P-55

Safe Needle Trajectory for Flexor Carpi Ulnaris EMG : An Ultrasound Study

Sunjung Park, M.D.[1], Joon Shik Yoon, M.D., PhD.[1]
[1] Department of Physical Medicine and Rehabilitation, Korea University Guro Hospital, Korea University College of Medicine

Introduction

- Since needle electromyography (EMG) is often performed without ultrasound guidance, defining precise anatomical relationships is essential to minimize nerve injury.
- This study quantified the **relationship between the flexor carpi ulnaris (FCU) and the ulnar nerve**, evaluated the **effects of elbow flexion**, and determined an **optimal insertion angle as a safer alternative to perpendicular insertion**.

Methods

- Eleven healthy adult volunteers underwent forearm ultrasonography.
- The probe was placed perpendicular to the ulna for short-axis views at 20% to 50% of the forearm length.
- At the maximal FCU cross-sectional area (CSA), **the following were measured in elbow extension and 90° flexion** (Figure 1):
  (a) horizontal distance from ulna to FCU center
  (b) horizontal distance from ulna to ulnar nerve
  (c) depth to FCU center
  (d) depth to ulnar nerve
- To simulate a safer trajectory maintaining **a 5-mm safety margin from the ulnar nerve**, we calculated the optimal skin insertion site (z'), required needle length (f), and optimal anterior insertion angle (A)—defined as the degree of anterior tilt relative to the vertical axis (0° = perpendicular insertion) (Figure 2).

Results

- Maximal FCU CSA was observed at 30% to 40% of the forearm length.
- Table 1 presents the anatomical measurements of the FCU and ulnar nerve, and the effect of elbow flexion.
- **Elbow flexion significantly increased the horizontal separation between the FCU center and the ulnar nerve (P = .001).**
- Table 2 introduces the optimal insertion site, depth, and angle required to maintain a 5-mm safety margin.

Variables	Mean ± SD		p-value
	Elbow extension	Elbow flexion	
Horizontal distance from center of FCU to ulna (a) (mm)	14.5 ± 3.1	15.0 ± 2.8	0.381
Horizontal distance from ulnar nerve to ulna (b) (mm)	15.0 ± 3.3	16.8 ± 3.0	0.017*
Depth to center of FCU (c) (mm)	8.2 ± 1.3	7.8 ± 1.3	0.151
Depth to ulnar nerve (d) (mm)	12.9 ± 1.9	12.5 ± 2.0	0.115
Horizontal distance between ulnar nerve and center of FCU (b-a) (mm)	0.5 ± 0.8	1.8 ± 1.3	0.001*

Table 1. Anatomic Measurements of FCU and Ulnar Nerve.
*: p<0.05, using paired t-test

Variables	Mean ± SD	Description
Optimal skin insertion site (z') (mm)	22.5 ± 2.6	Anterior to ulna
Required needle length (f) (mm)	11.3 ± 2.0	Distance to reach FCU center
Optimal anterior insertion angle (A) (°)	43.7 ± 7.8	Relative to vertical axis (0°)

Table 2. Simulation for Safe Angled Needle Insertion.

Conclusions

- For perpendicular FCU insertion at 30–40% forearm length, **the optimal target is approximately 15 mm anterior to the ulna at a depth of 8 mm, with depth limited to <13 mm**.
- Although the clinical significance of elbow flexion is modest, it remains a **practical alternative for patients with contractures or spasticity.**
- To maximize safety, **we recommend an oblique approach, inserting the needle approximately 23 mm anterior to the ulna, advancing it approximately 11 mm, with an anterior tilt of approximately 45 degrees relative to the vertical plane.**

