

# Upper Limb Motion Analysis (ULMA) for Surgical Decision-Making In Brachial Plexus Palsy: A Challenging Case Study

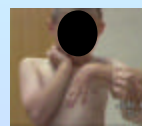
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## Patient History

- 8 year old with brachial plexus palsy of entire left upper limb (UL)
- Prior surgeries – all performed at other institutions
  - Primary repairs at 4 months and 3½ years
  - “Mod Quad” at 4 years  
*Release of subscapularis, triceps long head, pectoralis major & minor, biceps short head; lat dorsi/teres major transfer to teres minor; axillary nerve neurolysis and decompression*
  - Another “Quad” procedure at 5½ years  
*Teres major to teres minor tendon transfer*
  - Lysis of adhesions in anterior shoulder
  - Humeral derotation osteotomy at 6 years
  - Radioulnar derotation osteotomy at 7½ years
- Referred for ULMA for surgical planning to maximize function

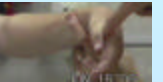
## Clinical Data

	MMT	R	L		MMT	R	L		MMT	R	L
Elbow	Flex	5	3-	Fingers	FDS	5	4-	Thumb	FPL	5	3
	Ext	5	5		FDP	5	4-		FPB	5	2-
Wrist	FCR	5	4-	EIP	5	3+	EPL	5	2-		
	FCU	5	5	EDC	5	2-	EPB	5	0		
	PL	5	4	EDM	5	0	APL	5	1		
	ECR	5	0	Lumb	5	0	APB	5	1		
	ECU	5	0	DAB	5	3-	AP	5	4		
				PAD	5	2-	OP	5	3+		



Attempt at wrist extension

HAND TESTS	RIGHT		LEFT	
	AROM	PROM	AROM	PROM
Volkman's Angle	Normal	Normal	75°	partial ability
DEN Test	Normal	Normal	75°	partial ability
ACE Test	Normal	Normal	39°	50°
Radial Web Space	Normal	Normal	30°	60°
Palmar Web Space	Normal	Normal	Normal	Slightly adducted
Thumb at Rest	No	No	No	No
MP Instability	No	No	No	No
Swan-Neck > 10°	No	No	No	No



Strong grasp using finger flexors and thumb adductors 4/5



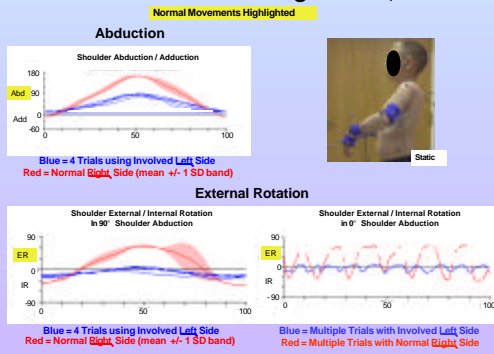
Digit Extension in Neutral (DEN)

## Motion Analysis Data

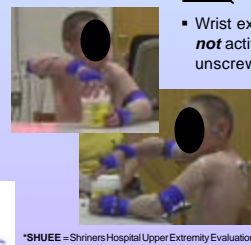
**Right Normal**  
RED Graphs

**Left BPP**  
BLUE Graphs

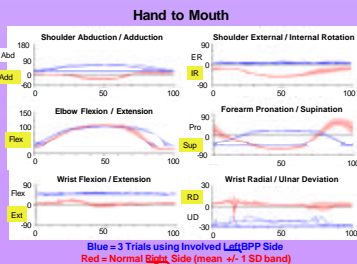
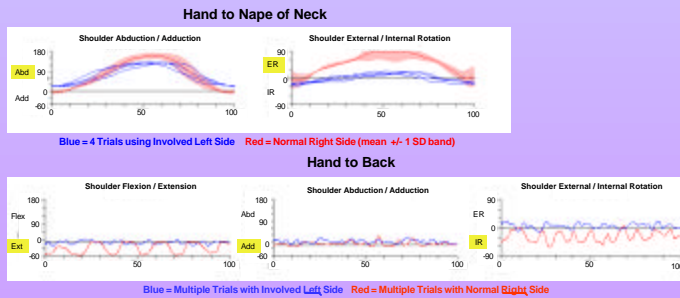
### Kinematics During Mallet



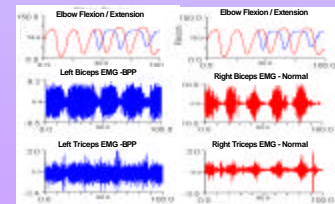
### Kinematics During SHUEE\*



- Pearls:**
- Wrist extension kinematics depicted passive, **not** active ROM (i.e. propping) during tasks of unscrew bottle cap, pull apart and cut playdough
  - Elbow kinematics focused on extension, rather than flexion deficit
  - Sitting position preferred during kinematic data collection, as this was more functional during tasks
  - Thumb and finger kinematics would be useful in treatment planning!
  - Sagittal and frontal straight-on video camera views assisted with evaluation of thumb and finger positions



### Electromyography



- EMGs not specific enough to accurately define strength deficit in left biceps

## Treatment Decisions

- Shoulder function maximized with prior surgery, but CT scan to confirm shoulder stability
- Elbow flexion deficits noted, but currently compensating well and functional for most tasks
- Forearm function maximized with prior bony surgery
- FCU to ECRB tendon transfer to assist with active wrist extension and power grip
- EDC tenodesis vs. EIP to EDC tendon transfer to augment finger extensor function
- EPL re-routing to augment thumb extension and active radial web for grasping
- PL to EPB to augment thumb extension and abduction

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