

Transverse Plane Deviations in Spastic Diplegia: An Expert Panel Case Review

M. Wade Shrader, MD¹; Lane Wimberly, MD²; Jason Rhodes, MD³; Jeremy Bauer, MD⁴

¹Nemours A.I. duPont Hospital for Children, Wilmington, DE; ²Texas Scottish Rite Hospital for Children, Dallas TX;

³Colorado Children's Hospital, Denver, CO; ⁴Shriners Hospitals for Children, Portland, OR

Case Study

This is a 20+6-year-old female who was born at 32 weeks gestation, complicated with an intra-ventricular hemorrhage, jaundice, and hydrocephalus requiring a shunt. She did not walk until the age of 3 and then with a walker. She has not had any surgery and only one round of adductor and hamstring Botox treatment. She received physical and occupational once a week through school but no longer receives any therapy. Her parents are concerned about her toe walking, dragging her toes, and walking with rotated legs. They are mostly worried about a decrease in her gait endurance, worsening of her hip rotation, and increases in hip and knee pain over the past two years. They want to discuss how this could be addressed. She presents to the Cerebral Palsy Clinic and

to the Gait Laboratory for preoperative assessment and surgical planning.

Her past medical history is significant for a seizure disorder, asthma, and cortical visual impairment. She is taking oral baclofen, multiple inhalers, and Onfi and Lamictal for her seizures.

Her physical exam is noted in Table 1 which is notable for mild bilateral hip flexion contractures and relatively good knee extension. She has significant rotational abnormalities at her hips, and Silverskioid test shows a 5-degree contracture with the right knee fully extended (Gastrocnemius) and 10 degrees of dorsiflexion with the knees bent. Her left ankle shows decreased dorsiflexion in both knee flexion and extension.

Table 1. Preoperative Physical Exam

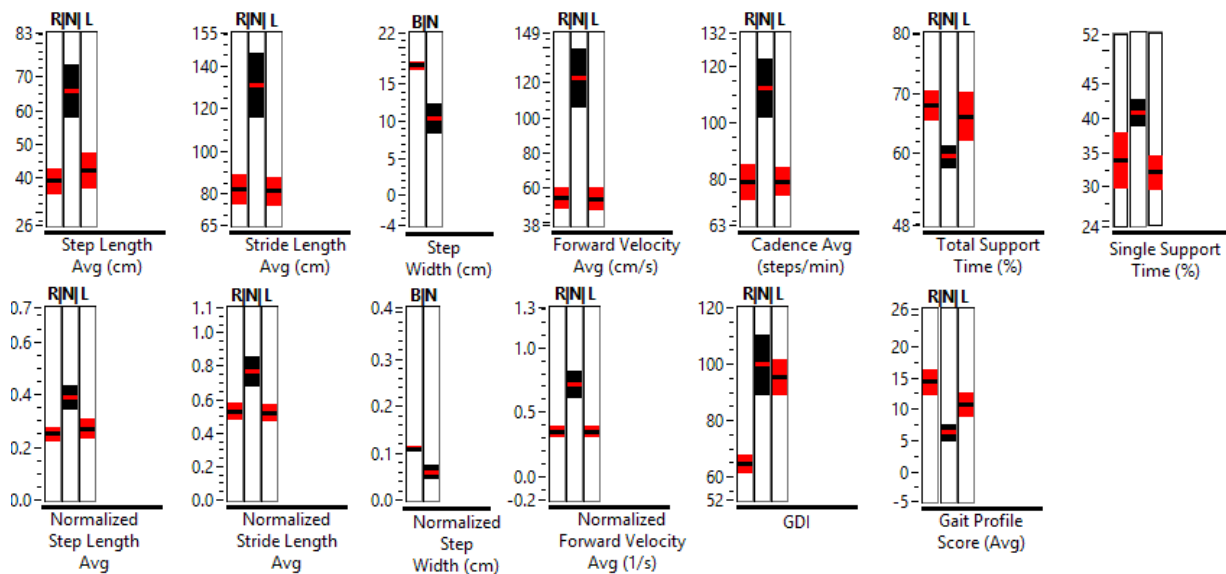
	PASSIVE ROM		STRENGTH		KEY
	Right	Left	Right	Left	
Hip Flex	110	110	3+	3+	0 No palpable contraction or observable movement.
Hip Ext	-10	-10	3+	3+	1 Contraction in the muscle but no observable movement
Hip Abd	25	22	3+	3+	1+ Visible movement of the part but <50% through the available range in a gravity-eliminated position.
Hip Int Rot	57	60			2- >50% AROM through the available range in a gravity-eliminated position.
Hip Ext Rot	10	8			
Knee Ext	-5	1	3+	3+	2 Full AROM through the available range in a gravity-eliminated position.
Knee Flex	WNL	WNL	3+	3+	2+ Full AROM with some manual resistance in a gravity-eliminated position.
Pop Angle	90 85	95 90			
Ely Test	85	80			3- >50 AROM through the available range against gravity.
Dorsi (flex)	10	-2	1+	1+	
Dorsi (ext)	-5	-10			3 Full AROM through the available range against gravity.
Plantar	30	30	1+	1+	
Ankle Inv	25	20	1+	1+	3+,4- Full AROM against gravity - minimal manual resistance.
Ankle Ever	20	20	1+	1+	
TMA	24 EXT	20 EXT			4,4+ Full AROM against gravity - moderate manual resistance.
TFA	10 EXT	10 EXT			
FF AB/ADD	3 ADD	3 ADD			5 Full AROM against gravity - maximal manual resistance.
Calcaneal Inv	25	25			
Calcaneal Ever	10	10			
Leg Length					
Knee Varus/Valgus					

