Original Article

Visual outcome after manual small-incision cataract surgery by viscoexpression technique

Narinder Kumar, Gagandeep Kaur[1], Charu Chadha[1], Neha Sethi[1], NR Gupta[1], Sugandhi Gauri[1]

Purpose: Globally, cataracts have remained the major cause of blindness. Cataract accounts for 62.6% of blindness affecting 9–12 million people. The only treatment for cataracts is surgical removal of cataracts. The surgical procedures include phacoemulsification and extracapsular cataract extraction (ECCE). In India, there is a huge backlog of cataract patients. Phacoemulsification is preferred nowadays for early visual rehabilitation, but in developing countries like ours, where facilities are not widely available, small-incision cataract surgery (SICS) is a cost-effective alternative as no machine is required. Also, it provides early visual rehabilitation as it is sutureless when compared to ECCE. So, manual SICS has emerged as a substitute for phacoemulsification and ECCE. The aim of the study was to evaluate the visual acuity and surgically induced astigmatism in patients more than 40 years of age, undergoing manual SICS with nucleus management by viscoexpression technique. **Methods:** This was a prospective study that included 50 patients over the age of 40 years undergoing manual SICS at a tertiary health-care center in North India by viscoexpression technique. Only those patients whose functional visual disability could be attributed to cataracts were included in the study. Preoperative and postoperative astigmatism were analyzed in the first, fourth, and sixth weeks. **Results:** Fifty patients who were undergoing manual SICS were analyzed. Preoperative best-corrected visual acuity (BCVA) and astigmatism were compared to postoperative BCVA and astigmatism. Of 50 patients, 48 (96%) patients were able to gain good vision after 6 weeks. **Conclusion:** This study showed early visual rehabilitation with less surgically induced astigmatism following manual SICS by viscoexpression technique.

Key words: Best-corrected visual acuity, manual small-incision cataract surgery, surgically induced astigmatism, visual acuity

Access this article online
Website: www.ijo.in
DOI: 10.4103/ijo.IJO_1582_22
Quick Response Code:

Globally, cataracts have remained the major cause of blindness. No medical treatment has been shown to be effective to cure it.[1] Globally, at least 2.2 billion people have a near or distant vision impairment. The leading causes of vision impairment and blindness are uncorrected refractive errors and cataracts.[2] According to a survey conducted by the National Program for Control of Blindness and Visual Impairment (NPCB and VI), cataracts were the principal cause of blindness (66.2%), severe visual impairment (80.7%), and moderate visual impairment (70.2%).[3] The main purpose of cataract surgery is to extract the lens completely with minimum trauma. There is a remarkable change in the patterns of surgical techniques used to deliver cataract services, from intracapsular cataract extraction (ICCE) to extracapsular cataract extraction (ECCE). ECCE further includes manual small-incision cataract surgery (MSICS) and phacoemulsification. Nucleus management is the most challenging part of the procedure. Delivery of the nucleus through the sclerocornea tunnel atraumatically is important for a good outcome. The nucleus in the anterior chamber can be delivered out of the sclerocornea tunnel pocket incision by a variety of techniques such as irrigating Vectis, snare technique, fishhook technique, phacofracture technique, hydro-expression technique, Blumenthal technique, and viscoexpression technique. In this study, the viscoexpression technique was used. Viscoelastic is injected through the tunnel in the space between the nucleus and the corneal endothelium. The cannula is passed below the nucleus and its tip is positioned 180° away from the tunnel incision. Viscoelastic is injected to fill the anterior chamber, deepening the anterior chamber and pushing the nucleus toward the incision. Simultaneously, posteriorly directed pressure is applied over the scleral incision with the cannula, resulting in the opening of the tunnel and causing the nucleus to engage in the tunnel. Nucleus delivery is followed by a gush of perinuclear material and viscoelastic. Residual epinuclear and loose cortical material can then be

Department of Ophthalmology, Consultant Ophthalmologist, Guru Nanak Dev Super Speciality Hospital, Tarn Tarn, Punjab, [1]Department of Ophthalmology, Guru Gobind Singh Medical College, Faridkot, Punjab, India

Correspondence to: Dr. Gagandeep Kaur, Assistant Professor Department of Ophthalmology, Guru Gobind Singh Medical College and Hospital, Faridkot, Punjab - 151 204, India. E-mail: drgaganbrar22@yahoo.com

