torso and shoulder angles and shoulder internal rotation (IR) and elbow varus moments were calculated. Based on the wrist height relative to the shoulder at SFC, participants were categorized into high (>5cm above shoulder), level (within 5cm of shoulder height), and low (>5cm below shoulder) wrist groups. One-way ANOVA and a Bonferroni post-hoc test was used to compare the upper torso and shoulder angles at specific timepoints and peak joint moments between groups. Statistical parametric mapping (SPM) was used to compare shoulder external rotation and upper torso rotation angles between the low and high wrist groups.
RESULTS: The high wrist group exhibited higher shoulder IR (p=.039) and elbow varus (p=.024) moments compared to the low wrist group. The SPM showed a significant difference between the two groups in both joint angles (p=<.001 and p=.0018) for the first 70% of the pitching motion (**Figure 1**).
CONCLUSION: High wrist position at SFC was associated with earlier trunk and shoulder rotation, which may have resulted in higher joint moments. Coaching young pitchers to keep the wrist below the shoulder at SFC could be beneficial for reducing the high joint moments placed on the throwing arm.
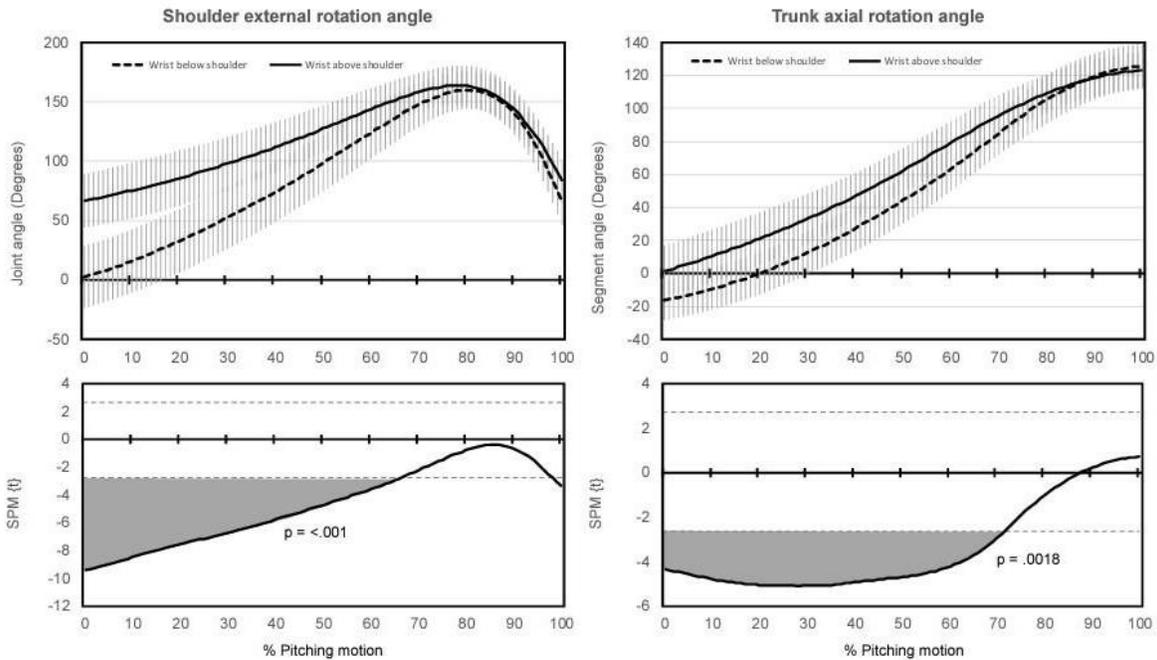
Figure 1. SPM analysis comparing shoulder external rotation and trunk axial rotation angles between pitchers who had the wrist below vs. above the shoulder at stride foot contact. The shaded areas in the figures indicate the % in pitching motion where the shoulder external rotation and trunk axial rotation angles were significantly different between groups.

