Management of high astigmatism after penetrating keratoplasty

Ahmed Sherif MD

Assistant Professor of Ophthalmology

Cairo University

No financial interest

Incidence

Several reports state that 15 -31% of PKP patients end up with astigmatism > 5 Diopters

Causes

- **Graft –Host disparity:**

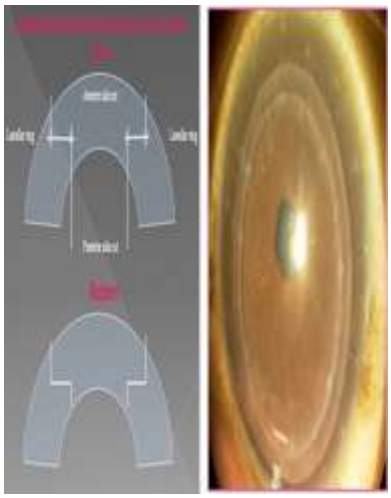
Trephination from **epithelial surface** in **recipient** → **oval cut**

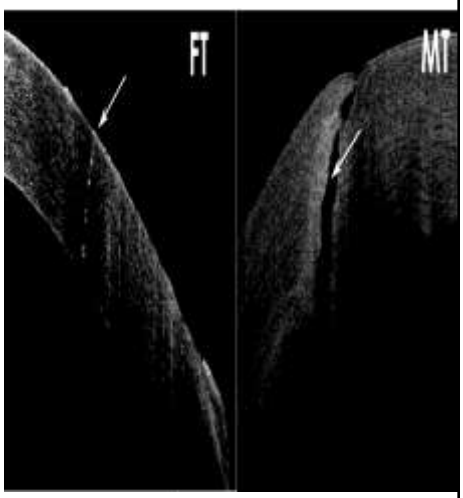
Trephination from **endothelial surface in donor** → **rounded button**

- **Vertical tilt**
- **Decentered cut**
- **Suturing technique**
- **Infant donor tissue**
- **Recipient tissue (Keratoconus)**

