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INTACS vs Cross-Linking for Keratoconus

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Siena X-Linking: 1° Corso Nazionale Abilitante

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Keratoconus

- Non inflammatory progressive corneal dystrophy. Collagen rigidity is reduced (3 aria structure modifications). Corneal shape is modified with progressive thinning. The infero-temporally dislocation and local curvature ray reduction produce asimmetric and hyper-refractive corneal surface. The last parameter is partially compensated by the thinning. Overmentioned shape modifications produces several optical effects.

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Keratoconic induced optical effects

- APEX TILTING → PRISMATIC EFFECT
  - ↓ COMA → SECONDARY-ASTIGMATISM
  - ↓ PRISMATIC EFFECT → SECONDARY-ASTIGMATISM
- CORNEAL RAY DECREASING → INCREASED DIOPTRIC POWER OF THE ANTERIOR SURFACE → MIOPIC SHIFT
- CORNEAL THINNING → REDUCED CURVATURE EFFECT → HYPEROPIC SHIFT
- DECREASED POSTERIOR CURVATURE RAY → REDUCED CORNEAL POWER → HYPEROPIC SHIFT

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The ideal conservative procedure for keratoconus

- ✓ Delay or stop corneal degeneration
- ✓ Improve KC related corneal asimmetry
- ✓ Reduce secondary refractive error (pseudoastigmatism)
- ✓ Low complications rate
- ✓ Metabolic error compensation (etiopathogenetic effect)
- ✓ Increase LAC tolerance
- ✓ Possibility of alternative techniques in the future (LK, PK)

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Low-Invasive Techniques

- **INTACS-ICRS, Ferrara Rings**
- PRK, PTK, LASIK
- Termo-keratoplasty, Conductive KP (CK)
- Manual and automatized ARK
- Cross-Linking Riboflavin-UVA **(CCL –C3R)**

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INTACS

- FDA approval for myopia: 1997
- First Keratoconus applications: 1999
- 2004 FDA approval for the reduction of myopia and irregular astigmatism associated with keratoconus
- Additive technique
- Refractive technique
- Target: astigmatism reduction
  Improving corneal shape ?
  Delaing keratoconus evolution ?
- Intacs (Addition technology)
- Ferrara rings: 5 thicks(150-350µm) implantable 5mm
- Intacs: 11 thicks (0.25-0.45 mm) implantable 7mm

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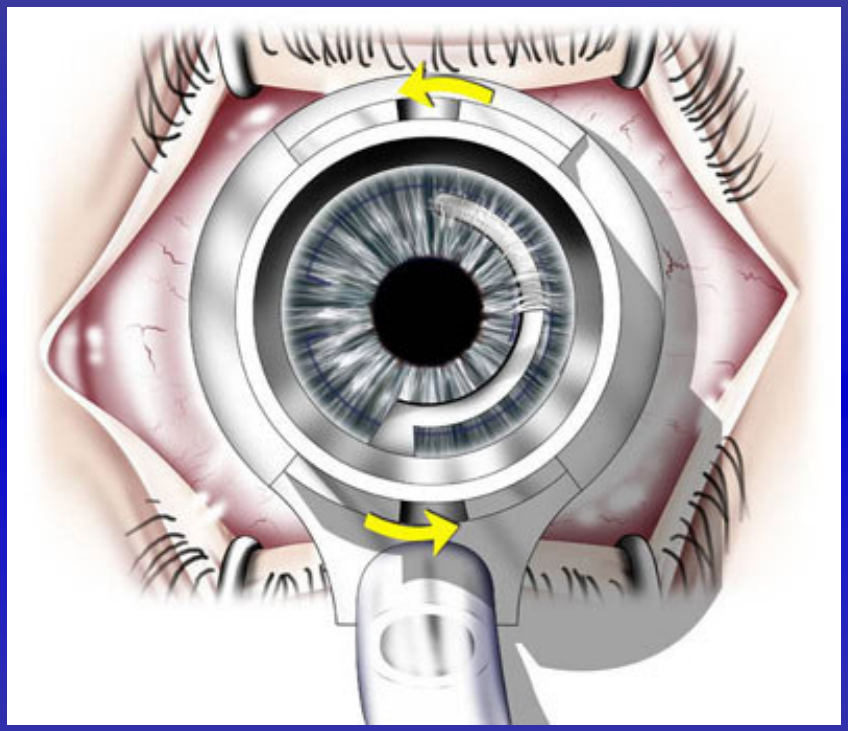
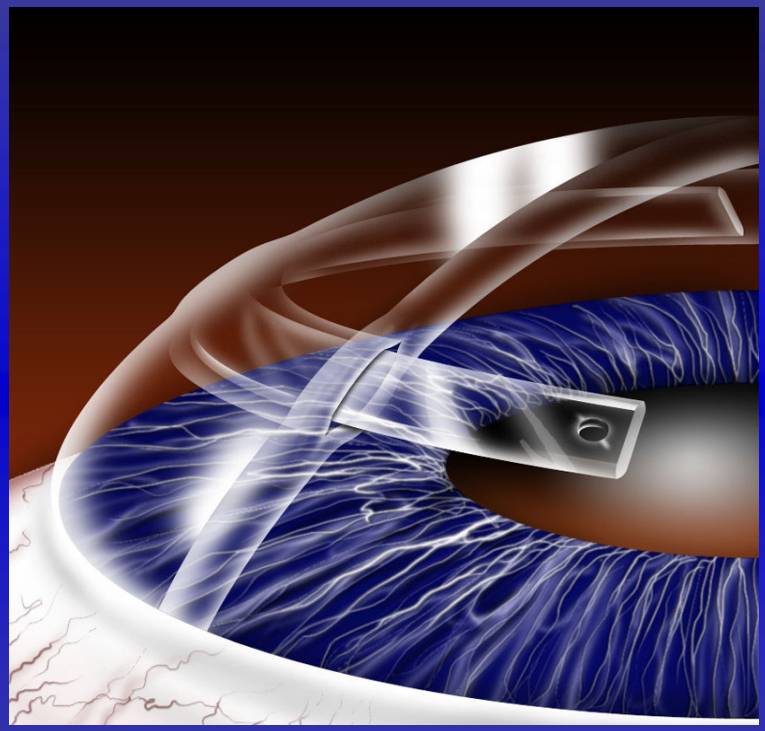
INTACS – ICRS: procedure





