Greater Muscle Activation Correlates with Lower Quality of Life in Individuals with Massive Rotator Cuff Tears

Heukshorst A[1], Remedios M, Sarah[1], Wong, Ivan[2], MacLean, Kathleen [1], Rutherford J, Derek[3]
[1]Faculty of Health, Dalhousie University
[2]Department of Surgery, Dalhousie University
[3]Department of Biomedical Engineering, Dalhousie University
Email: at594788@dal.ca

Summary

This study examined Patient-reported outcomes and biomechanical measures in individuals with massive rotator cuff (RC) tears**.** Greater anterior deltoid (ADT) activation correlated with lower EQ-5D-5L scores. Findings emphasize the need for integrated subjective and objective assessments.

Introduction

Rotator cuff (RC) tears are a leading cause of shoulder pain and functional impairment during tasks such as lifting [2]. These limitations can be assessed using Patient-Reported Outcome Measures (PROMs), including the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment, the Western Ontario Rotator Cuff Index (WORC), and the EQ-5D-5L [1]. While PROMs provide insights into self-reported pain, function, and quality of life, their relationship to objective biomechanical assessments of shoulder function remains poorly understood [1].

This study explored the relation between objective shoulder function measures of shoulder strength, deltoid muscle activation, and range of motion during maximal shoulder abduction (ABD) and flexion (FLX) with self-reported shoulder function, pain, and quality of life.

Methods

Fourteen patients diagnosed with massive RC tears and booked for surgery were recruited. Demographics were recorded, and participants completed the WORC, ASES, and EQ-5D-5L to assess patient-reported function, pain, and quality of life. Shoulder strength in FLX, ABD, internal rotation (IR), and external rotation (ER) were measured using a hand-held dynamometer. Using standardized procedures, EMG was recorded from the anterior deltoid (ADT), lateral deltoid (LDT), and posterior deltoid (PDT) during ABD and FLX, and maximal thoracohumeral motion was tracked during these tasks using retro-reflective markers affixed to standardized landmarks. Maximal range of motion and peak levels of EMG, amplitude normalized to % maximum voluntary contractions (%MVIC) were determined for the movement trials. Spearman's correlation coefficients were used to analyze the relation between PROMs, Strength, EMG, and ROM measures.

Results and Discussion

Analysis of 14 participants identified relationships between PROMs and biomechanical measures (Figure 1). EQ-5D-5L scores were negatively correlated with ADT - Full Flex (ρ = -0.634, $P < 0.05$) and ADT - Full Abd (ρ = -0.592, $P < 0.05$), while no correlations were observed between strength and ROM measures ($P > 0.05$). No correlations were observed between WORC or ASES scores and biomechanical measures of strength, ROM, and EMG during maximal FLX and ABD ($P > 0.05$).

Greater ADT activation during FLX and ABD was associated with lower self-reported quality of life, suggesting increased deltoid reliance due to RC dysfunction. Higher activation likely reflects greater neuromuscular effort, contributing to movement inefficiency, fatigue, and disability. The EQ-5D-5L captured these deficits, while WORC and ASES, which focus on shoulder-specific function, showed no significant associations.

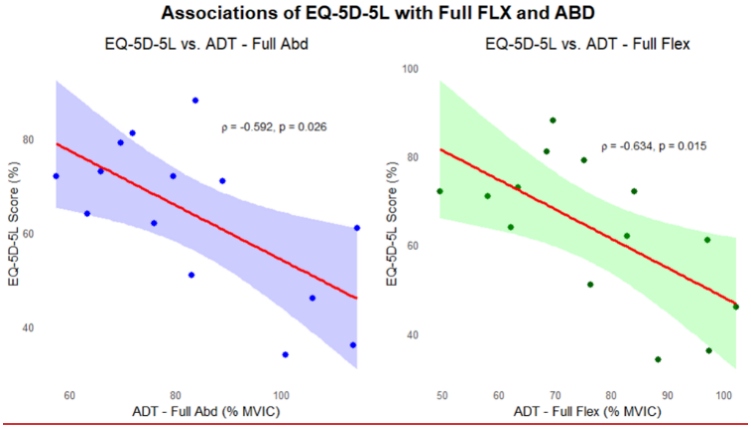

Figure 1. Negative correlations between EQ-5D-5L scores and ADT during maximal flexion and abduction (%MVIC). Shaded regions denote 95% confidence intervals.

Conclusions

Minimal correlations between biomechanical measures and PROMs highlight the complexity of the relationship between subjective and objective assessments. Despite this, the study demonstrated that greater anterior deltoid activation is associated with lower self-reported quality of life, reinforcing the need for integrated subjective and objective assessments to evaluate shoulder function.

References

[1] Friedman RJ et al. (2019). *JSES Open Access,* **3**:266-272.
[2] Gutman MJ et al. (2021). *J Shoulder Elbow Surg*, **30**:2475-2483.