Horses & Humans Foundation

Basic Version of the 2006 Winning Proposal

Research Team: St. Louis University

SPECIFIC AIMS: Effect of Hippotherapy on Trunk/Head Stability and Upper Extremity Reaching

Hippotherapy (HPOT) is the use of the rhythmic movement of a horse to provide input to multiple systems in the body to effect therapeutic gains (Benjamin, 2000). It is speculated that horse movement provides multi-sensory input that can improve human walking, postural stability, motor control, breathing, and increase cognitive arousal (Dismuke-Blakely, 1997). Recipients of HPOT are often children with spastic diplegia cerebral palsy since this population often struggles with trunk stability and upper extremity motor control.

Beliefs about the positive effects of hippotherapy are strongly held (AHA, 2000; Benjamin, 2000). Anecdotal evidence and several recent published studies support the benefits of hippotherapy (Benda, 2003; Casady, 2004; Lechner, 2003; MacPhail, 1998; Sterba, 2002; Winchester, 2002). However, no investigations have objectively quantified changes in control of both head/trunk and upper extremity movements as a consequence of hippotherapy. We believe that objective kinematic data collected using video motion capture (VMC) can augment or provide greater validation as to the efficacy of hippotherapy than the subjective clinical rating scales used in many of the previous investigations.

Previously, we developed a horse movement simulator (Figure 1), and performed preliminary tests to quantify efficacy of HPOT for trunk, head control and gait. Our preliminary work was valuable in developing methods, but we had a number of limitations including a small sample size and an insensitive upper extremity movement measure with a ceiling effect problem. The purpose of this study is to determine if HPOT can improve head/trunk stability as well as upper extremity function in patients with spastic diplegia cerebral palsy.

Specific Aim 1: Determine if a 12-week HPOT program will improve head/trunk stability in children with spastic diplegia cerebral palsy. Subjects will participate in an individualized 12-week HPOT program (1 time/week for 30 minutes). Outcome assessment testing will occur prior to the intervention, after completing the intervention, and after an additional 12 weeks to assess any carryover effects. The

assessment testing will use VMC to quantify head/trunk motions of the subject as he/she rides on a one translational degree of freedom motorized barrel (Figure 1). We hypothesize that there will be significant improvement in control of head/trunk movement at immediate post-intervention test session and that the improvements will be maintained at the second post-intervention test session.

Specific Aim 2: Determine if a 12-week HPOT program will improve upper extremity functional reaching ability in children with spastic diplegia cerebral palsy. In addition to the head/trunk assessment testing, subjects will also participate in an upper extremity movement assessment. Subjects will perform simple reach to target tasks while still sitting on the stationary barrel. VMC will be used to capture the subject's performance. We hypothesize that there will be significant improvement in upper extremity targeting and distal UE control at the immediate post-intervention test session and that the improvements will be maintained at the second post-intervention test session.

BACKGROUND AND SIGNIFICANCE:

Previous investigations of HPOT have demonstrated improvements in children with CP with walking, running, jumping along with decreased energy expenditure and increased efficiency while walking (McGibbon, 1998; Sterba, 2002). HPOT has also been shown to increase muscle symmetry in children (n=15) with CP (Benda, 2003) and reduce lower extremity spasticity in patients (n=32) with spinal cord injury (Lechner, 2003). Improvements (n=11) have been noted in static and dynamic posture, trunk stability and quality of lower extremity and UE weight bearing (Bertoti, 1988). Positive results for tone, timing, strength, motor programming and coordination were reported in a study of therapeutic riding with people (n=14) with extrapyramidal disorder (Pasquinelli, 1997). A recently published study demonstrated that ten weeks of HPOT created significant improvements in young children (n=10) with CP for functional motor performance measured by the Gross Motor Function Measure (GMFM) and the Pediatric Evaluation of Disability Inventory (PEDI) (Casady, 2004). With few exceptions, previous studies have used clinical observational scales which depend upon the judgment of an observer or retrospective scales depending on reports of

caregivers as outcome measures. It is our belief that precise, direct, objective measurements of changes in movement, stability, and function resulting from HPOT which are not subject to skill or bias of observers will add a level of precision and reliability to the growing body of evidence supporting HPOT treatment.

