

Original research

Visual management of aphakia with concomitant severe corneal irregularity by mini-scleral design contact lenses

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Abstract

Purpose: To evaluate visual results, comfort of use, safety, and efficacy of mini scleral contact lenses in optical management in patients with traumatic aphakia and severe concomitant irido-corneal injury.

Methods: In a case series, eight eyes with post traumatic aphakia and severe concomitant irido-corneal injury that were evaluated at the Contact Lens Clinic of Farabi Eye Hospital, Tehran, Iran for contact lens fitting and could not be corrected with conventional corneal RGP contact lenses were fitted with miniscleral contact lenses. Uncorrected visual acuity (UCVA), best spectacle corrected visual acuity (BSCVA), and BCVA (Best corrected visual acuity) with miniscleral lens were recorded. Slit lamp examination, comfortable daily wearing time, and any contact lens-related complication were documented in each follow-up visit.

Results: The mean UCVA and BSCVA of the cases was >2.7 and 0.41 LogMAR, respectively (BSCVA could not be assessed in one case due to severe corneal irregularity). The mean final BCVA with the miniscleral lens was 0.05 LogMAR (range from 0.4 to -0.04 LogMAR). The mean follow-up period was 14.6 months. The mean comfortable daily wearing time (CDWT) was 11.6 h, ranging from 8 to 16 h. The only contact lens-related complication was mild redness and irritation that was observed in 2 patients during the follow-up visits. All patients were comfortable with handling these lenses.

Conclusion: Miniscleral contact lenses can be considered a safe and effective option in aphakia patients with concurrent corneal scarring secondary to ocular injury for whom surgical intervention would be complicated.

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Keywords: Mini-scleral contact lens; Aphakia; Irregular cornea

Introduction

Utilization of the scleral family (full or mini) contact lenses is rapidly finding its way in various indications. The usefulness

of these lenses have been shown in many situations such as severe dry eye, advanced corneal ectasia, and post corneal inlay implantation.^{1–3} By considering the causes of corneal neovascularization,⁴ the limbus-friendly design of miniscleral lenses might lead to lower rates of corneal neovascularization at least in theory, compared to soft contact lenses, as they pass the limbal area without any direct continuous limbal irritation. On the other hand, scleral family lenses are relatively thick compared to other lenses that theoretically reduce the oxygen supply.⁵ Visual outcomes are comparable or even better than conventional RGP lenses in many patients.^{1,6,7} Scleral and semiscleral lenses have proven to be extremely beneficial for patients with highly irregular and/or asymmetric keratoconic corneas, especially large diameter (13.5 – 16.0 mm)

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semiscleral lens designs.⁷ Schornack showed a dramatic improvement in visual acuity by using scleral lens in a study.⁸

The lack of the corneal touch in these lenses makes them favorable-regarding safety and efficacy-for highly irregular corneas and ectatic corneal disorders.^{1,9} Corneal RGP lenses might be difficult or impossible to fit in eyes with severe corneal scars and coarse opacities. Fitting of these modern larger diameter contact lenses can be a good option for visual acuity and quality improvement. Patients with penetrating injury occasionally have extensively irregular corneal lacerations, severe iris injury or loss, and concurrent traumatic cataract. In many of the patients, after primary repair and lensectomy, it is impossible to insert the intraocular lens (IOL) in the remnants of the capsular bag if any remnant exists. Occasionally, in traumatic aniridia, iris fixation is even impossible, and scleral fixation remains the only surgical option in these cases; however, visual acuity remains poor because of the concomitant irregular astigmatism that would not be eliminated by IOL implantation.¹ The safety and efficacy of miniscleral contact lenses in visual improvement have been demonstrated in other settings, mostly for addressing patients with highly irregular corneas such as the cases with ectatic corneas, keratoglobus, and Terrien's marginal degeneration.^{1–3,10} On the other hand, highly gas permeable RGPs have been used for correcting aphakic patients with an excellent efficacy and safety profile.^{2,11} Considering the ability of miniscleral (MSD) contact lenses to correct high levels of corneal irregularity and their high permeability to oxygen, we decided to use them for visual rehabilitation of the patients with concomitant aphakia and severe irido-corneal injury. We present the visual rehabilitation outcomes of eight cases with a history of severe ocular trauma following the use of miniscleral contact lenses.

