Goal Specific Outcomes of Rectus Femoris Transfers in Children with Cerebral Palsy Based on Stance-Phase Characteristics

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Introduction

Some have assessed outcomes of rectus femoris transfers in children with Cerebral Palsy by grouping patients according to their functional level of ambulation [1,2]. However, it is thought that the biomechanics leading to knee flexion in swing will differ depending on stance phase characteristics [3,4]. A previous study, grouping patients into three stance-phase groups, showed differences in outcomes (peak knee flexion, timing, and swing range) between the groups[5]. Although these differences were not statistically significant, we feel they are of clinical significance, due to the inherent differences between the groups (based on stance-phase kinematics). It is the purpose of this study to determine goal specific outcomes of rectus transfers based on pre-operative stance-phase kinematics in order to provide a framework for outcome prediction in future patients with similar characteristics.

Statement of Clinical Significance

Patients with cerebral palsy often have diminished knee flexion in swing as well as delayed timing, causing difficulty with swing phase clearance. Although rectus transfers have been shown to be highly effective in improving these parameters [6,7], appropriate patient selection is debatable. Goals of rectus transfers are not identical for all patients. A patient with a crouch gait pattern may have a rectus transfer goal of maintaining peak knee flexion, whereas another with a jump knee pattern may need to increase the amount of peak knee flexion in swing. Therefore, if we can group patients into similar groups based on their stance-phase kinematics, common goals can be determined for each group. The results of this analysis can provide a framework for future patient selection for rectus femoris transfers based on common goals.

Methodology

Sixty children (n=104sides) with Cerebral Palsy were analyzed in this retrospective study. Subjects were ambulatory with or without assistive devices and underwent rectus femoris transfers in conjunction with multiple-level surgeries. Mean age at the time of surgery was 11.8 years. All patients underwent computerized gait analyses in the Motion Analysis Laboratory pre-operatively and 12-18months post-operatively. In addition, all patients received 4 to 6 weeks of post-operative inpatient physical therapy with a minimum follow-up of one year. Classification of patients into one of the following four cohorts was determined objectively through quantitative stance-phase characteristics from the pre-operative gait analysis: 1.) Sustained Crouch [SC n=32] 2.) Increased knee flexion at initial contact [IKF n=39] 3.) Jump Knee [JK n=19] 4.) Severe Crouch [SVC n=14].

Primary goals for each stance phase group were established and measured by analysis of the following outcome variables: minimum knee flexion in stance (MKFS), peak knee flexion in swing (PKFS), timing to peak knee flexion (TTPKF), and knee flexion swing range (KFSR).

Variables	Stance-Phase Groups / Goals			
	SC	**IKF**	**JK**	**SVC**
MKFS	decrease	*mild decrease*	*increase/ maintain*	decrease
TTPKF	normalize	normalize	normalize	normalize
PKFS	*maintain*	increase	increase	decrease
KFSR	increase	increase	increase	increase

Italics denote secondary goals not analyzed statistically.

Pre vs. post-operative data were analyzed using paired t-tests with Bonferroni's correction for multiple comparisons. Walking speed was analyzed pre and post-operatively on all patients as a group. Cohen's *d* (effect size) was calculated for each.

Results:

The SC group showed significant improvements in all three variables analyzed: MKFS (p=. 000), TTPKF (p=. 010), and KFSR (p=. 000). While the IKF and JK groups both obtained significant improvements among the following variables [PKFS (p=. 000) and KFSR (p=. 000)], timing (TTPKF) was not significant (p>. 017). The four outcome variables analyzed for the SVC group were statistically significant: MKFS (p=. 000), PKFS (p=. 001), TTPKF (p=. 001), and KFSR (p=. 006). Walking speed decreased significantly from a mean of .85m/s pre-op to .81 post-op (p=.024). Cohen's *d* (effect size) for walking speed was .15.

Discussion

Significant improvements were seen in all variables analyzed in each of the four groups, except for timing in the JK and IKF groups. Findings suggest that improvement in timing of peak knee flexion may not be a reasonable goal for future patients who fall into the JK and IKF groups. All other outcomes for each group were successful. We conclude that this classification model utilizing stance-phase groups may be beneficial in surgical planning and outcome measures for future rectus transfer patients with Cerebral Palsy.

Walking speed was significantly decreased post-operatively suggesting that rectus femoris transfers may have a deleterious effect on walking speed by removing its energy transfer capabilities at the knee. However, the small effect size (.15) calculated for walking speed suggests the decrease seen post-operatively, while statistically significant, may not be of clinical significance. Future studies at 3 years post-operative or greater would be beneficial to see if improvements were maintained, as well as to investigate the possibility of long-term effects on walking speed.

References:

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