

The characteristics of gait in Charcot-Marie-Tooth disease types I and II

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Objective: To characterize the gait pattern associated with Charcot-Marie-Tooth disease (CMT) types I and II.

Design: Cross-sectional study.

Setting: Gait laboratory in a national referral center for clients with neurological disabilities.

Subjects: The study group consisted of a convenience sample of sixteen participants with CMT. Eleven of them had a diagnosis of CMT 1 and 5 had a diagnosis of CMT 2. They were aged 8 to 52 years (median 14 years), 11 were male and 5 were female. The control group consisted of 40 normal subjects with no chronic health or gait impediments aged 8 to 32 years, 21 were male and 19 were female.

Methods: Neurological and musculo-skeletal examinations followed by a full gait analysis were performed on the study subjects. Kinematic variables were plotted over one representative gait cycle. Five examiners compared these to bands obtained from the control group to detect deviations from the normal gait cycle. Relevant static and dynamic measurements were retrieved, and comparisons were performed between the study and control group using non-parametric statistics to confirm the observed deviations.

Results: All participants demonstrated pes cavus on clinical examination. A decrease in vibratory sense was present in all cases. Deviations from the normal gait cycle were identified in all subjects. Foot-drop in swing was identified in 14 subjects. Failure of plantar flexion at push-off was seen in 11 cases. Increased foot supination was observed in 11. Excessive internal rotation of the knee and/or tibia was found in 10 and knee hyperextension in terminal stance in 12. Thirteen subjects displayed a pattern of excessive external rotation at the hips, and 13 had decreased hip adduction in stance and early swing (typical of a broad-based gait). CMT subjects had significantly tighter tendo achillei (mean passive ankle dorsiflexion 1° vs 11° , $p < 0.001$). They went into ground contact in higher plantar flexion (11° vs 1° , $p < 0.001$). All other features (foot supination, shank internal rotation, knee hyperextension, hip external rotation and decreased adduction) were confirmed on statistical comparison of relevant measurements in both groups ($p \leq 0.002$).

Conclusion: Patients with CMT present a number of typical gait characteristics. Certain of these are already well described, such as drop-foot and foot supination. These are both directly related to the primary disease and due to the weakness of ankle dorsiflexors and everters characteristic of this hereditary neuropathy. We also identified additional kinematic features that had not been previously documented. These are more proximal, affect the knees and hips, and could be an adaptation to or consequence of the disrupted ankle and foot biomechanics, however a direct relation to the neuropathy cannot be excluded despite normal sensory and muscle testing at the proximal levels in most subjects.