ACL Update: Graft Choice, Quad Tendon Graft, Emerging Issues

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2019

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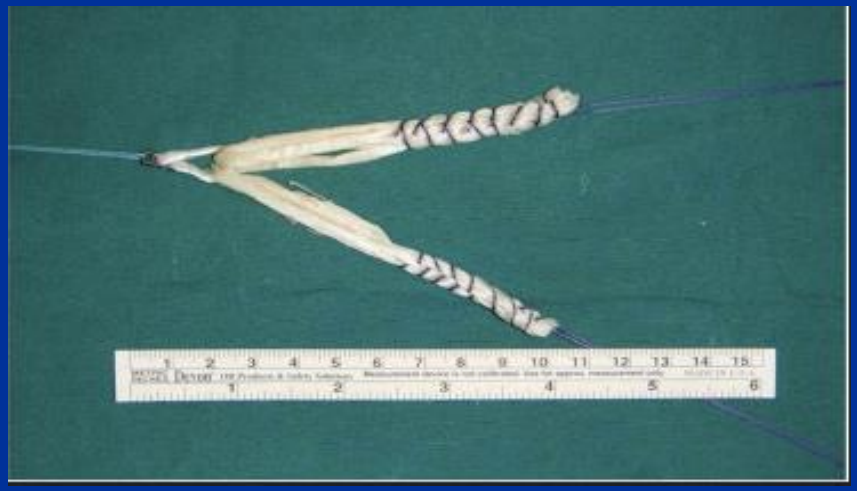
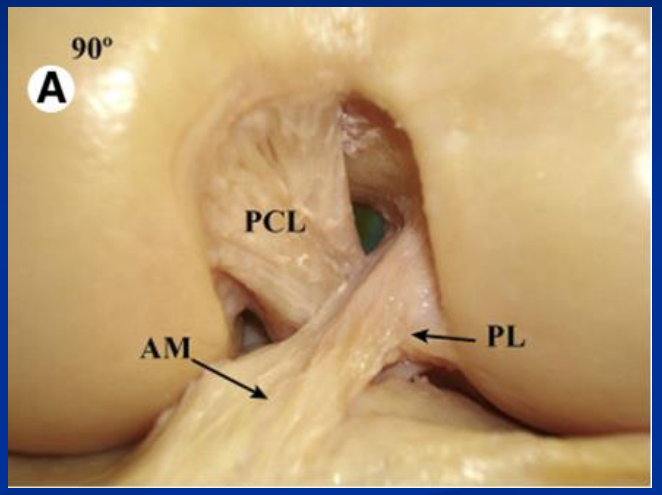
GRAFT CHOICE



The Ideal ACL Graft

- Reproduce native ACL
  - Strength: 2106 N
  - Width: 7-12mm
  - Intra-articular length: 31mm
- Minimal harvest morbidity
- Reproducible



Graft Options

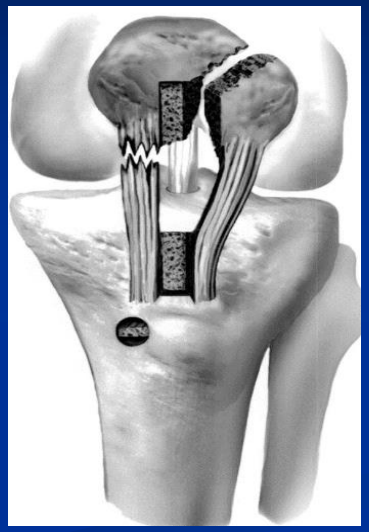
- Autograft
  - BTB (ipsilateral or contralateral)
  - Quad Tendon
  - Quadruple Hamstrings
- Allograft
  - BTB
  - Achilles (with or without bone block)
  - Semi T
  - Tib Ant

BTB – Pros

1. "Gold Standard"
2. Strong: 2977 N
3. Rigid Fixation (bone plug both ends)
4. Better KT values, Lachman, pivot vs. hamstrings
5. Bone incorperation in tunnels (faster)

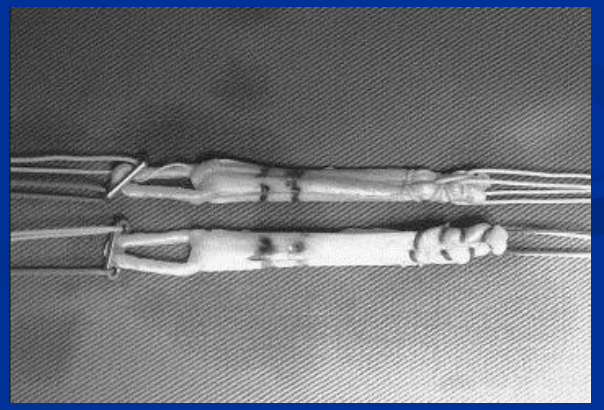
BTB – Cons

1. Anterior Knee pain
2. Kneeling pain – 70% at 15 years (Pinczweski)
3. Patella fracture!!!!
4. Less versatile (no double bundle)
5. Extensor weakness compared to hamstrings
6. Cosmesis, ant. numbness
7. PF Arthritis in >50% at 15 years (Pinczweski)



Hamstring – Pros

1. Strong: 4090 N (4 strands)
2. No kneeling pain
3. Better extension compared to BTB
4. Versatile graft (single and double bundle)
5. Cosmetic and Easy Harvest

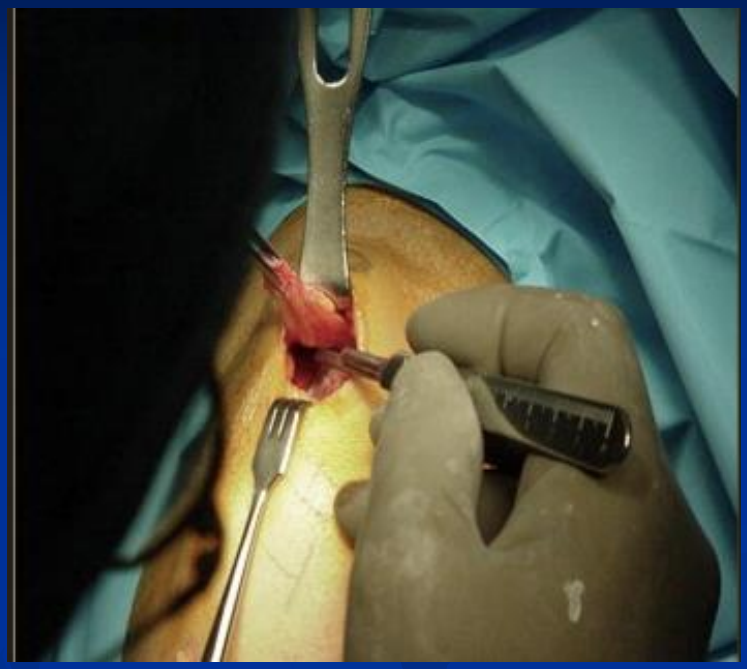


Hamstring - Cons

1. More post op laxity compared to BTB
2. Soft tissue fixation less rigid early
3. Often small diameter
    1. 8mm not uncommon! And linked to failure
4. Weakness in knee flexors persists
    - Better demonstrated by isometric testing – Morse
    - May put graft at risk by weakening dynamic protective function of knee flexors

