INTRODUCTION

Musculoskeletal injuries to the cervical region of the spine have historically been linked to many different injury mechanisms. These injury mechanisms range from acceleration injuries (whiplash) to injuries associated with lifting heavy loads (Hagberg, 1987; Herberts et al., 1981). Aaras and Ro (1997) found that frequently repeated lifts, as low as 1% of the MVC, are correlated to musculoskeletal injuries of the neck and shoulder. In epidemiologic studies by NIOSH (1997), it has been found that repetition, forceful exertion, and extreme postures contribute to musculoskeletal disorders of the cervical spine and shoulder. These musculoskeletal disorders have led to an increase in the number of permanent disability cases due to degeneration of cervical spine discs (Nygren et al., 1995).

METHODS AND PROCEDURES

It has been demonstrated (Woldstad & Nicolalde, 2001) that EMG levels increase in the musculature of the neck as hand loads are increased. From their findings, Woldstad and Nicolalde (2001) theorized that this increase in muscle activity corresponds to an increase in the compressive forces acting on the cervical spine. Currently, while there are predictive shoulder models and predictive neck models, the need for a combined neck and shoulder model exists. That is the aim of this study, to test the validity of using outputs from existing an existing shoulder model as inputs for a current neck model in an attempt to quantify the compressive forces exerted on the spine due to hand loads. For the purposes of this study, the shoulder model that will be the focus is the Chalmers Computerized Shoulder Model. This model is based on the shoulder modeling work done by Hogfors et al. (1987) and a series of papers by various authors following that original publication by Hogfors et al. The Chalmers shoulder model uses anthropometric, static posture, and muscle parameter inputs to estimate muscle forces in shoulder muscles and the resultant forces on the shoulder.

Output for this model is given in the form of force as a percentage of estimated maximum force for each muscle. The muscles in question are muscles shared by the cervical spine and the shoulder girdle: sternocleidomastoid, splenius, trapezius, and levator scapulae.

To test the model outputs, ten (5 male, 5 female) subjects were used for data collection. Surface EMG electrodes were attached to the specified muscles and each subject performed a series of
maximum voluntary isometric tasks (MVC) designed to isolate the muscles. Upon completion of the MVC tasks, subjects performed a series of lifting tasks modeled after the luggage-lifting task performed by Transportation Security Administration baggage screeners at airports, a task historically associated with high shoulder and neck injury rates. Subjects performed four (4) randomized trials each of nine (9) different luggage size/weight combinations.

Three-dimensional motion capture data was recorded for each trial for position input into the model.

Peak EMG values during the lifting task for each muscle for each trial were compared to the values of the MVC peak EMG values. In an attempt to replicate the data output of the Chalmers model, the peak trial values were calculated as percentages of the maximum values collected during the MVC collection period.

RESULTS

While data collection and analysis for all ten subjects has been performed, statistical analysis still remains to be completed for this study. The statistical analysis will center on testing the hypothesis that the Chalmers model accurately predicts muscle activity for given hand loads. The hypothesis test will compare the Chalmers model predictions of the percentage of maximum activity for each muscle during each combination to the observed results collected during the lifting task.

REFERENCES


