Why Microincisional Cataract Surgery and Microincisional IOLs?

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Why Microincisional Cataract Surgery and Microincisional IOLs?

- The quality of the images after cataract surgery depends on two main factors;
  - Intrinsic aberrations originating from the eye
    - 80% of ocular aberrations are derived from the cornea.
      Hamam H. *Optom Vis Sci* 2003; 80:175-184.
    - For customized intraocular lenses (IOLs) applications, we have to protect optical properties of the cornea.
  - Aberrations arising from the intraocular lens.
    Marcos S, et al. *J Refract Surg* 2005; 21:223-235.
    Wirbelauer C, Pham DT. *Klin Monatsbl Augenheilkd.* 2008; 225: 212-216.
    Alio J, et al. *Curr Opin Ophthalmol* 2006; 17:80-93.
    Guiaro A, et al. *Arch Ophthalmol* 2002; 120: 1143-1151.
    - Reliable micro-incision IOLs (MICS-IOLs) are the *sine qua non* component of this surgery.

Why Microincisional Cataract Surgery and Microincisional IOLs?

Preface

This book appears at a moment in which cataract surgery is probably making the last evolution in technology and surgical practice, according to the postulates that Charles Kelman started in the early 70s. The progressive transition from the initial concept of small inicision cataract surgery, the development of more and more sophisticated technology to support the surgeon's practice of the procedure, the development of intraocular lenses capable of correcting virtually all types of refractive errors, and the scientific knowledge available today on fluidics, micromechanics, biomaterials, viscomaterials, and surgical instrument technology has made cataract surgery experience one of the greatest progressions and advances of a surgical technique throughout the history of medicine and surgery.

Cataract surgery at the moment is transforming into a practice in which minimal agressiveness and optimized outcomes are targeted and tried to achieve by surgeons. Better diagnostic technology, sophistication in calculation formulas for IOL implantation, better instruments for incisions, and deeper knowledge into the structure of the cornea and corneal optics, greater knowledge into issues related intraocular lens per-

Throughout this process, the history of cataract surgery has been related to the decrease in incision size. This is why an important part of this book is targeting

biaxial microincisional surgery, which seems to be mandatory in the future evolution of cataract removal. Simplification of the procedure and separation of irrigation and aspiration seems to be related to better outcomes supported by current scientific evidence. This is possible, thanks to a better knowledge of the instrumentation, fluidics, use of ultrasound power, and indeed surgical knowledge and training. The development of new lenses capable of fitting through smaller incisions than those currently available seems to be a limit to the development of the technology. Today, we can precisely limit our capabilities for cataract removal to 1.6 mm and to 1.8 mm with IOL implantation. Throughout this book, the reader will be able to learn about the methods to achieve this benchmark of cataract surgery at this moment.

As we have already mentioned in our opinion, this book appears during the final stage of the evolution of cataract surgery as conceived today. We anticipate that sub 1 mm surgery will require new technologies, and especially, new IOL technology and biomaterials. Most probably, we are at the end of the revolution that was started by Charlie Kelman in the early 70s and in the next decade we shall start a new evolution toward new issues such as lens replacement through new biomaterials, new

accommodating lenses, regenerating surgery, and new technologies to soften the cataract and to eliminate it through punctures rather than through incisions.

We both, as co-authors, think that the readers will enjoy going through this book to discover the real cutting edge but practical image offered today by high-quality cataract surgery practice. We thank all the co-authors of this book, all of them most relevant professionals and surgical scientists, for their contribution to this book and to the progress of cataract surgery. Thanks to them and to the support of our families, this book appears ready to go to your operating room as an advisor for your progression toward the last transition that cataract surgery will experience with the technology available today.

Alicante, Spain
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Jorge L. Alió
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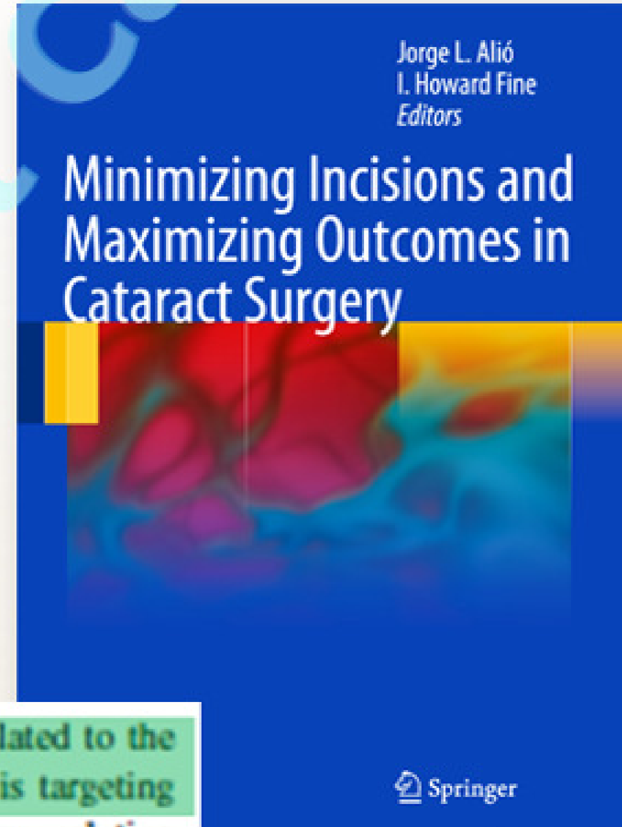


Why Microincisional Cataract Surgery and Microincisional IOLs? / History

1960	1970	1990	2000
Long Incision Cataract Surgery	Small Incision Cataract Surgery (Phaco + PMMA IOLs)	Mini Incision Cataract Surgery (Phaco + Foldable IOLs)	Micro Incision Cataract Surgery (MICS + Microincisional IOLs)
10 mm ICCE 8 mm ECCE	7 mm	4 mm ↓ mostly 2.8 – 3.2mm	2.2 mm ↓ even 1.5 – 1.8 mm

Why Microincisional Cataract Surgery and Microincisional IOLs? / Benefits

- **Less recovery time**

  Can İ, Takmaz T, Yıldız Y, Bayhan HA, Soyugelen G, Bostancı B. Coaxial, microcoaxial, and biaxial microincision cataract surgery: prospective comparative study**. J Cataract Refract Surg 2010** May; 36(5):740-746

- **Less wound closure problems**

  Can İ, Bayhan HA, Çelik H, Bostancı Ceran B. Anterior segment optical coherence tomography evaluation and comparison of main clear corneal incisions in microcoaxial and biaxial cataract surgery **J Cataract Refract Surg 2011** Mar; 37: 490-500.

- **Less inflammation**

  Alio J, Rodriguez-Prats JL, Galal A. Advances in microincision cataract surgery intraocular lenses. **Curr Opin Ophthalmol 2006**; 17:80-93.

- **Less endophthalmitis risk**

  Chee S-P, Bacsal K. Endophthalmitis after microincision cataract surgery**. J Cataract Refract Surg 2005**; 31:1834–5.

- **Less peroperative complication and haemorrhage risk**

  Alio JL. What does MICS require? In: Alio JL, Rodriguez Prats JL, Galal A, eds. **MICS Micro-incision Cataract** Surgery.Miami: Highlights of Ophthalmology 2004: 1- 4.

- **Protection of prolate shape and biomechanics of cornea (better visual quality)**

  Elkady B, Alio´ J, Ortiz D, Montalba´n R. Corneal aberrations aftermicroincision cataract surgery. **J Cataract Refract Surg** 2008; 34:40-5.

- **Less surgical induced astigmatism (enables presbyopic and toric IOL applications)**

  Can İ, Takmaz T, Bayhan HA, Bostancı Ceran B. Aspheric microincision intraocular lens implantation with biaxial microincision cataract surgery: efficacy and reliability**. J Cataract Refract Surg 2010** Nov;36(11):1905-11.

  Can İ, Bostancı Ceran B. Soyugelen G, Takmaz T. Clinical outcomes of two different small incision diffractive multifocal intraocular lenses: Comparative study**. J Cataract Refract Surg 2012** Jan; 38: 60-7

  Can İ, Bostancı Ceran B. Micro-incision intraocular lenses (review). **Ophthalmology International. 2011**;6(3):74-79.

- **Less surgical induced higher-order aberrations (enables customized IOLs)**

  Can İ, Bayhan HA, Çelik H, Bostancı Ceran B. Comparison of corneal aberrations after biaxial micro-incision and micro-coaxial cataract surgeries: A prospective study. **Curr Eye Res 2012** Jan; 37 (1): 18-24.

Why Microincisional Cataract Surgery and Microincisional IOLs? / Controversy

- Which technique?
  - Biaksial
  - Microcoaxial
- Are incision sites reliable?
- Are microincisional intraocular lenses functional, safe and effective?
- How small is meaningful ?

Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?

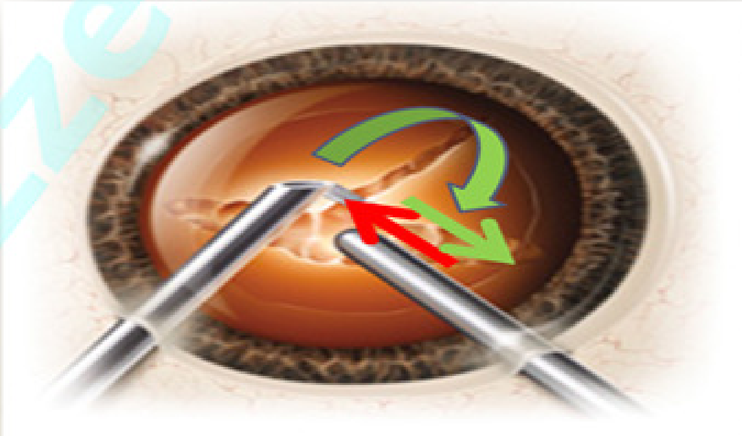
Microcoaxial Technique

For nuclear material
- **Repulsive forces:** U/S + Irrigation
- **Attractive forces :** Aspiration + Outflow from main incision

Phaco tip (same instrument) uses
- **U/S power**
- **Irrigation**
- **Aspiration**

- **So repulsive and attractive forces share the same axis**

Biaxial (=Bimanual) Technique



For nuclear material
- **Repulsive forces:** U/S
- **Attractive forces :** Irrigation + Aspiration + Outflow from main incision

Sleveless phaco tip uses
- **U/S power and Aspiration**

Irrigative chopper uses
- **Irrigation**

- **So repulsive and attractive forces are in the different axes**

Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?

