



Current evidence & knowledge in Anterior Cruciate Ligament (ACL) injury prevention program for community action.

MA CHUN CHEONG

MSc Sport Medicine & Health Science Student

Department of Orthopedics and Traumatology,

Faculty of Medicine, The Chinese University of Hong Kong

Introduction

Epidemiology

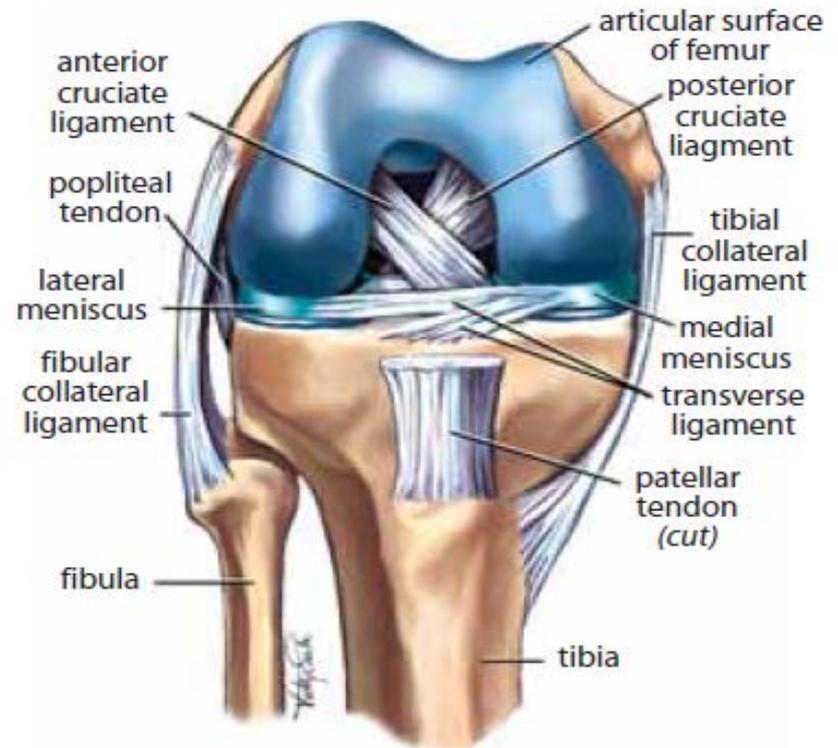
- ACL injury occurrence rate in females is 5 to 6 fold greater incidence compared to males playing the same landing and cutting sports

The ACL injury → Burdens

Physiological

Financially

Psychologically.



(Hoogenboom, 2010)

Figure 27.1 Anatomy of the knee joint

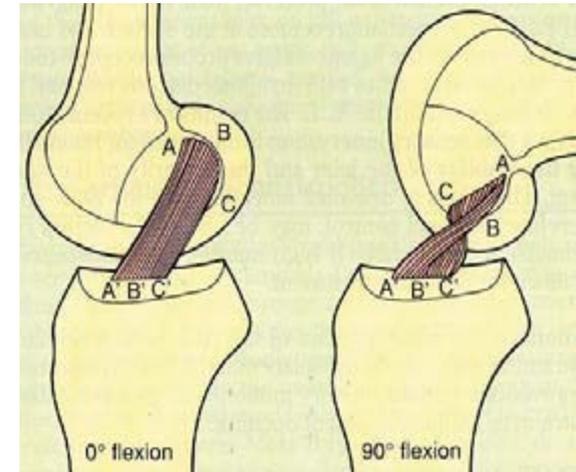
(a) The knee joint (anterior view) (Brukner, 2012).

Macroscopic Anatomy

Two bundles :

- Antero medial bundle (AMB):
- **Posterolateral bundle (PLB):**

Strain and length increase during passive flexion



(Brukner, 2012).

