ARTEMIS
Augenklinik am Neumarkt
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DOC 2022 Nürnberg

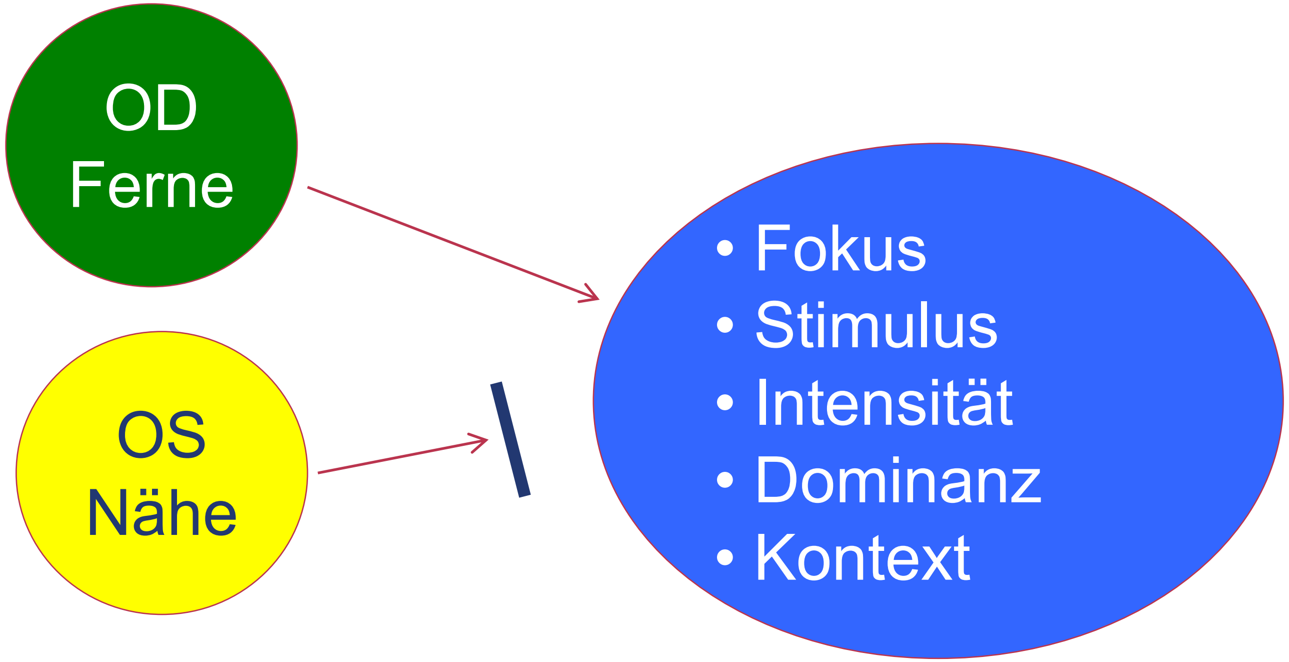
Monovision
Bei verschiedenen Refraktiv-Chirurgischen Operationen

Dr. Omid Kermani, MD
31.05.23

Keine finanziellen Interessen

Monovision: Dominanz und Supression

Instantane neuronale Selektion des je besseren Abbildes, oder Elementen hieraus, um die jeweiligen Anforderungen am besten lösen zu können.



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Monovision: Dominanz und Supression

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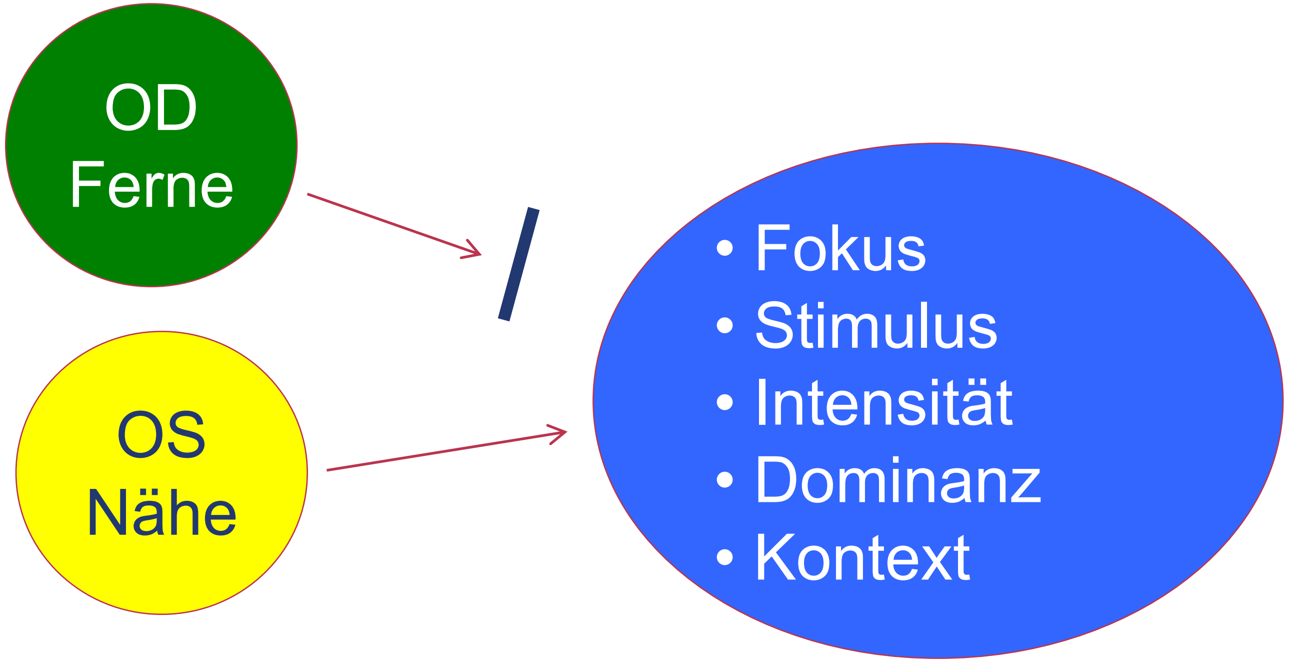

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Probleme der klassischen Monovision

Wenn ≥ 1,0D Anisometropie

- Verlust an räumlichem Sehen
    - Abstandsabhängig
    - Beleuchtungsabhängig
    - Beschleunigungsabhängig

- Fusion geschwächt (Doppelbilder)
    - Bei Müdigkeit
    - Bei Dunkelheit
    - Beim Lesen (Bildschirmarbeit)
    - Beim Autofahren (Dunkelheit)

Quelle: https://www.zeiss.de/vision-care/besser-sehen/gesundheit-vorsorge/gruener-star-grauer-star-amd-und-co-augenkrankheiten-und-wie-man-sie-rechtzeitig-erkennt.html

