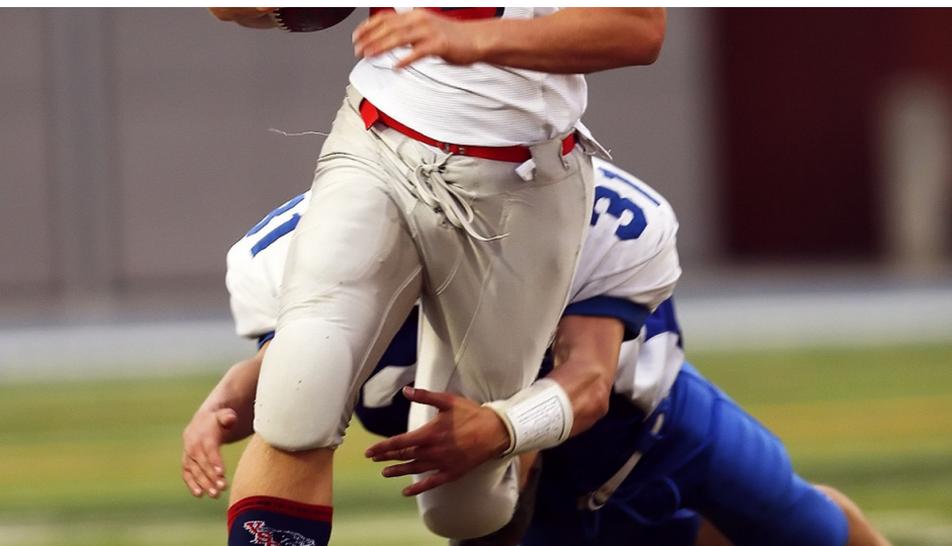


Common Knee Issues in Primary Care

Jordan D. Metzl, MD
Hospital for Special Surgery

- I have no conflicts of interest to disclose



Hey Doc, My Knee Hurts.....

- What is your role?
- How do you help your patient?
- How do you do the best thing for them and you?

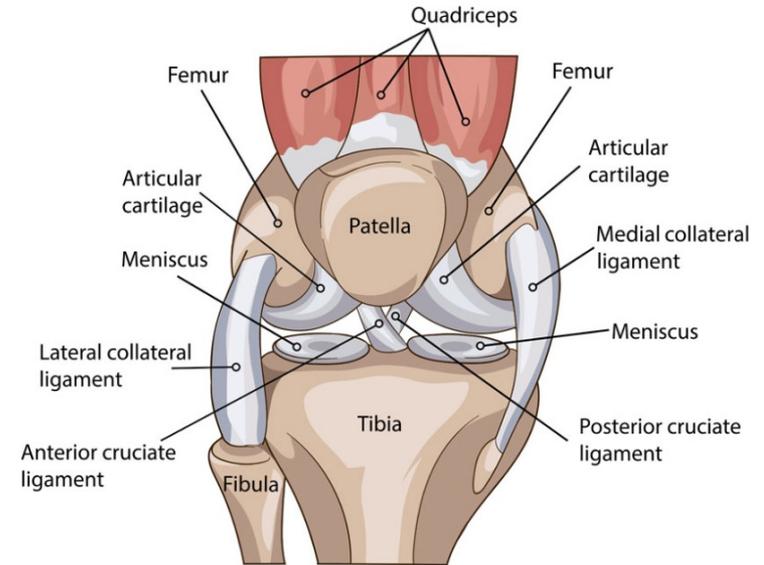
What is Injured In the Knee?

Soft Tissue (Peri-articular)

Cartilage

Ligament

Bone



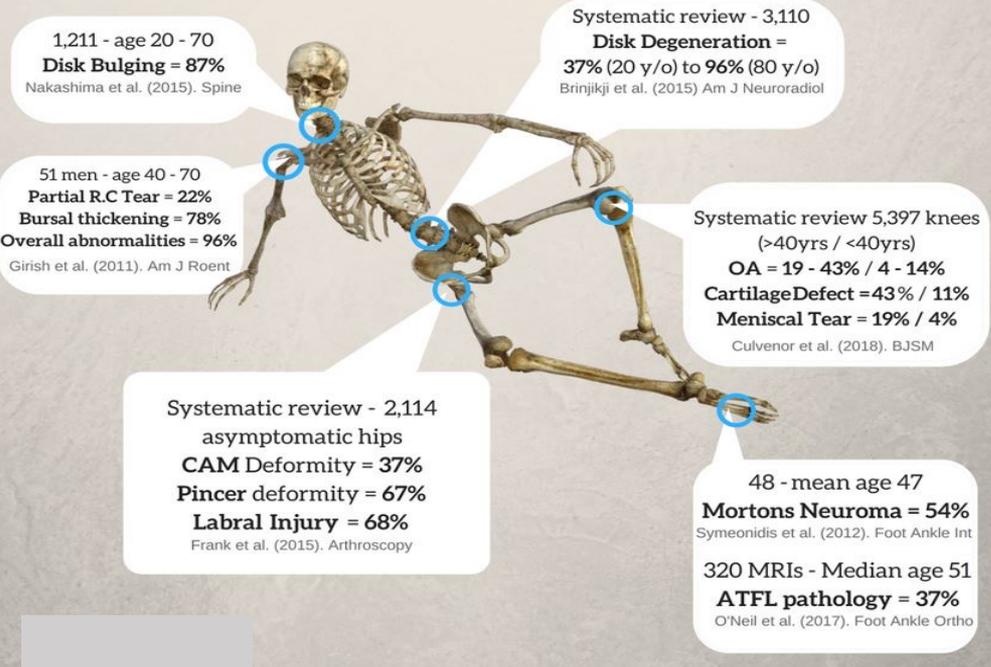
What Diagnostic Tools Do You Have?

