



Letter to the Editor

Kinetic chain disruption contributes to shoulder and elbow injuries

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The kinetic chain or link theory provides the basis for understanding and evaluating human movement patterns as well as the justification for using exercise training and recovery services that emphasise the whole body, despite the damage to a specific joint or anatomical structure. The motion of one segment affects all proximal and distal segments to the first segment. The overhead throwing motion is produced and regulated by a sequential position and motion of the body, involving sequential activation, both in initiation timing and peak activation moving from the lower extremities to the upper limbs. Since the throwing motion is an extremely rapid movement occurring within only 0.145 s, the efficient synchronous sequencing of the body segments is critical for optimising the efficiency of the kinetic chain.

Sciascia et al.¹ indicated that the kinetic chain is affected by multiple factors, including core strength, hip strength and range of motion (ROM), scapular kinematics, shoulder strength and ROM, knee and ankle mobility, and effective kinetic chains, showing reduced joint loads, maximum speed, and maximum force output during throwing. Dysfunction of the kinetic chain during throwing increases stress on the distal parts contributing to pathologies of the shoulder and elbow.

Kinetic chain dysfunction will decrease throwing performance while increasing the injury risk in both the shoulder and elbow.¹ Approximately 50% of the kinetic energy and force of the hip/trunk area contributes to the entire throwing motion. Therefore, force and power production are impaired by altered kinematic in this area, causing increased stress in the distal limb segments.

Robb et al.² found that reduced hip ROM is strongly associated with shoulder injuries and weak throwing mechanics in the dominant hip as compared with the non-dominant hip. Moreover, Kibler et al.³ reported that insufficient hip ROM and poor balance have a major impact on the ability of an athlete to transmit energy through the kinetic chain, contributing to impaired movement and increased stress on the shoulder and elbow. Several studies have found a link between overhead movement injuries and poor lower extremity balance.^{3,4,5,6}

The trunk is the essential structure for giving the upper limbs the force created by the lower limbs. Proper trunk movement during throwing is critical, as this movement is integral to transferring energy to distal body segments during the throwing motion. A 20% reduction in kinetic energy supplied to the arm from the hip and trunk allows a 34%

increase in shoulder rotational velocity to produce the same amount of force on the limb.⁴ Strength and agility deficiencies in these areas have a detrimental effect on shoulder and elbow kinematics that would raise injury risk. In the overhead throwing motion, failure of any links in the kinetic chain has consequences for injury to the shoulder and elbow. Effective interaction of kinetic chain segments is required for optimal efficiency and injury prevention. These circumstances advocate a comprehensive assessment of the overhead throwing motion in an athlete including key tests and measures to evaluate hip and core function. Preventative programming is best designed and implemented as part of the athlete's training programme to optimize the kinetic chain and lower risk of injury and/or re-injury.

Submission statement

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Authors' contributions

All authors listed have made a substantial and intellectual contribution to the work, and approved it for publication.

Conflict of interest

We have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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