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THE EFFECTS OF A FIVE-WEEK EXERCISE INTERVENTION USING EMG BIOFEEDBACK ON SCAPULAR STABILIZER MUSCLE ACTIVATION AND SCAPULAR KINEMATICS

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Introduction

- Electromyography (EMG) biofeedback has not been investigated as a preventative tool for those at risk for developing shoulder pathologies.
- Observing muscle activation on the screen allows the subjects to obtain the correct movement for the exercises performed¹.
- Desired scapular kinematics during scapular plane humeral elevation²
 - Upward rotation
 - External rotation
 - Posterior tilt
- This study investigated changes in scapular kinematics, and muscle activation patterns as a result of EMG biofeedback.
- Hypotheses:
 - The scapula will increase in upward rotation, posterior tilting and external rotation.
 - There will be a decrease in upper trapezius activity, with an increase in serratus anterior and lower trapezius activity.

Methods - Instrumentation

- Healthy subjects (9 Males, 11 Females)
 - age = 22.3 ± 1.9 y/o
 - height = 1.71 ± 0.1 m
 - weight = 67.3 ± 10.3 kg
- Exclusion criteria:
 - Current pain
 - SIS diagnosis
 - Shoulder surgery
- Ag/AgCl self-adhesive electrodes placed bilaterally (Figure 1A):
 - Upper Trapezius
 - Lower Trapezius
 - Serratus Anterior
 - Lumbar Paraspinals
- 3D kinematic receivers (Figure 1B):
 - Custom Scapular tracker
 - Humeral Cuff
 - Thorax

