Exposure to a workday environment results in an increase in anterior tilting of the scapula in dental hygienists with greater employment experience

Luke Ettinger [a], Philip McClure [b], Laurel Kincl [c], Andrew Karduna [a,]

[a] University of Oregon, Eugene, OR, United States
[b] Arcadia University, Glenside, PA, United States
[c] Oregon State, University, Corvallis, OR, United States

A ICLE INF

Article history:
Received 11 May 2011
Accepted 17 October 2011

Keywords:
Scapular kinematics
Dental hygienists
Workday fatigue

AB , AC

Background: Dental hygienists suffer a high incidence of shoulder pathology that seems to increase with job longevity. It has been hypothesized that occupational injuries could be due to local muscle fatigue caused by repetitive low level work and awkward and constrained working postures. In the laboratory, scapular kinematics can be temporarily altered using fatiguing protocols. It is unknown whether or not workday fatigue causes changes to scapular kinematics. The aim of this study was to examine if changes in scapular tilt and rotation occurs after a workday in dental hygienists.
Methods: The pre and post workday scapular kinematics were recorded from dental hygienists using an electromagnetic tracking system. All data were recorded within the place of employment of the dental hygienist.
Results: Following the workday, there was significantly more scapular anterior tilt in dental hygienists ($P<0.05$); however, no changes were found for upward or internal rotation. Greater kinematic differences were found for hygienists with greater job longevity.
Interpretation: The increase in scapular anterior tilting could be due to post workday fatigue. Anterior tilting of the scapula may have an influence on the development of subacromial impingement syndrome. Hygienists with greater duration of work experience may be at greater risk for developing shoulder injuries as they have

the kinematics protocol subjects performed a warm up that consisted of Codman's pendulum exercises to gently stretch the shoulder capsule (McClure et al. 2007). After the warm up, subjects removed all metallic objects and jewelry to eliminate interference. Once the digitization and calibration were completed, subjects completed three elevation trials. Each elevation trial consisted of the subject raising their dominant arm in the scapular plane (30° from the frontal plane) and returning along the same path to a count of four in each direction. Real-time angular feedback from the Polhemus Fastrack was observed by the researcher. From these observations, trials were repeated when the subject's arm elevation deviated from the scapular plane more than 5°. Data were collected continuously at a rate of 40 Hz for the three trials, and then were averaged for data analysis.

3. Data analysis

2003). In a study conducted by Borstad et al., serratus anterior muscle fatigue was induced by using an isometric fatiguing protocol. They suggest that if the fatiguing protocol is isometric versus dynamic, fewer rotations of the scapula are affected. They found that scapular tilting and scapular internal rotation were altered post fatigue; however, scapular upward rotation was unaffected (Borstad et al., 2009b). The only rotation that was altered in the present study was scapular tilting. Our findings seem to support the observations made by Marklin et al., and Oburg et al., who observed that for dental hygienists, the demands of the workplace often require low-level isometric loads of the shoulder (Akesson et al. 1999; Marklin and Cherney 2005). Unlike previous studies which induced muscle specific fatigue, our subjects likely had variable amounts of fatigue within various muscles. Dental hygienists may experience post workday fatigue differently based on the various working styles, number of patients seen, difficulty of patients and total number of years of work exposure. However, for direct comparisons to other fatigue studies, electromyography (EMG) should be used to determine muscle specific fatigued induced by work.

Anton et al., described dental hygienists with greater than 22 years of work exposure as having a higher incidence of upper extremities injuries (Anton et al. 2002). Results of our study suggest that dental hygienists with greater than 20 years of work exposure

McClure, P.W., Bialker, J., Neff, N., Williams, G., Karduna, A., 2004. Shoulder function and 3-dimensional kinematics in people with shoulder impingement syndrome before and after a 6-week exercise program. J. Phys. Ther. 84, 832–848.

McClure, P., Balaicuis, J., Heiland, D., Broersma, M.E., Thorndike, C.K., Wood, A., 2007. A randomized controlled comparison of stretching procedures for posterior shoulder tightness. J. Orthop. Sports Phys. Ther. 37, 108–114.

McQuade, K.W.S., Smidt, G., 1995. Effect of local muscle fatigue on 3-dimensional scapular kinematics. Clin. Biomech. 10, 144–148.

McQuade, K.J., Dawson, J., Smidt, G.L., 1998. Scapulothoracic muscle fatigue associated with alterations in scapulohumeral rhythm kinematics during maximum resistive shoulder elevation. J. Orthop. Sports Phys. Ther. 28, 74–80.

Neer, C., 1972. Anterior acromioplasty for the chronic impingement syndrome in the shoulder. Bone Joint Surg. 54, 41–50.

Ohlsson, K.H.G., Balogh, I., Stromberg, U., Palsson, B., Nordander, C., Rylander, L., et al., 1994. Disorders of the neck and upper limbs in women in the fish processing industry. Occup. Environ. Med. 51, 826.

Soslowsky, L.J., Thomopoulos, S., Esmail, A., Flanagan, C.L., Iannotti, J.P., Williamson, J.D., 3rd, et al., 2002. Rotator cuff tendinosis in an animal model: role of extrinsic and overuse factors. Ann. Biomed. Eng. 30 (8), 1057–1063.

Svendsen, S.W., Bonde, J.P., Mathiassen, S.E., Stengaard-Pedersen, K., Frich, L.H., 2004a. Work related shoulder disorders: quantitative exposure-response relations with reference to arm posture. Occup. Environ. Med. 61, 844–853.

Svendsen, S.W., Gelineck, J., Mathiassen, S.E., Bonde, J.P., Frich, L.H., Stengaard-Pedersen, K., et al., 2004b. Work above shoulder level and degenerative alterations of the rotator cuff tendons: a magnetic resonance imaging study. Arthritis Rheum. 50, 3314–3322.

Tsai, N.T., McClure, P.W., Karduna, A.R., 2003. Effects of muscle fatigue on 3-dimensional scapular kinematics. Arch. Phys. Med. Rehabil. 84, 1000–1005.

Wu, G., van der Helm, F.C., Veeger, H.E., Makhsous, M., Van Roy, P., Anglin, C., et al., 2005. ISB recommendation on definitions of joint coordinate systems of various joints for the reporting of human joint motion — Part II: shoulder, elbow, wrist and hand. J. Biomech. 38, 981–992.

Zuckerman, J.D.K.F., Cuorno, F., 1992. The influence of coracoacromial arch anatomy on