COMPARATIVE ANATOMICAL STUDY OF RADIAL, MEDIAN AND ULNAR NERVE (SUB-CARPAL REGION) IN INDIAN COW (*BOS INDICUS*) AND INDIAN WATER BUFFALO (*BUBALUS BUBALIS*)

A Thesis

Submitted to the

West Bengal University of Animal and Fishery Sciences

in partial fulfilment of the requirements for the degree of

Master of Veterinary Science

in

ANATOMY, HOSTOLOGY AND EMBRYOLOGY

By

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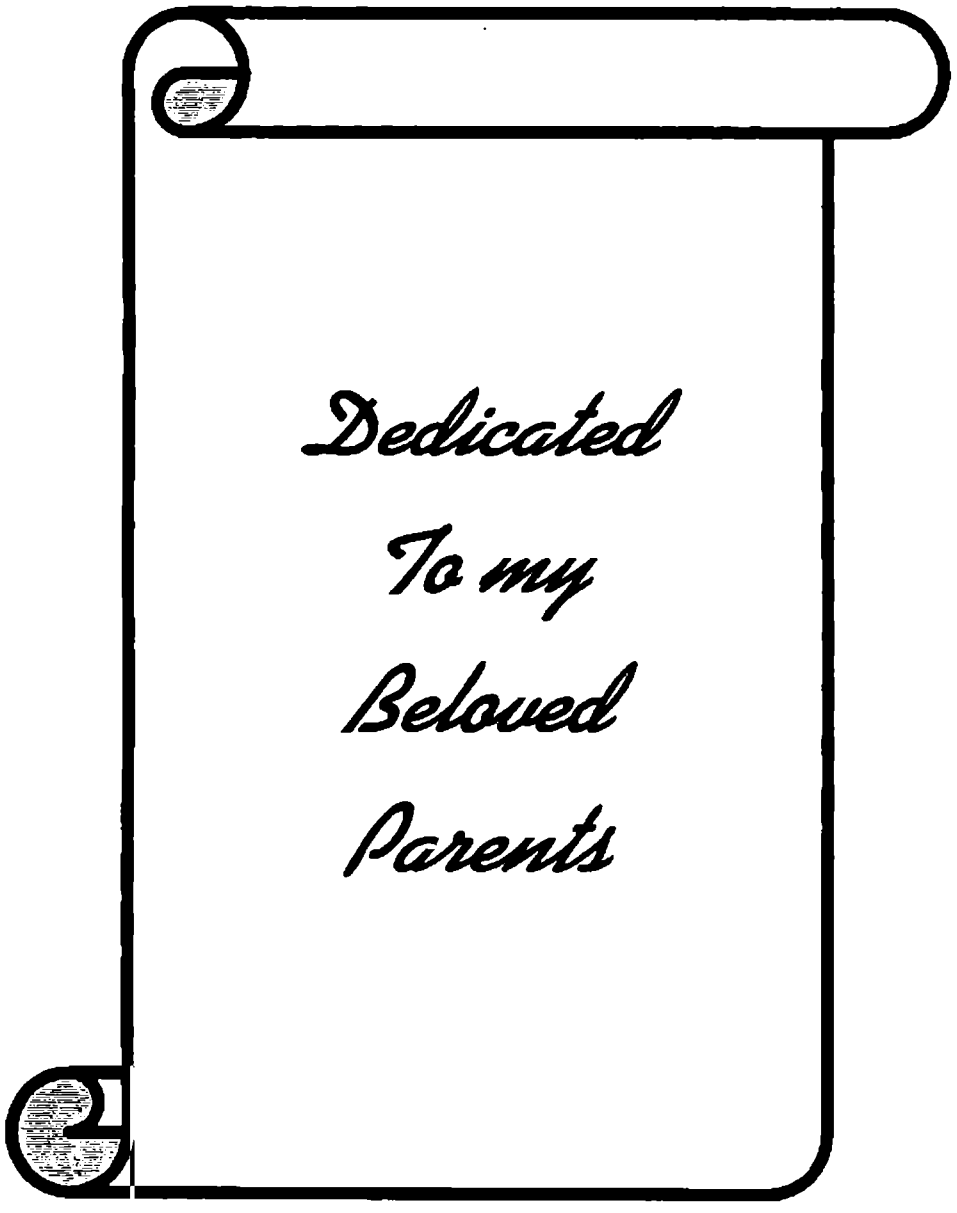
Dedicated
To my
Beloved
Parents