- Topic anestesia
- One or two (PMMA) segments insertion towards intra-stromal corneal tunnels
- Manual or Fotodisruptive (IntraLASE) Tunnel Dissection
- Insertion depth: 70 %
- Implant side: Steepest axis, Elevative axis, Coma axis?

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INTACS: indications

Keratoconus: stage I – II – III + + - -

"Analisis of results related to good and bad outcomes of Intacs
Implantation for Keratoconus correction" J. L. Aliò JCRS May-2006

Pellucid Marginal Degeneration: + + + +

"Menagement of Keratoconus With Intacs" S. Siganos AJO 2003

"Intracorneal ring segment for Keratoconus correction: long-term follow-up" J. L. Aliò JCRS 2006

"European clinical evaluation: Use of Intacs for the treatment of keratoconus" J. Colins JCRS 2006

"Intacs for the correction of Keratoconus: Two-year follow-up" J. Colins JCRS 2007

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INTACS complications

EARLY

- Chemosys and sub-conjunctival bleeding
- Epitelial plugs at the incision site (15,2% A. Ertan)
- Inclusions cysts
- Persistent epithelial defect on the implanted ring surface
- Corneal oedema

LATE

- Tunnel haze and deposits (30.7% J. Aliò)(8,5% A. Erta
- Infections
- Induced myopic and astigmatic shift with axis rotation (implatation site!-Decentration)
- Reduced corneal sensitivity
- Neovascularization and corneal pannus (15.3% regressed J. Aliò)
- Corneal melting
- Migration – Extrusion (Advanced Keratoconus grade IV?) 26,9% J. Aliò

7 eyes Ferrara ICRS for Keratoconus

1 eye INTACS for low Myopia

"Corneal Infection After Implantation of Intracorneal Ring Segment" Hofling-Lima Cornea August-2004

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Cross-linking corneale Riboflavina-UVA

Indications:

- Keratoconus stage 1, 2 with clinical-instrumantal progression (f.u. 6 months)
- Corneal Thickness > 400 micron (orbscan, pentacam, visante)™
- Thinnest point (Orbscan) > 380 micron
- Age > 14 anni

Limits:

- Dangerous for endothelium if thickness < 400 micron
- Presence of central corneal scarring
- Few treated cases
- *follow up*

Complications:

- Transient corneal oedema in over 10% patients
- *Persistent Haze* in stage III with Vogt striae or reticular *pattern of the dark micro-striae* in Confocal Microscopic Examination

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Cross-linking advantages

- Easy procedure
- Uninvasive technique
- Pathogenetic targets
- Refractive outcomes comparable with INTACS
- Absence of long-term complications (Haze < 1%)
- INTACS-CCL combination possible
- Indication for corneal melting and post lasik ectasia
- Unexpensive procedure

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Comparative refractive outcomes of Intacs vs CCL - UCVA / BSCVA