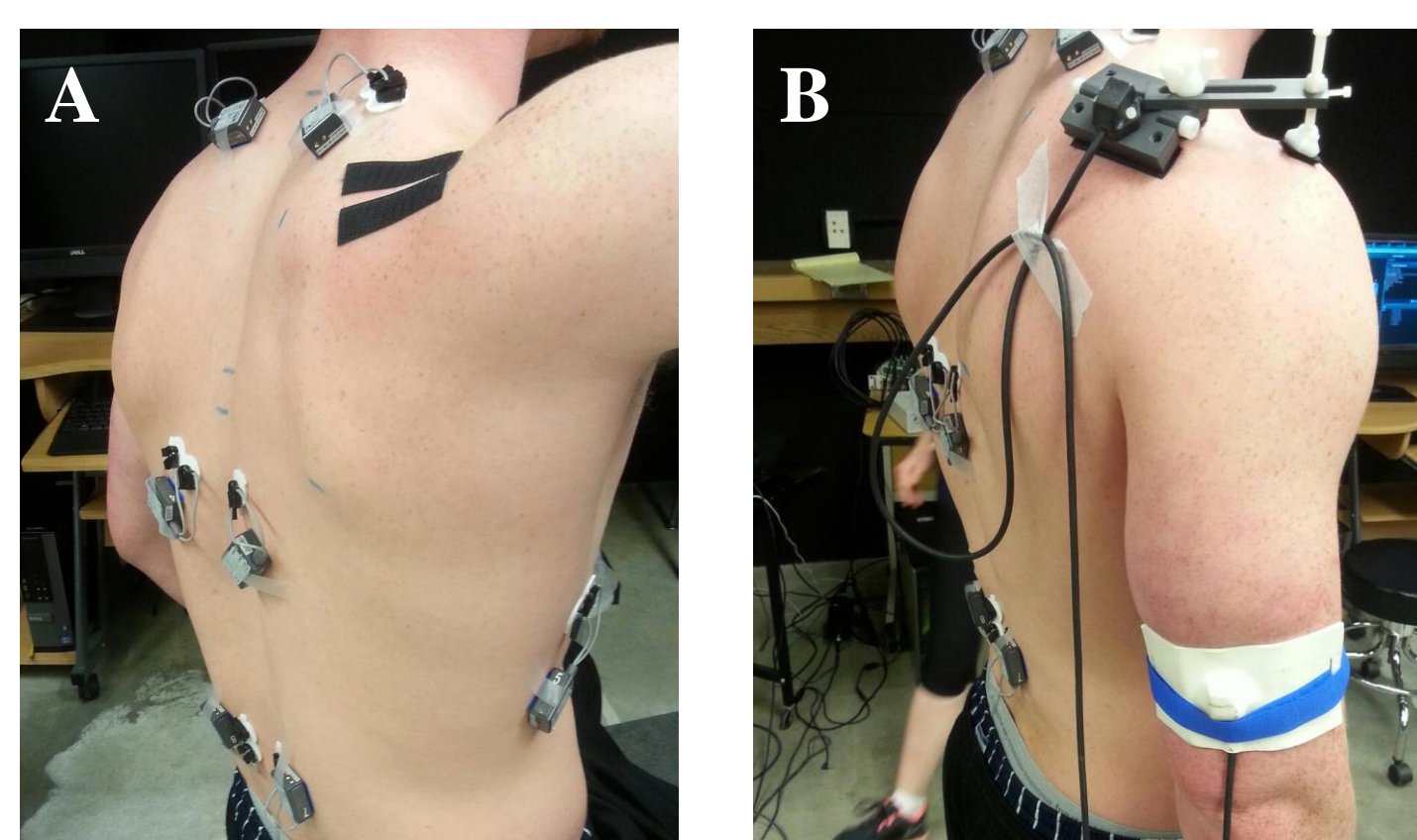


Figure 1: (A) Set up of the EMG electrodes on UT, LT, SA and LP and (B) set up of the Polhemus Fastrak 3D kinematics system.

Methods - Protocol

- Subjects divided into 2 groups
 - Exercise w/ biofeedback
 - Exercise only
- Humeral elevation in scapular plane
 - Baseline, week 6 & 8
- Subjects performed a warm up of pendulum swings
- Scapular stabilization exercises performed
 - I, W, T, Y (Figure 2 A, B, C, & D)
 - 1 x 10

