Original Research Article

Occurrence of post- operative complications in relation to the two types of surgeries; Phacoemulsification and small incision cataract surgery

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Abstract

For over a century, it has been recognized that cataract incisions influence astigmatism. Astigmatism after the cataract extraction is generally ATR variety, which is caused by some degree of steepening of the corneal meridian at right angles to the direction of the incision, termed as "surgically induced astigmatism". This effect is dependent on the size of incision and it's proximity to the center of the cornea. A total of 200 patients were admitted as inpatients for cataract surgery and were followed up as outpatients in the hospital. Most of the patients in the study showed pre operative astigmatism in the range of 0.50 – 1 D with more eyes having against the rule astigmatism. The most common post operative complication was corneal oedema and striae kerathopathy. One case each in Group A and B developed post operative iridocyclitis.
Keywords: Post- operative complications, Phacoemulsification, Small incision cataract surgery.

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INTRODUCTION

Jacques Daviel started a revolution in 1747, April 8th by performing a planned extraction of lens from behind the iris. An incision was made through the inferior cornea and enlarged with scissors. The cornea was elevated, lens capsule incised, the nucleus expressed and cortex removed by curettage. Since Daviel opened the anterior capsule, this was Extra Capsular Cataract Extraction. He is known as the father of modern cataract surgery.[1] Julius Jacobson in 1863 had practised a limbal incision which reduced complications. Albert Von Graffe further improved the technique with the development of a knife that created better wound closure. This innovation decreased the rate of infection and uveal prolapse.[2] ICCE was first performed by Samuel Sharp by removing the lens by applying pressure of his thumb over the limbus. In 1940's the ICCE was the procedure of choice of cataract extraction. It was done with limbal or fornix based conjunctival flaps with posteriorly placed corneal sutures. One major obstacle to patient's satisfaction was optical correction of aphakia. Despite causing complications like cystoid macular oedema, vitreous loss etc., it remained unchallenged till 1967, when kelman introduced phacoemulsification. This era saw the return of ECCE.[3] In 1967, Charles D Kelman made one of the most important contributions to ophthalmology when he introduced the technique of Phacoemulsification. It permitted the removal of cataract through 3mm incision, thus eliminating many of the complications of wound healing related to large incision cataract surgery and significant shortening of recuperative time. It is a sophisticated form of ECCE where the anterior capsule is removed by continuous curvilinear capsulorrhexis inverted