Publications in Favour of Biaxial Technique

- Tsuneoka H et al. *J Cataract Refract Surg* 2002; 28: 81-6.
  - 637 eye, 1.4 mm incision,
  - Ave. operation time : 8 min 42 sec
  - No thermal injury
  - Ave. endothelial loss 4.6% - 15.6%
  - SIA 1. wk. 0.35 D, 3. mo. 0.18D.
- Alio J. Et al. *Ophthalmology* 2005; 112: 1997-2003.
  - 100 eye,
  - 1. group 1.5 mm incision biaxial,
  - 2. group 2.8 mm. coaxial PE
  - EFT; 2.19 sec & 9.3 sec
  - SIA: 0.433 D. & 1.2 D.
- Kurz et al. *Ophthalmology* 2006 ;113: 1818-26.
  - 70 eye,
  - 1. group 1.5 mm incision biaxial ,
  - 2. group 2.75 mm. coaxial PE.
  - 1. day BCVA; ave. 20/25 & 20/33
  - 8. wk BCVA; ave. 20/20 & 20/25
  - EFT >3 sn 34% & 68%
  - SIA: 0.15 D & 0.31 D.
- Cavallini et al. *J Cataract Refract Surg* 2007; 33: 387-92.
  - 100 eye,
  - 1. group biaxial,
  - 2. group coaxial PE .
  - Total operation time: 637 sec. & 736 sec.
  - Less BSS usage with biaxial technique
- Kahraman G. et al. *J Cataract Refract Surg* 2007; 33: 618-22.
  - 33 patient, one eye biaxial (1.5 mm) , second eye coaxial PE (3.2 mm)
  - No difference.

Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?

Publications Against Biaxial Technique

- Osher RH and Injev VP. *J Cataract Refract Surg* 2007; 33: 401-7.
  - Better fluidics and wound structure in microcoaxial group (Lab. study)
- Kahraman G. et al. *J Cataract Refract Surg* 2007; 33: 618-22.
  - Postoperative 1st day more CCT increase in biaxial group.
- Crema AS et al. J Cataract Refract Surg 2007; 33: 1014-8.
  - More EFT and corneal endothelial cell loss in biaxial group.
- Praveen MR et al. *J Cataract Refract Surg* 2008; 34: 1007-12.
  - More tripan blue ingress to anterior chamber after cortex removal stage in biaxial group.
- Johar SR et al. *J Cataract Refract Surg* 2008; 34: 670-6.
- Gajjar D et al. *J Cataract Refract Surg* 2007; 33: 2129-34.
  - More wound injury and bacterial ingress in biaxial group. (Animal study)

Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?

ARTICLE

Coaxial, microcoaxial, and biaxial microincision cataract surgery

Prospective comparative study

İzzet Can, MD, Tamer Takmaz, MD, Yelda Yıldız, MD, Hasan Ali Bayhan, MD, Gülizar Soyugelen, MD, Başak Bostancı, MD

PURPOSE: To compare the intraoperative and postoperative results of 3 phacoemulsification techniques.

SETTING: Atatürk Training and Research Hospital, 2nd Ophthalmology Department, Ankara, Turkey.

METHODS: In this prospective randomized study, patients had standard coaxial (2.8 mm incisions), microcoaxial (2.2 mm incisions), or biaxial microincision (1.2 to 1.4 mm trapezoidal incisions) phacoemulsification. Intraoperative phaco parameters and total surgical time were measured and complications recorded. Postoperative visual acuity improvement, pachymetric differences, and surgically induced astigmatism (SIA) results were compared.

RESULTS: Each group comprised 45 eyes. There were no significant differences between the 3 groups in demographic, morphologic, or preoperative surgical data. The mean effective phaco time was 2.56 seconds ± 2.46 (SD) in the standard coaxial group, 1.98 ± 1.91 seconds in the microcoaxial group, and 1.29 ± 1.85 seconds in the biaxial microincision group (P<.05). The mean total surgical time was 14.48 ± 4.21 minutes, 13.01 ± 3.66 minutes, and 18.79 ± 6.58 minutes, respectively (P<.01), and the mean measured final incision size was 2.83 ± 0.11 mm, 2.26 ± 0.07 mm, and 1.89 ± 0.21 mm, respectively. The mean SIA 90 days postoperatively was 0.46 diopter (D), 0.24 D, and 0.13 D, respectively (P<.01). There was no statistically significant difference in the complication rate, visual acuity gain, or pachymetric change between the groups (P>.05).

CONCLUSIONS: All 3 techniques were reliable, functional, and effective, yielding good visual outcomes and low phaco parameters and complication rates. Biaxial microincision surgery, with the smallest incisions, induced less astigmatism and reduced all intraoperative phaco parameters except total surgical time.

Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2010; 36:740–746 © 2010 ASCRS and ESCRS

- Journal Cataract Refract Surg 2010; 36: 740-6.
- ASCRS, 2009, San Francisco, Free Paper

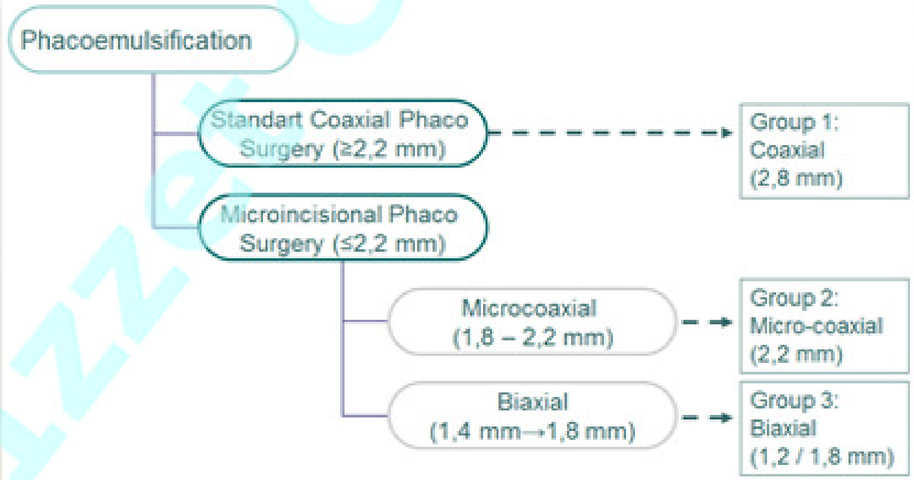


Table 1. Phaco parameters by group.

Parameter	Phaco Technique: Standard Coaxial	Microcoaxial	Biaxial MICS
Main incision size (mm)	2.8	2.2	2 × 1.2/1.4*
Planned capsulorhexis (mm)	4.5–5.0	4.5–5.0	4.5–5.0
Phaco needle	0.9 mm flared Kelman ABS (Alcon)	0.9 mm flared Kelman ABS	0.9 mm straight
Sleeve	0.9 mm blue microsleeve (Alcon)	0.9 mm pink ultrasleeve (Alcon)	Sleeveless
Chopper	Chang microfinger (Katena Instruments)	Chang microfinger	Fine-Nagahara irrigating chopper (MST)
Machine settings			
Power (%)	50	50	40
Burst on (ms)	30	30	30
Burst off (ms)	5	5	5
Vacuum (mm Hg)	400	400	300
Aspiration rate (cc/min)	42	42	25
Bottle height (cm)	110	110	110
Cortex and OVD removal	Bimanual I/A	Bimanual I/A	Bimanual I/A
I/A set	Buratto bimanual I/A tips (Alcon, Grieshaber)	Buratto bimanual I/A tips	Du-02301 and Du-02302 cannulas (Duet)
Machine settings			
Vacuum (mm Hg)	600	600	600
Aspiration rate (cc/min)	60	60	60
Bottle height (cm)	110	110	110
Injector and cartridges	Royale injector, C and D cartridges (Alcon)	Royale injector, C and D cartridges	LP 604350 (Medicel); Acri.Shooter A2-2000 (Acri.Tec)
Incision closure	Stromal hydration with BSS	Stromal hydration with BSS	Stromal hydration with BSS
Endophthalmitis prophylaxis	1.0 mg/0.1 mL cefuroxime in AC	1.0 mg/0.1 mL cefuroxime in AC	1.0 mg/0.1 mL cefuroxime in AC

AC = anterior chamber; BSS = balanced salt solution; I/A = irrigation/aspiration; MICS = microincision cataract surgery; OVD = ophthalmic viscosurgical device

*Trapezoidal

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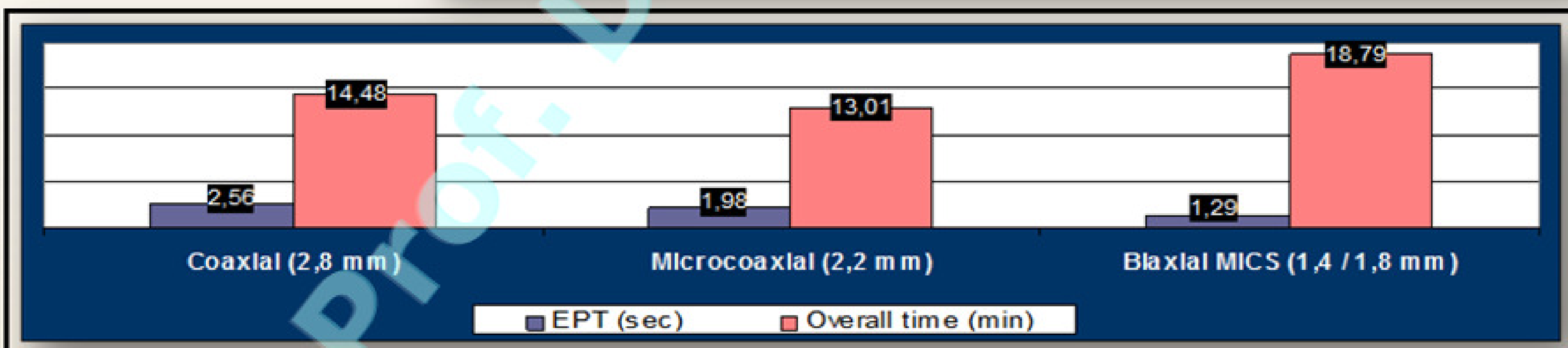
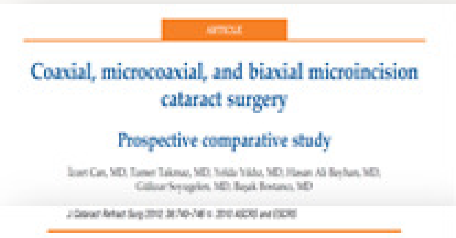
Table 3. Intraoperative parameters.