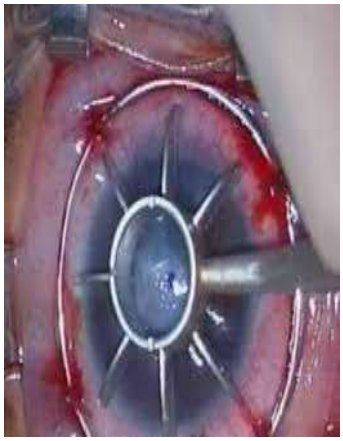
Prevention

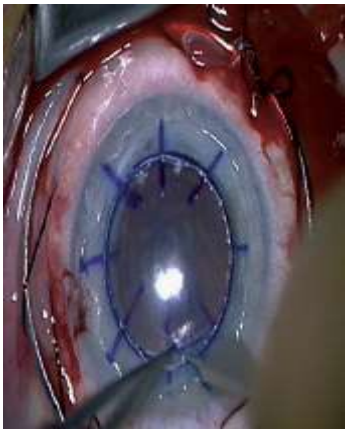
Femtosecond laser trephination



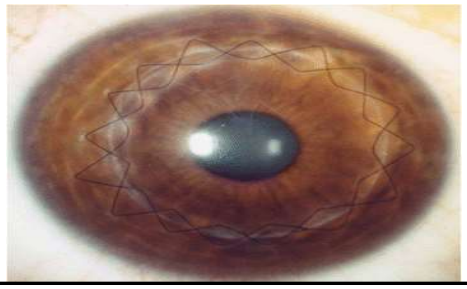


Marking the cornea

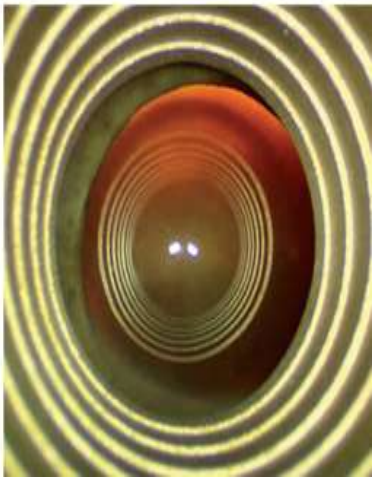




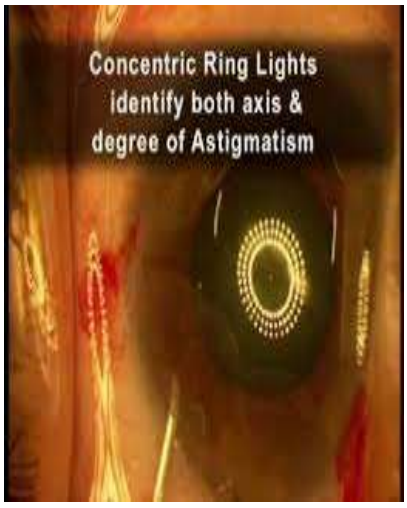
Adequate suturing technique



Maloney ring



Intraoperative keratoscope

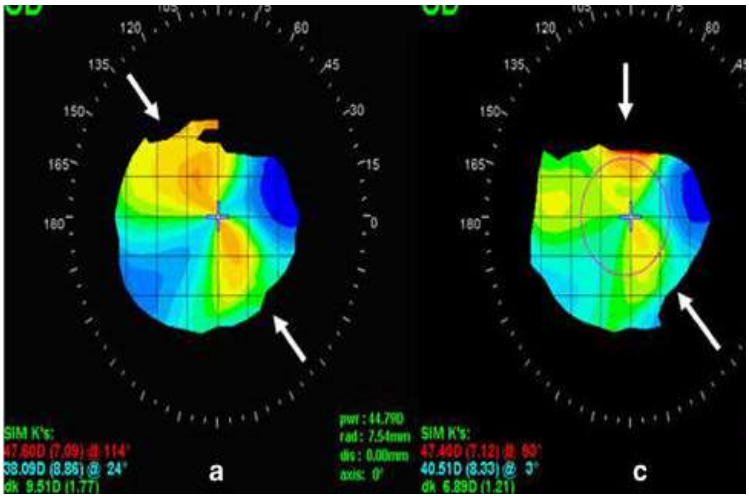


Management

Selective suture removal

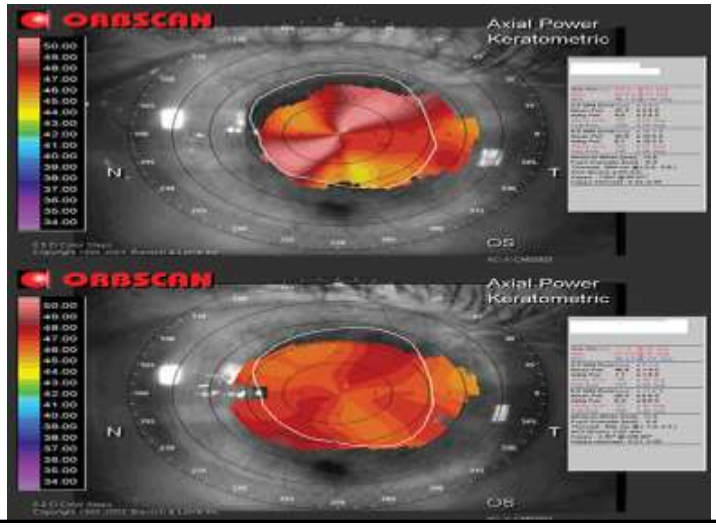
- **Removal of tight sutures along steep meridian**
- **Guided by Topography**
- **Single suture at a time**
- **As early as 2-4 months after surgery**
- **Strict aseptic measures**

Selective suture removal



Adjustment of running suture

On the slit lamp or in the Operating Room



If still high residual astigmatism

→Complete suture removal by 12-18 months

→Wait for 3-4 months for refraction to stabilize : (up to 2 Diopters of astigmatic change)