- Patient History
- Physical Examination
- Imaging
 - Xray
 - MRI
 - *Beware the Consequences of Your Imaging*



Technology and Diagnosis

Abnormalities found on scans in asymptomatic people



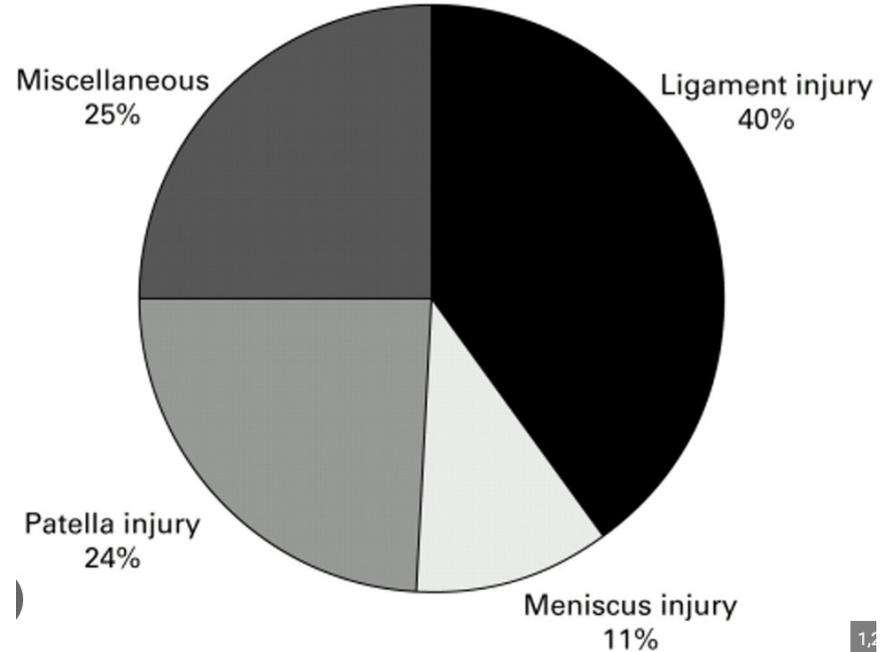
Understanding Knee Pain

- **Athletic Knee**

- Pain
 - 13% under 25 (Iwatsu 2023)
- Injury
 - 10 year athletic knee (Majewski 2005)

- **Knee Ache**

- Under 50
 - 22% of people under 50 (Sales 2013)
- Over 50
 - Incidence of TKR 2-3x higher in former soccer players (Fernandez 2018)
 - 65% of adults > 50 have knee pain (Nguyen 2011)



3 Knee Topics

- Knee Osteoarthritis
- Meniscus Tears
- ACL Injuries



Patient with Knee OA

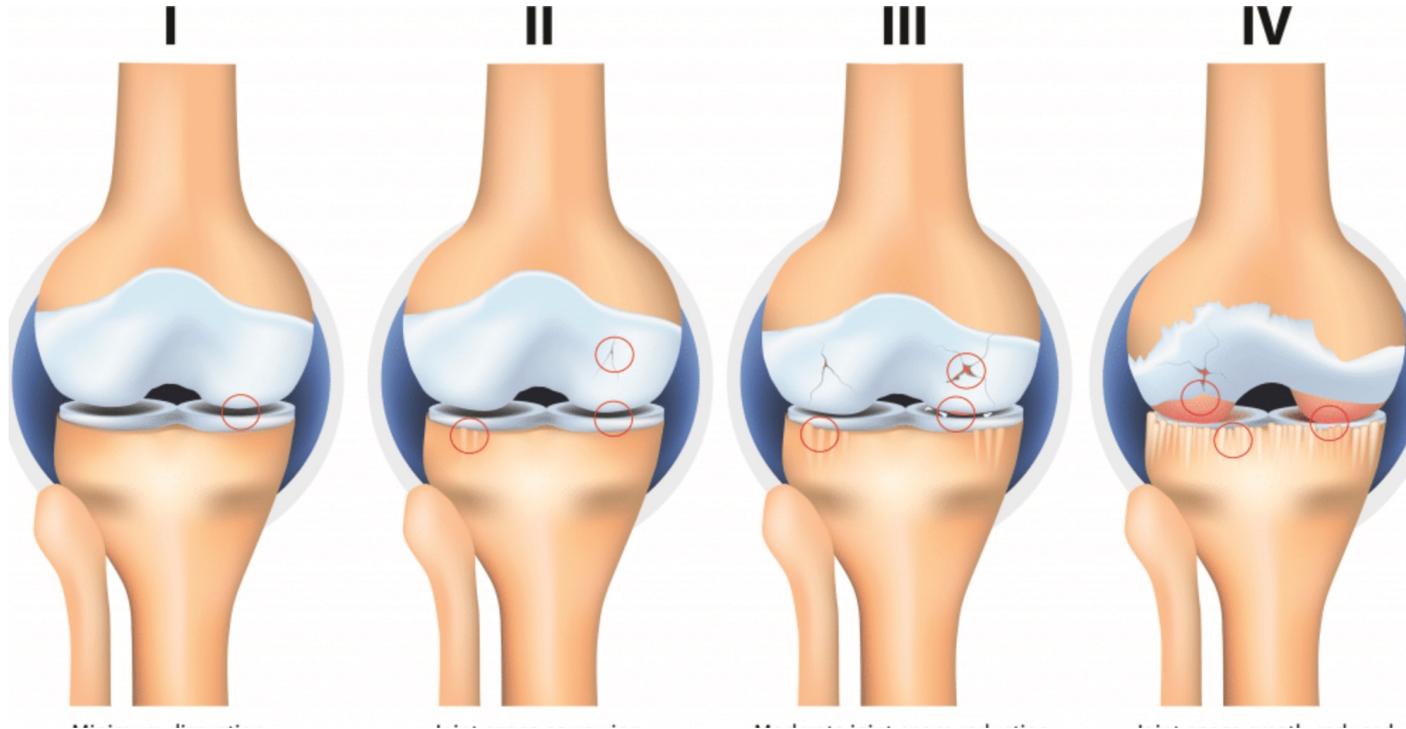
- > 50 years old
- Generalized achiness in and around the knee
- Pain with activity
- Night time ache
- Anterior, Medial, Lateral

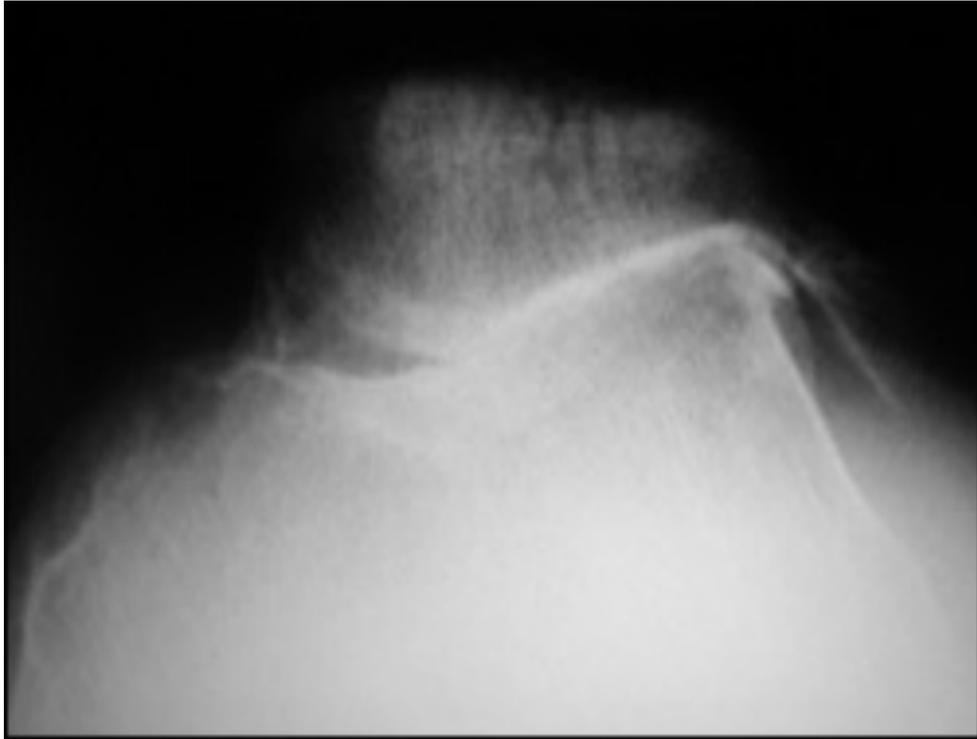
What is Your Role?

