The Toe Strength Dynamometer

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The Toe Strength Dynamometer allows you to precisely quantify toe strength deficits. The objective strength score provides the doctor and the patient clear proof of the need to perform toe exercises. The final score also provides measurable guidelines for return to sport and/or restoration of activity. The test can be performed in seconds and repeated during follow-up examinations (Fig. 1). Repeating strength scores allows you to reliably evaluate response to a home strengthening program, such as the ToePro Exercise Platform.

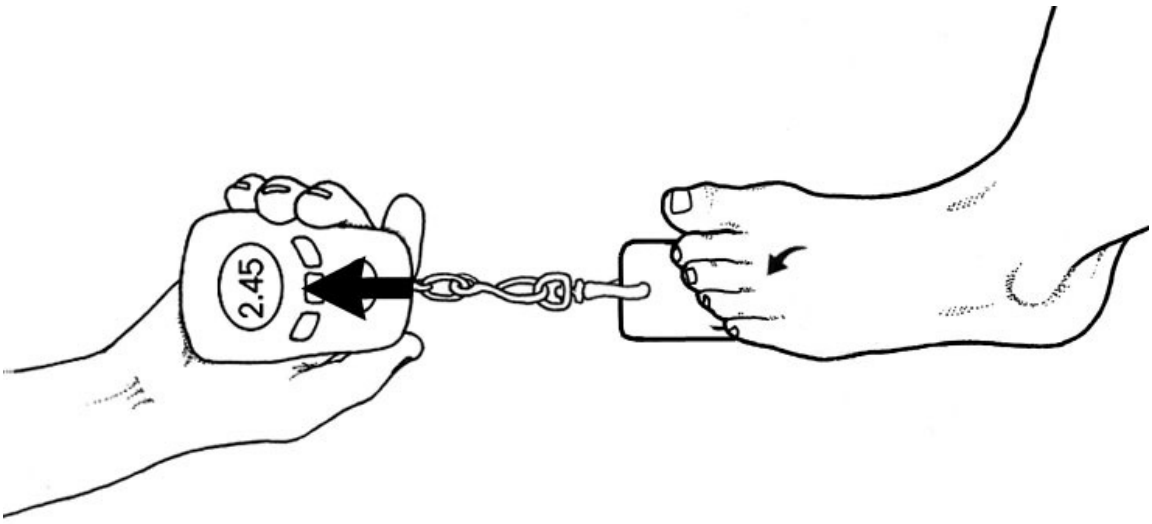

Fig. 1. The Toe Strength Dynamometer. The subject sits in a chair with the heel and forefoot flat on the floor. The examiner places the plastic card beneath the 2nd through 5th toes and pulls the device in a straight line (**arrow**) while the patient resists by gripping with the toes. Strength is recorded and the process is repeated on the other foot.

Toe weakness is an overlooked cause of a wide range of injuries, including plantar fasciitis, metatarsal stress fractures, and Achilles tendinitis (1-3). Causes of toe weakness include advanced age, compensation for a painful injury, neurological injury, and/or prolonged boot immobilization (e.g., following stress fracture or foot surgery). Aging produces the largest deficits in toe strength as by age 70, toe strength reduces by more than 35%, and the reduced toe strength has been shown to correlate with falls in the elderly (4,5).

Another common cause for toe weakness is compensation for painful injuries, particularly plantar fasciitis and Achilles tendinitis. The altered walking pattern necessary to compensate for these injuries results in disuse atrophy of the toe muscles. Toe weakness is strongly associated with chronic plantar fasciitis (1). Failure to address the underlying toe weakness may explain why 40% of patients with plantar fasciitis continue to have pain 2 years after diagnosis (6).

The most frequent cause of neurological toe weakness is an L5-S1 disc injury. Often, the only sign of motor loss is decreased endurance in the toe muscles, which is rarely evaluated. Neurologically induced toe weakness may explain why the vast majority of Achilles injuries occur on the side of prior nerve root injury (7).

Boot immobilization following stress fracture or foot surgery almost always results in large deficits in toe strength. Because boot immobilization results in more than a 1% atrophy of the arch muscles daily, just 6 weeks of wearing a walking boot can produce 35% asymmetries in toe strength. Disuse atrophy following boot immobilization explains why so many individuals develop plantar fasciitis and/or metatarsal stress fractures following tibial stress fractures: the strength deficits following boot immobilization were not corrected. Foot surgery results in even greater strength deficits and foot exercises are rarely recommended in the vast majority of post-operative treatment protocols.

An often overlooked cause of toe weakness is long-term use of orthotics. While orthotics are one of the safest and most effective methods for treating chronic heel pain, recent research shows that prolonged use of orthotics may cause the toe muscles to weaken (8). While the majority of research shows that regular orthotic use does not produce foot weakness, Jung et al. (9) show that coupling orthotic intervention with foot exercises results in significantly thicker and stronger toe muscles. Given the proven connection between toe weakness and plantar fasciitis, every individual prescribed orthotics for the management of heel pain should have their toe strength evaluated before and 6 months after regular orthotic use. In fact, given the widespread prevalence of toe weakness following injury, surgery and/or immobilization, the Toe Strength Dynamometer should be a part of every lower extremity examination.

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