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ORIGINAL RESEARCH

Visual Rehabilitation with Mini-Scleral Lenses in Children With Post-Traumatic Corneal Irregularity After Open Globe Injury

Mehmet Ömer KIRIŞTIOĞLU[1], Sevde İŞLEKER[2], İbrahim TALYURT[1], Gamze UÇAN GÜNDÜZ[1], Esin SÖĞÜTLÜ SARI[1], Mehmet BAYKARA[1]

[1] Bursa Uludag University, Faculty of Medicine, Department of Ophthalmology, Bursa, Türkiye.
[2] Konya Beyhekim Eğitim ve Araştırma Hastanesi, Department of Ophthalmology, Konya, Türkiye.

ABSTRACT

The aim of this study was to evaluate the visual and refractive outcomes of mini-scleral lens rehabilitation in pediatric patients with post-traumatic corneal irregularity after open globe injury. This single-center retrospective case series included patients aged 18 years or younger who underwent contact lens-based rehabilitation after open globe injury between January 2023 and April 2026. Of 80 pediatric open globe injury eyes screened, 13 completed contact lens rehabilitation; two eyes fitted with soft contact lenses were excluded, leaving 11 eyes of 11 patients in the mini-scleral lens analysis. Demographic, trauma-related, visual, refractive, topographic, keratometric, lens-fitting, and clinical outcome data were reviewed. Visual acuity was converted to logarithm of the minimum angle of resolution units, and paired values were compared using the Wilcoxon signed-rank test. Median age at fitting was 9 years. Median best-corrected visual acuity improved from 1.30 logMAR with spectacle correction based on pre-fitting manifest refraction with subjective refinement to 0.40 logMAR with the final mini-scleral lens after at least 30 minutes of lens settling ($p = 0.002$), with improvement observed in 10 eyes. Median pre-fitting refractive cylinder was -3.75 D, and median topographic astigmatism was 4.57 D. At final follow-up, 10 of 11 patients remained regular lens wearers; one discontinued regular wear because of insufficient perceived subjective benefit, not a severe lens-related complication. Mini-scleral lenses provided significant visual improvement and may be a useful non-surgical rehabilitation option in selected pediatric eyes with post-traumatic corneal irregularity.

Keywords: Open globe injury. Mini-scleral lens. Corneal scar.

Açık Glob Yaralanması Sonrasında Travmaya Bağlı Korneal Düzensizliği Bulunan Çocuklarda Mini-Skleral Lenslerle Görsel Rehabilitasyon

ÖZET

Bu çalışmanın amacı, açık glob yaralanması sonrasında travmaya bağlı korneal düzensizlik gelişen pediatrik hastalarda mini-skleral lens rehabilitasyonunun görsel ve refraktif sonuçlarını değerlendirmektir. Bu tek merkezli retrospektif olgu serisine, Ocak 2023 ile Nisan 2026 arasında açık glob yaralanması sonrasında kontakt lens temelli rehabilitasyon uygulanan 18 yaş ve altındaki hastalar dahil edildi. Taranan 80 pediatrik açık glob yaralanması gözünden 13'ü kontakt lens rehabilitasyonunu tamamladı; yumuşak kontakt lens uygulanan iki göz dışlandı ve mini-skleral lens analizine 11 hastanın 11 gözü alındı. Demografik ve travmayla ilişkili veriler ile görme, refraksiyon, topografi, keratometri, lens uyarlaması ve klinik sonuçlara ilişkin veriler incelendi. Görme keskinliği minimum rezolüsyon açısının logaritmasına dönüştürüldü ve eşleştirilmiş değerler Wilcoxon işaretli sıralar testiyle karşılaştırıldı. Lens uyarlaması sırasındaki medyan yaş 9 yıldı. Medyan en iyi düzeltilmiş görme keskinliği, uyarlama öncesi manifest refraksiyon ve subjektif refraksiyona dayalı gözlük düzeltmesiyle 1,30 logMAR iken en az 30 dakikalık oturma süresi sonrasında nihai mini-skleral lensle 0,40 logMAR'a yükseldi ($p = 0{,}002$) ve 10 gözde artış izlendi. Uyarlama öncesi medyan refraktif silindir -3,75 D, medyan topografik astigmatizma 4,57 D idi. Son kontrolde 11 hastanın 10'u düzenli lens kullanıyordu; bir hasta ciddi lens ilişkili komplikasyon nedeniyle değil, yeterli subjektif fayda algılamadığı için düzenli kullanımı bıraktı. Mini-skleral lensler anlamlı görsel iyileşme sağlamış olup travmaya bağlı korneal düzensizliği bulunan seçilmiş pediatrik gözlerde yararlı bir cerrahi dışı rehabilitasyon seçeneği olabilir.