Authors	UCVA (pre-op.)	UCVA (post-op.)	BSCVA (pre-op.)	BSCVA (post-op.)
Colin (100 eyes) f-up: 24 m	1/10	3,8/10	4/10	5,8/10
Siganos (33 eyes) f-up: 11 m	Mean 1,1/10	Mean 3.,4/10 Gain +2,3/10 + 230%	Mean 4,2/10	Mean 6,05/10 Gain +1,65/10 +38%
Boxer W. (74 eyes) f-up 12 m				
Aliò (13 eyes) f-up: 36 m				
Wollensak (23 eyes) f-up: 36 m	Mean 1.7	Mean 3.9 Gain +2,2 +164%	Mean 4.05	Mean 5.95 Gain +1.9 +46%
Caporossi (30 eyes) f-up: 18 m				

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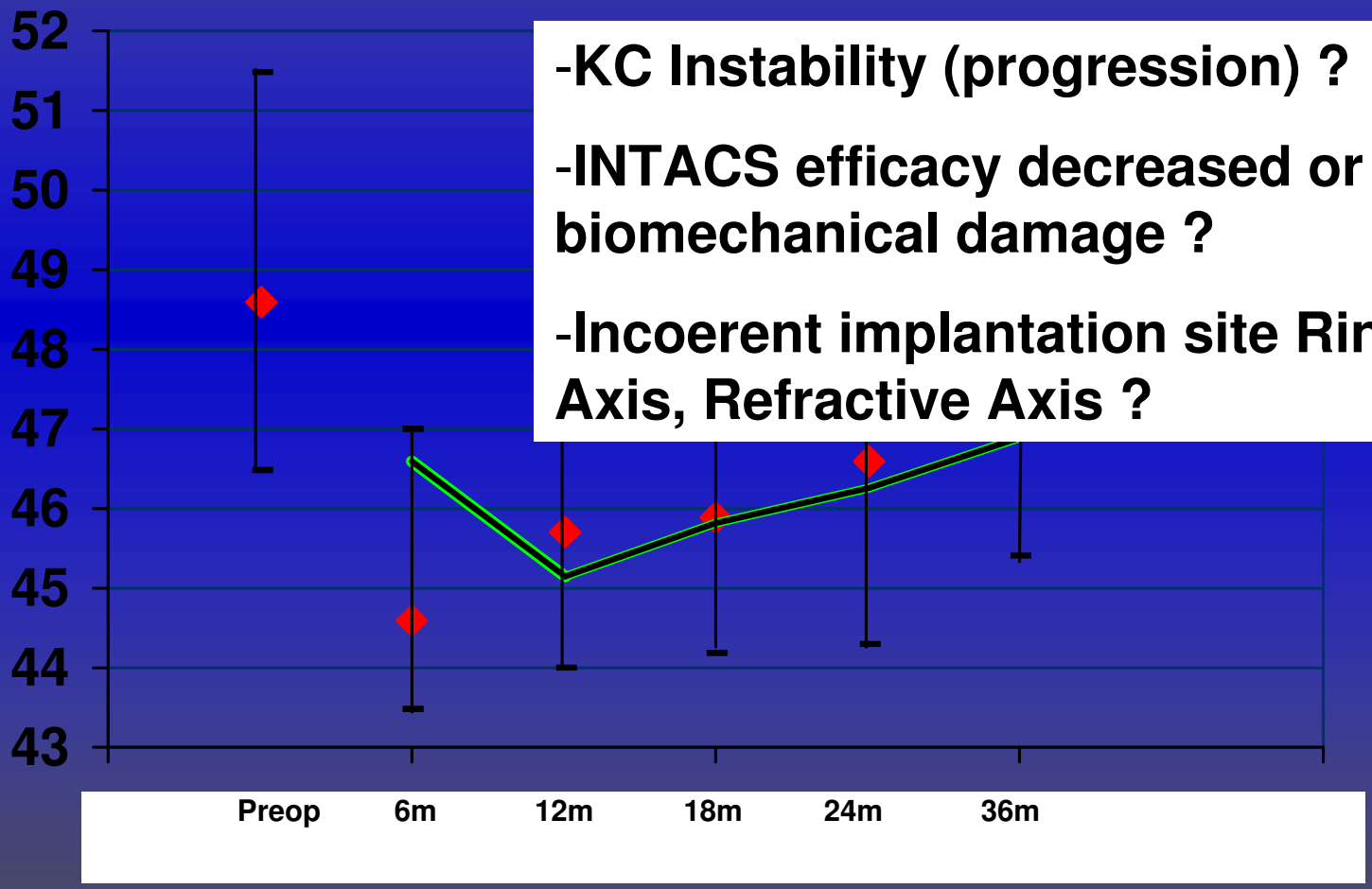
INTACS: Konus instability, decreased efficacy, or….?



