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Key Findings

1 There was a significant difference in hip ROM between hand positions, with the akimbo hand position producing the greatest ROM as a result of increased peak hip flexion.

2 Hand position during CMJ task appears to influence trunk and lower joint kinematics as shown by significant differences in peak hip flexion and time of peak trunk flexion.

3 When using the CMJ as an assessment tool, both researchers and practitioners should consider the influence of hand position on the execution of the jumping task.

BACKGROUND & PURPOSE

Countermovement Jump (CMJ) testing is commonly used in athletics to assess and monitor athletes. Two common CMJ protocols exist to remove the influence of arm swing: placing the hands on the hips (akimbo) or utilizing a dowel across the upper back. Thus, this investigation aimed to examine the differences in joint kinematics between the two CMJ testing protocols using markerless motion capture.

METHODS

Participants

10 recreationally trained participants (M= 5, F= 5) participated in this pilot investigation (age = 23.5 ± 4.9 years, height = 173.7 ± 9.4 cm, body mass = 79.4 ± 17.9 kg).

Experimental Procedures

All data was collected during a single session. Prior to testing, each participant completed a standard dynamic warmup, including submaximal vertical jumps. Participants completed five CMJs in each condition with their hands either akimbo or holding a dowel across the upper back. Markerless motion capture data was collected at 80 Hz (Qualisys, Sweden). 3D human pose estimation was generated using a markerless motion capture video data software (Theia Markerless Inc., Kingston, ON, Canada).

Data and Statistical Analysis

All data was low pass filtered at 6 Hz. 4x4 Pose matrices of each body segment were exported and analyzed in Visual3D (Version 6, C-Motion, Inc., Germantown, MD, USA) to calculate trunk position and hip and knee kinematics. All data was time-normalized to 101 data points from the point of movement initiation to takeoff. Range of motion (ROM), peak flexion angle, time of peak flexion angle, and joint angle at take-off was calculated for the trunk, hip, and knee. Comparisons across CMJ protocol conditions were assessed using a paired samples t-test. An a priori alpha level of 0.05 was used to determine statistical significance. Hedges g effect sizes were calculated for each metric. In addition, mean differences between the two conditions were calculated.

RESULTS

Table 1: Comparison of Joint Kinematics Based on Hand Position

	Dowel	Akimbo	p	g (95% CI)
Trunk ROM (°)	24.43 ± 11.14	21.43 ± 8.27	0.140	0.47 (-0.15 – 1.06)
Hip ROM (°)	72.96 ± 11.27	75.34 ± 10.47	0.011	-0.92 (-1.60 – -0.20)
Knee ROM (°)	87.84 ± 10.26	89.82 ± 9.10	0.155	-0.45 (-1.04 – 0.02)
Peak Trunk Flexion (°)	21.26 ± 12.97	19.49 ± 10.58	0.447	0.23 (-0.35 – 0.80)
Peak Hip Flexion (°)	77.21 ± 10.82	79.72 ± 11.32	0.009	-0.97 (-1.67 – -0.23)
Peak Knee Flexion (°)	-90.89 ± 8.15	-92.58 ± 6.36	0.216	0.39 (-0.22 – 0.97)
Time of Peak Trunk Flexion (%)	65.20 ± 6.39	62.90 ± 6.79	0.037	0.71 (0.04 – 1.34)
Time of Peak Hip Flexion (%)	68.00 ± 2.58	67.90 ± 1.97	0.882	0.44 (-0.52 – 0.61)
Time of Peak Knee Flexion (%)	70.40 ± 2.80	70.00 ± 2.45	0.591	0.16 (-0.41 – 0.73)
Joint Angle at Takeoff – Trunk (°)	2.90 ± 6.05	1.83 ± 4.88	0.276	0.34 (0.26 – 0.91)
Joint Angle at Takeoff – Hips (°)	20.65 ± 5.47	19.63 ± 5.45	0.118	0.50 (-0.12 – 1.10)
Joint Angle at Takeoff - Knees (°)	-23.67 ± 6.74	-22.20 ± 6.48	0.132	-0.48 (-1.07 – 0.14)

Bold = Significantly Different at p < 0.05 level

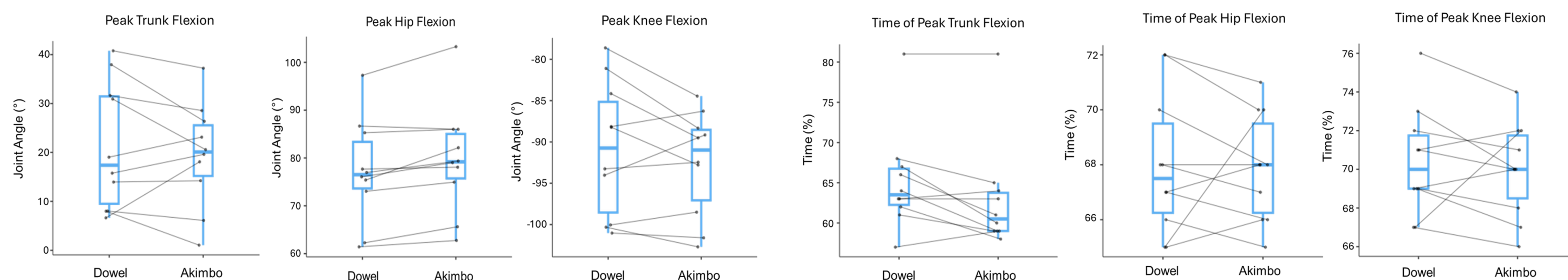


Fig 2. Peak flexion angle comparison of arms akimbo vs fixed using a dowel

Fig 3. Time at peak flexion angle comparisons of arms akimbo vs fixed using a dowel