- Proper diagnosis
- Plan to maintain activity
- Plan to reduce symptoms
- Plan to monitor progress

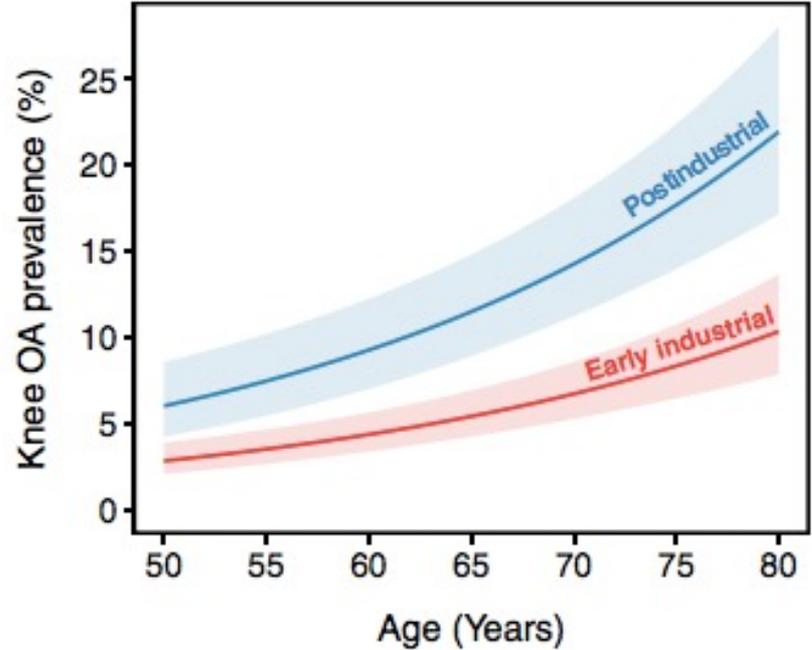


Different Stages of Knee OA



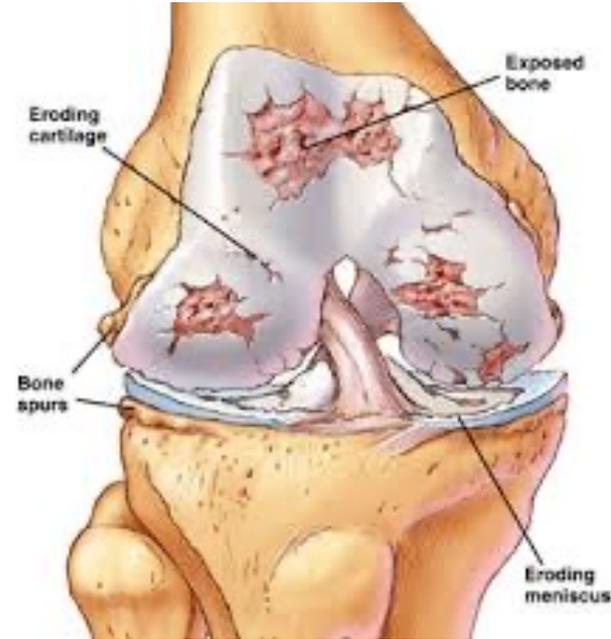


Knee osteoarthritis has doubled in prevalence since the mid-20th century



Muscle Strength & Arthritic Knee Pain

- 1,106 subjects, 2032 knees
- Stronger quads = less knee pain
- All treatments work better with stronger muscles



Current Treatment Options for Knee OA

Muscle strength(Santos 2011)

(Corticosteroid Injections (Bhanaru 2015)

Viscosupplement therapy (Bhandari 2017)

PRP (Fillardo 2020)

Stem Cells (Jeyraman 2021)

Other



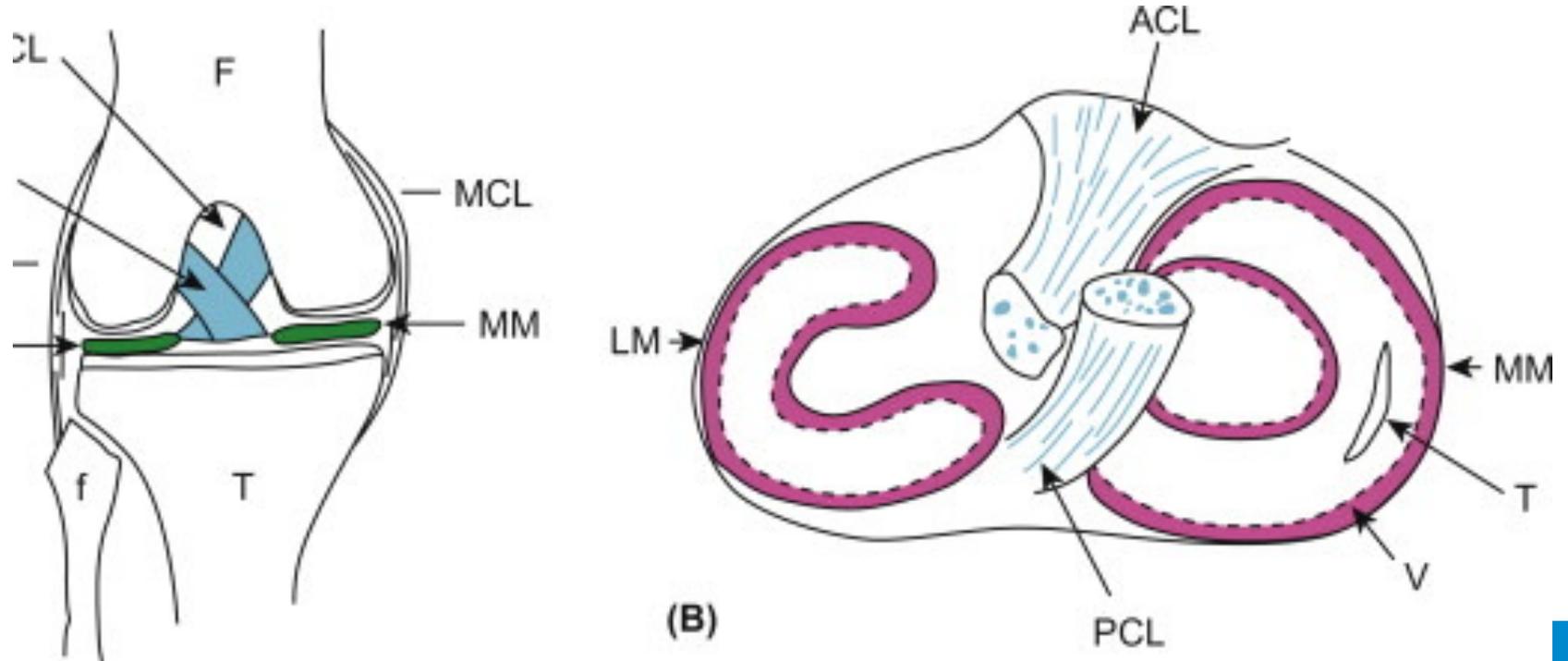
What Should You Do?

