

Original article

Phacoemulsification surgery by a nationally-trained cataract surgeon of Nepal

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Abstract

Introduction: A one month phacoemulsification training course had been implemented by the Nepal Netra Jyoti Sangh (NNJS) in collaboration with Association for Ophthalmic Cooperation to Asia, Japan (AOCA).

Objective: To evaluate the visual outcomes of phacoemulsification surgery by a nationally trained surgeon in Nepal.

Materials and methods: A retrospective study of patients that underwent phacoemulsification with foldable intraocular lens implantation during a period of 18 months was carried out. Cases that had a six-week follow-up period were included. Effective phaco time (EPT), intra-operative and postoperative complications were noted. Uncorrected visual acuity (UCVA) at day 1 and best corrected visual acuity (BCVA) at week 6 were noted. The data were analyzed using SPSS 11.5.

Results: A total of 172 patients that had completed a 6 week follow-up evaluation were included in the study. The mean age of patients was 57.12±10.19 years. The mean effective phaco time (EPT) was 9.74±7.41 seconds. Posterior capsule rupture (PCR) with vitreous loss occurred in 2 eyes (1.2%), Descemet's membrane detachment in 1 eye (0.6%), capsulorhexis extension in 1 eye (0.6%) and wound site thermal injury (WSTI) occurred in 3 eyes (1.7%). Postoperative complications were mild to moderate striate keratopathy (9/172), corneal edema (1/172), corneal epithelial defect (1/172) and uveitis (1/172). At 6 weeks post-operatively, 165 eyes (95.9%) had a BCVA better than 6/18 and 7 eyes (4.1%) had a BCVA of 6/18 to 6/60.

Conclusion: Patients undergoing phacoemulsification had a good visual outcome as a result of the procedure performed by cataract surgeon trained from AOCA/NNJS national phacoemulsification training program of Nepal.

Key-words: phacoemulsification, training program, Nepal

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Introduction

The ultimate goal of a cataract surgery is to restore and maintain the pre-cataract vision and to alleviate other cataract-related symptoms. Phacoemulsification permits removal of the cataractous lens through a smaller incision, a quicker visual recovery and a faster physical rehabilitation. The first phacoemulsification was performed by Charles Kelman in 1967 (Kelman et al 1967). The techniques and results of cataract surgery have changed over the last three decades and phacoemulsification has become the preferred technique in developed countries (Seibel et al 1999; Linebarger et al 2000; Lundstrom et al 2002). In a survey on the practice styles of American Society of Cataract and Refractive Surgeons (ASCRS) members, it was found that only 3% of the cataract surgeons did not use the phacoemulsification technique at all (Leaming et al 2002). Similarly, 93% of the members of Japanese Society of Cataract and Refractive Surgery preferred phacoemulsification (Oshika et al 2000). The scenario in South Asian countries a decade before was opposite; less than 5% of the eye surgeons in India performed phacoemulsification (Basti et al 1999). Despite the rapid development in technology-driven cataract surgery in the developed world, it is still in its infancy in developing countries.

Cataract surgery is the most common intraocular surgery performed worldwide. Over the past two decades, extra-capsular cataract extraction (ECCE) has become a more commonly performed procedure than intra-capsular cataract extraction (ICCE), which is now performed less often in Nepal. In developing countries, manual sutureless small incision cataract surgery (SICS) has been accepted as a low cost cataract surgery and the best option for addressing high volume cataract backlog (Ruit et al 2000; Chang DF 2005). In recent years, phacoemulsification technique has brought cataract surgery results as close to anatomical perfection as possible. However, implementation of phacoemulsification is limited by

the startup and training cost. As a result, ophthalmologists in developing countries such as Nepal, have limited opportunity to acquire the skill of phacoemulsification. To address this problem, the Association for Ophthalmic Cooperation in Asia (AOCA) in joint collaboration with the Nepal Netra Jyoti Sangh (NNJS) started the first bi-annual national phacoemulsification training program in Nepal from December 2007, with the financial support of the Japan International Cooperation Agency (JICA). The author (BS), after completing a one-month phaco training program, started performing phacoemulsification independently. The objective of this study was to analyze the surgical outcome of phacoemulsification by a young ophthalmologist after receiving training in Nepal.

