



Review

Observational gait assessment tools in paediatrics – A systematic review



Chandrasekar Rathinam^{a,*}, Andrew Bateman^{b,1}, Janet Peirson^c, Jane Skinner^{d,2}

^a Block 9, Physiotherapy Department, Ida Darwin, Fulbourn, Cambridge CB21 5EE, United Kingdom

^b Oliver Zangwill Centre for Neuropsychological Rehabilitation, Princess of Wales Hospital, Ely CB6 1DN, United Kingdom

^c Block 13, Ida Darwin, Fulbourn, Cambridge CB21 5EE, United Kingdom

^d Norwich Medical School, Faculty of Medicine and Health Sciences, University of East Anglia, Norwich NR4 7TJ, United Kingdom

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ABSTRACT

Instrumented gait analysis (IGA) is an expensive technique used to objectively detect gait abnormalities in children. Observational gait assessment is considered as a cost effective alternate for IGA in regular clinical practice. This article is aimed at systematically reviewing the available paediatric gait analysis tools and examines their reliability and validity compared to IGA. This review also examines the structure of these tools, their clinical use and limitations. Articles were searched from PubMed, CINHL, AMED, BNI, EMBASE, PEDro and Cochrane library from the earliest record on the database to December 2012. Hand searches were carried out in a few journals. Studies that examined children's gait using a structured assessment tool were included and analysed for their quality, reliability and validity. Pre-established criteria were used to judge the quality of methodology and reliability and validity. Five observational gait tools for children with Cerebral Palsy (CP) and one for children with Downs Syndrome were identified. Nine studies related to children with CP were enrolled for this review. None of the tools have accomplished the level of IGA's consistency. Edinburgh Visual Gait Score (EVGS) was found to have better reliability and validity than the other tools. Very limited studies were available for most of the gait assessment tools therefore their clinical use cannot be judged based on the existing evidence. EVGS was found to have better concurrent validity and reliability and it should be considered to assess CP gait in regular practice. Future work to investigate the use of low cost technology to improve observers' accuracy of EVGS is suggested.

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1. Introduction

Gait poses a significant challenge to those with neurological disorders and analysing the deviation of gait is an integral part of a visual assessment. Gait assessment assists in determining the degree and cause of abnormality and it can be used as an outcome measure to evaluate the effectiveness of intervention [1]. Instrumented gait analysis (IGA), the gold standard for evaluation of movement, uses sophisticated technology that enables objective analysis of patients' mobility in laboratory environments. IGA technology involves the assessment of video recordings, clinical

measures, electromyography activity and 3 dimensional joint kinematic and kinetic values to detect gait abnormality with accuracy [2–5]. IGA has been widely used to assess the gait of children with cerebral palsy (CP) and helps the clinician to formulate a management plan and evaluate the outcome of the intervention [6]. A gait laboratory requires considerable capital investment, trained personnel, and is not often readily accessible for routine clinical work [7,8]. Each session which includes the assessment and interpretation of the results by experts takes approximately three to six hours [6].

Clinicians require simple and cost-effective outcome measures to analyse the kinematic parameters of gait in their day-to-day practice. Visual diagnosis of a patient's gait in real time is subjective, lacks accuracy and relies on the clinician's training and experience [9]. Visual gait analysis using a structured proforma has been suggested as an alternative to the IGA [5]. Observational gait tools are often and widely used as an essential tool for an assessment of gait problems of children with CP [8]. In

* Corresponding author. Tel.: +44 1223 883382.

E-mail addresses: chandrasekar.rathinam@nhs.net (C. Rathinam), Andrew.Bateman@ozc.nhs.uk (A. Bateman), janetpeirson@me.com (J. Peirson), jane.skinner@uea.ac.uk (J. Skinner).

¹ Tel.: +44 1353 652169; fax: +44 1353 652164.

² Tel.: +44 01603 59 3120.

observational gait analysis the examiner visually assesses the gait pattern with the aid of video recordings using various scales that describe gait abnormalities in different joints and planes [5]. Video recording of gait in the clinical setting is relatively easy and a preferred method of examination for clinicians. Computer-based video image analysis systems are able to provide an interface for precise recording, quantifying and the analysing of events [10]. They can be applied to capture abnormal posture and movements, to reduce them to basic parameters such as joint angles, swing distances and curvatures [10]. However, Toro et al. quoted several authors in saying that observational gait assessment is relatively subjective in nature and that it may lead to poor validity, reliability, sensitivity, and specificity compared to IGA [11].

In order to overcome the shortfalls of the real time gait examination, various gait assessment tools have been developed over the past two decades to assess children's gait from video recorded files [2,3,12–14]. Examination of the reliability and validity of those tools has given a variable range of results which has been influenced by the experience of examiners and their professional background [1,2,4,5,7,9,12,15–17]. Despite the variable level of accuracy and reliability of the visual gait assessment tools there continues to be a dependency on this method [2,7].

