Original Article

Visual Outcome and Complications of Manual Sutureless Small Incision Cataract Surgery

Muhammad Tariq Khan, Sanaullah Jan, Zakir Hussain, Samina Karim, Muhammad Kamran Khalid, Lal Mohammad

Pak J Ophthalmol 2010, Vol. 26 No.1

See end of article for authors affiliations

Correspondence to:
Muhammad Tariq Khan
2-Lakhkar Khan Road
University Town
Peshawar

Received for publication
May' 2009

Purpose: To determine the surgically induced astigmatism and complications of manual sutureless small incision cataract surgery (SICS).

Material and Methods: The study was conducted in the Department of Ophthalmology, Khyber Institute of Ophthalmic Medical Sciences (KIOMS), Postgraduate Medical Institute (PGMI), Hayatabad Medical Complex (HMC), Peshawar. In this study evaluation of 150 eyes of 134 patients were included in this study. Cataract surgery was performed in all cases by manual sutureless small incision technique. Patients were thoroughly examined and visual acuity & keratometry were recorded pre-operatively and at follow-up visits. The type and amount of astigmatism were calculated from the keratometry readings. Any complications found during surgery or on follow up visits were also recorded.

Results: Final best-corrected visual acuity 6-months post-operatively was ≥ 6/18 in 86.8 % of cases as compared to pre-operative VA (≤ 6/60) in 82% of eyes. Astigmatism was noted to be *significant* or *high* in 50 % cases. This study proved that course of time has no significant effect on the final amount of post-op astigmatism in eyes operated by manual SICS. Other complications included hyphema noted in 17 (11.3 %) cases, posterior capsule rupture in 5 (3.3 %) cases, endophthalmitis in 2 cases (1.3 %) at 1st post-op day. Third case, who had developed panophthalmitis presented 1-week post-operatively and affected eye was eventually eviscerated.

Conclusions: Manual SICS is a safe and effective procedure with rapid visual rehabilitation. The amount of post-operative astigmatism was high in significant number of cases. The final best-corrected visual outcome was good in most of cases.

According to WHO estimates of global data on blindness, there are an estimated 38 million blind people worldwide, and a further 110 million with low vision who are at risk of becoming blind. Age-related cataract accounts for nearly half of these blind individuals, and is particularly common in developing countries. WHO reports that there is a backlog of cataract of approximately 15.8 million people with an annual increase of over 2 million newly cataract-blind patients[1]. Blindness rate in Pakistan is unacceptably high (1.78% of the total population), of which 66.7% are blind because of cataract[2]. Phacoemulsification is now standard technique routinely performed for cataract extraction in developed countries, as it offers early visual rehabilitation and better un-aided visual acuity than the conventional sutured planned extracapsular cataract extraction (ECCE). Owing to the expenses of equipment and consumables, and the high proportion of eyes with densely mature cataracts, phaco-

emulsification has had a limited role in many developing countries including Pakistan. In order to obtain the advantages of a self-sealing sutureless incision with least surgically induced astigmatism at a low cost, developing world ophthalmologists have adopted alternatives to phaco-emulsification. Manual sutureless small incision cataract surgery (SICS) has been proved to be an equally effective and a highly cost-effective alternative to instrumental phaco with a low complications rate[3,4]. It is generally noticed that the incidence of postoperative astigmatism is more when cataract extraction is done through the corneal incision and the more anterior the incision the greater the induced astigmatism[5].

Different studies from local and international studies had reported that manual sutureless small incision cataract surgery is an encouraging technique and that good visual results can be obtained in over 85% of cases with some associated complications like post-operative astigmatism, per-operative hyphema and irido-dialysis, etc[6,7,8,9]. The purpose of this study was to produce local evidence regarding visual outcome, surgically induced astigmatism and technique-related complications of manual sutureless SICS.

MATERIAL AND METHODS

This study included 134 patients (150 eyes) at Khyber Institute of Ophthalmic Medical Sciences (KIOMS), PGMI, Hayatabad Medical Complex, Peshawar, Pakistan.

