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The Movement Analysis Profile (MAP) and the Gait Profile Score (GPS)

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Summary: A new method for summarising gait data, the Movement Analysis Profile (MAP) is presented, which gives rise to a simple measure of gait pathology, the Gait Profile Score (GPS).

Conclusions: The MAP has high face validity and illustrates which kinematic parameters show the most marked deviation from those of people without gait pathology. The GPS correlates strongly with the square root of the Gillette Gait Index [1] (GGI), and frequency plots across patients with different Functional Assessment Questionnaire [2] (FAQ) or Gross Motor Function Classification System Levels [3] (GMFCS) confirm it is a valid measure of gait pathology.

Introduction: Full 3-D kinematic data are complex. There have been several attempts to derive a single score to summarise the extent of gait pathology of which the GGI1 is the most widely accepted. This has several shortcomings that have been recognised by the original developers who are now proposing the GDI as an alternative [4]. One particular limitation of both is that they cannot be decomposed in any obvious way to give insight into where gait pathology is arising. This study proposes a new measure of overall gait pathology which allows this.

Patients/Materials and Methods: The analysis focuses on the root mean square (RMS) difference between a kinematic variable for a particular subject and the average values of that variable from people without pathology calculated over the gait cycle. The MAP is defined as the composite of these values for all the clinically relevant kinematic variables (see Figure 1). The GPS is defined as the RMS average of the components of the MAP and represents the RMS difference from the average reference dataset calculated over all relevant kinematic variables and across the whole gait cycle. The validation of this approach is based on a retrospective analysis of all patients seen by a paediatric Gait Analysis Service in 2005–2007 and 24 children with no gait pathology. 315 children were included of which 180 had cerebral palsy. Analyses performed included correlation with the square root of the GGI and plotting of frequency distributions for each level of the GMFCS.

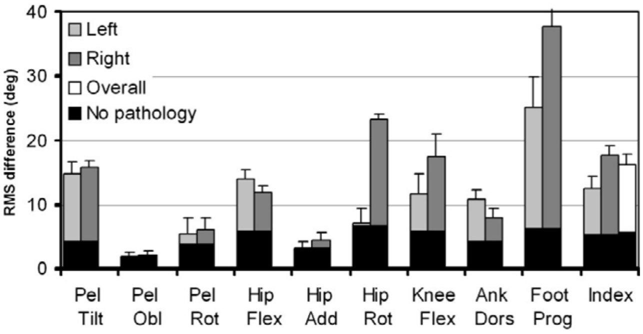

Figure 1.

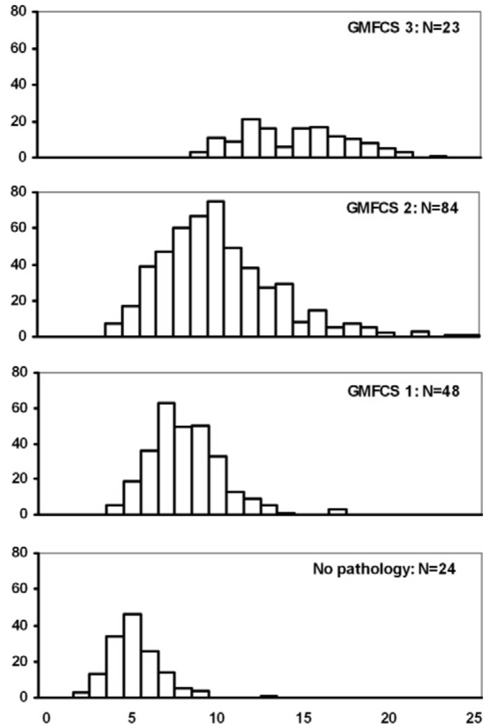

Figure 2.

Results: The MAP has proved a useful overview of a patient's gait pattern. The example above shows significant issues with foot progression bilaterally and hip rotation on the right. Smaller but still important problems are observed in pelvic tilt and hip flexion, knee flexion and, to a lesser extent, dorsiflexion. The strong correlation between GPS and the square root of GGI ($r^2 = 0.62$) and the frequency distribution across GMFCS levels (see Figure 2) and FAQ (not presented here) both validate the GPS as a measure of gait pathology.

Discussion: The MAP is not intended to be used instead of the full kinematic data. It has been found to be most useful as a starting point in the interpretation of the full data to focus on the key issues for any particular individual. Comparing pre- and post-op MAPs can also give an overview of how effective surgery has been. Both the MAP and GPS are now being used routinely in a range of clinical and clinical research applications.

References

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