Visual Cueing Using Laser Shoes Reduces Freezing of Gait in Parkinson’s Patients at Home

Freezing of gait (FOG) in Parkinson’s disease (PD) is common and debilitating. Although the evidence for cueing efficacy is encouraging, it remains difficult to translate cueing strategies into an efficient visual cueing device for use in patients’ home environments, allowing them to benefit from a safer gait in everyday life and prevent falls and related injuries. Laser shoes might offer such a home-based cueing device, and a recent laboratory study showed reduced FOG severity. Here, we assess the effectiveness of laser shoes at home in a pilot study. A total of 21 PD patients with severe FOG completed 3 consecutive conditions: week 1 = wearing laser shoes, week 2 = wearing laser shoes, with cueing (“with cueing”); week 3 = without laser shoes (“follow-up”). Outcomes were assessed at the end of each week. The primary outcome was FOG severity (New FOG Questionnaire [NFOGQ]). The relation with cognitive status was explored by correlating the NFOGQ results with the Fronto Assessment Battery. Exploratory secondary outcomes included quality of life (Parkinson’s Disease Questionnaire-39), self-reported falls and near falls, number of self-reported FOG episodes, and perceived efficacy. An activity monitor objectively measured relative locomotion duration.

FOG severity improved significantly (NFOGQ: 20.35 ± 5.00 without cueing vs 18.12 ± 5.44 with cueing, P = .036; Fig. 1A). There was no correlation with the Fronto Assessment Battery. Furthermore, the NFOGQ did not differ between with cueing and follow-up (P = .235), perhaps suggesting a possible carry-over, although the difference between without cueing and follow-up was nonsignificant (P = .156). Secondary outcomes show a reduction of self-reported falls (41%), near falls (58%; Fig. 1B), and FOG episodes (31%) with cueing. The reduction in near falls continued during the follow-up week. Although the overall number of falls decreased with cueing, the number of individuals who fell actually increased, from 3 at baseline to 5 with cueing, and similarly in the follow-up week. These results were paralleled by positive subjective experiences on the efficacy of laser shoes. The Parkinson’s Disease Questionnaire-39 and relative locomotion duration did not differ across conditions.

The findings from this pilot study, although preliminary, suggest that laser shoes have potential as a mobile visual cueing device to reduce FOG and risk of falls in PD patients within their home situations and that improvements may last beyond their punctual use. Using laser shoes for 1 week perhaps boosted the participants’ confidence, but the carry-over might also represent a training effect. However, a significant difference between without cueing and follow-up is missing, hence we cannot make any firm statements about the possible existence of carry-over effects. The reduction in FOG severity did not lead to an increase in net locomotion time, perhaps because physical performance and physical activity represent associated but separate domains of physical function. It is also possible that longer lasting use of laser shoes is needed to change the patient’s walking habits, and future studies should evaluate this. Finally, laser shoes induced falls in some individuals, possibly because the patients gained too much confidence or were too distracted and ended up falling. We acknowledge that placebo effects might partially explain the effects seen in the present open-label study, and further work should include passive or active control interventions. Moreover, new studies should investigate the added value of laser shoes relative to other cueing techniques. Finally, longer training periods and prolonged follow-ups are needed to better document the long-term efficacy and to further study possible learning and retention effects.

Ethical Standards

All participants gave written informed consent prior to the experiment, and the experiment was performed in accordance with the declaration of Helsinki and with local ethical guidelines.

Acknowledgments: This research was funded by the Hersenstichting for Murielle U. Ferraye (project F2015(1)-21) and by a European Community’s Seventh Framework Programme FP7/2012 under Grant 316639 to

References


Supporting Data

Additional Supporting Information may be found in the online version of this article.

Corresponding author: Dr. Murielle Ferraye, Biomedical Signal and Systems Group, MIRA Institute for Biomedical Technology and Technical Medicine, University of Twente, Enschede, The Netherlands; m.u. ferraye@utwente.nl

Funding agencies: This research was funded by the Hersenstichting for Murielle U. Ferraye (project F2015(1)-21) and by a European Community’s Seventh Framework Programme FP7/2012 under Grant 316639 to Claudia Barthel. The institution Radboud University Medical Center (Radboudumc) does not have any conflicts of interests.

Ethical Standards

All participants gave written informed consent prior to the experiment, and the experiment was performed in accordance with the declaration of Helsinki and with local ethical guidelines.

Acknowledgments: This research was funded by the Hersenstichting for Murielle U. Ferraye (project F2015(1)-21) and by a European Community’s Seventh Framework Programme FP7/2012 under Grant 316639 to
Claudia Barthel. The authors wish to thank Joseph Ferraye for designing and building the first prototypes of the laser shoes, the Technical Support Group (Radboud University, Faculty of Social Sciences, Nijmegen, The Netherlands) for building the prototypes tested in the present study, and McRoberts for DynaPort hardware, software, and analysis support.

Claudia Barthel, MSc,1 Milou van Helvert, MSc,1 Renée Haan, MSc,1 Arno M. Janssen, PhD,2 Arnaud Delval, MD, PhD,3 Nienke M. de Vries, PhD,1 Vivian Weerdesteyn, PhD,4,6 Bettina Debû, PhD,6,7 Richard van Wezel, PhD,8,9 Bastiaan R. Bloem, MD, PhD,1 Murielle U. Ferraye, PhD,1,8*

1Department of Neurology, Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Center, Nijmegen, The Netherlands
2Department of Otorhinolaryngology, Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Center, Nijmegen, The Netherlands
3Lille university medical center, Department of clinical neurophysiology, Lille, France
4Department of Rehabilitation, Donders Institute for Brain, Cognition and Behaviour, Radboud University Medical Center, Nijmegen, The Netherlands
5Sint Maartenskliniek Research, Development & Education, Nijmegen, The Netherlands
6Grenoble Alpes University, Grenoble, France
7Grenoble Institute of Neurosciences, Institut National de la Santé et de la Recherche Médicale, U1216, Grenoble, France
8Biomedical Signal and Systems Group, MIRA Institute for Biomedical Technology and Technical Medicine, University of Twente, Enschede, The Netherlands
9Department of Biophysics, Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands

References


First Replication That Biallelic Variants in FITM2 Cause a Complex Deafness-Dystonia Syndrome

Hereditary dystonia syndromes are clinically and genetically heterogeneous disorders. Over the past decades, more than 200 genes have been associated with different forms of dystonia, most of them presenting as complex dystonia syndromes in childhood.1 Deafness-dystonia syndromes comprise 1 subgroup of complex dystonias, and published cases are, yet again, extremely heterogeneous.2 Recently, the case of a consanguineous family from Pakistan was published, in which 5 of 8 children had limb dystonia, sensorineural hearing impairment, global development delay, ichthyosis-like hyperkeratoses (mainly at the shins), low body mass index, short stature, and signs of sensory polyneuropathy. Whole-exome sequencing (WES) identified a homozygous nonsense variant in FITM2, which segregated with the disease in the family.3

Key Words: FITM2; dystonia; deafness; hyperkeratosis; exome

*Correspondence to: Matias Wagner, MD, Institute of Human Genetics, Klinikum rechts der Isar, Technical University of Munich, Troger Straße 32, 81675 Munich, Germany; matias.wagner@mri.tum.de

Relevant conflicts of interest/financial disclosures: Nothing to report.

Funding agencies: This work was supported by the German Research Foundation (DFG) and the Technical University of Munich (TUM) in the framework of the Open Access Publishing Program.

Received: 13 March 2018; Revised: 11 July 2018; Accepted: 16 July 2018

Published online 4 October 2018 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/mds.27481