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Certificate

*This is to certify that the work recorded in the thesis entitled "**Comparative Anatomical Study of Radial, Median and Ulnar Nerve (Sub-Carpal Region) in Indian Cow (Bos Indicus) and Indian Water Buffalo (Bubalis bubalis)**" submitted by **Shri Arindam Chatterjee**, in partial fulfilment of the requirements for the Degree of Master of Veterinary Science in Veterinary Anatomy, Histology and Embryology of the West Bengal University of Animal and Fishery Sciences, is a faithful and bona fide research work carried out under my personal supervision and guidance. The results of the investigation reported in the thesis have not so far been submitted for any other Degree or Diploma. The assistance and help received during the course of investigation have been duly acknowledged.*

Dated, Mohanpur
The 11/11/99

(Dr. M. M. Roy)
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APPROVAL OF EXAMINERS FOR THE AWARD OF THE DEGREE OF MASTER OF VETERINARY SCIENCE

We, the undersigned, having been satisfied with the performance of Shri Arindam Chatterjee, in the viva-voce examination, conducted today, the 23rd December 1999, recommended that the thesis be accepted for the award of the degree.

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Arindam Chatterjee

Dated, Mohanpur, Nadia,
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CHAPTER - 1

The economy of our motherland India is agriculture dependent. The contribution of the cattle and buffalo to our agriculture based economy is many fold. The farmers utilize cattle and buffalo as a helping tool for their farming operation as well as an alternative source of income. Whenever cattle and buffalo are utilized for farming operation as drought purpose, they are having every chance to injure their forelimb which can't be treated by ordinary medicinal treatment like reduction of fracture, dislocation below the carpal joint, amputation of foot-pad, median neurectomy or correction of lameness of the fore limb. Surgical operation becomes obligatory in the aforesaid cases.

Here to perform digital surgery, local anaesthesia is performed as general anaesthesia is contraindicated in large animals, because of the fact that general anaesthesia brings about many physiological hazards *i.e.* ruminal tympany, respiratory problem etc.

The disposition of radial, ulnar and median nerve which ultimately form the digital nerves in the fore limb of cattle has been reported in some text books earlier. Habel (1970), Sission and Grossman (1967) have mentioned the distribution pattern of the above mentioned nerves in large and small ruminants as well as in horses and pigs. All of these have been worked out presumedly in exotic breed of animals. Regarding the surface anatomy of the nerves, Taylor (1960), Getty and Ghoshal (1967), Elmore (1981) reported about different surface anatomical position for blocking the digital nerves.

No much information on the distribution pattern of the said nerves below the knee in buffalo could be detected in existing literature and the fibre diameter spectra has been ignored.

However, Raghavan (1964) in his textbook stated the distribution of the digital nerves in Indian ox.

Due to inappropriate knowledge about the anatomical position of the digital nerves in Indian cow and buffalo, surgery is performed without looking into the proper anaesthesia of the nerves, which in turn leads to cruelty to animals.

Therefore, an attempt has been made to study the surface anatomical positions of radial nerve, ulnar nerve and median nerve with their subsequent branches (digital nerves) in cow and buffalo on comparative basis along with their fibre diameter spectra which may be helpful to the veterinary surgeons to perform local anaesthesia successfully in specific surgical sites.

CHAPTER - 2

The main nerve trunks which are distributed to the areas of the forelimb with their ultimate main branches are radial nerve, median nerve and ulnar nerve. The major contribution to the dorsal aspect of the digital area of the forelimb is provided by the radial nerve and to the volar side by the median nerve. However, the ulnar nerve is contributing to both dorsal and volar surfaces along its lateral aspect.

The literatures available on aforesaid three nerves have been reviewed separately under the following sub headings :

A. Gross distribution of the nerves and their surface anatomical position (Surgical sites).

B. Quantitative studies on the nerve trunks (Number of fasciculi, Total fascicular area, Total fibre count and density of fibre per unit area).