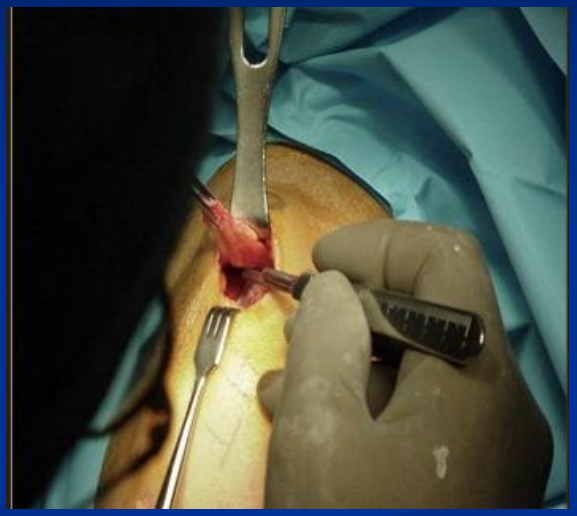
Quad Tendon - Pros

1. Strong – 2174 N
2. Bone plug available
3. Large x- sectional area 62 mm
4. Less Kneeling pain compared to BTB
5. No anterior numbness
6. Versatile – good for double bundle
7. Excellent stability – equal to BTB
   - Shelton 198 knees-equal to BTB
   - Kim 48 knees- equal to BTB
   - Han 144 knees- equal to



Quad Tendon -Cons

1. Bone plug only on one end
2. Scar on top of knee…more visible
3. Soft tissue fixation- less rigid



Allografts

- Est. 300,000 ACL/year in United States,
- 20% Allografts (60,000)

MTF Musculoskeletal Transplant Foundation

Allografts – Strength Comparisons

	Strength (N)	X-Sections (mm)
Normal ACL	2160	44
BTB	2977	35
Hamstrings(4)	4090	53
Ant. Tibials(2)	4122	48
Post. Tibials(2)	3594	44
Achilles	4617	67

Allograft Disease Transmission

- Incidence of allograft related infection: 0.014%
- Hep C: 1/1 million
- HIV: 1/1.6 million
- Most common bacteria: Clostridium

Table II. Routine donor testing

Pathological agent
HIV*
Hepatitis B
Hepatitis C*
Human T-lymphocyte virus (HTLV)
Syphillis (TPHA)
Prions (CJD)

* these were also tested by polymerase chain reaction

Allograft Concerns

- Rates of failure higher than autograft for young, active patients
  - 23-34% vs autograft around 5%
  - Sun '09, Singhal '07,Barrett '08
- Increased graft elongation and laxity?...controversial
- Prolonged incorperation

Allografts Current Recommendations

1. Use in Older Patients – Over 30
2. Protect 18-24 Months to Allow Maturation
3. Know your graft supplier (Tissue Bank)
4. Avoid Gamma Irradiation

Overview of Graft Choices

1. BTB and Quad tendons slightly more stable than Hamstrings – instrumented testing
2. Hamstrings and Quad tendon have better extension than BTB
3. Allografts, BTB, Hamstrings, and Quad tendons all equal in functional testing
4. Kneeling pain and anterior numbness prevalent with BTB

5. Extensor weakness more with BTB and Quad tendon
6. Flexor weakness more with Hamstrings which may put graft at higher risk
7. Allografts have higher graft rupture risks especially in young patients
8. Degenerative Arthritis prevalent in greater than 50% of BTB patients at 15 years

WHY I CHOOSE QUAD

WHY I DEVIATE?

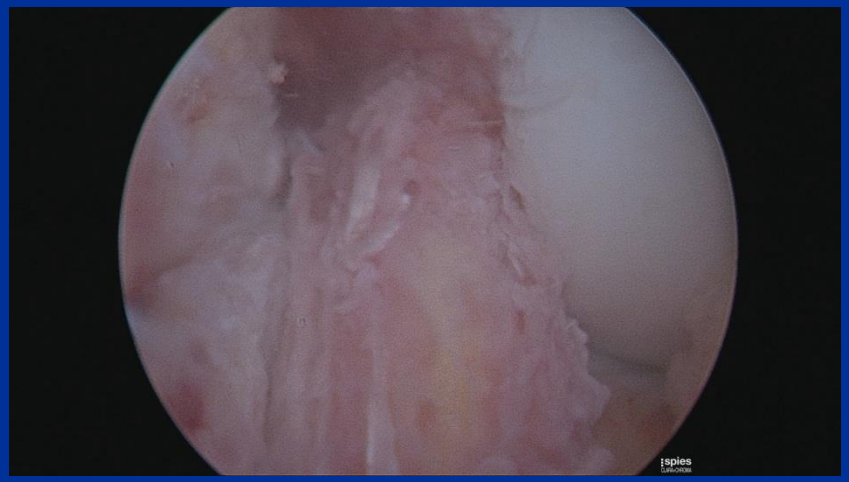
- Lots of acceptable choices, but we are in the business of striving for better
- Gives patient more options
- Bigger “toolbox” for revision situations
- Great graft for almost all populations including pediatric

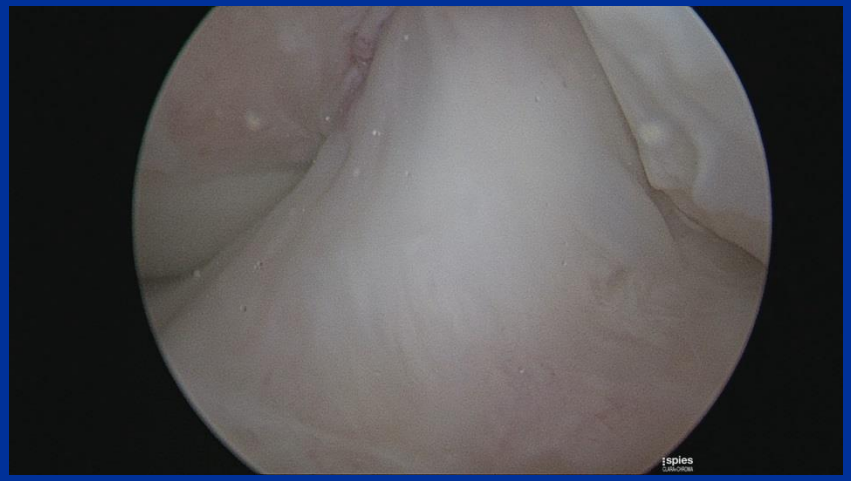
WHAT REALLY SOLD ME

- Bigger, thicker BTB without the harvest morbidity or fracture risk
- Big x-section fills tunnel
- Intra-articular volume: 88% more than BTB
- Modulus of Elasticity very close to native ACL
- Harvest fast and produces consistently sized graft through relatviely small incision
- Relook arthroscopy

RELOOK ARTHROSCOPY

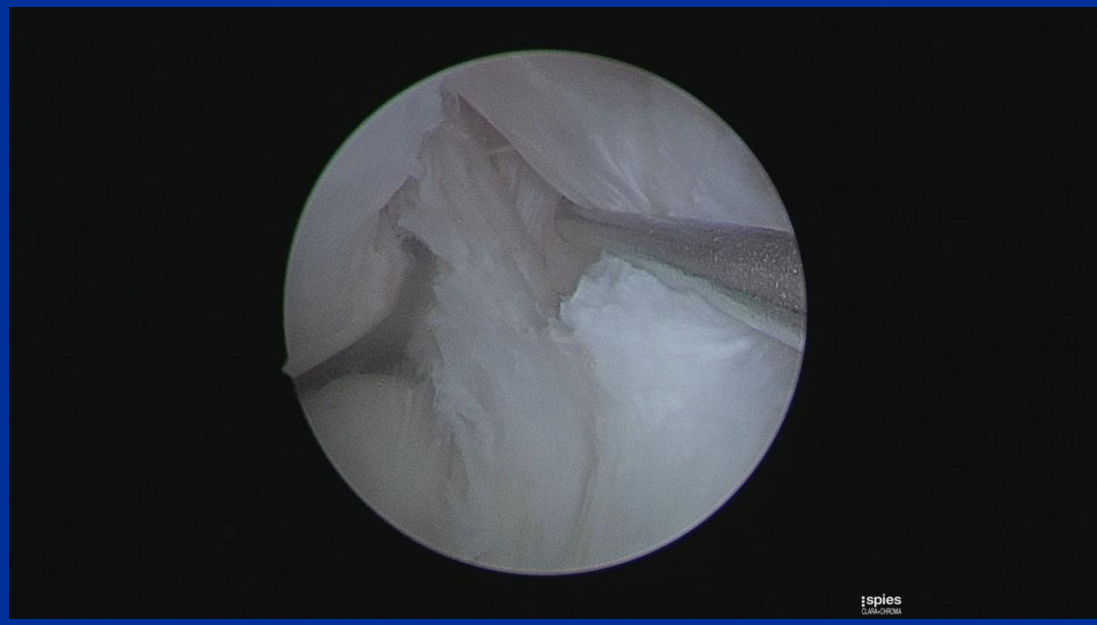
- My patient…HS football athlete
- 1 year post ACL recon with Quad
- Scope for MMT
- Synovialized, no tunnel visible