All surgeries included in the study, were performed by the principal author. Pre-operative examination like visual aquity, detailed slit lamp examination, IOP check, a scan and keratometry was carried out for all cases. Type of cataract was recorded on the basis of morphology as immature, mature, hypermature (morgagnian), intumescent, and large nucleus.

Keratometric findings of all the eyes were recorded pre-operatively and then at all follow-up visits. Keratometric findings were noted in diopters and the axis was mentioned. The type and amount of astigmatism was calculated from keratometry findings pre-operatively and at all follow-up visits. On each follow-up visit, un-aided visual acuity (UAVA), best-corrected visual acuity (BCVA), significant signs (like A/C reaction, corneal striate, wound deformity, hyphema, etc), and any significant symptoms (like eye pain, double vision, FB sensation, etc) were recorded.

Astigmatism was recorded as negative cylinder values. Astigmatism was graded and classified according to Holmström's gradation as,

No astigmatism, when it was < 0.25 D

Non-significant, when it was ≥ 0.25 D but <1.00 D

Significant, when it was ≥ 1.00 D but < 2.00 D

High, when it was ≥ 2.00 D

The axes of astigmatism were divided into three classes,"With the rule" (minus cylinder at $180^{o} \pm 15^{o}$), "Against the rule" (minus cylinder at $90^{o} \pm 15^{o}$) and "Oblique" (minus cylinder at $16 - 74^{o}$ & $106 - 164^{o}$).

All the surgeries were performed within either micro-surgical training center's operation theatre or within the main operation theatre of the Khyber Institute of Ophthalmic Medical Sciences. The eye to be operated would properly be dilated by putting mydriatic drops. Mixed peri-bulbar and retro-bulbar anesthesia was given by injecting mixture of Lignocaine and Bupivacaine at two different sites superiorly and inferiorly. The eye and peri-ocular skin would properly disinfected by painting with povidone-iodine solution. After proper draping, surgeon would approach from superior or temporal side, depending upon the keratometry readings. After conjunctival section, gentle cautry was done to stop any bleed. Any of the four types of scleral incision (smile, straight, frown, inverted V shaped) was given at a distance of about 2 mm from the limbus, with a number 15 blade. The external width of the incision was 6-8 mm according to the expected size of the nucleus. Sclero-corneal tunnel was made with a crescent knife and entry into the anterior chamber with a 3.2 mm keratome. The internal opening of the incision was wider, so as to facilitate the nucleus delivery. Before entering into the AC, a side port was made at the limbus, at right angle to the plane of approach with the same 3.2 mm keratome. Anterior chamber was filled with visco-elastic substance by injecting it through the side port. Anterior capsulotomy was done with the help of a self-made cystitome and a capsular forcep. Hydro-maneuvers were performed in almost all cases and nucleus was delivered either by hydro-expression or by visco-expression. Cortical matter was then washed out with Simcoe's cannula and rigid, single-piece poly methyl methacrylate (PMMA) IOL was implanted within the bag or in the cilliary sulcus. Three step scleral wound was then checked for its self sealing character and conjunctiva approximated by closing with gentle

cautry. Visco-elastic material was washed out through the side port, and anti-septic dressing was done.

Cases were examined at the first post-operative day, 1-week post-op, 6-weeks post-op, and 6-months post-operatively with a slit-lamp and/ or direct/ indirect ophthalmoscope for any significant sign. Z-test (Normal test) and Chi-squared test were applied to the data.

In order to see the stabilization of refractive status in the operated eyes, Chi-squared test was applied in testing the hypothesis for time-elapse after surgery and BCVA. SPSS (Statistical Package for Social Sciences) version 8.0 was used in data analysis and graphs formation.

RESULTS

All 134 patients were divided into three categories according to age. 40 (29.9%) patients were found to fit in category-I (age 40 to 59 years), 81 (60.4%) patients in category-II (age 60 to 79 years), and 13 (9.7%) patients in category-III (age 80 years and above). The mean age of all the patients was found to be 67.18 years. Out of all 134 patients, 77 (57.5%) were males and 57 (42.5%) were females.

Out of 150 eyes operated, 82 (54.7%) were right eyes and 68 (45.3%) were left eyes. Site of incision was superior in 57 (38.0%) cases, while in 93 (62.0%) cases, temporal incision was given.

