

**CLEAR LENS EXTRACTION FOR
SURGICAL MANAGEMENT OF
REFRACTIVE ERRORS**

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**REFRACTIVE LENS
EXCHANGE**

**PEARLS OF
SUCCESS**

CLE

DEF:

Removal of a non cataractous natural lens as a refractive procedure.

HISTOREY:

MORE THAN 100 ys.

Frequency:

1% of refractive procedures

CLE

OTHER NAMES

REF. LENSECTOMY:

WITHOUT IOL

REF. LENS EXCHANGE (RLE)

WITH IOL

PRESBYOPIA LENS EXCHANGE

PRELEX

LENS BASED REFRACTIVE SURGERY COMPARED TO LASIK AND PRK

Basic needs for refractive surgery are:

Accuracy:

- SD of less than 0.25D is wanted giving 20/25 UCDVA in 95% of patients.

Stability:

- most stable +/- 0.02D per Year over 9-year f/u.

Quality:

- Unop. Cornea is optically superior to operated one

Safety:

- fear of RD, ENDOPHTHALMITIS, CME
VS
FLAP LOSS, CORNEAL SCARRING needing PKP

Modern indications for refractive lens exchange with a balanced risk/benefit ratio

RLE

- ⦿ a predictable refractive procedure with rapid recovery,
- ⦿ addresses all types of refractive errors, including presbyopia,
- ⦿ Patients will never develop cataracts.

LENS BASED SURGERY COMPARED TO PHAKIC IOLS & CORNEAL SURGERY

- TECHNIQUE FAMILIARITY
- COMPLICATIONS
- CONSENT
- COST

INDICATIONS

- Patients with LASIK limitations (thin corneas, large pupils, dry eyes, etc...)
- Patient preference (Good LASIK candidates!)



INDICATIONS

○ RLE

- Moderate to high Myopia
- HYPEROPIA
- ASTIGMATISM

○ PRESBYOPIA .



○ ICL

- Spherical ICL:
 - • Myopia from -0.5D to -20.0D •
 - Hyperopia from +0.5D to +8.0D
- Toric ICL:
 - • Myopic, Hyperopic, Mixed, & Pure Astigmatism (Cylinder 0.5D - 6.0D)

INDICATIONS

- **After corneal refractive surgery:**
LASIK, PRK, etc..
- **Stable KC,**
forme-fruste, suspicious corneas .
- **Post Corneal Grafts:**
KP, DLKP, etc..
- **Post ICRs:**
Intacs,... Post Cross-Linking
- **Pediatric**
anisometropic amblyopia

COMPLICATIONS

ICL

- ⦿ Intra-ocular surgery complications
- ⦿ **early post-op:**
- ⦿ Pupillary block
- ⦿ Toric ICL misalignment
- ⦿ Oversizing / Undersizing

- ⦿ **LATE**

LENS OPACITIES

PIGMENT DISPERSION GLAUCOMA

RLE

Intra-ocular

LATE POST OP

- ⦿ PCO
- ⦿ RD
- ⦿ CME
- ⦿ CHOROIDAL EFFUSION

PEARL

The ideal technical elements of a successful RLE surgery

- ⦿ Anatomically minimally invasive surgery with minimal trauma to the corneal endothelium, iris, and other ocular tissues.
- ⦿ A secure, watertight 2.2 mm (or less) micro incision in clear cornea, optimally 1.0 mm from the limbus, situated at the steepest corneal meridian in order to minimize surgically induced astigmatism or to reduce pre-existing corneal astigmatism.
- ⦿ Fixation of an appropriate PC-IOL in the capsular bag with low induction of posterior capsular opacification (PCO).

PEARL

The ideal technical elements of a successful RLE surgery

- Some special considerations
- In eyes with high axial myopia, depth and stability of the anterior chamber are abnormal, which necessitates the use of dispersive (heavy) viscoelastic material.
- In eyes with excessive axial length, the risk of perforation during retrobulbar injections is high.
- In short, hyperopic eyes, an increased risk of choroidal effusion and macular edema should be considered.

Patient Selection

How motivated is the patient to be spectacle free?

Topography: Regular cornea (cylinder <-0.75D)

Personality, needs, expectations and life style

Repeated meticulous biometry

Dry eye disease.

