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Objectifying Biomechanical Parameters Related To Chronic Low Back Pain In Competitive Horseback Riders Using IMUs

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PURPOSE: A clear biomechanical explanation for chronic low back pain (CLBP) in horseback riders remains absent, despite its high prevalence. Studies performed in other sport disciplines suggest that peak acceleration and shock attenuation might play a role in CLBP. Since inertial measurement units (IMUs) have been used to measure these parameters in walking and running, the purpose of this study is to investigate if and how IMUs can be used to measure these parameters in horseback riders.
METHODS: Ten female horseback riders (21-37 years, no back pain, minimum of 3 training hours/week, medium level) performed a riding protocol. Subjects performed 3 laps of walk, sitting trot and canter with and without stirrups on their own horse whilst being instrumented with 8 IMUs (feet, lower legs, upper legs, pelvis and sternum). Peak accelerations measured by the IMUs were used to calculate shock attenuation (from foot to lower leg and from pelvis to sternum) in trot and canter as: *Shock attenuation = (1 - peak acceleration superior segment/peak acceleration inferior segment) x 100.*
RESULTS: No clear movement patterns are observed in walk, with acceleration values being below 2 m/s^2. A clear movement pattern with two peaks per gait cycle is visible for sitting trot (figure 1). In canter, one peak is visible per gait cycle. The only clear trend in the shock attenuation values is a negative shock attenuation from pelvis to sternum in sitting trot (-53.5 ± 39.6%).
CONCLUSIONS: An 8 IMU set-up can be used to objectify peak acceleration and shock attenuation in sitting trot and canter, but not in walk due to low acceleration values. The negative shock attenuation from pelvis to sternum in sitting trot indicates that the shock in the torso is increased, rather than attenuated. This could be of interest with regards to the occurrence of CLBP. The increase in shock could potentially be explained by a rotational component in the pelvis, highlighting the importance of core stability for horseback riders.

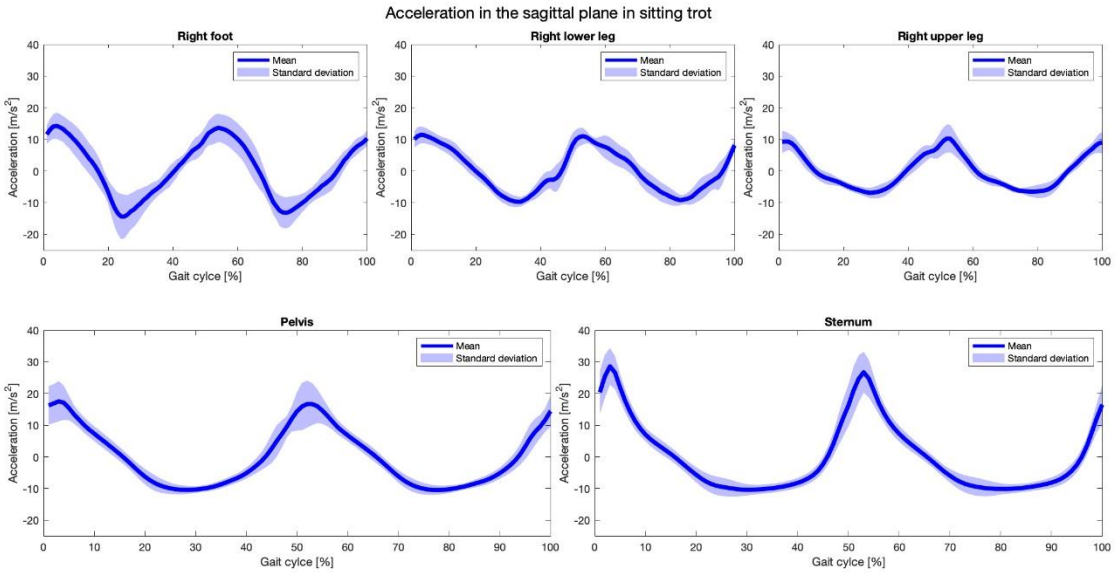

Figure 1: Accelerations in the sagittal sensor plane in sitting trot for the different segments. The mean acceleration is represented by the dark blue line. The light blue shaded area represents the standard deviation. The peak accelerations per segment (represented as mean ± standard deviation) are: 14.8 ± 3.6 (right foot), 12.4 ± 2.0 (right lower leg), 11.4 ± 2.6 (right upper leg), 19.2 ± 6.3 (pelvis) and 27.5 ± 4.8 (sternum).

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Longitudinal Analysis Of Mobile Smartphone Application For The Assessment Of Facioscapulohumeral Muscular Dystrophy (FSHD) Gait

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Facioscapulohumeral muscular dystrophy (FSHD) can be categorized as having a loss of muscular function in the torso, pelvic girdle, and legs. FSHD patient's gait may decline over time, which could be used as a marker of disease progression. If so, this may be beneficial for potential clinical trials.
PURPOSE: Evaluate gait velocity and cadence across three gait tasks using a novel smartphone application among individuals with FSHD over 6 months.
METHODS: 2 (male=1, female=1; avg. age=65 years) genetically confirmed FSHD1 patients completed three gait trials that required them to walk on a level surface at home 5 out of 7 days a week at two time points, 6 months apart. Patients used a custom smartphone application (FSHD Gait), installed on a smartphone (LG KG40) and secured on the lower back using a running belt, while walking. FSHD Gait application was used to take pictures of their shoes and walking environment. The first task (T1) involved walking 10 meters 12 times once each day. The second task (T2) was to walk 10 meters 6 times, with 6 trials being performed in the morning and 6 in the afternoon with a minimum of 4 hours between sessions. In the final week (T3), participants were instructed to walk for 6 minutes without any breaks. One-way ANOVAs compared the two time points while controlling for shoe type and walking surface.
RESULTS: Over the course of 6 months, neither participant expressed a significant decline in gait velocity. There was no difference in gait velocity between time point one and two for T1 (PRE= 0.93 ± 0.24 m/s, POST= 0.85 ± .04 m/s; Cohen's d= 0.27; p=0.75), T2 (PRE= 0.93 ± 0.15 m/s, POST= 0.88 ± 0.07 m/s; Cohen's d= 0.50, p= 0.54) or T3 (PRE= 0.94 ± 0.21 m/s, POST= 1.00 ± .09 m/s; Cohen's d= 0.47; p= 0.63). Similarly, over the course of 6 months, neither participant expressed decline in cadence between time point one and two for T1 (PRE= 94.07 ± 4.78 steps/min, POST= 99.66 ± 6.44 steps/min; Cohen's d= 3.36; p= 0.13), T2 (PRE= 103.71 ± 5.17 steps/min, POST= 0.85 ± 0.04 steps/min; Cohen's d= 0.44; 0.64) or T3 (PRE= 98.74 ± .25 steps/min, POST= 86.88 ± 11.30 steps/min; Cohen's d= 1.03; p= 0.35).
CONCLUSION: FSHD Gait application can successfully collect and analyze gait for FSHD patient assessments over a 6-month period. While cadence nor velocity significantly changed, overall both metrics declined in both participants during T1 and T2.