

Correction of Pre-existing Against-the-rule Corneal Astigmatism by Temporal Approach Manual Small Incision Cataract Surgery: A Case Series

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ABSTRACT

Against-the-rule corneal astigmatism is more prevalent in senile cataracts and results in poorer uncorrected visual acuity if not corrected at the time of cataract surgery. Although phacoemulsification with toric IOL implantation is preferred for the management of pre-existing corneal astigmatism, ophthalmologists often encounter cases of cataracts with significant corneal astigmatism in which phacoemulsification surgery is not feasible. This case series describes six eyes of six different patients with cataracts and against-the-rule corneal astigmatism who underwent cataract surgery by temporal-approach Manual Small Incision Cataract Surgery (MSICS), and their postoperative astigmatism outcomes were evaluated. The first patient was initially planned for phacoemulsification with toric IOL implantation; however, an intraoperative posterior capsule rupture occurred, and the surgeon opted to convert to MSICS. The second patient had a hard brown brunescence cataract with a visual acuity of finger counting close to the face. The third patient could not afford a foldable IOL required for phacoemulsification and therefore opted for MSICS with a rigid Polymethyl Methacrylate (PMMA) IOL. The fourth patient had a white intumescent mature cataract with visual acuity of only light perception. This patient was planned for phacoemulsification but experienced an intraoperative capsulorhexis extension to the lens equator, leading to abandonment of phacoemulsification and conversion to MSICS. The fifth patient had a black hard cataracta nigra with visual acuity of only light perception. The sixth case was a post-traumatic white mature cataract with visual acuity of only light perception and zonular dialysis, and MSICS with anterior vitrectomy and retropupillary-fixated iris-claw IOL implantation was performed. All patients, on review at one month after surgery, showed reduced or neutralised corneal astigmatism.

Keywords: Intraocular lens implantation, Phacoemulsification surgery, Temporal incision

INTRODUCTION

Cataracts occur due to degeneration and opacification of lens fibres or through the formation of aberrant fibres or material deposits in their place [1]. Most patients with cataracts fall within the age group of 60–79 years, followed closely by those aged 40–59 years [2]. With ageing, there is an increased predominance of against-the-rule corneal astigmatism [3]. Significant pre-existing corneal astigmatism, if not managed during cataract surgery, can lead to poorer uncorrected visual acuity. Although phacoemulsification with toric IOL implantation is the preferred method for correcting corneal astigmatism during cataract surgery [4], certain clinical scenarios—such as hard brown brunescence cataracts [5]—may favour the MSICS technique. In such situations, pre-existing corneal astigmatism can be neutralised by modifying the corneal wound architecture [6], as scleral incisions made on the steeper axis, whether temporal or superior, produce flattening of that axis [7], thereby reducing or eliminating the pre-existing astigmatism.

In the developing world, access to phacoemulsification has been limited [8]. In this case series, the correction of pre-existing against-the-rule corneal astigmatism in six eyes of six patients who underwent cataract surgery by temporal-approach MSICS was evaluated.

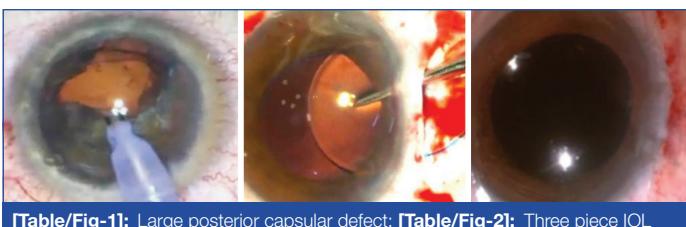
CASE SERIES

Written informed consent, detailing the surgical procedure and associated risks, was obtained from all patients. Intraocular Lens (IOL) power calculation was performed after measuring Axial Length (AL), K1, K2, and Anterior Chamber Depth (ACD) using the Carl Zeiss IOL Master 500. Only patients with no posterior segment pathology were included. All procedures were performed by the

same ophthalmologist under peribulbar anaesthesia using a mixture of lignocaine 2%, bupivacaine 0.5%, and hyaluronidase. A sclero-corneal tunnel was constructed on the temporal side, a side-port entry was made, the anterior capsule was stained with trypan blue, and an adequately sized capsulorhexis was created with a bent cystotome. After hydrodissection, the nucleus was delivered by viscoexpression. A single interrupted 9-0 polyamide suture was used to close the tunnel following IOL implantation. Corneal astigmatism was measured as the difference between the keratometry readings of the steep and flat meridians obtained with the Carl Zeiss IOL Master 500. Unaided and best-corrected visual acuity at one month postoperatively were compared with preoperative values.

