Submuscular versus Subcutaneous Ulnar Nerve Transposition: A Cadaveric Study Evaluating their Utility in Primary Ulnar Nerve Repair at the Elbow

Brandon S. Smetana, MD[1]; Edward W. Jernigan, MD[1], Wayne A. Rummings Jr, MS[1], Paul S. Weinhold, PhD[1,2], Reid W. Draeger, MD[1] and J. Megan M. Patterson, MD[1]

1. University of North Carolina Department of Orthopaedic Surgery, Chapel Hill, NC; 2 Joint Department Biomedical Engineering, University of North Carolina, Chapel Hill, NC

Background

- Complete acute ulnar nerve lacerations occur commonly
- Delayed repairs often necessitate nerve grafting, and carry worse outcomes than acute end to end repairs[1]
- Teachings emphasize the importance of anterior subcutaneous transposition in order to gain length for primary nerve repair[2]
- Little consensus on expected length gained from transposition with reported length gains ranging from 1cm to 13cm[3,4,5]

Objective

- To investigate the length gained from subcutaneous and submuscular transposition of the ulnar nerve at the elbow

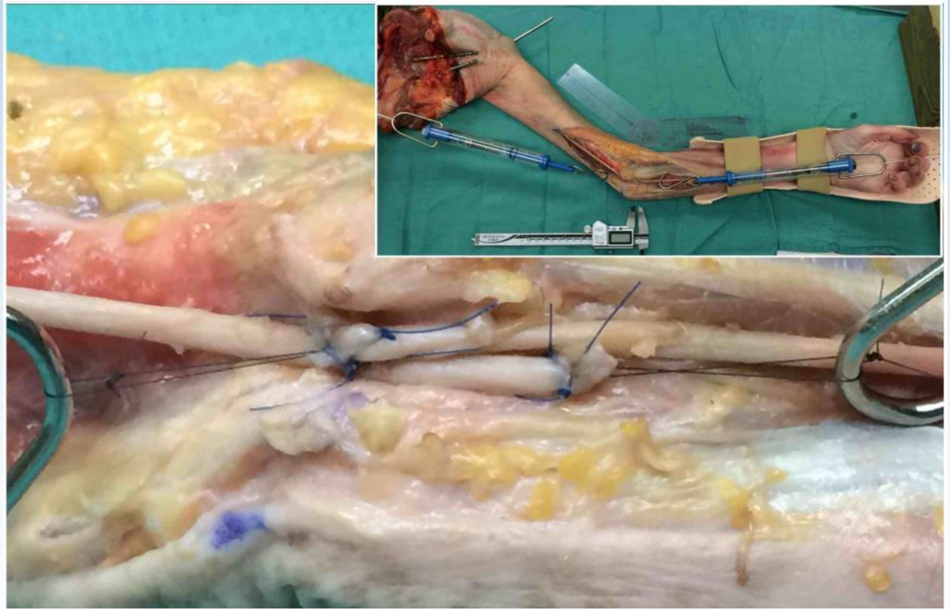

Figure 1: Photograph of the Experimentation Methodology. Note spring gauge attachment to either nerve end and marking sutures placed 5mm proximal to the laceration site. Glenohumeral joints and scapulae were secured with Steinmann pins, overlap was measured with an electronic caliper, and elbow flexion was measured with a goniometer (top right). Wrist flexion positions were held with prefabricated thermoplastic splints with built in flexion of 0, 30, and 60 degrees.

Methods

- 11 cadaveric complete upper extremity specimens were utilized
- *In situ* decompression and mobilization of the ulnar nerve at the elbow was performed
- A laceration 2cm distal to the medial epicondyle was created
- Nerves were marked 5mm proximal and distal to the laceration site to simulate clinical nerve end preparation during repair
- Nerve ends were attached to spring gauges set at 100g of tension (strain ≤ 10%) with 5.0 nylon suture (Figure 1)
- Measurements of nerve overlap were obtained in varying degrees of wrist and elbow flexion using an electronic caliper
- Measurements were performed after in situ decompression/ mobilization and repeated after both subcutaneous and submuscular transposition
- Two and one way RMANOVA analyses were performed to compare overlap means