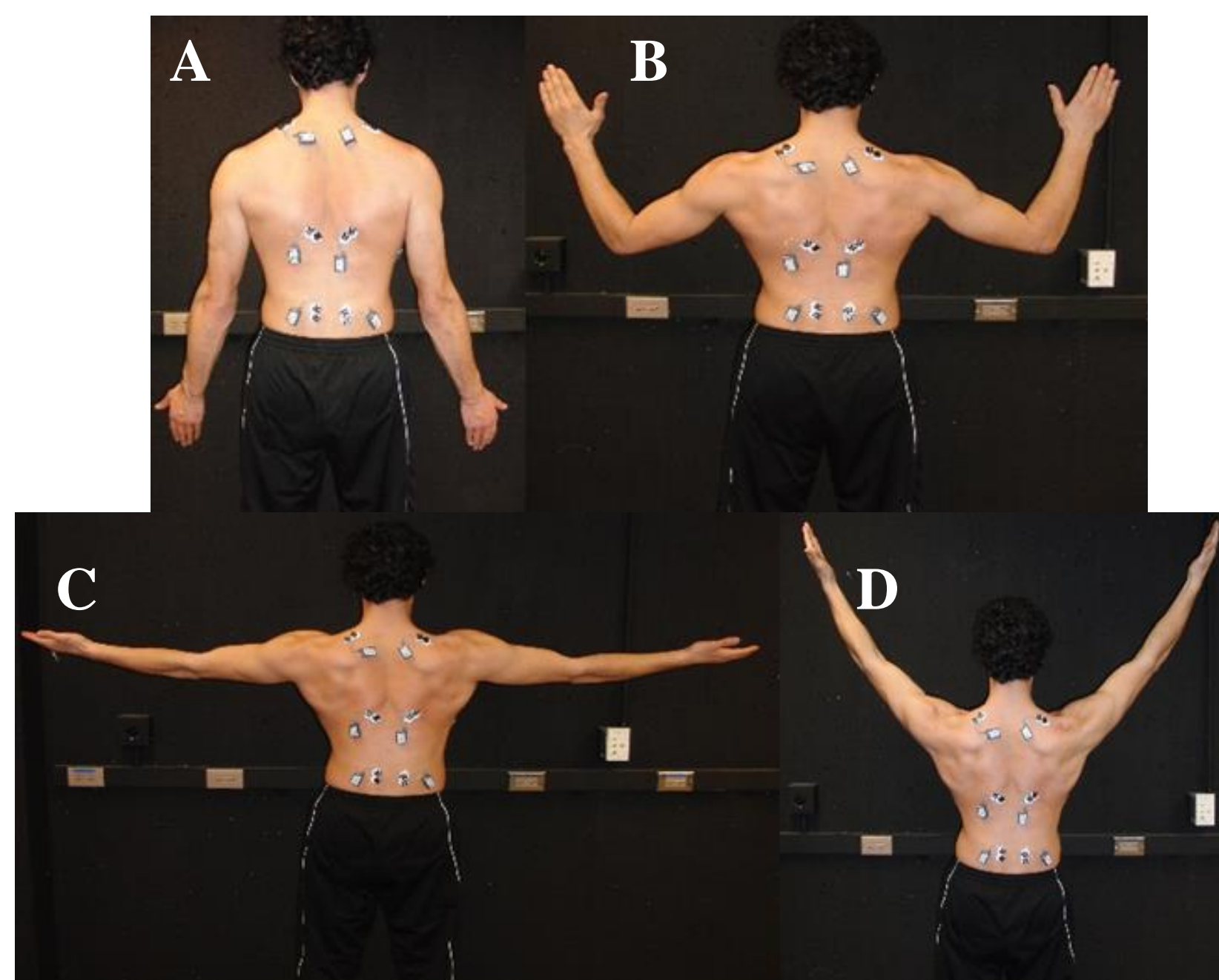


Figure 2: (A) I, (B) W, (C) T, and (D) Y scapular stabilization exercises performed by both groups.

- Exercises performed for five weeks
 - 3 x week
- Biofeedback group:
 - 1 x week EMG biofeedback
 - Exercises on screen in % MVIC
- Exercise only group:
 - Exercises at home w/ video instruction