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by Howard Gimbel. The cataract is then fragmented and aspirated.[4] In 1983, Richard Kratz moved the cataract incision from the limbus to the sclera. In 1984, Girard and Holfman were the first to call this a sclera tunnel. In 1989 , Mac Farland introduced a two plane incision architecture. In 1990, Paul Earnest introduced the concept of three plane incision. In 1992, Fine described a self sealing temporal clear corneal incison.[5] Small Incision Sutureless Cataract Surgery – Manual Phaco was done first in 1983 by Dr Gerald Keener by introducing the technique of phacofracture with a wire loop. Phaco sandwich technique was described by Luther.L.Fry in 1985. Blumenthal introduced the 'mini- nuc' technique in 1987 which is the most preferred technique. In 1988 Peter Kansas introduced the technique of phaco fragmentation using a bisector / trisector and a vectis. Richard Kratz developed the scleral tunnel (scleral pocket) two step incision where the scleral incision is made more posterior to the limbus and a scleral tunnel along with a small corneal ledge is created. However the internal wound of a moderately long scleral tunnel incision with the entry into the anterior chamber at schwalbe's line will tend to separate and leak due to internal forces acting at the internal corneal surface. Sutures were used to above mentioned limbal incision and scleral tunnel incision.[6] In 1990's Michael Mc Farland performed the first sutureless surgery using the three step (three plane) internal corneal lip incision (corneal valve incision) which incorporated a perpendicular incision through the sclera, a horizontal incision into the clear cornea and an angled bevelled incision into the anterior chamber. This three step procedure leaves an internal corneal lip of endothelium, descement's membrane and corneal stroma that seals on itself when the IOP returns to normal.[7] For over a century, it has been recognized that cataract incisions influences astigmatism. Astigmatism after the cataract extraction is generally ATR variety, which is caused by some degree of steepening of the corneal meridian at right angles to the direction of the incision, termed as "surgically induced astigmatism". This effect is dependent on the size of incision and it's proximity to the centre of the cornea. The site of SIA is the internal lip of incision and the changes in the external wound construction do not affect much on the SIA. Longer incision, corneal incision, limbus parallel incision, uniplanar and sutural incision increases SIA.[8] The cataract surgeon can modify his wound parameters to undo any undesirable pre operative astigmatism. Pre-op astigmatism could be low (O.0-l.0D) Moderate (1.OD to 2.OD) or high (> 2.OD). Doug Koch with Jim Gills introduced the concept of "Incisional Funnel" and concluded that the corneal astigmatism is directly proportional to cube of the length of the incision and inversely proportional to the distance from the limbus. Incisions made within this funnel will be astigmatically equivalent. Short incisions can be made closer to the limbus and longer ones further away, and all will have equivalent corneal stability. Placement of incision temporally or superotemporally is one modification to minimize the high pre - existing ATR astigmatism as compared to superior incision thereby improving visual outcome. The superotemporal incision being further away from the visual axis causes less distortion of central corneal curvature. When the incision is located superiorly, both gravity and eyelid blink tend to create a drag on the incision. The superotemporal incision has better wound strength due to minimal separational force of the lid pressure and gravity. These forces are neutralized well with temporally placed incisions because the incision is parallel to the vector of the forces. With the rule astigmatism induced by a temporal incision is advantageous because most elderly cataract patients have pre-operative against the rule astigmatism.[9]

METHODOLOGY

PATIENT SELECTION

A total of 200 patients were admitted as inpatients for cataract surgery and were followed up as outpatients in the hospital.

Group A: 100 who underwent Manual Small Incision Cataract Surgery with rigid PMMA IOL implantation.

Group B: 100 who underwent Phacoemulsification with foldable IOL implantation.

Inclusion Criteria

All cataract patients in age group of 45 – 80 years with normal fundus and intraocular pressure

Exclusion Criteria

1) Complicated cataract.
2) Traumatic cataract.
3) Congenital and developmental cataract.
4) Uveitis with corneal oedema.
5) Any macular or optic nerve disease.
6) Any preceding eye disease other than cataract

PREOPERATIVE EVALUATION

1. Visual acuity with Snellen's chart and improvement with pin hole.
2. Detailed evaluation of anterior segment using slit lamp biomicroscope.
3. Grading of nucleus hardness is done on slit lamp biomicroscope.
4. Intraocular pressure in both eyes using Goldman Applanation Tonometer / Rebound Tonometer
5. Patency of lacrimal system.
6. Active or indolent foci of sepsis in ear, nose, throat and lacrimal region ruled out.
7. Thorough fundus examination of both eyes under full pupillary dilatation.
8. Random blood sugar.

9. Blood pressure.
10. IOL power calculation by biometry (A- Scan and keratometry reading)

PREOPERATIVE PREPARATION

- All the patients were admitted in the hospital one day prior to the surgery.
- An informed and detailed consent was taken.
- Topical ofloxacin eye drops were instilled on the day before the surgery and every half hourly for 2 hours before surgery.
- Systemic anxiolytics (Diazepam) were given orally if necessary.
- Eye lashes of operating eye were trimmed on the day before surgery.
- A combination of tropicamide and phenylephrine eye drops were instilled every half hourly for 2 hours before surgery.

RESULTS

Out of the 200 cases 28 were below 50 years of age, 76 were between 51 – 60 years, 64 were between 61 – 70 years and 32 were 71 - 80 years.

Table 1: Table showing the age distribution of the patients in the study

AGE (IN YEARS)	NO OF CASES	PERCENTAGE
< 50	28	14%
51 - 60	76	38%
61 - 70	64	32%
71 - 80	32	16%

Out of the 200 cases 94 cases were female and 106 were male.