Parameter	Phaco Technique: Standard Coaxial	Microcoaxial	Biaxial MICS	P Value
Mean pupil diameter (mm)	7.60 ± 0.77	7.52 ± 1.16	7.80 ± 0.80	.369[†]
Mean capsulorhexis diameter (mm)	5.16 ± 0.70	5.16 ± 0.62	4.93 ± 0.33	.089[†]
Hydrodelineation, n (%)	32 (71.1)	33 (72.1)	36 (80.0)	.600[‡]
Mean phaco time (min)	0.27 ± 0.19	0.20 ± 0.13	0.19 ± 0.23	.121[†]
Mean phaco power (%)	13.48 ± 7.63	12.39 ± 8.10	7.79 ± 6.00	.001[†]
Mean EPT (sec)	2.56 ± 2.46	1.98 ± 1.91	1.29 ± 1.85	.019[†]
Mean total surgical time (min)	14.48 ± 4,21	13.01 ± 3.66	18.79 ± 6.58	.001[†]
Mean final incision (mm)	2.83 ± 0.11	2.26 ± 0.07	1.89 ± 0.21	.001[†]
Incision enlargement (mm)				.001[†]
Mean ± SD	0.031 ± 0.046	0.068 ± 0.076	0.131 ± 0.195	
Change (%)	1.07	2.72	5.00	



Can İ, Takmaz T, Yıldız Y, Bayhan HA, Soyugelen G, Bostancı B. Coaxial, microcoaxial, and biaxial microincision cataract surgery: prospective comparative study. *J Cataract Refract Surg* 2010 May; 36(5): 740-746.

Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?


ARTICLE

Coaxial, microcoaxial, and biaxial microincision cataract surgery

Prospective comparative study

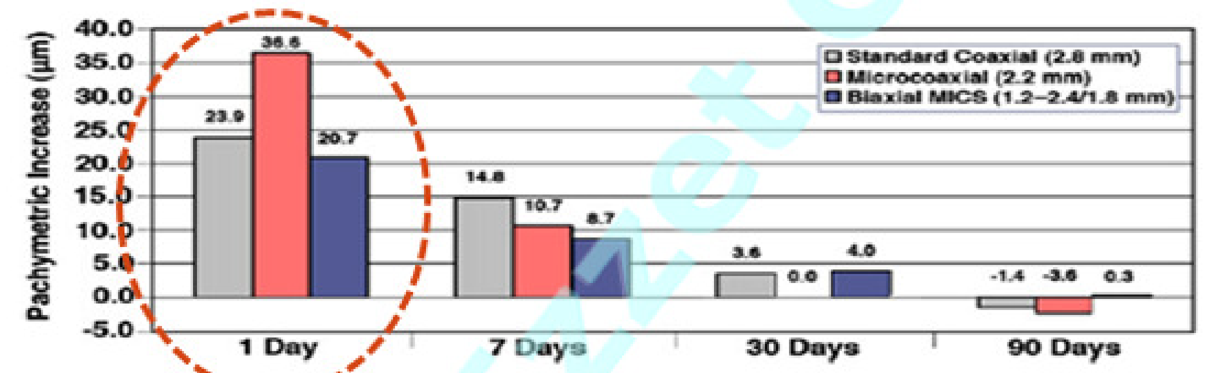
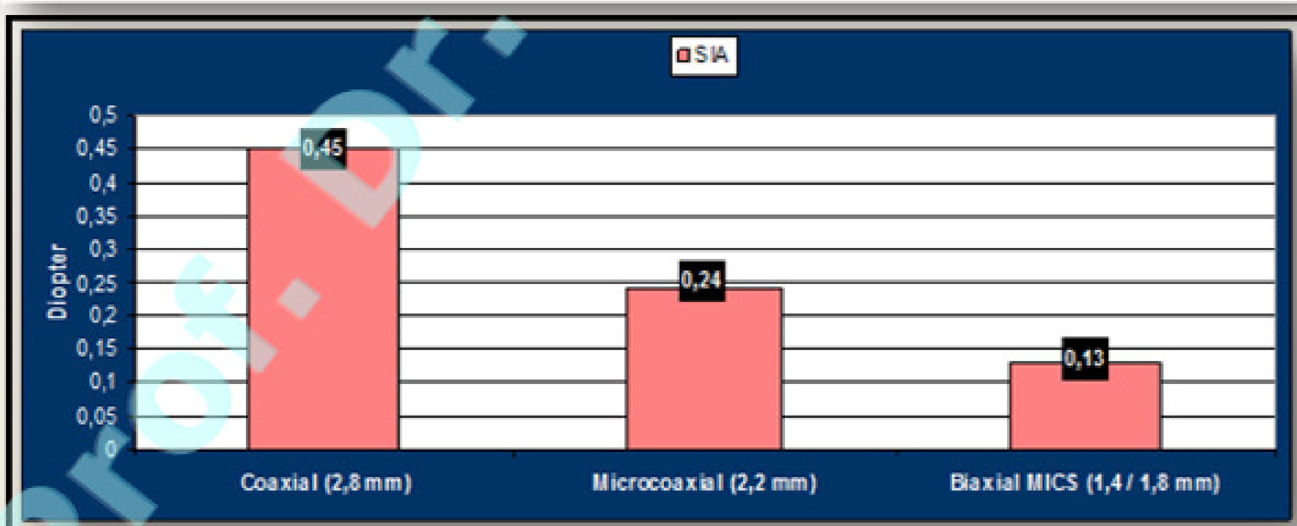


Figure 1. Change in CCT postoperatively (MICS = microincision cataract surgery).



Ave. incision widths : 2.83 mm 2.26 mm. 1.89 mm

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Coaxial, microcoaxial, and biaxial microincision cataract surgery

Prospective comparative study

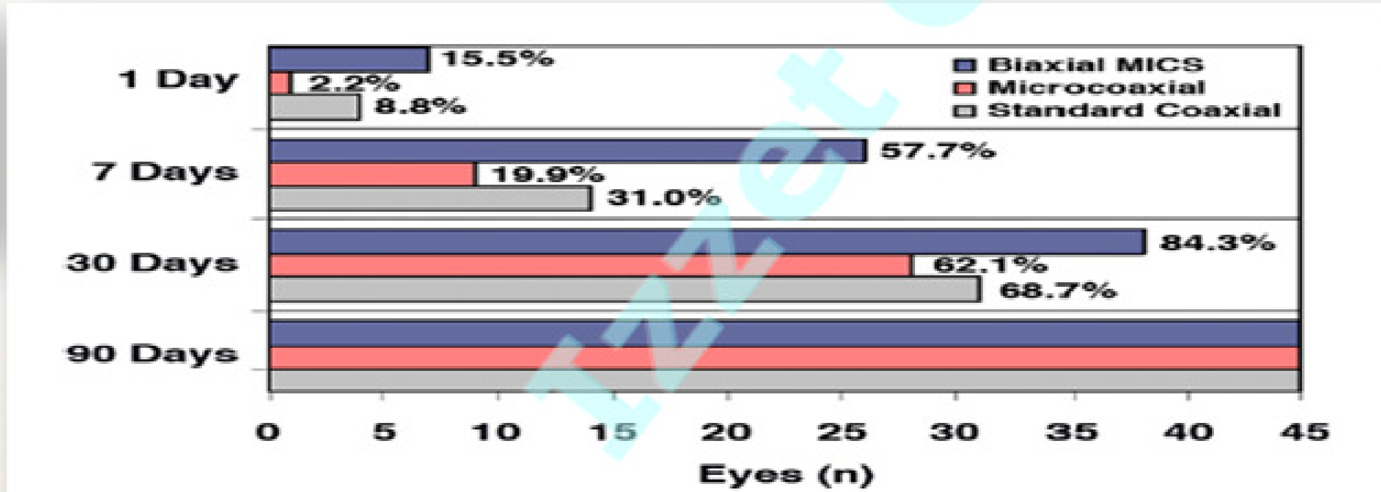
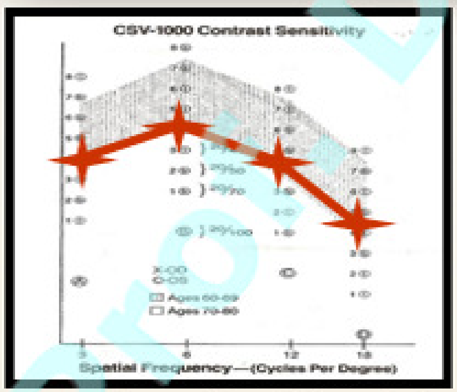
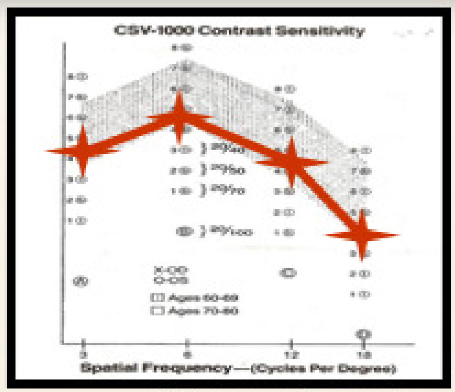


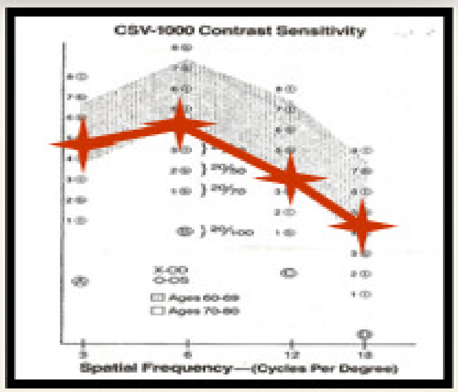
Figure 2. Visual recovery time; that is, time to best visual acuity post-operatively (MICS = microincision cataract surgery).



Standard Coaxial



Micro-Coaxial



Biaxial

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Why Microincisional Cataract Surgery and Microincisional IOLs? / Which Technique?