PRELIMINARY STUDIES:

In our previous work, six subjects from 6 to 17 years old with spastic diplegia cerebral palsy participated in 12 weeks of hippotherapy for 30 to 45 minutes per week. They were tested sitting astride and in a side-sit position on a motorized barrel (Figure 1). The barrel reciprocates in one degree of freedom horizontal translation. It has a translation amplitude of 16 cm and a maximum cycle rate of 1hz.

Using VMC, motor control of the trunk and head in response to a standardized test movement was recorded immediately prior to the HPOT intervention and immediately after. The pre and post test head positions for one subject show the movement of the test barrel on the X axis and the angle of the head on the Y axis (Figure 2). The more tightly packed pattern of the post test (Figure 2, right) illustrates the change in head control. This pattern was relatively consistent across the sample and illustrates the changes that were made. Even with this small sample head control showed statistically significant changes. The pre and post intervention standard deviations and ranges of motion of head movement control were compared using paired t-tests. Change in the average standard deviation of head control was 3.2° (from 9.97º pre HPOT to 6.77º post HPOT with $p = .03$ on paired t-test). Change in average range of head angle went from 44.21º (pre) to 29.03º (post) for a change of 15.18º with $p = .05$ on a paired t-test. Our hypothesis that head control would improve with hippotherapy intervention was marginally confirmed given this small sample.

Trunk stability (i.e., movement of C7 relative to the barrel) was also shown to improve after treatment (Figure 3). The more regular, more tightly packed pattern in the post test (Figure 3, right) illustrates the improved trunk control after HPOT for one subject. While visual analyses with several members of the small pilot sample show the same pattern change indicating improvement in trunk control, we expect a larger sample will show statistical significance for changes in C7 movement and lateral and AP trunk rotation after

HPOT.

In addition to measuring head control, we also measured upper extremity functional movements using the Action Research Arm Test (ARAT), a test of grip, grasp, pinch and gross movement (Van Der Lee et al., 2001). Our hypothesis was that improved trunk control should improve the functional use of the upper extremities because the improved stability of the proximal foundation of the upper extremities at the shoulder would enable improved distal control of the hands. Total ARAT sample mean changes from pre to post test went from 96 (22.37) to 99 (20.18) (max possible = 114) with a total difference of 3.0 (2.76), p=.07 using a non-parametric Wilcoxin test. This result suggests that a larger sample will be able to show significant changes in upper extremity function. Further, we will use tests that do not have a "ceiling" effect as two subjects recorded perfect scores prior to their intervention.

METHODS:

We will recruit 12 subjects with Spastic Diplegia Cerebral Palsy (SDCP) through networking with families, from referrals from local professionals, and from lists of prior subjects (CP group). Subjects (5-17 years) will: be able to sit unaided, have receptive communication, and will be able to follow two-step directions. They will have had no significant horse riding experience and will be able to abduct the hips to sit astride the motorized barrel and on an appropriate horse. They will require family commitment for 15 weeks consisting of pre testing, 12 weeks of HPOT intervention and post testing, and then a follow-up testing after 12 weeks. They must have their doctor's approval to ride horses. Candidates will be excluded who have had HPOT experience or other significant horseback riding experience, other movement disorders, cognitive, affective or attentional disorders, significant visual impairment or low tone/low strength making them unable to sit unaided. Any serious health condition on the NARHA list of contraindications will also exclude them. We have selected SDCP as a subject population because children with this diagnosis are very frequent consumers of HPOT treatment and because they typically have some degree of trunk/head instability and UE disability.

Potential subjects will be recruited with a letter describing the study and a phone call to answer questions to screen candidates for inclusion/exclusion criteria. They will then visit a treatment site for an OT/PT criteria evaluation. If they are appropriate candidates for the study, they will be scheduled for testing. Six age-matched able bodied (AB) controls (AB group) with no disabilities or horse riding experience will provide "typical" movement data for comparison with the CP group. AB controls will be recruited from families of researchers and university faculty/staff, or may be siblings of research subjects.

A sample size of 12 subjects was determined to be adequate to fully power this investigation (Type I error $\alpha = 0.05$, Type II error $1-\beta = 0.8$). The sample size was determined from clinically relevant differences for head angle range of motion and standard deviation. Group differences (15 and 4), standard deviations (σ=20 and 4.3), correlations (ρ =0.85 and 0.88) were used for the respective variables (Johnson et al., 2004). We assumed no loss to follow-up as our subjects in our previous work were extremely motivated to participate.

