

ACL Injuries in Adolescent Athletes

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Introduction

- The most common mechanisms of injury for Anterior Cruciate Ligament (ACL) ruptures: landing from a jump and the cutting manoeuvre.
- ACL ruptures occur at 4-6 times higher rates in girls than boys after puberty

Differences in adolescent females and males

- Post puberty changes:
 - Boys demonstrate a significant increase in vertical jump height; a significant decrease in landing ground reaction forces (GRFs); a maintenance of take off GRFs; and a significant decrease in loading rate
 - Girls demonstrate no change in vertical jump height, no change in landing GRFs; a significant decrease in take off GRFs of the dominate side only; and a significant decrease in loading rate
 - Girls GRFs in both landing and takeoff and the rate of loading where significantly higher than boys – therefore, **girls do not undergo a neuromuscular spurt at puberty**
- For cutting manoeuvres, **females have increased knee valgus and ankle eversion angles compared with males** – this increased knee valgus is significant at initial contact and there is a trend in this direction at maximum contact.
- Hypothesis: females rely more on ligaments, rather than musculature, to absorb a significant portion of GRFs in cutting than males, and that **ligament dominance** may be a risk factor in ACL injuries in adolescent female athletes.
- There may be other anatomical and hormonal factors contributing to the increased rate of ACL injuries in adolescent female athletes, but they are difficult and controversial to modify, so the greatest opportunity for risk identification, modification and intervention may lie with biomechanical and neuromuscular factors

Neuromuscular Training

- Neuromuscular training should be introduced at or near the onset of puberty. It should involve both jumping / landing skills and the cutting manoeuvre.

Ligament Laxity

- Prior to puberty there is no gender difference in respect to ligament laxity, but at the onset of puberty, girls develop greater generalised ligament laxity, which is maintained post puberty, whilst boys do not develop ligament laxity
- This **increase in ligament laxity** in girls at puberty may contribute to increased incidence of ACL injuries.
- Adolescent girls also have a positive measure of knee hyperextension, which increases their risk of ACL injuries 5-fold.
- Measures of knee joint laxity may be used in conjunction with measures of neuromuscular control of the knee joint to more accurately identify females at higher risk of ACL injury, allowing for targeted intervention programs

Avulsion Fractures

- Avulsion fractures in adolescents, especially about the knee, are particularly common.
- Up to 80% of ACL injuries in skeletally immature patients are avulsions of the tibial spine – this is due to the distal fibres of the ACL being stronger than the adjacent bone at this stage of development.

- Presentations are often subtle on plain radiographs (tunnel and oblique projections need to be taken), but the multiplanar capabilities of MRI are useful in revealing the exact location and extent of the lesion. MRI can also distinguish bone oedema patterning in impaction from avulsion; the state of the ACL (which is generally intact but displaced superiorly); and other soft tissue and bony injury such as meniscus, other ligament injury or bone marrow oedema.
- **ACL avulsion injuries need to be surgically reduced within one week** of injury, so it is crucial that adolescents who sustain ACL injuries have x-rays ASAP to establish if an avulsion # has occurred and then arrange referral for MRI and to an orthopaedic surgeon

Outcome measures

- In adolescents, the **Lysholm knee scoring scale** (designed to determine functional status of adults following ACL injury) demonstrated high responsiveness for traumatic and atraumatic knee pain / injury, whereas the WOMAC osteoarthritis index (developed for patients with hip and knee OA) did not show as high responsiveness in adolescents.
- Thus, while not specifically designed for adolescents, the Lysholm knee scoring scale would be highly appropriate for use by sports physios working with adolescent athletes who have sustained a knee / ACL injury

Post Surgical Complications and the need for 'Pre-habilitaiton'

- Post ACL reconstruction, adolescents reported **greater pain and catastrophising** than adults, particularly pain related helplessness and rumination
- This is possibly due to a lack of understanding of injury, lack of experience with recovery and potential threat to competition in adolescent athletes
- Differences in pain experiences between adolescents and adults make 'pre-hab' very important before ACL reconstruction – it should **include education and discussion** regarding the injury, rehab, recovery and return to sport
- **CRPS (Complex Regional Pain Syndrome)** may also occur in children and adolescents after surgery. The ratio of lower and upper limb involvement is 8:1 compared to adults where CRPS is much more prevalent in the upper limbs. There is also a much higher ratio of CRPS in female adolescents than males (7:1) (adults 2-4:1)
- Adolescents and children have a very good prognosis for CRPS compared with adults – early weight bearing seems to be very important in preventing and treating CRPS. Thus, it is very important, particularly in females, to **encourage early weight bearing and functional activity** after an ACL injury – this would form part of the 'pre-hab'