Summary

- The microcoaxial phacoemulsification technique has the advantages of a small incision but
  - Fluidics ?
  - Torsional technology may solve fluidics problems in micro-coaxial technique
- The biaxial MICS technique, has clinical advantages
  - Shorter effective phaco time
  - Reduced visual recovery time
  - Less surgical induced astigmatism

	Standard Coaxial PE	Micro-coaxial PE	Biaxial PE
REPULSIVE FORCES			
U/S Energy (Jackhammer effect)	↑↑	↑↑	↑↑
Irrigation	↑↑	↑↑	
ATTRACTIVE FORCES			
Vacuum and AFR	↑↑	↑↑	↑↑
Outflow	↑↑	↑	↑
Irrigation			↑

	Standard Coaxial PE	Micro-coaxial PE	Torsional Micro-coaxial PE	Biaxial PE
REPULSIVE FORCES				
U/S Energy (Jackhammer effect)	↑↑	↑↑	→ ↑	↑↑
Irrigation	↑↑	↑↑	→ ↑	
ATTRACTIVE FORCES				
Vacuum and AFR	↑↑	↑↑	→ ↑	↑↑
Outflow	↑↑	↑	↑	↑
Irrigation				↑

Can İ, Takmaz T, Yıldız Y, Bayhan HA, Soyugelen G, Bostancı B. Coaxial, microcoaxial, and biaxial microincision cataract surgery: prospective comparative study. *J Cataract Refract Surg* 2010 May; 36(5): 740-746.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Incisions Are ?

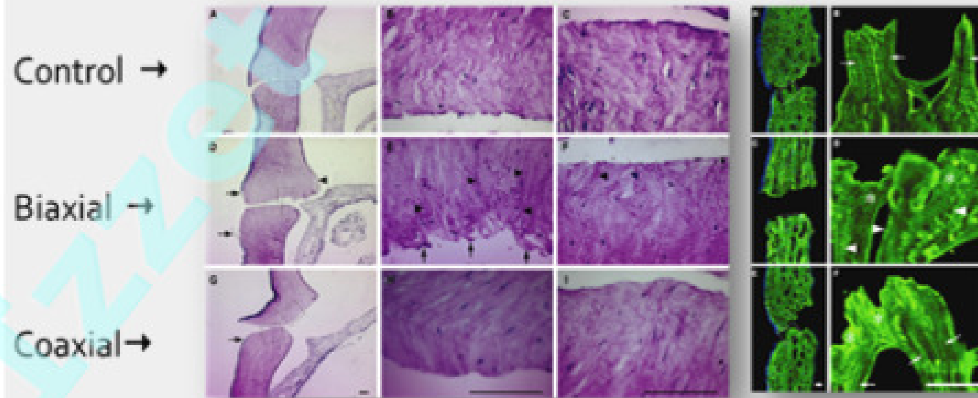
Debate Over Small Incisions Used in Biaxial Technique

- Berdahl JP, DeStafano JJ. Corneal wound architecture and integrity after phacoemulsification evaluation of coaxial, microincision coaxial, and microincision bimanual techniques. *J Refract Cataract Surg* 2007; 33:510-515

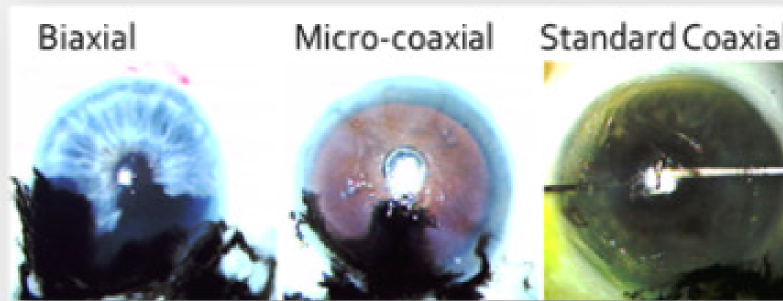
- Gajjar D, Praveen MR, Vasavada AR, Pandita D, Vasavada VA, Patel DB, Johar K, Raj S. Ingress of bacterial inoculum into the anterior chamber after bimanual and microcoaxial phacoemulsification in rabbits. *J Cataract Refract Surg* 2007; 33:2129-2134.

- Johar SRK, Vasavada AR, Praveen MR, Pandita D Nihalani B, Patel U, Vamuganti G. Histomorphological and immunofluorescence evaluation of bimanual and coaxial phacoemulsification incisions in rabbits. *J Cataract Refract Surg* 2008; 34:670-676.

- Praveen MR, Vasavada AR, Gajjar D, Pandita D, Vasavada VA,Vasavada MS, Raj MS. Comparative quantification of ingress of trypan blue into the anterior chamber after microcoaxial,standard coaxial, and bimanual phacoemulsification Randomized clinical trial. *J Cataract Refract Surg* 2008; 34:1007-1012



Johar SRK, et al. J Cataract Refract Surg 2008; 34:670-6



Berdahl JP, et al. J Refract Cataract Surg 2007; 33:510-5.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Incisions Are ?

AS-OCT Studies For Corneal Incisions

- Torres LF et al. In vivo architectural analysis of 3.2 mm clear corneal incisions for phacoemulsification using optical coherence tomography. *J Cataract Refract Surg* 2006; 32:1820–6.
- Fine IH, et al. Profile of clear corneal cataract incisions demonstrated by ocular coherence tomography. *J Cataract Refract Surg* 2007; 33:94–7.
- Schallhorn JM, et al. Optical coherence tomography of clear corneal incisions for cataract surgery. *J Cataract Refract Surg* 2008; 34:1561–5.
- Dupont-Monod S, et al. In vivo architectural analysis of clear corneal incisions using anterior segment optical coherence tomography. *J Cataract Refract Surg* 2009; 35:444–50.
- Elkady B et al. Corneal incision quality: Microincision cataract surgery versus microcoaxial phacoemulsification *J Cataract Refract Surg* 2009; 35:466-74.
- Xia Y et al. Early changes in clear cornea incision after phacoemulsification: an anterior segment optical coherence tomography study. *Acta Ophthalmol* 2009; 87:764-8.
- Behrens A et al. Dynamics of small-incision clear cornea wounds after phacoemulsification surgery using optical coherence tomography in the early postoperative period. *J Refract Surg* 2008; 24:46–9.
- Wylegala E, et al. Anterior segment imaging: Fourier-domain optical coherence tomography versus time-domain optical coherence tomography. *J Cataract Refract Surg* 2009; 35:1410–4.

ARTICLE

Anterior segment optical coherence tomography evaluation and comparison of main clear corneal incisions in microcoaxial and biaxial cataract surgery

İzzet Can, MD, Hasan Ali Bayhan, MD, Hale Çelik, MD, Başak Bostancı Ceran, MD

PURPOSE: To use Fourier-domain anterior segment optical coherence tomography (AS-OCT)) to evaluate the main clear corneal incisions (CCIs) in microcoaxial and biaxial cataract surgery, the effects of incision enlargement, and the probable reasons for problematic healing.

SETTING: Atatürk Training and Research Hospital, 2nd Ophthalmology Department, Ankara, Turkey.

DESIGN: Cohort study.

METHODS: Eyes that had microcoaxial cataract surgery through a 1.8 mm CCI or biaxial cataract surgery through a 1.2 to 1.4 mm trapezoidal CCI were divided into 2 equal subgroups based on incision enlargement. All surgeries were completed by stromal hydration. Incisions were evaluated 1, 8, and 30 days postoperatively.

RESULTS: The CCIs in the microcoaxial group were longer, thinner, and more slanted than those in the biaxial group, with no statistical difference. The microcoaxial incisions had significantly more arcuate configuration at 1 day ($P = .003$); however, the configuration became linear in the following days in both groups. The endothelial gap rates were less and Descemet membrane detachment rates greater than reported in the literature. In eyes with enlarged CCIs, the endothelial gap rate was higher in the microcoaxial group and the Descemet membrane detachment rate was higher in the biaxial group (both $P = .05$). At 1 day, the intraocular pressure (IOP) was significantly lower in Descemet membrane detachment and endothelial gap cases ($P = .006$ and $P < .001$, respectively).

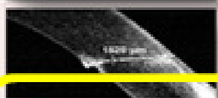
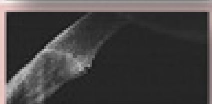
CONCLUSIONS: Although closure was reliable in both groups, the microcoaxial group had slightly fewer undesirable effects on the incision site. Low postoperative IOP seemed to be a significant factor in problematic healing.

Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

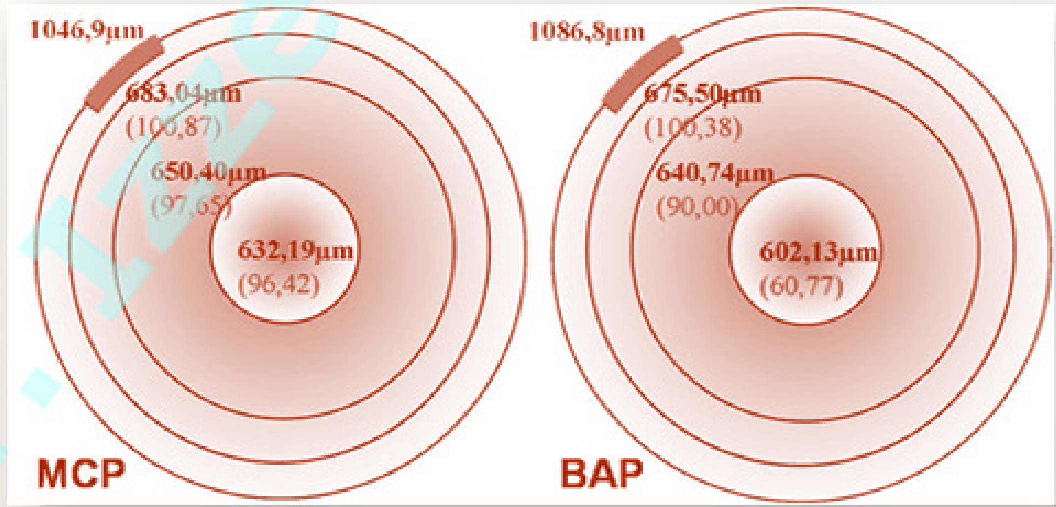
J Cataract Refract Surg 2011; 37:490–500 © 2011 ASCRS and ESCRS

- Journal Cataract Refract Surg 2011; 37: 490-500.
- ASCRS, 2010, Boston, Free Paper

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are Incisions ?

Incision 1st day 8th day 30th day	Micro-Coaxial	Biaxial	Difference
Angle			N.S.
Lenght			N.S.
Configuration	Mostly Arcuate 	Mostly Straight 	Significant
Epithelial Gaps			N.S.
Endothelial Gaps			N.S.
Endothelial Gap / Incisional Lenght Ratio			N.S.
Incision Site Thickness			N.S.
Descemets' Membrane Detachment			N.S.

