Special Focus, Ocular Surface and Cornea, Original Article

Pterygium surgery by double-sliding flaps procedure: Comparison between primary and recurrent pterygia

Jong Soo Lee, Yun Su Choi[1], Yeon Ji Jo, Ji-Eun Lee[2]

Purpose: This study aimed to evaluate the surgical outcomes of pterygial excision for primary and recurrent pterygia by a single method of pterygia excision combined with two conjunctival flaps. **Methods:** This retrospective study divided 193 cases of pterygium into the primary (140 cases) and recurrent (53 cases) pterygium groups. Following double-sliding conjunctival transposition flap operation and surgical excision of the pterygium, the success and recurrence rates of pterygial surgery were assessed based on visual acuity and corneal and total astigmatism during follow-up at least 6 months. **Results:** Both primary and recurrent pterygium groups showed significant improvements in visual acuity and astigmatism (corneal and total) between before and after this procedure. Total astigmatism and success rate of primary pterygium were significantly better than those for recurrent pterygium. Two cases (1.4%) of primary pterygium and four cases (7.5%) of recurrent pterygium developed recurrence, corresponding to a rate of 3.1% (6/193 cases). The success rates significantly make a difference between primary and recurrent groups but did not differ significantly between the first recurrent and over twice recurrent pterygium. However, visual acuity, cornea, and total astigmatism improved significantly after surgery in first recurrent group but not in over twice recurrent group. **Conclusion:** The double-sliding conjunctival flaps surgery appeared to be a useful method, with a better success rate and lower pterygial recurrence in pterygium surgery. Especially, when pterygium is larger or recurrent type, this technique can be easily covered the bare sclera, as compared to any transposition conjunctival flap operation.

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A pterygium is a commonly found ocular surface disease, which characterized by hyperplasia of conjunctival tissue, subconjunctival vascularization and fibrovascular proliferation, and chronic inflammation. Although the pterygium surgery is simple, the recurrence of pterygium happens very frequently, combined with inflammatory reactions such as fibrovascular proliferation and vascularization from limbus and sclera. In addition, the recurrences of most pterygium surgery are generally observed within 1 year of pterygium excision, especially within 6 months.[1-4] Thus, the goal of pterygial surgery should not only be the excision of pterygium but also prevention of its recurrence. There are many procedures with different results.

The bare scleral technique of pterygial surgery, producing a bare sclera after simple pterygial excision, had a recurrence rate of 23.1%–37%.[5,6] Although this technique has the advantage of a short surgical time and simplicity, it has a relatively high risks of pterygial recurrence and serious complications including necrotizing scleritis. Thus, the bare scleral technique is no longer recommended for pterygial surgical treatment. Various surgical techniques of pterygial surgery have been devised to reduce the recurrent rate of pterygium, and developed to prevent recurrences of pterygium, for example, conjunctival autograft, transposition conjunctiva flaps, and amnionic membrane graft on to the bare sclera.[7] By the various reports, the removal of pterygium and tenon tissue was performed combined with conjunctiva graft is currently considered the gold standard surgical method.[8-10]

Although Hara *et al*. reported that pterygium could be removed through contact inhibition theory without removing the surface conjunctiva.[11] The use of conjunctival flaps is a well-established strategy to prevent recurrence after pterygium excision.[9,10] Pterygial surgery combined with a conjunctival graft is generally associated with a 5%–10% rate of pterygial recurrence.[12-14] Covering the bare sclera with autologous conjunctival tissue significantly reduces postoperative recurrence and postoperative inflammation.[15] Among these, sliding conjunctival flaps can supply better vascular circulation of the conjunctival flaps and accelerate wound healing compared to auto-conjunctival flaps.[16] Two sliding conjunctival flaps could be easily used to cover the wider bare sclera rather than one sliding conjunctival flap operation. The survival rate after sliding transposition conjunctival flap was better than conjunctival

Department of Ophthalmology, Pusan National University School of Medicine, [1]Hadan Sungmo Eye Hospital, Pusan, [2]Department of Ophthalmology, Pusan National University Yangsan Hospital, Yangsan, Republic of Korea

Correspondence to: Dr. Jong Soo Lee, Department of Ophthalmology, Pusan National University College of Medicine and Medical Research Institute of Pusan National University Hospital, Pusan, Republic of Korea, 179, Gudeok-ro, Seo-gu, Busan 49241, Republic of Korea. E-mail: jongsool@pusan.ac.kr

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autograft, because the transposition flap has the conjunctival feeding vessels from noncutting conjunctival surface.

