Crouch Gait in Spastic Diplegia:
An Expert Panel Case Review

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Case Study

This is a 12-year-old female who was born at 32 weeks gestation and was subsequently diagnosed with cerebral palsy and periventricular leukomalacia. She did not walk until the age of 3 and then with a walker. She has never received Botox, but she did undergo a soft-tissue surgery at the age of 8, including gastrocnemius recessions and hamstring lengthening. She receives weekly physical and occupational once a week through the school. She is mainstreamed in a typical classroom, and she is toilet trained, although she needs some assistance in the bathroom. Her parents are concerned about her progressive collapse into crouch, with increasing knee flexion. They want to discuss how to correct this, and she presents to the Cerebral Palsy Clinic and to the Gait Laboratory for preoperative assessment and surgical planning.

Her past medical history is significant only for her CP; she does not take any medications.

Her physical exam is noted in Table 1, which is notable for mild bilateral hip flexion contractures and marked knee flexion contractures. She also has internal hip rotation and external tibial torsion on the left.
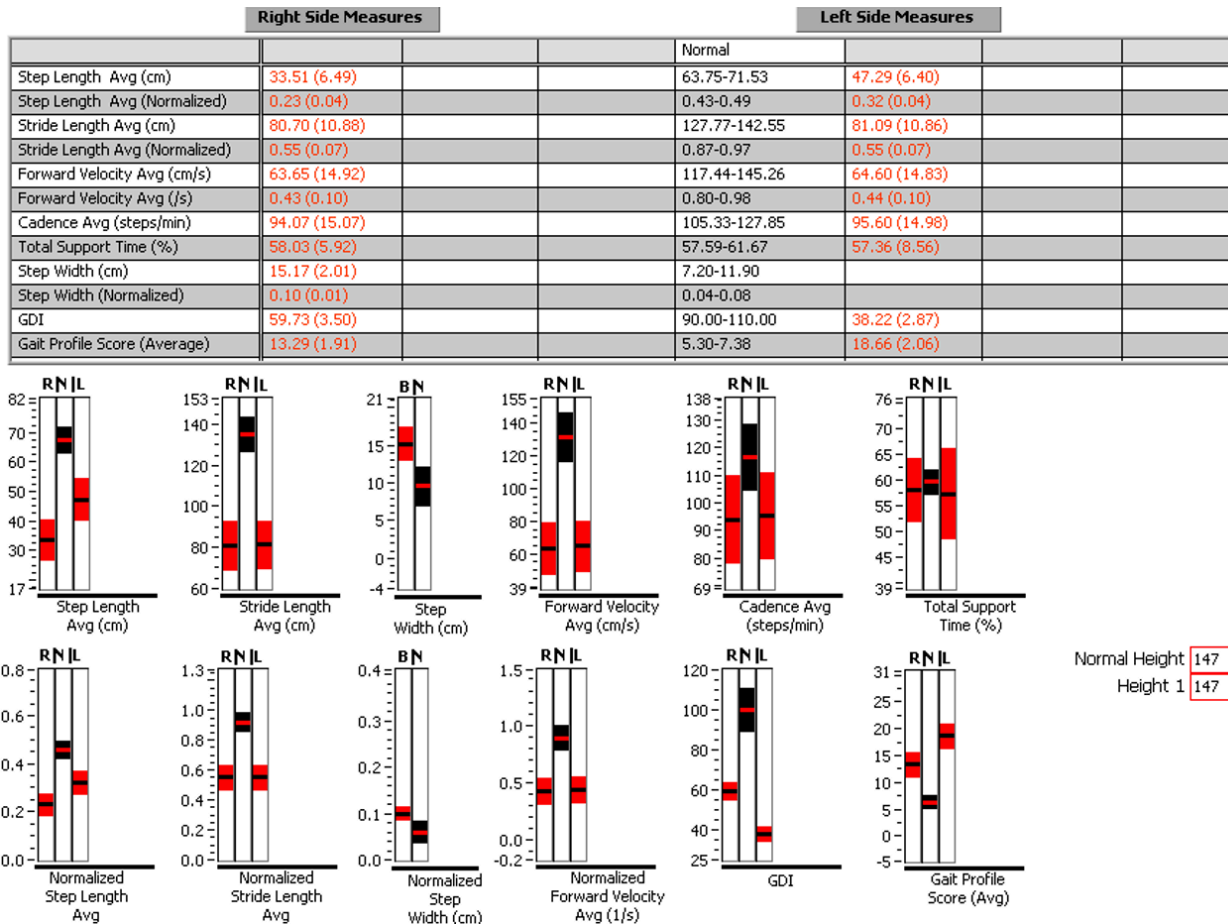
Table 1. Preoperative Physical Exam