Options

- **PRK**
- **LASIK**
- **Astigmatic keratotomy**
- **Wedge resection and compression sutures**
- **Toric ICL or toric iris claw lens**
- **Phaco with toric IOL**

PRK

Advantages:

- **Simple → no flap complications**
- **Predictable**

Disadvantages:

- **HAZE → Mitomycin is a must !!**
- **Regression**
- **Delayed epithelialisation (DM, Dry eye)**
- **Reactivation of HSV**
- **Rejection**

LASIK

Advantages:

- **No haze**
- **Less regression**
- **Correct larger errors**

Disadvantage:

- **More flap complications: Incomplete flap, free cap, button hole, wound dehiscence, flap dislocation**
- **Epithelial ingrowth**
- **Rejection**

LASIK

One step or Two-step?

- **Cutting the flap causes biomechanical changes in graft**

→Better to cut flap and leave it for 4-8 weeks

→ change of astigmatism up to 2 diopters

Disadvantage: More incidence of epithelial ingrowth

LASIK

Mikrokeratome or Femtosecond?

Femto is better to:

- **Control flap size to be within graft**
- **Better geometry of flap edges**

→ less flap dislocation

→ less epithelial ingrowth

LASIK

- **Wavefront –Guided?**
- **Topography - guided?**
- **Standard ?**

Controversial → mixed results

With any type of excimer laser correction, steroids must be withdrawn over a long period to avoid triggering graft rejection

Astigmatic keratotomy

- **Incision along the steep meridian**
  →flattening of this meridian with steepening of the flat meridian (Coupling)
- **Done inside graft-host junction**
- **Effect depends on:**
  - **Length of incision**
  - **Depth**
  - **Optical zone**

Astigmatic keratotomy

- **Several normograms** different from normograms correcting native astigmatism:

  Hanna , St. Claire
- **Incisions guided by topography**
- **Incisions may be symmetric or not** according to regularity of astigmatism

Astigmatic keratotomy

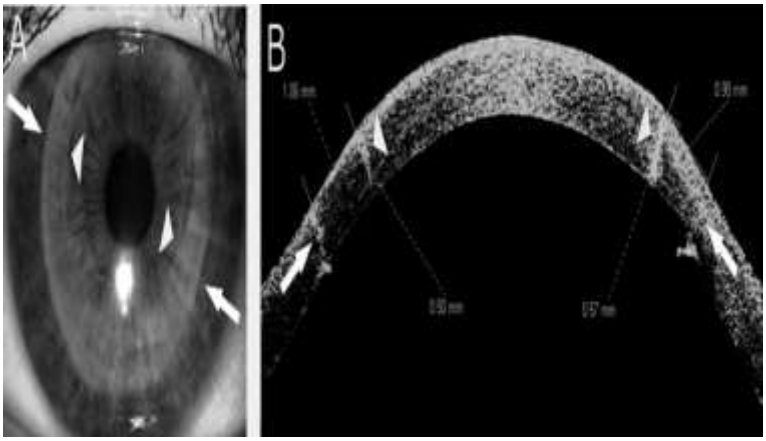
Manual xx or Femtosecond laser √√ ?

- **More predictable depth (up to 90%)**
- **More uniform curvature**
- **More precise length**

