Anterior staphyloma repair following trauma and surgery – A retrospective review of techniques and outcomes over 25 years

Rama Rajagopal, Hiren D Matai, Lingam Gopal¹, Pradeep Susvar, Pramod S Bhende

Purpose: To review surgical options, techniques, and outcomes of anterior staphyloma repair done following trauma and surgery. Methods: This was a retrospective case study of patients who underwent staphyloma repair with scleral or tibial periosteal patch grafts following trauma and surgery with a minimum follow-up of 3 months postoperatively. Preoperative risk factors, choice of graft materials, surgical details, and outcomes in terms of graft uptake and tectonic integrity were analyzed. Results: Seventeen patients underwent successful staphyloma repair (scleral 15, tibial periosteal two). Mean follow-up was 47.1 months (3–159 months). Postoperative intraocular pressure rise noted in four eyes was controlled medically or surgically. Three patients underwent successful repeat patch grafting (graft melt one and recurrent ectasia two). Tectonic integrity of the eyeball was restored and maintained in all patients at the final follow-up. Conclusion: Comprehensive evaluation of the risk factors, control of ocular comorbid conditions, and early and meticulous surgery can optimize results.

Key words: Anterior Staphyloma Repair, periosteal patch graft, scleral patch graft

The sclera is an important structure that provides structural support to the eye.[1] Scleral integrity can be compromised by several causes including trauma, surgery, high myopia, glaucoma, and degenerative, infectious, and immunological processes.[2,3] As a consequence, depending on the extent of the initial insult, the virulence of the organism and host factors in infection, and systemic control of the underlying disease, in immunological processes, scleral tissue can thin out as ectasia and can sometimes be lined by uveal tissue called a staphyloma. Occasionally, this compromise in scleral integrity can lead to scleral perforation and prolapse of the intraocular contents. Hence, early intervention is recommended in these cases.[2] In patients with scleral necrosis secondary to an underlying disorder, control of underlying systemic disease with steroids, anti-inflammatory drugs, and immunosuppressive agents forms the first line of management. Irrespective of the etiology, localized tectonic support of the sclera is required in most cases. This can be achieved through autologous tissues like periosteum,[4,5] fascia lata,[6,7] and cartilage,[8] cadaveric tissues like pericardium[9] and aortic tissue,[10] synthetic materials like Gore-Tex,[11] and, more commonly, with autologous[12]/homologous sclera or cadaveric donor cornea.[2,13]

There is scanty literature on scleral and tibial periosteal patch grafts in staphyloma repair.[2,5] MEDLINE search did not reveal any study that has comprehensively reviewed the surgical techniques, outcomes, and complications of staphyloma repair in patients who underwent scleral or tibial periosteal patch grafts for nonimmunological, noninfectious etiology including trauma and surgery.

Methods

We reviewed the medical records of all the patients who underwent scleral or tibial periosteal patch grafts between 1995 and 2020 following trauma or surgery and found 17 patients fulfilling our inclusion criteria. We included patients having at least 3 months of follow-up after primary anterior staphyloma repair and excluded those who had anterior staphyloma repair done for infectious or autoimmune etiology. A written informed consent was obtained from all the patients. Approval was obtained from the Institutional Review Board, and the study was conducted according to the guidelines of the Declaration of Helsinki. Fifteen patients had undergone processed cadaveric donor scleral patch graft, while two had undergone an autologous tibial periosteal patch graft. The parameters recorded were primary etiology, duration from the initial insult to presentation, symptoms, details of past surgical history, ocular risk factors, preoperative best-corrected visual acuity (BCVA) of the affected eye, preoperative intraocular pressure (IOP), location and type of staphyloma, details of the surgery, duration of follow-up, complications and their management, postoperative BCVA, and the graft uptake at final follow-up.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