Anahtar Kelimeler: Açık glob yaralanması. Mini-skleral lens. Korneal skar.

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Dr. Mehmet Ömer KIRIŞTIOĞLU
Institution and Address: Bursa Uludag University Faculty of Medicine, Department of Ophthalmogy, Gorukle Campus, Bursa, Türkiye
E-mail: mokiristioglu@uludag.edu.tr

AUTHORS' ORCID INFORMATION
Mehmet Ömer KIRIŞTIOĞLU: 0000-0001-8010-0105
Sevde İŞLEKER: 0000-0002-7352-7044
İbrahim TALYURT: 0000-0002-8156-0944
Gamze UÇAN GÜNDÜZ: 0000-0002-5458-1686
Esin SÖĞÜTLÜ SARI: 0000-0003-3729-6178
Mehmet BAYKARA: 0000-0002-5555-1649

Pediatric ocular trauma is common and can significantly affect visual development and long-term quality of life. Worldwide, approximately 250,000 children require hospitalization for serious ocular injury each year, and an estimated 6 million sustain some form of ocular trauma annually[1,2]. Open globe injury (OGI) in childhood is a potentially devastating form of ocular trauma in which successful anatomical repair does not necessarily ensure satisfactory visual recovery[3-5]. Post-traumatic corneal scarring, irregular astigmatism, aphakia, and other anterior segment sequelae may substantially compromise optical quality and limit the effectiveness of spectacle correction[6-8].

Contact lenses (CL) can play an important role in this setting by masking irregular corneal optics and providing a more regular refractive surface than spectacles in selected eyes. Previous studies have demonstrated meaningful visual improvement with CL rehabilitation after repaired corneal perforation or OGI, and adult series have also shown that scleral lenses (SL) may be particularly valuable in eyes with post-traumatic corneal scarring and irregular astigmatism[6,9]. However, evidence regarding CL rehabilitation after ocular trauma in children, particularly in those at risk of amblyopia, remains limited[8]. Available pediatric studies have largely focused on injury characteristics, prognostic factors, and, in some cases, rigid gas-permeable (RGP) lens rehabilitation. In contrast, the existing literature on SL or mini-scleral lenses (MSL) in children has primarily addressed conditions such as ocular surface disease and keratoconus rather than post-traumatic eyes[10-13]. Therefore, data specifically evaluating MSLs after pediatric OGI are scarce, and dedicated case series in this setting are lacking.

This gap is clinically important because MSLs may provide meaningful visual rehabilitation in post-traumatic eyes with severe corneal irregularity, unstable optics, or poor tolerance to smaller-diameter rigid lenses. In selected pediatric patients, they may also offer a non-surgical rehabilitation option before keratoplasty is considered[9]. Therefore, the present study aimed to evaluate the visual, refractive, and clinical outcomes of MSL rehabilitation in pediatric patients after OGI.

Materials and Methods

Study design and patients

This single-center retrospective case series included patients aged 18 years or younger who underwent contact lens-based visual rehabilitation after OGI between January 1, 2023 and April 1, 2026 at the Bursa Uludag University Faculty of Medicine, Department of Ophthalmology. Cases were identified through a review of the hospital information system and CL clinic records.

The study adhered to the tenets of the Declaration of Helsinki and was approved by the Bursa Uludağ University Health Research Ethics Committee 2026/213/7-24. Because of the retrospective design, the requirement for written informed consent was waived by the ethics committee. Patient confidentiality was preserved throughout data collection and analysis.

All pediatric OGI records during the study period were screened for potential contact lens-based visual rehabilitation. Rehabilitation was considered after anatomical stabilization when the principal remediable cause of reduced vision was a corneal scar or irregular astigmatism not adequately corrected with spectacles, sufficient visual potential remained, and the ocular surface and expected patient/family cooperation permitted fitting and follow-up. Of 80 pediatric OGI eyes screened, 67 did not enter or complete the rehabilitated cohort: 26 had no clinically meaningful CL indication because functional vision was adequate with spectacles or without correction, 16 had insufficient visual potential because of severe ocular or posterior segment damage, 14 were lost to follow-up during rehabilitation, 4 could not obtain the prescribed lens or the family declined treatment, 4 could not complete fitting or lens use because of cooperation or handling limitations, and 3 were considered unsuitable or at high risk because of corneal or ocular-surface status. Thirteen eyes completed CL rehabilitation. Two were excluded from the MSL analysis because they were rehabilitated with soft CL: one aphakic eye was fitted with an aphakic silicone hydrogel lens and one eye with low corneal astigmatism was fitted with a soft hydrogel lens. Consequently, 11 eyes of 11 pediatric patients fitted with MSLs were included in the final analysis (Figure 1).

