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Conventional Coaxial Phacoemulsification (CCP) (3.2mm) Vbimanual Phacoemulsification (BMP) (1.8mm)

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Abstract
Objective: *To compare & evaluate Conventional coaxial phacoemulsification (CCP)(3.2mm) with bimanual phacoemulsification(BMP)(1.8mm) .*
Patients & Methods*: Fourty patients were enrolled between Nov2014 -March 2015,all with Senile cataract. Twenty patients were randomly assigned to the bimanual microincision phacoemulsification group, twenty patients to the coaxial phacoemulsification group. All patients were followed after 1 day, 1 Week, 1 month and 3 months of the procedure.*
Results: *The visual outcomes in Bimanual group is slightly better with UCVA on Day 90 is >6/9 in 11out of 20 patients whereas it is in 7 out of 20 patients in conventional coaxial phacoemulsification. The bimanual group demonstrated a reduced surgically induced astigmatism (SIA). The coaxial group demonstrated a slight rise in SIA than bimanual group.The SIA was 0.312 ± 0.137,0.592±0.346 resp.in bimanual phacoemulsification, coaxial phacoemulsification.There is a highly significant difference between postoperative SIA in between two groups during the postoperative period(P<0.001).The EPT was also less in Bimanual phacoemulsification(1.26±0.861) whereas it was more in conventional coaxial phacoemulsification (2.80±0.465) mins, whereas the operative time in bimanual phacoemulsificaton was 18.54±1.99 & in conventional coaxial phacoemulsification it was 14.92± 2.03 mins.*
Conclusions*: Microincisional cataract surgery using bimanual phacoemulsification has many advantages like one of the main advantages of such a low power phacoemulsification technology is that it minimizes intraoperative damage to ocular structures, maximizing the level of rapidity of patient's visual rehabilitation, but it is limited by the lack of suitable intraocular lenses for implantation through microincisions; hence, switching to this technique from the conventional one still depends on the advancement in IOL Technology available & its cost effectiveness. So, that in future it can become gold standard technique.*
Keywords*:Bimanual microincision, coaxial phacoemulsification, cataract surgery,Surgically induced astigmatism.*
EPT=Effective Phacoemulsification Time, UCVA=Uncorrected visual Acuity

I. Introduction

Cataract is the main cause of avoidable blindness worldwide, with the developing world accounting for more than 60% of patients. Despite the 10–12 million cataract operations performed globally, cataract blindness is still thought to be increasing by 1–2 millions/year**[1].**Developed health systems such as those in Western Europe, North America, and Australia have greatly reduced the prevalence of cataract by establishing an adequate cataract surgical rate (CSR), which refers to the number of cataract operations performed per million populations per year.If the CSR is less than 2000, the surgery rate will not keep up with the incidence and the backlog will continue to increase. This is the situation in much of the developing world**[2]** . In more affluent areas of the world, phacoemulsification has become the primary method of performing cataract surgery & it continues to evolve, embracing smaller incisions that allow quicker recovery, better wound strength, and increased surgical control, resulting in lower complication rates and better outcomes. Phacoemulsification was carried out through an ∼3-mm incision using an ultrasound (US) tip that is within a silicon sleeve, allowing irrigation, US delivery, and aspiration of lens matter through the same instrument**[3]**.Microincision phacoemulsification through a sub 2-mm incision was reported in the mid 1980s. However, it has only become popular in recent years, as technical improvements have allowed this to be performed with safety in addition to the availability of intraocular lenses (IOLs) that can be implanted through a sub 2-mm incision**[4]** . Microincision cataract surgery offers quicker visual recovery, reduced surgically induced astigmatism (SIA), and reduced complication rates with more secure wounds, and some unique advantages offered by bimanual microincision phacoemulsification make it the preferred technique for some surgeons**[5].**

Objective of the study

To compare & evaluate bimanual phacoemulsification (BMP) (1.8mm) with Conventional coaxial phacoemulsification(CCP)(3.2mm) .

