EFFECT OF WEARING A WRIST SPLINT ON SHOULDER POSTURE WHEN PICKING AN OBJECT FROM A BOX

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INTRODUCTION

Reducing wrist motion may affect shoulder motion because of the kinematic interdependence of the joints of the upper extremity. Previous reports have suggested that wearing a wrist splint can affect shoulder posture during activities of daily living (Adams et al., 2003). Many occupational tasks require reaching into boxes to retrieve objects. Understanding whether wearing a wrist splint affects shoulder posture is clinically important because patients being conservatively treated for hand/wrist disorders often return with shoulder disorders. A scientific analysis of the interrelationship between wrist splint use and risk factors for shoulder disorders is necessary to assist in determining whether the shoulder pain may be caused by the conservative treatment of the hand/wrist disorder.

The objective of this study was to test the hypothesis that wearing a flexible wrist splint while picking an object from a box increases known postural risk factors for shoulder disorders. A secondary hypothesis was that the height of the front of the box modulated the effect of wearing a wrist splint on shoulder kinematics.

MATERIALS AND METHODS

Ten healthy volunteers participated in the study. Each study participant was asked to grasp a plastic ball in a box (figure 1) and move it to a tube that returned the ball to its original position. This task was completed five times for each test condition. A wooden dowel was placed at four heights at the front of the box (2.5, 5, and 7.5 cm) to experimentally control the front barrier height. One test condition did not have any dowel at all. Two splint conditions were tested (wearing a large Donjoy Orthopaedics wrist splint and not wearing a splint). Therefore, there were eight experimental conditions, and each study participant completed each test condition. The order of test conditions was randomized for each study participant.

Data were collected using a MotionStar electromagnetic tracking system using MotionMonitor data acquisition software. Sampling rate was 100 Hz. Data were smoothed using a two-way low-pass fourth order Butterworth filter with an 8 Hz cutoff frequency. Digitized landmarks were used...
to construct anatomic coordinate systems, and these were represented in the local coordinate systems of each electromagnetic sensor. The anatomic coordinate systems used were those proposed by van der Helm and Pronk (1995). At each point in time, the anatomic coordinate systems were rotated using the rotation matrices of the electromagnetic sensors. Euler angles were computed using the sequences proposed by van der Helm and Pronk (1995).

A repeated measures two-way ANOVA model was used to test for the effect of wearing a wrist splint and barrier height on minimum (and maximum) humeral elevation, plane of elevation, and axial rotation.

RESULTS

![Figure 2. Mean (S.D.) humeral elevation angles with and without a wrist splint for four barrier heights.](image)

Wearing a wrist splint increased the maximum humeral elevation angle (p<0.001), and the height of the barrier also increased the maximum humeral elevation angle (p<0.001). The mean maximum humeral elevation angle was lowest for the no splint and no barrier condition (62.3°), and it was highest when reaching over the highest barrier with a splint (90.0°) (figure 2). The average difference in maximum humeral elevation between the splint and no splint conditions was 6.8°. No statistically significant interaction between wrist splint and barrier height was found (p=0.463). No statistically significant effects were found for minimum elevation angle.

Wearing a wrist splint also increased maximum axial rotation (p<0.001), and higher barriers caused increased maximum axial rotation (p<0.001). Maximum plane of elevation, which represents how far forward the humerus is, was decreased by both wearing a splint (p<0.001) and height of the barrier (p<0.001). In contrast to the other two measures, the minimum of the plane of elevation was also reduced by wearing a splint (p<0.001) and decreased with increasing barrier height (p=0.028).

DISCUSSION

Our data suggest that wearing a wrist splint while reaching into a box may increase the likelihood of shoulder injury. Epidemiological studies have shown that elevated arm postures is a risk factors for shoulder pain, including rotator cuff pathology. Punnett et al. (2000) showed, for example, that elevated humeral postures were associated with shoulder disorders in automobile assembly work. Therefore, an increase in humeral elevation, which was produced by wearing a wrist splint, increases the risk of a shoulder disorder. Unfortunately, however, the epidemiological data is unclear about how much increase in risk results from the magnitude of elevation increase found in our study.

REFERENCES