Three local treatment sites will be used for providing the intervention. They are all accredited centers with the North American Riding for the Handicapped Association (NARHA). Treatment safety and efficacy will be ensured by following all applicable NARHA/HPOT standards. Treatments will be conducted by state licensed, and NARHA registered therapists with a certified instructor in the riding arena during each session (responsible for horses, leaders, sidewalkers and for safety).

Subject response to the rhythmic movement of a horse during 12 weekly hippotherapy sessions is the common denominator in all treatment plans and the focus of this study. While the intervention therapy for each subject is individualized based on the OT/PT evaluation, there are common themes. All subject treatment plans will be 30 minutes mounted on a moving horse. Riders will ride forward sitting astride. They may also ride facing backward or side sit on the horse. Some will kneel or weight bear on upper extremities or ride in a quadruped position. Most will weave around cones in a serpentine pattern to add lateral challenge to the ride. Some will even weave up and down a side hill to add more vestibular challenge. Some will have

stops/starts and half-halts to further challenge and develop trunk and head stability. Most will perform upper extremity and cognitive tasks and may play “games” with therapeutic intent while riding.

Prior to the intervention (within 14 days), subjects in the CP group will come to the Gait Analysis Laboratory at St. Louis University for a two-hour data collection session. Prior to testing, subjects and/or parents will sign a consent form approved by the St. Louis University Institutional Review Board. Subjects will also be tested within 14 days post treatment and then again 12 weeks after intervention is completed to establish any carry-over effects. AB controls will be tested once. Movement of the AB group will provide a basis for comparison for the CP group, both pre- and post-intervention.

We will use the motorized barrel (Figure 1) described above for the trunk and head control measure of stability. Prior to testing, 21 small (5mm) reflective markers will be placed over anatomical landmarks of the trunk and head. During the tests, 6 video cameras will simultaneously record the position of the markers (60 Hz) as the subject moves. Subjects will be tested at four speeds (15 seconds/trial) with a maximum cycle rate of 1Hz, first in anterior/posterior and then in lateral movement. Two sets of trials will be completed in each direction for a total of 16 trials at each test session. To enhance positional stability and safety on the moving barrel, foam blocks will be affixed to the barrel with velcro and placed against anterior and posterior aspects of the thighs when astride, and at the hips and inner and outer thighs when side sitting.

After the head/trunk stability measure is completed, UE functional reaching tests will be performed with both sides. All reaching tasks will begin at a standard starting position: upright sitting position on the barrel with shoulder at 0° of flexion and abduction and only enough internal rotation (10-20°) to allow hand to rest on ipsilateral thigh. We will apply VMC to the Reaching Performance Scale (RPS) (Levin, et al, 2004). The RPS is a simple targeting test in which only the gross distal control of the UE’s is tested. While the subject is still sitting on the barrel, additional markers will be placed on both UE’s (Wagner, et al., 2006). Markers will be placed on the lateral epicondyle, dorsal hand just distal to wrist crease, the index finger, the thumb, and upon a target cone which is placed at the height of the shoulder at the distance of the wrist

crease when the subject is sitting upright (Wagner, et al 2006). The subject will reach forward to grasp the target. The motions will be measured only be to the point where the grasp begins. The fine motor control of the grasping function is disregarded. This test will yield information about how increased proximal stability from HPOT contributes to control of UE distal targeting.

The second UE/Trunk measure will be a modified Functional Reach Test (FRT) (Duncan, et al, 1990). In the traditional FRT, the standing subject reaches forward at the level of the shoulder as far as possible. Maximum distance is measured at the failure point when the subject takes a step or quits reaching. We will perform the FRT while still astride the barrel to isolate trunk stability from the lower extremities. The subject will reach forward/laterally as far as possible at the level of the shoulder until he/she stops reaching, loses balance or reaches down to widen base of support to avoid falling. VMC measurement will also be used for the FRT.

The VMC data will be tracked and edited to produce X,Y,Z, coordinates of the surface markers as a function of time. The surface markers will be grouped to permit the calculation of specific variables. These variables will be used in the statistical analysis (Table 1).