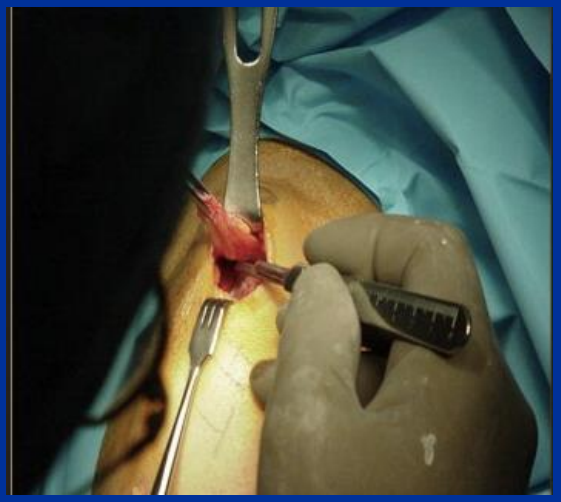


RELOOK ARTHROSCOPY

- Hamstring graft
- Failed with bucket MMT



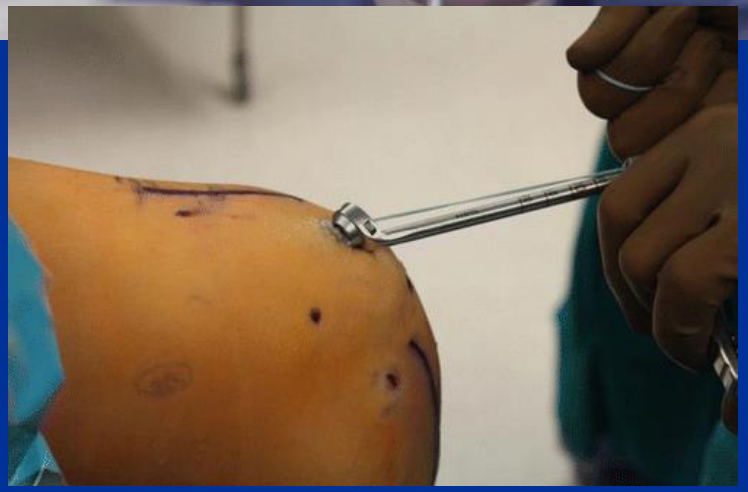
THE QUAD GRAFT



- Not a new graft (Marshall 1979)
- Strong: 2174 N
- Bone plug available but not necessary
- Large X-sectional area (62 mm)
- Less kneeling pain compared to BTB
- Less anterior knee numbness compared to BTB
- Versatile – double bundle possible
- Excellent stability – equal to BTB
- Shelton 198 knees-equal to BTB
- Kim 48 knees- equal to BTB
- Han 144 knees- equal to BTB

GRAFT HARVEST

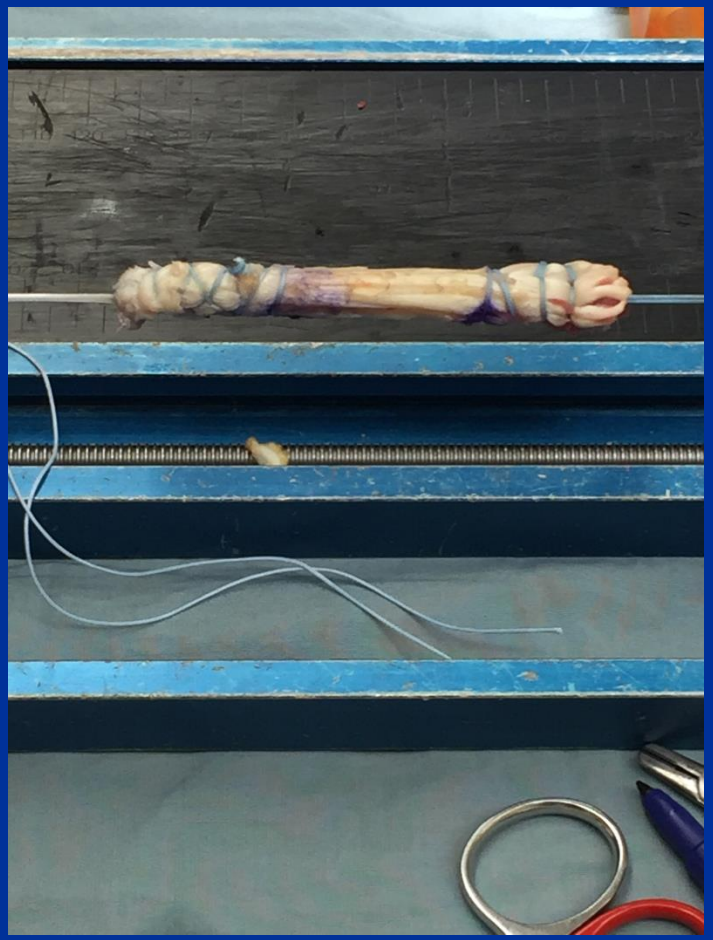
- New instrumentation allows smaller incisions and more accurate partial thickness grafts



