Excellence Eye Research Centre
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CNAT Centro Nazionale di Alta Tecnologia in Oftalmologia

Stromal lenticule addition keratoplasty (SLAK): For Keratoconus

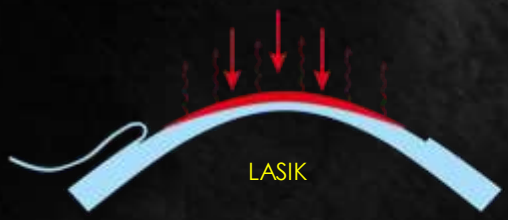
No Financial Interest

M. NUBILE

RIO 2020 34TH INTERNATIONAL CONFERENCE OF THE RESEARCH INSTITUTE OF OPHTHALMOLOGY

RIO Cairo January 2020

A Potential Major Advantage of RELEx to Patients



Removed tissue is still vital

A Reversible procedure

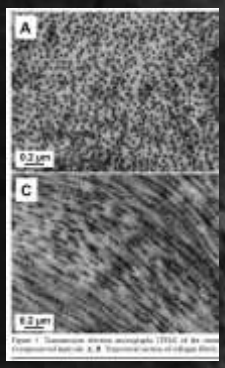
Extracted lenticule can be reimplanted

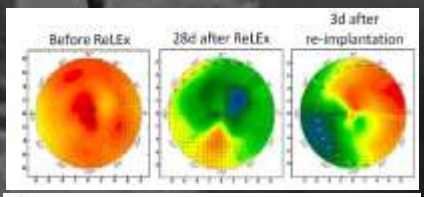
«The potential option of stromal lenticule storage after ReLEx offers patients the **unique opportunity of bank their tissue** in case of future need, **or to donate their tissues** to others in need».

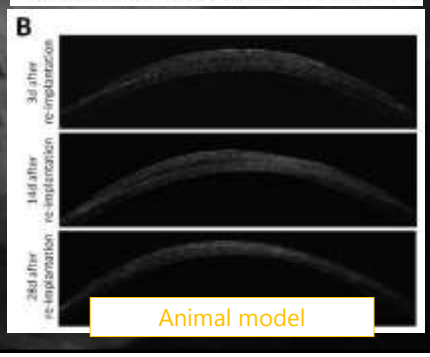
Refractive Lenticule Re-Implantation after Myopic ReLEx: A Feasibility Study of Stromal Restoration after Refractive Surgery in a Rabbit Model

IOVS, 2012

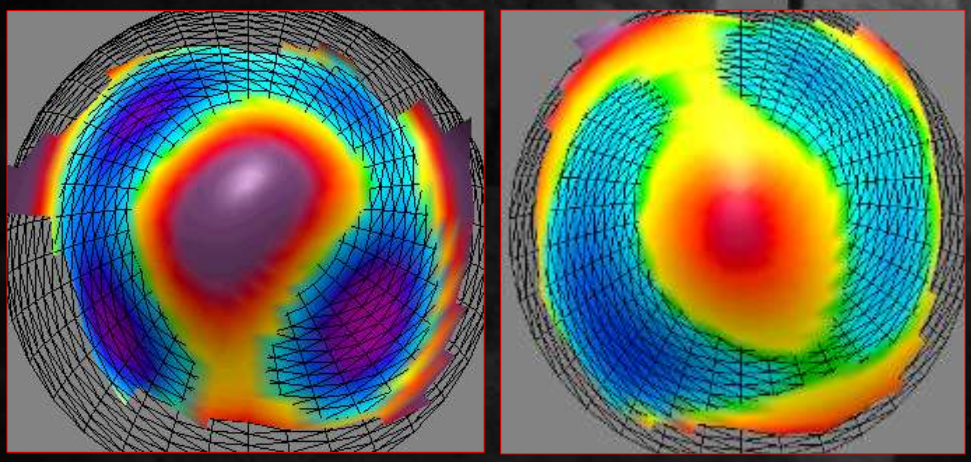
The stromal lenticule extracted following ReLEx **maintain keratocyte viability** and overall **collagen structural integrity** in pre- and post- cryopreserved tissue samples.







Corneal Re-shaping in ectasia

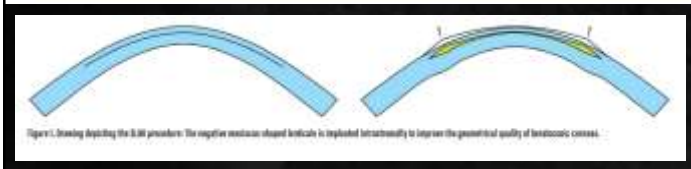


The Rich Promise of Lenticule Transplantation in Keratoconus

A brief history of stromal lenticule addition keratoplasty.

BY LEONARDO MASTROPASQUA, MD; AND MARIO NUBILE, MD

CRST 2019



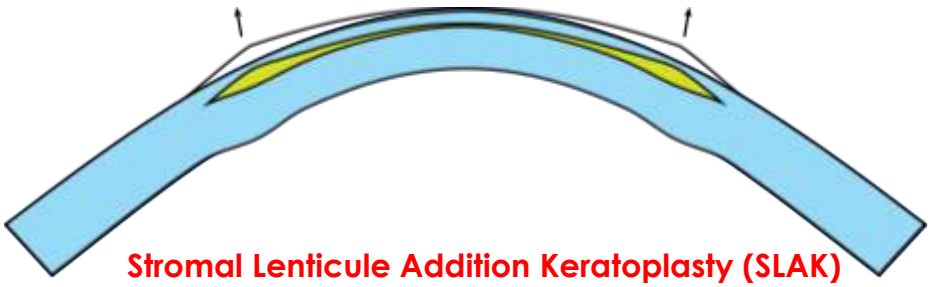
WHAT IS SLAK?