Materials and methods

This study was a hospital-based retrospective one that included data from 172 patients that underwent phacoemulsification with foldable intraocular lens implantation by a single surgeon (BS) during a period of 18 months (1st July, 2008 to 31st December, 2009) and who had also completed a 6-week follow-up. Diabetics and hypertensives were included. Cataract grading was classified under Lens Opacity Classification System (Chylac et al 1989). Nuclear sclerosis grades 1 and 2 were included in one group and Grades 3 and 4 were included in a second group. Posterior sub-capsular cataracts (PSCC), posterior polar cataracts, traumatic cataracts without subluxation, and myopic patients were also included. Preoperative visual acuity, slit lamp biomicroscopy findings with 90D examination, corneal astigmatism and IOL power calculations were recorded. Under peribulbar anesthesia, phacoemulsification was performed by a clear corneal incision (CCI). The CCI of 2.8 mm was placed at the 12'o clock position in cases of with-the-rule (WTR) astigmatism and a superior temporal CCI was performed in cases of against-the-rule (ATR) astigmatism. The anterior chamber was refilled with hydroxypropyl methyl cellulose 2%. Continuous curvilinear capsulorrhexis (CCC) was then

performed with a 26 G bent cystotome through empty 1 ml disposable syringe. In case of difficulty, capsulorrhexis forceps were used for completion of the CCC. Four quadrant cortical - cleaving hydrodissection was performed with a 24 gauge cannula in a 3 ml disposable syringe, and rotation was done with a blunt chopper via a side port. The AMO sovereign compact (White Star) phaco machine was used, and the stop and chop technique was the preferred method for nucleotomy.

After central sculpting, the nucleus was fractured into two hemi-sections and chopping was performed. The parameters of phacoemulsification used in cases of grade 1 and 2 nuclear sclerosis were: US energy of 20-30%; vacuum of 150-250 mmHg and aspiration flow rate (AFR) 18-22 cc/min. The parameters used in grade 3 and 4 cataracts: US energy was 30-50%, vacuum 250-350 mmHg and AFR 22-28 cc/min. The phaco machine had its own program setting for above parameters, and the surgeon could switch to different phaco modes by using a foot pedal. Care was taken to perform the entire emulsification and aspiration at the posterior plane as much as possible. A single piece foldable acrylic intraocular lens (Tecsoft, The Fred Hollows IOL Laboratory, Tilganga Eye Center, Nepal) was implanted via a hydraulic injector. Irrigation and aspiration were performed with a single piece coaxial hand piece. At the end of the surgery, sub-conjunctival injection of gentamicin and dexamethasone was given in all cases. Effective phaco time (EPT), intra-operative and postoperative complications were noted. Uncorrected Visual Acuity (UCVA) at day 1 and Best Corrected Visual Acuity (BCVA) at week 6 were noted. A 90 D fundus examination was done in eyes that had decreased BCVA after 6 weeks. The data were analyzed using SPSS 11.5 (Chicago, IL, USA).

Results

Two hundred and fifty-three eyes had undergone phacoemulsification during an 18-month period. A total of 172 (67.9%) eyes that had a six week follow up were included in the analysis. The mean age of patients was 57.12 ± 10.19 years (range 30-84 years). One hundred and five were male patients (61%) and 67 were females (39%) with a male to female ratio of 1.5:1 (105/67). Of the total, 73.8% of patients were from India and 26.2% from Nepal. Thirteen patients (7.6%) were found to have hypertension, 7 patients (4.1%) had diabetes mellitus and one patient had a history of cardiac surgery. Preoperative uncorrected visual acuity (UCVA) was $<1/60$ in 40 eyes (23.3%), between $1/60$ and $6/60$ in 88 eyes (51.2%), between $6/60$ and $6/18$ in 39 eyes (22.6%) and between $6/18$ and $6/9$ in 5 eyes (2.9%). The preoperative mean corneal astigmatism was 0.641 ± 0.404 Diopter against-the-rule (ATR) in 125 eyes, 0.525 ± 0.372 Diopter with-the-rule (WTR) in 41 eyes, and 6 eyes had no astigmatism. The mean IOL power was 20.52 ± 1.743 D (range 15.50- 25.00 D).