A. Gross distribution of nerves & its surface anatomical positions :

A. 1. Radial nerve :

Taylor (1960) stated that in bovine the dorsal metacarpal nerve was a continuation of the cutaneous branch of the radial nerve. It ran over the dorso-medial aspect of the metacarpal bone in company with the metacarpal vein to gain the medial border of the medial extensor tendon situated half-way down the metacarpus. It then crossed the tendons and divided into the axial dorsal nerves of the third and fourth digits just above the fetlock. At about the middle of the metacarpus, the dorsal metacarpal nerve gave off a medial branch which continued downward as the abaxial dorsal nerve of the third digit.

The analgesia might be produced by the injection, at the site of middle third of the metacarpus and the nerve could be located by palpation at that region.

Getty (1964) reported that in ox, the radial nerve could be located and blocked at the proximal one third of the metacarpus, at its medial aspect.

Raghavan (1964) described in his text book "Anatomy of ox" that the radial nerve descended to the metacarpus and terminated at about the middle of the metacarpus by dividing into anterior common digital nerve and anterio-internal proper digital nerve. Of these, anterio-internal proper digital nerve descended along the internal side of the medial digit, while the anterior common digital nerve arrived at the upper part of the inter digital space and divided into two anterior digital nerves.

Ghoshal and Getty (1967) mentioned that the radial nerve descended along the dorsal surface of the carpus, medial to the tendon of insertion of extensor carpi radialis muscle. It divided into dorsal common digital nerves II & III. The dorsal common digital nerve II, during its distal course gave off few branches to the medial (second) digit and continued on the abaxial side of the third digit as a dorsal proper (abaxial) digital nerve III. Some times, a transverse connection existed between the dorsal proper digital nerve III and the palmar proper digital nerve III at the middle of the proximal phalanx in bovine. The dorsal common digital nerve III, after coursing over the medial tendon of the extensor digitorum communis divided into two dorsal proper digital nerve III and IV which descended along the axial side of the principal digits. A communicating branch connected (variably) the dorsal and palmar digital nerve III and IV through the inter-digital space.

Habel (1970) reported that the superficial branch of the radial nerve could be palpated on the bone medial to the tendon of the medial extensor muscle and was began to diverge from the common extensor, a little below the middle of the dorsal surface of the metacarpus. Injection could be done before the branching of radial nerve to block the axial dorsal nerves of both the digit and the abaxial dorsal nerve of the third digit.

Soma (1971) found out that in bovine, the dorsal metacarpal nerve could be detected at the dorsal surface of the metacarpal bone, medial to the extensor tendon. At the junction of proximal and middle third, it was possible to palpate the nerve well beneath the finger.

Singh *et al.* (1979) detected the radial nerve at elbow joint and operation was done for the neuroanastomosis of the nerve in buffalo.

Elmore (1981) stated that in bovine, the blocking of dorsal metacarpal nerve could be done by giving injection into the soft area proximal to the dorsal surface of pastern joint. The needle was inserted slightly downward direction towards the middle of the inter digital space to a depth of 5 cm.

Denoix (1982) reported that the pattern of the nerves supplying the bovine foot fits the basic mammalian pattern, numerous variations in the nerves were found, but a basic pattern was established. The common digital nerves extended at or near the level of carpus. Common digital nerve III was plexiform and was represented by two parallel nerve trunks. The proper digital nerves had a consistent course.

Dyce *et al.* (1987) reported that in bovine the radial nerve crossed the dorso-medial surface of the carpus. It then inclined laterally, reached the extensor tendons in the mid-metacarpal region and came to lie between them under the skin. The superficial branch accompanying accessory cephalic vein could be palpable where they climbed over the margin of the tendons.

Venugopalan (1994) located the radial nerve of bovine about 7.5 cm (3″) above the fetlock joint on the anterior aspect of the limb, drawing a vertical line with the inter-digital space, he recommended the site for blocking of the nerve *i.e.* the common dorsal digital nerve.

A. 2 Ulnar nerve :

Taylor (1960) stated that in bovine, the dorsal branch of the ulnar nerve descended laterally in the groove between the metacarpal bone and the suspensory ligament and continued into the foot as abaxial dorsal nerve of the fourth digit. The volar branch of ulnar nerve descended downward laterally in the groove between the suspensory ligament and flexor tendon. It joined with the lateral ramus of the median nerve and the abaxial volar nerve of fourth digit was formed.