II. Material And Methods

The Prospective type of study included 40 cases of age related cataract (Senile cataract) which were conducted in ophthalmology department of M.L.B. medical college, Jhansi from Nov2014 -March2015. Patients having good endothelial cell counts,well dilated pupils, intact zonular apparatus and good ocular tone and with no systemic or any other ocular disease were included & those having Fuch's dystrophy, Microphthalmos, Zonular dialysis, Lens subluxation,Congenital anamolies, recurrent episodes of anterior uveitis with synechiae formation, earlier filtering surgery or previous ocular surgery history in the same eye, Glaucoma, corneal dystrophy, scaring, any other corneal pathology, retinal diseases, relative anterior microophthamos, diabetes, hypertension, complicated cataract were excluded from the study. Enrolled patients were prospectively randomized before intervention into one of the two treatment groups. All participants signed an informed consent. Cataract was confirmed by clinical examination,slit-lamp examination &fundus examination. Patient's biometry was done.Visual acuity assessed-unaided, with pin hole & aided (with glasses) in each eye using snellen's chart preoperatively & then postoperatively at post-op day1^{st} ,7^{th},30^{th} ,90^{th}day. The patients were given 'peribulbar block'.

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2.1 Conventional Coaxial Phacoemulsification Technique: A 3.2 mm partial thickness incision was given at the superior clear corneal area at 12o'clock.A side port was made at 10 o'clock with MVR knife. A cystitome-bent 26G needle was inserted through 10o'clock side port and a continuous curvilinear capsulorrhexis (4.5-5.5mm) was done under usage of HPMC 2%.Second side port was made at 2o'clock position with MVR knife.Hydrodissection followed by hydrodilineation done & bimanual nucleus rotation was performed with the dialer. Phacoemulsification machine used is of ZEISS visalis 100. An ozil torsional handpiece with a standard ultrasonic titanium 30 degree tip covered with standard microsmooth infusion sleeve having bubble suppression insert was used to emulsify cataracts using stop & chop technique.The phaco probe was placed through the 12o'clock incision.The groove was enlarged & the nucleus cracked, keeping the non-irrigating chopper & phaco tip at the base of the groove & pulling horizontally in the opposite direction. After emulsification of nuclear fragments, irrigation & aspiration of residual cortical matter was done. A foldable IOL was inserted through the preloaded injector(Acrysofa) into the capsular bag & dialed to proper position. HPMC 2% is aspirated coaxially from AC,from behind the iris & from behind the IOL. Subconjunctival injection of antibiotic and steroid given & eye is bandaged.

2.2 Bimanual Phacoemulsification Technique: A 1.8mm partial thickness incision was given at the superior corneal meridian at 12o'clock.A side port was made at 10 o'clock with MVR knife.AC formed with HPMC 2%.A cystitome-bent 26G needle was inserted through 10o'clock side port to make continuous curvilinear capsulorrhexis (4.5-5.5mm). Second side port was made at 2o'clock position with 0.9mm MVR Knife. Hydrodissection followed by hydrodilineation done & bimanual nucleus rotation was performed with the dialer.Phacoemulsification machine used is of ZEISS visalis 100. An ozil torsional handpiece with a 0.9 mm titanium 45degree sleeveless tip introduced into the AC from 12o'clock position & 20G irrigating chopper was introduced from 2o'clock side port. Chop technique was used to emulsify cataract. After emulsification of nuclear fragments, irrigation & aspiration of residual cortical matter was done. A foldable IOL inserted through the preloaded injector(Acrysofa) into the capsular bag & the IOL is dialed. HPMC 2% is aspirated coaxially from AC,from behind the iris & the IOL. Subconjunctival injection of antibiotic and steroid given &eye is bandaged.

2.3 Post-Operative Parameters/Follow Up: Following postoperative parameters were evaluated on post-op day1, day7, 1 month, 3 months .

- **Visual acuity(VA):**Unaided
- **Best corrected visual acuity(BCVA):** With pin hole .
- Corneal astigmatism was measured.
- Corneal astigmatism was calculated by using simple substraction method. The difference in K reading values of vertical & horizontal meridias were calculated & compared with their preoperative values. The mean K value readings were calculated separately for two meridian & compared within the group & between the groups preoperatively & postoperatively at different time intervals.SIA was calculated by substracting preoperative from postoperative astigmatism.
- Refraction

2.4 Statistical Analysis: Chi square test & Unpaired T–test were applied to find out the significant difference between these techniques & to analyze the results of study.

