

## INTRODUCTION

- Hypermobile Ehlers-Danlos Syndrome (hEDS):
  - The most common heritable connective tissue disorder
  - As many as 1:5000 people worldwide [1]
- Symptoms including [2]:
  - Early onset osteoarthritis and osteoporosis
  - Joint laxity and instability
  - Excessive joint range of motions (ROM) in joints
- Joint pain, dislocation and instability during walking [3]
- Laxity of tendons and ligaments: a major determinant for musculoskeletal complaints
- **Research Question:** whether these complications affect joint dynamics in children during musculoskeletal development

- **GOAL:** To quantify 3D joint dynamics of children with hEDS and compared them to healthy children

## METHODS

### Subjects

- 8 children (4 males, 4 females, age:  $12.5 \pm 2.8$  years)
- 83 healthy children (age:  $10.5 \pm 3.5$  years) [5]

### Data Collection

- A 15-camera Vicon T-Series motion capture system and four AMTI force plates (Fig. 2)
- Task: walk at a self-selected speed (free)
- Five gait cycles for each subject (Fig.1)
- A modified Newington-Helen Hayes marker set on lower extremity bony landmarks (Fig. 3)
- Joint dynamics and spatio-temporal parameters were measured
- Statistics: The Mann-Whitney U-test (significance level < 0.05).

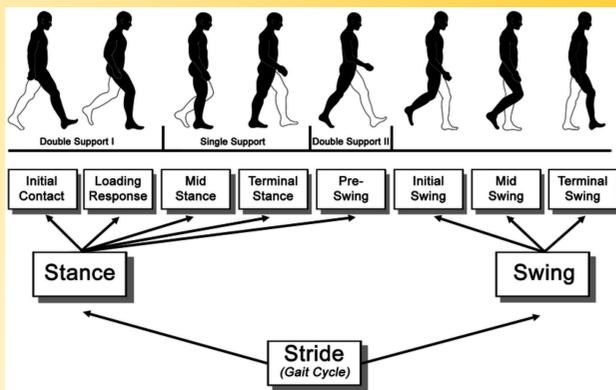


Figure 1: One gait cycle; Stance phase accounts for approximately 60 percent, and swing phase for approximately 40 percent, of a single gait cycle [4]