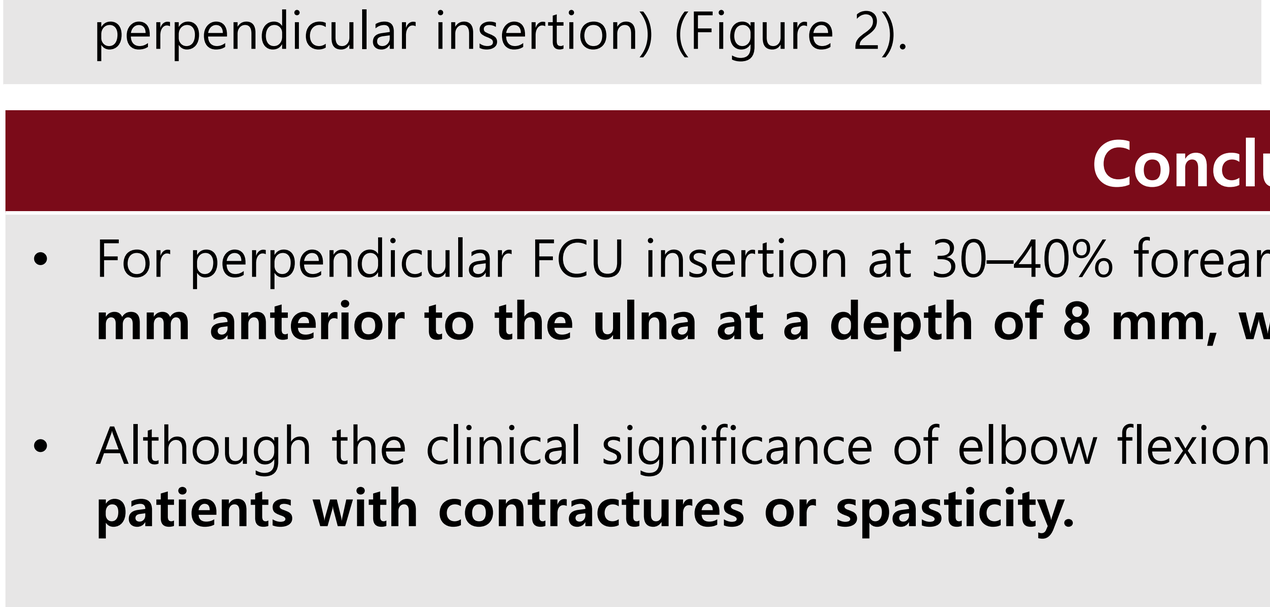

Figure 1. Ultrasonographic measurements of FCU and surrounding structures.

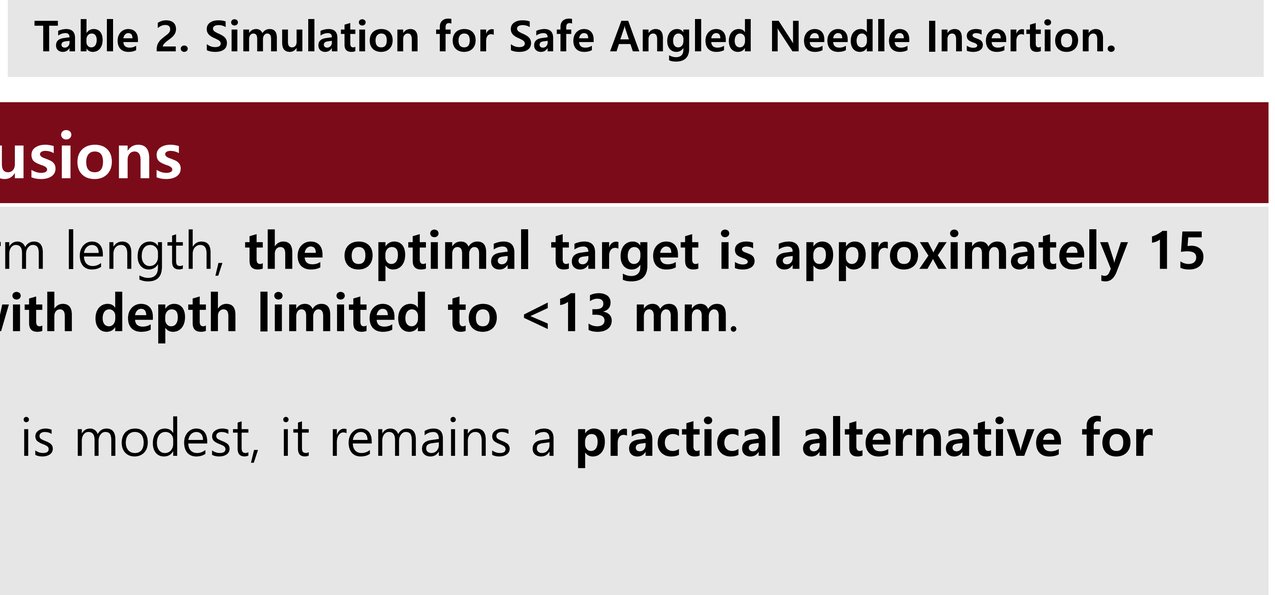

Figure 2. Geometric simulation of the safe angled needle trajectory for FCU.

Acknowledgement :
This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT)(RS-2025-00532972).