disorders while conducting high intensity and long term installation works. However the automation equipment cannot always solve the problems for companies in industrial sector, and industrial workers cannot completely be replaced by these equipment. A mechanical Unpowered Upper Extremity Exoskeleton to reduce the fatigue of the upper extremity muscles is proposed. The purpose of this study is to find out whether the exoskeleton can effectively lower the risks of musculoskeletal disorders by reducing the fatigues.

Methods: Ten volunteers as the test subjects participated in the experiment to test the exoskeleton by lifting a hand-held tool weighing 5 kg. Each subject maintains his/her upper extremity at a fixed position with a certain angle when grasping the tool. A FlexComp Infiniti surface electromyography (EMG) system was used to acquire magnitudes of the muscles that are assisted both with and then without the support from the exoskeleton during the manual handling tasks. The EMG data acquired from the experiment were then used for analysis.

Results: The results showed that the fatigues in brachioradialis, biceps brachii and deltotoid are significantly reduced ($P < 0.05$), and the reduction is quite obvious. The average normalized RMS of brachioradialis was reduced 27.01% with the exoskeleton in-use compared to not-in-use. The average normalized RMS of biceps brachii was reduced 150.26%. The average normalized RMS of triceps was reduced 36.59%. The reduction of the normalized MPF of the tested muscles with the exoskeleton are much smaller than without the exoskeleton - Respectively: 10.3% (biceps brachii), 7.8% (deltoid), 7.1% (triceps) and 12.0% (diaphragm).

Conclusions: Unpowered Upper Extremity Exoskeleton can significantly relieve the worker's stresses on the brachioradialis, biceps brachii, deltotoid, and triceps by partially taking the load of the tool for the workers, and also transferring the load to the ground. The use of the exoskeleton does not only decrease fatigues of upper extremities, but also significantly increase the work efficiency by reducing the risk from the development of musculoskeletal disorders. Thus the workers can focus on the manipulation and installation during their work tasks.

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