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- **LASIK, PRK und SMILE**
- **Corneales Inlay**
- **Phake Intraokularlinse**
- **Refraktiver Linsenaustausch**

Refraktiv Chirurgische Verfahren

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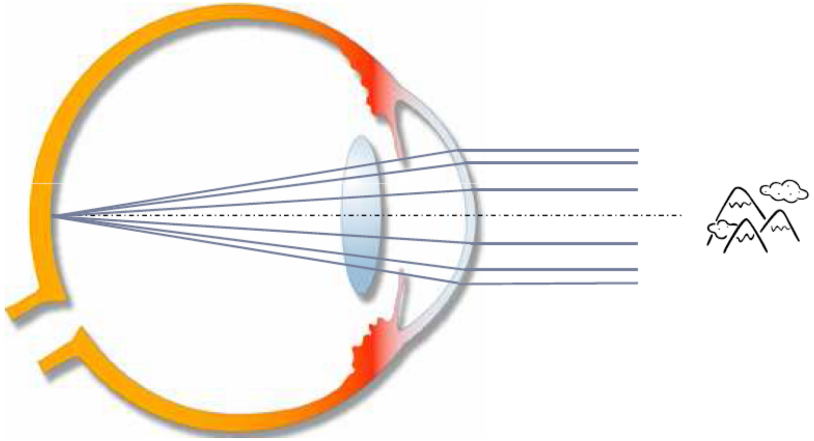
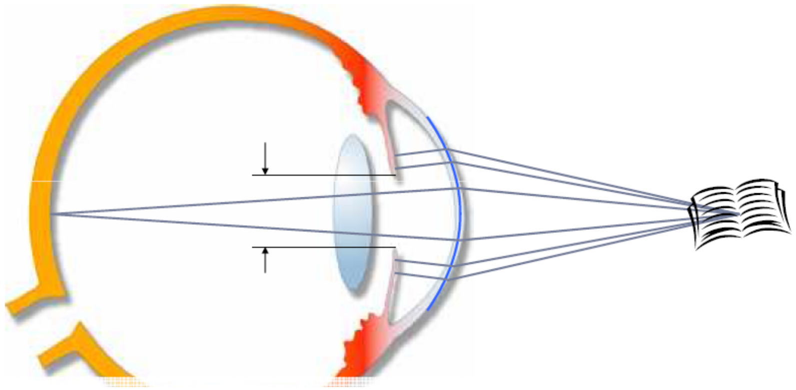
Laser Blended Vision bei Hyperopie bis +2,5D

„Smart“ Monovision

- Dominantes Auge
  - Korrektur auf Emmetropie



- Nicht-Dominantes Auge
  - Monovision mit hyperprolater Cornea (sphärische Aberrationen) Ziel -1,5D
  - Bei Akkommodation: Verbesserung der Schärfentiefe (Pupillenabhängig)



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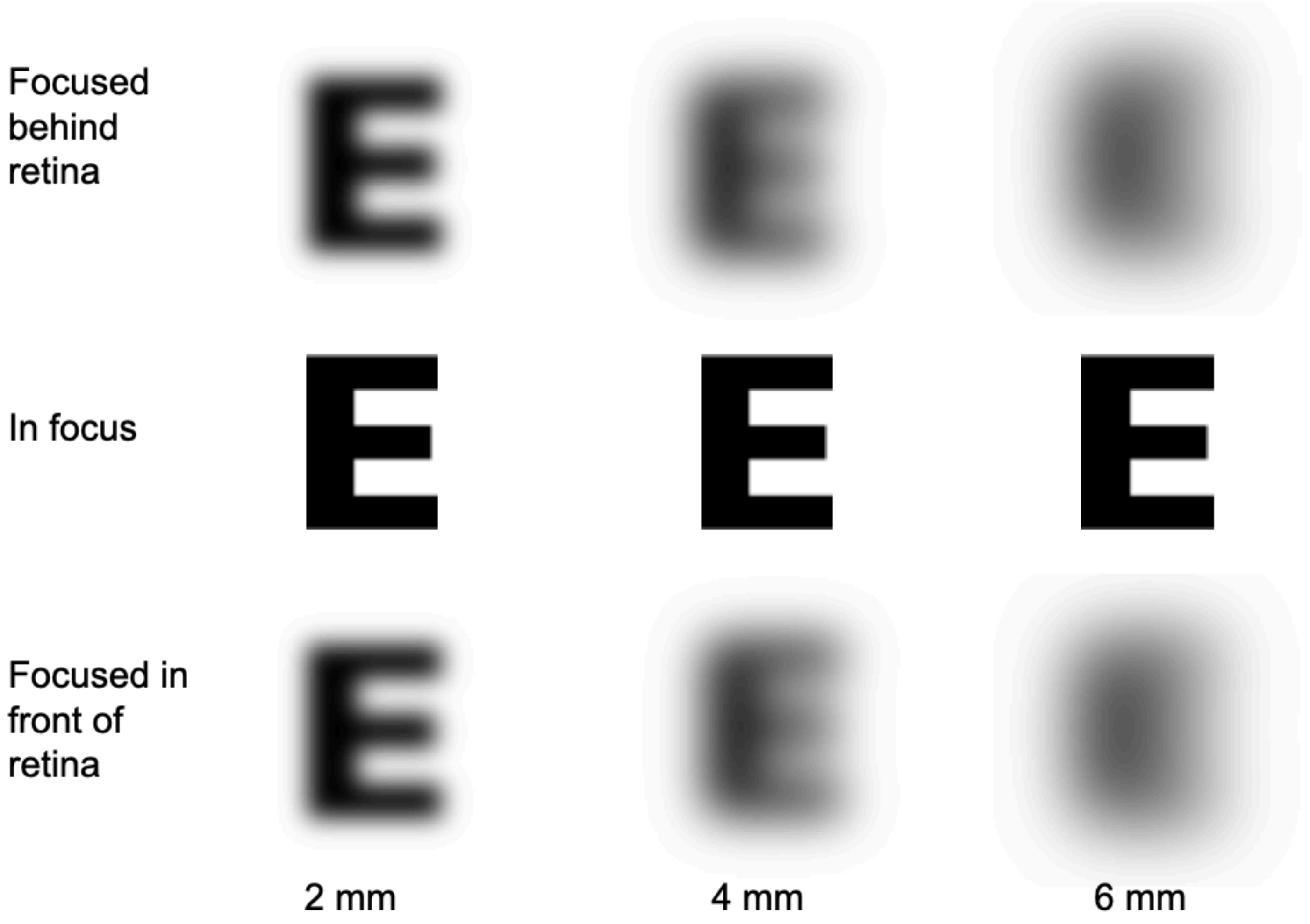
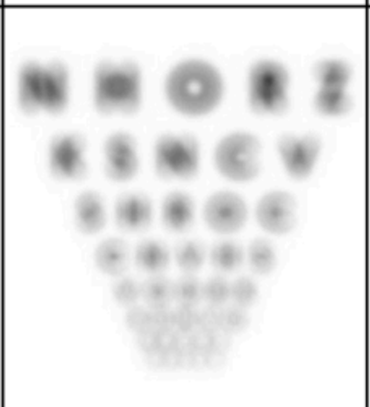
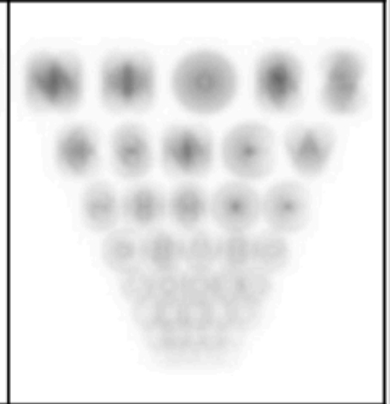
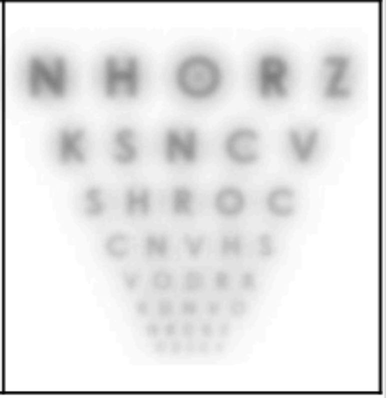
Schärfentiefe als Funktion der Pupillenweite

