Mythbusters—Don’t Believe Everything Your Colleagues Tell You (Except Me)!?

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What Are We Going to Discuss?

- Posterolateral Corner Injuries
- Activity and joint replacements
- Running and the knees
- X-rays and splinting
- Ferritin—soapbox update

Disclosures

- I have no relevant financial relationships

Conflict of Interest?

Posterolateral Corner

“Give it a couple of weeks.”

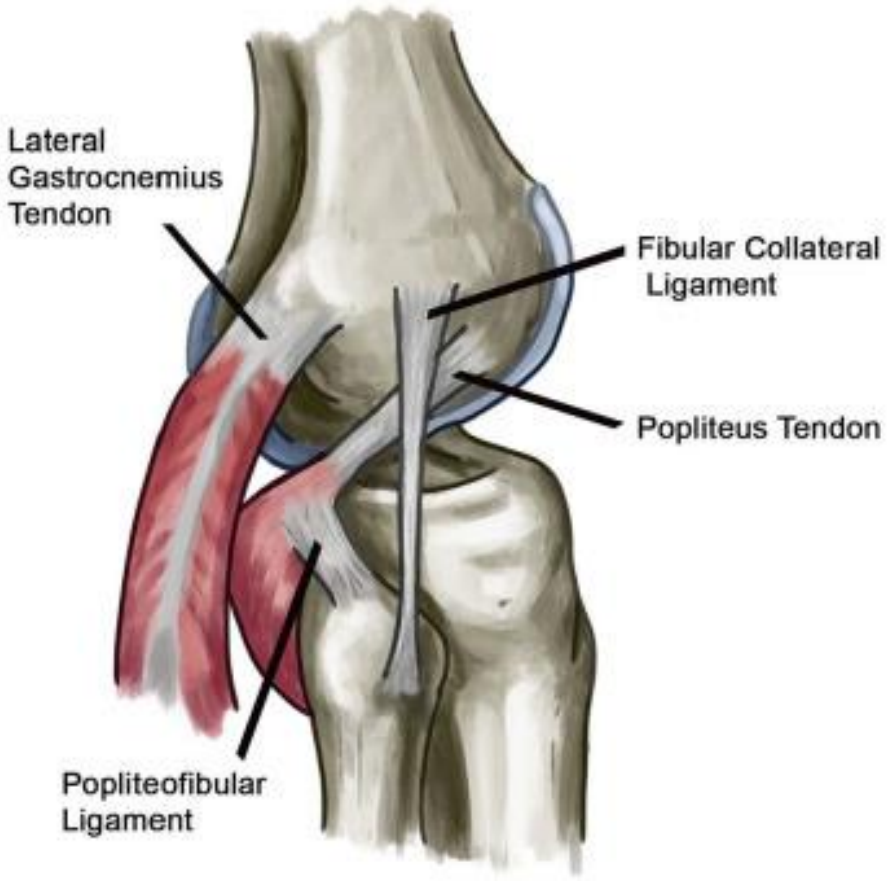
NIH Open Review 2021

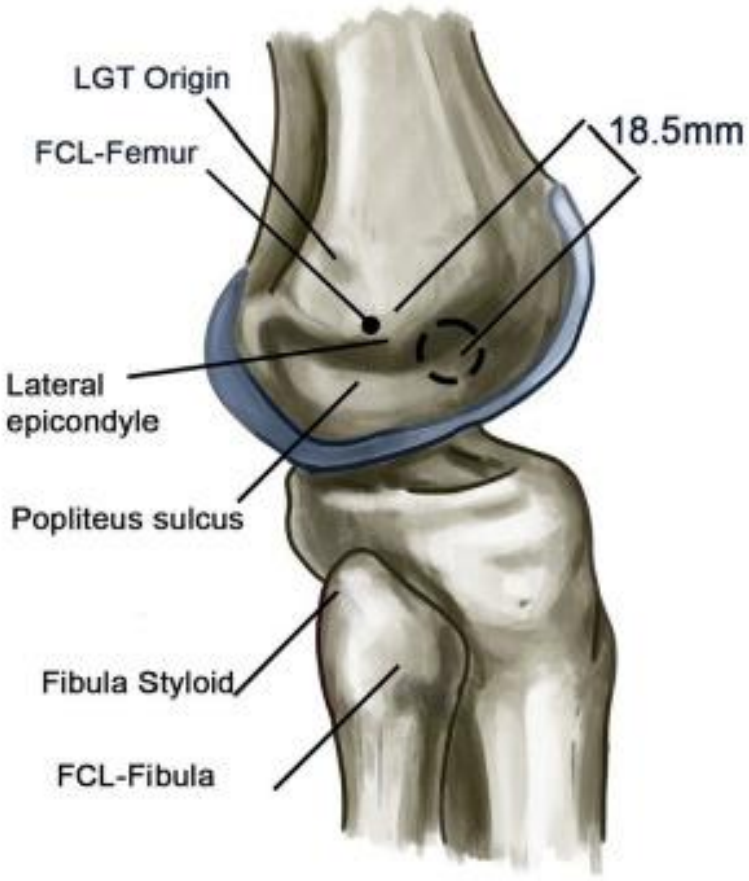
- “Limited knowledge of the anatomy and biomechanics of the posterolateral corner (PLC) of the knee, coupled with poor outcomes with non-operative management, resulted in the PLC often being labeled as the ‘dark’ side of the knee.”