Received: 30-Jun-2022 Revision: 11-Aug-2022
Accepted: 07-Sep-2022 Published 25-Oct-2022

Cite this article as: Kumar N, Kaur G, Chadha C, Sethi N, Gupta NR, Gauri S. Visual outcome after manual small-incision cataract surgery by viscoexpression technique. Indian J Ophthalmol 2022;70:3933-7.

again viscoexpressed in a similar way to make the next step of irrigation aspiration easy.[4]

Methods

A prospective interventional study was conducted over a period of 1 year (2016–2017) in the Department of Ophthalmology at a tertiary health care center in North India. This study included 50 patients with cataracts who underwent MSICS by viscoexpression technique and were evaluated for the visual outcome. The study was approved by the institutional ethics committee. Statistical analysis was done using Student's *t*-test and Chi-square test.

Inclusion criteria

Only those patients whose functional visual disability can be attributed to cataracts were included in the study. Cataract patients with with clear cornea , well dilating pupil, normal anterior chamber depth and intact zonules were included in study.

Immature, mature, and hypermature cataracts were included.

Exclusion criteria

Patients with other causes of diminution of vision, such as glaucoma, diabetic retinopathy, corneal opacities, and macular pathology, were excluded. Inability to come for follow-up and traumatic cataracts were excluded from the study. Informed consent was taken from all patients before surgery.

History

Detailed history of the patient was taken to rule out other causes of diminution of vision and systemic diseases which affect eyes, like diabetes, hypertension, and tuberculosis.

General physical examination

This was done to rule out systemic disease-causing visual impairment. Blood pressure, random blood sugar, and viral markers were checked for all patients, and physician's opinion for fitness was taken where required.

Ocular examination

Visual acuity, intraocular pressure, lacrimal sac syringing, slit-lamp biomicroscopy, and fundus examination were conducted for all the patients. B-scan was done where fundus could not be visualized.

Refraction and keratometry

Preoperative visual acuity and refraction were done in all cases with Snellen's chart. Keratometry was done using Bausch and Lomb keratometer. Axial length was calculated by A-scan, and the intraocular lens (lOL) power was calculated by the Sanders-Retzlaff-Kraff (SRK) II formula. The difference in corneal power in steeper and flatter meridians was taken as preoperative astigmatism. The two meridians taken were at 90° and 180° in all cases. Type and amplitude of astigmatism were recorded. Antibiotic eyedrops were instilled 1 day before the surgery. Tropicamide and phenylephrine eyedrops were used to dilate the pupil.

Surgical procedure

Viscoexpression technique in MSICS

The eye was cleaned and draped under aseptic conditions, and a peribulbar block was given. The eye was cleaned and draped again. The superior rectus bridle suture was passed and fixed, speculum was put, fornix-based conjunctival flap was raised superiorly, and wet-field cautery was applied to coagulate the bleeding vessels. A frown-shaped incision was made with a surgical blade no. 11, of about 5–6 mm in length and about 2 mm from the surgical limbus, perpendicular to the external scleral groove and about half of the thickness of the sclera. With a bevel-up crescent blade, a horizontal tunnel about halfway through the thickness of the sclera was dissected parallel to the sclera up to 1–1.5 mm into the clear cornea. Side pockets were made on either side of the tunnel to accommodate the thickness of the nucleus. Side-port entry was made at 9'o clock limbus with a 2.8-mm keratome. Trypan blue dye was injected into the anterior chamber. Excessive dye was removed with Balanced salt solution (BSS) and anterior chamber filled with viscoelastic. The anterior chamber was entered with a 2.8-mm keratome at the corneal end of the tunnel. After injecting viscoelastic in the anterior chamber, capsulorhexis was performed with a bent 26-gauze needle. Hydrodissection was performed to free the cortex from the capsule, and the nucleus was rotated within the bag with a sinskey hook. More BSS was injected under the capsular margin at 3'o clock position, which lifted the opposite pole of the nucleus out of the bag. Viscoelastic was injected under the lifted pole of the nucleus and over the nucleus, and the nucleus was cart-wheeled out of the bag with a sinskey hook. Then, the anterior chamber was filled with the viscoelastic both below and above the nucleus and the internal opening was enlarged on either side to make it funnel shaped. The posterior lip of the wound was depressed with the viscoelastic cannula itself or with a Vectis. This enforced the viscoelastic out of the tunnel, thus engaging the nucleus in the mouth of the tunnel. Once the nucleus was engaged, a slow but sustained pressure was applied over the posterior lip of the tunnel. The anterior chamber was again filled with viscoelastic. Irrigation and aspiration of the residual cortex was done with a Simcoe cannula. Posterior chamber IOL was implanted in the bag. Residual viscoelastic was removed by irrigation and aspiration, and the anterior chamber was formed by hydration of the side port. The conjunctival flap was reposited back. Eye was patched. Next day, the patients were given topical and oral antibiotics and steroids.