Type of incision given in 13 (8.7%) cases was smile, in 41 (27.3%) cases was straight, in 43 (28.7%) cases was frown and in 53 (35.3%) cases, inverted V shapedv (chevron) type of incision was given. Minor intra-operative complications were not documented. Amongst the note-worthy per-operative complications, 23 (15.3%) cases bled from the tunnel causing intra-operative hyphema was noted. These cases were only let to leave operation theatre, when the bleeding had stopped. In 6 (4.0%) cases, some degree of irido-dialysis occurred, none of them to the extent to need repair. In 5 (3.3%) cases, posterior capsule (PC) got ruptured.

The astigmatism, calculated from pre-operative keratometry findings was found to be with-the-rule (WTR) in 73 (48.7%) eyes, against-the-rule (ATR) in 27 (18.0%) eyes, and oblique in 32 (21.3%) eyes. No astigmatism was found in 18 (12.0%) eyes pre-operatively. Type of astigmatism preoperatively and on every follow up visit is shown in Table I. Details regarding amount of astigmatism with different type of astigmatism is shown in (Table 2).

It is worth to note that during follow up visits, significant no of patients were lost. On 1st post-operative day, all 150 eyes were examined but at 1 week post-operative visit 114 (70%) eyes of 107 (79.9%) were examined, at 6 weeks, post-operatively, 98 (65.39%) eyes of 91 (67.9%) patients were available for assessment and on final visit (6 months post-operatively) only 68 (45.3%) eyes of 64 (47.8%) patients showed for follow up.

Regarding complications, 17 (11.3%) eyes were found having hyphema at the 1st post-op follow-up examination. Hyphema resolved in 11 (7.3%) cases in one week and in all cases 6-week post-operatively. Post-operative endophthalmitis was diagnosed in 2 (1.3%) cases on 1st post-op day, which were successfully treated. Another one case, presented 1-week post-operatively with panophthalmitis. This eye had to be eventually eviscerated. Corneal complications (like significant corneal edema and striate keratopathy) were noted in 19 (12.7%) patients at 1st post-op day. Most of these cases were cleared up by the 1-week post-op, after topical steroids and antibiotics usage. In 5 (3.33%) cases, intra-ocular pressure (IOP) was found to be more than the upper level of normal (i.e. above 21 mm Hg) on 1st post-op day. 3 (2.0%) of these cases were put on topical IOP lowering drugs for about a week and were properly monitored. None of these cases was having increased IOP, when they presented 1-week post-operatively.

During the six months follow-up period, 7 (4.7%) eyes were found having significant posterior capsule opacification (PCO) to the extent that Nd: YAG capsulotomy had to be done to clear the visual axis. One case was diagnosed with cystoid macular edema (CME) at 6-week post-op and yet another with bullous keratopathy at 6-months post-op follow-up visit. Details of complications in the post-operative follow up is given in (Table 3). Un-aided visual acuity (UAVA) both pre-operatively and post-operatively is shown in Table IV while best corrected visual acuity (BCVA) is shown in (Table 4).

DISCUSSION

In this study, we tried to assess the safety, efficacy in terms of visual recovery and induced astigmatism in eyes undergoing cataract surgery by the technique of manual sutureless small incision cataract surgery.

Table I: Types of astigmatism (n=150)

Visits	No: of eyes examined n (%)	WTR* astigmatism n (%)	ATR** astigmatism n (%)	Oblique Astigmatism n (%)	No astigmatism n (%)
Pre-op	150 (100)	73 (48.7)	27 (18.0)	32 (21.3)	18 (12.0)
1st day post-op	150 (100)	90 (60.0)	36 (24.0)	15 (10.0)	9 (6.0)
1-week post-op	114 (76.0)	73 (64.0)	22 (19.3)	11 (9.6)	8 (7.0)
6-weeks post-op	98 (65.3)	62 (63.3)	19 (19.4)	8 (8.2)	9 (9.2)
6-months post-op	68 (45.3)	44 (64.7)	14 (20.6)	5 (7.4)	5 (7.4)