  – Figueroa F, Figueroa D, Putnis S, Guiloff R, Caro P, Espregueira-Mendes J. Posterolateral corner knee injuries: a narrative review. EFORT Open Rev. 2021 Aug 10;6(8):676-685. doi: 10.1302/2058-5241.6.200096. PMID: 34532075; PMCID: PMC8419800.

PLC Anatomy

- Three primary static stabilizing structures:
  - Lateral (fibular) collateral ligament (FCL)
    - Primary varus stabilizer of the knee
    - Also provides restraint to tibial external rotation and secondary stabilizer to internal rotation
  - Popliteus tendon
    - Intra-articular at points
    - Assists in initial flexion of the knee joint
    - Acts as a ligament by functioning as a stabilizer for external rotation of the knee and stabilizing varus stress
  - Popliteofibular ligament
    - Secondary stabilizer to varus and internal rotation


Lateral
Gastrocnemius
Tendon
Fibular Collateral
Ligament
Popliteus Tendon
Popliteofibular
Ligament


LGT Origin
FCL-Femur
18.5mm
Lateral
epicondyle
Popliteus sulcus
Fibula Styloid
FCL-Fibula

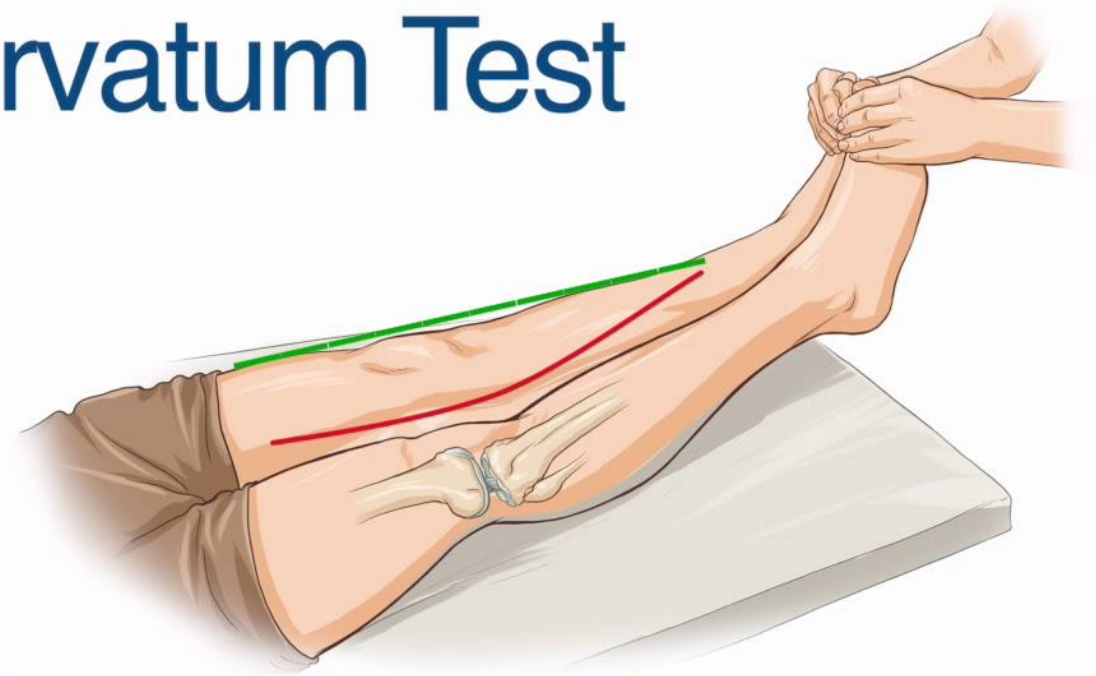
Injury Mechanism

- Direct varus stress to the knee
- Contact or non-contact hyperextension
- Twisting of the knee when combined with multiple ligamentous injury including tibiofemoral dislocation