Data collection

The following variables were obtained from the medical records: age at injury, age at fitting, sex, affected eye, date of injury, mechanism and type of injury, extent of injury, additional ocular surgeries and relevant ocular comorbidities, interval between OGI and MSL initiation, duration of post-fitting follow-up, pre-fitting visual acuity (VA), VA with MSL wear, pre-fitting refractive error, residual refraction after fitting, and CL-related clinical outcomes.

Corneal topographic and keratometric parameters, including topographic astigmatism magnitude and K1 and K2 values, were recorded from measurements obtained using the Sirius topography system (CSO, Florence, Italy). MSL parameters, including lens sagittal depth, final lens power, and total lens diameter, were also recorded.

Pre-fitting best-corrected visual acuity (BCVA) was measured through the best spectacle correction obtained by subjective refraction. BCVA with MSL was measured at the lens dispensing visit using the final prescribed lens after at least 30 minutes of settling and after over-refraction with subjective refinement. Visual acuity values documented in decimal notation were converted to logarithm of the minimum angle of resolution (logMAR) units for statistical analyses. Decimal values were retained where clinically informative.

Contrast sensitivity was assessed in three cooperative patients using the Pelli-Robson contrast sensitivity chart at a distance of 1 meter according to the standard testing protocol. The log contrast sensitivity (logCS) value corresponding to the lowest-contrast triplet in which at least two of three letters were correctly identified was recorded.

Mini-scleral lens fitting procedure

Mini-scleral lens fitting was performed using the ICD FLEXFIT lens system (KATT Design Group/Spectrum International, Atlanta, GA, USA). The ICD FLEXFIT system includes 14.8-mm and 16.3-mm diagnostic lens designs and allows customization of sagittal depth, landing zone, and overall diameter according to ocular anatomy and fitting requirements.

All MSL trials were performed after complete removal of corneal sutures. Fittings were performed while the patient was awake, and no sedation was required. In younger children, a drop of topical anesthetic was used before the first diagnostic lens insertion when necessary to reduce initial discomfort and improve cooperation.

Initial diagnostic lens selection was based on refractive findings together with corneal topographic and tomographic measurements. Before insertion, the lens bowl was filled with fluorescein-stained preservative-free saline. The lens was inserted using a plunger, with attention to avoiding fluid loss and air bubble formation. After application, lens centration, movement, and the post-lens fluid reservoir were initially evaluated using slit-lamp biomicroscopy with cobalt blue illumination. If no corneal touch or air bubble was observed and a homogeneous fluorescein pattern was present beneath the lens, the patient was allowed to wait for lens settling before final assessment.

The post-lens fluid reservoir and corneal clearance were evaluated using fluorescein assessment and anterior segment optical coherence tomography (AS-OCT) with the Spectralis OCT Anterior Segment Module (Heidelberg Engineering, Heidelberg, Germany). A satisfactory fit was defined as complete corneal and limbal vaulting without touch, adequate central clearance of approximately 250–350 µm after at least 30 minutes of lens settling, absence of marked edge lift, and no clinically significant conjunctival vessel impingement or blanching. Lens fit was evaluated and approved by two experienced ophthalmologists.

After at least 30 minutes of lens settling, cycloplegic autorefractometry was performed using the ARK-1 auto ref/keratometer (NIDEK Co., Ltd., Gamagori, Japan) after cyclopentolate administration when clinically feasible. These measurements were recorded as supportive objective data but were not considered absolute refractive endpoints. Final visual correction, MSL power customization, and BCVA with MSL were based on over-refraction followed by subjective refinement with the final prescribed lens in place. In pseudophakic children, additional near correction with bifocal spectacles was prescribed when indicated.

Injury classification

Open globe injuries were classified according to the Birmingham Eye Trauma Terminology System and the Ocular Trauma Classification Group. Zone I injuries were defined as injuries limited to the cornea and limbus, Zone II injuries as scleral injuries extending up to 5 mm posterior to the limbus, and Zone III injuries as injuries extending more than 5 mm posterior to the limbus[14]. Corneal laceration/scar location was additionally categorized using corneal-apex-centered 3- and 6-mm diameter zones: central (C), within the central 3-mm circle; paracentral (PC), the annulus between 3 and 6 mm; and peripheral (P), outside the 6-mm circle to the limbus. Wounds crossing more than one region were coded with all involved categories (for example, C+PC+P)[15].

