Foot & Ankle: Studies

Open Access

Austin Publishing Group

Research Article

Foot Posture after MS and Functional Consequences

Alireza Taheri*; Saeed Forghany; Vahid Shaygannejad; Mostafa Kamali

Department of Orthotics and Prosthetics, School of Rehabilitation Sciences, Isfahan University of Medical Sciences, Isfahan, Iran

***Corresponding author: Alireza Taheri**

Department of Orthotics and Prosthetics, School of Rehabilitation Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

Email: taheri@rehab.mui.ac.ir

Received: July 17, 2023

Accepted: August 31, 2023

Published: September 07, 2023

Abstract

Background: Clinical convention suggests that foot posture and movements are adversely affected by MS and cause walking difficulties but there is little objective data to support or refute these beliefs. This study explores static foot posture in people with MS and their relationship to walking disability and limitations

Materials and Methods: This is a cross-sectional study that was conducted in the multiple scoliosis specialist department of Kashani Hospital in Isfahan on 44 patients with MS with mobility limitations. The indices for determining Foot Posture Index (FPI), demographic characteristics, Expanded Disability Status Scale (EDSS), and walking scale (msws-12) were investigated.

Results: About one-third of participants had abnormal foot posture, which wasn't associated with walking limitations. Most (80%) had a symmetrical foot posture with similar frequencies of supination (9%) and pronation (11/5%) abnormalities. There was no relationship between foot posture and walking limitation and expanding disability.

Conclusions: A minority of people with MS had abnormal or asymmetrical foot posture and equal numbers suffered pronation and supination abnormalities; these findings challenge the beliefs that underpin the clinical management of MS-related foot problems.

Keywords: Multiple sclerosis; Walking; Foot posture; Disability

Background and Aim

Multiple Sclerosis (MS) is a common cause of functional disorder in persons of able-bodied age. The female to male ratio is about 2:1. The disease is commonly divided into a relapsing remitting form and a progressive form (primary or secondary) [1].

Regaining mobility is a priority for MS survivors and rehabilitation [2]. There is extensive literature on gait abnormalities after stroke but Clinical Rehabilitation can't information on the impact of MS on the foot. The foot is a highly complex and adaptable functional unit [3-5] and its problems are related to mobility limitations in other chronic conditions [6-8]. The shape of the foot or static foot posture is generally believed to be a significant predictor of foot function [9]. The significant relationship between foot posture and dynamic foot function, lower limb function and walking ability have been demonstrated in normal subjects and patients with musculoskeletal and neurological disorders [10-13].

Age-related changes in the static foot posture have been reported through several cross sectional studies; the older subjects have been shown to have more pronated feet compared to the younger adult population [14,15].

As the first report of a programme of work to develop evidence-based interventions for foot problems after MS, we undertook a nature of foot abnormalities and the relationships between foot abnormalities, MS-related impairments and mobility limitations in people with MS. Given the lack of previous work in this field, we addressed this aim by investigating five prevailing beliefs that underpin clinical reasoning and decision-making [16,17].

The impairments we investigated were walking disability; .foot posture is related to walking ability – MS survivors with more severe abnormalities will have more limited walking ability.

Method and Material

The study used a cross-sectional survey design. MS survivors who could stand without assistance and were able to give informed consent were recruited from the MS services of kashani hospital. Participants were excluded if they had another mobility limiting condition or lower limb. If they were interested, the project was explained to them and the information sheet given.

Citation: Taheri A, Forghany S, Shaygannejad V, Kamali M. Foot Posture after MS and Functional Consequences. Foot Ankle Stud. 2023; 5(1): 1029.

After informed consent was obtained, the following were measured: static foot posture (Foot Posture Index); Expanded Disability Status Scale (EDSS Index) and walking scale (MSWS-12). All testing was undertaken in a one-off measurement session at the ward, clinic. Testing took about 10 minutes. Age, sex, height, weight were also recorded.

Static foot posture was measured in a standing position since a weight-bearing measure better represents foot function compared to non-weight bearing measures and have a high correlation with dynamic foot function [15,18]. The six item Foot Posture Index (FPI6) was selected as the most appropriate clinical measure of foot posture in people with MS. It is a six item scale that observes the posture of the rearfoot and forefoot in multiple planes, defining foot position as normal, supinated or pronated of course It is reliable, valid, and easy to use [13,19]. FPI can identify foot posture changes in pathological conditions such as neurological disorders [15] and predicts dynamic foot function, midstance posture during normal walking [13]. It is quick and easy to use in clinical settings [15] and adequate component, concurrent and predictive validity and inter and intra-tester reliability of FPI has been reported [13,19,20] and healthy older adults [21].

