





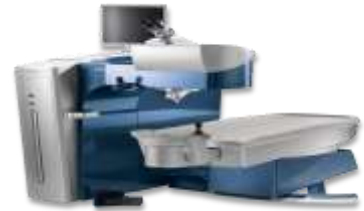
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## Implantation Technique

Two surgical methods have been described for ICRS implantation:

- **Mechanical**
- **Femtosecond laser assisted**



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## Femtosecond-assisted ICRS

Compared to Mechanical method:

- Easier and faster surgery
- Centration
- Create a more uniform and accurate stromal dissection plane
- Less complications rate



**BUT...**

- Not resulted in superior visual/refractive outcomes compared with the manual technique.



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# Femtosecond-assisted ICRS

Monteiro T. *et al* – accepted in Journal of Refractive Surgery

## OBJECTIVE:

To compare the **accuracy** and the **predictability** of Ferrara-type ICRS between the mechanical manual technique and the femtosecond laser assisted technique using a swept source OCT (Casia SS-1000 (Tomey®, Nagoya, Japan)).

## Study Groups

Manual Group: Hospital de Braga, Portugal

Femto Group: Instituto Oftalmologico Fernandez-Veja, Oviedo, Spain



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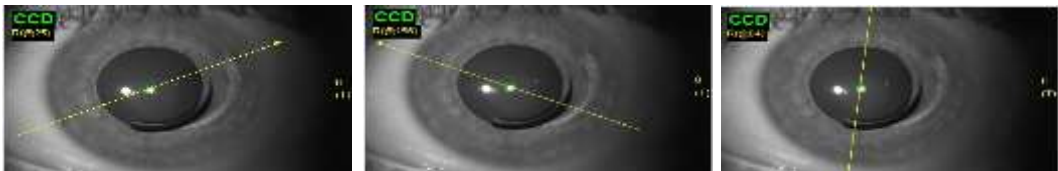


# Femtosecond vs Manual

## Parameters evaluated:

**Difference between the desired depth and obtained**

Depth obtained 3 points: proximal / central / distal





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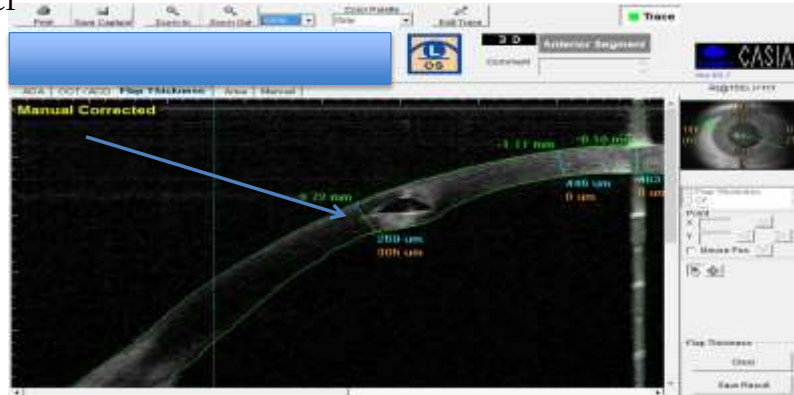
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## Femtosecond vs Manual

### Measurement:

Distance between the epithelial border and the hyperefectivity external line that marks the intrastromal tunnel



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## Femtosecond vs Manual

Parameter	Mean $\pm$ SD Mechanical	Mean $\pm$ SD Femtosecond
Eyes (n)	105	53
Intra-op Pachymetry	514.13 $\pm$ 35.43	525.38 $\pm$ 36.41



# Manual



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Relative Delta	Surgical Technique									
	Manual					Friedman test				
	N	Mean (µm)	SD (µm)	Min (µm)	Max (µm)	Variables	Central Delta	Distal Delta	Proximal Delta	Mean Rank
Central Delta	105	-25.54	71.01	-218	136	Central Delta		-	P<0.05	2.1524
Distal Delta	105	-26.52	73.21	-211	136	Distal Delta	-		P<0.05	2.1381
Proximal Delta	105	-40.87	69.03	-263	74	Proximal Delta	P<0.05	P<0.05		1.7095

The difference between intrastromal depth intended versus achieved was **significantly shallower in the manual group, for all three locations** ( $p<0.05$ )

57.14% of eyes had a superficial implantation shallower than 10 µm from the intended