-KC Instability (progression) ?

-INTACS efficacy decreased or biomechanical damage ?

-Incoerent implantation site Ring/Coma-Axis, Refractive Axis ?

Aliò J. Et al.: Intracorneal ring segments for Keratoconus correction: long-term follow-up. JCRS: 2006, June (13 casi)

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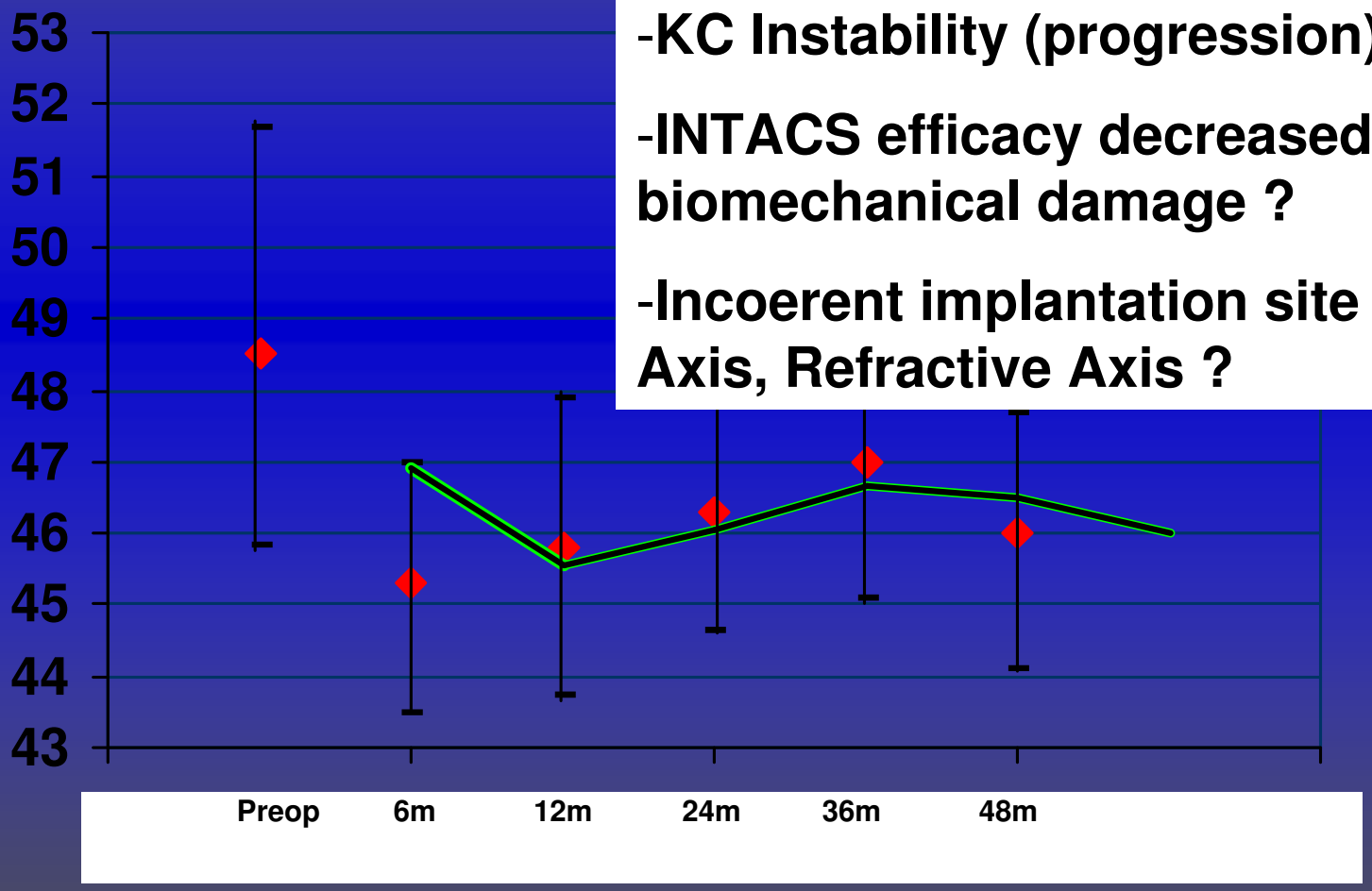

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Aliò J. Et al.: Intracorneal ring segments for Keratoconus correction: long-term follow-up. JCRS: 2006, June (6 casi)

