The Egyptian Journal of Hospital Medicine (April 2025) Vol. 99, Page 1662-1666

Comparison Between Posterior Scleral Reinforcement, Scleral Collagen Cross Linkage in Treatment of Progressive Myopia

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ABSTRACT

Background: One typical cause of vision loss is myopia. It has already been observed that high myopia is becoming more and more common. The prevalence of myopia rose from 20.3% in 1990 to 28.3% in 2002,

Purpose: This study aimed to compare the efficiency and safety of posterior scleral reinforcement and scleral collagen cross linkage in treatment of progressive myopia

Patients and methods: A prospective study that was conducted on 40 eyes of 40 patients suffering from progressive myopia (24 males, 16 females). They were divided into two groups: The first group contained 20 eyes that underwent posterior scleral reinforcement. The 2nd group contained 20 eyes that underwent scleral collagen cross linkage

Results: At the postoperative follow-up, we discovered that both groups' best corrected visual acuity (BCVA) had significantly improved from preoperative to postoperative measurements. In the first group, the BCVA improved in 15 eyes (75%) and stayed stable in five eyes (25%). In the second group, it improved in 13 eyes (65%) and was stable in seven eyes (35%). No postoperative patient's vision status had declined, according to any of the documents. At the last follow-up, BCVA performed noticeably better than it had before to the procedure. There were no statistically significant difference between gender and BCVA.

Conclusion: In conclusion, the two management approaches were equally effective at slowing the progression of myopia and nearly equally effective at improving subjective symptoms. PSR, which directly reinforces the eyeball's wall mechanically, is crucial for slowing the growth of myopia, particularly in cases of high myopia. Scleral collagen cross linking is a safe and efficient way to avoid axial elongation and stabilize vision, but the first group's long-term impacts are still better.

Keywords: Progressive myopia, Posterior scleral reinforcement, Scleral collagen cross linkage.

INTRODUCTION

One typical cause of vision loss is myopia. It has already been observed that high myopia is becoming more and more common. The prevalence of myopia rose from 20.3% in 1990 to 28.3% in 2002, with untreated myopia expected to be leading source in distant image decrease through 2015 disturbing 108 million persons and the 2nd leading reason of loss of sight worldwide [(1)]. Primary cause of permanent blindness is now myopic retinopathy. Thus, stopping myopia from getting worse could help lower the number of blindness cases in these patients. The spherical equivalent of <− 6.00 D is the maximum shared definition of progressive myopia, albeit it varies from study to study. Pathologic myopia is associated through progressive myopia. With increasing myopic affective fault or axial distance, the prevalence of myopia retinopathy rose dramatically. Rising beginning was 4.9% inside patients with a myopic affective fault of less than 5.1 Diopter and 84.5% inside patient among a myopic affective fault at minimum − 9.8 Diopter [(2, 3)].

Atropine, soft- modulating contact lenses, stiff, and under corrected are some of the conservative treatments that have been suggested. Atropine was the most successful intervention in decelerating development in myopia, with a major reduction. Pirenzepine also ensured reasonable results, while progressive addition spectacle lenses had little effect. Furthermore, under corrected specific - sight lenses, soft contact lenses, and rigid gas-permeable contact lenses did not slow the development of myopia. Despite this outcome, additional large-scale data trials are probably required to substantiate these findings [(4)].

Any surgical procedure increases the strength; of sclera posterior scleral reinforcement are among the surgical options. Of these surgical techniques, only posterior scleral reinforcement works well through times of axis measurement. In order to cure excessive myopia, researchers have recently also suggested subscleral injections of affected patient in early treatment, which is a potential new method to stop the growth of myopia [(5)]. **Shevelev** [(6)] originally proposed posterior scleral reinforcement surgery in 1930. This procedure uses organic otherwise nonorganic resources with reinforce the posterior pole's scleral fragile region and prevent the axial length from continuously elongating. **Ma** [(7)] and **Thompson** [(8)] altered the method. Comprising strong collagen fibers embedded in the stromal matrix, the human sclera makes up over 85% of the outer tunic of the eyeball [(9)] The sclera's collagen fibers are opaque because of their varying sizes and interstices. The fiber in the inner stroma layer is the thinnest, while the fiber in the outer scleral stroma layer is the thickest [(10)].

