ACL Fixation Devices

Material & Shape

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Rationale : Graft Failure

✓Bone to bone partial **healing by 6 weeks**

✓**Soft tissue grafts incorporate by 12 weeks (Sharpey fibers)**

Till that time, fixation device should secure the graft

As the fixation is the weakest link in the early postoperative period

3 Types of Graft Motion

✓Longitudinal = Bungee Cord Effect

✓Horizontal = Wind-Wiper Effect

✓Creep of graft tissue leading to elongation

✓3 mm motion interferes with integration
- ✓ Tunnel widening
- ✓ Fixation far from aperture

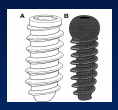
Martin Orthop Clin North Am 2002
Clawerthy KSSTA 1999

Material

Metallic implants

✓Advantages : long follow-up, solid, tolerance

✓Inconvenients : Artefacts with imaging
✓(Interference with resurgery)

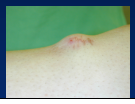


Material

Absorbable implants

✓Advantages : Friendly for re surgery
Facilitate Post op MRI (not imaging)

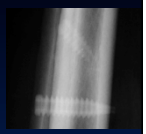
✓Inconvenients : LB reaction & consequences
- ✓PGA early without bony ingrowth
- ✓PLLA delayed osteolysis with fragmentation



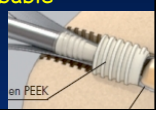
Material

Absorbable implants

✓PLLA + HAP + PTC
- ✓Porous 3D scaffold
- ✓Slow resorption
- ✓Bony ingrowth



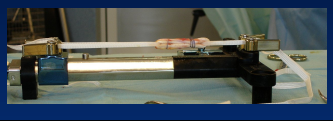
✓PEEK (Polyether-ethercetone) Semi-cristaline Plastic
- ✓Advantages of both metal & absorbable
- ✓Inconvenients
  - ✓ No resorption
  - ✓ No follow up / re surgery?



Material

Suspensory devices

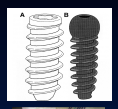
- ✓Combined with a screw or a button
- ✓Non absorbable (eg : PE-telephtalate)
- ✓Preset or adjustable lengh
- ✓Tape, cord, …

Many types of fixation

3 groups

Cancellous

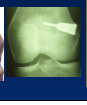
Cortical





Cortico-cancellous




Ideal Graft Fixation

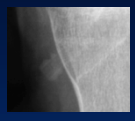
- ✓<u>Close / articular aperture</u>
  - ✓ High resistance
  - ✓ Less graft/ bone motion
- ✓Reproducibility, reliability
- ✓Biocompatible
- ✓Allow easy revision
- ✓MRI possible

Zantop AJSM 2008

Cancellous fixation = Interference screws

- ✓Pull out forces 200 to 700 N
- ✓Gold standard for bone to bone fixation
- ✓Material ??



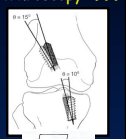


Kurosaka, AJSM 1987
Brown C Jr, Techniques in Orthopaedics, 1998

Influencing Factors / Screw Fixation

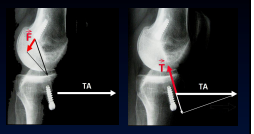
- ✓Length
- ✓Size
  - ✓ ≥ 1mm / tunnel
- ✓Geometry of screw
  - ✓ Soft threads/ soft tissue
- ✓Divergence of screw
- ✓Torque of screw insertion
- ✓Screw material (breakage)

Harvey JBJS Br 2005
Stadelmayer AJSM 1999
Kohn AJSM 1994
Weller AJSM 2000
Schroeder Artrhroscopy 1999

Influencing Factors / Screw Fixation

- ✓Tibial bone
  - ✓Lower density
  - ✓Risk of slippery
  - ✓Pulling forces in tunnel axis
- ✓Graft choice : Pb w hamstring…





New cancellous screw type

- ✓Enlarge the tendon to bone contact
- ✓Mechanical properties

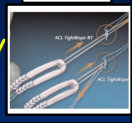
- ✓Expansion devices
- ✓Absorbable (elasticity)

Cortical fixation

- ✓Suspensory devices
- ✓Higher pullout load
- ✓Lower stiffness
- ✓Graft mobility : tunnel widening

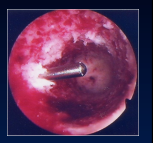
Brown Tech in Orthopaedics 1998
Giuera AJSM 1999
Weiler Arthroscopy 1998
Magen & Howell AJSM 1999

- ✓New designs
  - ✓To fill femoral socket
  - ✓Increased strengh (1456 N)
  - ✓No significant change/graft mobility
- ✓Double fixation?

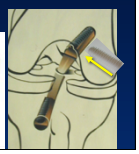


Cortico cancellous fixation

- ✓Intermediate devices
  - ✓Many materials
  - ✓@ Femoral level



- ✓Almost aperture fixation
- ✓Pull out strengh (perpendicular)
  - ✓Transverse pins : 700 to 900N
  - ✓Transverse screw : 400N
  - ✓TLS : 1500 N



Cortico cancellous fixation

- ✓Keep intact transplant / tunnel contact
- ✓But still some graft mobility
  - ✓Delayed integration

Peyrache KSSTA 1996
Clatworthy SFA 2002
Robert in « Pathologie LGT du genou » Springer Ed 2004

Not well adapted to tibial site

« New » devices

- ✓Suspensory system combined with screws (& cage)
- ✓Significant screw size
  - ✓Pain at tibial level

- ✓Keep the bone graft contact intact and (too?) rigid (titanium, peek or PLLA – TCP)

- ✓Huge tension of the graft
  - ✓Aseptic arthritis (necrosis)

Take home messages

- ✓No ideal fixation
- ✓BTB :
  - ✓Gold standard = interference screws
  - ✓Traps
- ✓Hamstring
  - ✓Cortico cancellous fixation at femur site
  - ✓Tibia still the weak
- ✓So called absorbable materials are often not…
  - ✓Rate of own complications from 2 to 5%