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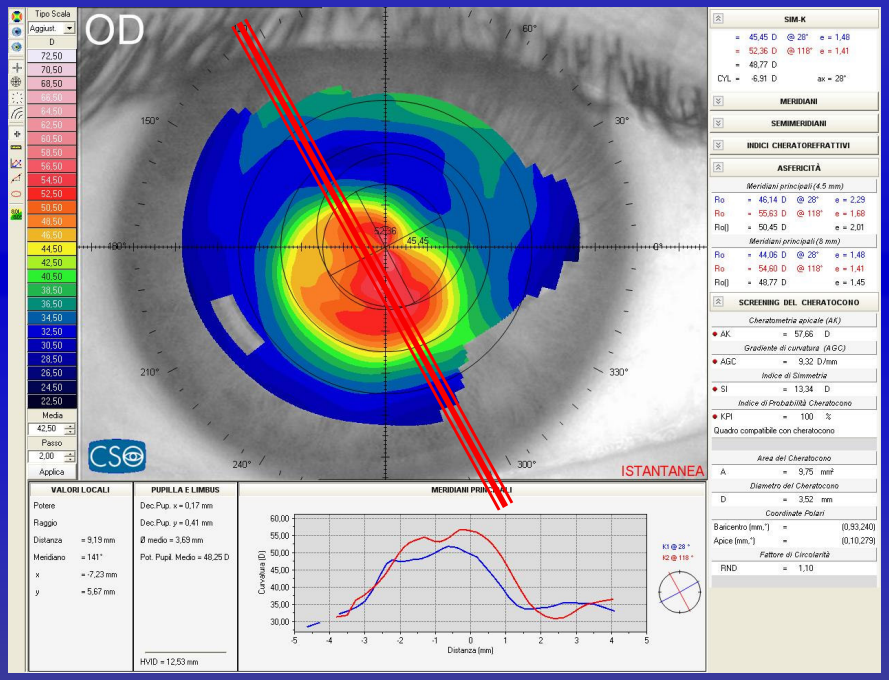
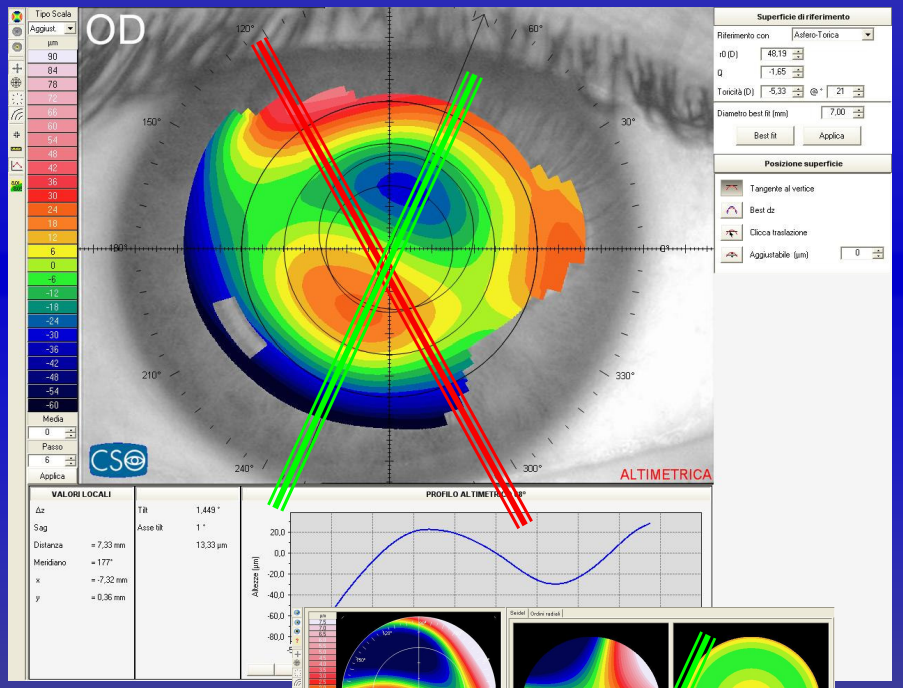
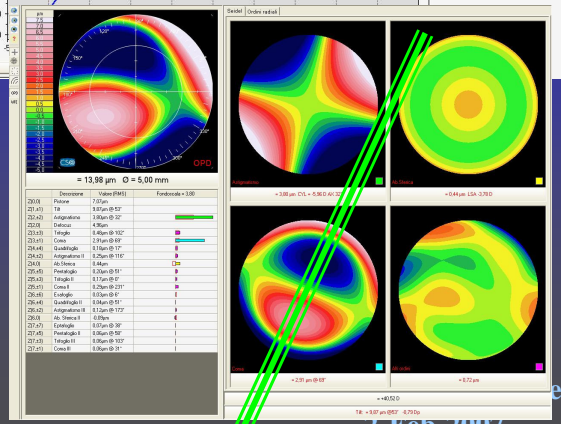
Uncoherence between Refractive and Elevative (Aberrometric) Axis





