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Non-surgical Presbyopia correction

Presbyopia is the decreasing age-related ability of the eye to focus on objects at close distances.

The rate of decline in “near” visual work is faster compared to 100 other human biological functions on a statistical significant basis!!

The accommodative amplitude diminishes 1.5 to 2 times faster than e.g. the bone fracture threshold, the concentration of striate myelin, the regenerative power of damaged DNA (Weale, 1995)
Non-surgical Presbyopia correction

Reading glasses (for near, bifocal, trifocal, multifocal, progressive electronic designs)

Contact lenses - monovision

Contact lenses - multifocal / bifocal designs
Cornea
Intracorneal Inlays
Synthetic Keratophakia

- José Ignacio Barraquer Modern Keratophakia (1949)
- Cryolate lenticules
- 1964 glass and plexiglass
- Failure and necrosis
Corneal Pockets Timeline

- **2001**: Mechanical microkeratome
- **2009**: Femtosecond assisted using mask
- **2010**: Femtosecond assisted using iPocket software
- **Evolution in the material of intracorneal inlays**
Flexivue Micro-Lens (Presbia)

Kamra (Acufocus)

Vue+ (ReVision)

UOC-IVO
CRETE
FLEXIVUE MICRO-LENS (PRESBIA)
Flexivue Micro-Lens (Presbia) Design

- Thickness: 20µm
- Diameter: 3mm

Peripheral zone with refractive power: +1.25D to +3.00D
Central zone without refractive power
Femto parameters:
- iPockets software
  - Depth: 280-300
  - Diameter: 4 mm
  - Bed energy: 0.60-0.70
  - Spot-Line Sep: 2-2 (or 3-3)
  - Side cut energy: 1.6-1.7
  - Side cut angle: 30
- Deactivate pocket
- Suction-applanation
The Lens is “invisible” and does not influence the S/L and fundus examination.
One year after surgery 82% of the patients UNVA between 20/30 and 20/20.

One year after surgery UDVA was 20/32 in the operated eye and 20/20 binocularly.

100% of the patients have CDVA between 20/30 and 20/16.

At the last visit, 37% (17 patients) had lost 1 line of CDVA (0.1 logMAR) in the operated eyes.

No patient lost two or more lines in CDVA in the operated eye.

Binocular CDVA was not significantly altered. (p=0.13).
There is a central myopic effect only when we analyze the 3.5mm zone.

**The concept of “Smart Monovision”**

Seidel Sphere
-0.34
Cylinder
-0.50 X 160

Seidel Sphere
-0.54
Cylinder
-0.26 X 167

Seidel Sphere
-2.05
Cylinder
-0.50 X 174

Seidel Sphere
-0.75
Cylinder
-0.36 X 161
Flexivue Micro-Lens
Conclusions

- Easy procedure (Implantation within minutes)
- Minimal invasive technique
- Easy removal of the implant if required without loss of tissue and/or replace another inlay (reversibility).
- Restoring near vision in all the patients including post refractive, post cataract patients.
- Far vision is less influenced in the operated eye than with usual monovision procedures.
- No photoablation of the cornea
- No flap
- Transparency
- No interference with potential future cataract operation.
KAMRA (Acufocus)
KAMRA
Characteristics

Increases depth of focus
Monovision
Pin hole Effect
Flap

Thickness: 10 µm
Diameter: 3,8 mm
Biocompatible material

Near Visual Acuity

UVA-N in the operated eye


UOC-IVO
CRETE
VUE + (ReVision)
VUE+ (Revision)

- Non-dominant eye
- Natural emmetropes or emmetropes after LASIK surgery.
- Provides a central zone for near vision and a paracentral zone for intermediate, which allows the remaining cornea to be used for distance vision
- Proprietary micro-porous hydrogel material called Nutrapore®
- Two millimetres in diameter
- Changes the anterior curvature of the cornea when placed under a superior-hinged lamellar LASIK corneal flap
Results

(At six months natural or post Refr Surg emmetropians)

• Near VA: 20/25
• Intermediate VA: 20/25
• No patient lost two or more lines in far VA

Slade St. Early results using the presbylens corneal inlay to improve near and intermediate vision in emmetropic presbyopes. Paper present at the ESCRs annual meeting. September 2010, Paris
CORNEAL LASER
LASIK

- Monovision

- Residual myopia (-0.75 to -1.50D) in the non-dominant eye of patients aged 40-50 years old.
Create a multifocal cornea that increases the depth of focus using the Excimer Laser

- **MULTIFOCALITY**
  - multistep treatment to produce customized ablations at various optical zones.

- **LASIK**
  - absence of post-operative haze
  - absence of regression
  - regular and thin flap that can protect a multifocal profile
• **Central near ablation** with intermediate-distance midperipheral ablation
  → hyperopic correction with central “steepening” for the correction of near vision.

(Tamayo 2000)
Results

Improvement of Near Uncorrected Visual Acuity after six months after surgery.

• **Central distance ablation** (central cornea relatively aberrations free) with mid-peripheral cornea for near vision.
  
  → use a 10mm optical zone under a very large flap resulting in an aspherical curvature of the cornea.

(Anschuetz, Dausch, Klein, Joly 1991)
Improvement of Near and Distance Uncorrected Visual Acuity after six months after surgery in hyperopic presbyopians.

