ALTERATIONS IN SHOULDER JOINT PERCEPTION PRE AND POST WORKDAY

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INTRODUCTION

Dental hygienists have a high incidence of shoulder pain and pathology, which may be associated with the demands of the workplace environment and or work related responsibilities. In dental hygienists, injuries to the upper extremity are believed to be the result of low level static loads placed on the shoulder, awkward and constrained posture and fatigue inducing repetitive arm motions (1, 4). The sensation of joint position is believed to help maintain posture and joint stability during motor tasks (3). Joint Position Sense (JPS) tasks are an established method for accessing proprioceptive responses to limb movement (2). The current study attempts to measure shoulder proprioception in dental hygienist using JPS before and after a typical workday. It is hypothesized that repetitive arm usage in the workplace will result in decrements in shoulder JPS in dental hygienists. It is conceivable that proprioceptive errors could affect the fine motor skills needed to perform dental hygiene, and could thus place patients and hygienists at a higher risk of injury. To date, there have been no published studies comparing unconstrained JPS tasks between pre and post workdays in any population. Additionally, no studies of this nature have been conducted within the workspace of any population.

METHODS

Twenty four female dental hygienists participated in this study (mean age, 43 years). All subjects worked more than 40 hours per week and all data were collected before and after an 8 hour or longer workday. All data were collected at the dental hygienists' place of employment. Kinematic data were collected via the Polhemus Fastrack magnetic tracking system with two receivers: thorax and humerus (Figure 1). The thoracic receiver was attached using double sided adhesive tape to the manubrium, inferior to the jugular notch. The humeral receiver was placed over the deltoid tuberosity using a molded cuff. Bony landmarks were digitized using the stylus during the calibration phase of our experimental protocol. For all trials, data were collected at a rate of 40 Hz.

Figure 1: Experimental setup, attachment of sensors and head mounted display.

During calibration and data collection trials, subjects were in a standing position. The arbitrary coordinate systems defined by the Polhemus were converted to anatomically appropriate coordinate systems based on the recommendations of the International Society of Biomechanics Committee for Standardization and Terminology (6). Subjects were fit with a head mounted display (Cybermind Hi-Res) that removed visual input of their arm in space. During the active positioning phase, target positions for humeral plane and elevation were presented to the subject digitally using a custom program written in LabView (Figure 2). Subjects preformed 5 active positioning and repositioning tasks to previously established coordinates in a random order. Target positions were [45°, 75°] [40°. 70°], [35°,70°], [40°, 75°], [45°, 65°] for plane and elevation respectively. Once the subject had actively positioned their arm in the target, they were asked to try and remember where there hand was in space. Then the subjects were instructed to relax their arm at their side for several seconds. The subject was asked to reposition their arm to the perceived target location; no visual information was presented to the subject during reposition of the arm. When the subject perceived that they had successfully repositioned their arm to the positioned coordinates, they clicked a button with their non-dominant hand which automatically ended the trial.

For statistical analysis a 2-way repeated measure ANOVA was run where vector error was the dependent variable. Both trial number and pre – post workday conditions were the independent variables. Vector error is defined as the angle between the positioned vector, located between the center of the humeral head and the elbow center and the repositioned vector, located again between the center of the humeral head and elbow center (5). The α level was set at 0.05 for all statistical analysis.

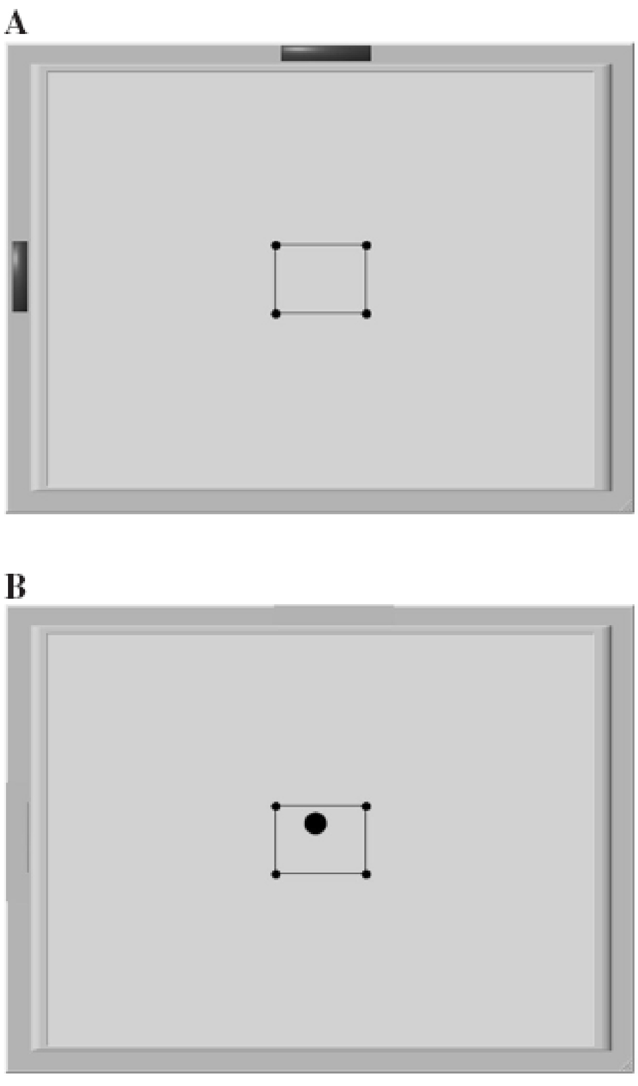

Figure 2: Computer output as seen in the head mounted display (**A**) guiding the subject to the target position and (**B**) with the shoulder in the target position.

RESULTS AND DISCUSSION

The results of the ANOVA indicate that there were no significant differences for vector error ($p = 0.13$) between the pre and post workday conditions. Additionally, there were no significant differences in repositioning error based on target location.

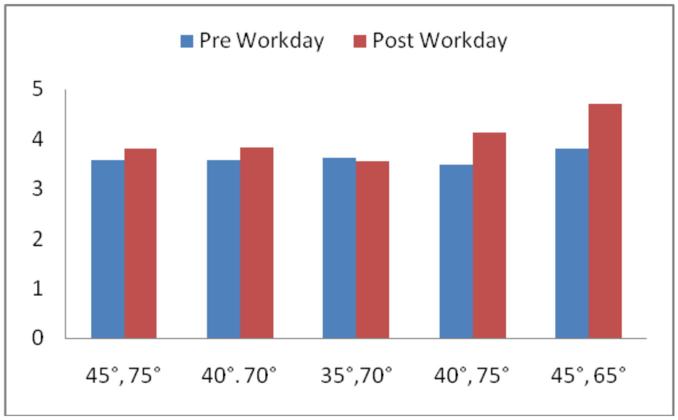

Figure 3: Vector error for pre and post workday JPS.

Fatigue mechanisms have been related to alterations in proprioceptive tasks such as JPS (2). Our study design accesses JPS immediately before and after a full workday in order to accurately identify any changes in proprioception that might result from workday fatigue. Although there were no significant changes in proprioception post workday in dental hygienists, it is possible that proprioceptive changes occur in other populations with high incidences of work related injury. Further analysis might separate dental hygienists into groups based on duration of employment as hygienist injury rates are correlated to job longevity (1).

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