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Grip Strength and Hand Force Estimation

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Abstract

Two experiments were made to (1) collect normative data of power grip and pinch grip with a newer digital dynamometer; (2) study the ability of hand grip force matching using a hand dynamometer; (3) study the accuracy of hand grip force matching using common activities as references; and (4) study the relationship between hand grip force matching and muscle activities of three forearm and hand muscles.

In experiment 1, hand grip strength (power grip and palmar pinch grip) data were collected from 120 volunteers using a digital hand dynamometer. Three different force estimation methods (force matching) were used for activities involving hand power and pinch grips. In experiment 2, four different force estimation methods were used for activities involving hand power and pinch grips among 14 subjects. Electromyograms (EMG) were collected simultaneously during the test activities.

Results showed that the power grip and pinch grip strengths collected with a newer digital dynamometer are comparable to similar studies. The normative power grip strength is 66 and 106 pounds for women and men respectively. The normative pinch grip strength is 20 and 28 pounds for women and men respectively. A 10-lb power

grip force requirement represents about 9%MVC for men and 15%MVC to women, and a 4-lb pinch grip force requirement represents about 14%MVC to men and 20%MVC to women.

Using a hand dynamometer, the force matching method is accurate and consistent in estimations of power grip force (at 10-lb level) and pinch grip force (at 2-lb level). Using the pinch/power grip forces in lifting weights as references for force matching could obtain reasonable consistent results. Accuracy can be improved when effort is made to provide subjects with proper instructions. Using other activities involving pinch and power grips as references for force matching are somewhat consistent at the group level. In practical applications, repeated tests by several people could increase the accuracy of force estimation. Accuracy can also be improved when effort is made to provide subjects with proper instructions.

The forearm flexor digitorum superficialis and first dorsal interosseous muscles play an important role in pinch force matching, and the extensor digitorum and forearm flexor digitorum superficialis muscles play an important role in power force matching.