

Three Topics to Keep in Mind This Season (and the Rest of the Year as Well)

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What Are We Going to Discuss?

- Skiing and hockey (and walking on icy driveways)—how does the Amsterdam 2022 concussion update help?
- “Off-season” runner readiness—ferritin (redux).
- Hunting (or hiking or shoveling)—is your heart ready for this?
- Other winter injuries/strength training for runners— if we have time (included in handout).

Amsterdam 2022 Concussion Update

Practical Applications You Can Use



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How Did We Get Here?

- Concussion in Sports Group (CISG) has met six times since 2001—most recent prior to 2022 was Berlin 2016 (large gap due to pandemic).
- Meeting 2022/update released June 2023.
- This update is the end-product of ten systematic reviews, screened 78,000 citations and the completion of 1500 full-text reviews.
- Consensus statement and reviews in British Journal of Sports Medicine:
 - Patricios JS, et al. Br J Sports Med 2023; 57:695-711.

R's!

- Recognize
- Reduce
- Remove
- Refer
- Re-evaluate
- Rest
- Rehabilitate
- Recover
- Return (RTLearn/RTSport)
- Reconsider/Residual
Effects
- Retire (new 2023)
- Refine (new 2023)

Definition (Recognize)

- *Sport-related concussion is a traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities. This initiates a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain. Symptoms and signs may present immediately, or evolve over minutes or hours, and commonly resolve within days, but may be prolonged.*
- *No abnormality is seen on standard structural neuroimaging studies (computed tomography or magnetic resonance imaging T1- and T2-weighted images), but in the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies. Sport-related concussion results in a range of clinical symptoms and signs that may or may not involve loss of consciousness. The clinical symptoms and signs of concussion cannot be explained solely by (but may occur concomitantly with) drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction) or other comorbidities (such as psychological factors or coexisting medical conditions).*

Definition is Conceptual

- *Traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities.*
- *Neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain.*
- *Symptoms and signs may present immediately, or evolve over minutes or hours, and commonly resolve within days, but may be prolonged.*
- *No abnormality is seen on standard structural neuroimaging studies*
 - *(Abnormalities may be present on functional, blood flow or metabolic imaging studies.)*
- *Sport-related concussion results in a range of clinical symptoms and signs that may or may not involve loss of consciousness.*
- *The clinical symptoms and signs of concussion cannot be explained solely by (but may occur concomitantly with) drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction) or other comorbidities (such as psychological factors or coexisting medical conditions).*

Reduce

- Mouthguards? 28% reduction in concussion rate in hockey across all ages.
- Headgear in non-helmeted sports? More research needed.
- On-field neuromuscular training (NMT) warm-up programs 3x/week lowered concussion in rugby across all ages. More research needed for women and in other sports. (NMT reduces other injuries as well).
- Limit contact practice in football.

Remove

- Remove if concussion suspected. Period.
 - Goal on sideline is not to diagnose concussion (although can be diagnosed) but to keep safe if concussion a possibility.
 - Signs that warrant immediate removal:
 - Actual or suspected LOC
 - Seizure
 - Tonic posturing
 - Ataxia
 - Poor balance
 - Confusion
 - Behavioral changes
 - Amnesia

Remove/Re-eval—5 New Forms

- Concussion Recognition Tool (CRT6)—lay person
 - Does NOT dx—helps to know to remove
- Sport Concussion Assessment Tool 6 (SCAT6)
- Child Sport Concussion Assessment Tool 6 (Child SCAT6)
 - SCAT within 72 hours
- Sport Concussion Office Assessment Tool 6 (SCOAT6)
- Child Sport Concussion Office Assessment Tool 6 (Child SCOAT6)
 - SCOAT 72 hours+
 - Take 15-20 minutes to perform

Rest and Exercise

- Strict bed rest until complete the complete resolution of symptoms is NOT beneficial following sport related concussion.
- Relative rest including ADL's and reduced screen time indicated up to first 2 days after recovery.
- Light-intensity physical activity like walking that does not more than mildly exacerbate symptoms is OK in initial 24-48 hours.
- Walking, stationary cycling (avoid risk of contact activities) should be encouraged after 24-48 hours.
- Reduce screen time first 48 hours. After??
- Can increase activity if symptoms don't worsen by more than 2 points on a 10-point scale that lasts less than an hour. HR can be used as well.

Refer/Rehabilitate

- Utilize concussion specialists where available.
- Symptoms lasting >4 weeks across all age groups.
- If I have a patient with symptoms lasting more than 7-10 days I will utilize concussion PT/OT/speech.
- If neck pain or vestibular symptoms I will refer to PT/vestib tx sooner.

Recovery

- RTL/RTS.
- Preinjury level of function and performance.
- Biomarkers? Further research needed.

RTL/RTS

- RTL:
 - 93% of athletes of all ages have full RTL with no additional support by 10 days.
 - Avoid complete rest/isolation.
 - Early return to ADL's as noted (<3 point change).
 - Consider environmental, physical, curriculum, and testing adjustments.
 - Order:
 - ADL's
 - School activities at home
 - Return part time
 - Return full time

RTL/RTS

- RTS:

- Graduated stepwise approach supervised by qualified HCP (ATC's are great at this).

