

# Jump Gait in Spastic Diplegia: An Expert Panel Case Review

M. Wade Shrader, MD<sup>1</sup>; Benjamin J. Shore, MD, MPH, FRCSC<sup>2</sup>; David M. Scher, MD<sup>3</sup>; Robert Kay, MD<sup>4</sup>

<sup>1</sup>Nemours A.I. duPont Hospital for Children, Wilmington, DE; <sup>2</sup>Boston Children's Hospital, Boston, MA; <sup>3</sup>Hospital for Special Surgery, New York, NY; <sup>4</sup>Children's Hospital of Los Angeles, Los Angeles, CA

## Introduction

This case study is a continuation of the *JPOSNA* Tutorial on Gait Analysis in Cerebral Palsy. Interested readers should consider reviewing prior *JPOSNA* publications on Observational and Instrumented Gait Analysis published in *JPOSNA* Vol. 2, No. 3 and Vol. 3, No. 1. In this edition, we present a case example of a diplegic patient who had limitations in walking. After undergoing instrumented Gait Analysis with Video, her case will be presented to three experts in cerebral palsy: Drs. Ben Shore, David Scher, and Bob Kay. We will discuss indications and methods of treatment based upon the child's video of her gait, physical examination, and gait analysis. Patient follow-up video and summary video statement will follow. –MWS

## Case Study

This is a 5+3-year-old female with a history of 30-week premature delivery and known intraventricular hemorrhage in the Neonatal Intensive Care Unit. She did not walk until the age of 3 and then began with a walker. She has not had any surgery or botulinum-A toxin treatment. She currently receives physical and occupational

therapy once a week through the school; she also receives similar services through a home therapy agency. Her parents are concerned about her toe walking, dragging her toes, and walking with bent knees and rotated legs. She presents to the Cerebral Palsy Clinic and to the Gait Laboratory for preoperative assessment and surgical planning.

Her past medical history is otherwise unremarkable. She also has a diagnosis of cortical visual impairment. She is taking oral baclofen. She does not have a seizure disorder.

Her physical exam is noted in Table 1, which is notable for mild bilateral hip flexion contractures and knee flexion contractures of 28 (right) and 30 degrees (left). Silfverskiold test shows a 5-degree contracture with the knees fully extended (Gastrocnemius), and 15 degrees of dorsiflexion with the knees bent. She has poor motor control with increased tone (with increased Ashworth scores) in all muscle units in her bilateral legs. Her pre-treatment video of gait is presented separately. Hip radiographs were obtained for basic screening purposes (Figure 1).

**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	-15	-15	2+	2+	1 Contraction in the muscle but no observable movement
Hip Abd	20	20	2+	2+	1+ Visible movement of the part but <50% through the available range in a gravity-eliminated position.
Hip Int Rot	60	58			
Hip Ext Rot	25	30			
Knee Ext	-30	-28	4	4	2- >50% AROM through the available range in a gravity-eliminated position.
Knee Flex	WNL	WNL	3+	3+	2 Full AROM through the available range in a gravity-eliminated position.
Pop Angle	90 80	95 85			
Ely Test	90	90			2+ Full AROM with some manual resistance in a gravity-eliminated position.
Dorsi (flex)	14	15	1	1	
Dorsi (ext)	-5	-5			3- >50 AROM through the available range against gravity.
Plantar	35	35	1	1	
Ankle Inv	25	25	1	1	3 Full AROM through the available range against gravity.
Ankle Ever	10	10	1	1	
TMA	14 EXT	5 EXT			3+,4 Full AROM against gravity - minimal manual resistance.
TFA	1 EXT	5 INT			4,4+ Full AROM against gravity - moderate manual resistance.
FF AB/ADD	5 ADD	6 ADD			
Calcaneal Inv	20	20			5 Full AROM against gravity - maximal manual resistance.
Calcaneal Ever	10	10			
Leg Length	49.2	49.3			
Knee Varus/Valgus					



**Figure 1. Preoperative Hip Radiographs**

### Instrumented Gait Analysis

Temporodistance parameters showed that she walked with an overall slow gait compared to age-matched typ-

ically developed children used as controls. She also had a low Gait Deviation Index (GDI) bilaterally (Figure 2).