Stromal Lenticule Addition Keratoplasty entails implanting a negative meniscus-shaped lenticule that is thinner in the center and thicker in the periphery—the geometric opposite of a myopic lenticule—to reshape and stabilize the corneas in eyes with progressive keratoconus.

The basic idea of SLAK surgery is to implant the lenticules intrastromally in order to improve the geometrical quality of pathological corneas affected by keratoconus.

Addition Keratoplasty

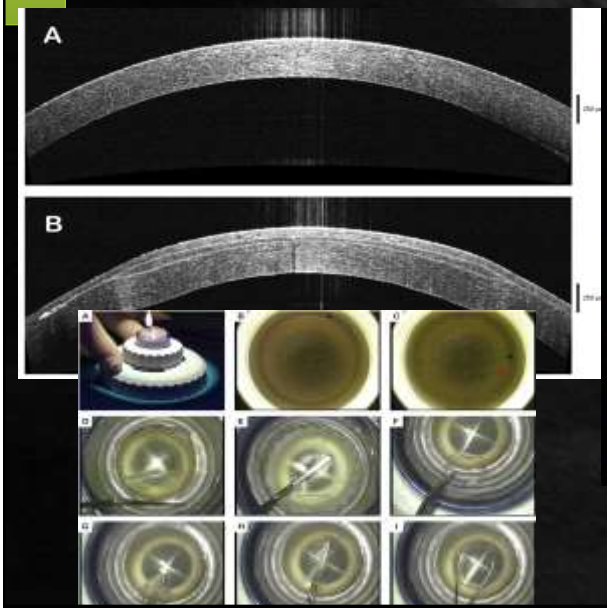
Negative meniscus lenticule IMPLANTATION



Stromal Lenticule Addition Keratoplasty (SLAK)

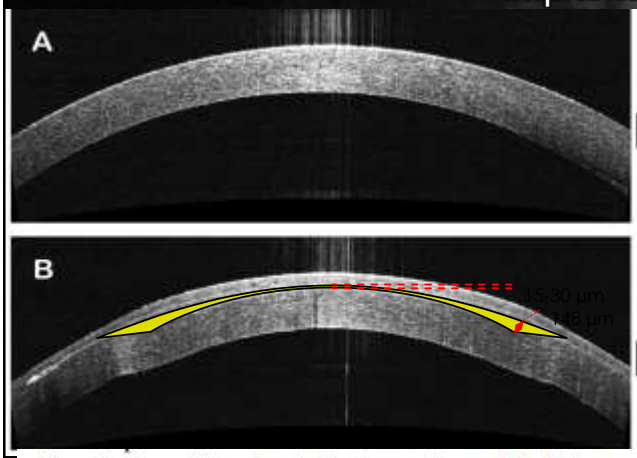
Lenticule Implantation procedure in Eye-bank cornea

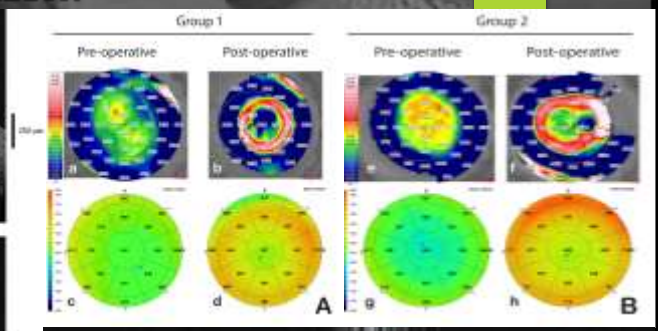
Mastropasqua L, Nubile M. Int Ophthalmol 2016

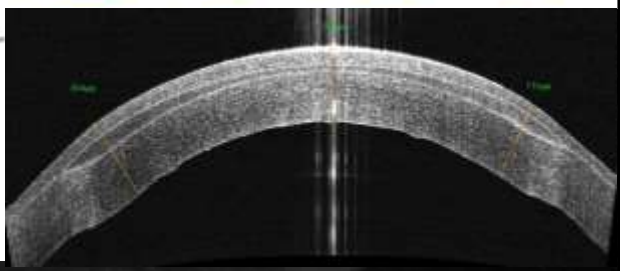


Mastropasqua – Nubile: Lenticule Insertor (e.Janach)

Corneal profiles, curvature and thickness changes after lenticule implantation







Conclusion The implantation of modified hyperopic-shaped intra-corneal stromal lentoid is a feasible and reproducible technique for achieving central corneal flattening while increasing thickness. Whether