One hundred and seventy one eyes had a well-dilated pupil and 1 eye was poorly dilated. In this case, 4 metallic iris hooks with silicon sleeves were used to dilate the pupil. One hundred and sixty-nine eyes (98.3%) had undergone phacoemulsification by stop and chop technique. The mean effective phaco time (EPT) for all cases was 9.74 ± 7.41 seconds. The mean EPT for nuclear sclerosis (NS) 1 and NS 2 was 7.92 ± 4.97 seconds, the mean EPT for NS 3 and NS 4 was 15.75 ± 9.45 seconds; and the mean EPT for hypermature senile cataracts (HMSC - white and brown cataracts) was 11.92 ± 5.88 seconds. Two eyes (1.2%) had posterior capsule rupture (PCR) with vitreous loss, 1 eye (0.6%) had a Descemet's membrane detachment; 1 eye (0.6%) had a CCC extension and 3 eyes (1.7%) had wound site thermal injury (WSTI) (Table 1).

Table 1
Effective phaco time in different types of cataract and intra-operative complications

Cataract types	EPT Mean (SD)	PCR	Iris Injury	Corneal burn	Dm Strip	Radial extension of CCC	No complications	Total
NS 1 – NS 2	7.92(4.97)			1			100	101
NS 3 – NS 4	15.75(9.45)	1	1	2	1		38	43
only PSCC	2.96(3.06)						13	13
Posterior polar	6.25(8.27)	1					1	2
HMSC, White/Brown	11.92(5.88)					1	11	12
Traumatic cataract	2.70(0.0)						1	1
Total (%)		2 (1.2%)	1 (0.6%)	3 (1.7%)	1 (0.6%)	1 (0.6%)	164 (95.3%)	172 (100%)

Table 2
Visual acuity of eyes that underwent phacoemulsification

Visual acuity	Pre-operative UCVA	Post-operative Day 1 UCVA	Follow-up week 6 BCVA
Better than 6/18	5 (2.9%)	136 (79.1%)	165 (95.9%)
6/18 to 6/60	39 (22.6%)	34 (19.7%)	7 (4.1%)
5/60 to 1/60	88 (51.2%)	2 (1.2%)	0
<1/60	40 (23.3%)	0	0
Total	172 (100%)	172 (100%)	172 (100%)

Table 3
Post-operative complications

Cataract types	Striate Keratopathy	Corneal Edema	Uveitis	Corneal Epithelial Defect	None	Total
NS1 - NS2	2	1			98	101
NS 3 - NS4	7		1	1	34	43
only PSCC					13	13
Posterior polar					2	2
HMSC, White/Brown					12	12
Traumatic cataract					1	1
Total (%)	9	1	1	1	160 (93%)	172 (100%)

Table 4
Visual outcomes in eyes with intra-operative and postoperative complications

Surgical Complications	UCVA at Day 1			BCVA at Week 6		
	Better than 6/18	6/18- 6/60	<6/60	Better than 6/18	6/18- 6/60	<6/60
Intraoperative						
PCR	2			2		
Corneal burn		3		2	1	
DM detachment	1			1		
Postoperative						
SK	2	5	2	8	1	
Corneal Edema		1		1		
Corneal epithelial defect	1			1		
Uveitis	1			1		

