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ESTIMATION OF FASCICLE COUNT AND DIAMETER IN PIG MEDIAN AND ULNAR PERIPHERAL NERVES

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AIM: The understanding of the morphological, intrinsic mechanical behavior and electrical characteristics of the large human sized peripheral nerve plays an important role in development of new neural interfaces for selective stimulation or recording. Here we aim to gain insight of the morphological structure of the peripheral forelimb nerves in a large nerve animal model.

METHODS: Pig nerves are geometrically and functionally similar with human nerves. A total of 12 specimens from the Median and Ulnar nerve were harvested from both upper limbs of 6 female Landrace-Yorkshire pigs (<50 kg). Nerve samples were taken from 5 different levels of the nerve, i.e. 3 levels just above the elbow joint and 2 levels below it. Approximate nerve circumference at each level was measured by tying a suture around it and then measuring the suture length. A standard Hematoxylin and Eosin stain (H&E) was used for staining to study the morphological structure. Digital pictures were first taken through a microscope of all histological slides. The free software Axio Vision (Axio Vs40 v. 4.6.30, Carl Zeiss Imaging solutions GmbH, Germany) was then used for image analysis. Each picture was loaded into the software. The fascicles were visually identified and counted. Then the fascicle diameters and surface area were measured (Table 1).

RESULTS: The Median nerve contains a higher number of fascicles than the Ulnar nerve at all levels. For both type of nerves the highest number of fascicles was observed at the level just above the elbow joint. As expected the nerve diameter decreases from the most proximal to most distal level.

Table 1: Mean and standard deviation of different parameters measured in pig nerve specimen.

Nerve	Parameter	Level 1	Level 2	Level 3	Level 4	Level 5
Median (M)	Fascicle diameter	0.28±0.09 mm	0.27±0.08 mm	0.23±0.09 mm	0.24±0.09 mm	0.27±0.09 mm
Ulnar (U)	Fascicle diameter	0.26±0.06 mm	0.24±0.06 mm	0.23±0.08 mm	0.25±0.09 mm	0.24±0.09 mm
Median (M)	Cross-sectional area	0.067±0.04 mm ²	0.061±0.036 mm ²	0.048±0.033 mm ²	0.050±0.03 mm ²	0.061±0.04 mm ²
Ulnar (U)	Cross-sectional area	0.054±0.03 mm ²	0.048±0.024 mm ²	0.042±0.025 mm ²	0.035±0.03 mm ²	0.05±0.03 mm ²
Whole Nerve	Diameter	M,U 3.6±0.4mm	No measurements	M: 2.9±0.04mm U: 2.0±0.5mm	M: 2.2±0.6mm U: 1.8±0.5mm	No measurements

CONCLUSION: This study provided information on the number and size of fascicles in selected forelimb nerves at selected levels. New generation of neural interfaces, like the intrafascicular electrodes, will be used to selectively stimulate specific areas in nerve to activate specific muscles. This experiment may provide input to optimize electrode design.