MOTION ANALYSIS: ONE VERSUS TWO STRIDE ANALYSES

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The purpose of this study was to analyze two consecutive strides and compare results of gait and posture between the first stride, second stride and mean of the two strides. Two strides were filmed and digitized for 36 children at both 100m and 900m on three separate occasions. Head and trunk flexion, stride length, stride rate and double support time were recorded. No significant differences were found between the first, second and mean of the two strides for trunk/ head flexion and stride length. Differences were recorded between the first and second stride in stride rate and double support time, although neither stride was significantly different from the mean of the two strides. It was concluded that only one stride need to be digitized for an accurate representation of posture and gait.

KEY WORDS: gait, stride, posture.

INTRODUCTION: Two steps comprise one stride, whereas one stride is defined as heel down on one leg until the next consecutive heel down with that same leg (Hamill & Knutzen, 2003). It has not been clear in the past whether more than one stride needs to be digitized for accurate representation of motion. This is particularly troublesome with data collected outdoors or in competition that is not easily automatically digitized. Although digitizing more than one stride often occurs, it is questionable whether there are differences between one and two stride analyses. In load carriage some studies used multiple stride analysis to report posture or gait characteristics (Hans et al., 1992; LaFiandra et al., 2002; Stokes, Anderson, & Forssberg, 1989), while other studies used just one stride (Harman, Han, Frykman, 2000; Pascoe et al., 1997, Quesada et al., 2000). It would be helpful to know if significant differences occur when analyzing one and two stride analyses, so that a standard for data collection could be employed. The purpose of this study was to analyze two consecutive strides and compare results of gait and posture characteristics between the first stride, the second stride and the mean of the two strides.

METHOD: This study was approved by the University of Puget Sound Institutional Review Board. Experimental procedures were explained to 36, 10-12 year old children and their parents and written informed consent were obtained from both.
The children were filmed on three separate occasions at 60Hz walking 1000 m around a 400 m track carrying 15% of their body weight in a backpack. Two strides were filmed in the saggital plane of motion at 100 m and again at 900 m. A total of 416 strides were manually digitized using Peak Performance (v5.3) software. Mean trunk and head flexion, as well as stride rate, stride length, and double support time were compared between the first stride, the second stride and the mean of the two strides.
Trunk flexion was measured from the neck to the hip to the y-axis. Head flexion was measured from the ear to the neck to the y-axis. Stride length was measured as the horizontal displacement from left heel down to the next consecutive left heel down. Stride rate was measured as the time it took to take one stride. Double support was measured as a factor of time both feet were in contact with the ground. One-way analysis of variance was used to determine significance (? < .05).

RESULTS: Neither of the posture characteristics showed significant differences between the first, second and mean of the two strides. Mean head flexion was measured as 25.9°, 25.4°, and 25.7° for the first, second and mean stride respectively. Mean trunk flexion was measured as 9.0°, 9.7° and 9.4° for the first, second and mean stride respectively (Table 1 & Figure 1). Stride length also showed no significant differences between the first stride (1.30m), second stride (1.31m) and the mean of the two strides (1.30m) (Figure 2).

Table 1 Mean, SD, and cell size for head and trunk flexion for the first stride, the second stride, and the mean of the two strides.

	Head			Trunk		
	Stride 1	Stride 2	Mean	Stride 1	Stride 2	Mean
Mean	25°	26°	25°	9°	10°	9°
SD	12.6	12.0	11.6	4.7	4.8	4.6
n	209	207	416	209	207	416

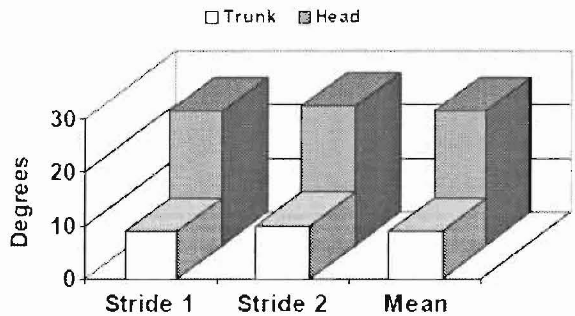

Figure 1: Mean head and trunk angles.

Stride rate and double support time showed significant differences between the first and second stride, but not between the mean of the two strides. Stride rate for the first stride was 1.00 strides/s, while for the second stride it was equal to 1.04 strides/s (Figure 2). Double support time for the first stride was 27.2% and for the second stride it was 26.2% (Figure 3).

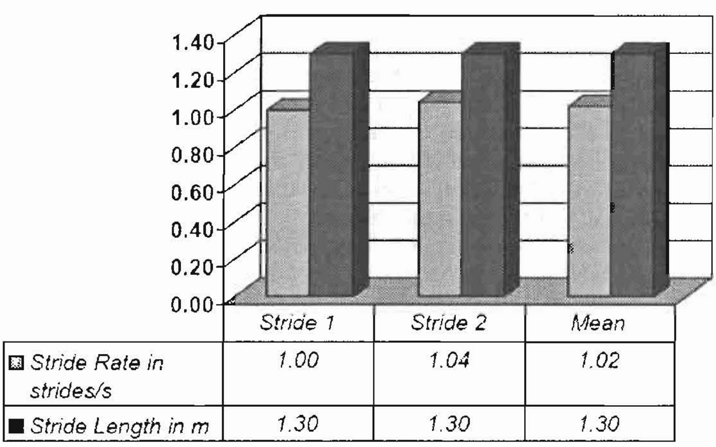

Figure 2: Stride rate and stride length.

DISCUSSION: It has not been evident from past literature whether analysis of one stride would accurately represent gait and posture characteristics. Some studies have used one stride analysis (Orloff et al., 2001; Harmon, Han, Frykman, 2001; Pascoe et al., 1997), while others have used two or more strides (Hans et al., 1992; LaFiandra et al., 2002; Stokes, Anderson, & Forssberg, 1989). This study hoped to clarify if digitizing more than one stride was necessary. Posture characteristics were not significantly different between the first stride, second stride or the mean of the two strides. This would indicate that one stride analyses would be sufficient for studies reporting only posture data.

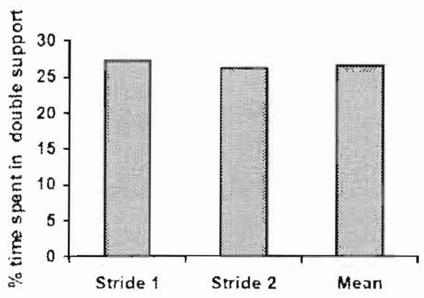

Figure 3: Double support time.

Stride length did not differ between the first, second and mean of the two strides. In fact it was quite consistent across all of the conditions in which the children walked. Stride rate and double support time did change from the first to the second stride. Double support time in load carriage when carrying loads of 15-20% of body weight has been reported as 40% (Kinoshita, 1985). Other studies have reported double support time to be closer to 30% when carrying a load (Rose & Gamble, 1994). This study would support numbers closer to the 30% time spent in double support, although both strides (26.2-27.2%) fell below the 30% mark. Although double support was significantly different from first to second stride the percentage seems relatively close. The low standard deviation (.029 for both strides) may indicate that the subjects were very similar and small differences were magnified. It was also evident that the data was consistent with the first stride having greater double support time. Time in double support did not differ between the mean and either the first or second stride. This was also true of stride rate, which showed the most inconsistency between the two strides, but neither stride was significantly different from the mean of the two strides.

CONCLUSION: One stride analyses do not differ from the mean of two stride analyses in posture and gait characteristics.

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