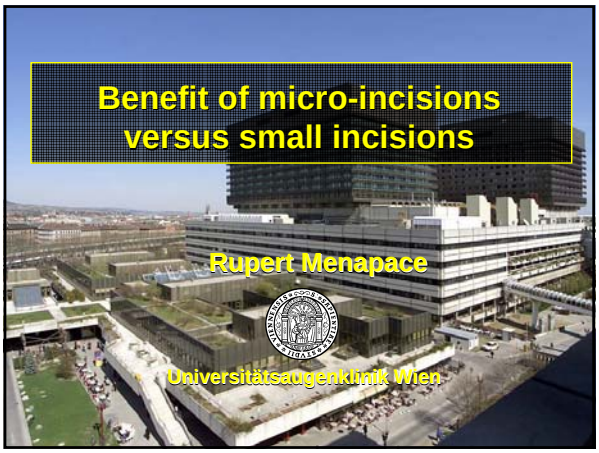
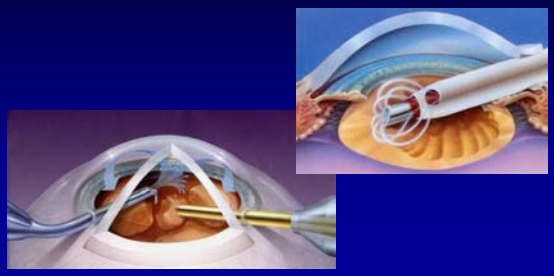


MICS versus SICS
=
„ Bimanual “ versus „ Koaxial “ Phako



What is a „small incision“, and what is a „micro-incision“ ?

- „Small incision“: 3.2 > 2.6mm
  koaxial phako → standard foldable IOL
- „Micro-incision“: 1.6 > 1.4mm (19 > 20 gauge)
  „sleeveless“ bimanual phako → MICS-IOL
  (extension to 2mm+ required)

→ Difference 0.5mm approx.

What must incisions provide?

- Cornea: astigmatic neutrality
- Wound: deformation restistence

Question #1:

Do microincisions provide for greater astigmatic neutrality than small incisions ?

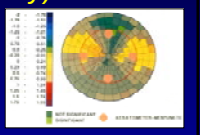
Criteria of judgement:

Change of corneal curvature
- within area of *pupillary zone*
- as evaluated by *topography*

Why
„within pupillary zone“ ?

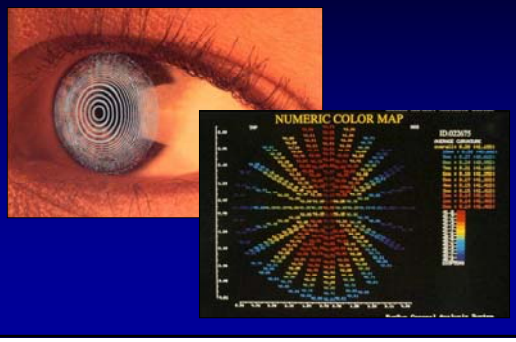
... because
peripheral areas visually *irrelevant*

Why
„as measured by topography“
(instead of keratometry)?

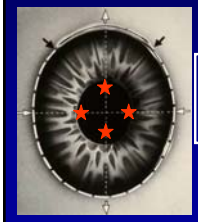


... because
keratometry is based on only
2 pairs of points each 1.5mm apart

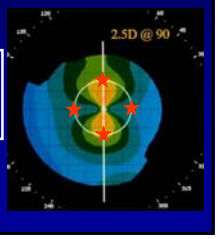
... whereas *topography*
picks up several thousand data points



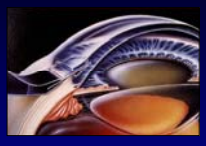
... therefore *keratometry* sufficiently
describes corneal shape changes
with *large* incisions



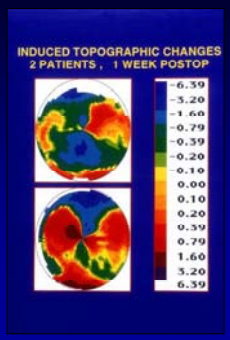
deformation
- pronounced
- symmetric
- orthogonal



... while *topography* is required
for *micro*-incisions:

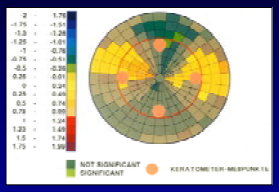


deformation
- minor or minimal
- variable
- asymmetric



How can corneal shape changes
typical for a given incision
be adequately descibed?