Table 2: Table showing gender distribution of the patients

GENDER	NO OF CASES	PERCENTAGE
Female	94	47%
Male	106	53%

Most of the patients in the study showed pre operative astigmatism in the range of 0.50 – 1 D with more eyes having against the rule astigmatism.

Table 3: Table showing amount of pre operative astigmatism

ASTIGMATISM	NO OF CASES	PERCENTAGE
NIL	40	20%
< 0.50 D	38	19%
0.50 – 1 D	76	38%
1.25 – 2 D	44	22%
> 2 D	2	1%

Table 4: Table showing type of preoperative astigmatism

NO ASTIGMATISM	WTR	ATR
40	54	106

53% of the patients in the study group showed a post operative astigmatism of 0.50 -1.0 D with of them showing against the rule astigmatism.

Table 5: Table showing amount of post operative astigmatism

ASTIGMATISM	NO OF CASES	PERCENTAGE
< 0.50 D	84	42%
0.50 – 1.0 D	106	53%
1.25 – 2.0 D	8	4%
> 2.0 D	2	1%

Table 6: Table showing type of post operative astigmatism

NO ASTIGMATISM	WTR	ATR
16	64	120

Surgically induced astigmatism in most cases in Group A has an average value between 1 and 1.25 D with a mean of 0.99D. On the other hand surgically induced astigmatism in Group B has an average valve of 0.5 – 0.75 D with a mean of 0.67D.

Table 7: Table showing Surgically induced astigmatism in Group A

SURGICALLY INDUCED ASTIGMATISM	NO OF CASES	PERCENTAGE
<0.50 D	4	4%
0.50 – 0.75 D	36	36%
1.0 – 1.25 D	48	48%
1.5 – 2.0 D	12	12%
> 2.0 D	-	-

Table 8: Table showing Surgically induced astigmatism in Group B

SURGICALLY INDUCED ASTIGMATISM	NO OF CASES	PERCENTAGE
<0.50 D	16	16%
0.50 – 0.75 D	56	56%
1.0 – 1.25 D	22	22%
1.5 – 2.0 D	6	6%
>2.0 D	-	-

The most common post operative complication was corneal oedema and striae kerathopathy. One case each in Group A and B developed post operative iridocyclitis.

Table 9: Table showing post operative complications

COMPLICATIONS	GROUP A	GROUP B
Corneal oedema	5	4
Striae keratopathy	5	4
Post operative iridocyclitis	1	1
Peaked pupil	2	0
Hyphaema	2	1

DISCUSSION

Many studies concluded that phaco reduces SIA at 6 weeks follow up compared to MSICS although there is no significant difference in the long term. However, with the use of smaller and tunnelled incisions located temporally, the astigmatism caused by MSICS can be decreased to a great extent.

Henning *et al* conducted a prospective study in Nepal. In their study cataract surgery was conducted on eyes with no coexisting diseases, in 500 consecutive patients who were likely to return for follow up. The technique involved sclerocorneal tunnel, capsulotomy, hydrodissection, nucleus extraction with a bent needle tip hook and posterior chamber intraocular lens (PC-IOL) implantation according to biometry values. Surgical complications, visual acuity at discharge, 6 weeks and 1 year follow up, and surgically induced astigmatism were reported. The uncorrected visual acuity at discharge was 6/18 or better in 76.8% of eyes, and declined to 70.5% at 6 weeks follow up, and 64.9% at 1 year. The best corrected visual acuity was 6/18 or better in 96.2% of eyes at 6 weeks and 95.9% at 1 year. Poor visual outcome (<6/60) occured in less than 2%. Intraoperative complications included 47 (9.4%) eyes with hyphaema, and one eye (0.2%) with posterior capsule rupture and vitreous in anterior chamber. Surgery led to an increase in against the rule astigmatism, which was the major cause of uncorrected visual acuity less than 6/18. Six weeks post operatively, 85.5% of eyes had against rule astigmatism, with a mean induced cylinder of 1.41 D (SD 0.8). There was a further small increase in against the rule astigmatism of 0.66 D (SD 0.41) between 6 weeks and 1 year. The mean duration of surgery was about 4 minutes. They concluded that rapid recovery with good vision can be achieved with sutureless manual ECCE at low cost in areas where there is a need for high volume cataract surgery. Trivedi *et al* conducted a retrospective interventional study at a high volume eye care centre including 368 patients who underwent cataract surgery. Of the total, 81.8% of the patients achieved post operative uncorrected visual acuity of 6/18 and better by the 4th week. Only 0.3% had a posterior capsular tear without vitreous loss, 0.5% posterior capsular tear with vitreous loss and 0.8% had hyphaema. Post operative examination done at the camp site on day 30 did not reveal anterior segment complications in any of the patients. Fifteen patients were found to have posterior capsule opacification and had the UCVA between 6/24 – 6/60. Only 12.9% of the patients had first post operative day complications, which included transient corneal oedema (3.0%) with less than 10 descemets folds, transient corneal oedema with >10 descements folds (3.6%), transient corneal oedema (4.3%), shallow anterior chamber (0.3%) and others like iritis and peaked pupil.[10] Raiz Y *et al* reviewed studies between phaco and SICS and concluded that phacoemulsification may result in better UCVA in the short term (upto three months after surgery) compared to Small incision cataract surgery, but similar BCVA and that