Large Angle Kappa (>0.5 mm) may increase photic symptoms.

Normal pupil, clear cornea, no subluxation/PXF, No retinal pathology.

]-[8]

Criteria for IOL calculation formula selection depending on axial length of the eye

Criteria	Axial length < 22.0 mm	Axial length 22.0 mm	Axial length 24.5 mm	Axial length > 26.0 mm
1 st choice formula	HOFFER-Q, HAIGIS	SRK-T, HAIGIS	SRK-T, HAIGIS	SRK-T, HAIGIS
2 nd choice formula	HOLLADAY II	HOLLADAY	HOLLADAY	---

RLE FOR HYPEROPIA

- Small, hyperopic eyes with shallow anterior chambers are more predisposed to closed-angle glaucoma.
- In several studies satisfactory refractive results were reported in the treatment of hyperopia with RLE.

Kolahdouz- Isfahani AH, Rostamian K, Wallace D, Salz JJ: CLE with IOL implantation for hyperopia. J Refract Surg. 1999, 15: 316-323.

Siganos DS, Pallikaris IG: Clear lensectomy and ocular lens implantation for hyperopia from +7 to +14 diopters. J Refract Surg. 1998, 14: 105-113.

RLE FOR HYPEROPIA

- ◉ Comparing the magnitude of wavefront aberrations in eyes after hyperopic LASIK and RLE
- ◉ RLE
 - much safer and a better refractive procedure for minimizing total higher order optical aberrations which occur after hyperopic refractive surgery.
- ◉ Ruiz-Moreno JM, Alio JL, Shabayek MH: Complications of refractive lens exchange. Management of Complications in Refractive Surgery. Edited by: Alio JL, Azar DT. 2008, Springer-Verlag, Berlin Heidelberg, 266-269. 1

RLE FOR HYPEROPIA VS PHAKIC IOLS

- ◉ A study compared RLE with pseudophakic IOL implant and phakic Artisan iris-claw IOL in the treatment of hyperopia.
- ◉ At 1 month postoperatively, the uncorrected visual acuity (UCVA) of the RLE group was slightly better than the Artisan

Pop M, Payette Y: Refractive lens exchange versus iris-claw Artisan phakic intraocular lens for hyperopia. J Refract Surg. 2004, 20: 20-24 postoperatively.

RLE FOR HYPEROPIA

RLE can be used to treat

- hyperopia in extremely short, nano-phthalmonic eyes
- eyes of patients who underwent laser refractive surgery and require correction of remaining hyperopia.

Alfonso JF, Fernández-Vega L, Baamonde B, Madrid-Costa D, Montés-Micó R: Refractive lens exchange with spherical diffractive intraocular lens implantation after hyperopic laser in situ keratomileusis. J Cataract Refract Surg. 2009, 35: 1744-1750. 10.1016/j.jcrs.2009.04.045.

PEARL

- THE GLAUCOMA FACTOR
- In angle closure glaucoma, clear lens extraction represents an etiological treatment that takes into account the role of the lens in the pathogenesis of the disease:

[The role of clear lens extraction in angle closure glaucoma.](#)

Potop V, Corbu C.

Rom J Ophthalmol. 2017 Oct-Dec;61(4):244-248. Review

RLE FOR ASTIGMATISM FOR, 1- 5 D ASTIGMATISM



- **After surgery:**
mean reduction of astigmatism was 80%.
 - Good rotational stability was achieved –
 - no eye needed a repositioning of IOL.
 - No eye had any kind of complications, neither intraoperative nor postoperative.
- Sun XY, Vicary D, Montgomery P, Griffiths M: Toric intraocular lenses for correcting astigmatism in 130 eyes. *Ophthalmology*. 2000, 107: 1776-1781.
 - Ruíz-Mesa R, Carrasco-Sánchez D, Díaz-Alvarez SB, Ruíz-Mateos MA, Ferrer-Blasco T, Montés- Micó R:
 - Refractive lens exchange with foldable toric intraocular lens. *Am J Ophthalmol*. 2009, 147: 990-996.