Case 1

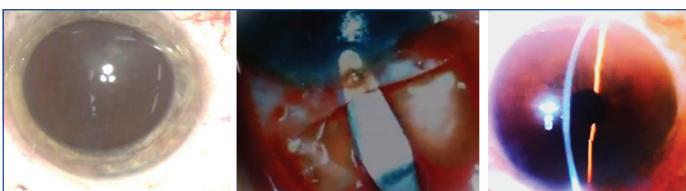
A 51-year-old female presented with an age-related senile cataract consisting of nuclear sclerosis grade II and posterior subcapsular cataract in the right eye, with a preoperative visual acuity of 6/24 that did not improve with refraction. Keratometry readings were K1=43.72 D @102° and K2=45.84 D @12°. Considering the corneal astigmatism of +2.12 D @12°, phacoemulsification with toric IOL implantation was planned. However, during phacoemulsification, a posterior capsular tear was noted [Table/Fig-1] while more than half of the nucleus was still inside the capsular bag. As the capsular tear was large, the decision was made to abandon phacoemulsification, and MSICS was performed with implantation of a three-piece foldable IOL in the ciliary sulcus [Table/Fig-2,3] after a thorough anterior vitrectomy. At the 1-month follow-up, visual acuity in the operated eye was 6/9 unaided, improving to 6/6 with -0.75 DC @78°. Keratometry readings were K1=44.45 D @87° and K2=45.23 D @177°.



[Table/Fig-1]: Large posterior capsular defect; [Table/Fig-2]: Three piece IOL implanted; [Table/Fig-3]: Post-op day 3. (Images from left to right)

Case 2

A 90-year-old man presented with a brown brunescent cataract in the right eye [Table/Fig-4], with a visual acuity of Counting Fingers Close to Face (CFCF). Keratometry readings were $K_1=45.83$ D @106° and $K_2=47.63$ D @16°. Considering the hardness of the cataract, MSICS was performed [Table/Fig-5], and a three-piece foldable IOL was implanted in the capsular bag [Table/Fig-6].



[Table/Fig-4]: Brown brunescent hard cataract; [Table/Fig-5]: Temporal MSICS incision; [Table/Fig-6]: Post-op day 3. (Images from left to right)

At the 1-month follow-up, unaided visual acuity was 6/6 with autorefractometry showing -0.25 DS / +0.50 DC @87°. Keratometry readings were $K_1=46.59$ D @78° and $K_2=47.18$ D @168°.

Case 3

A 62-year-old male presented with a thick posterior subcapsular cataract and nuclear sclerosis grade II in the left eye, with a visual acuity of 3/60 that did not improve. Keratometry readings were $K_1=44.49$ D @110° and $K_2=46.36$ D @20°. The patient could not afford a foldable IOL and consented to undergo MSICS. MSICS was performed, and a rigid PMMA IOL was implanted in the capsular bag [Table/Fig-7,8]. At the 1-month follow-up, unaided visual acuity was 6/12, improving to 6/6 with -0.75 DC @65°. Keratometry readings were $K_1=45.06$ D @78° and $K_2=46.13$ D @168°.



[Table/Fig-7]: Rigid PMMA IOL implanted; [Table/Fig-8]: Post-op day 3. (Images from left to right)

Case 4

A 69-year-old female presented with a white intumescent mature cataract in the right eye, with visual acuity of only light perception with accurate projection of light. Keratometry readings were $K_1=43.38$ D @93° and $K_2=44.81$ D @3°. During surgery, the capsulorhexis extended to the lens equator, prompting the surgeon to convert to MSICS. A three-piece foldable monofocal IOL was implanted in the ciliary sulcus. At the 1-month follow-up, unaided visual acuity was 6/9, improving to 6/6 with -0.50 DC @80°. Keratometry readings were $K_1=43.78$ D @113° and $K_2=44.63$ D @23°.

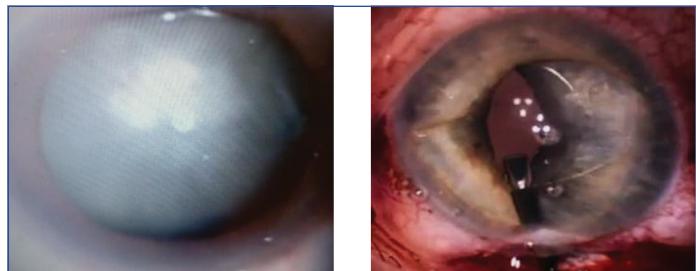
Case 5

A 92-year-old female presented with a black cataracta nigra in the right eye, with visual acuity of only light perception. Keratometry

readings were $K_1=43.43$ D @107° and $K_2=45.74$ D @17°. MSICS was performed considering the extreme hardness of the nucleus, and a three-piece foldable monofocal IOL was implanted in the ciliary sulcus. At the 1-month follow-up, unaided visual acuity was 6/6, with autorefractometry showing -0.25 DS / +0.50 DC @8°. Keratometry readings were $K_1=44.26$ D @111° and $K_2=44.72$ D @21°.