- Steps (each one min 24 hours):

1. Symptom limited activity

2. Aerobic exercise

3. Sport-specific exercise

Move to 4-6 when no symptoms, cognitive issues, and not worsened by physical activity.

4. Non-contact training drills

5. Full contact practice

6. Return to sport

If symptoms worsen during 1-3 try and repeat that step. If occur 4-6 then return to step 3.

Reconsider/Residual

- Studies of pro American football and soccer players:
 - NOT at increased risk for depression, suicidality, psychiatric hospitalization, death assoc with having psych disorder or of suicide.
 - GREATER mortality from neuro diseases, dementia and ALS.
- Male amateur athletes NOT at increased risk for cognitive impairment or neurologic/neurodegenerative diseases.
- Studies to date limited as most do not examine or adjust for many factors assoc with mental health and neuro outcomes (genetics, smoking, socioeconomic, HTN, diet, physical activity...).

Reconsider/Residual

- CTE???
- CTE is a neuropath entity.
- CTE-NC is chronic traumatic encephalopathy neuropathic change—post-mortem dx.
- Traumatic encephalopathy syndrome (TES) is a new clinical dx first defined in 2021.
- Looking to correlate symptoms and path.
- The prevalence of CTE-NC and TES in former athletes, military veterans, and people from the general population is not known.

Retire

- No clear evidence of the factors that, if present, would unequivocally lead to retirement or discontinued participation in contact or collision sport.
- Decision is complex, multifaceted and should involve clinicians with experience in TBI and sport.
- Discussion should provide scientific evidence and uncertainties of their condition balanced against the benefits of participation in sport.
- Incorporate athlete's preference and risk tolerance as well as psychological readiness to make an informed decision.
- Encourage non-contact or low-contact physical activity for health benefits if athlete decides to retire.

Refine

- More to come in regarding Para athletes.
- Pediatric issues:
 - Working on more prevention.
 - Lack of trained med professionals (AT's, docs) at events.
 - RTL is the priority, but the processes should run in parallel.
 - Limited evidence exists on SRC in 5-12 age group.

Summary

- More and future focus on prevention: rule changes, mouthguards, neuromuscular training work in some sports—will they in others?
- Early return to ADL's and light/moderate aerobic exercise is important.
- CRT/SCAT's up to 72 hours, SCOAT's >72 hours in office setting.
- Cervicovestibular rehab indicated in athletes with neck pain, headaches, dizziness or balance problems.

Summary

- Individuals with persisting symptoms (>4 weeks) should be evaluated with a multimodal clinical assessment.
- Discontinuation from contact sports is complex and there is no number of concussions that are OK to have or necessitate removal.

Claudication/Leg Cramps as a Marker of Low Iron?



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Objectives

- Understand the role of iron/ferritin and anemia in the athlete.
- Create a plan to investigate fatigue in the athlete.
- Does the type of iron make a difference?
- Recent text (4/23/23):
 - “PR today at Glass City. Definitely in part to taking iron. Thanks for checking that, doc!”

Calf Pain, Out of Breath Easily

- 1/25/23
 - TIBC 439
 - Iron 171
 - Iron sat 39%
 - Hgb 15.4
 - Ferritin 14.9
- Being treated for EIB

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.
 - 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.

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.

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

Type of Iron Make a Difference?

- Whatever they can tolerate.

Calf Pain, Out of Breath Easily

- 1/25/23 (advised iron infusion)
 - TIBC 439
 - Iron 171
 - Iron sat 39%
 - Hgb 15.4
 - Ferritin 14.9

Calf Pain, Out of Breath Easily

• 1/25/23		3/24/23 (post infusion)
– TIBC	439	310
– Iron	171	116
– Iron sat	39%	37%
– Hgb	15.4	15.7
– Ferritin	14.9	194

Calf Pain, Out of Breath Easily

• 1/25/23	3/24/23	6/15/23
– TIBC 439	310	332
– Iron 171	116	148
– Iron sat 39%	37%	45%
– Hgb 15.4	15.7	15.0
– Ferritin 14.9	194	69.1

- Now on 1-2 tabs per day
- No need for inhaler
- Don't forget about vocal chord dysfxn