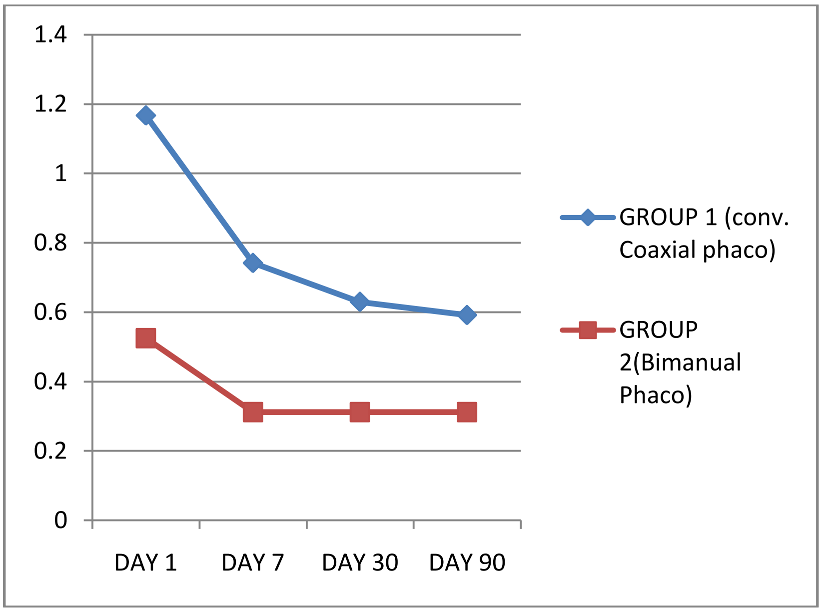
III. Figures And Tables

Between Nov 2014- March 2015, 20 patients were operated using CCP, 20 patients were operated using BMP .The analysis was carried out on 40 patients consisting of 20 female patients and 20 male patients ranging in age between 45and 65years.Baseline characteristics were similar in both groups.

Table I: Demographic Details And Outcomes For Study Eyes Undergoing Bmp, & Ccp .

	CCP Mean± SD	**BMP Mean± SD**	**p-value**
SEX			
Male	12	6	
Female	8	14	
Age(years)	54.25	54.9	
Preoperative data:			
VA			
>6/18	0	0	
6/18-6/60	8	9	
<6/60	12	11	
BCVA:	1.511±0.687	1.454±0.729	
Average Kv	44.61±2.004	44.66 ±2.509	
Average Kh	45.15 ±2.09	44.71 ±1.98	
Axial. Length	22.51±0.993	22.44±1.10	
Biometry	21.75±2.28	22.07±3.51	
Nuclear Grade			
N+1	3	5	
N+11	9	6	
N+111	6	8	
N+1V	2	1	
Mean EPT Values			
N+1	0.1±0.01	0.076±0.062	
N+11	2.79±0.38	0.35±0.49	
N+111	3.125±0.528	1.48±1.36	
N+1V	5.18±0.94	3.13±1.53	
Total	2.80±0.465	1.26±0.861	
Operative Time			
N+1	10.25±1.26	15.40±0.55	
N+11	14.44±2.55	17.13±1.55	
N+111	16.50±1.41	20.63±2.50	
N+1V	18.50±2.89	21±3.37	
Total	14.92±2.03	18.54±1.99	
Mean Preop & Postop BCVA (LogMar Values)			
Preop			
Day 1	1.511±0.687	1.454±0.729	=0.8005(NS)
Day 7	0.1935±0.15	0.2105±0.135	=0.7085(NS)
Day 30	0.17±0.13	0.189±0.102	=0.6101(NS)
Day 90	0.17±0.13	0.189±0.102	=0.6101(NS)
	0.17±0.129	0.180±0.110	=0.7934(NS)
Distribution of UCVA on			
Preoperative day			
>6/9	0	0	
6/12-6/18	0	0	
6/24-6/60	8	9	
>6/60	12	11	
On Day 1			
>6/9	0	1	