Evaluation of *collectives* using *statistical algorhythms*

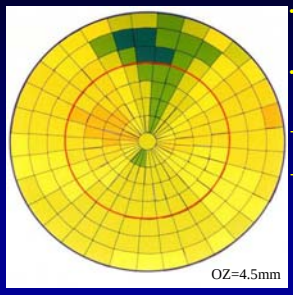


for *large* incisions:
Keratometry → *Vectoranalysis*

for *small* & *micro*-incisions
Topography → *„Batchanalysis“*

Vass C, Menapace R. Computerized statistical analysis of corneal topography for the evaluation of changes in corneal shape after surgery. Am J Ophthalmol 1994; 118: 177-184

Batchanalysis of Topographies



OZ=4.5mm

- The visual relevant 4.5mm zone is devided into 225 concentric fields covering 30 measuring points each
- The topographic data of 30 eyes with the same type of incision are acquired and processed

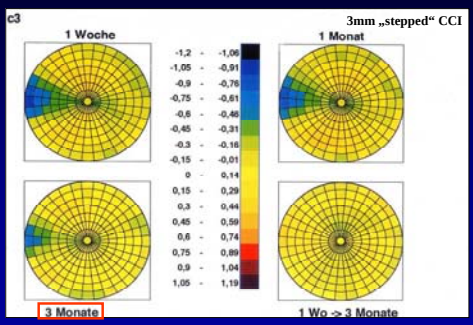
→ Means & SDs are calculated and depicted color-coded

→ Statistical significance of changes is calculated (WILCOXON-Test) & graphically highlighted

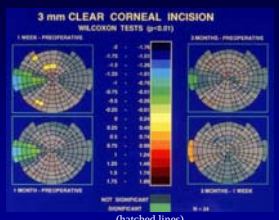
culculations made for all current incision constructions & sizes

Vass C, Menapace R. Computerized statistical analysis of corneal topography for the evaluation of changes in corneal shape after surgery. Am J Ophthalmol 1994; 118: 177-184

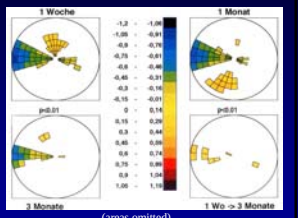
Time course & „Difference Mapping“



Judgement of significance of changes
(Wilcoxon-Test, preset level of significance)



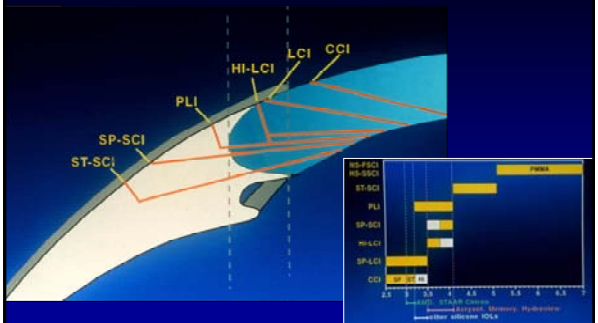
(hatched lines)



(areas omitted)

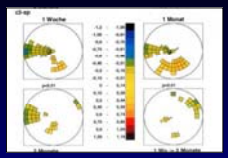
Vass C, Menapace R, Rainer G, Schulz H. Improved algorithm for statistical batch-by-batch analysis of corneal topographic data. J Cataract Refract Surg 1997; 23: 903-912

Systematic of incisions according to type & width

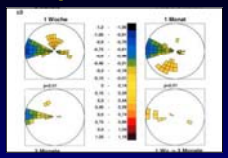


Menapace R. Aktuelle Wundkonstruktionen: Indikation, Technik, Deformationsresistenz, & Hornhautkurvaturveränderung. Proceedings 10. Kongress DGII 1997, Springer, S 27-40 .

