The Effects of Equine Handling on the Biomechanics of Mounted Human Subjects

A Study to Help Validate the Use of Equine Movement as a Therapy Strategy

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Learning Objectives:
1. Describe 2 basic equine handling methods used in hippotherapy.
2. Identify the movement quality options available for therapists utilizing equine movement.
3. Realize the impact of education and skill for both equines and handlers on gait/treatment quality.
4. Immediately apply the knowledge of how handling affects human movement, as well as how each horse is different, to make clinical decisions in client treatments.

Research – the why’s & how’s:

- **Current Issue in the Industry:**
  - Hippotherapy has been documented to benefit a multitude of clients.
  - Confusion over terminology and limited, but growing, quantitative research has resulted in poor acceptance of this strategy by many in the medical and insurance communities, despite documented progress in clients with a variety of diagnoses.

- **Purpose:**
  - To quantify the effects of equine handling on mounted human subjects’ pelvic and lumbar spine biomechanics.
  - To determine the degree to which a skilled horse handler can directly grade mounted human subjects’ movement.
  - To verify that equine movement is variable and can be individualized to clients’ needs under a qualified therapist’s direction.
The Research Process and Methods:

• IRB Approval – LeTourneau University, Longview, TX

• Equipment
  • Study Conditions/Design
  • Results
  • Conclusions
  • Practical Applications

Equipment:

• A marker-based visual motion capture system (PhaseSpace Inc., San Leandro, CA)

  Marker locations:

<table>
<thead>
<tr>
<th>Human:</th>
<th>Horse:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 around head</td>
<td>lumbosacral junction</td>
</tr>
<tr>
<td>AC joints (shoulders)</td>
<td>point of hips</td>
</tr>
<tr>
<td>C7 &amp; manubrium (sternum)</td>
<td></td>
</tr>
<tr>
<td>Bracketed sacrum (incl. PSIS’s)</td>
<td>croup</td>
</tr>
<tr>
<td>AIS5’s (front of pelvis)</td>
<td></td>
</tr>
<tr>
<td>Cluster on thighs</td>
<td></td>
</tr>
<tr>
<td>Medial &amp; lateral knees</td>
<td></td>
</tr>
</tbody>
</table>

Equipment – cont’d:

• A wireless event-detection system (Orbis, Inc., Charleston, SC)

• To record spatio-temporal data (records heel-strike to heel-strike to precisely compare data for each stride)
Equipment – cont’d:

- Biomechanical, statistical, and computational modeling was performed by commercially-available software - OBSIS (Orbis, Inc., Charleston, SC).

Study Conditions:

- 3 human subjects, 9 horses
- Each subject sat astride three horses drawn at random (none on the same horse) and each horse was handled using three techniques:
  - Leading – Casual walk
  - Leading – Working walk
  - Long Lining – Working walk
- All trials used the same expert equine handler, and handling technique order was randomly chosen.

Leading at the Casual Walk (LC)

- Casually led from left side, horse self-selected pace, loose lead, relaxed handler posture and unclear body language
- 1.2 m/s on average
- Too often used in hippotherapy/EAT!
Leading at the Working Walk (LW)

- Actively led from left side with lead contact, purposeful body language and direction for a true working walk with connection & impulsion
- 1.5 m/s on average

Long Lining at the Working Walk (LLW)

- Actively long lined from behind & to the side of the hindquarters, with rein contact, connection, purpose and impulsion for a true working walk
- 1.4 m/s on average

Variables:

**Human:**
- Pelvic anterior/posterior tilt
- Pelvic lateral tilt
- Pelvic rotation
- Lumbar flexion
- Lumbar lateral flexion (sidebending)
- Lumbar rotation

**Horse:**
- Left hind foot heel-strike to heel-strike
Results:

**Average Gait Characteristics:**

<table>
<thead>
<tr>
<th></th>
<th>Gait/Stride Velocity (m/s)</th>
<th>Stride Length (m)</th>
<th>Stride Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC</td>
<td>1.16</td>
<td>1.46</td>
<td>0.80</td>
</tr>
<tr>
<td>LW</td>
<td>1.49</td>
<td>1.60</td>
<td>0.93</td>
</tr>
<tr>
<td>LLW</td>
<td>1.42</td>
<td>1.56</td>
<td>0.91</td>
</tr>
</tbody>
</table>

