THE EFFECT OF THERATOGS ON THE GAIT OF A CHILD WITH CEREBRAL PALSY A CASE STUDY.

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ABSTRACT

PURPOSE: The purpose of this case study was to investigate the effectiveness of *Theratogs (Available at www.Theratogs.com) as a physical therapy intervention for a child with spastic diplegia and whether or not the Theratog strapping system altered the child's gait in a beneficial manner. Further, our study looked to translate these results to other children suffering from inefficient gait associated with CP. **SUBJECT:** An eight year old boy (CM) with a diagnosis of spastic diplegic cerebral palsy who ambulates with bilateral rigid AFO's. He is currently in physical therapy to maximize function and gait efficiency and has no significant complicating PMH. **METHODS AND MATERIALS:** The project was conducted in the kinesiology laboratory of the Physical Therapy Department of FIU. Reflective markers were attached to the subject and video cameras were used to record the subject ambulating both with Theratogs and without. The APAS Gait analysis system was used to interpret the video and analyze the child's gait. **ANALYSIS:** Video data was collected using the APAS gait analysis system. The child's gait was filmed from five different camera angles simultaneously several times (with and without Theratogs) to ensure the capture of usable data. Full length videos were analyzed and the best single gait cycles were selected (with and without Theratogs). Attention was focused on the child's right side (Right Initial Contact to Right Initial Contact). These shortened video segments were turned into stick figure representations of the child's gait cycle using APAS. Stick figure representations were used to create line graphs of all major joints in the X, Y, and Z planes. Video segments, stick figure representations, and graphs of with and without Theratogs were then compared to one another to more accurately assess for subtle gait nuances not easily seen by the naked eye. Lastly, results were compared to a normal gait cycle. **RESULTS:** In general we found the application of Theratogs did improve the quality and efficiency of the child's gait. At each joint some improvement was noted signifying a gait pattern more closely resembling that of normal. **CONCLUSION:** Our findings demonstrated an improved gait from a biomechanical perspective with the use of Theratogs. The child showed greater separation of metatarsal heads in the frontal plane indicating less of a stereotypical CP scissoring motion. Furthermore, at the ankle, there was increased plantar flexion at IC and dorsiflexion during stance and at the end of swing. The knee presented with less flexion at IC and during swing. The graph portraying CM's hip motion during stance indicating more coordinated muscle activity between the flexor and extensor muscle groups. Lastly, the child's pelvis, trunk, and shoulders all stayed closer to level indicating less overall excursion and a more efficient, less energy consumptive gait pattern.

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PURPOSE

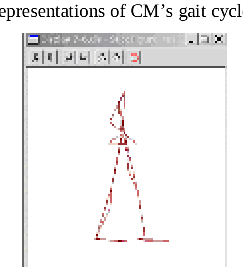
Children with CP commonly suffer from a variety of gait defects which lead to highly inefficient gait patterns. The purpose of this study was to investigate the effectiveness of Theratogs as a physical therapy intervention for a child with spastic diplegia and whether or not the Theratog strapping system altered the child's gait in a beneficial manner. Further, our study looked to translate these results to other children suffering from inefficient gait associated with CP

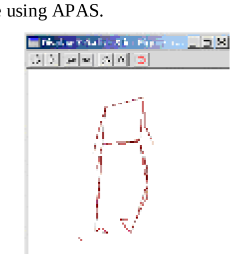
SUBJECT

ØAn eight year old boy (CM) with a diagnosis of spastic diplegic cerebral palsy.
ØNo significant complicating PMH
ØCM is currently in physical therapy to maximize function and gait efficiency
ØThe child ambulates with rigid plastic AFO's

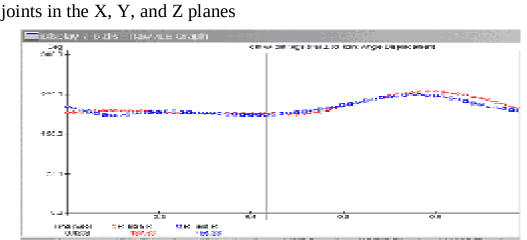
DATA ANALYSIS

ØVideo data was collected using the APAS gait analysis system.
ØCM's gait was filmed from five different camera angles simultaneously several times (first without theratogs, then with) to ensure the capture of usable data.
ØFull length videos were analyzed and the best single gait cycles were selected for both with and without theratogs.
ØAttention was focused on CM's right side (Right Initial Contact to Right Initial Contact).
ØThese shortened video segments were turned into stick figure representations of CM's gait cycle using APAS.