1. *Precut & its depth*

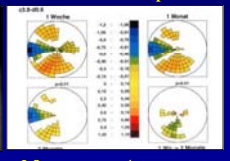


no precut



0.3 mm precut

precut → stability

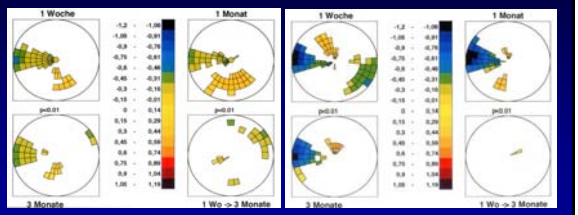


0.8 mm precut (Langerman)

Vass C, Menapace R, Rainer G, et al. Comparative study of corneal topographic changes after 3.0 mm beveled and hinged clear corneal incisions. J Cataract Refract Surg 1998; 24:1498-1504

2. *Axis* of incision

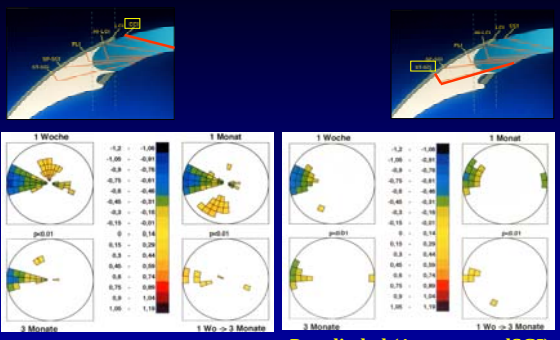
(3mm single-plain CCI)



temporal ***superotemporal (oblique)***

Rainer G, Menapace R, Vass C, et al. Corneal shape changes after temporal and superolateral 3.0 mm CCIs. J Cataract Refract Surg 1999; 25:1121-1126

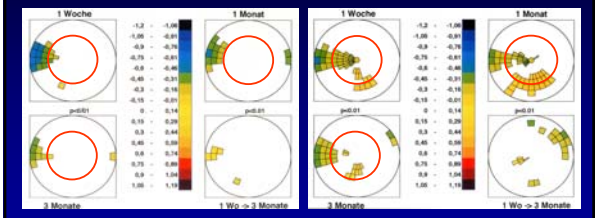
3. *Relation* of tunnel entry *to limbus*



***Pre*limbal (3mm steppedCCI)** ***Retro*limbal (4mm steppedSCI)**

CCI ... Clear corneal incision, SCI ... sclerocorneal incision

„Key finding“: *Sclero*corneal incisions up to a width of *4mm* are astigmatically *neutral* within the visually relevant 3mm zone



4mm SCI as opposed to 3mm CCI …

Rainer G, Menapace R, Vass C, et al. Surgically induced astigmatism following a 4.0 mm sclerocorneal valve incision. J Cataract Refract Surg 1997; 23:358-364

Conclusion #1:

Are microincisions *„astigmatically more neutral“* compared to (adequately designed) small incisions ?

NO !

Question #2:

Do microincisions provide for greater deformation resistence than small incisions ?

Importance of deformation stability

peristent/intermittent wound reopening by eye rubbing
→ iris prolapse → bacteria inoculation

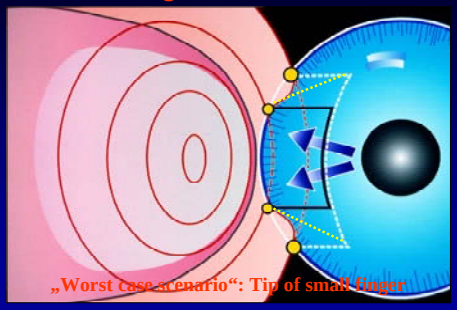
Menapace R. Delayed iris prolapse with unsutured 5.1 mm CCI. J Cataract Refract Surg 1995; 21:353-357

How to measure deformation resistence?

