Complications of ACL Surgery

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- 80% of ACL surgery is performed by surgeons less than 20 years old.

“There is nothing so bad that surgery cannot make worse” Jack Hughston 1978
Complications of ACL Surgery

- Patient factors
- Intraoperative technical
- Post-operative
  - Hematoma/compartment
  - Periostitis
  - Sepsis
- Medical
  - DVT/Pulmonary embolism
Patient factors:

- Patient factors – Match the procedure to the patient, not the patient to the procedure
- Timing of intervention
  - Make sure the knee is ready for the intervention
Patient factors:

- Graft selection: morbidity v. stability

- Avoid the use of patella tendon autograft in the arthritic knee
Technical Errors:

- Visualization
- Tunnel location
- Graft preparation
- Graft passage
- Graft fixation
- Wound closure
- Pain control
Technical Errors: Visualization

• When in doubt use a tourniquet
• The morbidity of a quick efficient procedure is less than a long drawn-out procedure with poor visualization
• *Maximum tourniquet time 2 hours*
• *Tourniquet pressure 100 mm > systolic pressure*
Tourniquet Complications: *Avoidable!*

- Skin Burn
- Femoral nerve palsy
- Quadriceps shutdown
- Arthrofibrosis

*CONCLUSION:* Following TKA, wound closure with the knee in flexion and after deflating the tourniquet significantly decreased postoperative pain and promoted the recovery of ROM in the early postoperative period.
Technical Errors: Graft Harvest

- Patella tendon
- Pro’s
  - 88-94% stability
  - Biomechanically the stiffest construct
  - Late rupture rare and less common than other methods
Graft options: Patella tendon autograft

• Con’s
  – Patella/anterior knee pain 5-35%
  – Risk of rupture/fracture 1.5/1000 cases
  – Surgical morbidity greatest, flexion contracture, motion loss
Technical Errors: Graft Harvest

- Prevent fracture
  - Avoid violation proximal cortex of the patella
  - Use the saw for a complete cut
  - Gently lever graft out with osteotome
  - Minimize use of mallet on the patella

**References**


Response of joints to impact loading. 3. Relationship between trabecular microfractures and cartilage degeneration.

Radin EL, Parker HG, Pugh JW, Steinberg RS, Paul IL, Rose RM.
Technical Errors: Graft Harvest

- Patella fracture
  - Immediate fixation
  - Screw and/or wire
  - Immediate motion
  - Protected weight bearing 6-8 weeks
  - **Outcomes excellent if minimal articular damage**
Technical Errors: Graft Harvest

• Patella tendon rupture
  – Acute
  – Subacute
  – Errors of visualization and graft size!
Patella Tendon Rupture:

- 16 year female soccer injury
  - ACL DB hamstring
  - Reinjured 8 months post-op
  - Revision with contralateral patella tendon
  - 15 months harvest site weakness and pain
  - Delayed distal tendon repair
Technical Errors: Graft Harvest

- **Quad tendon bone harvest**
  - Articular portion of the patella
  - Greater incidence of fracture
  - Convert to soft tissue only graft
Graft Harvest: Patella tendon

- **Fractured** bone plug?
  - Secure with #5 suture
  - Drill to allow for easy passage thru tunnels
  - Convert to “Achilles type” graft
Graft Options: Hamstring harvest
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- Care to free sartorial fascia
- Release semitendinosus attachments to gastroc sharply to avoid delamination
Graft Options: Hamstring harvest

- Always use tourniquet in first 20 graft harvest
- Harvest may take 10-15 minutes longer than patella tendon
- Avoid injury of the MCL and main trunk of saphenous nerve
Technical Errors:

- Hamstring harvest: Gastrocnemius bands will divert the semitendinosus
Graft Options: Hamstring harvest failure

- 3 strand 10 cm graft (usually 7 mm diameter)
- Proceed to quad tendon or patella tendon graft
- Would not use unconsented allograft
- Pre-op consent flexibility is key
Technical Errors: Hematoma

- Always let tourniquet down before closure
- Use drain 24 hours if excessive bleeding
- Evacuation if skin or wound at risk
Graft Contamination: Graft on the Floor!!

- Serial 2% chlorhexidine wash for 10-12 minutes
- 5x more effective than saline (Burd AJSM 2000)
- 3 L power wash had no adverse effect on graft mechanical properties (Yan AJSM 2011)
- Allografts have up to 24% culture positive (Guelich AJSM 2007)
Graft Contamination: Osteochondral Allografts

- Campbell, Cole et al., AJSM 2014
  - Dilute chlorhexidine 0.002% with pulse lavage
  - Effective decontamination without significant cell death
  - Solutions > 2% led to high levels of cell death
Graft Passage:

• Visualization

• Graft tunnel sizing
  – Bone plugs 0.5 over-reaming
  – Length of plug (2.0 cm)
  – Soft tissue grafts end taper
Technical Errors: Graft fixation

• Femoral fixation
  – Usually 7 mm interference
  – Use 9 mm screw with poor bone quality
  – Suspension fixation as adjunct
Technical Errors: Graft fixation

• Intra-operative fluoroscopy to avoid office embarrassment
• Consider some delay in full motion but always maintain extension
Complications: Post-operative Fractures

• Traumatic
  – Multi-ligament with multiple tunnels

• Hoffa’s fracture
  – Are we drilling too low?
  – Are tunnels too large?
Complications: Post-operative Fractures

