Gait Parameters in Primary Orthostatic Tremor: A Case Study

Adam M. Fullenkamp, BS, RKT[1], Charles W. Armstrong, PhD[1]
[1]The University of Toledo, Department of Kinesiology, Toledo, OH

Introduction

Tremor may be categorized in descriptive terms and also by the underlying frequency associated with a particular tremor (Gunther et al., 2001). Through the use of spectral analysis of EMG data, clinicians have been able to differentiate forms of tremor previously assumed to be the result of Parkinson's disease. Primary Orthostatic Tremor (POT), a relatively rare condition, is one such tremor, which until recently was commonly misdiagnosed (Findley, 1996). Like Parkinson's disease, symptoms of POT do not often manifest until later adulthood. However, POT is easily distinguished from other forms of pathological tremor in that the tremor occurs in the range of 13-20 Hz, where other forms of tremor typically occur below 12 Hz (Fung et al., 2001). Additionally, POT is exacerbated during static posture, diminishing as an individual initiates gait or sits down. The tremor often affects balance and elicits feelings of overall instability. Although clinical diagnosis of POT has been simplified via spectral analysis, there is still a great deal to be learned about the condition. Specifically, gait parameters associated with POT have not yet been defined.

Statement of Clinical Significance

In adults who suffer from POT, balance and subjective feelings of stability are compromised in static postures. Consequentially, it is reasonable to suspect that such impairments might carry over into gait despite the apparent cessation of tremor during ambulation. The identification of gait elements may help to define normal patterns in POT along with indicating overall stability during ambulation. Additionally, these dynamic features may provide another means by which to discern POT from other forms of tremor.

Methodology

The subject selected for this clinical case study was a 79 year-old male who had experienced symptoms of POT for 21 years. The subject was able to walk comfortably to distances up to 30 feet with minimal assistance, however static bouts of standing were difficult due to tremor. Both postural sway and tremor frequency data were initially collected to confirm a diagnosis of POT. The subject then underwent 3-D gait analysis using a Motion Analysis Hi-Res system and Noraxon Inc. EMG telemetry. Kinematic, temporal/spatial, and EMG data were collected, analyzed and normalized to 100% of the gait cycle.

Results

Initial spectral analysis of lower extremity EMG during static posture demonstrated a prevalent tremor frequency of 13 Hz (Figure 1). Six gait cycles were analyzed for kinematic and temporal/spatial data and all trial data were averaged. Sagittal motion at the hip, knee, and ankle varied substantially from normative data. The hips remained in a flexed position (50º) throughout the gait cycle with limited extension movement (Figure 2). The knees also evidenced excessive flexion, failing to extend much beyond 50º (Figure 3). Sagittal motion at the ankle was limited, tending toward dorsiflexion (Figure 4). Nearly all temporal/spatial values varied noticeably from the norm (Table 1).

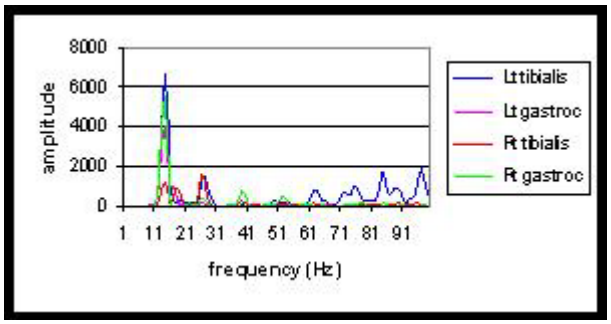

Figure 1. Spectral Analysis of postural EMG

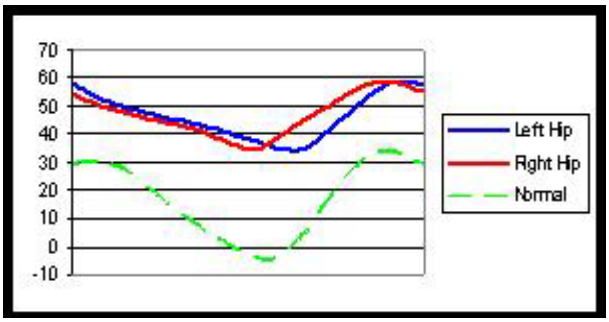

Figure 2. Hip range of motion (100% gait cycle)

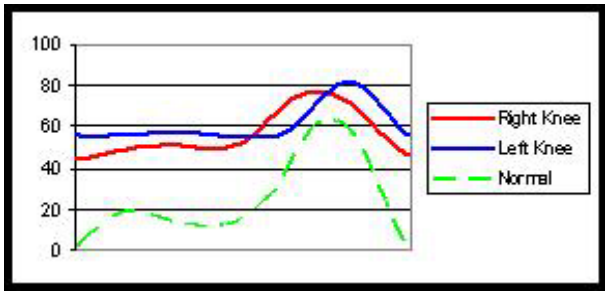

Figure 3. Knee range of motion (100% gait cycle)

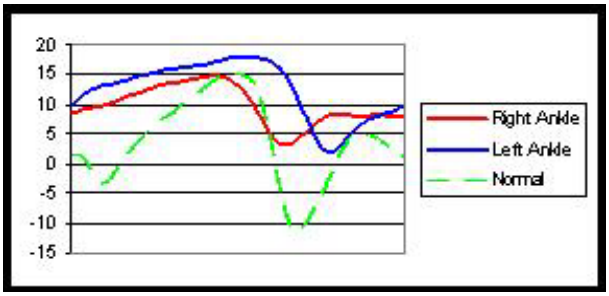

Figure 4. Ankle range of motion (100% gait cycle)

Discussion

Spectral analysis of EMG data supported previous findings of high frequency tremor in POT. Additionally, the test results indicated weakness and instability during locomotion. The kinematic data suggests an inability to generate the necessary extensor moments at the hip, knee, and ankle which would ultimately limit propulsive force, in addition to adversely affecting posture during gait. Variation in temporal/spatial data is also indicative of instability. The impact of POT on gait parameters may prove clinically useful in providing further criterion by which to differentiate the condition from other similar forms of tremor.

Table #1

Temp/Spat Variables	Right Side	Left Side	Normal
Step Length (cm)	26.13	20.18	64.88
Walking Velocity (cm/s)	44.12	50.8	118.33
Cadence (steps/min)	121.09	117.39	109.46
Total Support Time (%)	58.55	69.82	60.56
Step Width (cm)	18.90		11.97

References

Findley LJ (1996) Journal of Clinical Neurophysiology, 13(2):122-132.
Fung VSC, et al. (2001) Brain, 124:322-330.
Gunther D, et al. (2001) Muscle and Nerve, 24:716-735.