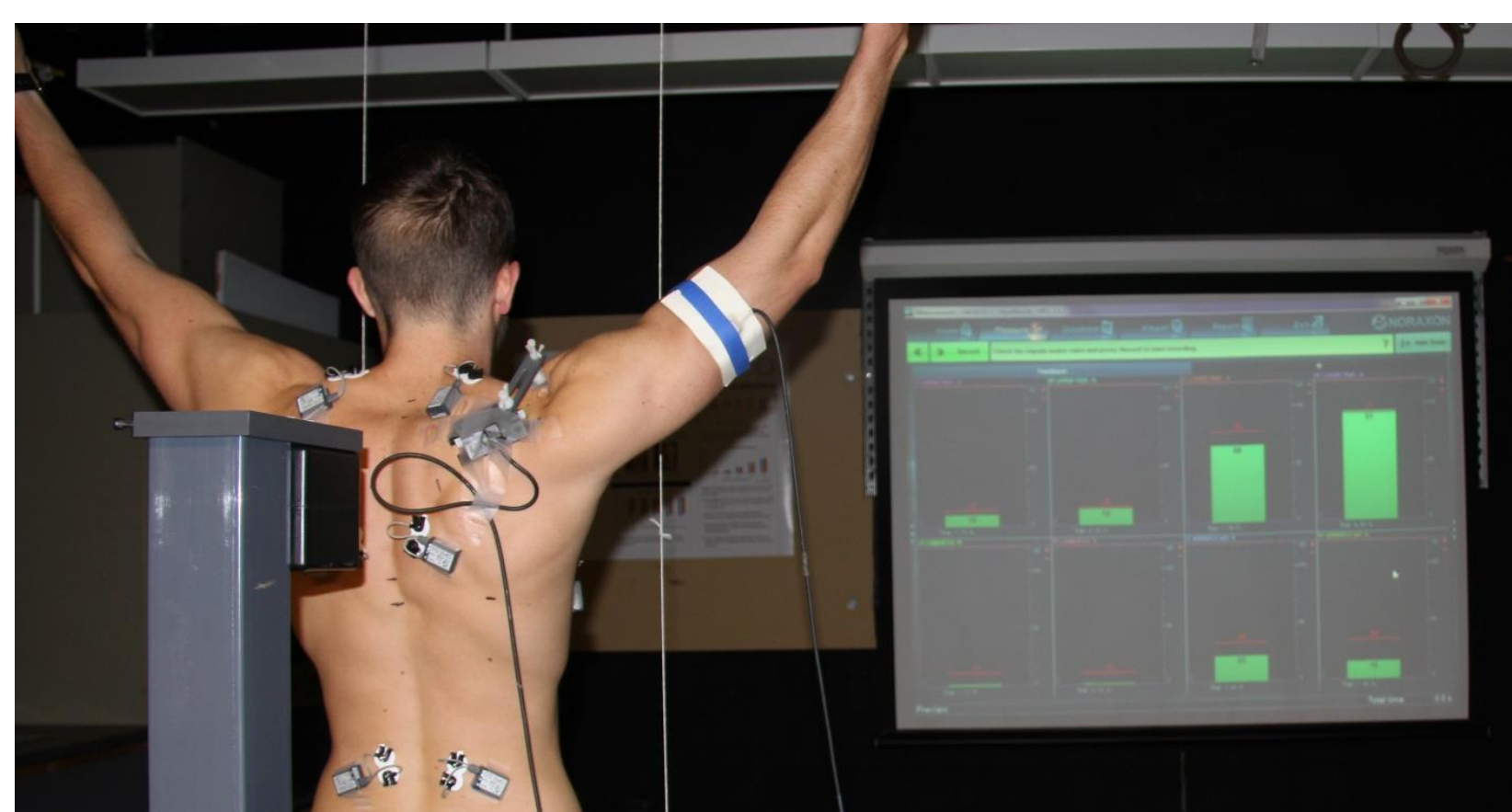


Figure 3: EMG biofeedback session. The green bars represent muscle activation in %MVIC. The muscles displayed on the screen are bilateral and are as follows: Top Left: UT, Top Right: LT, Bottom Left: LES, Bottom Right: SA.

Results

- No significance found for scapular external rotation ($p = 0.880$), posterior tilt ($p = 0.212$), or upward rotation ($p = 0.668$) for either group
- No significance 3-way interaction of muscle activation ($p = 0.249$)
- Increased upward rotation and decreased UT activation - Although not significant