Assessing symmetry of foot posture: the FPI is a two-tailed scale in that a negative score Forghany et al. indicates a different type of deficit to a positive score [22].

Activity limitation and impairment were measured on admission and discharge of the rehabilitation trial using the motor sub-items of the Expanded Disability Status Scale (EDSS) score [23-26] Such findings highlight the poor sensitivity of current clinical assessment tools including the Expanded Disability Status Scale (EDSS), which is the MS-specific outcome measure most widely used in current clinical practice and experimental trials. Although scoring of the EDSS is heavily weighted towards mobility dysfunction in the middle and higher ranges of the scale, it is insensitive to subtle functional impairments at the lower end of the scale [27]. EDss divided to sub title: full ambulatory score was1-4/5 and ambulatory 5-8 [23].

Walking ability at home and in the community is an indicator of an individual's ability to participate in activities of daily living [28] and is used to assess walking handicap [29]. Walking ability was assessed using Scale-12 (MSWS-12) is a 12-item patient-rated measure of the impact of MS on walking and patients were categorized as either household or community walkers according where they were able to walk using a self-reported questionnaire. We provide evidence that both confirms and extends the validity of inferences from scores of the MSWS-12 as a measure of the impact of MS on walking in a community-based sample of individuals with MS [24]. The MSWS-12 satisfies standard criteria as a reliable and valid patient-based measure of the impact of MS on walking [30]. The MSWS-12 satisfies standard criteria as a reliable and valid patient-based measure of the impact of MS on walking. In these samples, the MSWS-12 was more responsive than other walking-based scales [31].

However as the data was collected by one person on a single testing session this was not felt to be a critical short-coming for the current study.

Ethical approval was obtained from musculoskeletal Research center Ethic Committee of faculty rehabilitation.

SPSS version 16.0 was used to conduct statistical analyses. Our predetermined alpha level of significance was set at .05 for all statistical procedures. To determine appropriate parametric or nonparametric statistical tests, Shapiro-Wilk statistics checked the normality of distribution of the data sets. Parametric tests were employed in cases of normal distribution.

To compare the FPI in different groups, independent t-tests, paired t-tests, one way ANOVAs or nonparametric counterparts (Man-Whithney, Wilcoxon and Kruskal-Wallis, respectively) were employed. Correlations were determined using Pearson or Spearman statistics as appropriate.

Results

Fourty four MS subjects (8 men and 36 women, age 36.47±9.07 years, height 1.63±9.56 meters, weight 63.02±14.55 kilograms were recruited.

All subjects walked without any assistive device during the test.

In MS subjects, the mean score of total EDSS (3.87±1.99) and MSW (3.54±.15), EDSS: full ambulatory (%59.1) and Ambulatory Impairment %40.9). The mean score of total Right foot FPI (Most MS subjects (%59.1) showed normal foot posture on the affected side and abnormal %40.9). When there was an abnormal foot posture, pronation was more common than supination.

Right foot FPI (%6.8 of the affected feet were in the supinated range, %59.1 normal and %34.1 pronated). the mean score of total left foot FPI (abnormal %36.4 and normal %63.6), left foot FPI (%9.1 of the affected feet were in the supinated range, %63.6 normal and %27.3 pronation).

Fifteen (25%) participants had abnormally pronated feet, 16 (22%), were in the 'abnormal' range. Eleven (16%) were abnormally supinated. None were highly abnormal.

Most participants had a symmetrical foot posture, only 6 (13.6%) were asymmetrical.

The binary logistic regression model showed age, walking and symmetry index to be nonsignificant predictors ($P<0.05$).

There was no difference between the right and left sides of the healthy aged-matched subjects. Table 1 shows the distribution of participants across the five categories of symmetry FPI labeled as relative foot types and asymmetry FPI.

Table 1:

Symmetry and Asymetry FPI (Relative foot types)		Frequency (n)
Symmetrical	both normal	24(54.5 %)
	both abnormal pronated	11(25%)
	both abnormal supinated	3(6.8%)
	Right more pronation	5(11.4%)
	Right more supination	1(2.3%)
Asymmetrical		6(13.6%)
Total		44(100%)

Discussion

The results of the clinical evaluation of foot posture variations after MS showed that about one half of MS subjects suffered from abnormal foot posture with limitation in functional walking ability. The aim of this study was to investigate the effects of MS on the foot and ankle.

