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P118

# A systematic clinical reasoning tool to support gait analysis interpretation: an SDR case example

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## 1. Introduction

The process of clinical gait analysis interpretation is complex and subject to the experience and professional background of the gait analyst. Here we present a novel, systematic way of reasoning, to bridge the critical gap between identifying abnormal gait features and finding their underlying impairments [1], to be addressed by a therapeutic intervention. The method is illustrated using a clinical case of a 7yo girl M. with spastic diplegic cerebral palsy, GMFCS level II, due to periventricular leucomalacia associated with prematurity (26 + 2 weeks).

## 2. Research question

Can a systematic clinical reasoning tool assist in treatment decision making for an individual patient?

## 3. Methods

M. received pre-treatment 3D gait analysis using a 28 marker set (Vicon Nexus, ISB anatomical definitions [2]), complemented with force plate measurements (AMTI), 16-channel EMG, and standardized physical examination (PE). Kinematic gait features were identified manually.

For our clinical reasoning tool, two tables were developed to help group gait features and relating them to their underlying impairments. Table A contained 30 common gait features identifiable from 3D gait graphs or video, each described by side, variable, type, and timing; as well as 1–9 potential causes (impairments) for each of these features. Table B was developed as the reverse of Table A, containing 22 potential impairments, each with 1–7 accompanying gait features. In total, 56 gait feature-impairment pairs were listed. These pairs were based on a combination of clinical experience, biomechanical reasoning and available literature.

The systematic reasoning approach consisted of the following steps: (1) select one prominent abnormal gait feature from the gait graphs or video, e.g. 'right ankle plantar flexion increased in stance' (see Fig. 1 Pre SDR); (2) search in Table A for potential underlying impairments and select one, e.g. 'soleus spasticity'; (3) search in Table B for other gait features related to this impairment (e.g. 'knee extension movement in loading response' and 'knee hyperextension in late stance') and check their presence in the gait graphs or video. If present, this strengthens the likelihood of this impairment limiting the gait; (4) search for additional evidence in PE, kinetic and EMG data; (5) if the impairment not likely, repeat from step 2 until a likely impairment is found; if the impairment is likely, repeat from Step1 until all features are explained.

Using this systematic approach, spasticity in soleus, gastrocnemius, hamstrings, and adductors were identified as the main limiting impairments for M., each with a strong effect on gait. These impairments could explain almost all of the abnormal gait features. Combined with

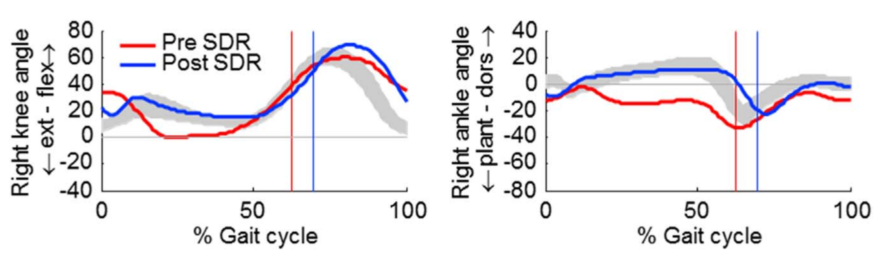


**Fig. 1**

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additional criteria such as sufficient strength, selective motor control, and motivation, as well as evidence from literature [3–5], a treatment decision for selective dorsal rhizotomy (SDR) surgery was made.

## 4. Results

One year post surgery, all gait features related to spasticity were improved (see Fig. 1 for knee and ankle angles).

## 5. Discussion

This systematic reasoning approach is a promising tool for novel gait analysts to help develop their skills, as well as for experienced users to verify the consistency of their decisions. Further (literature) study is needed to extend the developed tables including possible interactions, and to validate each of the gait feature-impairment pairs. The gait feature-impairment pairs can form the basis of a (semi-) automated reasoning tool.

## References

[1] Baker, et al. Measuring walking – a handbook of clinical gait analysis, Mac Keith Press, London, UK, 2013.
[2] Cappozzo, et al. Gait Posture 21 (2) (2005) 186–196.
[3] Grunt, et al. Dev. Med. Child Neurol. 53 (6) (2011) 490–498.
[4] Grunt, et al. Dev. Med. Child Neurol. 56 (4) (2014) 302–312.
[5] Roberts, et al. Gait Posture 42 (1) (2015) 16–22.