Mastropasqua L, Nubile M. Int Ophthalmol 2016

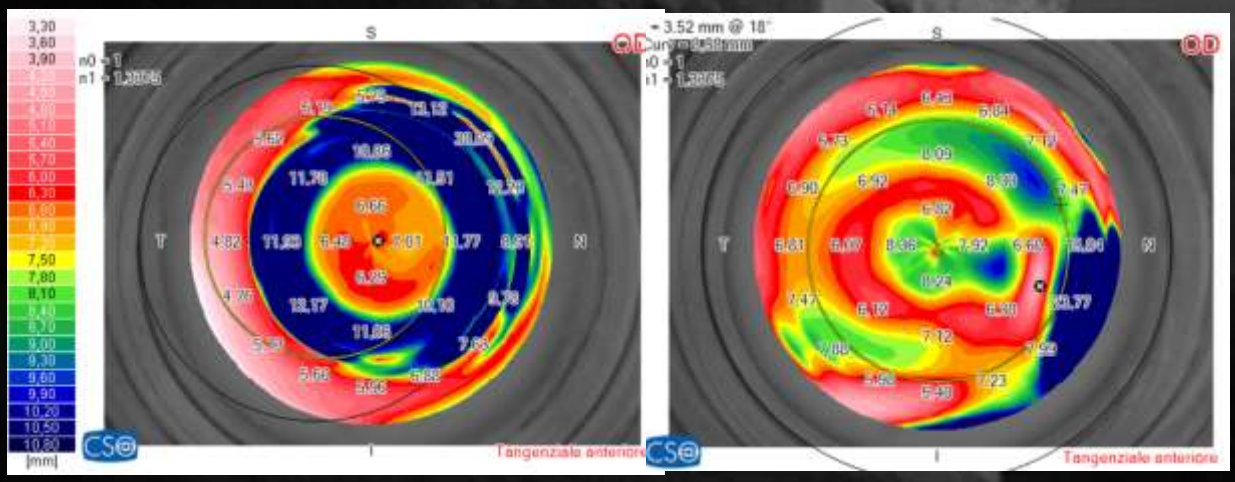
Keratoconus model example

After

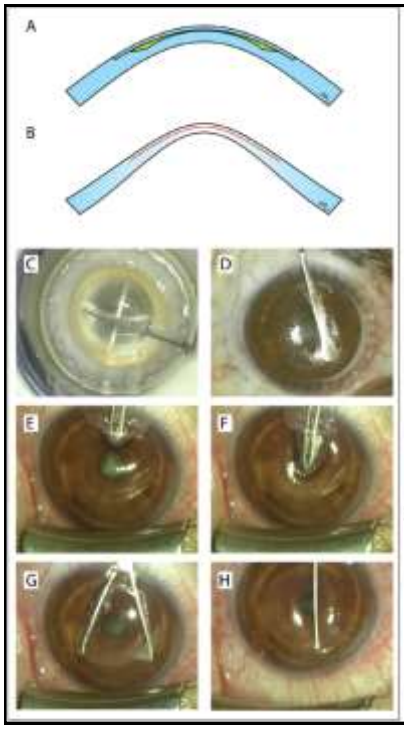
Lenticule diameter 6 mm
8D power

Keratoconus model example

Before



After

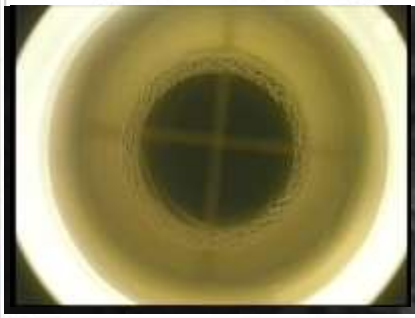


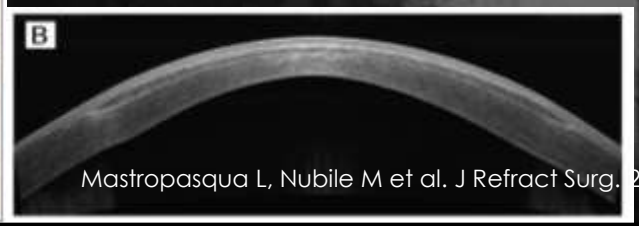
THERAPEUTIC REFRACTIVE SURGERY

SLAK

Femtosecond Laser–Assisted Stromal Lenticule Addition Keratoplasty for the Treatment of Advanced Keratoconus: A Preliminary Study

Leonardo Mastropasqua, MD; Mario Nubile, MD, PhD; Nicolò Salgari, MD; Rodolfo Mastropasqua, MD