She has poor motor control with increased tone (with increased Ashworth scores) in all muscle units in her bilateral legs. Hip radiographs are shown to be normal (Figure 1).

**Figure 1. Preoperative Hip Radiographs**

Figure 2. Preoperative Temporodistance Parameters

				Normal			
Step Length Avg (cm)	39.17 (3.07)			58.35-72.87	42.30 (4.70)		
Step Length Avg (Normalized)	0.25 (0.02)			0.35-0.43	0.27 (0.03)		
Stride Length Avg (cm)	82.14 (5.81)			116.70-145.44	81.11 (5.98)		
Stride Length Avg (Normalized)	0.53 (0.04)			0.69-0.85	0.52 (0.04)		
Forward Velocity Avg (cm/s)	54.03 (5.33)			107.04-138.58	53.53 (5.22)		
Forward Velocity Avg (/s)	0.35 (0.03)			0.63-0.81	0.35 (0.03)		
Cadence Avg (steps/min)	78.98 (5.67)			102.50-122.02	78.98 (4.48)		
Total Support Time (%)	68.05 (2.21)			57.71-61.01	66.08 (3.78)		
Single Support Time (%)	33.92 (3.78)			38.99-42.29	31.95 (2.21)		
Step Width (cm)	17.53 (0.37)			8.70-12.18			
Step Width (Normalized)	0.11 (0.00)			0.05-0.07			
GDI	64.52 (2.60)			90.00-110.00	95.42 (5.54)		
Gait Profile Score (Average)	14.32 (1.63)			5.30-7.38	10.73 (1.69)		
Arm Posture Score (Average)	NaN (NaN)			12.30-18.38	NaN (NaN)		



Temporodistance parameters showed that she walked with an overall slow gait compared to age-matched typically developed children used as controls. She also had a low Gait Deviation Index (GDI) bilaterally (Figure 2).

Selected kinematics plots obtained from her gait analysis shows abnormalities in her sagittal joint angles at the pelvic, hip, knee, and ankle (Figures 3, 4, 5, and 6). Pedobarographs show no heel contact on the right (Figure 7).