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Fastball Velocity In Professional Baseball: Relationships With Trunk Rotation, D2 Flexion, And D2 Extension

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In Major League Baseball (MLB), fastball velocity is increasingly emphasized as a component of pitching success. Effective training programs should incorporate exercises that influence velocity.
PURPOSE: To evaluate the effects of trunk rotation and D2 flexion and extension on fastball velocity in MLB pitchers.
METHODS: We enrolled 28 MLB pitchers to perform a standardized test on a Proteus Motion device (Proteus Motion, USA). Testing consisted of 5 repetitions on the following exercises: straight arm trunk rotation in the dominant throwing direction (12 lb), D2 flexion (shoulder flexion, abduction, and external rotation) on the dominant arm (6 lb), and D2 extension (shoulder extension, adduction, and internal rotation) on the dominant arm (6 lb). Averages of peak power in watts (W) and peak acceleration in m/s^2 were recorded across the 5 repetitions. Simple linear regression models tested the effect of power and acceleration in each exercise on subsequent in-game fastball velocity from official MLB reports.
RESULTS: Subjects were 29.5 ± 4.1 years of age with a height of 192.0 ± 6.0 cm and weight of 96.7 ± 9.2 kg. Their MLB careers spanned 4.1 ± 3.1 seasons at the time of testing. Proteus performances were: trunk rotational power (294.8 ± 50.3 W) and acceleration (15.1 ± 3.5 m/s^2), D2 flexion power (117.5 ± 18.8 W) and acceleration (10.2 ± 3.5 m/s^2), and D2 extension power (103.3 ± 15.2 W) and acceleration (7.1 ± 2.4 m/s^2). Fastball velocity was 92.6 ± 2.6 mph. Significant predictors of velocity were trunk rotational acceleration ($r^2=0.176$; $\beta=0.307$; p=0.026; 95% CI: 0.039, 0.576), D2 flexion power ($r^2=0.170$; $\beta=0.057$; p=0.029; 95% CI: 0.006, 0.107), D2 extension power ($r^2=0.387$; $\beta=0.106$; p<0.001; 95% CI: 0.052, 0.159), and D2 extension acceleration ($r^2=0.350$; $\beta=0.649$; p<0.001; 95% CI: 0.293, 1.005). Non-significant predictors were trunk rotational power (p=0.155) and D2 flexion acceleration (p=0.134).

CONCLUSION: Among the exercises tested, dominant arm D2 extension was the most robust predictor of fastball velocity. Athletes and coaching personnel may consider incorporation of this exercise into conditioning programs aimed at increasing fastball velocity.

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Pitching Kinematics But Not Countermovement Jump Kinetics Increase With Fall Practice Phases In Collegiate Baseball

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Assessment of sports performance is commonly relegated to off field evaluations due to the impractical nature of biomechanical analysis. With advances in markerless motion capture, previously immeasurable hypotheses can now be examined, such as whether variations in practice phase impact off-field testing or pitching mechanics.
PURPOSE: This study assessed lower extremity (LE) and center of mass (COM) pitching kinematics and countermovement jump (CMJ) kinetics during the Fall baseball season. We hypothesized that practice phase would affect LE and COM pitching kinematics and CMJ kinetics.
METHODS: 18 collegiate pitchers (RH/LH: 15/3; Mass: 92.01 ± 1.90 kg; Height: 1.90 ± 0.06 m; Pitch Speed: 39.62 ± 1.42 m/s), participated in the Fall season, divided into bullpen (BP), where only the pitcher and catcher occupied the field of play and simulated game (SG) phases with batters present. Kinematics were derived from tracked key points using an 8-camera markerless motion capture system (300 Hz), specialized for pitching analysis. In parallel, CMJ kinetics were collected during training sessions using a wireless dual force platform system (1000 Hz). Paired t-tests were used to compare practice phases to pitching kinematics, and CMJ kinetics.
RESULTS: Max stride phase COM velocity (to home plate) (MD±SE [CI95]: 8.73 ± 1.92 [4.58, 12.87] cm/s, p < .001, Cohen's d: 1.216), post stride foot contact COM velocity (away from home plate) (MD±SE [CI95]: 7.99 ± 2.60 [2.10, 13.88] cm/s, p < .001, Cohen's d: 0.970), stride length (MD±SE [CI95]: 0.98 ± 0.28 [0.39, 1.57] % height, p = .004, Cohen's d: 0.760), max pelvis rotation velocity (MD±SE [CI95]: 15.99 ± 15.75 [-34.15, 66.14] degrees/sec, p = .046, Cohen's d: 0.508), and pitch speed (MD±SE [CI95]: 0.91 ± 0.48 [2.09, 10.33] m/s, p < .001, Cohen's d: 1.910) were greater during SG compared to BP. Average vertical concentric force (MD±SE [CI95]: -25.96 ± 11.13 [-49.18, -2.73] N, p = .045, Cohen's d: -0.509) decreased during SG compared to BP, without differences in eccentric rate of force development (p=.79), or vertical concentric impulse (p=.30).
CONCLUSIONS: Progression in practice phases drives increases in pitching kinematics without differences in CMJ kinetics, highlighting the practice setting as a modifiable variable in player development and rehabilitation programs.

