A Preliminary Evaluation of Gait Changes after Orthopaedic Surgery in Adolescents with Charcot-Marie-Tooth

Kristan Pierz, MD, Kelly Pogemiller PT, DPT, Gyula Acsadi MD and Sylvia Önpuu MSc
Center for Motion Analysis, Connecticut Children's Medical Center, Farmington, CT, USA
E-mail: sanpuu@connecticutchildrens.org  Web: www.connecticutchildrens.org

Introduction:
Charcot-Marie-Tooth (CMT) is an inherited peripheral neurological that affects 1 in 2,500 people in the USA [1]. The resulting muscle weakness and foot deformity have implications on ankle function during gait [2]. Orthopaedic surgical intervention is warranted in many patients for a variety of reasons including foot pain, ankle instability, orthosis fit and shoe issues. The impact of these surgeries on ankle kinematic and kinetic function during gait is not known. Therefore, the goal of this study was to measure gait changes in ankle function due to surgical intervention in adolescents with CMT.

Participants/Setting:
A convenience sample of fourteen patients (10±4 years at analysis 1 and 14±5 years at analysis 2) with a diagnosis of CMT who had orthopaedic surgery (23 sides) were analyzed in a tertiary center. All sides had a plantar fascia release plus a combination of other procedures (metatarsal and/or cuboid osteotomies). Fourteen patients (mean age 10.8±4 years at analysis 1 and 13.5±5 years at analysis 2, 5 females) with a diagnosis of CMT who had no orthopaedic intervention between the two analyses served as a control group.

Methods:
All surgical patients completed two gait analyses during barefoot walking using analysis techniques following a standardized protocol [3]. The changes in ankle kinematics and kinetics and temporal-spatial parameters were analyzed in reference to a control group of patients with CMT without intervening surgeries between gait analyses as well as normal reference data collected in the same gait laboratory [4]. Paired t-tests were used to assess the changes in ankle function due to surgery between the two motion analysis assessments (p<0.05). Specific ankle motion analysis kinematics and kinetics are the focus of this analysis (Figure 1). The changes over time were referenced to a typically developing reference data base collected in the same facility [4].

Results:
There was a mean of 3.8 years between the two gait assessment kinematics and kinetics (n=23 sides) for the surgical group. Patients showed a significant increase in stance and post-operative gait analyses but no changes in temporal-spatial and ankle function during gait with the exception of foot progression (Table 1). There were similar findings for the control group (Table 2). A comparison between pre vs. post surgery foot progression for a patient (Fig 3) demonstrates post surgical improvements.

Figure 2. Case example of pre/post pedobarograph data with red indicating abnormally high pressures.

Table 1: Comparison between test 1 and 2 for mean ±1 SD temporal-spatial and ankle kinematics and kinetics (n=23 sides) for the surgical group. p values compare between tests 1 and 2 only.

Table 2: Comparison between test 1 and 2 for mean ±1 SD temporal-spatial and ankle kinematics and kinetics (n=23 sides) for the non surgical group. p values compare between tests 1 and 2 only. Typically developing (TD) data provided for reference.

Conclusion/Significance:
Although showing a significant increase in height, the patients in this study did not show any changes in the temporal and stride parameters after surgery (which remained less than in TD). This was consistent with the control group findings. The mean sagittal plane ankle kinematics and kinetics showed no statistically significant changes as a result of surgery. However, assessment of individual results showed the peak ankle dorsiflexion in terminal stance (which is most likely to be impacted by the plantar fascia release) increased in 10, no change in 6 and decreased in 7 sides. The mean average foot velocity showed a significant improvement, likely a direct result of surgery to correct adductus deformity. The results also show that these surgeries may not improve gait efficiency in terms of walking velocity that would be expected with increasing stature. However, there were similar findings in the control group which suggests that function in terms of walking velocity may decline over time in youth with CMT. Gait outcomes vary from patient to patient and therefore assessment at the individual patient level is important to understand the impact of surgery.

Computerized motion analysis makes this possible.

References

Acknowledgement
Funding for this ongoing study is being provided by the Harold and Rebecca Gross Foundation.