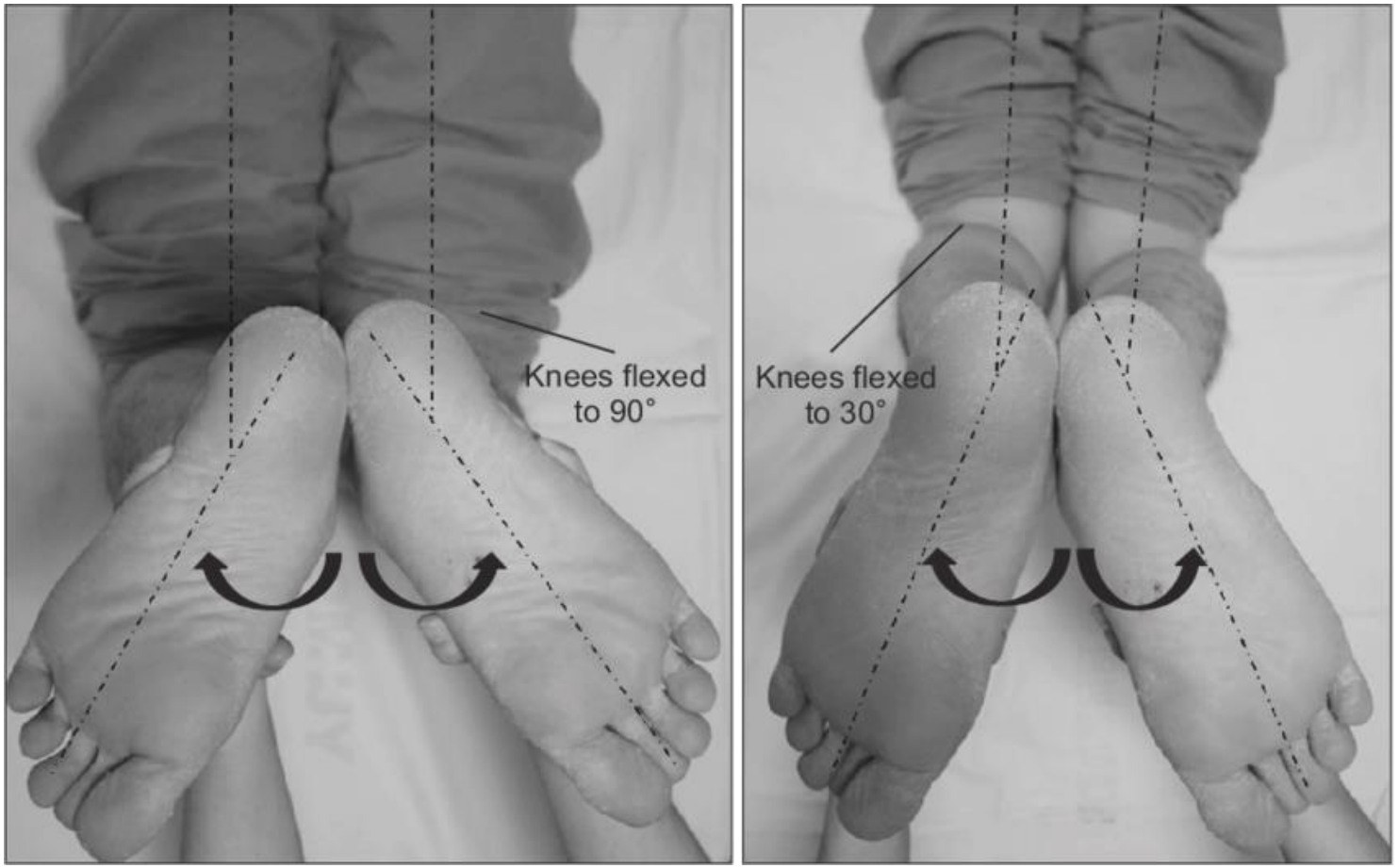
Physical Exam

- Varus Testing
  - Test at 0º and 30º and compare to opposite side
  - Gapping at 0º suggests injury to PLC and one or more cruciate ligament
  - Varus gapping at only 30º suggests isolated FCL injury
- Hughston's external rotation recurvatum test
  - Stabilize distal thigh of a supine patient with one hand lifting the leg by the great toe with the other
  - Compare hyperextension to opposite side
- Dial test
  - Prone position
  - Test ER at 30º and 90º knee flexion
  - Increase of 10º to 15º of ER at 30º knee flexion—PLC
  - Increase at 90º indicative of PLC and post cruciate lig

External Rotation Recurvatum Test

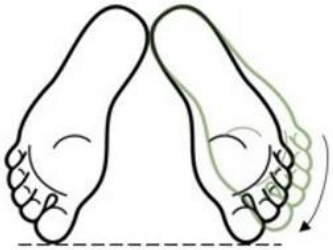


Dial Test



Dial Test

Negative at 30°

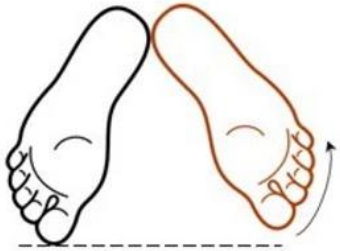


No PLC injury.

