Background and purpose

Though times are changing, it still seems that we are behind on understanding the mechanics of the windmill softball pitch from a clinical sports medicine perspective of injury prevention and performance enhancement. Within the sports medicine community, there is considerable interest in youth baseball pitching and injury prevention. Since 1996 Dr. James Andrews and the American Sports Medicine Institute have worked to not only regulate pitch counts in Little League Baseball [1], but also to educate the masses regarding baseball pitching, injury susceptibility, and injury prevention [2-8]. Throughout the years of youth baseball research, a common consensus of risk factors has emerged. One particular modifiable risk factor that is thoroughly recognized within throwing and injury prevention is depicting the body as a kinetic chain and thus kinetic chain efficiency as a means of improving dynamic throwing mechanics [9]. Therefore, in the past 20 years, sports medicine research has been successful in emphasizing kinetic chain efficiency for proper pitching mechanics, as well as implementing organizational sanctions to monitor and limit pitch counts in an attempt to curtail fatigue in youth baseball pitchers.

Often referred to as a scaled-down version of baseball, is the sport of fast-pitch softball. Though the differences between baseball and softball are represented in all positions, the major difference is the pitching style. Due to the repetitive high demand of throwing that occurs within the two sports, injuries are an inherent risk. Copious efforts have researched the pathophysiology and predisposing risk factors for these overuse injuries in baseball, however there are scarce research determining underlying the pathophysiology and risk factors involved in injuries sustained in softball pitchers. Therefore, the purpose this commentary is to discuss how similar baseball and softball pitching can be from an injury prevention approach when examining the two movements as an upper extremity dynamic movement.

The kinetic chain and dynamic upper extremity movement

A biomechanical model for striking and throwing is an open-linked system of segments working in a proximal to distal sequence with the goal to impart high velocity or force on the most distal segment [10]. Therefore, the ultimate velocity of the distal segment is dependent upon the segmental histories of the most proximal segments. Dynamic upper extremity movements such as throwing, and pitching occur as a result of the body working efficiently as a kinetic chain. Efficient utilization of the body as a kinetic chain allows for coordinated segmental sequencing of activation, movement and stability [10,11]. Throwing and pitching are dynamic upper extremity movements that requires the total kinetic chain to sequentially coordinate force development and transfer from the most proximal segments of the lower extremity to the most distal segments of the wrist and hand. Specifically, the kinetic chain must provide proximal stability for distal mobility; maximal force development proximally in the lower extremity and lumbopelvic-hip complex (LPHC) and transfer it through the upper extremity to produce optimal distal mobility. When we consider anticipatory movements, it is the trunk and lower extremity that are initiated prior to the upper extremity dynamic movement [12,13]. Thus, proper utilization of the kinetic chain during dynamic upper extremity movements allows maximal force to be developed in the LPHC which then can efficiently be transferred to the wrist and hand [9,14].

Kinetic chain deficits in dynamic upper movement

Pathologic deficits with the dynamic throwing shoulder are about the lower extremity, LPHC, scapula, and shoulder [15]. In both pitching styles, baseball and softball, the athlete has to maintain trunk control via LPHC stability over the stance leg (throwing side leg) in attempt to control their center of mass as they stride to position their stride foot in line with the target [9,16-18]. The importance of controlling...
one’s center of mass over base of support is an attempt to engage the stride leg in pulling the body forward during the acceleration phase [19]. Additionally, scapular control and mobility is essential to position the humerus for acceleration [20,21]. Both pitch styles utilize the aforementioned concepts with the ultimate goal of producing ball spin and velocity to the desired target.

What is the difference between the two pitch styles?

Traditionally, the baseball pitch is considered overhand or overhead while the softball pitch is underhanded. Within this traditional description one assumes vast differences in the two pitching styles and thus, the common misconception of the underhanded softball pitch producing less stress to the upper extremity when compared to the overhand baseball pitch [22]. Tough it is has been continually reported that the stresses to the upper extremity in softball pitching are similar to that in baseball pitching [17,22-25] the traditional opinion of overhand versus underhand neglects the reality. The reality is that there is a difference in arm slot between the two pitching styles. Within baseball pitching there are three common arm slots: overhand (arm near vertical at approximately (140° from the ground)), sidearm (arm near horizontal (70° to 90° from the ground)) and 3-quarter (approximately halfway between overhand and sidearm (50° to 60° from the ground)); and one additional slot, that is not as common, is submarine (arm is below sidearm similar to 3-quarter (approaching 50° or less from the ground)) [26,27].

