

**FORMULA FOR THE DEPTH OF THE  
FEMTOTUNNEL IN THE IMPLANTATION OF  
THE KERARING SI 5, SI 6 BY MEANS OF  
INTRALASE iFS 150**

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$$DF = (80\%TP \times AC) - (SC \times RC)$$

In our centre we have been conducting the implantation of corneal rings since 2006. Up until last year, the tunnel was created manually, and the results were very encouraging. The acquisition of the IntraLase iFS 150 femtolasers enabled us to perform implantation through the use of the femtotunnel, whose activity, including the incision, lasts 8 seconds. Additionally, the patented planar aplanation system markedly negates the one disadvantage of the femtotunnel, which is that it „doesn't exactly copy“ the lamellar structure of the cornea. The main problem for us was the assessment of the safety setting of the depth of the femtotunnel created. Regarding the difference detected between the outer and inner diameter, we could go by a series of publications and advice from different authors (**Alio, Azar** – Eds.: Management of Complications in Refractive Surgery, 2008, Chapter 16. **Coscunseven**: ESCRS 2009 Barcelona). But as for the question concerning the assessment of the depth, the situation was the opposite

# HOW DID IT THUS DEVELOP, AND WHICH COEFFICIENT MAKE UP THE FORMULA ?

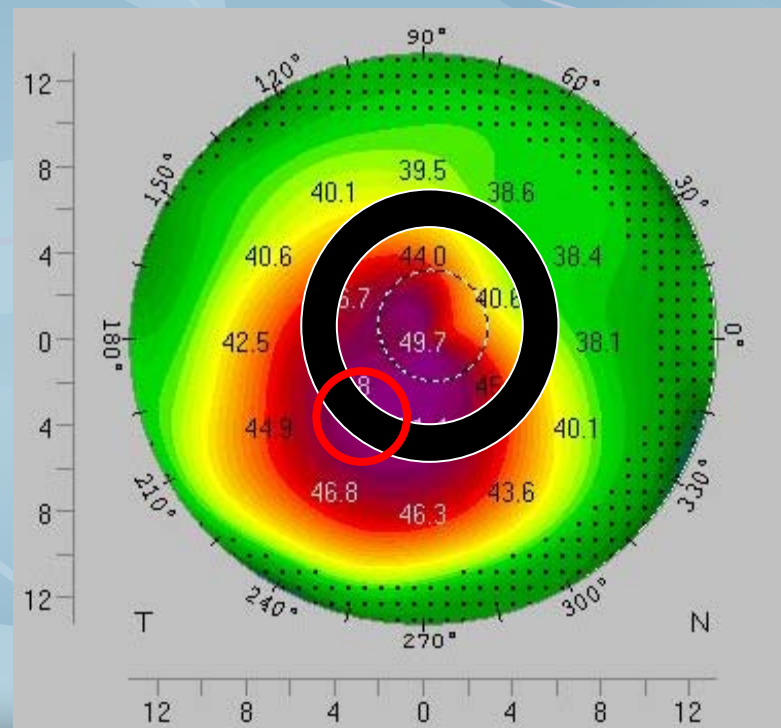
$$DF = (0.8 TP \times AC) - (SC \times RC)$$



$$DF = (80\%TP \times AC) - (SC \times RC)$$

## THINNEST PACHYMETRY ( $\mu$ )

We used the findings of Prisant presented at ESCRS 2008 in Berlin, assessed by the smallest values in the pachymetry zone 5.0 – 6.0 mm. In the case of Keraring SI 6 we set the smallest values in the pachymetry zone 5.5 – 6.5 mm.



$$DF = (80\%TP \times AC) - (SC \times RC)$$

## APLANATION COEFFICIENT

It can also be called compression. It is the most important coefficient in the entire formula. Its assessment came from the discovery that in the majority of cases of the corrective laser method, the flap – whether created with a blade or with the femto – is thicker than was planed. Additionally, creating the flap with the iFS 150 system, visavis 2 equivalent pressures in the value 60 – 80 torrs. It is the pressure of the suction and against that the pressure of the aplanation, whereas the period of the aplanation is noticeably longer in the iFS 150 system – yellow light - (8 seconds)



$$DF = (80\%TP \times AC) - (SC \times RC)$$

## APLANATION COEFFICIENT

Therefore a change comes up in the value of the pachymetry cornea. In creating the lamella with the Moria MK-2 90 and MK-2 130 blade system, we got an evaluation of 500 measurements of coefficient D1 and D2, which distinguished about 0.005 ( $0.845 - 0.840 = 0.005$ ).

