

28th Annual ECSS Congress Paris France, 4-7 July 2023

Upper limb joints coordination during jump pull-ups in rock climbers

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INTRODUCTION:

The pull-up exercise is a complex motor task involving multiple joints. The jump pull-up (JPU) is representative of climber's skill and is given as a relevant upper-limb power test (1), but JPU's joint coordination is not described in the literature. JPU task can be related to squat or counter-movement jumps where complex motor task rules the activation joint from proximal to distal (2) (3). This study investigates the coordination pattern of the upper limb joints during JPU exercise with or without stretch shortening cycle.

METHODS:

Six skilled climbers (over 7c French lead climbing grade grade.) performed 4 trials of two forms of JPU : counter-movement JPU and stato-dynamic JPU. Climbers were asked to jump in order to ascend their two hands as high as possible. Each participant was equipped with an adapted Qualisys® marker set to measure upper limbs displacements. Two 3-axis force sensors were used to measure each hand reaction force during the JPU. Upper joint angular kinematics and hands maximal height were estimated from Qualisys measurements. The onset times of maximum joint velocities (NT) were normalized to JPU duration. t-test were performed to realize statistical analysis.

RESULTS:

Statistical tests realized on NT deviation between the wrist and elbow joints (14.1 ± 5.8 % NT of JPU, $p < 0.05$) and the elbow and shoulder joints (38.7 ± 12.0 % NT of JPU, $p < 0.05$) indicate significant differences. The joints were involved from the shoulder to the wrist in a proximal to distal sequence. No significant difference of the height reached by the hands between the two JPU exercises were found.

CONCLUSION:

This study demonstrates that the recruitment pattern of the upper limb joints obeys the proximal-distal order when performing JPU. This is consistent with the observations conducted on lower limb squat jumps. However, the comparison of the two JPU forms performed reveals no significant improvement in jump high performance due to the presence of a stretch shortening cycle. Further investigation should be conducted in order to confirm these findings.

REFERENCES :

- 1) Laffaye et al., Int. J. Sports Med, 2014
- 2) Bobbert et al. , J. Biomech 1988
- 3) Gregoire et al. , Int. J. Sports Med, 1984

GRANTS:

This study was partly funded by the ANR PPR STHP 2020 (project PerfAnalytics, ANR 20-STHP-0003) andUGA Cross Disciplinary Program SportPerfHealth