Methods

The protocol of this case series study was approved by the Eye Research Center Ethics Committee of Farabi Eye Hospital, Tehran, Iran. Aphakic patients with a history of concomitant irido-corneal injury were referred to the Contact Lens Clinic, at a tertiary referral center, Farabi Eye Hospital, Tehran, Iran. Among these patients, consecutive patients with severe corneal irregularity that could not be fitted by conventional corneal RGP lenses were included. The measurement of uncorrected visual acuity, manual Javal keratometry, auto kerato-refractometry, objective refraction by means of retinoscopy in dim light, subjective refraction, and best spectacle corrected visual acuity (BSCVA) were recorded. Visual acuity was measured with Snellen charts and converted to LogMAR units. Manual Javal keratometry was performed three times on each eye, and the mean of the three measurements was used for lens power estimation. These patients underwent MSD contact lens fitting (non-fenestrated; diameter 15.8 mm) (Blanchard Contact Lens Inc., Manchester, Canada). The material of the lenses was Boston XO with DK of 100 ISO, 141 gas to gas. Best corrected visual acuity with the MSD contact lens was assessed, and retinoscopy was

performed once again with the MSD lens fitted on the eye. Slit lamp examination was used to evaluate fitting and fluorescein pattern by one contact lens practitioner experienced in this field (FA), and the pattern was evaluated as three groups:

- *Ideal fit*: no touch over the entire cornea in the fluorescein pattern viewed by Cobalt light, vaulting between 100 and 200 μm evaluated by 30-degree oblique slit lamp beam, no impingement over conjunctival vessels.
- *Acceptable*: no corneal touch and minimal conjunctival/scleral impingement (less than three clock hours) with only small conjunctival vessels being under pressure.
- *Unacceptable*: corneal touch with maximum available sagittal vault or more than three clock hours conjunctival/scleral impingement and reported subjective dissatisfaction

After fitting the optimal lens in our cases, they were followed at regular intervals every other month. Comprehensive ophthalmic examinations including slit lamp examination and assessment of visual acuity were performed at each follow-up visit. The patients were asked about their comfortable daily wearing time, any redness, irritation, fluctuation in the quality of vision, and any other problem with these lens in a form. Complications and subjective and objective visual outcomes were investigated and recorded in follow-up sessions.

Results

The age range of the 8 patients was between 11 and 59 years old. Keratometry readings ranged from 6.8 to 10 mm. Objective spherical equivalent ranged from +11.00 to +15.00. Seven patients used glasses or RGP lenses in the past for refractive correction. One patient had a history of an unsuccessful attempt for secondary IOL insertion, had difficulty with RGP fitting trial, and used no mode of vision correction. These cases were not candidates for the IOL implantation procedure or corneal keratoplasty to improve vision, at the discretion of Cornea Department. The low quality of the spectacle corrected visual acuity was the chief complaint of all of our patients. High amounts of visual aberrations and glare were remarkable in 5 patients. Clinical findings and past surgical history of the cases are demonstrated in [Tables 1 and 2](#). Characteristics of the fitted MSD lenses are listed in [Table 3](#).

All of the patients were followed closely every other month. Aside from examinations, they were asked about subjective issues they had with the lenses, by means of a checklist, in each session. The mean follow-up period was 14.6 months, ranging from 12 to 18 months, and the follow-up sessions are ongoing.