Figure 3. Preoperative Pelvic Kinematics

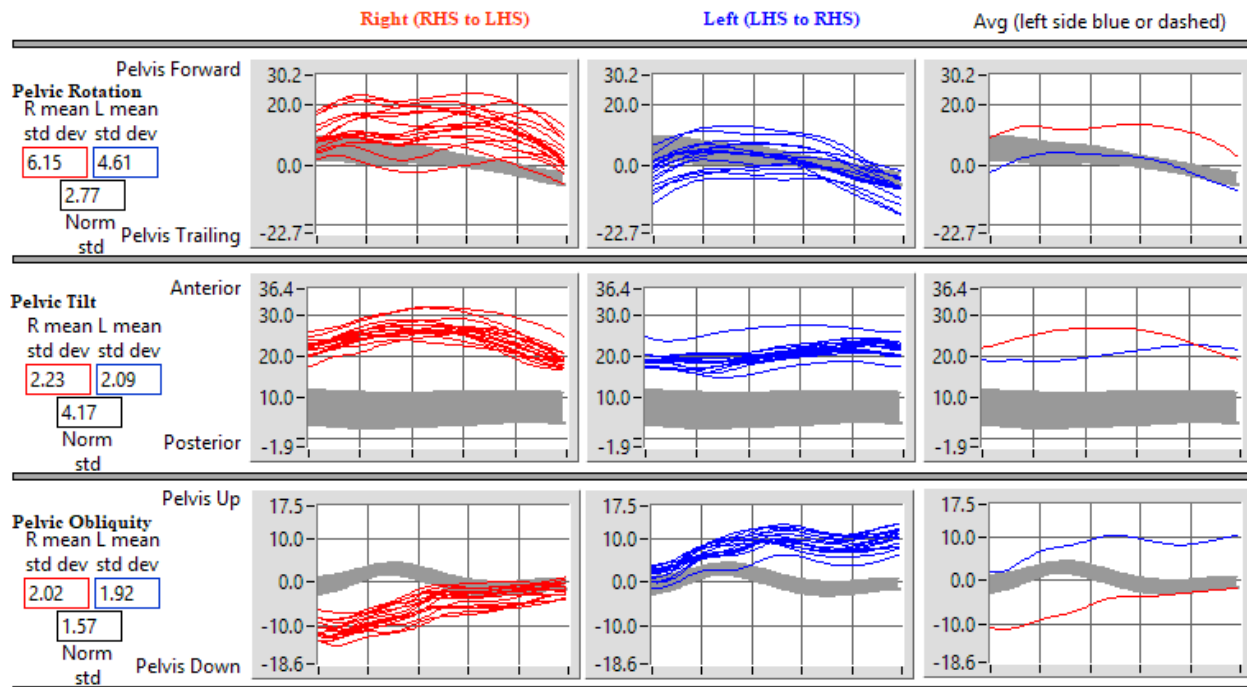


Figure 4. Preoperative Hip Kinematics

