# Microcoaxial Phacoemulsification versus Conventional Phacoemulsification: A Prospective Study

*Seyed Javad Hashemian, MD[1] • Farzad Pakdel, MD[2] • Alireza Foroutan, MD[2]*
*Mahmood Joshaghani, MD[2] • Jafar Ghaempanah, MD[2]*
*Majid Mohebbi, MD[3] • Mohammad Ebrahim Jafari, MD[4]*

## Abstract

***Purpose*****:** To compare the outcomes of microcoaxial phacoemulsification and conventional phacoemulsification techniques

***Methods*****:** In this prospective comparative clinical study in the Negah eye center, 69 eyes of 69 patients with senile cataract of grade 3 to 4 on the Lens Opacities Classification System III (LOCSIII) were placed in two groups. Thirty nine eyes were assigned to undergo surgery by the microcoaxial technique (2.4 mm) and 30 eyes by the conventional coaxial technique (3.2 mm). All surgeries were performed by a single surgeon using the same machine (Sovereign WhiteStar, AMO). In all cases, a temporal clear corneal incision (CCI) was constructed and hydrophobic acrylic flexible intraocular lens (Acrysof Natural, SN60AT) were implanted. Intraoperative parameters including mean phacoemulsification time, total phacoemulsification percentage, effective phacoemulsification time (EPT), total volume of balanced salt solution (BSS) used, and the final size of the corneal incision were measured. Postoperative parameters including uncorrected and best spectacle corrected visual acuity (UCVA, BSCVA), keratometric and astigmatism changes by vector analysis, at 1 day, 5 days and 2 months, were checked.

***Results*****:** Postoperative BCDVA in 5 days and 2 months in conventional and microcoaxial groups were significantly different. At 5 days, BCDVA was 0.04±0.07 logMAR and 0.00±0.02 logMAR respectively (P=0.006). At 2 months BCDVA was 0.02±0.06 logMAR and 0.00±0.02 logMAR respectively (P=0.044). Mean induced keratometric change in 5 days in conventional and microcoaxial groups were 0.39±0.06 and 0.18±0.24 diopter respectively (P=0.035), but long-term keratometric values showed no significant differences. Other measured intraoperative and postoperative variables showed no significant difference between the two groups. There were no intraoperative or postoperative complications.

***Conclusion*****:** Microcoaxial phacoemulsification showed significantly less induced keratometric changes and also better corrected visual acuity in early postoperative period. Long-term keratometric values showed no significant differences. Both techniques were effective for surgery in cases with senile uncomplicated cataract.

***Keywords*****:** Conventional Phacoemulsification, Microcoaxial Phacoemulsification, Intraoperative Parameters, Postoperative Parameters

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1. Associate Professor of Ophthalmology, Eye Research Center, Rassoul Akram Hospital, Tehran University of Medical Sciences, Tehran, Iran
2. Assistant Professor of Ophthalmology, Eye Research Center, Rassoul Akram Hospital, Tehran University of Medical Sciences, Tehran, Iran
3. Ophthalmologist, Eye Research Center, Rassoul Akram Hospital, Tehran University of Medical Sciences, Tehran, Iran
4. General Practitioner, Eye Research Center, Rassoul Akram Hospital, Tehran University of Medical Sciences, Tehran, Iran

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Correspondence to: *Seyed Javad Hashemian, MD*
*Associate Professor of Ophthalmology, Eye Research Center, Rassoul Akram Hospital, Tehran University of Medical Sciences, Tehran, Iran, Tel:+98 21 66509162, Email: sj_hashemian@yahoo.com*

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## Introduction

Today, due to improvement of modern cataract surgery; cataract extraction is not only considered a therapeutic procedure for cataract itself but also a refractive surgery procedure. Advances in technology of phacoemulsification machines, new foldable intraocular lens (IOL) designs and surgical techniques have made cataract surgery safer with better refractive results than before. Reduction in incision size reported to be associated with a decreased amount of postoperative corneal edema,[1] stable anterior chamber and less wound-related complication,[2,3] less surgically induced astigmatism (SIA),[4-6] less corneal aberration,[5,9] less surgical[7] and phacoemulsification time,[4,8] and shorter postoperative rehabilitation.[4,8] Other probable advantages include faster wound healing and lower risk of endophthalmitis.[10] Because cataract surgery is now performed as a standard procedure for millions of patients around the world every year, it has a tremendous socioeconomic impact, and postoperative rehabilitation of the patient is a very important issue. The aim of this study was to compare the outcomes of microcoaxial phacoemulsification and conventional phacoemulsification.