PLC: posterolateral corner

THE KNEE RESOURCE

Positive at 30°



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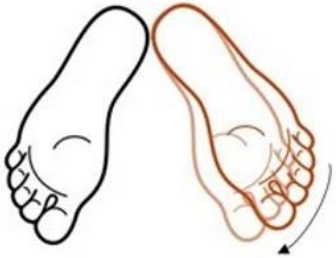
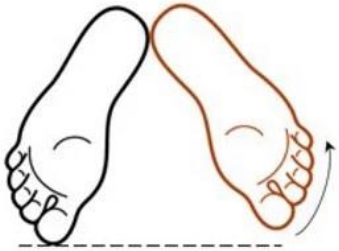
Negative at 90°



PLC injury.

Positive at 30°



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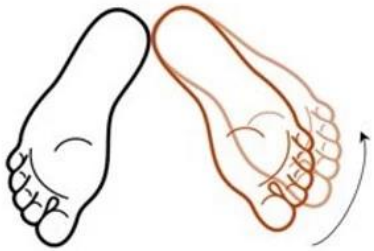
Positive at 90°



Combined PLC-PCL injury, OR medial knee injury.

OrthoFixar
Orthopedic Surgery

Imaging

- X-ray—look for lateral joint space widening or anteromedial tibial fractures or fibular head avulsion fractures
- MRI—looks for ligamentous concomitant injuries

Treatment

- If known/dx'd PLC injury—refer to ortho
- If concerned but not diagnosed—refer to sports med for further evaluation
- Operative tx superior to non-op
- Some debate around technique

X-rays (and Splinting)

“But I’m not worried about a fracture.”

Why x-ray?

- Even if not suspecting a fx, if there is any sort of trauma you may be surprised to find one
- Outside of fx conditions you may see/can assess:
  - Arthritis—knee get standing views
  - Ankle sprain—mortise intact?
  - Stress reaction
  - Tumor

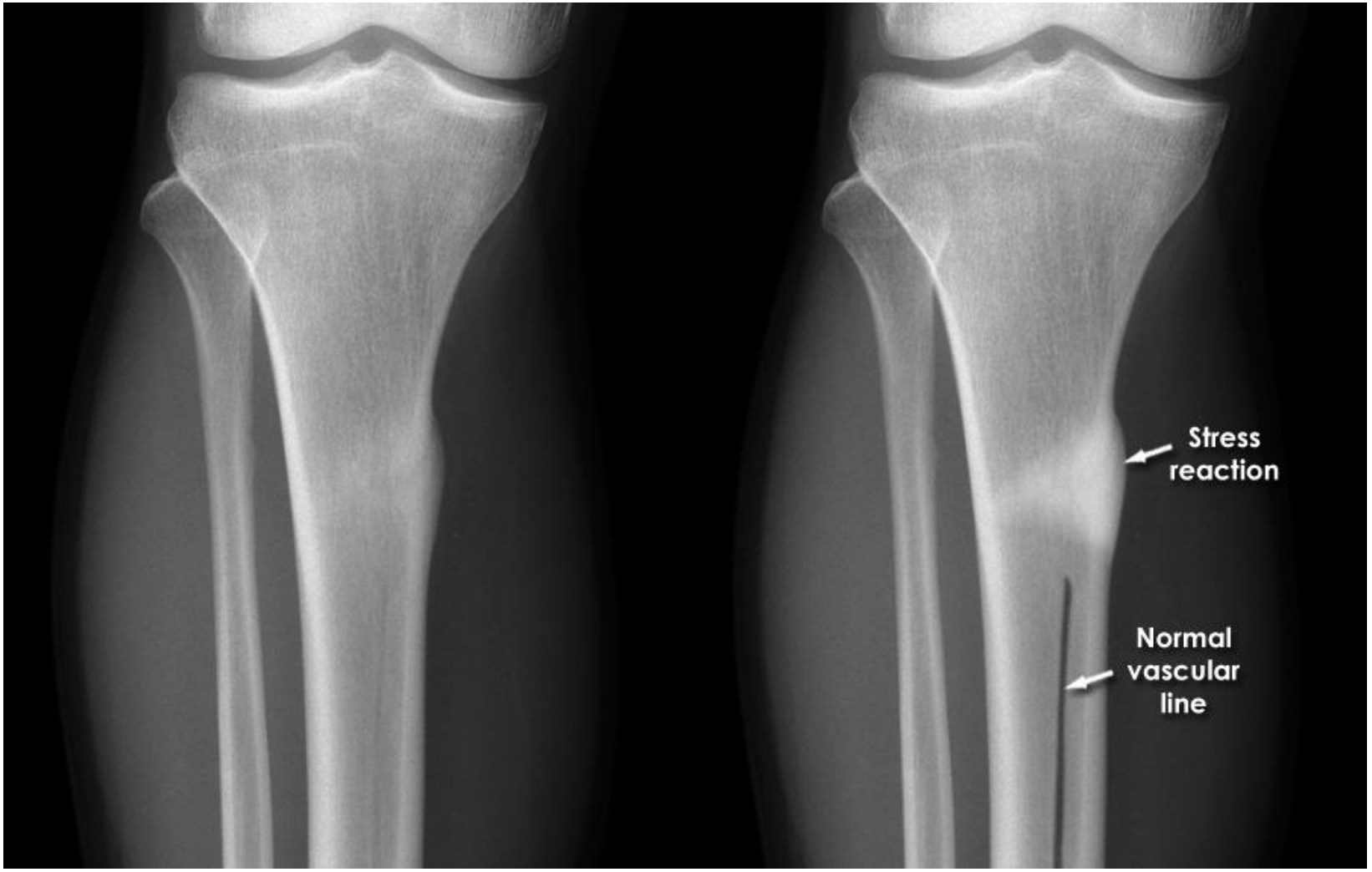
  - TAKE A LOOK AT THE X-RAY YOURSELF!