Quelle: Austin Roorda (vision.berkeley.edu/roordalab)



Sphärische Aberration & Schärfentiefe

Quelle: Hartmut Vogelsang

	0.00 D	-0.50 D	-1.00 D	-1.50 D	-2.00 D
without spherical aberration @ 7 mm					
with spherical aberration @ 7 mm					

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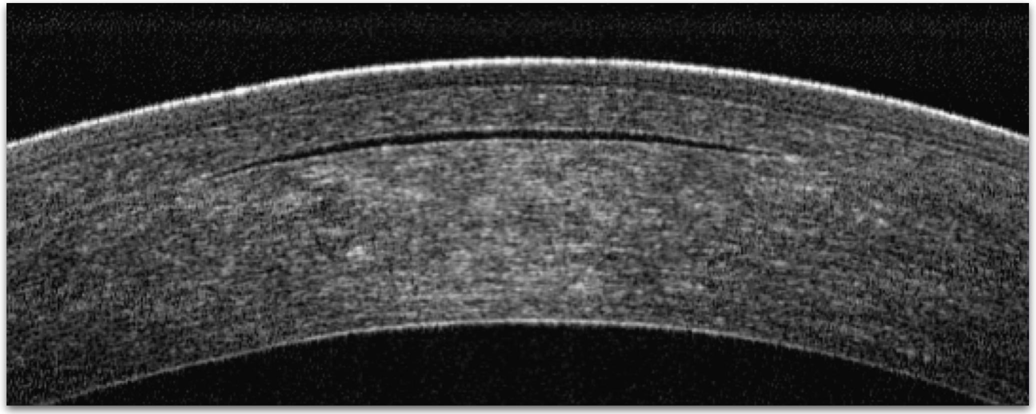
Corneale Inlays

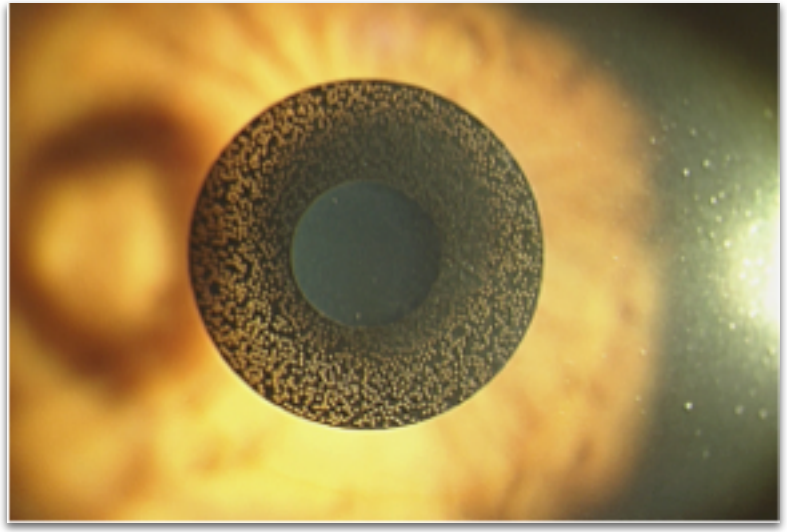
...haben sich nicht durchsetzen können

- Raindrop Near Vision Inlay



Optovue high resolution OCT image

- Kamra Small Aperture Corneal Inlay



Quelle: Draxl et al. JCRS

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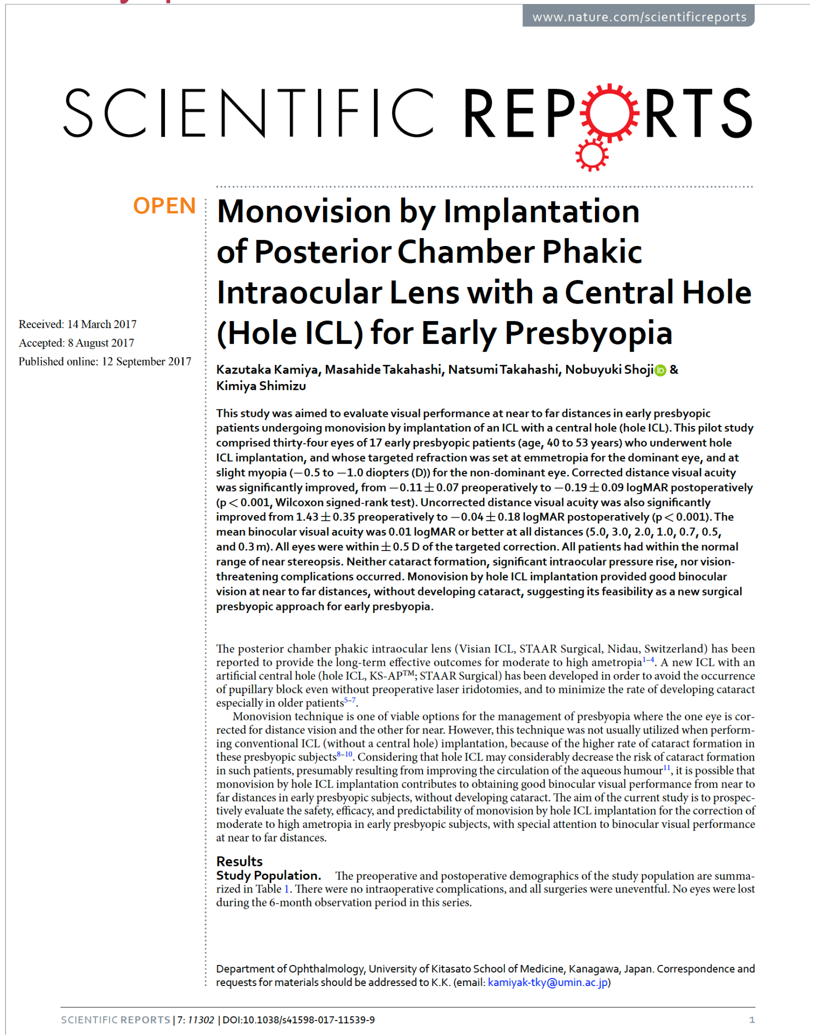
Visian ICL Monovision