6/12-6/18	11	18	
6/24-6/60	9	1	
>6/60	0	0	
On Day 7			
>6/9	0	1	
6/12-6/18	17	19	
6/24-6/60	3	0	
>6/60	0	0	
On Day 30			
>6/9	4	4	
6/12-6/18	15	16	
6/24-6/60	1	0	
>6/60	0	0	
On Day 90			
>6/9	7	11	
6/12-6/18	12	9	
6/24-6/60	1	0	
>6/60	0	0	
Mean Pre & post-op corneal astigmatism			
Preop	0.937 ±0.450	0.475±0.291	<0.0001(HS)
Day 1	1.725 ±0.785	0.875±0.275	<0.0001(HS)
Day 7	1.3 ±0.719	0.687±0.267	<0.0001(HS)
Day 30	1.212 ±0.694	0.687±0.267	=0.0031(VS)
Day 90	1.175±0.698	0.687±0.267	=0.0059(VS)
Mean Sphere value(Diopters)			
Day 30	0.575 ±0.345	0.362±0.23	=0.0284(S)
Day 90	0.4125±0.356	0.275±0.27	=0.1774(NS)
Mean Cylindrical value (Diopters)			
Day 30	1.212±0.694	0.687±0.26	0.0031(S)
Day 90	1.175±0.698	0.687±0.26	0.0059(S)
Surgically Induced Astigmatism (SIA)			
Day 1	1.167±0.459	0.525±0.111	<0.0001(HS)
Day 7	0.742±0.390	0.312±0.137	<0.0001(HS)
Day 30	0.63±0.383	0.312±0.137	<0.0001(HS)
Day 90	0.592±0.346	0.312±0.137	<0.0001(HS)



Mean Surgically Induced Corneal Astigmatism (Sia) At Different Time Intervals.

Table Ii: Distribution Of Preoperative Corneal Astigmatism In Different Study Groups

Corneal astigmatism (D)	Group 1 Conv. Phaco(n=20)		Group 2 Bimanual Phaco(n=20)		Total	
	No.	%	No.	%	No.	%
0	1	5%	1	5%	2	5%
<1	9	45%	17	85%	26	65%
>1	10	50%	2	10%	12	30%
Total	20		20		40	
x^2 =	17.733					
df=	4					
p-value	0.001391(S)					

IV. Discussion & Conclusion

Cataract surgery has evolved remarkably from ICCE-ECCE-phacoemulsification in 1967 to development of foldable IOL in late 1980s. The drive toward less traumatic surgery with minimal postoperative complications and more rapid visual rehabilitation after cataract surgery has given rise to various modalities for reducing incision size decreasing energy utilization. One such technique is conventional phacoemulsification ,it is a coaxial system which requires an incision of 2.8-3.5mm for emulsification & implantation of foldable IOL has become gold standard procedure.Its merits include minimal SIA, early & stable visual rehabilitation, reduced tissue trauma & postoperative inflammation. Other modality is microincisional cataract surgery, for example, bimanual phacoemulsification, which is being evaluated in this study **[6]**and Microincision phacoemulsification is a part of continuing process of evolution & it is claimed to be more safe & effective, less invasive, reducing SIA & surgically induced higher order corneal aberrations, faster having better fluidics with insertion of rollable IOL. One of the expected advantages of bimanual phacoemulsification is that it causes a less SIA due to creation of a small self-sealing incision**[7]** in addition to performing less manipulation within the wound. The ability to switch instruments between the two incisions increase the overall maneuverability, which facilitate removal of subincisional nuclear fragments or cortex or manipulation when there is a complication or when a nucleus is not rotating appropriately, making this approach safer on wound integrity than coaxial phacoemulsification **[8,9]**

Currently, two methods of MICS are in vogue-Bimanual MICS & Coaxial MICS.MICS was originally developed as bimanual MICS (irrigation & aspiration separated) which has all advantages of MICS but also has disadvantages including end steep learning curve,AC instability, limitation in infusion and vaccum & more mechanical trauma to the wound.So keeping in mind about these points this prospective randomized study was undertaken to evaluate the results of these two different techniques. Most of the patients in our study were between 45 & 65 years with mean age of 54.575years & was less than other studies like Vasavada etal (65.3years).Maximum number of patients were females (55.00%).The sex ratio in our study matches with the study done by Saber H. et al(53.33% females and 46.67% males).

