

[Guest Editorial]

Overuse Noncontact ACL Injury in Young Athletes: Since We Can't Completely Fix It, Why Not Prevent It?

The youth and adolescent athletes of today experience seemingly endless seasons, with minimal recovery, poor nutrition, and high volume performance and skill training that does not consider the need for ligament healing homeostasis.¹⁶ In the Bob Marley song “I Shot the Sheriff,”¹⁰ the lyrics state that “reflexes got the better of me and what is to be must be, every day the bucket goes into the well, one day the bottom drops out.” In many youth and adolescent athletes, these reflexes represent regular musculoskeletal and cardiopulmonary system or skill training, with little or no consideration for total volume, intensity, or duration. The bottom of the bucket represents the anterior cruciate ligament (ACL), a tissue with a slower extracellular matrix (ECM) and entheses healing rate. The obsessive sport passion that many youth and adolescent athletes possess negates the likelihood of any voluntary training modifications or competition scheduling in favor of the recovery needed to avoid overuse.¹⁵

Being largely “driven” by self-identity and self-esteem from sport participation, youth and adolescent athletes may be uniquely vulnerable to the high training and competition volume that results in overuse injury.^{4,6,9} Personal identity develops during late adolescence (16-19 years of age) as athletes explore new activities. When the youth or adolescent athlete places excessive time and energy solely on sports, they tend to not engage in other exploratory behaviors. This hinders self-identity development, leading to “identity foreclosure.”³ When self-identity or self-esteem is obtained from this single source, other essential attributes that characterize adulthood may not be adequately developed.¹⁵ Multiple self-identity or self-esteem sources are more likely to create and support long-term psychological and physical health into adulthood. Within this scenario, focused attention solely on high volume skill or performance training and competition may get the better of the capacity of the ACL ECM to heal, replacing natural recovery homeostasis with progressive collagen fiber and crosslink degradation, leading to the ligament histopathology that precedes sudden noncontact fatigue rupture.^{8,24} For any

athlete who has ever experienced this, it remains a memorable event for the rest of their life and often is later recalled as the initial marker that led to the need for more knee surgery.

Adolescence is a robust time for growth of multiple bodily systems.¹⁵ In addition to musculoskeletal concerns, rehabilitation clinicians who work with this population need to remember that physical changes in puberty generally occur during early (10-13 years) and mid- (14-16 years) adolescence.³ The changes associated with late adolescence (16-19 years), however, are dominated by dramatic cognitive, psychosocial, and behavioral development.^{3,12} These include structural brain development and cognition changes across all phases of adolescence lasting up until the third decade of life.¹² In today's society, concerns related to high total volume sports training spans all of adolescence. Solely focusing on sport skill or performance training to the point of ACL ECM overuse likely occurs in association with the underuse of other developing systems that are needed to become a healthy adult. Youth and adolescent athletes are early in the process of learning to reason. This creates a somewhat troubling combination when they are left to their own beliefs in determining how much training or competition might be too much.

After a noncontact ACL injury, youth and adolescent athletes who undergo surgery and rehabilitation want to return to their premorbid performance level as quickly as possible, with no long-term concerns. However, given that they are in the process of ongoing growth of multiple bodily systems, they possess no valid reference point from which to judge their true recovery status. Formal analysis, decision-making, and judgment are not the requisite strengths of the youth and adolescent athlete, particularly when it comes to the thought of modifying or decreasing participation in their primary source of self-identity and self-esteem.

Parents today also have the challenge of managing this dilemma and, in my opinion, are too often satisfied with having a pleased youth or adolescent athlete who does not complain. In my experience, many parents attempt to live vicariously

through their child's athletic interests to the extent of serving more as a cheerleading big brother, big sister, or a friend. When they do this, they are also displaying poor reasoning. In this age of early sport specialization and, more troubling, early professionalism or elite-like training,^{13,15} it is essential that parents and other essential stakeholders, such as coaches, healthcare providers, and event organizers serve as voices of reason and guidance. No matter how dedicated they are to their players and the team, coaches need to understand that in playing to win, they possess an inherent conflict of interest regarding youth or adolescent athlete playing status. I advise many parents or guardians that if their youth or adolescent athlete is not upset with them at least 50% of the time then they are not doing their job. Saying "no" seems to be a lost art.

Sometime between adolescence and about 25 years of age, athlete expectations change and the process of athletic foreclosure begins.^{3,9,23} At this time, the passion associated with sports play decreases somewhat, as athletes change their quality-of-life perceptions, gradually assuming some of the responsibilities of early adulthood.⁵ Therefore, if noncontact, overuse-related ACL injury could be better prevented between early adolescence and approximately 25 years of age, the chance that they will sustain one thereafter decreases substantially.²³ By young adulthood, healthy adolescents have normally developed multifaceted and complex self-identities; however, when they define their identity solely as an athlete, this process becomes constrained.¹¹ Adolescent athletes with more complex self-identities are better prepared to mediate current and future life successes and failures as well as sport stresses.¹¹

