

ACUTE EFFECTS OF MUSCLE LENGTH DURING THE CONTRACTION PHASE OF CONTRACT-RELAX STRETCHING ON MUSCLE-TENDON MECHANICS

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Introduction: Proprioceptive neuromuscular facilitation (PNF) stretching frequently results in the greatest increases in range of motion (ROM), with contract-relax (CR) being a common variant of the PNF technique. However, despite its efficacy to increase ROM, the underlying mechanisms are poorly understood; furthermore the contractions performed in a highly stretched position during CR stretching can be painful and induce muscle tissue damage, thus its use is somewhat limited in athletic environments. Therefore, the acute effects of CR stretching and a modified CR (MCR) stretching technique (with the contraction phase performed 'off stretch') were studied in 14 healthy human volunteers. **Methods:** Passive ankle joint moment and dorsiflexion ROM were recorded on an isokinetic dynamometer with electromyographic (EMG) monitoring of the triceps surae, whilst simultaneous real-time motion analysis and ultrasound imaging recorded gastrocnemius medialis muscle and Achilles tendon elongation. The subjects then performed either CR (4 x 10 s stretches + 5 s contractions) or MCR stretches randomly on separate days before reassessment. **Results:** Significant increases in dorsiflexion ROM (4.0-4.1°; $P < 0.01$) and decreases in the slope of the passive moment curve (13.3-19.1%; $P < 0.01$), muscle stiffness (21.3-21.7%; $P < 0.01$) and tendon stiffness (15.7-20.4%; $P < 0.01$) were observed in both conditions. A significant increase in peak passive moment (stretch tolerance) occurred after MCR (8.8%; $P < 0.05$) with a similar mean increase after CR (8.9%; $P = 0.053$); significant correlations ($r = 0.70-0.75$; $P < 0.01$) were observed between the changes in peak passive moment and ROM. No differences in between-condition changes were found in any measure ($P > 0.05$). **Conclusion:** Similar mechanical and neurological changes were observed between conditions, indicating that identical mechanisms explain the analogous ROM improvements, regardless of muscle length during the contraction phase. Importantly, performing the contractions 'off stretch' removes the need for partner assistance, and reduces the potential for microtrauma, likely minimising the risk of inducing muscle strain injury. Thus, the modified CR stretching technique represents an equally effective, simpler, and yet potentially safer, stretching paradigm.

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