Short Term Outcome Comparisons of TAL Procedures in Children with CP

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Introduction

Equinus deformity is a common problem in children with cerebral palsy (CP). Two different categories of surgical interventions are performed to alleviate this deformity. One class alters the length of both the gastrocnemius and soleus muscle-tendon unit. This category includes Z-lengthening and open or percutaneous Hoke procedures of the Achilles tendon. The other category alters the length of the gastrocnemius muscle-tendon unit without altering the soleus. This category includes Vulpius, Strayer, and Baker procedures. Although both categories of procedures improve ankle kinematics throughout the gait cycle [1,2,3], both categories may also weaken the plantarflexor muscles resulting in decreased ankle power during the stance phase of gait. The purpose of this study was to examine the effects of surgical interventions on gait kinematics and kinetics in children with equinus deformity secondary to cerebral palsy. The study specifically compares Baker lengthening of the gastrocnemius with Z-lengthening and percutaneous Hoke lengthening of the Achilles tendon.

Statement Of Clinical Significance

Comparison of surgical intervention outcomes is a prerequisite for effective and efficient clinical decision making and patient management.

Methodology

Thirty-seven ambulatory children with a mean (SD) age of 10.8 (3.8) years and spastic CP who had unilateral (n=19) or bilateral (n=18) surgical intervention for equinus deformity were included in the study for a total of 55 surgical limbs. Achilles-tendon lengthenings were performed on 39 limbs and gastrocnemius lengthenings were performed on 16 limbs. Nine children (14 limbs) had previous equinus deformity lengthenings.

Children were evaluated 4 (4) months prior to and 17 (10) months after surgery. Equinus deformity was evaluated by measuring maximal ankle dorsiflexion with the knee at 0° and 90°of flexion. After being instrumented with the standard Vicon marker set, subjects walked barefoot across a 10 *m* walkway at a self-chosen velocity with data collected in the middle 4 *m*. Marker data were sampled at 60 *Hz* using a six camera Vicon 370 system in combination with four AMTI force plates. Vicon Clinical Manager software was used to determine kinematics, kinetics, and temporal measures.

For subjects having unilateral lengthening, only the limbs having surgery were included in the analysis. To minimize the effects of within subject variability, gait parameters were averaged across three gait cycles prior to statistical analysis. Statistical analysis included

physical examination and gait analysis data of knee and ankle parameters. Repeated measures ANOVA were used to compare the soleus preserving group (gastrocnemius lengthening) to the soleus lengthened group (Achilles-tendon lengthening) at the pre- and post-operative states.

Results

Variable	Soleus Lengthening		Soleus Preserving		*p* Values	
	Pre	Post	Pre	Post	Group	Time
Physical Exam						
Max. DF w/Knee @ 0 (deg.)	-2	7	-7	6	.2548	<.0001
Max. DF w/Knee @ 90 (deg.)	4	14	5	13	.9702	<.0001
Temporal						
Velocity (m/s)	.88	.94	1.05	1.04	.0513	.4760
Step Length (m)	.44	.48	.51	.52	.0621	.0396
Cadence (steps/min)	116	119	133	125	.0799	.5515
Ankle Kinematics						
Mean Dorsiflexion (deg.)	-4	7	-2	7	.7113	<.0001
Peak Dorsiflexion (deg.)	6	16	5	15	.9465	<.0001
Ankle Kinetics						
Peak Generated Power (W/kg)	1.2	1.3	1.2	1.6	.3868	.0258
Peak Absorbed Power (W/kg)	-1.5	-.9	-1.5	-.8	.7298	<.0001

Table 1. Means and associated *p* values determined from repeated measures ANOVA. *Group* values represent between factors comparison of soleus lengthening and preserving groups, *Time* values compare changes between pre- and post-operative data. DF=Dorsiflexion.

Discussion

Both maximal dorsiflexion with the knee at 0° and 90° showed significant improvement following surgery, but there were no differences between groups. The soleus preserving group had higher velocities and step length; these were not altered by surgery. Both peak and mean ankle dorsiflexion increased due to surgery, but changes were not different between groups. Significantly less ankle power was absorbed post-surgically, without a difference between groups. Similarly, peak generated ankle power increased and peak absorbed power decreased, but there were no differences between groups. Additional knee and ankle parameters studied showed similar results: improvements with surgery, with no differences between groups.

These results agree with previous studies that both soleus preserving and soleus lengthening procedures improve gait kinematics. There were no differences found between the procedures in either kinematic or kinetic variables. It should be emphasized that these are short term results, changes between groups may occur with time, growth and weight gain. Future work will include continuing follow up to determine longer term effects.

References

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