Although sport participation can be an important self-identity and self-esteem building source, sole identification as an athlete can also be a problem when the athletic "experience" is delayed abruptly or ended due to injury.¹⁹ After injury, the dynamic nature of the self in the context of sport identity represents a complex process involving personal, situational, cognitive, behavioral, emotional, and recovery outcome variables.^{5,22} Identity foreclosure generally happens during late adolescence with a broader range of academic, social, cognitive, motivational, or emotional affective factors.³ This athletic identity divestment naturally occurs to help the adolescent maintain a positive self-concept.² Devaluing the athletic identity increases the likelihood that the threat of reduced performance from knee injury is no longer as important to how the individual defines themselves.² To ease the transition from competitive sports and minimize the likelihood of identity-related adjustment difficulties, Lally⁹ reported that many college athletes reduced athletic identity influence proactively. Brewer et al² reported that, by 2-years post-ACL reconstruction, patients gradually decreased athlete role identification. Interestingly, the greatest decrease occurred between 6 and 12 months postsurgery, which is often the key return-to-sport decision-making rehabilitation phase.²

Whether the injured ACL is reconstructed or repaired, neither option is truly "anatomical." The medical literature is replete

with long-term issues after ACL surgery related to decreased performance, the need for revision surgery, and a greater contralateral knee injury incidence.^{17,18} The healthy ACL and the graft used for its replacement differ greatly. The native ACL is a vital lower extremity sensorimotor circuitry component serving neuromotor activation and joint position sense functions in addition to helping biomechanically constrain excessive knee joint motion.¹⁶ Although we continue to improve our understanding of the importance of ACL graft type, strength, stiffness, placement location, fixation method, and biomechanical attributes, we have not improved the capacity for graft remodeling or ligamentization to progress to anything that remotely matches the holistic functions of the native ACL.^{14,16}

At the instant of a noncontact overuse ACL rupture, everything changes as the youth and adolescent athlete unexpectedly enters a world of new medical, surgical, and rehabilitation terminology and experiences that creates a multitude of questions that they are ill-prepared to answer, including, but not limited to, questions about their pain, fear, or perceived function levels. Based on the premise that current ACL reconstruction or repair methods and rehabilitation are poor substitutes for the native ACL, I present a fundamentally different primary ACL injury prevention viewpoint that could be achieved with well-designed, implemented, and monitored programs.

Associated with a more wellness-based approach is the fact that, from a medical economics standpoint, society cannot continue to subsidize the growing burden of primary and secondary ACL injury, contralateral knee injuries, and associated surgical and rehabilitation treatment. We have much more to learn, but fatigue failure from overuse is likely associated with many noncontact ACL injuries, and this overuse is likely related to the accumulated training volume associated with early professionalism and specialization in youth and adolescent sports that has replaced what used to be called "play."^{8,13,16}

Why not prevent what we can't completely fix? Perhaps in 2023, healthcare providers, coaches, event organizers, parents, and youth and adolescent athletes can resolve to better protect the ACL. Although optimized neuromuscular control and biomechanical alignment during single-leg jump landings decreases ACL injury risk,⁷ from both neuromuscular control and biomechanical alignment perspectives, this may be less effective in the presence of a deteriorated ACL ECM given its less rapid capacity for post-training homeostasis restoration. The ACL ECM histopathology associated with the overuse from seemingly endless practices, skills training, and competitions might likewise impair the essential knee neuromuscular control acuity that drives dynamic knee stability during sports. Perhaps through a well-designed wellness approach, everyone can be better stewards in preventing ACL injury. Through baseball pitch counting, and limiting the number of games played per week, youth baseball has significantly decreased shoulder and elbow injury frequency.²⁰ Consensus group recommendations have also led to slower, more staged recovery after sports concussion injuries, with it being required that any headaches, impaired cognition, blurred vision, light or sound hypersensitivity, or

balance impairments have been ameliorated before returning to sport.²¹ Can lessons learned from other sport injuries help us better prevent overuse noncontact ACL injury risk in youth and adolescent athletes? To have any chance for success, all stakeholders must be invested in this process. By necessity, parents, coaches, athletes, event organizers, and sports healthcare team members must be engaged as collaborative problem solvers. This will decrease the likelihood of sustaining an initial noncontact ACL injury, as well as any other musculoskeletal injuries that may occur as sequelae.

I have always questioned why premier league soccer players only play once a week, while many youth and adolescent athletes play 2 to 3 games a week. If the bucket didn't have to go into the well so often, or if it was seldom completely full when it was raised from the well, it might last longer and be more resistant to fatigue failure. Given the natural capacity for the youth and adolescent athlete to heal and restore ACL ECM healing homeostasis, they might have a greater likelihood of avoiding an overuse related noncontact ACL injury up to that time in their mid-20s when sport expectations change and their risk for sustaining an overuse related noncontact ACL injury from sports decreases dramatically.²³ An added benefit is that if they should sustain a knee injury after this time period, they likely would have better reasoning skills, enabling more insightful long-term health decisions that are less influenced by the obsessive passion of adolescence. This might also improve their quality of life as adults and decrease healthcare system financial burdens.

The exact combination of recovery time, reduced or modified loading, and nutrition that is needed to decrease the potential for sustaining an overuse noncontact ACL injury is not currently known.^{8,16} Taken in the aggregate, however, any combination of increased or enhanced recovery, reduced or modified loading, and improved nutrition has high potential to prevent fatigue failure from overuse-related noncontact ACL injury mechanisms.¹⁶ Let's start these discussions. Current evidence in regard to returning athletes to premorbid performance levels after ACL reconstruction, repair, and rehabilitation have been far from totally successful.¹ By designing, implementing, and monitoring a wellness plan designed to better manage the accumulated loads that occur from high volume sport practice, skill training, and competition, we may be better able to restore the ACL ECM homeostasis of youth and adolescent athletes and decrease their overuse-related, noncontact ACL injury risk.

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