Handling, adherence, and safety assessment

Mini-scleral lens handling, daily wearing pattern, caregiver involvement, barriers to use, and lens-related complications were reviewed from the available chart records. During lens training, patients and caregivers were instructed regarding lens insertion, removal, hygiene, disinfection, and replacement of the lens-filling solution. Practical lens use was assessed according to whether the child and/or caregiver could manage insertion, removal, and routine care without discontinuing lens wear because of handling difficulty.

Families were advised to use the lenses during waking hours according to the child's tolerance and clinical needs. In routine practice, MSLs were generally worn in approximately 4-hour intervals, with lens removal and replacement of the preservative-free filling solution between sessions. Younger children required parental assistance for insertion, removal, and solution replacement. When needed, teacher support during school hours was also recommended. Older cooperative children were encouraged to learn supervised self-handling.

Reported concerns regarding lens cost, possible lens loss, handling difficulty, intolerance, deposits, midday reservoir fogging, and other lens-related symptoms were documented when available. For safety assessment, ocular surface-related adverse effects, lens intolerance, and complications requiring discontinuation were recorded. Because wearing time, handling difficulty, caregiver support, and adherence-related variables were not uniformly documented in all patients, these data were summarized descriptively and were not included in formal statistical analyses.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median and interquartile range (IQR), depending on data distribution. Categorical variables were presented as number and percentage.

Because pre-fitting and post-fitting measurements were paired and the sample size was small, visual and refractive comparisons were performed using the Wilcoxon signed-rank test. Changes in refractive outcomes were analyzed similarly when applicable. A p value of less than 0.05 was considered statistically significant.

Results

Among the 80 screened pediatric OGI eyes, 67 did not enter or complete the rehabilitated cohort for the reasons detailed in the Methods and Figure 1. Thirteen eyes completed CL rehabilitation; after exclusion of two soft CL eyes, 11 MSL eyes constituted the final cohort. The median age at injury was 66 months (IQR, 47–114 months), and the median age at fitting was 9 years (IQR, 8–12 years). Six patients were male (54.5%) and five were female (45.5%). The left eye was affected in 8 patients (72.7%) and the right eye in 3 patients (27.3%). According to the Birmingham Eye Trauma Terminology classification, 8 eyes had penetrating injuries, 2 eyes had perforating injuries, and 1 eye had globe rupture. The most common injury mechanism was sharp injury, observed in 8 eyes (72.7%), followed by blunt trauma in 3 eyes (27.3%). Traumatic cataract surgery had been performed in 7 eyes (63.6%), and pars plana vitrectomy in 1 eye (9.1%) (Table I). The median interval from OGI repair to MSL initiation was 27.0 months (IQR, 5.5–74.4 months), and the median post-fitting follow-up duration was 14.9 months (IQR, 11.1–19.1 months) (Table II). Representative anterior segment photographs are shown in Figure 2.

Table I. Patient-Level Demographic, Trauma, and Visual Outcome Characteristics of the Included Eyes

A. Demographic and injury characteristics

Case	Age at injury (months)	Age at fitting (years)	Sex/Eye	BETT	Injury mechanism; laceration length; corneal zones
1	66	5	M/Left	Penetrating	Sharp injury—glass; 5 mm; C+PC+P
2	40	6	F/Left	Penetrating	Blunt trauma—sibling's foot; 3 mm; C
3	76	7	F/Left	Penetrating	Sharp injury—scissors; 5.5 mm; C+PC+P
4	67	9	F/Right	Penetrating	Foreign body impact; 8 mm; C+PC+P
5	114	9	M/Left	Penetrating	Blunt trauma—spoon; 4 mm; C+PC
6	24	9	F/Left	Penetrating	Sharp injury—glass plate; 5 mm; C+PC+P
7	47	10	F/Left	Penetrating	Sharp injury—knife; 2 mm; PC
8	64	11	M/Left	Rupture	Blunt trauma—trash-bin lid; 4 mm; PC+P
9	48	13	M/Right	Penetrating	Sharp injury—umbrella spoke; 1 mm; P
10	192	17	M/Right	Perforating	Sharp injury—metal object; 3.5 mm; C
11	204	17	M/Left	Perforating	Sharp injury—pellet fragments; 2 mm; PC