Summary



- Thickness (µm)
- Increase (µm)

Can İ, Bayhan HA, Çelik H, Bostancı Ceran B. Anterior segment optical coherence tomography evaluation and comparison of main clear corneal incisions in microcoaxial and biaxial cataract surgery *J Cataract Refract Surg* 2011 Mar; 37: 490-500.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

Ideal Microincisional IOL should

- be implanted 2.0 mm and under incision sizes
- maintain its structure and optic properties during insertion
- have high capsular and uveal biocompatibility
- sustain its stability and centralization in the bag
- not increase capsular rupture risk
- not cause positive and negative dysphotopsia
- not lead to light scatter
- not cause higher order aberrations

Unfavaourable Publications in The Past

- Meaningful PCO
- Tilt and Decentralization Problems
    - Kaya V, et al. ThinOptX vs AcrySof: comparison of visual and refractive results, contrast sensitivity, and the incidence of posterior capsule opacification. *Eur J Ophthalmol* 2007; 17:307-314
    - Prakash P, et al. Microincision bimanual phacoemulsification and Thinoptx implantation through a 1.70 mm incision. *Eye* 2007; 21:177-182
    - Pandey SK, et al. Phakonit. Cataract removal through a sub-1.0 mm incision and implantation of the ThinOptX rollable intraocular lens. *J Cataract Refract Surg* 2002; 28:1710-1713

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

Current MICS IOLs in the Market

MONOFOCAL

Hydophlic

- Ultrachoice 1.0 Lenses (Thinoptx, Abingdon, VA, USA)
- AcriFlex MICS IOL 46CSE (Acrimed GmbH, Berlin, Ger),
- CareFlex IOL (W20 Medizintechnik AG, Bruchal, Ger),
- SuperFlex and C-Flex (Rayacryl, Rayner IOL Ltd, UK),
- IOLTech MICS lens (LaRochelle, Fra and Carl Zeiss Meditec, Stuttgard, Ger),
- Microslim and SlimFlex (PhysIOL, Liege, Bel)
- Akreos MI-60 (B+L, USA)
- Incise (B+L, USA)

Hydrphobic

- Hoya Y-60H (Hoya Corp. Tokyo, Japan)

Hydrophilic with Hydrophobic Surface

- Acriva UDM 611 (VSY Technologies, İstanbul , Tur)

Flexiacril Hybrid Acrilic

- Miniflex IOL (Mediphacos Ltd, Minas Gerais, Bra)

Collamer

- NanoFlex (CC4204A) (Staar Surgical Co., Monrovia, Ca, USA)

TORIC

- AT Lisa Toric 909M / MV (=Acri Comfort 646TLC)) (Carl Zeiss Meditec, Berlin, Ger) :
- Acriva UD Toric T UDM611 (VSY Technologies, İstanbul , Tur)

PRESBIYOPIC

Accommodative

- TetraFlex KH-3500 micro-incision lens (Lenstec Inc, St. Petersburg, FL, USA)
- 1-CU: (Human Optics, Erlangen, Ger.)

Multifocal and Multifocal Toric

- AT LISA (809 M / 809 MV) (Acri.Lisa 366 D)
- AT LISA® 909M/MP (Zeiss, Berlin, Ger)
- AT LISA Toric (AcriLisa Toric 466 D) (Carl Zeiss Meditec, Berlin, Ger)
- Acriva Reviol 611 MFM
- Acriva UD Toric T UDM611(VSY Biotechnologies, İstanbul, Tur)

Trifocal

- FineVision Micro F (PhysIOL, Bel)
- AT LISA tri 839MP (Zeiss, Berlin, Ger)

Duet

- Sulcoflex (Rayner, UK)

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

ARTICLE

Aspheric microincision intraocular lens implantation with biaxial microincision cataract surgery: Efficacy and reliability

İzzet Can, MD, Tamer Takmaz, MD, Hasan Ali Bayhan, MD, Başak Bostancı Ceran, MD

PURPOSE: To evaluate the efficacy and reliability of a microincision intraocular lens (IOL) and its use in biaxial microincision cataract surgery (MICS).

SETTING: Atatürk Training and Research Hospital, Ankara, Turkey.

DESIGN: Prospective clinical study.

METHODS: A microincision IOL (Akreos MI60) was implanted after cataract extraction by the biaxial MICS technique. Over a postoperative follow-up of 12 months or more, visual acuity, contrast sensitivity, surgically induced astigmatism (SIA), corneal and ocular aberrations, and early and late complications were recorded.

RESULTS: The IOLs were implanted in the capsular bag in all 100 eyes. The mean final incision size was 1.82 mm ± 0.09 (SD). Postoperatively, the mean corrected distance visual acuity was 0.06 ± 0.10 logMAR; the mean spherical equivalent, −0.48 ± 0.91 diopter (D); and the mean calculated SIA, 0.20 ± 0.22 D. Contrast sensitivity with and without glare was within normal limits. There was no statistically significant difference in the root mean square of total corneal aberrations between preoperatively and postoperatively. Ocular wavefront analysis 3 months postope… values of 0.15 ± 0.2 μm for spherical aberration, 0.38 ± 0.16 μm for hig… 0.18 ± 0.14 μm for coma, and 0.14 ± 0.08 μm for trefoil. The 4 cases (… anterior chamber reaction resolved with treatment. None of the 20 eyes (… capsule opacification required neodymium:YAG capsulotomy. All IOLs remai…

CONCLUSION: The aspheric microincision IOL was safely implanted throug… incision during biaxial MICS and gave good postoperative outcomes.

Financial Disclosure: No author has a financial or proprietary interest in a… mentioned.

J Cataract Refract Surg 2010; 36:1905–1911 © 2010 ASCRS and ESCRS

JCRS 2010; 36: 1905-11.

- 81 patients, 100 eyes
- IOL: Akreos MI-60 (Bausch / Lomb)
- Biaxial PE: ~ 1.82 mm incision
- Gr II-IV Cataract (LOCS III)
- Follow-up: at least 1 year

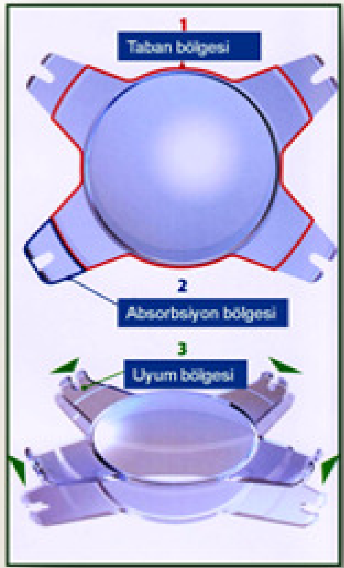


Table 1. Patient characteristics and preoperative data.

Parameter	Value
Patients/eyes (n)	81/100
Mean age (y) ± SD	64.2 ± 13.0
Sex, n (%)	
Female	41 (50.6)
Male	40 (49.4)
Eye, n (%)	
Right	49 (49.0)
Left	51 (51.0)
Mean CDVA ± SD	
Decimal	0.34 ± 0.19
LogMAR	0.56 ± 0.36
Mean UDVA ± SD	
Decimal	0.23 ± 0.15
LogMAR	0.75 ± 0.39
Mean CCT (μm) ± SD	547.9 ± 37.7
Nuclear hardness (LOCS III)	NO2-4

CCT = central corneal thickness; CDVA = corrected distance visual acuity; LOCS = Lens Opacities Classification System; UDVA = uncorrected distance visual acuity

Table 2. Surgical parameters.

Parameter	Mean ± SD
Effective phaco time (s)	5.31 ± 3.77
Total operation time (min)	14.91 ± 3.79
Used fluid volume (mL)	102.07 ± 31.42
Final incision width (mm)	1.82 ± 0.09

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

Table 3. Postoperative visual acuity, refraction, and contrast sensitivity at 3 months.

Parameter	Mean ± SD
UDVA	
Decimal	0.49 ± 0.22
LogMAR	0.35 ± 0.21
CDVA	
Decimal	0.89 ± 0.17
LogMAR	0.06 ± 0.10
UNVA	
Jaeger	3.02 ± 2.14
LogMAR	0.16 ± 0.16
DCNVA	
Jaeger	4.70 ± 1.77
LogMAR	0.29 ± 0.13
CNVA	
Jaeger	1.09 ± 0.35
LogMAR	0.008 ± 0.03
Required near add power* (D)	2.24 ± 0.57
SE refraction (D)	−0.43 ± 0.91
SIA by vector analysis (D)	0.20 ± 0.22
Contrast sensitivity (log units)	
Without glare	
3 cpd	1.59 ± 0.18
6 cpd	1.86 ± 0.17
12 cpd	1.56 ± 0.25
18 cpd	1.15 ± 0.27
With glare	
3 cpd	1.56 ± 0.17
6 cpd	1.77 ± 0.19
12 cpd	1.47 ± 0.21
18 cpd	1.08 ± 0.22

add = addition; CDVA = corrected distance visual acuity; CNVA = corrected near visual acuity; cpd = cycles per degree; DCNVA = distance-corrected near visual acuity; SE = spherical equivalent; SIA = surgery induced astigmatism; UDVA = uncorrected distance visual acuity; UNVA = uncorrected near visual acuity
*Calculated to assess pseudoaccommodation

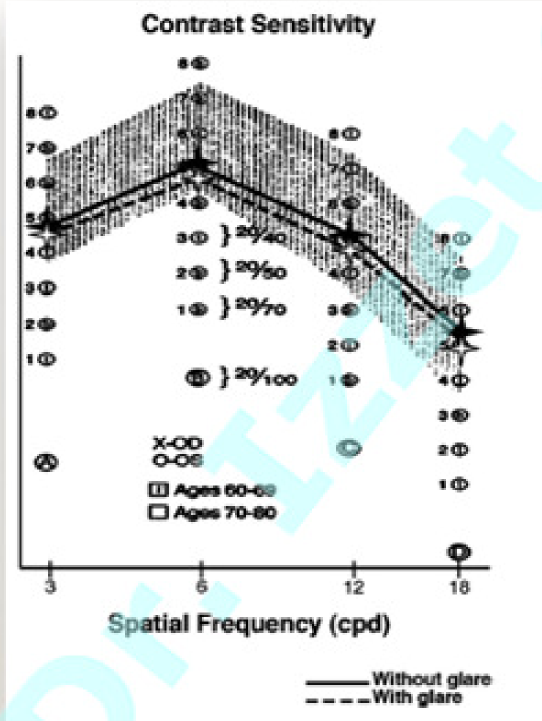


Figure 2. Contrast sensitivity results with and without glare (cpd = cycles per degree).

Table 4. Preoperative and postoperative corneal aberrations and postoperative ocular aberrations.