RLE FOR ASTIGMATISM STABLE KC . CXL PLUS

- **RLE for correcting a myopic spherical error .**
- **RLE with toric lens implantation associated with stable keratoconus in stage I and II**

Jaimes M, Xacur-Garcia F, Alvarez- Melloni D, Graue-Hernandez EO, Ramirez-Luquin T, Navas A: Refractive lens exchange with toric intraocular lenses in keratoconus. *J Refract Surg*. 2011, 27: 658-664. 10.3928/1081597X-20110531-01.

- Leccisotti A: Refractive lens exchange in keratoconus. *J Cataract Refract Surg*. 2006, 32: 742-746. 10.1016/j.jcrs.2006.01.063.

RLE FOR PRESBYOPIA

several presbyopia-correcting IOLs using accommodating or multifocal designs have been developed.

The aim is to restore distance, near, and intermediate visual functions after cataract surgery.

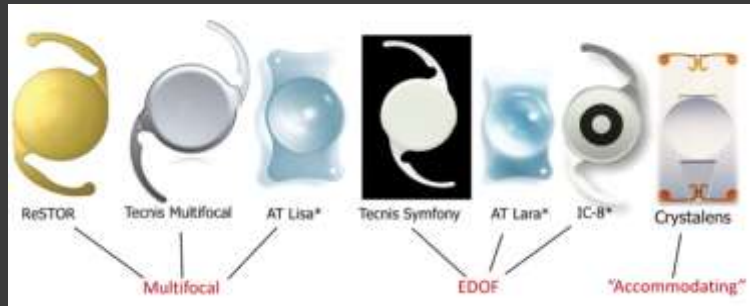
Alio JL, Tavalato M, De la Hoz F, Claramonte P, Rodriguez- Prats J-L, Galal A:
Near vision restoration with refractive lens exchange and pseudoaccommodating and multifocal refractive and diffractive intraocular lenses; comparative clinical study. J Cataract Refract Surg. 2004, 30: 2494-2503.
10.1016/j.jcrs.2004.04.052.



MONO VISION

- MONOFOCAL
- DOMINANT EYE FULL CORRECTION
- NON DOMINANT MYOPIC -1.5
- MINI MONO VISION
- -0.75

ROLE FOR PRESBYOPIA



EXTENDED DEPTH OF FOCUS IOL

Extended depth of focus IOL provides a continuous range of high-quality vision - from near to far and points in between - and may reduce the frequency of wearing glasses.

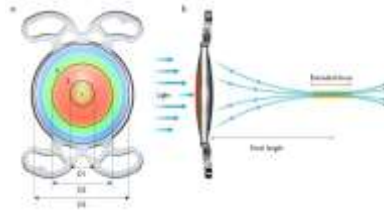


Multifocal IOL exchange among dissatisfied patients ranging from **0.85% to 7%** (1,2)

No intermediate vision

1. Venter JA, Pelouskova M, Collins BM, et al. Visual outcomes and patient satisfaction in 9366 eyes using a refractive segmented multifocal intraocular lens. J Cataract Refract Surg. 2013;39(10):1477-1484.
2. Woodward MA, Randleman JB, Stulting RD. Dissatisfaction after multifocal intraocular lens implantation. J Cataract Refract Surg. 2009;35(6):992-997.

Extended Depth of Focus (EDOFs)

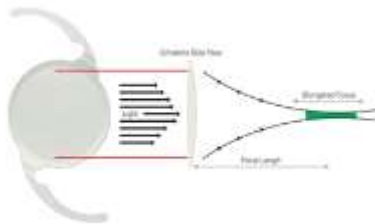


Mini Well Ready (Sifi Medtech)

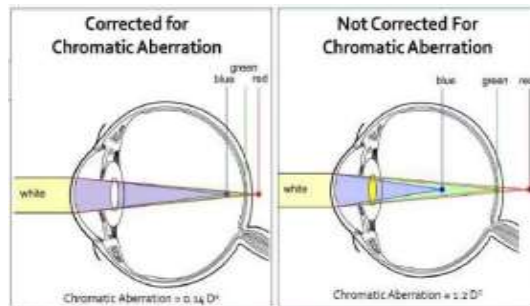


IC-8 IOL (AcuFocus)

EDOFs Lenses



- 1- Diffractive achromatic technology
- 2- A proprietary echelette design



Tecnis Symphony corrects chromatic aberration with its patented achromatic technology