ACL injury impacts

Physiological :

- Pain
- Immobilization difficulty

Financially:

- Medical cost in imaging, Reconstruction surgery,
- Postoperative bracing and rehabilitation
- loss of income

Psychologically

- Stress
- Depression
- Miss about 6-9 months of sport engagement as result of ACL injury (Particular Elite Athlete)

ACL Function

- Stabilize the knee joint,
- Prevent abnormal movements
- Steer the movement of the knee
- prevents forward translation of the tibia to the femur
- Prevents hyperextension
- Stabilizes the knee against tibia rotation

Most occur in a non-contact episode during sport performance

- Deceleration
- landing tasks, or lateral pivoting are typical motions associated with high external knee joint loads

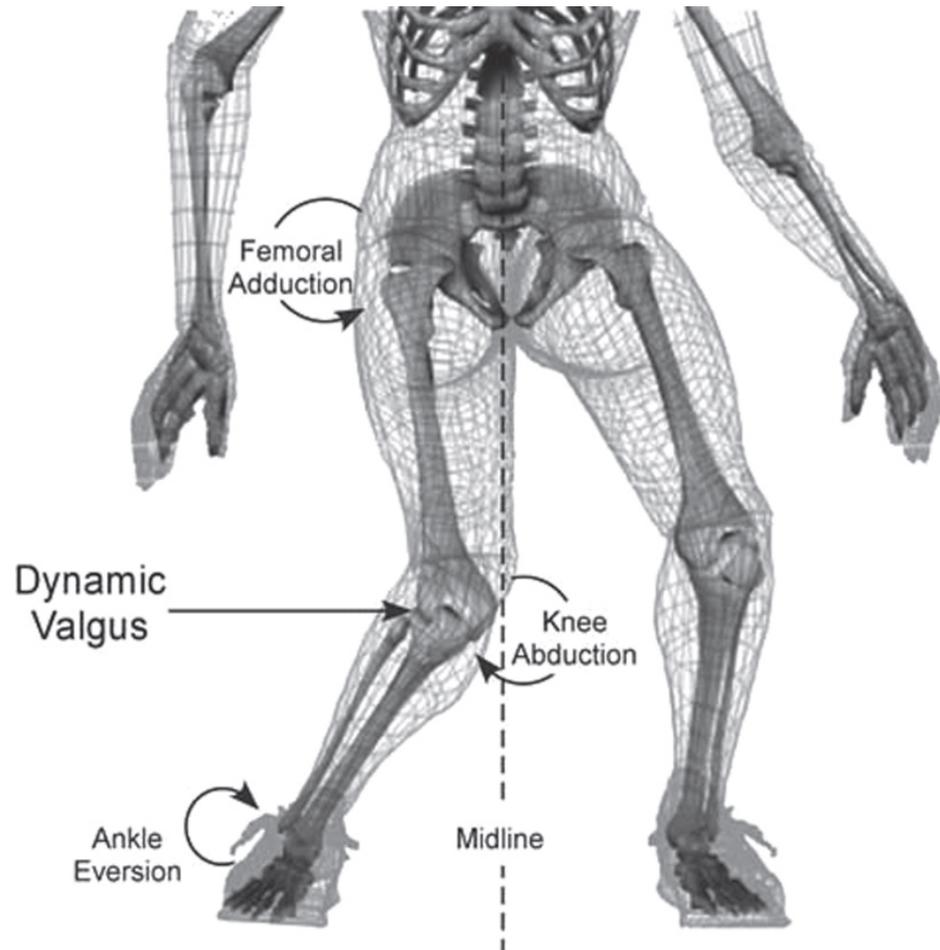
Boden, Dean, Feagin & Garrett, 2000).

(Olsen, Myklebust , Engebretsen & Bahr,2004) (Nordin & Frankel, 2001)

ACL injury mechanism

Movement trigger the ACL injury

- (1) hip internally rotated
- (2) semi flex knee
- (3) dynamic knee valgus



(Hoogenboom, 2010)

4 Components of ACL injury Mechanism

4X neuromuscular imbalances:

- Ligament dominance
- Quadriceps dominance
- Leg dominance
- Trunk dominance

ACL injury Risk Factors

Non-modifiable	Modifiable
Sex: Female	External -Equipment e.g. boot -Environment
Anatomical & Structural -Narrow intercondylar notch width -Q angle -Increased posterior tibial slope of lateral plateau	Internal -Muscle Strengthen -Neuromuscular imbalance
Hormonal -Estrogen	

Source: Brukner, P. (2012). Brukner & Khan's clinical sports medicine. North Ryde: McGraw-Hill.