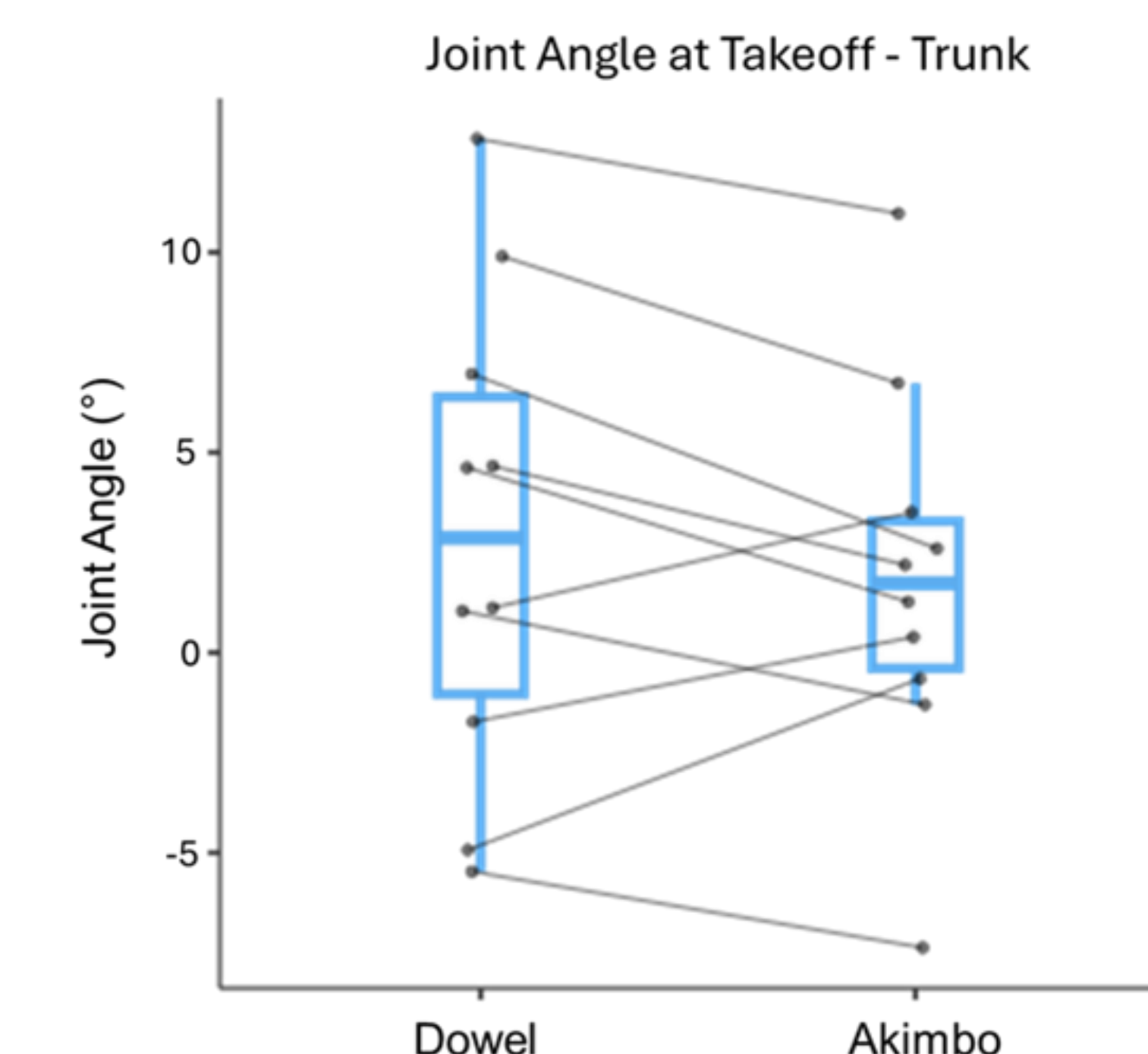


Fig 1. Joint angle at Takeoff comparisons of arms akimbo vs fixed using a dowel

CONCLUSIONS & PRACTICAL APPLICATIONS

Placing the hands on the hips during CMJ task produced greater ROM at the hip joint and subsequently greater peak hip flexion. In addition, the hands on the hips CMJ condition experienced a shorter time of peak trunk flexion, indicating that performing a CMJ with the hands on the hips potentially influences athletes to keep a more upright torso during the CMJ task. **PRACTICAL APPLICATIONS:** The influence of CMJ protocol on joint kinematics should be considered by practitioners when selecting a protocol for hand placement during CMJ testing. Given the differences in hip joint ROM, peak hip flexion angle, and time of peak trunk flexion angle between the two protocols, practitioners should select a CMJ testing protocol that best fits the specificity of their sport as it applies to the execution of the CMJ. Further investigations into the influence of CMJ protocols on outcome metrics commonly used to assess performance is warranted.