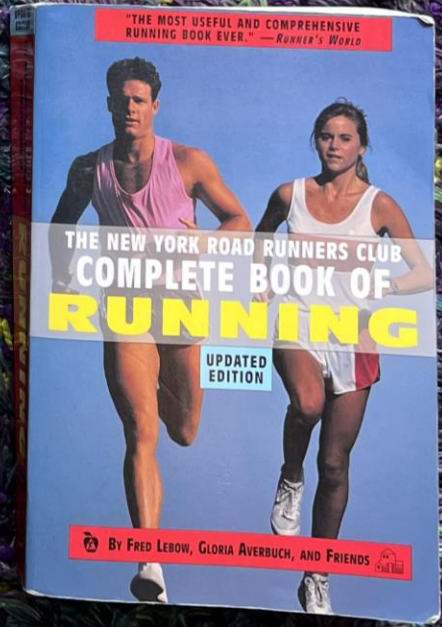
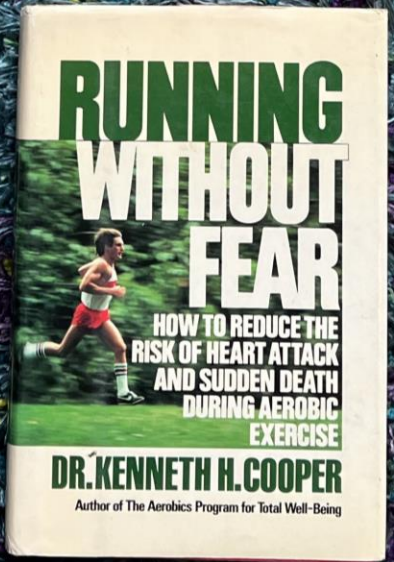
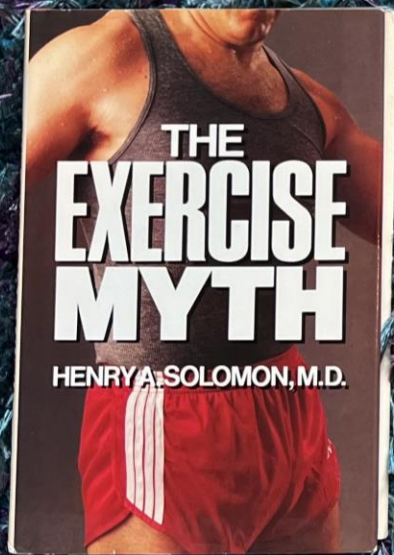
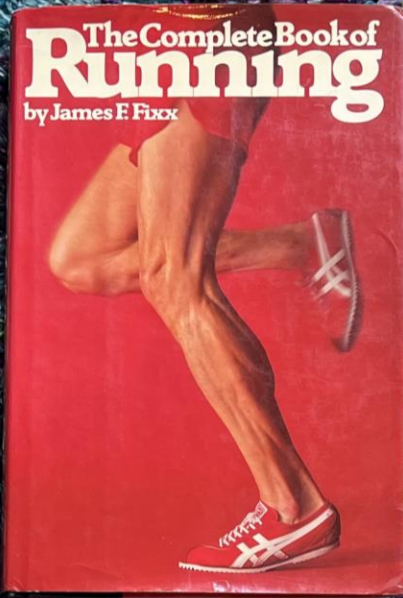
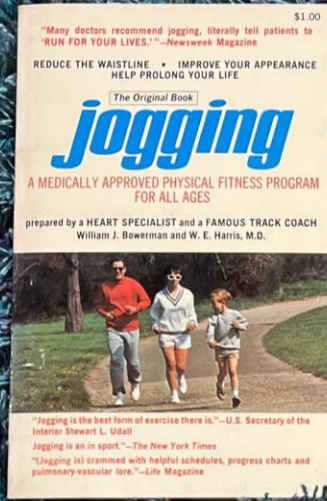
Periods—Athlete Info

- 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).

Heart Health: Exercise/Activity Guideline Update



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THE EXERCISE MYTH

HENRY A. SOLOMON, M.D.

Thirty million Americans believe they are jogging their way to good health and a longer life. Other millions flock to tennis courts, health spas, and exercise classes—hoping to escape the number one killer, heart disease. Exercise is sold as the prime panacea of our time: a billion dollars a year are spent on exercise equipment and clothing and advice.

Are we the victims of the Exercise Myth? Almost nothing, Dr. Solomon says, you have been told about the benefits of exercise is true. Vigorous activity cannot prevent heart disease or slow its eventualty. Exercise has *no* effect on longevity. You can be healthy without being fit. You can also be fit and still develop fatal heart disease.

(Continued on back flap)

Risks of Activity

- Fall and winter—hunting, raking, shoveling...
- If someone has not been exercising (or even if they have) risk of heart attack and stroke go up.
- Work on modifiable risk factors:
 - High LDL
 - HTN
 - Obesity
 - Smoking/exposure
 - Diabetes
 - Nutrition
 - Physical activity

Starting activity—who needs a stress test?

- In the past there were specific age guidelines—these are gone.
- Concerning symptoms: chest pain or pressure; neck, jaw, or arm pain; SOB; unusual fatigue; palpitations; dizziness/presyncope; LE swelling or overnight SOB.
- For those who do not exercise regularly this is from ACSM:
 - If you have not been diagnosed by a doctor with, AND do not have signs or symptoms of cardiovascular, metabolic, or kidney disease, THEN you can start right away with light to moderate intensity exercise. You can gradually build up to vigorous exercise if you stay free of any symptoms of health problems.

Exercise/activity—How Much?

- More than we thought, BUT some is better than none and more is better than some.
 - Dong Hoon Lee, ScD, Leandro F.M. Rezende, ScD, Hee-Kyung Joh, MD, PhD, NaNa Keum, ScD, Gerson Ferrari, PhD, Juan Pablo Rey-Lopez, PhD, Eric B. Rimm, ScD, Fred K. Tabung, PhD, and Edward L. Giovannucci, MD, ScD. Long-Term Leisure-Time Physical Activity Intensity and All-Cause and Cause-Specific Mortality: A Prospective Cohort of US Adults. *Circulation* **146**, 523-534 (2022).