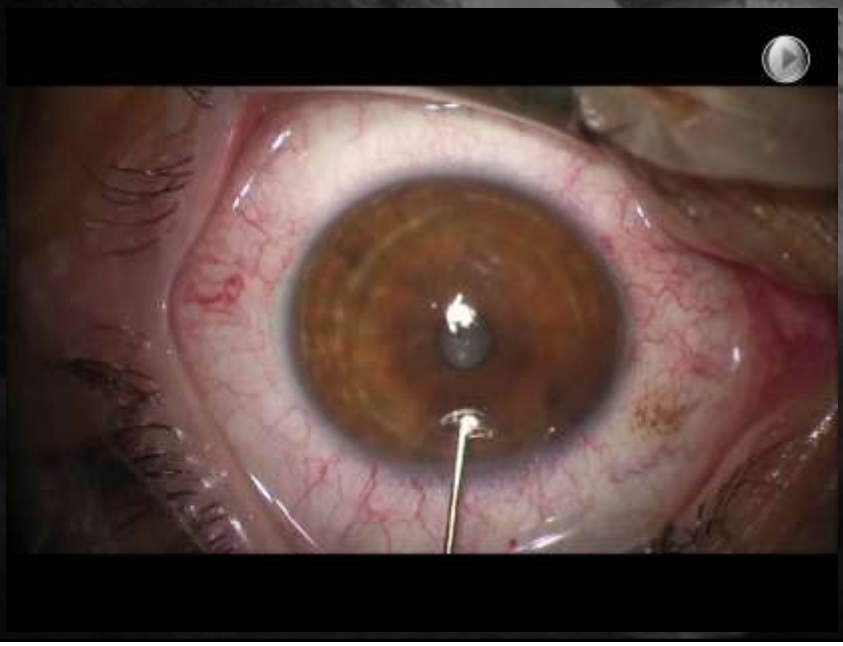




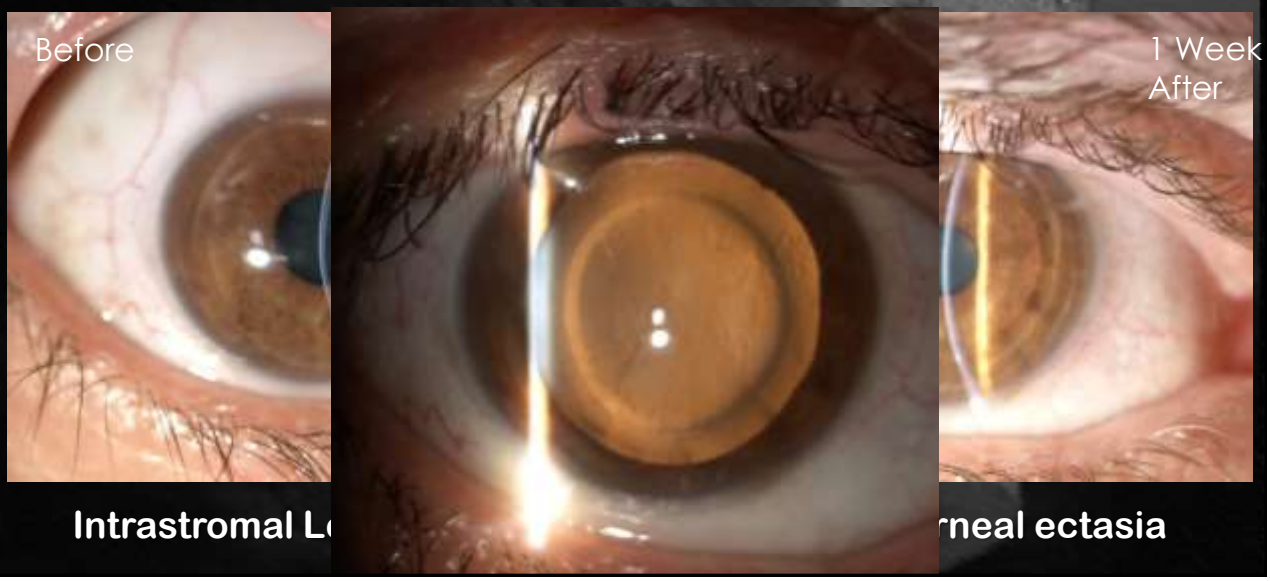
- 10 cases of **Advanced Keratoconus** (curvature range 55-70 D – CCT: 290-450 microns)
- Transparent cornea
- BSCVA (<20/200)
- Contact lens intolerant
- Stable keratoconus / Candidate for DALK/PK
- LENTICULES were obtained from Eye-bank donor corneas suitable for PK-DALK

