Original Article

Comparative study between conventional and 4 mm manual small-incision cataract surgery

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Purpose: Comparative study of intraoperative and postoperative complications, visual outcomes, and cost-effectiveness between conventional and 4-mm manual small-incision cataract surgery with MVR blade. **Methods:** In total, 600 patients having nuclear sclerosis grade I–IV were operated under peribulbar anesthesia and were divided into two groups of 300 each. In group A (300), conventional small-incision cataract surgery was done, whereas in group B (300), 4-mm manual small-incision cataract surgery was performed through a 4-mm sclerocorneal tunnel. A wire vectis was passed through the 4-mm incision below the nucleus to stabilize it, and a 20-G MVR blade was introduced from 11o'clock limbus and nucleus was bisected into two halves, which were removed through main incision. Cortical wash was given, and foldable IOL was implanted. Intraoperative and postoperative complications between the two groups were compared. Postoperative visual outcome and surgically induced astigmatism between the two groups was studied. **Results:** The most common intraoperative complication was hyphema (11.33%) and irido-dialysis (8.00%), whereas postoperatively, striate keratopathy (36.33%) and hyphema (19.33%) were common. Short-term complications such as striate keratopathy, hyphema, and irido-dialysis were significantly more in group B, and long-term results in terms of visual outcome and surgically induced astigmatism were significantly less in group B. **Conclusion:** Although intraoperative and short-term postoperative complications were observed more in 4-mm manual small-incision cataract surgery, it was found to be more effective in terms of surgically induced astigmatism and final visual outcome. In addition, it is cost-effective as compared to phacoemulsification.

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Website: www.ijo.in
DOI: 10.4103/ijo.IJO_1607_22
Quick Response Code:

Key words: 4 mm, ECCE, IOL, MSICS, MVR

Cataract is the leading cause of blindness (66.2%) and severe visual impairment in India (80.7%).[1] Recent advances in cataract surgery techniques have led to improved postoperative outcomes even in difficult cases.[2] Two randomized, controlled trials in Pune found MSICS to be more effective[3] and economical[4] than ECCE and as effective as[5] phacoemulsification.[6] MSICS is also cost-effective and prevents the expenses for the purchase and maintenance of the phacoemulsification machine.[6]

This study evaluates cataract surgery through a small-incision with non-sophisticated equipment with better wound stability, less astigmatism, and early visual rehabilitation.

Aim and objectives

1. To study and compare the intraoperative and postoperative complications.
2. To study and compare surgically induced astigmatism and its long-term effects on the visual outcome.

Methods

In this prospective interventional study, eyes of 600 patients were selected and divided into two groups, namely group A and group B. In group A, 300 eyes of 300 patients underwent conventional manual small-incision cataract surgery, while in group B, 300 eyes of 300 patients underwent 4-mm manual small-incision cataract surgery by using 20-G MVR blade by phaco-fracture through superior sclerocorneal tunnel incision with a foldable IOL implantation.

Inclusion criteria: All patients having cataract from grade I to grade IV were included in the study.

Exclusion criteria: Any other ocular pathology, dry eye, glaucoma, corneal pathology, scleral pathology, operated case of glaucoma, traumatic cataract, complicated cataract, subluxated lens, gross astigmatism, patient having diabetes, one-eyed patient, patient not willing for follow-up and operation.

Patients were admitted one day before surgery. Detailed history was taken, and anterior segment examination was performed using slit lamp. Visual acuity was checked using Snellen's visual acuity chart. After pupillary dilatation, detailed fundus examination was done. Cataract was assessed,

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Received: 05-Jul-2022 Revision: 02-Sep-2022
Accepted: 09-Sep-2022 Published: 25-Oct-2022

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Cite this article as: Chauhan RA, Agrawal SO, Sawarkar RR, Agrawal S. Comparative study between conventional and 4 mm manual small-incision cataract surgery. Indian J Ophthalmol 2022;70:3879-82.

and LOCS III grading was done. Intraocular pressure was measured using an applanation tonometer, and the patency of the lacrimal system was checked. Keratometry was performed using an autorefractokeratometer. Axial length was measured by immersion A-scan, and IOL power was calculated using the SRK II formula. Systemic investigations were carried out to rule out diabetes, hypertension, and other infections. Endothelial cell count was measured by specular microscopy preoperatively. Postoperative follow-up was done up to the 6th month.

All cases were performed by a single surgeon, and observation was noted by the same person throughout the study.