Patient with Meniscus Tear

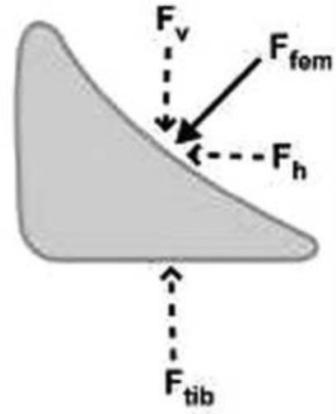
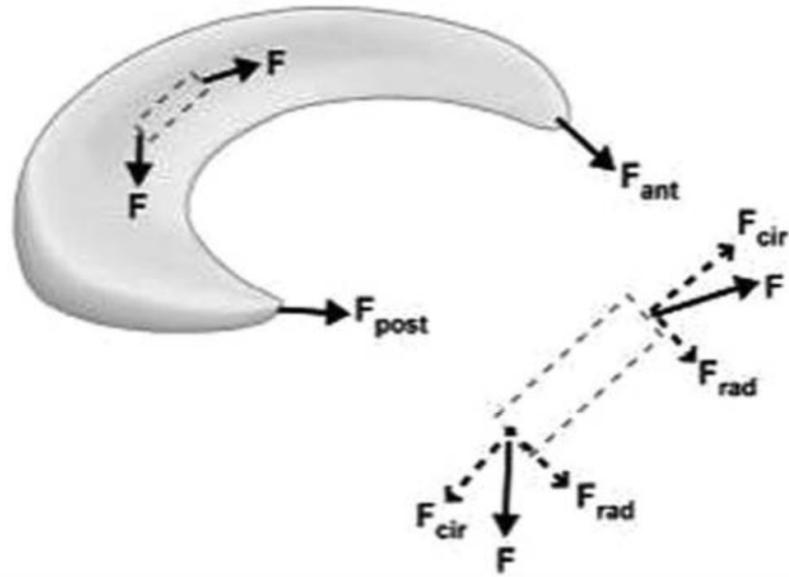
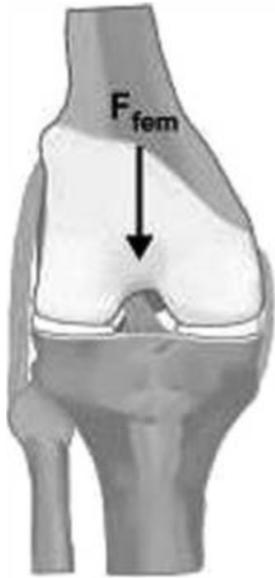
- 47 year old runner
- “Hey doc, my knee hurts”
- Pain with bending
- Pain with squatting
- Joint line tenderness



Meniscal Anatomy



Force Distribution - Meniscus



Vertical longitudinal



Vertical radial



Horizontal



Oblique



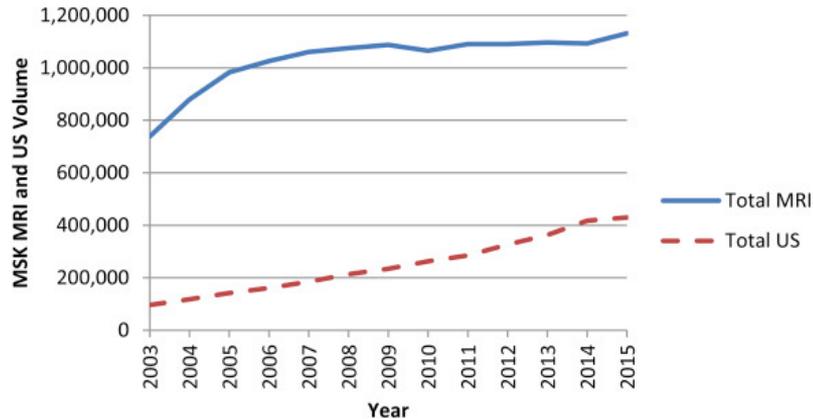
Complex/degenerative



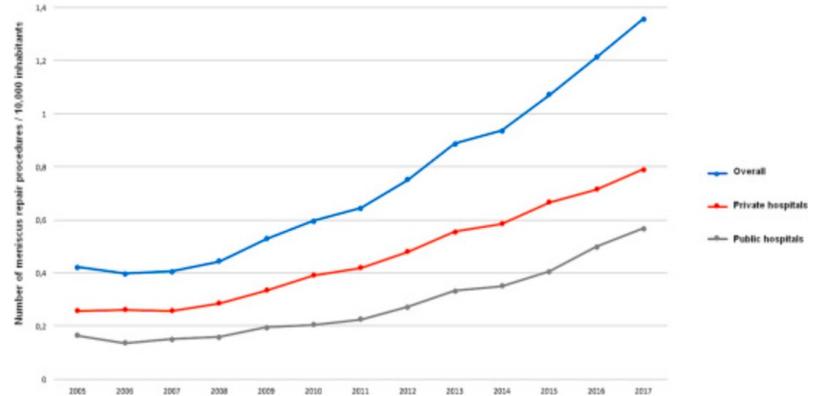
We Are Seeing More Meniscus Tears and More Patients Are Having Meniscus Surgery

USA

Meniscus Surgery in France



347% growth 2003-2015



Overall More Meniscus Surgery

Orthopedic and Traumatology

Research, 2019

HSS

Jl of American College of Radiology, 2018

DOI: <https://doi.org/10.1016/j.iacr.2017.10.015>

Meniscal Tearing in Asymptomatic Knees

Zanetti et al, American Journal of Roentgenology. 2003

100 patients with knee pain, 18-73 y/o. Avg – 42.7

Patients with unilateral knee pain

Bilat knees MRI – meniscal tears in 57/100 (57%) symptomatic knees and 36/57 (63%) asymptomatic knees

Horizontal or oblique meniscal tears were more frequently encountered in both asymptomatic and symptomatic knees and were not always be related to symptoms

Conclusion – certain types of meniscus tears are common in asymptomatic patients

Meniscal Tearing in Older Asymptomatic Knees

Englund et al, New England JI Medicine, 2008.