In approximatively 20% of first-second stage KC we have this discrepancy between refractive and elevative axis orientation. This condition can produce impredictability in INTACS results



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Single-Segment VS Double-Segment

Segment Size	N° treated eyes	percentage
0.25	2	5.40
0.30	6	16.20
0.35	9	24.30
0.25/0.30	7	18.9
0.25/0.35	11	29.7
0.30/0.35	1	2.70
0.35/0.35	1	2.70
total	37	100

"comparison of Single-Segment and double-Segment Intacs for Keratoconus and Post-Lasik Ectasia" M. Sharma Am. J. O. May-2006

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Single-Segment VS Double-Segment

	Preoperative-postoperative Change	
Variable	Single-Segment	Double-Segment
UCVA	9 lines	2.5 lines
BSCVA	2.5 lines	< 1 lines

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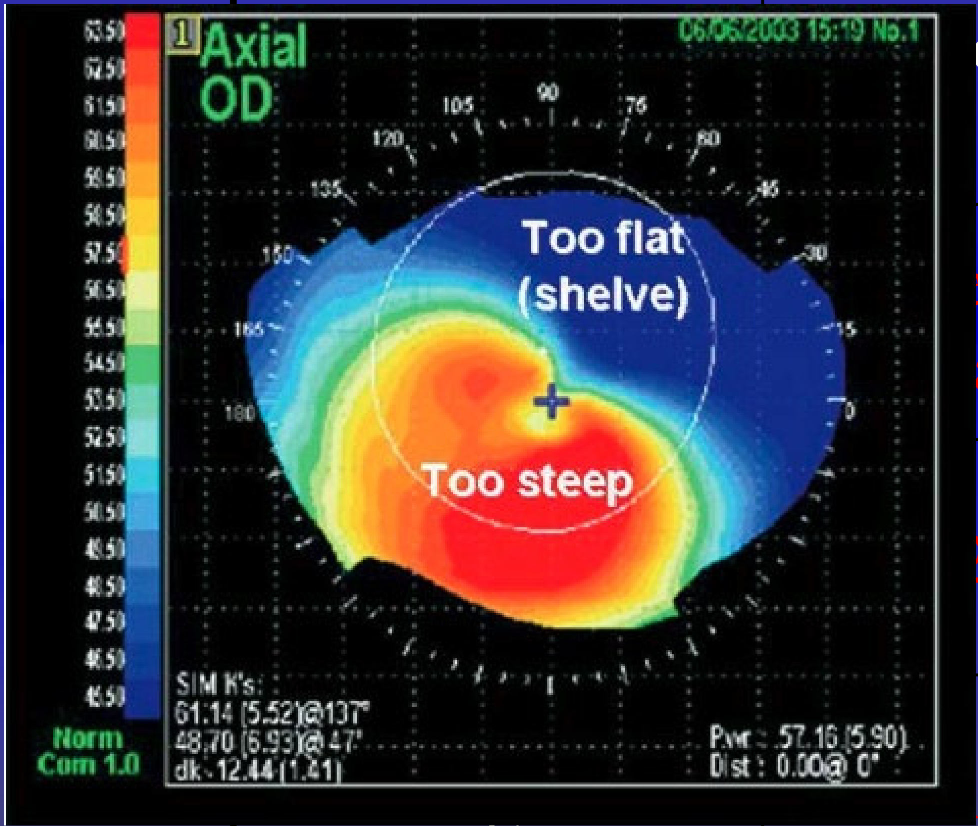
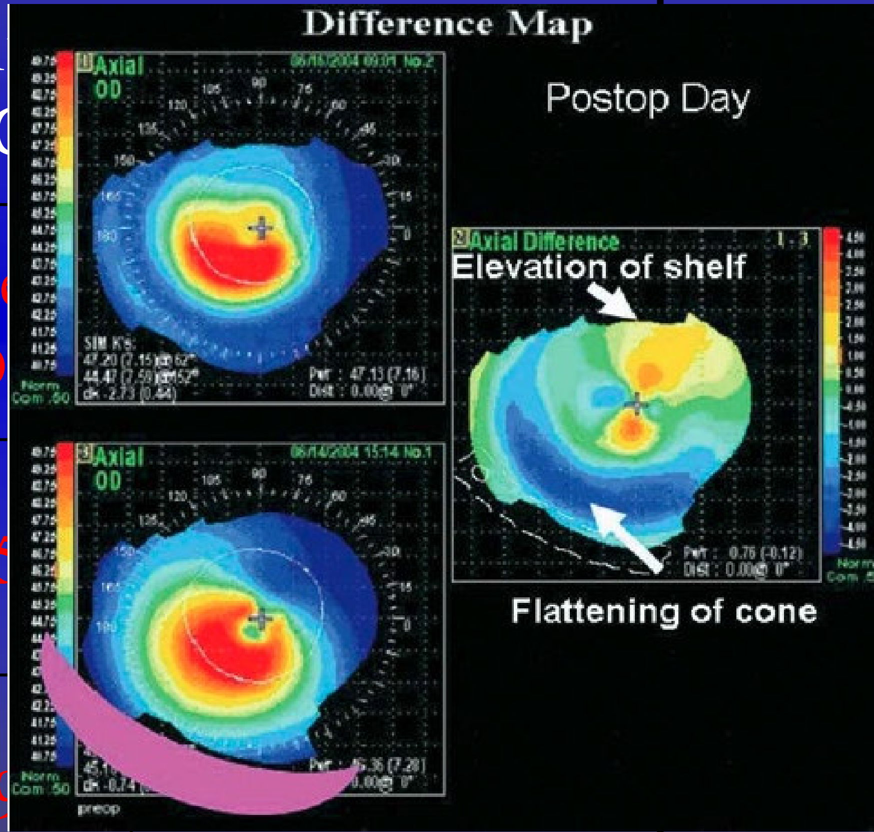
Single-Segment VS Double-Segment



