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Reliability and validity of Edinburgh visual gait score as an evaluation tool for children with cerebral palsy

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ABSTRACT

Assessment of gait abnormalities in cerebral palsy (CP) is challenging, and access to instrumented gait analysis is not always feasible. Therefore, many observational gait analysis scales have been devised. This study aimed to evaluate the interobserver reliability, intraobserver reliability, and validity of Edinburgh visual gait score (EVGS). Video of 30 children with spastic CP were reviewed by 7 raters (10 children each in GMFCS levels I, II, and III, age 6–12 years). Three observers had high level of experience in gait analysis (10+ years), two had medium level (2–5 years) and two had no previous experience (orthopedic fellows). Interobserver reliability was evaluated using percentage of complete agreement and kappa values. Criterion validity was evaluated by comparing EVGS scores with 3DGA data taken from the same video visit. Interobserver agreement was 60–90% and Kappa values were 0.18–0.85 for the 17 items in EVGS. Reliability was higher for distal segments (foot/ankle/knee 63–90%; trunk/pelvis/hip 60–76%), with greater experience (high 66–91%, medium 62–90%, no-experience 41–87%), with more EVGS practice (1st 10 videos 52–88%, last 10 videos 64–97%) and when used with higher functioning children (GMFCS I 65–96%, II 58-90%, III 35–65%). Intraobserver agreement was 64–92%. Agreement between EVGS and 3DGA was 52–73%. We believe that having EVGS as part of the standardized gait evaluation is helpful in optimizing the visual scoring. EVGS can be a supportive tool that adds quantitative data instead of only qualitative assessment to a video only gait evaluation.

1. Introduction

Gait analysis is frequently used in the management of children with walking disabilities [1], providing systematic measurements of the various gait components. This information is helpful in the decision making process that guides the treatment of children with cerebral palsy (CP) [2–4]. Three dimensional gait analysis (3DGA) has been considered the gold standard of gait assessment, [2,4–8] providing quantitative analysis of the gait pattern. However, 3DGA requires a high level of expertise as well as expensive and sophisticated equipment [5], which reduce its availability especially in emerging countries [2]. Moreover, this level of detailed assessment might not be necessary in less complex cases [1,5,6,9]. Consequently, several techniques of observational gait scales, using video gait analysis, have been developed [4,7]. These scales provide a less detailed assessment of gait quality than the 3DGA, and each has its own strengths and shortcomings [10]. Visual observation relies on the observer being able to assess the two dimensional movements occurring in different segments of the body during the gait cycle [1,4,5].

The Edinburgh visual gait score (EVGS) [11] was developed for gait assessment using video recordings in children with CP [10,11]. For each limb, this score includes 17 variables, and each of these variables can be scored 0, 1 or 2 according to the movement deviation from normal. These variables were assessed in previous studies [8,12,13] with good reliability and validity, making the scale, as described previously, the best visual scale currently available [13]. However, available studies, focused on this scale, have been developed mainly by the Edinburgh group [10–12,14]; and in the studies where different groups applied the scale, only specific aspects were addressed such as observer reliability [2,6], influence of experience on reliability [8] and responsiveness of the EVGS to surgical interventions [15]. Therefore, more information is still needed from different groups, to evaluate the role that the scale can have in the routine clinical assessment of gait even when 3D gait analysis is available.

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At our institution, EVGS is not used in gait assessment and 3D gait analysis is the established method in the management of children with CP. The aim of this study is to evaluate the interobserver reliability of the score between our team members, to determine if this is affected by the level of training of the observer or by the functional level of the evaluated individual, and to evaluate intraobserver reliability. The validity of the EVGS was evaluated as well by comparing the results to 3DGA.

2. Methods

After obtaining the approval of our Institutional Review Board, existing video files were identified and reviewed. A random selection of 30 gait videos for 30 children with spastic CP was performed. Children were at different levels of the Gross Motor Function Classification System (GMFCS). Ten children were at GMFCS I, ten at GMFCS II and ten at GMFCS III. All children had a three dimensional gait analysis at the same visit when the video was recorded. The video recording was performed in the gait laboratory, using sagittal and coronal views from a handheld camera. All 30 videos were reviewed following an order determined by the GMFCS level (video 1: level I, video 2: level II, video 3: level III, video 4: level I, video 5; level II and so on successively).

