Extreme Sports Surgery: The Multiligament-Injured Knee

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Extreme Sports Surgery:
The Multiligament-Injured Knee

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The following relationships exist:
Smith+Nephew: Consultant, Honoraria, Speaker’s bureau
Arthrex: Honoraria, Speaker’s bureau
Arthrosurface: Consultant, Honoraria
A story of 243 patients, 4 ligaments, and some crazy bad decisions

1. Low-velocity ≠ Low-energy.
2. What you don’t know will hurt you.
3. The foot faces forward for a reason.
4. A good pulse means nothing.
5. Lost sensation means something.
6. Normal X-rays are worse than abnormal ones.
7. Sometimes a fracture of the tibial plateau isn’t a tibial plateau fracture.
8. Never trust the surgeon who says “I never” or “I always”.
9. Change is good, until it isn’t.
10. Some are pistachios, some are mussels.
Welcome to extreme sports medicine, when things go good, it’s soooo good... when things go south, it’s a shitstorm.
You will decide the outcome.

Roger
42yo Professional Skier/Climber
MOI: Avalanche Bilateral Knee Dislocations (KD4, KD3L)

Gretyl
18yo Div 2 Soccer Player
MOI: On-field Soccer Collision (KD3L)
Early recognition/diagnosis and initial management is critical.

1 year post-injury (to the day):
Skiing the Slot Couloir, where he was injured.

9 months post-injury:
Above-knee amputation due to complications from missed diagnosis.
#1: Low-velocity ≠ Low-energy.

- Multilig injuries are ALL high-energy injuries
  - 59% high-velocity, 41% low-/ultra-low velocity
  - Based on history, the extent of injury may not be suspected after low-velocity
#2: What you don’t know will hurt you (examine, don’t assume)

- Most multiligament injuries spontaneously reduce
#3: The foot faces forward for a reason.

- If *you* think the leg is at an awkward angle, *the leg* thinks so too.

- Most knee dislocations reduce easily, and will maintain relative redux.

- Rapid reduction decreases tension on neurovascular structures and will often restore blood flow (limit ischemic injury).
#4: A good pulse means nothing.

- Overall incidence of vascular injury: 4.8-64%
- Arterial injury: 7.5-14%
  - delay in diagnosis >6-8h results in irreversible ischemic damage and increased risk of AKA (86%)
- In our series (n=238): 9%
  - Observed in EVERY ligament combination except KD1M (ACL/MCL)
  - poorer outcomes noted in population transferred after missed diagnosis
- Intimal tears (normal pulses) result in limb-threatening injury 5-15%
#4: A good pulse means nothing.

- **No hard signs**
  - Symmetric pulses
  - $\text{ABI} > 0.9$
  - 24hr observation
  - Serial exams
  - Duplex

- **No hard signs**
  - Asymmetric pulses
  - $\text{ABI} < 0.9$
  - Angiography

- **Absent pulses**
  - (+) hard signs
  - **without negative angio, pt must be admitted for serial exams!!**
  - immediate OR evaluation & management
#5: Lost sensation means something.

- In our series (n=238):
  - 38% of patients presenting with a common peroneal palsy had an associated arterial injury
  - 62% of patients in whom an arterial injury was identified also had a peroneal injury
  - 43% of CPN injuries improve/resolve if nerve is in situ
  - Durable peroneal or tibial nerve injury was associated with much poorer subjective outcome
#6: Normal X-rays are as dangerous as abnormal ones.

- a problem
- tells someone there’s a problem
- no problem?
#7: Sometimes a fracture of the tibial plateau isn’t a tibial plateau fracture.
Fracture–Dislocation of the Knee

Tillman M. Moore, M.D.

CORR 156, 1981
#8: Never trust the surgeon who says ‘I always’ or ‘I never’.

• …they’ve not yet stared into the abyss.