4-mm MSICS with MVR knife surgical procedure: Under all aseptic precautions, under peribulbar block, a universal wire speculum is applied. A superior rectus bridle suture is made. A fornix-based conjunctival flap is made with conjunctival scissors. A linear superior 4-mm sclerocorneal tunnel is made 2 mm behind the limbus [Fig. 1]. The internal incision of approximately 6 mm is made 1.5 mm inside the cornea. Continuous curvilinear capsulorhexis is done with a 26-G needle cystitome after staining the anterior capsule with trypan blue dye. Hydrodissection is done. Nucleus is prolapsed in the anterior chamber. Viscoelastic substance is injected in front and behind the nucleus. The anterior chamber is sufficiently deepened with viscoelastic to prevent injury to the corneal endothelium, iris, and posterior capsule. A wire vectis is passed through a sub-4-mm incision below the nucleus in the anterior chamber to stabilize the nucleus. A 20-G MVR blade is introduced from 11 o' clock limbus. It is pierced through the substance of the nucleus horizontally. The nucleus is stabilized and then MVR blade is turned vertically and pressed against wire vectis to divide it into two equal halves [Fig. 2]. Each half is removed through 4-mm incision. Cortical aspiration is done with Simcoe's bimanual irrigation and aspiration cannula. Viscoelastic substance is injected to deepen the anterior chamber. Foldable intraocular lens is implanted in the bag. Anterior chamber is formed by hydrating the wound. Subconjunctival gentamycin and dexamethasone are given. Pad and bandage are applied [Video 1].

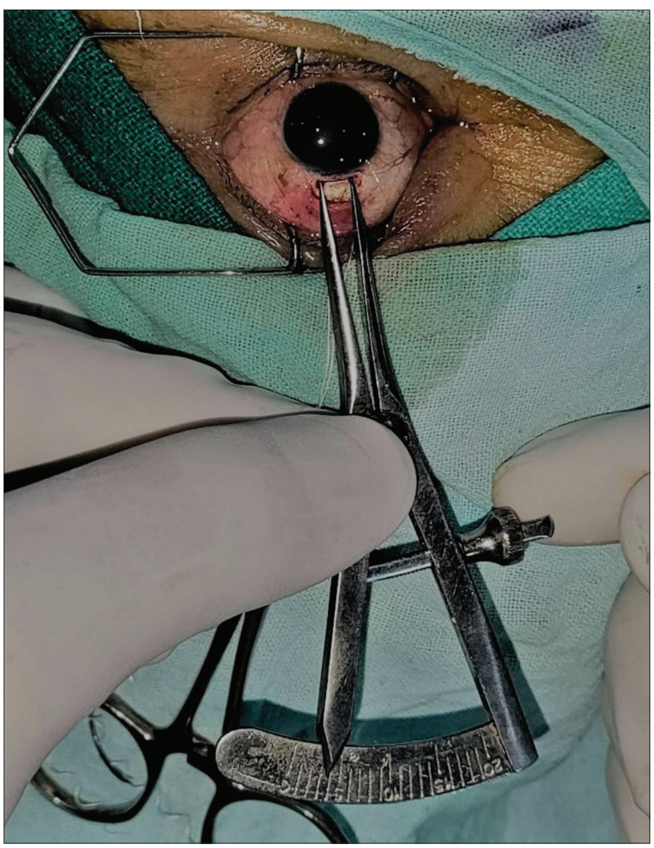

Figure 1: Linear superior 4-mm sclerocorneal tunnel made 2 mm behind the limbus

This technique is safe as the corneal endothelium is protected by means of injecting a sufficient amount of viscoelastic substance below it, and the posterior lens capsule is protected by stabilizing the nucleus against wire vectis. As the incision length is small, it helps in early wound healing and less postoperative astigmatism.

Statistical methods: Statistical analysis was done using software MS EXCEL and Epiinfo version 7.2.5.0. Principles of descriptive analysis were applied. Quantitative data were represented using mean ± SD. Qualitative data were compared using Chi-square tests. Unpaired *t* test was used for the comparison of mean between two groups of study participants. $P \leq 0.05$ was considered statistically significant.

Results

Intraoperative complications: Hyphema was noted in 11 (3.66%) out of 300 patients of group A and 34 (11.33%) out of 300 patients of group B. We found intraoperative iridodialysis in 12 (4%) out of 300 patients of group A and in 24 (8%) out of 300 patients of group B. Various intraoperative complications in both groups were studied. Its *P* value was <0.05, which is significant. Thus, there was a statistical difference between the two groups. Intraoperative complications were slightly more in group B [Table 1].