Trifocal Lenses



The FineVision trifocal lens PhysiOL



Ziess AT LISA tri



The AcrySof IQ PanOptix toric IOL .Alcon



Acriva Trinova

Visual Outcomes (EDOF)

Parameter	Monovision Group	Non-monovision Group	All Patients
UDVA			
Decimal			
Mean \pm SD	0.94 \pm 0.23	0.95 \pm 0.19	0.95 \pm 0.20
UIVA			
Decimal			
Mean \pm SD	0.88 \pm 0.29	0.79 \pm 0.26	0.82 \pm 0.27
UNVA			
Decimal			
Mean \pm SD	0.74 \pm 0.26	0.67 \pm 0.24	0.69 \pm 0.25

Concerto Study: 411 patients micro-monovision in 112 patients and intended emmetropia in 299 patients

B. Cochener for the Concerto Study Group, "Clinical outcomes of a new extended range of vision intraocular lens: International Multicenter Concerto Study," Journal of Cataract & Refractive Surgery, vol. 42, no. 9, pp. 1268-1275, 2016.

Glasses Independence(EDOF)

Table 3. Postoperative spectacle independence data 4 to 6 months after surgery.

Level of Spectacle Dependence	Monovision Group	Non-monovision Group	All Patients
Distance (%)			
Never/occasionally	89.3	92.1	91.4
50% of time	5.4	2.7	3.4
Frequently	5.4	5.2	5.2
Intermediate (%)			
Never/occasionally	88.0	92.8	91.5
50% of time	6.3	2.8	3.8
Frequently	5.8	4.4	4.7
Near (%)			
Never/occasionally	80.8	72.1	74.5
50% of time	10.3	11.5	11.2
Frequently	8.9	16.4	14.4

Concerto Study: 411 patients micro-monovision in 112 patients and intended emmetropia in 299 patients

B. Cochener for the Concerto Study Group, "Clinical outcomes of a new extended range of vision intraocular lens: International Multicenter Concerto Study," Journal of Cataract & Refractive Surgery, vol. 42, no. 9, pp. 1268-1275, 2016.

Visual Outcomes (Trifocals)

Binocular UCVA at distance
 $0.00 \pm 0.094 \text{ logMAR}$

Binocular UCVA, intermediate (80 cm, 60 cm), $0.09 \pm 0.107, 0.00 \pm 0.111 \text{ logMAR}$

Binocular near UCVA
 $0.01 \pm 0.087 \text{ logMAR}$

Visual Performance of a Quadrifocal (Trifocal) Intraocular Lens Following Removal of the Crystalline Lens, Kohnen, Thomas et al., American Journal of Ophthalmology, Volume 184, 52 - 62

Glasses Independence (Trifocals)

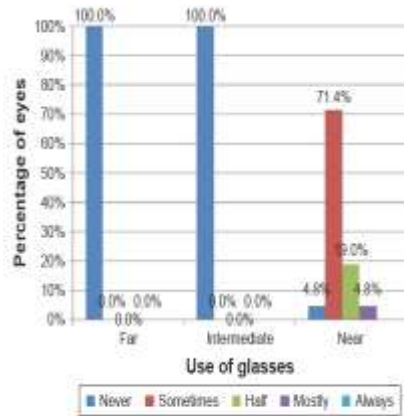


Figure 4 Postoperative frequency of spectacle use at far, intermediate, and near distances.

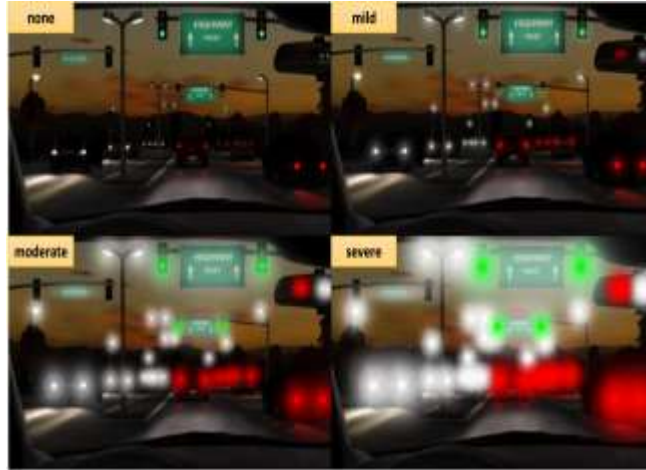
Mencucci R, Favuzza E, Caporossi O, Rizzo S, Visual performance, reading ability and patient satisfaction after implantation of a diffractive trifocal intraocular lens, [Clin Ophthalmol](#), 2017 Nov 13;11:1987-1993.



