Keratoplasty in 2011

(Corneal Transplant)

Rafael I. Barraquer MD, PhD
Head, “J. Barraquer” Chair for Eye Research - IUB – UAB - Barcelona
Keratoplasty-Corneal Transplant in 2011

- **Corneal transplants** remain THE major procedure in corneal surgery.

- Many developments in the recent years: 3 aspects:
  - Instrument technology progress: microkeratomes, femtosecond lasers
  - New techniques in the wider field of “Keratoplasty”:
    - **Corneal molding without cutting** (sometimes called “corneoplasty”).
      ➔ Effect on indications of corneal transplants.
    - New techniques of “**selective keratoplasty**”:
      - DALK,
      - DSAEK-DMEK, etc..
    - **What are the current (remaining) indications for PK?**
Keratoplasty: Functional classification:

Which function is being restored?

- Transparency ➔ Optical K.
- Shape (Refraction) ➔ Refractive K.
- Structural (Eye wall) ➔ Tectonic
- Defensive (Anti-infectious) ➔ Therapeutic, “à chaud”
Keratoplasty: Indications
(Barcelona Series 1948-1995)
Corneal Transplant: Techniques

s/ depth
- **Penetrating**
- **Anterior Lamellar**
  - Superficial (SALK)
  - Deep (DALK)
- **Posterior Lam. (EK)**
  - PLK, DLEK (manual, mkt.)
  - DSEK, DSAEK (strip)
  - DMEK, DMAEK (DM only)
- Endothelial seeding?

s/ extension
- Partial
- Total (corneoscleral)

s/ position
- Central
- Peripheral

s/ shape
- Circular
- Horseshoe
- Ring/coronal
- Fusiform
Lamellar Keratoplasty Types

- Epithelial Keratoplasty
- Bowman Layer Transplantation
- Superficial Anterior Lamellar Keratoplasty (SALK)
- Deep Anterior Lamellar Keratoplasty (DALK)
- Posterior Lamellar K. (PLK)
- Deep Lamellar Endothelial K. (DLEK)
- Descemet-Stripping Endothelial K. (DSEK, DSAEK)
Non-Corneal Trasplant Keratoplasty Techniques

• Ablation (Keratectomy)
  – Therapeutic (Manual vs. PTK)
  – Refractive (PRK, LASIK…)

• Surface restoration
  – Mucosa, Limbus, Amnion Tr.

• Intracorneal implants
  – Refractive (Keratophakia)
  – Biomechanical (ICRS)

• Tissue modification
  – Retraction (CK, etc.)
  – CXL

• Keratoprosthesis
PK indications: Deformity

(→ Refractive K)

- Keratoconus
- Keratoglobus
- Pellucid M.D.
- Terrien’s D.
- 2ª Ectasia
Keratoconus & Keratoplasty

- **Classically:** major indication for PK
- **Current trend:**
  - Non-transplant treatments (ICRS, CXL, MW, etc…)
  - Spare the patient endothelium: \( \Rightarrow \) **DALK**
- Optical quality? \( \Rightarrow \) similar, only if a “clean Descemet” plane is obtained, *no stroma (big bubble)*
- ¿When DALK and when PK-IEK?
DALK: Neumodissection (Anwar) + mid-lamella (Tan)
DALK: Direct technique (John’s canula for air)
Result @3 days (microperfor.)
Result @ 20 days (1 wk post-rebubbling + Nd:YAG iridotomy)

\[140^\circ - 6 + 2 = 0.55\]
The challenge: Technology....

**Seduction by...**
- Hi-Tech
- "Power"
- Sophistication

**Pressure by...**
- Industry
- Hype
- "To be at the crest"
FsL are *tools*: relatively large, complex tools...

**A Priori PROS:**
- Hi-Tech
- Power
- Precision
- Flexibility

**A Priori CONS:**
- High cost
- Complex logistics
- Longer operative times
- Dependency: possible failure
- Do they really deliver...?
Non-mechanical PK – “IEK” (femtosecond lasers)
Best FsL trephination profile?

