

Chronic Ischemic Preconditioning Improves Muscle Strength in Older Adults with and without Leg Amputation

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Summary

Maintaining quadriceps strength is critical for preserving function in older adults, especially those with leg amputation, because it has been associated with improved mobility and decreased fall risk. The most common method for improving strength is through exercise, however most aging adults report more barriers than facilitators to participate. The purpose of this study was to explore the use of ischemic preconditioning (IC) as a passive intervention to improve quadriceps strength in older adults. Our results demonstrate that 7 sessions of IC over 2 weeks improved quadriceps strength in older adults, suggesting that IC may be an alternative therapy to increase strength and improve function in older adults with and without leg amputation.

Introduction

Maintaining muscle strength is critical for preserving function in older adults. Quadriceps strength has been widely researched in aging adults because quadriceps muscle weakness has been associated with increased fall risk and increased sedentary lifestyle [1,2]. This is particularly important for aging individuals with lower limb amputation, who are the least likely to engage in activity and develop a plethora of comorbidities [3]. The purpose of this study was to investigate the use of ischemic preconditioning (IC) as a passive intervention to improve quadriceps strength in older adults with and without leg amputation.

Methods

Eleven older adults (7F/4M, 65.3±7.0yrs, 88.7±21.0kg, 168.5±12.1 cm) and 11 older adults with history of unilateral transfemoral/transtibial amputation (4F/7M, 62.6±6.2yrs, 87.6±17.8kg, 164.1±11.2cm) completed concentric isokinetic quadriceps strength testing at 120 degrees/second for 6 repetitions on an instrumented dynamometer. Participants then completed 7 sessions of IC every other day over 2 weeks. The IC intervention included placing a blood pressure cuff around the involved thigh (defined as the leg with most knee pain or the intact limb for those with amputation) while the participant lied supine on a treatment table. The cuff was inflated to 225mmHg (IC) or 25mmHg (sham) for 5 minutes followed by 5 minutes of reperfusion for 5 cycles (50 minutes). Participants were randomly assigned to intervention condition (IC or sham). Participants returned 24-48 hours following the last intervention session to repeat strength testing. Change in peak quadriceps torque (Nm) and average power (W) were calculated by subtracting the baseline from the follow-up. A multivariate analysis of variance was used to test the group effect (older adults/amputation), intervention effect (IC/sham), and the group x interaction effect. Alpha level was set at 0.05 *a priori*.

Results and Discussion

Six older adults and 6 persons with amputation were randomly assigned to the IC intervention and the remaining 5 in both groups received sham. There were no significant differences in demographics between groups or interventions ($p=0.45 - 0.98$). There was a significant difference in intervention groups in the change in peak quadriceps torque with a very large effect size ($p=0.03$, $d=1.03$). The IC group increased quadriceps torque by 7.99 ± 11.02 Nm while the sham group had decreased quadriceps torque 2.26 ± 8.75 following intervention. Both older adults and persons with amputation demonstrated trending increases in quadriceps power, however it was not statistically significant ($p=0.13$, $d=0.69$).

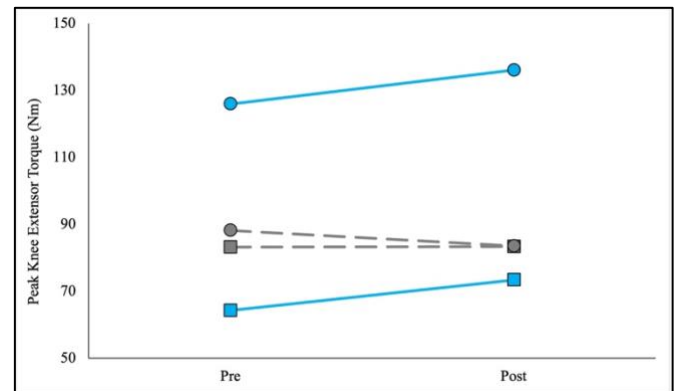


Figure 1: Change in peak quadriceps torque from baseline (pre) and after (post) 7 sessions of ischemic preconditioning in older adults with leg amputation (circle) and without amputation (square). The IC group is in blue, and the sham groups are in gray with dashed line.

Conclusions

These data support that IC can lead to increased quadriceps strength in older adults, both with and without leg amputation. IC is a passive, noninvasive intervention that has high compliance and may be an alternative treatment to improve activity in older adults who are less likely to lead active lifestyles. Future research should continue investigating the use of IC in conjunction with exercise and strengthening programs to examine changes in function and strength in these at-risk populations.

Acknowledgments

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References

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