B. Ocular findings, visual outcomes, and follow-up

Case	Relevant ocular findings / previous procedures	Pre-fitting BCVA (logMAR)	BCVA with MSL (logMAR)	Follow-up (months)
1	Post-traumatic corneal scar and irregular astigmatism	1.30	0.30	15.0
2	Post-traumatic corneal scar and irregular astigmatism	0.70	0.40	14.0
3	Traumatic cataract surgery	0.82	0.10	25.0
4	Traumatic cataract surgery	0.70	0.10	23.6
5	Traumatic cataract surgery	0.52	0.15	16.3
6	Severe amblyopia	1.30	1.30	3.4
7	Traumatic cataract surgery	0.52	0.15	15.8
8	Traumatic cataract surgery; severe amblyopia	1.30	0.70	8.2
9	Traumatic cataract surgery; severe amblyopia	1.52	0.70	21.8
10	Traumatic cataract surgery; PPV; macular scar	1.85	1.00	3.4
11	Post-traumatic corneal scar and irregular astigmatism	2.30	0.52	14.0

BETT, Birmingham Eye Trauma Terminology; C, central (central 3-mm-diameter circle); PC, paracentral (3- to 6-mm annulus); P, peripheral (outside the 6-mm circle to the limbus); BCVA, best-corrected visual acuity; MSL, mini-scleral lens; PPV, pars plana vitrectomy. Combined C/PC/P codes indicate that the wound crossed more than one corneal region.

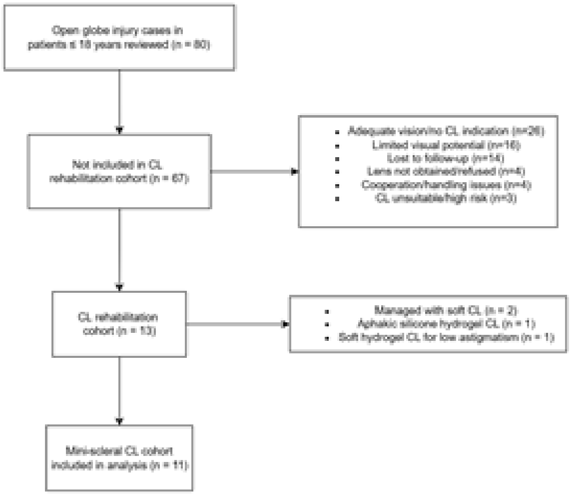

Figure 1:
Patient selection flowchart.

Among 80 pediatric open globe injury eyes screened, 67 did not enter or complete the contact lens rehabilitation cohort for the reasons shown. Thirteen eyes completed contact lens rehabilitation; two eyes fitted with soft contact lenses were excluded from the MSL analysis, leaving 11 eyes of 11 patients in the final MSL cohort. *CL, contact lens; MSL, mini-scleral lens*

Table II. Corneal, Refractive, and Mini-scleral Lens Parameters of the Included Eyes (n=11)

Parameter	Median	Range	IQR
Pre-fitting BCVA, decimal	0.05	0.01–0.30	0.04–0.20
Pre-fitting BCVA, logMAR	1.30	0.52–2.30	0.70–1.41
BCVA with MSL, decimal	0.40	0.05–0.80	0.20–0.70
BCVA with MSL, logMAR	0.40	0.10–1.30	0.15–0.70
Interval from OGI repair to MSL initiation (months)	27.0	1.6 - 113.8	5.5 – 74.4
Post-fitting follow-up duration (months)	14.9	3.4 – 25.0	11.1 – 19.1
Pre-fitting sphere (D)	1.50	−11.25 to 11.50	−3.25 to 3.88
Pre-fitting cylinder (D)	-3.75	−11.00 to −1.25	−7.75 to −2.50
Topographic astigmatism (D)	4.57	0.78–7.86	3.56–7.21
Topographic astigmatism axis (°)	138	5–161	117–148
K1 (D)	43.12	32.05–46.43	37.46–44.33
K2 (D)	46.72	39.92–52.12	41.84–49.62
Lens sagittal depth (µm)	3800	3400–4200	3600–4000
Lens power (D)	-1.00	−6.00 to 12.00	−2.25 to 2.00
Residual sphere (D)	3.50	−9.25 to 14.00	−3.50 to 4.88
Residual cylinder (D)	-0.75	-2.00 to -0.25	−1.63 to −0.38

Final lens diameter was 14.8 mm in 6 eyes (54.5%) and 16.3 mm in 5 eyes (45.5%). Residual refractive findings require cautious interpretation because post-lens refraction in pediatric traumatic eyes may be affected by lens centration, settling, the post-lens fluid reservoir, tear exchange, and patient cooperation.