Presbyopiekorrektur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SCIENTIFIC REPORTS

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Monovision by Implantation of Posterior Chamber Phakic Intraocular Lens with a Central Hole (Hole ICL) for Early Presbyopia

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Kazutaka Kamiya, Masahide Takahashi, Natsumi Takahashi, Nobuyuki Shoji & Kimiya Shimizu

This study was aimed to evaluate visual performance at near to far distances in early presbyopic patients undergoing monovision by implantation of an ICL with a central hole (hole ICL). This pilot study comprised thirty-four eyes of 17 early presbyopic patients (age, 40 to 53 years) who underwent hole ICL implantation, and whose targeted refraction was set at emmetropia for the dominant eye, and at slight myopia (−0.5 to −1.0 diopters (D)) for the non-dominant eye. Corrected distance visual acuity was significantly improved, from −0.11 ± 0.07 preoperatively to −0.19 ± 0.09 logMAR postoperatively ($p < 0.001$, Wilcoxon signed-rank test). Uncorrected distance visual acuity was also significantly improved from 1.43 ± 0.35 preoperatively to −0.04 ± 0.18 logMAR postoperatively ($p < 0.001$). The mean binocular visual acuity was 0.01 logMAR or better at all distances (5.0, 3.0, 2.0, 1.0, 0.7, 0.5, and 0.3 m). All eyes were within ± 0.5 D of the targeted correction. All patients had within the normal range of near stereopsis. Neither cataract formation, significant intraocular pressure rise, nor vision-threatening complications occurred. Monovision by hole ICL implantation provided good binocular vision at near to far distances, without developing cataract, suggesting its feasibility as a new surgical presbyopic approach for early presbyopia.

The posterior chamber phakic intraocular lens (Visian ICL, STAAR Surgical, Nidau, Switzerland) has been reported to provide the long-term effective outcomes for moderate to high ametropia[1–4]. A new ICL with an artificial central hole (hole ICL, KS-AP™; STAAR Surgical) has been developed in order to avoid the occurrence of pupillary block even without preoperative laser iridotomies, and to minimize the rate of developing cataract especially in older patients[5–7].

Monovision technique is one of viable options for the management of presbyopia where the one eye is corrected for distance vision and the other for near. However, this technique was not usually utilized when performing conventional ICL (without a central hole) implantation, because of the higher rate of cataract formation in these presbyopic subjects[8–10]. Considering that hole ICL may considerably decrease the risk of cataract formation in such patients, presumably resulting from improving the circulation of the aqueous humour[11], it is possible that monovision by hole ICL implantation contributes to obtaining good binocular visual performance from near to far distances in early presbyopic subjects, without developing cataract. The aim of the current study is to prospectively evaluate the safety, efficacy, and predictability of monovision by hole ICL implantation for the correction of moderate to high ametropia in early presbyopic subjects, with special attention to binocular visual performance at near to far distances.

Results

Study Population. The preoperative and postoperative demographics of the study population are summarized in Table 1. There were no intraoperative complications, and all surgeries were uneventful. No eyes were lost during the 6-month observation period in this series.

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Characteristic	Mean ± Standard deviation
Age (years)	46.1 ± 4.2 years (range, 40 to 53 years)
Gender (Male: Female)	8: 9
Manifest spherical equivalent (D)	−8.67 ± 4.35 D (range, −2.25 to −18.25 D)
Manifest cylinder (D)	0.80 ± 0.76 D (range, 0.00 to 3.00 D)
LogMAR UDVA	1.43 ± 0.35 (range, 0.52 to 2.00)
LogMAR CDVA	−0.11 ± 0.07 (range, −0.18 to 0.00)
Targeted refraction in the dominant eye (D)	−0.08 ± 0.09 D (range, −0.25 to −0.00 D)
Targeted refraction in the non-dominant eye (D)	−0.66 ± 0.18 D (range, −0.455 to −1.00 D)
White-to-white distance (mm)	11.7 ± 0.4 mm (range, 11.0 to 12.6 mm)
Anterior chamber depth (mm)	3.14 ± 0.28 mm (range, 2.82 to 3.74 mm)

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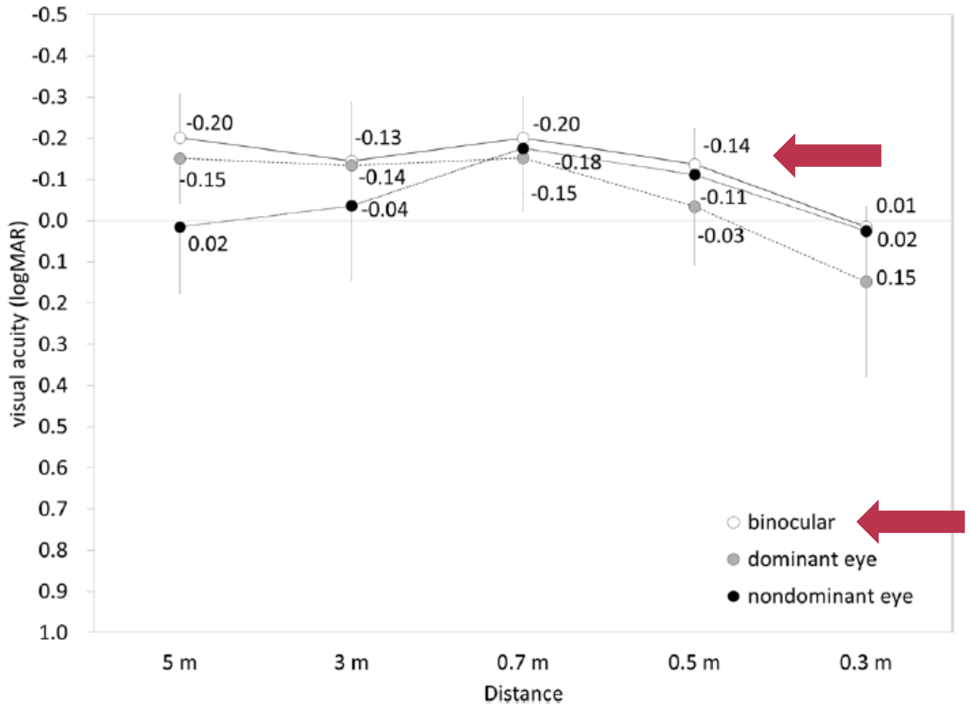
Visian ICL Monovision