The dorsal branch of the ulnar nerve was blocked 5 cm above the fetlock joint on the lateral aspect of the limb, in the groove between the suspensory

ligament and the metacarpal bone. At this point, the volar branch of the ulnar nerve might also be blocked. The two nerves being respectively situated in front of and behind the suspensory ligament.

Getty (1964) reported that the superficial branch of the ulnar nerve could be blocked by placing needle between metacarpal bone and the suspensory ligament on the lateral side of the foreleg, 5 cm above the fetlock joint. The deep branch of ulnar nerve could be blocked in between suspensory ligament and deep flexor tendon in bovine.

Raghavan (1964) described that in ox, the superficial branch of ulnar nerve continued superficially downwards and outwards in the metacarpal region, and continued as the antero-external digital nerve on the external aspect of the lateral digit and the deep branch continued in between the suspensory ligament and metacarpal bone and joined with the branch of median nerve and continued as the postero-external digital nerve of the external aspect of the lateral digit.

Ghoshal and Getty (1967) mentioned that the dorsal branch of the ulnar nerve emerged in between the tendons of flexor carpi ulnaris and ulnaris lateralis and descended along the palmaro-lateral aspect of carpus and ultimately reached the dorso-lateral aspect of the metacarpus as the dorsal common digital nerve IV, near the fetlock joint, gave branches to it and the lateral accessory (fifth) digit. It was extended further as the dorsal proper (abaxial) digital nerve IV.

The palmar branch of ulnar nerve descended along the flexor digitorum superficialis and its superficial branch received a communicating branch of the median nerve, thereby continuing the palmar common digital nerve IV in bovine, sheep and goat.

Habel (1970) reported that in ox, the dorsal branch of the ulnar nerve was continued as the abaxial dorsal nerve of the metacarpus. Injection could be made in the groove between the interosseus and the metacarpal bone on the lateral side in the middle of the metacarpus. The abaxial dorsal nerves crossed the fetlock joint in close association with the abaxial palmar nerves.

The palmar branch of the ulnar nerve received the communicating branch from the median nerve and is continued as the palmar common digital nerve of fourth digit.

Soma (1971) reported that the dorsal branch of the ulnar nerve could be blocked with one injection. The site for that injection was 2.5 cm (1 inch) above the fetlock joint on the lateral side between the suspensory ligament and the flexor tendons in ox.

Jalaluddin and Rao (1972) stated that the ulnar nerve of buffalo could be blocked by injecting the needle from palmar surface at the lateral side which was at right angle to long axis of metacarpus, beneath the fascia on the lateral border of the suspensory ligament.

Dyce *et al.* (1987) mentioned that in bovine the palmar branch of the ulnar nerve received communication from the median nerve, descended distally in the groove between the flexor tendons and the interosseus.

The dorsal branch of ulnar nerve also passed over the lateral aspect of the carpus continued in the groove between the interosseous and metacarpal bone.

The palmar branch of ulnar nerve could be blocked in between the lateral border of deep flexor tendon and interosseus and at the same level, the dorsal branch of ulnar nerve where it was subcutaneous and palpable in the groove between the interosseous and the metacarpus.

Purohit *et al.* (1987) that in Camel, the palmar branch of ulnar nerve which was joined with the branch of median nerve could be blocked 1 – 1.5 cm deep in the channel formed by the lateral border of metacarpus and the lateral edge of deep flexor tendon.

Keg *et al.* (1992) noted that in horse, the tendinitis of superficial digital flexor tendon, deep digital flexor tendon and suspensory ligament could be treated by high palmar nerve block and ulnar nerve block.

Venugopalan (1994) stated that the lateral volar digital nerve of outer digit could be detected on the outer aspect of the bovine forelimb at distance of

5 cm (2 inch) above the fetlock joint and the nerve was formed by the branches of the median nerve and ulnar nerve. The nerve could be blocked in the above mentioned space.

A. 3 Median nerve :

Taylor (1960) reported that in bovine all the volar part of third digit, the axial part of the fourth digit and abaxial part of the lateral side was supplied by the median nerve. It descended down the metacarpus and deeply embedded in the local fascia along with the medial border of the flexor tendon related to the superficial volar metacarpal artery. In the first part of its course it might be deep into the tendon. On reaching, the distal third of the metacarpus, the nerve divided in variable manner, typically into medial and lateral branches. These eventually form three volar digital nerves and a part of fourth. The medial branch continued in the groove between suspensory ligament and flexor tendon. It crossed over the sesamoid behind the medial vein to became the abaxial volar nerve of the third digit. Just above the fetlock, the lateral branch was joined by the volar branch of ulnar nerve.