Compared with the planned thickness of the flap, with the SBK/femto method with the strenght of the flap resulting in most of the 200 measurements performed, the value of the D3 coefficient was 0.92. This value of D3, „in vivo“, stayed in the basic formula. It was confirmed in several „ex vivo“ tests with the respective SI 5 implantation ring.



$$DF = (80\%TP \times AC) - (SC \times RC)$$

**SAFETY COEFFICIENT -  $\mu\text{m}$**

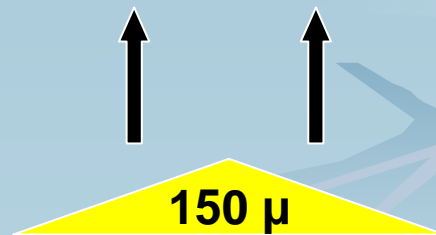
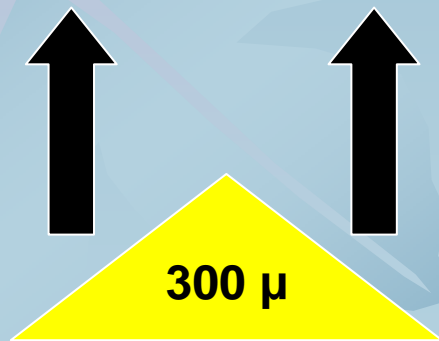
The operator assesses it on the basis of his experience.  
We recommend to start the value of 10 micrones (+10 till -20  $\mu$ )



# **DF = (80%TP x AC) – (SC x RC)**

## **IMPLANT RING COEFFICIENT**

It is different on the basis of the strength of the implanted Keraring SI 5, SI 6 (150 - 350  $\mu$ m). Whereby the strength of the ring is greater, thus the more it can counteract the biomechanistic process in the stromal cornea between the ridge of the ring and the epithelium, which, with an insufficient tunnel depth, can lead to an extrusive ring. FUNDERBURGH reports in Glycobiology (vol. 10 no. 10 pp. 951 – 958, 2000) that after several surgical corneal invasions, keratan sulfate begins to appear in the stromal cornea after 12 hours:



$$\text{RC 1 (150}\mu\text{)} = 0.5$$

$$\text{RC 1 (200}\mu\text{)} = 0.5$$

$$\text{RC 2 (250}\mu\text{)} = 0.1$$

$$\text{RC 2 (300}\mu\text{)} = 0.1$$

$$\text{RC 2 (350}\mu\text{)} = 0.1$$

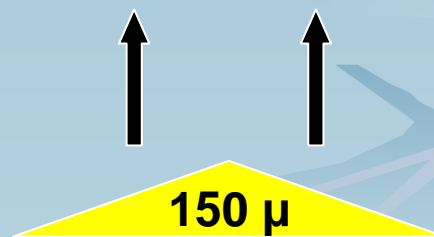
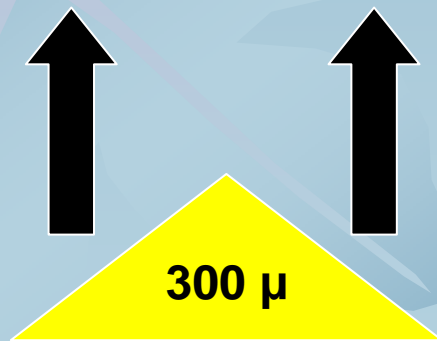
# **DF = (80%TP x AC) – (SC x RC)**

## **IMPLANT RING COEFFICIENT**

This KS is produced by keratocytes, which are activated by inflammatory cytosin. Synthesis of ptoteoglycan and hyaluronic acid also occurs.

And now this acid can alter the water balance in the cornea and affect the structure of the lamella. For this reason, we deduce that the thicker the ring, the deeper it should be implanted. For the Keraring SI 5, SI 6 with a thickness of 350, 300 and 250 micrones, the value is 0.1.