Femtosecond Laser IntraCOR

- FemTec Laser
- Flapless intrastromal correction
- Reshaping of the cornea

UOC-IVO CRETE
Results

Improvement of Near Uncorrected Visual Acuity after three months after surgery.

CONDUCTIVE KERATOPLASTY

CK

• Monovision
• Radiofrequency energy
• Mark around central cornea (number of spots correlates with the correction needed)
• Collagen shrinking
• Corneal flattening
• Hyperopia +0,75 ἐὼς +3,00D
• ‘Botox effect’ (Regression repetition)
• FDA approval (2004)
Preoperative and 1- and 3-year postoperative binocular uncorrected visual acuity at near (Jaeger) and distance (Snellen) demonstrate the initial effect in near vision at first year followed by a decrease three years later.
Lens
MONOFOCAL LENSES

- Monovision
Multifocal Lenses
Multifocal IOLs ReZoom

• Multizonal refractive principle
• Hydrophobic Acrylic
• Balanced View Optics™ technology for near intermediate and distance vision.
• OptiEdge™ design
• Near add +3.5 D
Multifocal IOLs
ReSTOR

- Apodised diffractive principle
- Refractive peripheral
- High refractive acrylic
- Blue light filter
- Near add +4.00 D
- Light distribution = Pupil dependent
- Incision size 2.2 mm
Multifocal IOLs TECNIS

- Diffractive principle
- High refractive silicone/acrylic
- Near add +4.00 D
- Light distribution 50:50
- Incision size 2.75 mm
- **Crystalens HD** features a proprietary optic design that is optimized to increase depth of focus, resulting in an improvement of near vision without compromising intermediate or distance visual acuity.

- Delivers the near vision benefit while maintaining contrast sensitivity, and low risk of halos and glare.

- Approximately 1D of pseudoaccommodation by deformation that the IOL underlies due to cigliary muscle contraction and vitreous mass displacement.
Crystalens HD Accommodation assessing with the i-trace
Accommodative-Multifocal Combination
WIOC – CF Basic properties

The WIOC - CF accommodative design is based on the biomimetic principle.

The hydro gel material used and the lens geometry simulate some of the key properties of the crystalline lens itself.

The WIOC – CF can be actually considered more as a natural product and not a typical engineered one.
Lens characteristics were selected to secure adequate contact with the biggest part of the posterior capsule but not alteration of the capsule shape.

Large continuous aspheric optics assures lens centricity and reduces reflections and halos that can cause night vision problems.

The lens design is intended to provide up to 2.5 diopters of “pseudoadaccommodation” capability facilitating near vision.
Pseudoaccommodation assessed with the iTrace

**Near**
- Mean diff: -1.18D
- Max diff: -7.20D
- Range: 9.35D

**FAR**
- Mean diff: -1.18D
- Max diff: -7.20D

Group: accommodative

**OS**
- Date: 11-08-2009 15:53:44
- Total Refraction: +3.53 D x 89° @ D = 2.00 mm
- Max Refraction: +4.44 D x 82° @ D = 2.70 mm

**Details:**
- Total: 1.067 µ
- LO Total: 1.014 µ
- Dfuscor: 0.986 µ
- Astigmatism: 0.519 µ x 172°
- HO Total: 0.351 µ
- Coma: 0.333 µ x 261°
- Spherical: 0.069 µ x 73°
- Secondary Astigmatism: 0.05 µ x 60°
- Trefoil: 0.062 µ x 60°

**Version:** 4.1.1 2010-01-31
Femtosecond Presby-LASER
Femtosecond Presby-LASER

• Precisely focused inside the tissue with small collateral tissue damage

• Infrared or far-infrared wavelength is not absorbed by water and may be focused in any position from anterior cornea to posterior surface of the crystalline.
Femtosecond Presby-LASER
Possible Applications

- Progressive sclerosis of the crystalline lens:
  - Presbyopic effect according to Helmoltz theory of accommodation
  - Possible relaxation of the lens through micro-incisions \( \rightarrow \) Lentotomies

- Possible effects:
  - Creation of “gliding planes” inside the lens and consequently retrieval of the deformation ability and elasticity of the lens.

One innovative new approach is using the LensAR femtosecond laser (Winter Park, Fla.) to soften the lens nucleus.

"The lens nucleus is softened by the femto pulses, as compared to the harder nuclear state that might have been there before, and that would allow for more flexibility of the crystalline lens.

Lipner M., 2008, ASCRS, Eye World
Pallikaris Presbyopia Algorithm

AGE and Pre-existing refractive status

40-45
Monovision, laser Multifocal laser CK

45-60
Myops/Hyperops

>60
CLE

Emmetrops

45-55
Monovision laser Multifocal laser CK(Hyper)

>55
Corneal Inlays

CLE
Patient Selection Guidelines

• Limit monovision approaches in:
  – **Professional near vision** (Surgeons or other microscope users, Accountants, Architects, etc..)
  – **Specific hobbies** (Hunting, shooting, etc..)

• Limit multifocal approaches in
  – **Professional far vision** (ex: Drivers)
  – **Specific night jobs** (ex: night-guard etc)

• Explain the realistic objectives and possible complications or limitations

• Exclude very high expectations patients

• Perform accurate monovision and multifocal trials preoperative
Thank you very much for your attention