

# COMPARISON OF BILATERAL AND UNILATERAL SQUAT EXERCISES ON BARBELL KINEMATICS AND MUSCLE ACTIVATION

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## ABSTRACT

**Purpose/Background:** Bilateral squats are commonly used in lower body strength training programs, while unilateral squats are mainly used as additional or rehabilitative exercises. Little has been reported regarding the kinetics, kinematics and muscle activation in unilateral squats in comparison to bilateral squats. Therefore, the purpose of this study was to compare muscle activity, kinetics, and barbell kinematics between unilateral and bilateral squats with the same external load per leg in experienced resistance-trained participants.

**Methods:** Fourteen resistance-trained males (age  $23 \pm 4$  years, body mass  $80.5 \pm 8.5$  kg and height  $1.81 \pm 0.06$  m) participated. Barbell kinematics and surface electromyography (EMG) activity of eleven muscles were measured during the descending and ascending phase of each repetition of the squat exercises.

**Results:** Total lifting time was longer and average and peak velocity were lower for the bilateral squat ( $p < 0.001$ ). Furthermore, higher muscle activity was found in the three quadriceps muscles, biceps femoris (ascending phase) and the erector spinae (ascending phase) in the bilateral squat, while greater activation for the semitendinosus (descending phase) ( $p = 0.003$ ) was observed for the unilateral squat with foot forwards. In the ascending phase, the prime movers showed increased muscle activity with repetition from repetition 1 to 4 ( $p \leq 0.034$ ).

**Conclusions:** Unilateral squats with the same external load per leg produced greater peak vertical ground reaction forces than bilateral squats, as well as higher barbell velocity, which is associated with strength development and rate of force development, respectively. The authors suggest using unilateral rather than bilateral squats for people with low back pain and those enrolled in rehabilitation programs after ACL ruptures, as unilateral squats are performed with small loads (28 vs. 135 kg) but achieve similar magnitude of muscle activity in the hamstring, calf, hip and abdominal muscles and create less load on the spine.

**Level of Evidence:** 1b

**Key words:** Ascending phase, descending phase, electromyography, kinematics, single limb squat, two-legged squat

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