Case 6

A 57-year-old male presented with a post-traumatic white mature cataract in the right eye, with zonular dialysis spanning 8 clock hours from 11 o'clock to 7 o'clock [Table/Fig-9], and vitreous prolapse into the inferonasal pupillary area. Visual acuity was only light perception. Keratometry readings were $K_1=43.77$ D @112° and $K_2=45.86$ D @12°. The case was taken up for MSICS. During capsulorhexis, the remaining zonules were found to be lax, resulting in complete detachment of the capsular bag, which was delivered along with the cataractous lens through a 2-mm temporal corneoscleral tunnel. A retropupillary-fixated iris-claw IOL was implanted [Table/Fig-10] after a thorough anterior vitrectomy. At the 1-month follow-up, unaided visual acuity was 6/12, improving to 6/9 with -0.75 DC @120°. Macular OCT was normal. Keratometry readings were $K_1=44.03$ D @126° and $K_2=45.38$ D @36°.



[Table/Fig-9]: Post-traumatic white mature cataract; [Table/Fig-10]: Retro-pupil fixated iris claw IOL. (Images from left to right)

In this series of six cases, the Surgically Induced Astigmatism (SIA) produced by a temporal MSICS incision was used strategically to reduce or eliminate pre-existing against-the-rule corneal astigmatism. A straight incision was made 2 mm away from the limbus in all cases except case 4, in which a frown-shaped scleral incision was used. This was because a straight incision induces more SIA than a frown incision. The pre-existing corneal astigmatism in case 4 was +1.43 D @ 3°, which was the least among the six patients, and therefore a frown incision was considered more appropriate. Correspondingly, the decrease in pre-existing astigmatism in case 4—from 1.43 D to 0.85 D (reduction of 0.58 D)—was also the smallest in the series. The scleral incision lengths were 7.5 mm, 8 mm, 8 mm, 7 mm, 9 mm, and 8 mm across the six cases. The maximum decrease in pre-existing astigmatism—from 2.31 D to 0.46 D (a reduction of 1.85 D)—was observed in case 5, which had the longest incision length of 9 mm. All six cases showed reduced corneal astigmatism at the one-month postoperative follow-up [Table/Fig-11].

DISCUSSION

Phacoemulsification with implantation of a posterior chamber foldable IOL in the capsular bag has become the gold standard and preferred technique for the management of cataracts, as it induces only minimal corneal refractive changes [9]. Vyas VJ et al., reported a higher average SIA at the one-month postoperative follow-up of 1.32 D for MSICS compared with 0.60 D for phacoemulsification [10]. Mukherjee S et al., similarly reported a greater mean SIA of 0.61 ± 0.25 D for MSICS compared with 0.21 ± 0.18 D for phacoemulsification [11]. Reddy B et al., also reported that MSICS produced an SIA of 1.92 ± 0.53 D for superior incisions and 1.57 ± 0.24 D for temporal incisions, whereas phacoemulsification produced an SIA of 1.08 ± 0.36 D for clear corneal incisions and 1.23 ± 0.71 D for scleral pocket incisions [12]. These findings help explain why phacoemulsification is generally preferred as the surgical

	Preoperative				Postoperative at 30 days follow-up				Decrease in astigmatism
	K1	K2	Astigmatism	Visual acuity	K1	K2	Astigmatism	Visual acuity	
1	43.72D @102°	45.84D @12°	+2.12D @12°	6/24 and not improving	44.45D @87°	45.23D @177°	+0.78D @177°	6/9 improving to 6/6 with -0.75 DC at 78°	1.34 D
2	45.83D @106°	47.63D @16°	+1.80D @16°	CFCF	46.59D @78°	47.18D @168°	+0.59D @168°	6/6 unaided	1.21 D
3	44.49D @110°	46.36D @20°	+1.87D @20°	3/60 and not improving	45.06D @78°	46.13D @168°	+1.07D @168°	6/12 improving to 6/6 with -0.75 DC at 65°	0.80 D
4	43.38D @93°	44.81D @3°	+1.43D @3°	Only PL+	43.78D @113°	44.63D @23°	+0.85D @23°	6/9 improving to 6/6 with -0.50 DC at 80°	0.58 D
5	43.43D @107°	45.74D @17°	+2.31D @17°	Only PL+	44.26D @111°	44.72D @21°	+0.46D @21°	6/6 unaided	1.85 D
6	43.77D @112°	45.86D @12°	+2.09D @16°	Only PL+	44.03D @126°	45.38D @36°	+1.35D @36°	6/12 improving to 6/9 with -0.75 DC at 120°	0.74 D

[Table/Fig-11]: Preoperative and postoperative findings of the cases.

technique of choice. Enany and Hesham A, concluded that MSICS was associated with lower complication rates and earlier visual rehabilitation compared with phacoemulsification for hard brown cataracts [5]. The SIA in MSICS is influenced by factors such as the size, shape, location, and configuration of the scleral incision. Larger incisions cause greater flattening of the corneal curvature, with the amount of flattening increasing proportionately with incision size. The configuration of the incision also affects SIA—"frown/curved opposite to the limbus" incisions induce less SIA, while "straight" incisions induce a moderate amount of SIA [13].

CONCLUSION(S)

This case series demonstrates that in patients with cataracts and against-the-rule corneal astigmatism in whom phacoemulsification with toric IOL implantation is not feasible, pre-existing astigmatism can be reduced or neutralised by performing temporal-approach MSICS.

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