Results – Graphical Representation

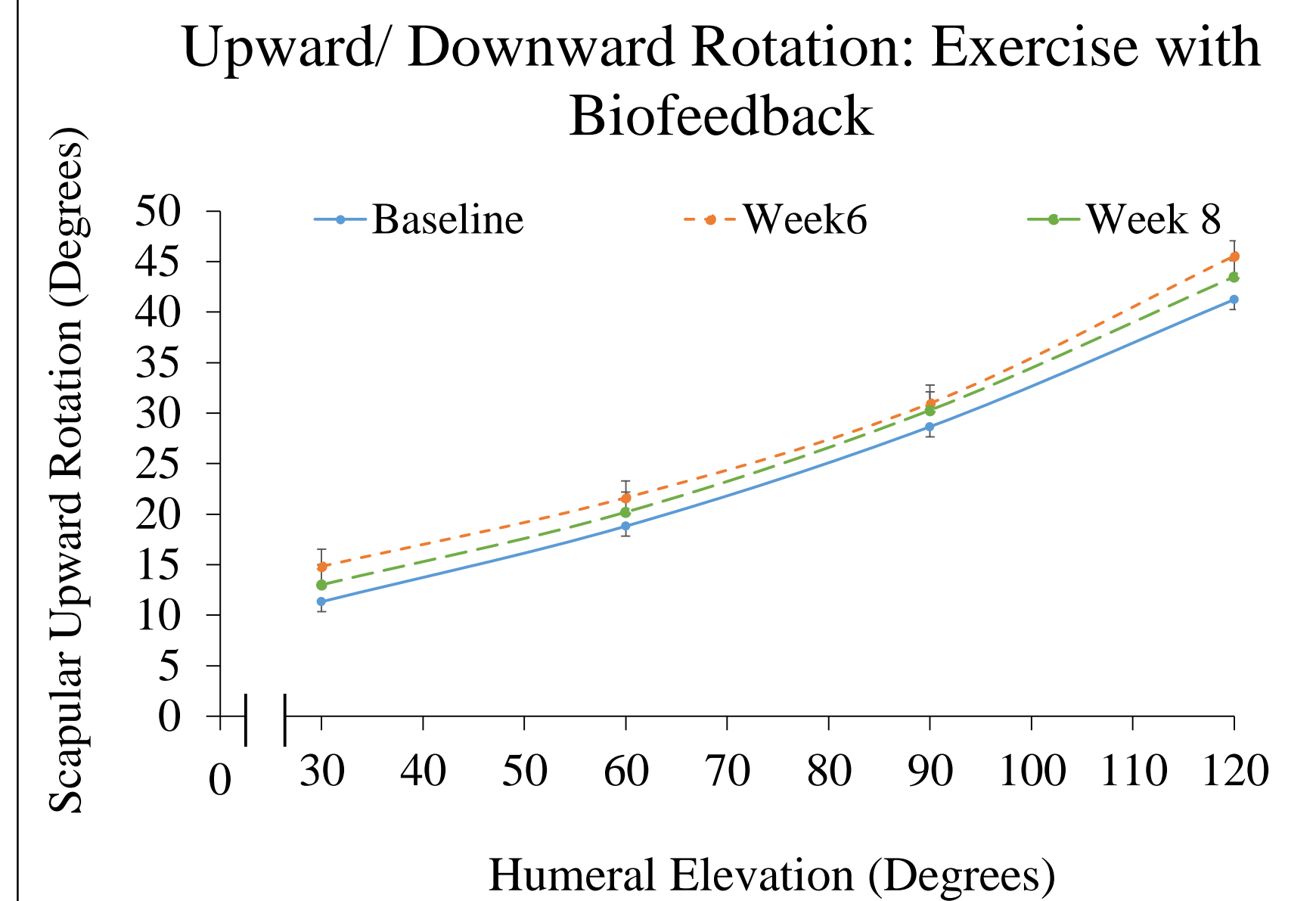


Figure 4: Scapular upward/downward rotation: Exercise w/ Biofeedback

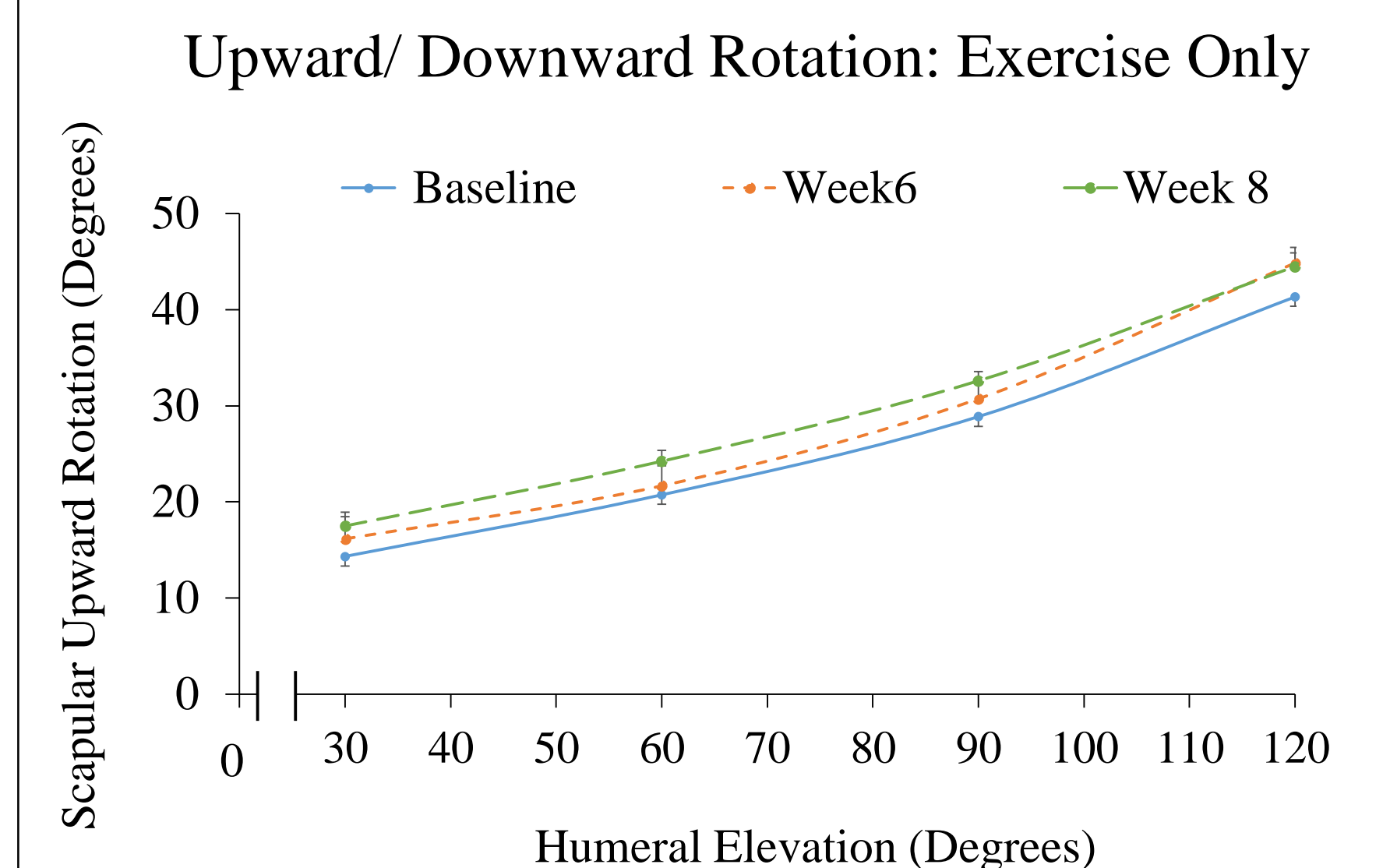


Figure 5: Scapular upward/downward rotation: Exercise Only

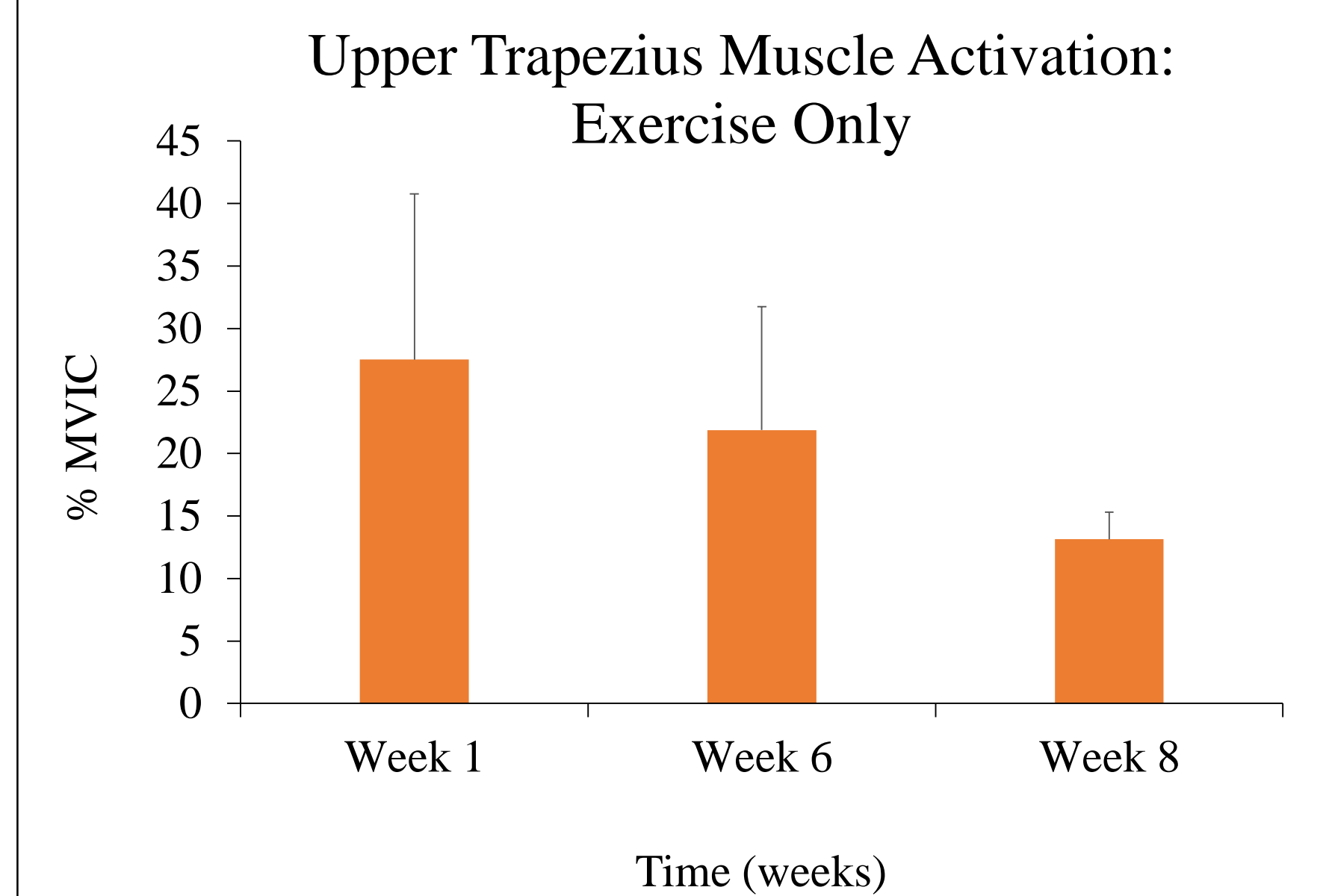


Figure 5: Upper trapezius muscle activation throughout the study: Exercise Only

Discussion & Conclusion

- Exercise intervention not long enough
 - 6 weeks in line with current recommendations³
- Healthy population
 - Could have already been within normal ranges for scapular kinematics
- Future studies should investigate a longer program with a pathological population

References

1. Holtermann A, et al. *J Electro and Kines*, **20**, 359-365, 2010
2. Kibler B, et al. *Am J Sports Med*, **36**, 1789-1798, 2008
3. Kuhn J. *J Shoulder Elbow Surg*, **18**, 138-160, 2009