Turning away from the traditional rhetoric of the overhead baseball pitch and the underhand softball pitch, let’s consider the two pitching styles as dynamic upper extremity movements that utilize different arm slots. As depicted in Figure 1, the differences in style now becomes a bit blurred. Though there are more options for different arm slots in baseball pitching, the softball pitching arm slot of underhand (arm near vertical (0° to 18° from the ground)) and 3-quarter (approximately halfway between overhand and sidearm (50° to 60° from the ground)); and one additional slot, that is not as common, is submarine (arm is below sidearm similar to 3-quarter (approaching 50° or less from the ground)) [26,27].

Current softball biomechanical data are revealing increasing similarities to the baseball pitch. In an examination of upper extremity pain and pitching mechanics in collegiate softball pitchers, it was found that those with upper extremity pain displayed greater shoulder abduction (arm further away from the body or the vertical) in the acceleration phase; this is similar to what has been found in baseball pitchers. Specifically, a more extended elbow at the beginning of the acceleration phase, during the baseball pitch, is associated with greater ulnar collateral stress [28,29]. Additionally, female softball pitchers with upper extremity pain displayed less trunk lateral flexion to the throwing side than those without pain [17]. Again, these softball findings are similar to what has been reported in the baseball literature regarding the importance of trunk positioning: greater rotation and lateral flexion to the throwing side for the most efficient energy transfer [30,31]. Thus, it was suggested that the pain-free group of softball pitchers transferred energy more efficiently from their lower extremity and LPHC to their upper extremity, due to the greater degree of trunk lateral flexion [17]. These latest data reiterate the further classification of baseball and softball pitching as dynamic upper extremity movements, the similar findings in both upper extremity and trunk kinematics are not surprising. As it is well documented that trunk or LPHC instability affects throwing mechanics, and ideally efficient mechanics requires an athlete to generate the most energy within the lower extremity and LPHC, [32-35] and transfer up through the trunk and on to the hand for ball release [14].

To further expound on the body working as a kinetic chain during dynamic upper extremity movement, we would be remiss not to mention the two studies performed by Barfield et al. [36,37] regarding the utilization of the glove arm in baseball and softball pitching. Previously, it has been documented that the utilization of the glove arm in baseball pitching is associated with trunk positioning during the baseball pitch [38]. Thus, follow up investigation by Barfield et al. reiterated the importance of a more active glove arm in youth baseball pitchers could assist in not only optimal trunk positioning for the most efficient use of energy transfer from the lower extremity but also, decreased throwing arm kinetics [37]. Then to follow-up, and theoretically support the notion of viewing both baseball and softball as dynamic upper extremity movements with different arm slots, Barfield and colleagues examined the influence of an active glove arm in softball pitching and the association with segmental sequencing of the pelvis and trunk as well as pitching arm kinetics [36]. Similar to the association of an active glove arm in baseball pitching, an active glove arm in softball pitching was also predictive of a more efficient kinetic chain during the softball pitching motion [36,37].

Discussion

Though the traditional rhetoric of the comparison of baseball and softball pitching is to classify baseball as overhand and softball as underhand, conventional wisdom encourages us to elucidate that both baseball and softball pitching are dynamic upper extremity movements. Both pitching styles are considered throwing and thus throwing is an open-linked system of segments working in a proximal to distal sequence with the goal to impart high velocity or force on the most distal segment [10].

Conclusion

Thus, the two pitching styles employ the same theoretical framework of proximal stability for distal mobility with the main difference being the arm slot. As sports medicine professionals, we should embrace the overall fact that throwing is throwing, then hopefully we can step out of hiding behind the unknowns of softball pitching and work for a stronger healthier athlete.

Conflicts of interest

The author has no financial affiliation (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.