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Review

The history of gait analysis before the advent of modern computers[☆]Richard Baker^{a,b,c,d,*}^a *Hugh Williamson Gait Analysis Service, Royal Children's Hospital, Melbourne, Australia*^b *Centre for Clinical Research Excellence in Clinical Gait Analysis and Gait Rehabilitation, Murdoch Childrens Research Institute, Melbourne, Australia*^c *Department of Mechanical and Manufacturing Engineering, University of Melbourne, Australia*^d *Musculo-skeletal Research Unit, La Trobe University, Bundooran, Australia*

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Abstract

Aristotle (384–322 BCE) can be attributed with the earliest recorded comments regarding the manner in which humans walk. It was not until the renaissance that further progress was made through the experiments and theorising of Giovanni Borelli (1608–1679). Although several scientists wrote about walking through the enlightenment period it was the brothers Willhelm (1804–1891) and Eduard (1806–1871) Weber, working in Leipzig who made the next major contribution based on very simple measurements. Both Jules Etienne Marey (1830–1904), working in France, and Eadward Muybridge (1830–1904), working in America, made significant advances in measurement technology. These were developed further by Otto Fischer (1861–1917) in collaboration with Willhelm Braune (1831–1892). The major developments in the early twentieth century were in the development of force plates and the understanding of kinetics. The team headed by Verne Inman (1905–1980) and Howard Eberhart (1906–1993) made major advances in America shortly after the Second War. David Sutherland (1923–2006) and Jacquelin Perry pioneered clinical applications in America and Jurg Baumann (1926–2000) in Europe. It was not until the advent of modern computers that clinical gait analysis became widely available.

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People have been thinking about how they walk since the earliest times. This article traces the history of this process from the time of Aristotle through to the dawn of the modern era of computerised analysis techniques. Through recounting this history it is possible to see how our present understanding of walking has developed as a series of steps each based on previous developments in the field and on the scientific and cultural environment in which the individual contributors were living. A particular aspect of the history of this field is how major developments have often been a consequence of collaborations of individuals with different expertise, particularly between those with expertise in the life sciences

and those with expertise in the physical sciences. A list of major contributors to the field is given in [Table 1](#).

Aristotle (384–322 BCE) made the first known written reference to the analysis of walking:

If a man were to walk on the ground alongside a wall with a reed dipped in ink attached to his head the line traced by the reed would not be straight but zig-zag, because it goes lower when he bends and higher when he stands upright and raises himself. [1]

Unfortunately he lived in a society in which it was assumed that scientific truth could be determined simply by thinking about a problem. None of his propositions were ever tested by experiment. As a consequence, whilst this particular observation is true, almost all his other related conjectures are now known to be false.

It was not until the time of the renaissance in Europe that science and mathematics in Europe started to develop coherently. It was at this time that some of the concepts that

[☆] Based on a lecture first given to the European Society for Movement Analysis in Children Annual Meeting in Heidelberg in 1999.

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