Received: 13/11/2024
Accepted: 14/01/2025

The equatorial and posterior areas have significantly different scleral thicknesses. The sclera determines the size and form of the eye. Any alteration to the scleral microstructure and mechanical characteristics may have an impact on both myopia and eye development. Collagen naturally creates chemical links through a process called cross-linking. The collagen in the cornea and sclera experiences the same thing [11-13]. Exogenous cross-linkage is the process by which two chemicals artificially form covalent connections with the aid of outside mediators. Both light and dark are used to purposefully produce it. There are two varieties of the light approach. The first is the photo approach, also known as the physical method, which starts the cross-linking process by exposing the target tissue to light. The second is the physiochemical or photochemical approach, which uses a mix of light and chemical compounds that are photosensitizing to create cross-linking [14].

The basic process behind different cross-linkage techniques is making the sclera more rigid. Collagen fiber diameter and intra- and inter-fibrillar cross-linking are the primary factors influencing the sclera's rigidity. To make the sclera tough, all of the techniques alter its biomechanical characteristics. By reducing the distance between fibers and creating new chemical bonds (covalent bonds) both within and between molecules of the same fiber, these biomechanical modifications are accomplished [15]. UV-A light combined with the photosensitizer riboflavin can cause photochemical cross-linkage. It has been applied to the human sclera for SXL and has been shown to alter its strength. The light approach has the benefit of localizing to the area of interest without causing damage to other areas [16, 17].

PATIENTD AND METHODS

A prospective revision of forty eyes from forty patients with progressive myopia (twenty-four males, sixteen females) were enlisted in our review. The 1st group 20 eyes treated with PSR while 2nd group of 20 eyes treated with scleral collagen cross linkage.

Every patient in-group 1 had a PSR, which was carried out while under general anesthesia. The procedure started with penetrating a curved scleral buckle beside the diameter direction while keeping root at 1-1.5 mm to produce a circular scleral buckle taken from a giver sclera through a width of 9-11 mm. The prefabricated bivalve buckle had restarted prior to use by submerging through 1.1% normal saline aimed at ten minutes. Initially, an opening remained prepared about 1.5 mm from the lower corneal limbus at the temporal bulbar conjunctiva. Second, the lateral rectus and inferior oblique muscles were located, separated, and made visible. Strabismus hooks were used to manipulate the two muscles as the eyeball was drawn toward the upper nasal edge, exposing the inferior temporal portion of the sclera. Finally, a pull seal inserted at the circular bivalve scleral buckle's root using 8-0 black silk. Partial from buckle where positioned beneath the lower oblique, which corresponds to the lower marginal macular, and other partial, after the buckle's root was secured to the muscle inset use at the forward close of the inferior oblique. Strabismus hooks were used to flatten the scleral buckle in order to complete this surgery. Lastly, the scleral buckle's placement was examined with particular, a strabismus hook should be used to verify its position with relation to the buckle and optic nerve. To guarantee that every component of the half-round scleral buckle covered the posterior staphyloma without compressing the optic nerve, the gaps was maintained at roughly 3 mm. In order to seal the conjunctiva, 8-0 absorbable sutures were used. Following surgery, eye drops containing 0.1% fluorometholone and 0.5% levofloxacin were given 4 times a day for 2 weeks.

Every patient in group 2 underwent a combination of UV-A light and photosensitizer riboflavin (Which is employed for SXL in the patient's sclera) that causes photochemical cross-linkage in the second group, which is shown to be altering its strength. The light approach has the benefit of localizing to the area of interest while causing no harm to adjacent locations. The drawback is that in order to reveal the irradiation zones, we must rotate the eyeball by inserting traction sutures at the rectus muscles after performing a peritomy at the limbus to reach the area of interest.0.1% riboflavin is the photosensitizer agent that is utilized. The entire process takes an hour. After dropping the photosensitizer solution onto the irradiation zone once every minute, we exposed the area to UVA irradiation (365 nm) for the following half hour.

Follow up: At standard and with each postoperative follow-up appointment (one, three, six, and twelve months after PSR and SXL), all patients received thorough ophthalmologic examinations that included fundus examinations, VA, IOP, AL, refractive error, BCVA slit-lamp examination, and more. Axial Length: An IOL Master was recycled to quantify the AL. Four measurements of the statistical results were made, and the average rates were noted.

Refractive error: An auto refractor was used to measure refractive error. The Snellen acuity test "E" was used to quantify (BCVA), and the outcomes were transformed into LogMAR for statistical assessment.

