Effect of gravity compensation on muscle activation in subjects with facioscapulohumeral dystrophy

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Abstract

In facioscapulohumeral dystrophy (FSHD), the muscles of the shoulder girdle and the upper arm are often affected [1]. This disruption of muscle function results in shoulder weakness, associated with scapular instability, and in limitations during activities of daily living (ADLs) [2]. Support devices can be used to improve arm function. The aim of this study was to compare muscle activity between subjects with FSHD and healthy controls during standardized tasks with and without an arm support.

Method

Eleven subjects with FSHD (mean age 33.9±11.5, 4 male, 7 female) and 8 healthy subjects (mean age 49.9±9.8, 5 male, 3 female) were tested on their dominant side. A VICON motion capture system was used to measure shoulder abduction (SAA) and shoulder flexion (SFE) movements with and without the SLING arm support device (Figure 1). EMGs were also recorded in 6 muscles (Table 1). EMGs during maximum voluntary contraction (MVC) were measured before and after the session. Ethical approval was obtained (CMO Arnhem & Nijmegen).

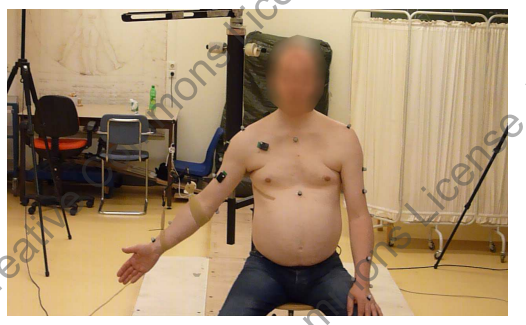

Figure 1: SLING-assisted setup for the shoulder abduction movement.

Results

In the FSHD group, the median EMG activity of the trapezius, deltoid and pectoralis muscles was close to the MVC activity during both SAA and SFE movements. Muscle activity during SLING-supported movements decreased significantly in all 6 muscles. The average reduction in median muscle activity was comparable in the control and the FSHD group: 37% and 36% respectively. The range of motion while using the SLING was reduced because of the SLING's design. However maximum arm elevation did not change in the FSHD group between the supported/unsupported conditions ($p > 0.05$).

Table 1: Maximum EMG activity during execution of SFE and SAA movements in FSHD subjects with and without arm support (*: $p < 0.05$; **:$p < 0.01$).

Movement	Biceps (%MVC)	Deltoid (%MVC)	Triceps (%MVC)	Trapezius (%MVC)	Pectoralis (%MVC)	Latissimus Dorsi (%MVC)
SAA unsupported	16	85	20	115	28	28
SAA supported	6**	46**	12*	47**	9*	9*
SFE unsupported	27	56	17	95	69	69
SFE supported	5**	29**	11**	28**	28**	28**

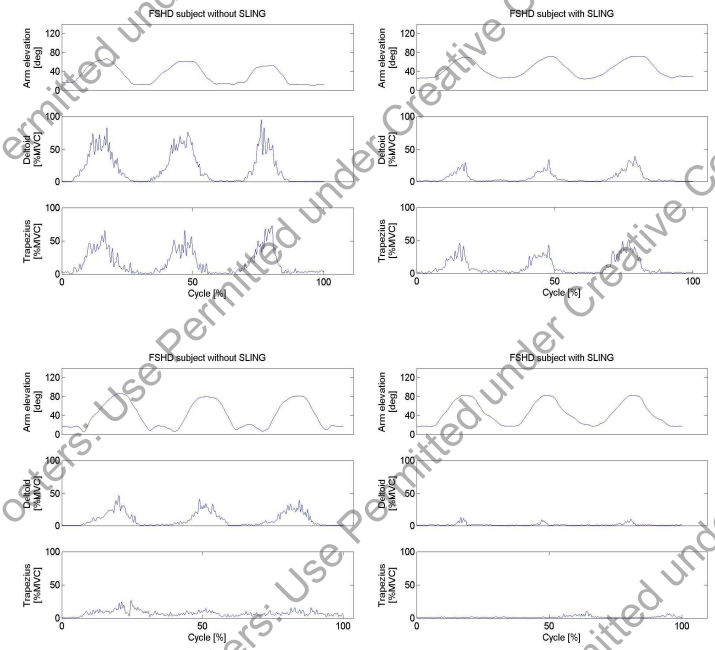

Figure 2: Arm elevation and EMG activity of deltoid and trapezius muscles in a typical FSHD subject. SAA movement: top; SFE movement: bottom.

Discussion

This is the first study where the mitigating effects of gravity arm support on muscle activity are investigated in FSHD subjects. The high activity of the trapezius in the FSHD group during unsupported movement is an indication of a muscle recruitment mechanism aimed at providing additional arm elevation around 90º. Using an arm support appears to decrease this muscular effort with possible implications for scapular stability. However, inverse dynamic analysis should be considered in future research to fully understand the underlying compensation mechanisms at kinematic and kinetic levels [3].

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