LATERAL TRUNK TILT INFLUENCES THE OPTIMAL SHOULDER ABDUCTION DURING BASEBALL PITCHING.

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INTRODUCTION

A previous study demonstrated that shoulder abduction angles for the professional baseball pitchers were well consistent with the angles calculated with the minimal square-torque for the throwing arm (Matsuo et al.; 2002). The angle was, therefore, regarded as a kind of optimal angle. The purpose of this study was to investigate whether trunk tilt angle influences the optimal shoulder abduction, in the intra-subject point of view.

METHODS

Motion data of 7 professional baseball pitchers (Ht 1.86 ± 0.04m, mass 89.8 ± 10.4kg, age 24.4 ± 3.3yrs, ball speed 38.0 ± 1.3m/s) were collected, using four 200Hz infrared cameras at American Sports Medicine Institute. The motion data from 0.1s before lead foot contact to 0.1s after ball release were used in the following simulation

By rotating a trunk axis (Xt in Figure 1; sagittal direction) and an upper arm axis (Xu in Figure 1; sagittal direction) for the actual pitching motion, the simulated motions with various lateral trunk tilt angles and various shoulder abduction angles were generated. The target angles for the lateral trunk tilt were –20, -10, 0, 10, 20, 30, 40° (0° means Yt = Yp and negatives mean ipsilateral bending) and those for the shoulder abduction angles were 70, 80, 90, 100, 110, 120°. Forty-two motions (7 X 6) were, therefore, generated for each subject.

![Figure 1](image)

Figure 1: The global and the local reference frames.

Using inverse dynamics with inertia parameters by Plagenhoef, the squared values of both the resultant shoulder torque and the elbow torque were calculated and integrated over the time, then normalized by that of the actual motion.

RESULTS AND DISCUSSION

Although the minimal square-torque was found in the combination of 30° of lateral trunk tilt and 100° of shoulder abduction for the mean, optimal combinations were different among the participants (Figure 2). However, the following results were commonly found: 1) the actual trunk tilt and the actual shoulder abduction angles were very closed to the angles showing the minimal square-torque, 2) the movements with the ipsilateral trunk tilt (IPSI) were required the greater square-torque than those with contralateral trunk tilt (CONT), 3) for IPSI, the greater shoulder abduction led the smaller square-torque 4) for IPSI, the square-torque was influenced by the lateral trunk tilt more than the shoulder abduction, 5) for CONT, the minimal square-torques were found around 100° of the shoulder abduction.

![Figure 2](image)

Figure 2: Two examples of the time-integrated squared torque of the throwing arm. The values were normalized with that of the actual motion.

The result of 1) was consistent with the previous study by Matsuo et al (2002). However, the result of 3) was not consistent with it which reported that the underhand baseball pitchers showed the optimal shoulder abduction angle at the lower angle, such as 70°. It was suggested, in this study, that the lower optimal shoulder abduction angle for the underhand pitchers were not due to at least the ipsilateral trunk tilt, although the lateral trunk tilt clearly influenced the optimal shoulder abduction angle during pitching.

REFERENCES