	Right Side Measures	Left Side Measures	Normal
Step Length Avg (cm)	19.19 (4.43)	19.12 (4.01)	39.86-48.38
Step Length Avg (Normalized)	0.19 (0.04)	0.19 (0.04)	0.35-0.43
Stride Length Avg (cm)	38.28 (6.27)	38.14 (6.32)	79.70-96.84
Stride Length Avg (Normalized)	0.38 (0.06)	0.38 (0.06)	0.70-0.86
Forward Velocity Avg (cm/s)	41.34 (11.26)	40.69 (10.41)	102.16-119.76
Forward Velocity Avg (/s)	0.41 (0.11)	0.41 (0.10)	0.91-1.07
Cadence Avg (steps/min)	129.40 (25.32)	129.17 (25.52)	144.18-157.96
Total Support Time (%)	47.95 (12.49)	49.82 (15.53)	57.10-60.86
Step Width (cm)	13.44 (0.92)		6.81-9.31
Step Width (Normalized)	0.13 (0.01)		0.06-0.08
GDI	38.87 (3.51)	43.67 (3.38)	90.00-110.00
Gait Profile Score (Average)	19.58 (2.02)	16.52 (2.20)	5.30-7.38

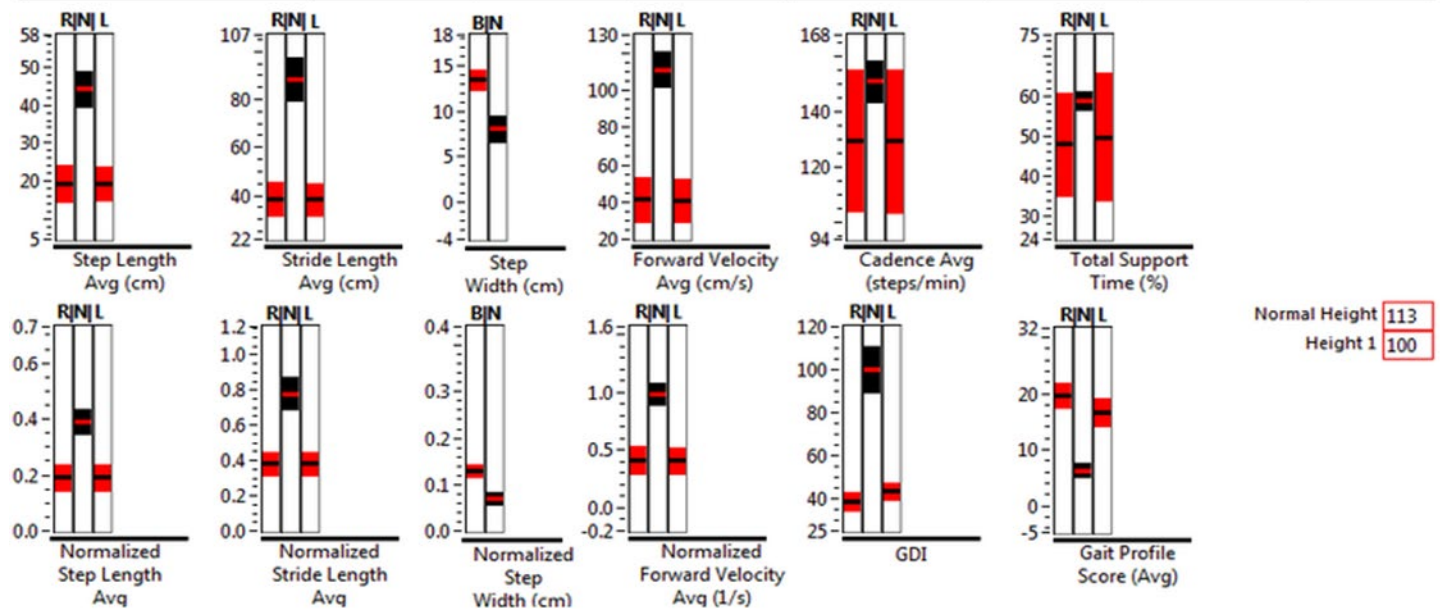


Figure 2. Preoperative Temporodistance Parameters

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 (Figure 7).

