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A comparative study on surgical outcomes in primary pterygium excision using argon laser therapy versus bare sclera technique: A randomized prospective trial

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Abstract

Objective: The frequency of recurrence is a critical factor in the utilization of different treatments for pterygium. The present study was undertaken to compare the pterygium recurrence rates after bare sclera excision with that of argon laser therapy.

Methods: Sixty eyes of 53 patients with primary pterygium were included in this prospective, interventional case series. The participants were randomly categorized into 2 groups each consisting of 30 subjects. In the first group, pterygium excision was performed using bare sclera technique whereas the second group received argon laser therapy alone. The patients were examined for pterygium recurrence and complications at postoperative 1 and 7 days as well as in months 1, 3, and 6 after the operation. All analyses were performed using SPSS software (version 17.0) and P-values less than 0.05 were considered significant.

Results: Pterygia recurred in 7 eyes (23.3 %) in the first group (*i.e.* bare sclera group) and in 4 eyes (13.3 %) in the second group (*i.e.* argon laser therapy group). The recurrence rate was not significantly different between the two groups. No ocular or systemic complication developed till the end of follow-up.

Conclusion: Argon laser photocoagulation of pterygium may be more favorable for patients with coagulopathy or a history of conjunctival surgery. The coagulation effect of the argon laser may prevent severe conjunctival bleeding, which may occur after surgical excision in patients with coagulopathy.

Introduction

Pterygium (Surfer's eye) is a benign ocular lesion characterized by a triangular fibrovascular growth from the bulbar conjunctiva on to the cornea [1-5]. It is a common pathology, especially in tropical and subtropical regions. Prevalence has been reported as 0.7% to 31% across different populations [6-8]. Pterygium usually causes visual impairment, astigmatism and cosmetic problems [9]. Risk factors strongly associated with the development of pterygium is exposure to ultraviolet light (UVB), wind, dust and heat, dryness, oncogenes, and viruses. Destruction of

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the Bowman's layer by fibrovascular growth revealed mild inflammatory changes in the cornea and conjunctiva [10–16].

Generally, pterygium excision surgery is indicated in any of the following situations: when the lesion threatens visual acuity, has dysplastic characteristics or causes significant astigmatism, when it restricts ocular movements, causes discomfort or contact lens intolerance, or for cosmetic purposes [17, 18].

In the past, excision of pterygium with no added therapy was widely accepted. However, it became apparent that the recurrence rates were unacceptably high (30%–82%) [19-20]. Various adaptations to the surgical technique, such as amniotic membrane transplantation, anterior lamellar keratoplasty, conjunctival and/or limbal autograft, and the application of anti-metabolites including mitomycin C, have been introduced to avoid recurrence [21,22]. However, it is still impossible to completely prevent recurrence, which still remains a great challenge [23, 24].

Various surgical techniques and application methods before and after surgery, such as pharmacotherapy and radiotherapy, have been used to get the best outcome and prevent a recurrence. The high cost of some of these methods and lack of access or unavailability affects their use in the treatment, especially in low-and middle-income countries [25]. Argon laser is a safe and inexpensive method that may be effective in the treatment of pterygium. This prospective, interventional study was performed to compare the recurrence rate and the complications between the bare sclera surgery and argon laser therapy in patients with pterygium.

Materials and Methods

Patients

The current investigation was performed at Imam Khomeini hospital affiliated with Urmia University hospital, a principal referral center in Northwest of Iran, from April 2019 to June 2020. It included 60 eyes of 53 patients with pterygia indicated for surgical removal. The study followed the tenets of the Declaration of Helsinki. Informed consents were obtained from all participants after a thorough explanation of the nature and the potential complications of the surgical technique, as well as the alternative treatment options. One surgeon (N. SA) performed all surgeries. Best corrected visual acuity and intraocular pressure measurement were measured in all patients before surgery and in all follow-up sessions. Recurrent pterygium cases were excluded from the study. A specialist determined all pterygia' horizontal lengths by measuring the distance from the limbus to the apex of the lesion on the cornea by slit lamp technique. Symptoms of pterygium were considered as the presence of any of following conditions: persistent redness, inflammation, foreign body sensation, tearing, dry, and itchy eyes.

Surgery

Patients were randomly assigned 1:1 to two groups: The first group underwent simple excision of the pterygium (*i.e.* bare sclera), whereas the second group received argon laser therapy. Treatment allocation was determined by picking an envelope containing a pre-prepared randomization label generated by a biostatistician with block size 4. Bare sclera surgery was performed under anesthesia with lidocaine hydrochloride 2%. The injection of lidocaine hydrochloride 2% was performed under the conjunctiva in the body of the pterygium. Before the injection, all patients received topical anesthesia with two drops of tetracaine instilled into the eye. Then, the body of the pterygium was dissected and excised by Westcott scissors and crescent knife after complete and meticulous resection of the pterygium from the cornea. The abnormal scarring tissue on the corneal surface was polished. Minimal, if any, cautery was used to control bleeding. Eyes were patched for one day with tetracycline 1% ointment. Ciprofloxacin drops were prescribed 4 times a day for 7 days, whereas corticosteroid (Betamethasone) drops were administered 8 times daily, for 7 days and then 4 times daily for two weeks.

