



**ROTHMAN**  
ORTHOPAEDIC INSTITUTE



**Sidney Kimmel  
Medical College**  
at Thomas Jefferson University

# Physical Examination vs Ultrasonography for Detection of Ulnar Nerve Subluxation in Professional Baseball Pitchers

Austin M. Looney, M.D.; Hannah K. Day, M.S.; Manoj  
P. Reddy, M.D.; Ryan W. Paul, B.S.; Levon N.  
Nazarian, M.D.; Steven B. Cohen, M.D.

# Disclosures

I (and/or my coauthors) have no relevant disclosures for this study. All other disclosures can be found on the AAOS disclosure website.



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# Introduction

- Ⓜ While ulnar nerve subluxation may be inconsequential, a subluxating ulnar nerve in throwing athletes can be associated with pathologic symptoms.
- Ⓜ The presence of ulnar neuropathy in baseball players can be a poor prognostic factor of return to play, and may complicate results of ulnar collateral ligament (UCL) reconstruction (UCLR).



# Introduction

- ① Due to improvements in imaging quality and diagnostic accuracy and superficial access to the ulnar nerve, dynamic ultrasound has become an increasingly utilized modality for evaluation of ulnar nerve subluxation.
- ② The only prior study evaluating ulnar nerve subluxation with ultrasound specifically in baseball players focused on youth athletes and found that 44% of dominant elbows and 19% of non-dominant elbows experienced ulnar nerve instability.



# Purpose

To characterize the diagnostic validity of physical examination in the detection of ulnar nerve subluxation at the cubital tunnel of the elbow compared with ultrasound.



# Methods – Inclusion/Exclusion

Ⓡ **Study design:** cross-sectional study during preseason evaluation

Ⓡ **Inclusion Criteria:**

Ⓡ Professional baseball pitchers in a minor league baseball organization

Ⓡ Patients with ongoing or history of ulnar nerve symptoms were not excluded if no formal treatment had been performed

Ⓡ **Exclusion Criteria:**

Ⓡ Elbows in which ulnar nerve surgery had been performed were excluded



# Data Collection

- Ⓡ Athletes underwent physical examination prior to ultrasound imaging.
- Ⓡ **Physical exam:** Both “perching” and “dislocating” nerves were considered positive for subluxation.
- Ⓡ **Ultrasound:** Performed by a radiologist fellowship-trained in musculoskeletal imaging who was blinded to physical examination findings. Nerves that were “type S (subluxation)” and “type D (dislocation)” were considered positive for subluxation.



# Statistical Analysis

- Ⓡ Ultrasound was considered the “gold standard” compared to physical examination.
- Ⓡ Accuracy and 95% CI of physical exam agreement was quantified with Cohen’s  $\kappa$  as follows:
  - Ⓡ 0 to 0.20, none
  - Ⓡ 0.21 to 0.39, minimal
  - Ⓡ 0.40 to 0.59, weak
  - Ⓡ 0.60 to 0.79, moderate
  - Ⓡ 0.80 to 0.90, strong
  - Ⓡ above 0.90, almost perfect
- Ⓡ Epidemiologic parameters including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were estimated.



# Results - Demographics

186 elbows (91 dominant arm, 95 nondominant arm) in 95 athletes were examined

**Table 1.** Baseline player characteristics.

Characteristic	Mean, Median, or No.	95% CI, IQR, or %	Range
Age, yr <sup>a</sup>	22	21–24	17–30
Arm dominance	L, 28; R, 67	L, 29.5; R, 70.5	NA
Height, cm <sup>a</sup>	191	185–193	178–208
Weight, kg <sup>b</sup>	95.4	93.0–97.7	66.0–129.0
BMI, kg/m <sup>2</sup>	26.46	25.83–27.09	18.62–33.75
Professional experience, yr <sup>a,c</sup>	2	0–3	0–6

<sup>a</sup>Median and IQR.

<sup>b</sup>Mean and 95% CI.

<sup>c</sup>Determined as *n* - 1 spring trainings attended.

# Results

**Table 2.** Performance of Physical Examination vs Ultrasonography.<sup>a</sup>

Parameter	Estimate	95% CI
Accuracy	86.6%	80.8% – 91.1%
Sensitivity	77.0%	64.5% – 86.8%
Specificity	91.2%	84.8% – 95.5%
PPV	81.0%	68.6% – 90.1%
NPV	89.1%	82.3% – 93.9%
PLR	8.76	4.90 – 15.65
NLR	0.25	0.16 – 0.40
DOR	34.79	14.73 – 82.19
NND	1.47	1.21 – 2.03
Youden Index	0.68	0.49 – 0.82

<sup>a</sup>CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value; PLR, positive likelihood ratio; NLR, negative likelihood ratio; DOR, diagnostic odds ratio; NND, number needed to diagnose.

# Results

**Table 3.** Positive Provocative Tests and Ulnar Nerve Subluxation: Dominant vs Nondominant

Provocative Test	Dominant			Nondominant		
	Stable <sup>a</sup> (N = 59)	Subluxating <sup>a</sup> (N = 32)	<i>P</i> value	Stable <sup>a</sup> (N = 66)	Subluxating <sup>a</sup> (N = 29)	<i>P</i> value
Tinel's	4 (6.8)	0 (0)	.293	4 (6.1)	1 (3.4)	> .999
Flexion compression	1 (1.7)	0 (0)	> .999	1 (1.5)	1 (3.4)	.520

<sup>a</sup>On ultrasound.



# Conclusion

Physical examination has moderate sensitivity and high specificity for detecting ulnar nerve subluxation at the cubital tunnel of the elbow when compared with ultrasound. These findings suggest that when detecting the presence of a subluxating ulnar nerve is most important it may be advisable to obtain an ultrasound evaluation instead of relying on physical examination; however, physical examination alone may be appropriate for ruling out subluxation.