Mastropasqua L, Nubile M et al. J Refract Surg. 2018

SLAK - Surgical Technique: real time with intraoperative OCT

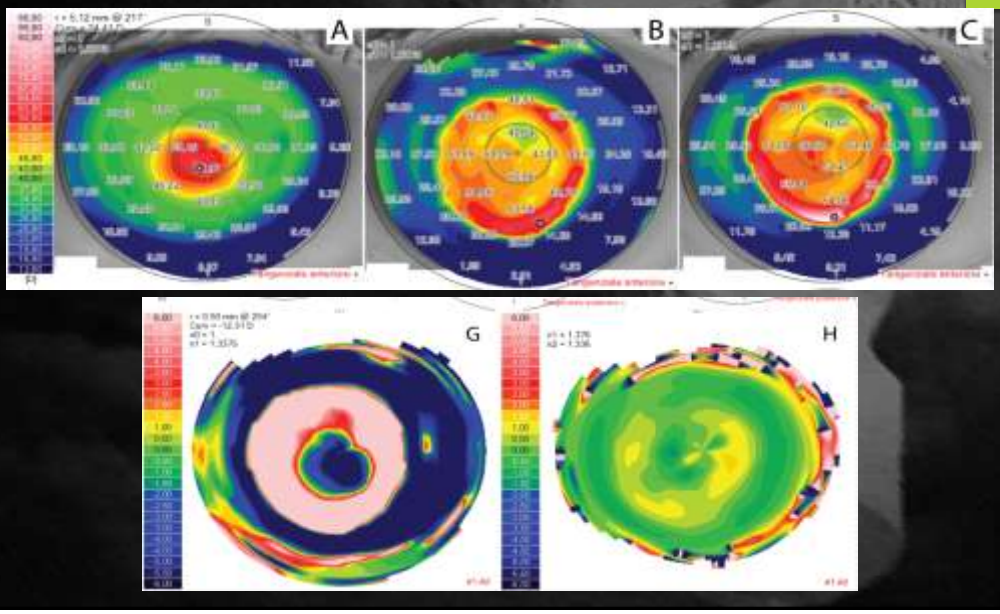


SLAK - minimally invasive procedure

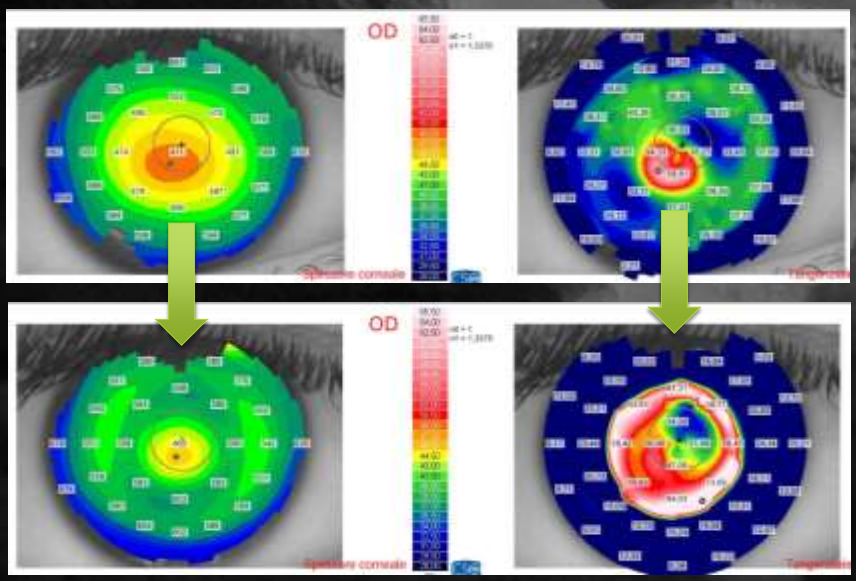


Intrastromal L[illegible] [illegible]rneal ectasia

Anterior corneal topographical changes in Central Keratotocnus after SLAK

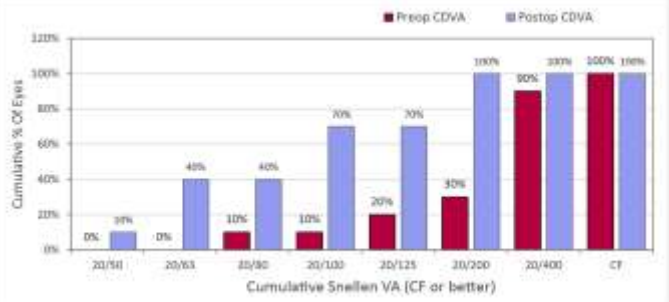


SLAK in advanced Keratoconus: 6 follow-up



Mastropasqua L, Nubile M et al. J Refract Surg. 2018

SLAK in advanced Keratoconus



Pre-operative

Post-operative

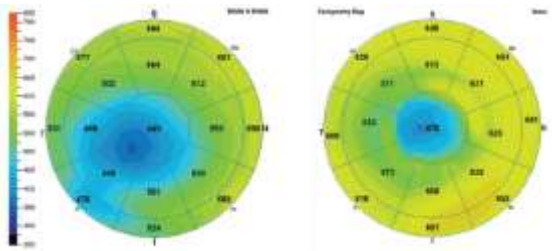
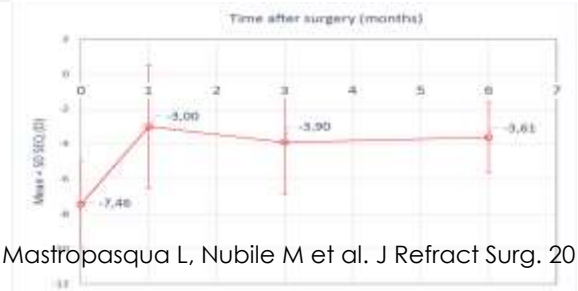


TABLE 1
Patient Demographics and Refractive Data of Patients Treated With SLAK

No.	Age / Gender	Eye	Stage	Preoperative: Manifest Refraction	Preoperative: UDVA	Preoperative: CDVA	Follow-up (6 Mo): Manifest Refraction	Follow-up (6 Mo): UDVA	Follow-up (6 Mo): CDVA	Change in Lines of VA
1	53 / M	OD	IV	-4.00 / -5.50 × 80	1.3	1.0	-2.00 / -3.00 × 90	1.3	0.7	+1
2	40 / M	OS	IV	-3.00 / -4.00 × 100	1.3	1.0	-1.25 / -2.50 × 75	0.6	0.4	+3
3	64 / M	OD	IV	-2.00 / -3.00 × 90	1.3	1.0	0.00 / -2.00 × 85	1.3	0.7	+1
4	27 / M	OD	IV	-10.00 / -5.00 × 95	2.0	1.3	-8.00 / -3.00 × 80	2.0	1.0	+1
5	35 / F	OD	IV	-5.00 / -3.00 × 85	1.3	1.0	-2.00 / -1.50 × 95	1.0	0.5	+2
6	45 / M	OS	IV	-7.00 / -4.00 × 105	2.0	1.3	-4.00 / -2.25 × 100	1.3	1.0	+1
7	37 / F	OS	IV	-6.00 / -2.75 × 85	1.3	1.0	-2.00 / -1.50 × 90	0.8	0.5	+2
8	42 / F	OS	IV	-6.50 / -3.50 × 95	2.0	1.0	-3.50 / -2.75 × 85	1.3	1.0	0
9	39 / M	OD	III	-4.00 / -4.00 × 90	1.3	0.8	0.00 / -2.50 × 90	1.3	0.5	+1
10	48 / M	OS	IV	-8.00 / -3.00 × 110	2.0	1.3	-4.00 / -1.75 × 100	1.3	0.7	+2

SLAK = sintral lamellar scalpel keratoplasty; UDVA = uncorrected distance visual acuity; CDVA = corrected distance visual acuity; OD = right eye; OS = left eye.



