

EFFECTS OF LIFTING-WEIGHT ON THE JOINT LADING OF LOWER LIMBS IN SUMO STYLE DEADLIFT

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Summary/conclusions

Not only the flexors and extensors but also the abductors, rotators are the mainly active muscles in sumo style deadlifts. The joint loadings are linearly increased with the increase of lifting-weight. The shear joint forces maybe another main factors that resulting in joint osteoarthritis in weight-lifter.

Introduction

The deadlift is one of three lifts in powerlifting competition of Olympics World Games. The start position for the deadlift is that the lifter in the squat position, arm straight, pointing down, and hold the lifting bar positioned in front of the lifter's feet. Then, the barbell is lifted upward until the lifter is standing erect with knees locked and the shoulders trust back [1]. In clinical, the weight lifter had a higher incidence of osteoarthritis in hip, knee and ankle joints [2-4]. The understanding of joint loading of lower limbs is helpful to design the strength training programs for the weight lifters. Escamilla et al. had studied the effect of stance width on joint kinetic parameters of lower limbs in the deadlift, and the differences between two different style deadlifts [1, 5-8]. However, only joint loading in sagittal plane were published in their studies. It is necessary to study a full three-dimensional joint forces and moments of lower limbs during deadlifts because of the lifter in the squat position with wild stance widths.

The joint loadings in frontal plane may play an important role in the injuries of lower limbs. The purpose of this study is to investigate the effects of lifting weights on joint forces and moments at three anatomic planes in sumo style deadlift.

Statement of clinical significance

To investigate the joint loadings in frontal and transverse plane are greatly helpful for the understanding the factors that resulting in joint osteoarthritis in weight lifter. The relationship between the joint loading and lifting-weight is helpful for a coach to design training program.

Methods

Eight college team members in powerlifting (four males and four females; age: 24.0 ± 4.1 years olds, body weight: 60.0 ± 6.7 kgw) were recruited in this study. Each subject was asked to perform the sumo style deadlift with four different lifting weights (30%, 50%, 70%, 90% of his one repetition maximum without using lifting suit). Twenty-one reflective markers were placed on selected anatomic landmarks bilaterally for each subject. The VICON612 motion analysis system with ten cameras was used to collect the marker's trajectories at 250 Hz. Each subject was asked to put his left leg on the AMTI force plate in order to record the ground reaction forces and moments at 1000 Hz sampling rates. Three useful repetitions were collected for each testing condition at least. The trajectories of the markers were smoothed using a generalized cross-validation spline smoothing routine at a cut-off frequency of 6 Hz. Personal designed programs in MATLAB language were used to calculate the joint forces and joint moments of the lower limbs.

Results

A full three-dimensional joint forces and moments were investigated in this study. The results showed that not only the flexors and extensor but also the abductors and rotators were mainly active muscles in Sumo style deadlifts. We also found that the peak moment occurred in

extensor moment when barbell liftoff. The peak moment occurred in abductor moment between barbell liftoff and maximum barbell acceleration. The peak moment occurs in plantarflexor moment during maximum barbell acceleration phase. The anterior, posterior, lateral, and compressive joint forces were linear increased with the lifting-weight ($p < 0.01$). Also, the flexor, extensor, rotator, and abductor moments were linear increased with the lifting-weight too ($p < 0.01$).

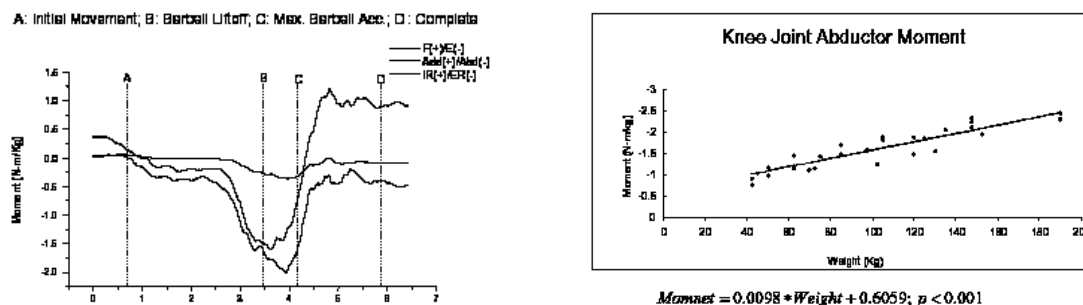


Figure 1. Three-dimensional knee joint moments in sumo style deadlift (left); the relationship between the knee abductor moment and lifting-weight (right).

Discussion

The results showed that not only the flexors and extensors but also the abductors, rotators are the mainly active muscles in sumo style deadlifts since the feet were positioned wide apart and turn outward. According to the results in this study, it suggests that the hip extensors and knee extensors are the mainly active muscles during barbell liftoff. The ankle plantarflexors are the active muscles during maximum barbell acceleration phase. The knee abductor moment reaches peak value between barbell liftoff and maximum barbell acceleration. It suggests that the knee brace is necessary for the prevention of the knee injuries in sumo style deadlifts. We found that the ankle, knee and hip joint forces and moments were linearly increased with the increase of lifting-weight. It implied that the shear joint forces may be another main factors that result in joint osteoarthritis. This information is greatly helpful for the coach to design the strength training programs.

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