Knee DJD

Normal Mortise

Widened Mortise

Tibial Stress Reaction/FX



Why splint?

- External device employed to immobilize an injury or joint
- Decrease likelihood of further damage. Protect soft tissues, alleviate pain, and accelerate healing
- May be the best initial treatment for an unstable injury
- May be definitive treatment for some injuries
- Goal is to restore the anatomic resting joint position

Considerations Prior to Splinting

- Assess neurovascular status
- Splint one joint above and below the injury
- Splint stable fractures as treatment, or unstable as a bridge to casting or surgery
- Oblique fractures can often shorten if splinted (and sometimes casted)

Indications

- Temporary stabilization of acute fractures, sprains, or strains before further evaluation or definitive operative management
- Immobilization of a suspected occult fracture, such as a scaphoid fracture
- Severe soft tissue injuries requiring immobilization and protection from further injury
- Definitive management of specific stable fracture patterns
- Peripheral neuropathy requiring extremity protection
- Partial immobilization for minor soft tissue injuries
- Treatment of joint instability, including dislocation
    - **Splinting:** Alyssa D. Althoff; Russell A. Reeves (NIH Stat Pearls)

Contraindications

- No specific contraindications
- Special considerations:
  - Open wounds—clean and consider abx
  - Neurosensory deficits-–watch for compartment syndrome and monitor those with neuropathy for pressure spots
  - Vascular compromise/injury—particularly if a reduction as been performed

Imaging Thoughts

- X-ray contralateral side if unsure
- Splint and re-x-ray 7-10 days later in unclear
- Look at your own x-rays
- Knees—get standing views and sunrise view
- Phone a friend if needed!

Joint Replacements

"Better not do that!"

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Claim

- Take it “easy” after hip and knee replacements:
  - Don’t run—walk only
  - No skiing, jogging, sprinting
  - Cycling, swimming, golf OK
  - No sports (or “doubles” activities—tennis/pickleball)
- Concern that joint may wear out and/or adverse reaction for patient

THA Study

- **Does Activity Level After Primary Total Hip Arthroplasty Affect Aseptic Survival?**
  - *Arthroplasty Today* 2021
  - Purpose: “evaluate survivorship and outcomes of high-activity patients compared to low-activity patients after total hip arthroplasty.”
  - 2002 patients (2532 hips)
  - Divided into 2 groups:
    - Low (LA) had 1054 patients (1299 THAs)
    - High (HA) had 984 patients (1231 THAs)
  - Mean 4.5 years f/u

THA Study

- Aseptic revisions:
  - LA 2.1%
  - HA 0.4%
- Controlled for age, gender, preop pain, preop HHS, and BMI
- “a higher postoperative activity level remained a significant factor for improved aseptic survivorship”
- “General concern with higher activity after THA is polyethylene wear…however, polyethylene durability has improved significantly…”.

THA/TKA Review

- **Return to Sport After Hip and Knee Arthroplasty: Counseling the Patient on Resuming an Active Lifestyle**
  - On-line NYU Langone and Rothman Ortho 2023
  - Current RTS guidelines formulated via survey data and expert opinions
  - Evidence-based consensus guidelines have not been compiled
  - Purpose: “summarize the available literature on the epidemiology, biomechanics, clinical outcomes, and complications of return to sport after TJA, as well as provide guidelines for patients’ safe return to athletic activity.”