*WTR -- With-the-rule ,**ATR -- Against-the-rule, Pre-op—Preoperatively, Post-op—Post operatively

Table 2: Amount of astigmatism (n=150)

Visits	No: of eyes n (%)	WTR Astig n (%)			ATR Astig n (%)			Oblique Astig n (%)			No Astig n (%)
		Nonsig-nificant	Signifi-cant	High	Nonsig-nificant	Signifi-cant	High	Nonsig-nificant	Signifi-cant	High	
		0.25<ID	≥1.0D <2.00D	2.00D	0.25<ID	≥1.0D <2.00D	2.00D	0.25<ID	≥1.0D <2.00D	2.00D	<0.25D
Pre-op	150(100)	31 (20.7)	25 (16.7)	17 (11.3)	9 (6.0)	7 (4.7)	11 (7.3)	11 (7.3)	14 (9.3)	7 (4.7)	18 (12.0)
1st day post-op	150(100)	39 (26.0)	32 (21.3)	19 (12.7)	14 (9.3)	15 (10.0)	7 (4.7)	7 (4.7)	5 (3.3)	3 (2.0)	9 (6.0)
1-week post-op	114(76.0)	34 (29.8)	26 (22.8)	13 (11.4)	9 (7.9)	7 (6.1)	6 (5.3)	5 (4.4)	4 (3.5)	2 (1.8)	8 (7.0)
6-weeks post-op	98 (65.3)	30 (30.6)	21 (21.4)	11 (11.2)	8 (8.2)	6 (6.1)	5 (5.1)	3 (3.1)	2 (2.0)	3 (3.1)	9 (9.2)
6-months post-op	68 (45.3)	21 (30.9)	15 (22.1)	8 (11.8)	6 (8.8)	4 (5.9)	4 (5.9)	2 (2.9)	1 (1.5)	2 (2.9)	5 (7.4)
Pre-op	150 (100)	31 (20.7)	25 (16.7)	17 (11.3)	9 (6.0)	7 (4.7)	11 (7.3)	11 (7.3)	14 (9.3)	7 (4.7)	18 (12.0)

*WTR -- With-the-rule,**ATR--Against-the-rule,***Oblique Astig –Oblique Astigmatism

Table 3: Post-operative complications

Post-op hyphema n (%)	Post-op endophthal-mitis n (%)	Corneal edema/ striate n (%)	Post-op IOP Rise n (%)	PCO n (%)	CME n (%)	Bullous kera-topathy n (%)
17 (11.3)	3 (2.0)	19 (12.7)	5 (3.3)	7 (4.7)	1 (0.7)	1 (0.7)

IOP: Intra-ocular pressure, PCO: Posterior capsule opacification, CME: Cystoid macular edema

Table 4: Un-aided visual acuity (n=150)

Visits	No of eyes examined n (%)	UAVA ≥ 6/18 n (%)	UAVA ≤ 6/18-6/60 n (%)	UAVA ≥ 6/60 - HM n (%)	UAVA ≤ HM-PL n (%)
Pre-op	150 (100)	03 (2.0)	24 (16.0)	97 (64.7)	26 (17.3)
1st day post-op	150 (100)	41 (27.3)	65 (43.3)	23 (15.3)	21 (14.0)
1-week post-op	114 (76.0)	73 (64.0)	26 (22.8)	11 (9.6)	04 (3.5)
6-weeks post-op	98 (65.3)	65 (66.3)	22 (22.4)	09(9.2)	02 (2.0)
6-months post-op	68 (45.3)	47 (69.1)	16 (23.5)	05 (7.4)	00

UAVA: Un-aided visual acuity, HM: Hand movement, PL: Perception of light

Table 5: Best corrected visual acuity (n=150)

Visits	No of eyes examined n (%)	UAVA ≥ 6/18 n (%)	UAVA ≤ 6/18-6/60 n (%)	UAVA ≥ 6/60 - HM n (%)	UAVA ≤ HM-PL n (%)
Pre-op	150 (100)	14 (9.3)	61 (40.7)	49 (32.7)	26 (17.3)
1st day post-op	150 (100)	58 (38.7)	51 (34.0)	20 (13.3)	21 (14.0)
1-week post-op	114 (76.0)	84 (73.7)	17 (14.9)	09 (7.9)	04 (3.5)
6-weeks post-op	98 (65.3)	79 (80.6)	11 (11.2)	06 (6.1)	02 (2.0)
6-months post-op	68 (45.3)	59 (86.8)	06 (8.8)	03 (4.4)	00