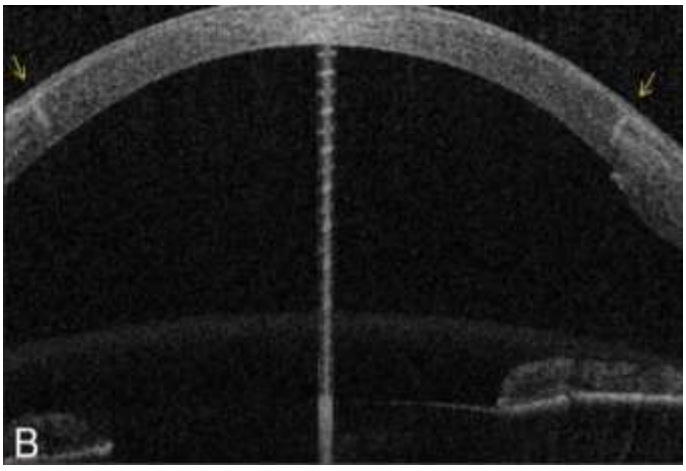
Intrastromal Astigmatic keratotomy

Less infection, less epithelial ingrowth, less discomfort

Astigmatic keratotomy



Intrastromal astigmatic keratotomy



Astigmatic keratotomy

Astigmatic keratotomy

Complications:

- **Overcorrection:**
  →Suture the incision
- **Undercorrection:**
  → Lengthen incision
  → Do a 2nd incision 0.5 mm central to original
  →Compression sutures on meridian 90o apart
- **Microperforation**

Wedge resection and compression sutures

- **Cutting a wedge of tissue along flat meridian and taking compression sutures to steepen it**
- **Done manually or with femtosecond laser**
- **Can correct large amounts of astigmatism (over 10D)**
- **Sutures can be removed after 2-3 months according to effect**
- **Poor predictability**

Wedge resection& compression sutures

Toric phakic IOLs

- **Iris supported (Artisan):**

Can be custom made to correct up to 10 D astigmatism

High endothelial cell loss (up to 30% at 1 year)

- **Toric ICL:**

Less endothelial cell loss

Both are not very accurate if there is an element of irregular astigmatism

Toric IOLs

- **In patients having cataract after keratoplasty with significant astigmatism**

Problems:

- **Endothelial cell loss with cataract surgery**
- 10 ^{o} **rotation**→ 30 ^{o} **loss of astigmatic correction**
- **Not very accurate** due to multifocality of cornea due to **irregular astigmatism**

Toric IOLs

Table 1. A selection of the available toric IOL models.

IOL model	Spherical power (D)	Cylindrical power (D)	Custom made (D)
AA4203TF (STAAR)	+24.0 +28.5 (0.5 increments)	2.0 and 3.5	
AcrySof IQ toric (Alcon)	+6.0 to +30.0	1.50 to 6.0	
T-flex (Rayner)	+6.0 to +30.0 (0.5 increments)	1.0 to 6.0 (0.5 increments)	Sphere: -10.0 to +35.0 (spherical equivalent; 0.5 increments) Cylinder: 1.0 to 11.0 (0.25 increments)
TECNIS toric IOL (Abbott Medical Optics*)	+5.0 to +34.0 (0.5 increments)	1.00, 1.50, 2.25, 3.00, 4.00	
MicroSil toric (HumanOptics)	+15.0 to +25.0 (0.5 increments) -30.0 to +14.0/+26.0 to +34.0 (1.0 increments)	1 to 3.0 (0.5 increments) 4.0 to max 30.0 (1.0 increments)	
LENTIS LS-312, -313 (Oculentis)	+10.0 to +30.0 (0.5 increments)	1.50, 2.25, 3.00, 3.75, 4.50, 5.25	Sphere: 0.0 to +35.0 (0.01 increments) Cylinder: 0.25 to 12.0 (0.01 increments)
AT TORBI 709M (Carl Zeiss Meditec)	-10.0 to +32.0 (0.5 increments)	1.0 to 12.0 (0.5 increments)	
AF-1 toric IOL (Hoya†; not yet available)		1.5, 2.25, 3.0	

*Santa Ana, CA, USA. †Tokyo, Japan. D: diopters; IOL: intraocular lens.

Image courtesy of Ramedeus Journals

Conclusion

- **Prevention is the best treatment**
- **Treat large degrees of astigmatism only**
- **Femtosecond laser flaps and arcuate keratotomies are more accurate**
- **Don’t overpromise**
- **A combination of techniques may be needed**
- **Don`t forget STEROIDS**


Thank You..