The supination of the rear foot in late stance is vital for the foot to form a propulsive lever to transfer the body weight to the opposite side [32,33].

To the best of our knowledge, this is the first survey of foot

abnormalities after MS and so there are no data with which to compare, but it is widely believed in clinical practice that foot deformities are common in people with MS and cause walking difficulties [9,10]. These results challenge those clinical beliefs; only about one half of participants had an abnormality. Clinical texts state that the primary influence on foot abnormalities is abnormal muscle control [9,10] but we found no significant relationship between foot abnormalities and EDSS and Walking limitation Our results suggest that most patients would not need adjustment to either side of their foot as their foot posture is normal. Although those with abnormal pronation may benefit from a medial wedge; those with abnormal supination would require a Clinical Rehabilitation lateral wedge. Some studies have suggested using a lateral sole wedge on the affected or non-affected side to improve balance or other gait parameters [27,28], but our data suggest that this may adversely affect the feet of many MS patients. Research on healthy participants has shown that a lateral wedge may increase the velocity of muscle plantarflexor and invertor muscle lengthening [29-31].

Our results suggest a relationship between foot posture and walking ability in that foot abnormalities were more frequent in people who could only walk indoors compared to those who were 'community walkers'.

The association between foot posture and mobility is not surprising as the foot is the only source of direct contact with the ground and is therefore likely to influence weight-bearing activities. Despite this, none of the 'household walkers' in the present study had received treatment to correct their abnormal foot posture. Further studies to develop effective patient care pathways to address foot posture abnormalities are indicated. There are several limitations to this exploratory study. As this is the first report of foot problems after MS, we had no data with which to calculate the sample size, and this was decided pragmatically based on the resources available. Consequently, the areas in which we did not find significant differences may have been under powered. We also recruited a convenience sample and this may limit generalisability of the results. However, we screened all MS admissions to one large acute hospital for three months and the recruited samples are similar to other studies of MS survivors with limited mobility, so we are confident that we recruited a representative sample.

Finally, our measurements were restricted to those we could feasibly undertake in busy clinical areas which restricted the positions in which we could take the measures and the tools we could use. We only measured foot posture while standing, but functionally important abnormalities may only become apparent during dynamic activities (especially walking). Furthermore, the measurement tools we used gave robust data but are relatively insensitive and may have failed to detect minor changes such that the full association between impairments functions and foot posture may have been underestimated. The scale has not been independently validated for use in differing MS populations patients in the hospital outpatients with MS completed the MSWS-12 and other outcome measures [3]. Further research using 3-D movement and muscle activity analysis while standing and walking would allow a more comprehensive assessment.

Limitations

In our study, the static position of joints was selected as reference or zero points and joint angles were calculated relative to the values corresponding to those positions.

MS is a multi-factorial pathology which could affect segments in different directions. This was demonstrated by great variability observed in the kinematic pattern of foot joints in our MS population.

References

1. Jonsson. A, Ravnborg. MH, rehabilitation in multiple sclerosis. Critical reviews in physical and rehabilitation. Medicine. 1998; 10: 100.
2. Bohannon RW, Andrews AW, Smith MB. Rehabilitation goal of patients with hemiplegia. Int J Rehabil Res. 1988; 11: 181-4.
3. Lundgren P, Nester C, Liu A, Arndt A, Jones R, Stacoff A, et al. Invasive in vivo measure¬ment of rear-, mid-and forefoot motion during walking. Gait Posture. 2008; 28: 93-100.
4. Nester C, Jones RK, Liu A, Howard D, Lundberg A, Arndt A, et al. Foot kine¬matics during walking measured using bone and surface mounted markers. J Biomech. 2007; 40: 3412-23.
5. Nester CJ, Liu AM, Ward E, Howard D, Cocheba J, Derrick T et al. In vitro study of foot kinematics using a dynamic walking cadaver model. J Biomech. 2007; 40: 1927-37.
6. Molenaar ETH, Voskuyl AE, Dijkmans BAC. Functional disability in relation to radiological damage and disease activity in patients with rheumatoid arthritis in remission. J Rheumatol. 2002; 29: 267-70.
7. Turner DE, Woodburn J. Characterising the clinical and biomechanical features of severely deformed feet in rheumatoid arthritis. Gait Posture. 2008; 28: 574-80.
8. O'Connell PA, D'Souza L, Dudeney S, Stephens M. Foot deformities in children with cerebral palsy. J Pediatr Orthop. 1998; 18: 743-7.
9. Razeghi M, Batt ME. Foot type classification: a critical review of current methods. Gait Posture. 2002; 15: 282-91.
10. Cowan DN, Jones BH, Robinson JR. Foot morphologic characteristics and risk of exercise-related injury. Arch Fam Med. 1993; 2: 773-7.
11. Dahle LK, Mueller MJ, Delitto A, Diamond JE. Visual assessment of foot type and relationship of foot type to lower extremity injury. J Orthop Sports Phys Ther. 1991; 14: 70-4.
12. O'Connell PA, D'Souza L, Dudeney S, Stephens M. Foot deformities in children with cerebral palsy. J Pediatr Orthop. 1998; 18: 743-7.
13. Redmond AC, Crosbie J, Ouvrier RA. Development and validation of a novel rating system for scoring standing foot posture: the Foot Posture Index. Clin Biomech (Bristol Avon). 2006; 21: 89-98.
14. Scott G, Menz HB, Newcombe L. Age-related differences in foot structure and function. Gait Posture. 2007; 26: 68-75.
15. Redmond AC, Crane YZ, Menz HB. Normative values for the Foot Posture Index. J Foot Ankle Res. 2008; 1: 6.
16. American Academy of Orthopaedic Surgeons, Goldberg B, Hsu JD, editors. Atlas of orthotics and assistive devices. 3rd ed. New York: Mosby; 2008.
17. Hunt GC, Mcpoil TG. Physical therapy of the foot and ankle. 2nd ed. New York: Churchill Livingstone; 1995.
18. McClay IS. Report of "Static and dynamic classification of the foot" meeting, Annapolis, Maryland,May 2000. J Orthop Sports Phys Ther. 2001; 31: 158.