Translation variables for Aim 1 will be calculated in AP direction (sitting astride) and Lateral direction (side-sitting). Variables will be calculated by measuring distance traveled by the vertex or C7 markers during the oscillating perturbation of the barrel using a laboratory frame of reference. A midpoint of movement will be calculated as the mean of all distances from the Zero point on the perturbation dimension. The variable will be described as the distances in cm from that midpoint in both positive and negative directions during the perturbation of the barrel at each recorded observation (60Hz). The standard deviation and range of movement will be used as variables for statistical analysis. Rotation variables for Aim 1 will be calculated as changes in the angles of the head (Vertex to C7) and trunk (C7 to S2) to the horizontal line of the barrel markers during the oscillating testing movement. Mean angle, standard deviation, and range of motion (ROM) will be variables representing head and trunk rotation for statistical analysis.

For Aim 2, XYZ position data as a function of time for UE, C7 and target markers will be used to calculate distances moved, reach/path ratio, and timing variables as inputs to calculate variables for statistical analysis (Table 1). Speed of reach is calculated as elapsed time from initiation of reaching motion to completion of reach. For accuracy of reach to target we will calculate how close to target subject came on first attempt. Efficiency of reaching is calculated as the Reach-Path Ratio, the ratio between a straight line from starting position to target vs. length of actual three dimensional path to target. The length of forward and lateral reach is the distance to the point of maximum reach measured from initial position of the C7 marker in starting position.

The statistical analysis will follow a two-step procedure and will be performed by Dr. Engsberg, and Dr. Shurtleff (Engsberg et al., 2006). In the first step, we will use the raw movement, angle and timing data to produce graphs for visual analysis. These graphs will permit us to confirm the relevancy of our variables (Table 1) and to potentially identify others that may offer a more complete explanation of HPOT.

In the second step, the variables will be used as inputs for the statistical analysis. Since the analysis will be identical for both Aims 1 and 2, they will be described together. For both aims, we will test the hypothesis that there will be significant improvement in control of head/trunk and UE movement at immediate post-intervention test session and that the improvements will be maintained at the second post-intervention test session. Pairwise comparisons (by visit or group) will be analyzed with SAS software (SAS Institutes, Inc., Cary, NC) with a mixed linear model to perform analysis of variance (ANOVA) (Engsberg et al., 2006). Data from 3 visits (pre-intervention, immediately following the intervention, and 12 weeks after the intervention) of the CP group and the single visit from the AB group will be included. The mixed model approach was selected over a traditional ANOVA to best accommodate unequal variances between groups and correlations between visits. Mixed models will be estimated with separate group variances, autoregressive first-order covariance structures across visits, and Satterthwaite degrees of freedom. The Tukey-Kramer method will be used to control the Type I error rate for multiple pairwise comparisons between

visits or groups (Neter, et al 1996). If the mixed model procedure is unable to fit any of the variables due to nonnormality, the data will be converted to normal scores on the basis of ranks. At the end of the analysis we will have determined if 1) head and trunk have become more stable after HPOT, 2) functional use of the UE's has improved, and 3) there is a carry over effect after treatment.

Figure 1. Child sitting astride testing barrel with surface markers on anatomical landmarks

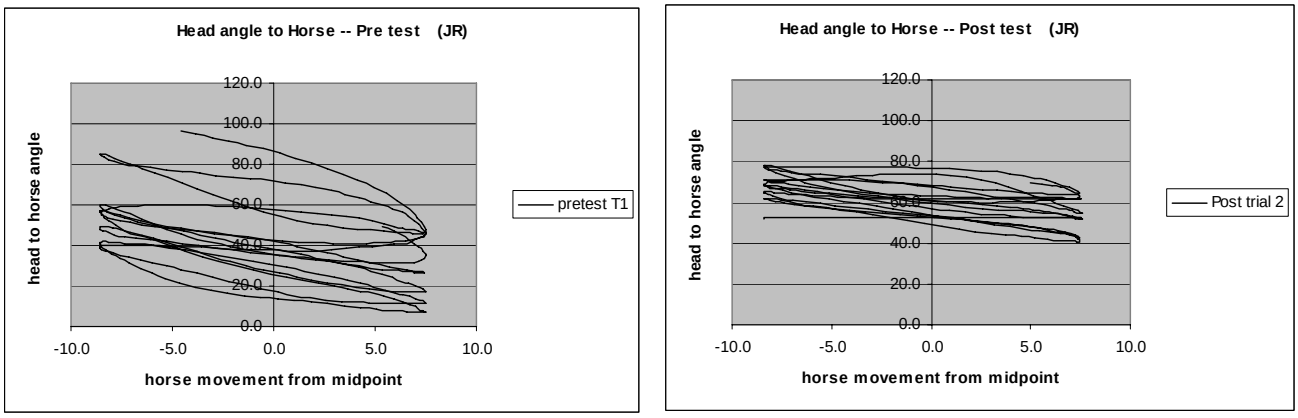

Figure 2. Angle of head (Y=degrees) as barrel moves (X=cm). Left graph is pre-test showing wide range of motion of head angle. Post-test on right shows reduced ROM of head after 12 weeks of HPOT treatment