BCVA: Best-corrected visual acuity, HM: Hand movement, PL: Perception of light

Phacoemulsification is the universally accepted and most widely practiced technique of cataract surgery in the developed countries; however, it cannot be widely adopted in the developing world because of the financial and technological constraints. In this regard, manual sutureless small incision cataract surgery technique turns out to be a safe, effective and cost-effective alternative[3, 4].

Before this study, several studies from different parts of the world have been published on various aspects of the manual small incision cataract surgery[10-14].

Hennig and co-authors selected 500 patients out of 14,500, upon which they operated. The un-corrected visual acuity was 6/18 or better in 76.8% of the patients at discharge, which declined to 70.5% at 6-weeks and 64.9% at 1-year follow-up. Best-corrected visual acuity was 6/18 or better in 96.2% of eyes at 6-weeks and in 95.9% at 1-year[15]. In our study, un-corrected visual acuity was 6/18 or better in 73 (64%) eyes at 1 week post-operatively and in 65 (66.3%) eyes at 6 weeks post-operatively. Best-corrected visual acuity was 6/18 or better in 79 (80.6%) of eyes at 6-weeks in this study. Rangaraj and co-author[16] found corneal striate in 7% cases while in our study it was present in 19 (12.7%) cases. The SICS involves touching of the iris at some point of time. This may lead to higher inflammation and cystoid macular edema.[17] But in our study one case was diagnosed with cystoid macular edema at 6 weeks post-operatively. In a study conducted by Huang and Tseng[18] from Taiwan, most common type of surgically induced astigmatism was WTR astigmatism. Similar result was found in our study in which WTR astigmatism was present in 73 (64%) cases. Shaumber and co-authors found posterior capsule opacification in 11.8% cases after 1 year[19]. In this study the incidence of posterior capsule opacification was lower (4.7% cases).

Bartov and his colleagues presented a technique of planned manual sutureless cataract extraction in which scleral tunnel was made wide enough to allow a

nucleus of any size to settle in the tunnel. After making the nucleus as small as possible by sufficient hydro-procedure, they would lodge it in the scleral pocket to be manually picked or fragmented and removed from there through a constant sized 5.0 mm chevron incision. They concluded that a nucleus of any size can be extracted through the same constant 5.0 mm incision with minimal post-operative corneal astigmatism[20].

Lagreze and co-authors studied the effect of technique and type of incision on the increase of IOP after cataract surgery. They concluded that sutureless scleral tunnel incision produces the lowest post-operative increase in IOP and should be considered for patients with glaucomatous damage[21]. In our cases IOP was raised more than 21 mmhg in 5 (3.3%) cases on 1st post-operative day. Although the cases in which sutures were applied were excluded from our study but Gimbel et al found that wound architecture and whether sutures are used or not, has a little effect on overall corneal astigmatism 1-year post-operatively.[11] In our study, we choose the site of incision before surgery on the basis of keratometric findings in vertical and horizontal meridians. For a pre-existing with-the-rule (WTR) astigmatism, we selected a superior approach and for pre-existing against-the-rule (ATR) astigmatism, we selected temporal incision. For cases with pre-operative non-significant or no astigmatism, we randomly selected temporal approach, keeping in consideration that natural eyelid pressure emphasizes "against-the-rule shift" (which is comparatively more intolerable) with a superior incision in elderly population, and that because of the elliptical cornea, superior incision would be closer to the center of the cornea than the temporal one, thus liable to cause more post-op astigmatism. In contrast to some previous studies, in which against-the-rule (ATR) astigmatism was the predominant type post-operatively, in our study we found more with-the-rule (WTR) astigmatism, may be because of the adopted temporal approach in more cases (62.0 %). Type of incision and type of capsulotomy were randomly selected in our cases.