Anatomical results: Eye movements and strabismus examinations were part of an extraocular muscle evaluation. A slit-lamp was used to examine the anterior segment of the eye, and postoperative adverse events, including edema, inflammatory reaction, and conjunctival injection, were noted. A varied copy with recurrent actions was used to compare postoperative axial length, refractive error, and BCVA with preoperative values at each follow-up appointment. Gender and age remained considered and examined using the same statistical manner, as these factors may be linked to myopic advancement.

Inclusion criteria: (i) Refractive error of myopia ≥ 6.0 (D) (ii) AL over 24 mm (iii) younger than eighteen years.

Exclusion criteria: (i) Eye conditions that may impair vision (such as nystagmus, increased IOP, lens abnormalities, eye damage, and retinal detachment) (ii) general conditions that may affect the outcome (iii) previous eye surgeries (such as vitrectomy, PSR and scleral buckle procedure, or refractive surgery).

Ethical approval: Al-Azhar University's Ethics Board accepted our research. Informed consents were obtained from all included patients after a thorough discussion about both the desired positive outcomes and the potential adverse events. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

RESULTS

In the 1st group, 20 participants were treated using PSR, (18 males, 2 females). Standard age was 38.6 ± 16.47 (from 21–65 years). In the 2nd group, 20 participants were treated with a scleral collagen cross linkage (14 male, 6 female) the mean age was 45.62 ± 21.48 (from, 31–75 years) (Table 1).

Table (1): Difference between both groups regarding age and gender

	1st group	2nd group
No of eyes	20 eyes	20 eyes
Age	38.6 ± 16.47	45.62 ± 21.48
M	18 (90%)	14 (70%)
F	2 (10%)	6 (30%)

Axial length: The Axial length in the first group before treatment was 6.6/82 ± 4.82/81 and improvement after therapy in first appointment was 5.14/91 ± 3.86/09 and last appointment was 4.26/83 ± 2.97/18. In the second group, axial length before therapy was 7.85/91 ± 4.04/92 and after therapy in the first appointment was 6.65/92 ± 5.37/10, and last appointment was 4.26/83 ± 3.97/18 Axial elongation over a one-year period averaged 1.46 mm. A statistical analysis revealed no significant variation by gender, suggesting that axial length and gender were unrelated (Table 2).

Table (2): Difference between axial length in both groups in first and last follow up visit

	1st group	2nd group
No of eyes	20 eyes	20 eyes
Before treatment (mm)	6.6/82 ± 4.82/81	7.85/91 ± 4.04/92
First visit (1 month)	5.14/91 ± 3.86/	6.65/92 ± 5.37/10
Last visit (1 year)	4.26/83 ± 2.97/18	4.26/83 ± 3.97/18

Refractive error: When preoperative and postoperative measures were compared, the first group's refractive error at the follow-up appointment following surgery was 8/75 ± 6.71/73, and at the last visit, it was 7/78 ± 5.82/65. This comparison revealed no discernible difference. Additionally, in the second group, the refractive error at the first visit (6/64 ± 5.69/71) and the last visit (5/79 ± 4.79/59) did not change significantly (Table 3).

Table (3): Difference between refractive error in both groups in first and last follow up visit

	1st group	2nd group
No of eyes	20 eyes	20 eyes
First visit (1 month)	8/75 ± 6.71/73	6/64 ± 5.69/71
Last visit (1 year)	7/78 ± 5.82/	5/79 ± 4.79/59

BCVA

At the postoperative monitor, we discovered that both groups' BCVA had significantly improved from preoperative to postoperative measurements. In the first group, the BCVA improved in 15 eyes (75%) and stayed stable in five eyes (25%). In the second group, it improved in 13 eyes (65%) and was stable in seven eyes (35%). No postoperative patient's vision status had declined, according to any of the documents. At the last follow-up, BCVA performed noticeably better than it had before to the procedure. The same investigation found no statistically significant difference between gender and BCVA (Figure 1).

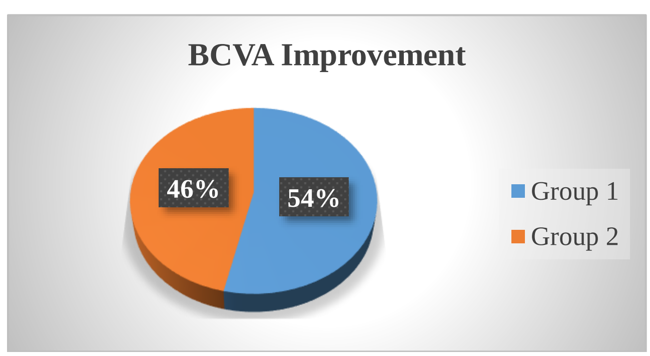

Figure (1): Difference between BCVA in both groups.

