Kinematics Of The ACL Reconstructed Knee

Andy Williams
Chelsea & Westminster Hospital
London

Focus- What do we want to achieve?

- Remove symptoms
- Restore normal function
- Prevent osteoarthritis

To achieve this:

- Restore kinematics

What I have achieved

With SB ACLR: In most cases-

- Removed symptoms
- Restored normal function

But-

- Not prevented osteoarthritis
- Restored kinematics variably- many have P/Shift!

Also:

- Imperfect motion: cadaveric and intra-op navigation studies
- Gait analysis: persistent ER and adduction

What does ACL Deficiency Do To Kinematics?

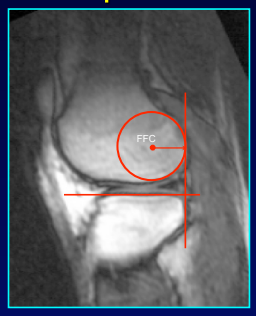
Method

- 10 males
- Mean age 25yrs
- Asymptomatic
- Sagittal images
- Right knee WB
  10° increments
  -5 ° to 120°,
  & full deep flexion
- 'MR' tracking

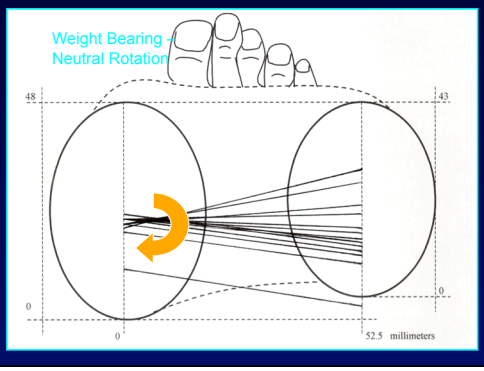
Johal et al JBiomech 2005

Measurement Technique

- Mid-medial & mid-lateral sagittal images
- Acetate overlays
- Digital Vernier



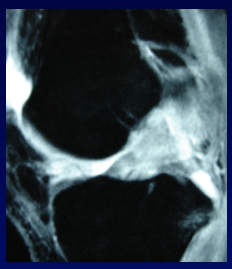
Differential Medial and Lateral Motion



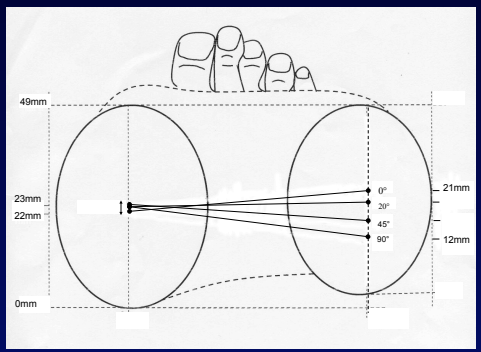
The Impact of A.C.L.- Deficiency

Logan et al AJSM 2004

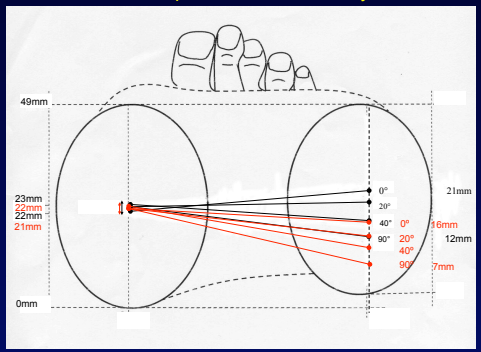
- 7 males
- Unilateral / Isolated A.C.L.– deficiency
- Both knees scanned
- -5 °, 20°, 45°, and 90°
- Results of pairs of knees compared with ANOVA with p=0.05



TF Motion in The ACL-Intact Knee



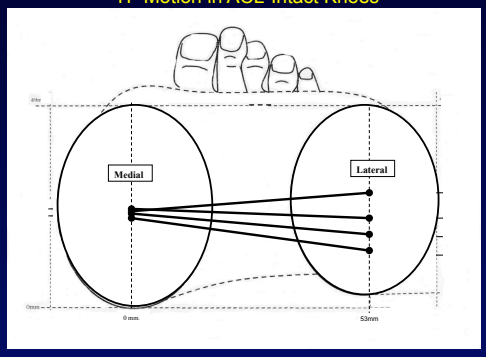
The Impact of ACL Deficiency



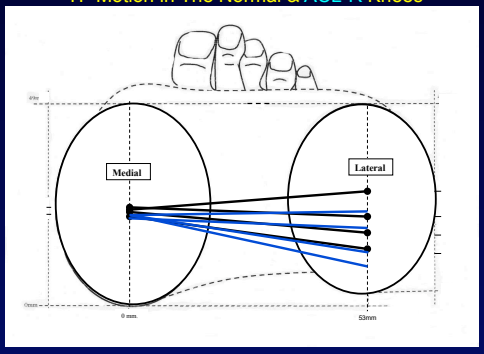
The Impact of A.C.L.Reconstruction

- 10 males
- Unilateral / Isolated A.C.L.R.
  - 4-strand hamstring graft
  - ALL successful
    (Av. Lysholm 98; All Pivot –ive; FROM)
- Both knees scanned 6-18/12 post-op.
- -5 °, 20°, 45°, and 90°
  Logan et al, AJSM 2004

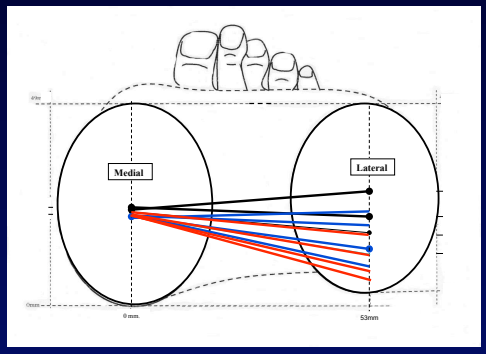
TF Motion in ACL-Intact Knees



TF Motion in The Normal & ACL-R Knees

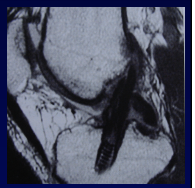


TF Motion in The Normal ACL-R & ACL-Def Knees

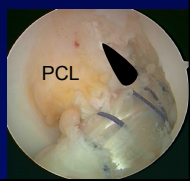


How can I improve SB ACLR?