Follow-up

Follow-up was done after the first, fourth, and sixth weeks. After 1 week, refraction was done. Best-corrected visual acuity (BCVA) was recorded. Slit-lamp examination, fundus examination, applanation tonometry, and keratometry were also performed. Surgically induced astigmatism (SIA) was calculated by finding the difference between postoperative and preoperative astigmatism. It was also verified by a SIA calculator, a free software program.

Statistical analysis

A prospective interventional study was performed on 50 cases and the results were represented in the form of numbers and percentages.

Results

Best-corrected visual acuity

- There were 31 males and 19 females with a male to female ratio of 1.6:1.
- Preoperative BCVA: No patient had BCVA of 6/24. The maximum number of patients, 31 (62%), had BCVA of less

than 6/60 in this study. Nineteen (38%) patients had BCVA of 6/24 and 6/60 [Fig. 1].

- On the first postoperative day, 18 (36%) patients had BCVA (pinhole vision) of 6/6–6/9, 19 (18%) patients had BCVA between 6/24 and 6/60, nine (38%) patients had BCVA between 6/24 and 6/60, whereas four (8%) patients had no improvement of vision and had visual acuity less than 6/60 [Figs. 1 and 2a].
- After 1 week, 37 (74%) patients had BCVA of 6/6–6/9. Three (6%) patients had BCVA less than 6/60 [Figs. 1 and 2b].
- After 4 weeks, 43 (86%) patients had BCVA of 6/9 or more and five (10%) patients had BCVA from 6/12 to 6/18 [Figs. 1 and 2c].
- After 6 weeks, 44 (88%) patients had BCVA of 6/9 or more. There were four (8%) patients who had BCVA from 6/12 to 6/18 [Figs. 1 and 2d].

Astigmatism

Preoperatively, astigmatism ranged between 0.0 and 0.5 D in 56% of patients, 32% had astigmatism between 0.51 and 1.0 D, whereas 12% of patients had astigmatism between 1.1 and 1.5 D. Of 50 patients, 16% were astigmatically neutral, 44% had with the rule astigmatism (WTR), and 40% patients had against the rule astigmatism (ATR) [Fig. 3a and b].

- After 1 week, astigmatism was calculated by finding the difference between steeper and flatter meridian by keratometry; 17 (34%) patients had astigmatism in the range 0–1.0 D, two (4%) had astigmatism ranging from 1.1 to 2.0 D, and 19 (38%) had astigmatism ranging between 2.1 and 3.0 D. There were 12 (24%) patients with astigmatism more than 3 D, the average number of postoperative astigmatism was 2, and 29 (58%) patients shifted toward ATR (Against the rule) astigmatism while 7 (14%) were astigmatically neutral [Fig. 3a and b].
- After 4 weeks, 31 (62%) patients had astigmatism of range 0–1.0 D, seven (14%) had astigmatism ranging from 1.1 to 2.0 D, seven (14%) had astigmatism ranging between 2.1 and 3.0 D, five (10%) had astigmatism more than 3 D, and the average amount of postoperative astigmatism at 4 weeks was 1.18 D [Fig. 3a].
- After 6 weeks, 40 (80%) patients had astigmatism in the range 0–1.0 D, 10 (20%) patients had astigmatism ranging from 1.1 to 2.0 D, and there was no patient who had astigmatism ranging between 2.1 and 3.0 D or more than 3. The average amount of astigmatism was 0.66 D, 37 (74%) patients were toward ATR astigmatism, and 11 (22%) were astigmatically neutral [Fig. 3a and b].

