

Use of an instrumented mat for objective gait metrics of CNS disorders

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INTRODUCTION

As lifespans increase, objective methods of assessing how well a person is ageing become necessary. This is especially important for those affected by chronic diseases. Many central nervous system (CNS) disorders are chronic in nature and have systemic effects on the patient; affecting the way the entire body functions, especially during movement. Historically, normal and abnormal gait in patients with CNS disorders have been appraised using clinical assessment and observation with the naked eye. These approaches are appealing because of their simplicity, rapidity, and low cost. However, visual gait assessments are limited by the fact that they only provide subjective information about outward appearances of gait [1]. Further, there is considerable variation in observer agreement for the most common clinical assessments [2]. Quantitative gait analysis is well established as a means of objective monitoring of neurologic disease progression and therapeutic interventions [3]. Literature reflects the efficacy of temporal distance (TD) gait measures for CNS conditions [4, 5]. TD gait metrics such as velocity, single limb support times, symmetry, step width and step lengths are valid measures that provide insight into a patient's health status, energy consumption during gait, fall risk, and survival [6-10]. Unfortunately, many providers do not objectively measure gait in patients with CNS disorders.

CLINICAL SIGNIFICANCE

People with CNS disorders visit their healthcare providers for medication management, mitigation of fall risk, and overall symptom management. Evidence based practice necessitates the use of objective TD metrics to assess the efficacy of clinical treatments. An objective gait study yielding TD factors will provide insight into the patient's mobility. The provider may modify medications to control disease related symptoms; then have the patient return for a follow up gait study to determine efficacy of the medication change. An instrumented walkway rather than a conventional gait study reduces appointment length and analysis time to provide faster reports to the provider.

METHODS

Our lab has instituted an instrumented walkway (ZenoTM walkway, ProtoKinetics, Havertown, PA) to objectively measure TD parameters during over-ground walking. The patient is asked to come to the gait lab appointment with their assistive device. A physical examination is completed by a licensed physical therapist. The patient is then instructed to walk in their typical manner across an instrumented walkway while wearing their usual footwear. The patient's gait metrics are collected and reduced by an engineer. The engineer creates a report detailing the patient's TD metrics. This information, combined with the physical exam, is analyzed by the physical therapist, and documented in the medical record. The objective gait metrics are referenced for future comparison.

DEMONSTRATION

An example of the TD metrics report is illustrated below (Fig. 1). This report demonstrates the pre-intervention and post-intervention metrics for a 72 year old female who underwent ventriculo-peritoneal shunt placement for treatment of normal pressure hydrocephalus. Gait metric changes are the objectively measurable outcome to demonstrate improvement or lack of improvement after treatment. The pre/post intervention metric changes are readily apparent to the provider, demonstrating the efficacy of intervention. Lack of improvement in gait metrics may indicate to the provider that shunt setting adjustment is necessary.

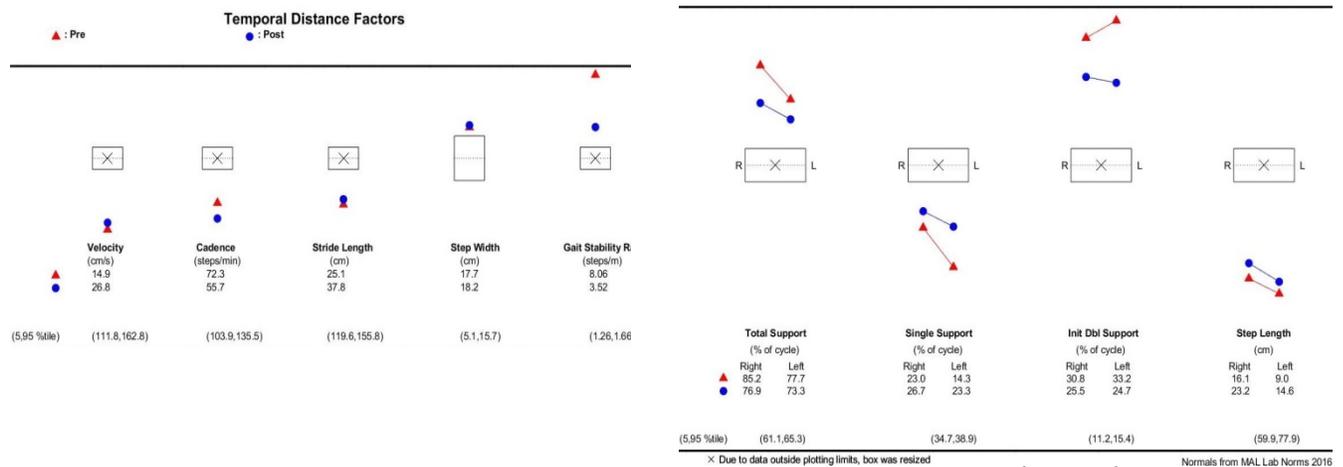


Figure 1: An example of a TD report detailing gait metrics before and after surgical intervention for treatment of normal pressure hydrocephalus. Red triangles denote pre-operative metrics; blue dots denote metrics six months post-operatively. The box

for each gait metric shows the 5th and 95th percentile of normative data. The patient's data is reported for each gait metric in addition to being plotted to give a graphical representation of the patient's performance relative to the normative data

SUMMARY

Objective gait metrics provide important insight into the functional mobility of patients, medication efficacy, and symptomology related to disease progression. Temporal distance parameter analysis via an instrumented walkway is an efficient, non-invasive way to objectively measure gait. These measurements inform providers of a patient's current functional status and changes following medical and surgical intervention.

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DISCLOSURE STATEMENT

Neither author has any conflicts of interest to disclose.