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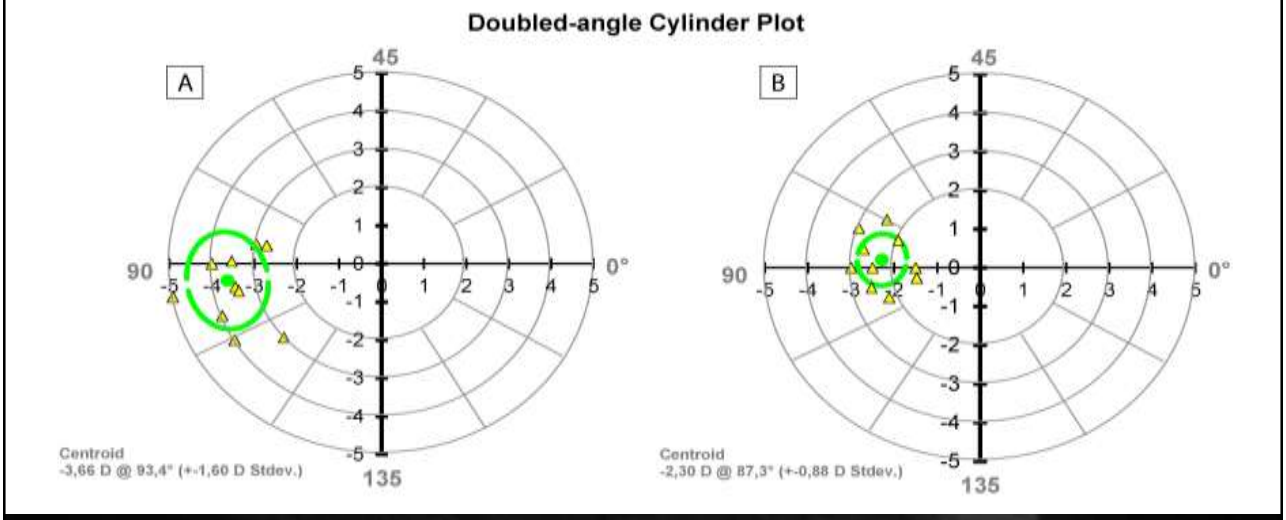
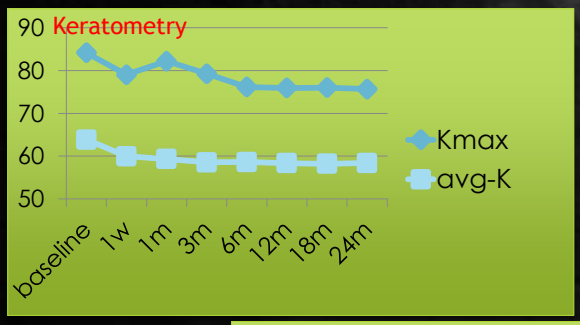
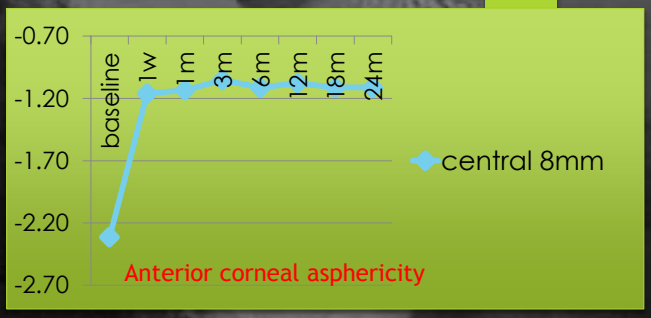
SLAK in advanced Keratoconus: Vector analysis of refractive astigmatism

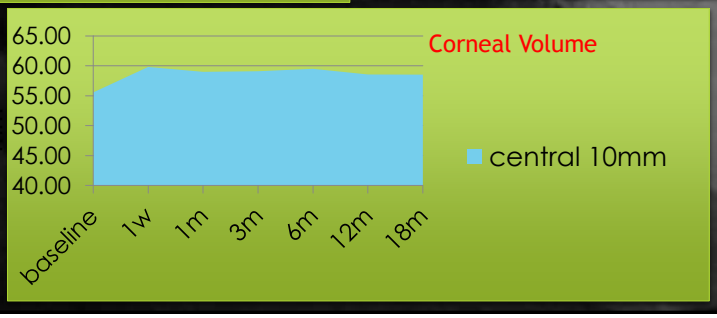


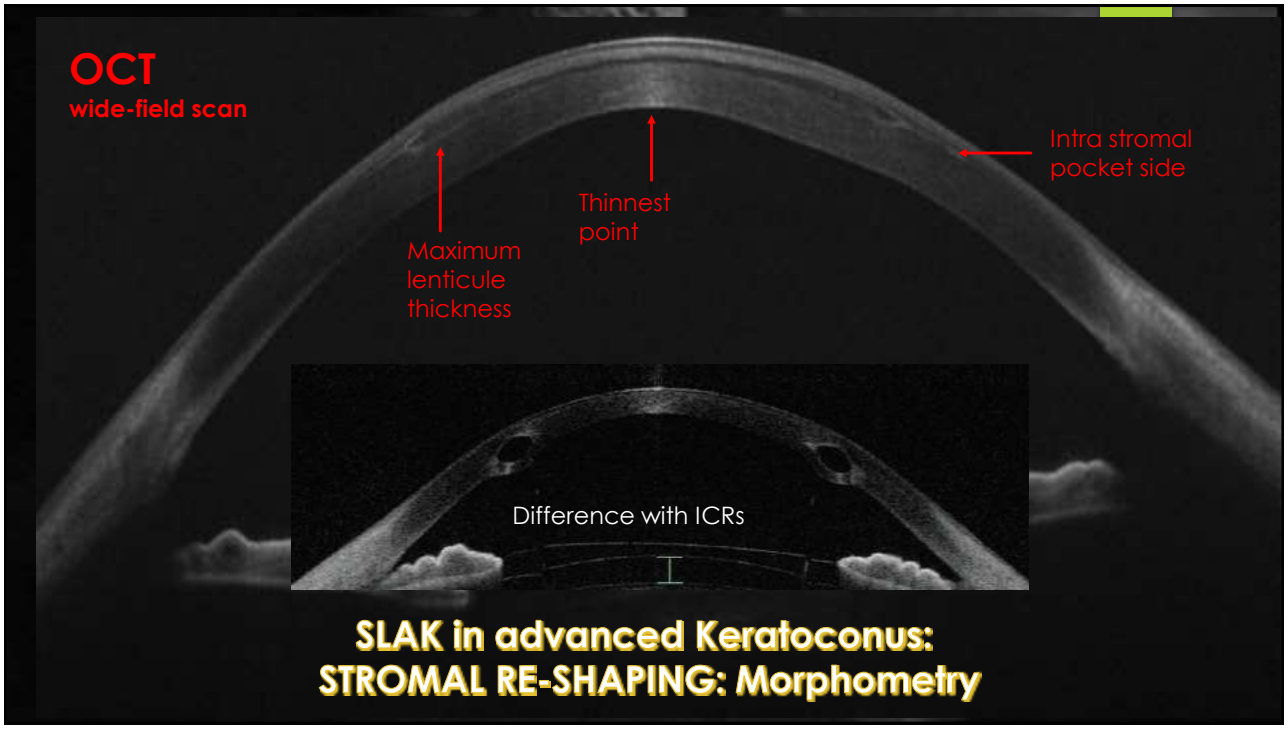
Mastropasqua et al. J Refract Surg. 2018