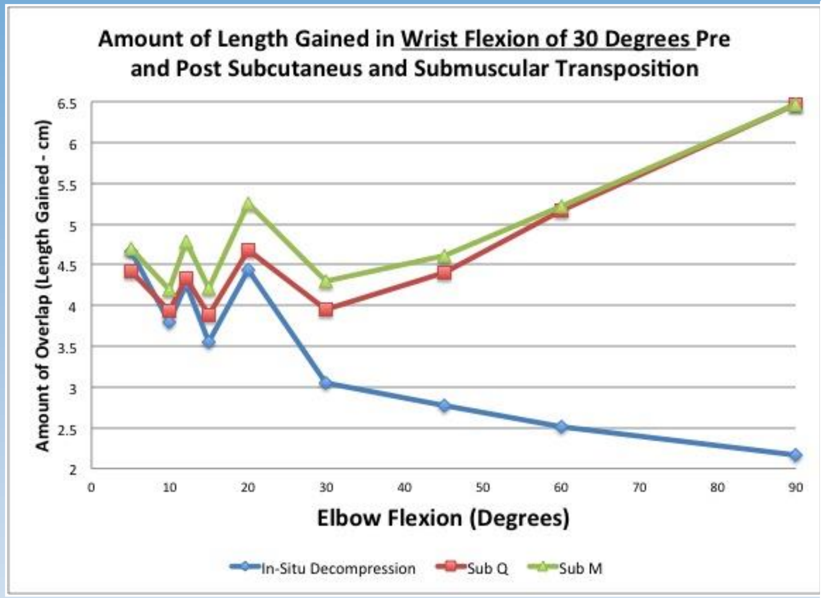

Figure 2: Average Nerve Overlap within our study's three subgroups (*In Situ* Decompression, Post Subcutaneous Transposition, and Post Submuscular Transposition) based on elbow flexion angle and with fixed wrist flexion angle of 30 degrees. Nearly equivalent trends were seen with wrist flexion angles of 0 and 60 degrees, although wrist flexion was associated with increased nerve overlap.

Results

- Ulnar nerve transposition was found to significantly increase nerve overlap past a threshold of 30 degrees of elbow flexion (Figure 2)
- No difference was seen between subcutaneous and submuscular transpositions at all wrist and elbow positions
- Nerve length gained from wrist flexion was significant in all groups independent of elbow flexion and transposition
- *In situ* decompression/mobilization alone with application of 100g tension provided an average of 3.5 cm of maximal length gain
- Transposition in conjunction with clinically reasonable wrist and elbow flexion (30 and 60 degrees respectively) provided 5.2cm
- Controlling for mobilization and with the wrist and elbow placed in clinically acceptable flexion positions a statistically significant increase in overlap of approximately 2cm was gained from transposition

Conclusions

- Transposition along with clinically reasonable elbow and wrist flexion afforded 5.2 cm of length gained, 2cm more than in situ decompression and mobilization alone
- Length gained with transposition was only significant at elbow flexion greater than 30 degrees
- No statistically significant difference between transposition techniques was seen

References

1. Pfaeffle HJ, Thanapong W, Trumble T. Ulnar Nerve Laceration and Repair. Hand Clin. 2007; 23:291-299
2. Trumble TE. Overcoming Defects in Peripheral Nerves. In Gelberman RH, ed. Operative Nerve Repair and Reconstruction.. Vol1. 1st ed. Philadelphia: JB Lippincott 1991. 36:507-524
3. Trumble TE, McCallister WV. Repair of Peripheral Nerve Defect in the Upper Extremity. Hand Clinics. 2000; 16(1):749-712
4. Tsujino A, Itoh Y, Hayashi K. Excursion of the Ulnar Nerve at the Elbow Following Epicondylectomy or Transposition. Journal of Hand Surgery (Br.). 1996; 21B (2): 255-256
5. Abrams RA, Fenichel AS, Callahan JJ, Brown RA, Botte MJ, Lieber RL. The Role of Ulnar Nerve Transposition in Ulnar Nerve Repair: A Cadaver Study. Journal of Hand Surgery. 1998;23A(2): 244-249