

A Clinical Study Comparing Different Techniques of Nucleus Delivery in Manual Small Incision Cataract Surgery

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Abstract

Aim: To compare different technique of nucleus delivery in small manual incision cataract surgery, regarding their safety and intra operative complication. **Material & Methods:** A total of 285 patients with cataract undergoing SICS with posterior chamber IOL implantation were selected. Patients were randomly divided into 7 groups of nucleus delivery. All of the patients were followed up on first postoperative day and discharge. Patients were advised regular follow up at 1st week, 4th week and 6th week. **Results:** Out of total 285 patients 68 (23.86%) patients had intraoperative complications for all the techniques. There was no intraoperative difficulty to the surgeon for delivery of nucleus by various techniques in 210 (73.68%) of cases. Group 1 (wire vectis) had minimum intraoperative complications whereas group 2 had maximum. 31 (10.88%) had grade 1 (minimal) difficulty intraoperatively. 25 (8.77%) cases had grade 2 (moderate) difficulty. 19 (6.67) cases had grade 3 (abandoned) difficulty. **Conclusion:** By adjusting parameters like size of cornean incision, hydrodissection or debulking of nucleus before delivery of nucleus in different grades of hardness of cataract, a surgeon may choose any one technique in which he or she is comfortable. Manual small incision Cataract surgery with its low complication rate has now come to be established surgical procedures for cataract surgery.

Keywords: Blumenthal, Fish Hook, Irrigating Vectis, Nucleus Delivery, Phaco fracture, SICS, Viscoexpression, Wirevectis

1. Introduction

Cataract is the single greatest cause of blindness in the world today and more so in developing countries such as India^{1,2}. There are 37 million blind people in the world today, the majority of whom live in developing countries^{3,4}. In 1990 an estimated 37 million people were blind worldwide, 40% of them because of cataract⁵. Every year, an extra 1 to 2 million people go blind. Every 5 seconds 1 person in our world goes blind, and a child goes blind every minute. In 75% of these cases the blindness is treatable or preventable. However, 90% of blind people live

in poorest section of the developing world, and without proper interventions the number of blind people will increase to 75 million by 2020. India bears a substantial part of the burden. Approximately 9 million Indians are blind from cataract with another 1.8-3.8 million going blind from cataract every year⁶⁻⁹. Our study aims to help surgeon to choose best method for nucleus delivery for particular grade of cataract.

The surgical options available in India are intracapsular cataract extraction (ICCE), extracapsular cataract extraction (ECCE), manual small incision cataract extraction and phacoemulsification¹⁰. Phacoemulsification

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has become the routine procedure for cataract extraction in industrialized countries, as it offers faster visual recovery and better uncorrected visual acuity than sutured manual extracapsular cataract extraction¹¹. Small Incision Cataract Surgery (SICS) is a fast, economical and effective way to deliver high quality cataract surgery. Its results are proven better than conventional ECCE and nearly comparable with phacoemulsification¹². An opacity in the lens or its capsule, whether developmental or acquired is called a cataract¹³. Construction of a small self-sealing sclera-corneal tunnel for delivering cataractous lens is the central principle in MSICS.

There are various techniques to deliver the nucleus out of the anterior chamber (AC) and it is a very important step in SICS. After initial steps of surgery the technique used to deliver the nucleus out of AC, depending upon the technique used, different types and multiple instruments may be required which may cause injury to the cornea, capsulorhexis rim, the iris and the posterior capsule. This will henceforth have a big impact on the visual outcome and success of the surgery.

The different methods used for delivery of nucleus in manual SICS are:-

1. Wire vectis : Wire vectis is used to deliver the nucleus.
2. Fish hook technique : Nucleus is delivered by engaging with a bent 26 ½ g needle.
3. Irrigating vectis : Irrigating vectis with continuous fluid infusion is used.
4. Phacofracture : Different instruments are used to fracture the nucleus and it is delivered in pieces.
5. Phacosandwich technique : Wire vectis and iris repository are used to deliver the nucleus.
6. Viscoexpression : Viscoelastic is continuously injected into AC to deliver the nucleus.
7. Blumenthal technique : AC maintainer, sheets glide and McPherson's forceps are used to deliver the nucleus.