To reduce this recurrence rate of pterygial surgery, adjunctive drugs including mitomycin-C (MMC), 5-fluorouracil (5-FU), and Avastin (anti-VEGF) have been used until recently.[17] Although the inhibition of pterygium recurrence by various adjunctive methods may be existed, the recurrence rates of pterygium surgery still range between 11.4% and 60.0%.[18] Moreover, adjuvant drugs can often induce corneal or scleral toxicity.[19] In addition, to prove the efficacy of this procedure, we did not use MMC, 5-FU, or Avastin. Therefore, this study will provide useful information for pterygium surgery.

However, to the best of our knowledge, no studies have compared recurrence rates of pterygial surgery by advanced sliding conjunctival flap technique between primary and recurrent pterygium. Therefore, this study evaluated and compared improvements in visual acuity and corneal and total astigmatism, recurrence rate, success rate, and complications of pterygial surgery using the two advanced sliding conjunctival flap technique in primary and recurrent pterygia.

Methods

Patients

We retrospectively reviewed the medical records of patients with primary or recurrent pterygia who had undergone excision followed by the use of double-sliding conjunctival transposition flaps between November 2013 and November 2019. All pterygia were characterized by fibrovascular tissue invasion the limbus, and no other anomalies of corneal surface were observed. A total of 193 eyes of 193 patients were divided into two groups based on the postoperative recurrence of pterygium surgery: the primary group included 140 eyes and the recurrent group included 53 eyes. The mean ages of the primary and recurrent pterygium groups were 56.7 ± 12.4 (range, 31–86) and 58.1 ± 11.4 (range, 32–77) years. The mean postoperative follow-up durations were 16.5 ± 15.3 (range, 6–51) and 8.3 ± 13.0 (range, 6–48) months.

We excluded cases with history of ocular trauma or surgery within 1 year. The additional exclusion criteria were pregnant, with systemic disease or infection. This study was approved by the Institutional Review Board Ethics Committee (IRB No. 1806-005-067) of Pusan National University Hospital. The requirement for patient informed consent was waived by the IRB because of the retrospective nature of the study. But the patients were fully explained about the complications and strengths associated with surgery.

Each patient received a comprehensive ophthalmic examination including measurement of distant best-corrected visual acuity (BCVA) using Snellen charts and anterior segment slit-lamp examination. The clinical outcomes were assessed by a single ophthalmologist. Anterior segment examinations including refractive errors, corneal, and total astigmatism, and BCVA were evaluated. The flow chart of pterygium study was recorded [Fig. 1].

Surgical technique

All operations were performed by a single experienced ophthalmic surgeon under subconjunctival and topical anesthesia. The main surgical technique consisted of complete removal of pterygium and subconjunctival tissue and covering of the conjunctival surface firmly by fixed conjunctiva–sclera–conjunctival suture after excision of primary and recurrent pterygial tissue.

First, 2% lidocaine was injected into subconjunctiva of primary and recurrent pterygium. We usually operated to remove the pterygial head on the cornea by simple removal with # 15 blade (Swann-Morton, Sheffield, UK), and portable diamond drill (Denville, New Jersey). In some case, some pterygial tissue was remained at the corneal surface, even though it was intended to be removed as possible. The body of pterygium with subconjunctival tenon was excised using Ellman electrocautery (Oceanside, New York). After complete removal of subconjunctival tissue under the pterygium, the healthy adjacent conjunctival tissue near the bare sclera was undermined and trimmed to make a covering conjunctival surface over the bare sclera with two superior and inferior sliding conjunctival flaps. The conjunctival flaps were generally made from the superior or inferior sides of the excised pterygial sites. In the case of a larger bare sclera, the covering of the exposed bare sclera could be done easier as the conjunctival flap is made by inserting a marginal incision of conjunctival flap from the limbus of cornea as far away as possible. The margins of the sliding conjunctival flaps were firmly fixed to the sclera surface with nonabsorbed suture material such as prolene 9-0. When the bare sclera was covered by two advanced sliding conjunctival transposition flaps, it was important to make a fixed suture between the sliding conjunctival flaps and sclera [Video 1]. Overall, the bare sclera was then covered completely by advanced conjunctival flaps with interrupted anchoring sutures to completely cover the sclera against excessive ocular movement [Fig. 2]. If needed, the advanced sliding conjunctival flaps of limbus could be fixed to the sclera with prolene 9-0 mattress sutures to prevent dehiscence of the conjunctival wound. In addition, we tried that the corneal epithelization of denuded corneal epithelial layer related with removal of the head of pterygium was first formed in corneal surface rather than proliferation of fibrovascular tissue, which grows from subconjunctival tissue after pterygium excision. Thus, therapeutic soft contact lens was used to escape the postoperative ocular discomfort and pain due to corneal epithelial defects.

