resection[J]. Ophthalmic Res. 2021;64:139–44.
23. Sergio K, Samare B. Toric intraocular lens in asymmetric astigmatism[J]. Int Ophthalmol. 2020;40(5):1291–8.
24. Baradaran RA, Eslani M, Haq Z, et al. Current and upcoming therapies for ocular surface chemical injuries[J]. Ocul Surf. 2017;15:48–64.
25. B I, Ibechukwu. Simultaneous pterygium and intraocular surgery[J]. Br J Ophthalmol. 1990;74(5):265–6.https://doi.org/10.1136/bjo.74.5.265
26. Fabian N, Fries S et al. Tenonplasty for closing defects during sclerocorneal surgery-A brief review of its anatomy and clinical applications[J]. Clinical anatomy. 2018;31(1):72–6.
27. Doctor K, Vunnava KP, Shroff R, et al. Simplifying and understanding various topographic indices for keratoconus using Scheimpflug based topographers[J]. Indian J Ophthalmol. 2020;68:2732–43.
28. Rezvan F, Khabazkhoob M. Prevalence and risk factors of pterygium: a systematic review and meta-analysis[J]. Surv Ophthalmol. 2018;63:719–35.
29. Seyed Mohammad Salar Zaheryani, Mohammad Essmail Ebrahimi, Abdollah Kasaei, et al. Expression of inflammatory-related NFκB genes in Iranian patients with Pterygium: a case-control Study[J]. Int J Mol Cell Med. 2018;7(3):169–75.
30. Thomas Clahsen, Karina Hadrian, Maria Notara, et al. The novel role of lymphatic vessels in the pathogenesis of ocular diseases. Prog Retin Eye Res. 2023;96:101157.
31. Kareem Moussa, Jessica Shantha, Julie M Schallhorn. Blurry Vision and Eye Pain after Pterygium Surgery[J]. JAMA Ophthalmol. 2018;136(7):827–8.
32. Mitra Akbari. Update on overview of pterygium and its surgical management[J]. J Popul Ther Clin Pharmacol. 2022;29(4):e30–45.
33. Eliya Levinger, Nir Sorkin, Sara Sella, et al. Posterior Corneal Surf Changes after Pterygium Excision Surgery[J] Cornea. 2020;39(7):823–6.
34. Eze BI, Okoye Madukafc, OI, et al. Pterygium: a review of clinical features and surgical treatment[J]. Nigerian J Medicine: J Natl Association Resident Doctors Nigeria. 2011;20(1):7–14.

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