

Selective Activation of the Infraspinatus Muscle

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Context: To improve selective infraspinatus muscle strength and endurance, researchers have recommended selective shoulder external-rotation exercise during rehabilitation or athletic conditioning programs. Although selective strengthening of the infraspinatus muscle is recommended for therapy and training, limited information is available to help clinicians design a selective strengthening program.

Objective: To determine the most effective of 4 shoulder external-rotation exercises for selectively stimulating infraspinatus muscle activity while minimizing the use of the middle trapezius and posterior deltoid muscles.

Design: Cross-sectional study.

Setting: University research laboratory.

Patients or Other Participants: A total of 30 healthy participants (24 men, 6 women; age = 22.6 ± 1.7 years, height = 176.2 ± 4.5 cm, mass = 65.6 ± 7.4 kg) from a university population.

Intervention(s): The participants were instructed to perform 4 exercises: (1) prone horizontal abduction with external rotation (PER), (2) side-lying wiper exercise (SWE), (3) side-lying

external rotation (SER), and (4) standing external-rotation exercise (STER).

Main Outcome Measure(s): Surface electromyography signals were recorded from the infraspinatus, middle trapezius, and posterior deltoid muscles. Differences among the exercise positions were tested using a 1-way repeated-measures analysis of variance with Bonferroni adjustment.

Results: The infraspinatus muscle activity was greater in the SWE (55.98% ± 18.79%) than in the PER (46.14% ± 15.65%), SER (43.38% ± 22.26%), and STER (26.11% ± 15.00%) ($F_{3,87} = 19.97$, $P < .001$). Furthermore, the SWE elicited the least amount of activity in the middle trapezius muscle ($F_{3,87} = 20.15$, $P < .001$). Posterior deltoid muscle activity was similar in the SWE and SER but less than that measured in the PER and STER ($F_{3,87} = 25.10$, $P < .001$).

Conclusions: The SWE was superior to the PER, SER, and STER in maximizing infraspinatus activity with the least amount of middle trapezius and posterior deltoid activity. These findings may help clinicians design effective exercise programs.

Key Words: side-lying wiper exercise, selective strengthening, shoulder external-rotation exercises

Key Points

- The side-lying wiper exercise is a novel and effective exercise for selectively activating the infraspinatus muscle while minimizing the use of the posterior deltoid and middle trapezius muscles.
- Clinicians may wish to consider adding the side-lying wiper exercise when designing a program to selectively strengthen the infraspinatus muscle.

Rotator cuff (RC) muscle activity is crucial for the normal performance of shoulder motion.¹ The RC muscles, which comprise the infraspinatus, teres minor, subscapularis, and supraspinatus muscles,² enable the humerus to pivot on its head within the glenoid fossa and produce rotational torque during shoulder motion.³ In particular, the infraspinatus muscle produces an approximation force to resist distraction during an overhead throwing motion.⁴ Furthermore, this muscle provides the primary external-rotation force.⁵ Given that the infraspinatus muscle plays a critical role in providing dynamic stability and producing external-rotation torque at the shoulder joint, infraspinatus-strengthening exercises have been recommended to enhance muscular strength and endurance of the RC in rehabilitation and athletic conditioning programs.^{2,6-11} A collective reduction in force

of the RC muscle group or an isolated reduction in force of any RC muscle potentially increases humeral head translation and reduces the force required to sublux the humeral head.¹² Lesions causing RC dysfunction are a common source of shoulder pain, impairment, and disability.^{13,14} Therefore, selective strengthening exercises to restore muscle function are an important aspect of nonoperative and postoperative treatment of RC injuries.¹⁵ Several researchers^{11,16,17} have recommended selective infraspinatus-strengthening exercises during rehabilitation or athletic conditioning programs to enhance muscular strength and endurance.

Among the infraspinatus muscle exercises are prone horizontal abduction with external rotation (PER),^{6,10,11} shoulder external rotation in the scapular plane,¹⁸ side-lying external rotation (SER),^{4,6,10} and standing external rotation