Original Article

Change in Axial Length and Astigmatism after Scleral Buckling in Patients of Rhegmatogenous Retinal Detachment

PJO – Official Journal of Ophthalmological Society of Pakistan

Muhammad Zaheer Ullah Babar[1], Faisal Nawaz[2], Asif Ali[3], Muhammad Usman[4], Abdul Munim[5]
[1-5]Peshawar Medical College, Peshawar

ABSTRACT

Purpose: To determine changes in axial length and corneal astigmatism caused by scleral buckling in patients of uncomplicated retinal detachment undergoing scleral buckling procedure.

Study Design: Quasi-experimental design.

Place and Duration of Study: Peshawar Medical College and Allied hospitals, Pakistan from December, 2020 to May, 2021.

Methods: This study included60 patients of uncomplicated rhegmatogenous retinal detachment, recruited through consecutive sampling technique and managed with primary scleral buckling. After a detailed history and complete examination including A-scan and Keratometric readings, patients underwent scleral buckling procedure. Changes in axial length and corneal curvatures were measured at 6 months follow up. Quantitative analysis was done using paired T test.

Results: Mean age of the sample was 41.95±13.67 years. The sample consisted of 42 males and 18 females. Encircling Band was used in 46 patients, segmental circumferential tire was used in 58 patients in one or more quadrants depending on the extent of the retinal detachment. Two patients underwent additional surgeries. The pre-operative mean axial length (AL) was 23.44±1.51 mm and post-operative AL at 6 months was 24.25±1.61mm ($p < 0.05$). The pre-operative and post-operative astigmatism were 1.08±0.43 and 1.75±0.33 diopter respectively ($p < 0.05$).

Conclusion: Scleral buckling led to a significant increase in axial length and astigmatism over a 6-month period. These changes suggest that scleral buckling can alter the optical properties of the eye, potentially affecting visual acuity and requiring careful consideration of these factors in post-operative management.

Key words: Scleral Buckling, rhegmatogenous retinal detachment, astigmatism, axial length, eye.

How to Cite this Article: Babar MZU, Nawaz F, Ali A, Usman M, Munim A. Change in Axial Length and astigmatism after Scleral Buckling in Patients of Rhegmatogenous Retinal Detachment. 2024;40(4):410-413.
Doi: 10.36351/pjo.v40i4.1884

Correspondence: Muhammad Zaheer Ullah Babar
Peshawar Medical College, Peshawar
Email: drzaheerbabar123@gmail.com

Received: June 30, 2024
Accepted: September 01, 2024

INTRODUCTION

Scleral buckling (SB) is a conventional surgical procedure for management of rhegmatogenous retinal detachment (RRD).[1,2] It is a safe and effective treatment for the management of uncomplicated RRDs even after the advent of modern machines and internal tamponade techniques with a success rate from 82% to 92%.[3] Another reason for choosing this treatment option is that, besides being effective and safe, it addresses the lack of modern facilities, equipment, and specialized training required for performing pars plana vitrectomy in developing countries.[4]

Different buckling materials are being used to provide external tamponade and the surgical procedure

may vary in several aspects, including the extent of indentation, the size and thickness of the buckle, as well as the type, location, and positioning of the buckling material.[5] The external pressure applied with the help of external band or tire results in a change in the geometry and certain clinically important parameters of the eye ball such as astigmatism due to variation in corneal curvatures, corneal thickness and AL.[6,7] These changes are secondary to the surgically induced change in the ocular or scleral rigidity which is influenced by the material and type of the buckle used, the buckling technique, positioning of the buckle, episcleral area covered, type and tension of sutures, ethnicity and refractive state of the eye.[8] Ocular optics and physiology is also greatly influenced by age related biochemical processes which also alter the ocular tissue matrix resulting in a change in the thickness and elasticity of the cornea as well as scleral compliance and rigidity.[9] These changes can also have effects on the final outcomes of the SB procedure.

This study is aimed to assess the changes in axial length and astigmatic changes occurring with scleral buckling in our patients treated at a tertiary care hospital of Peshawar.

