

骨格筋の外的圧迫は 筋伸長ストレスを低減させるか？

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Does External Compression of Skeletal Muscle Reduce Passive Muscle Elongation Stress?

by

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ABSTRACT

External compression with a support belt has been used as a means of preventing the development of disability and recurrence of muscle injury. However, the effect of external compression on passive muscle elongation stress has not been fully demonstrated. Muscle elasticity obtained by ultrasound shear wave elastography is highly reflective of the passive force generated by muscle elongation ($R^2 = 0.99$). To investigate the effect of external compression by a support belt on muscle elasticity and to examine whether local compression is useful in reducing the elongation stress of skeletal muscles.

Methods: The muscle elasticity of the rectus femoris (RF) muscle of 11 healthy males was measured using shear wave elastography (Aixplorer Ver.12, 10-2 MHz

linear probe) under three conditions: 40 mmHg compression with a support belt, sham condition, and control condition. We set the wearing conditions to a random order. Measurements were performed in three positions: 0°, 60°, and 120° of knee flexion at the neutral hip position. We set the order of knee flexion to 0°, 60°, and 120° to eliminate the effect of stretching. Muscle elasticity was measured at two points: the proximal (33% RF lengths) at the support belt wearing site and the distal (66% RF lengths) non-wearing site.

Results: The proximal muscle elasticity showed an interaction between knee angle and wearing condition and was significantly lower in the compression condition at 40 mmHg pressure than in the control condition at 120° of knee flexion (137.8 ± 42.7 v.s 168.5 ± 64.1 kPa, -17.8%, $p = .002$). The elasticity of the sham condition at the proximal (120°: 147.7 ± 39.0 kPa) did not differ from that of the control and 40 mmHg compression conditions at all knee angles. Distal muscle elasticity showed only the main effect of knee angle, not the main effect of wearing condition and interaction (120; Support belt: 126.1 ± 53.2 , Control: 146.3 ± 78.0 , Sham: 128.5 ± 50.0 kPa).

Conclusions: Compression of 40 mmHg reduced the muscle elasticity at muscle elongation by about 18% compared to the control condition. External compression by the support belt suppresses the increase in muscle stress at the wearing site due to muscle elongation.

要 旨

サポーターによる外的圧迫は傷害発生を予防する手段として広く用いられているが、傷害に関係する筋力学ストレスの軽減効果は十分に実証されていない。本研究の目的はサポーターによる外的圧迫が筋弾性に与える影響を検討し、局所圧迫が骨格筋の伸長ストレス軽減に有用であるか検討することである。若年健常男性11名の大腿直筋を対象にサポーターによる40mmHgの圧迫を加える条件とシャム条件、コントロール条件の3つにおいてせん断波エラストグラフィを用いて近位の着用部および遠位の非着用部における筋弾性を測定した。近位の筋弾性は膝角度と着用条件に有意な交互作用を認め、膝屈曲120°において40mmHg圧迫条件の弾性率がコントロール条件よりも有意

に低値を示した ($p < 0.05$)。非着用部の遠位における筋弾性には膝角度の主効果のみを認め、着用条件の主効果および交互作用はみられなかった。以上より、サポーターによる外的圧迫は着用部位の力学ストレスを軽減する可能性が示唆された。