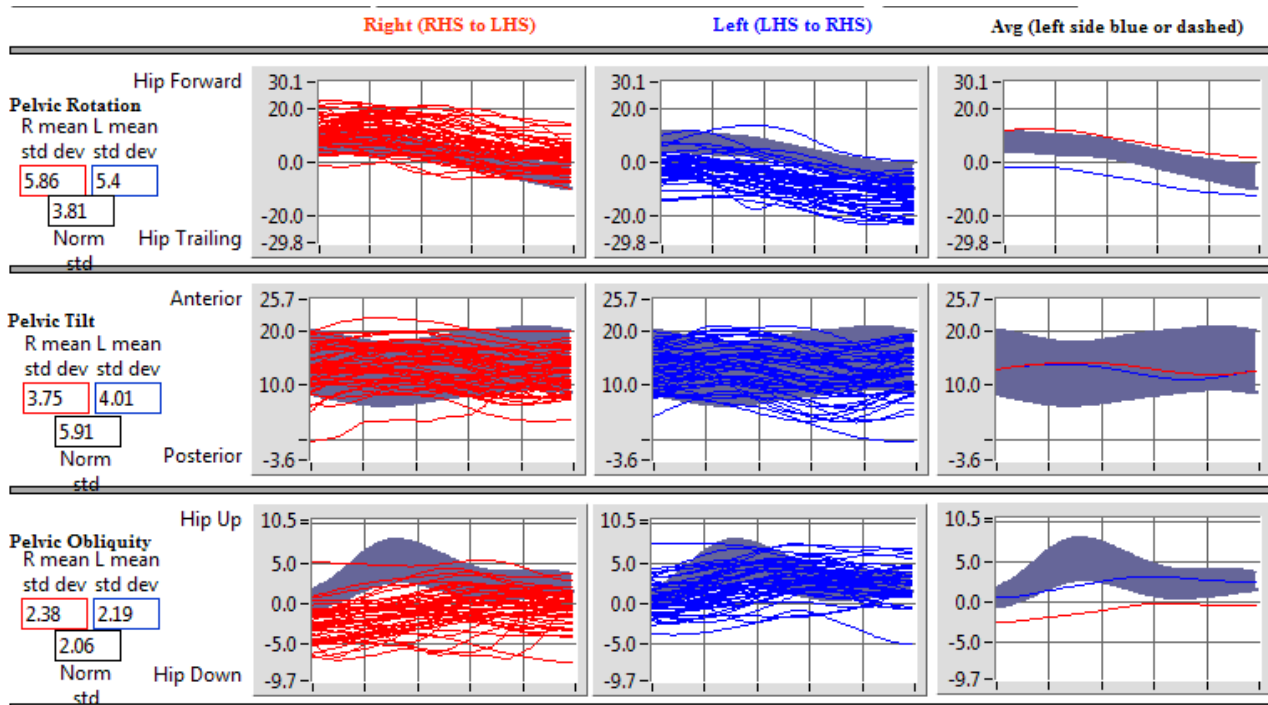


Figure 3. Preoperative Pelvic Kinematics

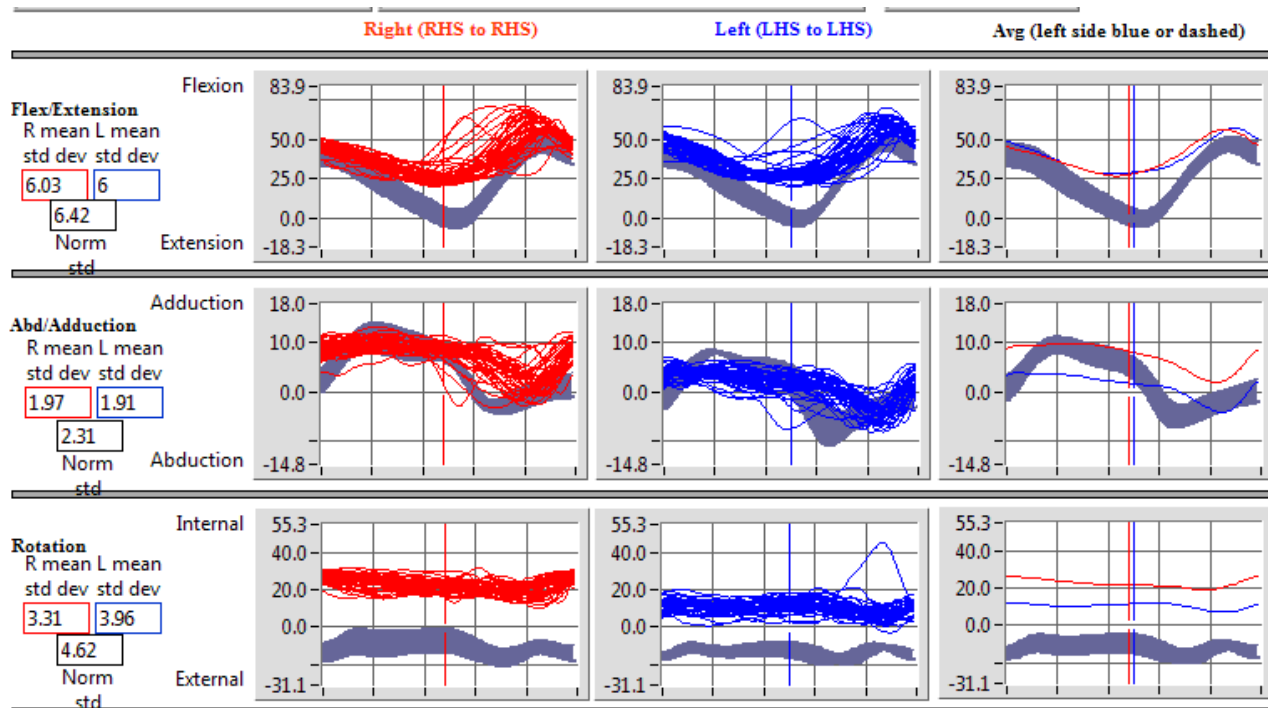


