

Chapter III

Reporting Clinical Gait Analysis Data

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ABSTRACT

Gait analysis is a special investigation that can assist clinical staff in the decision making process regarding treatment options for patients with walking difficulties. Interpretation of gait analysis data recorded from 3D motion capture systems is a time consuming and complex process. This chapter describes techniques and a software program that can be used to simplify interpretation of gait data. It can be viewed with an interactive display and a gait report can be produced more quickly with the key results highlighted. This will allow referring clinicians to integrate the relevant gait measurements and observations and to formulate the patient treatment plan. Although an abbreviated analysis may be useful for clinicians, a full explanation with the key features highlighted is helpful for movement scientists. Visualization software has been developed that directs the clinician and scientist to the relevant parts of the data simplifying the analysis and increasing insight.

INTRODUCTION

Gait analysis is the systematic measurement, description and assessment of those quantities thought to characterize human bipedal locomotion (Davis et al., 1991). Kinematic, kinetic, electromyographic (EMG) and temporo-spatial data of the subject is acquired and analyzed during the gait analysis process. Human gait is a cyclical event and by convention the gait cycle begins and

ends at initial foot contact of the same leg. That is, it represents two steps.

The purpose of clinical gait analysis is to communicate reliable, objective data on which to base clinical decisions. It can also be used to quantify outcomes and may ultimately predict the effects of various interventions for a patient with ambulatory difficulties. This requires a multi-disciplinary team to synthesize, analyze and evaluate the large number of variables used

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to describe a person's gait and to provide a clear course of surgical, orthotic, prosthetic, pharmaceutical or therapeutic intervention.

Clinical gait analysis techniques using 3D motion capture systems have several inherent sources of errors due to limitations of the modeling software used, skin movement artifacts and marker placement errors (Kadaba et al., 1989). The current cost of gait analysis for a patient is high and is estimated to be equivalent in cost to six MRI scans. This is an important limitation of these techniques. Also, the current method of presentation of clinical gait analysis data is not readily understood by many clinicians and this also inhibits the widespread use of these techniques.

At present there are no universally accepted techniques for interpretation of clinical gait analysis data, but a consensus has developed in some areas, notably in cerebral palsy gait. Clinical gait analysis begins to provide a scientific basis to determine how neuromuscular impairments correspond to abnormal movements. Traditionally, clinicians report changes in joint angles following surgery as an outcome measure of the effectiveness of the surgical procedure, for example, increased knee flexion following hamstring lengthening. This does not give any indication of functional improvements to the patient's gait and therefore gait analysis data can be an important adjunct to the clinical examination. For gait data to be useful in the management of the patient, both the clinical examination data (a static, passive assessment) and the gait data (a dynamic or functional assessment) should correspond.

In most gait laboratories clinicians normally require only summary information from the gait recording provided by the gait analysis team (movement scientists). The movement scientists carry out is an comprehensive investigation of the data and therefore needs detailed information to support the quality of their reporting to the clinical team. However, both the clinician and the movement scientist would benefit from the data processing being automated and the

reporting to be simplified and presented in an easily comprehensible, standardized format. This will lower the cost of a gait assessment and may improve the consistency of the reporting. This chapter describes the development of a software package that shows how clinical gait analysis data can be presented in alternative ways and can offer simplifications that may aid understanding and reduce costs.

Three-dimensional motion capture systems such as Vicon (Oxford Metrics, Oxford, UK) offer accurate, high-resolution recordings of human locomotion. These systems acquire, and display three-dimensional motion data on patients while walking and are able to integrate analogue data to enable simultaneous acquisition of force plate, EMG and video data.

The Vicon system has a specifically designed software package, Polygon (Oxford Metrics, Oxford, UK) to generate interactive multimedia reports from the captured 3D data. This software produces the graphical data used in clinical reports.

BACKGROUND

Bipedal gait represents each person's unique solution of how to get from one place to another. There is a natural variability to a person's gait as motor tasks cannot be repeated identically from walking trial to walking trial. Therefore, intra- and inter-subject variability are natural elements of movement patterns associated with functional tasks (Manal et al., 2004). This natural variation is an important consideration when analyzing the gait of patients' with walking disabilities.

Diagnosis and rehabilitation of patients with locomotor disorders is increasingly supported by gait analysis data (Barton et al., 1995). Cerebral palsy is a locomotor disorder that can prevent or inhibit walking and cause a lack of muscle coordination and spasms due to an injury to the brain prior to or shortly after birth. Children with

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