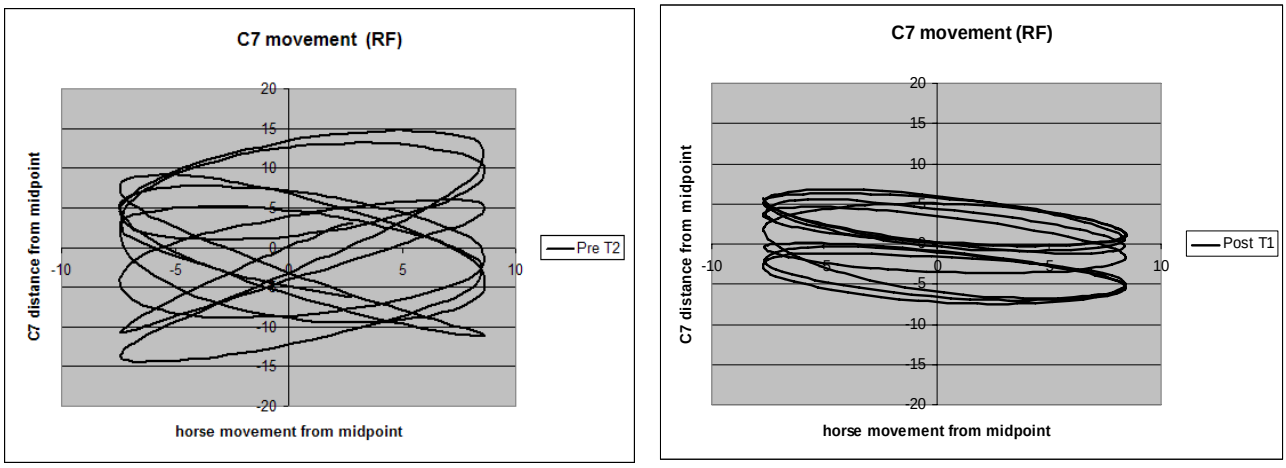

Figure 3. Movement of top of trunk in cm at C7 (Y=cm) as barrel moves (X=cm). Left (pre test) shows wide ROM of trunk movement at C7. Right shows more tightly packed pattern of improved trunk control after HPOT.

Aim 1			
Head	AP and Lat translation SD and ROM	Sagittal and Frontal rotation Mean, SD and ROM	
Trunk	AP and Lat translation SD and ROM	Sagittal and Frontal rotation Mean, SD and ROM	
Aim 2			
RPS	Speed	Accuracy	Reach/Path ratio
FRT	Distance forward	L/R Distance Lateral	

Table 1. Variables of head/trunk control and UE functional reaching ability derived from VMC data.

Table 2. Timetable for 12 month study beginning in the fall of '2006, Data collection/analysis to be completed by End of September 2007.

TASKS	Fall06	Jan07	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec07
IRB approval	X												
Recruit subjects	X	X	X										
Collect data			X			X			X				
Intervention				X	X	X							
Process Data			X	X			X	X	X	X			
Statistical Analysis								X	X	X			
Disseminate Results											X	X	X

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HHF Grant Proposal Update : Effect of Hippotherapy on Trunk/Head Stability and Upper Extremity Reaching

PI: Jack Engsberg, PhD; Co-investigator: Tim Shurtleff, OTD/C
Physical Therapy Dept. , Saint Louis University.