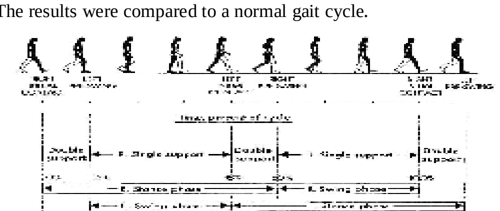




ØStick figure representations were used to create line graphs of all major joints in the X, Y, and Z planes



ØVideo segments, stick figure representations, and graphs of with and without theratogs were then compared to one another to more accurately assess for subtle gait nuances not easily seen by the naked eye.
ØThe results were compared to a normal gait cycle.

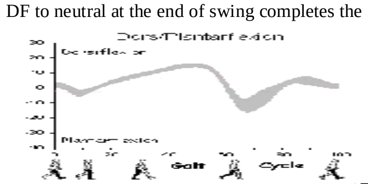


RESULTS

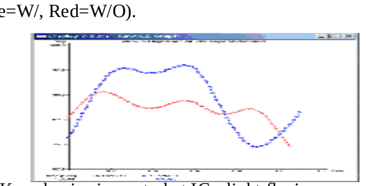
Stance/Swing:
ØNormal gait: Stance(60%)/Swing(40%) of gait cycle.
ØW/O Theratogs: Stance(65%)/Swing(35%) of gait cycle.
ØW/ Theratogs: Stance phase (66%)/Swing(34%) of gait cycle.

Metatarsal Foot Placement in the Frontal Plane:
ØNormal gait: Separation of metatarsal heads allow foot/toe ground clearance and toe/back of opposite heel clearance.
ØW/O Theratogs: Decr. metatarsal separation frontal plane.
ØW/ Theratogs: Greater separation between right and left indicating less of a scissoring motion.

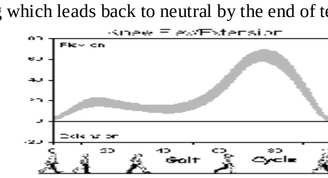
Ankle:
ØNormal gait: Neutral immediately into slight plantarflexion (PF), incr. dorsiflexion (DF) throughout stance, followed by PF at pre-swing, and incr. DF to neutral at the end of swing completes the cycle.



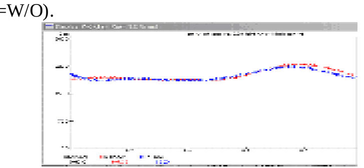
ØW/O Theratogs: Less PF evident at initial contact (IC), less DF during stance, and at the end of swing.
ØW/ Theratogs: More PF at IC, incr. DF during stance, and at the end of swing.
ØAnkle graph shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O).



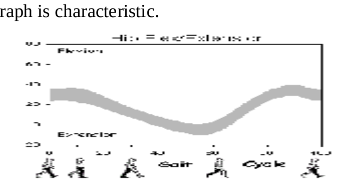
Knee:
ØNormal gait: Knee begins in neutral at IC, slight flexion occurs through loading response (LR), remains almost neutral through rest of stance. During swing a marked flexion moment occurs through initial/mid- swing which leads back to neutral by the end of terminal-swing (TS).



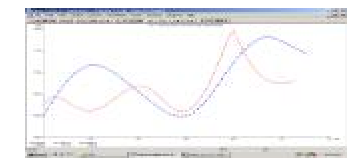
ØW/O Theratogs: Knee flexion at IC and during swing.
ØW/ Theratogs: Less knee flexion at IC and during swing.
ØKnee graph shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O).