	PASSIVE ROM		STRENGTH		KEY
	Right	**Left**	**Right**	**Left**	
Hip Flex	110	110	4	4	**0** No palpable contraction or observable movement.
Hip Ext	-10	-10	2	2	**1** Contraction in the muscle but no observable movement
Hip Abd	15	20	2	2	**1+** Visible movement of the part but <50% through the available range in a gravity-eliminated position.
Hip Int Rot	50	70			
Hip Ext Rot	45	14			**2-** >50% AROM through the available range in a gravity-eliminated position.
Knee Ext	-24	-34	3+	3+	
Knee Flex	WNL	WNL	2+	2+	**2** Full AROM through the available range in a gravity-eliminated position.
Pop Angle	80 75	80 70			**2+** Full AROM with some manual resistance in a gravity-eliminated position.
Ely Test	120	100			
Dorsi (flex)	12	7	1	1	**3-** >50 AROM through the available range against gravity.
Dorsi (ext)	5	2			**3** Full AROM through the available range against gravity.
Plantar	28	15	1	1	
Ankle Inv	20	25	1	1	**3+,4-** Full AROM against gravity - minimal manual resistance.
Ankle Ever	15	15	1	1	**4,4+** Full AROM against gravity - moderate manual resistance.
TMA	20 EXT	35 EXT			
TFA	7 EXT	25 EXT			**5** Full AROM against gravity - maximal manual resistance.
FF AB/ADD	7 ABD	4 ABD			
Calcaneal Inv	8	4			
Calcaneal Ever	5	4			
Leg Length	81.0	79.5			
Knee Varus/Valgus					

She has poor motor control with increased tone (with increased Ashworth scores) in all muscle units in her bilateral legs. Knee radiographs showed significant patella alta (Figure 1).

Figure 1. Preoperative Knee Radiographs

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, but worse on the left (Figure 2).

Figure 2. Preoperative Temporodistance Parameters

	Right Side Measures			Normal	Left Side Measures		
Step Length Avg (cm)	33.51 (6.49)			63.75-71.53	47.29 (6.40)		
Step Length Avg (Normalized)	0.23 (0.04)			0.43-0.49	0.32 (0.04)		
Stride Length Avg (cm)	80.70 (10.88)			127.77-142.55	81.09 (10.86)		
Stride Length Avg (Normalized)	0.55 (0.07)			0.87-0.97	0.55 (0.07)		
Forward Velocity Avg (cm/s)	63.65 (14.92)			117.44-145.26	64.60 (14.83)		
Forward Velocity Avg (/s)	0.43 (0.10)			0.80-0.98	0.44 (0.10)		
Cadence Avg (steps/min)	94.07 (15.07)			105.33-127.85	95.60 (14.98)		
Total Support Time (%)	58.03 (5.92)			57.59-61.67	57.36 (8.56)		
Step Width (cm)	15.17 (2.01)			7.20-11.90			
Step Width (Normalized)	0.10 (0.01)			0.04-0.08			
GDI	59.73 (3.50)			90.00-110.00	38.22 (2.87)		
Gait Profile Score (Average)	13.29 (1.91)			5.30-7.38	18.66 (2.06)		