Preoperatively 65% of patients had a corneal astigmatism of <1D,30% had>1D astigmatism and 5% patients had no astigmatism[Table 2]. Pranda Shukla[10] in his"A study of Astigmatism in Cataract Patients stated the average astigmatism in the present study was 0.842D which is nearly same as astigmatism has been reported by Duke Elder[11] 0.5 -0.75D,Baseley[12] 0.75D, Luntz[13] 0.75D, Mahesh S.V. et al[14]. 0.42 to 0.77D, Kamlesh et al[15] 0.83D and Ravindran[16]. Mohammed Isyaku, Syed A Ali, Sadiq Hassan et al[17] in their study"Preoperative corneal astigmatism among adult patients with cataract in Northern Nigeria"showed mean corneal astigmatism was 1.16 diopter and a majority(45.92%) of eyes had astigmatism between 1.00and1.99diopters.The phacoemulsification chop technique was chosen in this study because it is one of the low energy producing techniques of phacoemulsification. It is a high vacuum technique that evolved with a main target to reduce the amount of US energy during phacoemulsification [18] and is characterized by the use of mechanical forces (chopper) rather than the US to disassemble the nucleus [19]. The analysis of the intraoperative data in this study proved that there is a clinically significant reduction in the EPT used in the bimanual phacoemulsification group (1.26 ±0.861) compared with that used in the coaxial phacoemulsification group (2.80 ± 0.465).In a study conducted by Olson *et al.* [8], the mean EPT used was 1.14±1.3 for performing bimanual phacoemulsification. However, as the US power increases with the increase in nuclear hardness the mean EPT used for each nuclear grade was compared with that of the other group for more accuracy shows that the EPT was 0.1, 2.79, 3.13, and 5.18 in group 1 and 0.08, 0.35, 1.48, and 3.13 in group 2 for N+I, N+II, N+III, and N+IV, respectively, which showed that there was a statistically significant reduction in the energy needed for emulsification of each nuclear grade when performing bimanual phacoemulsification. Although increased energy can allow phacoemulsification of dense nuclei, but it can also damage the corneal endothelium; hence, the surgeon must utilize the minimal effective phacoemulsification power to obtain the best results keeping the corneal integrity in mind. One of the main advantages of such a low power phacoemulsification technology is that it minimizes intraoperative damage to ocular structures, maximizing the level of rapidity of patient's visual rehabilitation.

As for the operative time, the time required for performing phacoemulsification (19.16 ± 3.84) was statistically more significant than that for conventional phacoemulsification (15.08 ± 3.26). This time increases for harder nuclei: 10.25 ± 1.26, 14.44 ± 2.55, 16.50 ± 1.41, and 18.50 ± 2.89 for group 1 and 15.40 ± 0.55, 17.13 ± 1.55, 20.63 ± 2.50, and 25 ± 3.37 for group 2. Similar results were obtained by Tsuneoka *et al.* **[20]** with a total group mean operative time of 8.42 ± 2.20 and also reported the same increase according to the nuclear grading (7.94 ± 1.24, 8.06 ± 1.50, 9.46 ± 2.06, and 13.48 ± ± 2.14 for N+I, N+II, N+III, and N+IV, respectively; **[21]**; other studies showed a comparable time between the two techniques. However, the beginning of the learning curve may explain the need for more time to perform the operation in this study.The postoperative data can be considered as a parameter to detect the efficacy of the bimanual phacoemulsification technique. One of the main advantages of such a low power phacoemulsification technology is that it minimizes intraoperative damage to ocular structures, maximizing the level of rapidity of patient's visual rehabilitation **[6]**. The main interest of the study was to evaluate the effect of bimanual phacoemulsification on the cornea and this was carried out by studying the effect of increasing power on the increase in the nuclear hardness

BCVA was markedly increased on postoperative day1 as compared to preoperative visual acuity in both groups .It improved slightly more by postoperative day7 & subsequently maintained at same level at 1month & 3months follow up .Mean BCVA was 0.19,0.21log mar value resp.in CCP,BMP on postoperative day1.Thus, mean BCVA was almost similar in BMP & CCP .It improved gradually over 1week 0.17,0.19 log mar value resp.in CCP, BMP & got stabilized at almost same level by 1month to 0.17,0.19 log mar value resp.in CCP,BMP & remained same even after 3 months(0.17, 0.18log mar values) resp.in CCP,BMP.