After completing the procedure, Maxidex® (0.1% dexamethasone ophthalmic suspension, Alcon, Texas) and Tarivid®oint (Santen, Japan) were applied to the eye with a bandage. The bandage was opened the next day and topical Flumetholon® (Santen, Japan), Vigamox® (Alcon, Texas), and Refresh Plus (Allergan, Irvine, California) were prescribed and gradually tapered over 1 month according to graft site status. The stitches and therapeutic soft contact lens were removed 1–2 weeks (average 9 days) after pterygium surgery.

Outcomes

The patients' subjective symptoms and surgical wound status were recorded at postoperative days 1 and 7 and 1, 3, and 6 months, or more often when clinically indicated. Snellen visual acuity was converted to logarithm of the minimum angle of resolution (logMAR) units for analyses. The degree of astigmatism and refractive errors were measured using an automated keratometer (KR8100PA, Topcon, Tokyo, Japan). Pterygial recurrence was defined as the presence of fibrovascular tissue crossing the limbus (corneal recurrence) at 6 months postoperatively.

Results

A total of 193 eyes from 193 patients underwent double-sliding conjunctival flaps [Fig. 3]. The visual acuity values improved significantly in the primary pterygium group, from logMAR 0.24 preoperatively to logMAR 0.21 postoperative ($P = 0.001$). The visual acuity in the recurrent pterygium also improved significantly, from logMAR 0.24 to logMAR 0.20 ($P = 0.001$). However, the difference between the two groups was not significant ($P = 0.286$). The total astigmatism in the primary pterygium group was significantly less than that of the