27.61% of eyes had a deeper implantation above 10 µm from the intended

**15.24%** of eyes reached an achieved depth within  $\pm 10$  µm from the intended



# Femtosecond



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Relative Delta	Surgical Technique									
	Femtosecond Laser					Friedman test				
	N	Mean (µm)	SD (µm)	Min (µm)	Max (µm)	Variables	Central Delta	Distal Delta	Proximal Delta	Mean Rank
Central Delta	53	-3.26	10.58	-26	22	Central Delta		P<0.05	-	2.2453
Distal Delta	53	-8.09	11.91	-56	20	Distal Delta	P<0.05	-	P<0.05	1.6509
Proximal Delta	53	-4.24	11.89	-27	25	Proximal Delta	-	P<0.05	-	2.1038

The difference between intrastromal depth intended versus achieved was **not significantly different for all three locations** ( $p>0.05$ )

22.64% of eyes had a superficial implantation shallower than 10 µm from the intended

9.44% of eyes had a deeper implantation above 10 µm from the intended

**67.92%** of eyes reached an achieved depth within  $\pm 10$  µm from the intended



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## Femtosecond vs Manual

The implantation of ICRS for the treatment of Keratoconus assisted by **Femtosecond** laser is a **more precise and reproducible** technique, compared to the manual technique;

The femtosecond technique is a **safer** technique: associated with a lower incidence of mechanical complications (late extrusions of the implant), it allows obtaining a more precise implant in the corneal stroma.



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## Different Phenotypes of Keratoconus

PHENOTYPE	ANTERIOR CURVATURE	ANTERIOR ELEVATION	FINDINGS
CROISSANT			<ul style="list-style-type: none"> <li>Inverted Astigmatism</li> <li>Topo/Coma axis coincident</li> <li>K1 axis &gt; 45°</li> </ul>
DUCK			<ul style="list-style-type: none"> <li>Direct/Oblique Astigmatism</li> <li>Topo/Coma axis non-coincident (difference 30° – 75°)</li> </ul>
SNOWMAN			<ul style="list-style-type: none"> <li>K1 axis horizontal</li> <li>Topo/Coma axis perpendicular (difference &gt;75°)</li> </ul>
BOWTIE			<ul style="list-style-type: none"> <li>High astigmatism</li> <li>Similar ant-post elevation</li> </ul>
NIPPLE			<ul style="list-style-type: none"> <li>Less astigmatism</li> <li>Central hyperprolate</li> </ul>





# Adjustment of ICRS to the phenotype

Cornea. 2018 Feb;37(2):182-188. doi: 10.1097/ICO.0000000000001448.

## Adjustment of Intrastromal Corneal Ring Segments After Unsuccessful Implantation in Keratoconic Eyes.

Monteiro T<sup>1,2</sup>, Mendes JF<sup>1,2</sup>, Faria-Correia F<sup>1,2</sup>, Franqueira N<sup>1,2</sup>, Madrid-Costa D<sup>3</sup>, Alfonso JF<sup>4</sup>.

Author information

### Abstract

**PURPOSE:** To evaluate visual, refractive, and corneal topography outcomes in eyes with keratoconus that have undergone exchange/adjustment surgery with a new intrastromal corneal ring segment (ICRS) combination after unsuccessful visual and/or refractive outcomes after primary ICRS surgery.

**METHODS:** A retrospective nonrandomized case series was conducted including consecutive eyes of patients with keratoconus that underwent ICRS adjustment after an unsuccessful visual outcome. Patients were divided into 2 groups: group 1 was made up of patients with Intacs ICRSs that were exchanged for the Ferrara ICRS type, and group 2 consisted of patients who maintained the same ICRS type after undergoing ICRS adjustment surgery (change of the arc length or thickness). Uncorrected distance visual acuity, best-corrected distance visual acuity (CDVA), keratometry, asphericity, higher-order aberrations, and corneal regularity indexes (ISV and IHD) (Pentacam HR; OCULUS) were assessed preoperatively and 12 months after each procedure.

**RESULTS:** Twenty-six eyes from 26 patients were included, 8 eyes in group 1 and 18 eyes in group 2. The eyes in both groups improved their CDVA values after ICRS exchange, in group 1 from  $0.27 \pm 0.11$  preoperatively to  $0.54 \pm 0.17$  postoperatively ( $P = 0.001$ ), and in group 2 from  $0.34 \pm 0.22$  to  $0.61 \pm 0.15$  ( $P < 0.0001$ ). In both groups, there was also a significant improvement in the refractive cylinder, topographic cylinder, and coma after ICRS adjustment ( $P < 0.05$ ).

**CONCLUSIONS:** ICRS implantation has been shown to be a reversible and adjustable surgical procedure for keratoconus treatment. Good outcomes can be obtained after ICRSs are exchanged.