operati
e-segm
an±SD
VS
2 ± 1.55
± 7.49



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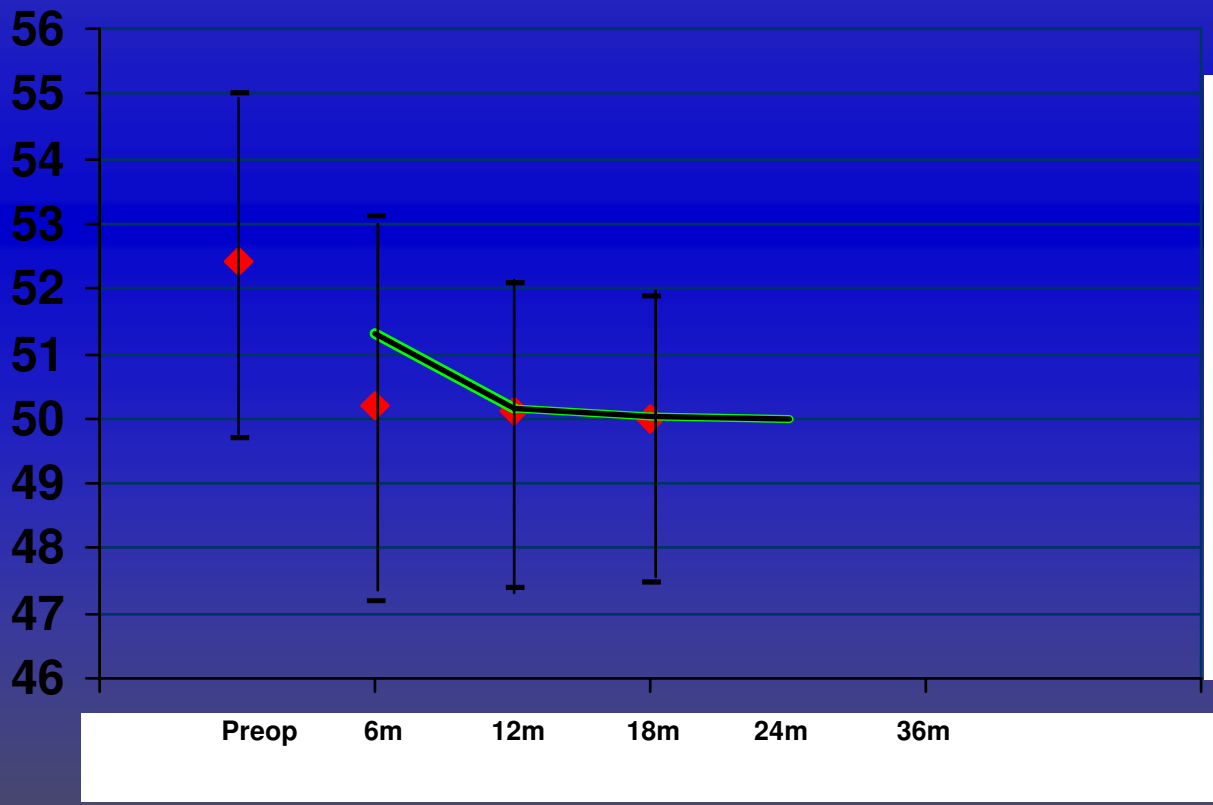
Cross-Linking: Konus stability or mid term efficacy?



