LOAD COMPARISON RATIO IN SINGLE AND DOUBLE LEG MOVEMENTS

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PURPOSE

When comparing or prescribing loads for single leg (SL) squat or jump movements there is a tendency to assume that the load will be half of what an athlete performs in the double leg (DL) movement. Whilst this is a reasonable starting point, the reality is that the SL movement is more challenging and we cannot make this assumption.

AIMS

The aims of this study were to develop a theoretical model to determine the load ratio between SL and DL movements and to compare against actual force data in SL and DL Countermovement Jumps (CMJ's).

METHOD

The model was based on the segmental weight distributions acting above or rotating about the hip joint(s) in SL and DL squat or jump movements.

Segmental data of Dempster (1955) indicates that the combined body weight (BW) acting above the hips in a DL movement is 68%, that acting about the hip in a SL movement is 84% (see Figure 1).

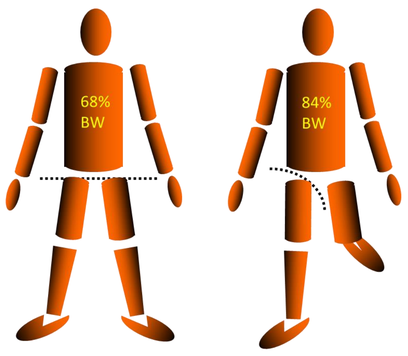

Figure 1. Segmental weight distribution acting above or about the hip joints in DL and SL movements

We can therefore estimate SL forces on the basis of the following equation:

$SL_{FORCE} = 0.81 \times DL_{FORCE}$ (equation 1),

where (68/84 = 0.81).

To test this model five male athletes (age 16 ±1 year, body mass 65.6 ±9.2kg) were tested performing DL and SL CMJ's on a Kistler force platform (type 9287B) at 1000 Hz. Peak Forces were collected over three trials and the average taken for each athlete.

RESULTS & DISCUSSION

Peak forces in the DL and SL CMJ's were 1739N ±241 and 1458N ±215 respectively corresponding to jump height performances of 37.5cm ±2.2 and 22.1cm ±2.1.

The estimated SL force from equation 1 was 1408N ±196 with a standard error between actual and predicted forces of 62N.

Assuming an equal load distribution between limbs in a DL movement, the SL movement equates to 1.62 times the intensity in one leg of the DL movement. This is supported by actual force data which was found to elicit a ratio of 1.67, highlighting that the segmental approach provides a very good estimation.

To estimate the actual additional load to elicit the same relative loading in limbs (one limb in a DL movement to that of a SL movement) then we can derive from the following equation:

$0.84\ BW + SL_{ADD.\ LOAD\ (BW)} = 0.5\ (0.68\ BW + DL_{ADD.\ LOAD\ (BW)})$

$SL_{ADD.\ LOAD\ (BW)} = [(DL_{ADD.\ LOAD\ (BW)} - BW)] / 2$ (equation 2)

Findings indicate that additional loads of less than one BW in a DL movement will not develop the same level of loading (in each leg) compared to a SL movement with no load. An additional load of one BW applied to a SL movement is the equivalent to a DL movement with an additional load of 3 BW (1/3rd of the DL additional load), (see Figure 2).

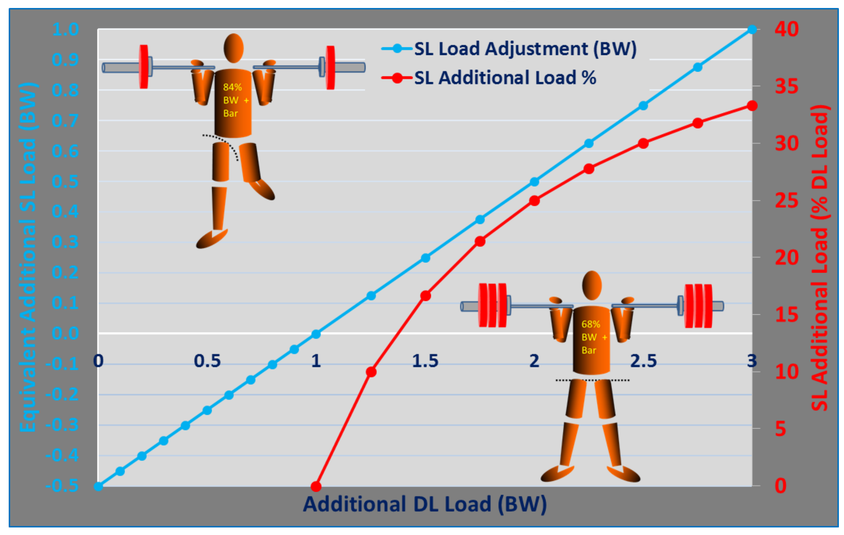

Figure 2. Comparison of additional loads in DL and SL movements

CONCLUSION:

The use of segmental analysis and the evaluation of loads acting above and around the hip joint(s) in SL and DL movements have helped to provide some logical understanding of exercise progression, the relative intensities of each and the amount of additional loading required to elicit the same levels of loading through limbs.

REFERENCES

Dempster, W.T. (1955). Space requirements of the seated operator. WADC technical report, Wright-Patterson Air Force Base, OH. pp. 55-159.

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