991 random subjects, ages 50-90 in MA. MRI of right knee + knee questionnaire

Meniscus tears by age: 19% age 50-59, 56% age 70-90

With Moderate OA: OA > grade II, meniscal tears in 63% of patients with knee pain/stiffness and 60% without symptoms

With Mild OA: OA < grade II, 32% with meniscal tears had symptoms and 23% had none

Overall – 61% of patients with meniscal tears had no symptoms in past month

Conclusion – meniscus tears are common in asymptomatic patients and more common in the setting of increasing age and arthritic knees

Meniscus Injury and Treatment

Patients <40 with acute injuries
Patients with activity related pain
No OA
Mechanical symptoms (?)

Patients with advanced
OA
Patients with fixed flexion
deformity
Patients with night pain

GREY AREA

The NEW ENGLAND
JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

MAY 2, 2013

VOL. 368 NO. 18

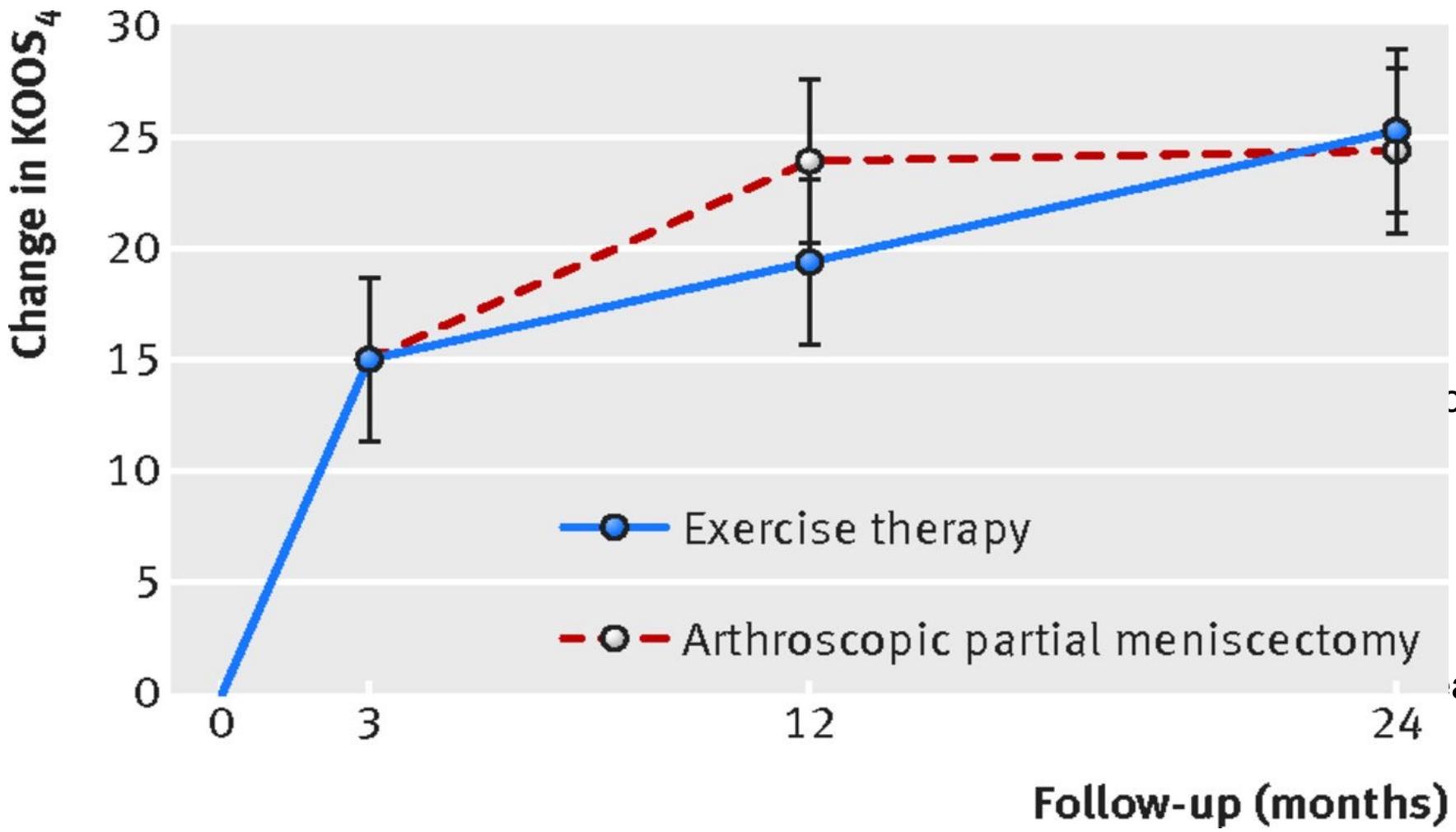
Surgery versus Physical Therapy for a Meniscal Tear
and Osteoarthritis

RCT of 351 patients aged 45+ (average age 56), symptomatic,
knee OA (mild/moderate) + meniscal tear

Assigned to surgical and rehab groups (RCT)

No significant differences in outcomes at 6 months (MeTeOR clinical trial)

However - 27% of the PT arm crossed to APM < 5 months



ce of O

ars for

Follow-up (months)



Predictors and Outcomes of Crossover to Surgery from Physical Therapy for Meniscal Tear and Osteoarthritis

A Randomized Trial Comparing Physical Therapy and Surgery

Subjects > 45 y/o with meniscal tearing + mild/moderate OA (MeTeOR group) (avg 56 y/
RCT – 351 pts, 7 sites, 164 randomized to meniscectomy (APM), 177 randomized to PT (

Of the 177 to PT, 48 (27%) crossed over to APM in first 140 days

16 crossed over 140 days -2 years

Total = 64 of 140 (38%) crossed to surgical arm

Who needs surgery? Who can wait? Does waiting make a difference?