The ECCE and MSICS with posterior chamber lens implantation are one of the best ways to rehabilitate the cataract patient, but has some pre-operative, intra-operative & post-operative complications.

2. Materials and Methods

A total of 285 participants after satisfying the inclusion and exclusion criteria were included in the study, which was conducted at The Dept. of Ophthalmology of Dr. V.P. Medical College & Research Centre, Adgaon, Nashik. The sample size was calculated by applying Proportionate Sampling Methods.

An informed consent was obtained from every patient.

Cases were collected using piloted proforma meeting the objectives of the study.

Slit Lamp examination which included grading of cataract and was graded as 4:

- Grade I – Greyish nucleus.
- Grade II – Slightly yellow nucleus.
- Grade III – Brown nucleus.
- Grade IV – Black signifying an extremely hard nucleus.

Patients were randomly divided into 7 groups of nucleus delivery according to their grades of cataract. The groups were:

- Group I – Wire vectis
- Group II – Fish hook
- Group III – Irrigating vectis
- Group IV – Phacofracture
- Group V – Phacosandwich
- Group VI – Viscoexpressin
- Group VII – Blumenthal

All the surgeries were carried by surgeons experienced in SICS and well versed with all the 7 techniques of nucleus delivery, in operation theatre under operating microscope.

In this study the intraoperative difficulty of the nucleus delivery technique to the surgeon while performing MSICS was assessed. It was graded as:

- Grade 0 – No difficulty
- Grade 1 – Minimal difficulty
- Grade 2 – Moderate difficulty
- Grade 3 – Procedure abandoned.

In postoperative period all patients received eye drops of antibiotic, steroids and oral antibiotics and analgesics. In case of any complications oral steroids, ocular and oral hypotensives and cycloplegics were given where needed. All patients were followed up on first postoperative day and discharged. Patients were advised regular follow up at 1st week, 4th week and 6th week. Visual acuity and refraction was assessed at each visit and final optical correction was given at the end of 6th weeks.

3. Results

Table 1. Age wise distribution of cases in study groups

Age(yrs)	I	II	III	IV	V	VI	VII	Total
45-54	7	0	4	2	1	5	2	21
55-64	19	9	12	8	8	17	7	80
65-74	21	17	20	19	19	18	20	134
75-84	13	7	5	6	7	6	6	50
Total	60	33	41	35	35	46	35	285

Out of 285 patients, a maximum of 134 patients, were in 65 to 74 year age group.

Minimum 21 patients were in 45 to 54 year age group.

Age group 55 to 64 years had 80 patients while 75 to 84 had 50 patients.

The mean age \pm SD in all the 7 groups was statistically not significant ($P>0.05$) (Table 1).

Table 2. Sex-wise distribution of case in study groups

Sex	Group							Total
	I	II	III	IV	V	VI	VII	
Male	29	23	20	24	26	26	15	163
Female	31	10	21	11	9	20	20	122
Total	60	33	41	35	35	46	35	285

$\chi^2=14.19, P<0.01$

Total number of males in our study were 163 (57.19%) compared to 122 (42.81%) females.

There was a statistical significant difference ($P>0.05$) in male to female ratio in our study (Table 2).

Table 3. Intra operative complication

Group	Intra operative complication		Total
	Present	Absent	
1	7(11.67%)	53(88.33%)	60(100%)
2	19(57.58%)	14(42.42%)	33(100%)
3	8(19.51%)	33(80.49%)	41(100%)
4	10(28.57%)	25(71.43%)	35(100%)
5	7(20%)	28(80%)	35(100%)
6	10(21.74%)	36(78.26%)	46(100%)
7	7(20%)	28(80%)	35(100%)
Total	68(23.86%)	217(76.14%)	285(100%)

Out total 285 patients 68(23.86%) patients have intraoperative complication for all the technique (Table 3).