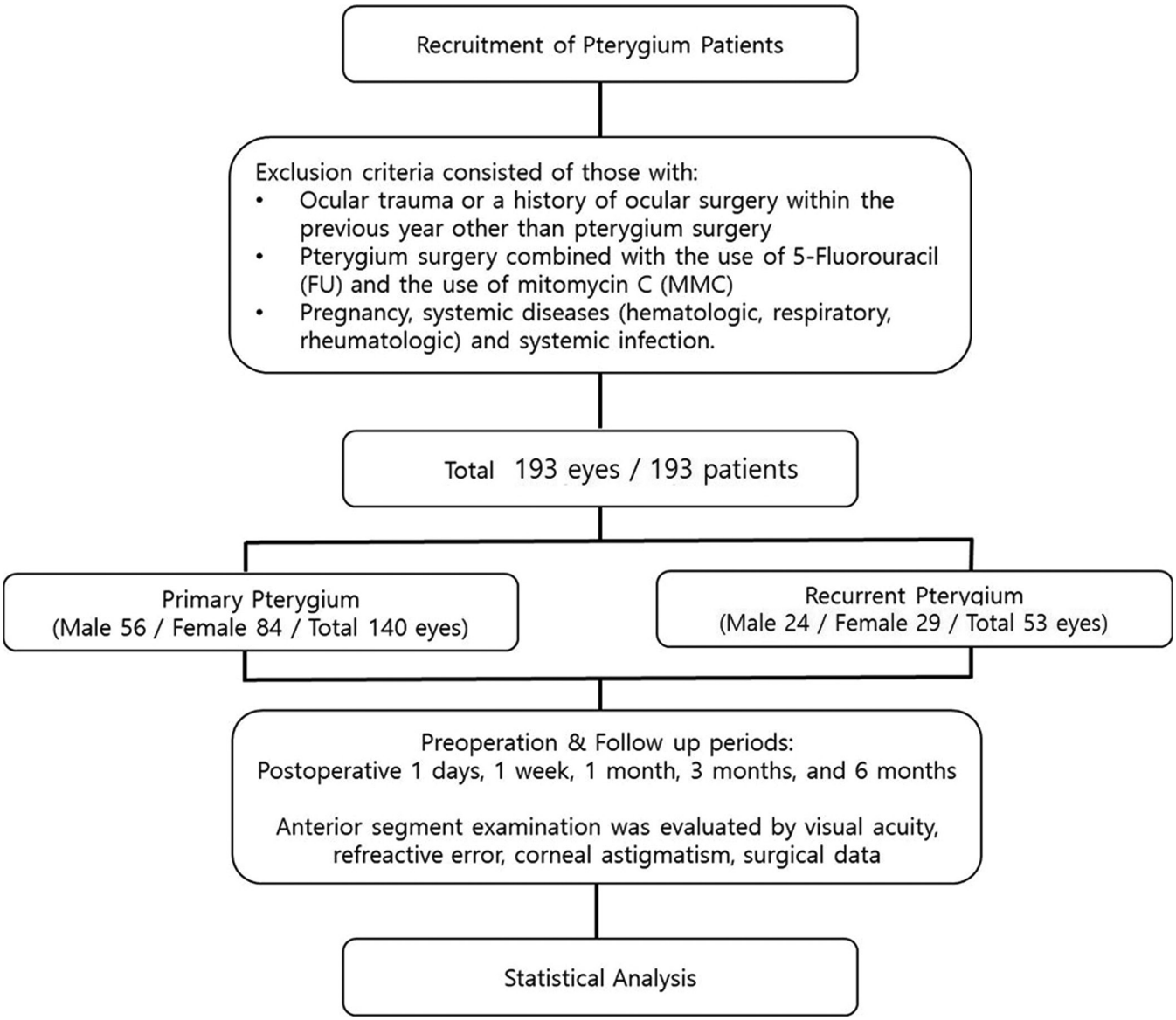

Figure 1: Pterygium study flow chart

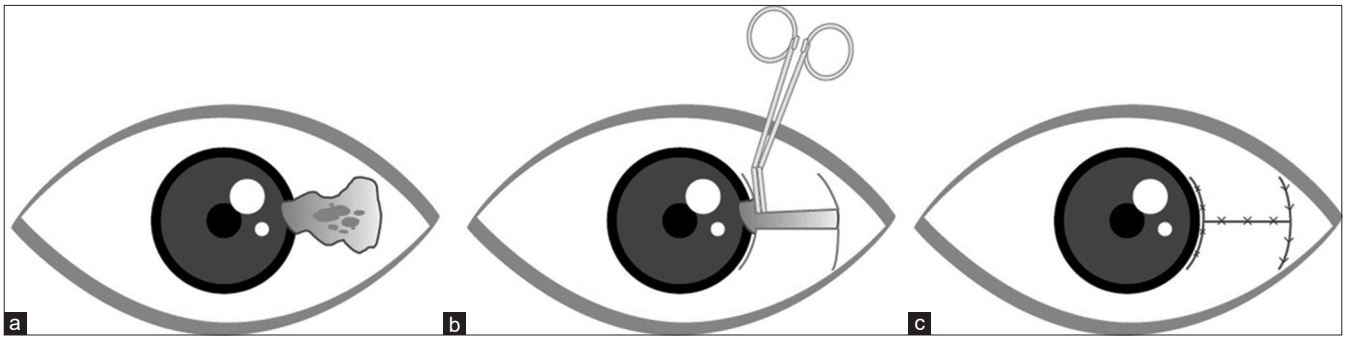

Figure 2: Diagram of the surgical procedure. (a) Nasal fibrovascular tissue invasion of the cornea surface. (b) Making double conjunctival flaps harvested from above and below the pterygia. (c) Conjunctival flap fixation over the bare area of the pterygium

recurrent pterygium after surgery ($P < 0.001$). No significant improvement in corneal astigmatism was observed between the primary and recurrent pterygium groups ($P = 0.162$). The rates of recurrence were 1.4% (2/140 cases) in the primary pterygium group and 7.5% (4/53 cases) in the recurrent pterygium group. The success rate of primary pterygium was 98.6%, compared to 92.5% in recurrent pterygium by double-sliding conjunctival flap surgery ($P < 0.001$) [Table 1].

