Comparison of stride frequency measured using a leg mounted accelerometer and opto-electronic system.

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INTRODUCTION

Accelerometer systems can be used to measure equine gait variables in a range of environments (Witte *et al.* 2004, Robilliard *et al*. 2007). Most commercially available gait analysis systems are designed for use in research laboratories and veterinary hospitals and are either too expensive, inflexible, complex or time consuming to be used by riders and trainers seeking basic gait information. A commercially available leg mounted accelerometer has been developed for measurement of stride frequency. The system determines stride frequency in all gaits when mounted on a boot on the left or right forelimb.

The objective was to compare measurements of stride frequency obtained using the leg mounted accelerometer and a 2 camera, 3D motion capture system during walk, trot and canter on a treadmill.

METHODS AND MATERIALS

Data were collected using four clinically sound horses. All horses measured 165cm at the wither with a mean weight of 554kg ± 33kg (SD). A two camera ProReflex system (Qualisys, Sweden) with a sampling frequency of 120Hz was used to track the movement of a hemispherical marker (diameter 30mm) placed on the lateral wall of the left hind hoof for determination of stride frequency. The accelerometer unit or sensor (ETB, Herts., U.K.) (see Fig.1); measuring 78 x 36 x 19mm and weighing 51g was fitted into a pocket which was then attached to a standard protective boot fitted to the left metacarpus. An identical protective boot was fitted to the right metacarpus.

The protocol consisted of: 12 minutes of walk at 1.4m/s on 0% incline, 2 minutes of trot at 3.1m/s on 0% incline, 2 minutes of left lead canter at 7m/s on 5% incline and 2 minutes of right lead canter at 7m/s on 5% incline. During the exercise test horses were held by two handlers, one on each side of the treadmill in order to produce flexion to left or right to assist correct canter lead when required.

Data was collected continuously throughout walk, trot and canter using the Pegasus G system. The times of the two systems were synchronised to within one second. For both the Pegasus G system and the ProReflex system, the mean and standard deviation of stride frequency were taken over the same 30 second period at the end of each of the gait steps. Mean stride frequencies obtained using both systems were compared using a Mann Whitney U test. Significance was set at $P<0.05$

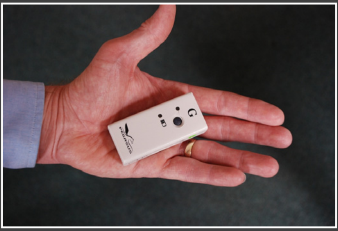

Figure 1. Pegasus G unit

RESULTS

Stride frequencies for the four horses are shown in Table 1. There was no significant difference between stride frequencies obtained using the two systems ($P>0.05$). The mean difference between the two systems (ProReflex-Pegasus G) at walk, trot, left and right canter were 0.008, 0.002, -0.017 and 0.004 Hz, respectively. A Bland-Altman plot of the difference between the two systems as a function of the standard system (i.e. the ProReflex) is shown in Fig. 2. There was a trend for the difference between the two systems to increases from walk to trot to canter. However, the maximum difference observed between the systems was 0.04 Hz or 2.2% of the absolute stride frequency.

SF (Hz)	Walk (mean ± s.d.)		Trot (mean± s.d.)		Left Canter (mean± s.d.)		Right Canter (mean± s.d.)	
Horse	ProReflex	Pegasus G	ProReflex	Pegasus G	ProReflex	Pegasus G	ProReflex	Pegasus G
1	0.79±0.03	0.78±0.01	1.33±0.02	1.35±0.01	1.82±0.02	1.86±0.03	1.89±0.03	1.89±0.03
2	0.80± 0.01	0.80±0.03	1.27±0.03	1.25±0.01	1.86±0.04	1.86±0.04	1.85±0.04	1.84±0.02
3	0.80± 0.01	0.79±0.03	1.35±0.01	1.35±0.01	1.86±0.01	1.88±0.01	1.90±0.02	1.89±0.02
4	0.79± 0.03	0.78±0.00	1.30±0.02	1.30±0.01	1.72±0.01	1.73±0.01	1.71±0.02	1.71±0.02
Mean ± s.d	0.80±0.01	0.79±0.01	1.31±0.04	1.31±0.04	1.82±0.07	1.83±0.07	1.84±0.09	1.83±0.08

Table 1. Stride frequency (Hz, mean±s.d) obtained using ProReflex and Pegasus G systems during walk, trot, left canter and right canter.

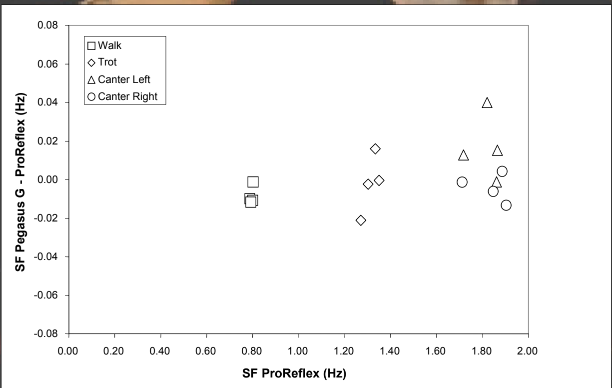

Fig. 2. Bland-Altman plot showing the difference between measurements of stride frequency (Hz) obtained with the ProReflex system and the Pegasus G system as a function of the values obtained from the ProReflex system in four horses during treadmill exercise at walk (1.4m/s on 0% incline, trot (3.1m/s on 0% incline) and left and right lead canter (7m/s on 5% incline).

CONCLUSION

The accelerometer based sensor system when mounted on the leg provides accurate measurements of stride frequency at walk, trot and medium speed canter on either the lead or non-lead leg. The largest difference between the two systems was only 2.2% of the absolute stride frequency. At 51g, the weight of the sensor is considerably less than that necessary to bring about changes in limb kinematics. The system provides reliable data which requires far less calibration or processing than the opto-electronic system and has the potential to be used by riders and trainers as a training aid.