## RESULTS

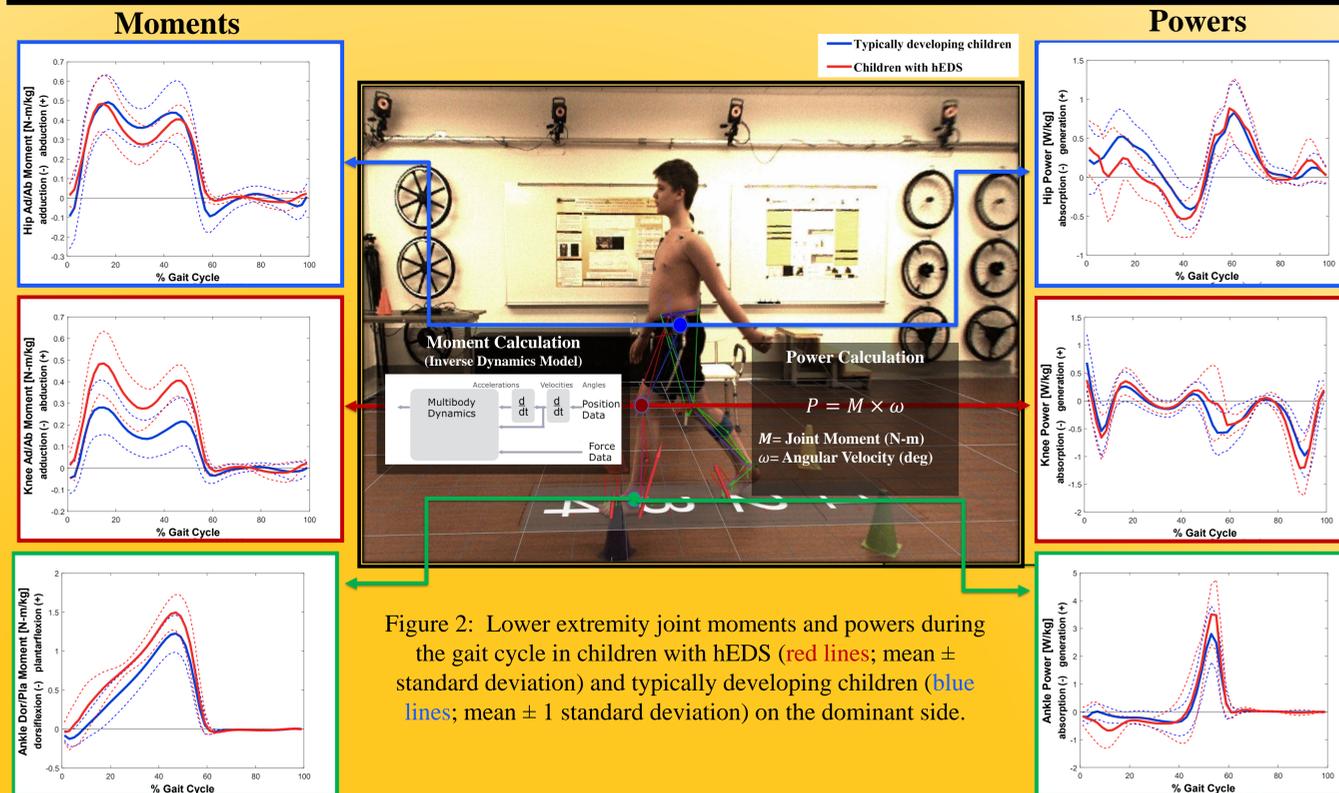


Figure 2: Lower extremity joint moments and powers during the gait cycle in children with hEDS (red lines; mean  $\pm$  standard deviation) and typically developing children (blue lines; mean  $\pm$  1 standard deviation) on the dominant side.

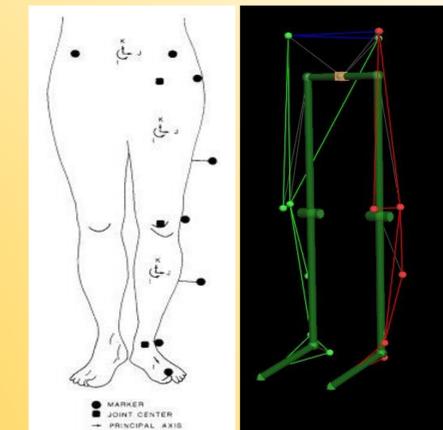


Figure 3: Helen Hayes lower extremity marker configuration on subject 2 and embedded coordinate systems in Vicon software [4]

## RESULTS

- ❖ Differences in moments and powers vs. no significant differences in joint ranges of motion
- Ankle: hEDS generated significantly
  - **More generated power** ( $30.1 \pm 15.4$  W vs.  $11.6 \pm 5.2$  W)
  - **More absorbed power** ( $16.9 \pm 3.9$  W vs.  $4.7 \pm 0.2$  W)
- Significant difference in knee abduction moment ( $0.5 \pm 1.4$  N-m/kg vs.  $2.9 \pm 0.8$  N-m/kg)

Table 1: Spatio-temporal parameters for children with hEDS

Pace	Stride Length (m)	Cadence (strides/min)	Walking Speed (m/s)	Single leg support (%)	Double support (%)
Free	$1.3 \pm 0.1$	$56.3 \pm 2.2$	$1.2 \pm 0.1$	$40.2 \pm 2.4$	$19.2 \pm 3.1$

## DISCUSSION

- Significantly higher ankle and knee moments and ankle powers vs. no significant difference in joint angles in children with hEDS as compared to typically developing children:
  - An indication of *increased effort and energy demands*
- Increased energy and power generation in ankle and hip could change the gait pattern and have musculoskeletal challenges for children.

## CONCLUSION

- ❖ This novel research is one of few quantitative studies of patients with hEDS.
- We found that children with hEDS appeared to have differences in ankle and knee moments and ankle and hip powers.
- The long-term goal of this research is to improve hEDS diagnosis and to develop effective therapeutic interventions based on these dynamic joint differences to maximize quality of life for children with hEDS.

## ACKNOWLEDGEMENTS

- This study was supported by the Genetics Center of Children's Hospital of Wisconsin and college of Health Sciences SPARC grant.

## REFERENCES

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