PCR= Posterior capsule rupture; DM= Descemet membrane; SK= Striate keratopathy

On the first postoperative day, 136 eyes (79.1%) had an UCVA of better than 6/18, 34 eyes (19.7%) had an UCVA of 6/18 to 6/60 and 2 eyes (1.2%) had an UCVA of less than 6/60 (Table 2). Table 3 shows postoperative complications which included mild to moderate striate keratopathy (9/172), corneal edema (1/172), corneal epithelial defect (1/172) and uveitis with grade 3 cells in anterior chamber (1/172). Striate keratopathy was higher in the grade 3 and 4 nuclear sclerosis group (7/43) than in the grade 1 and 2 nuclear sclerosis group (2/101). Complications were not present in 160 eyes (93%) on the first post-operative day. After 6 weeks, 143 eyes (83.2%) had a BCVA of 6/6-6/9, 22 eyes (12.7%), had a BCVA of 6/12 to 6/18 and 7 eyes (4.1%) had a BCVA of 6/24 to 6/60 (Table 2). PCR in 2 eyes achieved a BCVA of better than 6/18 on the last follow up. Eyes with striate keratopathy (SK) achieved BCVA better than 6/18 in 8 cases and 6/18 to 6/60 in one case (Table 4).

Discussion

The learning curve for phacoemulsification cataract surgery is generally accepted to be quite steep (Prasad et al, 1998). It is vital that young surgeons learn this procedure in a manner that is safe and time efficient. The author (BS) had performed nearly one thousand cases of manual sutureless extra-

capsular cataract surgery before starting phacoemulsification training. Since 2007, the Nepal Netra Jyoti Sangh (NNJS) and Association for Ophthalmic Cooperation to Asia, Japan (AOCA) have been conducting a one month bi-annual phacoemulsification training program. During the first two weeks of training (May 2008), the author (BS) was taught in stages to perform a single part of the procedure several times in succession under direct supervision of an experienced surgeon (SJB & MIM) at the Himalaya Eye Hospital (Ghari Patan, Pokhara, Nepal). After each step had been mastered on dummy eyes (pig's eye) in the wet lab, trainees had to ask to learn the next step of the procedure. During the last two weeks, hands on training in the operation theatre setting led to acceptable surgical outcomes including reasonably low complication rates. After completing the training, the author (BS) began performing phacoemulsification in Lumbini Eye Institute (Bhairahawa, Western Nepal) under the guidance of an experienced phaco surgeon (SBR) for one month (June 2008) and then transitioned to independently performing phacoemulsification starting in July 2008 onwards.

Two hundred and fifty-three eyes had undergone phacoemulsification over an 18 months period. However, only two thirds (172/253, 67.9%) of cases had presented for a 6 week evaluation. The

lost to follow up could be due to long distance, as 3/4th of the patients were required to travel from India. Additionally, we can speculate that the patients who achieved better working vision did not come for follow-up after surgery. The results of this study show that harder cataracts (nuclear sclerosis grade 3 and 4) were associated with high occurrence of intra-operative and postoperative complications (Table 1 and 3). Posterior capsule rupture (PCR) occurred in 2 eyes (1.2%): one eye had undergone a closed chamber anterior vitrectomy with a 3-piece foldable posterior chamber intraocular lens (PCIOL) implanted in the sulcus. The other case of PCR was converted to a conventional ECCE and a PMMA PCIOL was implanted in sulcus as well. It has been reported that experienced surgeons have a 0-5% incidence of PCR with vitreous loss (Chan et al 2003; Kothari et al 2003; Dholakia et al 2004) compared to 10.0-19.7% in learning surgeons (Cotlierat al 1976; Thomas et al 1997; Hennig et al 2004). In one of the studies, author's first 1000 cases of phacoemulsification surgery (Ng et al, 1998) were studied prospectively and consecutively, and the major complication rate was compared between the first 150 cases and the last 850 cases. The rate was 9.3% in the first 150 cases, but improved to 0.9% in the final 850 cases. In another prospective analysis of the first 3000 cases of phacoemulsification (Martin et al 2000), the rate of vitreous loss in the first 300 and the last 300 cases was 4.0% and 0.7%, respectively.