- Group 1 (Wire vectis) had minimum 7(11.67%) patients with some kind of intraoperative complication.
- Group 2 (Fish hook) 19(57.58) had maximum patients with some kind of intraoperative complication.
- Group 3 (Phacosandwich) and Group 4 (Blumenthal technique) had similar intraoperative complication, 7(20%) patient each.

$\chi^2=21.54, p<0.01$

A total of 75 cases had intraoperative difficulty from a total of 285 cases (Table 4).

Group 2 (Fish hook technique) had maximum intraoperative difficulty with 19 (57.58%) cases out of total of 33 patients.

Table 4. Intra operative difficulty in Study groups

Group	Intra operative difficulty		Total
	Present	Absent	
1	10(16.67%)	50(83.33%)	60(100%)
2	19(57.58%)	14(42.42%)	33(100%)
3	9(21.95%)	32(78.05%)	41(100%)
4	10(28.57%)	25(71.43)	35(100%)
5	7(20%)	28(80%)	35(100%)
6	13(28.26%)	33(71.74%)	41(100%)
7	7(20%)	28(80%)	35(100%)
Total	75(26.32%)	210(73.68%)	285(100%)

Table 5. Visual acuity at 6 weeks in study groups

VA(Weeks)	GROUP							Total
	1	2	3	4	5	6	7	
6/6	29	17	21	13	16	27	15	138
6/9	27	14	16	16	14	19	16	122
6/12	4	2	4	4	4	0	4	22
<6/18	0	0	0	2	1	0	0	3
Total	60	33	41	35	35	46	35	285

$\chi^2= 19.18, p>0.05$

138(48.42%) of patients achieved 6/6 corrected vision by 6 weeks post-surgery.

122(42.84%) of the patient achieved corrects vision by 6 weeks post-surgery.

260(91.23%) of the patient achieved corrected vision more than 6/9 by 6 weeks.

3(1.05%) patient achieved corrected visual acuity less than 6/18 by 6 week.

This visual acuity showed no statistically significant difference ($p>0.05$) for the 7 study groups (Table 5).

4. Discussion

4.1 Age-wise Distribution

The age of the patients ranged from 45-84 years. The maximum number of patients, 134 was in 65-74 age group. There were 80 patients in 55-64 years age group and 50 patients in 75-84 years age group. The minimum number of patients, 21 was in 45-54 years age group. There is no significant statistical difference between the age wise distribution in various groups. The Aravind Comprehensive Eye Study⁶⁸ for Risk factors for age related cataract in a rural population of southern India found that the prevalence of definite age related cataracts of all types increased significantly ($p<0.001$) with increasing

age, from 15.7% among those aged 40-49 years to 79.4% among those aged ≥ 70 years. The age distribution was much similar to our study.

4.2 Sex-wise Distribution

Out of the total 285 patients, 163 were males and 122 females. The sex distribution in the various study groups was statistically significant.

4.3 Intraoperative Complication in Study Groups

Out of the 285 patients in this study, 68 (23.86%) cases had some kind of minor to major intraoperative complication. Group I (Wire Vectis) had 7(11.7%) cases with intraoperative complications. 2 cases had major complication of posterior capsule rent with vitreous prolapse which were nuclear sclerosis grade 4 cataract and another 2 had corneal oedema. Out of 8 mature cataracts in group I (Wire Vectis), 2 cases had hyphaema and one case had iris injury. All these intraoperative complications were managed appropriately. No other grade of cataract had any minor or major intraoperative complication.

Group II (Fish Hook) had 19 (57.58%) cases with intraoperative complications. In 14 cases (42.41%), fish hook was unable to deliver the nucleus in soft cataracts like nuclear sclerosis grade 1-2, and also 3 cases of nuclear sclerosis Grade 3, as it could not hook the nucleus effectively and thus the technique was abandoned and nucleus was delivered effectively through wire vectis technique. 2 cases with hard cataracts, nuclear sclerosis grade 4 had Posterior capsule rent with vitreous prolapse. Mature cataracts had no complications. Also Descemet's stripping and corneal oedema was seen in nuclear sclerosis grade 3. Kumar et al¹⁹ performed SICS with Fish hook technique, intraoperative complications occurred in 47 (9.4%) eyes which were Hyphaema and posterior capsular rent with vitreous prolapse in one eye. Also a study conducted by Sanjiv Kumar Gupta et al¹⁴ in 96 patients showed only one complication. Complications in our study were more than in the study by Gupta et al, and Henning et al.