Laser therapy

Argon laser therapy was applied on the second group of patients. Argon laser applications ranged from 1 to 4 sessions (mean, 2.5 sessions), with a mean of 95 spots in each session (range: 46 to 150). An argon green laser (wavelength, 514 nm; VISULAS 532; Carl Zeiss, Jena, Germany) was used for photocoagulation. The laser spot size was 500 micrometer (μm), the duration was 0.1 second, and the power was set between 200 and 500 mW. Lower power was used for superficial vessels (laser spot size = 300

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mm) in which the wattage had to be increased to 0.5 second. The shots were arranged in 3 to 4 rows parallel to the limbus with approximately 1.5 mm distance between each row. Immediate post-operative treatment was similar to the first group.

Patients were invited for postoperative clinical evaluation for recurrence and complications on Days 2 and 7 as well as on Months 1, 3, and 6 after the operation. The recurrence was defined as the postoperative regrowth of fibrovascular tissue invading the cornea ≥1 mm at the area of previous pterygium excision.

Statistical analyses

All analyses were performed using SPSS software (version 17.0, SPSS Inc., Chicago, USA). Mann-Whitney U test and Fisher's exact test were utilized for comparing quantitative and qualitative variables, respectively. Changes relative to baseline in visual acuity, intraocular pressure, and recurrent pterygium length were evaluated by paired t-test within the investigated groups. P values less than 0.05 were considered as statistically significant. The statistician who performed the analysis was masked to the details of the investigation.

Results

Sixty eyes of 53 patients were initially enrolled in the current investigation. 30 cases were assigned to each of the groups. Altogether, 37 men and 23 women were included to the study all of who underwent surgery to have their pterygia removed. The clinical and demographic characteristics of the participants are shown in Table 1. No statistically significant differences were observed between the 2 groups in terms of sex, age, laterality, anatomical position of pterygium (temporal vs. nasal), pterygium symptoms, intraocular pressure, and pterygium length.

Table 1. *Pre-operative demographic characteristics of participants*

	Group 1 (n=30) (bare sclera)	Group 2 (n=30) (argon laser therapy)	P value
Age (years), mean [range]	37 [20-64]	34 [22-60]	0.812
Sex, n (Male/Female)	19/11	18/12	1.000
Eye, n (Right/Left)	14/16	18/12	0.438
Temporal/Nasal, n	0/30	0/30	1.000
Pterygium symptoms* (n) (%)	30 (100)	30 (100)	1.000
Intraocular pressure (mmHg), mean ± SD	15.05±3.00	14.07±3.20	0.776
Best collected visual acuity	10/10	10/10	1.000
Pterygium Length, mean ± SD	2.60±0.18	2.40±0.25	0.817

*: Considered as the presence of any of following conditions: persistent redness, inflammation, foreign body sensation, tearing, dry, and itchy eyes.

Table 2 compares demographic and clinical data between two groups of patients six months after the surgery. The length of recurrent pterygia was the only variable which showed significant difference between two groups, albeit at a borderline-significant level (Mann–Whitney U test, P = 0.039). Postoperative lengths of recurrent pterygia were 1.43±0.22 mm and 0.87±0.20 mm in the first (i.e. bare sclera group) and second group (i.e. argon laser therapy group), respectively (Table 2). Pterygium symptoms were observed in 26.8% (8 of 30 eyes) of eyes in the first group and 6.7% (2 of 30 eyes) in the second group (Fisher's exact test, P = 0.078). Recurrence rates were found to be 23.3% (7 out of 30 eyes) in the first group and 13.3% (4 out of 30 eyes) in the second group (Fisher's exact test, P = 0.506). No significant differences were observed between the 2 groups in terms of best corrected visual acuity and intraocular pressure (Table 2).

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Table 2. *Demographic and clinical data of patients 6 months after surgery*

	Group 1 (n=30) (bare sclera)	Group 2 (n=30) (argon laser therapy)	P value
Pterygium symptoms (n) (%)	8 (26.8)	2 (6.7)	0.078
Intraocular pressure (mmHg), mean ± SD	16.01±3.03	15.50±3.10	0.869
Best collected visual acuity	10/10	10/10	1.000
Pterygium Length, mean ± SD	1.43±0.22	0.87±0.20	**0.039**

Table 3 compares postoperative clinical variables with baseline values in each group. There was a statistically significant reduction in the length of the recurrent pterygia at the end of the 6-month follow-up session compared to baseline values in both groups of patients (Table 3).