On postoperative day 1,55% patients of CCP group had UCVA in the range 6/12-6/18 whereas in BMP group 90% patients fell in the range 6/12-6/18 .By the postoperative day7, 85% patients of the CCP group came in 6/12-6/18 range of vision ,whereas in BMP group 5% rose to>6/9 vision range & rest 95% fell in 6/12-6/18 vision range .By the postoperative day30,in 20% patients of CCP group, UCVA improved to>6/9,75% patients had vision in the range of 6/12-6/18,rest 5% had vision in the range of 6/24-6/60,whereas in BMP group 20% of the patients vision rose to>6/9rest 80%of the patient had vision in the range of 6/12-6/18.On postoperative day90,situation remained almost same as of postoperative day30 with 35% patients having >6/9 vision ,60% having 6/12-6/18 vision and rest 5% in 6/24-6/60 vision range in the CCP group ,whereas in BMP 45% patients having>6/9 vision and rest of 55% patients having 6/12-6/18 vision.Wilczynski et al[15] showed no significant difference between postoperative visual acuity in CCP group and BMP group. Abdulrahman-Al- Muammar(2009)[22] in his study "Postoperative Bimanual microincisional cataract surgery technique and clinical outcome" found out that UCVA was better in B-MICS than standard phacoemulsification but not statistically different(Saeed etal.,2008)[23].Alio etal.(2005)[24]found that postoperative UCVA in B-MICS group was better at day 1 and 1month but not at 3months and the differences was not statistically significant. Postoperative BCVA was found to be statistically better with B-MICS than standard phacoemulsification(Kurz etal.,2006)[4].Other studies (Alio et al., 2005[24]; Kurz et al., 2006[4]; Wilczynski et al., 2006[25]; Crema et al., 2007[26]; Denoyer et al., 2008.) [27] did not find any statistical differences between the two techniques.Saber H. El-Sayed, Amin F. Ellakwa, Nermeen M Badawi,Abeer M. Wahba etal[28] in their study"Bimanual microincision versus coaxial phacoemulsification cataract surgery" showed that comparison between the difference in mean values of postop VA readings in both groups during the postoperative period using paired *t*-test showed that there was no statistically significant difference. Similarily,no difference in mean values of the postop BCVA readings in both groups. Postoperative corneal astigmatism on day 1:1.7D ,0.87D in CCP,BMP resp. It was gradually decreased on postoperative day7,it became1.3D,0.69Din CCP,BMP resp. Gradually over a period of a month it stabilized to around1.2D,0.69Din CCP,BMP resp which remained almost same over 90 days follow up visit.

Postoperatively majority of the patients in all three groups converted into ATR (Against the Rule) type of astigmatism. Mean postoperative surgically induced corneal astigmatism increased significantly on day 1 as compared to preoperative astigmatism in all three groups. It was found to be 1.2D,0.5D on day 1postoperatively,which decreased to 0.7D,0.3D in CCP, BMP resp. on day7 postoperatively and stabilized to around 0.6D,0.3D on day30 postoperatively it remained almost same by day 90. When CCP group was compared to BMP it was significant statistically. Axis of SIA was ATR type in most of the patients.