- **Mushroom ?:**
  - Greater anterior area, less endothelial transplant (*less antigenic charge*).
  - Simpler dissection (& calculations)
  - The lamellar junction (worse healing) “open” anteriorly.
    - *(does not oppose to IOP)*

- **Zig-Zag & similar types ?:**
  - Anterior and posterior diameters relatively equal.
  - More *complex* dissection / calculations.
  - Lamellar junction “closed” anteriorly: *(spur opposes IOP).*

- **Both increase contact/healing surface similarly (≈ x2)**
Keratoconus + leucoma $\rightarrow$ PK

- Keratoconus, post-hydrops full thickness leucoma
- UCVA = 0.02 175°-7-9 = 0.2
Zig-Zag FsL Trephination
PK + ZigZag FsL Trephination
PK+Fsl: Result

- @ 1 week
  - UCVA= 0.06;  -6 = 0.2

- @ 6 weeks
  - UCVA= 0.03  90°-2-7 = 0.35
  - Astig Topo (SimK) ➔ 0.4D (irr)
Comparison of Penetrating Keratoplasty Performed with a Femtosecond Laser Zig-Zag Incision versus Conventional Blade Trephination


Less Astigmatism since month 1 and at 12 months (about 1.3 D less)

Better BSCVA at month 1 & month 3 (faster recovery) becomes NS at 6 m.
PK+FsL Issues

- **Trephination**
  - Centering is critical → mark !!
  - IOP (donor) insufficient/excessive
  - Applanation loss → Oval
  - *Applanation deformity (Kcone) → Oval*

- **Button dissection**
  - Adjust energy parameters (not a flap !!)
  - Total depth cut in recipient ? (transport)
  - Complex profiles → difficult to identify

- **Sutures**
  - Identify / correctly apposition complex profiles
  - Adequate depth
How to avoid the applanation deformation in keratoconus?

- Avoid applanation ➔ concave lens
  - Femtec, Visumax
  - BUT ➔ complex calculations

- Topo-guided compensation of applanation -induced ovalization?

- Reduce prominent cone ➔ cautery (W. Culbertson)
PK+FSL: cone cauterization
PROS:

- Better control of lamellar plane (superficial)
- Superficial LK ➔ can be sutureless (+TCL)
- Can be combined with techniques (like big bubble for DALK)
- Planar disk (esp. for DLEK, DSEK), avoiding induced refractive change.
FsL in Lamellar K

• **CONS / Issues:**
  - Surface quality degradation w. deeper cuts: "soft stroma"?
  - *Aplanation inevitably causes folds in deep stroma*
  - To prevent folds (ideally): *no applanation* (*Femtec, VisuMax*)
  - DALK: "Bare Descemet" not possible with lamellar FsL cut
  
  **BUT** → FsL complex profile can be combined with *Big Bubble*

Keratoconus \\

Keratoconus: “Mostly anterior” corneal pathology

DALK preferable !?

Always?

Not all DALK are completed ➔ PK convers

➔ Or else leave significant remnant stroma !

Endothelium in KC frequently anormal (➔ specular m. !)

Descemet breaks, full thickness leucomas (post-hydrops), vascularization? ➔ PK preferable?

➔ +advantages of femto-Laser (IEK)

Visual quality (PK) vs. safety (DALK)… which is best?
Classic PK Indications: Transparency Loss (→ Optical K)

- Leucomas
- Dystrophies
- Edema
- Regrafts
  - ¿Where is the origin of pathology?
  - ¿Risk of recurrence?
DSAEK through 3.2 mm (Endoshield)
DMEK: I: Endothelium harvesting
DSAEK failure: Preoperative

- 44a. W (Angola)
- Myopia, AC phIOL (7 y. before)
- OS explanted 3 m. before \(\leadsto\) edema
- OS: \(90^\circ - 6 - 4 = 0.03\)
- OD clear cornea (604 cel/mm\(^2\))
Initial Result

Regains VA: 155°-2.5-1=0.65

- Endothelial counts:
  - Donor: 2747 c./mm²
  - @ 2 m.: 621 c./mm²
  - @ 6 m.: 494 c./mm²
  - @12m.: no cell visible
OCT: Very thin graft

- @ 3 days: 60-97 µm (central)

- @ 2 mo.: 47-59 (central)
Descompensation...

@ 1 year:

- Corneal Edema recurs
- No signs of rejection
- Specular M.: cannot see/count cells

OCT: 624 μm central, the DSAEK graft is also thickened (122-148 μm)
- AV drops again to 0.15 (165°-1.75)
Final result
Fuchs ➔ EK... Always?
PK Indications...

- **Structural (Tectonic)**
  - Peripheral thinning
  - Descemetocèle
    - ➔ DALK??
  - Perforation

- **Defensive, “à chaud” (Therapeutic)**
  - Resistant infections
    - Herpes
    - Fungal
    - Amebae
    - ➔ CXL ?
High risk: Multiple failures, etc.