19. Evans AM, Copper AW, Scharfbillig RW, Scutter SD, Williams MT. Reliability of the foot posture index and traditional measures of foot position. J Am Podiatr Med Assoc. 2003; 93: 203-13.

20. Yates B, White S. The incidence and risk factors in the development of medial tibial stress syndrome among naval recruits. Am J Sports Med. 2004; 32: 772-80.

21. Menz HB, Morris ME. Clinical determinants of plantar forces and pressures during walking in older people. Gait Posture. 2006; 24: 229-36.

22. Forghany S, Tyson S, Nester C, Jones R, Preece S. Effect of lateral wedges on lower leg muscle length and potential for exacerbating spasticity. Gait Posture. 2008; 28: S105-6.

23. Mokkink LB, Galindo-Garre F, Uitdehaag BM. Evaluation of the Multiple Sclerosis Walking Scale-12 (MSWS-12) in a Dutch sample: application of item response theory. Mult Scler. 2016; 22: 1867-73.

24. Motaharinezhad F, Parvaneh S, Ghahari S. Multiple sclerosis walking Scale-12 (MSWS-12) and its relationship with fatigue in people with multiple sclerosis. Func Disabil J. 2020; 3: 53-60.

25. Zuber P, Tsagkas C, Papadopoulou A, Gaetano L, Huerbin M, Geiter E, et al. Efficacy of inpatient personalized multidisciplinary rehabilitation in multiple sclerosis: behavioural and functional imaging results. J Neurol. 2020; 267: 1744-53.

26. Decavel P, Sagawa Jr Y. Gait quantification in multiple sclerosis: A single-centre experience of systematic evaluation. Neurophysiol Clin. 2019; 49: 165-71.

27. Ayan H, Ertekin Ö, Kahraman T, Özakbaş S. Balance and gait impairment in persons with multiple sclerosis with the absence of clinical disability. Turk J Neurol. 2020; 26: 224-9.

28. Perry J, Garrett M, Gronley JK, Mulroy SJ. Classification of walking handicap in the stroke popu¬lation. Stroke. 1995; 26: 982-9.

29. van der Veen S, Evans N, Huisman M, Welch Saleeby P, Widdershoven G. Toward a paradigm shift in healthcare: using the International Classification of Functioning, Disability and Health (ICF) and the capability approach (CA) jointly in theory and practice. Disabil Rehabil. 2022: 1-8.

30. Gasper JM, Lewis M, Kroeger A, Muz B, LaRocca N, Frankel D. Multiple sclerosis adult day programs and health-related quality of life of persons with multiple sclerosis and informal caregivers. Int J MS Care. 2020; 22: 187-92.

31. Dalgas U, Langeskov-Christensen M, Skjerbæk A, Jensen E, Baert I, Romberg A, et al. Is the impact of fatigue related to walking capacity and perceived ability in persons with multiple sclerosis? A multicenter study. J Neurol Sci. 2018; 387: 179-86.