Mean pre-operative astigmatism was 0.78 D, while mean post-operative astigmatism 6-months post-operatively was 1.76 D. Mean surgically induced astigmatism, six months post-operatively, calculated by simple subtraction method was 0.98 D. This value is greater than previous studies conducted by Huang and Tseng[18] (0.69 D), Bartov et al[20] (0.54 D), Zvia Burgansky et al [17] (0.16 ± 0.98 D), and Muralikrishnan et al[16] (1.33 D – vector analaysis method). The reason for the more amount of surgically induced astigmatism may be factors related to the grade of surgeon (the author, being a senior resident).

The mean post-operative un-aided visual acuity (UAVA) ≥ 6/18 in our study was 27.3% at 1st post-op day and 69.1 % at 6-months post-operatively. Similarly, post-op best-corrected visual acuity (BCVA) was 6/18 or better in 38.7% cases at 1st day post-op and in 86.8% cases at 6-months post-op. The main reason for the decreased unaided visual acuity is thought to be the surgery-induced astigmatism, followed by post-op corneal edema and anterior chamber reaction. A Hennig and co-authors [15] reported intra-operative hyphema in 9.4 % of cases and posterior capsule (PC) rupture in 0.2 % cases. In our study, intra-operative hyphema happened in 15.3 % cases, in 4.0 % cases some degree of irido-dialysis occurred, and in 5 cases (3.33 %) posterior capsule tear was noted. We assume that surgeon's inadequate experience of the technique may be the cause for the increased incidence of intra-operative complications. Among the post-operative complications, other than induced astigmatism, 11.3 % cases were found having post-op hyphema at the 1st day post-op examination. This hyphema had resolved in 7.3 % of cases till the 1-week post-op and in all cases till the 6-week post-op follow-up. Therefore hyphema did not result in significant adverse effect and was mostly sponta-neously resolved in due course of time. Post-operative endophthalmitis occurred in 3 cases (2%), in which two responded well to the therapy, which was instituted from the 1st post-op day. The third case, contracted infection after 24 hours of surgery and presented at 7th day after operation. This eye had to be eviscerated eventually. Multi factors, both intrinsic and extrinsic are thought to be responsible for the high incidence of post-operative endophthalmitis in poor socio-economic set-ups like ours.

CONCLUSIONS

1. Manual small incision cataract surgery is a safe and effective technique of extra-capsular cataract extraction that can be confidently adopted.
2. Surgically induced astigmatism and per-operative hyphema are the main complications of this technique.
3. Almost all grades of nuclear sclerosis and all sizes of cataractous lenses can be dealt with this technique.

4. Early rehabilitation of the patients because of the early stabilization of the refractive status of the eye and no suture-related problems are some of the advantages of this technique.
5. Early diagnosis and early institution of treatment decreases the risk of loss of eye because of post-operative endophthalmitis.
6. We can manipulate the pre-existing pre-operative astigmatism as well as can minimize post-operative one, by following the keratometry readings for planning the site and type of incision before cataract surgery.
7. Post-operative hyphema in case of manual SICS is a benign condition, which usually do not cause increase in intra-ocular pressure. It usually gets absorb by 1-week post-operatively with almost no sequellae.

Author's affiliation

Dr. Muhammad Tariq Khan
Trainee Medical Officer (Vitreo-retinal Ophthalmology)
Khyber Institute of Ophthalmic Medical Sciences PGMI, Hayatabad Medical Complex, Peshawar

Dr. Sanaullah Jan
Senior Registrar
Khyber Institute of Ophthalmic Medical Sciences PGMI, Hayatabad Medical Complex, Peshawar

Dr. Zakir Hussain
Trainee Medical Officer
Khyber Institute of Ophthalmic Medical Sciences PGMI, Hayatabad Medical Complex, Peshawar

Dr. Samina Karim
Trainee Medical Officer
Khyber Institute of Ophthalmic Medical Sciences PGMI, Hayatabad Medical Complex, Peshawar

Dr. Muhammad Kamran Khalid
District Eye Specialist
Lakki Marwat, NWFP, Pakistan

Dr. Lal Mohammad
Assistant Professor
Kohat Medical College
Kohat University of Science and Technology Kohat, NWFP, Pakistan