Exercise/activity—How Much?

- 5-10 hours/week moderate activity (40-80 min daily).
- 2.5-5 hours per week vigorous activity (20-40 min daily).
- Any combo.
- Moderate:
 - Brisk walk
 - Doubles tennis
 - Raking
- Vigorous:
 - Jogging/running
 - Shoveling snow
 - Carrying heavy items
 - Fitness classes

Exercise/activity—How Much?

- 2022 study (6000+ participants):
 - 8,600 steps to maintain weight, and 11,000 if overweight to keep from becoming obese.
 - 8,200 steps to lower risk of HTN, DM, sleep apnea, GERD, depression.
- Master, H., Annis, J., Huang, S. *et al.* Association of step counts over time with the risk of chronic disease in the *All of Us* Research Program. *Nat Med* **28**, 2301–2308 (2022).
<https://doi.org/10.1038/s41591-022-02012-w>

What does this mean?

- All the preceding and following are essentially equivalent to about **4 miles/day**:
 - 64 min walk at 16:00 pace
 - 38 min run at 9:30 pace
 - 8500 steps

Strategies

- OK to break into smaller pieces—4x10 min moderate activities.
- Walk/jog—walk 2 min/jog 30 seconds.
- Rucking!
- Park and walk farther to store (when not using Amazon!).
- Stairs/stairs/stairs!
- COVID seems to have had some of us exercise more (more time) or less (Y closed, so many services bring things to us now—Uber Eats).

Knee Osteoarthritis

- Affects older patients, those with valgus or varus knee alignment, and those with long history of high impact activities.
- Joint may show valgus or varus alignment, patellofemoral narrowing, swelling or bony changes.

Knee Osteoarthritis

- Diagnostic tests include weight bearing X-ray to evaluate joint space and osteophyte formation, MRI may show associated meniscus tearing.
- Tx with NSAIDs, glucosamine chondroitin, PT, corticosteroid injection, viscosupplementation, bracing, surgery.

Exercise

- OA shown to benefit from exercise.
- Cartilage gets its nutrition from ROM and pressurization of the synovial fluid.

Take Home Tips

- Don't be afraid to image.
- Strike up relationship with sports med or ortho doc.
- Knee pain may signal hip pathology.
- Often weak glut med (or other pelvic/hip) musculature.
- Be a practitioner who gives home exercises.
- Use your PT's and AT's—find some that work with athletes.

Support!



Questions?



Thank you!

- Contact:
 - 616-252-7778 (SM line)
 - 616-443-5494 (cell)