In our study, intra-operative corneal complications were found in 3 eyes (1.7%) with wound site thermal injury (WSTI) and 1 eye (0.6%) with a Descemet's membrane detachment. Postoperative corneal complications included mild to moderate striate keratopathy (9/172), corneal edema (1/172), and epithelial defect (1/172). Corneal complications were more common with grade III and IV nuclear sclerosis. None of the cases required suturing of the corneal incision. These results can be compared to those of a retrospective study of 100 cases by a beginner phaco surgeon (Ali et al 2007), which

showed intra-operative corneal complications including corneal abrasion (40%), corneal hydration (3%) and Descemet's membrane detachment (3%). Postoperative corneal complications included mild (18%), moderate (22%) and severe (13%) striate keratopathy with corneal edema. A study by Hennig et al (2004) showed that postoperative corneal complications which resulted in reduced visual acuity were more common in cases performed by surgeons who had no formal training (11/100 eyes) when compared to surgeon who had learnt phacoemulsification in a stepwise manner and had been taught by an experienced phaco-surgeon (3/100 eyes). In this retrospective study, none of the eyes developed post-operative endophthalmitis. Our preoperative prophylaxis was topical Chloramphenicol drops once every 2 hours one day prior to surgery. A single dose of tablet Ciprofloxacin 750 mg was prescribed on the day of surgery. After the completion of surgery, sub-conjunctival injection of Dexamethasone (2mg) and Gentamycin (20mg) was given in all cases. Post-operative topical medications were a combination of Chloramphenicol and Dexamethasone 6 times daily for 2 weeks and 4 times daily till 6 weeks.

The mean effective phaco time (EPT) in our study was 7.92 seconds (SD \pm 4.97) for nuclear sclerosis I and II, whereas EPT was 15.75 seconds (SD \pm 9.45) for nuclear sclerosis III and IV. As stop-and-chop technique was preferred for above cataracts, the low EPT in our study can be attributed to the use of an AMO Sovereign phaco machine with white star technology. One of the studies from northern India (Vajpayee et al 2000) has shown an EPT of 28 ± 16 seconds for immature senile cataract done by Storz Protégé phaco machine by stop and chop technique, and had concluded that the phaco-chop and the stop-and-chop nucleotomy techniques were equally efficacious for nuclear management during phacoemulsification. Izzet Can et al (2004) showed an EPT of 22 ± 14 seconds in stop-and-chop technique done with the Series 2000 Legacy Phacoemulsification unit (Alcon), and had concluded that the phaco-chop was superior to the



stop-and-chop nucleotomy. A comparative clinical trial on White Star system (Fishkind W et al 2006), has concluded that the Sovereign with White Star power modulation system provides effective lens removal at lower levels of phaco power and ultrasound energy (Mean EPT= 6.67 ±8.2 seconds) than the Sovereign 4.0 system (Mean EPT =8.59±9.3 seconds).

On the first post-operative day, uncorrected visual acuity (UCVA) was better than 6/18 in 136 eyes (79.1%) and on the sixth week, best corrected visual acuity (BCVA) was better than 6/18 in 165 eyes (95.9%). The major cause of reduced visual acuity on day 1 was corneal complications; whereas reduced BCVA at the sixth week in 7 eyes was due to high astigmatism and posterior segment pathology. Two patients had dry age-related macular degeneration (AMD), one diabetic patient had a severe NPDR with macular edema in one eye and another patient was found to have myopic fundus degeneration. A prospective study of 173 patients by Dholakia SA et al (2004), followed their patients for 3 years, and showed that a BCVA of better than 6/18 was achieved in 146 eyes (88.89%) at last follow up (Dholakia SA et al 2004). A prospective randomized comparative study (Ruit et al 2007) on phacoemulsification by phaco-chop technique done by experienced surgeon has reported a BCVA equal to or better than 6/18 in 98% of patients at six months follow up period. Gogate et al have reported a BCVA of better than 6/18 in 98.5% of eyes at 6 week postoperatively that had undergone phacoemulsification by stop- and- chop technique (Gogate P et al 2010).

The limitation of this retrospective study was a short period of follow up and the post-operative corneal astigmatism, which was not included in the study. A study with at least a 6 month follow up period and calculation of surgically induced astigmatism (SIA) would have added more insight into the outcome of phacoemulsification.

Conclusion

Bi-annual national phacoemulsification training program has provided an opportunity to cataract surgeons of Nepal to perform effective phaco surgery in their own nation. Patients undergoing phacoemulsification by a nationally-trained phaco surgeon had a good visual outcome with minimum pre-operative and post-operative complications.

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