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Factors of importance for dynamic balance impairment and frequency of falls in individuals with myotonic dystrophy type 1 – A cross-sectional study – Including reference values of Timed Up & Go, 10 m walk and step test

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Abstract

Patients with myotonic dystrophy type 1 suffer from gait difficulties including stumbles and falls. To identify factors of importance for balance impairment and fall-risk a mapping of functional balance was performed, in a cross-sectional study of 51 adults. Walking, balance, falls and muscle force were self-assessed and measured. Reference values of balance were established through measurements of 220 healthy subjects. Falls were more frequently observed in the patients who were more severely affected of muscle weakness than in mildly affected patients, $p = 0.014$. The number of falls showed negative correlation with balance confidence ($r_s = -0.516$, $p < 0.001$). The ankle dorsiflexor force together with the time difference between comfortable and maximum speed in 10 m-walk proved to be significant factors for fall frequency. A ten Newton muscle force decrease showed 15% increase in odds ratio for frequent falls. One-second increase in time difference between comfortable and maximum walking speed showed 42% increase in odds ratio for frequent falls. In conclusion, assessing the ankle muscle force and the time difference in different walking speeds is important to detect risk of falling. The activities-specific balance confidence score reflects the consequences of the muscle force decrease. Certain patient strategies to diminish risk of falling could be due.

Keywords: Myotonic dystrophy; Postural balance; Muscle strength; Gait; Reference values; Physiotherapy; Self-reported falls

1. Introduction

Neuromuscular disorders include disorders in which muscular weakness is the symptom of predominance [1]. The inherited neuromuscular disorder with the highest prevalence among adults is myotonic dystrophy type 1 (DM1) [1,2]. Several aspects of DM1 could lead to impairment of balance and walking. The most obvious is the muscle affection, characterised by muscle weakness and myotonia [3]. There are also cognitive deficits linked to the disorder [4].

Many factors have been shown to increase the fall risk in elderly people. These factors include: reduced muscle strength, impairments of systems contributing to postural balance (the visual, vestibular and sensory systems) and

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an increasing number of chronic disabilities such as heart failure, diabetes [5,6]. In a way the middle-aged DM1 population shows similarities with the elderly [7].

The normal human postural balance is a result of many cooperating systems [8]. The understanding of postural balance includes responses to different movements of the body in relation to the ground. Steady state stability refers to maintaining a taken position, and the pro-active, anticipatory stability will help the body, during a foreseen movement, to keep a stable position [8]. In the clinic, measures of the steady state and the anticipatory stability are made with so-called static and dynamic balance tests. In this paper we use these concepts. Dynamic balance is defined as a subject's ability to manage dynamic balance tests. A reliability study of clinical balance tests in a DM1 patient group showed great test–retest reliability in the dynamic tests [9]. The analysis of disagreement showed high variability in the steady state tests, and a higher congruence in the dynamic balance tests. There is a lack of reference values for dynamic tests in younger adults, as the tests mainly have been used in geriatric patients.

A Welsh study has shown that the frequency of stumbles or falls in DM1-individuals is increased tenfold in relation to their activity level, compared to healthy controls [10]. The authors concluded that distal weakness combined with knee and hip weakness particularly might predispose to a loss of pillar support after a minor perturbation in stance. Twenty individuals with DM1, participating in a 6-week rehabilitation program, reported a mean frequency of falls of 1,5 fall per month (range 2 per week to 1 per year) [11]. The authors discuss the impact of cognitive limitations on this patient group, especially on the domains of gait and balance. Some patients did not acknowledge their balance impairments at start; some even denied it. The factors of increased fall risk in DM1 have not yet been fully explored. The weakness in leg muscles, the cognitive deficits and the fatigue could all contribute to the impaired balance resulting in frequent stumbles and falls.

The objectives of this study were the following in individuals with DM1:

- To map self reported gait ability, balance confidence, and falls, together with measures of walking and dynamic balance in relation to muscular impairment and a healthy reference group.
- To map isometric muscle force in relation to gender and in relation to published reference values.
- To identify factors of importance for dynamic balance impairment and risk of frequent falls.

In addition,

- To establish reference values in healthy men and women, 20–59 years old for timed 10 m walk, step test and Timed Up & Go.

2. Patients and methods

2.1. Patients

All 72 eligible individuals between 20 and 60 years of age with genetically proven DM1 at the Neuromuscular Centre, Sahlgrenska University Hospital, were invited by letter, and/or by phone call to participate in the study, which was performed in 2006–2007. The ability to stand up from an armchair (45 cm high) and walk two times 3 m with or without handheld gait aids was required as minimum mobility to enrol in the study. Exclusion criteria were: congenital form of DM1 (where intellectual disability is common) or other disorders that could interfere with the postural balance.

2.2. Reference group

A healthy reference group was recruited by announcement in different work places (hospital, university, chemical factory, school, geriatric care) for establishing reference values in the dynamic balance tests including timed gait. The intention was to recruit twenty subjects in each gender for each age-decade. The individuals had to assert an absence of balance problems.

2.3. Procedures

The self-assessments and physical examinations were performed at a single visit at the clinic. The patients filled in the questionnaires during the first part of the visit, in order not to be affected by their performance in the balance tests. All patients got the support they needed to answer the questions. One experienced physiotherapist examined each patient and demonstrated the positions in the balance tests. Resting pauses between the tests were allowed and encouraged. The timing was performed with an electronic stopwatch with an accuracy of 1/100 s. Three different examiners (one experienced physiotherapist and two physiotherapy students), made the measurements of the reference group. A subgroup of the reference group, consisting of the individuals assessed by one of the examiners ($n = 43$), filled in a questionnaire concerning number of falls during last year and activity-specific balance confidence.

2.4. Ethical considerations

The study participants gave their written, informed consent to participate in the study and knew that they could refuse further participation without any impact on further treatment. The study was approved by the Regional Council of Ethical Vetting in Gothenburg, Sweden, dnr 248-06.