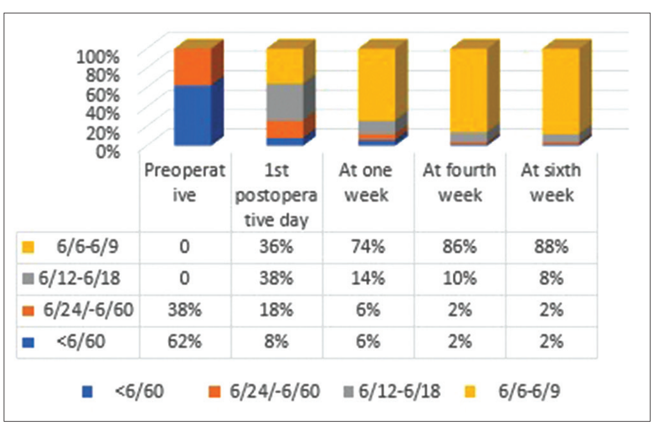

Figure 1: Best-corrected visual acuity preoperatively and at follow-ups

Discussion

Cataract is the leading cause of blindness across the world, and MSICS is a widely performed cataract surgery in our country as it is significantly faster, less expensive, and requires less technology. Visual outcome in MSICS is almost equal to phacoemulsification and superior to conventional extracapsular cataract extraction.[5] The present study was conducted on a total number of 50 patients with age ranging from 41 to 86 years. The mean age of presentation was 59.8 years. Out of 50 patients, 31 (62%) were males and 19 (38%) were females. The maximum number of patients were in the age group 61–70 years, with a male predominance. These findings were comparable with the reports of Jha and Vats,[6] Jauhari *et al*.,[7] and Nkanga *et al*.[8] They found that the maximum number of patients were within the age range of 40–80 and 61–70 years, with an M: F ratio of 1.7:1.

BCVA and astigmatism were recorded before surgery. After refraction, no patient had BCVA more than 6/24. Also, 38% of patients had BCVA between 6/24 and 6/60. The maximum number of patients (31; 62%) had BCVA less than 6/60 in the present study. Preoperative astigmatism was detected and ranged from 0.0 to 2.0 D. There was a difference in the selection of patients in the present study and in the study conducted by Khurana and Chawla,[9] who took only astigmatically neutral patients in their study. The present study included only eight (16%) patients who were astigmatically neutral, WTR astigmatism was found in 44% of patients, and 40% of patients had ATR astigmatism. In the present study, patients with already existing low and high astigmatism were included and postoperative astigmatism was due to both SIA and already existing astigmatism, whereas in Khurana and Chawla's[9] study, as no patient had preoperative astigmatism,

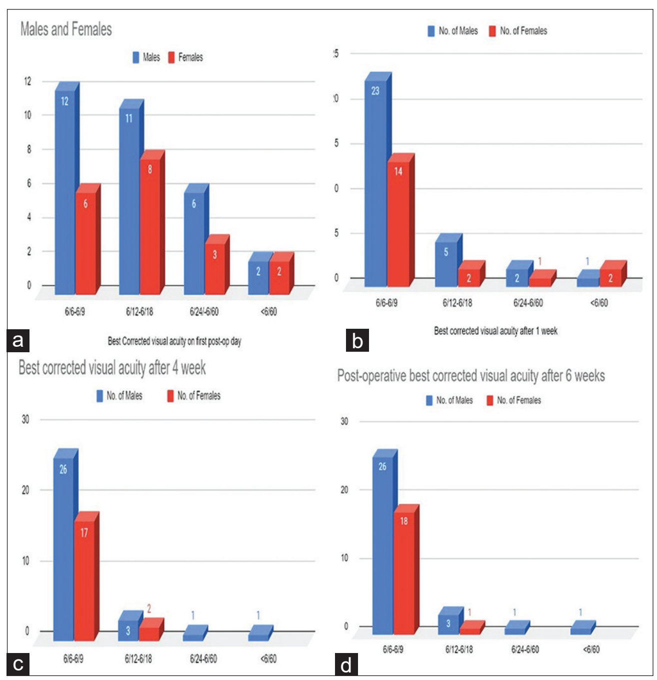

Figure 2: (a) Best-corrected visual acuity in males and females on the first postoperative day. (b) Best-corrected visual acuity in males and females at 1 week. (c) Best-corrected visual acuity in males and females at 4 weeks. (d) Best-corrected visual acuity in males and females at 6 weeks