indentation of wound base → iris prolapse

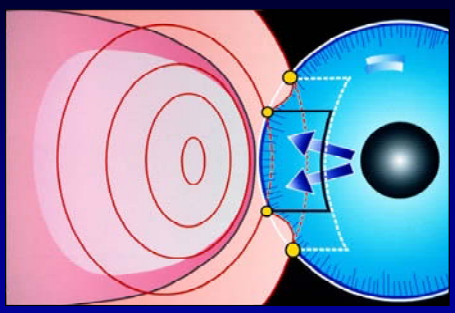
Ernest PH, Lavery KT, Kiessling LA. Relative strength of scleral corneal and clear corneal incisions constructed in cadaver eyes. J Cataract Refract Surg 1994; 20: 626-629: 1mm pinpoint indentation

Clinically relevant deformation resistance: Resistance to *digital* indentation/massage

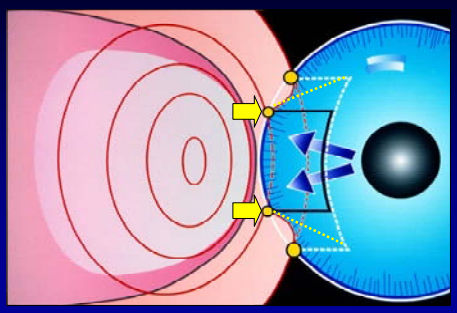


Menapace R. Aktuelle Wundkonstruktionen: Indikation, Technik, Deformationsresistenz, & Hornhautkurvaturveränderung. Proceedings 10. Kongress DGII 1997, Springer, S 27-40 .

How to increase/optimize deformation resistence?

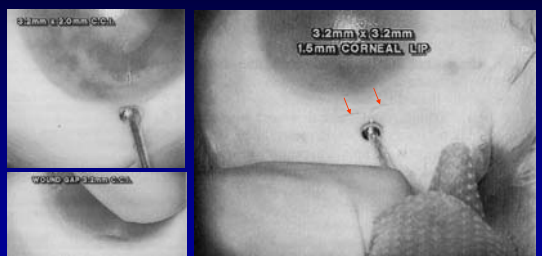


1. Approximating of *external* corner points



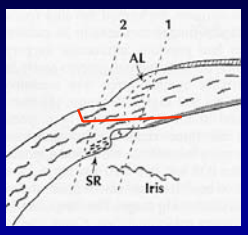
Menapace R. Aktuelle Wundkonstruktionen: Indikation, Technik, Deformationsresistenz, & Hornhautkurvaturveränderung. Proceedings 10. Kongress DGII 1997, Springer, S 27-40 .

2. Encorporating *limbal* area …



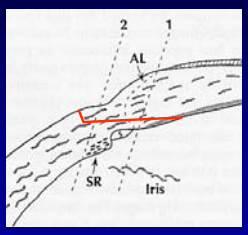
Ernest PH, Lavery KT, Kiessling LA. Relative strength of scleral corneal and clear corneal incisions constructed in cadaver eyes. J Cataract Refract Surg 1994; 20: 626-629

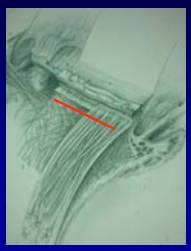
… encorporating stretchable tissue allows for extension of proximal wound canal during lens implantation



Komai Y, Ushiki T. The three-dimensional organization of collagen fibrils in the human cornea and sclera. Invest Ophthalmol Vis Sci 1991; 32:2244-2258

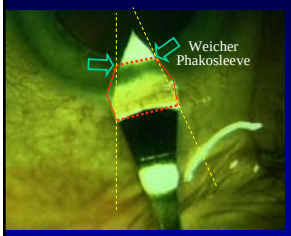
… encorporating vascularized tissue
allows for fast & permanent healing of incision

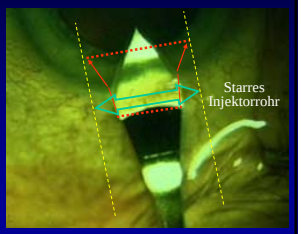




Komai Y, Ushiki T. The three-dimensional organization of collagen fibrils in the human cornea and sclera. Invest Ophthalmol Vis Sci 1991; 32:2244-2258

→Optimal incision architechture:
Limbocorneal incision with the corneal section secondarily widened for lens implantation





1. Phako/I&A:
stress-free tilting

2. IOL-implantation:
available tunnel width

Conclusion #2:

Do microincisions provide for
greater deformation resistence
as compared to
(adequately designed) small incisions
?

