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Influence of using individualized ergonomic handles on upper limb kinematics, neuromuscular activity and perceived comfort, during scull rowing.

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INTRODUCTION:
All the power generated by the rower is transmitted to the oars and water by the handles, resulting in significant mechanical stress on wrist, elbow and shoulder joints. This might explain the large injury rate of the upper limb, representing more than 60% of injuries in paddle sports. This could be linked to joint overuse (e.g. repetition of 1800 propulsive cycles per training session in rowing (1)). In addition, the use of the standard circular handle could increase the injury risk, since a circular handle with a generalized size is not optimal for a strong and simple gripping pattern (2). Also, discomfort could lead to a higher risk of injuries (3). The purpose of this study was to measure the impact of using individualized ergonomic handles on upper limb kinematics and neuromuscular activity and perceived comfort during rowing.
METHODS:
Twelve elite rowers performed 250 meters runs in single scull at their own race stroke rate with three handle types: (a) standard circular handles, (b) ratio handles following a 1:1.25 diameter ratio with an irregular hexagon shape fitted to the hand length of the athlete (CareMoSim, Nancy, France) and (c) comfort handles with ratio handles optimized based on adequacy of the rowers (CareMoSim, Nancy, France). Rowers were equipped with surface EMG electrodes (Flexor carpi Ulnaris, Brachioradialis, Biceps brachii, Triceps brachii longus, posterior and anterior Deltoid), and inertial movement units on the left upper limb. Joint range of motion and EMG were calculated from the recorded data. A comfort scale was used after the test for each handle (3). Repeated measures ANOVAs and Statistical parametrical mapping (SPM) were performed.
RESULTS:
SPM showed a significantly smaller amplitude pattern of wrist flexion-extension during the first and last third of the drive phase ($p<0.001$), and during the last half of the recovery phase ($p<0.001$) with both ratio and comfort handles compared to the standard handle. There was significantly less EMG activity of posterior Deltoid ($p=0.01$) and Triceps brachii longus ($p=0.03$) with the ratio handle. There was significantly more comfort with the ratio ($p=0.04$) and comfort ($p<0.001$) handles compared to regular handle.
CONCLUSION:
Individualized handles increased comfort and decreased wrist flexion/extension amplitude suggesting less articular stress on the wrist. It also induces lesser neuromuscular stress on the shoulder with less recruitment of Deltoideus posterior and Triceps Brachii Longus. Greater comfort, and lesser stress may decrease injury risks. The ergonomic design of the handle allows the rower to precisely control his wrist due to a constant wrist position feedback provided by the hand-fitted shape, thus decreasing stress over the upper limb. Hand-casted handle may be the next step.

1. Thornton et al., Sports Med, 2017
2. Rossi et al., Journal of Applied Biomechanics, 2015
3. Revilla et al., Journal of Occupational and Environmental Hygiene, 2022

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