GAIT KINEMATICS AND SYMMETRY IN PATIENTS WITH HEMIPARESIS USING AN AUDIO FEEDBACK DEVICE

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Introduction

Symmetry is an important gait feature that is measured and reported frequently, particularly in patients with hemiparesis. For many rehabilitation professionals, a goal of gait re-education is the achievement of symmetry during locomotion [1, 2]. The objective of this work is to examine changes in gait symmetry when using an audio feedback device in paediatric patients with hemiparesis that follow a training plan.

Methods

Four patients with hemiparesis (aged 9 - 17 years) from Hospital Sant Joan de Déu of Barcelona were analysed using an optical motion capture system.

The audio feedback device is placed on both thighs of the patient and it allows measuring the angle of the thigh with respect to the vertical axis. The device makes a sound when it reaches a threshold angle, which can be set as desired.

The patients' motion was analysed under four different scenarios: natural gait (N), gait using the audio feedback device (F), gait after feedback training (T), and gait after feedback training and pause (TP).

During scenario N, the patient walks normally without hearing the auditory feedback. During scenario F, the patient should pay attention to the feedback, trying to lift their leg until hearing the sound. The patient is asked to train with feedback for 10 min and the gait is captured again: T. After 5 minutes of pause, the last scenario is captured: TP. For the last two scenarios, the audio-feedback is removed and the study intends to check if the patient is able to incorporate the new learnt gait pattern. Three trials for each scenario and each patient are analysed.

Eight spatiotemporal parameters, *V* in Eq. (1), were calculated: cycle time, stance time, swing time, cadence, stride length, step length, step width, and walking speed. Moreover, parameters related to gait kinematics, including displacements and angular velocity of the lower limbs, were also analysed.

Results

The spatiotemporal parameters were measured on the affected and unaffected sides in order to analyse symmetry during gait. The following ratio *R* was calculated for each parameter *V* [3]:

$$R = \left[\frac{V_{\text{non affected side}} - V_{\text{affected side}}}{V_{\text{non affected side}}}\right] \cdot 100 \qquad (1)$$

Ratio values close to zero indicate symmetric behaviour. Some of these ratios are shown in Figure 1.

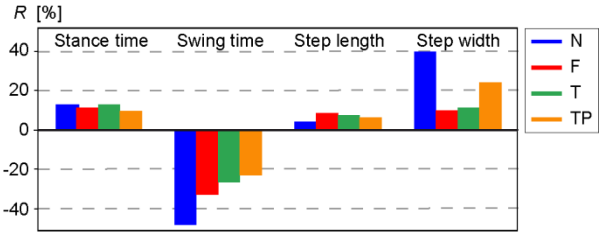

Figure 1: Four symmetry ratios for one patient.

Pelvic tilt, and hip, knee and ankle angles in the sagittal plane were compared between the affected and non-affected sides. The results of the knee angle α_k for one of the patients can be seen in Figure 2.

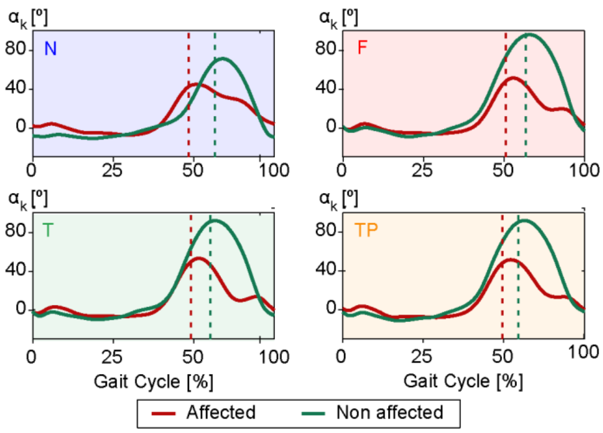

Figure 2: Knee flexion angle in affected and non-affected sides measured for one patient.

Discussion

It has been shown that the feedback device produces changes in the patients' gait that can be useful to help physiotherapist's work. In general, the device increases the symmetry of the gait parameters, although some of them can decrease its symmetry. Moreover, an increment of the range of motion of the affected side was observed for all patients, which can be seen as an important improvement for their gait pattern.

References

1. K. Patterson et al, Gait Posture 31(2): 241–246, 2010.
2. H. Böhm et al, Gait Posture, 35(2): 322–327, 2012.
3. H. Sadeghi et al, Gait Posture, 12(1): 34–45, 2000.