

Objectives. To compare upper-limb range of motion, muscle activations, and muscle fatigue during training exercises performed with Orbital rotation bar, a device allowing dynamic elbow pronation and supination, and standard bar.

Methods. Twenty adult participants were equipped with inertial measurement units (Xsens) and electromyography sensors (Delsys) to record their upper-limb kinematics and muscle activity, respectively (Figure 1). During the first experiment, participants performed overhead press, biceps curls, high pulley overhead triceps, and upright row exercises (Figure 2) with the

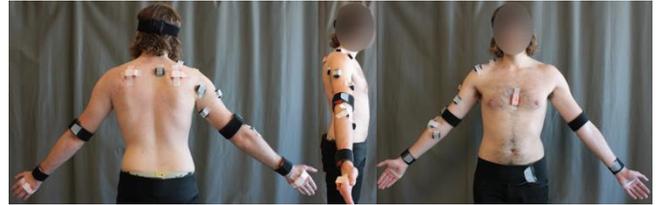


Figure 1. Participant equipped with the Xsens and Delsys systems

Orbital rotation device and a standard bar at 30% and 60% of their previously measured maximum voluntary force. Five repetitions were performed in each experimental condition. The upper-limb range of motion and muscle activations were compared between Orbital rotation and standard bar using *t*-tests. During a second experiment, participants performed the biceps curls exercise at 30% of their maximum voluntary force until complete exhaustion. The median frequency of electromyographic signals, a marker of muscle fatigue, was compared between Orbital rotation and standard bar using *t*-tests.

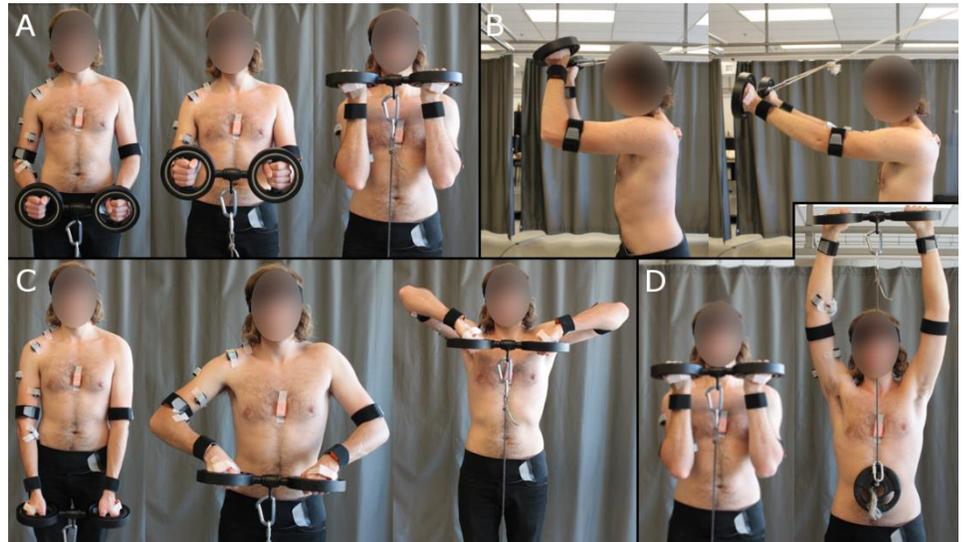
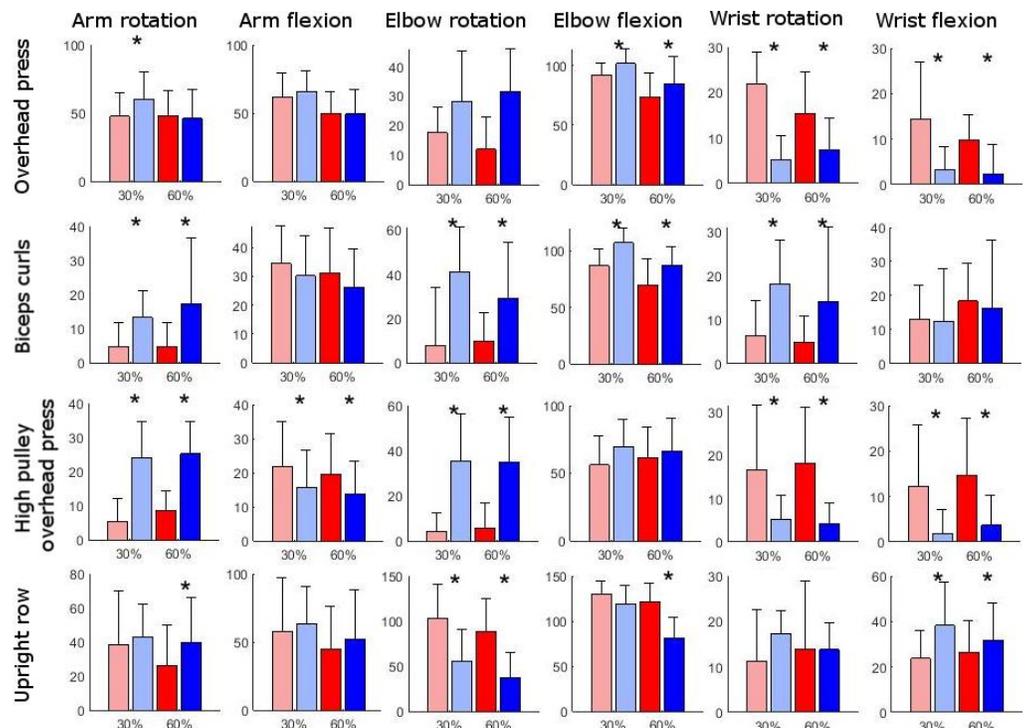


Figure 2. Participant performing biceps curls (A), high pulley overhead triceps (B), upright row (C), and overhead press (D) with the Orbital rotation device.

Results. During the overhead press exercise (Graph, 1st line), Orbital rotation increased significantly elbow flexion by 13% and decreased wrist rotation and flexion by 214% and 332%, respectively, compared to standard bar. During the biceps curls exercise (Graph, 2nd line), Orbital rotation device increased arm rotation, elbow rotation, and flexion, and wrist rotation by 218%, 309%, 24%, and 188%, respectively, compared to the standard bar. During the high pulley overhead press exercise (Graph, 3rd line), Orbital rotation increased arm and elbow rotation by 270% and 638%, respectively, and decreased arm flexion, wrist rotation and flexion by 42%, 277%, and 420%, respectively, compared to standard bar. Finally, during the upright row exercise (Graph, 4th line), Orbital rotation decreased elbow rotation by 112% and wrist flexion by 40%, respectively compared to the standard bar. Orbital Rotation and the standard bar are equal in Muscle activation and Muscle fatigue but is superior in Range of Motion.



Orbital rotation (blue) and standard bar (red) at 30% and 60% of the maximum voluntary force.

Standard bar at 30%

Orbital Rotation at 30%

Standard Bar at 60%

Orbital Rotation at 60% of Maximum Force