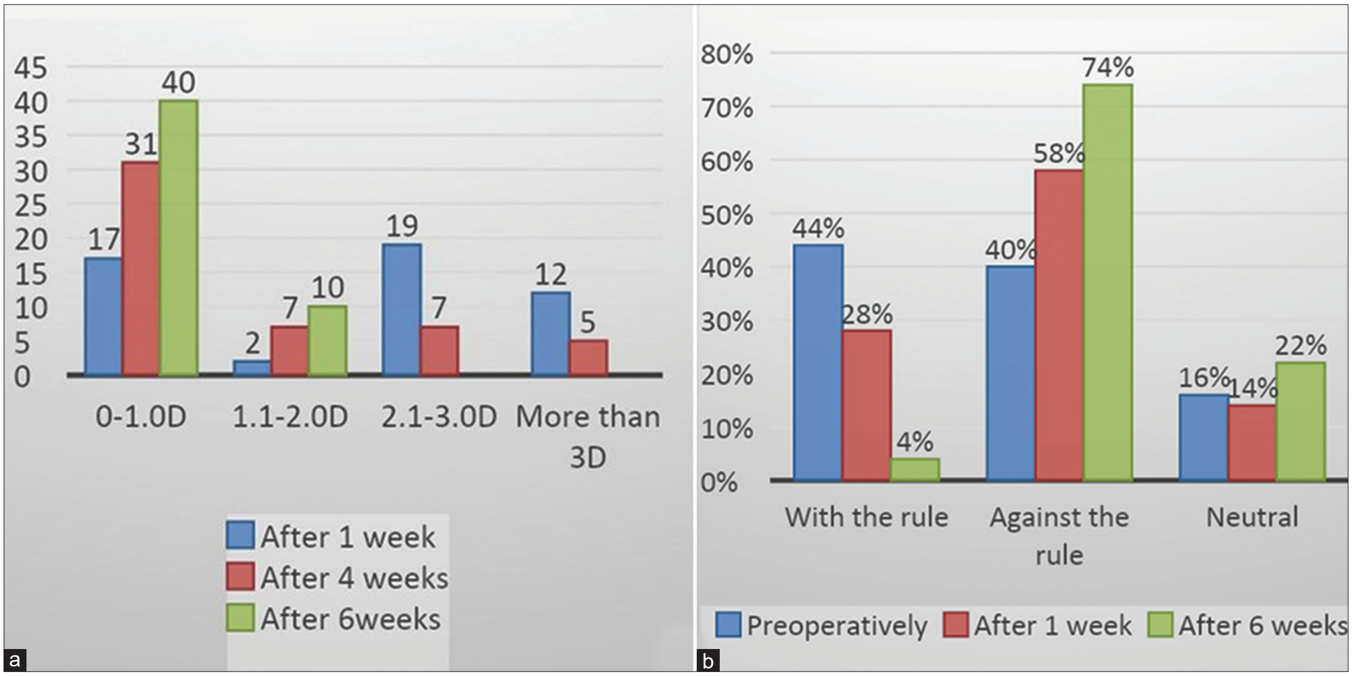

Figure 3: (a) Postoperative astigmatism. (b) Type of astigmatism

postoperative astigmatism was considered as SIA. An algebraic difference between postoperative and preoperative astigmatism was used to calculate SIA. For this, SIA calculator, a free software program in Excel format was used. Similar methods were adopted by Zheng *et al.*[10] in their study of astigmatism and visual recovery after "large-incision" ECCE and "small" incisions for phacoemulsification. According to this method, the algebraic difference between the keratometric value at 90° and 180° is taken as the amplitude of astigmatism. If 90° meridian is greater, it is taken as a positive value and if 180° meridian is greater, it is taken as a negative value.

In the present study, 44% of patients had WTR astigmatism and 40% of patients had ATR astigmatism. The patients having ATR astigmatism were in the age range of more than 40–70 years. The present study was discordant with the study conducted by Anstice,[11] who found ATR astigmatism with a shift of both corneal and refractive astigmatism after 35 years in 621 patients. The small size of the sample was the factor responsible for the prevalence of the type of astigmatism in a particular age group. Postoperatively, 37 (74%) patients had shifted toward ATR astigmatism. Our results were comparable with the results of Ahmed *et al*.[12] Hennig *et al*.[13] also found that 85.5% of 500 patients had ATR astigmatism and this was responsible for uncorrected visual acuity of less than 6/18. There were 22% of patients who had postoperative WTR astigmatism, out of which seven patients had already existing WTR astigmatism up to 1.5 D. The persistence of postoperative WTR astigmatism in patients with preexisting WTR astigmatism preoperatively was explained by Garg *et al*.[14] that wound induces minimum astigmatism and has minimal capacity to correct preexisting astigmatism.