Aberration	Mean (µm) ± SD: Preoperative	Mean (µm) ± SD: Postoperative (3 Mo)	P Value*
Corneal			
HO RMS	0.57 ± 0.24	0.62 ± 0.26	.658
Total RMS	1.28 ± 0.67	1.24 ± 0.44	.764
Spherical	0.18 ± 0.17	0.17 ± 0.15	.925
Coma	0.42 ± 0.23	0.34 ± 0.26	.525
Trefoil	0.32 ± 0.15	0.37 ± 0.1[illegible]	.625
Ocular			
HO RMS	—	0.38 ± 0.16	—
Spherical	[illegible]	[illegible]	[illegible]
Coma	—	0.18 ± 0.14	—
Trefoil	[illegible]	[illegible]	[illegible]

HO RMS = higher-order root mean square; RMS = root mean square
*Comparison between preoperative and postoperative (paired-samples t test)

Negative result: 20% PCO

Can İ, Takmaz T, Bayhan HA, Bostancı Ceran B. Aspheric microincision intraocular lens implantation with biaxial microincision cataract surgery: efficacy and reliability. J Cataract Refract Surg. 2010 Nov; 36(11): 1905-1911.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

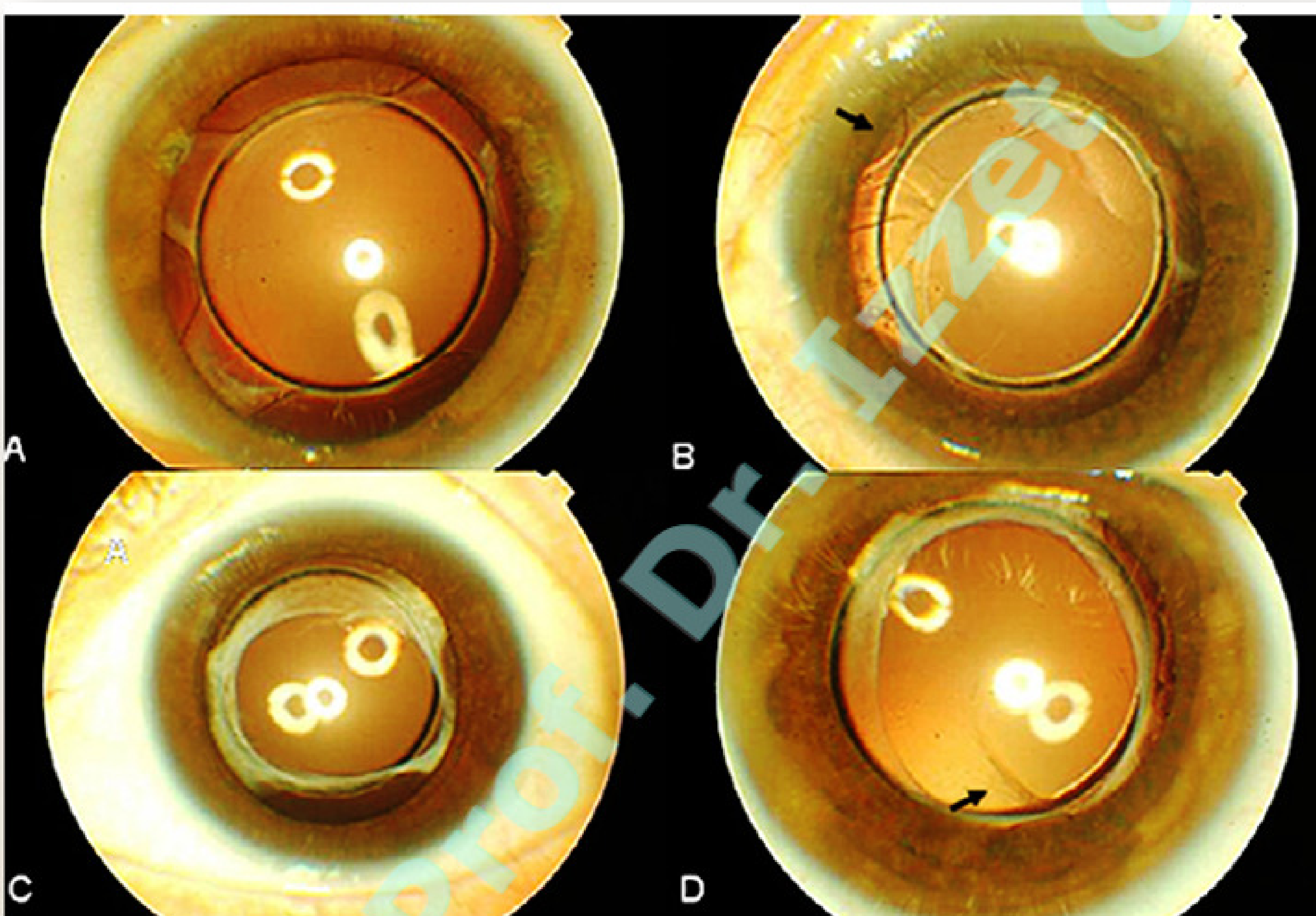


Figure 3. *A:* The IOL is well centered 9 months postoperatively in an eye with no intraoperative complications. *B:* The IOL remains well centered 6 months postoperatively in an eye with partial zonular dialysis (*arrow*) as a result of traumatic cataract. *C:* The IOL is well centered at 6 months in an eye with anterior capsule fibrosis that developed a severe membranous anterior chamber reaction. *D:* The IOL is centered 6 months postoperatively in an eye in which the IOL was implanted in the capsular bag despite posterior capsule rupture (*arrow*).

Can İ, Takmaz T, Bayhan HA, Bostancı Ceran B. Aspheric microincision intraocular lens implantation with biaxial microincision cataract surgery: efficacy and reliability. J Cataract Refract Surg. 2010 Nov; 36(11): 1905-1911.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

ARTICLE

Comparison of clinical outcomes with 2 small-incision diffractive multifocal intraocular lenses

İzzet Can, MD, Başak Bostancı Ceran, MD, Gülizar Soyugelen, MD, Tamer Takmaz, MD

PURPOSE: To evaluate and compare the clinical results of 2 diffractive multifocal small-incision intraocular lenses (IOLs) implanted after biaxial microincision cataract surgery (MICS).

SETTING: Atatürk Training and Research Hospital, 2nd Ophthalmology Department, Ankara, Turkey.

DESIGN: Comparative case series.

METHODS: Eyes that had biaxial MICS with implantation of an AcriLisa 366D IOL (Group 1) or Acriva Reviol MFM 611 IOL (Group 2) were followed for at least 6 months postoperatively. Uncorrected distance (UDVA), intermediate (UIVA), and near (UNVA) visual acuities; corrected distance visual acuity; distance-corrected intermediate and near visual acuities; and contrast sensitivity measurements with and without glare were determined. Early and late complications and subjective complaints were recorded and evaluated.

RESULTS: The study enrolled 60 eyes of 32 patients. The preoperative and intraoperative data were comparable in the 2 IOL groups. There were no statistically significant postoperative differences in the mean spherical equivalent (Group 1, −0.30 diopter (D) ± 0.30 [SD]; Group 2, −0.26 ± 0.28 D; $P = .584$), mean UDVA (0.80 ± 0.14 and 0.86 ± 0.17, respectively; $P = .158$), and mean Jaeger UNVA (1.46 ± 0.73 and J 1.23 ± 0.50, respectively; $P = .155$). However, there was a significant difference in mean Jaeger UIVA (3.06 ± 0.90 and 2.23 ± 0.72, respectively; $P = .000$). Mesopic contrast sensitivity and the incidence of complications and dysphotopsia symptoms were not significantly different between the 2 IOL groups.

CONCLUSIONS: Both IOLs provided excellent distance and near visual acuity and contrast sensitivity. The Group 2 IOL gave better intermediate distance results.

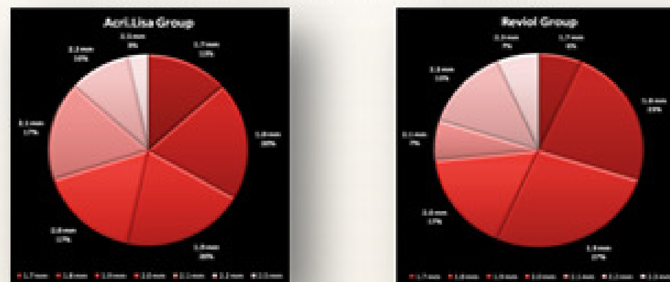
Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2012; 38:60–67 © 2012 ASCRS and ESCRS

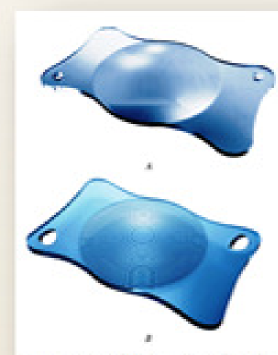
- •ESCRS Winter, 2011, İstanbul
- •JCRS 2012; 38: 60-7.

- 30 eyes AcriLisa 366 D (Zeiss Acritech)
- 30 eyes Acriva Reviol MFM 611 (VSY Biotechnologies)
- Follow-up: at least 6 mo.

Incision Sizes Disribution



Acri-Lisa : 1.975mm ±0.26 Reviol : 1.963 mm ±0.17

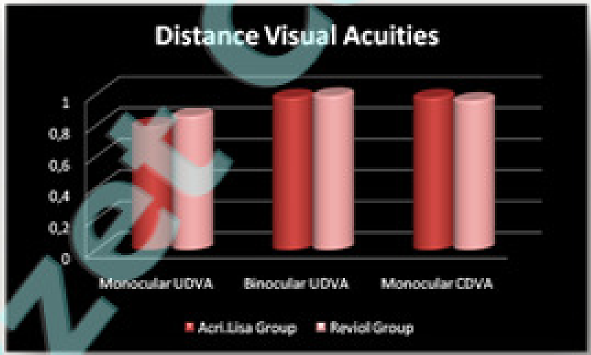


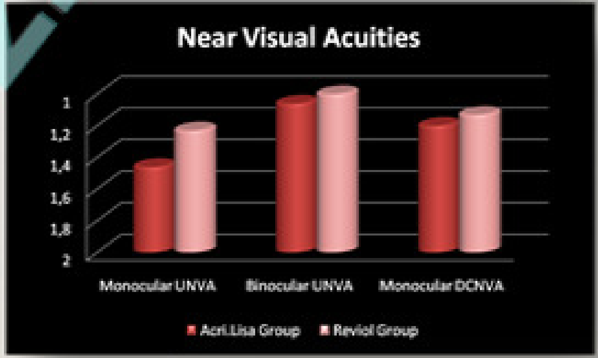
Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

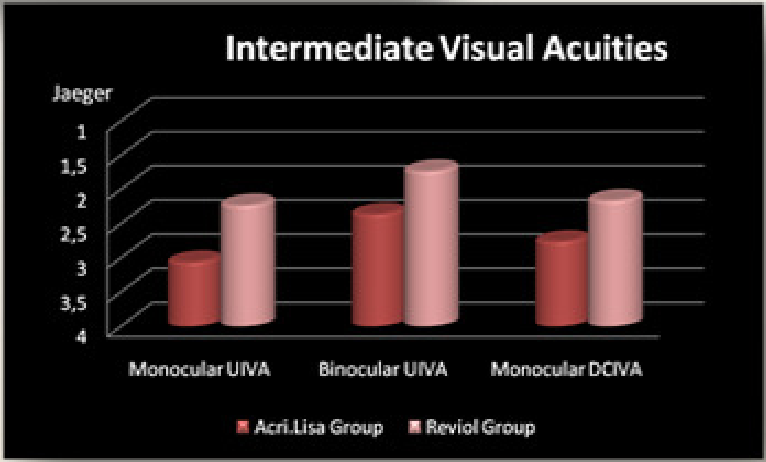
Table 4. Postoperative visual acuity, refraction, and spectacle independence at 3 months.