THA/TKA Review

- Multiple studies show an INCREASE in percent of patients participating in preferred activity after TJA (35%→61% Wylde 2008), TKA (36→89% Witjes 2016) and UKA (75%→100% Witjes 2016)
- 10-30% do not participate in sports and physical activity up to a satisfactory level
- “Though theoretical concerns for implant failure exist…evidence to associate failure with increased physical activity following TJA is limited.”

THA/TKA Review

- Skiing: 70% return to skiing after TKA and THA (Lancaster 2022)
- Tennis: mean 7-year f/u players noted improvement in mobility, ability to play on various surfaces, weight shifting and follow-through. Two of the 46 TKA needed revision (at 8 and 11 years post-op) and remained asymptomatic at 5 and 7 years after revision (Mont 1999).

Truth

- It is OK and advisable to return to desired activity level post TJA
- Low-impact (e.g. walking, golf, swimming, cycling, rowing, dancing, bowling) and intermediate-impact (doubles tennis, stair climber, skiing, weightlifting, ice skating) should be good for all (assuming you have experience in the activity)
- High-impact (running/jogging, singles tennis, soccer, rugby, football) activity-specific discussion—non-contact activities likely not a problem

And what about running and arthritis?

- 2017 Meta-analysis
- 25 articles with 125,810 individuals
- Findings:
  - Running not associated with OA
  - Running at recreational level associated with significantly lower odds of knee and/or hip OA compared with individuals running competitively and more sedentary, nonrunning individuals

- Alentorn-Geli E, Samuelsson K, Musahl V, Green CL, Bhandari M, Karlsson J. The Association of Recreational and Competitive Running With Hip and Knee Osteoarthritis: A Systematic Review and Meta-analysis. J Orthop Sports Phys Ther. 2017 Jun;47(6):373-390. doi: 10.2519/jospt.2017.7137. Epub 2017 May 13. PMID: 28504066.

Knee OA Radiograph Study

- 2008 Prospective study
- 45 runners and 53 controls
- Monitored for 18 years—radiographic OA
- Knee OA:
  - Start: 6.7% of runners and 0% of controls
  - End: 20% of runners and 32% of controls

- Chakravarty EF, Hubert HB, Lingala VB, Zatarain E, Fries JF. Long distance running and knee osteoarthritis. A prospective study. Am J Prev Med. 2008 Aug;35(2):133-8. doi: 10.1016/j.amepre.2008.03.032. Epub 2008 Jun 12. PMID: 18550323; PMCID: PMC2556152.

OA and Marathoners

- 2018 Survey
- 675 runners:
  - Mean age: 48
  - Mean weekly milage: 36
  - Mean time: 19 years
  - Mean number of marathons: 76
- OA:
  - Marathoners: 8.8%
  - Matched US population: 17.9%
- Age, family history and surgical history independent risk factors for OA
- Running duration, intensity, mileage and # of marathons were NOT

- Ponzio DY, Syed UAM, Purcell K, Cooper AM, Maltenfort M, Shaner J, Chen AF. Low Prevalence of Hip and Knee Arthritis in Active Marathon Runners. J Bone Joint Surg Am. 2018 Jan 17;100(2):131-137. doi: 10.2106/JBJS.16.01071. PMID: 29342063.

Running and OA

- Multiple studies show no relationship between running and knee/hip OA
- Cartilage research shows response to exercise builds stronger cartilage
- Running with OA does NOT make the OA worse and may slow the progression
- Strength training likely slows OA progression

* Aerobic exercise to live longer—strength train to live better *

Iron/Ferritin (My soapbox update)

"Your iron/ferritin is normal."

Low ferritin

- We are not checking this enough
- Can check any age, but young active individuals often have low ferritin
- >30% of young females have low iron
- Several studies have shown improved performance using a cutoff of 30 as the low end of normal (I like 35)
- We have moved level of infusion in some instances from single digits/teens to 30
- New hematologist at UMHWest Steven Fein MD

Why is iron/ferritin low?

- My opinion biggest factors are:
  - Red blood cells damaged due to pounding (foot strike hemolysis)
  - Nutritional deficiencies
  - Heavy periods

Symptoms

- Recent studies suggest those with normal hemoglobin levels, but low ferritin levels feel better, perform better, and have better treadmill test results after taking iron and getting the ferritin level up.
    - Burdon et al., Is iron treatment beneficial in iron-deficient but non-anemic (IDNA)endurance athletes? A systemic review and meta-analysis. *Br J Sports Med.* 2015; 49:1389-97.
- Symptoms of this will include fatigue, having trouble keeping up during workouts, plateau in performances, injuries, odd muscle pain, brain fog and even GI discomfort/issues.
- If an athlete develops any of these symptoms, getting blood work done (CBC, chemistry panel, serum iron, ferritin and thyroid tests) would be a good idea.