8 (19.51%) cases in Group III (Irrigating Vectis) had intraoperative complications. Minor complication like corneal touch was seen in 4 cases, 3 in nuclear sclerosis grade 4 cataracts and 1 in mature cataract. Other minor complications like Hyphaema and iris injury were also seen in 1 case each of mature cataract. 2 cases both were hard cataracts, nuclear sclerosis grade 4, had major complication of posterior capsule rent with vitreous

prolapse in which, in 1 case anterior vitrectomy and ACIOL was implanted. No intraoperative complication was seen for delivery of soft cataracts.

Rengaraj¹⁵ in their study on 100 eyes with white cataract with use of trypan blue and nucleus delivery by irrigating vectis found that no eye had posterior capsular rupture and zonular dialysis and no eyes were converted to conventional ECCE. Postoperatively 6 eyes (6%) developed corneal oedema with more than 10 Descemet's fold and 7 eyes (7%) had corneal oedema with less than 10 Descemet's folds. Mild iritis was seen in 6 eyes observed and moderate iritis in 3 eyes. Iridodialysis was observed in 1 eye.

Gogate et al.,²⁹ studied SICS using irrigating vectis and ECCE in 741 patients. 329 out of the 358 surgeries (91.9%) in MSICS group were without any intraoperative complications. Of the 358 patients who were assigned to the MSICS group, 2% nevertheless underwent ECCE surgery, either because the surgeon converted by extending the incision on facing an intraoperative difficulty or because they felt they would not be able to do MSICS in the very beginning after seeing the cataract (hard nucleus or miotic pupil). 29 of 358 surgeries in MSICS group had an intraoperative complication episode like posterior capsular rent with or without vitreous loss and iridodialysis. Anecdotally, the incidence of capsular rupture was higher in hyper mature and hard cataracts and those with fixed small pupils. The latter caused difficulty in bringing the nucleus in anterior chamber during MSICS. Iridodialysis was a complication seen only in the MSICS group among 2 patients.⁴⁸ Aravindharipriya et al, to analyze the rate of intraoperative complications, and endophthalmitis with phacoemulsification, manual small incision cataract surgery (SICS), and large incision extracapsular cataract extraction (ECCE). The surgical distribution was 20438 (26%) phacoemulsification, 53603 (67%) manual small incision cataract surgery (SICS), and 5736 (7%) ECCE. The technique used in manual small incision cataract surgery (SICS) was irrigating vectis. Extracapsular cataract extraction had the highest overall rate of surgical complications (2.6%). The overall complication rate was 1.01% for manual small incision cataract surgery and 1.11% for phacoemulsification.

Venkatesh et al.,²⁸ compared the surgical outcome of SICS with irrigating vectis on 593 patients. Intraoperative complications occurred in 11 (1.9%) patients which included 8 cases with posterior capsular rent with and without vitreous prolapse. 76 eyes had complications on first postoperative day which includes hypopyon in one, severe iritis in 19, mild iritis in 16, transient corneal oedema in 33 and residual cortex in one case.

In our study there was no case of tunnel length increase intraoperatively in the irrigating vectis group and the rate of posterior capsular rent was similar except in study conducted by Rangaraj¹⁵.

In our study group IV phacofracture technique had intraoperative complications in 10 (28.57%) of cases. The complications were either due to 2 choppers functioning together in the anterior chamber or due to instruments injuring the iris or Descemet's membrane split while entering the anterior chamber especially in cases of hard cataracts like mature cataract, nuclear sclerosis grade 3-4. There were 2 cases of posterior capsule rent seen while delivering of hard cataract, nuclear sclerosis grade 4. There were 3 cases of corneal oedema 1 in each nucleus sclerosis grade 1, 3 and 4 respectively. Intraoperative miosis, hyphaema were seen in 1 case each in nucleus sclerosis grade 3. 1 case of Descemet's tear was seen in nucleus sclerosis grade 1. Iris injury was seen in 1 case while delivery of nucleus sclerosis grade 3 cataract.

