Hip Mechanics of Infants

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**BACKGROUND**
- Developmental Dysplasia of the Hip (DDH) can occur in 1-3% of newborns.
- DDH is responsible for 29% of hip replacements in people under the age of 60.
- The Pavlik Harness (PH) is used to treat DDH and is the standard for the healthy hip position of 90° flexion and 80° abduction angles.
- Some commercial baby carriers subject babies to specific hip positions, but limited research exists on infant hip biomechanics and development in baby carriers.
- Quantifying hip angles within infant devices may improve understanding of healthy hip positions in commercial baby gear.

**PURPOSE:** To develop testing methods to accurately measure infant hip angles in various baby carriers.

**METHODS**
3 baby carriers and 4 positions
1 infant manikin (Figure 2): 2.83kg.
1 adult manikin

**Measurement Methods**
- Goniometer: Device that measures flexion and abduction angles of the infant’s hips.
- MATLAB: Photo analysis functions calculate the flexion angles.
- Novel Pressure Sensors: Placed pressure sensors around one thigh and back/gluteus maximus of the infant manikin.
- Measured maximum force, peak pressure, and mean pressure that the carrier exerted onto the infant.

**RESULTS**

- The Pavlik Harness is the ideal model for hip position in baby carriers.
- Baby carrier B, data resulted in the most similar hip position to the optimal 90° flexion and 80° abduction angles.
- 75% of the photo analysis data resulted in smaller flexion angles compared to the measured angles using the goniometer.
- Labeling the anatomical landmarks for the photo analysis method was accessible and consistent.
- It was difficult to measure angles with the goniometer due to its shape and the positioning of the infant in the baby carrier.
- The pressure sensor data was inconsistent and unreliable to measure forces exerted on the infant.

**CONCLUSION**
- Pressure and force data collection was inconclusive to the understanding of infant hip mechanics.
- Baby carrier C in both inward and outward facing conditions did not support the infant’s hips for a healthy position.
- The preliminary data collection will help us create a study with human subjects.
- Identify the style of baby carrier that is optimal for hip positioning.

**FUTURE WORK**
- The preliminary data collection will help us create a study with human subjects.
- Identify the style of baby carrier that is optimal for hip positioning.
- The free joint newborn manikin was too small for 3 of the original 7 conditions. Use inserts for baby carriers to adjust for the size difference.
- Use a standardized infant manikin.
- Identify a more accurate method for measuring hip abduction.
- Use a digital goniometer that is imbedded in the manikin to measure the flexion and abduction angles of the hip.
- Use marker-based motion capture system, VICON, to measure hip angles.

**REFERENCES:**
5. Healthwise, Pavlik Harness.