A simple gait tool is needed for clinicians to identify and quantify changes in a walking pattern at individual anatomical levels. It is required to reflect the deviation from the normal gait parameters both in the stance and swing phase, and truly reflect functional gait problems. This review is aimed at identifying the variety of paediatric gait analysis tools that have been reported in the literature, and examine their reliability and validity compared to IGA. It considers the structure of these tools, their quality, clinical use and their limitations.

2. Materials and methods

2.1. Search strategy

In December 2012, a comprehensive computerised bibliographic databases search was performed in the following database: PubMed (1966 to current), Cumulative Index to Nursing and Allied Health Literature (CINHL; 1982 to 2012), Allied and Complementary Medicine (AMED; 1985 to current), British Nursing Index (BNI; 1992 to current) and Excerpta Medica Database (EMBASE; 1980 to current). We extended our search to the Cochrane library and Physiotherapy Evidence Database (PEDro). Scopus database was separately accessed to find relevant citations and articles.

The following search terms were used: (observation* OR Video*) AND (Gait* OR Walk* OR GAIT) AND (Analy* OR Examinat* OR Assess*). A broad search strategy included free-text words, medical subject heading and all thesaurus subject terms in the database wherever applicable. In order to limit the number of results the searches were confined to humans only, and the paediatric population (age group 0–18 years; different variations denoting the age limit which included child, infant, pre-school and adolescent) wherever possible. No limit was set for language and all were included.

In addition to the electronic database search, a hand search was carried out in specific journals [Archives of Physical Medicine and Rehabilitation (1995–2012), *Gait and Posture* (1995–2012), Developmental Medicine and Child Neurology (1989–2012) and Paediatric Physical Therapy (1989–2012)]. A further search tracking citation of all the primary studies were scanned and examined for inclusion.

2.2. Inclusion and exclusion criteria

2.2.1. Participants

Gait abnormality in children (0–18 years) with neurological, neuromuscular, orthopaedic and other developmental delay due to genetic disorders. Studies that involved the adult population were excluded.

2.2.2. Tools

Only observational and video gait analysis tools that assess either reliability, validity or both compared against IGA were included. Studies describing IGA data alone on gait and as gait index based on IGA were excluded.

2.2.3. Study type

Any type of study that reported observational gait analysis including commentaries and case studies in journals was included. Dissertations, conference abstracts and other sources of unpublished data were not included.

2.3. Data extraction

The reviewers preliminarily screened the titles and abstracts of the references formed by the literature search based on the inclusion and exclusion criteria and duplicated independently. Full articles that met the review criteria were gathered for further evaluation.

2.4. Appraisal of reliability and validity

Research concerning the reliability and validity of the clinical tools are judged by their psychometric properties and high methodological qualities [18]. A checklist was designed by Brink and Louw to appraise the quality of reliability or validity and the combined reliability and validity of studies. It can also be used to assess the reporting quality of objective clinical tools. Bellet et al. modified this further to assess the responsiveness element [19]. The modified checklist has seventeen items (4 reliability, 4 validity, 1 responsiveness and 8 generic items) with specific scoring criteria which ensure a 'yes', 'no' or 'not applicable' response. Although this tool does not report a quality score, the studies scoring more than 60% of positive responses were considered to be of good quality [19] (Table 1). The quality of the extracted articles, their reliability, validity and responsiveness were assessed using the checklist. The examiners (1st and 3rd author) had a good understanding of the scoring method, they assessed the quality of the articles independently and reached a consensus through discussion.

3. Results

The search strategy resulted in 1508 citations and after removing duplicates this was narrowed down to 961 citations. The preliminary selection, based on the title and abstracts contained 58 citations, with information about gait tools and gait variations, reliability and validity. We collected full text articles for all of the citations. Eight articles that fulfilled the criteria were chosen for the review (Fig. 1). The corresponding authors of all of the selected articles were contacted to identify any additional related work published or unpublished, which had been carried out on the scales.

Over the past two decades five different gait assessment tools to assess the gait of children with CP and one tool to assess children with Downs Syndrome have been developed (Fig. 2). The authors of some gait scales [1,2,9,15,17,20,21] have confirmed that they have not carried out further studies on their tool and reported that they were not aware of any other studies by associates. In order to maintain homogeneity only the gait tools related to children with CP were included for this review.

In every study that has been included in this review, the authors have acknowledged that the IGA is the accepted gold standard and used the IGA result to establish their tools' validity. All the tools were compared to IGA. The studies also indicated that the examiners extracted the data from pre-recorded video footage of gait from the gait lab and compared them with their corresponding IGA data. The

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