REFERENCE

1. **Thylefors B, Négrel AD, Pararajasegaram R, et al.** Global data on blindness. Bull World Health Organ. 1995; 73: 115-21.
2. Pakistan National Programme for the prevention of blindness: Second five year plan - National Committee for prevention of blindness. Ministry of Health, Special education and Social welfare; Chapter 2:11.
3. **Natchiar G.** Manual small incision cataract surgery: an alternative technique to instrumental phacoemulsification. 2nd ed. Aravind Eye Hospitals: 2004: 8-56.
4. **Malik KS, Goel R.** Manual of small incision cataract surgery. 1st ed. CBC publishers: 2003: 71-95.
5. **Anwar MS.** Changes in Surgically induced Astigmatism over a period of time after Extra-capsular Cataract Extraction. Pak J Ophthalmol. 1999; 15: 102-4
6. **Hussain M, Rehman S, Din N, Akhtar S, et al.** Small Incision Sutureless Cataract Extraction with and without Posterior Chamber Lens. Ann KE Med Coll. 2003; 9: 224-6.
7. **Rao SK, Lam DS.** A simple technique for nucleus extraction from the capsular bag in manual small incision cataract surgery. Indian J Ophthalmol. 2005; 53: 214-5.
8. **Gokhale NS, Sawhney S.** Reduction in astigmatism in manual small incision cataract surgery through change of incision site. Indian J Ophthalmol. 2005; 53: 201-3.
9. **Venkatesh R, Das M, Prashanth S, et al.** Manual small incision cataract surgery in eyes with white cataracts. Indian J Ophthalmol. 2005; 53: 173-6.
10. **Vazquez LA, Panesso JL.** Surgically induced astigmatism. A comparison of different cataract incisions and closures. P R Health Sci J. 1993; 12: 99-103.
11. **Gimbel HV, Sun R, DeBroff BM.** Effects of wound architecture and suture technique on postoperative astigmatism. Ophthalmic Surg Lasers. 1995; 26: 524-8.
12. **Ruit S, Paudyal G, Gurung R, et al.** An innovation in developing world cataract surgery: sutureless extracapsular cataract extraction with intra-ocular lens implantation. Clin Experiment Ophthalmol. 2000; 28: 274-9.
13. **Guzek JP, Ching A.** Small-incision manual extra-capsular cataract surgery in Ghana, West Africa. J Cataract Refract Surg. 2003; 29: 57-64.
14. **Gogate PM, Deshpande M, Wormald RP, et al.** Extra-capsular cataract surgery compared with manual small incision cataract surgery in community eye care setting in Western India: a randomized controlled trial. Br J Ophthalmol. 2003; 87: 667-72.
15. **Hennig A, Kumar J, Yorston D, et al.** Sutureless cataract surgery with nucleus extraction: outcome of a prospective study in Nepal. Br J Ophthalmol. 2003; 87: 266-70.
16. **Venkatesh R, Das M, Parashanth S, et al.** Manual small incision cataract surgery in eyes with white cataracts. Ind J Ophthalmol. 2005; 53: 173-6.
17. **Ruit S, Tabin G, Chang D, et al.** A prospective randomized clinical trial of phacoemulsification vs. manual sutureless small incision extracapsular cataract surgery in Nepal. Am J Ophthalmol. 2007; 143: 32-8.
18. **Huang FC, Tseng SH.** Comparison of surgically induced astigmatism after sutureless temporal clear corneal and scleral frown incisions. J Cataract Refract Surg. 1998; 24: 477-81.
19. **Shaumberg DA, Dana MR, Christen WG, et al.** A systemic overview of the incidence of posterior capsular opacification. Ophthalmology. 1998; 105: 1213-21.
20. **Bartov E, Isakov I, Rock T.** Nucleus fragmentation in a scleral pocket for small incision extracapsular cataract extraction. J Cataract Refract Surg. 1998; 24: 160-5.
21. **Lagreze WD, Bomer TG, Funk J.** Effect of surgical technique on the increase in intraocular pressure after cataract extraction. Ophthalmic Surg Lasers. 1996; 27: 169-73.