➤ CONCERNS.

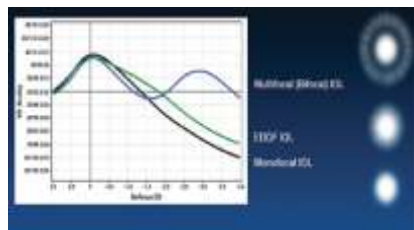
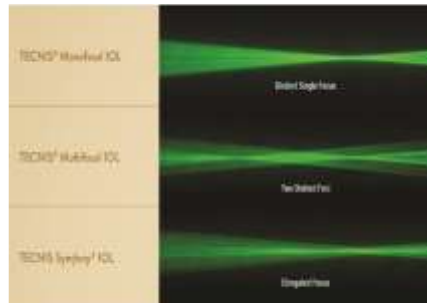
- HALOES ,GLARE
- CS
- HIGH CYLINDER
- POST LASIK RLE
- NEED FOE FLACS,
- RESIDUAL REFRACTIVE ERRORS
- PRICE

Halos and Glare



Simulator

Halos and Glare



Simulated halo effects for a theoretical monofocal IOL, multifocal IOL, and EDOF IOL.

Halos and Glare

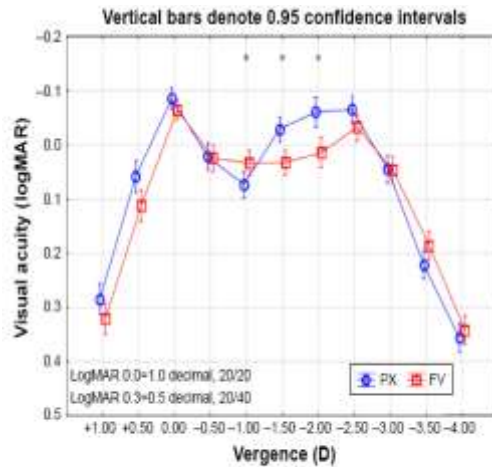
Table 4. Incidence and level of photic phenomena 4 to 6 months after surgery.

Photic Phenomenon	Percentage		
	Monovision Group	Non-monovision Group	All Patients
Halos			
No/Mild	87.0	91.6	90.3
Moderate	9.4	5.6	6.6
Severe	3.6	2.9	3.1
Glare			
No/Mild	96.0	91.9	93.0
Moderate	3.1	5.7	5.0
Severe	0.9	2.4	2.0
Starburst			
No/Mild	96.4	97.6	97.3
Moderate	2.7	1.7	2.0
Severe	0.9	0.7	0.7
Other			
No/Mild	95.5	98.3	97.6
Moderate	4.0	1.7	2.3
Severe	0.4	0.0	0.1

Concerto Study: 411 patients micro-monovision in 112 patients and intended emmetropia in 299 patients

B. Cochener for the Concerto Study Group, "Clinical outcomes of a new extended range of vision intraocular lens: International Multicenter Concerto Study," Journal of Cataract & Refractive Surgery, vol. 42, no. 9, pp. 1268-1275, 2016.