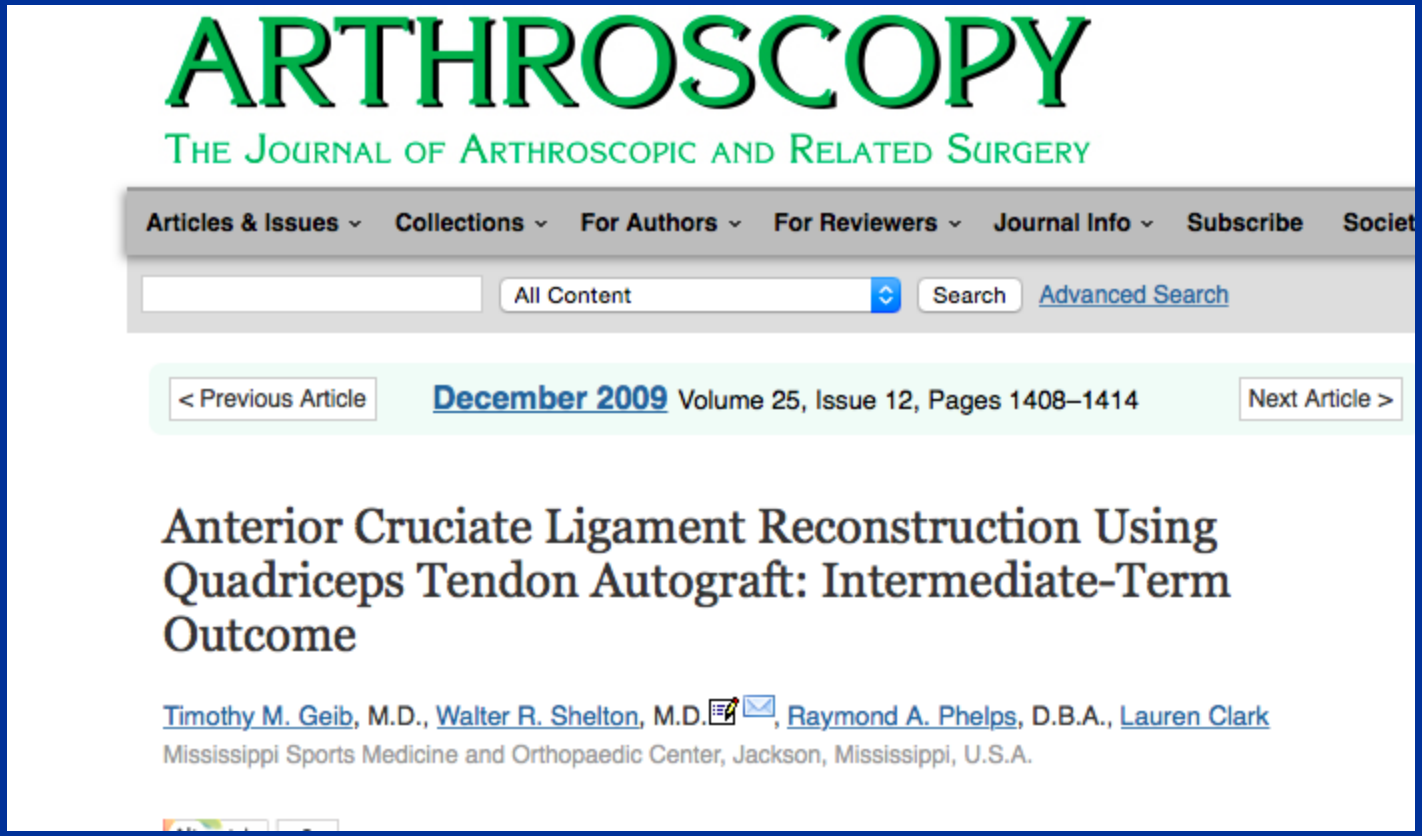
GRAFT HARVEST

GRAFT PREP

- Suture both ends
- Use cortical button and/or screw for fixation
- For me always 9mm diameter or larger. Usually have to size down!



LITERATURE



ARTHROSCOPY
THE JOURNAL OF ARTHROSCOPIC AND RELATED SURGERY

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Anterior Cruciate Ligament Reconstruction Using Quadriceps Tendon Autograft: Intermediate-Term Outcome

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LITERATURE

Purpose

The purpose of this study was to compare the intermediate-term outcomes of anterior cruciate ligament (ACL) reconstruction by use of bone–patellar tendon–bone (BPTB), quadriceps tendon with a bone plug (BQT), and quadriceps tendon without a bone plug (QT).

Methods

We evaluated 198 primary ACL reconstructions in 191 patients at a mean of 55.6 months postoperatively. Assessment included side-to-side comparison of range of motion, arthrometer values, presence of effusion, anterior knee pain, and numbness. Comparisons were made between QT and BQT patients and between men and women. The results were compared with data from 30 patients in a previous study who had undergone ACL reconstruction by the same surgeon (W.R.S.) with BPTB.

Results

Range of motion averaged –3.2° ± 2.2° of extension to 134.3° ± 10.2° of flexion for the operative extremity compared with –3.6° ± 2.07° to 134.2° ± 10.6° for the contralateral extremity at final follow-up. KT-1000 manual maximum measurements (MEDmetric, San Diego, CA) of the operative extremity averaged 0.94 mm more than those of the normal contralateral knee. When compared with BPTB autograft, the quadriceps tendon autograft showed significantly better results, with less anterior knee pain (4.56% *v* 26.7%), less anterior numbness (1.5% *v* 53.3%), a higher percentage of arthrometer measurements showing a side-to-side difference of 0 to 3 mm (88% *v* 68%), and better extension (mean loss, 0.55° *v* 2.77°). There was no significant difference between the 2 groups with regard to loss of flexion, Lachman test, pivot-shift test, presence of effusion, or number of failures.

Conclusions

Central quadriceps tendon autograft, QT or BQT, produces equivalent results when compared directly with BPTB autograft in arthroscopically assisted ACL reconstruction. There was no difference in results between men and women with a quadriceps tendon autograft, either with or without the use of a bone plug. ACL reconstruction using quadriceps tendon autograft is an effective surgical option that reduces donor-site morbidity.

LITERATURE

- **Quadriceps tendon autograft for anterior cruciate ligament reconstruction: a comprehensive review of current literature and systematic review of clinical results**
- Slone et al, Arthroscopy 2015
- **CONCLUSIONS:**
- Use of the quadriceps tendon autograft for ACL reconstruction is supported by current orthopaedic literature. It is a safe, reproducible, and versatile graft that should be considered in future studies of ACL reconstruction.

LITERATURE

- Is quadriceps tendon a better graft choice than patellar tendon? a prospective randomized study.
- Lund et al, Arthroscopy 2014
- 51 patients randomized to BTB or QT
- Less kneeling pain, ant numbness, graft site pain with equivalent stability and subjective outcomes

WHAT ABOUT QUAD WEAKNESS?

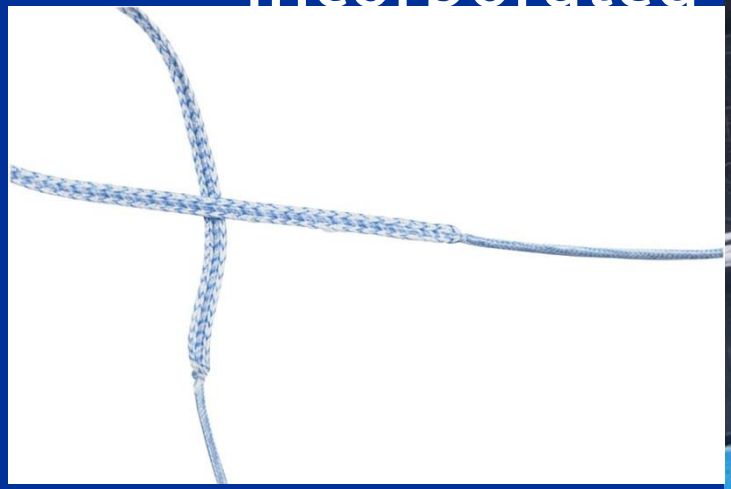
- Adams, et.al
- Arthroscopy 2006
- Cadaveric study showed tensile strength of quad after 10mm graft harvest still stronger than an INTACT patellar tendon!
- My experience is same as BTB if rehab appropriate