Intraoperative complications

Buttonholing during tunnel formation was not seen in any case intraoperatively. It corroborates with the study result of Parkar *et al*.[15]

Iris prolapse was also reported in three cases during delivery of the nucleus. Iris prolapse occurred in these three cases due to the large size of the nucleus, which was repositioned with methylcellulose and iris repositor. 10-0 Ethicon interrupted sutures were applied to ensure safety of the tunnel. In order to prevent posterior capsular tear in one case in which hard nucleus was present, the case was converted into standard ECCE.

Continuous curvilinear type of capsulorhexis was performed in all the cases except in cases of hard nuclei, where the can opener technique of capsulorhexis was used. Extension of can opener was not reported in any case. In all cases, hydrodissection was the procedure of choice, except in the cases with posterior polar cataracts where hydrodelineation was done. In two cases, posterior capsular rent occurred. In both cases, the capsular rent occurred during the process of hydrodissection. The nucleus was successfully delivered, and the posterior chamber intraocular lens (PCIOL) was implanted without any complication in both cases. The present study had less (4%) posterior capsular rent in comparison to the study conducted by Gogate *et al*.[16] They found 12 cases (6%) with posterior capsular rent.

In comparison to the present study, Jha *et al*. found that out of 59 cases, four (5.8%) cases had a vitreous loss.[5] Similarly, Kothari *et al*.[17] reported 8.1% cases with vitreous loss. The incidence of vitreous loss varies from 0 to 20% in different studies. This may be due to the small sample size, or it may depend upon the skills of the surgeon.

In our study, in 50 cases, six (12%) had striate keratopathy and seven (14%) had early stromal edema. These findings were comparable to those of Jha *et al*.[6] who observed striate keratopathy in 7.2% of the 59 cases at the Military Hospital. In the present study, this might be due to the large and hard nuclei, which were excluded by Jha *et al*.[5] Due to lack of facility, the endothelial count was not done in the present study preoperatively. There were 88% of patients who had uncorrected visual acuity of 6/18 or more after 1 week, 8% had striate keratopathy after 1 week, and two (4%) had corneal edema after 1 week. This might be attributed to a mismatch between corneal wound size, size of the nucleus, and excessive manipulation during surgery. There was no intraoperative miosis or intraoperative hyphema due to least instrumentation in the anterior chamber with the viscoexpression technique, which can be seen more in phacosandwich, fishhook, and irrigating Vectis techniques of nucleus delivery[18] After 4 weeks, 96% of patients had uncorrected visual acuity and BCVA of 6/18 or more and 8% of patients had striate keratopathy.

After 6 weeks, 96% of patients had uncorrected visual acuity and BCVA of 6/18 or more and only 8% of patients had decompensated cornea.

In the present study, intraoperative complications included premature entry, iris prolapse, and posterior capsular tear. Postoperative complications included striate keratopathy, decompensated cornea, and high astigmatism. Intraoperative complications in MSICS are responsible for low visual outcomes. Out of 50 patients, 48 achieved BCVA of 6/18 or more. There were only two patients who had low vision due to decompensated cornea. Small cataract incisions are better than larger incisions due to wound integrity and control of iatrogenic astigmatism.[6] Belluci *et al*. compared nucleus delivery by viscoexpression in 77 eyes, irrigating Vectis in 25 eyes, and nucleus fragmentation in 40 eyes in a series of 142 eyes. Nucleus expression was successful in 68% of eyes, nucleus fragmentation in 90%, and viscoexpression in 93% of eyes. Therefore, they concluded that nucleus delivery by viscoexpression had the best results with the least postoperative complications.[19] Hence, proper selection of patients, changes in incision site according to astigmatism, and proper technique of nucleus delivery can further improve the results.