Fatigue tests

- CBC
- Chem 12 (CMP)
- Ferritin
- TIBC (has iron and saturation as well)
- Vit D
- Thyroid Cascade

- Can add: B12, Folate, Mg
- In females consider adding: Estradiol
- ?Cortisol (AM), HSCRP, CK, DHEAS

“Normal” Levels

- Hemoglobin, iron and ferritin levels are all important, and athletes with normal hemoglobin and iron levels, but low ferritin levels benefit from iron supplementation.
- One other confounding factor is that ferritin levels are considered “normal” down to levels of 10 or 12 even though this is too low for the endurance athlete (more on levels later). **Different levels are “normal” for different people**–what is normal for many may not be normal for those who push their bodies on a regular basis.

Ferritin Low?

- **If the ferritin is low (less than 35)** even if hemoglobin and serum iron are normal, I would recommend supplementing with two over the counter iron pills per day (there is typically 65 mg of active iron in each tablet), with Vit C (which helps absorption) and folate (a deficiency in this can also inhibit absorption).
  - Do NOT take at the same time as calcium.
  - Meat sources absorbed better than plant sources.

Recheck

- **Recheck levels in 6 weeks.**
  - Target > 50.
  - Once reaches mid 30's will often feel better.
  - >40 often do well, 50 gives a buffer.
  - Recheck labs every 6 weeks until 45/50 or greater, then 1-3 times a year.

Infusions

- **If for some reason an athlete has an exceedingly low ferritin level** (single digits/teens) or has problems with absorption, we have utilized iron infusions
  - Make sure no other causes of iron loss
  - We tell patients: Considering this would warrant a thorough evaluation and discussion with a sports medicine physician who deals with endurance athletes
  - I will consider infusion if <30 (or even <50 if extremely symptomatic)

For More Info:

- Solberg A, Reikvam H. Iron Status and Physical Performance in Athletes. Life (Basel). 2023 Oct 2;13(10):2007. doi: 10.3390/life13102007. PMID: 37895389; PMCID: PMC10608302.

Thank you!

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  - 616-443-5494 (cell)

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Bonus Ferritin Information

Fatigue

Can be multi-factorial:

- Overtraining—is AM heart rate going up?
- Low thyroid—check TSH.
- Low iron—need to check iron, iron binding capacity (TIBC) and ferritin.

- Energy Balance

Anemia

- Two primary causes:
  - blood loss
  - nutritional deficiencies.
- GI bleeding may cause blood loss in some athletes, particularly distance runners.
- Genitourinary system may be source of chronic blood loss in athletes.
- Sweat represents a negligible loss of iron.
- Low ferritin—red blood cells damaged due to pounding (foot strike hemolysis).

Iron Deficiency

- Many male and female endurance athletes fail to meet recommended energy intake, and many female athletes also consume less than the RDA of iron (**disordered eating**).

- Those who follow vegetarian or modified vegetarian diets have lower ferritin levels and lower iron bioavailability, although iron intake is similar (source of iron may be important).

Iron Deficiency

- **Iron deficiency is the most common nutritional deficiency** in the US--up to 11% of females and 4% of men, but 20%-50% of female athletes and up to 17% of male athletes.

- Iron deficiency with anemia is less common, occurring in only about 1-2% of all adults, but 10%-15% of female athletes.

    - Incidence of Iron Deficiency and Iron Deficient Anemia in Elite Runners and Triathletes. Coates et al, *Clin J Sports Med,* 2016.

Ferritin

- Ferritin is the protein bound iron stored in the body (liver, spleen, and bone marrow in particular).

- Ferritin is important in endurance athletes; **knowing the number** may be as important as any training plan you are following; and ferritin should be checked at least yearly.

How do they all work together?

- Iron is a key component of hemoglobin (the oxygen carrying component in blood).
- Endurance athletes need to get oxygen to working muscles while training and racing.
- When hemoglobin levels are low there will be an **issue with oxygen transport**.
- When iron levels are low, hemoglobin levels may be low as well, but sometimes not (iron deficiency nonanemia-IDNA).
- Hemoglobin levels do NOT directly assess iron levels. Athletes are often told their iron levels are normal, but if only the CBC was tested, they are not getting the complete story.