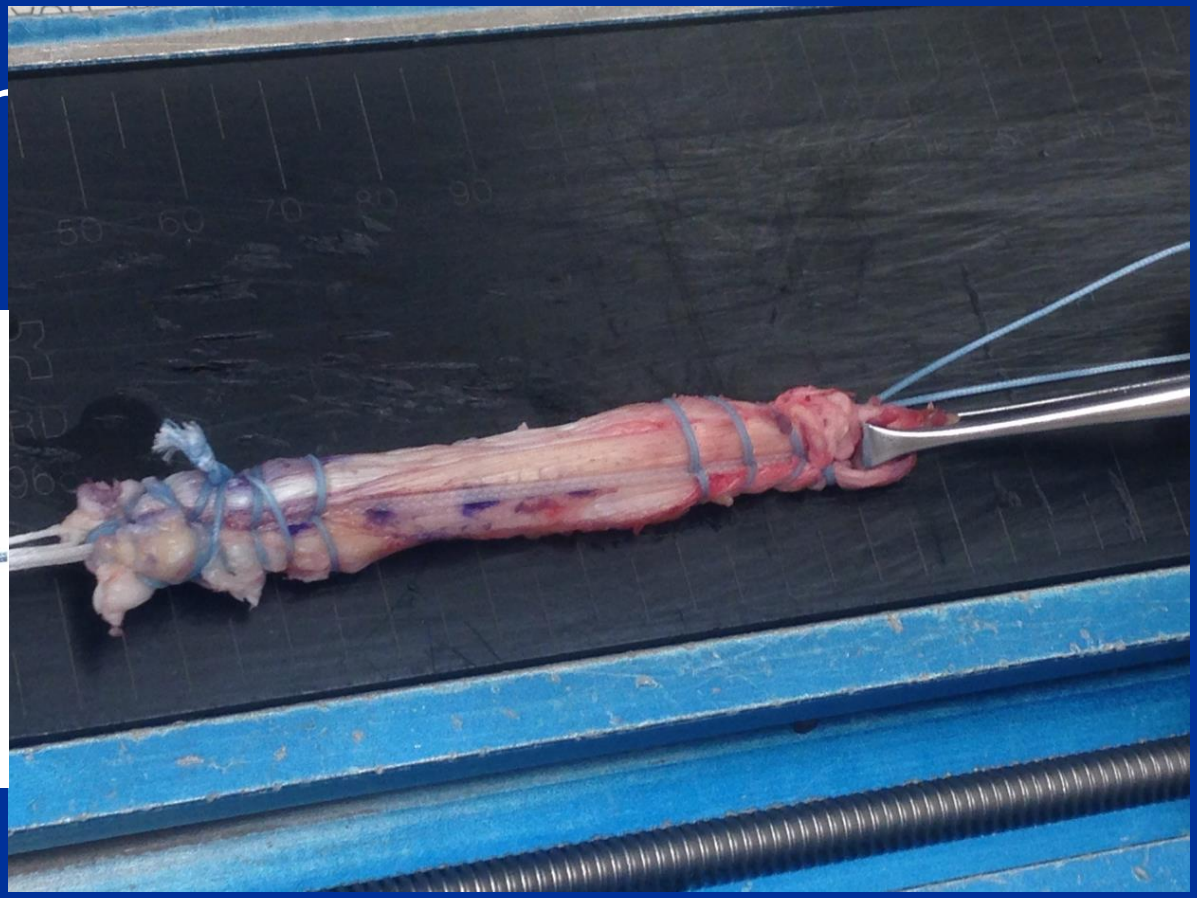
REHAB

- Brace in extension until muscle functioning well
- BTB protocols work fine
- Early Attention to patellar mobs and deep flexion!
- PT early and often (next day preferable)

NEW HORIZONS

- Internal Bracing
  - High strength suture incorporated





NEW HORIZONS

- Biologic Augmentation
  - Scaffolds?
  - Role of PRP and BMAC?

FURTHER INTEREST

- My harvest and ACL technique can be seen on youtube:
- Search: Murphy ACL

EMERGING ISSUES

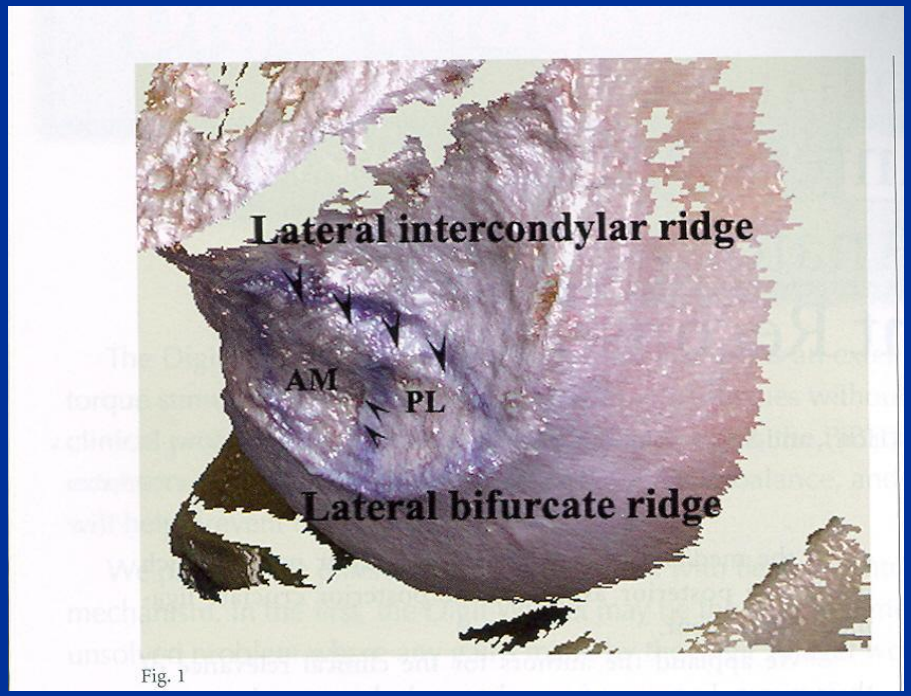
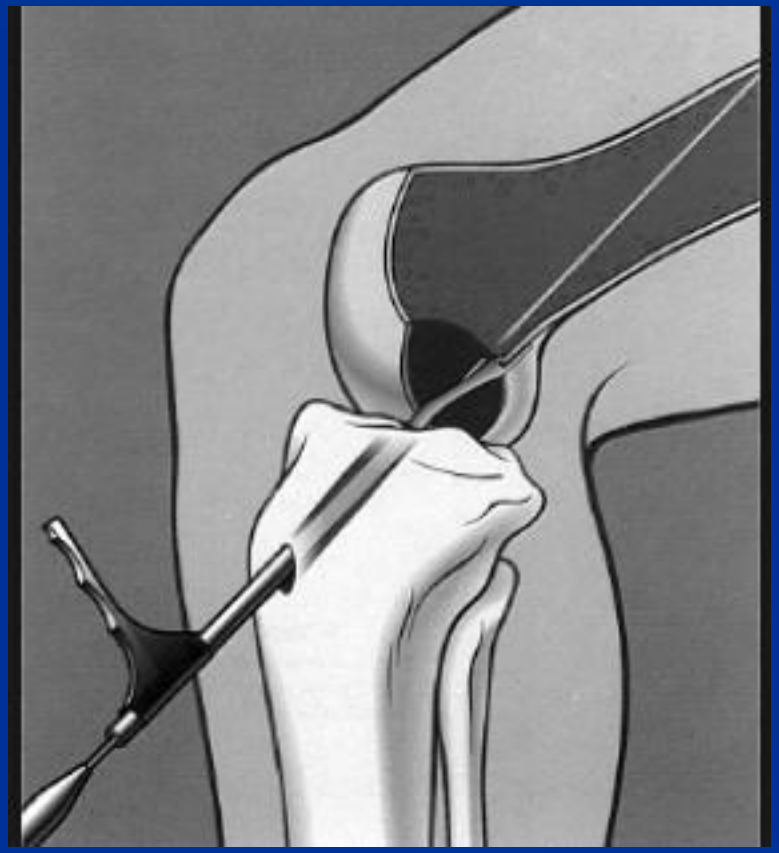
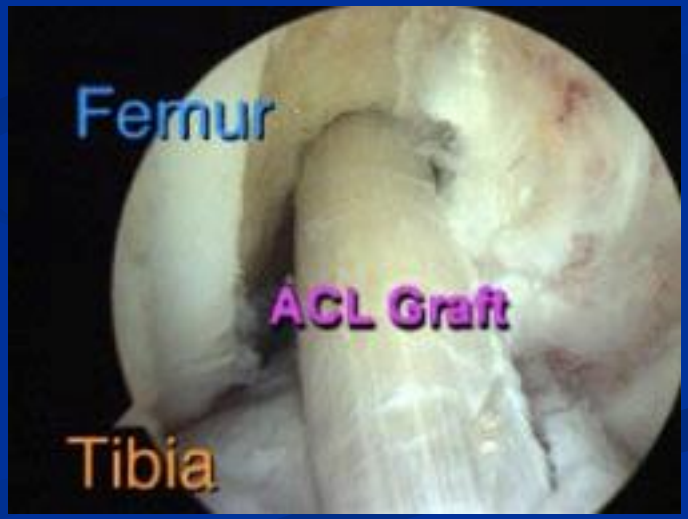