METHODS

This quasi-experimental study involved 60 patients of RRD recruited through consecutive sampling technique. Patients of age 16-60 years with RRD and PVR A or B intended to be managed with primary scleral buckling were included in this study. Patients with complicated RRD and other ocular diseases (uveitis, vascular occlusions, choroidal detachment, macular degeneration, vitreous hemorrhage, cataract, anterior proliferative vitreoretinopathy, glaucoma, maculopathy, other preexisting corneal and retinal diseases) were excluded. Change in axial length was measured by an A-scan machine; a difference of one or more than one millimeter between the pre-op and post-op axial lengths was considered as changed due to scleral buckling. Change of one or more than one diopter power along the two meridians of the cornea was considered changed due to scleral buckling.

The sample size was calculated using the WHO Software with the following assumptions; mean axial length of 23.47±2.31mm before surgery and mean axial length of 25.25±2.07 mm at 04 months after surgery.[10]Letter of ethical approval was received from research board of Peshawar Medical College (Prime/IRB/2020-261).

A detailed history was taken from the all patients regarding previous ocular diseases, ocular surgeries and a slit lamp examination was performed, axial length was measured with A-scan instrument (Nidek 4000, US) and Keratometric readings measured with Keratometer (Topcon kr-8800), pre-operatively and later upon subsequent follow ups.SB was performed by a single surgeon in all the patients under local anesthesia/general anesthesia. After localization of retinal breaks, drainage of subretinal fluid (SRF) and cryotherapy was performed. Circumferential band was applied in all the patients and segmental tire was used in some of the patients (Style 240/ style 276 Labtician Ophthalmics, Inc., Oakville, Canada). Four 5/0 ethibond (3/8 spatulated needle) scleral sutures were applied in all four quadrants and 2 scleral sutures were applied over the segmental tire 3 mm wider than the width of the buckle to maintain the optimum adequate scleral indentation over the area of the break. Data analysis was performed by SPSS version 22.0. Categorical variables like gender are described as frequencies and percentages. Quantitative variables like axial length and Keratometric readings before and after the surgery were described in terms of mean ± SD. To compare axial length and keratometry readings before and after surgery, paired T test was used at 5% level of significance.

RESULTS

The study comprised of60 patients (42 male patients and 18 female patients). Mean age was 41.95±13.67 years. Band was used in 46 patients; segmental circumferential tire was used in 58 patients in one or more quadrants depending on the extent of the retinal detachment. Two patients underwent additional surgeries. Table1 shows pre-operative and post-operative variables.

Table1: *Pre-operative and post-operative axial length and astigmatism.*

S/N	Parameters	Pre-operative (Mean ± SD)	Post-operative at 06 Months (Mean ± SD)	P-value
1.	AL (mm)	23.44 ± 1.51	24.25 ± 1.61	$p < 0.05$
2.	SIA (D)	1.08±0.43	1.75 ± 0.33	$p < 0.05$

AL: Axial length, SIA: Surgically induced astigmatism, D: Diopters

DISCUSSION

Antero-posterior axial length was found to be increased and a myopic shift was evident in our analysis at 06 months follow up. Similar increase in axial length of the eyeball has been reported by various studies.[11] Increase in axial length occurs secondary to the lengthening of the eye ball due to tight circumferential encircling band around the eyeball making it more elongated. However, a hard silicone explant or an encircling band with tight mattress sutures invaginated the sclera to such an extent that it causes shortening of the eye ball is also reported rather than an increase in the axial length.[12,13] Decrease in axial length in SB patients is a rare manifestation, if care is taken and the appropriate suturing technique is used, the antero-posterior increase in AL predominates the invagination. We did not find decrease of AL in our study in any case. The change in axial length may be influenced by the suturing technique, choice of buckle, its configuration and location.[12]

In this particular study, significant change in corneal astigmatism was noted at 6 months. Surgically induced astigmatism after SB surgery has been reported by previous studies as well.[13,14] If astigmatism induced by the buckling material is very high, it is difficult to overcome by glasses or simple contact lenses.[15] The ocular rigidity coefficient and age-related stiffening of cornea leads to an increase in Young's modulus and cohesive tensile strength.[16] These factors may lead to a more pronounced change in the corneal curvatures after surgery.[17]