Presbyopiekorrektur



Safety Outcomes. CDVA was significantly improved, from −0.11 ± 0.07 preoperatively to −0.19 ± 0.09 logMAR postoperatively ($p < 0.001$, Wilcoxon signed-rank test). Seven eyes (21%) showed no change in CDVA, 17 eyes (50%) gained 1 line, 6 eyes (18%) gained 2 lines, and 4 eyes (12%) lost 1 line, 6 months postoperatively (Fig. 1). Although 4 eyes lost 1 line of CDVA, all these eyes had a CDVA of 20/20 or more.

Efficacy Outcomes at Near to Far Distances. Near monocular and binocular visual acuities (at 0.3 m) when correcting far vision preoperatively were 0.17 ± 0.23 and 0.10 ± 0.19 logMAR, respectively. UDVA was also significantly improved from 1.43 ± 0.35 preoperatively to −0.04 ± 0.18 logMAR postoperatively ($p < 0.001$, Wilcoxon signed-rank test). The cumulative percentages of eyes attaining specified cumulative levels of UDVA and the postoperative binocular uncorrected visual acuity at 5.0, 3.0, 2.0, 1.0, 0.7, 0.5, and 0.3 m distances are shown in Figs 2 and 3, respectively. The mean binocular visual acuity was 0.01 logMAR or better at all distances. Sixteen of 17 patients (94%) had simultaneous binocular acuities of 20/25 or better at far and J2 or better at near.

Predictability. A scatter plot of the attempted versus the achieved correction is shown in Fig. 4. The achieved refraction was −0.08 ± 0.17 diopters (D) in the dominant eye, and −0.65 ± 0.29 D in the non-dominant eye. All eyes were within ± 0.5 D of the targeted correction.

Near Stereopsis, Contrast Sensitivity, and Patient Satisfaction. All patients had within normal range of near stereopsis (40 seconds of arc, 15 eyes, 50 seconds of arc, 1 eye, and 60 seconds of arc, 1 eye) without refractive correction. The postoperative contrast sensitivity was shown in Fig. 5. All eyes had within normal range of contrast sensitivity function. The postoperative satisfaction score was 9.1 ± 0.8 (range: 8 to 10). All patients have satisfied with overall visual performance after hole ICL implantation.

Adverse events. Neither cataract formation, intraocular pressure rise (≥22 mmHg), pigment dispersion glaucoma, pupillary block, nor any other severe complications, occurred in any case during the 6-month follow-up period.

Figure 3. Uncorrected visual acuity at near to far distances after hole implantable collamer lens (hole ICL) implantation.

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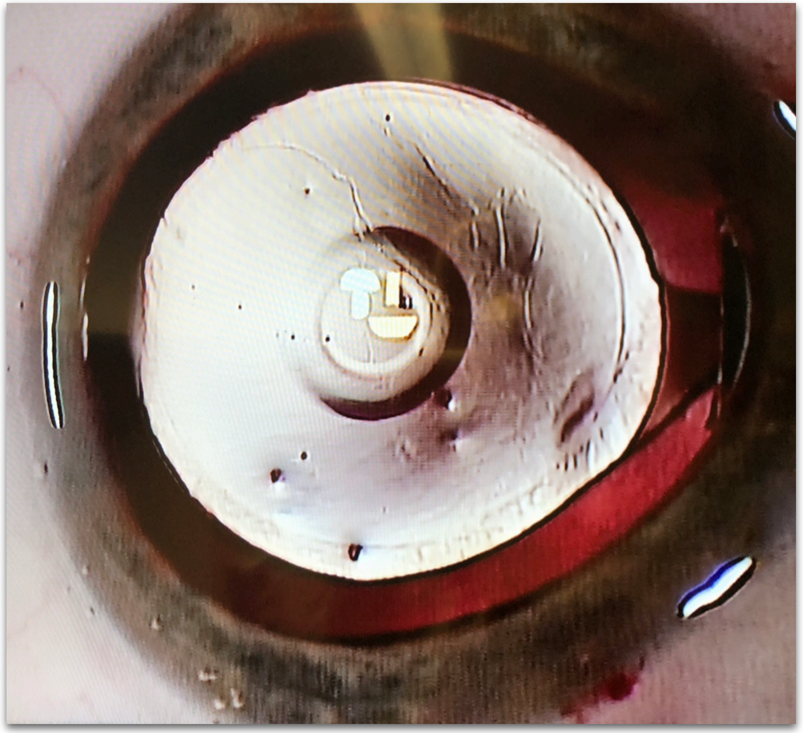
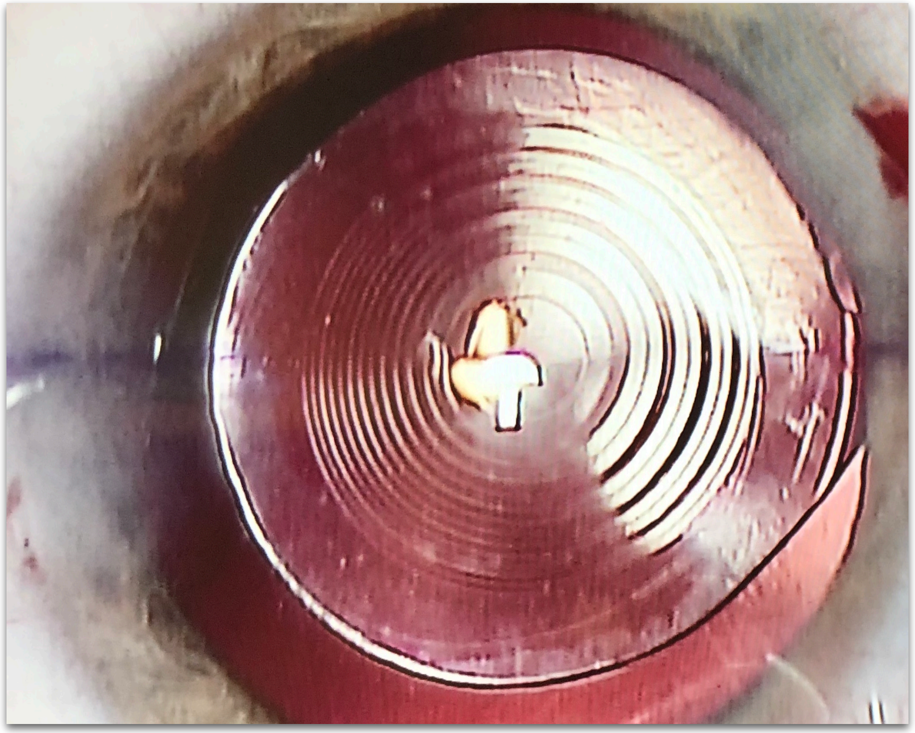
Refraktiver Linsenaustausch