Uncorrected visual acuity ranged from finger count at 10 cm (2.7 LogMAR) to 1.3 LogMAR (20/400 or 1/20). The power of the MSD lenses ranged from +4.0 to +16.0 D. The mean of the BCVA (Best corrected visual acuity) with MSD lenses, was 0.05 LogMAR (range from 0.4 to -0.04 LogMAR). Most of the patients were comfortable with handling these lenses. However, in one of the patients, the MSD lens tear occurred on handling the lens at home. The lens was ordered again, and the

Table 1
Clinical and surgical history of the patients.

Case no.	Past surgical history	Age	Sex	Clinical findings	Previous correction	Failure reason of previous mode of refractive correction	F/U ^c (months)	CDWT ^d (h/day)
1	P.R. ^a & L. ^b , unsuccessful trial of secondary IOL implantation	15	F	Corneal scar and partial aniridia	RGP	Dry eye, Uncomfortable fit	12	12–16
2	P.R., S.L. and anterior vitrectomy	30	M	Irregular corneal scar	glasses	Unsatisfactory refractive correction/prescribed to be used only with patching of the sound eye	14	10–12
3	P.R. & L.	33	F	Irregular corneal scar	glasses	Unsatisfactory refractive correction/prescribed to be used only with patching of the sound eye	15	10–12
4	Primary repair and secondary lensectomy	11	M	Irregular corneal scar	RGP	Uncomfortable fit	14	12–14
5	P.R. & L., and anterior vitrectomy	30	M	Mild exotropia and hypertropia	RGP	Dry eye, Uncomfortable fit	12	8–10
6	P.R. & L., and deep vitrectomy with gas tamponade for subsequent retinal detachment	59	M	Near total traumatic aniridia and a limbus-to-limbus vertical corneal scar	RGP	Unsatisfactory refractive correction	16	10–12
7	P.R. & L.	32	M	Irregular corneal scars and superior corneal vascularization	None	Dry eye, Uncomfortable fit	18	12–14
8	P.R. & L., and deep vitrectomy for vitreous hemorrhage	13	M	A large center involving cross-shaped corneal laceration	RGP	Unstable fit/excess movement	16	10–12

^a P.R.: primary wound repair.

^b L.: lensectomy.

^c F/U: Follow up period after receiving mini scleral lens.

^d CDWT: Comfortable daily wearing time of mini scleral lens hours per day.

patient received it one month later. In the meantime, she used her RGP and announced that her quality of vision was far less acceptable compared to the MSD lens that she had been using. Two of the cases also had mild irritation and ocular redness in first few months, which improved with the use of non-preserved artificial tears in the course of follow-ups.

The comfortability of the patients was noticeably high, and all the cases were satisfied with the visual outcomes. They noted highly improved quality of vision and comfortable use

of the miniscleral lenses in their last follow-up visit. Fig. 1a demonstrates one of the highly damaged eyes that did not tolerate the RGP contact lens. Fig. 1b demonstrates one of the cases fitted with the MSD lens.

Discussion

Visual correction with spectacles has many drawbacks in unilateral aphakia.¹¹ As high amounts of hyperopia are to be

Table 2
Keratometry, Objective/subjective refraction, uncorrected, best spectacle corrected visual acuity and best corrected visual acuity by MSD.

Case number	Keratometry		Refraction		Uncorrected VA (LogMAR)	Best spectacle corrected VA (LogMAR)	Best corrected VA with MSD (LogMAR)
	K1	K2	Objective	Subjective			
1	9.90*140	9.10*30	+14.00–3.50*180	+12.00–2.00*180	1.7	0.22	–0.04
2	10.00*120	7.50*35	+12.50–3.00*130	+13.00–2.00*130	1.3	0.3	1.0
3	7.9*25	7.1*100	+11.00–2.75*180	+11.00–2.00*180	2.0	0.52	1.0
4	NA	NA	NA	NA	1.7	NI	0.4
5	7.60*135	6.80*40	+14.50–5.00*125	+14.00–4.00*130	1.7	0.4	–0.04
6	8.6*35	8.3*158	+14.00–3.00*65	+12.50–2.25*70	2.7	0.52	0.1
7	9.60*60	8.40*125	+15.00–2.50*140	+15.00–3.00*150	1.7	0.22	0.15
8	9.10*30	7.00*140	NA	NA	2.4	NI	1.0

NA: Not accessible.

