Chapter 32

The Relationship between Knee Extension Strength and Activities of Daily Living in Patients with Dementia

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ABSTRACT

The purpose of this study was to examine the test-retest reliability of hand-held dynamometer measurements in patients with dementia and determine if predictions about a patient’s ability to perform daily activities can be made from knee extension strength measurements. This study was composed of two rounds of data collection. Sixty patients with dementia were enrolled in the first round to assess the reliability of hand-held dynamometer measurements, and 54 patients with dementia were enrolled in the second round for predicting their ability to perform daily activities. Knee extensor strength was measured twice, separated by a three minute interval, with hand-held dynamometer. The authors also assessed daily activities related to the patient’s lower extremities, including dressing the lower body, using the toilet, transferring to the bed/toilet/shower, and walking. Lower extremity activities of the Functional Independence Measure were assessed by the nursing home caregiver that had the most regular contact with each subject. When the Functional Independence Measure score of each lower extremity function was ≥6 points, the subject

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was considered to be independent. The intraclass correlation coefficient was 0.97. Bland-Altman plots showed the 95% difference value to be within 2 SDs of the mean. The curves of negative and positive predictive values revealed the following threshold levels: 0.8 Nm/kg was the best predictor for dressing the lower body and using the toilet; 1.2 Nm/kg was the best predictor for transferring to the bed/toilet/shower; and 0.6 Nm/kg was the best predictor for gait performance. Strength measurements taken with a hand-held dynamometer were reliable in patients with dementia, and normalized knee extensor strength was found to be a predictor of the ability to perform activities of daily living.

INTRODUCTION

Lower limb weakness can prevent a person from performing activities of daily living, such as walking, sit-to-stand transfer, climbing steps, and dressing the lower-body (Bohannon, 1995; Cheng et al., 1998; Lamoureux et al., 2002; Moreland et al., 2004; Wolfson et al., 1995; Corrigan and Bohannon, 2001; Azegami et al., 2007; Puthoff and Nielsen, 2007). As people age, they undergo an overall decline in muscle mass (Lexell et al., 1988; Sato et al., 1984; Janssen et al., 2000). This generalized loss of skeletal muscle is considered to be a major factor in the impairment of muscle strength in older adults (Janssen et al., 2002). Muscle weakness that is associated with aging is obvious in locations where the population is dramatically aging, such as Japan, the United States and Europe (Okamoto, 1992; Ory et al., 2003; Franceschi et al., 2007). Lower extremity dysfunction related to every-day life activities is also common among older adults (Boyle et al., 2007; Bennett et al., 1996; Waite et al., 2005). In particular, lower extremity dysfunction is common in elderly people with dementia (Goldman et al., 1999; Wilson et al., 2000) and increases in frequency and severity as the disease progresses (Goldman et al., 1999; Wilson et al., 2000; Scarmeas et al., 2004). For people with dementia, as well as their caregivers, lower extremity functional decline may be the most problematic aspect of the condition, as loss of function in the lower extremities is associated with cognitive decline (Bennett et al., 1998; Scarmeas et al., 2005) and death (Wilson et al., 2003; Bennett et al., 1998). Dysfunction in a patient’s lower limbs also increases the need for care and increases the risk of institutionalization. Such care accounts for the majority of disease-related costs for patients with dementia (Kinosian et al., 2000; Taylor et al., 2000).

Various methods can be used to assess muscle strength, including manual muscle testing, isokinetic and isometric dynamometry, and 1- and 2-repetition maximum testing. Because the use of fixed dynamometers is time-consuming, these instruments are not suitable for routine application in clinical practice. Furthermore, in patients with dementia, impaired balance, a diminished ability to concentrate, and an apprehension toward unfamiliar devices may impede these measurements (Brill et al., 1995). For ease of measurement, a hand-held dynamometer (HHD) may be used to quantify maximal strength and may offer several advantages over free weights, including ease of transport, time efficiency and lower costs. Isometric strength assessment of patients with dementia by means of a HHD is becoming increasingly popular due to its technical simplicity, low cost, and objectivity relative to other methods of strength testing (Brill et al., 1995). Intraclass correlation coefficients used to characterize the reliability of strength testing by HHD have been shown to range between 0.84 and 0.99, which is considered sufficient (Schaubert and Bohannon, 2005; Suomi et al., 1993). However, there is limited evidence about the reliability of strength assessment by HHD in patients with dementia (Thomas and Hageman, 2003). Furthermore, little
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