# THREE-DIMENSIONAL SHOULDER JOINT POSITION SENSE

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## INTRODUCTION

Joint position sense (JPS) is an important ability contributing to coordinated joint function, and is especially important for the stability and function at the shoulder [1]. The vast majority of studies in this area focus on movement about one axis of rotation, whereas there exists a scarcity of information concerning how shoulder joint position sense behaves in three dimensions. Therefore, the purpose of this study was to examine the effects of elevation angle on three-dimensional (3D) active repositioning error of a presented joint position. We hypothesized that error magnitude, defined as the angle between the presented and reproduced joint positions, would increase as the humeral elevation angle moved away from 90°, the position in which torque due to gravity about the shoulder joint is maximized.

## METHODS

A total of 20 subjects (12 males, 8 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.

**Figure 1**: Experimental Set-up.

## RESULTS AND DISCUSSION

A one-way repeated measures ANOVA revealed a significant main effect for elevation angle. Pairwise comparisons across elevation angle showed significantly smaller repositioning error at 90° compared to that at 30°, 50°, and 70° of elevation (Figure 2). The trend indicating improved JPS as the presented position is moved toward 90° elevation may be related to the torque generated at the shoulder joint due to gravity. Greater muscle activation is required in order to counteract this increase in torque and maintain the presented shoulder position. This finding may implicate muscle spindles as a primary source of afferent input related to JPS, due to the increased stimulation of these receptors with increasing muscle activation. This role of the muscle spindles has been hypothesized by various authors in the past [2, 3].

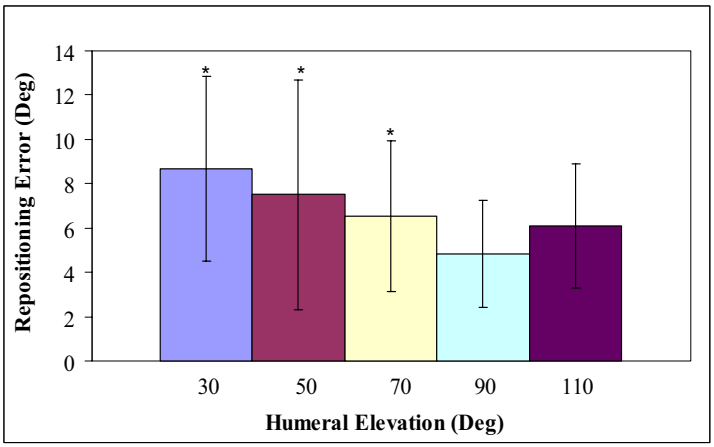


**Figure 2**: Error Magnitude Across Elevation Angle (Mean ± SD).

## CONCLUSIONS

The results of this study indicate that 3D JPS in the shoulder is affected by the humeral elevation angle. More investigation is necessary to elucidate the role of muscle contraction intensity in 3D JPS.

## REFERENCES

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3. Ribot-Ciscar, E, et al. *Exp Brain Res* **149**, 512-19, 2003.

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