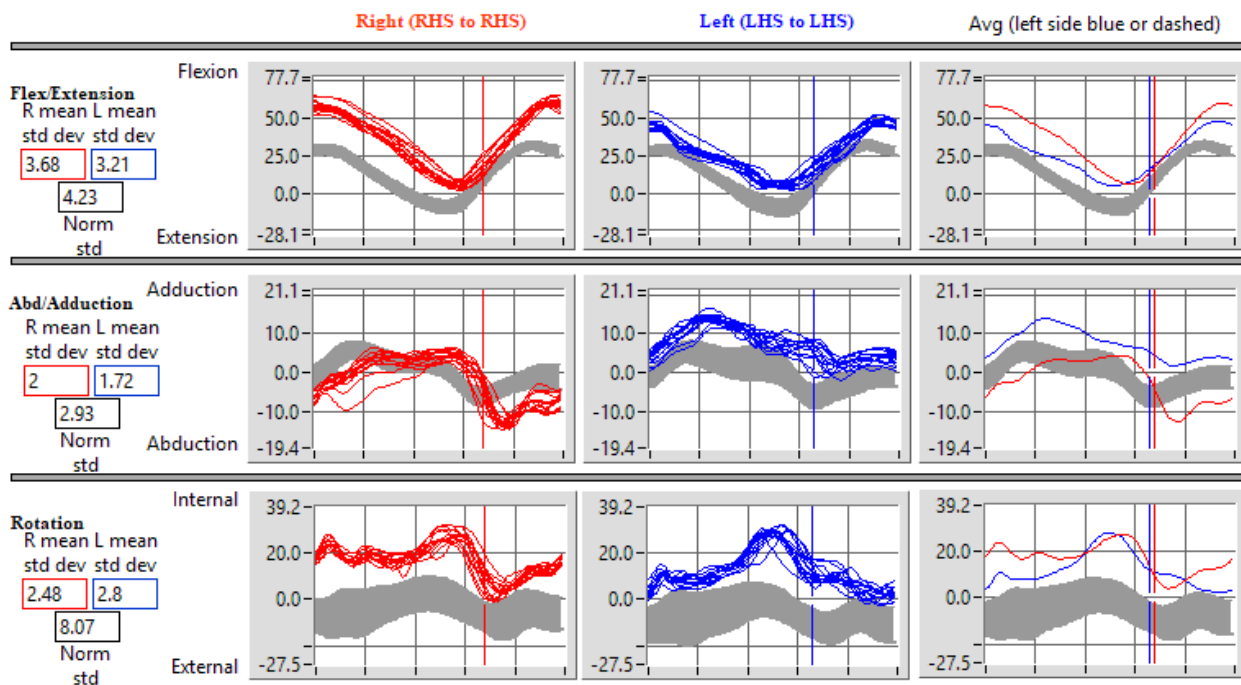


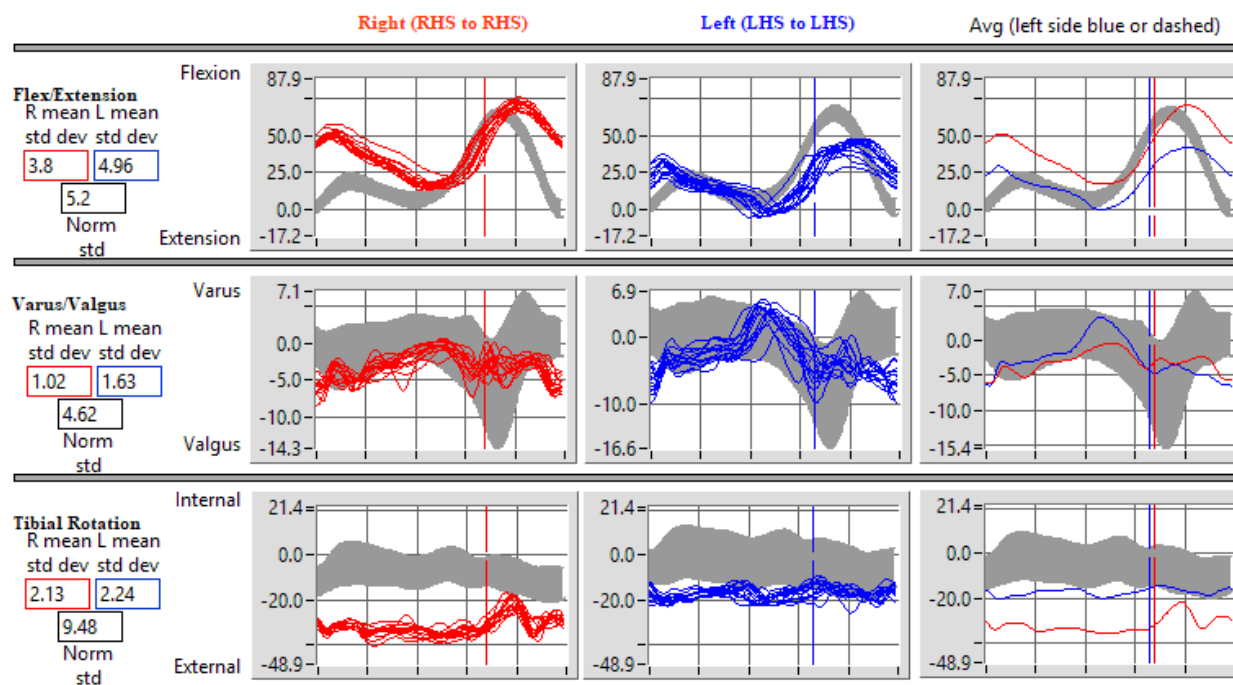
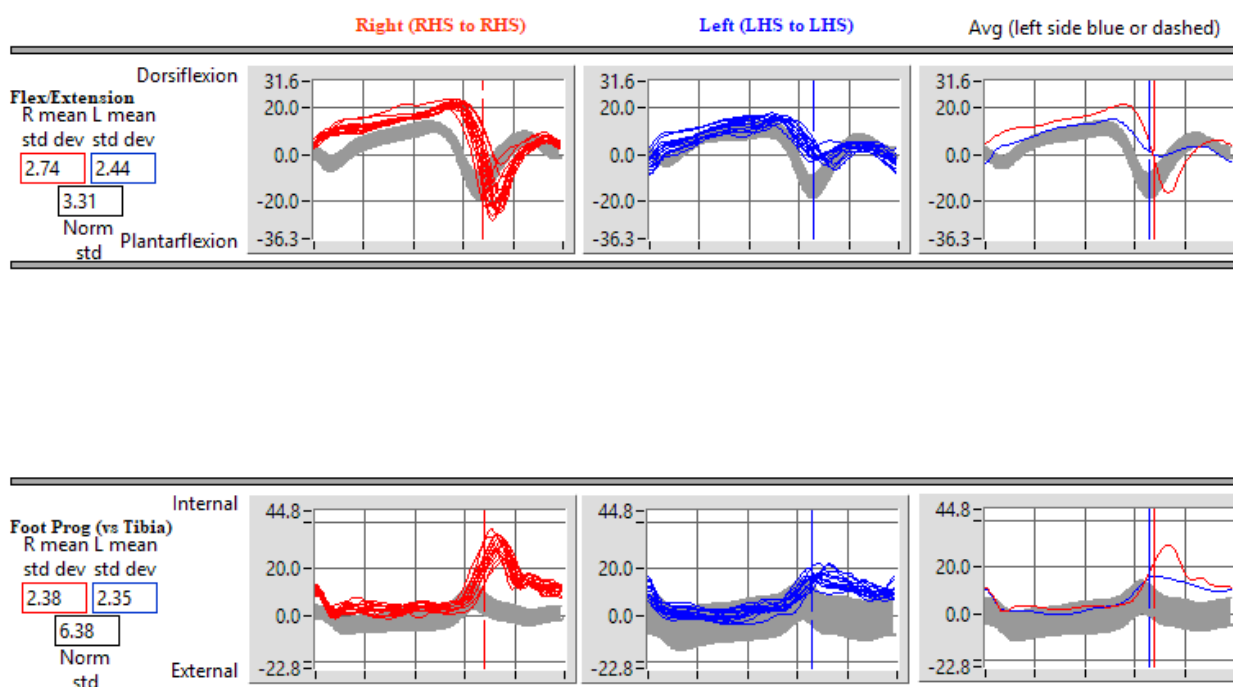
