
一般 1 「投球フォーム」

2月3日(金) 11:10~11:50
第2会場 (山形テルサ 1F テルサホール)

English & Japanese Oral Session 1 "Throwing form"

Feb. 3rd (Fri) 11:10~11:50
Room 2 (Yamagata Tessa 1F Tessa Hall)

O1-1

小学生野球投手における球速と上下肢身体機能の関係

森本 暢¹、木下 裕矢²、泉 仁¹

¹高知大学医学部整形外科、

²いの町立国民健康保険仁淀病院/仁淀清流苑リハビリテーション科

Impact of upper and lower extremities physical function on pitching speed in young baseball players

Toru Morimoto¹, Hiroya Kinoshita², Masashi Izumi¹

¹Department of Orthopaedic Surgery, Kochi Medical School, Kochi University,

²Department of Rehabilitation, Niyodo Hospital

【目的】投球動作は全身運動であり、下肢、体幹、上肢の運動連鎖により達成される事が知られている。我々は少年野球選手を対象として、上下肢の身体機能が球速に与える影響について検討したので報告する。

【方法】対象は投手経験を有する71名(男子64名、女子7名、年齢9-12歳、身長145.3 ± 8.8cm)とし、TECHNICALPITCH軟式J号球を7球投げてその平均球速を算出した。身体機能として、上肢はアームスピード(PULSE THROW)と握力を、下肢は反復横跳び回数、軸足・ステップ足でのシングルレッグホップ(SLH)を測定し、それぞれと球速との関係を検討した。

【結果】平均球速:80 [75-86] Km/h (中央値 [四分位範囲])、握力:18.4 [16.6-20.9] Kg、アームスピード:912 [852-998] RPM、反復横跳び:45 [41-49] 回、SLH (軸足 / ステップ足): 120 [107-135] / 118 [103-139] cmであった。球速は握力 ($R=0.61, P<0.05$)、反復横跳び回数 ($R=0.43, P<0.05$) 両側のSLH ($R=0.47, P<0.05$ / $R=0.49, P<0.05$) と有意な正の相関を示したが、アームスピードとは相関しなかった。身長を補正した重回帰分析の結果、反復横跳び回数とSLHが有意な説明変数として選択された。

【考察及び結論】学童期の野球選手において、投球パフォーマンスを向上するためには、腕を速く振ることや握力強化よりも、跳躍力や俊敏性といった下肢機能向上が重要であることが示唆された。本研究結果は、現場においてエビデンスに基づいた効果的なトレーニングを構築していく上で有用であると思われる。

一般 1 「投球フォーム」

2月3日(金) 11:10~11:50
第2会場 (山形テルサ 1F テルサホール)

English & Japanese Oral Session 1 "Throwing form"

Feb. 3rd (Fri) 11:10~11:50
Room 2 (Yamagata Terrsa 1F Terrsa Hall)

O1-2

投球障害肘選手における投球動作の運動学的特性

松井 知之¹、瀬尾 和弥²、東 善一¹、宮崎 哲哉¹、松澤 寛大¹、森原 徹¹

¹丸太町リハビリテーションクリニック、²京都府立医科大学附属病院

Kinematic Characteristics of Throwing Motion in Players with Throwing elbow Injury

Tomoyuki Matsui¹, Kazuya Seo², Yoshikazu Azuma¹, Tetsuya Miyazaki¹, Kanta Matsuzawa¹, Toru Morihara¹

¹Marutamachi Rehabilitation Clinic,

²Rehabilitation Unit, Kyoto Prefectural University of Medicine

【はじめに】

不良な投球動作を続けると、肩・肘関節へのストレスが増大し、投球障害につながる恐れがある。不良なフォームの改善は重要であるが、投球障害選手の特徴を示した報告は少ない。

今回われわれは、投球障害肘選手と健常選手との投球動作フォームの違いを検討したので報告する。

【対象・方法】

投球障害肘と診断された高校生投手16例(障害選手)および健常選手15例を対象とした。被検者に3m前方のネットに全力投球を行わせ、10台の赤外線カメラで構成される三次元動作解析装置(VICON MX)を用いて投球動作を計測した。肩関節・下肢・体幹における関節角度(33変数)を算出し、対応のないt検定を用いて投球障害肘選手と健常選手を比較、検討した。

【結果】

障害選手の有意差を認めた角度特徴として、障害選手では、投球動作開始姿勢において、軸脚股・膝関節屈曲、足関節背屈角度が高値であった。並進運動時では、股関節外転角度が低値、ステップ脚股関節では、屈曲・内旋角度が高値であった。フットコンタクト直後に胸郭は前傾していた。MERでは、肩関節外転角度、投球方向への骨盤回旋が低値であった。

