

Histological study of ulnar nerve fascicles

Harish Gaikwad^{1*}, Rajneesh Pandey²

^{1,2}Associate Professor, Department of Anatomy, Seth GS Medical College and KEM Hospital, Parel, Mumbai
Email: harishgaikwad@kem.edu

Abstract

Introduction: Ulnar nerve is a mixed peripheral nerve. This peripheral nerve have fibers which are grouped in widely variable numbers into bundle (fasciculi). The size, number and pattern of fasciculi vary in different nerves and at different levels along their paths. This micro-anatomical knowledge of ulnar nerve is the basis for nerve repair and nerve grafting. Hence the study was done on the ulnar nerve. **Methods:** The study was carried on seventeen left and fifteen upper limbs of formalin fixed cadavers. The total number of fascicles of ulnar nerve were studied at three different levels with the Trinocular research microscope after staining sections with H & E. **Results:** The average number of fascicles at the levels of Axilla, epicondyle and the wrist were 7.09 ± 1.23 , 5.34 ± 1.12 and 4.41 ± 1.24 respectively. The maximum range was found in the wrist that is 3 to 10. **Conclusion:** This data from the present study will be helpful for surgeons especially plastic surgeons for various surgical procedures involving nerve repair, grafting.

Key Word: Ulnar nerve, fascicles, microanatomy, trinocular, peripheral, nerve repair.

*Address for Correspondence:

Dr. Harish Gaikwad, Associate Professor, Department of Anatomy ,Seth GS Medical College and KEM Hospital, Mumbai, Maharashtra, INDIA.

Email: harishgaikwad@kem.edu

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INTRODUCTION

The ulnar nerve is the main continuation and the largest branch of the medial cord of the brachial plexus of upper limb. The ulnar nerve supplies most of the small muscles of the hand and is mainly responsible for the fine movements of the hand. There are rapid changes in the fascicular pattern of the ulnar nerve. The ulnar nerve is polyfascicular, as it exits the brachial plexus until just before the elbow, at which point it becomes oligofascicular. After the division of the ulnar nerve into the motor branch at the wrist, the pattern is monofascicular. These patterns of ulnar nerve may help to determine which type of nerve repair is appropriate for a particular nerve injury. The fascicular pattern is altered so rapidly that the transverse sections of the ulnar nerve taken after few millimeters failed to present precisely the same fascicular pattern. The maximum length of the ulnar nerve with an absolutely constant pattern is

approximately 15mm¹. Hence the study was carried on the ulnar nerve to know the number of fascicles at various levels to substantiate further knowledge of the nerve. This microanatomy of fascicular pattern of the ulnar is helpful for surgical techniques in various types of fascicular repair and nerve-grafting.

MATERIAL AND METHODS

The study was carried on seventeen left and fifteen right upper limbs of formalin fixed cadavers. The ulnar nerve was dissected meticulously from the origin till its terminal branches. Then about one-inch of ulnar nerve tissue was taken at the three levels, at the level of axilla (at the origin), at the level of elbow (at the level of medial epicondyle), at the level of Wrist (just proximal to flexor retinaculum). Each section was kept in 10% formalin saline for 48 hours. Then it was treated successively with alcohol and xylene. Then the process of paraffin embedding was carried out and Paraffin blocks were prepared and labeled. Slides were prepared using egg albumin for fixing the tissue on the side and labelling was done using diamond writing pencil. Staining was done using haematoxylin and Eosin. Each slide was seen under trinocular research microscope. (Fig 1, 2 and 3) Each image of the ulnar tissue on the slide was grabbed by a camera (pinnacle studio of version 9.1, Nikon view) connected to the microscope and to the computer. Low power was used having magnification of 4X. Then the number of the fascicles of the nerve were noted using the image proplus software.

RESULTS

Table 1: Total number of fascicles in the ulnar nerve at axilla (at the origin)

Side	No. of specimens	Average	SD	Range
Left	17	7	1.37	5 to 9
Right	15	7.20	1.08	5 to 9
Total	32	7.09	1.23	5 to 9

Table 2: Total number of fascicles in the ulnar nerve at elbow (at the level of medial epicondyle)

Side	No. of specimens	Average	SD	Range
Left	17	5.24	1.30	3 to 8
Right	15	5.47	0.92	4 to 7
Total	32	5.34	1.12	3 to 8

Table 3: Total number of fascicles in the ulnar nerve at wrist (just proximal to flexor retinaculum)

Side	No. of specimens	Average	SD	Range
Left	17	4.41	1.66	3 to 10
Right	15	4.40	0.51	4 to 5
Total	32	4.41	1.24	3 to 10

Table 4: Average number of fascicles at the levels of Axilla, epicondyle and wrist

