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Research Article

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[Shoulder muscle weakness effects on muscle hardness around the shoulder joint and scapulae](#)

**Purpose:** The time course of muscle stiffness of muscles around the shoulder joint and the scapula was investigated according to the degree of muscle weakness. This study was conducted to clarify the recovery process of muscle hardness of the muscles surrounding the shoulder joint and the scapula after the shoulder internal and external rotational exercises.

**Methods:** Participants were 7 healthy men ( $23.6 \pm 1.4$  yr), repeated internal and external rotations of the shoulder joint until the mean work of three internal and external rotations each was less than 90%, 80%, or 70% of the standard. Muscle hardness of the supraspinatus muscle, the infraspinatus muscle, and the rhomboideus muscle was measured before, immediately after, and 1 to 72 hr after each bout of exercise.

Muscle hardness was measured as Strain ratio using an ultrasound real-time tissue elastography. In addition, the rates of change were calculated using muscle hardness before exercise as the standard, to compare differences in the rate of change after exercise between conditions.

**Results:** The rates of change of the Strain ratio between measurements taken before and after exercise were compared among conditions for the infraspinatus muscle. Results were  $-7.1 \pm 5.3$ ,  $-15.2 \pm 10.3$ , and  $-25.0 \pm 8.8$ , respectively, at 90%, 80%, and 70%, with a significant difference between a decrease to 90% and to 70% ( $p < 0.05$ ). Significant difference was found in the change over time for the infraspinatus muscle only between values obtained immediately after exercise and after 72 hr at a decrease to 70% ( $p < 0.05$ ).

**Conclusion:** Those results described above demonstrated that the infraspinatus muscle and the supraspinatus muscle were harder immediately after exercise when the shoulder joint was at a higher degree of muscle weakness, and demonstrated that the change was likely to be recovered after 72 hr.

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