Cite this article as: Rajagopal R, Matai HD, Gopal L, Susvar P, Bhende PS. Anterior staphyloma repair following trauma and surgery – A retrospective review of techniques and outcomes over 25 years. Indian J Ophthalmol 2022;70:2967-71.
All patients were operated under general anesthesia, except three (patients 2, 14, and 15) who were operated under peribulbar anesthesia. Before scleral patch grafting, the donor sclera was soaked in Ringer’s lactate solution three times for 10 min, then in 5% povidone-iodine solution for 10 min, and finally in gentamicin 20 mg/ml solution for 10 min. Adequate exposure of the eye was obtained with wire speculum or lid sutures with 6-0 silk. Limbal traction sutures were used wherever necessary. Conjunctival peritomy was done for adequate exposure of the area. Careful diathermy was applied to the stretched scleral fibers over the staphyloma to flatten it. In large staphylomas, paracentesis was done to reduce the IOP and further flatten ectasia. A scleral graft of the required size was fashioned from the donor tissue and secured over the staphyloma with fibrin glue and/or 7-0 polyglactin 910 interrupted sutures. The conjunctival flap was repositioned and secured with fibrin glue or 7-0 polyglactin 910 interrupted sutures. In patients with large staphylomas with inadequate conjunctiva to cover the graft, amniotic membrane was additionally used to cover the patch graft.

For tibial periosteal graft harvesting, the area from the knee to the ankle was also prepped for surgery. An incision was made over the shin, cutting the skin and the subcutaneous tissue. Hemostasis was achieved. The periosteum was identified, lifted, and cut out. The subcutaneous tissue and the skin of the leg were closed in layers. The surgical steps for staphyloma repair were essentially the same. At the end of the surgery, the periosteal grafts were covered with conjunctiva in both patients. Postoperatively, the patients received topical antibiotics, corticosteroids, and copious lubrication.

**Results**

Records of a total of 17 eyes of 17 patients, fulfilling our inclusion criteria, who underwent anterior staphyloma repair with either scleral or tibial periosteal patch grafts for staphyloma following surgery or trauma between 1995 and 2020 were reviewed. Twelve patients (70.6%) were male and five (29.4%) were female. The mean age at presentation was 26.9 years (9–52 years). Mean follow-up was 47.1 months (3–159 months), and the mean duration between the initial insult and presentation was 76.6 months (from 2 weeks to 468 months).

Staphyloma occurred following surgery in four patients (patients 1, 3, 10, and 11) and trauma occurred in 10 patients (patients 2, 4, 5, 8, and 12–17). Three patients (patients 6, 7, and 9) had trauma followed by surgery as a risk factor. In the trauma group, patients underwent staphyloma repair following trauma after a mean interval of 107.6 months (1–468 months). In the group that had trauma followed by primary surgery, staphyloma repair was done after a mean interval of 15.2 months following primary surgery (from 2 weeks to 36 months).

The commonest symptom was diminution of vision (13 patients) followed by noticing a swelling in the eye (four patients). The BCVA of the affected eye preoperatively ranged from no light perception (patient 3, who was operated on for cosmesis) to 20/20 on Snellen’s chart. Five patients (4, 7, 10, 11, and 15) had medically controlled glaucoma, while patient 3 had undergone diode cyclophotocoagulation (CPC) in the affected eye for glaucoma. Fifteen patients (88.23%) had ciliary, one had intercalary, and one had equatorial staphyloma. The superior quadrant was the most common location (six patients). Preoperative clinical data pertaining to the patients is described in Table 1.

Surgery was performed for tectonic support in 15 patients (88.23%) and for cosmesis in two patients (11.77%; patients 3 and 13). Fifteen patients (88.23%) underwent scleral patch graft from a cadaveric donor, and two patients (11.77%) operated earlier in the series underwent autologous periosteal tibial patch graft, as was preferred by the operating surgeon. The intraoperative course was uneventful. Details of the surgeries and additional surgical procedures performed with the primary staphyloma repair (eight out of 17 patients) are listed in Table 2.