SIA after SB surgery depends on various factors. The amount of tension being rendered by the sutures, the buckling material and the location and height of the buckle. Radial buckles are known to cause more astigmatism than the circumferential ones which may prevail for years or unless the radial buckles are removed.[18] Compared to sponge material, hard silicone buckles tend to cause more astigmatism. Even if the retina has been attached successfully, SIA limits the optical properties of the eye to form similar images and thus fusion of the images formed by both the eyes does not occur at the higher centers.[19,20] Hence it is important to keep in mind the amount of SIA produced by different buckling materials and the suturing technique which can help to minimize it. Post-operatively if the SIA is very high, the surgeon can remove the buckling material after 3-6 months if it is no more needed.

Limitations of this study include a relatively small sample of 60 patients, which may limit the generalizability of the findings to a broader population. Additionally, the sample consisted primarily of male patients (42 out of 60), which may not fully represent the gender distribution in the general population. The follow-up period was limited to 6 months. Longer-term effects of scleral buckling on axial length and corneal astigmatism were not assessed, which may provide a more comprehensive understanding of the procedure's impact over time. The study employed a quasi-experimental design without a control group. The study used only A-scan and Keratometric readings for assessing changes in axial length and corneal curvature. Additional imaging techniques, such as optical coherence tomography (OCT), might provide a more detailed analysis of the changes in eye structure. These limitations should be considered when designing future research in this area.

CONCLUSION

Scleral buckling led to a significant increase in axial length and astigmatism over a 6-month period. These changes suggest that scleral buckling can alter the optical properties of the eye, potentially affecting visual acuity and requiring careful consideration of these factors in post-operative management.

Funding: This study was not funded by any organization.

Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(Prime/IRB/2020-261)**.

REFERENCES

1. **Shanmugam MP.** Why scleral buckling is still relevant. Indian J Ophthalmol. 2024;**72(5):**615-616. Doi: 10.4103/IJO.IJO_247_24.
2. **Wang KY, Adams OE, Yu MD, Yonekawa Y.** The necessity and role of scleral buckling for rhegmatogenous retinal detachment. Curr Opin Ophthalmol. 2024;**35(5):**376-381. Doi: 10.1097/ICU.0000000000001065.