ed.kornoelje@umhwest.org

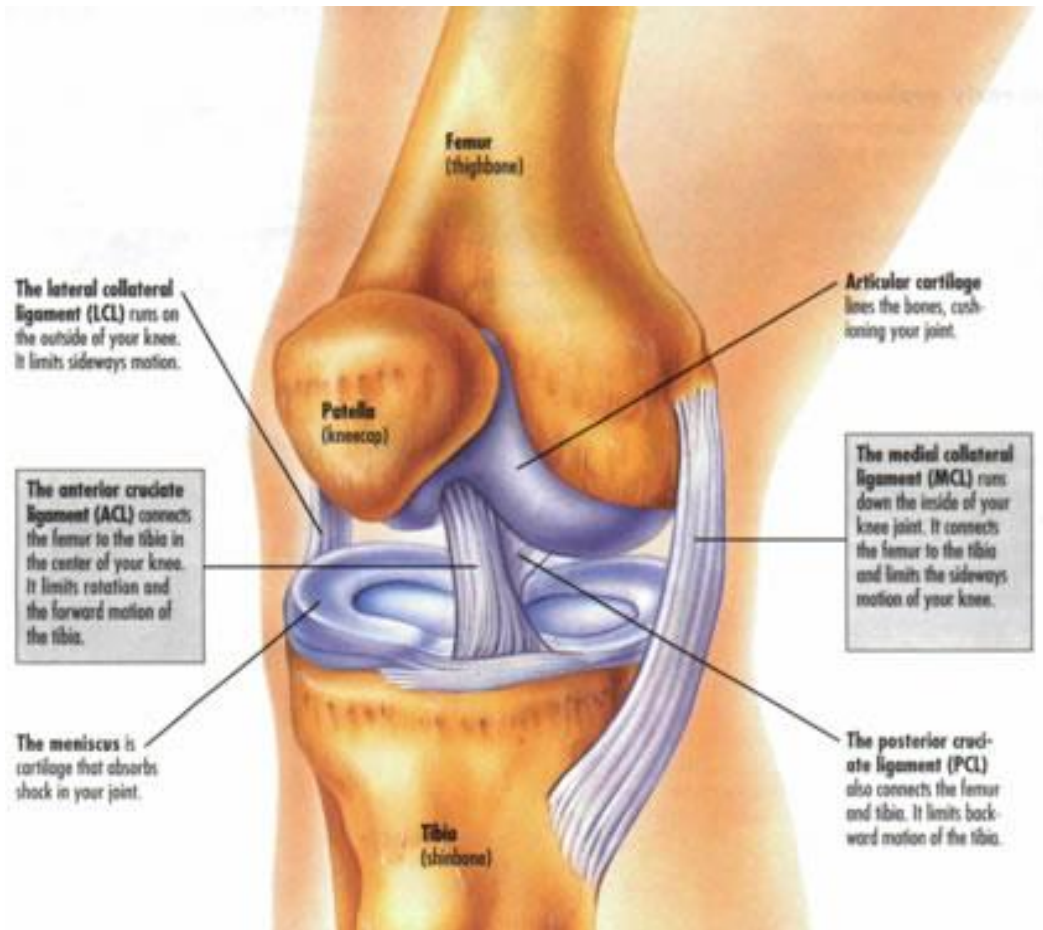


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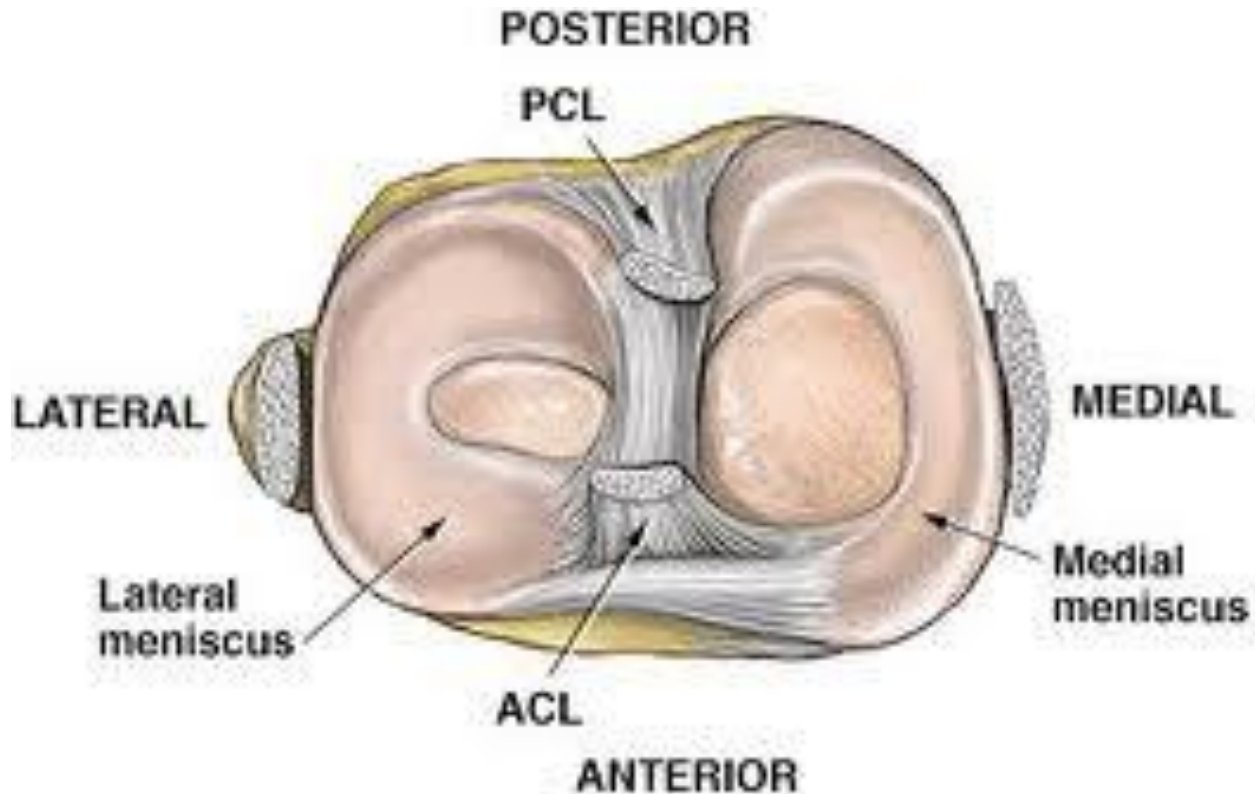
A Few Injuries