Postoperative IOP control needed both medical and/or surgical intervention, except in one patient (patient 4) who was advised to discontinue topical antiglaucoma medications postoperatively. Patient 15 was continued on the same preoperative regimen postoperatively. Patient 3 developed glaucoma postoperatively, which was medically controlled. IOP control needed further augmentation besides medical therapy postsurgery in three patients. Patient 7 required maximum medical therapy as well as multiple diode CPC postoperatively. Two patients (patients 10 and 11) required antiglaucoma surgery besides additional topical medical therapy. Patient 10 underwent Ahmed glaucoma valve implantation 17 months after staphyloma repair, while patient 11 required diode CPC 6 months after staphyloma repair and trabeculectomy 3 months after diode CPC. In summary, four out of six patients (66.67%) required stepping up antiglaucoma treatment.

Three patients underwent repeat patch grafts (patients 4–6). Patient 4 developed recurrent ectasia 6 years after the primary repair and underwent repeat scleral patch grafting. Patient 5, who had primarily undergone tibial periosteal patch grafting, developed a recurrent localized area of ectasia with uveal prolapse 2 years after the primary repair, which was managed with scleral patch grafting. Patient 6 [Fig. 1] had an early retraction of the amniotic membrane due to inadequate graft closure leading to graft melt at 3 weeks. In all these three patients, no further ectasia was noted over a minimum postoperative follow-up of 3 years. Glaucoma was not a contributing factor in the development of recurrent ectasia in these three patients.

Postoperative BCVA at the last follow-up remained the same in four patients (23.53%) and improved in 11 patients (64.71%). A decrease in vision was noted in two patients (11.76%). Patient 7 developed band-shaped keratopathy, while patient 11 had advanced glaucomatous cupping. He also suffered a globe perforation during peribulbar block for diode CPC. The resultant inferior retinal break was barricaded subsequently without consequences.

**Discussion**

Scleral staphyloma can pose a threat to the integrity of the globe and warrants early repair to avoid perforation and vision-threatening consequences like uveal prolapse and extrusion of intraocular contents. Staphyloma could be a sequel to trauma, surgery, high myopia, glaucoma, and degenerative, infectious, and immunological processes."[2,3]"

**Materials for staphyloma repair**

A variety of materials have been described for staphyloma repair, including autologous tissues like periosteum, fascia lata, and cartilage, cadaveric tissues like pericardium and aortic tissue, synthetic materials like Gore-Tex, and cadaverous sclera, and, more commonly, homologous sclera or cadaveric donor cornea."[2,3]"
Table 1: Preoperative details

| Patient number | Sex | Age (years) | Affected eye | Primary etiology/Inciting factor | Risk factor | Preoperative BCVA in the affected eye | Location and type of staphyloma | Postoperative BCVA (at the final follow-up) |
|----------------|-----|-------------|--------------|----------------------------------|-------------|--------------------------------------|-----------------------------------|------------------------------------------|
| 1              | M   | 14          | OS           | Surgery for conjunctival cyst    | Surgery     | 20/30                                | ITQ, equatorial                   | 20/30                                    |
| 2              | M   | 52          | OD           | Blunt trauma                     | Trauma      | 20/400                               | Superior, intercalary              | 20/120                                   |
| 3              | F   | 27          | OS           | Diode cyclophotocoagulation      | Surgery, glaucoma | NLP                                  | SNQ, ciliary                       | NLP                                      |
| 4              | F   | 20          | OS           | Blunt trauma                     | Trauma, glaucoma | 20/20                               | Nasal, ciliary                     | 20/20                                    |
| 5              | M   | 20          | OD           | Trauma                           | Trauma      | 20/20 P                              | Inferior, ciliary                  | 20/20 P                                  |
| 6              | M   | 26          | OD           | Scleral tear and RD repair       | Trauma, surgery | HM                                  | Superior, ciliary                  | 20/200                                   |
| 7              | M   | 10          | OD           | Corneal tear and RD repair       | Trauma, surgery, glaucoma | CF 3 ft.                            | Superior, ciliary                  | 20/400                                   |
| 8              | F   | 52          | OS           | Road traffic accident            | Trauma      | CF 6 ft.                             | Superior, ciliary                  | 20/30                                    |
| 9              | M   | 9           | OS           | Scleral tear repair following blunt trauma | Trauma, surgery | 20/120                             | SNQ, ciliary                       | 20/400                                   |
| 10             | M   | 32          | OS           | Cataract surgery                 | Surgery     | CF 50 cm                             | Superior, ciliary                  | 20/400                                   |
| 11             | M   | 13          | OD           | Cataract surgery and RD repair   | Surgery     | 20/120 P                             | ITQ, ciliary                       | PL+PR accurate                         |
| 12             | F   | 45          | OS           | Blunt trauma                     | Trauma      | HM                                   | SNQ, ciliary                       | 20/600                                   |
| 13             | F   | 24          | OS           | Blunt trauma                     | Trauma      | CF 50 cm                             | ITQ, ciliary                       | CF at 50 cm                             |
| 14             | M   | 34          | OS           | Penetrating trauma               | Trauma      | 20/400                               | Inferior, ciliary                  | 20/30                                    |
| 15             | M   | 38          | OS           | Blunt trauma                     | Trauma      | HM                                   | Superior, ciliary                  | 20/16                                    |
| 16             | M   | 26          | OD           | Blunt trauma                     | Trauma      | 20/30                               | STQ, ciliary                       | 20/16                                    |
| 17             | M   | 15          | OD           | Blunt trauma                     | Trauma      | 20/20 P                             | SNQ, ciliary                       | 20/20 P                                  |

