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Relationship between muscular strength, gait and postural parameters in multiple sclerosis

Étude des corrélations des forces musculaires avec les paramètres de marche et d'équilibre dans une population de sclérosés en plaques

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Abstract

Objective. – To evaluate muscle strength, balance control and gait capacity in patients with multiple sclerosis (MS) and to study the correlations between these parameters.
Patients and methods. – Twenty MS patients were evaluated in terms of knee muscle strength, gait and balance parameters. These evaluations were performed using an isokinetic dynamometer (the Cybex II®), a Bessou gait analyzer and a Satel® force platform, respectively. The patients' results were compared with those of a healthy control group.
Results. – Hamstring and quadriceps peak torque values were lower in the MS group than in the control group. The sway area was greater in the MS group under eyes-open and eyes-closed conditions. The MS patients displayed lower gait speed, cadence and stride length. Hamstring and quadriceps strength values were significantly correlated with posture and gait parameters.
Conclusion. – The present study revealed the value of an overall evaluation of knee muscle strength, gait and posture in MS patients.

Keywords: Multiple sclerosis; Strength; Isokinetic; Gait; Balance

Résumé

Objectif. – Mesurer les forces musculaires, les capacités d'équilibre et de marche dans une population de sclérosés en plaques et d'étudier les corrélations entre ces différents paramètres.
Patients et méthodes. – Vingt patients ayant une sclérose en plaques (SEP), ont bénéficié d'une évaluation de la force musculaire des genoux, de la marche et de l'équilibre. Cette évaluation a été réalisée respectivement par l'appareil isocinétique Cybex II®, le locomètre de Bessou et la plateforme stabilométrique SATEL®. Les résultats de ces mesures ont été comparés à un deuxième groupe sain.
Résultats. – Les pics de couple moyens des patients atteints de SEP sont inférieurs à ceux de la population saine au niveau des ischio-jambiers et des quadriceps. La surface et la longueur totale du stabilogramme étaient plus importantes dans ce groupe en condition yeux ouverts et fermés. Une réduction de la vitesse, de la longueur de l'enjambée et de la cadence a été retrouvée dans le groupe SEP. Des corrélations significatives ont été retrouvées entre les forces des quadriceps et des ischio-jambiers avec les paramètres de marche et de l'équilibre.
Conclusion. – Cette étude témoigne de l'intérêt d'une évaluation globale chez les patients ayant une SEP portant sur les forces musculaires, la marche et l'équilibre.

Mots clés : Sclérose en plaque ; Force ; Isocinétisme ; Marche ; Équilibre

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1. English version

1.1. Introduction

Multiple sclerosis (MS) is a demyelinising, inflammatory disease of the central nervous system. It is the most frequent neurological disease in young adults. The prevalence of MS is greater in Northern Europe. There is clear female predominance, with an F/M gender ratio of 2:1. Onset occurs between the ages of 20 and 40 in 70% of cases, with a peak at 30. The progressive forms of MS (in which long-term treatment is indicated) have been classified in international consensus statements. Four subtypes are generally described: the relapsing remitting subtype (the most frequent form, characterized by successive remissions and relapses which may or may not leave sequelae), the secondary progressive subtype (in which patients with initially relapsing-remitting MS show increasing neurological decline during remissions), the primary progressive subtype (characterized by progressive worsening after the initial symptoms) and the progressive relapsing subtype (characterized by a steady decline that is nevertheless interspersed with relapses) [16,26,28,41,44,45].

Although between 10 and 40% of cases are benign [24], MS can lead to severe handicap. Over the course of the disease, a patient's functional capacities may worsen to a variable extent.

Changes in balance control in MS have already been reported [33,38]. This type of evaluation is based on either clinical measurements (mainly using generic scales) or posturographic measurements. A validated, MS-specific scale ''A short measure of balance in MS'' has been suggested [39].

Furthermore, gait disorders are frequent [12,40] and constitute the first signs of MS in 10 to 20% of patients. After several years of disease progression, gait disorders are observed in over 50% of patients [12]. After 18 years of disease progression, half of all patients will be unable to walk unaided [12,44,45].

Several studies have focused on the clinical evaluation of gait in MS [25,42,29]. Gait speed constitutes a pertinent functional parameter for ambulatory patients [5]. In practice, this is measured by the time needed to walk 8 or 10 m [5]. Other tools have been used to evaluate gait capacities in MS but have not been comprehensively validated.

Few studies have focused on the quantitative analysis of motor strength in general and isokinetic measurements in particular [29,21,11].

The correlations between muscle strength, postural capacities and gait have rarely been studied [29,11].

Over recent years, the quantification of these parameters and the analysis of their correlations have changed the way we manage patients with central nervous system damage and gait disorders [31]. Patient management programmes now involve a number of more analytical rehabilitation methods – principally strength training exercises and particularly those based on isokinetic paradigms [35].

The objective of the present study was to:

- measure muscle strength, balance control and gait capacity in a population of MS patients;
- compare the patients with a healthy population and;
- study the correlations between these various parameters, with a view to sharpening the focus of the rehabilitation protocols used in this disease.

1.2. Patients and methods:

1.2.1. Patients

We have recruited 20 patients (group G1) consulting the outpatient neurology clinic at Habib Bourguiba University Hospital (Sfax, Tunisia). There were no age restrictions. We included patients with relapsing remitting MS, no relapse within the previous 6 months and an expanded disability status scale (EDSS) score below 6 (as evaluated by a neurologist). The diagnosis of MS had also been made by a neurologist, according to the criteria published by Poser et al. [34].

Patients with cognitive disorders, severely impaired visual function, a severe psychiatric disorder or severe arthritis of the knees and/or hips or those experiencing a relapse were excluded from the study.

The EDSS scale [27] is used worldwide to evaluate MS. It is a basic scale for evaluating neurological status and is notably used for making treatment decisions. The score ranges from 0 to 10: a score of 0 corresponds to a normal neurological examination, whereas a score of 6 or more corresponds to limited walking ability and the need to use a technical aid for walking. The spasticity scores for the quadriceps and hamstring muscles were below 3 on the modified Ashworth scale [8], enabling the isokinetic evaluation of these knee muscles. We used the modified Ashworth scale because it is the gold standard for spasticity evaluation and is frequently used in the literature: the score ranges from 0 (no muscle tone disorders) to 4 (one or more rigid limb segments in flexion or extension).

This comprehensive examination was completed by an evaluation of overall function using the functional independence measure (FIM) [14], a simple performance scale.

Patients were provided with comprehensive information on the study protocol and gave their verbal consent to participate.

1.2.2. Methods

Balance was evaluated first (i.e. before the isokinetic testing), in view of the risk of fatigue-related bias. We used a Satel® force platform. This balance analysis technique is based on measurement of the centre of pressure's sway in a standing subject [22] and enables calculation of the intensity and vector of the ground reaction forces, with a recording time of 51.2 seconds and a sampling frequency of 40 Hz. The patient stood upright on the platform with bare feet and with his/her arms by the side. He/she was instructed to stand as still as possible and to look horizontally at a wall about 1.5 m in front (with no particular visual target). The evaluation was performed under static conditions with the eyes open (EO) and then closed (EC).

The following parameters were used to assess balance: the postural sway area (in mm^2, corresponding to the surface area