Parameter	Group 1	Group 2	P Value
Mean monocular UDVA ± SD			
Decimal	0.80 ± 0.14	0.86 ± 0.17	.158[†]
LogMAR	0.10 ± 0.07	0.07 ± 0.08	.113[†]
Mean binocular UDVA ± SD			
Decimal	0.98 ± 0.06	0.96 ± 0.09	.647[†]
LogMAR	0.01 ± 0.02	0.007 ± 0.01	.647[†]
Mean monocular CDVA ± SD			
Decimal	0.98 ± 0.05	0.96 ± 0.09	.219[†]
LogMAR	0.01 ± 0.02	0.02 ± 0.05	.219[†]
Mean monocular UNVA ± SD			
Jaeger	1.46 ± 0.73	1.23 ± 0.50	.155[†]
LogMAR	0.08 ± 0.20	0.02 ± 0.05	.104[†]
Mean binocular UNVA ± SD			
Jaeger	1.06 ± 0.25	1.00 ± 0.00	.155[†]
LogMAR	0.007 ± 0.03	0.00 ± 0.00	.155[†]
Mean monocular DCNVA ± SD			
Jaeger	1.20 ± 0.55	1.13 ± 0.34	.577[†]
[illegible]	[illegible]	[illegible]	[illegible]
Mean monocular UIVA ± SD			
Jaeger	3.06 ± 0.90	2.23 ± 0.72	0.000[†,§]
LogMAR	0.16 ± 0.055	0.11 ± 0.064	0.002[†,§]
Mean binocular UIVA ± SD			
Jaeger	2.36 ± 1.32	1.73 ± 0.78	.028[†,§]
LogMAR	0.11 ± 0.10	0.07 ± 0.07	.041[†,§]
Mean monocular DCIVA ± SD			
Jaeger	2.76 ± 0.81	2.16 ± 0.74	.004[†,§]
LogMAR	0.14 ± 0.051	0.11 ± 0.066	.013[†,§]
Mean SE refraction (D)	[illegible]	[illegible]	[illegible]
Mean corneal toricity* (D)	0.53 ± 0.26	0.66 ± 0.22	.057[†]
Subjective complaints, n (%)			
Halo	7 (23.3)	8 (26.6)	.766[‡]
Glare	6 (20.0)	6 (20.0)	1.000[‡]
Spectacle Independence (%)			
Far	100.0	100.0	—
Near	100.0	100.0	—
Intermediate	96.6	100.0	.313[‡]

Means ± SD
CCT = central corneal thickness; CDVA = corrected distance visual acuity; DCIVA = distance-corrected intermediate visual acuity; DCNVA = distance-corrected near visual acuity; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UIVA = uncorrected intermediate visual acuity; UNVA = uncorrected near visual acuity
*Simulated keratometry
[†]Student t test
[‡]Chi-square test
[§]Statistically significant

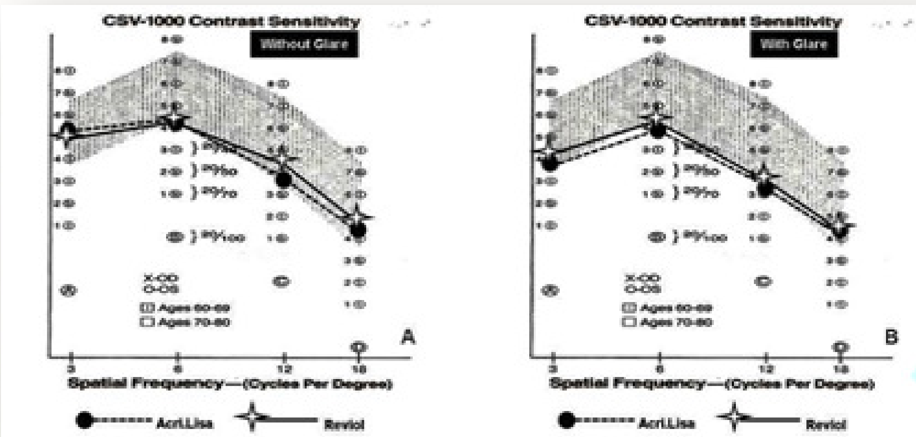


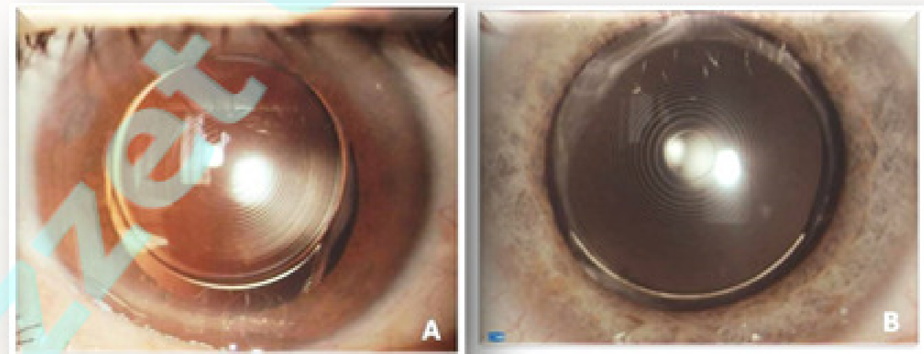




Can İ, Bostancı Ceran B. Soyugelen G, Takmaz T. Comparison of clinical outcomes with 2 small incision diffractive multifocal intraocular lenses. *J Cataract Refract Surg.* 2012 Jan; 38: 60-67.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?





A: AcriLisa 8. mo. B: Reviol 7. mo.

	Group 1 Acri.Lisa	Gorup 2 Reviol	*P*
Inflammation	-	-	
Halo Glare	7 eyes (23.3%) 6 eyes (21.4%)	8 eyes (26.6%) 6eyes (20.0%)	0.766* 1.000*
Spectacle independence for near and far	100%	100%	1.000
Intermediate distance visual problems	4 patients (25.0%)	-	
Spectacle for far	1 patient (6.2%)	-	
PCO - Nd YAG Capsulotomy	1 eye (3.3%)	1 eye (3.3%)	

Can İ, Bostancı Ceran B. Soyugelen G, Takmaz T. Comparison of clinical outcomes with 2 small incision diffractive multifocal intraocular lenses. *J Cataract Refract Surg.* 2012 Jan; 38: 60-67.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Safe Are MICS IOLs?

Summary

- There are many other studies confirming the safety and functionality of new generation MICS IOLs .
- In spite of having an overall diameter of 10.5–11.0 mm, microincisional IOLs provide comparable efficacy, functionality and safety to conventional IOLs. Moreover, they also offer premium lens characteristics.

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- Gangwani V, et al. *J Cataract Refract Surg*. 2011; 37:1988-92.
- Kohnen T, Klaproth OK. *Ophthalmologe*. 2010; 107:127-35.

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

Publication	Incision (mm)	SIA (D.)
Alio J, et al. *Ophthalmology.* 2005; 112: 1997-2003.	1.7	0.36
Kurz S, et al. *Ophthalmology.* 2006; 113: 1818-26.	1.5 – 1.7	0.15
Hayashi K, et al. *J Cataract Refract Surg.* 2009; 35: 233-9.	2.19 2.84	0.56 0.74
Wilczynski M, et al. *J Cataract Refract Surg.* 2009; 35: 1563-9.	1.7	0.23
Can İ, et al. *J Cataract Refract Surg.* 2010; 36: 740-6.	2.83 2.26 1.89	0.46 0.24 0.13
Can İ, et al. *J Cataract Refract Surg.* 2010; 36: 1905-11.	1.82	0.20

SIA: surgically induced astigmatism


CATARACT SURGERY BONUS FEATURE

How Small Is Too Small?

Incision width is a parameter that directly affects surgical results.

BY İZZET CAN, MD; AND BAŞAK BOSTANCI CERAN, MD

MICS TECHNIQUES

SIZE COMPARISON

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

- Guirao A, et al. (IOVS 2004;45:4312-9)
  - <u>3.5 mm. incision</u>

Total RMS	**0.65→0.85μm**	**<0.05**
Temporal	0.64→0.68μm	
Nasal	**0.66→0.99μm**	**<0.05**
Spherical aberration	0.32→0.34μm	
Astigmatism	**0.9 →1.1μm**	**<0.05**
Coma	0.27→0.32μm	
Trefoil	**0.31→0.54μm**	**<0.05**

- Alio JL et al. (Middle East Afr J Ophthalmol 2010;17:94-9)

	<u>1.8 mm B-MICS</u>	<u>2.2 mm C-MICS</u>
Total RMS	1.77→1.65μm	2.00→2.09μm
Mean HOA	0.45→0.53μm	0.54→0.75μm
Spherical Aberration	-0.12→-0.1μm	-0.25→-0.23μm
Astigmatism	0.7→0.65μm	1.14→0.96μm
Coma	**0.41→0.35μm <0.05**	0.46→0.47μm

Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

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ORIGINAL ARTICLE

Comparison of Corneal Aberrations After Biaxial Microincision and Microcoaxial Cataract Surgeries: A Prospective Study

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ABSTRACT

Purpose: To compare the effects of biaxial microincision cataract surgery (B-MICS) and microcoaxial cataract surgery (C-MICS) techniques on corneal optical quality.

Materials and methods: In this prospective study, 40 eyes underwent B-MICS and 40 eyes C-MICS. Corneal aberrations were derived from conversion of the corneal elevation profile into corneal wavefront data with 6.0mm aperture diameter using Zernike polynomials by corneal topography preoperatively and 1 month postoperatively. Both magnitude and axes of surgically induced corneal aberrations were calculated.