Halos and Glare

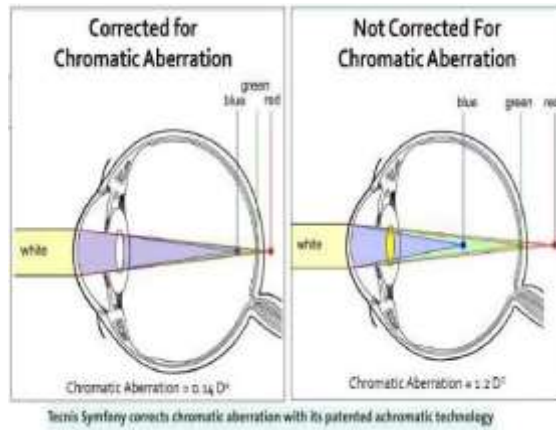


Best distance-corrected binocular defocus curve

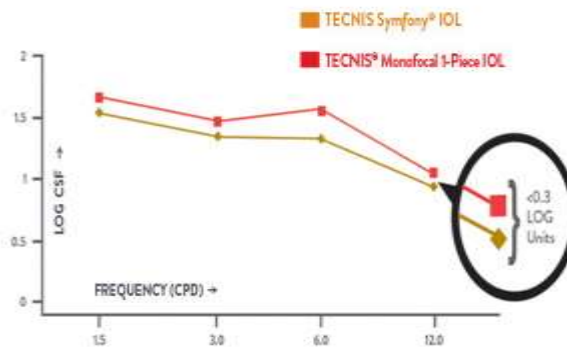
Kjell G Gundersen, Rick Potvin, Trifocal intraocular lenses: a comparison of the visual performance and quality of vision

provided by two different lens designs, clinical ophthalmology, Volume 2017:11 Pages 1081–1087

Contrast Sensitivity



Contrast Sensitivity



Contrast Sensitivity (Trifocals)

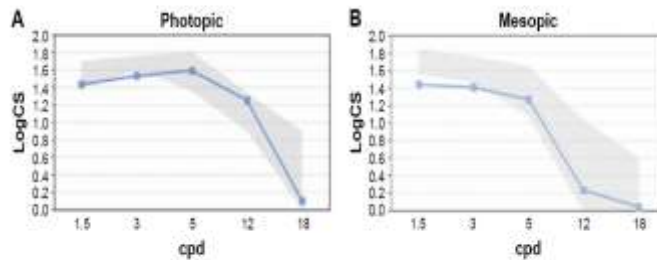


Figure 2 Three mesopic photopic (A) and mesopic (B) contrast sensitivity.
 Note: The grey areas represent the normal range of similar age groups under photopic and mesopic conditions.¹⁴
 Abbreviations: CS, contrast sensitivity; cpd, cycles per degree.

Mencucci R, Favuzza E, Caporossi O, Rizzo S, Visual performance, reading ability and patient satisfaction after implantation of a diffractive trifocal intraocular lens, [Clin Ophthalmol](#). 2017 Nov 13;11:1987-1993.

Conclusion

EDOF and Trifocal lenses are an excellent option for eligible patients seeking glasses independence.

EDOF lenses show better intermediate, contrast sensitivity and less photic phenomenon

Trifocals offer better near vision

RLE FOR MODERATE & HIGH MYOPIA

PROBLEMS

- **AGE:** NOT LESS THAN 40 YS !!
- In children, main indications for refractive surgery are severe anisometropia and severe bilateral ametropia



Unilateral lens extraction FOR HIGH ANISOMETROPIC MYOPIA IN CHILDREN AND ADOLESCENCE

ALI A , Packwood E., et al JAAPOS,2007 Apr;11(2):153-8

RLE FOR HIGH MYOPIA

PROBLEMS: **LENS OPACITY.**



AXIAL LENGTH: A RISK FACTOR FOR CATARACTOGENESIS

WU.z., et.al. Ann Acad Singapore. 2006;34:416-9.

CLE FOR HIGH MYOPIA PROBLEMS

LENS OPACITY.

- HIGH MYOPIA IS KNOWN TO BE ASSOCIATED WITH CATARACT
- Increases risk of posterior sub capsular cataract , an important predictor of cataract surgery.



Myopia and Incident Cataract And Cataract Surgery. The blue Mountain Eye Study

Christine Y. et al. Invest. Ophthalmol. Vis. Sci DEC.2002. 43no 12: 3625-3632

RLE VS PHAKIC IOLS

- LENS OPACITY WILL DECTATE REMOVAL OF PHAKIC IOL AND 2ND OPERATION

RLE FOR MYOPIA VS PHAKIC IOL

compared RLE and collamer lens (Visian) implantation in patients less than 45 years old with myopia greater than -12.0 D.

The RLE group showed better results for postoperative CDVA, and had **no serious complications** such as retinal detachment (RD), endophthalmitis or inflammatory reaction.

In the implantable collamer lens (ICL) group however, **lens opacity, pigment dispersion, macular hemorrhage or pupillary block glaucoma occurred.**

Emarah AM, El-Helw MA, Yassin HM: Comparison of clear lens extraction and collamer lens implantation in high myopia. Clin Ophthalmol. 2010, 14: 447-454.