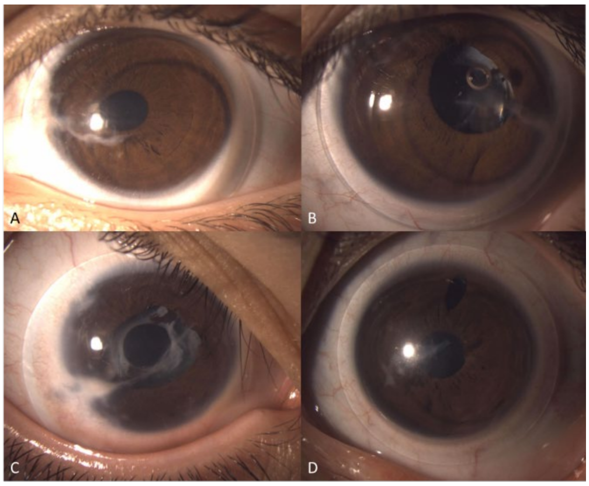

Figure 2:
Clinical appearance of post-traumatic corneal scarring in eyes rehabilitated with mini-scleral lenses.

Panels A–D show representative anterior segment photographs from Case 1, Case 3, Case 5, and Case 6, respectively, demonstrating corneal scarring and anterior segment irregularity after pediatric open globe injury. Mini-scleral lenses were used for visual rehabilitation in these eyes.

Mini-scleral lens fitting resulted in significant visual improvement. Median BCVA improved from 1.30 logMAR (IQR, 0.70–1.41) with the best spectacle correction before fitting to 0.40 logMAR (IQR, 0.15–0.70) with the final MSL after settling and over-refraction (Wilcoxon signed-rank test, $p = 0.002$). In decimal notation, median BCVA improved from 0.05 (IQR, 0.04–0.20) to 0.40 (IQR, 0.20–0.70). VA improved in 10 of 11 eyes (90.9%); Case 6 was the only eye without numerical change (Table I and Table II).

Median pre-fitting refractive cylinder was −3.75 D (IQR, −7.75 to −2.50 D), whereas median residual cylinder after fitting was −0.75 D (IQR, −1.63 to −0.38 D). Median topographic astigmatism magnitude was 4.57 D (IQR, 3.56–7.21 D). Median K1 and K2 values were 43.12 D (IQR, 37.46–44.33 D) and 46.72 D (IQR, 41.84–49.62 D), respectively (Table II, Figure 3).

The median MSL sagittal depth was 3800 µm (IQR, 3600–4000 µm), and the median lens power was −1.00 D (IQR, −2.25 to +2.00 D). Final lens diameter was 14.8 mm in 6 eyes (54.5%) and 16.3 mm in 5 eyes (45.5%) (Table II). In all fitted eyes, AS-OCT assessment after lens settling showed adequate corneal vaulting and a clinically acceptable post-lens fluid reservoir without evident corneal touch. A representative AS-OCT image is shown in Figure 4. Among the eyes in which MSL fitting was attempted and completed, no fitting failure due to poor cooperation was recorded. Daily wearing time, long-term adherence, handling difficulties, caregiver support, cost-related concerns, and lens-related complications were reviewed from available chart records but were not included in formal statistical analyses because documentation was not uniform.

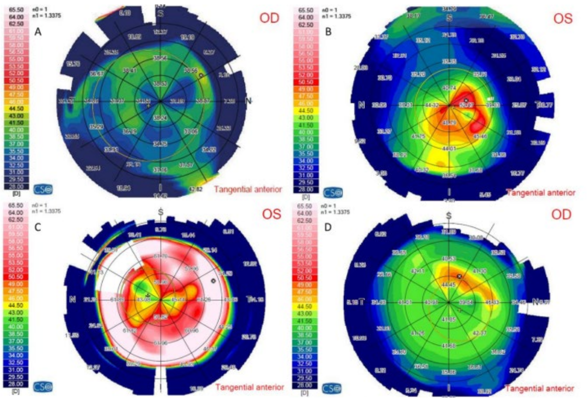

Figure 3:
Representative Tangential Anterior Corneal Topography Maps of Included Eyes

Representative tangential anterior corneal topography maps showing post-traumatic corneal irregularity in selected eyes fitted with mini-scleral lenses. Panels A–D correspond to Cases 4, 6, 7, and 11, respectively. The maps demonstrate varying degrees and patterns of irregular corneal astigmatism after pediatric open globe injury. OD: right eye; OS: left eye.