Fig. 1

How we do it: Transtibial

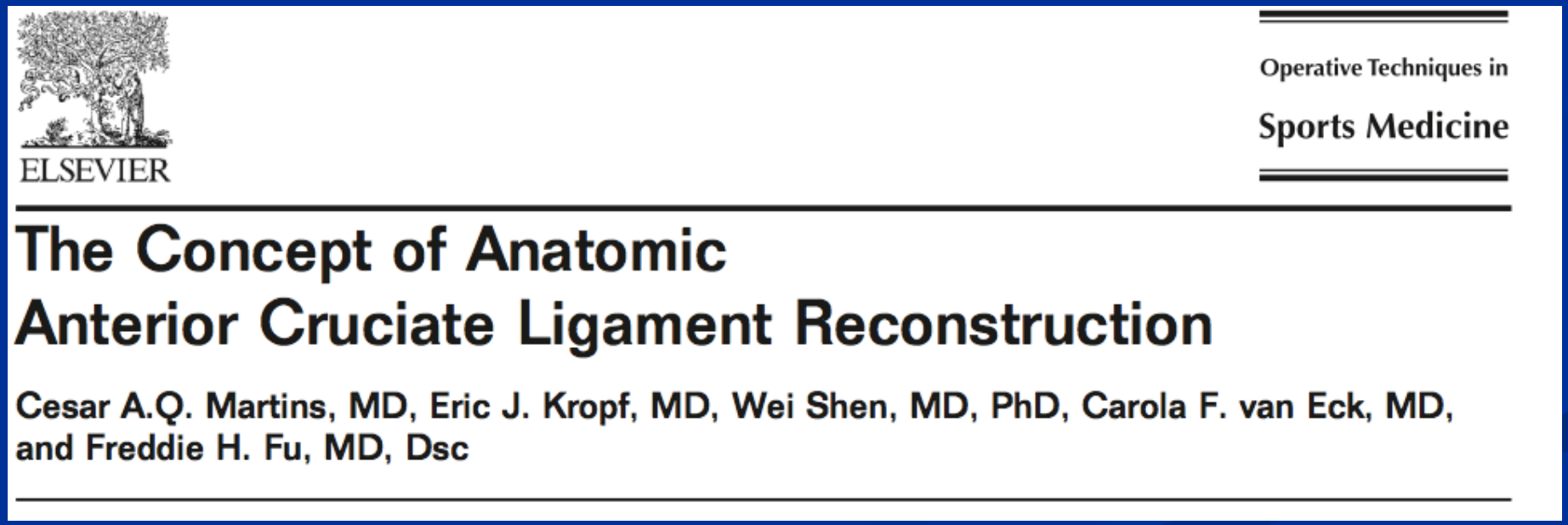
- For many years, transtibial drilling of femoral tunnel has been standard





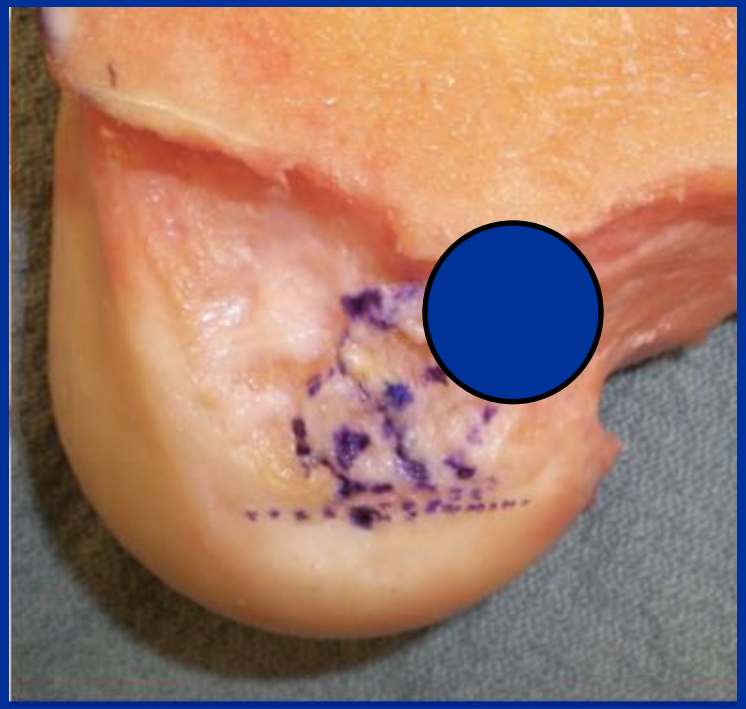
Anatomic ACL

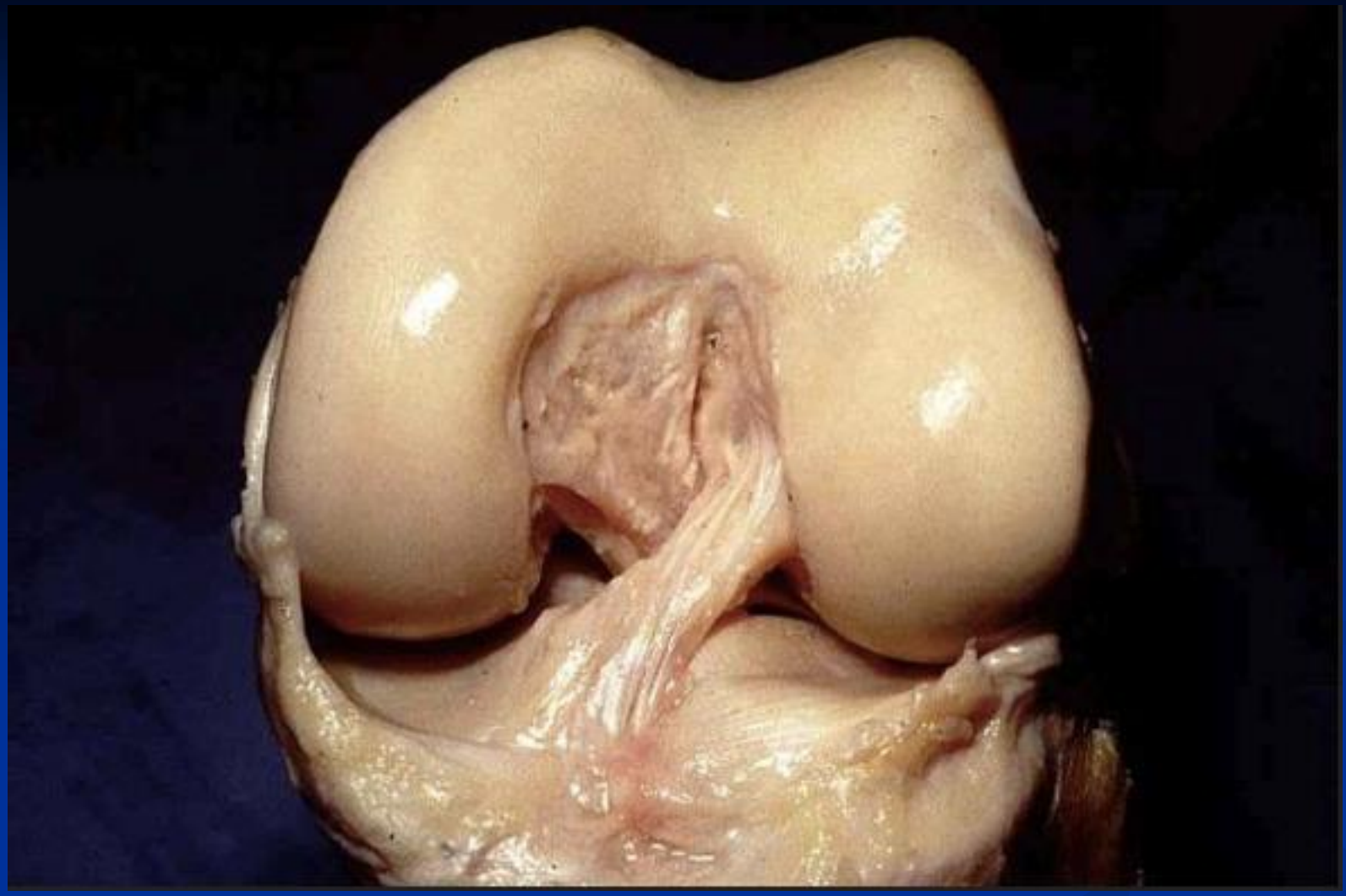
- In past decade, increased focus on recreation of ACL anatomy