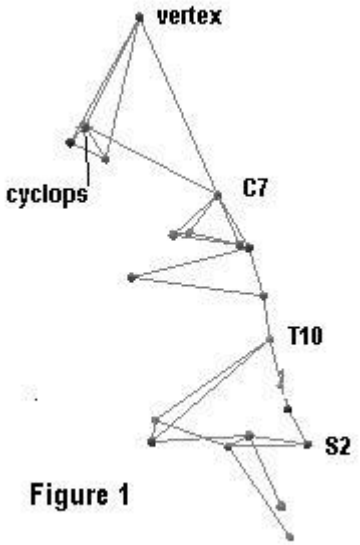

Figure 1

We have continued to analyze our pilot data, and have developed another variable further demonstrating the efficacy of Hippotherapy. Briefly, using our video motion capture data, we measured the range (amplitude) of the anterior-posterior horizontal translation of the surface markers named in Figure 1 as the subjects rode the motorized barrel (speed 1 Hz, amplitude 16 cm). The data were recorded from six subjects with CP who received 12 weeks of HPOT intervention, and from six subjects with able bodies (AB group).

The results, in general, demonstrate a reduction in movement for all subjects as the markers moved towards the head (Figure 2). Thus, S2 had about the same amount of translation as the barrel, with less translation at T10 and C7. There are two key results. The first is that there was a significant reduction in horizontal translation at C7 (p=0.017), Cyclops eye (p=0.025) and the vertex (p=0.005) in the CP group as a consequence of the intervention. The second was that the change in the CP group following the intervention brought their results closer to that of the AB group. In fact, while C7 (p=0.010), Cyclops eye (p=0.006), and Vertex (p=0.002) of the CP group were significantly different from the AB group prior to the intervention, C7 was no longer significantly different from the AB group (p=0.111) after the intervention. The Cyclops eye (p=0.008) and vertex (p=0.041) remained significantly different from the AB group after the intervention.

The results of our pilot investigation demonstrate a significant change in head/trunk movement as a result of the HPOT intervention. This change brought the children with CP closer to the AB group. The results also demonstrate the potential for additional improvement. It would appear that the HPOT intervention stimulated a motor learning outcome improving the CP group's ability to "unlink" their pelvic movement to that of the upper trunk and head. This "unlinking" had the effect of keeping the upper trunk and head more stable. A typical belief in motor control theory is the need to stabilize the head in order to improve input to the visual and vestibular systems. Our results seem to support HPOT as a means to this end. Better input to the visual and vestibular systems in children with CP could improve response to the environment and lead to improved "control" of many activities of daily living (e.g., gait and functional tasks). It has long been a claim of those who use horses for therapy that riding builds "core stability. It is possible that our results are objectively quantifying this "core stability" and the changes that occur as a result of HPOT. Applying these methods in a fully powered study will likely provide clear and objective evidence for this assertion. Such evidence directly coincides with the objectives of the Horses and Humans Foundation.

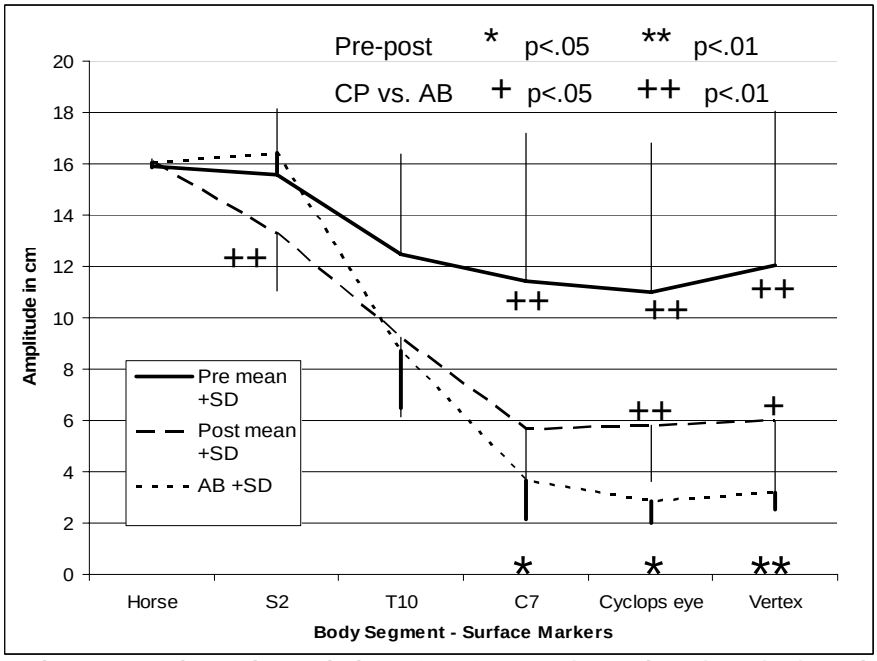

Figure 2. Horizontal translation of surface markers placed on the barrel and subject's head and spine.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Jack R. Engsberg, PhD	Associate Professor
eRA COMMONS USER NAME	
JACK_R_ENGSBERG	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
University of Wisconsin at LaCrosse	B.S.	1973	Mathematics
University of Wisconsin at LaCrosse	M.S.	1979	Kinesiology
University of Iowa	Ph.D.	1985	Biomechanics