**Stride velocity, length and frequency increased from LC to LW and LLW as expected**
- Stride velocity = stride length x stride frequency
- If any 2 of the 3 factors increase, the 3rd increases by default

Results – cont’d:

**Average Human ROM Values**

<table>
<thead>
<tr>
<th>Handling</th>
<th>ROM (deg)</th>
<th>Lead Casual</th>
<th>Lead Working</th>
<th>Long Line Working</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic A/P Tilt</td>
<td>5.6</td>
<td>7.9</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Pelvic Lateral Tilt</td>
<td>5.2</td>
<td>5.5</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Lumbar Flexion</td>
<td>8.0</td>
<td>9.1</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>Lumbar Lateral Flexion</td>
<td>6.0</td>
<td>6.2</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Lumbar Rotation</td>
<td>6.3</td>
<td>8.3</td>
<td>8.5</td>
<td></td>
</tr>
</tbody>
</table>

**In general, the handling methods of LW and LLW (working walk) resulted in statistically greater range of motion (ROM) of the mounted subjects’ pelvis and lumbar spine when compared to LC.**

Statistically Significant Changes:
- p=0.1, perfect correlation is r=1; (+)= direct, (-)= inverse
- Anterior/posterior pelvic tilt (p=0.004), lumbar flexion (p=0.01), and lumbar rotation (p=0.003) ROM were statistically greater in both LW and LLW when compared to LC.
- Change in lateral pelvic tilt across handling methods was more correlated to change in stride velocity (r=-0.69) > length > frequency
- Change in lumbar flexion across handling methods was more correlated to change in stride frequency (r=0.75)> velocity > length
- Lumbar rotation and lateral pelvic tilt had negative correlations with changes in stride velocity, frequency and length (inverse relationship) – so ROM decreased from LC to LW/LLW
Trends: (not statistically significant, but showed a trend)

- Change in anterior pelvic tilt across handling methods showed a trend of stronger correlation to change in stride frequency > velocity > length
- Change in lateral pelvic tilt across handling methods showed a trend of stronger correlation to change in stride velocity > length > frequency
- Change in lumbar rotation across handling methods showed a trend of stronger correlation to change in stride length > velocity > frequency

General Summary of Statistically Significant Findings and Trends

<table>
<thead>
<tr>
<th>Stride velocity</th>
<th>Stride frequency</th>
<th>Stride length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral Pelvic Tilt (inversely related)</td>
<td>Lumbar Flexion (inversely related)</td>
<td>Lumbar Rotation (inversely related)</td>
</tr>
<tr>
<td>Ant. Pelvic Tilt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BOLD = Statistically Significant (p=0.1)

Conclusions: We have objectively shown that:

1. Therapists have the ability to selectively grade the movement and input for their clients during a treatment session, through a skilled horse and handler, just as they would grade input using any other treatment strategy.
2. Three of the handling methods seen in hippotherapy are: casual leading (walking); leading at the working walk, and long lining (at the working walk). Human pelvic and lumbar spine ROM in all three planes of movement can be influenced/induced by equine movement differently depending on the handling technique used.
3. In general, the handling methods of LW and LLW (working walk) resulted in statistically greater range of motion (ROM) of the mounted subjects’ pelvis and lumbar spine when compared to LC (casual walk).
   • anterior/posterior pelvic tilt, lumbar flexion, and lumbar rotation ROM were statistically greater in both LW and LLW when compared to LC.
4. Stride frequency, length and velocity are all related and can affect the degree, direction and quality of equine and client movement.
Practical Applications:

• **Analyze** your program, horses, handlers and quality of movement – are they meeting your needs, progress goals and quality standards?
• **Educate** – therapists, handlers & horses for effective, informed clinical decision-making
• **Evaluate** your handling options – practice, safety, tolerance, effectiveness, equipment, number & skill of staff
• **Prioritize** which horses or clients need which handling techniques and what resources are available (if limited)

Practical Applications:

• If a patient needs A/P movement, then consider a horse that has adjustable stride frequency.
• If a patient needs lateral movement, consider a horse that has adjustable velocity (speed)
• If a patient needs rotational movement, consider a horse that has adjustable stride length
  • Examples:
    • MK & crookedness - longlining
    • Horse preferences – driving history/preference, dislike bits, distracted by a leader, respond better to closer handler, etc.
• Able to objectively rate or select horses based on their movement characteristics, gradability and performance with various handling methods.

Thank you, go use it and spread the word!