## “The Big” ICRS

- Indications:
  - Nipple Cone
  - Low astigmatism
- K Max > 60 D
- CCT at least 400 microns at center
- Femtosecond laser **required**
  - Tunnel
  - Pocket
- Nomogram
  - 200 microns if SE < 6.0 D
  - 300 microns if SE > 6.0 D



340°/320°



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## Clinical Case 1

- Male
- 34 years-old
- KC
  - Penetrating keratoplasty OS
  - **Contact lens intolerance OD**
- **VA OD: 5/10? cc -13.00** (does not improve with cylinder)
- VA OS: 5/10 sc 8/10 cc +1,00 -3,00 x 35°
- BIO OD: no scars; Vogt striae
- BIO OS: PK transparent and well-centered

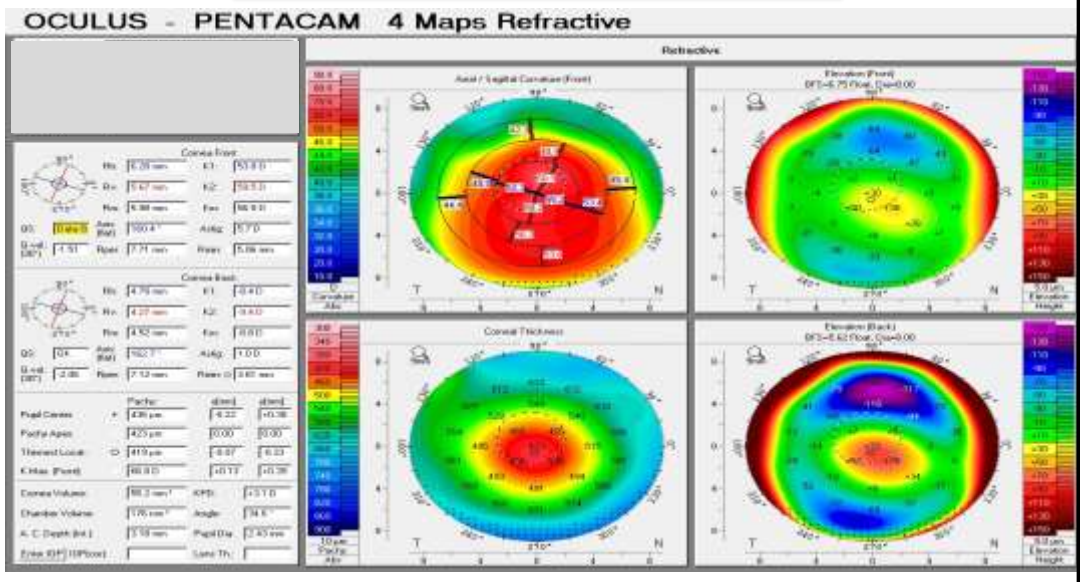


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## Preoperative Exam







## Surgical procedure

- Kerating 340° / 300 microns
- Femtosecond-assisted implantation (FS 200 - Wavelight)
  - Inner diameter: 4.8 mm
  - Depth: 340 microns
  - Outer Diameter: 6.2 mm
  - Incision 90° (1.4 mm x 1.4 mm)



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## Postoperative Visit

- 6 months postop
- VA OD: 7/10 + cc -8.00
  - Contact lens Bausch & Lomb Purevision 2 -7.0 D/8.6 mm/14.0 mm
  - Tolerant to CL
  - VA: 8/10
- BIO OD: ICRS well centered and incision OK



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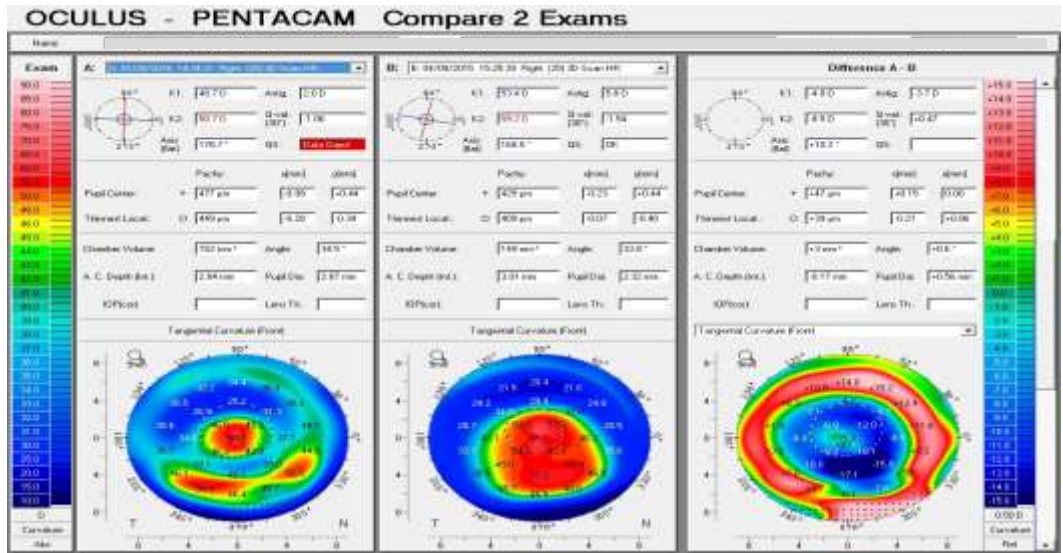




