INTRODUCTION

Joint position sense (JPS) is important in the maintenance of optimal movement coordination and injury prevention of limb segments in functional activities. It is well established that the accuracy of visually guided reaching movements declines as movement speed increases. However, very few studies have examined the influence of movement speed on accuracy of 3D reaching movements to memorized targets without visual feedback (Messier et al. 2003). Previous data from our laboratory indicate that joint position sense acuity improves as the presented position is moved toward an elevation of 90° (Suprak et al., 2006). Therefore, the purpose of this study was to examine the effects of elevation angle on movement velocity. We hypothesized that velocity would increase as the elevation angle increased from 30° to 110°.

METHODS

A total of 22 subjects (12 males, 10 females), with a mean age of 23.3 yrs. (± 4.8 yrs.) participated in the study. Following a standardized warm-up procedure, subjects were fitted with a head-mounted display and asked to remove shirts (females wore sports bras) to minimize visual and tactile cues (Figure 1). Kinematic data were collected via the Polhemus Fastrak magnetic tracking system, with one receiver on the thorax and one on the humerus. Testing involved the presentation of five target positions, consisting of various elevation angles in the scapular plane (35° plane). These positions were presented via custom-made Labview software through the head-mounted display. Once the target position was achieved, the display turned black and remained so for the remainder of the trial. Subjects held the position for five seconds, and returned to the side. Subjects then attempted to replicate the target position in three dimensions, in the absence of visual cues. Target positions were presented in a randomized order. Vector position data collected during the repositioning phase was processed via a forth order Butterworth filter. Peak angular velocity was calculated from the filtered position data using the central difference method.

RESULTS AND DISCUSSION

A one-way repeated measures ANOVA revealed a significant main effect of elevation angle on peak velocity (Figure 2). Analysed data also showed a significant cubic polynomial contrast. However, previous data using the same protocol to assess position sense acuity indicated that repositioning accuracy improved as the elevation angle of the presented position approached 90° (Figure 3). Cordo et al. (1994) studied the role of velocity on the proprioceptive coordination of movement.
sequences using passive rotation of the elbow at fixed speeds. There results suggested that the nervous system uses velocity information to coordinate movement sequences. Our results indicate that movement velocity increases in a cubic pattern with increase elevation angle at the shoulder. This finding, along with previous data, may indicate that in an unconstrained active repositioning movement, the accuracy of movement without vision is not exclusively affected by velocity.

**Figure 2:** Angular velocity with Elevation Angle (Mean ± SEM).

**CONCLUSIONS**

The results of this study indicate that angular velocity increases with an increase in elevation angle of the shoulder. Taken together with previous accuracy data (Suprak et al., 2006), these findings may indicate that in an unconstrained reaching task to remembered targets, movement velocity does not play a dominant role in determining movement accuracy. More investigation is necessary to elucidate the role of velocity in the processing of proprioceptive information by the central nervous system.

**Figure 3.** Repositioning Error Across Elevation Angle (Mean ± SEM).

**REFERENCES**