Gait & Posture 33 (2011) 48–53

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Arm posture score and arm movement during walking: A comprehensive assessment in spastic hemiplegic cerebral palsy

Jacques Riad [a,b,*], Scott Coleman [c], Dan Lundh [d], Eva Broström [b]

[a] Department of Orthopedics, Skaraborgs Hospital, 541 42 Skövde, Sweden
[b] Department of Woman and Child Health, Karolinska Institutet, 171 76 Stockholm, Sweden
[c] Motion and Sports Lab, Baylor University Medical Center, 411 N. Washington Ave Suite 2100, Dallas, TX 752 46, USA
[d] Högskolan Skövde, Box 408, 541 28 Skövde, Sweden

ARTICLE INFO

Article history:
Received 13 April 2010
Received in revised form 14 September 2010
Accepted 22 September 2010

Keywords:
Arm posture score
Three dimensional gait analysis
Motion analysis
Arm movement
Cerebral palsy

ABSTRACT

Patients with hemiplegic cerebral palsy often have noticeably deviant arm posture and decreased arm movement. Here we develop a comprehensive assessment method for the upper extremity during walking.

Arm posture score (APS), deviation of shoulder flexion/extension, shoulder abduction/adduction, elbow flexion/extension and wrist flexion/extension were calculated from three-dimensional gait analysis. The APS is the root mean square deviation from normal, similar to Baker's Gait Profile Score (GPS) [1].

The total range of motion (ROM) was defined as the difference between the maximum and minimum position in the gait cycle for each variable. The arm symmetry, arm posture index (API) was calculated by dividing the APS on the hemiplegic side by that on the non-involved side, and the range of motion index (ROMI) by dividing the ROM on the hemiplegic side by that on the non-involved side.

Using the APS, two groups were defined. Group 1 had minor deviations, with an APS under 9.0 and a mean of 6.0 (95% CI 5.0–7.0). Group 2 had more pronounced deviations, with an APS over 9.0 and a mean of 13.1 (CI 10.8–15.5) ($p = 0.000$). Total ROM was 60.6 in group 1 and 46.2 in group 2 ($p = 0.031$). API was 0.89 in group 1 and 1.70 in group 2 ($p < 0.001$). ROMI was 1.15 in group 1 and 0.69 in group 2 ($p = 0.003$).

APS describes the amount of deviation, ROM provides additional information on movement pattern and the indices the symmetry. These comprehensive objective and dynamic measurements of upper extremity abnormality can be useful in following natural progression, evaluating treatment and making prognoses in several categories of patients.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

The arm posturing (AP) typically described in spastic hemiplegic cerebral palsy (CP) consists of increased shoulder flexion and adduction, increased elbow and wrist flexion and with forearm pronation. Increased tone in the muscles causes the posturing, which often becomes more pronounced in transitions between movements such as gait initiation, when starting and stopping running, and when turning during walking, for example [2,3]. The deviation from normal varies significantly between individuals depending on the degree of involvement and on the natural progression of the CP [4,5].

The absence of normal movement on the hemiplegic side during walking is plainly visible and the asymmetry makes the deviation even more noticeable. This can be particularly problematic in adolescence, when one's general appearance becomes more important. AP adds to the stigma of CP and may develop into a cosmetic and social impediment [6,7].

Usually, assessments and treatment of the upper extremities of patients with CP are almost exclusively aimed at improving hand function and may also address dressing and hygiene problems [7–11]. The possibility of treating AP during walking is not often considered. It falls outside the main field of interest for the hand surgeon and the paediatric orthopaedic surgeon focus mainly on improving gait performance.

Comprehensive objective measurement of gait pathology in CP and other neuromuscular diseases has gained popularity during the last few years [1,12]. Three-dimensional motion analysis has made this possible and the complex data is made accessible to a larger group of physicians and caregivers.

Comprehensive assessments of the upper extremity of patients with CP are hard to find. Studies in CP patients mainly focus on

* Corresponding author. Tel.: +46 500 410545.
E-mail addresses: Jacques.riad@vgregion.se, famriad@hotmail.com (J. Riad).

0966-6362/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.gaitpost.2010.09.022

hand and arm function, particularly on the hemiplegic side. The Assisting Hand Assessment (AHA) is a rare example of a complementary assessment to achieve a more holistic view of the upper extremity in spastic hemiplegic CP [13]. Murgia et al. reported results from three dimensional movement analyses using range of motion in the shoulder and arm during daily living activities in a group of patients with distal radius fractures and found decreased range on the injured side [14]. Assessments of arm swing in patients with Parkinson disease have been reported and methods to describe arm movement asymmetry have been developed [15,16].

The AP during walking in spastic hemiplegic CP is not well investigated.

By quantifying deviations of arm posturing and movement pattern during walking, one might obtain an objective measurement that could be used to follow treatment and natural progression and help in making prognoses.

The primary goal of this study was to develop a measure to quantify deviation in arm posturing and deviation of arm movement pattern, with a focus on symmetry, in ambulatory patients with spastic hemiplegic CP. The second goal was to investigate whether the method could relevantly be used to identify subgroups within this population.

2. Methods

2.1. Study population

The study included 35 patients with spastic hemiplegic CP, median age 17.1 years (range 13.1–24.0 years) and 15 healthy controls, median age 18.6 (range 13.1–22.0 years). In the patient group 15 were female and 20 male and in the control group 8 were female and 7 male. Among the participating patients, 12 had left side involvement and 23 had right side involvement.