Postoperative complications: Striate keratopathy was noted in 68 (22.66%) out of 300 patients of group A and in 109 (36.33%) out of 300 patients of group B. Hyphema was seen in 24 (8%) out of 300 patients of group A and in 58 (19.33%) out of 300 patients

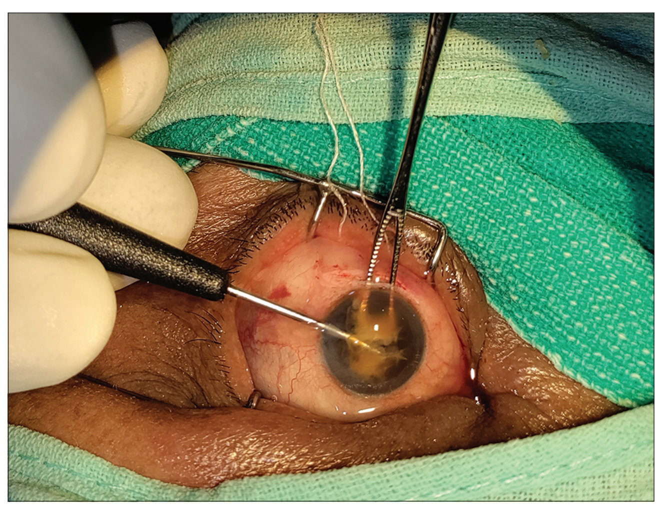

Figure 2: MVR blade pressed against wire vectis and pierced through the substance of the nucleus

of group B. Various post-operative complications in both groups were studied. Iridodialysis and iris prolapse occurred more in group B initially and decreased significantly as the surgeon developed expertise over the technique. Its *P* value was <0.05, which is significant. Thus, there was a statistical difference between the two groups. Short-term postoperative complications were slightly more in group B [Table 2].

Surgically induced astigmatism at the end of 6 weeks: Approximately 68% of the group A population had postoperative surgically induced astigmatism of < 1.50 D, while approximately 95% of the group B population had postoperative surgically induced astigmatism of < 1.50 D. Its *P* value was < 0.05, which is significant. Thus, there was a statistical difference in surgically induced astigmatism between the two groups [Table 3].

Preoperative and postoperative mean K1 values: Preoperatively, the mean K1 value in group A (42.53) and group B (42.55) was not statistically significant (*P* = 0.499). One month postoperatively, the mean K1 value in group A (41.25) and group B (42.25) was statistically significant (*P* = 0.000). Six months postoperatively, the mean K1 value in group A (41.31) and group B (42.02) was statistically significant (*P* = 0.000) [Table 4].

Preoperative and postoperative mean K2 value: Preoperatively, the mean K2 value in group A (43.63) and group B (43.64) was not statistically significant (*P* = 0.756). One month postoperatively, the mean K2 value in group A (42.26) and group B (43.61) was statistically significant (*P* = 0.000) .

Six months postoperatively, the mean K2 value in group A (42.35) and group B (43.50) was statistically significant (*P* = 0.000) [Table 5].

Comparison of keratometry readings between the two groups: The mean change in values of K1 in group A from preoperatively to one month postoperatively was 1.28 (SD: 0.42), and the mean change in values of K1 in group B from preoperatively to one month postoperatively was 0.29 (SD: 0.45). This difference was statistically significant (*P* = 0.000). The mean change in values of K1 in group A from preoperative to six months postoperatively was 1.22 (SD: 0.39), and the mean change in values of K1 in group B from preoperative to six months postoperatively was 0.53 (SD: 0.40). This difference was statistically significant (*P* = 0.000) [Table 6].

The mean change in values of K2 in group A from preoperative to 1 month postoperatively was 1.37 (SD: 0.46), and the mean change in values of K2 in group B from preoperative to 1 month postoperatively was 0.04 (SD: 0.42). This difference was statistically significant (*P* = 0.000). The mean change in values of K2 in group A from preoperative to 6 months postoperatively was 1.28 (SD: 0.45), and the mean change in values of K2 in group B from preoperative to six months postoperatively was 0.15 (SD: 0.41). This difference was statistically significant (*P* = 0.000).

Discussion

Out of 600 patients, 1% had grade I cataract, 20% had grade II cataract, 55% had grade III cataract, and 24% had grade IV cataract.