“Normal” Levels

- Hemoglobin, iron and ferritin levels are all important, and athletes with normal hemoglobin and iron levels, but low ferritin levels benefit from iron supplementation.
- One other confounding factor is that ferritin levels are considered “normal” down to levels of 10 or 12 even though this is too low for the endurance athlete (more on levels later). **Different levels are “normal” for different people**–what is normal for many may not be normal for those who push their bodies on a regular basis.

Symptoms

- Recent studies suggest those with normal hemoglobin levels, but low ferritin levels feel better, perform better, and have better treadmill test results after taking iron and getting the ferritin level up.
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- Symptoms of this will include fatigue, having trouble keeping up during workouts, plateau in performances, injuries, odd muscle pain, brain fog and even GI discomfort/issues.
- If an athlete develops any of these symptoms, getting blood work done (CBC, chemistry panel, serum iron, ferritin and thyroid tests) would be a good idea.

Symptoms/Testing

- There are other problems that can produce the above symptoms, but the labs are the best way to get the work-up underway.
- One problem with waiting until there are symptoms, however, is that by the time the blood is tested the ferritin level may be very low and it **takes a little time to get the levels up**.
- We recommend if possible that endurance athletes get it checked at least once a year, and more frequently if a problem is identified.

1. Assess Levels.

- **Assess serum ferritin levels** (as well as CBC and serum iron) in the “pre-season” if possible.
  - Early summer for XC.
  - Consider recheck September/early October.
  - Track athlete as well—consider Feb/early March.

2. If Ferritin Low?

- **If the ferritin is low (less than 35)** even if hemoglobin and serum iron are normal, I would recommend supplementing with two over the counter iron pills per day (there is typically 65 mg of active iron in each tablet), with Vit C (which helps absorption) and folate (a deficiency in this can also inhibit absorption).
  - Do NOT take at the same time as calcium.
  - Meat sources absorbed better than plant sources.

3. Recheck.

- **Recheck levels in 6 weeks.**
  - Target > 50.
  - Once reaches mid 30's will often feel better.
  - >40 often do well, 50 gives a buffer.
  - Recheck labs every 6 weeks until 45/50 or greater, then 1-3 times a year.

4. Why Not Just Start Iron?

- **DO NOT just start iron** as 1 in 250 may have hemochromatosis that can cause a toxic build-up of iron in the liver.

- Monitoring levels will help stay away from this issue as well as guide ongoing treatment.

5. Maintenance.

- **When the desired level is achieved,** I usually have the athletes cut down to one tablet a day. While endurance training is going on there is a good chance the levels will drop again if the supplementation is stopped completely.

6. Info for patients: Who Should Perform the Tests?

- **Talk to your doctor about this.** If they agree with testing and understand that for an endurance athlete “normal” is 35 or more (not just barely inside the normal range of 10 or 12 for the normal population) make sure you get the actual number from your doc, not just “everything looks fine.”

7. Infusions.

- **If for some reason an athlete has an exceedingly low ferritin level** (single digits/teens) or has problems with absorption, we have utilized iron infusions.
  - Make sure no other causes of iron loss.
  - We tell patients: Considering this would warrant a thorough evaluation and discussion with a sports medicine physician who deals with endurance athletes.
  - I will consider if <30.

Anemia Caveats (E. Randy Eichner MD 2021)

- "Fatigue has many faces"
  - Fatigue means different things to different people.
  - Multiple factors can be present—depression, recent illness.
- "Anemia can be pseudoanemia"
  - Exercise is a plasma builder (a good thing), so endurance athletes can have low baseline Hgb--dilutional affect.
  - Single bout of exercise can expand plasma volume by 10% within 24 hours.
  - Hgb can go up when training ceases.

Anemia Caveats (E. Randy Eichner MD 2021)

- "Anemia can be relative anemia"
  - Mild anemia is relative—can vary by gender, age, altitude…
  - What is anemia for one may not be anemia for another.
  - Define NOT relative to cutoff value, but relative to baseline.
  - If ferritin less than 20, likely anemic for that person.
- IDNA is likely mild anemia

  - Athletes, Anemia, and Iron Redux. Eichner. Cur Sports Med Reports (2021) 20:335-336.

Type of Iron Make a Difference?

- Whatever they can tolerate.

Periods—Athlete Info

- Is it normal to miss periods? NO.
  - (Does it happen a lot in runners/other female athletes? Yes.)
- Why do we care?
  - Often a sign of underfueling (often accidental).
  - Not enough calories coming into body. Body shuts down reproductive system. Normal cycle necessary for bone density. Missing periods can lead to performance declines and stress fractures.
  - Often small deficit (200-400 cal/day)—reversal will restart periods.
  - Hormones (birth control pills) will NOT reverse the problem.
  - Goal is 10 or more periods a year.
  - Should have first period by age 15 (even if "family history" of starting later).

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