Predictors and Outcomes of Crossover to Surgery from Physical Therapy for Meniscal Tear and Osteoarthritis

A Randomized Trial Comparing Physical Therapy and Surgery

Factors affecting crossover to APM group

WOMAC pain score > 40

Western Ontario and McMaster Universities Arthritis Index

Pain, stiffness, physical function

If WOMAC > 40 (0-100) and pain < 1 year and in non-surgical arm had greater likelihood of crossing over to surgical arm of study

Duration of symptoms < 1 year

Factors not affecting crossover to APM group

Age

Sex

BMI

Mechanical Symptoms

Predictors and Outcomes of Crossover to Surgery from Physical Therapy for Meniscal Tear and Osteoarthritis

A Randomized Trial Comparing Physical Therapy and Surgery

Patient satisfaction after treatment at 6 month follow up

Criteria pain reduction > 10% on KOOS Score (Pain/ADL/Sport Function/QOL)

APM – 82%

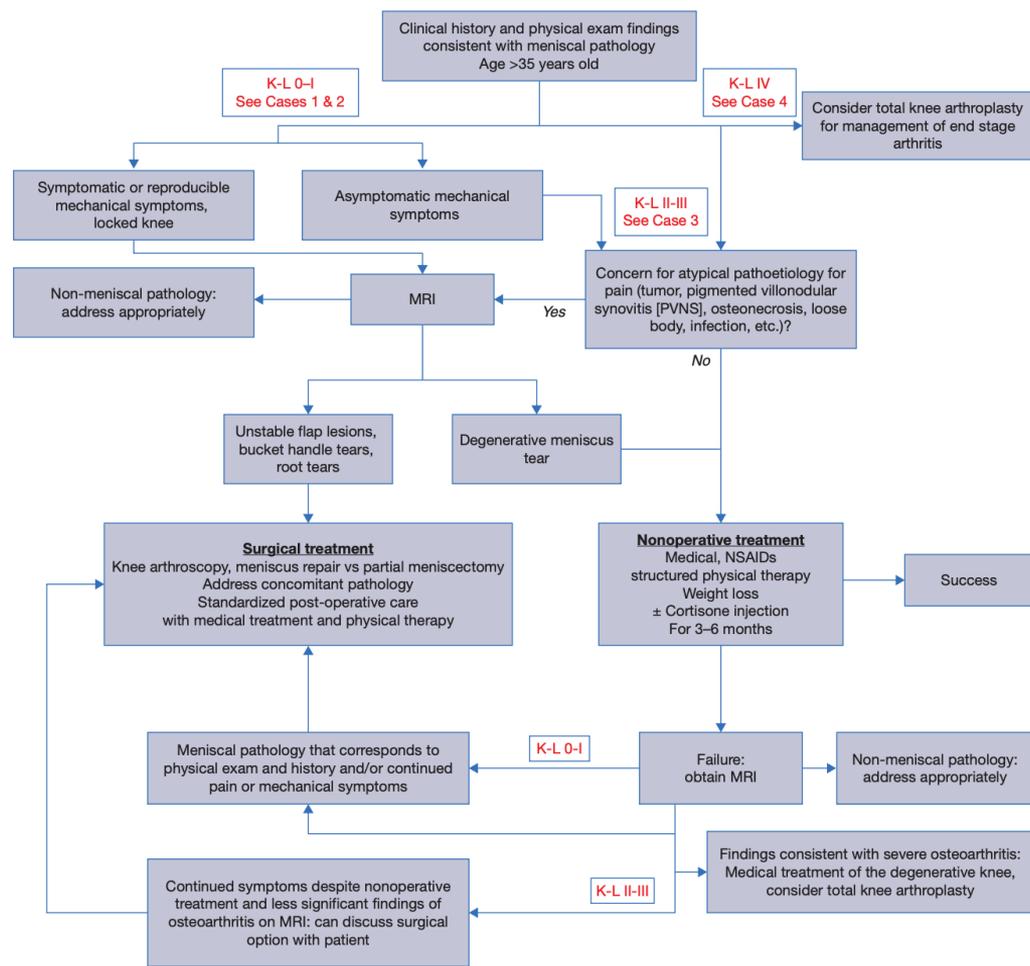
PT – 73%

PT and then Crossed to APM – 81%

-not a major difference if conservative care is attempted first

Conclusion: patients with OA and meniscal injury can be managed conservatively in most cases. Some patients will end up with surgery.

Katz J et al, JI Bone Joint Surg, 2016





**MRIs of
Patients
with Joint
Line Pain**



Meniscus Injury and Treatment

Patients <40 with acute injuries
Patients with activity related pain
No OA
Mechanical symptoms (?)

Patients with advanced
OA
Patients with fixed flexion
deformity
Patients with night pain

GREY AREA

What Should You Do?



Patient with ACL Tear

- 36 year old softball player
- Feels a “pop” while hitting
- Falls to the ground
- Immediately painful



ACL Injury: Epidemiology



- 200,000 to 250,000 ACL injuries annually in USA
- > 50% of surgical cases of knee injury
- High financial (>\$13,000/injury, 2-3 billion/yr) + physical, and mental cost of injury
- 50-60% incidence of dropping out of sport after surgery (soccer) with 26% higher risk of retear in surgical knee
- Lifetime consequences regardless of treatment (65-80% risk of OA development 15+ years)

