

## **COMPARISON OF OUTCOMES IN CHILDREN WITH CEREBRAL PALSY WHEN THE RECOMMENDATIONS FROM GAIT ANALYSIS ARE OBSERVED**

<sup>1,2</sup>Frank Chang, <sup>1</sup>Alexander K. Meininger, and <sup>1,2</sup>James J. Carollo

<sup>1</sup>Center for Gait and Movement Analysis (CGMA), The Children's Hospital, Denver, CO

<sup>2</sup>University of Colorado Health Sciences Center, Department of Orthopaedics, Denver, CO  
contact: [chang.frank@tchden.org](mailto:chang.frank@tchden.org), 1056 E. 19<sup>th</sup> Ave. B476, Denver, CO 80218

### **Introduction**

Clinical gait analysis is useful in the evaluation and measurement of gait abnormalities in the ambulatory child with cerebral palsy and recommendations derived from these measurements can be used to tailor treatment specific to the patient's needs. When recommendations from comprehensive gait analysis have been implemented, families and clinicians often detect a noticeable improvement in ambulatory performance, but because of the complexity of bipedal walking, these improvements are often difficult to quantify. While there are a growing number of publications addressing technical aspects of gait analysis, those outside the field continue to demand objective outcome studies documenting the efficacy and benefits of modern gait analysis procedures. Ethical and experimental considerations prevent the use of prospective, randomized studies for justifying the use of gait analysis, but an experimental opportunity exists if a gait analysis is obtained and the recommendations from that analysis are never implemented. This study was designed to take advantage of that rare opportunity.

### **Statement of Clinical Significance**

This retrospective study compares the clinical outcomes of two groups of matched subjects who underwent comprehensive gait analysis and received the same surgical recommendations, with the experimental group following the surgical recommendations and the control group continuing a course of non-surgical treatment.

### **Methods**

A total of 14 patients diagnosed with spastic cerebral palsy underwent two comprehensive gait analyses (3D kinematics, 3D kinetics, bilateral EMG) in our laboratory, spaced at least one year apart between July 1999 and June 2003. Following the first analysis, surgical recommendations were made based on laboratory findings and a systematic data interpretation strategy described previously [1]. The subjects were selected to create two groups of seven (control and experimental), matched on diagnosis, surgical recommendations from the first gait analysis, and approximate age. The patients in the control group (Group C) received surgical recommendations, but chose not to proceed to surgery. Group C continued to receive physical therapy or alternative treatments as part of their ongoing clinical management, and had repeat gait analysis after approximately one year. The patients in the experimental group (Group X) received all surgical procedures recommended by the first gait analysis, and a follow up gait analysis one year post-operative. Single-event multilevel surgery was performed an average of 7 months after the analysis (range 2.5-13mo.), with the average number of surgical procedures equal to 6.29 (range 4-8). Marker trajectory data from all subject analyses were processed in the customary way using Vicon Workstation and the plug-in gait module (VCM marker set), to yield time normalized joint displacements for each analysis. For each recommended surgical procedure, stance and swing phase criteria (e.g. rectus femoris transfer – swing: peak knee flexion at initial swing, stance: peak knee flexion at loading response) were used to evaluate the specific procedure. Differences between the first and second gait analysis joint angle data for all criteria from each subject were then

mapped to three categorical variables corresponding to either a negative change (away from normal), no change (+/- 5 degrees), or a positive change (closer to normal). The percent positive, negative and no change were then calculated by dividing the frequency of each categorical variable by the total number of variables for each subject in each group. These were then compared between the two groups using logistic regression.

### Results

Results of the study are summarized in the table below. Matched subjects are shown on the same row, and since there are two criteria for each surgical procedure (stance, swing), the number of criteria per subject is twice the procedure count. Group X showed an average 46.7% positive outcome for all surgical evaluation criteria compared to 19.9% in the control group. Results of the Wald Test in the logistic regression analysis comparing the percent positive rate between the two groups was significant at a level of  $p < 0.001$ . The odds ratio was calculated as 3.168 (95% CI: 1.64–6.12), suggesting that the chance of a positive outcome criteria resulting from Group X was 3 times more likely to occur than from Group C.

subject pair	# of surg. proc.	Group C - Control						Group X - Experimental					
		negative		no change		positive		negative		no change		positive	
		n	%	n	%	n	%	n	%	n	%	n	%
1	6	4	33.3	7	58.4	1	8.3	0	0.0	6	50.0	6	50.0
2	6	6	50.0	4	33.3	2	16.7	0	0.0	5	41.7	7	58.3
3	4	1	12.5	7	87.5	0	0.0	3	37.5	1	12.5	4	50.0
4	6	1	8.3	5	41.7	6	50.0	2	16.7	4	33.3	6	50.0
5	6	1	8.3	10	83.4	1	8.3	3	25.0	6	50.0	3	25.0
6	8	1	6.3	11	68.7	4	25.0	5	31.3	0	0.0	11	68.8
7	8	4	25.0	7	43.8	5	31.3	1	6.3	11	68.8	4	25.0
Avg.	6.29	20.5%		59.5%		19.9%		16.7%		36.6%		46.7%	
SD	1.38	16.4%		21.2%		17.0%		15.2%		23.6%		16.3%	

### Discussion

Previous studies have compared gait analysis to clinical observation for recommendations of surgical interventions in cerebral palsy patients [2-4]. This study has found that when matched pairs of subjects receive the same surgical recommendations following an initial gait analysis, there is a higher likelihood that gait performance criteria based on joint angle data will improve if the recommendations of the gait analysis are implemented. This supports the use of gait analysis for clinical decision-making in the cerebral palsy child, and suggests that measurements at the impairment level common to modern gait analysis can be used to evaluate surgical outcomes.

### References

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