Injury Prevention Program

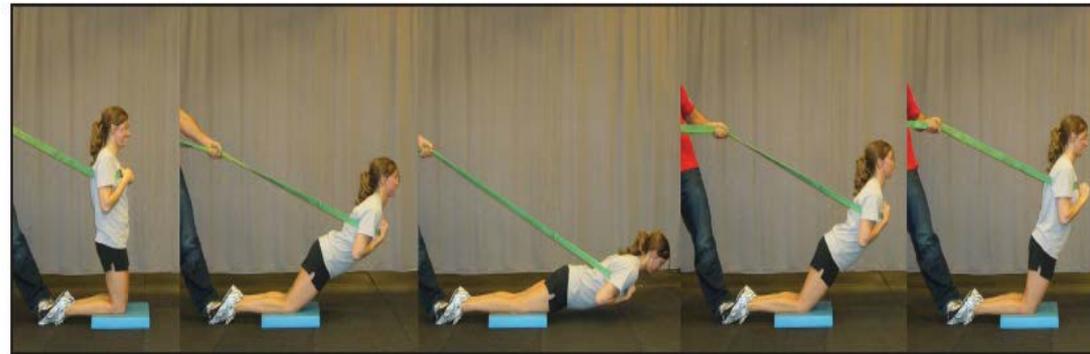
1. Neuromuscular Training
2. FIFA 11+ Prevent and Enhancement Performance Program (PEP)
3. 3.3 ACL injury screening test

(1) Neuromuscular Training Quadriceps Dominance

sportspeople are encouraged to become less quadriceps dominant and reminded to recruit the posterior kinetic chain muscles

Corrective Exercises

1. Polymeric exercises
2. Russian Hamstring Curls
3. Dynamic core stabilization and hamstring curl on Swiss ball



(2) Neuromuscular Training (Leg Dominance)

- **Leg asymmetry**

- Muscular Strength
- Muscle Recruitment Pattern
- Muscle Flexibility

- Shift the body weight to one leg

♀ ↑ higher injury% on non- dominant leg

- **Corrective Exercise**

1. single leg balance
2. single leg hopping techniques



(3) Neuromuscular Training (Trunk Dominance)

- Instability to precisely control the trunk in 3D space.

Corrective Exercise

Core training



FIFA 11+ Prevent and Enhancement Performance Program (PEP)

FIFA 11+ a complete warm up program developed in 2006

- ◆ Prevent injuries in amateur football players. Significantly prevent (non-contact) injuries in football
- ◆ Was also acknowledged as the Prevent and Enhance Performance(PEP) and ACL injury prevention program

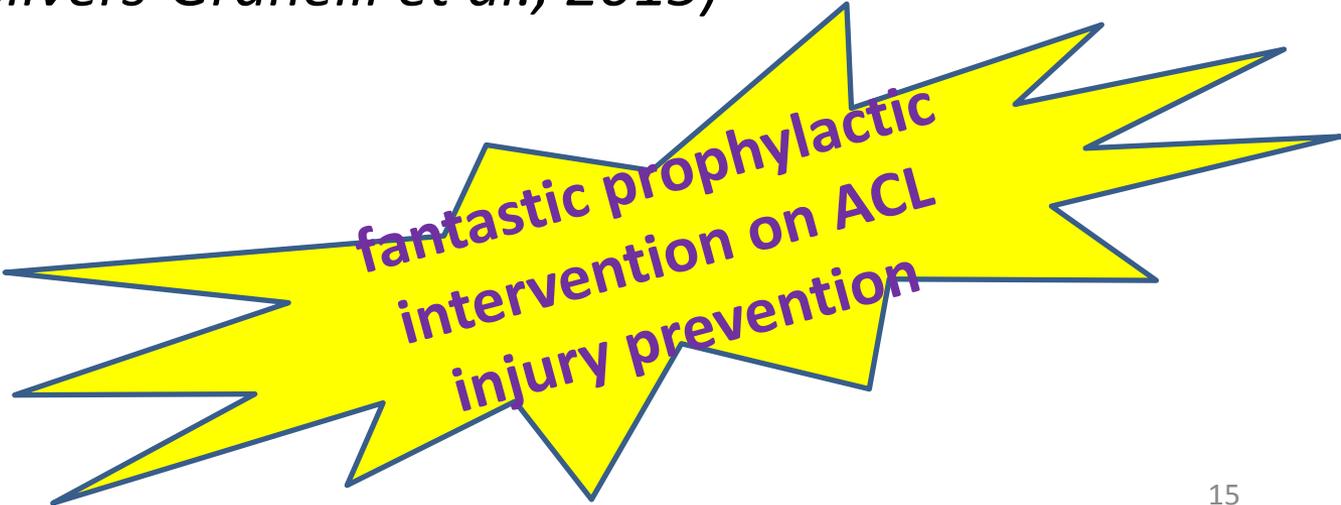
(Owoeye, Akinbo, Tella & Olawale, 2014 & Steffen et al, 2013)