ACL Injury: Gender and Age

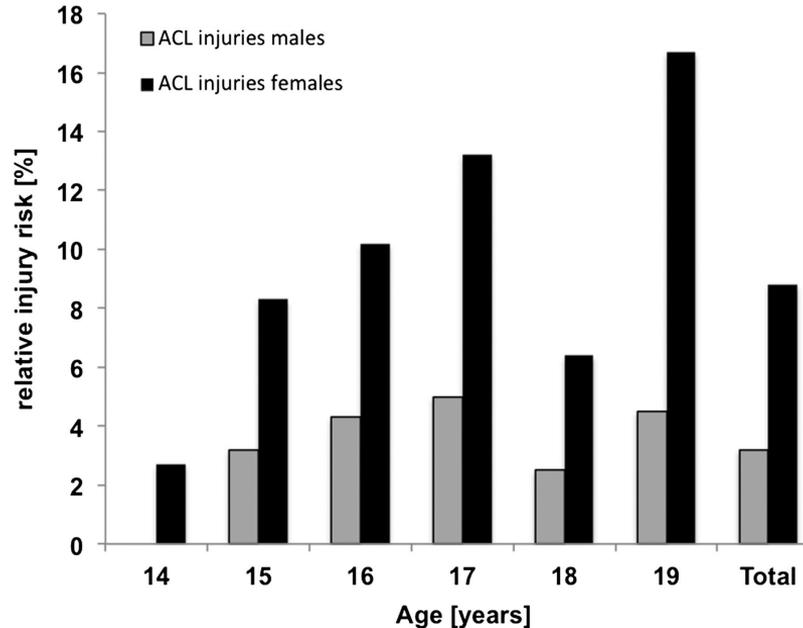
- 90% of ACL injuries occur in sport (*Dunn WR et al., AJSM 2010*)
- 2-8x> incidence in females>males
- Prospective 9-year study of collegiate ACL injury rates across 15 sports in NCAA, among sex-comparable sports including basketball, lacrosse, and soccer, females sustained significantly higher rates of ACL injury compared to males
- Per 1,000 AE//(0.22 versus 0.08 in basketball, 0.23 versus 0.13 in lacrosse, and 0.10 versus 0.04 in soccer)
- ACL injury in late adolescence mirrors adult data with 5-6x more common injury in females compared to males. 6.5/1,000 AE. (*Mjannes et al. 2019*)
- **Despite 20 years of ACL prevention, injuries still occur at high rate**



Gender

Females are at **2-10x** higher risk

- Biomechanical
- Anatomical
- Hormonal
- Neuromuscular
- Coordination



Prevention of ACL Injuries in Female Team Handball Players: A Prospective Intervention Study Over Three Seasons

Elite Division Results

Season	ACL Injuries
1998-1999	13
1999-2000	6
2000-2001	5

Roughly 1,000 athletes/season

P= 0.17 between 1st intervention season and control

P= 0.06 between 2nd intervention season and control

ACL Prevention: Identifying at Risk Athletes

- Risk factors – modifiable vs. non-modifiable
- Non-contact mechanisms - most common rapid change of direction during deceleration, stopping abruptly, and landing from a jump
- Decreased neuromuscular control and increased valgus loading are predictors of increased ACL injury risk in a prospective study on female athletes (Hewitt et al, 2005)
- ACL injured athletes showed greater dynamic valgus compared to uninjured athletes during landing, cutting, and decelerating maneuvers (Hewitt et al, 2005)
- **Proper co-activation and coordination between these complementary muscles is a critical aspect of dynamic knee stabilization (hamstring>quad)**

Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial

- Randomized 93 teams
 - Treatment arm with FIFA developed injury prevention program
 - (52 teams, 1055 players)
 - Control arm with no prevention program
 - (41 teams, 837 players)



Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial

	Intervention Group		Control Group		Rate Ratio	P value
	Injuries	Incidence	Injuries	Incidence		
Knee injuries	35	0.7	58	1.3	0.55	0.005

- Rate ratio used to compare the risk of injury between the two groups
- Incidence is per 1000 player hours

Systematic review of Injury Prevention Programs

Significant Risk Reduction

52-85% in athletes

No “best” ACL injury prevention program, but effective programs:

- Include at least **10 minutes** of exercises
- Are executed at least **3 times** per week
- Focus on neuromuscular training

ACL Prevention Programs: Do They Work?

- 2019 systematic review of randomized controlled trials with meta-analysis of injury prevention programs reported that use of such programs led to a **53%** overall reduction in ACL injury rates.
- 2021 meta-analysis of 35 studies and 1019 exercises showed only **1%** incorporated all 4 elements (multiplanar movements, single limb stance, trunk and hip dissociation, flight phase) (Dischiavi P et al, 2021)
- The preventative outcomes that result from plyometric training are related to improved landing mechanics including a decrease in knee valgus and increase in knee flexion at landing after implementing training. (Willadsen EM et al, 2019)
- The most effective programs included plyometric, agility, and strengthening exercises
- Learning new ways to jump and land might also be dependent on neuroplasticity - younger brains are more "moldable". (Grooms et al, 2018)
- Learning is augmented with use of "cues" external, internal, visual (Grooms et al, 2018)

Prevent Injury and Enhance Performance™ (PEP)	The “HarmoKnee” Program	11+ (former FIFA 11+)	Sportsmetrics™
3 warm-up activities, 5 stretching techniques, 3 strengthening exercises, 5 plyometric activities, and 3 sport-specific agility drills	Warm-up, muscle activation, balance, strength, and core stability	Part 1: multi-directional running exercise session at lower intensity Part 2: 6-set exercise session focusing on strength Part 3: intensive running exercise session	Stretching, jump training exercises/plyometrics, strength and weight training, and sport-specific agility drills
20 min/session, 3 times a week, on-field warm-up to replace traditional warm-up	20–25 min/session, twice a week during preseason, once a week during regular season	20 min/session, at least twice a week in training. part 1 performed prior to matches	90 min/session, 3 times a week for 6 weeks
Up to 88% injury rate reduction	70% injury rate reduction	20–50% in the long term	3.6 times higher injury incidence in untrained vs. trained female athlete
Mandelbaum BR et al (2005)	Kiani A et al (2010)	Bizzini M, et al (2013) Al Attar WSA, et al (2016)	Hewett TE et al (1996) Barber-Westin SD et al (2009)



ACL Prevention: What Are Keys?

- Implementing a preseason program at least 6 weeks prior to the start of the sport participation and continuing a lower intensity maintenance program throughout the competitive season that can replace a traditional warm-up.
- Educational aspect for coaches, trainers, and athletes, such as a video and supplemental written materials, that exemplifies proper execution of the exercises.
- **Feedback, particularly placing emphasis on good technique and correcting errors**

Feedback cues improve the alignment and technique of children performing ACL injury prevention exercises

Daphne I Ling , Caroline Boyle, Joseph Janosky, Brenda Chang, Naomi Roselaar, James Kinderknecht, Robert G Marx

- 360 participants were evaluated, 165 8–11 y/o 165, 136 12–15 y/o
- 7 exercises done twice, visual/verbal instruction first pass, feedback cues second pass (“Hips, knees, and toes point straight ahead as you run”)
- Judged on ability to maintain neutral body alignment
- **The use of feedback cues significantly increased the proportion of participants who correctly completed the exercise ($p < 0.001$)**

Compliance



Training the Trainers – The Coach Education Model

- Norwegian female handball ACL injury prevention study.
- Prospective study which showed 50% decrease of ACL injuries over 13 year time period with increasing “buy in” from the coaches over years correlating to decreasing injuries (Myklebust G et al, 2013)
- Over past 10 years, FIFA 11 + (now 11+) has been widely distributed. In study of German coaches, less than 50% knew of the program (Wilke J et al 2019)
- Comparing players with high 11+ compliance (1.5 sessions per week) to players with intermediate compliance (0.7 sessions per week), players with high compliance had a 35% lower injury risk