For the Keraring SI 5, SI 6 with a thickness 200 and 150 micrones, the value is 0.5



$$\text{RC 1 (150}\mu\text{)} = 0.5$$

$$\text{RC 1 (200}\mu\text{)} = 0.5$$

$$\text{RC 2 (250}\mu\text{)} = 0.1$$

$$\text{RC 2 (300}\mu\text{)} = 0.1$$

$$\text{RC 2 (350}\mu\text{)} = 0.1$$

# MADUNICKY'S FORMULA

$$DF = (0.8 TP \times 0.92) - (10 \times 0.1/0.5)$$

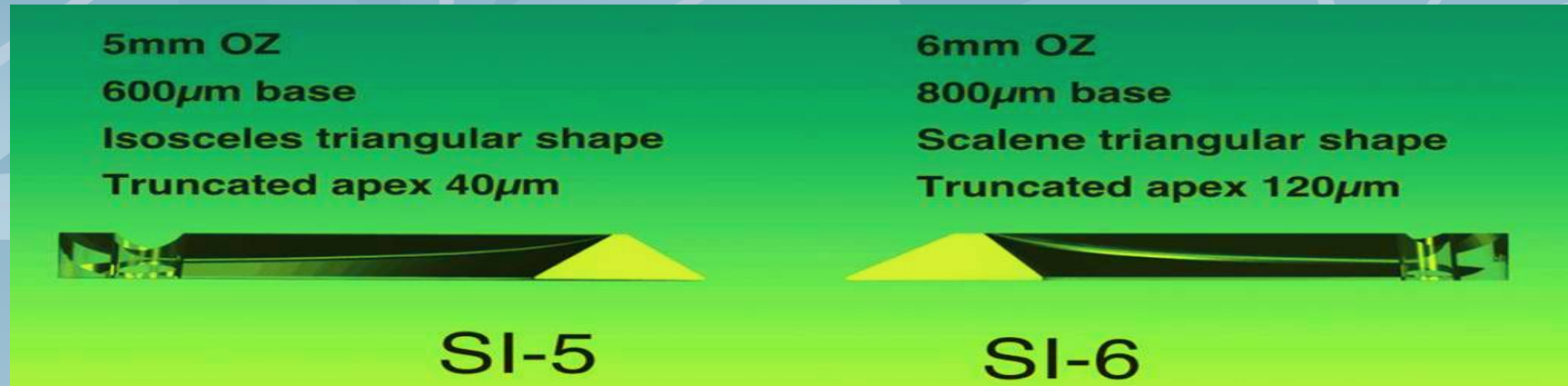
$$DF = (0.8 TP \times 0.92) - (-10 \times 0.5/0.1)$$

At the presence we use this formula



$$DF = (0.8 \times 0.92) - (10 \times 0.1/0.5)$$

**KERARING SI 5, SI 6**



### KERARING SI 5

The segment manufactured by PMMA CQ in in 20 modifications is in the shape of an isosceles triangle with a base of 600, an apex of 40 micrones, and its inner, lower part is implanted 2.5 mm from the center of the cornea.

### KERARING SI 6

The ring of the same material, but in the shape of a multi-faceted triangle, has a base of 800 and an apex of 120 micrones. It is implanted 2.75 or 3.0 mm from the center of the cornea. It also makes some 20 modifications, however the angle of 160 degrees is replaced by 150 degrees

$$DF = (0.8 \times 0.92) - (10 \times 0.1/0.5)$$

## SETTING OF THE INTRALASE IFS 150 PARAMETERS FOR KERARING SI 5 IMPLANTATION

- Depth in Cornea ( $\mu\text{m}$ ):  $(0.8 \times 0.92) - (10 \times 0.1/0.5)$ 
  - Entry Cut Length (mm): 1.1
  - Entry Cut Thickness ( $\mu\text{m}$ ): 1
  - Inner Diameter (mm): 4.9
  - Outer Diameter (mm): 5.7
  - Ring Energy ( $\mu\text{J}$ ): 1.40
  - Ring Cut Energy ( $\mu\text{J}$ ): 1.40
  - S/L Separation ( $\mu\text{m}$ ): 3/3

$$DF = (0.8 \times 0.92) - (10 \times 0.1/0.5)$$

## COMPLICATIONS

There are quite a number of complications after the implantation of a intrastromal corneal ring. Among the most basic are:

- endothelial perforation, extrusion
- deposits, decentration
- vascularization, infectious keratitis