Kongsap⁵⁷ conducted a prospective study, 105 consecutive patients with uncomplicated age-related cataract underwent SICS using the nylon loop technique (phacofracture). The most frequent intraoperative complication was iris prolapse (n = 11). One posterior capsule break without vitreous loss occurred during implantation of the intraocular lens and a posterior chamber intraocular lens was implanted in the sulcus. The most important postoperative complication was transient corneal oedema, which developed in 8 eyes (7.6%). No corneal decompensation occurred in any patient.

Vajpayee¹⁶ carried out a prospective, randomized study comprised 60 cases of age-related cataract randomly divided into 2 groups: 30 eyes had phacoemulsification and 30, manual phacofracture using a trisection technique. Endothelial cell loss at 3 months was 17.66 +/- 3.65% in the phacofracture group and 12.03 +/- 3.06% in the phacoemulsification group and central corneal oedema persisting for more than 1 week, 7 and 0 cases, respectively.

Hepsen et al.,¹⁷ in series of 59 eyes of 54 patients performed SICS with phacofracture method. They found that the most common intraoperative complication was posterior capsule rupture in with vitreous loss, seen in 5 eyes. No permanent complication like corneal endothelial decompensation occurred in any case.

Preeti et al.,¹⁸ compared 30 cases of phacofracture with chopper and 30 case of phacofracture with wire snare. Wound enlargement was needed in 3(10%) cases of wire snare and in 2(6.67%) cases of phacofracture with choppers. Wire snare had two cases of posterior capsule rent while there were no cases of posterior capsule rent with choppers.

The rate of posterior capsule rent in our study was less

as compared to study by Hepsen et al, while there was no case of incision enlargement or tunnel length increase intraoperatively in our study.

In our study there was no case of iris prolapse intraoperatively as was the case found in study by Kongsap et al.

Group V (Phacosandwich technique) had 7(20%) case with minor to major intraoperative complications. Descemet's membrane split was seen in 1 patient while entering instruments in the anterior chamber while delivering hard cataract, nucleus sclerosis grade 4. Corneal touch was seen in 4 cases while delivering hard cataracts, 2 each in nucleus sclerosis grade 4 and mature cataract. Hyphaema was seen in 1 cases of mature cataract. Posterior capsule rent with vitreous prolapse was seen in 1 case of nucleus sclerosis grade 4 cataract.

Naqaish et al.,³⁰ performed SICS with phacosandwich technique on 96 eyes of 88 patients. 2 patients had Descemet's detachment and 5 eyes with localized corneal oedema postoperatively.

Bayramlar et al.,³¹ studied a series of 37 eyes. Complications seen were posterior capsule rupture, vitreous loss, and transient corneal oedema by sandwich technique.

Huseyinbaayramalar et al.,⁶³ did SICS with phacosandwich techniques 99 eyes with cataract and pseudoexfoliation and 125 eyes without pseudoexfoliation. In the eyes without pseudoexfoliation 7(5.5%) eyes had complications like posterior capsular rent and zonular dialysis. They found that, lower the preoperative visual acuity and harder the cataract, the greater the risk of intraoperative complications.

The intraoperative complications of corneal oedema, posterior capsule rupture and vitreous loss in our study were similar to other studies. The rate of intraoperative complications increases with increasing hardness of cataract in our study and is similar to study by Huseyinbaayramalar et al²⁵.

In our study group VI (Viscoexpression) had complications in 10(21.73%) cases. In harder cataracts (mature senile cataract or nucleus sclerosis grade 4) viscoexpression technique was abandoned in 5 cases, in 3 mature cataract and 2 in nucleus sclerosis grade 4. Tunnel length had to be increased intraoperatively to deliver the nucleus in nucleus sclerosis grade 4. There was no other minor or major complication seen in the group.