Answer: Theoretically yes, but:
With proper design 4mm incision provides for adequate resistence against digital indentation
➔ Advantage clinically irrelevant

Advantages of MICS over SICS:

>4mm retrolimbal small incision

- astigmatically neutral
- sufficiently resistent against finger tip indentation
- allows for atraumatic forceps or injector implantation of all current foldable IOLs

Microincisions:
What do we *win* ?

no practically relevant advantages
with regard to
astigmatic neutrality
or
deformation stability

2. Advantages/Disadvantages of „bimanual Phako“ & IOL-implantation through microincisions?

What we do not want to *loose* :

Phako:

optimum efficiency & safety

- High flow → followability
- High vacuum → holdability

} Efficacy

„power coupling“

- Sufficient inflow → „rock solid“ chamber

} Safety

What we do not want to *loose* :

IOLs:

- atraumatic implantation
  - for wound
  - for IOL
- optimal optic quality
- optimal capsular bag performance
  - stable fixation
  - low after-cataract rate

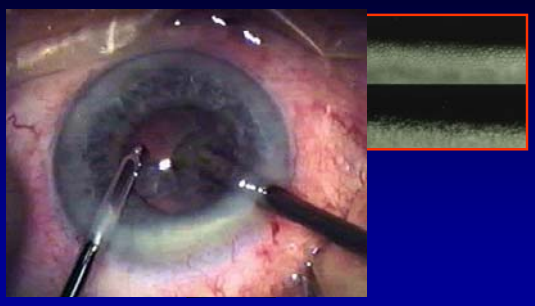
MICS: What it must provide for :

„Tight incisions“
=
intraoperatively non-leaking
&
postoperatively self-sealing

MICS: 1. Phako

- Bimanual phako through 2 paracentesis openings
- IOLs for injection through 2 mm incision

Bimanuelle Phako with *narrow* wound: wound stress → stress folds

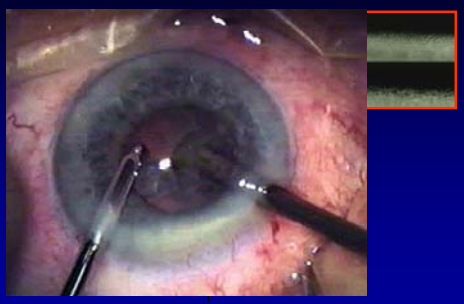


→ 1. intraop visualization, endothel integrity?

Wound stress→over-extension

→ 2. postop wound leakage, iris apposition

Bimanuel Phako with *wider* wound: Outflow
→increased turn-over of fluid, turbulences



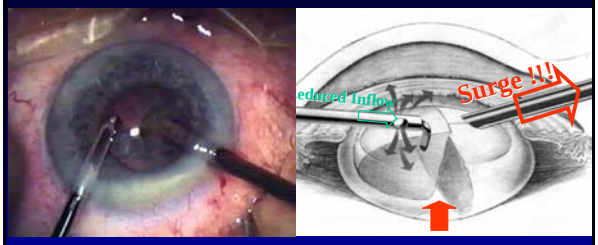
→ endothelial damage by particle bombardement

Bimanual Phaco technique requires *tilting of instruments*

→ with tight-fit wound:
increased wound stress
→ visibility, endothelial loss, postop leak

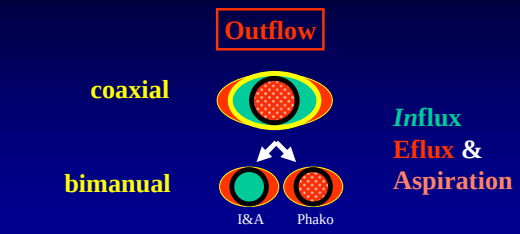
→ with larger wound:
varying outflow, & thus
varying chamber depth
→ imminent collapse