Anatomical outcomes: Postoperative extraocular muscle evaluations revealed no strabismus or limitation of eye movement in either group. All of the patients who had early scleral cross linking and scleral reinforcement showed signs of conjunctival congestion and edema. A slit-lamp check revealed no postoperative infections in any of the patients. In the fundus examination conducted at the most recent appointment, no postoperative pathological symptoms were discovered in either of the eyes. IOP increase, bleeding, or diplopia were not observed. Neither the surgery nor the follow-up time caused any of the eyes to lose their visual acuity.

Complication

During the follow-up period, neither group showed any indications of inflammation. None of the patients experienced any symptoms following surgery and cross-linking, including redness, eye irritation, the formation of conjunctival granulomas, or scleral disintegration (Table 4).

Table (4): Complication in both groups

Complication	1st group	2nd group
redness	No	No
eye pain	No	No
conjunctival granulomas	No	No
scleral dissolution	No	No

DISCUSSION

Our analysis contained 40 eye divided in two groups, 1st group 20 eyes treated with PSR while 2nd group of 20 eyes treated with scleral collagen cross linkage. This analysis illustrated that BCVA was much better postoperative than preoperative. BCVA improved in first group 15 eyes (75%), remained stable in five eyes (25%), in second group 13 eyes (65%), and remained stable in seven eyes (35%). These differ from **Snyder-Thompson *et al.*** [18] who implemented a similar analysis, which involved 48 eyes included a 1-year monitor proved BCVA better in 21 eyes (31.12%), and unaffected in 29 eyes (69.24%), and not improved in 4 eyes (6.88%).

Our findings demonstrated that measurements made prior to and following the implementation of this updated PSR did not significantly differ in refractive error. According to the **Lin *et al.*** [19] study, girls had a comparatively greater prevalence of myopia, which may be related to the ways that boys and girls engage in different outdoor activities. We included 16 females and 24 males in our study, and the results were unaffected by the genders.

In this analysis, outcomes showed standard (AL) in the first group before treatment was 6.6/82 ± 4.82/81 and improvement after treatment in first visit was 5.14/91 ± 3.86/09 and last visit 4.26/83 ± 2.97/18. In the 2nd group Axial length before management was 7.85/91 ± 4.04/92 and after treatment in the first visit was 6.65/92 ± 5.37/10, and last visit 4.26/83 ± 3.97/18. This change is equivalent to study by **Gerinec *et al.*** [20]. In addition, the same result of **Rey *et al*.** [21] gained an important outcome, coinciding with PSR patient who displayed a marked decrease in axial length.

PSR was conducted on high myopia patients (ages 22 to 65) in **Zhao *et al.*** [22] study. Similar to findings from a study by **Yan *et al.*** [23] with a 1-year monitor following PSR, their study showed that (AL) dropped by about 1.31 mm every month during a 1-year stage following PSR.

In our research, postoperative extraocular muscle evaluations revealed no strabismus or limitation of eye movement in either group. All of the patients who had early scleral cross linking and scleral reinforcement showed signs of conjunctival congestion and edema. A slit-lamp check revealed no postoperative infections in any of the patients. In the fundus examination conducted at the most recent appointment, no postoperative pathological symptoms were discovered in either of the eyes. IOP increase, bleeding, or diplopia were not observed. Neither the surgery nor the follow-up time caused any of the eyes to lose their visual acuity. This is not the same as **Ohno-Matsui *et al.*** [24] and **Hayashi *et al.*** [25]. They mentioned a few instances of posterior staphyloma, myopic maculopathies, scleral ectasia, and staphylomata. No serious complications following the PSR were noted in our study. Other investigations by **Yang *et al.*** [26] showed normal postoperative responses, including edema and conjunctival congestion.

CONCLUSION

In conclusion, the two management approaches are equally effective at slowing the progression of myopia and nearly equally effective at improving subjective symptoms. PSR, which directly reinforces the eyeball's wall mechanically, is crucial for slowing the growth of myopia, particularly in cases of high myopia. Scleral collagen cross linking is a safe and efficient way to avoid axial elongation and stabilize vision. The first group's long-term impacts are still better.

Conflict of interest: None.
Funding: None.

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