- 75 a. W (Iran)
- Initial Dx. Unknown (Keratoconus?)
- 1ª PK (O?) 1950s (Dr. Castroviejo)
- 2ª PK (O?) 1970s
- 3x PK more (OD) in 1988 (Dr. Khodadoust)

2007:
- OD = PL (bad localization)
- OS = 0.03 generalized melting, descemetocele (post.-rejection?)
Central & peripheral defects

- General health problems: dehydration, anemia (coecal ulcer), hypoproteinemia, esophagitis (post-steroids?)...
- “Waiting” Tx.: Exocin, Medrivás → Dexta-free 3/d, Homatropina, Timolol, Vibracina,
- TCL
- Ciclosporin A (initiates)
- After 15 days → PK 10 mm (tectonic) +EC/IOl (OS)
Result (early)
Result (to 5 mo.)

1 Wk:
- $60^\circ -1.5 -2 = 0.3$  +2 Nº 2
- Endothelium: 2183 cel/mm$^2$
- IOP = 8 mm Hg
- Rx: Dexa-free, Dacortin 1mg/Kg/day, CsA, Oculotect

1 mo.:
- $30^\circ -2 -1 = 0.5$  +3 Nº 2
- Endothelium: 2617 cel/mm$^2$
- Steroids tapered (mant. CsA)

5 mo.
- $30^\circ -4 -1.50 = 0.2$  +2.50 Nº 5
- Endothelium: 2427 cel/mm$^2$
- Pigmented PKs, no line, Tyndall, Cél + in CA & Vitreous.
- Rx $\Rightarrow$ 30x drops Dexa, restarts Dacortín, cont. CsA, Ciclo
Result 5 to 13 mo.

- **One week later...**:  
  - $30^\circ - 1 - 3 = 0.4 + 1$ Nº2  
  - No signs of inflammation  
  - IOP= 15 mm Hg  
  - Rx: Slow taper of *Dexa-free, Dacortín, mantiene CsA, etc.*

- **9 mo. postop.**  
  - Stable (*VA = 0.4*)  
  - Tyndall minimal (cronic?)  
  - Ends Dacortín, keeps CsA, Dexa 4/d, lubricants...

- **13 mo.**  
  - $130^\circ - 1 - 3.50 = 0.15 + 0.5$ Nº 4  
  - “Worsening since a few months”  
  - Edema, folds, pigment, Tyndall?, min. ciliary hyperemia.  
  - Rx → **restarts Dacortín, Pred-F c/h, cont. CsA, Anti-Edema**
Result: 14 to 28 mo.

- **3 weeks later...**:
  - Slow improvement (VA = 0.15), IOP= 15
  - New: Dendritic ulcer
  - Rx: add Zovirax top. 5/d

- **9 mo. later (21 m. post.)**
  - Still with mild edema (VA = 0.1)
  - Quiet eye
  - We consider DSAEK... ?
  - PC “seems somewhat opaque”
  - Nd:YAG ➔ 0.35; (+1 m) ➔ 0.5 !!
  - “Feels very weak” ➔ returns home

- **Mantains VA 0.3 – 0.4 until 28th mo.**
  - Fluctuating vision
  - Epithelial problems (autologous serum, LCT➔ edema)
  - Difficulties for Rx. (lives alone in Teheran)
  - Depressed...
  - Desires a solution ➔ **VA drops to 0.25 ➔ we decide DSAEK...**
Pseudo-anterior pathology
PPD presenting as band degeneration

Early recurrence after scraping
Emerging Lamellar Techniques

**DALK:**
- Keratoconus (not treatable by molding)
- Leucomas: Superficial to Non-full thickness (?)

**Endothelial K. (DSAEK, DMEK):**
- Endothelial dystrophies (w/o sec. stromal opacity)
- Endothelial decompensation (sec., id.)
- Failed grafts (id. no stromal opacities)

**Issues: Visual quality vs. Safety?**
Summary

PK remaining indications:
- Full thickness leukoma
- Tectonic / Therapeutic K
- Risk of recurrence (dystrophies)
- Visual quality vs. safety

PK updated techniques:
- Non-mech. trephination (FsL)
- New issues brought in by the newer options.
- Good suturing / astigmatism awareness remain crucial.
Muito Obrigado