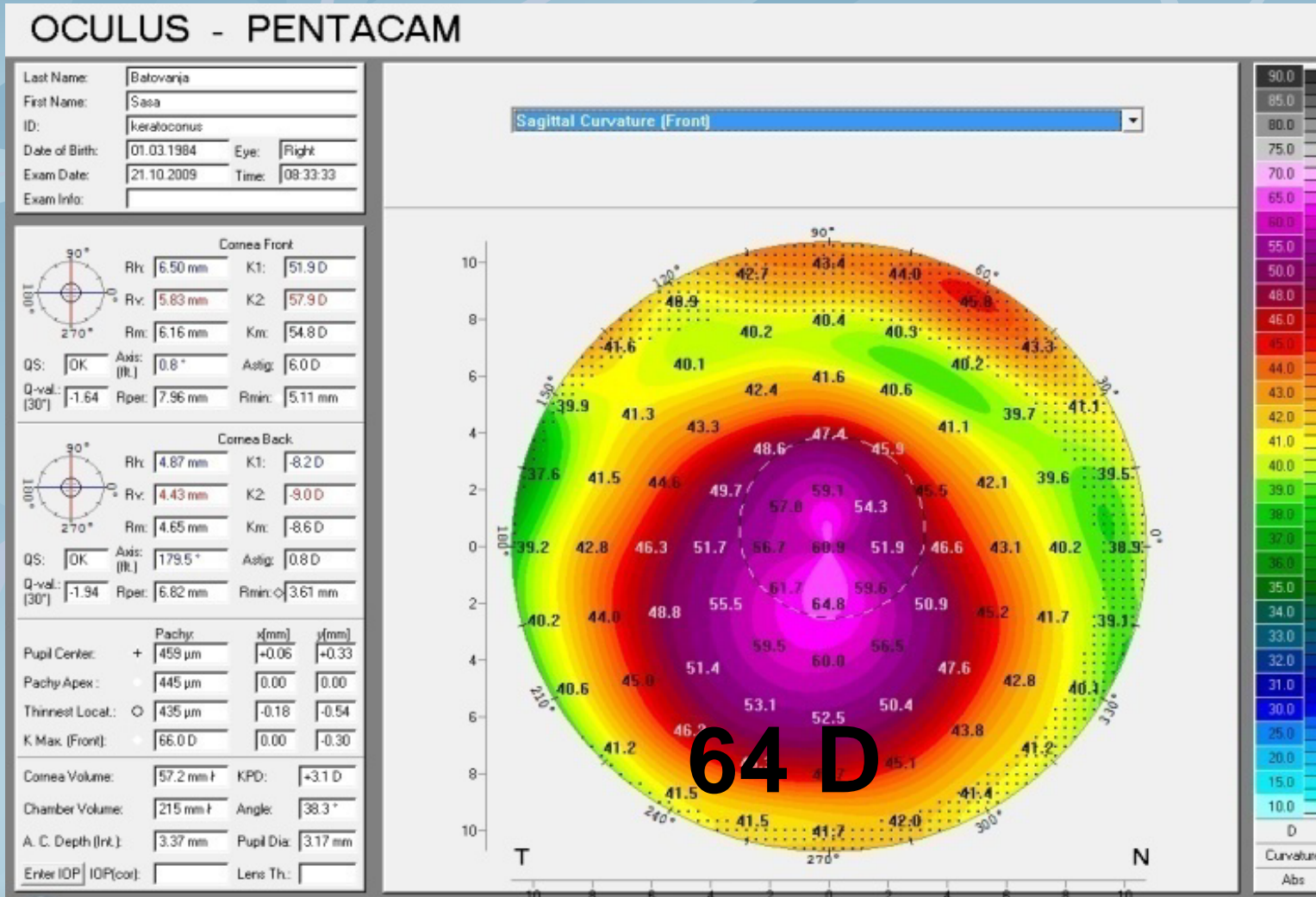
The depth of the implantation, which should be 80% the thickness of the cornea, minimizes the endothelial perforation and extrusion. Determination of the inner and outer diameters is important for negating the production of deposits and for the minimalization of vascularization in the tunnel