CF=counting fingers, F=female, HM=hand motion, INQ=inferonasal quadrant, ITQ=inferotemporal quadrant, M=male, NLP=no light perception, OD=oculus dexter, OS=oculus sinister, P=part, PL=perception of light, PR=projection of rays, RD=retinal detachment, SNQ=superonasal quadrant

Scleral grafts

The sclera has the most important advantage in that it is easy to procure, is pliable, and its natural curvature allows a more appropriate fit over the host bed.[14] It is avascular, and hence immunologically inert. But this can be a risk factor for necrosis and sloughing, and hence the need to cover it with a vascularized pedicle like conjunctiva or amniotic membrane, especially if there is inadequate conjunctiva to cover the area.[5] In our case study, patient 6 suffered a scleral graft melt at 3 weeks after the surgery due to inadequate graft cover with conjunctiva. Both conjunctiva and amniotic membrane were used to cover the scleral graft during repeat surgery. At the final follow-up of 40 months, the patient had a good scleral graft uptake.

In patient 4 with a primary scleral patch graft, rhinosporidiosis was noted on histopathologic examination of the sample obtained during surgery for recurrence. The authors attribute the recurrent ectasia to a rhinosporidiosis infection of a recent onset, as it occurred after 6 years, although in the same area. Repeat scleral graft did well over a period of 9 years.

Autoscleral grafts have also been described for staphyloma repair by Gopal and Badrinath.[3] The key advantages are better cosmesis, no visible surface irregularity compared to a full-thickness homologous scleral patch graft, and less inflammation as the tissue is autologous.

Tibial grafts

Autologous tissues like tibial periosteal graft have advantages of easy accessibility and the ability to retain their vasculature. This reduces the chances of graft melt.[4] However, the surgical procedure can be cumbersome and might need the help of a surgeon experienced in tibial periosteal tissue harvesting. In our case study, one patient (patient 5) developed a recurrent localized area of ectasia with uveal prolapse 2 years after the primary repair, which was managed successfully with scleral patch grafting.

Preoperative evaluation and surgical technique

Surgical outcomes in staphyloma repair primarily depend on careful patient selection, adequate preoperative and postoperative IOP control, and a meticulous surgical approach. Staphyloma following surgery or trauma can be difficult to manage in view of ocular comorbidities like retinal detachment, vitreous hemorrhage, and raised IOP. Detailed scleral evaluation of adjoining areas surrounding the staphyloma and the entire sclera can help in surgical planning. Surgery is preferably done under general anesthesia. If a peribulbar block is considered, it should be carefully administered to avoid complications like globe perforation.

