HAND SUPPORT REDUCES PEAK L5/S1 MOMENTS IN ONE-HANDED LIFTING

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INTRODUCTION

Manual lifting can result in high low back loading [1] which is probably the reason that lifting is a an important risk factor for low back pain [2]. In one-handed lifting, low back loading could be reduced by using the free hand to support the upper body. This study investigates the effect of hand support on back loading in one-handed lifts of a pencil and a heavy weight, using a self-selected and a weightlifters' technique (wide foot placement and straight back). It is hypothesized that hand support reduces back loading and that the effects of hand support are larger when lifting a heavier load and when using a weightlifters' instead of a self-selected technique.

Figure 1: Subject performing supported lifts of a pencil (top) and a 25kg weight (bottom) using a self-selected (left) and weight lifters technique (right).

METHODS

Nine healthy subjects performed supported and unsupported one-handed lifts. Hand support forces exerted on the left thigh were measured using a 6-DOF force/moment transducer (Fig. 1). These support forces were used together with ground reaction forces, lower body anthropometrics and kinematics of the lower body segments and the force/moment transducer in a bottom-up 3D inverse dynamics model [3] to calculate peak total L5/S1 moment (PTM). Repeated measures ANOVAs were used to test the effects of hand support, object weight and lifting technique and their interactions.

RESULTS AND DISCUSSION

In line with the hypothesis peak support forces were higher when lifting the 25kg weight instead of the Pencil. However, no effect of lifting technique was found (Fig. 2).

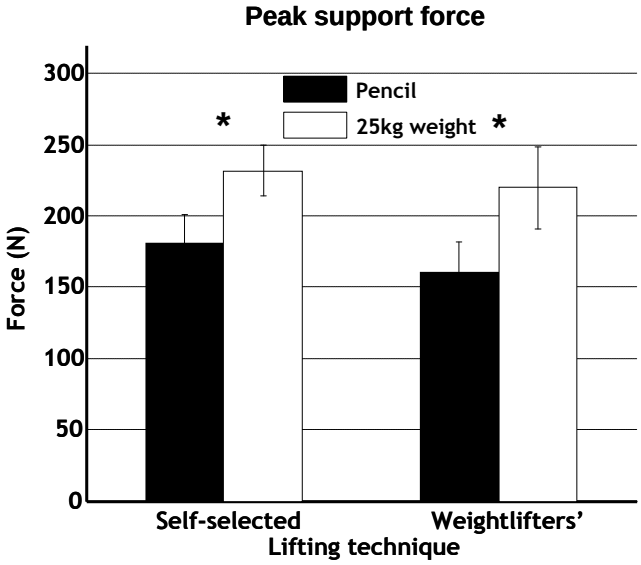

Figure 2: Peak support forces. * indicate significant differences between the lifts of the pencil and 25 kg weight. Error bar = 1 SEM.