Match Level Fitness: ACL Risk Mitigation and Preventive Conditioning + Pre-Season

TABLE 2 Number of ACL injuries in the NFL seasons around the 2011 Lockout and 2020 COVID-19-affected season^{110,111}

	Preseason/off-season organized team activities (OTA)	Regular season/postseason
2010 (Full season)	64 Games/11 ACL injuries	331 Games/35 ACL injuries
2011 (NFL lockout, limited preseason training)	64 Games/13 ACL injuries	331 Games/35 ACL injuries
2012 (Full season)	64 Games/29 ACL injuries	331 Games/33 ACL injuries
2018 (Full season)	64 Games/13 ACL injuries	331 Games/21 ACL injuries
2019 (Full season)	64 Games/17 ACL injuries	331 Games/32 ACL injuries
2020 (COVID-19, data as of January 3, 2021)	No preseason games/11 ACL injuries	256 Games/41 ACL injuries

Abbreviations: ACL, anterior cruciate ligament; COVID-19, 2019 novel coronavirus; NFL, National Football League; OTA, organized team activities.

Increasing Awareness: Helpful Patient Educational Resources

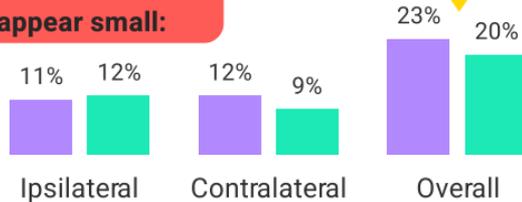
Re-Injury

ACL injuries may be treated operatively or non-operatively, with the goal of restoring knee function and preventing future injury.



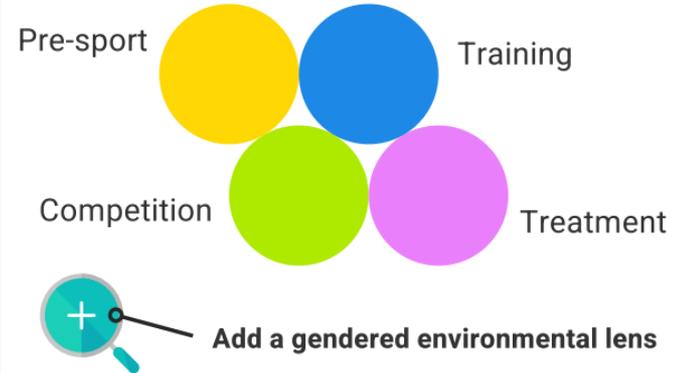
Any differences in secondary injury risk between sexes appear small:

Both sexes have ~20% risk of secondary ACL injury!



Other risk factors for secondary injury (previous injury, age, return to sport, graft type, confidence) may overpower the causal/predictive influence of sex.

Environmental Factors



Environments are experienced differently by males and females, which can affect ACL injury risk, treatment, and recovery.



What Should You Do?

Conclusions

- Knee complaints are common in primary care setting
- Make a specific diagnosis
- Develop a treatment plan
- Remember these points:
 - Knee OA does not mean knee replacement
 - Most meniscus tears don't require surgery
 - ACL prevention can work
 - Consider all treatment options

Thank You



Questions and
Discussion

References

- McTiernan A, Friedenreich CM, Katzmarzyk PT, et al. Physical activity in cancer prevention and survival: A systematic review. *Medicine and Science in Sports and Exercise* 2019; 51(6):1252-1261.
- Rezendes LFM, Sá TH, Markozannes G, et al. Physical activity and cancer: an umbrella review of the literature including 22 major anatomical sites and 770 000 cancer cases. *British Journal of Sports Medicine* 2018; 52(13):826-833.
- Patel AV, Friedenreich CM, Moore SC, et al. American College of Sports Medicine Roundtable Report on physical activity, sedentary behavior, and cancer prevention and control. *Medicine and Science in Sports and Exercise* 2019; 51(11):2391-2402.
- Keimling M, Behrens G, Schmid D, Jochem C, Leitzmann MF. The association between physical activity and bladder cancer: systematic review and meta-analysis. *British Journal of Cancer* 2014; 110(7):1862-1870.
- Moore SC, Lee IM, Weiderpass E, et al. Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA Internal Medicine* 2016; 176(6):816-825.
- Pizot C, Boniol M, Mullie P, et al. Physical activity, hormone replacement therapy and breast cancer risk: A meta-analysis of prospective studies. *European Journal of Cancer* 2016; 52:138-154.
- Hardefeldt PJ, Penninkilampi R, Edirimanne S, Eslick GD. Physical activity and weight loss reduce the risk of breast cancer: A meta-analysis of 139 prospective and retrospective studies. *Clinical Breast Cancer* 2018; 18(4):e601-e612.
- Eliassen AH, Hankinson SE, Rosner B, Holmes MD, Willett WC. Physical activity and risk of breast cancer among postmenopausal women. *Archives of Internal Medicine* 2010; 170(19):1758-1764.
- Fournier A, Dos Santos G, Guillas G, et al. Recent recreational physical activity and breast cancer risk in postmenopausal women in the E3N cohort. *Cancer Epidemiology, Biomarkers & Prevention* 2014; 23(9):1893-1902.
- Liu L, Shi Y, Li T, et al. Leisure time physical activity and cancer risk: evaluation of the WHO's recommendation based on 126 high-quality epidemiological studies. *British Journal of Sports Medicine* 2016; 50(6):372-378.
- Schmid D, Behrens G, Keimling M, et al. A systematic review and meta-analysis of physical activity and endometrial cancer risk. *European Journal of Epidemiology* 2015; 30(5):397-412.
- Du M, Kraft P, Eliassen AH, et al. Physical activity and risk of endometrial adenocarcinoma in the Nurses' Health Study. *International Journal of Cancer* 2014; 134(11):2707-2716.
- Friedenreich C, Cust A, Lahmann PH, et al. Physical activity and risk of endometrial cancer: The European prospective investigation into cancer and nutrition. *International Journal of Cancer* 2007; 121(2):347-355.
- Borch KB, Weiderpass E, Braaten T, et al. Physical activity and risk of endometrial cancer in the Norwegian Women and Cancer (NOWAC) study. *International Journal of Cancer* 2017; 140(8):1809-1818.
- Behrens G, Jochem C, Keimling M, et al. The association between physical activity and gastroesophageal cancer: systematic review and meta-analysis. *European Journal of Epidemiology* 2014; 29(3):151-170.