The key factor for a successful outcome, both in terms of cosmesis and restoring tectonic integrity, is a meticulous intraoperative surgical approach. Lid sutures can help to achieve good exposure. Conjunctiva around the area of

Vascularized grafts

Vascularized grafts are obtained from autologous tissues such as the endaural lamina dura, corneal button, or nasal septum. The endaural lamina dura is used in cases of moderate to severe ectasia where autologous tissues are preferred.
staphyloma should be carefully dissected both for adequate exposure and to provide adequate cover to the graft. Decompression of the anterior chamber, especially in large staphylomas, helps to reduce the height of the staphyloma before diathermy. Flattening of the staphyloma can be achieved with careful diathermy over the scleral fibers in low settings. The effect of diathermy can be appreciated as shrinkage of scleral fibers and should be observed before proceeding to the adjacent area. This should preferably be done from the edges, gradually proceeding toward the center. Intraoperative complications like perforation and/or extrusion of the intraocular contents can be minimized by careful diathermy. The sizing of the graft should be such that it fits in the area of the defect snugly. Although fibrin glue can be used to secure the sclera in a small staphyloma, suturing the sclera with 7-0 polyglactin 910-interrupted sutures is preferred in most instances, as it also helps to achieve better flattening of the staphyloma. An adequate vascular cover is crucial, either with conjunctiva or amniotic membrane, to enhance graft uptake and prevent graft melt.\[2\] Periodic review and copious use of lubricants are recommended postoperatively.

Preoperative glaucoma should be adequately controlled before surgery, as uncontrolled glaucoma can lead to progressive ectasia. All patients, especially those with preoperative glaucoma, need to be counseled about a possible further increase in IOP with surgery.

There is a paucity of data in literature describing anterior staphyloma repair with patch grafts. In the study by Sangwan et al.,\[5\] only two patients out of 13 who underwent scleral patch grafting had ciliary staphyloma; one associated with high myopia and the other with aphakic glaucoma. The minimum period of follow-up was 6 months. This case series of scleral patch grafting included both immunological and nonimmunological causes of scleral thinning. Ozcan et al.\[15\] described a series of eight eyes that underwent corneoscleral, scleral, and fascia lata patch grafting. Two patients had staphyloma following previous ocular surgery and one following blunt trauma. The patients were followed up for a mean period of 13 months. In the study by Yao et al.,\[11\] three out of the total eight cases had staphyloma secondary to previous ocular surgery. The minimum reported follow-up period was 6 months. Koenig et al.\[4\] describe four eyes of three cases, all of whom had rheumatoid arthritis and underwent periosteal patch grafting for scleromalacia perforans (two eyes) and corneoscleral wound dehiscence following cataract surgery (two eyes). The mean follow-up period was 36 months.

The limitations of the current study are its retrospective nature and a small sample size. However, it is the largest and the first study discussing the surgical techniques and outcomes of patch grafts for anterior staphyloma following trauma and surgery.

**Conclusion**

In summary, we present a retrospective case study of 17 patients undergoing successful anterior staphyloma repair with scleral or tibial periosteal patch graft, where the tectonic integrity of the eyeball was restored. A comprehensive evaluation of the risk factors, control of ocular comorbid conditions, and an early and meticulous surgery can optimize results.

**Acknowledgements**

The authors are grateful to Dr. Bhaskar Srinivasan, Dr. Niveditha Narayanan, and Dr. Mamta Agarwal for their contribution.
Table 2: Surgery and postoperative details