## Methods

This study was a prospective comparative study conducted in Negah eye center from February 2005 to February 2006. Sixty-nine eyes of 69 patients were consecutively enrolled in the study. Inclusion criteria included age range between 50 and 85 years, senile cataract grade 3 and 4 of Lens Opacities Classification System III (LOCSIII) and keratometric cylinder <1.0 D. Exclusion criteria were hard cataract (grade 5-6 LOCS III), ocular comorbidities, axial length greater than 24.5 mm, or lower than 22 mm, corneal dystrophy and opacity, keratometric astigmatism more than 1.0 D and endothelial cell density less than 1500 cells/mm$^2$. Thirty-nine eyes underwent surgery by the microcoaxial technique and 30 eyes by the conventional technique. Preoperatively, a complete ocular examination including autorefraction (Keratorefractometer Topcon; KR-8100, Japan), UCVA, BSCVA, Goldmann tonometry, slit-lamp examination, indirect ophthalmoscopy, biometry (IOL Master, Carl Zeis.), topography (Eye-sys, 2000 USA) for keratometric indices, refraction were performed.

Far Snellen visual acuity (VA) with and without spectacle correction were performed at 1 and 5 days, and 2 months after surgery.

The study was performed according to the tenets of the Declaration of Helsinki.

### *Surgical techniques*

All surgeries were performed by the same surgeon (S.J.H). Perioperating conditions and dilation regimens (tropicamide %1, Sina Darou, Iran) were similar in the two groups. In all cases, surgery was performed under topical anesthesia with tetracaine HCL %0.5 (Sina Darou, Iran) a temporal clear cornea incision and 5 to 5.5 mm continuous curvilinear capsulorrhexis were made. In both groups the Aspiration Bypass System (ABS) was used with a ABS/Kelman 30 degree, using the same phacoemulsification equipment (Sovereign White Star, AMO) with Stop and Chop technique, aspiration 400 mmHg/60 cc per minute and Irrigation bottle height at 110 cm. A hydrophobic acrylic flexible intraocular lens (Acrysof Natural, SN60AT) was implanted in the capsular bag using a Monarch II injector and a B cartridge in conventional group and C cartridge in microcoaxial group (Alcon) in all cases.

In the conventional phacoemulsification group a 3.2 mm temporal clear corneal incision (CCI) was constructed with a diamond knife (RHEIN medical inc. USA) and one 1.2 mm sideport incisions at 1 o'clock in right eyes and at 5 o'clock in left eyes were created (RHEIN medical inc. USA). The phaco-tip was Kelman 30 degrees, 1.1 mm flared.

In the Micro-coaxial phacoemulsification group a 2.4 mm temporal CCI with diamond knife (RHEIN medical inc. USA) and one 1.2 mm sideport incisions at 1 o'clock in right eyes and at 5 o'clock in left eyes were created (RHEIN medical inc. USA). Phaco-tip was Kelman 30 degree, 0.9 mm flared tip with ultrasleeve.

Outcome measurements included both intraoperative and postoperative parameters. Intraoperative parameters were: mean phacoemulsification time, total phacoemulsification percentage, effective phacoemulsification time (EPT), total volume of balanced salt solution (BSS) used, and final size of the corneal incision.

Postoperative parameters were UCVA, BSCVA, keratometric and astigmatism changes by vector analysis, at 1 day, 5 days and 2 months.

### *Statistical analysis*

Parametric variables were analyzed by SPSS (Ver. 13). Parameters were analyzed using Student t-test. A P value of 0.05 or less was considered statistically significant.

## Results

The mean age of the patients were 67.7(±8) years in conventional group and 67.9(±9) years in micro-coaxial phacoemulsification group (Table 1). There were no statistically significant differences in intraoperative parameters in two groups (Table 2).

BCVA at 5 days in standard co-axial phacoemulsification and micro-coaxial phacoemulsification were 0.04(±0.06) and 0.00(±0.02) logMAR, respectively. BCVA at 2 months after operation in standard co-axial phacoemulsification and micro-coaxial phacoemulsification were 0.02(±0.06) and 0.00(±0.02) logMAR, respectively.