All were classified as GMFCS 1 (gross motor function classification scale) and as type 1 or 2 in the Winters' classification based on sagittal plane kinematics from gait analysis [17,18]. In Winters' classification for type 1 and 2 individuals have involvement only in the ankle joint (type 1 plantar flexion during swing phase and type 2 having plantar flexion throughout the entire gait cycle). Type 3 has additional involvement in the knee joint and type 4 in the knee and hip joint. Medical records were assessed to confirm the diagnosis of hemiplegic cerebral palsy before the age of 2 years. Spastic hemiplegic CP is defined as unilateral neurological involvement registered during physical examination, with the patient showing typical upper and lower extremity positioning, as well as gait deviations in the gait analysis.

From the total group of 47 recruited patients 12 were excluded because of previous upper extremity surgery. Of the 35 remaining patients, 13 had previously undergone calf muscle lengthening surgery but no other lower limb surgery. Patients with developmental delay were excluded.

Institutional Review Board approval was obtained.

In this prospective study patients were recruited from the neuromuscular clinics and from the databases of two hospitals in Sweden. A letter of information and an invitation to participate were sent to individuals over 18 years of age. If the potential participants were under 18 years of age, the material was sent both to them and to their parents or guardians.

Those that agreed to participate all paid a single visit to the same gait laboratory, where a three dimensional gait analysis was performed.

2.2. Three-dimensional instrumented gait analysis (GA)

All participants were examined by a physiotherapist. Assessments included passive range of motion of the upper and lower extremity using standardized positions and spasticity in elbow flexors and extensors according to the modified Ashworth scale [19].

Gait data was recorded at 100 Hz with an 8-camera three-dimensional motion capture system (Vicon Motion Systems, Oxford, England). Retroflective markers were placed on specific anatomical locations in accordance with the Vicon Plug-in-Gait Model. Segments included the thorax, upper and lower arms, hands and the head. Patients walked at a self selected speed across the capture volume which was 10 m long. Upper extremity calculations were taken from the mean of the individual gait cycles. Variables of interest included shoulder flexion/extension, shoulder abduction/adduction, elbow flexion/extension, and wrist flexion/extension. Shoulder and elbow calculations were performed by Orthotrak, the clinical gait measurement and evaluation tool of Motion Analysis Corporation (Santa Rosa, CA). Wrist flexion/extension is not included in Orthotrak, thus calculations were conducted by a custom LabView program. A set of Euler rotations were performed between the hand segment, consisting of the two wrist markers and a marker placed on the dorsum of the hand just proximal to the metacarpals, and the forearm segment, consisting of the wrist markers and the elbow marker. Time and distance variables were registered.

2.2.1. Calculations

2.2.1.1. Arm posture score. The total deviation of arm movement from four kinematic variables was calculated and named arm posture score (APS). The four

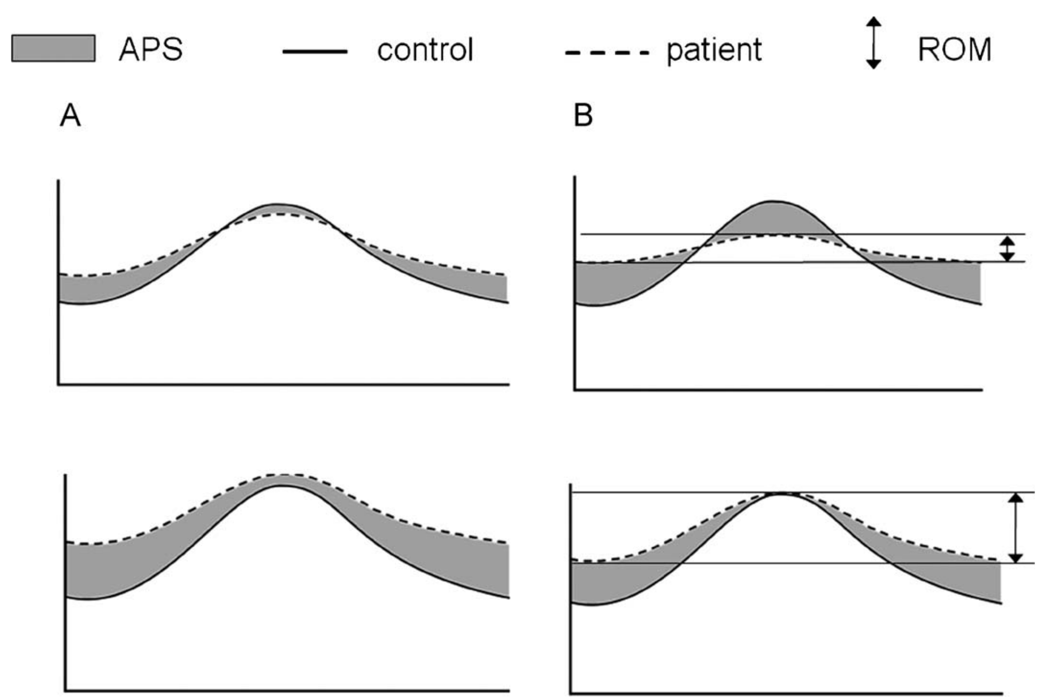

Fig. 1. (A and B) Schematic drawing of separate gait cycles with the elbow as an example. The purpose is to illustrate differences in deviation depending on curve positioning and amplitude. The *x*-axis shows the gait cycle from beginning to end and the *y*-axis shows the degrees of motion. (A) Impact of basal arm position. The gait cycle curves for the patient and control have the same shape and amplitude in the top and bottom graph. However, the patient's curves have different positions (along the *y*-axis) and therefore the amount of deviation (grey area) is different in the top and bottom graph. (B) Impact of arm movement amplitude. The gait cycle curves for the patient and control have different amplitudes in the top and bottom graph. Even if the patient and control have different ranges of motion they have almost the same amount of deviation (grey area).

Download English Version:

https://daneshyari.com/en/article/6207625

Download Persian Version:

https://daneshyari.com/article/6207625

Daneshyari.com