Proof-of-concept study of accelerometery to quantify knee joint movement to assist with juvenile idiopathic arthritis diagnosis [abstract only]

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PROOF-OF-CONCEPT STUDY OF ACCELEROMETRY TO QUANTIFY KNEE JOINT MOVEMENT TO ASSIST WITH JUVENILE IDIOPATHIC ARTHRITIS DIAGNOSIS

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Introduction: Body-worn accelerometers can accurately quantify joint movements, and could potentially assist with the diagnosis of juvenile idiopathic arthritis (JIA) as joint movement restriction is a feature of the condition.

Objectives: This proof-of-concept study aimed to evaluate the use of accelerometry to objectively quantify knee joint movements in children with clinically active JIA. Restriction in joint movement can be observed in JIA, so an accurate, cost effective, and portable tool that objectively measures restriction could aid diagnosis.

Methods: Seven participants (age: 11.7 (2.7) years) with suspected active arthritis of a single knee joint were recruited. Participants had established diagnoses of oligoarticular (n = 2) and polyarticular JIA (n = 5) and were recruited just prior to planned appointments for steroid joint injections. paediatric Gait, Arms, Legs and Spine (pGALS) examination[1] was performed by an experienced practitioner on the day of data collection, to confirm the suspicion of active arthritis. The contralateral knee joint acted as reference. An accelerometer is a miniature sensor for measuring movements in three perpendicular dimensions. Four tri-axial accelerometers were integrated individually in soft elastic bands. The data from the accelerometers were collected using a microprocessor and stored on a computer. Accelerometers were placed above and below each knee and participants were asked to perform ten consecutive flexion and extension movements of each knee joint while lying, followed by walking ten meters. Accelerometry data were processed using a data analysis package called Matlab© to quantify knee movement according to range of movement, maximum velocity, maximum acceleration, angular displacement, and period of movement. A participant questionnaire was used to establish procedural acceptability.

Results: The accelerometry results were concordant with pGALS examinations in 86% (n = 6) of cases. In all variables measured, the extent of movement was reduced in the knee joint with active JIA, this was most pronounced during flexion and extension movements compared to walking. Joint range of movement had a greater standard deviation (16.6 degrees) and interquartile range (29.1 degrees) in the knees with active JIA compared to the healthy knees during flexion and extension movements, demonstrating inconsistency of movement in the joints with active JIA. There were statistically significant differences between the range of movement ($p = 0.032$) and angular displacement ($p = 0.030$) of the knees with active JIA and the healthy

contralateral knee joints during flexion and extension. No statistically significant differences were identified between knee joints with active JIA and the healthy knee joints during walking. The questionnaire indicated one participant suggested future improvement in the accelerometer's band design due to discomfort, and the remaining participants found the procedure acceptable. **Conclusion:** The study demonstrated proof-of-concept for the use of accelerometry to quantify knee joint movement in JIA. It examined accelerometry variables that suitably represented joint movement. It was found that accelerometry has potential for differentiating between joints with active arthritis and unaffected joints, particularly through assessment of flexion and extension movements. Further research is required to confirm these findings and refine the use of this novel technology in children with JIA.

References:

1. Foster HE et al. Musculoskeletal screening examination (pGALS) for school-age children based on the adult GALS screen. Arthritis Rheum. 2006 Oct 15;55(5):709-16.

Disclosure of Interest: None Declared