

# Effects of Upper Extremity Pain History on Softball Pitching Mechanics of the Screwball

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Approximately 370 overuse injuries were reported in collegiate and high school fast-pitch softball players from 2004-2009 [1]. However, there are few data on softball pitching injury rates and their etiologies. Investigating pain history in softball pitchers could divulge information about injury-susceptible pitching mechanics. The purpose of this study was to compare pitching mechanics in collegiate softball pitchers with a history of upper extremity pain (UEP) to those with no history of UEP. We hypothesized that statistically significant kinematic differences would be found between pain history groups (stride knee flexion and valgus; pelvis rotation, anterior/posterior tilt, and lateral flexion; trunk flexion, rotation, and lateral flexion; shoulder horizontal abduction, elevation, and rotation; and elbow flexion).

Twenty-nine collegiate softball pitchers volunteered for this study. Participants were divided into those with UEP ( $n=7$ ;  $19.7 \pm 1.3$  years;  $177.7 \pm 7.3$  cm;  $77.0 \pm 15.3$  kg) and without UEP ( $n=22$ ;  $19.8 \pm 2.0$  years;  $172.3 \pm 8.4$  cm;  $80.0 \pm 10.1$  kg). Participants were classified as UEP if they sought the medical care of their athletic trainer or team physician within six months prior to the study.

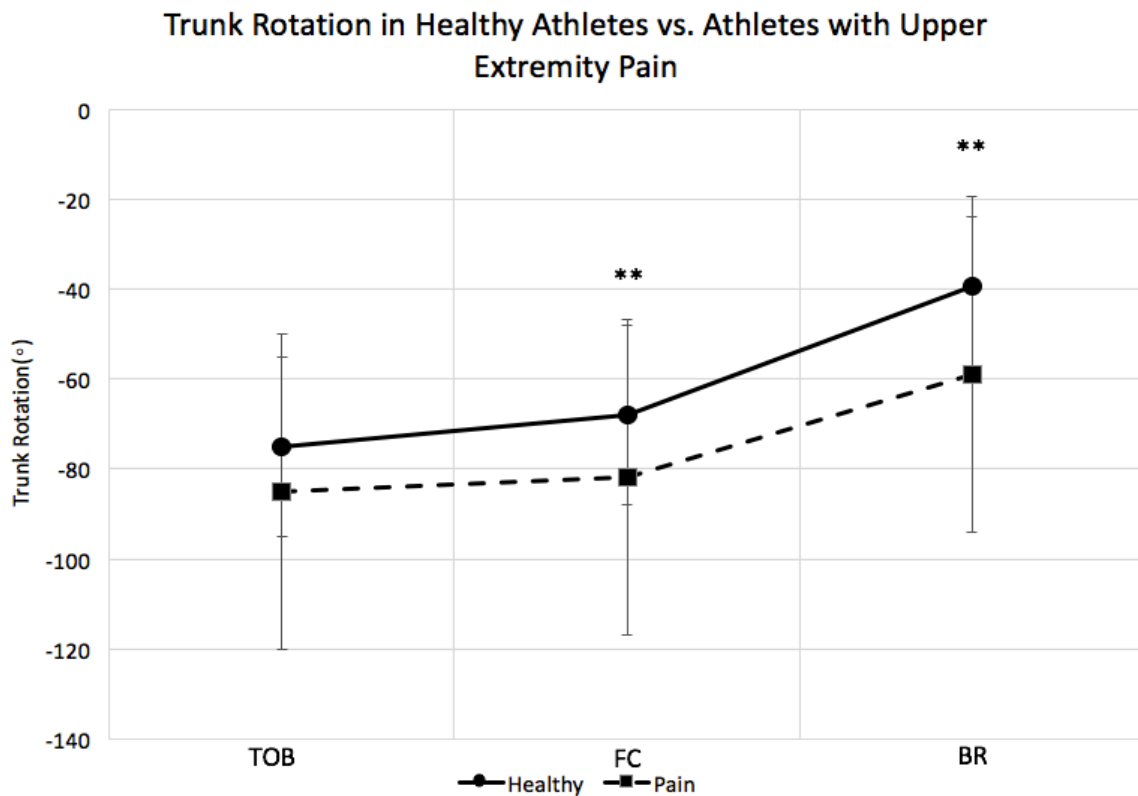


Figure 1: Trunk rotation was plotted versus the throwing events (foot contact (FC), top of the backswing (TOB), and ball release (BR)). The healthy group displayed significantly higher trunk rotation at FC and BR when compared to the pain group. \*\* denotes significance.

Kinematic data were collected with The MotionMonitorTM synchronized with an electromagnetic tracking system. Eleven electromagnetic sensors were attached to the following locations: (1) the trunk at T1, (2) pelvis at S1, (3-4) bilateral upper arm, (5) flat, broad portion of the acromion of the scapula, (6-7) bilateral forearm, (8-9) bilateral lower leg, and (10-11) bilateral upper leg [2]. Following sensor application, participants were given an unlimited time to perform their warm-up. The screwball was chosen for analysis because it was the most common pitch reported by those with UEP as noted in a health history questionnaire. Participants were instructed to pitch three screwball pitches at maximum effort for strikes over a regulation distance (43ft; 13.11m) to a catcher. Kinematic variables were averaged for the three executed trials at the pitching events of top of backswing (TOB), stride foot contact (FC), and ball release (BR).

Kinematic data were analyzed within IBM SPSS Statistics 23 software using an independent samples t-test with an alpha level of  $p \leq 0.05$ . Pitchers with a history of UEP displayed greater trunk rotation at both FC (95% CIs = -32.70, 4.97, Mean difference=-13.87°;  $p=0.05$ ), and BR, (95% CIs = -42.57, 3.44, Mean difference= -19.57°;  $p=0.01$ ) (Fig. 1). The observed trunk rotation indicates that the UEP group's trunk lagged behind over the course of the throw.

The UEP group displayed a trunk position that was more sideways to the target. Specifically, a right-handed pitcher's trunk was more square to the third baseline, with the left shoulder pointing more to the target at FC and BR. This difference in trunk rotation might result in the pitchers having to throw across their body more than necessary, thus putting the shoulder and elbow in a more injury susceptible position. Though it is known that softball pitchers do not rotate square to the target until after ball release [3], the rotational differences in the present study should be further investigated. Positioning the shoulders perpendicular to the target versus shoulders square to the target at BR may contribute to greater upper extremity forces about shoulder and elbow. Future research should analyze larger groups of participants to better determine the relationship between trunk positioning and pitching mechanics.

### Statement of Research Advisor:

Gabrielle assisted in data collection, data analysis, and writing of this segment of data regarding pain history and pitching mechanics in collegiate softball pitchers.

—Gretchen Oliver, Associate Professor School of Kinesiology

### References

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2. Wu G, et al. *J Biomech.* 38: 981-992, 2005.
3. Oliver GD, et al. *J Strength Cond Res.*24:2400-2407