Anatomy & Physiology

Hutchings, Anat Physiol 2014, 4:2
http://dx.doi.org/10.4172/2161-0940.1000e131

Editorial Open Access

Editorial Review: Understanding the Causes of Non-Contact ACL Injuries as a Potential Progressive Imbalance from the Connective Tissue to the Body-As-A-Whole

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Rec date: Feb 01, 2014, **Acc date:** Feb 01, 2014, **Pub date:** Feb 03, 2014

Editorial

Anterior cruciate ligament (ACL) is probably the most common and detrimental injury in athletes today. Some researchers estimate between 100,000 to 200,000 ACL injuries occur per year in the United States alone [1,2]. ACL injuries are commonly classified into two categories, contact-injuries and non-contact-injuries with 70 percent of the injuries being non-contact (ncACL) and 30 percent a result from direct contact with another player and/or object [3]. ALC injuries are also 4 to 6 times more frequent in female athletes then male athletes at the same level for the same sport [4,5]. Most studies suggest ncACL injuries are a result of arthrokinetic dysfunction, commonly presented as dynamic knee valgus and includes but not limited to landing, cutting, deceleration coupled with cutting, pivoting sports and can occur with or without contact [3,6,7].

The specific cause of injury to the ACL varies per athlete but most commonly occurs when athletes suffer from arthrokinetic dysfunction during vigorous activity. Most ncACL injuries occur when an athlete attempts to decelerate from a jump or forward running while the knee is in a shallow flexion angle [8-10] and worsened if its combined with dynamic knee valgus and/or knee internal-external axis rotation [8,11,12].

Can an Athlete's Risk for ncACL Injuries be Detected and/or Prevented?

To better answer this question we need to fully understand all the potential contributing risk factors to arthrokinematic dysfunction in athletes. By reviewing various research data from connective tissue and neuromuscular to the body-as-a-whole during vigorous activity, we can have a greater understanding of the potential and progressive contributing risk factors leading to arthrokinematic dysfunction to potentially improve early detection and/or prevention of ncACL injuries.

Connective Tissue (CT) Factors

Currently, there is insufficient research to illustrate a direct correlation between the connective tissue and ncACL injuries, but it is key to understand how the connective tissue can contribute early to neuromuscular imbalances and in this case potentially affecting the integrity of the tibiofemoral joint and the anterior cruciate ligament. Research has shown that chronic repetitive movements and poor joint alignment creates abnormal inflamed connective tissue, resulting in myofascial adhesions and the creation of an inelastic collagen matrix which decreases normal elasticity of soft tissue. [13,14-18] If this is left untreated it can negatively effect over-all neuromuscular behavior causing an altered length-tension relationship and altered reciprocal inhibition, and ultimately arthrokinetic dysfunction [13,14-16] which in this case could potentially lead to ncACL injuries in athletes during vigorous activity.

Muscular & Neuromuscular Factors

The majority of research on potential contributing risk factors for ncACL injuries primarily focuses on various muscular, neuromuscular and structural biomechanics as the main causes. Ranging from a specific muscle group of a limb, angles of the tibiofemoral joint, to leg-dominance and the body-as-a-whole during dynamic activity. Results from these independent muscular, neuromuscular and biomechanical studies all conclude that their findings are possible contributing factors towards ncACL injuries.

-Quads vs Hamstrings Ratio

Beynnon and Fleming research concluded; "*In-vivo* studies [19] have concluded that ACL strain increases if there is an increase in quadriceps activity relative to hamstring activity."

-Tibial Slope & Dominant Leg

Seçkin Şenişik, Cengizhan Özgürbüz research concluded, "Higher tibial slopes in injured soccer players compared to the uninjured players may indicate a relationship between the tibial slope and ACL injury risk" [20].

-Hip, Knee Valgus

Ekegren and Miller research concluded, "A deficiency in the neuromuscular control of the hip has been identified as a key risk factor for non-contact anterior cruciate ligament (ACL) injury in post pubescent females. This deficiency can manifest itself as a valgus knee alignment during tasks involving hip and knee flexion" [11].

-Body-as-a-whole: Truck position at the time of injury

Sipprell, Boden, and Sheehan research concluded that, "Landing with the center-of-mass far posterior to the base-of-support may be a risk factor for noncontact ACL-injury and potentially can be addressed in prevention programs" [21].

Boden and Sheehan's comprehensive research on ACL injuries, studied ten different risk factors including the body-as-a-whole and concluded, "...that a combination of forces contributes to noncontact ACL injuries"[12].

Additional Factors of ncACL Injuries to Consider but not Covered in this Editorial are

-Athlete's mental and/or physical fatigue.

-Ankle, foot, hip ratio.

-Landing: heal vs. toe, one-leg vs. two.

-Lactic acidosis during vigorous activity and temporary neuromuscular imbalances.

-Lack of or improper dynamic stretching and warm-ups for athletes before activity.

-Chronic and progressive neuromuscular imbalances leading to structural weakness and/or damage of stabilizing muscles, tendons and/or ligaments.

Conclusion

While this is a small summary review of the research performed on contributing risk factors affecting ncACL injuries, it helps illustrate that there are many different angles in which researchers can, and may have to continue research in order to better understand and improve early detection and prevention of ncACL injuries in athletes. As we continue research on ncACL contributing risk factors, most experts conclude that no single factor leads to non-contact ACL injuries [12,22,23] and it can vary per athlete.

For effective risk assessment, prevention and rehabilitation of athletes with ACL injuries, all factors must be considered. To improve early detection and prevention of ncACL injuries, further researcher is needed in the area of connective tissue and neuromuscular imbalances as a potential progressive contributing risk factor for arthrokinetic dysfunction executed by athletes during vigorous activity.

Acknowledgements

I agree with Ekegren and Miller, that to prevent and/or reduce the number of ncACL injuries, trainers, coaches and clinicians should perform observation risk screenings [11]. Currently, observational risk screening is the most practical and cost-effective method of screening for ncACL injuries [11]. Recognizing the connective tissue, muscular and neuromuscular imbalances as a "potential progressive contributing risk factor to ncACL injuries in athletes during vigorous activity" I recommend frequent observational risk screenings of athletes throughout their season beyond an initial assessment for effective results in early detection and/or prevention of ncACl injuries.

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