BIOMECHANICAL ANALYSIS OF A WEARABLE SUPPORT DEVICE FOR OVERHEAD WORK

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Introduction There is a broad agreement that e.g. in aircraft assembly overhead work with forceful movements is one risk factor for musculoskeletal disorders (MSD) of the upper extremity (Rhode, 2015). At the HSU two wearable support devices were engineered specifically to support overhead work. The aim of this study is to assess the systems effects on reducing exposure on movement-involved muscles for the upper extremity and the lower back while working. **Methods** 24 participants completed an overhead task using a power drill (load 1,5kg) without (baseline) and with the two exoskeletons A and B. 3D motion-analysis (Vicon) examined full body movements. EMG signals were obtained from eight muscles (e.g. biceps brachii, trapezius, deltoid). Statistical analysis for curve data of the shoulder angles was performed using confidence bands for the difference between the means based on the bootstrap method (Duhamel et al. 2004) using matlab. Repeated measures ANOVAs using SPSS were used to examine the differences in EMG parameters and elevation angle of the shoulder girdle. **Results** Both exoskeletons decreased muscle activity significantly. For exoskeleton A: biceps 1,6%MVC*sec ($F=14.2$; $p<.001$; ▪2=.381), forearm extensors 8,6%MVC*sec ($F=12.4$; $p<.001$; ŋ2=.350) and infraspinatus 9,7%MVC*sec ($F=5.5$; $p=.037$; ŋ2=.152), for exoskeleton B: trapezius 12%MVC*sec ($F=4.1$; $p=.022$; ŋ2=.153), deltoid 6,3%MVC*sec ($F=20.7$; $p<.001$; ŋ2=.474) and triceps 3,8%MVC*sec ($F=5.8$; $p=.006$; ŋ2=.202). No significant differences were found for lower back muscle. Both exoskeletons (A/B) showed significant differences for shoulder mobility compared to baseline for the following parameters: abduction: 0-18%/0-15% and 82-100%/85-100%, internal rotation 0-10%/0-5% and 91-100%/96-100%, flexion 0-13% and 79-100% for A and 14-26% of the movement cycle for B. Exoskeleton B showed an increased elevation angle of the shoulder girdle of 4,9° ($F=5.9$; $p=.005$; ▪2=.204). **Conclusion** Although both support systems restrict shoulder mobility, positive effects of reducing muscle activity were found for overhead work. Especially system B relieved muscles close to the shoulder joint. Therefore, we conclude that wearing the support systems can minimize risk factors for MSD. However, with regard to multifactorial pathways of MSD additional parameters e.g. EMG frequency analysis of muscle fatigue or additional body segments should be further examined. Moreover, ongoing evaluation and adaptions of the systems for the practical use are necessary. **Reference** Rhode, B. A. (2015). MOJ Orthopedics & Rheumatology, 3(4), 4–11 Duhamel, A., Bourriez, J. L., Devos, P., Krystkowiak, P., Destée, A., Derambure, P., Defebvre, L. (2004). Gait & Posture, 20 (2), 204–212. **Contact** Christine Berger: [bergerc@hsuhh.de]