in view of lower cost of MSICS this may be a favourable technique in the patient populations examined in these studies, where high volume surgery is a priority. Our study also shows uncorrected visual acuity at the end of 6 weeks of 72 % in phacoemulsification group and 60% in manual small incision cataract surgery group showing a visual acuity of more than or equal to 6/18 (p=0.7). The best corrected visual acuity was more than or equal to 6/18 in 96 % in the phacoemulsification group and 94% in the small incision cataract surgery group. However the best corrected visual acuity of both the groups were similar. [11]

Gogate *et al* compared endothelial cell loss and visual recovery in patients undergoing manual small incision cataract surgery and phacoemulsification. They found that there was no clinically or statistically significant difference in endothelial cell loss or visual acuity between manual SICS and phacoemulsification groups. The BCVA at 6 week was better than 6/18 in 98.5 % of eyes in the phacoemulsification group and 97.3% in the manual SICS group which is comparable with our study.[12]

A study conducted by Rohit C Khanna *et al* compared the outcomes of manual small incision cataract surgery and phacoemulsification performed by ophthalmology trainees. The outcome measures included BCVA along with the rates and types of complications between the two groups. Post operatively the number of patients having BCVA > 6/12 was similar in both the groups (84.3% versus 88%). The complication rates were higher in the MSICS group (15.1%) compares to the phacoemulsification group (7.1%). Most common risk factor for poor visual outcome with BCVA <6/60 in both the groups was the presence of associated ocular pathologies. This study concluded that although the complication rate was higher in the manual small incision cataract surgery group, there was no difference in BCVA in both the groups. In our study the post operative best corrected visual acuity was similar in both the groups and the rate of complications was higher in the manual small incision group as seen in the above mentioned study, though it was not statistically significant .[13] Colin Cook *et al* compared the results of phacoemulsification and manual small incision cataract surgery. The primary outcomes measure was UCVA at 8 weeks and the secondary measures included UCVA on day 1, BCVA at week 8, the refraction at week 8 and the intra operative and post operative complications. The results showed that there was no difference in the visual acuities on day 1 (p= 0.28), however both UCVA and BCVA at week 8 were better in the eyes that had phacoemulsification (p= 0.02 and p=0.03) and there was less astigmatism (p=0.001) at week 8 in the eyes that had phacoemulsification. Other similar studies conducted in Afria showed that there was more post operative astigmatism following manual small incision surgery, the visual acuity at the final post operative visit there was no significant difference in both the UCVA and BCVA. [14] A study conducted by Reddy *et al* compared the astigmatism induced by superior and temporal incisions in manual small incision cataract surgery to the clear corneal incision in phacoemulsification. They found that there was significant against the rule shift in astigmatism in the phacoemulsification group and the manual small incision cataract surgery group. The manual small incision group with temporal incison had with the rule shift in astigmatism.[15] SK Singh *et al* compared the safety and efficacy of manual small incision cataract surgery and phacoemulsification in immature cataract. This was a prospective randomised controlled trial carried out on patients with immature senile cataracts undergoing cataract surgery either by manual small incision cataract surgery or phacoemulsification. There was no difference between the groups in terms of gender, age and pre operative visual acuity (p=0.09). In phacoemulsification group more than two thirds and in manual small incision cataract group more than three quarters of the patients had good visual outcome on the first post operative day (p= 0.065). Poor outcome was recorded in 6% in the phacoemulsification group and 1% in the manual small incision cataract surgery group. Mean visual acuity was 0.43 in phacoemulsification group and 0.47 in manual small incision group. Mean surgical time was shorter in the small incision group (0.0003). This study concluded that there was no signification difference in visual outcome on the first post operative day in between phacoemulsification group and manual small incision cataract surgery group. However, performing SICS was significantly faster and is a suitable technique in treating immature senile cataract in developing countries .