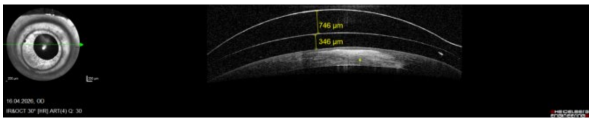

Figure 4:
Representative AS-OCT Image of Mini-Scleral Lens Fitting

Anterior segment optical coherence tomography showing mini-scleral lens vaulting over a post-traumatic irregular cornea. The measured lens thickness and post-lens fluid reservoir were approximately 746 µm and 346 µm, respectively. The green line indicates the scan axis, and the asterisk marks the area of corneal scarring/irregularity. *AS-OCT: anterior segment optical coherence tomography; MSL: mini-scleral lens.*

Families most commonly expressed concerns about cost and possible lens loss. MSLs were generally worn in approximately 4-hour intervals, with replacement of the lens-filling solution between sessions. In younger children, lens care was performed by parents or, when needed, with teacher assistance during school hours, whereas some older children managed lens handling under supervision. Handling difficulties were reported by families to varying degrees but did not lead to discontinuation in any patient. Families of children younger than 10 years were counselled regarding the risk of amblyopia, and occlusion therapy was continued when indicated.

During the available follow-up, no patient required conversion to corneal RGP lens wear. No severe CL-related complication requiring discontinuation was recorded. There were no documented reports of midday reservoir fogging, CL intolerance, or clinically significant deposits; however, these findings should be interpreted cautiously because symptom reporting may be less reliable in pediatric patients. At the final follow-up, 10 of 11 patients (90.9%) were regular lens wearers. One child discontinued regular lens wear because the patient did not perceive sufficient subjective benefit, rather than because of fitting failure or a lens-related adverse effect.

In the three cooperative patients assessed with the Pelli-Robson chart, logCS improved from 1.00 to 1.25, 1.30 to 1.55, and 0.55 to 0.95, respectively; these findings were analyzed descriptively because of the small number of tested patients. In addition, several families subjectively reported brighter color perception and reduced light sensitivity after MSL wear. In two patients with sensory exotropia, an apparent reduction in the angle of exotropia was observed after MSL correction, estimated by Hirschberg testing as approximately 15 prism diopters in one patient and 25 prism diopters in the other. However, formal prism cover testing could not be performed reliably in these patients.

Discussion and Conclusion

In this retrospective pediatric case series, MSL rehabilitation provided significant visual improvement after OGI. Median BCVA improved from 1.30 logMAR before fitting to 0.40 logMAR with MSL wear, and VA improved in 90.9% of eyes. Given the substantial pre-fitting refractive and topographic astigmatism in this cohort, these findings suggest that MSLs can provide meaningful optical rehabilitation in selected pediatric eyes with post-traumatic corneal scarring and irregular astigmatism.

Successful anatomical repair after pediatric OGI does not necessarily ensure satisfactory functional vision. Post-traumatic corneal scarring, irregular astigmatism, aphakia, and anterior segment distortion may limit spectacle-corrected VA, making optical rehabilitation an essential component of long-term management [13]. Scanzera et al. reported that CL rehabilitation after OGI improved VA beyond manifest refraction, supporting the role of CLs in post-traumatic visual rehabilitation[11]. Similarly, Titiyal et al. showed that, after repaired corneal perforations, 6/18 or better vision was achieved in 25% of eyes with spectacles and in 92.5% with CLs, although their study mainly involved corneal RGP lenses and did not specifically analyze pediatric cases separately[6].

A distinctive aspect of the present study was the use of MSLs as the primary CL modality, rather than only after an unsuccessful corneal RGP lens trial. This approach was based on the clinical characteristics of post-traumatic pediatric eyes, including marked corneal irregularity, potential lens instability, risk of corneal bearing over scarred tissue, and the need for sustained optical correction during visual development. MSLs can vault the irregular corneal surface and provide stable centration without direct corneal contact. Although most comparative data come from keratoconus and largely adult populations, previous studies have reported greater satisfaction with vision and comfort among SL wearers, similar perceived ease of use, and no significant difference in annual spending compared with corneal RGP wearers, whereas lens movement or loss appears to be more frequent among corneal RGP lens wearers[14-16]. These findings cannot be directly extrapolated to pediatric OGI; nevertheless, lens stability, retention, and avoidance of corneal bearing are particularly relevant in children with traumatic corneal irregularity.

The pediatric context is especially important because delayed or insufficient optical correction may contribute to amblyopia[8]. Goppalakrishnan and Prabhu reported a child with OGI in whom a corneal RGP lens improved vision but was poorly tolerated because of symptoms, handling difficulty, and lens dislocation; after transition to a fenestrated SL, comfort and lens use improved, allowing amblyopia treatment to continue[17]. The present series extends this case-level observation to a pediatric cohort managed with the same general rehabilitative principle. The feasibility of MSL use even in a 5-year-old child also suggests that this approach may be applicable in selected young children when fitting, training, and caregiver support are adequate.