Diffraktive und EDOF HKL und AddOn IOL

- EDOF



- Diffraktiv



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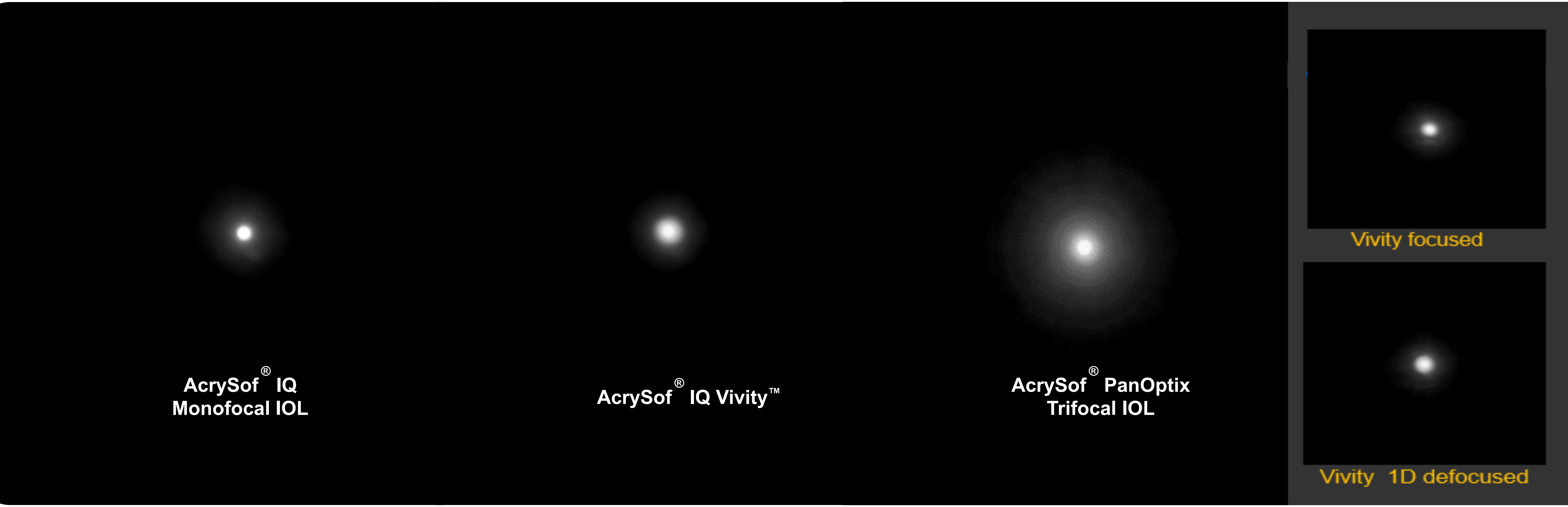
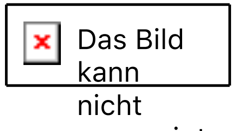
Monofokal | EDOF | Multifokal

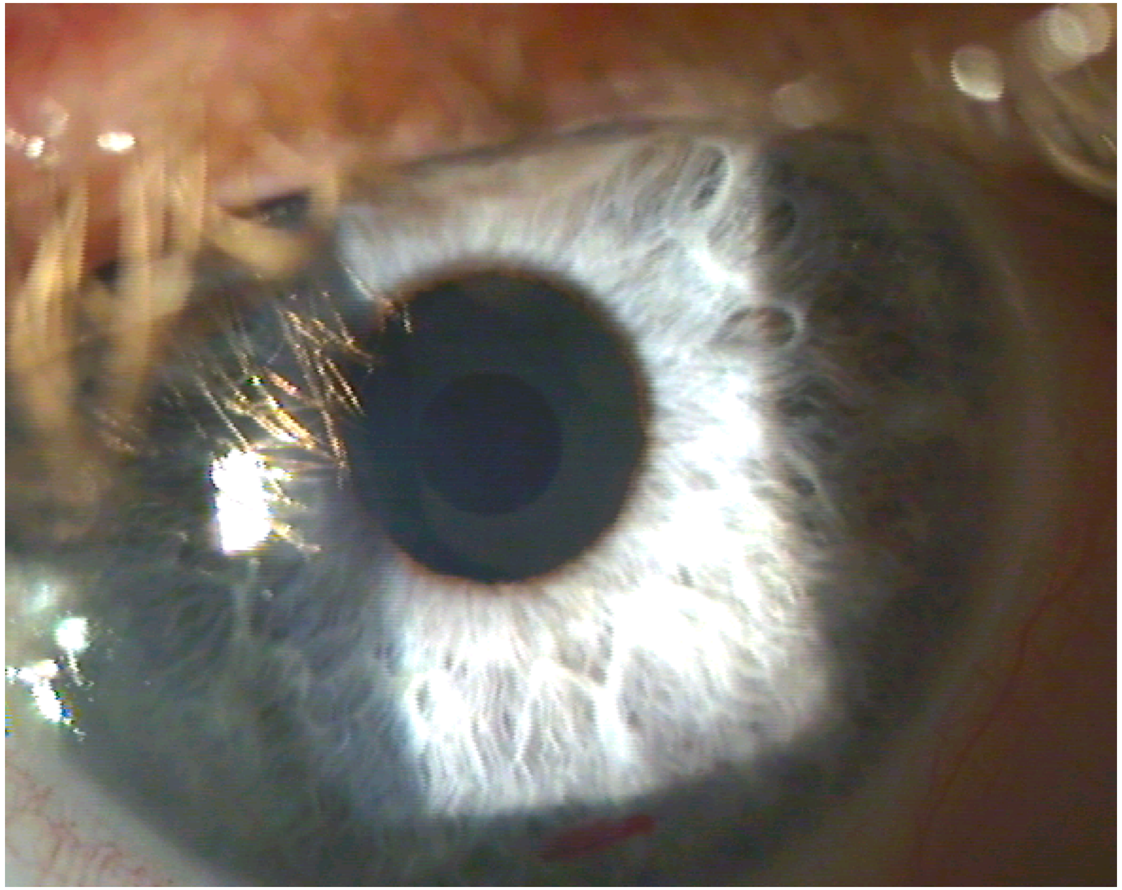
PSF (Quelle Alcon)