Anatomic ACL

- In literature, we revisited the insertional anatomy…





- It’s lower / more oblique than we thought!

Paradigm Shift

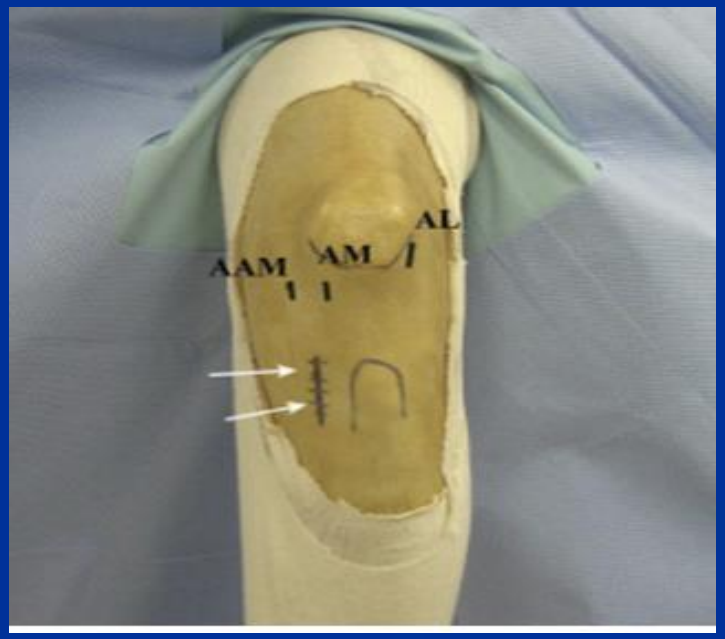
- Exact recreation of femoral footprint difficult, if not impossible with trans-tibial drilling
- Thus, new methods arose!

Anatomic ACL

- Allows creation of oblique tunnel in center of femoral footprint
  - restore rotational stability
  - prevent pivot shift phenomenon
  - protect the menisci