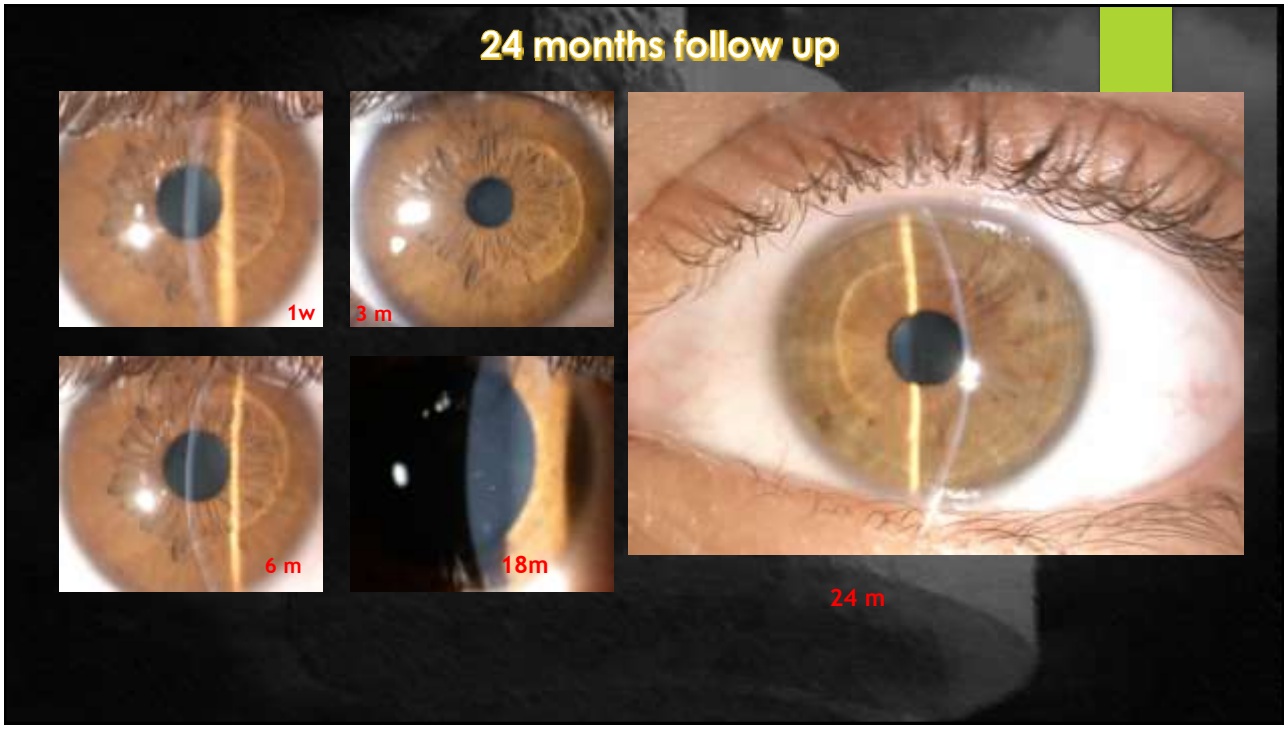
Extended follow-up results



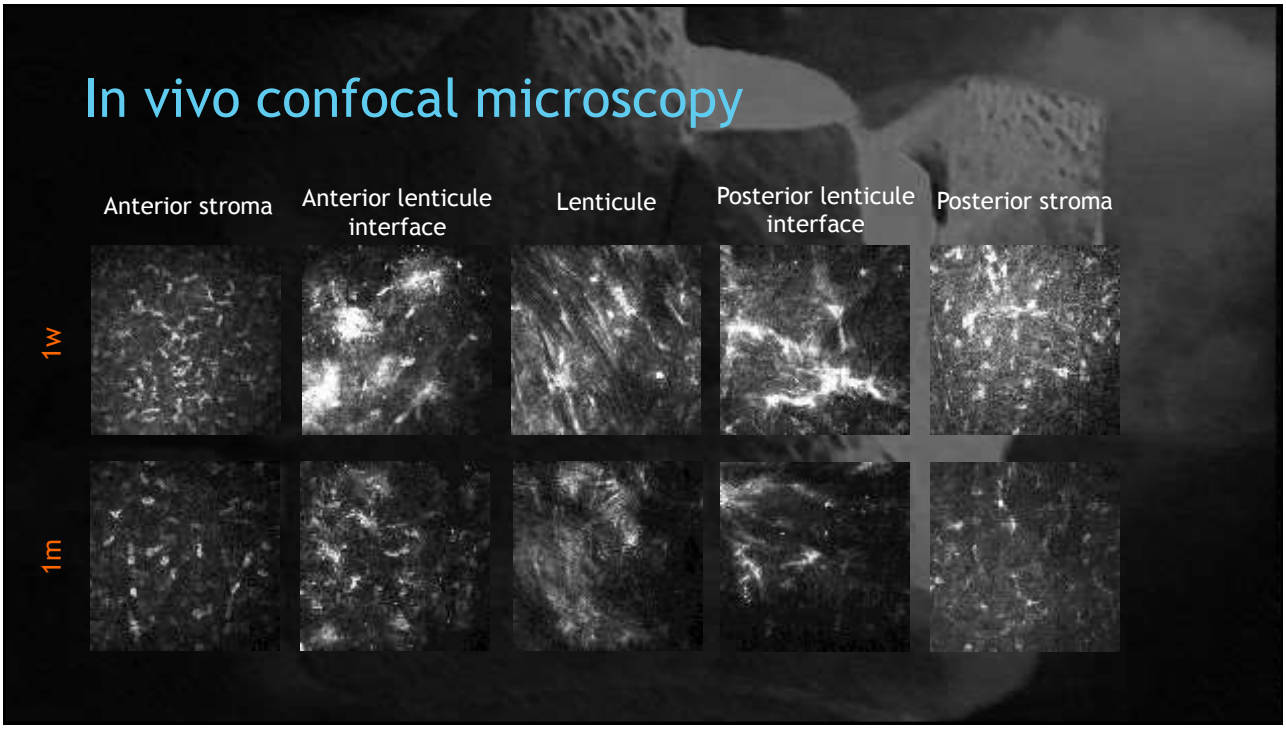


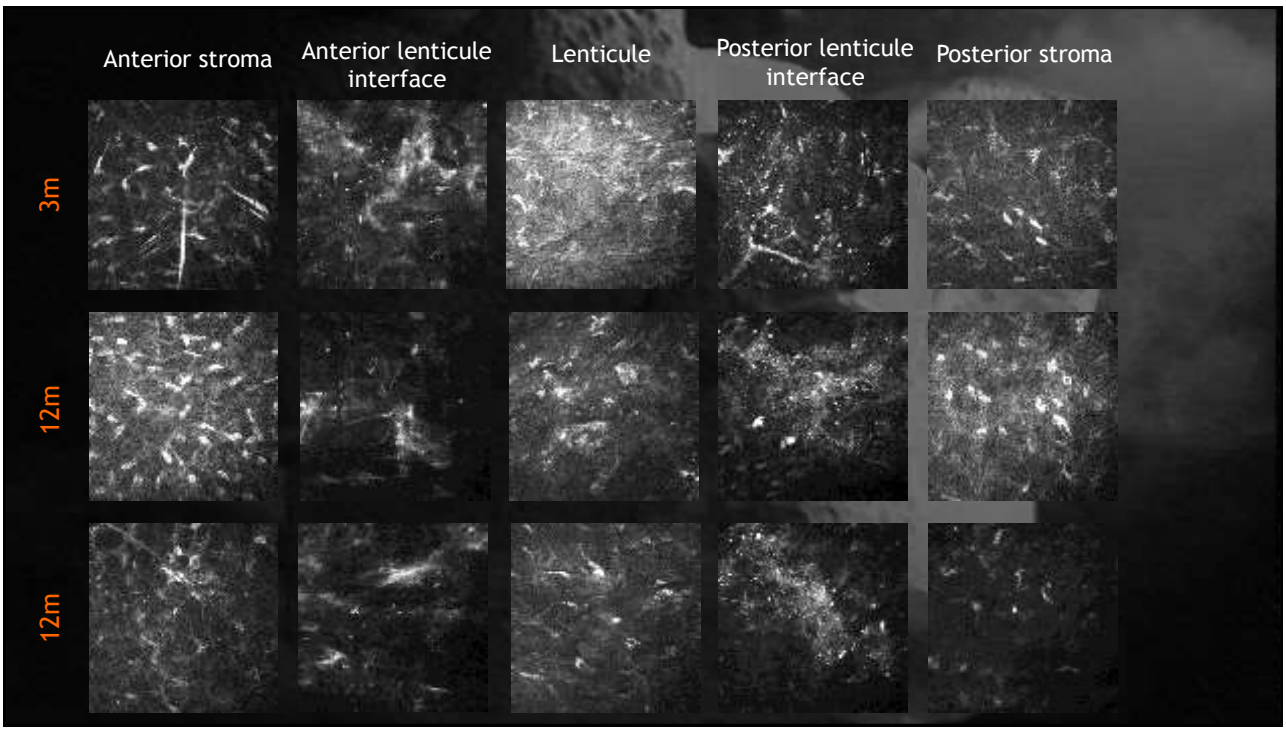



OCT
wide-field scan
Intra stromal pocket side
Thinnest point
Maximum lenticule thickness
Difference with ICRs
SLAK in advanced Keratoconus:
STROMAL RE-SHAPING: Morphometry


24 months follow up
1w
3 m
6 m
18m
24 m

In vivo confocal microscopy





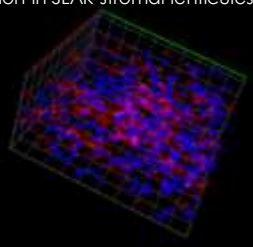
Decellularization and lenticule bio-engineering

Ongoing **collaboration** for lenticule implantation in experimental keratokonus model

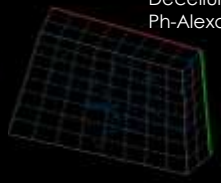
L. Mastropasqua M. Nubile

CNAT Centro Nazionale di Alta Tecnologia in Oftalmologia

Keratocyte (nuclei and cytoplasm) distribution in SLAK stromal lenticules



Decellularized Lenticule 3 Ph-Alexa488/DAPI 3D



2016

Transplantable bio-scaffold with native-like stromal architecture and chemistry

2018

2019

Jodhbir S. Mehta

Singapore Eye Research Institute

Harminder S. Dua

The University of Nottingham

Beatrice Cochener

CHU Brest

Jorge Aliò / del Barrio

Vissum

International Research Group SLAK and lenticule implantation field for basic and clinical applicarions

Jesper Hjortdal

Aahrus University

Josè Luis Guell

IMO - Barcelona

Conclusion

- **A new era in KERATOPLASTY is born** with the introduction of a group of «SMILE-derived» lenticule implantation procedures:

Stromal Lenticule Addition Keratoplasty – SLAK

- Lenticule can be used also as a PATCH in perforation or scleral exposition
- Novel approaches to treat AMETROPIA are now possible (hyperopia, presbyopia)
- Higher amount of tissues is now available for transplantation thanks to LIVING DONOR
- Tissue bio-engineering can further optimize the procedure with lenticule enrichment for targeted disease treatment

Thank you for your attention