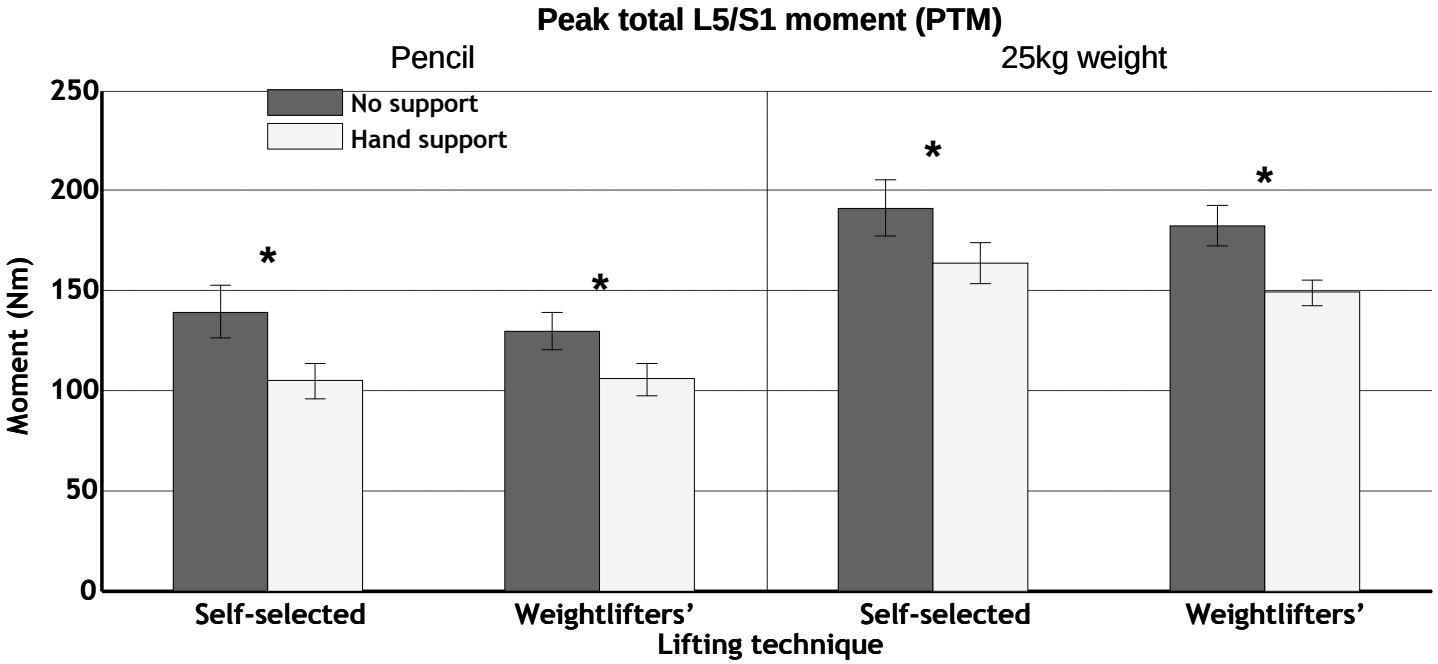

Figure 3: Peak total L5/S1 moments. * indicate significant effects of hand support. Error bar = 1 SEM.

Because the heavier lifts resulted in larger support forces, it was expected that the effect of hand support on the peak total L5/S1 moments would be larger in the 25kg lifts than in the pencil lifts. However, the ANOVA did not reveal any significant interactions indicating that the effect of hand support was independent of load mass and lifting technique (Fig. 3). On average, the effect of hand support was about 30Nm (20%). This effect appears to be low when considering the magnitude of the peak support forces (about 200N): when assuming a 0.5m moment arm of the support force, an effect of about 100Nm would be expected. The reason that the peak support forces did not result in such a large effect is because the peak total L5/S1 moment usually occurred slightly after the peak support force. At this instant in time support forces were considerably lower (around 70N). In addition, no effects of load weight or lifting technique were found at this instant in time (Fig. 4).

CONCLUSIONS

In conclusion, we found that using one hand to support the upper body during one-handed manual lifting reduced back loading by about 20%. Furthermore, the effect of hand support appeared to be independent of load weight and lifting technique.

REFERENCES

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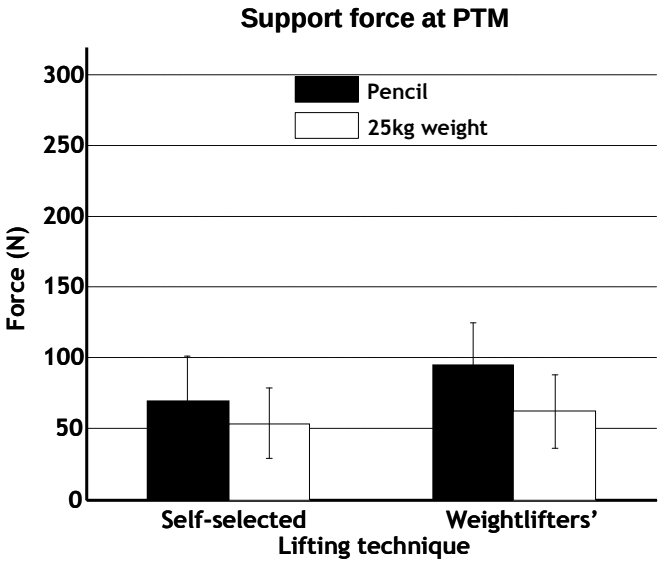

Figure 4: Support forces at the instant of PTM. * indicate significant differences between the lifts of the pencil and 25 kg weight. Error bar = 1 SEM.