

WHAT CAN ISOMETRIC CONTRACTIONS TELL US ABOUT MUSCLE INJURY AND REHABILITATION?

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WHY STUDY ISOMETRIC CONTRACTIONS?

Exercise-induced muscle damage, injury, and adaptation

- Most research has involved eccentric contractions
 - Much less known about isometric contractions as an exercise
- Isometric contractions are experimentally simple
 - May help our understanding of mechanisms involved and key risk factors

AIM: To investigate which parameters of isometric exercise are associated with muscle damage



METHODS

Experiment 1: Effect of muscle length (joint angle) on damage during isometric exercise





RESULTS – EXPERIMENT 1

Experiment 1: Effect of muscle length (joint angle) during isometric exercise



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RESULTS – EXPERIMENT 1

Experiment 1 (n=10): Effect of muscle length (joint angle) on damage



Q: What other parameters of contraction are associated with damage?



Experiment 2 (n=9): Effect of contractions with different relaxation rates



6



Experiment 3 (n=8): Effect of different relaxation rates (same plateau duration)





Experiment 4 (n=8): Effect of contractions of different durations





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Experiment 5 (n=8): Effect of one (3s) contraction vs. three (1s) contractions





POOLED RESULTS FROM ALL EXPERIMENTS

Multiple linear logistic regression analysis:

Prolonged force deficit (24h post-exercise) was significantly associated with:

• Total time spent at greater than 60 – 90% of MVC

Prolonged force deficit (24h post-exercise) was *not* significantly associated with:

- Torque: time integral (total area under torque vs. time curve)
- Number of contractions during exercise



SUMMARY AND CONCLUSIONS

- Isometric contractions *can* produce muscle damage (prolonged force deficit)
- Muscle damage from isometric contractions :
 - Was strongly muscle length dependent
 → could be minimised by exercising at shorter than optimal length
 - Was associated with total time spent at high force levels (>60% max. capacity)
 → could be minimised by exercising at half of max. voluntary strength or less
 - Was not associated with either number of contractions or relaxation time
 → most likely occurs during the plateau phase of the contraction
 - Was *not* influenced by contraction duration
 → seemed to have a prompt onset and was cumulative



FUTURE QUESTIONS

- Can we use isometric contractions to improve exercise guidelines for optimising muscle recovery while minimising risk of damage or injury?
- Can isometric contractions offer similar benefits to eccentric contractions with lower risk of damage?

Related publication: J Appl Physiol (2018) 124: 388-399