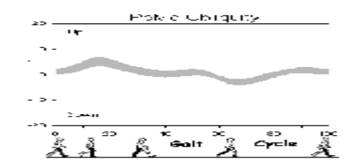
Hip:
ØNormal gait: At IC approx. 30 degrees flexion, decr. flexion into extension throughout stance. Extension occurs at beginning of TS peaking at beginning of pre-swing where it continues to decr. into flexion. U Shaped Graph is characteristic.



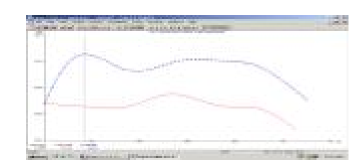
Hip cont'd:
ØW/O Theratogs: Less extension during stance.
ØW/ Theratogs: More extension occurred during stance.
ØHip graph shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O). Evidence also suggests less uncoordinated muscle activity between flexors and extensors demonstrated by the smooth gradient of the blue line.



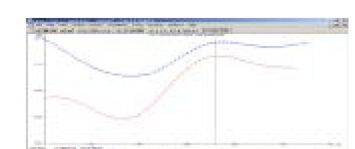
Pelvis:
ØNormal gait: Very little pelvic excursion. Graph is almost a straight line.



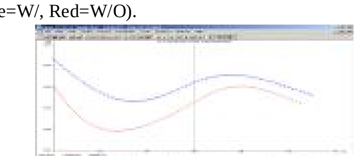
ØW/O Theratogs: More displacement before IC and ASIS was less level after IC.
ØW/ Theratogs: Less displacement before IC and ASIS closer to level after IC.
ØPelvic graph shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O), there is less overall pelvic excursion.



Trunk:
ØNormal gait: Very little trunk excursion. Graph is a relatively straight line.
ØW/O Theratogs: More overall excursion.
ØW/ Theratogs: Less excursion overall.
ØTrunk graphs shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O), there is less overall trunk excursion.



Shoulder Girdle:
ØNormal gait: Minimal excursion. Graph nearly straight.
ØW/O Theratogs: More excursion.
ØW/ Theratogs: Less excursion.
ØShoulder graph shows motion closer to normal while wearing Theratogs (Blue=W/, Red=W/O).



DISCUSSION

In general we found the application of Theratogs improved the quality and efficiency of CM's gait. At each joint some improvement was noted signifying a gait pattern more closely resembling that of normal.
The results were somewhat unexpected. We expected to see a more visibly noticeable difference in CM's gait with the Theratog application. It wasn't until after data processing that the effect of the Theratogs was noted.
The results show that there was less excursion of CM's trunk and shoulder girdle. Even small changes in degrees of excursion can make a tremendous impact on CM's gait pattern and efficiency. More space was seen between contra-lateral metatarsal heads, indicating less of a scissoring gait pattern, also leading to increased gait efficiency.
Many reasons exist as to why we could have obtained unexpected results. One possibility is that on this particular day, at this particular time CM was tired or not as attentive to directions of walking in a strait line at his normal speed. The speed of CM's gait could have changed throughout the course of his GA.
Another possible factor to obtaining unexpected results is potentially faulty GA equipment (i.e. cameras, fire wire, computer(s)/computer program). Although we used five cameras, the system on this day was only working with three synched cameras; two camera views of CM were recorded on video. This factor led to the timing of the video GA being off. Lastly, marker placement might not have been completely accurate on bony landmarks due to inter/intra rater reliability.

CONCLUSION

Our findings demonstrated an improved gait from a biomechanical perspective with the use of Theratogs. CM showed greater separation of metatarsal heads in the frontal plane indicating less of a stereotypical CP scissoring motion. Furthermore, at the ankle, there was increased plantar flexion at IC and dorsiflexion during stance and at the end of swing. The knee presented with less flexion at IC and during swing. Data of CM's hip motion during stance indicates more coordinated muscle activity between the flexor and extensor muscle groups. Lastly, CM's pelvis, trunk, and shoulders all stayed closer to level signifying less overall excursion and a more efficient, less energy consumptive gait pattern.