A COMPARISON OF HIP EXTENSION TORQUES IN CONVENTIONAL AND SPLIT SQUAT EXERCISES

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INTRODUCTION

Conventional two-leg squats are considered an important part of lower extremity strength training programs, as they serve to exercise the hip and knee extensor musculature. However, the exertion of a large hip extension torque requires a large load and/or a large forward lean of the trunk. In turn, this requires the exertion of large torques by the lumbar extensor musculature, and thus increases the risk of spinal injury. As an alternative to conventional squats, some athletes use split squats as part of their training (Figure 1). The exercise is focused on the forward leg.

The purpose of this study was to examine the relationship between load and hip extension torque in the conventional and split squat exercises, and to draw inferences in regard to the risk of injury for the lumbar spine.

METHODS

Ten male athletes (standing height = 1.76 ± 0.07 m; mass = 88 ± 14 kg) volunteered for the study. The subjects performed conventional squats at 60, 70, and 80% of their raw one-repetition maximum (1-RM), and split squats at 20, 25, and 30% of their raw conventional squat 1-RM. (Raw lifts are those performed without the use of knee wraps or squat suits.) At the low point, the thigh was approximately parallel to the ground.

Each trial was recorded with a Vicon 370 motion analysis system, and the ground reaction forces and torques exerted on the right foot were measured with an AMTI OR6-7-1000 force platform. The sampling rate was 60 Hz for both. Joint torques were computed using the method proposed by Andrews [1,2]. Lifted mass was defined as the sum of the masses of the trunk, arms, head, and barbell. Trunk angles were expressed relative to the vertical. Data were calculated for the low point of the lift, defined as the instant of minimum thigh angle.

RESULTS AND DISCUSSION

Figure 2 shows that the split squat required less lifted mass than the conventional squat to attain any given amount of hip extension torque. In addition, the subjects used a smaller amount of forward lean of the trunk in the split squat (25 ± 12°) than in the conventional squat (35 ± 6°). The combination of a smaller lifted mass and a smaller forward lean of the trunk in the split squat for any given amount of hip extension torque implied smaller lumbar extension torques. In turn, this implied a smaller risk of injury for the lumbar spine when the split squat is used.

CONCLUSIONS

The results of this project indicate that athletes who wish to focus their efforts on the hip extensor musculature should perform the split squat. The use of the split squat reduces the risk of lumbar spine injury by reducing the forward lean of the trunk and the lifted mass in relation to the conventional squat.

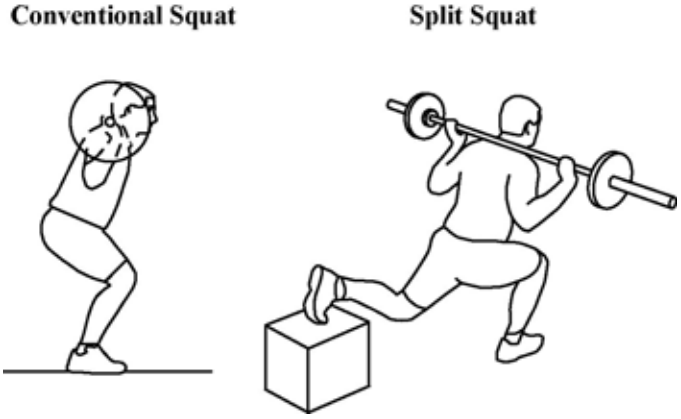

Figure 1: Conventional and split squat exercises.

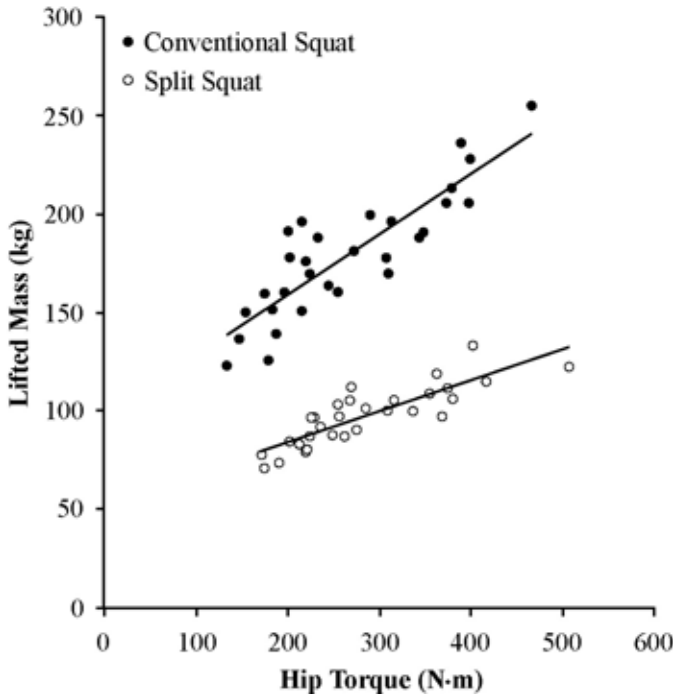

Figure 2: Relationship between lifted mass and hip torque in the conventional and split squat exercises.

REFERENCES

1. Andrews, J.G. *Kinesiology IV*, 32-42, 1974.
2. Andrews, J.G. *Med. Sci. Sports Exerc.* **14**, 361-367, 1982.

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