NI: Not improved.

Table 3
Characteristics of the final miniscleral contact lens fitted and the BCVA by MSD.

N	Number of trials	Vault	Midperipheral curve	Profile	Power	Best corrected visual acuity with MSD
1	2	4.6	Increased	7.60	+4.0	−0.04
2	3	4.2	Increased	8.00	+15.5	1
3	2	4.6	Increased	7.40	+7.5	1
4	3	4.2	Standard	—	+12.0	0.4
5	3	4.2	Standard	—	+16.0	−0.04
6	2	4.6	Standard	7.40	+7.5	0.1
7	3	4.4	Increased	8.00	+10.0	0.15
8	3	4.2	Standard	7.80	+16.0	1

corrected, peripheral image shape distortion, induced aberration, and restricted peripheral field because of the prismatic effect make spectacles an unpleasant mode of correction, even in bilateral cases.^{11,12} The vertex distance has its own negative effects on the image shape, quality, and field of clear vision. Aniseikonia in unilateral cases makes spectacles an intolerable option for optical correction.¹² IOL implantation is the best optical substitute for aphakia, but since there are concomitant corneal scars and irregularity, visual correction is sometimes unsatisfactory despite IOL implantation in some traumatic cases.^{12,13} Additionally, partial or total aniridia makes IOL implantation difficult, and complications such as corneal edema due to endothelial cell damage, wound leakage, vitreous hemorrhage, uveitis, retinal detachment, and cystoid macular edema have been reported in attempted scleral fixation of the IOLs.^{13,14}

Contact lenses have been considered great optical options for addressing both aphakia and corneal irregularity.^{1,3,11,15,16} Some types of soft contact lenses have been used for correction of aphakia. The Silsoft extended wear soft contact lens is a commonly used brand worldwide in aphakia due to its high permeability to oxygen and easy handling.¹⁷ Rigid highly gas permeable contact lenses have gained more popularity nowadays, especially in the patients with concomitant high astigmatism.^{1,6,7,18} Central corneal opacity is an issue in the RGP

use especially at the bearing point on the cornea. Peripheral corneal neovascularization has also been reported.^{15,16} In recent years, scleral family lenses have become favorable because of availability of high Dk material and newer design. These lenses are indicated when all other contact lenses fail to improve the vision, with any inability to get an optimal fit with RGP or RGP intolerance, or any complication of other lens groups.¹⁹

Traumatic cataract with concomitant corneal scar is a challenging condition to manage. Concomitant conditions such as dry eye and irregular tear film distribution makes patients look for a more effective and comfortable mode of refractive correction with best visual outcome with minimum risk. Many of the available surgical options have lost their popularity, considering their low visual gain and high potential risks. The MSD lens is a good choice to try in order to address high degrees of irregular corneal astigmatism besides aphakia if conventional corneal RGP lenses fail to fit. Scleral family contact lenses have been widely used recently for different indications such as keratoconus or other corneal ectasias, dry eye, damaged, scarred, or vascularized corneal surface, persistent corneal epithelial defect, and irregular or oblique corneal astigmatism.^{1,18–22} Successful scleral lens fitting has been reported recently for the treatment of post-LASIK ectasia and superficial neovascularization of intrastromal corneal ring segments in two eyes of a patient.²² The overall success rate of scleral family lenses has been reported 70–80% in the literature review variable in different indications.⁸ Their highly gas permeable material makes them a good option for correcting aphakia since they are required to be used for longer hours in this situation. As the MSD lenses are smaller and less expensive than scleral lenses, and they might be easier to fit, they can be better choices when compared to other lenses of the scleral family in patients with ocular surface abnormalities.²¹ Therefore, for those eyes intolerant to the conventional corneal RGP, that have a low chance for achieving good visual outcomes at a high risk of complications, MSD lenses seem to be a good option. No weight bearing point on the cornea is a remarkable advantage of the MSD lenses over corneal RGP