• Every multilig has its own personality

• Timing/treatment must be individualized based on:
  – stability of the patient
  – stability of the tissue environment
  – stability of the kinematic environment
Stability of the patient

• High-energy with frequent concomitant injuries:
  – 39% associated skeletal fractures
  – 18% nerve injury (CPN)
  – 9% popliteal artery injury
  – 7% pelvic/acetabular fractures
  – 7% spinal injuries
  – 3% traumatic brain injury
  – 2% open joint

• Address long bone fractures (they kill people)
• Address peri-articular fractures (they kill joints)
Stability of the tissues

• **External fixation only if the reduction can’t be maintained**
  – at most one week
  – avoid the “FLASCID” knee

• **Early ROM if tissues allow**
  – hinged knee brace, start ROM at 48-72h

• **High-velocity/open/articular fx**
  – delay reconstructions 6 weeks
  – 75% infection rate with ORIF + MLR
  – ex-fix = increased infection
Stability of the *tissues*

- **Ideal (2-3 weeks)**
  - primary repair and augment
- **Questionable (4-6 weeks)**
  - “scarball judgement call”
  - can be hard to repair primarily
  - stiffness/HO
- **Delayed (> 6 weeks)**
  - periarticular ORIF
  - infection/open injuries
  - late presentations
  - medically unstable
  - salvage cases
Stability of the *kinematic environment*

- Staged vs all-at-once?
  - Veltri et al., Harner et al.
  - Complex coupled translations/rotations
  - Altered center of axial rotation without ACL or PCL
  - Single-stage when possible
  - take what you get, don’t burn bridges
#9: Change is good, until it isn’t.

- Evolution in technique
- A few things I’ve changed
  - order of repair/reconstructions?
  - tourniquet: the tool of the devil?
  - the ‘right’ posterolateral reconstruction?
  - tunnel theory
  - grafts
Surgical tactic

1. Anatomic dissection prior to arthroscopy
   • easy dissection before imbibation
   • tag structures for repair
   • allows low pressure egress during arthroscopy…

2. Reconstruct central pivot (PCL/ACL)
   • restores sagittal + coronal stability
   • kinematics greatly normalized

3. Reconstruct MCL/PLC
   • anatomic repairs
   • check isometry
   • augment with grafts
The tool of the devil?

- **Selective** tourniquet use:
  - Negative acute vasc w/u
  - Preop ABI normal
  - No risk factors
    - age <60
    - BMI < 30-35
    - Smoking, malignancy, hx

- 222 cases
  - 31 (14% excluded)
  - avg. 106 min.
  - 3.6% symptomatic infrapopliteal DVT postop
  - 11% in excluded group
PLC: Choose the Right Weapon

Colt .357 Magnum
- smaller, user friendly
- 6 shots, can only do so much
- works for 80% of situations

AK-47
- more complicated
- can be overkill (constraint)
- goto for difficult situations
PLC Recon:  Working Windows
Tunnel theory: live on ‘the edge’
Tunnel theory: live on ‘the edge’
#10: Some are pistachios, some are mussels.

• Pistachios
  – vegetable
  – easy to prepare
  – you can eat about 30 in a row before you get a bad one

• Mussels
  – animal
  – harder to prepare
  – they can make you pretty ill if you don’t cook ‘em just right
#10: Some are pistachios, some are mussels.

- SF-36 (pre-/post-tx)
- IKDC subjective
- Tegner
- Lysholm

**Satisfaction**
- 5 normal
- 4 labor/sports w/occ symptoms
- 3 ADLs w/o pain/inst
- 2 occ pain/inst with ADLs
- 1 daily pain/inst with ADLs
- 0 assistive device

**Mode of Failure** (what keeps you from a 5)
- stiffness (41%)
- pain/sore (38%)
- instability (17%)
- weak (15%)
- other injury (14%)
  - 64% neurologic!
  - mechanical (11%)
  - swelling (7%)
#10: Some are pistachios, some are mussels.

- 76% satisfied
- avg score 4.03
  - 41% residual stiffness*
  - 21% pain/soreness
  - 11% limited by other inj
  - 11% residual weakness
  - 5% mechanical sx
  - 4% instab
  - 4% swelling
  - ROM < 110° : 17%

- 24% not satisfied
- score 2.02 (p < 0.001)
  - 36% pain/soreness
  - 20% residual instability
  - 16% stiff*
  - 16% swell
  - 4% other injury
  - 4% weakness
  - ROM < 110° : 40%
#10: Some are pistachios, some are mussels.

- young (20-40)
- **high** baseline Tegner
- normal BMI
  
  - injuries recognized, tx’d
  - medically healthy
  - acute presentation
  - normal alignment
  - no OA
  
- older (40-60’s)
- middling Tegner
- BMI > 35-40
  
  - missed injuries
  - DM, infection, DVT
  - chronic injury
  - varus/valgus malignation
  - presenting OA
Thank you!