FIFA 11+

- Randomized controlled trial (RCT) study in female aged 13-18 , performing the FIFA 11 + program at twice a week can largely lower injuries rate up to 50% (*Soligard,2009 ; Steffen et al, 2013*)
- RCTs on 414 players aged 14-19 significantly reduced the overall rate of injury by 41 % (p=0.006), while all lower extremity injuries rate was reduced by 48% (p=0.004) (*Owoeye et al. 2013*)

FIFA 11+

- FIFA 11+ efficacy in the male population
- 1525 players (aged 18-25) were recruited from United States National Collegiate Athletic Association (NCAA) to performing FIFA 11+regularly (2-3/week).
- The results showed the injury rates significantly reduced by 46.1%, and the time loss to injury also decreased by 28.6% ($P < 0.0001$) (*Silvers-Granelli et al., 2015*)



fantastic prophylactic
intervention on ACL
injury prevention

FIFA 11+

PART 1 RUNNING EXERCISES - 8 MINUTES



1 RUNNING STRAIGHT AHEAD

Start in a ready position in the center of the pitch. Run straight ahead for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**



2 RUNNING HIP OUT

Start in a ready position in the center of the pitch. Run with your hips out for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**



3 RUNNING HIP IN

Start in a ready position in the center of the pitch. Run with your hips in for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**



4 RUNNING CIRCLING PARTNER

Start in a ready position in the center of the pitch. Run in a circle with your partner for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**



5 RUNNING SHOULDER CONTACT

Start in a ready position in the center of the pitch. Run with your shoulders touching for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**



6 RUNNING QUICK FORWARDS & BACKWARDS

Start in a ready position in the center of the pitch. Run forwards and backwards for 30 seconds. Repeat 7 times for a total of 8 minutes. **2 sets.**

PART 2 STRENGTH · PLYOMETRICS · BALANCE · 10 MINUTES

LEVEL 1



7 THE BENCH STATIC

Start in a ready position in the center of the pitch. Perform the bench static exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



LEVEL 2

7 THE BENCH ALTERNATE LEGS

Start in a ready position in the center of the pitch. Perform the bench alternate legs exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



LEVEL 3

7 THE BENCH ONE LEG LIFT AND HOLD

Start in a ready position in the center of the pitch. Perform the bench one leg lift and hold exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



8 SIDeways BENCH STATIC

Start in a ready position in the center of the pitch. Perform the sideways bench static exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



8 SIDeways BENCH RAISE & LOWER HIP

Start in a ready position in the center of the pitch. Perform the sideways bench raise and lower hip exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



8 SIDeways BENCH WITH LEG LIFT

Start in a ready position in the center of the pitch. Perform the sideways bench with leg lift exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



9 HAMSTRINGS BEGINNER

Start in a ready position in the center of the pitch. Perform the hamstring beginner exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



9 HAMSTRINGS INTERMEDIATE

Start in a ready position in the center of the pitch. Perform the hamstring intermediate exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



9 HAMSTRINGS ADVANCED

Start in a ready position in the center of the pitch. Perform the hamstring advanced exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