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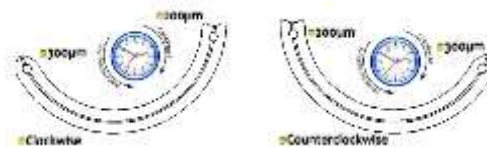
## Comparative Map

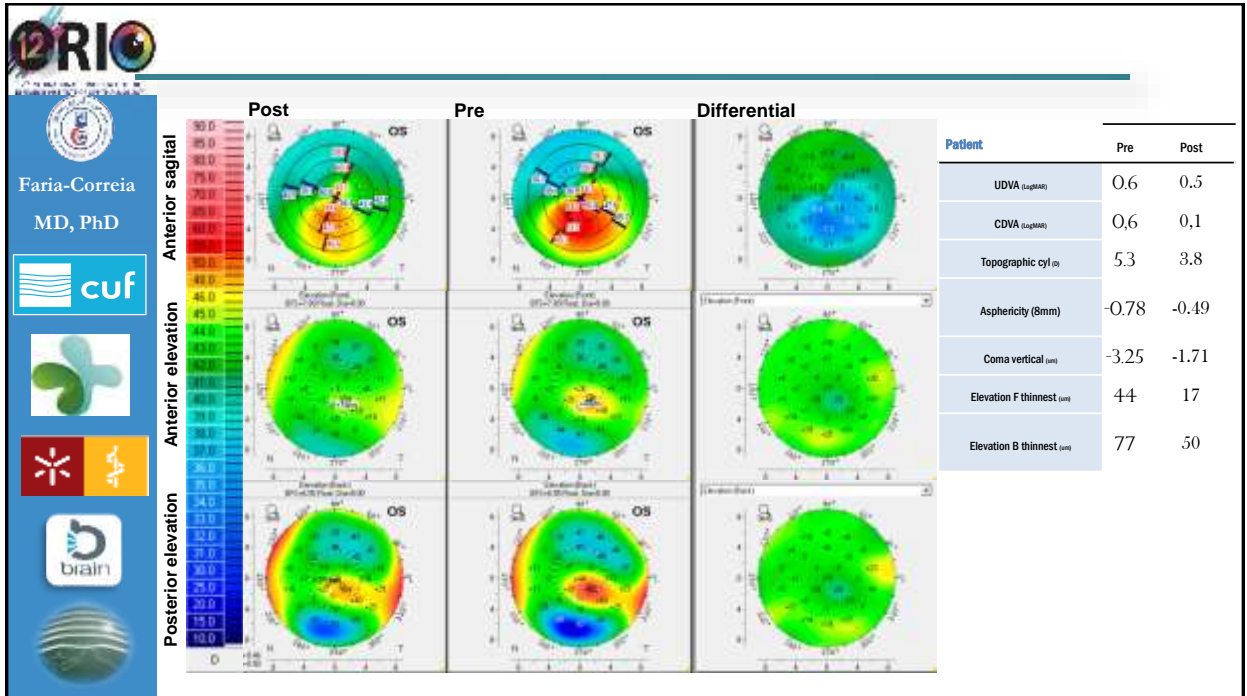


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- Indications:
  - Asymmetric topography, in which a more pronounced flattening effect on one end of the ICRS is beneficial.





## Take-home Messages

- ICRS have a definitive role in the treatment of Ectatic Corneal Diseases
- New **nomograms** and **ICRS** design allow **customization**
- **Femtosecond** laser offers more safety and efficiency to the procedure
- Can be **combined** with other treatment modalities (CXL, PRK, phakic IOL)
  - Indication should be considered based on individual patient characteristics, including UDVA, DCVA, ectasia progression and should NOT be generalized.



**Thank you for your attention!**

Cairo (Egypt) – 25/01/2018