EMPLOYMENT/EXPERIENCE

Associate Professor, Department of Physical Therapy, Saint Louis University, St. Louis, Missouri 2005-
Adjunct Associate Professor, Department of Biomedical Engineering, Saint Louis University 2005-
Director, Human Performance Laboratory, Department of Neurosurgery, Washington University School of Medicine, St. Louis, Missouri. 2003-2005
Adjunct Associate Professor, Department of Occupational Therapy, Washington University School of Medicine, St. Louis, Missouri. 1999-
Adjunct Associate Professor, Department of Biomedical Engineering, Washington University 1999-2005
Adjunct Associate Professor, Department of Orthopaedic Surgery, Washington University School of Medicine, St. Louis, Missouri. 1997-2005
Scientific Staff, Shriners Hospitals for Children, St. Louis Unit
1996-2005
Director, Human Performance Laboratory, Barnes-Jewish Hospital, St. Louis, Missouri. 1996-2003
Affiliate Professor of Biomechanics, Department of Mechanical Engineering
1994-2005
Washington University, St. Louis, Missouri.
Graduate Faculty Advisor, Department of Physical Therapy, Washington University
1993-2005
School of Medicine, St. Louis, Missouri.
Director, Motion Analysis Laboratory, St. Louis Children's Hospital, St. Louis, Missouri. 1993-1996
Associate Professor in the Department of Neurosurgery, Washington University School of Medicine, St. Louis, Missouri. 1993-2005
Adjunct Assistant Professor in the Department of Mechanical Engineering, Faculty of Engineering. The University of Calgary.
1991-1999
Adjunct Assistant Professor in the Department of Surgery, Faculty of Medicine.
The University of Calgary.
1988-1998
Assistant Professor in the Human Performance Laboratory, Faculty of Kinesiology.
The University of Calgary.
1987-1993

PROFESSIONAL HONORS

University of Calgary Teaching Excellence Award
1991

Canadian Physical Therapy Association Golden Quill Award (Co-author)
1995

Toby Long Award for Outstanding Article in *Pediatric Physical Therapy* (Co-author)
2002

Howard R. Thranhardt Lecture Honorarium , American Orthotic and Prosthetic Association 2003

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BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Timothy L Shurtleff, OTD/C	Co-investigator
COMMON USER NAME Tim Shurtleff	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Brigham Young University	B.A.	1973	German Language (minor in Psychology)
Brigham Young University	M.A.	1976	Organizational Behavior
Washington University School of Medicine, St. Louis	OTD	2006	Occupational Therapy

EMPLOYMENT/EXPERIENCE

Occupational Therapy Doctorate -- Research Focus:

- To develop a set of objective quantified outcome measures to provide efficacy data for hippotherapy for children and adults with neuromuscular disabilities, supervised by Jack Engsberg, PhD, SLU Dept of PT/Gait Analysis laboratory.
- To demonstrate that improvement of postural stability from equine assisted therapy improves upper extremity functional capabilities of people with neuromuscular disorders. To determine how this leads to increases in participation in age appropriate activities, supervised by Carolyn Baum, PhD, OTR, FAOTA, Department Chair, Washington University Program in Occupational Therapy.

Occupational Therapy Clinical Rotations:

- General Disability and Injury: outpatient sports and rehabilitation center, Missouri Baptist Hospital, Sullivan, MO
- Acute inpatient neuro and ortho rehabilitation, St. John's Mercy Hospital, Washington, MO.
- Psychosocial Rehabilitation – State forensic mental hospital, Fulton, MO.
- Pediatric rehab. – St. Louis Children's Hospital - outpatient, inpatient and neonatal, St. Louis & Chesterfield, MO.
- General Outpatient Rehab, 12 wk clinical fieldwork, Missouri Baptist Hospital, Sullivan, MO.