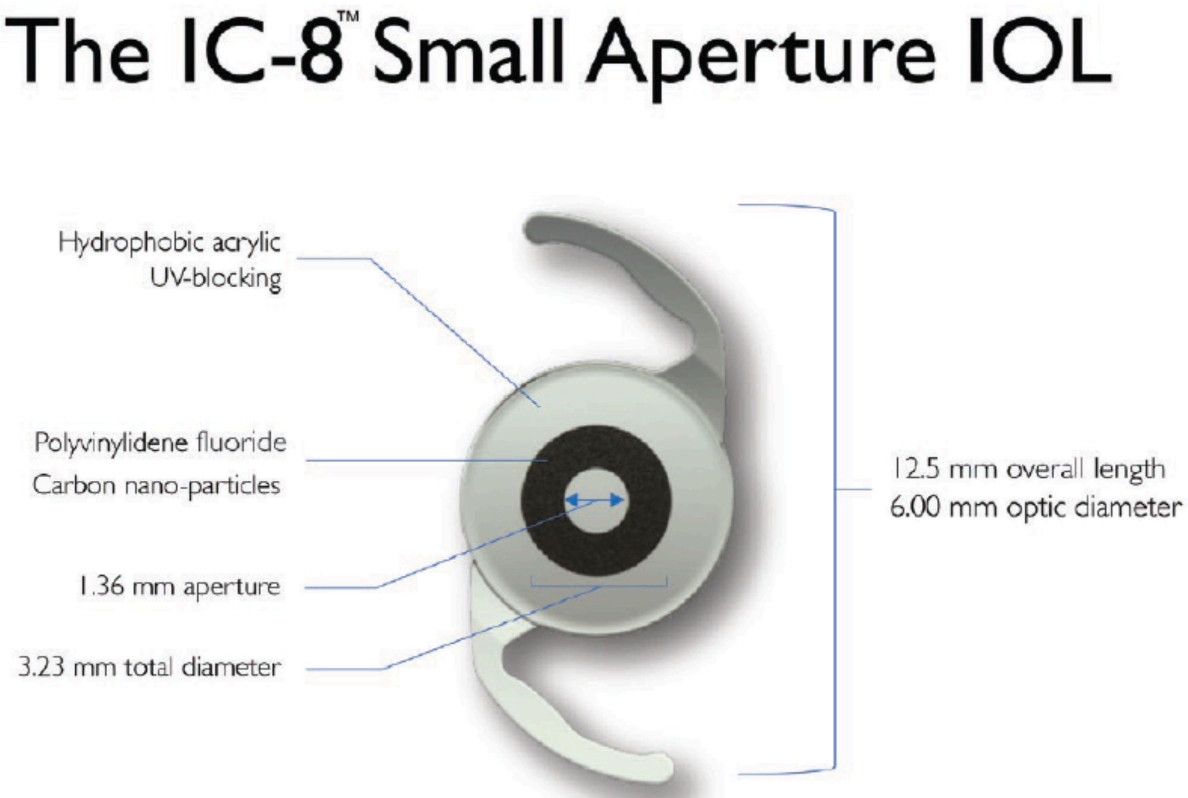




Monovision HKL

Insbesondere bei stark aberrierten Hornhäuten geeignet





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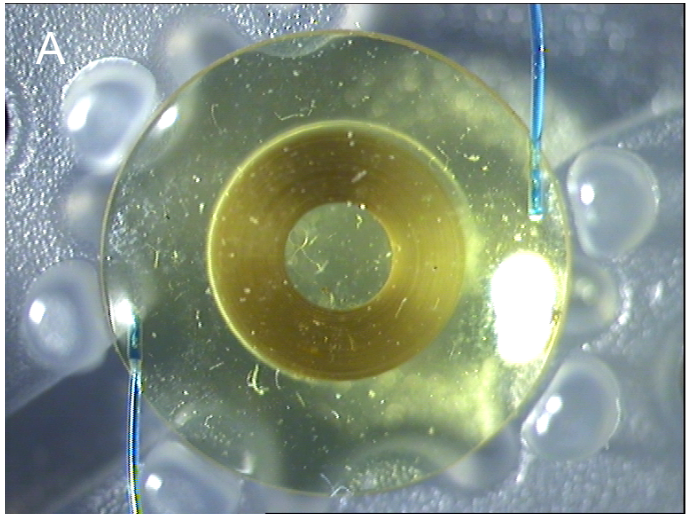
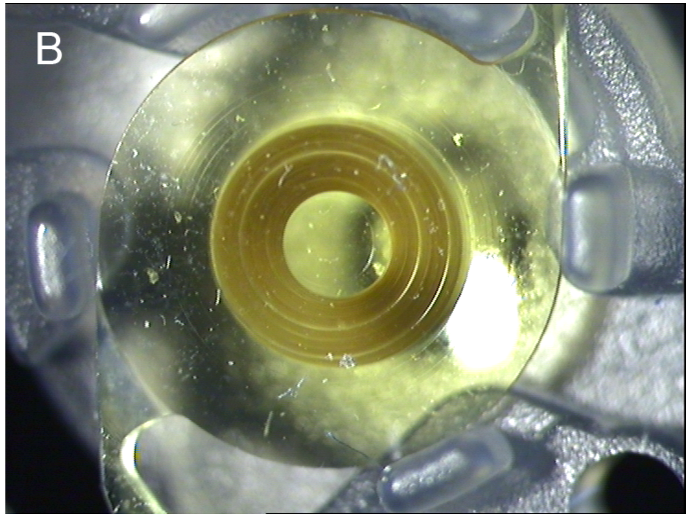
IOL Femto-Masking