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). She has mild increased hip flexion in mid-stance, with normal, but variable pelvic tilt. She has internal hip rotation on the left, with bilateral tibial torsion, worse on the left. Her most striking finding on the kinematics is the severe knee flexion through-out the gait cycle. Pedobarographs show valgus foot position on the left and near normal foot position on the right (Figure 7).
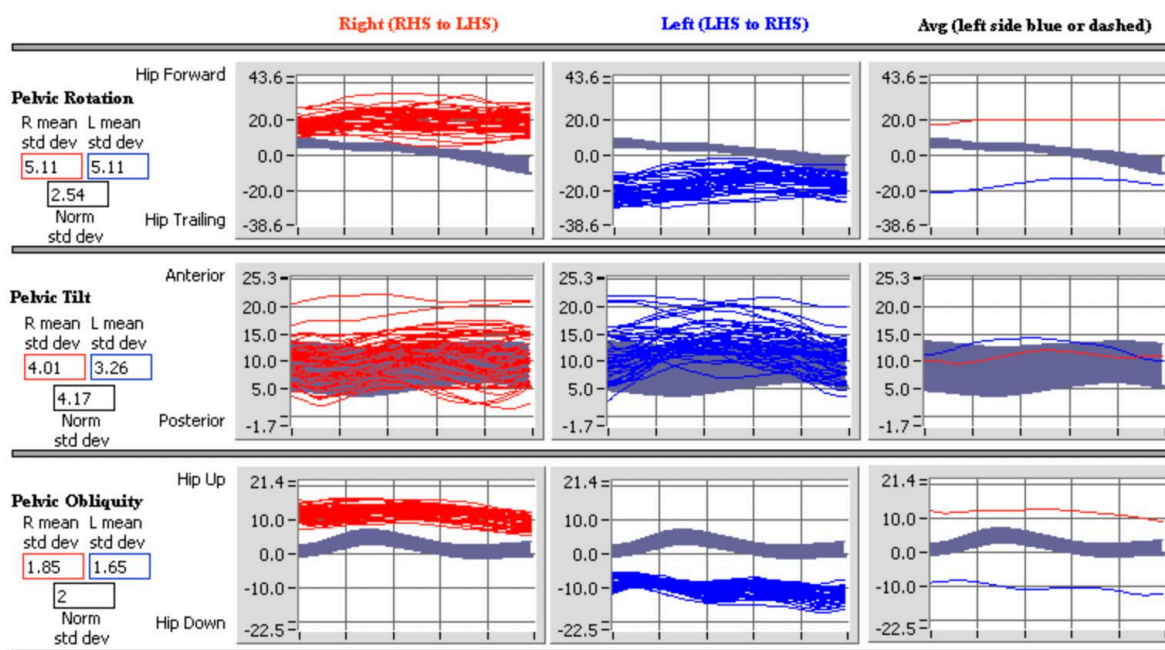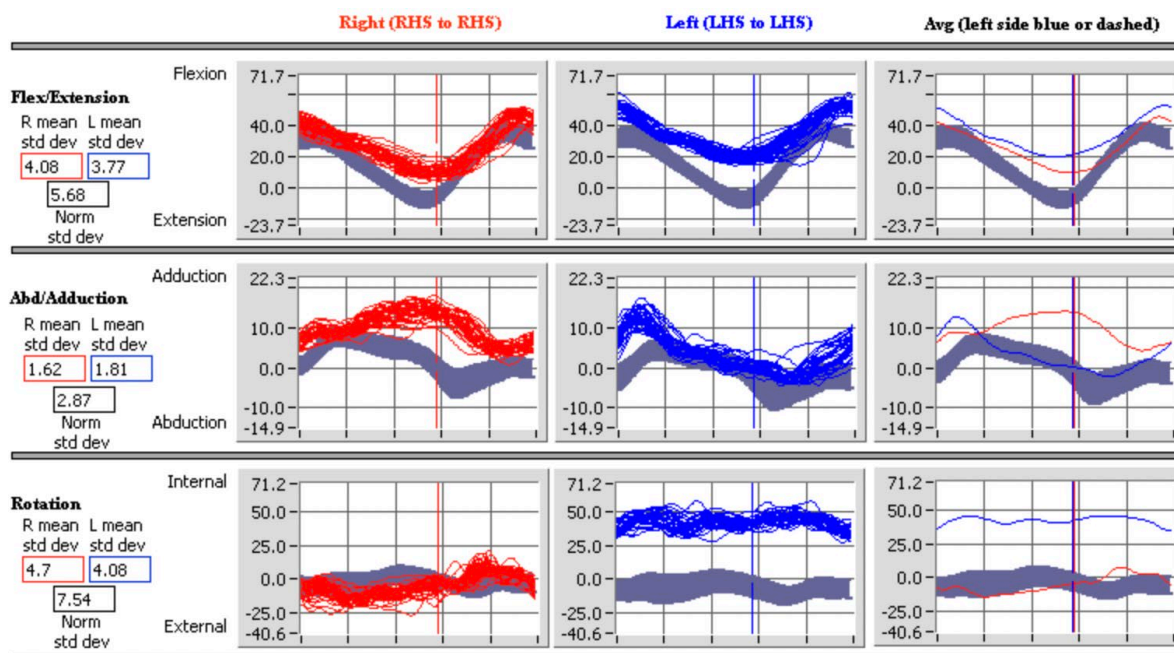
Figure 3. Preoperative Pelvic Kinematics
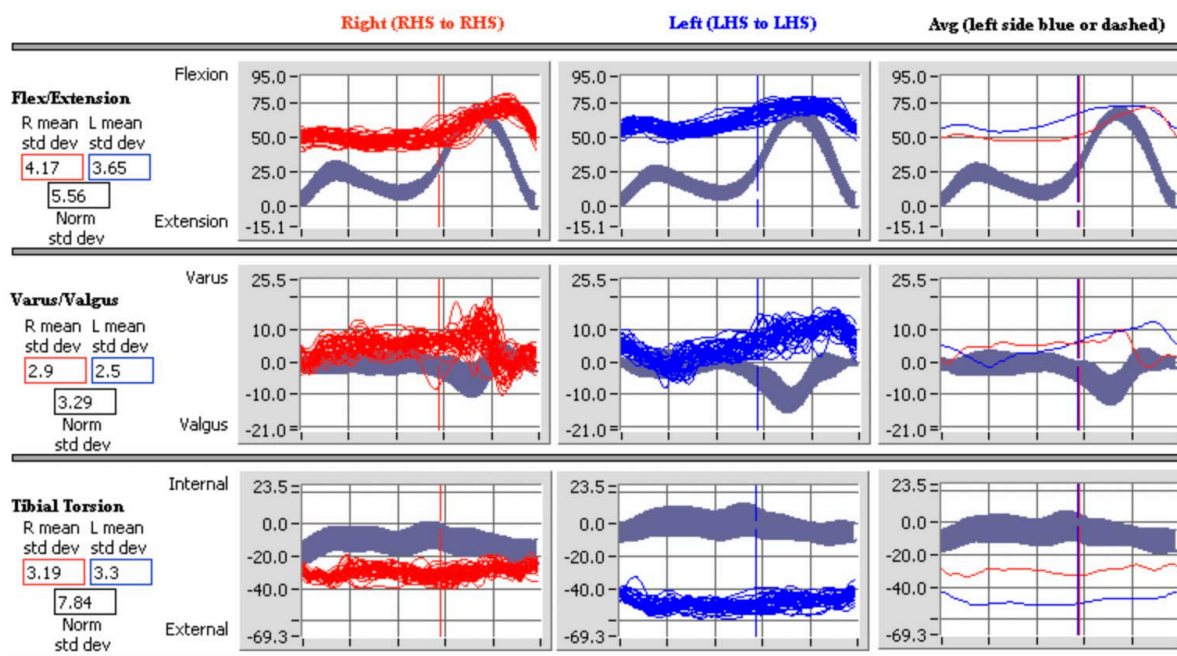