Bimanual phaco requires high vacuum but: limited inflow and significant leak



→ „surge“ → instable chamber:
→ jeopardizes endothelium & capsule

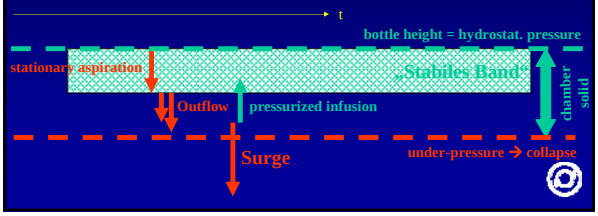
Inherent shortcoming of bimanual Phako = sleeveless Phako:



→ imbalance Inflow : Outflow

„Band of Stability“

Band between
static pressure without aspiration and
the pressure under stationary, unoccluded conditions
(the smaller the BoS, the greater the risk of collaps)

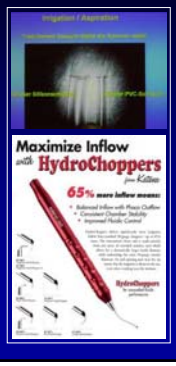


Manace of *unforseen* chamber collapse due to

→ surge following loss of vacuum

→ limited inflow, and significant
& varying outflow
→ Band of Stability narrow
& variable in width!

Limited inflow indespite of …



"pressurized infusion"

- pump reaction time (lag)
- tubing compliance

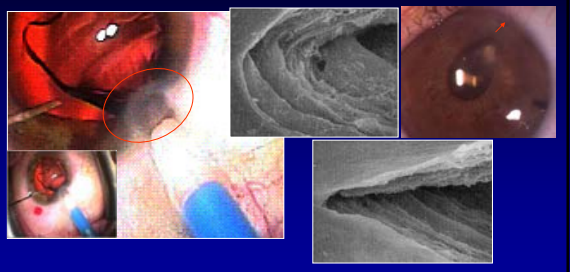
MICS: 2. IOLs

- Bimanual phako through 2 parazentesis openings
- IOLs for injection through 2 mm incisions

MICS-IOL = Ultrathin plate designs:
→deformation by capsular shrinkage
→increased after-cataract rates

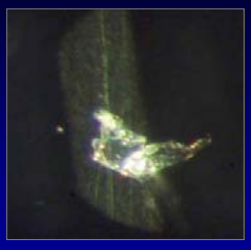
Kaya V, Sivrikaya H, Kayaarasi Z, et al. ThinoptiX vs Acrysof: A prospective randomized paired comparison. J Cataract Refract Surg (submitted)

Over-extension of corneal incision
→ compromized self-sealing properties



Radner W, Menapace R, Zehetmayer M, et al. Ultrastructure of clear corneal incisions. Part II Corneal trauma after lens implantation with the Microstaar injector system. J Cataract Refract Surg 1998; 24:493-497

Mini-cartridges
→ abrasion of lens a/o cartridge material



Alcon SA60AT / Monarch II

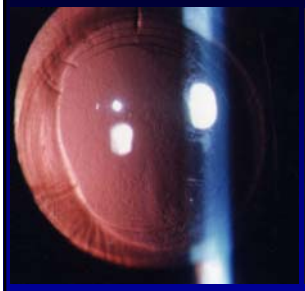
Stepped Optic

- bothering light reflexes & prismatic color rings
- intensity & color dependent upon
  - angle of infalling light
  - angle of light bending
  - source of illumination
  - IOL-position within capsular bag
  - pupil diameter

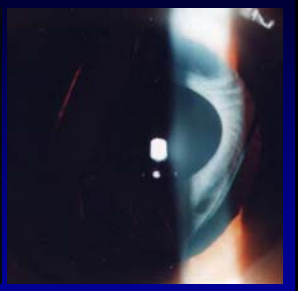
Source: J Novák, DGII 2004

Plate design …

… with ultra-thin flanges



Regeneratory after-cataract (6 mo)



Fibrotic deformation
(inferior haptic fold-over)