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The Relationship Between Unilateral Press Performance And Fastball Velocity In Major League Baseball Pitchers

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Fastball velocity (FV) is a primary determinant of success in Major League Baseball (MLB) pitching. Understanding which exercise motions predict higher velocity can aid in the optimization of training programs.
PURPOSE: To evaluate the relationships between FV and power and acceleration in unilateral pressing motions.
METHODS: We tested 28 professional MLB pitchers using a Proteus device (Proteus Motion, USA). Each pitcher performed 5 repetitions of unilateral horizontal press (12lb) with dominant and non-dominant arms and shot put (18lb) on the dominant arm with and without a countermovement loading phase. Peak power (W) and peak acceleration (m/s^2) achieved during each repetition were recorded. Average peak values across the 5 repetitions served as predictors in simple linear regression models. The dependent variable was official MLB reports of subsequent in-game FV.
RESULTS: Player age was 29.5 ± 4.1 yr, height was 192.0 ± 6.0 cm, weight was 96.7 ± 9.2 kg, and they had played 4.1 ± 3.1 seasons in the MLB. Shot put power was 401.9 ± 43.4 W and acceleration was 13.7 ± 2.9 m/s^2. Including countermovement loading, shot put power was 417.6 ± 53.4 W and acceleration was 14.5 ± 4.3 m/s^2. Horizontal press power was 209.7 ± 26.4 W for the dominant arm and 201.8 ± 19.6 W for non-dominant. Acceleration was 19.5 ± 7.0 m/s^2 for the dominant arm and 18.3 ± 5.0 m/s^2 for non-dominant. FV was 92.6 ± 2.6 mph and was related to age (β=-0.303; p=0.010) and number of seasons played (β=-0.456; p=0.002). Simple linear regressions found FV to be predicted by shot put acceleration (r^2=0.147; β=0.343; p=0.044; 95% CI: 0.010, 0.677), shot put countermovement power (r^2=0.182; β=0.021; p=0.023; 95% CI: 0.003, 0.038), shot put countermovement acceleration (r^2=0.229; β=0.288; p=0.010; 95% CI: 0.075, 0.501), dominant horizontal press acceleration (r^2=0.242; β=0.182; p=0.008; 95% CI: 0.052, 0.312), and non-dominant horizontal press acceleration (r^2=0.139; β=0.190; p=0.051; 95% CI: -0.001, 0.381). Non-significant predictors were shot put power (p=0.113) and horizontal press power in the dominant (p=0.134) and non-dominant (p=0.908) arms.
CONCLUSION: Acceleration predicted FV better than power in the exercises tested. Velocity may be improved by conditioning programs that emphasize acceleration in unilateral press motions.

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Lower Body Lean Mass Asymmetry Is Not Associated With Performance Asymmetries In Collegiate Baseball Players

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