Figure 4. Preoperative Hip Kinematics

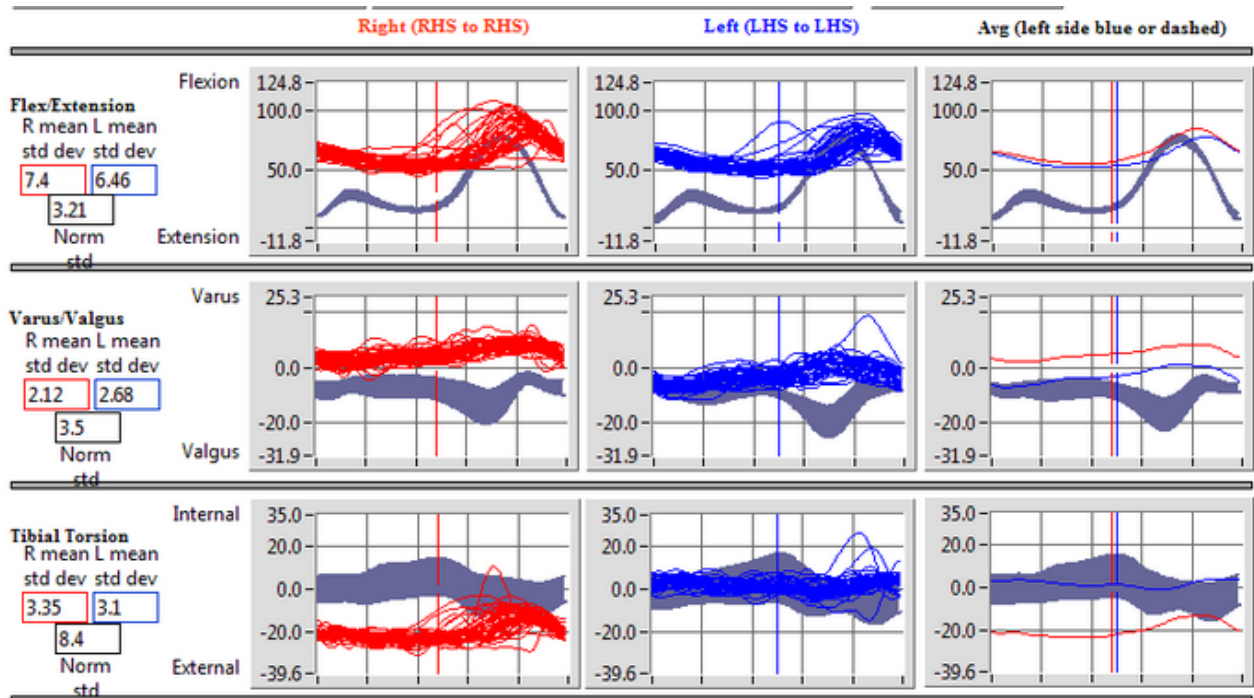


Figure 5. Preoperative Knee Kinematics