- Werner, Miller: Arthroscopy 2014
  - 32 year female
  - Hamstring diameter 6.5 mm, added contralateral hamstring to get 9 mm graft
  - Intra-operative fracture with immediate fixation
Post-operative Wounds: Periostitis

- Redness and burning pre-tibial region
- Chemical periostitis
- “Can’t let the sheet touch it”
- Observation, elevation, muscle activation
Post-operative Wounds: Sepsis

- Deep Sepsis 0.2-1.7%
- Fever, worsening pain most common
- Multiple procedures
- Professional athletes (Locker room issues?)
- Allografts not independent risk factor
Post-operative Wounds: Sepsis

- Maletis et al. AJSM 2013
  - Kaiser data 2005-10
  - 10,626 cases
  - Ave age 29
  - Time to diagnosis 20 days
  - Even distribution within hamstring, patella tendon and allograft
Post-operative Wounds: Sepsis

- Brophy, MOON group
  - JBJS Am 2015
- 2189 patients, 0.8% occurrence
- Risk Odds Ratio
  - Allografts > hamstring > BTB
  - Diabetics
  - Smoking
Post-operative Wounds: **Sepsis**

- ESR > 40, CPR > 10
- Aspirate > 20,000 WBCs
- Systemic WBC unreliable but high normal or greater
- Staph A and meth-resistant Staph A most common
Post-operative Wounds: Sepsis Treatment

- Aggressive scope debridement with graft retention (ave. 1.7 per occurrence)
- Graft removal on 2nd or 3rd procedure
- 4-6 week parental antibiotics
- Hardware removal > 6 weeks
- Aggressive maintenance of extension and motion (no role for immobilization)
Post-operative Wounds: Outcomes in the Septic ACL

- Fibrosis more common than instability
- Flexion contracture, cartilage loss
- Lower Tegner and IKDC scores

- Gille, Int Nat Ortho 2015 - inferior
- Bostrom Windharme, Arthroscopy 2014 – no difference
- Parker, AJSM 2012 - inferior
Motion Loss:

- Multifactorial
- Loss of extension poorly tolerated
  - Proper timing of surgery
  - Proper pain control
  - Aggressive muscle activation
Arthrofibrosis: Treatment

• Aggressive pain management
• Supervised rehabilitation with muscle activation (EMS)
• Oral steroids when wounds sealed (JP Rue: Arthroscopy 2008, 80% improved if given within 6 weeks of surgery)
• Extension splint
Arthrofibrosis: Arthroscopic Release

- Consider scope lysis at 6-12 weeks with global motion loss
- 12-24 weeks with isolated loss of flexion or extension
Arthrofibrosis: Arthroscopic Release

• Flexion loss: Suprapatellar pouch and gutters
• Extension loss: Retropatellar space, infrapatella contractures band
• Rarely posterior capsule release
Arthrofibrosis: Arthroscopic Release

- Chronic: Posterior medial and lateral releases
- Night splint in full extension
Arthrofibrosis: Arthroscopic Release
Arthrofibrosis: Arthroscopic Release

- Tunnel epidural 4-6 weeks in patients with disabling pain
- Weekly anesthesia visits to maintain motor function with sensory block
Deep Venous Thrombosis/Pulmonary Embolism:

• Struiik-Mulder et al.: Arthroscopy 2013
  – 100 ACL patients, No prophylaxis or bracing. Doppler ultrasound at 2 and 8 weeks po
  – 9% US detected DVT
    • 5 asymptomatic calf vein
    • 2 symptomatic calf vein
    • 2 symptomatic deep vein
    • 1 symptomatic pulmonary embolism
Deep Venous Thrombosis/Pulmonary Embolism:

• Incidence: DVT 1-2%, PE 0.3%, fatal events anecdotal
• Prophylaxis: Clotting history, family history, birth control, smoking, obesity
• Mandatory with Factor V resistance or antithrombin III deficiency
• Mechanical compression, ASA, Low molecular weight heparin, warfarin
• Factor Xa inhibitors: Rivaroxban 10 mg/day, Apixiphan 2.5 mg/BID
Deep Venous Thrombosis/Pulmonary Embolism: Prophylaxis

- Risk of DVT v. bleeding
- ASA for all
- Pretreatment of high risk patients
- Bridge therapy for all with chronic anti-coagulated patients
- Cost-benefit ratio of mechanical compression is not clear
Deep Venous Thrombosis/Pulmonary Embolism:

- Symptoms: Calf pain, swelling, **tachycardia**, shortness of breath
- Doppler or Duplex scanning with any history
- Spiral CT scan with SOB or pulse oximetry <95%
Deep Venous Thrombosis/Pulmonary Embolism:

- **Calf Clots** – Observe, Low dose heparin
- **Popliteal/femoral clots** – immediate full dose heparin as bridge to 3-6 months warfarin therapy (INR 2-2.5) or factor Xa inhibitor
- Expect some measure of post-thrombotic symptoms of fatigue, swelling, ulcers (up to 24%)
ACL Complications:

1. Informed consent, set proper expectations
2. Aggressive work-up on suspicion of complication, always provide an air of concern
3. Information management key to avoid patient anger and litigation
4. Provide a rationale for treatment decisions as patient may lose faith in your judgment
Thank You!