Table 3. *Pre- and post-operative clinical variables*

	Group 1 (n=30) (bare sclera)	P value	Group 2 (n=30) (argon laser therapy)	P value
Intraocular pressure (mmHg), mean ± SD	15.05±3.00	0.848	14.07±3.20	0.909
Baseline	16.01±3.03		15.50±3.10	
6-month follow-up session				
Pterygium Length, mean ± SD				
Baseline	2.60±0.18	**0.027**	2.40±0.25	**0.005**
6-month follow-up session	1.43±0.22		0.87±0.20	

Discussion

Pterygium is an ocular surface disease of humans attributed to chronic UV-B exposure. Clinically, the condition involves invasive centripetal growth with associated inflammation and neo-vascularization [26]. Prior clinical studies focused primarily on the clinical characteristics and surgical management of pterygia and, due to this fact, the pathogenesis of pterygia remains incompletely understood. However, considerable progress in this area has been achieved, providing additional insight into this complex disease. This recent evidence implicates anti-apoptotic mechanisms, immunological mechanisms, cytokines, growth factors, extracellular matrix modulators, genetic factors, viral infections, and other possible causative factors [26, 27].

Pterygium removal has always been associated with a variable recurrence rate with most scientific reports describing existing or new techniques that purport to reduce the rate at which the pterygium returns [28]. There seems to be a consensus that simply excising the pterygium and leaving bare sclera or simply closing the resultant conjunctival defect results in a recurrence rate of up to 82% [29, 30]. If these findings are replicated by other surgeons, then it would be reasonable to suggest that this method should no longer be used. The advantage of these outdated methods was simplicity and speed, which are also the principal advantages of the methods that have generally replaced these, namely, bare sclera technique with adjunctive radiotherapy [31, 32] or cytotoxic agents [33], both of which reduce the unacceptable recurrence rate of bare scleral closure, to <15%. However, adjunctive radiotherapy has been demonstrated to result in a high rate of scleral thinning or necrosis, which is usually seen only after 10–20 years of postoperative follow-up [34]. This

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complication leaves the eye at risk of endophthalmitis, which has been reported in the literature [35]. Complications of mitomycin have also been reported in the literature, with not only late-onset scleral necrosis [36], similar to that seen after the administration of radiotherapy, but also acute scleritis [37], both of which may result in loss of all vision. It is difficult to rationalize the use of these agents for a disease that can be successfully treated with extremely low complication rates with a conjunctival autograft, when the reason for their use is speed and simplicity only.

The other commonly used method is amniotic grafting, which results in a wide range of recurrence rates, from 5% to 64% [38]. Researchers who promote this method have found it necessary to combine the amniotic membrane graft with mitomycin, extensive tenonectomy, and a variable number of postoperative injections of steroids to achieve the lowest recurrence rate reported for amniotic membrane [39]. It would seem reasonable to postulate that the lowered recurrence rate may be because of the mitomycin or the tenonectomy and not the amniotic membrane. The same researchers have been unable to provide consistent cosmetic results and report a very high rate of granuloma formation [40].

Photocoagulation of those vascular structures with argon laser therapy could prevent inflammatory response and cause regression of pterygia. Argon laser application could evolve as a safe and simple therapy that avoids excision and potential subsequent complications such as infectious scleritis etc [41]. In fact, argon laser photocoagulation has already been described for treating pterygium [42]. However, it has not achieved uniform acceptance because of vessel recanalization, thermal damage to adjacent tissue, and possible worsening of pterygium.

Some limitations of our study require consideration. First, a small number of patients does not necessarily allow for a definitive conclusion regarding the effects of laser therapy. Second, bias can be introduced by including both eyes of a study patient. The short duration of follow up is another noteworthy limitation of our study. Moreover, parameters like environmental risk factors (*e.g.* sunlight, wind and dust) were not considered in this study because they were not well referenced in clinical histories.

Conclusion

In conclusion, laser therapy showed better outcome when compared with the simple excision surgery in terms of recurrence rate. In the first group (i.e. bare sclera group), the success rate was 76.7%, while in the second group (i.e. argon laser therapy group) the success rate was about 86.7%. Therefore, more studies with higher population size and with a much longer follow-up period is advised because; it is rational to imagine that recurrence rate may elevate with time. Argon laser photocoagulation of pterygium may be more favorable for patients with coagulopathy or a history of conjunctival surgery. The coagulation effect of the argon laser may prevent severe conjunctival bleeding, which may occur after surgical excision in patients with coagulopathy. Previous conjunctival surgery might cause adhesions between the conjunctiva and underlying tissues, making surgical excision of the pterygium more difficult.

Statements and Declarations

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Competing interests:

The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval:

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Urmia University of Medical sciences (No. IR.UMSU.REC.1398.234).

Consent to participate:

Informed consent was obtained from all individual participants included in the study.

Author contributions:

N S A: Conceptualization, the original draft writing, investigation, writing including reviewing and editing and investigation and formal analysis; G. M. : Conceptualization, supervision, and project administration; N KH.:

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Conceptualization, the original draft writing, investigation, writing including reviewing and editing

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