CLE FOR HIGH MYOPIA

CNV membrane:

Develop more common;

- - in younger patients
- -in the presence of lacquer cracks or patch atrophy.
- May develop after surgery !!!
- Rapid visual loss
- Poor visual outcome if left un treated.

ANTI VEGF: GOOD RESULTS

PEARL

When not to perform RLE in myopic eyes:

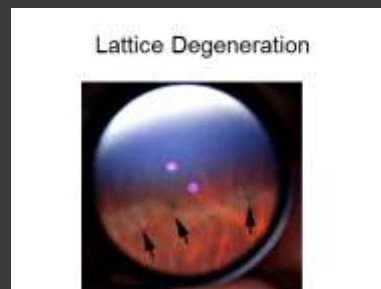
- ◉ Eyes with advanced peripheral lattice degenerations
- ◉ Young eyes with no posterior vitreous detachment
- ◉ Laquer cracks in high myopia or myopic CNV in the fellow eye
- ◉ Presbyopic eyes with macular degeneration beginning in the fellow eye



PEARL

PROPHYLACTIC ARGON LASER OR CRYO

- ◉ **ACTUAL LESIONS**
 - LATTICE WITH HOLES.
 - = SYMPTOMATIC HORSE SHOE BREAKS!
 - BUCKLE !
- ◉ **360 DEGREE.**
- ◉ **NO TTT:**
 - TTT MAY LEAD TO PVD, ERM
 - NEW H/S BREAKS MAY OCCUR POST TO TTT OR EVEN TO ENCIRCLING BUCKLE .
- ◉ **CLOSE POST OP**
F/U



RLE OPERATIVE

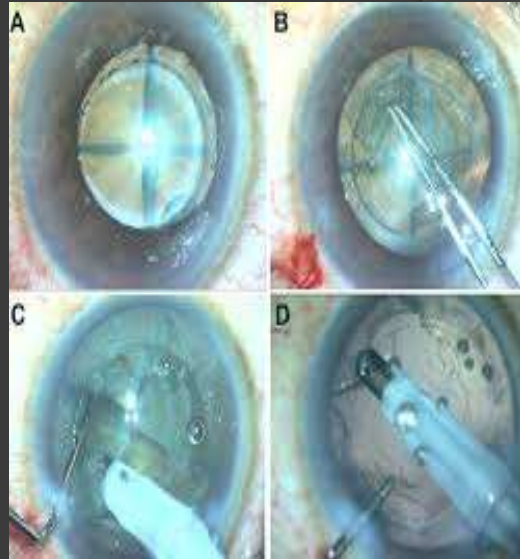
- ⦿ ECCE : NOT ANY MORE.
- ⦿ PHACO EMULSIFICATION
- ⦿ FLACS
- ⦿ COMBINED PHACO & PP VITRECTOMY
- ⦿ Manvikar S, Steel D: Refractive lens exchange combined with pars plana vitrectomy to correct high myopia. Eye(Lond). 2006, 20: 1399-1400.

PEARL

RISK REDUCTION PHACO TECHNIQUE:

- ⦿ SMALL INCISION
- ⦿ PREVENT AC
FLUCTUATIONS
- ⦿ FOLDABLE IOL
- ⦿ INTACT POST. CAPSULE

FLACS



Is Femto Phaco worth it?



LENSECTOMY, IOL & PP VITRECTOMY

REFRACTIVE LENS EXCHANGE COMBINED WITH PARSPLANA VITRECTOMY TO CORRECT HIGH MYOPIA

Uhlmann S, WIEDMANN P EYE 2006(6)655-60.