$$DF = (0.8 \times 0.92) - (10 \times 0.1/0.5)$$

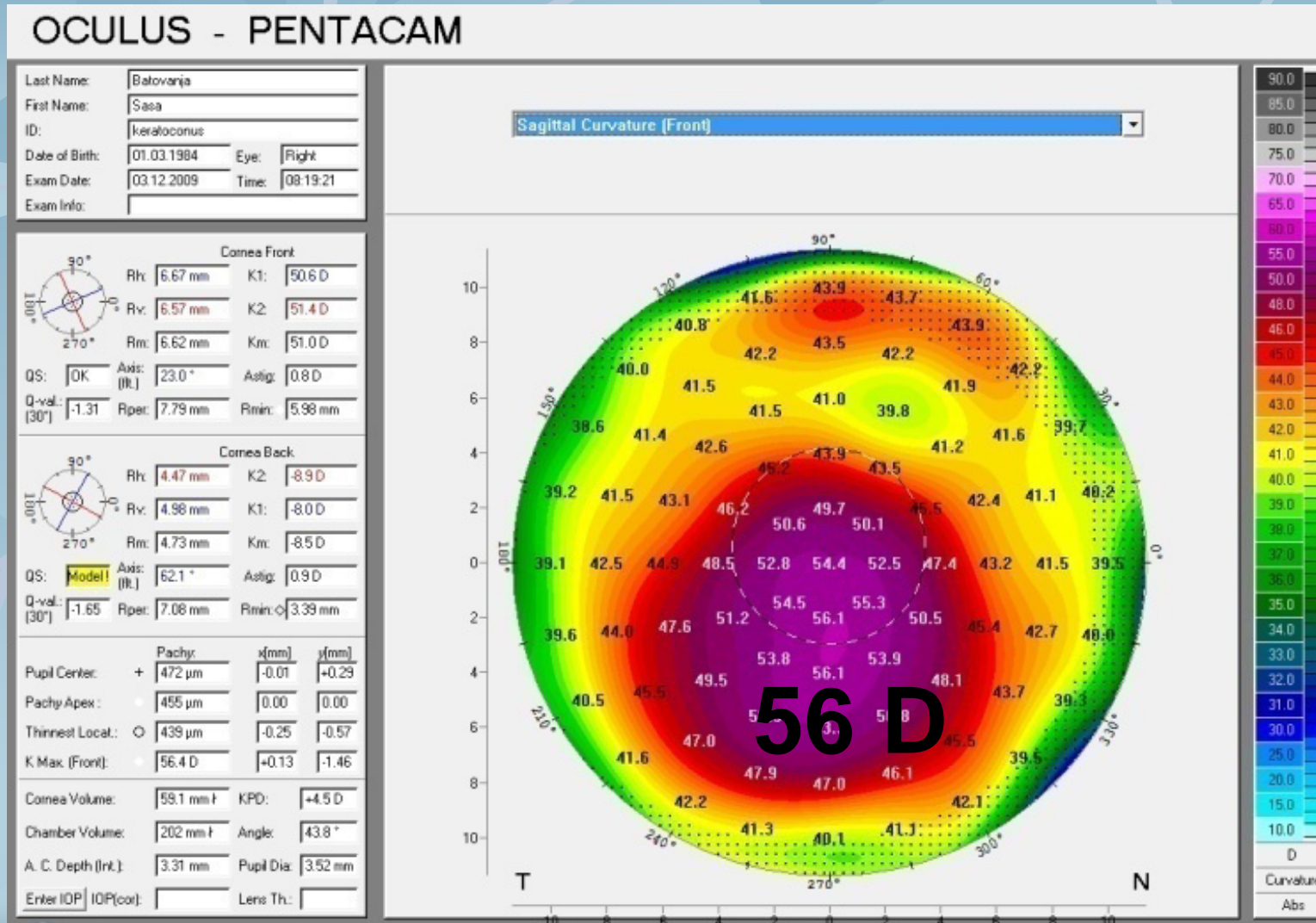
## CONCLUSION

Since November 2009 we have performed femtoimplantation of the Keraring SI 5 in 25 eyes— with the duration of observation being 2-7 months. In 20% (5 eyes) we noted discreet deposits around the ring. No other of the above mentioned complications as from endothelial perforation and infectious keratitis appeared. Not even in one case did keratoconus occur, whereas it did in some 18 followed cases in the space of a month with the CXL treatment method (keratoconus levels II. to III-IV.). UCVA improved in 84% of cases (21 eyes), in 16% (4 eyes) vision remained at the same as before the operation. BCVA was better in 64% (16 eyes), the same in 28% (7 eyes) and in 8% (2 eyes) deteriorated by 1-2 lines.