BSCVA at 5 days after surgery (P=0.006), 2 months postoperation (P=0.044) and surgically induced keratometric changes at 5 days after surgery (P=0.037) were significantly different (Table 3) (Figures 1 and 2). At 5 days, BSCVA≥$^{20}/_{20}$ were 71.4% in conventional group and 94.4% in microcoaxial group (P=0.03). No statistically differences between two groups were observed in the other measures.

**Table 1.** Patient demography

| | Microcoaxial | Standard coaxial | P |
|---|---|---|---|
| Number | 39 | 30 | - |
| Age (Mean±SD) | 67.90±9 | 67.70 ± 7.6 | 0.963 |
| Sex<br>Female<br>Male | <br>15 (38.5%)<br>24 (61.5%) | <br>21 (70%)<br>9 (30%) | 0.013 |
| Preoperative Keratometry | 44.12±1.69 | 44.40±1.58 | 0.458 |
| Preoperative corneal cylinder | 0.585±0.32 | 0.586±0.32 | 0.991 |

**Table 2.** Intraoperative parameter (Mean±SD)

| | Microcoaxial | Standard coaxial | P |
|---|---|---|---|
| Phaco power percent | 9.94%±4.46 | 9.72%±3.77 | 0.827 |
| Total phaco time (sec) | 69.18±40.99 | 61.13±27.25 | 0.357 |
| EPT(sec) | 7.42±6.02 | 6.66±4.51 | 0.562 |
| Used BSS (ml) | 149.12±60.72 | 148.97±66.40 | 0.937 |

**Table 3.** Postoperative measures comparison between two groups

| | Microcoaxial | Standard coaxial | P |
|---|---|---|---|
| *logMAR UCVA (Mean±SD)* | | | |
| 1 Day | 0.16±0.14 | 0.21±0.14 | 0.173 |
| 5 Days | 0.10±0.11 | 0.16±0.13 | 0.278 |
| 2 Months | 0.12±0.12 | 0.16±0.14 | 0.204 |
| *logMAR BCVA (Mean±SD)* | | | |
| 5 Days | 0.00±0.02 | 0.04±0.07 | 0.006 |
| 2 Months | 0.00±0.02 | 0.03±0.06 | 0.044 |
| *Induced keratometric change (Mean±SD)* | | | |
| 5 Days | 0.18±0.24 | 0.39±0.48 | 0.035 |
| 2 Months | 0.10±0.23 | 0.13±0.23 | 0.633 |
| *Induced cylinder change (Mean±SD)* | | | |
| 1 Day | 0.53±0.60 | 0.72±0.71 | 0.263 |
| 5 Days | 0.28±0.37 | 0.38±0.50 | 0.408 |
| 2 Months | 0.07±0.19 | 0.07±0.29 | 0.942 |



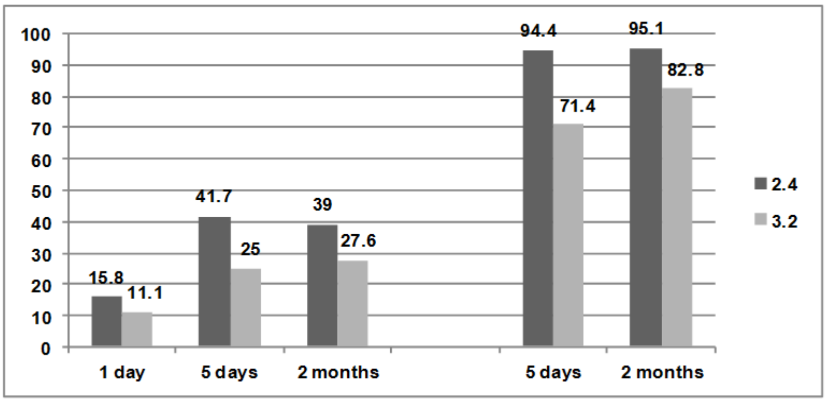


**Figure 1.** Uncorrected and best spectacle corrected visual acuity ≥20/20 in conventional coaxial phacoemulsification (3.2 mm incision) and microcoaxial phacoemulsification (2.4 mm incision)

