Asymmetries in Shoulder Ultrasound Parameters and Wheelchair Propulsion Work in Para-Athletes with Neuromusculoskeletal Impairment

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Summary

Manual wheelchair users (MWU) perform approximately 3,500 strokes per day, subjecting the shoulder complex to substantial mechanical stress [1]. This study identified asymmetries in both ultrasound-based shoulder parameters and wheelchair propulsion work, which may, over time, lead to shoulder-related issues. Given the complexity of shoulder problems in this population, a multidisciplinary approach is essential for comprehensively understanding and addressing the interaction between upper extremity function, wheelchair interface/ergonomics, and propulsion performance.

Introduction

Shoulder complaints are prevalent among manual wheelchair users (MWUs), primarily due to repetitive stress on the shoulder, which serves as the primary locomotor joint. Since the shoulder is not biomechanically adapted to withstand daily propulsion forces, MWUs are susceptible to conditions such as rotator cuff tendinopathy, rotator cuff tears, and subacromial impingement [1]. Additionally, impaired trunk function exacerbates shoulder dysfunction by altering posture, scapulothoracic rhythm, and glenohumeral mobility, thereby reducing subacromial space and increasing soft tissue compression [1, 2]. Maintaining maximal propulsion capacity is essential for MWUs to retain independence and navigate challenging environments, such as overcoming obstacles or ascending steep inclines. However, biomechanical imbalances, physical impairments, or suboptimal wheelchair configurations can result in asymmetric force production, increasing the risk of shoulder pathology and pain development. This study investigates the association between shoulder ultrasound parameters, including soft tissue thickness and subacromial space, and maximal propulsion work (MPW). Particular attention is given to the influence of asymmetries on ultrasound and wheelchair propulsion parameters.

Methods

Data was collected from 23 para-athletes (PA) with neuromusculoskeletal impairment. Ultrasound (Logic IQ, GE Healthcare) was used to measure acromion-humeral distance (AHD), supraspinatus tendon thickness (STT), and bursa thickness (BT) bilaterally, with SSR calculated as (STT + BT)/AHD. To measure wheelchair performance, PA completed 10 s maximum accelerations on a dual-roller ergometer (Lode Esseda, Netherlands). MPW (Nm) during the first 6 s for each shoulder was used in the analysis. This abstract presents preliminary data from nine PA (mean age 35.4 ± 7.6 years, all male), encompassing 18 shoulders.

Results and Discussion

A larger STT (5.9 ±0.5mm) was shown in MWUs compared to the able-bodied reference value (~4.6 mm) [3], which may indicate an overused tendon. Significant asymmetries between sides were found in all ultrasound shoulder parameters (AHD, STT, BT, SSR). There was also a tendency ($p=0.078$) towards a difference between sides in MPW. A significant negative correlation was found between SSR and MPW (Spearman's $\rho = -0.67$, $p = 0.003$), suggesting that a narrower subacromial space is associated with reduced propulsion work (Figure 1).

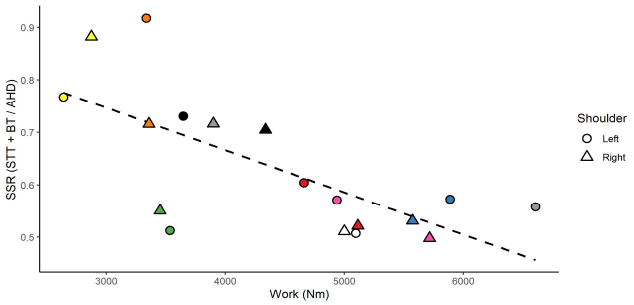

Figure 1: Plot of SSR and MPW for nine para-athletes (18 shoulders) colored by individual and shaped by left and right side.

Conclusions

Asymmetries were identified both in shoulder parameters and force production during wheelchair propulsion, which may result from underlying injuries or overuse of tendons. Identifying the contributing factors, such as overuse injuries, suboptimal seating posture, poor propulsion technique, or muscle imbalances, is essential to address these asymmetries. In the long term, a multidisciplinary approach is important to reduce the risk of shoulder complaints in MWU, thereby safeguarding the individual's independence and health.

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References

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