Table 2 shows the distribution of recurrent pterygium according to the frequency of recurrence. We divided these patients into two groups; first or over twice recurrences. Significantly improved visual acuity and total and corneal astigmatism were observed after surgery in the first recurrence group (P = 0.001, P < 0.001, and P < 0.001) but not for the second recurrence or higher group (P = 0.490, P = 0.670, and P = 0.715). No significant difference in success rates was observed between these groups (P = 0.533) regardless of the frequency of recurrence in recurrent pterygium. However, corneal and total astigmatism improved more significantly for the first recurrence than those in the second or higher cases (P = 0.047, and P = 0.034). Pterygium recurrence developed in three of 43 cases (7.0%) in the first recurrence group and one of 10 cases (10%) in the second recurrence and later group. The success rates for the first and second and later recurrences were 93.0% (40/43 cases) and 90.0% (9/10 cases), respectively (P = 0.533).

The main preoperative symptoms included a sensation of foreign body, red eye, blurred vision, and tearing. However, no significant complications such as symblepharon or delayed wound healing of the cornea and conjunctival surfaces were observed after the operation. The inflammation had subsided and complete re-epithelialization of ocular conjunctival surface occurred within 2–3 weeks after surgery. Pain and redness were the most common subjective symptoms immediately after the surgery. The pain resolved within 2 months in all cases, whereas the redness lasted as long as 3 months.

Discussion

The sliding conjunctival flap of transposition was first introduced in the middle and late twentieth century.[14,20] Autogenous sliding conjunctival flap transposition can be used to cover exposed sclera and to prevent exposed ocular surface complications such as dry eye, scarring, vascularization, and infection caused by exposure of the bare sclera.[21] The advanced sliding conjunctival flap induces better circulation of the conjunctiva regardless of implanted donor tissue to facilitate easier wound healing compared to auto-conjunctival flap.[22] Moreover, as the huge primary or recurrent pterygium were excised, the size of the bare sclera is large not enough to cover with healthy conjunctival tissue using a single sliding conjunctival flap. Thus, in cases in which it is difficult to cover the bare sclera with one advanced sliding conjunctival flap, and this double-sliding conjunctival flap operation is a more useful surgical technique compared to traditional one sliding conjunctival flap operation.

The recurrence rates of autogenous conjunctival flap transposition in recent years vary from less than 1% to 7.1%,[20,23,24] similar to the 3.1% (6/193 cases) recurrence rate in this study. Previous reported study shows recurrence rate by various surgical techniques: bare sclera (38%–88%), conjunctival autograft (5%–30%), conjunctival transposition flaps (1%–10%), and amniotic membrane graft (6%–40%). Adjuvant drug treatment such as MMC and anti-VEGF showed a recurrence rate of up to 66.7%.[25] This study observed a

Table 1: Characteristics of patients with primary and recurrent pterygium

	Primary pterygium (n=140)	Recurrent pterygium (n=53)	P
Sex (M:F)	56:84	24:29	0.463
Age (years) (range)	56.7±12.4 (31-86)	58.1±11.4 (32-77)	0.265
Follow-up (months) (range)	16.5±15.3 (6-51)	8.3±13.0 (6-48)	0.130
Preoperative visual acuity (logMAR)	0.24±0.50	0.24±0.56	0.296
Postoperative visual acuity (logMAR)	0.21±0.55	0.20±0.58	0.272
P between pre-post VA	0.000	0.001	
Preoperative total astigmatism (diopter)	1.28±1.40	2.45±2.12	0.010*
Postoperative total astigmatism (diopter)	1.09±1.12	1.35±1.00	0.061
P between pre-post total astigmatism.	0.002**	<0.001***	
Preoperative corneal astigmatism (diopter)	1.65±1.32	2.34±1.86	<0.001***
Postoperative corneal astigmatism (diopter)	0.76±0.71	1.59±1.93	<0.001***
P between pre-post corneal astigmatism	<0.001***	<0.001***	
Postoperative recurrence status, n (%)	2 (1.4)	4 (7.5)	
Success (%)	138 (98.6)	49 (92.5)	<0.000***