Belluci et al.,³² compared 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%. Post-operative inflammation was least in the viscoexpression group.

In group VII (Blumenthal) 7 (20%) cases had intraoperative complications. Corneal touch was seen in 3 cases of hard cataract in nucleus sclerosis grade 3 and 4. Hyphaema, Descemet's tear and intraoperative miosis in 1 case each of nucleus sclerosis grade 4. Posterior capsule rent with vitreous prolapse was seen in 1 case of nuclear sclerosis grade 4 cataract. All other cases were uneventful.

While Kothari et al.,¹⁹ studied a non-concurrent cohort of 2095 consecutive patients undergoing cataract surgery by ECCE, Blumenthal technique (SICS) and phacoemulsification for incidence of vitreous loss and visual outcome. The incidence was matched with cases without vitreous loss. With Blumenthal technique incidence of vitreous loss was 8.1% among 1455 cases while it was 5% among the 340 cases which underwent Phaco.

Sharma et al.,²⁰ studied the results of SCIS using AC maintainer (Blumenthal technique) on all 300 consecutive patient. They found that 90% of the patients had a good visual acuity at the end of 3 months. The rate of posterior capsule opacification was to 3%, the rate of posterior capsule opacification was comparable to the results of the National cataract surgery survey (RLO1993), i.e. 3%, but the rate of corneal endothelial decompensation and endophthalmitis was marginally higher.

The most common and significant complication that can affect the final visual acuity in cataract surgery is vitreous loss. Jaffe has proposed that an acceptable figure would be less than 3%²¹.

Yorston et al.,²² in 1999 conducted a study on 1800 eyes undergoing routine extracapsular cataract extraction with posterior chamber lens implants carried out at Kenya. They reported 114 (6.3%) cases of post capsule rupture, 17 (0.9%) cases of zonular dehiscence and 97 (5.3%) cases of vitreous loss in their study.

In the study rate of posterior capsular rent with vitreous prolapse was 3.5% which was nearly equal to the previous studies.

Lumme and Laatikainen²³ evaluated the risk factors for intraoperative and early postoperative complications were in 351 consecutive cataract operations. Bleeding into the anterior chamber during the operation was recorded in 8.6%.

In our study intraoperative hyphaema was seen in 2.1% cases, which was lesser as compared to previous study.

Chirambo²⁴ evaluated the intraoperative complications of cataract surgery from 1st June 2000 to 31st December 2000 in 454 patients. He reported corneal oedema in 0.8%.²⁵ In our study corneal oedema was reported as 6.3% which was higher than the previous study, however most cases resolved post operatively.

In our study intraoperative complications like iris prolapse, zonular dialysis, capsule related complications were not seen.