Section taken at	No. of specimens	Mean	SD	Range
Axilla	32	7.09	1.23	5 to 9
Epicondyle	32	5.34	1.12	3 to 8
Wrist	32	4.41	1.24	3 to 10

Out of 32 specimens, the average total number of fascicles in the ulnar nerve at axilla was 7 in 17 specimens of the left side and 7.09 in 15 specimens of the right side. The range on both sides was 5 to 9. (Table 1). Out of 32 specimens, the average total number of fascicles in the ulnar nerve at axilla was 5.24 in 17 specimens of the left side and 5.47 in 15 specimens of the right side. The range on the left side was 3 to 8 and on the right side was 4 to 7. (Table 2). Out of 32 specimens, the average total number of fascicles in the ulnar nerve at axilla was 4.41 in 17 specimens of the left side and 4.40 in 15 specimens of the right side. The range on the left side was 3 to 10 and on the right side were 4 to 5. (Table 3). The average number of fascicles at the levels of Axilla, epicondyle and the wrist were 7.09, 5.34 and 4.41 respectively. The maximum range was found in the wrist that is 3 to 10. (Table 4).



Figure 1

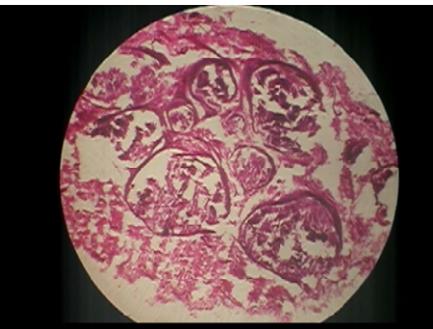


Figure 2



Figure 3

Legend

Figure 1: H & E stained section of the ulnar nerve at the level of axilla

Figure 2: H & E stained section of the ulnar nerve at the level of elbow

Figure 3: H & E stained section of the ulnar nerve at the level of wrist

DISCUSSION

Sunderland studied the intraneuronal topography of the ulnar nerve at various levels in the upper limb. He found that each fascicle of the ulnar nerve usually contains motor, sensory and sympathetic fibres, in varying numbers and combinations, but in some fascicle one or two of the types may be absent^{1,2}. It is also uncommon for human peripheral nerves to be composed of a single fascicle. They are, on the contrary, usually composed of several fascicles which, by repeatedly uniting and dividing, engage in plexus formations along the full length of the nerve¹. Also the number of fascicles of the ulnar nerve provide the anatomical basis for the

recommended surgical techniques of group fascicular repair and nerve-grafting³. According to Teboul F et al one or more fascicles of the ulnar nerve can be transferred to the nerve supplying biceps to restore elbow flexion in patients with upper brachial plexus palsy⁴. Also in the surgical treatment of acute lacerations of the ulnar nerve at these levels, one should direct special attention to the correct identification, matching, and alignment of the motor fascicular group to enhance reinnervation of the intrinsic muscles of the hand⁵. In the ulnar nerve when there was a polyfascicular pattern with a group fascicular arrangement, interfascicular dissection was performed to isolate the fascicle groups, which were grafted individually⁶.

Watchmaker GP et al studied the intraneuronal topography of the ulnar nerve in five cases. In his study the cross-section analysis of the fascicular anatomy of the ulnar nerve was helpful in transposition of the ulnar nerve⁷. David J. Slutsky also reported 20 fascicles in ulnar nerve at the level of elbow joint⁶. Sunderland found out that the number of fascicles of ulnar nerve at corresponding levels in different specimens was subject to a wide range of variation. Fascicles of ulnar nerve, regardless of their number, were more compactly arranged in some regions and in some ulnar nerves than in others. In the axilla the numbers ranged from 1 to 9 in all but in three specimens values of 14, 15 and 20 were recorded. At the wrist the numbers ranged between 11 and 27 in all but two cases. With few exceptions the number at the wrist exceeded that in the axilla⁸. In the present study the average number of fascicles at the level of axilla is 7.09, at epicondyle is 5.34 and at the wrist is 4.41 found in 32 specimens. So in the present study it was found wide variation in the number of fascicles of the ulnar nerve. A comprehensive knowledge of the intrafascicular topography is quite helpful in successful nerve grafting.

CONCLUSION

The mean of the total number of fascicles in the ulnar nerve at axilla was 7.09 at elbow was 5.34 and at the wrist was 4.41. The range of the total number of fascicles in the ulnar nerve at axilla was 5 to 9 at elbow was 3 to 8 and at the wrist was 3 to 10. There was significant decrease in the number of fascicles of the ulnar nerve in its course from axilla to wrist. So the knowledge of fascicular arrangement is crucial to

achieving a successful outcome in surgical nerve repair of ulnar nerve.

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