VA=Visual acuity

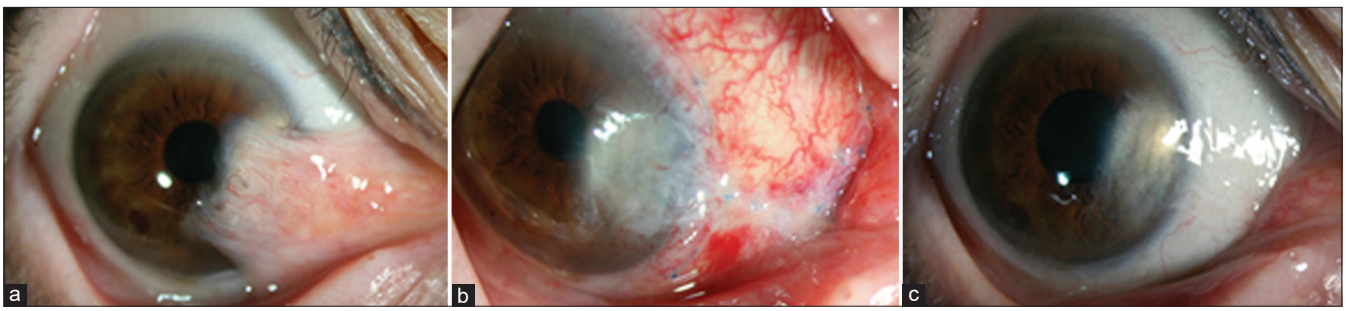

Figure 3: Representative case of two advanced sliding conjunctival flap surgical procedure. (a) Preoperative photograph of a recurrent pterygium. (b) Anterior photograph of conjunctival flap operation after 1 week. (c) And the postoperative 12 months anterior photograph

Table 2: Distribution of patients with recurrent pterygium by frequency of recurrence

	Groups by recurrent number		*P*
	1st recurrent (*n*=43)	Over two times recurrent (*n*=10)	
Sex (M:F)	20:23	4:6	0.678
Age (years) (range)	57.8±11.5 (32-77)	59.5±11.3 (46-77)	0.574
Follow-up (months) (range)	8.3±13.6 (1-48)	8.1±10.7 (1-36)	0.302
Preoperative visual acuity (logMAR)	0.25±0.56	0.23±0.51	0.962
Postoperative visual acuity (logMAR)	0.20±0.59	0.21±0.55	0.816
P between pre-post VA	0.001**	0.490	
Preoperative total astigmatism (diopter)	2.66±2.34	1.34±0.73	0.029*
Postoperative total astigmatism (diopter)	1.43±1.06	1.14±0.80	0.636
P between pre-post total astigmatism.	<0.001***	0.670	
Preoperative corneal astigmatism (diopter)	2.42±1.80	2.12±1.73	0.597
Postoperative corneal astigmatism (diopter)	1.52±1.68	1.65±2.18	0.981
P between pre-post corneal astigmatism	0.001**	0.715	
Postoperative recurrence status, *n* (%)	3 (7.0)	1 (10.0)	
Success (%)	40 (93.0)	9 (90.0)	0.533

VA=Visual acuity

1.4% (2/140 cases) recurrence rate in primary pterygium, whereas the rate of pterygial recurrence was slightly lower in the recurrent pterygium group (7.5%, 4/53 cases). However, there was no significant difference of the recurrent rate between pterygium with the first recurrence (7.0%, 3/43 cases) and with the second or higher recurrences (10%, 1/10 cases). The size of subjects is so small that it is difficult to compare the two groups according to the frequency of recurrence, so it should be needed to compare more recurrent pterygial subjects. It is important to make a suitable size and thin conjunctival flaps for a low successful recurrence. Based on the experience of using double-sliding conjunctival flap operation, an appropriate size of conjunctival flap is considered to be 6–8 mm size to completely cover the bare sclera after removing the pterygium.

The pterygium thickness is related to the visibility of the episcleral vessel and is a significant risk factor for recurrence.[26] In general, recurrent pterygium has relatively thick pterygial tissue and severe adhesive attachment between subconjunctival connective and pterygial tissues. Recurrent pterygial tissue included tenon tissue, which were not easy to completely separate or remove. Special care should be taken to completely excise the tenon tissue under the free edges of the conjunctiva as this is the source of fibroblastic proliferation leading to pterygial recurrence. Thus, the success rate of recurrent pterygium is generally lower than that of primary pterygium.[27] Under this influence, we obtained a 98.6% (138/140 cases) success rate in primary pterygium, whereas the rate was slightly lower in the recurrent pterygium group (92.5%, 49/53 cases). The success rate in the primary pterygium group was higher than that in the recurrent pterygium group ($P < 0.001$, Chi-square test). Rock *et al*. showed the success rate of conjunctival autograft operation had 93.6%, and 85.6% in primary closure and 85.3% in amniotic membrane graft of 521 patients, respectively.[28] The success rate of pterygium surgery in our study is 187/196 (95.4%), which is higher compared to Rockrgereport.