We waited for a month for the refraction to get stabilized with SIA to settle down with all the postoperative complications.On day30 refraction,the mean sphere(D) in CCP, BMP was 0.58D, 0.36Drespectively, whereas on day 90 postoperatively the results were 0.41D,0.27D. when CCP group was compared with BMP group result was not significant statistically. Similarly for cylindrical power, refraction on day30 and 90postoperatively was done & result was as follows in CCP, BMP was1.2D,0.69D, respectively, whereas on day90 postoperatively when refraction got further settled and stabilized the results were 1.1D,0.69D respectively. But again when CCP group was compared with BMP group result was significant statistically. Our SIA findings correlate with the conclusion of Saber H. El-Sayed, Amin F. Ellakwa, Nermeen M. Badawi, Abeer M. Wahba etal[28] who compared Bimanual microincision versus coaxial phacoemulsification cataract surgery and found that the bimanual group demonstrated a reduced SIA.The coaxial group demonstrated a slight rise in SIA. There is a highly significant difference between postoperative SIA in both groups during the postoperative period (P < 0.001). Yao etal. (2006)[29] measured the change in simulated keratometry values. The mean postoperative ΔSim$K$ value was 0.78 ± 0.38 D for B-MICS group and1.29 ± 0.68 D for the standard group. The difference between the two groups was statistically significant(P = 0.001).The optical quality of the cornea is essential to good vision (Elkady etal. 2008)[30].Since B-MICS has less SIA in comparison with standard phacoemulsification which might be associated with better optical quality. Wilczyńska O,Wilczyński M,Omulecki W[31], in their article on SIA after bimanual phacoemulsification (Group 1)through microincision and after standard phacoemulsification(Group2) showed that in vector method SIA did not differ significantly between the groups during the whole follow-up. In vector decomposition method, SIA was higher in group 2 than in group 1, one day and 1month postoperatively.Cravy's and Naeser's method showed that SIA in group 2 was significantly higher as long as the 1-st month postoperatively. In the final examination,there was no significant difference in SIA values. In Phacoemulsification, postoperative astigmatism is mostly of ATR type, which is caused by postoperative flattening of vertical meridian as in both types of surgery there is superiorly placed incision. Thus, final conclusion came out to be group 2 i.e. BMP produced least SIA followed by group1 i.e. CCP among these techniques. Thus, BMP became surgery of choice for performing cataract extraction as it has many advantages but it is limited by the lack of suitable intraocular lenses for implantation through microincisions as they are expensive and it was difficult in our government set-up for patients to afford such expensive IOLs; hence, switching to this technique from the conventional one still depends on the surgeon’s performance and other economic factors in consideration & the advancement in IOL Technology available & its cost effectiveness. So, that in future it can become gold standard technique.

References

[1]. Thylefors B, et al. Global data on blindness: an update. Bull World Health Organ 1995; 73:115–121.

[2]. Foster A. Elimination of cataract blindness. Survey 2000; 45:532–543.

[3]. Ruit R, Tabin G, Chang D, et al.A prospective randomized clinical trial of phacoemulsification versus manual sutureless small-incision extracapsular cataract surgery in Nepal. Am J Ophthalmol 2007; 143:32–38.

[4]. Kurz S, Krummenauer F, Gabriel P, Pfeiffer N, Dick HB Biaxial microincision versus coaxial small-incision clear cornea cataract surgery. Ophthalmology.

[5]. Jean, Claude. Bimanual micro-incision phacoemulsification the way forward. l’ophthalmographe 2005;22:4–5.

[6]. Fine IH, Packer M,Hoffman RS.New phacoemulsification technologies. J Cataract Refract Surg 2002; 28:1054–1060**.**

[7]. Dogru M,Honda R,Omoto M, Fujishima H, Yagi Y,Tsubota K. Early visual results with the rollable YhinOptx intraocular lens.J Cataract Refract Surg 2004;30:558–565.

[8]. Olson R J, Soscia W, Howard JG. Microphacoemulsification WhiteStar: a wound-temperature study. J Cataract Refract Surg 2002; 28:1044– 1046.

[9]. Soscia W, Howard JG, Olson RJ. Bimanual phacoemulsification through 2 stab incisions. A wound–temperature study.J Cataract Refract Surg 2002; 28:1039–1043. 2006; 113:1818–1826

[10]. A study of Astigmatism in Cataract Patients September 2014; 1(9): 514-516. http://www.medpulse.in.

[11]. Duke Elder W.S. system of ophthalmology volume vth ophthalmic optics refraction 95-128

[12]. Baseley C.H. keratomertic changes after cataract surgery. Trans. Amer. Opthal. Soc.65, 168-188(1967).