| Patient no. | Indication for surgery | Type of graft | Additional procedures | Complications and management | Follow-up duration (in months) |
|-------------|------------------------|---------------|-----------------------|------------------------------|------------------------------|
| 1           | Tectonic               | Tibial periosteal patch graft | None | None | 60 |
| 2           | Tectonic               | Scleral patch graft | RD repair | None | 74 |
| 3           | Cosmetic               | Scleral patch graft | None | IOP rise; topical AGMs | 54 |
| 4           | Tectonic               | Scleral patch graft | None | Did not require topical AGMs postoperatively | 108 |
| 5           | Tectonic               | Tibial periosteal patch graft | None | Recurrent staphyloma, scleral patch graft | 60 |
| 6           | Tectonic               | Scleral patch graft | Silicone oil exchange + epiretinal membrane removal | Graft melt, scleral patch graft | 40 |
| 7           | Tectonic               | Scleral patch graft | Endocyclophotoocoagulation | IOP rise, topical AGMs and diode cyclophotoocoagulation | 159 |
| 8           | Tectonic               | Scleral patch graft | None | None | 5 |
| 9           | Tectonic               | Scleral patch graft | Lensectomy, RD repair | None | 16 |
| 10          | Tectonic               | Scleral patch graft | Penetrating keratoplasty | IOP rise, topical AGMs and subsequently AGV | 23 |
| 11          | Tectonic               | Scleral patch graft | Diode cyclophotoocoagulation, trabeculectomy | IOP rise; topical AGMs, diode cyclophotoocoagulation followed by trabeculectomy | 16 |
| 12          | Tectonic               | Scleral patch graft | None | None | 3 |
| 13          | Cosmetic               | Scleral patch graft | None | None | 32 |
| 14          | Tectonic               | Scleral patch graft | Pupilloplasty | None | 39 |
| 15          | Tectonic               | Scleral patch graft | RD repair | IOP rise, topical AGMs | 27 |
| 16          | Tectonic               | Scleral patch graft | None | None | 8 |
| 17          | Tectonic               | Scleral patch graft | None | None | 78 |

AGM=antiglaucoma medication, AGV=Ahmed glaucoma valve, IOP=intraocular pressure, RD=retinal detachment

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Watson PG, Young RD. Scleral structure, organisation and disease. A review. Exp Eye Res 2004;78:609-23.
2. Sangwan VS, Jain V, Gupta P. Structural and functional outcome of scleral patch graft. Eye 2007;21:930-35.
3. Borley WE, Snyder AA. Surgical treatment of high myopia; the combined lamellar scleral resection with scleral reinforcement using donor eye. Trans Am Acad Ophthalmol Otolaryngol 1958;62:791-801.
4. Koenig SB, Sanitato JJ, Kaufman HE. Long term follow-up study of scleroplasty using autologous peristeum. Cornea 1990;9:139-43.
5. Breslin CW, Katz JI, Kaufman HE. Surgical management of necrotizing scleritis: Scleral reinforcement with autogenous peristeum. Arch Ophthalmol 1977;95:2038-40.
6. Torchia RT, Dunn RE, Pease PJ. Fascia lata grafting in scleromalacia perforans. Am J Ophthalmol 1968;66:705-9.
7. Kobtan H. Use of autologous fascia lata as a natural biomaterial for tectonic support in surgically induced necrotizing scleritis. Eye (Lond) 2015;29:580-4.
8. Chun YS, Kim KW, Kim JC. Autologous tragal perichondrium patch graft for Ahmed glaucoma valve tube exposure. J Glaucoma 2013;22:27-30.
9. Weissgold DJ, Millay RH, Bochow TA. Rescue of exposed scleral buckles with cadaveric pericardial patch grafts. Ophthalmology 2001;108:753-8.
10. Merz EH. Scleral reinforcement with aortic tissue. Am J Ophthalmol 1964;57:766-70.
11. Yao Y, Jhanji V. Short-term observation of management of sclera patch grafts used in the scleral defects. Ann Eye Sci 2017;2:30-6.
12. Gopal L, Badrinath SS. Autoscleral flap grafting: A technique of scleral repair. Ophthalmic Surg 1995;26:44-8.
13. Nishiwaki-Dantas MC, Abbott RL, Dantas PE. Use of corneal patch graft to repair scleral or corneoscleral defects. Arq Bras Oftalmol 1995;58:295-8.
14. Hodge C, Sutton G, Devasahayam R, Georges P, Treloggen J, Cooper S, et al. The use of donor scleral patch in ophthalmic surgery. Cell Tissue Bank 2017;18:119-28.
15. Ozcan AA, Bilgic E, Yagmur M, Ersoz TR. Surgical management of scleral defects. Cornea 2005;24:308-11.