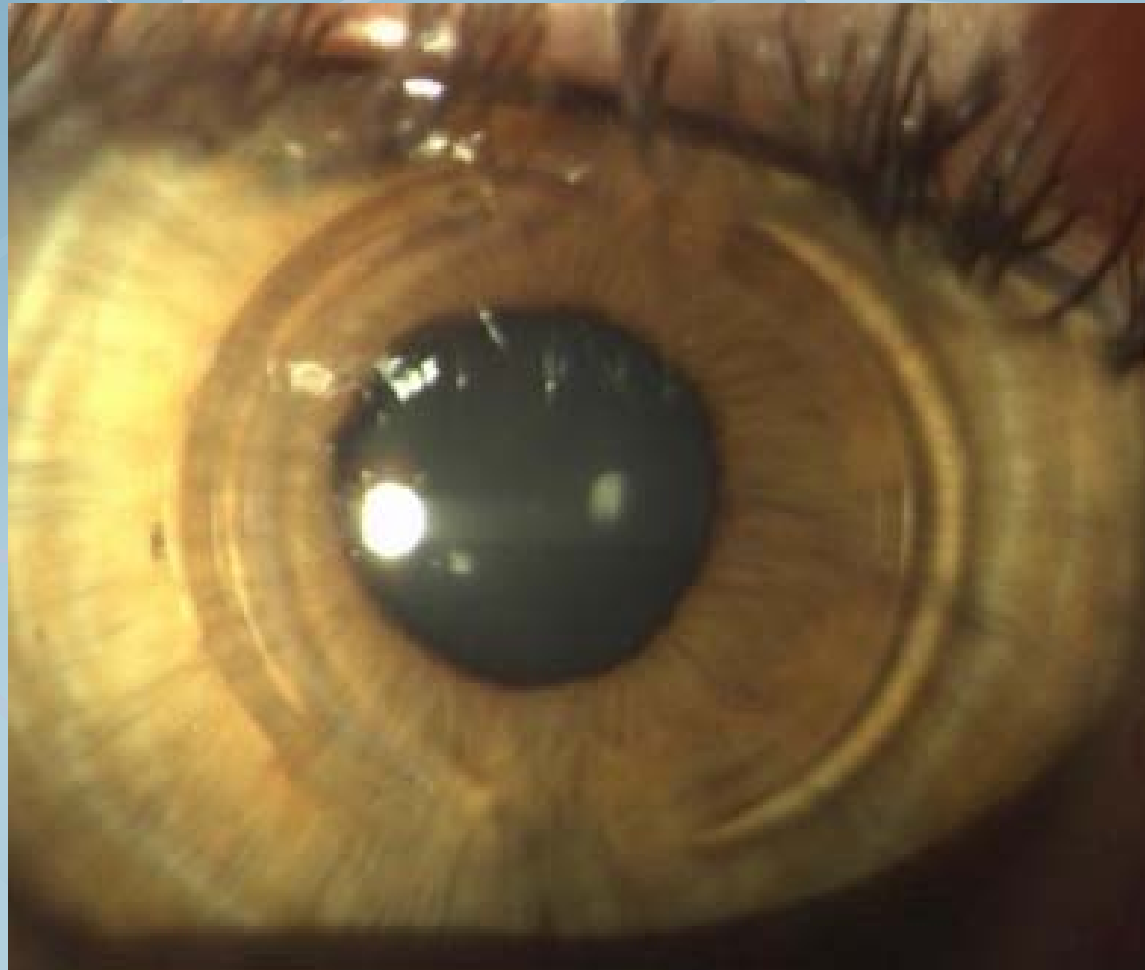
# KERATOTOPOGRAPHY FINDINGS IN A PATIENT WITH KERATOCONUS III. - IV. DEGREES (64 D) BEFORE OPERATION



