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EDITORIAL

Handheld dynamometers for muscle strength assessment: pitfalls, misconceptions, and facts

Clinical assessment of muscle function provides important clinical information to help with diagnosis and treatment of patients affected by a variety of neuromusculoskeletal disorders.[1,2] In the clinical setting, *muscle force output* can be measured using handheld dynamometers (HHDs).[3,4]

However, the measurements obtained with HHDs are commonly misrepresented and/or misinterpreted.[5] Reporting the raw force values measured using HHDs as the *muscle force*, is a misconception. To accurately report *muscle force output*, the force applied to the HHD needs to be multiplied by the length of the lever arm used to apply the resistance to the limb, and be expressed as a torque or moment of force as determined by the following equation,

$$\tau = \vec{F} \times \bar{d}_{\perp}$$

where $\vec{F}$ (N, or kg, or pounds) is the force measured by the HHD, and $\bar{d}_{\perp}$ (meter or inches) is the perpendicular distance (*lever arm*) from the location where the HHD is placed to the center of rotation of the joint of interest.

There are important clinical considerations to be derived from the above equation. First, the HHD needs to be oriented perpendicular to the limb of interest. Second, it is important to measure the distance between the center of rotation of the joint and the location of the HHD, even when a specific anatomical landmark (eg, above the lateral malleolus) is used, as the lever arm will vary based on the anthropometrical dimensions of each individual. Unfortunately, many published articles report strength data without taking these important methodological issues in consideration.[6–8]

An understanding of the torque-angle relationship is also necessary when interpreting muscle function as measured with an HHD. The ability to generate a torque at a given joint is based on the length-tension relationship as well as the moment arm of all participating muscles. Therefore, muscle force output (torque) measured for a joint is critically dependent on the joint angle at which the measurement is made. Therefore, the reporting and interpretation of strength data using HHD need to be made with knowledge of that joint angle at which the measurement was made.

Another relevant aspect of strength assessment that is often ignored is consideration of the torque generated by the weight of the body segment itself, which will vary based on body position, anthropometry (size of the person measured), and joint angle used for testing. This is further reason for standardization and complete reporting of testing position – especially when this factor cannot be fully controlled or torque related to the weight of the segment cannot be measured/estimated.

Highlights

Based on the above, we outline recommendations that we judge to be important in evaluating *muscle force output* or *torque* using HHD:

1 Reporting of *muscle force output* should reflect *torque* values obtained from the force applied to the HHD multiplied by the length of the lever arm used
2 Using anatomical references for HHD placement is not a substitute for the measurement of the *lever arm* as limb length varies among individuals and even within individuals over time when testing children
3 Careful consideration should be made for the position of the individual and the joint angle used for testing to control for the angle-torque relationship and minimize the influence of weight of the segment on the measurements

Conflict of interest

None.

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