THE INDEPENDENCE OF BILATERAL KNEE FLEXION DATA IN CHILDREN WITH DIPLEGIC CEREBRAL PALSY

T. Niiler and F. Miller

1 A.I. duPont Hospital for Children, Wilmington, DE, USA
E-mail: tim.niiler@gmail.com

INTRODUCTION
There is growing concern in orthopedics literature that researchers are incorrectly using bilateral data to lend power to their results [1,2,3]. The consequence of this is that studies which report significant findings in interventions may be misleading clinicians due to artificially low p-values or too-small confidence intervals. One metastudy of literature during 2003 from common orthopedic journals indicated that 50% of clinical studies on any limb or joint used bilateral data in this manner [1]. Another metastudy of articles published in Bone and Joint Surgery over a two year period indicated that 31% of studies made use of bilateral data [2]. Since, in many cases, there exist statistical tests which can properly account for dependencies in bilateral data, these should be used, or else the data should be scrutinized for statistical independence and the experimental design should be carefully considered.

This work demonstrates a method to quantify the independence of bilateral time series data such as are often used in gait analysis. The method involves comparisons between limbs throughout the data set to determine whether intra or inter limb relationships are stronger. Because our lab's caseload is primarily children with Cerebral Palsy, we have chosen to apply the methodologies to this group for the purpose of this abstract. Clinical experience with this group indicates that the kinematics of each leg may be very different within a patient dependent on the specifics of the dysfunction.

CLINICAL SIGNIFICANCE
The assumption of independence of contralateral limbs is used frequently in gait analysis (for example, the GDI). A method which can demonstrate the degree of independence between contralateral limbs of a subject relative to the data set gives researchers a means to better design future experiments and assess the true significance of previous work.

METHODS
Retrospective bilateral knee flexion kinematics from twenty nine subjects with diplegic cerebral palsy (aged 11.2 ± 4.2) were pulled randomly from our database. All subjects walked without assistance or AFOs. In the first analysis, a simple matching of curves was attempted. Pearson product moment correlation coefficients (r) and root-mean-square (RMS) differences were calculated between each flexion curve. Counts were taken where the correlation coefficient equaled or exceeded the between leg value for a subject and where the RMS value equaled or was less than the between leg value for a subject.
RESULTS

In the first analysis, using an RMS criterion, only six out of 58 legs (10.7%) matched their contralateral side better than matching the legs from other subjects. When using the correlational criterion, the intralimb r-value exceeded the interlimb r-values in only five out of 58 legs (8.6%). Figure 1 indicates how many legs matched legs other than the contralateral leg better and in how many cases. For example, in Figure 1a, there are two cases where a leg matched 45 legs better than the leg matched its contralateral leg.

![Figure 1a: RMS results](image1.png)

![Figure 1b: Correlational results](image2.png)

DISCUSSION

These results indicate that when considering the entire knee flexion curve, in better than nine times out of ten, a given leg is more closely related kinematically to the leg from another subject than to the contralateral leg. This is true whether the shapes of the curves are considered (Pearson's r) or the differences between curves (RMS). Biomechanically, these results can be explained by the degrees of freedom available to the contralateral leg, especially when only considering kinematics. For instance, hemiplegic children are known to have completely different kinematics between legs. However, this study indicates that even in diplegic children, there are enough interlimb differences that limbs from a given subject cannot be matched purely on the basis of sagittal plane knee flexion angles. This implies that for many statistical treatments, with these data, each side may be considered independently of the other. While this study does not give a cut-off for the determination of bilateral independence, it does suggest a manner in which the relative independence of time-series data may be assessed prior to statistical testing or modeling.

REFERENCES


DISCLOSURE STATEMENT

T. Niiler and F. Miller have no conflicts of interest to disclose.