Anatomy

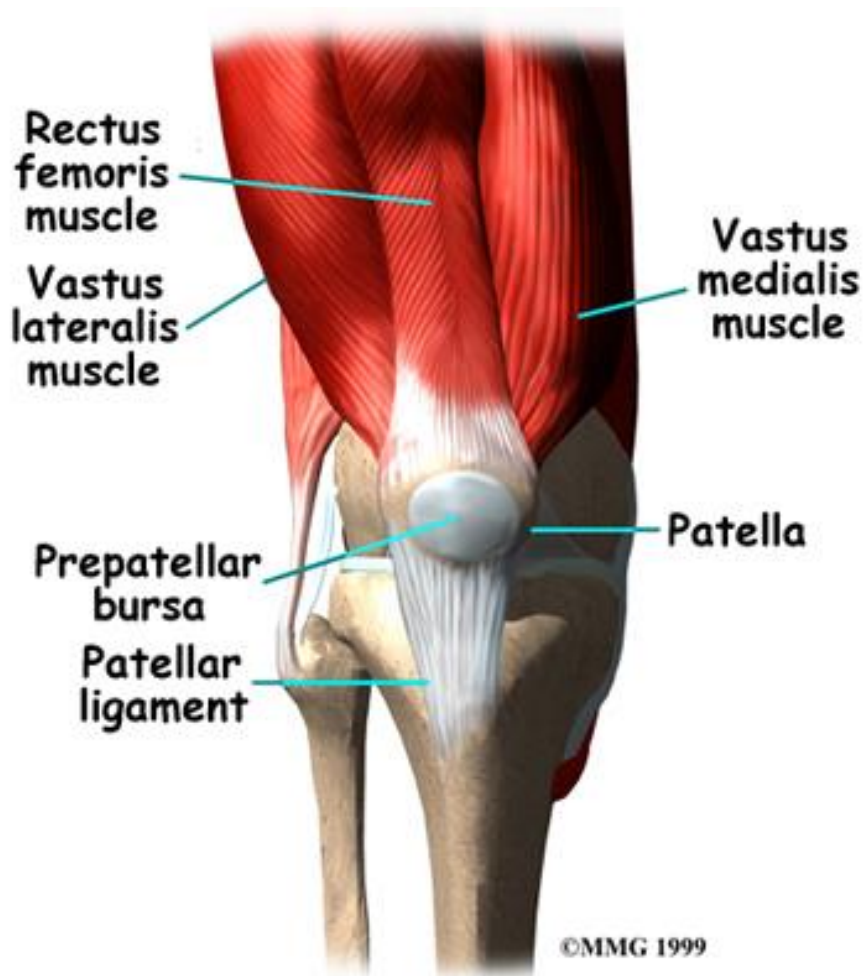


Anatomy



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Anatomy



Medial Compartment

- Medial Femoral Condyle
- Medial Tibial Plateau
- Medial Meniscus
- Medial Plica

Also: pes bursa

Posterolateral Corner

- popliteus muscle and its tendon
- popliteofibular ligament
- joint capsule
- arcuate ligament
- lateral collateral ligament (LCL)
- fabella
- fabello-fibular complex
- peroneal nerve

Exam—Observation

- Standing: front/side/back
 - Varus/valgus/recurvatum/femoral torsion/tibial torsion
 - Pes planus/pes cavus
 - Standing leg length
 - Atrophy/hypertrophy
- Sitting:
 - Patellar position
 - Tibial tuberosity
 - VMO
 - Patellar tracking

Exam—Observation

- Supine:
 - ROM
 - Muscle Bulk
 - Q-angle—ASIS->patella->tib tuberosity ($\leq 10^\circ$ for males/ $\leq 15^\circ$ females)
 - Hamstring and heel cord tightness
- Prone:
 - ROM
 - Popliteal masses

Exam—Palpation

- Joint effusion: milk from superior to inferior
- Areas of tenderness:
 - Joint lines—menisci
 - Ligament attachments—med fem epicondyle-> proximal medial tibia (under pes)/lat fem epicondyle->head of fibula
 - Tendons—patellar, quad, popliteus, hamstrings
 - Bursae—prepatellar, pes anserinus
- Crepitation

Exam—KEY Tests

- MCL: Valgus stress at 0 and 30 degrees
- LCL: Varus stress at 0 and 30 degrees
- ACL: Lachman, anterior drawer, pivot shift
- PCL: Posterior drawer, sag test
- Posterolateral corner: posterolateral drawer test, external rotation recurvatum test, prone (or supine) external rotation (Dial) test
- Menisci: McMurray's, Appley's, squat

Select Injuries

- Ligament tears: ACL/MCL/PCL/LCL
- Meniscal injuries
- Extensor mechanism problems:
dislocation/subluxation/PFPS/patellar
tendonitis/plica/Osgood-Schlatter's/quad
tendonitis
- Misc: bursitis/loose bodies/cysts/IT band
syndrome/somatic dysfunction/OA

ACL Tear

- Two bundles (post-lat/ant-med)
- Contact and non-contact
- Loud pop, swelling
- Lachman best
- MRI
- Surgery

ACL Tear



ACL Tear



MCL Tear

- Valgus force, often with external tibial rotation
- Noncontact twist or blow to lat side of joint
- Medial tenderness
- Valgus stress test
- MRI NOT usually done
- Grade III surgery?

PCL Tear

- Valgus/varus in full extension, direct blow to anterior proximal tibia
- Mild swelling
- Sag sign
- MRI
- Conservative V. surgery
- Look for PL corner injuries—can be hard to distinguish

Posterolateral Corner Tests

- Posterolateral drawer test
- External rotation recurvatum test
- Prone (or supine) external rotation (Dial) test

Dial Test



LCL Tear

- Varus or twisting injury
- Noncontact or contact
- Tender over LCL—cross leg to palpate
- Varus stress test
- MRI NOT usually needed
- Conservative v. surgery (Grade III)

Meniscal Injuries

- Multiple types
- Twisting
- Young—acute injury/“old” wear and tear
- Joint line tenderness, pos McMurray’s, Appley’s and squat, swelling?
- May lock/give out
- MRI
- Repair v. resection v. visco (with OA)

Patellofemoral Pain Syndrome

- Imprecise term for problems with anterior knee pain.
- Often called “chondromalacia patella”—reserve this for observed articular cartilage damage.
- Overuse/malalignment/weak VMO or pelvic stabilizers.
- Anterior knee pain often after sitting (“theatre sign”), stairs often bother as well.
- May see lateral tracking patella on exam or x-ray
- Tx with rehab (HEP)/NSAID/orthotics.

