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和文抄録
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# 漸増強度投球プログラムが肩・肘関節の状態および投球パフォーマンスに及ぼす影響

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【目的】
投球時の姿勢と距離の組み合わせによるエルボートルクの相違を明らかにし、それに基づいて投球強度が段階的に高くなるように調整された投球プログラムが肩・肘関節機能や投球パフォーマンスに与える影響を明らかにすること。

【方法】
本学硬式野球部投手を対象に、両膝立ち・片膝立ち・正面立ち・横立ちの姿勢で10m、20mの距離の投球を行わせ、エルボートルク、アームスロット、アームスピード、球速を測定した。次に得られた結果を基に作成した60球の投球プログラムと普段の投球フォームによる投球をそれぞれ実施し、その後ブルペンにて投球パフォーマンスを測定した。投球前・投球後および全力投球後に肩関節内旋外旋・肘関節屈曲伸展・前腕回内回外可動域、肩関節内旋外旋筋筋力、腕尺関節裂隙距離、主観的感覚を測定した。

【結果】
姿勢と距離の組み合わせによりエルボートルクに差がみられ、横立ちかつ20mで最も高く、両膝立ちかつ10mで最も低値を示した（横立ち20m：34.5±10.3Nm、両膝立ち10m：18.4±5.8Nm, $p<0.05$）。肩関節内旋可動域は普段の投球のみで全力投球後に低下がみられた（投球前：69.20±5.64°、全力投球後：64.00±4.00°, $p<0.05$）。投球パフォーマンスの球速、回転効率、縦横の変化量は投球プログラムで普段の投球と比べ高値を示した（$p<0.05$）。

【結論】
姿勢と距離の組み合わせにより投球強度が差別化でき、横立ちの姿勢で距離が20mとの時にエルボートルクが最も高かった。また、姿勢と距離の組み合わせによる個別化された投球プログラムの方が普段の投球と比べ、全力投球後の肩関節内旋可動域の減少が抑えられ、投球パフォーマンスにおいては球速や回転効率が高く、ボールの変化量も大きかった.

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# Effects of a progressive intensity throwing program on shoulder and elbow joint condition and pitching performance

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[Purpose]
This study was designed to clarify differences in elbow torque according to combinations of throwing posture and distance, and to assess effects of a throwing program adjusted for progressively increased throwing intensity based on differences of shoulder and elbow joint function and pitching performance.

[Methods]
Collegiate baseball pitchers from a university team performed throws at 10 m and 20 m distances using four postures: double-kneeling, single-kneeling, square standing, and open standing. Elbow torque, arm slot, arm speed, and ball velocity were measured. Based on findings from these throws, a 60-throw throwing program was developed. Participants performed both the throwing program and their usual throwing motion. Pitching performance was then evaluated in a bullpen setting for the following: shoulder internal and external rotation; elbow flexion and extension; forearm pronation and supination ranges of motion; shoulder internal and external rotation strength; and ulnohumeral joint space. Furthermore, subjective sensations were assessed before throwing, after throwing, and after maximal-effort throwing.

[Results]
Significant differences in elbow torque were found among combinations of posture and distance: the highest values in the open-standing 20 m condition and the lowest values in the double-kneeling 10 m condition (20 m open standing, 34.5 ± 10.3 Nm; 10 m double-kneeling, 18.4 ± 5.8 Nm; $p < 0.05$). Shoulder internal rotation range of motion was significantly lower after maximal-effort throwing only in the usual throwing condition (69.20 ± 5.64° before throwing, 64.00 ± 4.00° after maximal-effort throwing; $p < 0.05$). The values of pitching performance variables, including ball velocity, spin efficiency, and vertical and horizontal movement, were significantly greater during the throwing program than during usual throwing ($p < 0.05$).

[Conclusion]
Throwing intensities differed according to combinations of posture and distance. The highest elbow torque was achieved when throwing from a lateral-stance posture at 20 m distance. Furthermore, compared with habitual throwing, the individualized throwing program based on posture–distance combinations was associated with a smaller decrease in shoulder internal-rotation range of motion after maximal-effort throwing and with greater ball velocity, spin efficiency, and vertical and horizontal movement in throwing performance.