- 14 EYES TTT,
- MYOPIA OF -19 ± 5.4 D
- 30 MONTH F/U

CONCLUSION:

RLE WAS EFFECTIVE IN CORRECTING HIGH MYOPIA.
PP VITRECTOMY MAY REDUCE THE RISK OF POST OP
RD & CME

anaesthesia

- General
- topical
- never retrobulbar

Unilateral or bilateral

- ◉ Unilateral
- ◉ Post op refraction
- ◉ Any complication

PEARL IOL

- ◉ NEVER 5 mm
- ◉ Never silcon
- ◉ 3 piece
- ◉ Posterior square edge
- ◉ Anterior rounded slope
- ◉ Aspheric
- ◉ hydrophobic

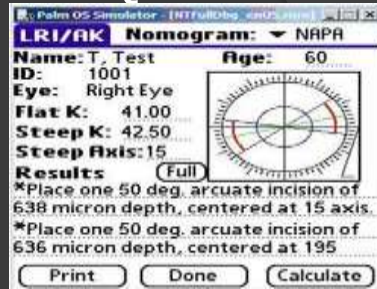
CLE- SURGICAL TECHNIQUE

ASTIGMATISM MANAGEMENT

MONO FOCAL& LRI:

- RANGE: 1.5 -3.00 D.
- PLACED 1.5 mm to limbus
- Use nomogram.
- NEW

FS LASER LRI

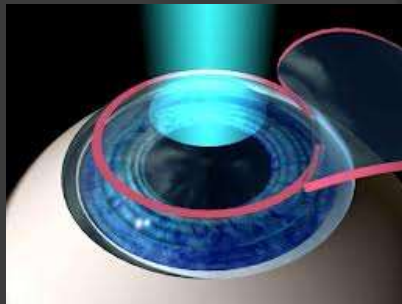


CLE- SURGICAL TECHNIQUE

ASTIGMATISM MANAGEMENT

LVC

- HIGH DEGREES
- 2-3 M POST OP.
- PRK-LASIK
- GOAL TO END UP WITH IS 0.5-0,75 D



CLE- SURGICAL TECHNIQUE

ASTIGMATISM MANAGEMENT

OCCI :

Corneal astigmatism correction with opposite clear corneal incisions or single clear corneal incision:
Comparative analysis

- Journal of Cataract & Refractive Surgery

Volume 32, Issue 9 , Pages 1432-1437 , September 2006

Sudar Khoshankhar, MD, Pavan Lohiya, MD, Vanathi Murugesan, MD, Anita Panda, MD:



CLE- POSTOP. PROBLEMS

- KNOWN TO CATARACT SURGERY
CME , Endophthalmitis

SPECIAL:

- DIPLOPIA.
- PCO
- RD
- CNVs

CLE FOR HIGH MYOPIA POST OPERATIVE PROBLEMS

RD:

- ⦿ 1- 8 % .
- ⦿ risk factors of post-RLE RD include
 - ⦿ increased axial length,
 - ⦿ age less than 50 years,
 - ⦿ male sex, Caucasian race,
 - ⦿ peripheral retinal degenerations,
 - ⦿ intraoperative rupture of the posterior capsule, and Nd:YAG capsulotomy for PCO.

⦿ **VITRUS MOBILITY, --- PVD, --
RET. BREAKS**

Ruiz-Moreno JM, Alio JL, Shabayek MH: Complications of refractive lens exchange. Management of Complications in Refractive Surgery., 266-269.
1

PEARL

RD RISK IS DECREASED WITH

New cataract techniques & IOLS.
Careful preop. And post op. fundus exam.& TTT of any lesions.

Patients education of symptoms of PVD

CLE POSTOPERATIVE PROBLEMS PCO

POST CAPSULOTOMY:

DEC. HYALURONIC ACID. CONCENTRATION

● **SURGICAL:**

WHEN !

- INTRAOP. , POSTOP.

● **YAG:**

SHOCK WAVES, SYNCHESIS, SYNRESIS

WHEN, TECHNIQUE, RISK OF RD

PEARL

- **Intraoperative methods to reduce the incidence of PCO**
- capsulorrhexis
overlying the edge of the IOL optic
- EXCESS hydrodissection
- meticulous cortical clean-up .
- implantation of a sharp posterior edge IOL.

conclusion

RLE is an elective intraocular surgery that needs to be minimally invasive, and performed with precision and high accuracy.

The indication is the presence of high refractive error in the absence of cataract requires an approach with the risk–benefit ratio in mind depending on the age, refractive condition and pre-operative condition.

CONCLUSIONS

The main challenge involved is to reach emmetropia.

Due to rapid recovery and astigmatically neutral incisions , RLE can be done with greater predictability .

For restoration of near, intermediate and far vision, MANY IOLs are currently available
WITH EXCELLENT VISUAL OUT COME