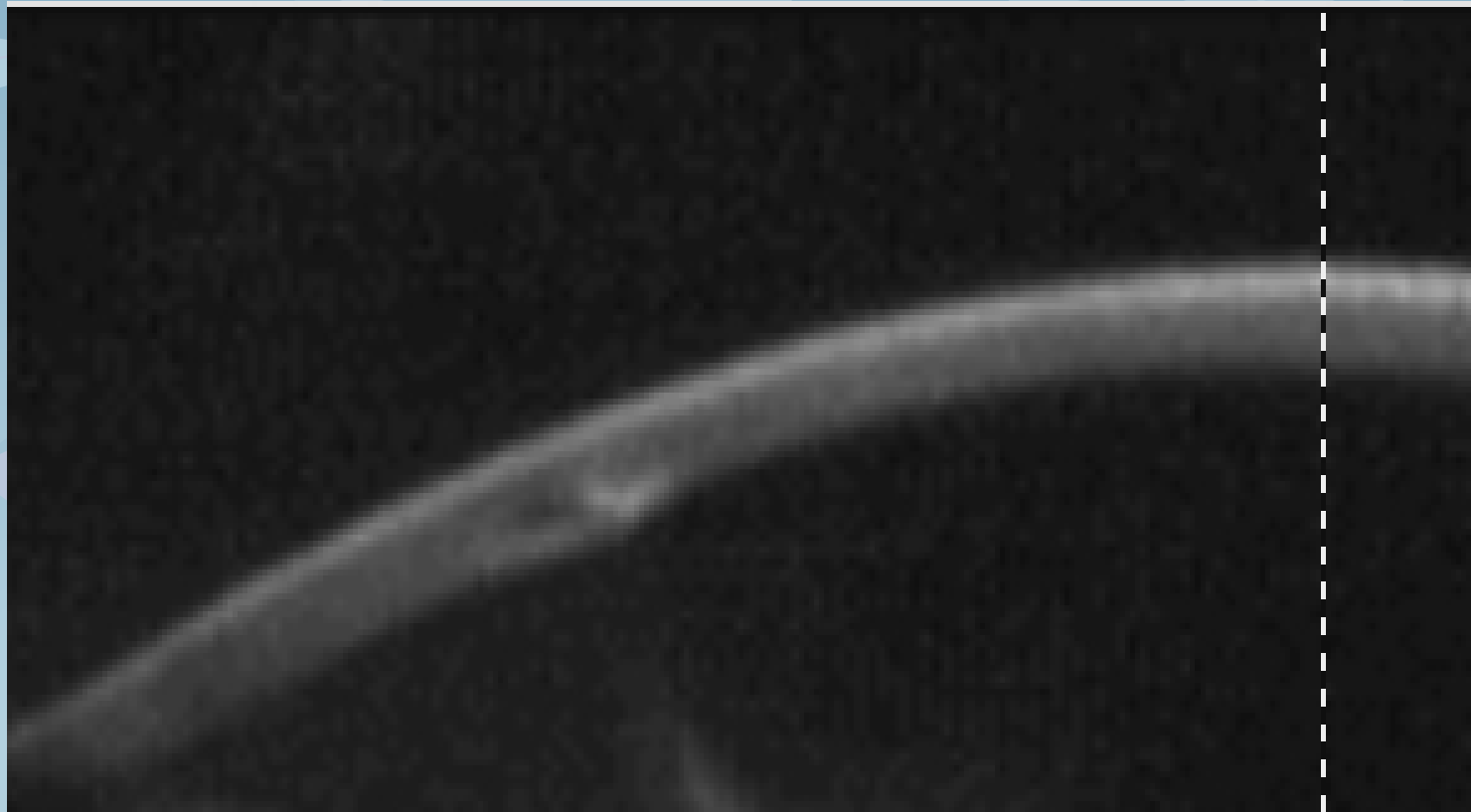
# KERATOTOPOGRAPHY FINDINGS A MONTH AFTER FEMTOIMPLANTATION (56 D)



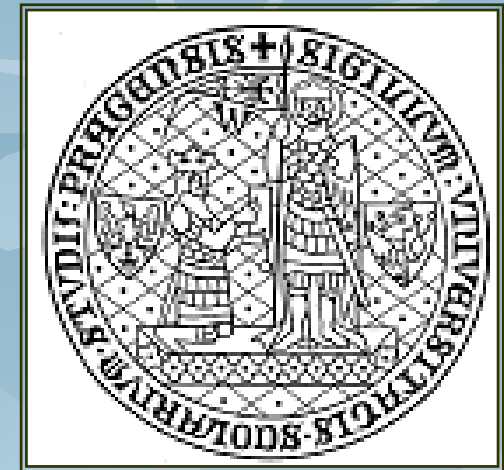
**PHOTO OF THIS PATIENT A MONTH AFTER  
OPERATION**



# THE DEPTH OF THE RING UPON EXAMINATION OF THE UNSPANNED OCT



# THANK YOU FOR YOUR ATTENTION



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