The overall results of this study showed that 4-mm manual small-incision cataract surgery with posterior chamber intraocular lens implantation using MVR blade is favorable in terms of various aspects such as bisecting or trisecting the

Table 1: Comparison of intra operative complications between two groups

Intraoperative Complications	Group A (*n*=300)	Group B (*n*=300)	*P**
Hyphema	11 (3.66%)	34 (11.33%)	0.000
Iridodialysis	12 (4.00%)	24 (8.00%)	0.03
Extended rhexis	11 (3.66%)	22 (7.33%)	0.04
Posterior capsular rupture with vitreous loss	9 (3.00%)	2 (0.66%)	0.03
Zonular dehiscence	9 (3.00%)	2 (0.66%)	0.03

*Chi-square test

Table 2: Comparison of post operative complications between two groups

Postoperative Complications	Group A (*n*=300)	Group B (*n*=300)	*P**
Striate keratopathy	68 (22.66%)	109 (36.33%)	0.000
Hyphema	24 (8.00%)	58 (19.33%)	0.000
Posterior capsular opacification formation	14 (4.66%)	14 (4.66%)	0.99
Iridodialysis	12 (4.00%)	24 (8.00%)	0.03
Iris prolapse	11 (3.66%)	22 (7.33%)	0.04
Postoperative iritis	11 (3.66%)	11 (3.66%)	0.99
Epithelial ingrowth	-	-	-
Flat anterior chamber	-	-	-
Fibrous downgrowth	-	-	-
Secondary glaucoma	-	-	-

*Chi-square test

Table 3: Comparison of Surgically induced astigmatism at the end of 6 weeks between two groups

Surgically induced astigmatism	Group A (*n*=300)	Group B (*n*=300)	*P**
0-0.50 D	12 (4.00%)	24 (8.00%)	0.03
0.50 D-1.00D	100 (33.34%)	140 (46.66%)	0.000
1.00 D-1.50 D	95 (31.67%)	124 (41.34%)	0.01
1.50 D-2.00 D	75 (25.00%)	9 (3.00%)	0.000
>2.00 D-2.50 D	9 (3.00%)	2 (0.67%)	0.03
>2.50 D	9 (3.00%)	1 (0.33%)	0.01
Total	300	300	

*Chi-square test

Table 4: Comparison of pre-operative and post-operative mean K1 values between two groups

K1	Group A Mean	Group B Mean	*P**
Preoperative	42.53	42.55	0.499
One month postoperatively	41.25	42.25	0.000
Six months postoperatively	41.31	42.02	0.000

*-unpaired *t* test

Table 5: Comparison of pre-operative and post-operative mean K2 value between two groups

K2	Group A Mean	Group B Mean	P*
Preoperative	43.63	43.64	0.756
One month postoperatively	42.26	43.61	0.000
Six months postoperatively	42.35	43.50	0.000

*-unpaired *t* test

Table 6: Comparison of keratometry readings between two groups

Change in keratometry	Group A		Group B		P
	Mean	SD	Mean	SD	
Difference of K1 (Preop one month)	1.12	0.42	0.29	0.45	0.000
Difference of K1 (Preop six month)	1.22	0.39	0.53	0.40	0.000
Difference of K2 (Preop one month)	1.37	0.46	0.04	0.42	0.000
Difference of K2 (Preop six month)	1.28	0.45	0.15	0.41	0.000

nucleus avoids stretching of the tunnel during delivery and minimizes surgically induced astigmatism.[7] All the grades of nuclei can be phacofractured very well with 20-G MVR blade in less time. Foldable IOL can be implanted safely through 4-mm incision. It reduces the hospital stay, results in early stabilization of the wound, and results in rapid visual recovery. Minimum instruments are required for surgery. The technique of 4-mm MSICS is easier to master with little practice and is cost-effective; thus, it can be used for performing a high volume of surgeries.

Hence, we conclude that 4-mm MSICS with MVR blade is reasonably safe, with early rehabilitation and good visual outcome without much financial burden to both patients as well as to surgeons. Although 4-mm manual small-incision cataract surgery demonstrated a slightly higher percentage of complications when compared with conventional small-incision cataract surgery, these complications were early, short-lived, and resolved with minimal treatment within 1 week of surgery. This technique gave us long-term good results of final visual outcomes with less astigmatism. Our technique is new but with experience, we improved our technique, reduced the complications, and improved our results. Furthermore, 4-mm manual small-incision cataract surgery was found to be more effective in terms of the final visual outcome, reduced surgically induced astigmatism, and cost-effectiveness.

Conclusion

Our novel technique of 4-mm manual small-incision cataract surgery has all the inherent advantages of universally acceptable sutureless cataract surgery with greater wound stability, less surgically induced astigmatism, and greater patient comfort with early visual recovery.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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