10 SINGLE LEG STANCE HOLD THE BALL

Start in a ready position in the center of the pitch. Perform the single leg stance hold the ball exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



10 SINGLE LEG STANCE THROWING BALL WITH PARTNER

Start in a ready position in the center of the pitch. Perform the single leg stance throwing ball with partner exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



10 SINGLE LEG STANCE TEST YOUR PARTNER

Start in a ready position in the center of the pitch. Perform the single leg stance test your partner exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



11 SQUATS WITH TOE RAISE

Start in a ready position in the center of the pitch. Perform the squat with toe raise exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



11 SQUATS WALKING LUNGES

Start in a ready position in the center of the pitch. Perform the squat walking lunges exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



11 SQUATS ONE-LEG SQUATS

Start in a ready position in the center of the pitch. Perform the one leg squat exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



12 JUMPING VERTICAL JUMPS

Start in a ready position in the center of the pitch. Perform the jumping vertical jump exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



12 JUMPING LATERAL JUMPS

Start in a ready position in the center of the pitch. Perform the jumping lateral jump exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**



12 JUMPING BOX JUMPS

Start in a ready position in the center of the pitch. Perform the jumping box jump exercise for 30 seconds. Repeat 7 times for a total of 10 minutes. **2 sets.**

PART 3 RUNNING EXERCISES - 2 MINUTES



13 RUNNING ACROSS THE PITCH

Start in a ready position in the center of the pitch. Run across the pitch for 2 minutes. **2 sets.**



14 RUNNING BOUNDING

Start in a ready position in the center of the pitch. Perform the running bounding exercise for 2 minutes. **2 sets.**



15 RUNNING PLANT & CUT

Start in a ready position in the center of the pitch. Perform the running plant and cut exercise for 2 minutes. **2 sets.**

ACL injury screening test

- (1) Laboratory Based Screening test
- (2) Clinical based screening test
- (3) A field based assessment tool

ACL injury screening test

(1) Laboratory Based Screening test

- Knee abduction moments (valgus torques) and angles can predict 73 % sensitivity and 78% specificity of ACL injury risk.

(2) Clinical based screening test

- pre-participation screening test identify whom prone to knee injury and who would benefit from strength, proprioception, and neuromuscular stabilization training intervention

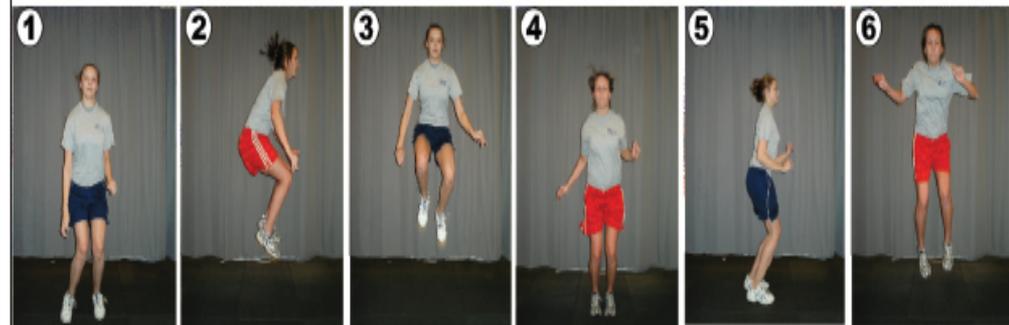
(Hoogenboom, 2010 & Hewett et al, 2005).

ACL injury screening test

(3) A field based assessment tool

- Adopts tuck jump to identify lower extremity technical flaws during a plyometric activity and improve lower extremity biomechanics by progress training

Tuck Jump Assessment	Pre	Mid	Post	Comments
<u>Knee and Thigh Motion</u>				
① Lower extremity valgus at landing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
② Thighs do not reach parallel (peak of jump)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
③ Thighs not equal side-to-side (during flight)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<u>Foot Position During Landing</u>				
④ Foot placement not shoulder width apart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
⑤ Foot placement not parallel (front to back)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
⑥ Foot contact timing not equal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7. Excessive landing contact noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<u>Plyometric Technique</u>				
8. Pause between jumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9. Technique declines prior to 10 seconds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10. Does not land in same footprint (excessive in-flight motion)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Total ____	Total ____	Total ____	