The visual outcomes of this series are broadly consistent with previous pediatric and adult CL rehabilitation studies. Alipour et al. evaluated MSLs in 72 eyes of 52 pediatric patients and identified traumatic corneal scar as an important indication; in their traumatic scar subgroup, mean logMAR VA improved from 1.46 to 0.38[18]. In adult OGI, Biberoğlu Çelik et al. reported that scleral lenses improved median BCVA from 0.50 to 0.10 logMAR after repair and also described visual improvement in two pediatric cases aged 6 and 9 years [9]. The final VA in the present cohort was lower than that reported in adult series, which is expected given the additional influence of amblyopia, visual deprivation, injury severity, and pediatric cooperation.

Visual acuity improved in 10 of 11 eyes. Case 6 was the only eye without numerical improvement (1.30 to 1.30 logMAR) and had severe amblyopia. Severe amblyopia also limited final visual potential in Cases 8 and 9, and a macular scar limited Case 10, although these three eyes showed numerical improvement from 1.30 to 0.70, 1.52 to 0.70, and 1.85 to 1.00 logMAR, respectively. Thus, limited final visual potential in these eyes reflects residual amblyopia or posterior segment pathology rather than absence of a numerical response to MSL correction. Broader SL and MSL series also support the practical value of this approach while emphasizing that handling, cost, and adherence remain important determinants of long-term [19-21].

The absence of prior keratoplasty is clinically relevant because pediatric post-traumatic keratoplasty is challenging and requires prolonged postoperative cooperation and follow-up[9,22,23]. In this context, MSLs may serve as a useful non-surgical rehabilitation option before keratoplasty is considered, particularly when the main limitation is corneal scarring with irregular astigmatism rather than irreversible posterior segment damage, and when adequate optical rehabilitation can be achieved without corneal transplantation.

Safety and tolerability require careful interpretation in pediatric MSL wear. Information regarding SL-associated corneal edema in children remains limited[26]. In the present cohort, no clinically evident corneal edema, severe lens-related complication, midday reservoir fogging, significant deposits, or lens intolerance was documented; however, underreporting is possible in pediatric patients[25]. The main practical barriers were cost, possible lens loss, and handling difficulty. Because young children are often unable to insert and remove these lenses independently, successful wear also depends on caregiver motivation and daily support. At final follow-up, 10 of 11 patients remained regular lens wearers; one stopped regular wear because of insufficient perceived benefit, not handling failure or an adverse effect. Secondary functional observations were exploratory. Contrast sensitivity improved in the three cooperative patients tested with the Pelli-Robson chart, and some families reported brighter color perception and reduced light sensitivity after MSL wear. A reduction in the apparent angle of sensory exotropia was also observed in two patients by Hirschberg estimation, but reliable prism cover testing could not be performed. These observations require confirmation in prospective studies with standardized functional assessments.

This study has several limitations. Its retrospective design, small sample size, single-center setting, and relatively short follow-up limit the generalizability of the findings. Selection bias should also be considered, because the cohort included only eyes deemed suitable for MSL rehabilitation and therefore does not represent the full clinical spectrum of pediatric OGI. Longer observation is needed to determine whether the visual benefit is sustained and to better assess long-term compliance, handling burden, cost-related barriers, parental or school-time support, and lens-related complications. Because the cohort consisted of pediatric patients, self-reported lens wearing time could not be reliably quantified and was not analyzed as a formal outcome. Measurements in children may also be less reliable because of limited cooperation, fixation instability, and difficulty maintaining consistent testing conditions. Furthermore, measurements obtained over or with the lens in place may be influenced by lens centration, settling, the post-lens fluid reservoir, tear exchange, and patient cooperation. Objective and subjective refractive measurements in this setting should therefore be interpreted cautiously. Final visual outcomes should also be considered in relation to age at injury, amblyopia, trauma severity, posterior segment status, previous surgeries, and adherence to optical correction. Larger prospective cohort studies are needed to evaluate whether MSL rehabilitation can support amblyopia management through earlier and sustained optical correction, and to determine its long-term effects on visual development, corneal morphology, treatment adherence, and the need for keratoplasty in selected post-traumatic pediatric eyes.

In conclusion, MSLs provided significant visual improvement in pediatric eyes after OGI. In this trauma-specific pediatric cohort without prior keratoplasty, MSL rehabilitation appeared feasible as an initial rigid lens-based rehabilitation modality, with no need for conversion to corneal RGP lenses during follow-up. These findings support MSLs as a useful non-surgical visual rehabilitation option in selected children with post-traumatic corneal scarring and irregular astigmatism, particularly before keratoplasty is considered.

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