**Development of three-dimensional computer modeling of ‘paediatric Gait, Arms, Legs, Spine’ (pGALS) manoeuvres and description of reference data for children and young people without joint pathology**

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**Background**

Juvenile idiopathic arthritis (JIA) is the commonest chronic rheumatology condition in childhood, characterised by relapsing and remitting flares. Recent work has shown early treatment leads to improved long-term outcomes. Currently, diagnosis of joint inflammation rests largely on clinician examination; pGALS is a musculoskeletal screening examination, widely practiced, to determine presence or absence of active joint inflammation. Clinical findings may be subtle in the early course of inflammation flares therefore tools which aid detection of joint inflammation are desirable.

Three-dimensional movement analysis is widely used to assess gait. However, the technology has not been developed beyond this application in part due to the challenge of developing complex upper limb models.

**Aims**

1. To develop the necessary computer models and protocols for 3-dimensional analysis of the movements associated with pGALS
2. To define a normative dataset for pGALS movements using 10 healthy volunteers

**Methods**

Ten healthy volunteers aged 9-15 years were recruited; each undertook a 2-hour session at the Sheffield Gait Laboratory during which retro-reflective markers were positioned on the upper and lower-limbs, as per the developed protocol. Participants copied demonstrated pGALS movements, broken down into individual movements with defined start and end points. Each movement was repeated a minimum of three times. Data was recorded using 12 Vicon (Oxford, UK) Vantage cameras and in-house models developed in Vicon Bodybuilder were applied, allowing detailed analysis of three-dimensional movement data.

**Results**

Three-dimensional movement data was recorded for 10 healthy volunteers (1:1 male:female ratio, age range 9-15 years). Wrist extension/flexion data during the pGALS ‘prayer movement’ is presented.



Figure 1. Mean (bold) ± 1 s.d (shaded area) wrist flexion/extension during prayer movement (start and end position, hands on knees). Left side = red, right side = blue. n=10.

Preliminary analysis of wrist movement data demonstrates mean (1.s.d.) change in wrist angle during prayer sign for right and left wrists of 80.4° (10.6°) and 77.9° (13.4°) respectively. Root mean square differences (RMSD) across the whole of the movement were calculated for the three trials for each subject, and across all trials for each arm to determine intra and inter-subject variability, with a mean (1.s.d.) intra-subject variability of 5.6° (1.9°), and inter-subject variability of 14.3° (6.9°).

**Conclusions**

1. We have developed the computer modeling necessary to describe the three-dimensional movements associated with pGALS.
2. We have collected a normative dataset for pGALS movements using 10 healthy children/young people.
3. Further work is planned to process and analyse the data collected for all pGALS movements, and compare normative data with that from children with joint pathology