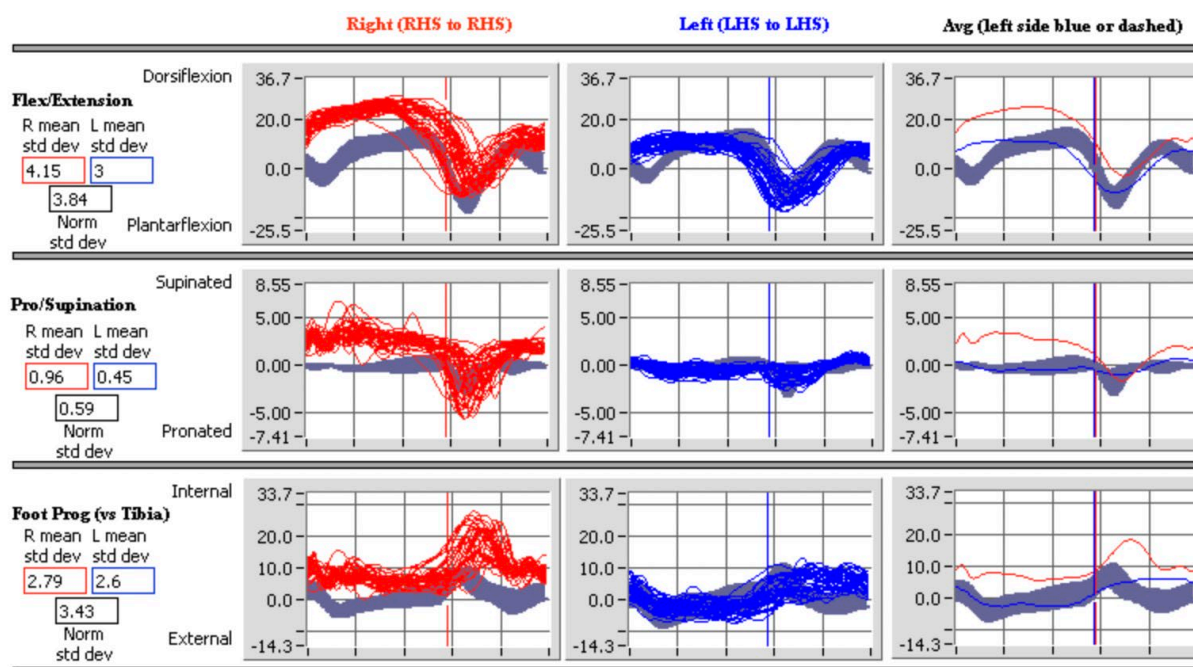## Figure 4. Preoperative Hip Kinematics

Figure 5. Preoperative Knee Kinematics

Figure 6. Preoperative Ankle Kinematics

Figure 7. Preoperative Pedobarograph