- Old trans-tibial technique
  → AM femur to PL tibia

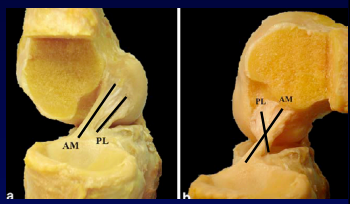


- 'Anatomic' SB ACLR
  - *KSSTA* 2010 Kato et al, Pittsburgh mid-mid position best for SB in pigs
  - *Arthroscopy* 2002 Loh et al, Pittsburgh 10 o'clock better than 11 o'clock at controlling rotation



What about DB ACLR?

- Seems logical
  - Radford and Amis *JBJS Br* 1990



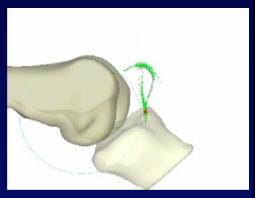
- Cadaveric evidence supports it- many studies

Except

- Markolf UCLA *JBJS Am* 2009
  minor ↓ in ATT / rotation control → high PLB forces & ↑ PLB ruptures

What about DB ACLR?

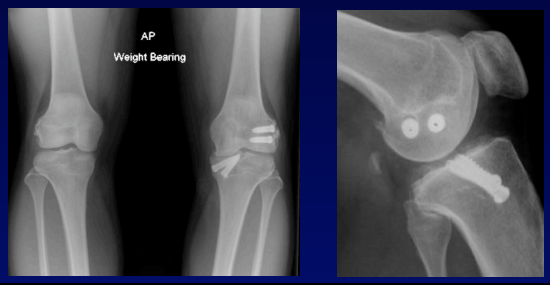
- Animal studies support it
  - Kinematics
  - Healing better
    AJSM 09 Ekdahl et al Goats
- Intra-operative studies support it
  - Merignac, Robinson et al *AJSM* 2007
  - Rome, Ferretti et al *AJSM* 2009 no better with PLB



Courtesy of James Robinson / Philippe Colombet

Why not Double Bundle ACLR?

- For many surgeons, technically difficult…
  - Zantop et al *AJSM* 2008 Done wrong, DB does not work!



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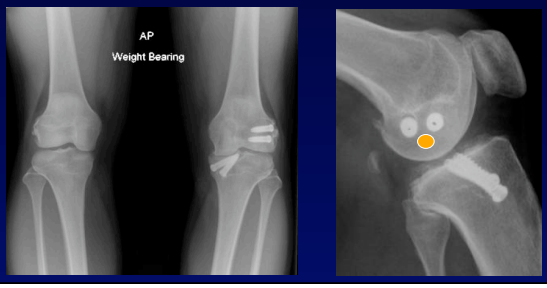
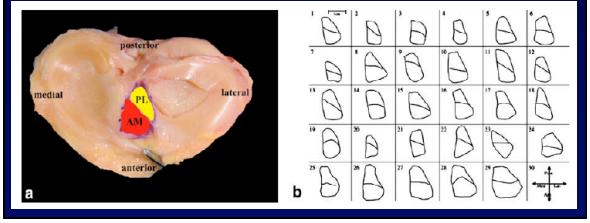


BIG Problems with literature

- Selective quotation proves what you want
  - What's new in sports medicine *JBJS Am* 2010
  - Annotation *JBJS Br 2009*
- All cadaver studies are at 'Time zero'
  - Grafts stretch / remodel
    eg Arnold et al *AJSM* 2005
    eg Tashman et al *CORR* 2007
- Only isolated ACLD considered
  - role of MM etc significant

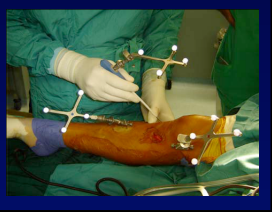
BIG Problems with literature

- Sites for tunnels 'arbitrary' and not reproducible
- Bundle insertion sites vary greatly



BIG Problems with literature

- A tight graft gives good kinematic results
  - Markolf UCLA *JBJS Am* 2009
    - high PLB forces and increased PLB ruptures
- Role of tenodesis
  - Monaco et al *KSSTA* 2007
    - AMB + lateral tenodesis better than AMB + PLB



BIG Problems with literature

- Grafts cannot reproduce normal proprioception
  - May help: Barrett *JBJS Br* 1991
- Poor measurement tools
  - instrumented and clinical laxity tests don't correlate
  - Pivot shift subjective

BIG Problems with literature

- Dynamic tests needed for real end result
  - ? Gait analysis best
  - More challenging assessment eg running / cutting

And finally…

- No clinical outcome to support DB
  - Less tunnel widening with DB Jarvela et al *AJSM* 2008
- We still cannot measure outcome!!

What do I conclude?

- DB may be valuable but proving it may be hard
  - Our measures are too insensitive
- Worth pursuing
- Cautious because of potential problems
  - NOT- *'ideal for high demand athletes'*
- *B-PT-B would be back if not for DB ACR*

Thank You