Patellar Tendinitis

- “Jumper’s knee”
- Often tender at inferior pole.
- Usually in jumping sports, can be running.
- X-ray may show irregularity at inf pole.
- MRI demonstrates degen changes (often read as partial tear)—do in chronic cases.
- PT/infrapatellar strap?/PRP?/ surg as last resort.

Synovial Plica

- Medial or lateral—symptomatic usually medial.
- Overuse often exacerbates.
- May present like other ant knee issues.
- Difficult to palpate—try by internally rotating tibia, passively flex and extend.
- Imaging not helpful—in some cases may see on MRI.
- Tx: often surgical/may try conservative first.

Osgood-Schlatter's “Disease”

- Painful enlargement of tibial tuberosity.
- Mechanical stress and excessive tension on growing tibial tuberosity apophysis.
- Pre and early adolescence, often during rapid growth.
- X-ray shows enlarged/irregular tibial tuberosity.
- Tx: stretch hams/heel cords/quads, VMO strength, activity mod dictated by symptoms.
- OK to play through pain if able.
- Sinding-Larsen-Johansson Syndrome inferior pole patella.

Quad Tendonitis

- Inflammation of quad tendon at patellar insertion.
- Look for defect—can rupture.
- X-ray normal—may see patella baja with rupture.
- Similar to patellar tendonitis.
- Quick surgical repair for rupture.

Bursitis

- Multiple bursa
- Pes anserinus and prepatellar common
- Pes:
 - sartorius, gracilis, semitendinosus
 - Tender to palp—light knee flexion helps determine location
 - Ice/NSAID/PT/inject
- Prepatellar:
 - NSAID/compress/aspirate



Loose Bodies

- Cartilaginous or osteocartilaginous fragments
- Usually free floating.
- May come from patellar dislocation or other trauma.
- May cause locking/moveable mass/pain
- OCD from lateral aspect of medial femoral condyle
- X-ray/MRI.
- Remove lesions.
- OCD controversial—younger and stable try conservative first.

Cysts

- Fluid filled lesion about the knee arising usually as an extension of synovial space.
- Popliteal swelling is Baker's cyst—may be related to meniscal tear.
- MRI helpful.
- Surgical excision usually curative.

IT Band syndrome

Iliotibial Band Syndrome



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- Rule out diagnoses:
 - Meniscal tear
 - Chondromalacia patella
 - Fibula head dysfunction
- Look for:
 - Overpronation
 - Glut medius weakness
 - Knee instability/MCL laxity
- Ober's Test
- Stretch/ice/massage/roll/PT/inject

Dislocation Basics

- Field Evaluation:
 - Palpation of joint involved.
 - Evaluate for sensation and pulses (neurovascular compromise is an emergency).
- Always be conscious of the possibility of fracture.
- Do not relocate open dislocations or obvious fractures.
- Dislocations can occasionally relocate on their own when athlete attempts active motion at the time of injury.

Dislocation (sublux) of Patella

- Usually lateral.
- Persists until reduced (usually with extension).
- Valgus/twisting with strong quad contraction.
- Often reduces on own.
- Swelling usually within first 2 hours.
- Apprehension sign—pain with attempted (gentle) reproduction of dislocation.
- Imaging—hard to see in plain film as often reduces on x-ray table.
- Look for medial edge of patella fx—not true sunrise view—flex only 30-45 degrees.
- +/- MRI.
- Immobilize first time only as long as needed for comfort—extensive PT and functional patellar bracing.
- Do not attempt to relocate vertical or horizontal dislocations → splint and send to ER!

Strength Training for Runners



UNIVERSITY OF MICHIGAN HEALTH-WEST
MICHIGAN MEDICINE

Strength Training Questions For Runners

- Runners run and often strength train as an afterthought.
- What type of strength training is best: heavier training (1-5 RM with or without plyometrics) or lighter/more reps (15+ RM)?
- Is one 20-minute session per week enough?

General Strength Training is Good

- “In conclusion, a **strength training program** including low to high intensity resistance exercises and plyometric exercises performed 2-3 times per week for 8-12 weeks is an **appropriate strategy to improve running economy** in highly trained middle- and long-distance runner.”
 - Balsalobre-Fernández C, Santos-Concejero J, Grivas GV. Effects of Strength Training on Running Economy in Highly Trained Runners: A Systematic Review With Meta-Analysis of Controlled Trials. J Strength Cond Res. 2016 Aug;30(8):2361-8. doi: 10.1519/JSC.0000000000001316. PMID: 26694507.