Ruchi Goyal *et al* compared the feasibility of cataract surgery with IOL implantation in subluxated cataract in phacoemulsification and small incision cataract surgery. They found that capsular bag retention in subluxated lens was possible in 90% cases in phacoemulsification versus 76.6% cases in manual small incision cataract surgery (p=0.16). Both groups achieved similar BCVA (p=0.73), although additional procedures, intraoperative and postoperative complications were more common in manual small incision cataract surgery.[16] Parmar *et al* compared the per –operative contamination of anterior chamber among eyes undergoing MSICS and phacoemulsification. They studied 150 eyes undergoing cataract surgery. Aqueous samples were taken before and at the end of surgery. Collected material was subjected to standard microbiological analysis. No preoperative antibiotics were used, but povidone iodine 5% drops were instilled before surgery. They found that the incidence of anterior chamber contamination in the MSICS group (4%)

did not differ significantly (p=0.65) from the PE group (2.7%; p=0.65). Haripriya *et al* compared the rate of complications, reoperations and endophthalmitis with phacoemulsification, MSICS and large incision ECCE. They found that ECCE had the highest overall rate of surgical complications (2.6%). The overall complication rate was 1.01% for MSICS and 1.11% for phacoemulsification. The BCVA was > 6/12 in 96% after phacoemulsification complications and 89% after MSICS complications (p=0.001). The rate of endophthalmitis was 0.04% but no statistical difference between surgical methods or surgeon groups. They concluded that for staff surgeons experienced with both phacoemulsification and manual small incision cataract surgery, intraoperative complication rates were comparably low. However, for trainee surgeons, the complication rate was significantly higher with phacoemulsification, suggesting that manual SICS may be a safer initial procedure to learn for inexperienced cataract surgeons in the developing world.[17] Tabin *et al* reviewed the published literature and concluded that MSICS may be the preferred technique for cataract surgery in the developing world. It is significantly faster, less expensive and reqires less technology. As phacoemulsification is a surgery that is done in the "capsular bag or endocapsular" the anterior chamber inflammation is comparatively less than in MSICS. The corneal endothelium is protected and endothelial damage is comparatively less as shown by Beltrame G *et al* in their study that the scleral tunnel group had less post operative endothelial damage than the clear corneal incision group. A study conducted by Zhang JY *et al* included a series of randomised control trials to compare outcomes of SICS and phaco for age related cataracts. The primary outcome measures of the study included BCVA and UCVA. The secondary outcome measures included SIA, percentage of endothelial cell count loss and complications. This study has shown that there were no significant differences between the techniques regarding the BCVA 6/9 or better (p=0.69) and less than 6/18(p=0.68), percent of endothelial cell loss (p=0.45), intra operative and post operative complications (p=0.44 and p=0.87 respectively). However a greater portion of patients in the phaco group had a final UCVA >6/9 (p=0.03), whereas a greater portion of patients in the MSICS group had a final UCVA <6/18 (p=0.03) and the phaco group had less SIA (p< 0.00001). This study concluded that Phaco is superior to SICS in UCVA and causes less SIA, but there were no significant difference in visual rehabilitation, endothelial cell loss and complications between the two procedures.