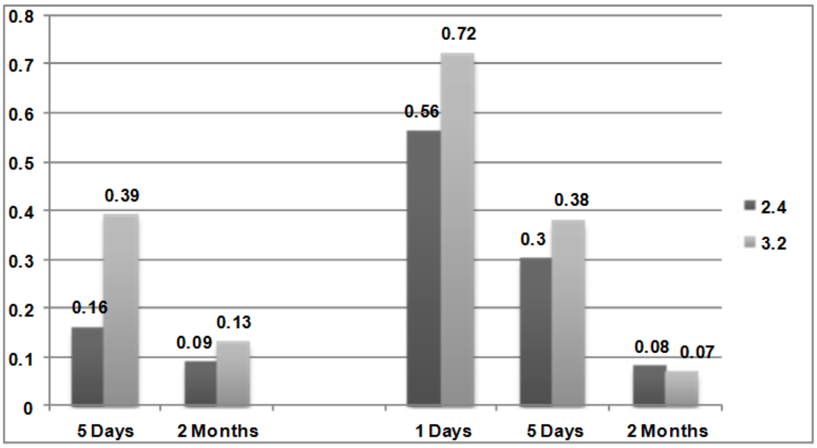


**Figure 2.** Mean surgical induced Keratometric and astigmatism change between two groups

## Discussion

The smaller incisions used for cataract extraction today make the surgery less invasive and safer, stable anterior chamber,[2,3] easier capsulorrhexis and better intraocular view because of smaller instrument; and probably resulting in less surgical trauma, less postoperative intraocular inflammation, fewer incision-related complications, lower SIA,[4-6] and shorter total surgical time.[7] These factors provide faster postoperative visual recovery, and increased patient satisfaction.[4,13] Increasingly, patients expect good refractive outcomes after cataract surgery in addition to the therapeutic benefits from treating the pathology.

Despite there is a clear trend toward smaller incisions; in this study we choose microcoaxial phacoemulsification technique, because of the small learning curve, better fluidics, less wound thermal burn compared to bimanual MICS technique and using same conventional instrumentation, and same IOL inserted through a 2.4 mm incision.

In this study we compared intraoperative phacoemulsification parameters, VA and SIA in two matched groups; conventional 3.2 mm CCI phacoemulsification group and microcoaxial 2.4 mm CCI phacoemulsification group. We observed no intraoperative and postoperative complication.

There were no significant differences in intraoperative parameters (mean phacoemulsification time, EPT, total phacoemulsification percentage, total volume of BSS used). Therefore, based on these findings, microcoaxial technique may be as efficient and effective as conventional standard coaxial technique, in patients with senile cataract.

Microcoaxial phacoemulsification group showed significantly better BSCVA and SIA in early postoperative period (5 days and 2 months). These may be due to less postoperative inflammation, less corneal edema and faster wound healing process. Thus microcoaxial technique may result in faster recovery. Final SIA between two groups at 2 months follow-up visit were not statistically different.

There are some published studies with different results that compared conventional phacoemulsification with microcoaxial or bimanual MICS approach. Some studies showed the smaller incision size resulted in lesser SIA.[4,5] In Denoyer et al surgically induced corneal and refractive astigmatism were not significantly different. Dosso et al compared microcoaxial (1.6 mm) with conventional phacoemulsification (2.8 mm), the only significant differences were ultrasound time and surgical time.[11] They showed no significant differences between two techniques in postoperative BCVA, endothelial cell loss, or corneal thickness, however their incision were smaller than our study. In Berdahl et al corneal wound integrity was better in coaxial surgery (microincision and standard) than microincision bimanual phacoemulcification.[12]

Although randomized clinical trial studies should be performed to evaluate and compare early and late results of the three major techniques including: conventional coaxial; microcoaxial and microincision bimanual phacoemulsification with more participants. Also, it would be appropriate to evaluate endothelial cell damage and surgical trauma in future randomized clinical trials.

## Conclusion

Microcoaxial phacoemulsification and conventional phacoemulsification both are effective techniques for surgery of senile cataracts. However, microcoaxial phacoemulsification may be superior to conventional coaxial technique as it provides faster postoperative visual recovery and increased patient satisfaction and does not require an additional learning curve.

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