Results: Mean final incision widths were 1.80 ± 0.09 mm and 1.89 ± 0.11 mm ($p = 0.062$) in B-MICS and C-MICS groups, respectively. There were no significant changes in total and higher order root mean square in both groups postoperatively. In B-MICS group, all aberration terms were similar, before and after surgery. However, vertical coma ($p = 0.002$), vertical trefoil ($p < 0.001$) and primary trefoil ($p = 0.042$) significantly increased post-operatively in the C-MICS group. Except surgically induced trefoil ($p = 0.047$), there was no significant difference in all surgically induced corneal aberrations between groups. The axes of the induced trefoil were found to be mostly related and close to the incision site in both groups which was more prominent in the C-MICS group.

Conclusions: Microincision cataract surgery techniques performed through sub-1.9 mm clear corneal incisions do not generally degrade optical quality of the cornea while only small amount of higher order aberrations seem to be induced with C-MICS technique.

Keywords: Microincision cataract surgery, Corneal wavefront aberrations, Optical quality of the cornea

INTRODUCTION

With the advance in technol… evolved from a sight-saving…

the complaints like glare, halo and ghost image[6,7] and cannot be corrected with spectacles in contrast to lower

	Biaxial	Micro-coaxial
Eyes (n)	40	40
Final Ave. Incision Size	1.80 mm ±0.09	1.89 mm ±0.11

TABLE 1 Patients' demographics and preoperative characteristics.

Parameter	B-MICS	C-MICS	p
Eyes/patients (n)	40/28	40/32	–
Sex (male/female)	16/12	17/15	0.555*
Laterality (right/left)	20/20	20/20	–
Mean age (y) ± SD	65.29 ± 8.24	63.59 ± 11.77	0.656**
Δ SimK (D)	0.68 ± 0.34	0.72 ± 0.43	0.565**
Mean BCVA ± SD			
Snellen	0.36 ± 0.18	0.29 ± 0.22	0.239**
LogMAR	0.53 ± 0.36	0.67 ± 0.40	

B-MICS: biaxial microincisional cataract surgery; C-MICS: micro-coaxial cataract surgery; Δ SimK: the difference in power between the steep and flat meridians; BCVA: best corrected visual acuity.
*χ^2-test, **independent samples *t* test.

TABLE 2 Intraoperative data.

	B-MICS	C-MICS	p*
Effective phaco time (sec)	5.11 ± 2.22	6.25 ± 3.18	0.151
Mean fluid used (mL)	111.75 ± 32.12	107.66 ± 30.90	0.812
Total operation time (min)	15.49 ± 3.36	14.19 ± 3.08	0.195
Final main incision width (mm)	1.80 ± 0.09	1.89 ± 0.11	0.062
IOL power (D)	21.73 ± 1.68	22.41 ± 1.92	0.215

B-MICS: biaxial microincisional cataract surgery; C-MICS: micro-coaxial cataract surgery.
*Independent samples *t* test.

- Curr Eye Res 2012; 37(1): 18-24.
- ASCRS, 2011, San Diego, Free Paper

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Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

TABLE 3 Mean preoperative and postoperative corneal Zernike terms.

	B-MICS			C-MICS		
	Preoperative	Postoperative	p*	Preoperative	Postoperative	p*
Z(2,−2)	−0.195 ± 0.475	−0.245 ± 0.508	0.676	0.051 ± 0.348	0.040 ± 0.468	0.902
Z(2, 2)	0.0613 ± 0.524	0.139 ± 0.546	0.530	[illegible]	[illegible]	[illegible]
Z(3,−1)	0.176 ± 0.303	0.044 ± 0.350	0.217	0.098 ± 0.363	−0.121 ± 0.344	0.002
Z(3, 1)	0.092 ± 0.416	0.005 ± 0.033	0.062	[illegible]	[illegible]	[illegible]
Z(3,−3)	−0.151 ± 0.081	−0.196 ± 0.193	0.623	−0.097 ± 0.156	−0.269 ± 0.190	<0.001
Z(3, 3)	0.017 ± 0.212	−0.015 ± 0.066	0.585	[illegible]	[illegible]	[illegible]
Z(4,−2)	−0.003 ± 0.073	−0.003 ± 0.089	0.998	−0.007 ± 0.120	−0.005 ± 0.169	0.845
Z(4, 2)	0.0815 ± 0.188	−0.038 ± 0.130	0.177	−0.005 ± 0.176	−0.325 ± 0.254	0.427
Z(4,−4)	−0.003 ± 0.196	0.002 ± 0.198	0.921	0.015 ± 0.184	0.015 ± 0.177	0.996
Z(4, 4)	−0.039 ± 0.192	−0.009 ± 0.202	0.385	0.002 ± 0.153	0.020 ± 0.218	0.644

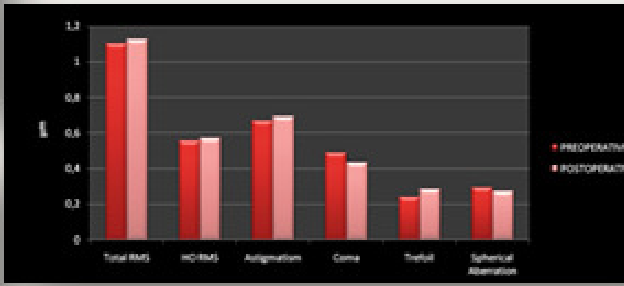
B-MICS: biaxial microincisional cataract surgery; C-MICS: microcoaxial cataract surgery.
*Paired samples *t* test.

Ave. Final Incision Sizes:
Biaxial group: **1.80 mm**
Micro-coaxial group: **1.89 mm**

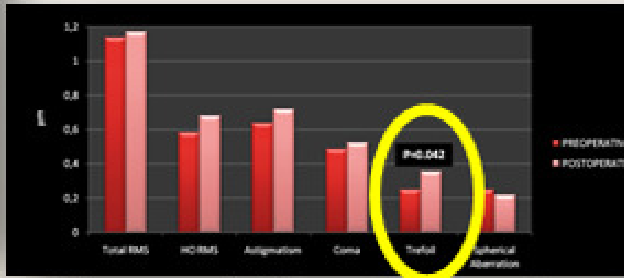
TABLE 4 Preoperative and postoperative wavefront aberrations in groups.

B-MICS				C-MICS			
Aberrations	Preoperative	Postoperative	p*	Aberrations	Preoperative	Postoperative	p*
Total RMS	1.102 ± 0.303	1.127 ± 0.266	0.779	Total RMS	1.138 ± 0.517	1.171 ± 0.395	0.665
HO RMS	0.557 ± 0.152	0.572 ± 0.145	0.574	HO RMS	0.584 ± 0.296	0.683 ± 0.207	0.088
Astigmatism	0.670 ± 0.282	0.694 ± 0.317	0.709	Astigmatism	0.637 ± 0.389	0.690 ± 0.426	0.269
Coma	0.491 ± 0.216	0.433 ± 0.187	0.272	Coma	0.486 ± 0.163	0.525 ± 0.218	0.156
Trefoil	0.240 ± 0.105	0.285 ± 0.285	0.778	Trefoil	0.249 ± 0.132	0.358 ± 0.157	0.042
Spherical Aberration	0.295 ± 0.127	0.272 ± 0.118	0.523	Spherical Aberration	0.250 ± 0.193	0.218 ± 0.158	0.372

B-MICS: biaxial microincisional cataract surgery; C-MICS: microcoaxial cataract surgery.
*Paired samples *t* test.
RMS: root mean square; HO: higher order.



Biaxial Group (1.80 mm)



Micro-coaxial Group (1.89 mm)

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Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

	Biaxial	Microcoaxial	*P**
SI Spherical Aberration	0.006±0.161	-0.031±0.211	0.502
SI Astigmatism	0.23±0.32 (25% of them ±20° adjacent to the axis)	0.26±0.42 (27.5% of them ±20° adjacent to the axis)	0.874
SI Coma	0.319±0.255 (10% of them ±20° adjacent to the axis)	0.376±0.229 (12.5% of them ±20° adjacent to the axis)	0.109
SI Trefoil	0.306±0.211 (42.5% of them ±20° adjacent to the axis)	0.451±0.229 (57.5% of them ±20° adjacent to the axis)	0.047

SI spherical aberration: postop.Z(4,0)- preop(Z4,0)
SI trefoil:
Δ(Z3,-3) = postop(Z3,-3)- preop(Z3,-3)
Δ(Z3,3) = postop(Z3,3)- preop(Z3,3)
SI trefoil (μm) = √(Δ(Z3,-3)²+Δ(Z3,3)²
Axis (degree)=1/3 x arctan (Δ (Z3,-3) /Δ(Z3,3))

SI coma:
Δ(Z3,-1) = postop(Z3,-1)- preop(Z3,-1)
Δ(Z3,1) = postop(Z3,1)- preop(Z3,1)
SI coma (μm) = √(Δ(Z3,1)²+Δ(Z3,1)²
Axis (degree)=)= arctan(Δ(Z3,-1) /Δ(Z3,1))

SI Aberration amount and axis measurement formulae

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Why Microincisional Cataract Surgery and Microincisional IOLs? / How Small is Meaningful?

Summary

- **Optical properties of corneal surface is a key factor to determine a retinal image because 80% of the ocular aberrations take it's source from corneal surface.**
  - Hamam H. A new measure for optical performance. *Optom Vis Sci* 2003; 80:175-84.

- **Optical quality of cornea can be degraded due to surgical incisions during cataract operations. Because these may cause surgical induced aberrations.**
  - Guiaro A, Tejedor J, Artal P. Corneal aberrations before and after small-incision cataract surgery. Invest *Ophthalmol Vis Sci* 2004; 45:4312-4319.

- **For this reason smaller incisions are being preferred not only to minimize astigmatism but also all HOA aberrations.**
  - Alio J, Rodriguez-Prats JL, Galal A, Ramzy M. Outcomes of microincision cataract surgery versus coaxial phacoemulsification. *Ophthalmology* 2005; 112:1997-2003.
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Why Microincisional Cataract Surgery and Microincisional IOLs? / Discussion

Conclusion

- From the point of functional outcomes biaxial technique seems to be superior.
  - But torsional technology or endothelial friendly surgical techniques might change this conclusion.
- But from the point of microincision safety and stability micro-coaxial technique seems to be better
- Today, with the advances in manufacturing technology, MICS-IOLs could be accepted as reliable as conventional ones.
- When all surgical induced abberrations take in to consideration, ideal incision size for aberration-free surgery may be between 1.80-1.89 mm.

Thank You Very Much For Your Attention