[18] This study correlates with our study in terms of uncorrected visual acuity being better at the end of 6 weeks in the phacoemulsification group, but no statistical significance was noted in our study. The surgically induced astigmatism was significantly lower in the phacoemulsification group in our study (p< 0.001) which is similar to the above study. Tabin *et al* reviewed the published literature on the prevalence of cataract blindness, cataract surgery coverage and the reviews on the different surgery techniques used in the developing world. The authors concluded that both SICS and phaco achieve excellent visual outcomes however, MSICS may be preferred technique for cataract surgery in the developing world because surgery is faster, more affordable and is less technology dependent. Hepsen *et al* (2000) achieved a post operative BCVA of 6/9 or better in 83% of eyes that underwent MSICS. A study conducted by Da-Dong Guo *et al* compared the safety and efficacy of phacoemulsification and manual small incision cataract surgery. This was a randomised prospective study conducted on patients with white cataracts undergoing phacoemulsification or manual small incicion cataract surgery. The surgical complications, operative time, UCVA and BCVA and surgically induced astigmatism were compared. The results showed that on the first post operative day, the UCVA was comparable in the two groups (p=0.805) and the MSICS group had less corneal oedema (10.2%) compared to the phacoemulsification group (18.7%, p=0.047). At 6 weeks, the UCVA was 20/60 or better in 87.6% of the patients in the phacoemulsification group and 82% in the MSICS group (p=0.10) and the BCVA was 20/60 or better in 99%and 98.2% respectively (p=0.59). The mean time was statistically significantly shorter in the MSICS group (8.8 mins) than in the phacoemulsification group(12.2 mins, p<0.001). Posterior capsule rupture occurred in 3 eyes (2.2%) in the phacoemulsification group and 2 eyes (1.4%) in the manual small incision cataract surgery group (p=0.681). This study concluded that manual small incision cataract surgery is a safe and effective surgery and is far more economical than phacoemulsification. It has similar advantages to phacoemulsification in the rehabilitation of the cataract patients and thus ideal for developing countries. Kulkarni *et al* conducted a randomised prospective clinical trial to compare safety, efficacy and cost effectiveness of MSICS with phacoemulsification in high volume cataract surgeries. The results indicated that MSICS has a faster surgery time (7-10mins) as compared to phacoemulsification (0-20 mins). The surgical time of phacoemulsification changes with the type of cataract.

The authors assert that the cost of surgery is reduced in high volume settings and thus the surgical cost will be higher if less number of surgeries are done per day. Better near vision was noted in MSICS group at 40 day follow up and patients indicated that they were satisfied with quality of vision without spectacles. However there was a

complaint noted from the phacoemulsification group about their near vision being grossly hindered.

The authors concluded that both MSICS and phaco achieve excellent visual results and minimal surgical complications, however, MSICS is faster, cheaper and less technology dependent. Therefore MSICS is a more suitable surgical technique for high volume cataract surgery loads.[14] The study conducted by Ravindran *et al* showed that phaco had less rate of endophthalmitis compared to SICS. Authors attributed this to the fact that more than 50% of MSICS patients in the study came from poor rural areas where risk of infections, such as poor personal hygiene, malnutrition, poor sanitation and lack of access to clean water were prevalent. These patients predominantly received charitable services and MSICS was the procedure of choice because of non- affordability of phaco. The same study reported a decreased incidence of endophthalmitis in private patients who had better standards of living as compared with charitable patients. The incidence of endophthalmitis between MSICS and phaco was similar among private patients concluding that MSICS is as safe as phaco. Our study also shows that the rate of complications are similar in both the study groups, however endophthalmitis was not noted in our study.[19]

CONCLUSION

The most common post operative complications encountered were striate keratopathy and corneal oedema in both group. The risk factors like increased maneuvering the anterior chamber, difficulty in prolapsing of hard nucleus, difficulty in maneuvering in left eye, blunt instruments, prolonged surgery and excessive irrigation were all statistically significant resulting in corneal complications.

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