Conclusion

Due to the huge backlog of cataract patients in India, there is a requirement for surgeries which are affordable to both patients and surgeons. As minimum equipment in this surgery can give results equivalent to phacoemulsification, it is preferred at many peripheral centers. Viscoexpression technique gives good results with minimum manipulation of the anterior chamber, and the corneal endothelium is well protected during nucleus delivery by viscoexpression and it is an easy-to-learn and a quick procedure. No extra port is required as for anterior chamber maintainer in Blumenthal technique, and no instrumentation is required. More studies are required to compare various nuclear delivery methods.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Sihota R, Tandon R. Parsons' Diseases of the eye. The Lens. 22nd ed. Reed Elsevier India Private Limited; 2015. p. 261-28.
2. Vision impairment and blindness [Internet]. [cited 2022 Sep 13]. Available from: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment.
3. NPCBVI [Internet]. Gov.in. Available from: https://npcbvi.gov.in/. [Last accessed on 2022 Jun 27].
4. Gokhale NS. Viscoexpression technique in manual small incision cataract surgery. Indian J Ophthalmol 2009;57:39-40.
5. Gogate P, Deshpande M, Nirmalan PK. Why do phacoemulsification? Manual small-incision cataract surgery is almost as effective, but less expensive. Ophthalmology 2007;114:965-8.
6. Jha KN, Vats DP. Manual small incision cataract surgery: Experience at a military hospital. Med J Armed Forces India 2006;62:212-5.
7. Jauhari N, Chopra D, Chaurasia RK, Agarwal A. Comparison of surgically induced astigmatism in various incisions in manual small incision cataract surgery. Int J Ophthalmol 2014;7:1001-4.
8. Nkanga DG, Asana UE, Etim BA, Ibanga AA, Nkanga ED. Outcome of surgery in a manual small incision cataract surgery training in Calabar, Nigeria. Arch Int Surg 2015;5:96.
9. Khurana AK, Chawla U. The efficacy of corneal relaxing incisions in reducing induced astigmatism in Manual small incision cataract surgery. Proceedings of All India Ophthalmology Conference, 2008. p. 97-8.
10. Zheng L, Merriam JC, Zaider M. Astigmatism and visual recovery after 'large incision' extracapsular cataract surgery and 'small' incisions for phacoemulsification. Trans Am Ophthalmol Soc 1997;95:387.
11. Anstice J. Astigmatism--its components and their changes with age. Am J Optom Arch Am Acad Optom 1971:48:1001-6.
12. Ahmed I, WahabA, Sajjad S, Untoo RA. Visual rehabilitation following manual small incision cataract surgery. JK Sci 2005;7:146-8.
13. Hennig A, Kumar J, Yorston D, Foster A. Sutureless cataract surgery with nucleus extraction: Outcome of a prospective study in Nepal. Br J Ophthalmol 2003;87:266-70.
14. Garg A, Fry LL, Tabin G. Clinical Practice in Small Incision Cataract Surgery: Phaco Manual. 1st ed. Jaypee Brothers Medical Publishers(P) Ltd; 2004. p. 260-71.
15. Parkar T, Gogate P, Deshpande M, Adenwala A, Maske A, Verappa K. Comparison of subtenonanaesthesia with peribulbaranaesthesia for manual small incision cataract surgery. Indian J Ophthalmol 2005;53:255-9.
16. Gogate PM, Kulkarni SR, Krishnaiah S, Deshpande RD, Joshi SA, Palimkar A, *et al*. Safety and efficacy of phacoemulsification compared with manual small-incision cataract surgery by a randomized controlled clinical trial: Six-week results. Ophthalmology 2005;112:869-74.
17. Kothari M, Thomas R, Parikh R, Braganza A, Kuriakose T, Muliyil J. The incidence of vitreous loss and visual outcome in patients undergoing cataract surgery in a teaching hospital. Indian J Ophthalmol 2003;51:45-52.
18. Sharma U, Sharma B, Kumar K, Kumar S. Evaluation of complications and visual outcome in various nucleus delivery techniques of manual small incision cataract surgery. Indian J Ophthalmol 2019;67:1073-8.
19. Bellucci R, Morselli S, Pucci V, Bonomi L. Nucleus viscoexpression compared with other techniques of nucleus removal in extracapsular cataract extraction with capsulorhexis. Ophthalmic Surg 1994;25:432–7.