Removal of subconjunctival tenon tissue under the pterygium is critical to prevent pterygial recurrence. Hara *et al*. reported the contact inhibition theory. They did not remove the conjunctiva but only the pterygium head, the recurrence rate was 1.3%.[11] As we agreed to this Hara's hypothesis, we tried to fix the front part of the excised preserved conjunctival tissue as well as margin of conjunctival flaps to the bare sclera for obtaining the firm attachment to prevent cellular proliferation of tenon tissue and dehiscence of conjunctival wound as interrupted and mattress sutures.

To completely cover the conjunctival flaps over bare sclera, we used double-sliding conjunctival flaps operation as transposition conjunctival flap technique. Double-side sliding conjunctival flaps can be easily obtained and covered the bare sclera compared to one-side sliding method. In the case of transposition conjunctival flap, the survival rate after sliding conjunctival transposition flap was better than that of conjunctival autograft, because the conjunctival transposition flap has the conjunctival feeding vessels from noncutting conjunctival surface. Thus, we tried to use this two sliding conjunctival transposition flaps technique in pterygial surgery. Also the adjuvant agent was not used in this operation due to high risk of recurrence and corneal toxicity and complications.

The most common complication of conjunctival flap transposition is wrinkling and fibrosis in the conjunctiva with flap construction.[20,24] This complication usually does not cause cosmetic problems and generally improves over time. In this procedure, the mild surgical complications include conjunctival wrinkles, conjunctival hyperemia, and wound dehiscence occurred, but there were no serious complications after surgery.

It is important to make a fixed suture between the sliding conjunctival flaps and sclera. When the bare sclera was incompletely covered by two advanced sliding conjunctival transposition flaps or wound dehiscence occurred between the sliding conjunctival flaps and sclera, the pterygial recurrence between the conjunctival surfaces easily occurs due to the proliferation of the subconjunctival tissue.

All six recurrences were women in both primary and recurrent pterygium groups. The recurrent pterygium group included 53 cases; of the 29 women, four required re-operation after the first operation. Two patients in the primary pterygium group required re-operation. We observed a statistically significant difference in pterygium recurrence in women but not in men ($P = 0.043$, Chi-square test). There is conflicting evidence regarding whether sex is protective against recurrence following pterygium surgery.[16] Cellular proliferation of fibroblasts may be higher in recurrent pterygium than that in primary pterygium.[29] However, the rate of recurrence was

lower for recurrent pterygium with more twice than the first recurrent pterygium. Furthermore, among cases of recurrent pterygium, we also found that the astigmatism associated with pterygium improved more significantly in the first recurrence than that for the second or higher recurrences. It is thought to that there was little existed subtenon tissue, which can be proliferated and acted the recurrent pterygium due to the loss of active subtenon tissue by several pterygium surgery performed in the recurrent pterygium. More subjects and longer-term follow-up periods are required as there were few subjects in the first and second or higher recurrences among subjects with recurrent pterygium.

The advancing cap of the pterygium may encroach on the visual axis to cause major against-the-rule (ATR) astigmatism. After pterygium removal, a significant myopic shift can occur postoperatively likely due to a steepening of the corneal surface, with only 48% of eyes within ±0.5 D and 82% within ±1.0 D of the targeted correction.[30] According to our result, the preoperative corneal astigmatism significantly improved to the postoperative corneal astigmatism in the primary and recurrent pterygium. However, there was no significant change of improved amount of astigmatism by this surgery between primary and recurrent pterygium ($P = 0.162$). In the recurrent pterygium group, the total and corneal astigmatism of the first recurrence was significantly improved compared to that for the second or higher recurrence ($P = 0.034$, $P = 0.047$). But there was no significant differences of success rate with procedure between two groups ($P = 0.533$).

Conclusion

In conclusion, the double-sliding conjunctival flap surgery was a simple procedure with good success and recurrence rates in primary and recurrent pterygium as compared to previously reported surgery techniques. Especially, when pterygium is larger or recurrent type, this procedure can be easily covered the bare sclera, compared to any transposition conjunctival flap operation. This procedure could be considered a useful technique for pterygium surgery.

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Conflicts of interest

There are no conflicts of interest.

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