[13]. Luntz M.H. and Livingston D.G. astigmatism in cataract surgery Br. J. Ophthal. 61, 360-5(1977)

[14]. Mahesh S.V. and Rao P.N. role of suturing and incision in astigmatism following cataract surgery Ind. J. ophthal. 32, 488-490(1984)

[15]. Kamlesh and Bihari V., “Role of multiples sutures in cataract surgery to control the corneal astigmatism”. Ind.J.Ophthal. 31, 978-982(1983).

[16]. Ravindran R.D. evaluation of corneal astigmatism following wound closer with continues suture. Proc.AIOS Bangalore (1991).

[17]. Mohammed Isyaku, Syed A Ali, Sadiq Hassan et al in their study“Preoperative corneal astigmatism among adult patients with cataract in Northern Nigeria” Department of Ophthalmology, Aminu Kano Teaching Hospital, Kano, Nigeria Department of Optometry, Makkah Specialist Eye Hospital, Albasar Foundation, Kano, Nigeria,Indian J Ophthalmol. 2014 Nov; 62(11): 1094–1095;doi: 10.4103/0301-4738.146751

[18]. Fishkind W J. Course on advanced concepts in phacoemulsification. Highlight of SCRS1998; 3: 11

[19]. Fine IH. The choo choo chop and flip phacoemulsification technique Operative Tech Cataract Refract Surg 1998; 1:61–65.
[20]. Tsuneoka H, Hayama A, Takahama M. Ultrasmall-incision bimanual phacoemulsification and AcrySofSA30AL implantation
[21]. Agarwal A, Narang P, Narang S. Phakonit: phacoemulsification through a 00.9 mm corneal incision. J Cataract Refract Surg 2001; 27:1548– 1552.
[22]. Abdulrahman-Al- Muammar(2009); Postoperative Bimanual microincisional cataract surgery technique and clinical outcome; Saudi Journal of Ophthalmology (2009) 23, 149–155
[23]. Saeed A., O'Connor J., Cunnife G. Uncorrected visual acuity in the immediate postoperative period following uncomplicated cataract surgery: bimanual microincision cataract surgery versus standard coaxial phacoemulsification. Int. Ophthalmol. 2008 [PubMed]
[24]. Alio J., Rodriguez-Prats J.L., Galal A., Ramzy M. Outcomes of microincision cataract surgery versus coaxial phacoemulsification. Ophthalmology. 2005;112(11):1997–2003. [PubMed]
[25]. Wilczynski M., Drobniewski I., Synder A., Omulecki W. Evaluation of early corneal endothelial cell loss in bimanual microincision cataract surgery (MICS) in comparison with standard phacoemulsification. Eur. J. Ophthalmol. 2006;16(6):798–803.
[26]. Crema A.S., Walsh A., Yamane Y., Nose W. Comparative study of coaxial phacoemulsification and microincision cataract surgery. One-year follow-up. J. Cataract Refract. Surg. 2007;33(6):1014–1018. [PubMed]
[27]. Denoyer A., Denoyer L., Marotte D. Intraindividual comparative study of corneal and ocular wavefront aberrations after biaxial microincision versus coaxial small-incision cataract surgery. Br. J. Ophthalmol. 2008 [PubMed]
[28]. Saber H El-Sayed, Amin F Ellakwa, Nermeen M Badawi, Abeer M Wahba. Bimanual microincision versus coaxial phacoemulsification cataract surgery. Year : 2015 | Volume : 28 | Issue : 1 | Page : 162-167.
[29]. Yao K, Tang X, Ye P. Corneal astigmatism, high order aberrations, and optical quality after cataract surgery: microincision versus small incision. J Refract Surg. 2006 Nov; 22(9 Suppl):S1079-82
[30]. Elkady B, Alió JL, Ortiz D, Montalbán R. Corneal aberrations after microincision cataract surgery. J Cataract Refract Surg. 2008 Jan; 34(1):40-5.
[31]. Wilczyńska O, Wilczyński M, Omulecki W. Klin Oczna. Surgically induced astigmatism after bimanual phacoemulsification through microincision and after standard phacoemulsification. 2010;112(4-6):115-9. Polish. PMID: 20825064.