Comparison of Kinematics and Kinetics of the Shoulder Between Professional and Little League Baseball Pitchers

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Introduction

Traditionally, the more externally rotated arc of shoulder motion in baseball pitchers has been attributed to soft tissue adaptations that result from stretching of the anterior capsule and glenohumeral ligaments as the upper arm is externally rotated and hyperabducted during the pitch. Recent research suggests retrotorsion of the humerus in the dominant arms of throwers may affect range of motion as well. However, the relationship between pitching biomechanics and development of retrotorsion of the humerus has not been studied. The aims of the current study were to provide a potential mechanism for development of humeral retrotorsion and to compare the torsional forces applied to the humerus in professional and little league baseball pitchers.

Materials and Methods

Two high-speed video cameras were used to videotape 25 professional pitchers and 14 little league pitchers throwing fastballs from front and dominant side views. The locations of 21 body landmarks were digitized manually and the three-dimensional locations of each of the points were calculated. From the three-dimensional coordinates, the kinematics of the pitching elbow and shoulder were calculated throughout the pitching motion. Joint kinetics at the shoulder and elbow were computed using an inverse dynamics approach.

Results

The ranges of motion produced on the shoulder and elbow in little league pitchers during pitching were less than in adult professional pitchers. The

peak internal rotation angular velocity of the shoulder in little league pitchers was more than in adult professional pitchers. For both groups of pitchers, the largest net force acting on the humerus was an axial force causing tension in the humerus. This force was largest in magnitude near the time of ball release when the shoulder internal rotation velocity was near its maximun. The largest net torque about the humerus was a twisting torque about the humeral shaft. These torques were 35.3±6.7 Nm in little league pitchers and 185±34 Nm in adult professional pitchers.

Discussion

Both humeral force and humeral torque were much greater in professional pitchers than in little league pitchers, suggesting size and weight are not the only differences between the groups. The forces and torques acting on the humerus are consistent with the development of retrotorsion of the humeral shaft. Base on the datas from this study, little league pitchers may be susceptible to overuse injuries, such as muscle fatigue, anterior capsular laxity and chronic physeal stress injury. Further research is needed to quantify the amount of humeral toque required to deform the cartilage of the humeral epiphyses in little league pitchers to cause retrotorsion.