Seven observers independently reviewed the same thirty videos, scoring the EVGS for each side/leg of the subject. Three observers (one senior orthopaedic surgeon and two physical therapists) had a high level of experience (10+ years) in gait analysis, two observers (two orthopaedic surgeons) had medium level of experience (2–5 years) and the last two observers (two orthopaedic fellows) had no previous experience in gait analysis. None of the seven observers had previous experience using the EVGS. To ensure consistency, all seven observers received a standardized training of how to use the EVGS with the scoring guidelines [11]. The observers were allowed to use a goniometer and to stop or repeat the video if necessary with no time limit. Each observer was blinded to the results of the others.

Interobserver reliability (between all observers and using all videos) was calculated using percentage of complete agreement and kappa value; similar to the analysis performed in previous studies [11,12]. The different items were ranked according to the kappa values obtained [16]. Reliability was calculated between observers within each group of experience (high, medium and no previous experience) to assess the effect of the observer's experience on the results. Reliability between all observers using two groups of videos (first 10 and last 10 reviewed videos) was calculated to assess the effect of scale learning on the results. Finally, reliability was calculated between all observers using three groups of videos according to the patients' GMFCS level (videos of patients at GMFCS I, II and III).

The two least experienced observers reviewed the videos at two different time points, three months apart. The observers were blinded to their first ratings. Intraobserver reliability was calculated using percentage of complete agreement and kappa value.

Validity was evaluated by comparing the observations with data from three dimensional gait analysis performed at the same day as the video visits. Comparison with the 3DGA was performed for only 16 items since clearance in swing does not have a correlate from the three dimensional gait analysis data. 3DGA data of the remaining 16 variables were converted to EVGS scores for statistical comparison. Thirteen of the 16 variables were directly converted from 3DGA to EVGS scores based on the EVGS definition. EVGS variables with more qualitative definitions (Mild/Moderate/Severe deviations), such as knee progression angle and trunk max lateral shift, were converted from 3DGA data based on normative values from typically developing children. A zero (normal score) was given for 3DGA results within 1 SD of the typically developing mean, a one (mild deviation score) was given for results between 1 and 2 SD outside the typically developing mean, and a two (severe deviation) was given for those scores more than 2 SDs outside the typically developing mean. Percentage of complete agreement was calculated. Motion analysis was performed using Cortex, and Orthotrak software (Motion Analysis, Santa Rosa, CA). Pedobarograph data were collected to compare time to heel rise to EVGS using a foot pressure mat (Tekscan). Normative kinematic data was obtained from an existing data set of 96 typically developing children ages 3 to 19 years.

3. Results

Percentage of complete agreement between all observers for the 17 items of EVGS, using all videos, ranged between 60% and 90% (Table 1). Foot initial contact was the most reliable item with agreement of 90% and kappa value of 0.85 (Almost perfect). All 17 items had positive kappa value, and only the pelvis obliquity at mid stance had value under 0.20 (Slight) (Table 1).

Based on the level of experience, interobserver reliability showed higher percentage of complete agreement between the

Table 1
Interobserver reliability (between all observers and using all videos). Percentage of complete agreement and kappa value were used.

Score item	Complete agreement (%)	Kappa value/Level of agreement	Rank by kappa value
1. Foot initial contact	90	0.85/Almost perfect	1[a]
2. Heel lift	82	0.74/Substantial	2
3. Max ankle dorsiflexion in stance	63	0.40/Fair	12
4. Hindfoot varus/valgus	70	0.46/Moderate	9
5. Foot rotation	69	0.5/Moderate	8
6. Clearance in swing	83	0.69/Substantial	5
7. Max ankle dorsiflexion in swing	82	0.71/Substantial	3
8. Knee progression angle	81	0.71/Substantial	4
9. Knee peak extn stance	74	0.57/Moderate	6
10. Knee extn in terminal swing	62	0.45/Moderate	11
11. Knee peak flexn swing	69	0.46/Moderate	10
12. Hip peak extn stance	75	0.57/Moderate	7
13. Hip peak flexion swing	76	0.27 Fair	15
14.Pelvis obliquity at mid stance	74	0.18/Slight	17[b]
15. Pelvis rotation at mid stance	62	0.27/Fair	16
16. Trunk peak sagittal position	60	0.40/Fair	13
17. Trunk max lateral shift	67	0.37/Fair	14

[a] Score item with the highest kappa value.
[b] Score item with the lowest kappa value.