General Strength Training is Good

- “Whilst there was **good evidence that strength training (ST) improves running economy, time trial, and sprint performance**, this was not a consistent finding across all works that were reviewed...Importantly for the distance runner, **measures relating to body composition are not negatively impacted** by a ST intervention. The addition of two to three ST sessions per week, which include a variety of ST modalities are **likely to provide benefits** to the performance of middle- and long-distance runners.”
 - Blagrove RC, Howatson G, Hayes PR. Effects of Strength Training on the Physiological Determinants of Middle- and Long-Distance Running Performance: A Systematic Review. Sports Med. 2018 May;48(5):1117-1149. doi: 10.1007/s40279-017-0835-7. PMID: 29249083; PMCID: PMC5889786.

Heavy Training or Plyos (or Both)?

- **“Heavy resistance training, especially with nearly maximal loads, may be superior to plyometric training in improving running economy and running time trial performance. In addition, running economy appears to be improved better when training is performed for a longer period in both heavy resistance and plyometric training.”**
 - Eihara Y, Takao K, Sugiyama T, Maeo S, Terada M, Kanehisa H, Isaka T. Heavy Resistance Training Versus Plyometric Training for Improving Running Economy and Running Time Trial Performance: A Systematic Review and Meta-analysis. Sports Med Open. 2022 Nov 12;8(1):138. doi: 10.1186/s40798-022-00511-1. PMID: 36370207; PMCID: PMC9653533.

Complex Training

- “Complex Training (CT) is a **combination training** method that alternates between performing **heavy resistance exercises and plyometric exercises within one single session**, resulting in great improvement in neuromuscular adaptation.”
- CT > heavy resistance training > strength training for strength and power indicators, running economy, and 5K performance.
 - Li F, Wang R, Newton RU, Sutton D, Shi Y, Ding H. Effects of complex training versus heavy resistance training on neuromuscular adaptation, running economy and 5-km performance in well-trained distance runners. PeerJ. 2019 Apr 25;7:e6787. doi: 10.7717/peerj.6787. PMID: 31086736; PMCID: PMC6487184.

What is Complex Training?

- Complex training is a workout comprising a resistance exercise followed by a matched plyometric exercise, e.g.:
 - squats followed by squat jumps
 - bench press followed by plyometric press-up
- The logic behind these matched pairs of exercises is that the resistance work gets the central nervous system (CNS) into full action. More Type IIb fibers are available for explosive exercise, hence a better training benefit.
 - BrianMac Sports Coach website

Complex Training

- A 6-week period of **concurrent complex training or heavy strength training and endurance training** resulted in similar **improvement in maximum strength, running economy, and $v\dot{V}O_{2\max}$** . Importantly, **both complex training and heavy strength training resulted in greater improvements** in eccentric strength and running economy compared to those that performed concurrent endurance-strength and endurance training.
 - Li F, Nassis GP, Shi Y, Han G, Zhang X, Gao B, Ding H. Concurrent complex and endurance training for recreational marathon runners: Effects on neuromuscular and running performance. *Eur J Sport Sci*. 2021 Sep;21(9):1243-1253. doi: 10.1080/17461391.2020.1829080. Epub 2020 Oct 19. PMID: 32981468.

Intensity is Key

- Brad Schoenfeld (Lehman College): “Think of the load as a type of run. If an easy jog is a five on the exertion scale, and 10 is an all-out sprint, you want to be lifting at an eight or nine – like a fast run, but not quite a sprint. The last rep shouldn’t be easy. You should be some what struggling.” (Note—I personally like a seven or eight on the scale).
- 2-3 RIR (Repetitions in reserve).
 - Millard and Pearson: Strength training for runners—your how-to guide. RW on-line 15 March 2023.

Repetitions in Reserve (RIR)

- RIR—number of extra reps you could have done had you kept going to volitional failure—how many left on the table.
- RIR is an iteration of rating of perceived exertion (RPE):
 - RPE 10 = Max Effort
 - RPE 9 = 1 RIR
 - RPE 8 = 2 RIR
- Good article on utilizing this correctly:

Helms ER, Cronin J, Storey A, Zourdos MC. Application of the Repetitions in Reserve-Based Rating of Perceived Exertion Scale for Resistance Training. *Strength Cond J*. 2016 Aug;38(4):42-49. doi: 10.1519/SSC.0000000000000218. Epub 2016 Aug 3. PMID: 27531969; PMCID: PMC4961270.

20 minutes 1x/week—Yes

- Frequency: 1x/week
- Exercises: 6 (chest press, pulldown, leg press, abdominal flexion, back extension, hip add/ab alternated between sessions)
- Sets: 1
- Reps: 4-6
- Rep duration: 10s concentric/10s eccentric with 20s rest between exercises
- Session length: <20 min
 - Steele et al, Long-term time course strength adaption to minimal dose resistance training: Retrospective longitudinal growth modelling of a large cohort through training records. SportRxiv, 2021.

Take Home:

- What type of strength training is best? More and more evidence suggests **heavier training** (fewer reps with or without plyometrics) is better for performance than lighter/more reps (15+ RM) BUT **higher rep/lower weight will help!**
- Can be done 1x per week, better 2x.
- Seasonal variations—2x/week when base building, 1-2x/week main training cycle, 1x/week six weeks out from race is a good rule of thumb (but programs can vary).
- Lift day before or day of (prior to) interval workout or 48 hours after.
- Form drills can be done more frequently.