【考察】

障害選手では、MER付近で肩関節外転が有意に低下し、その結果肘関節痛を生じていると考えた。MERでの肩関節外転不足になる要因として、投球動作前半における下肢・体幹角度との関連が報告されている。投球障害選手においても同様の結果であり、投球動作の評価ポイントとして考慮する必要があると考えた。

English & Japanese Oral Session 1 "Throwing form"

Feb. 3rd (Fri) 11:10~11:50
Room 2 (Yamagata Tessa 1F Tessa Hall)

O1-3

High School and Professional Pitchers with Decreased Variation in Joint/Segment Velocities Demonstrate Significantly Lower or Equivalent Throwing Arm Kinetics with Preserved Ball Velocity

Carlo Coladonato¹, Joseph E. Manzi², Brittany Dowling³, Matthew Nasra⁴, Bryan Ang⁵, Suleiman Sudah⁶, Michelle Kew⁷, Allen Nicholson⁶, Joshua S. Dines⁷

¹Drexel University School of Medicine, Philadelphia, PA, USA,

²Weill Cornell Medicine, New York, USA,

³Sports Performance Center, Midwest Orthopaedics at Rush, Oak Brook, IL,

⁴Robert Wood Johnson School of Medicine, Rutgers, NJ,

⁵Department of Orthopaedic Surgery, Lenox Hill New York, NY,

⁶Department of Orthopaedic Surgery, Monmouth Medical Center, Monmouth, NJ,

⁷Sports Medicine Institute, Hospital for Special Surgery, New York, NY

Background: Improper sequencing order of maximum joint and segment velocities has been identified as an important predictor for both throwing arm kinetics and ball velocity. High school and professional baseball pitchers with improper pelvis-trunk maximum rotation velocity order were found to have increased shoulder distraction forces. Professional pitchers with proper chronological order of the five joint/segment velocities were noted to have significantly greater ball velocity with no difference in throwing arm kinetics. Mixed cohort evaluations (high school, collegiate, and professionals) noted increased elbow varus torque for pitchers with improper sequence of maximum joint/segment velocities of the distal upper extremity. While these prior studies have noted differences in ball velocity or throwing arm kinetics for pitchers with improper sequence of maximum joint/segment velocities at several playing levels, no study to date has evaluated pitchers with high or low variance in maximum joint/segment velocities or the ability to obtain consistent values across multiple pitches. This consideration of pitcher ability to achieve repeatability among several pitches gives attention to 'within' rather than 'between' pitcher differences alone. Therefore, the purpose of this study was to investigate maximum joint/segment velocities between pitches and the relationship to throwing arm kinetics and ball velocity in high school (HS) and professional (PRO) pitchers.

Methods: HS (n=59) and PRO (n=338) pitchers instructed to throw 8-12 fastball pitches were evaluated with 3D-motion capture (480 Hz); both cohorts evaluated separately. The standard deviation of each of the five joint/segment velocity maxima were calculated per pitcher. Pitchers were classified as 'Overall Low Variance' or 'Overall High Variance'. Kinematic and kinetic parameters were subsequently compared among the subgroups.

Results: No differences in anthropometrics ($p \geq 0.239$), kinematics ($p \geq 0.051$), or throwing arm kinetics ($p \geq 0.094$) were noted between the HS Overall Low Variance group and Overall Hi Variance group (Table 1). For the PRO cohorts, no differences in anthropometrics ($p \geq 0.033$) or ball velocity ($p \geq 0.580$) was noted (Table 2). The Overall Low Variance subgroup had significantly lower shoulder distractive force (111.8 ± 14.1 vs. $119.6 \pm 15.5\%BW$ respectively, $p=0.008$) and elbow anterior force (40.6 ± 5.0 vs. $43.6 \pm 6.2\%BW$ respectively, $p=0.008$) compared to the Overall Hi Variance subgroup. The PRO Overall Low Variance subgroup had significantly lower shoulder distractive force (111.8 ± 14.1 vs. $119.6 \pm 15.5\%BW$ respectively, $p=0.008$) and elbow anterior force (40.6 ± 5.0 vs. $43.6 \pm 6.2\%BW$ respectively, $p=0.008$) compared to the PRO Overall Hi Variance subgroup.

