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Gait and Posture 16 (2002) 159–179

GAIT & POSTURE

www.elsevier.com/locate/gaitpost

The evolution of clinical gait analysis Part II Kinematics☆

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Accepted 18 December 2001

Abstract

Kinematics is treated as a single topic in this manuscript and the emphasis is on early history, just as it was in Part I, Electromyography. Needless to say, neither kinematics nor electromyography, nor kinetics and energy (the latter to be included in Part III) are stand-alone components of clinical gait analysis. The only reason for this selective format is that it lessens my task to be able to write about one subject at a time. One of the consequences of this arbitrary separation is that some contributors, who have enriched more than one portion of clinical gait analysis, are highlighted only in the area in which they have contributed the most. I began with Kinesiological Electromyography in Part I because the earliest stirrings of the dream of clinical gait analysis were expressed in the development of KEMG (kinesiological electromyography). The early investigators realized that very little could be said about the dynamic action of muscles without KEMG. Next, in chronological order, came kinematics. I have been an active participant and eyewitness, and take full responsibility for attempting to write an early history at a time when most of the contributors are still alive. Ordinarily, history is written much later, in order to fully grasp the significance of individual contributions in the tapestry of the whole. As stated in Part I, Electromyography, the emphasis has been placed on the early history. The application of motion analysis to sports medicine, and sports medicine functional analysis, is covered only lightly here, and this should not be interpreted as minimizing its importance. The literature on this subject is now quite voluminous and it would not be possible to cover it adequately in this manuscript. Later historical writings may differ significantly and will hopefully give more recognition to pioneers in later generations: those physicians, engineers, physical therapists and kinesiologists who are lifting the level of clinical gait analysis and directing their energies in expanding clinical directions. It is hoped that this manuscript will prompt additional manuscripts, as well as letters to the editor of *Gait and Posture* on the content of this review paper. © 2002 Published by Elsevier Science B.V.

Keywords: History; Kinematics; Clinical gait analysis

1. Introduction

Accurate measurement of motion is central in any scientific method of gait analysis. Measurements of individual joint angular rotations, as well as translations of segments and of whole body mass, allow the comparisons with normal that are necessary to distinguish pathological from normal gait. Complex hardware and software are necessary to accomplish this task with accuracy and reliability. This component of clinical gait analysis has proven to be very challenging and the evolutionary process continues to this day.

The individual joint angles and the displacements of segments and of the whole body mass were recognized to be essential measurement requirements in the late 1800s by Braun and Fischer [1–5]. Their clever ap-

☆ *Note from review editor:* This article is the second in a series of three historical narratives that Dr Sutherland has very kindly agreed to author for Gait and Posture. As Dr Sutherland indicated in his abstract for Part I, these are very personal accounts that focus primarily, although not exclusively, on the early history of clinical motion analysis. He further acknowledged that not all important contributors or events may be chronicled or weighted in the same manner as others might have done. Still, these accounts are extremely valuable because they provide a very alive 'behind the scenes' view of how our field has progressed over the years as told by one of its true pioneers, with a richness that could never be captured by a mere listing of names or documented events.

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0966-6362/02/$ - see front matter © 2002 Published by Elsevier Science B.V.
PII: S0966-6362(02)00004-8

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