(Hoogenboom, 2010)

(Myer, Ford & Hewett, 2004)

Conclusion

- ACL injury can impose devastating impacts on individual life
- Coach, Sport-Trainer should engage in scientific conference, course, continue education regularly in order to make your athlete/ clients enjoying sports safely
- Empower your athlete/clients/friends with strong compliance, discipline , attitudes, self belief, and self-efficacy in preventive medicine exercises

Reference

- Bruckner, P. (2012). *Bruckner & Khan's clinical sports medicine*. North Ryde: McGraw-Hill.
- Boden, B. P., Dean, G. S., Feagin, J. A., & Garrett, W. E. (2000). Mechanisms of anterior cruciate ligament injury. *Orthopedics*, 23(6), 573-578.
- Hoogenboom, B. J. (2010). NAJSPT. *North American Journal of Sports Physical Therapy/ Volume*, 5(4), 234.
- Hewett, T. E., & Johnson, D. L. (2010). ACL prevention programs: fact or fiction?. *Orthopedics*, 33(1).
- Hewett, T. E., Myer, G. D., & Ford, K. R. (2006). Anterior cruciate ligament injuries in female athletes part 1, mechanisms and risk factors. *The American journal of sports medicine*, 34(2), 299-311.
- Hewett, T. E., Myer, G. D., Ford, K. R., Heidt, R. S., Colosimo, A. J., McLean, S. G., ... & Succop, P. (2005). Biomechanical measures of neuromuscular control and valgus loading of the knee predict anterior cruciate ligament injury risk in female athletes a prospective study. *The American journal of sports medicine*, 33(4), 492-501.
- Myer, G. D., Ford, K. R., & Hewett, T. E. (2004). Rationale and clinical techniques for anterior cruciate ligament injury prevention among female athletes. *Journal of athletic training*, 39(4), 352.

Reference

- Nordin, M., & Frankel, V. H. (Eds.). (2001). *Basic biomechanics of the musculoskeletal system*. Lippincott Williams & Wilkins.
- Owoeye, O. B., Akinbo, S. R., Tella, B. A., & Olawale, O. A. (2014). Efficacy of the FIFA 11+ warm-up programme in male youth football: a cluster randomised controlled trial. *J Sports Sci Med*, *13*(2), 321-8.
- Olsen, O. E., Myklebust, G., Engebretsen, L., & Bahr, R. (2004). Injury mechanisms for anterior cruciate ligament injuries in team handball a systematic video analysis. *The American journal of sports medicine*, *32*(4), 1002-1012.
- Silvers-Granelli, H., Mandelbaum, B., Adeniji, O., Insler, S., Bizzini, M., Pohlig, R., ... & Dvorak, J. (2015). Efficacy of the FIFA 11+ injury prevention program in the collegiate male soccer player. *The American journal of sports medicine*, 0363546515602009.
- Steffen, K., Emery, C. A., Romiti, M., Kang, J., Bizzini, M., Dvorak, J., ... & Meeuwisse, W. H. (2013). High adherence to a neuromuscular injury prevention programme (FIFA 11+) improves functional balance and reduces injury risk in Canadian youth female football players: a cluster randomised trial. *British journal of sports medicine*, *47*(12), 794-802.
- Silvers, H. J., & Mandelbaum, B. R. (2011). ACL injury prevention in the athlete. *Sport-Orthopädie-Sport-Traumatologie-Sports Orthopaedics and Traumatology*, *27*(1), 18-26.
- Soligard, T., Nilstad, A., Steffen, K., Myklebust, G., Holme, I., Dvorak, J., ... & Andersen, T. E. (2010). Compliance with a comprehensive warm-up programme to prevent injuries in youth football. *British journal of sports medicine*, *44*(11), 787-793.
- Soligard, T., Myklebust, G., Steffen, K., Holme, I., Silvers, H., Bizzini, M., ... & Brooks. (2009). Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial. *BMJ: British Medical Journal*, 95-99.

Q&A

