FOREARM MUSCLE ACTIVITY DURING THREE HOSE INSERTION TASKS AS MEASURED BY SURFACE ELCTROMYOGRAPHY OF THE FLEXOR DIGITORUM SUPERFICIALIS MUSCLE

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INTRODUCTION

When the physical demands of a task exceed the capacities of the worker performing those tasks can often lead to losses in production, fatigue and sometimes pain or injury to the worker. Hose installation tasks during automotive assembly operations are an example of a physically demanding task. In a recent survey, automotive truck assembly plant workers rated hose insertion tasks as the most physically demanding part of their job [1].

This study examines the effect that insertion method has on subject exertion levels, as measured by surface finger flexor EMGs.

METHODS

This experiment involved the measurement of insertion loads and EMGs in subjects as they inserted a rubber radiator hose onto a horizontal flange. The hose had an inner diameter of 25.4 mm and a wall thickness of 5 mm. The tasks simulated three insertion methods similar to those observed in field studies of hose installation tasks – Straight Push, Rocking Push and Twisting Push. Surface EMG electrodes (AMBU Neuroline 720 Wet Gel Ag/AgCl) were placed over distal muscle belly fibers of the Flexor Digitorum Superficialis muscle. Exertion levels were normalized using maximum static power grip (MVC) prior to testing.

For straight insertions, subjects were instructed to insert the hose directly onto the flange. For rocking insertions, subjects were instructed to push the hose on while rocking the hose back and forth in either the vertical or horizontal direction. For twisting insertions, subjects were instructed to push the hose on while rotating it about the long axis of the flange.

6 male and 6 female university students volunteered to participate in the experiment. All subjects were free of known upper extremity disorders and gave informed consent prior to testing. The experimental design was approved by the University of Michigan Internal Review Board.

RESULTS AND DISCUSSION

Axial loads and exertion levels increased with fit and varied by the insertion method used (Figure 1). Axial insertion forces were 35% higher for the straight method (150.0 N) compared to the twist method (110.6 N), $p<0.0001$. There does not appear to be an advantage to using the twisting method over the straight or rocking method, even though the axial insertion force is reduced by 26%. There was a 64% increase in pooled exertion levels for the twisting method over the straight method. The increase in muscle activity is consistent with decreased power grip strength capabilities due to deviations of the wrist during twisting and rocking insertions [2, 3]. It is also possible that tighter grip is required to twist or rock the hose.

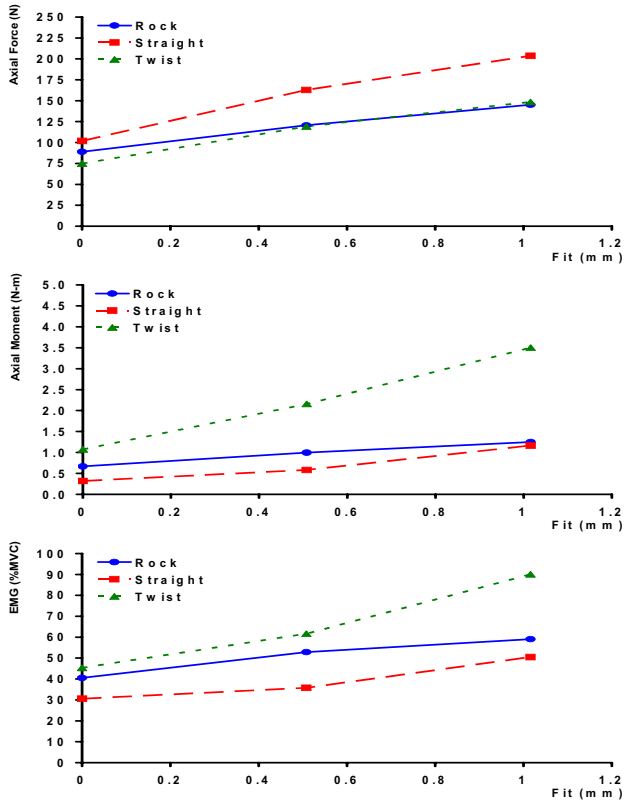

Figure 1: Average force, moment and EMG recordings for 12 subjects and three insertion methods. Fit is a measure of the amount of interference between the flange and the hose as it is inserted.

CONCLUSIONS

The greatest muscle activity was recorded while inserting hoses with the twisting method. The straight push has higher axial loading than the rocking push, but allows the subject to work in preferred static wrist posture. Future studies will investigate whether subjects use a tighter grip during twisting and rocking insertions.

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