Conclusion: HS and PRO pitchers with low variance for joint/segment velocities tend to achieve significantly lower maximum joint/segment velocities in the subgroup of interest, while preserving ball velocity. PRO pitchers with overall low variance among multiple maximum joint/segment velocities demonstrated decreased shoulder distractive and elbow anterior force. Pitchers with repeatability in maximum joint/segment velocities may be viewed as kinetically conservative throwers. These pitchers with similarly maintained mechanics between pitches may have an increasingly regimented form that preserves kinetic forces about the throwing arm, placing them at a theoretically decreased risk of injury.

English & Japanese Oral Session 1 "Throwing form"

Feb. 3rd (Fri) 11:10~11:50
Room 2 (Yamagata Tessa 1F Tessa Hall)

O1-4

A Comprehensive Analysis of Summative Maximum Joint/Segmental Velocity Relationships with Throwing Arm Kinetics and Ball Velocity in High School Pitchers

Carlo Coladonato¹, Joseph E. Manzi², Brittany Dowling³, Matthew Nasra⁴, Jay Moran⁵, Bryan Ang⁶, Suleiman Sudah⁷, Allen Nicholson⁷, James B. Carr⁸, Joshua S. Dines⁹

¹Drexel University School of Medicine, Philadelphia, PA, USA,

²Weill Cornell Medicine, New York, USA,

³Sports Performance Center, Midwest Orthopaedics at Rush, Oak Brook, IL,

⁴Robert Wood Johnson School of Medicine, Rutgers, NJ,

⁵Yale University School of Medicine, Stanford, CO,

⁶Department of Orthopaedic Surgery, Lenox Hill New York, NY,

⁷Department of Orthopaedic Surgery, Monmouth Medical Center, Monmouth, NJ,

⁸Sports Medicine Institute Hospital for Special Surgery Florida, West Palm Beach, FL,

⁹Sports Medicine Institute, Hospital for Special Surgery, New York, NY

Background: Individual maximum segmental/joint velocities (ie. pelvis rotation, trunk rotation, shoulder internal rotation, etc.) have shown positive associations with throwing arm kinetics and ball velocity in baseball pitchers. While these studies have noted faster ball velocity and/or throwing arm kinetics for pitchers with individual increases in maximum joint/segmental velocities, no study to date has evaluated pitchers with high or low maxima among multiple joint/segmental velocities. This consideration of the entirety of the kinetic chain, summing several joint and segmental velocities, may better elucidate how the combination of these factors may influence ball velocity and throwing arm kinetics, as a surrogate of injury risk. Therefore, the purpose of this study was to observe how summative maximum joint/segmental velocities may impact ball velocity and throwing arm kinetics in high school pitchers.

Methods: High school (n=59) pitchers threw 8-12 fastball pitches while evaluated with 3D-motion capture (480 Hz). The maxima of each of the five joint/segmental velocities were calculated per pitcher. Pitchers were classified as 'Overall Fast Joint/Seg Velocity' or 'Overall Slow Joint/Seg Velocity'. Kinematic and kinetic parameters were subsequently compared among the groups with post-hoc regressions and multi-variable regression models created to predict throwing arm kinetics and ball velocity, respectively.

Results: Pitchers with Overall Fast Joint/Seg Velocity were older (16.9 ± 1.4 vs. 15.4 ± 0.9 yrs. respectively, $p=0.007$), achieved faster ball velocity (32.7 ± 3.1 vs. 28.7 ± 2.3 m/s respectively, $p=0.002$), and had significantly higher shoulder internal rotation torque (4.7 ± 0.6 vs. $3.7 \pm 0.8\%$ BWxBH respectively, $p=0.003$), elbow varus torque (61.8 ± 16.4 vs. $41.6 \pm 11.4\%$ BWxBH respectively, $p=0.001$), and elbow flexion torque (3.5 ± 0.4 vs. $2.5 \pm 0.5\%$ BWxBH respectively, $p<0.001$) compared to the Overall Slow Joint/Seg Velocity group (Table 1). For every 1 standard deviation increase in maximum pelvis rotational angular velocity (86.7° /s), normalized elbow distractive force increased by 4.7% Body Weight (BW) (B: 0.054, β : 0.290 p : 0.013). A multi-regression model for ball velocity based on maximum joint/segmental velocities predicted 20.3% of variance.

Conclusion: High school pitchers with increasing summative maximum joint/segmental velocities (ie. lead knee extension, pelvis rotational angular velocity) demonstrated faster ball velocity at the cost of increased throwing shoulder and elbow kinetics. Pitchers and coaching staff should consider this trade-off between faster ball velocity and increased throwing arm kinetics with increasing, summative joint/segmental velocities. In particular, increased elbow varus torque, an established risk factor for elbow injury.