Related Professional Certifications:

- NARHA (North American Riding for the Handicapped Association) Certified Carriage Driving Instructor, since 2002
- NARHA Certified Therapeutic Riding Instructor for people with disabilities, since 1996
- CHA (Certified Horsemanship Association.) horseback riding instructor - English and Western, 1996
- CPR and First Aid since 1996,
- Missouri Med Tech (Certified as qualified to administer prescription medications), 2002.

Occupational Therapy - Practice Related Experience:

- NARHA Certified Instructor, part-time at Therapeutic Horsemanship since 1996
    - Therapy Aide with OT and PT in the hippotherapy program, one day per week for five years 1997-2003, 2006.
    - Invented/developed positioning and speech/language adaptive equipment for hippotherapy clients
    - Substitute instructor in sports riding program on per-deim basis from 1996-2006
- Instructor for therapeutic carriage driving program at Therapeutic Horsemanship, in Wentzville, MO since 2002
- Volunteer/NARHA Certified Instructor at Exceptional Equestrians of the Meramec Valley (EEMV) from 1990-1996

- Organization Consultant to EEMV Board of Directors develop/update strategic business Plan, 1996, 2004.
- Renovated and Adapted 120 year old farm buildings, built riding arena/facilities and managed a herd of up to 14 horses for a therapeutic riding center (EEMV), operating on my farm from 1990 to 1995.
- Volunteer, Paralympic Equestrian Games, Atlanta, GA, (two weeks) - August 1996. `
- Volunteer, week long brain injury camp for adolescents, Sunnyhill Camp, Ditmer, MO, summer of 2001.
- Vacation guide/care attendant for adults with developmental disabilities - to go on 3 day group vacations, 2002.
- Presented twice at NARHA regional conferences about therapeutic driving using horse drawn vehicles. 2004, 2005
- Presented Workshops - Strategic Planning for Therapeutic Riding Programs - NARHA national conferences 2000, 2002.
- Presented - hippotherapy positioning equipment/speech aids at NARHA regional and national conferences. 2000, 2001.

Previous Career focus: Internal and external organization development/organization effectiveness consultant

  - TL Shurtleff, LLC, independent external consulting practice, based in Villa Ridge, MO. 1993 to 2003
  - Monsanto Company, St. Louis, MO, 1989-1993, entrepreneurial internal consultant, competing with external consulting companies to keep money and expertise in-house.
  - Tenneco Oil Exploration and Production, Houston, TX; 1981-1989, internal team and organization consulting
  - Solar Turbines International, San Diego, CA; 1977-1981, Organization Effectiveness, supv./Mgmt. Training
  - Unites States Steel, Geneva Works, Orem, Utah; 1976-1977, Team building, supervisory training efforts.

- Facilitated strategic planning and organization design/redesign efforts for internal and external clients. Teams ranged from groups of as few as five employees, to the National Governors Association, several not-for profit organizations, Operating division redesign for a major oil company plus facilitating a design team for a new $20 billion company.
- Developed and conducted "team skills" as well as supervisory, middle and upper management development programs.
- Designed and conducted survey-feedback organization diagnosis, facilitated feedback and change efforts at all levels.
- Initiated and/or facilitated employee involvement efforts, total quality processes and self-directed teams.
- Conducted team-building, problem solving and issue identification/resolution/action-planning processes at all levels.

Appendix 1, Certified/Registered Personnel at three treatment sites who will be involved in 12 week intervention.

At Therapeutic Horsemanship, Wentzville, MO

Sandy Rafferty, OTR/L, Program Director

- Certified Instructor #96 Registered therapist (Req's completed 4/06 # is pending)
- Sandy will supervise and assign therapists and instructors from a staff of 7 NARHA Certified Instructors and six registered therapists for HPOT related to this project.

At Exceptional Equestrians of the Meramec Valley, Washington, MO

Laura Jensen, Program Director

- NARHA Certified Instructor #440

Charla Shurtleff, COTA/L

- NARHA Certified Instructor #1103
- Registered Therapist (Req's completed 4/06, # is pending)

Lindsay Keen,

- NARHA Certified Instructor #64416

At Ride-on St. Louis, Kimmswick, MO

Marita Wassman, Program Director

- NARHA Certified Instructor #37916

Anne Cochran, PT, Therapy Director.

- NARHA member number #55198
- Registered Therapist #79

Jane O'Connell COTA/L,

- NARHA Certified Instructor # 47045
- Registered Therapist #224