A.Caporossi e Coll.: JCRS 2006 aggiornato

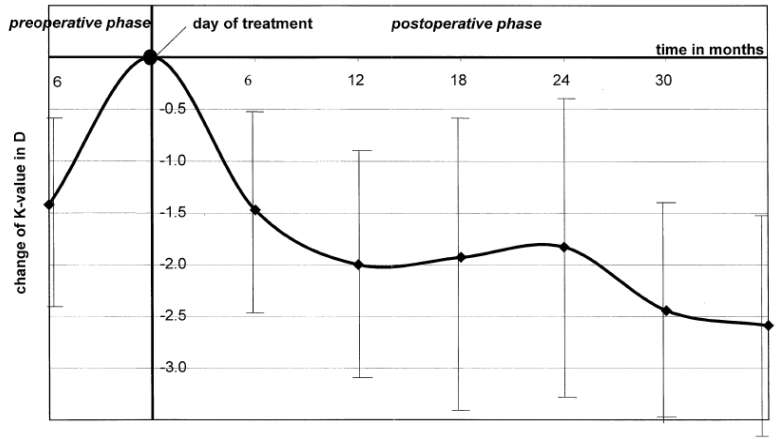


FIGURE 4. (Top) Column diagram demonstrating pretreatment progression of maximum K value in the half year before treatment and posttreatment regression as measured at the latest follow-up examination for each patient. y axis: difference in maximum K value in diopters; x axis: patient number; shaded bars = preoperative change of K value; solid bars = postoperative change of K value. (Bottom) Biphasic curve illustrating the mean change over time of the maximum K value relative to the K value on the day of treatment with mean preoperative progression by 1.4 diopters and postoperative regression by 2.0 diopters (x axis: time in months; y axis: change of maximum K value in D).

Riboflavin/Ultraviolet-A–induced Collagen Crosslinking for the Treatment of Keratoconus

GREGOR WOLLENSAK, MD, EBERHARD SPOERL, PHD, AND THEO SEILER, PHD, MD

AMERICAN JOURNAL OF OPHTHALMOLOGY MAY 2003

"Intacs insertion with femtosecond laser for the management of keratoconus one-year result" Aylin Ertan JCRS Dec-2006

Comparative refractive outcomes of Intacs vs Cross-linking - Astigmatism

Autors	Astigmatism (pre-op)	Astigmatism (post-op)
Colin 100 eyes F-up: 24 m	4.62 D SD: 2.80 D	3.31 D SD: 1.83 D
Siganos 33 eyes f-up: 12 m	3,3 D SD: 2,10 D	3,06 D SD: 2,14 D
Caporossi 30 eyes f-up: 18 m	4,5 D (- 1,5 - 6 D)	3,9 D (- 1 -5,50 D)
Aylin Ertan 118 eyes F-up: 12 m	3,90 D SD: 2.11 D	2.20 D SD: 1.50 D

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Comparative refractive outcomes of Intacs vs Cross-linking - Snellen lines

Authors	Snellen lines (UCVA)	Snellen lines (BSCVA)
Colin 100 eyes F-up: 24 m	+ 2.8 lines	+ 1.8 lines
Siganos 33 eyes f-up: 12 m	+ 2,5 lines	+ 1,7 lines
Caporossi 30 eyes f-up: 18 m	+ 2,4 lines	+ 1,9 lines
Aylin Ertan 118 eyes F-up: 12 m	+ 2,0 lines	+ 1,8 lines

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Conclusions

- CCL is a really low-invasive corneal procedure
- INTACS is a more invasive procedure for cornea
- CCL and INTACS outcomes at 12 months are very similar and comparable!
- CCL has lower complication rate!
- Biomechanically INTACS reversibility is still a open question
- CCL can be used to stabilize INTACS refractive effects
- CCL could be adiuvant therapy in several corneal deseases: melting, post-lasik ectasia, before or after refractive surgery

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The ideal conservative procedure for keratoconus

- ✓ Delay or stop corneal degeneration
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- ✓ Reduce secondary refractive error (Irregular astigmatism, Sphere)
- ✓ Low complications rate
- ✓ Metabolic error compensation (etiopathogenetic effect)
- ✓ Increase LAC tolerance
- ✓ Possibility of alternative techniques in the future (LK, PK)

CCL	Intacs
+++	+/-
++	++
++	++
++	-
++	-
+	-
+++	+