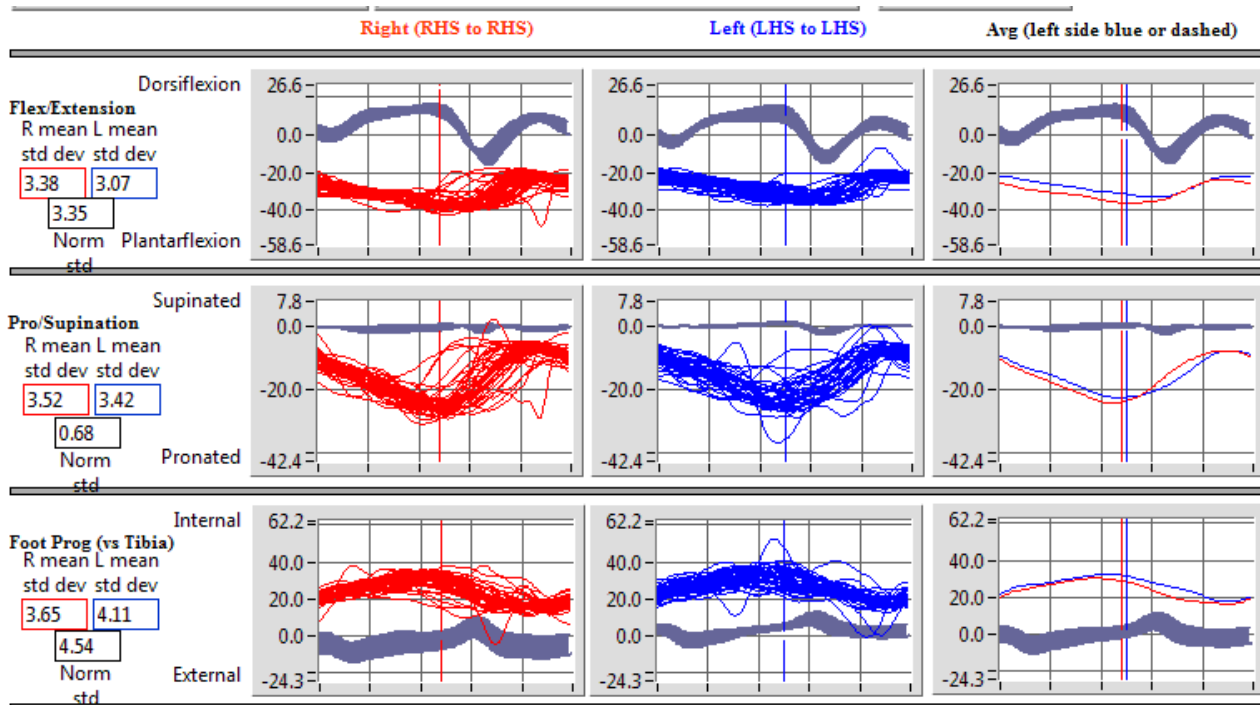


Figure 6. Preoperative Ankle Kinematics

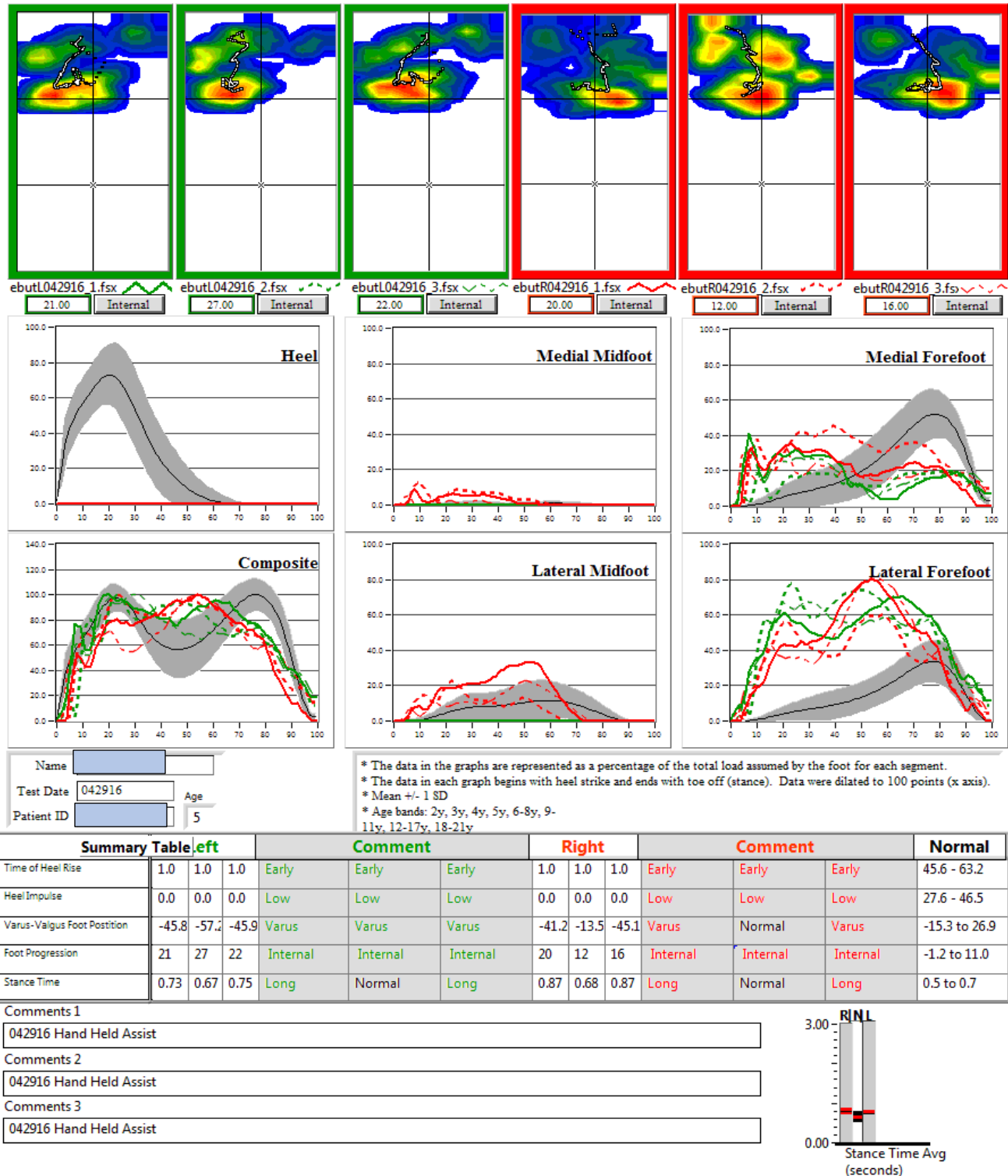


Figure 7. Preoperative Pedobarograph

Please watch the attached Panel Discussion of Treatment Strategies.