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Title

The effect of two ankle foot orthoses (AFO's) in drop foot.

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Summary

This study aims to compare two different AFO's for drop foot, during the gait in multiple sclerosis (MS) patients using the 2-minute walk test (2MWT), Orthotics and Prosthetics Users' Survey (OPUS) and Kinovea. Comfort and satisfaction appeared to be important in functional capacity.

Introduction/ Basics

MS is a chronic degenerative disease that can lead frequently to drop foot(1). Drop foot frequently affects the gait cycle, particularly in the loading response subphase and in the swing phase, increasing the compensatory movements in the gait of the patient(2). Physical ability is very important in the health and daily living of these patients, and therefore it is important to measure it(3). There are several evaluation tests, as the self-reported questionnaires or the walk tests, such as the 6-minute walk test and the 2MWT(4). The use of 2-dimensional video gait analysis is one of the most common methodologies to support the changes in the human gait(5). There is a wide variety of AFO's that can be used to rehabilitate the lower limb affected with drop foot, with different characteristics, such as the Toe-Off® or Boxia®. Toe-off® is a carbon fibre AFO with a cushioned anterior splint(6) and Boxia® is a dorsiflexor assistive device with a band above the malleolus and an elastic(7).

Methods/ work process

The subjects in this study were MS patients with unilateral drop foot, non-users of any type of AFO and independent walkers. A physical exam was performed to assess other types of spasticity or other anomalies in the ankle, foot or other joint. The subjects performed the 2MWT with each AFO (Toe-off® and Boxia®), at a self-selected walk speed in a walkway of 15 meters. Between the use of both AFO. There was a rest time of at least 5 minutes, to fill the

OPUS forms. Motion capture was obtain with a smartphone camera with a frame rate of 29,97 frame per second, located in a range of 2,5 meters of theof the principal sagittal plan. Video gait analysis of the lower limb sagittal angles was performed with Kinovea® software. All the participants were given a unique code to maintain anonymity of the collected data. This study was approved by the Ethics Committee of Escola Superior de Tecnologia da Saúde de Lisboa.

Implementation

3 participants ended the tests. "Patient_1" walked 51.5 meters in the 2MWT with the Boxia®, 5.4 meters more when compared when using the Toe-off®. This subject also had a superior score in OPUS with Boxia® (66 points compared to 27 points). "Patient_2" walked 111.4 meters and had a better score in OPUS (73) with the Toe-off®. "Patient_3", using the Toe-off®, walked more in the 2MWT (94.2 meters opposing to 87.7 meters) and had a higher score in OPUS (67 compared to 61). On joint velocity, "Patient_1" had a stride time of 1.60 seconds with Boxia® and 1.64 seconds with Toe-off®. "Patient_2" had a stride time of 1.23 seconds with Boxia® and 1.20 seconds with Toe-off®. "Patient_3" had a stride time of 1.27 seconds with Boxia® and 1.10 seconds with Toe-off®. In "Patient_1" in stance phase, Boxia® allowed a Peak Dorsiflexion Angle (PDA) of 15°, and Toe-off® 14°. Both AFO's allowed a Minimum Dorsiflexion Angle (MDA) in of -2°. In swing phase both AFO's allowed 10° of PDA and an MDA of -2°. In "Patient_2", in stance phase, Boxia® allowed a PDA of 6°, and Toe-off® 13°. The MDA with Boxia® was -9° and using Toe-off® was -5°. In swing phase, with Boxia® the PDA was -5° and with Toe-off® was -1°. The MDA was -21° with Boxia® and -14° with Toe-off®. In "Patient_3", in stance phase, Both AFO's allowed a PDA of 12°. The MDA with Boxia® was -3° and using Toe-off® was -1°. In swing phase with Boxia® the PDA was 10° and with Toe-off® was 13°. The MDA was -5° with Boxia® and -2° with Toe-off®

Conclusion

This study focused on the immediate effects of two AFO designs within each patient. It seems to exist a relation between the submaximal level of functional capacity (better results in 2MWT) and satisfaction and comfort reported, with patients with more comfort and satisfaction presenting more functional capacity. The comfort and satisfaction appear to have an important role in the submaximal level of functional capacity. This comfort also affected the 3 joints

velocity, with "Patient_2" and "Patient_3" presenting more comfort and slightly more velocity using Toe-off®, and "Patient_1" presenting more comfort and slightly more velocity with Boxia®. In general, all the subjects, when they used Boxia®, presented more ROM variation in the gait cycle, mostly allowing more movement in plantarflexion. Toe-off® prepositioned the ankle in a more dorsiflexed position in all the patients in several gait phases, and thus better toe clearance. This study had some limitations. Foremost, our sample size was small, with three participants. The filtering of a population may lead a more real results related with a specific population or subpopulation of MS patients with drop foot, being more, or less capable. The contralateral limb could also be considered for this study, in a way to assess the balance and/or asymmetry with the non AFO user limb. It could be evaluated the individuals without AFO, in a way to set a baseline.

References

1. Leddy S, Dobson R. Multiple sclerosis. Med (United Kingdom). Published online 2020. doi:10.1016/j.mpmed.2020.06.008

2. Graham J. Foot drop: Explaining the causes, characteristics and treatment. Br J Neurosci Nurs. Published online 2010. doi:10.12968/bjnn.2010.6.4.47792

3. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 10th ed. (Riebe D, Ehrman J, Liguori G, Magal M, eds.). LWW; 2017. doi:10.5860/choice.35-6295

4. Scalzitti DA, Harwood KJ, Maring JR, Leach SJ, Ruckert EA, Costello E. Validation of the 2-minute walk test with the 6-minute walk test and other functional measures in persons with multiple sclerosis. Int J MS Care. Published online 2018. doi:10.7224/1537-2073.2017-046

5. Robertson DGE, Caldwell GE, Hamill J, Kamen G, Whittlesey SN. Research Methods in Biomechanics.; 2014. doi:10.5040/9781492595809

6. Chui KK, Jorge MM, Yen SC, Lusardi MM. Orthotics and Prosthetics in Rehabilitation.; 2019. doi:10.1016/C2017-0-00955-2

7. Green-Buckley R, Hamlet I, Seccombe S. A guide to tuning AFOs and its relevance to stroke rehabilitation. Br J Neurosci Nurs. Published online 2017. doi:10.12968/bjnn.2017.13.sup2.s27

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