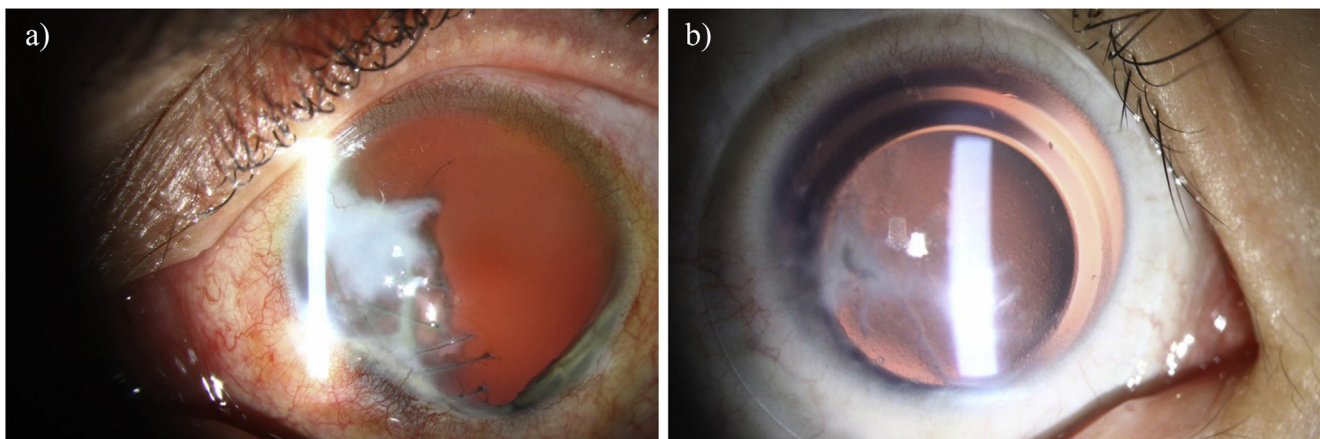


Fig. 1. A large white scar on the cornea, with very little iris remnants. The patient did not tolerate corneal RGP contact lens (a). A highly irregular cornea in an aphakic eye; MSD was fitted for the patient (b).

lenses; as a result, the risk of the aggravation of the existing corneal scars or development of new opacities seems to be lower, as the mechanical force and pressure is distributed on the sclera.⁹ Comfortable daily wear has been reported up to 16–18 h in literature.²¹

Because of the effect of the tear lens formed between the cornea and posterior surface of the contact lens, clarity of vision and corneal wetting improve markedly.²¹ Altogether, a better visual outcome is expected theoretically. As a pilot study, we found it in practical use as well. It is proposed that the MSD lens is a favorable choice for trial in patients with multiple anterior eye sources of poor vision, especially when surgical correction is almost impossible or may impose further damage to the traumatized eye.

However, a larger sample size and longer follow-ups are required to confirm these results.