MICS – Pros & Cons

Wound size MICS 2mm+ versus SICS 2.5mm

***Advantage* of increased corneal and wound stability**
theoretical – but clinically irrelevant

Disadvantages*, however, *clinically relevant:

- increased wound stress
- reduced phako efficiency
- increased risk for endothelium and capsule
- risk of IOL-damage and deformation
- Disturbing optical phenomena
- increased after-cataract rate

Kaya V, Sivrikaya H, Kayaarasi Z, et al. ThinoptiX vs Acrysof: A prospective randomized paired comparison. J Cataract Refract Surg (submitted)

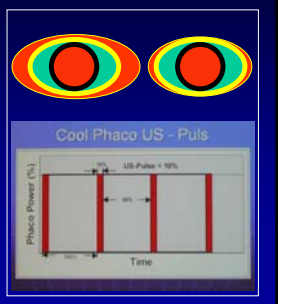
Does this mean that „Cool Phaco“-Technology is useless?

Does this mean that „Cool Phaco“-Technology is useless?

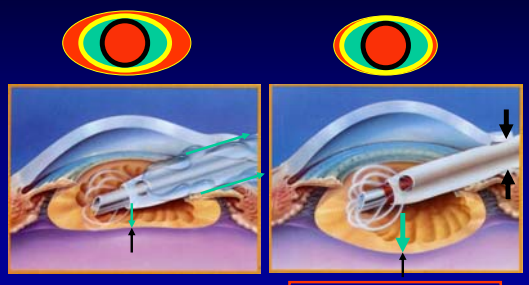
Definitely no

1. **„Cool Phaco“ *enhances* performance of „*Coaxial* Phaco“ → „*Tight-fit* Phako“!**
2. Potential of „Bimanual Phako“ not yet fully exploited, & thus unclear

No burn phaco allows for „tight-fit“ = „no-leak“ incision



„No-leak“ incision allows for „high-flow high-vacuum“ coaxial Phako



Efficacy & Safety

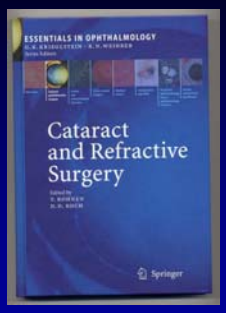
Modern lens systems allow for implantation through 2.5mm inzision

„time-tested“ IOL
(design & material)

- looped haptic
- optic
  - resistent to deformation
  - continuous circular sharp posterior optic edge

Sacu S, Menapace R, Findl O, et al. Long-term efficacy of adding a sharp posterior optic edge to a 3-piece silicone IOL on capsule opacification. 5-year results of a randomized study. Am J Opthalmol, in press

Standards of after-cataract performance



Menapace R. Prevention of PCO. In: T Kohnen, DD Koch (eds) Cataract and Refractive Surgery Essentials of Ophthalmology. Springer Berlin-Heidelberg-New York, 2004, pp 101-122

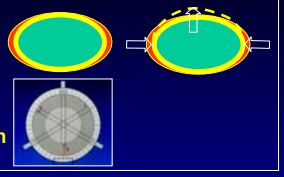
Does this mean that „Bimanual Phaco“ is useless?

???, depends on potential of future develops

1. „Cool Phaco“ enhances performance of „koaxial Phaco“! → „tight-fit Phaco“!
2. Potential for *technical improvements* not yet fully exploited - & thus unclear …

Technical improvements, e.g.:

- Tight-fit instruments: *oval(oid)* diameter
- *2nd* infusion (3-port) & *pressurized* infusion



- *tubings*: - inner resistence
  - compliance
  - air/gas content
- pump systems: sensors & venting
- Surge-control *handpieces*:
  - tip design
  - microsensors

Conclusion

Bimanual Phaco *today*: Ready for *Routine* use? No (or at least: not yet) !

Special indications ? – Yes:

- zonular coloboma (Marfan-Syndrom)
- zonular dialysis
- subluxated lens
- soft cataract
- esp. With small pupil

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Future of *Bimanual* Phako?

ICCE
→ ECCE
→ Coax Phako …
→ *biman* Phako/Laser

… the way it will be ?

???, Time will tell …