4.4 Intraoperative Complication in Various Grades of Cataract in Study Groups

- All intraoperative complications whether minor or major were taken into account while calculating the following statistical results.
- Nuclear sclerosis grade 1 had 38 patients, out of which 7 (18.42%) had intraoperative complications. There was a statistical significant difference ($p < 0.0001$) in intraoperative complications for the nuclear sclerosis grade 1 cataract among the 7 study groups.
- Nuclear sclerosis grade 2 had 84 patients, out of which 6 (7.14%) had intraoperative complications. Group II (Fish Hook technique) came out to be the most unsatisfactory as it was unable to hook the soft nucleus and thus had to be abandoned in all 11 cases of nuclear sclerosis grade 1 and 2 cataract. Also group IV (Phacofracture) had 2 cases 1 each of corneal oedema and Descemet's tear in nuclear sclerosis grade 1. None of the other group had intraoperative complication nuclear sclerosis grade 1 and 2. . Group II (Fish Hook technique) and Group IV (Phacofracture) were the most unsatisfactory techniques for delivery of nuclear sclerosis Grade 1 and 2 cataract. There was a statistical significant difference ($p < 0.0001$) in the intraoperative complications for the nuclear sclerosis grade 2 cataract among the 7 study groups.
- Nuclear sclerosis grade 3 had 79 patients, out of which 11 (13.92%) patients had intraoperative complications and the result were statistically significant ($p < 0.0001$). Group IV (Phacofracture) had complications in 3 (100%) patients while group II (Fish Hook technique) and Group VII (Blumenthal) had complications in 6 (42.86%) patients and 2 (50%) case respectively. Group IV (Phacofracture) , group II (Fishhook) and group VII (Blumenthal) were the most unsatisfactory techniques of nucleus delivery while group I (Wire vectis), group III (Irrigating Vectis), V (Phacosandwich) and group VI (Viscoexpression) were the best with no complications for delivery of nuclear sclerosis grade 3 cataract.
- Nuclear sclerosis grade 4 had 51 patients, out of which 31 (60.78%) patients had intraoperative complications. There was no statistical significant difference ($p > 0.05$) in intraoperative complications for nuclear sclerosis grade 4. Group IV (Phacofracture) had 4 (100%) and group VI (Viscoexpression) had 7 (100%) cases with complications. All the other groups also had intraoperative complications for nuclear sclerosis grade 4.

Viscoexpression technique was abandoned in 2 cases as the nucleus was much bigger than the size of tunnel and pressure by viscoelastic was not enough to deliver it while in 5 cases tunnel length had to be increased to deliver the grade 4 cataract. Group I (Wire vectis) and group II (Fish Hook) had least complications, hence were found to be the best for delivery of nuclear sclerosis grade 4 cataract.

- Mature senile cataract had 33 patients, 13 (39.39%) patients had intraoperative complications. Group V (Phacosandwich) and Group VI (Viscoexpression) had complications in 100% of cases. Group II (Fish hook) and Group VII (Blumenthal technique) had no cases with intraoperative complications. Phacosandwich and Viscoexpression came out to be the most unsatisfactory while group II (Fish Hook) and group VII (Blumenthal technique) proved best for delivery of mature senile cataract. There was no statistical significant difference ($p > 0.05$) in intraoperative complications for the mature senile cataract among the 7 study groups.

4.5 Intra Operative Difficulty in Various Study Groups

- Out of 285 patients, there was no intraoperative difficulty to the surgeon for delivery of nucleus by different techniques in 210 (73.68%) cases.
- 31 (10.88%) cases had grade 1 (minimal) difficulty.
- 25 (8.77%) cases had grade 2 (Moderate) difficulty.
- 19 (6.67%) cases had grade 3 (abandoned) difficulty.
- Group I (Wire vectis) had 10 (16.67%) cases with intraoperative difficulty.
- Group II (Fish Hook) had 19 (57.58%) cases with intraoperative difficulty.
- Group III (Irrigating Vectis) had 9 (21.95%) cases with intraoperative difficulty.
- Group IV (Phacofracture) had 10 (28.57%) cases with intraoperative difficulty.
- Group V (Phacosandwich) had 7 (20%) cases with intraoperative difficulty.
- Group VI (Viscoexpression) had 13 (28.25%) cases with intraoperative difficulty.
- Group VII (Blumenthal) had 7 (20%) cases with intraoperative difficulty.

Group II (Fish Hook) had grade 3 intraoperative difficulty in 14 (42.42%) cases which were for soft cataracts like, nuclear sclerosis grade 1-2 while 5 (10.87%) cases in group VI (Viscoexpression) had grade 3 intraoperative difficulty for hard cataracts like mature senile cataract or nuclear sclerosis Grade 4. None of the other techniques had grade 3 difficulties.

Group I (Wire vectis) 16.67% had the least intraoperative difficulty for the surgeon in this study and was followed closely by group V (Phacosandwich) 20% and group VII (Blumenthal) 20%.

Our study finds that Group I (Wire vectis) is the technique with maximum ease and minimal difficulty for nucleus delivery.

There was a statistical significant difference ($p < 0.0001$) in the intraoperative difficulty for all grades of cataract among the 7 study groups.