3. **Schwartz SG, Kuhl DP, McPherson AR ,Holz ER, Mieler WF.** Twenty-Year Follow-up for Scleral Buckling.Arch Ophthalmol.2002;**120(3):**325–329. Doi:10.1001/archopht.120.3.325
4. **Singh S, Khatri A, Byanju R, Kharel M, Joshi K, Khadka Thapa S.** Reviving the lost art of scleral buckling surgery for rhegmatogenous retinal detachment: evaluation of risk factors of detachments, poor physiological outcomes, and perspective from a developing country. Ther Adv Ophthalmol. 2019;**11:**2515841419838662. Doi: 10.1177/2515841419838662.
5. **Brinton DA, Wilkinson CP.** Retinal Detachment. Principles and practice. 3rd Edition. 2009; New York, Oxford University Press, pp149-180.
6. **Albanese GM, Cerini A, Visioli G, Marenco M, Gharbiya M.** Long-term ocular biometric variations after scleral buckling surgery in macula-on rhegmatogenous retinal detachment. BMC Ophthalmol. 2021;**21(1):**172. Doi: 10.1186/s12886-021-01928-0.
7. **Wong CW, Ang M, Tsai A, Phua V, Lee SY.** A Prospective Study of Biometric Stability After Scleral Buckling Surgery. Am J Ophthalmol. 2016;**165:**47-53. Doi: 10.1016/j.ajo.2016.02.023.
8. **Lee DH, Han JW, Kim SS, Byeon SH, Koh HJ, Lee SC, et al.** Long-term Effect of Scleral Encircling on Axial Elongation. Am J Ophthalmol. 2018;**189:**139-145. Doi: 10.1016/j.ajo.2018.03.001.
9. **Boote C, Sigal IA, Grytz R, Hua Y, Nguyen TD, Girard MJA.** Scleral structure and biomechanics. Prog Retin Eye Res. 2020;**74:**100773. Doi: 10.1016/j.preteyeres.2019.100773.
10. **Huang C, Zhang T, Liu J, Tan R, MM QJ.** Changes in axial length and anterior chamber depth after rhegmatogenous retinal detachment repair. J Clin Exp Ophthalmol. 2014;**5(6):**1-4. Doi: 10.4172/2155-9570.1000377
11. **Malukiewicz-Wiśniewska G, Stafiej J.** Changes in axial length after retinal detachment surgery. Eur J Ophthalmol. 1999;**9(2):**115-119. Doi: 10.1177/112067219900900207.
12. **Ophir SS, Friehmann A, Rubowitz A.** Circumferential silicone sponge scleral buckling induced axial length changes: case series and comparison to literature. Int J Retina vitreous. 2017;**3:**1-4. Doi: 10.1186/s40942-017-0063-1
13. **Huang C, Zhang T, Liu J, Ji Q, Tan R.** Changes in axial length, central cornea thickness, and anterior chamber depth after rhegmatogenous retinal detachment repair. BMC Ophthalmol. 2016;**16:**121. Doi: 10.1186/s12886-016-0296-z.
14. **Taroni L, Bernabei F, Pellegrini M, Roda M, Toschi PG, Mahmoud AM, et al.** Corneal Biomechanical Response Alteration After Scleral Buckling Surgery for Rhegmatogenous Retinal Detachment. Am J Ophthalmol. 2020;**217:**49-54. Doi: 10.1016/j.ajo.2020.03.054.
15. **Karimian F, Moradian S, Yazdani S, Mashayekhy A, Anisian A, Kouhestani N.** Corneal topographic changes after scleral buckling. Eur J Ophthalmol. 2006;**16(4):**536-541. Doi: 10.1177/112067210601600406.
16. **Knox Cartwright NE, Tyrer JR, Marshall J.** Age-related differences in the elasticity of the human cornea. Invest Ophthalmol Vis Sci. 2011;**52(7):**4324-4329. Doi: 10.1167/iovs.09-4798.
17. **Bedarkar A, Ranjan R, Khan P, Gupta RC, Kushwaha R, Mohan S.** Scleral buckling-induced ocular parameter changes in different age group patients of rhegmatogenous retinal detachment. Taiwan J Ophthalmol. 2017;**7(2):**94-99. Doi: 10.4103/tjo.tjo_7_17.
18. **Botsford BW, Durrani AF, Aldhafeeri R, Smolinski P, Friberg TR.** Biomechanics of scleral buckling and effects on eye geometry. In: Pallikaris I, Tsilimbaris MK, Dastiridou AI, editors. Ocular rigidity, biomechanics and hydrodynamics of the eye. Cham: Springer; 2021. p. 377-398. Doi: 10.1007/978-3-030-64422-2_23.
19. **Wang HZ, Chen MT, Chang CH, Tsai MC, Wu WC, Chung CB.** The changes of ocular axial length and corneal curvatures after scleral buckling for retinal detachment. Gaoxiong Yi Xue Ke Xue Za Zhi. 1994;**10(2):**77-83. PMID: 8176774.
20. **Hayashi H, Hayashi K, Nakao F, Hayashi F.** Corneal shape changes after scleral buckling surgery. Ophthalmology. 1997;**104(5):**831-837. Doi: 10.1016/s0161-6420(97)30226-7.

Authors Designation and Contribution

Muhammad Zaheer Ullah Babar; Consultant Ophthalmologist: *Concepts, Design, Manuscript preparation.*

Faisal Nawaz; Assistant Professor: *Manuscript review.*

Asif Ali; Assistant Professor: *Data acquisition, Statistical analysis.*

Muhammad Usman; Assistant Professor: *Data acquisition, Data analysis.*

Abdul Munim; Assistant Professor: *Data analysis, Manuscript editing.*