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References

- Alipour F, Jabarvand Behrouz M, Samet B. Mini-scleral lenses in the visual rehabilitation of patients after penetrating keratoplasty and deep lamellar anterior keratoplasty. *Cont Lens Anterior Eye*. 2015;38:54–58.
- Baran I, Bradley JA, Alipour F, Rosenthal P, Le HG, Jacobs DS. PROSE treatment of cornea ectasia. *Cont Lens Anterior Eye*. 2012;35:222–227.
- Mahadevan R, Fathima A, Rajan R, Arumugam AO. An ocular surface prosthesis for keratoglobus and Terrien's marginal degeneration. *Optom Vis Sci*. 2014;91(4 suppl. 1):S34–S39.
- Abdelfattah NS, Amgad M, Zayed AA, et al. Clinical correlates of common corneal neovascular diseases: a literature review. *Int J Ophthalmol*. 2015;8:182–193.
- Compañ V, Oliveira C, Aguilera-Arzo M, Mollá S, Peixoto-de-Matos SC, González-Méjome JM. Oxygen diffusion and edema with modern scleral rigid gas permeable contact lenses. *Invest Ophthalmol Vis Sci*. 2014;55:6421–6429.
- Romero-Jiménez MI, Flores-Rodríguez P. Utility of a semi-scleral contact lens design in the management of the irregular cornea. *Cont Lens Anterior Eye*. 2013;36(3):146–150.
- Ozkurt Y, Atakan M, Gencaga T, Akkaya S. Contact lens visual rehabilitation in keratoconus and corneal keratoplasty. *J Ophthalmol*. 2012;2012:832070. <http://dx.doi.org/10.1155/2012/832070>. Article ID 832070.
- Schorneck MM. Scleral lenses: a literature review. *Eye Contact Lens*. 2015;41:3–11.
- Van der Worp E, Bornman D, Ferreira DL, Faria-Rebeiro M, Garcia-Porta N, González-Mejome JM. Modern scleral contact lenses: a review. *Cont Lens Anterior Eye*. 2014;37:240–250.
- DeLoss KS, Fatteh NH, Hood CT. Prosthetic replacement of the ocular surface ecosystem (PROSE) scleral device compared to keratoplasty for the treatment of corneal ectasia. *Am J Ophthalmol*. 2014;158:974–982.
- Russell B, Ward MA, Lynn M, Dubois L, Lamert SR, Infant Aphakia Treatment Study Group. The infant aphakia treatment study contact lens experience: one-year outcomes. *Eye contact lens*. 2012;38:234–239.
- Lindsay RG, Chi JT. Contact lens management of infantile aphakia. *Clin Exp Optom*. 2010;93:3–14.
- Lockington D, Ali NQ, Al-Taie R, Patel DV, McGhee CNJ. Outcomes of scleral-sutured conventional and aniridia intraocular lens implantation performed in a university hospital setting. *J Cataract Refract Surg*. 2014;40:609–617.
- Ahmed Bhutto I, Qadir Kazi G, Mahar PS, Ahmed Qidwai U. Visual outcome and complications in Ab-externo scleral fixation IOL in aphakia in pediatric age group. *Pak J Med Sci*. 2013;29:947–950.
- Segal O, Barkana Y, Hourovitz D, et al. Scleral contact lenses may help where other modalities fail. *Cornea*. 2003;22:308–310.
- Takahide K, Parker PM, Wu M, et al. Use of fluid-ventilated, gas permeable scleral lens for management of severe keratoconjunctivitis sicca secondary to chronic graft versus host disease. *Biol Blood Marrow Transplant*. 2007;13:1016–1021.
- Ausuri MK, Venkata N, Preetam P, Rao NT. Management of pediatric aphakia with silsoft contact lenses. *CLAO J*. 1999;25:209–212.
- Ye P, Sun A, Weissman BA. Role of mini-scleral gas-permeable lenses in the treatment of corneal disorders. *Eye Contact Lens*. 2007;33:111–113.
- Rathi VM, Mandathara PS, Dumpati S. Contact lens in keratoconus. *Indian J Ophthalmol*. 2013;61:410–415.
- Rosenthal P, Croteau A. Fluid-ventilated, gas-permeable scleral contact lens is an effective option for managing severe ocular surface disease and many corneal disorders that would otherwise require penetrating keratoplasty. *Eye Contact Lens*. 2005;31:130–134.
- Alipour F, Kheirkhah a, Jabarvand Behrouz M. Use of mini scleral contact lenses in moderate to severe dry eye. *Cont Lens Anterior Eye*. 2012;35:272–276.
- Kramer EG, Boshnick EL. Scleral lenses in the treatment of post-LASIK ectasia and superficial neovascularization of intrastromal corneal ring segments. *Cont Lens Anterior Eye*. 2015;38(4):298–303. <http://dx.doi.org/10.1016/j.clae.2015.02.003>. pii: S1367–0484(15)00022-3.