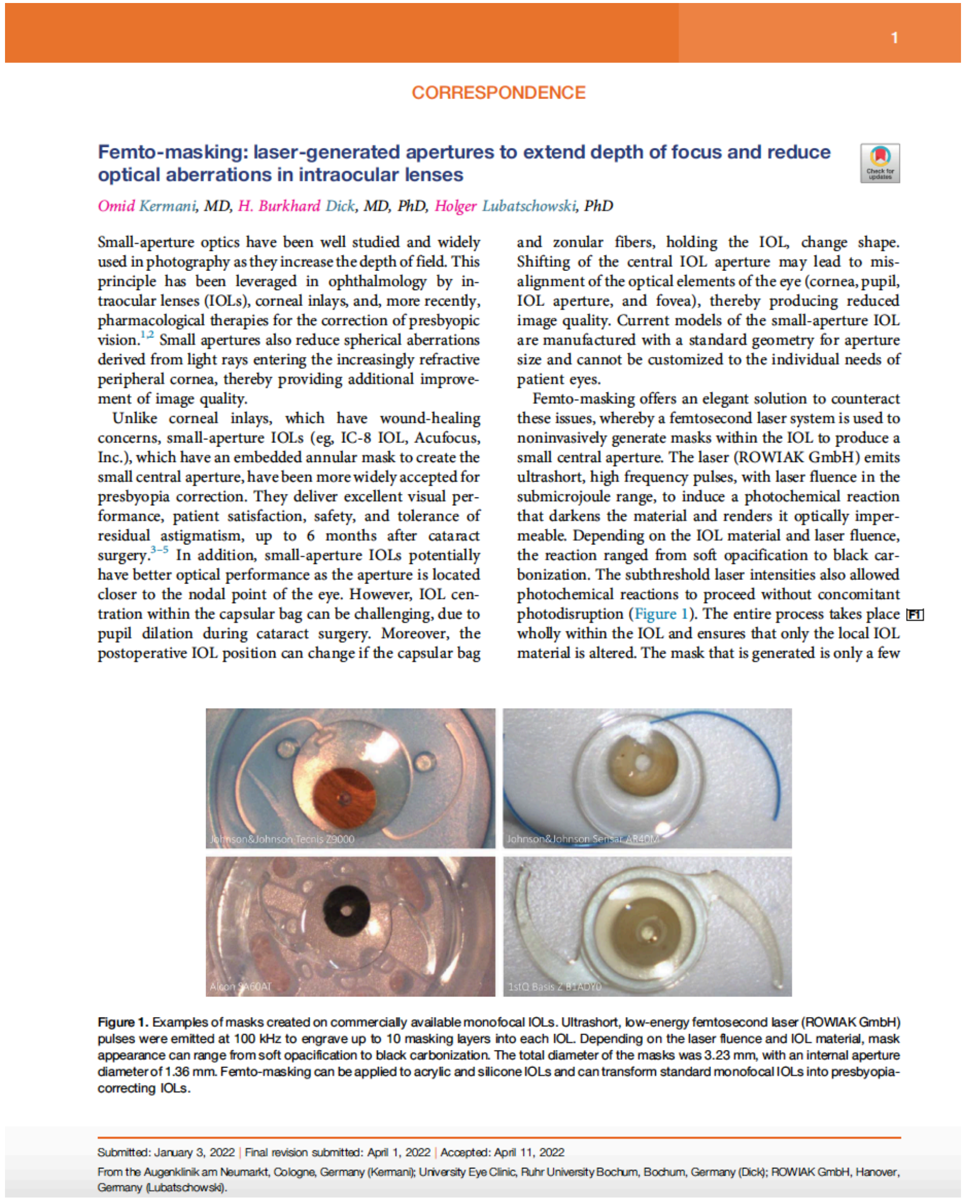
In-Situ Bearbeitung der IOL möglich

Small-Aperture zur Verbesserung der Schärfentiefe

Zur Ausblendung störender photischer Phänomene







CORRESPONDENCE

Femto-masking: laser-generated apertures to extend depth of focus and reduce optical aberrations in intraocular lenses

Omid Kermani, MD, H. Burkhard Dick, MD, PhD, Holger Lubatschowski, PhD

Small-aperture optics have been well studied and widely used in photography as they increase the depth of field. This principle has been leveraged in ophthalmology by intraocular lenses (IOLs), corneal inlays, and, more recently, pharmacological therapies for the correction of presbyopic vision.[1,2] Small apertures also reduce spherical aberrations derived from light rays entering the increasingly refractive peripheral cornea, thereby providing additional improvement of image quality.

Unlike corneal inlays, which have wound-healing concerns, small-aperture IOLs (eg, IC-8 IOL, Acufocus, Inc.), which have an embedded annular mask to create the small central aperture, have been more widely accepted for presbyopia correction. They deliver excellent visual performance, patient satisfaction, safety, and tolerance of residual astigmatism, up to 6 months after cataract surgery.[3–5] In addition, small-aperture IOLs potentially have better optical performance as the aperture is located closer to the nodal point of the eye. However, IOL centration within the capsular bag can be challenging, due to pupil dilation during cataract surgery. Moreover, the postoperative IOL position can change if the capsular bag and zonular fibers, holding the IOL, change shape. Shifting of the central IOL aperture may lead to misalignment of the optical elements of the eye (cornea, pupil, IOL aperture, and fovea), thereby producing reduced image quality. Current models of the small-aperture IOL are manufactured with a standard geometry for aperture size and cannot be customized to the individual needs of patient eyes.

Femto-masking offers an elegant solution to counteract these issues, whereby a femtosecond laser system is used to noninvasively generate masks within the IOL to produce a small central aperture. The laser (ROWIAK GmbH) emits ultrashort, high frequency pulses, with laser fluence in the submicrojoule range, to induce a photochemical reaction that darkens the material and renders it optically impermeable. Depending on the IOL material and laser fluence, the reaction ranged from soft opacification to black carbonization. The subthreshold laser intensities also allowed photochemical reactions to proceed without concomitant photodisruption (Figure 1). The entire process takes place F1 wholly within the IOL and ensures that only the local IOL material is altered. The mask that is generated is only a few

Figure 1. Examples of masks created on commercially available monofocal IOLs. Ultrashort, low-energy femtosecond laser (ROWIAK GmbH) pulses were emitted at 100 kHz to engrave up to 10 masking layers into each IOL. Depending on the laser fluence and IOL material, mask appearance can range from soft opacification to black carbonization. The total diameter of the masks was 3.23 mm, with an internal aperture diameter of 1.36 mm. Femto-masking can be applied to acrylic and silicone IOLs and can transform standard monofocal IOLs into presbyopia-correcting IOLs.

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From the Augenklinik am Neumarkt, Cologne, Germany (Kermani); University Eye Clinic, Ruhr University Bochum, Bochum, Germany (Dick); ROWIAK GmbH, Hanover, Germany (Lubatschowski).

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augenheilkunde
BMZ
A
EG
ZRD

Monovision Zusammenfassung

LVC | Phake IOL | EDOF IOL | MixMatch High & Low Add MF IOL

- Heute meist angewendet als „Blended Vision“ oder Mikro-Monivision
- Vergleichbar effektiv aber es treten seltener Unverträglichkeiten auf
  - LASIK, EDOF IOL, MixMatch High & Low Add MF IOL
  - Corneale Inlays haben sich nicht durchgesetzt

- Am besten geeignet für Patienten mit variablen Sehanforderungen

Safe The Date !

Samstag, 3. Dezember 2022

EUROPEAN PERSPECTIVES
IN OPHTHALMOLOGY