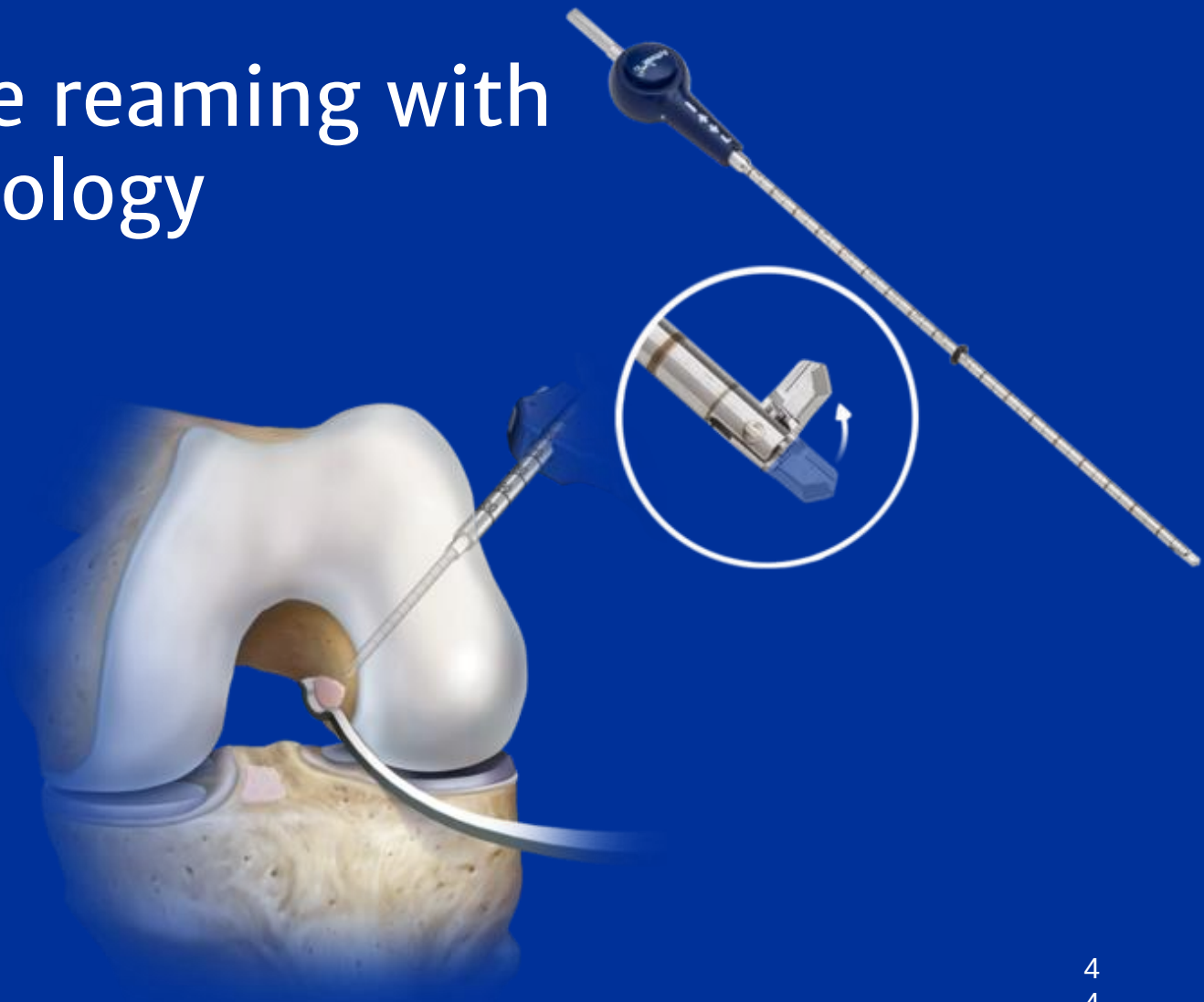
Anteromedial drilling

- More anatomic femoral tunnel with accessory AM portal, hyperflexion

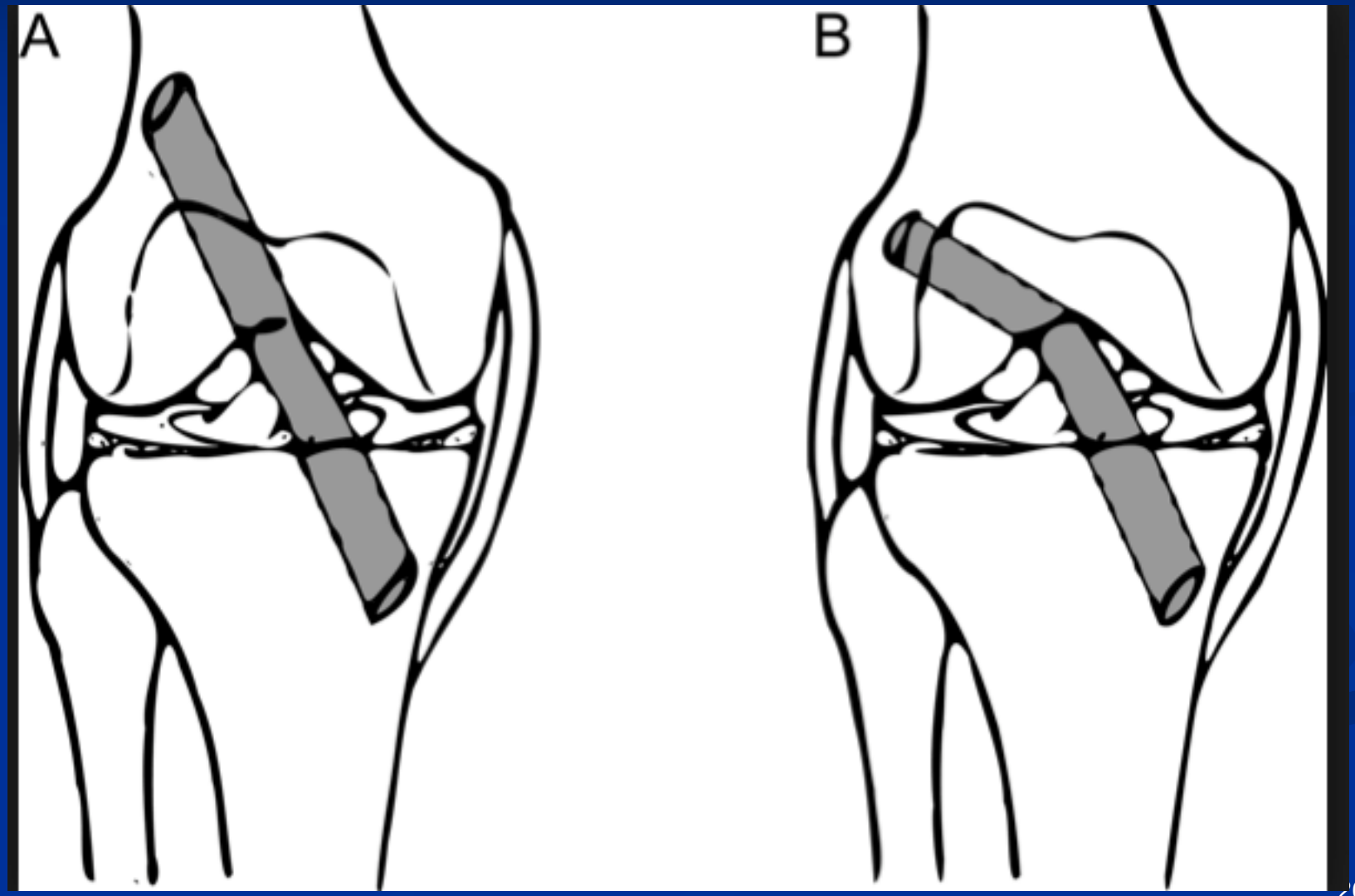


New Outside In Drilling

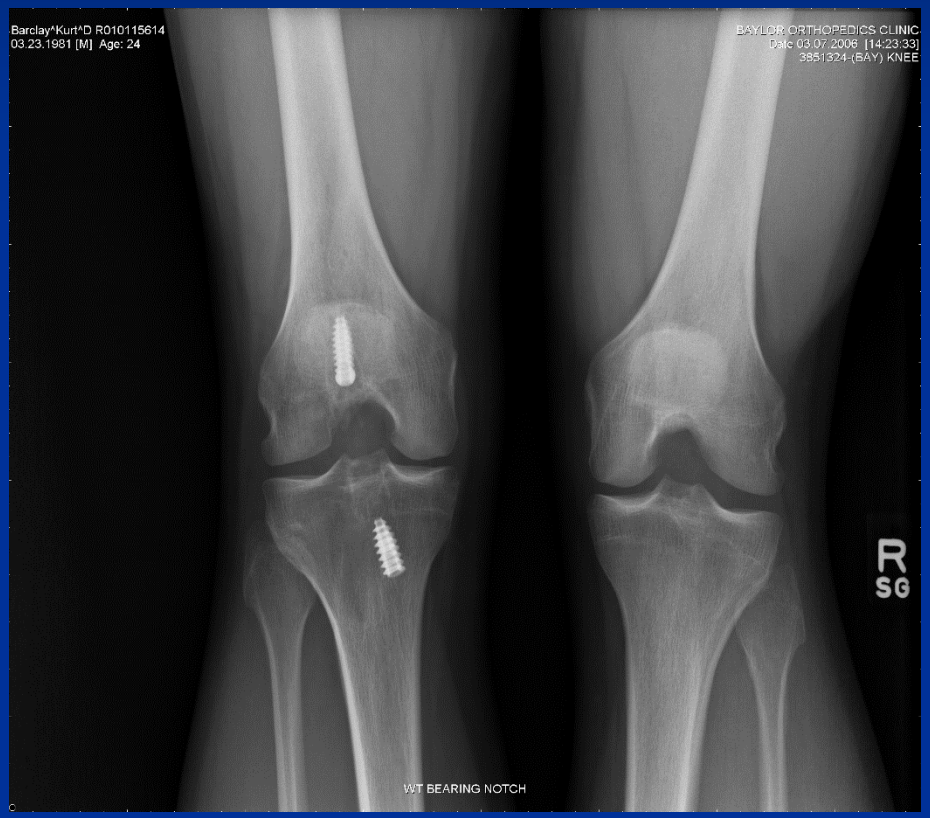
- Retrograde reaming with new technology



Vertical vs Oblique Tunnels



Post-Op XRays



VS

Does it matter clinically?

- Controversial
  - Evidence not definitive that AM drilling or “anatomic” position changes clinical outcomes but lab data does show improved tunnel position and reduced pivot shift in lab
- Outcomes remain very good for transtibial reconstructions

But…New Trends Emerge!

- Newest studies have shown that anatomic femoral tunnels may have higher failure rate than TT tunnels
- Why?

THE DICHOTOMY

- Anatomic tunnels better reproduce rotational stability and protect mensici but fail at higher rate
- TT tunnels may not fully restore pivot but fail at a lower rate
- Stay tuned!
- Tradeoff?

Illustrative CASE

- 16YO Male multisport athlete presents with new knee pain after injury
- ACL tear age 13, I did physial-sparing quad tendon ACLR
- Did well for 3 years then… reinjured with valgus torque

CASE

- MRI: partial retear of graft, new meniscal tear

CASE

- Intraop findings

CASE

- We got innovative! 7mm single Semit graft = double bundle ACL
- Using small retrograde reamer created new tunnel next to old, retaining residual intact quad graft, but augmenting

CASE

- Demonstrates how new ideas/technology create solutions for difficult problems in ACL care
- Innovation comes as surgeons work with companies to create answers to the problems we see

CONCLUSION

- ACL surgery remains a dynamic area of sports medicine.
  - Graft choice, biologics, drilling techniques, postop management, RTP timeline
- Many surgeons fall back on skill set: “this is how I do an ACL”
- As providers, help direct your patients to thoughtful surgeons that understand and can individualize treatment

Thanks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Surgeons l.l.c.

For further info on my Quad tendon ACL techniquee

- Youtube or Vumedi: Dr Murphy ACL