4.6 Visual Acuity at 6 Weeks Postoperative in Study Groups

Out of 285 patients, 138 (48.41%) achieved corrected visual acuity of 6/6 by 6 weeks after surgery. 122 (42.8%) patients achieved corrected visual acuity of 6/9. 22 cases (7.6%) had visual acuity 6/12 after 6 weeks of surgery. These patients had complications like ACIOL with vitreous, pupillary capture. 3 (1.04%) cases had best corrected visual acuity less than 6/18 on Snellens' chart. These patients had persistent corneal oedema at the end of 6 weeks which did not regress totally with postoperative treatment. There was no statistical significant difference ($p > 0.05$) in visual acuity at 6 weeks for all the grades of cataract among the 7 study groups.

Powe et al.,³³ did a Meta-analysis (formal systematic identification, selection, review, and synthesis) of published literature. Patients described in 90 studies published between 1979 and 1991 that addressed visual acuity ($n = 17,390$ eyes) or complications ($n = 68,316$ eyes) following standard extracapsular cataract extraction with PCIOL implantation, phacoemulsification with PCIOL implantation, or intracapsular cataract extraction with flexible anterior chamber intraocular lens implantation. The main outcome measures the proportion of eyes with postoperative visual acuity and the proportion of eyes with each complications. The pooled percentage of eyes (weighed by sample size) with postoperative visual acuity of 20/40 or better was 95.5% (95% confidence interval [CI], 95.1% to 95.9%) among eyes without preexisting ocular comorbidity and 89.7% (95% CI, 89.3% to 90.2%) for all eyes.

Gogate et al.,³⁴ using irrigating vectis technique in SICS gives good uncorrected visual acuity in comparison of ECCE. Of the 348 patients operated by this technique 47.9% had uncorrected visual acuity better than 6/18 in comparison to 37.3% achieved by ECCE.

Hepşen et al.,¹⁷ in Fifty-nine eyes of 54 patients had small incision ECCE by the manual phacotrisection technique with mean follow-up of 10 months. Postoperatively, best spectacle-corrected visual acuity of 20/40 or better was

achieved in 48 eyes (83%) and of 20/25 or better in 28 eyes (47%).

Sharma et al.,²⁶ studied the results of SICS using AC maintainer (Blumenthal technique) on all 300 consecutive patients between March 1997 to December 1998. Results were that 90% of the patients had a good visual acuity at the end of 3 months.

Kumar et al.,²⁷ performed SICS with Fish Hook technique in 500 consecutive patients. The best corrected visual acuity was 6/18 or better in 96.2% of eyes at 6 weeks and in 95.9% at 1 year. Poor visual outcome (<6/60) occurred in less than 2%.

Venkatesh et al.,²⁸ in a non-comparative interventional case series, the authors reviewed the surgical outcomes of 593 patients, reported a total of 491 patients (94.4%) achieved BCVA of 6/18, 21 patients (4%) achieved 6/24 to 6/60 and eight patients (1.6%) had 6/60.

Our study matched with the previous studies for the post-operative best corrected visual acuity at 6 weeks.

5. Conclusion

In our study we came to the following conclusions:

- Surgeons had the maximum difficulty for delivery of soft cataract with Fish Hook technique.
- Complications with Wire Vectis and Irrigating wire vectis were the least. Fish Hook technique had maximum complications.
- Surgeons had maximum intraoperative difficulty while developing nucleus with the Fish Hook technique followed by viscoexpression technique.
- Maximum patients had quite eyes at 1st day post operatively with Phacofracture technique.
- Most patient had quit eye on 6th week post-operative.
- We found that proper selection of cases according to grade of cataract is of paramount importance to decide which technique of nucleus delivery is to be used.
- By adjusting parameters like size of corneal incision, hydrodissection or debulking of nucleus before delivery of nucleus in different grades of hardness of cataract, a surgeon may choose any one technique in which he or she is comfortable.
- Manual small incision cataract surgery with its low complication rate has now established surgical procedure for cataract surgery. The complication managed with standard surgical techniques are compatible with good visual outcome.

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