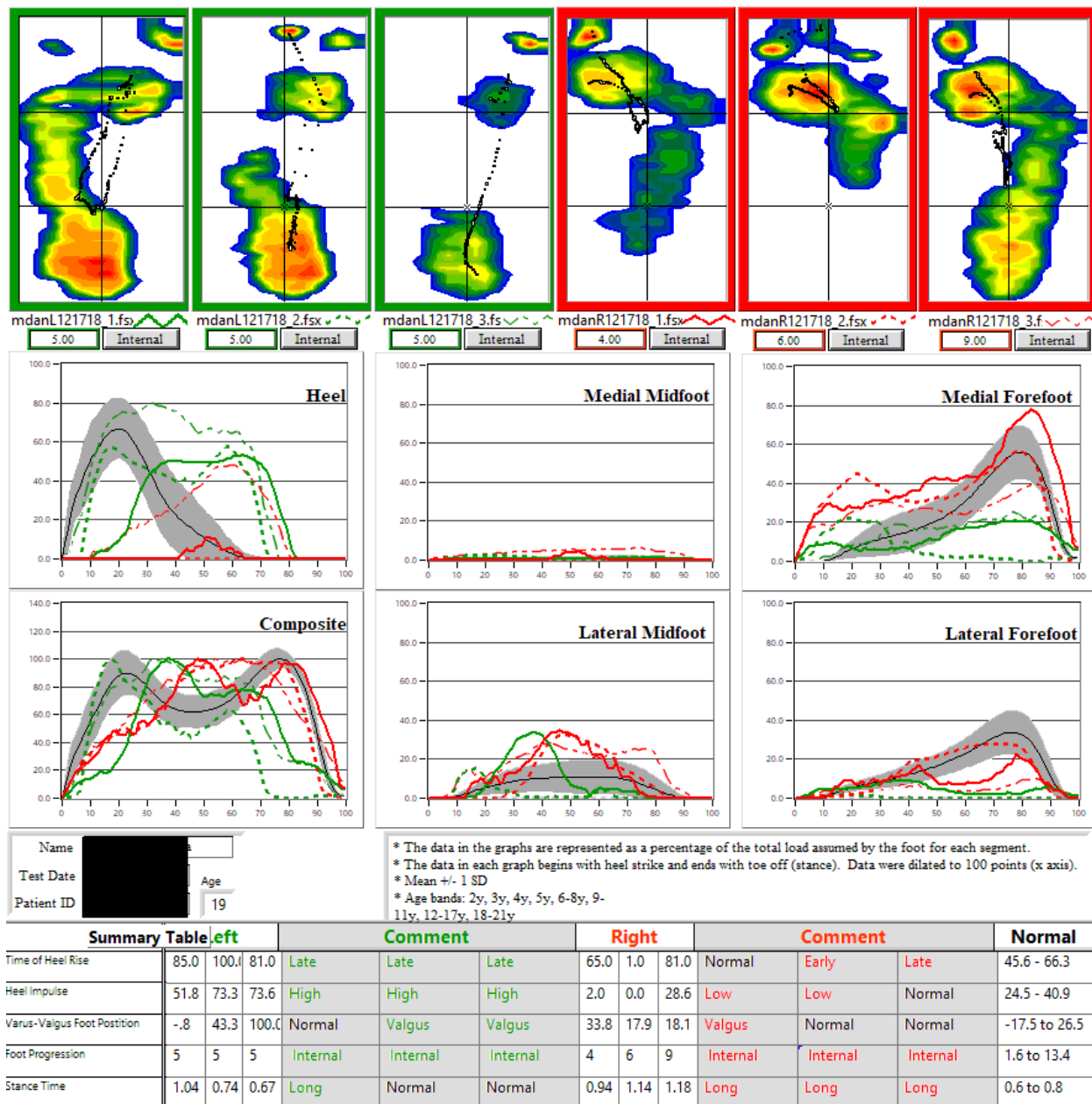
Figure 5. Preoperative Knee Kinematics**Figure 6. Preoperative Ankle Kinematics**

Figure 7. Preoperative Pedobarograph



Please watch the accompanying panel discussion on treatment strategies.