The axial volar aspect of the digits might be rendered analgestic by a single injection in the midline just above the fetlock joint. The injection would reach the medial and lateral branches of the median nerve, before it was divided or if it had already divided, its two branches would still be close to each other. The two branches might also be simultaneously blocked on the midline just below the level of the dewclaw. The medial branch of the median nerve was blocked on the inside of the limb in the groove between the suspensory ligaments and the flexor tendon about 5 cm above the fetlock.

As practically, the whole of volar aspect and the large part of lateral aspect were supplied by the median nerve, the obvious point of injection was high up the limb before the nerve divided. Unfortunately at this point, the nerve was lied beneath the artery and vein and was not conveniently situated for injection.

Getty (1964) reported that in bovine the median nerve could be blocked just beneath skin in proximal third of metacarpus before bifurcation of nerve.

Raghavan (1964) mentioned that in ox, the terminal branches of the median nerve were internal and external type. The internal and external branch divided into external and internal division. The internal division supplied branches to the medial accessory digit and was continued down on the inner aspect of the medial digit as the posterio-internal digital nerve. The external division joined with one of the division of internal branch and formed posterior common digital nerve. The rest one united with the deep division of ulnar nerve to form the posterior external digital nerve.

Ghoshal and Getty (1967) described that the median nerve descended along the palmar surface of the metacarpus and divided in the in the distal half into medial and lateral branches. The medial branch of median nerve again divided into the palmar common digital nerve II and the palmar (axial) digital nerve III in bovine and sheep. In bovine, the palmar (axial) digital nerve III and IV often reunited after a short distance, forming the palmar common digital nerve III. They passed along the inter-digital space, but they separated again immediately. The palmar common digital nerve III, near the fetlock joint, divided into the palmar proper digital nerve II and palmar (abaxial) proper digital nerve III. In bovine and sheep the lateral branch of median nerve divided into palmar (axial) digital nerve IV and a communicating branch. The former, after giving branches to the lateral accessory digit on the palmar aspect of the fetlock joint, descended along the axial surface of the fourth digit. The communicating branch joined with the palmar branch of ulnar and continued as per palmar common digital nerve IV.

Habel (1970) mentioned that the median nerve in the mid-metacarpal region divided in a variable manner into three volar (palmar) digital nerves and part of the fourth digit in case of bovine species.

Soma (1971) described that in the bovine the axial volar digital nerve was the branch of the median nerve and lied in the groove at the bifurcation of the flexor tendon. To block those nerves, injection should be given at (½ to milch) 2.5 cm proximal to the dewclaw on the volar midline. The medial branch of the median nerve could be blocked at 2.5 cm (1 inch) proximal to the fetlock joint in the groove formed by the suspensory ligament and flexor tendons.

The best site for blocking would be before the median nerve divided. Unfortunately, at the point, the nerve was situated deeply to the artery and vein and was not accessible to injection.

Elmore (1981) reported that in bovine for inter-digital surgery, the planter or palmar nerve could be blocked by injecting into the soft area proximal to the junction of the claw. The needle should be introduced in a slightly down word direction to words the middle of the inter-digital space to a depth of 5 cm.

Dyce *et al.* (1987) remarked that in bovine, the median nerve was accompanied by large satellite vessels descended medial to flexor tendons. It was divided into four branches above the fetlock. The first descended distally in the groove between the flexor tendons and interosseaus and supplied the abaxial surface of the medial digit. The two abaxial nerves passed over the flexor tendon going to the medial digit and entered into the inter-digital space to supply the axial surface of the digits. The fourth, a communicating branch crossed the superficial flexor tendon to join with the palmar branch of ulnar nerve.

The nerve could be blocked between the medial border of the deep digital flexor tendon and interosseous, just above the mid metacarpal bone.

Purohit *et al.* (1987) stated that in camel, the median nerve could be blocked on the medial side of the forelimb after 12 cm be low the elbow joint and 1-2 cm deep in the groove formed between the posterior border of the radius and anterior border of the extensor carpi radialis muscle.

The volar nerve which was the continuation of the median nerve could be blocked in the upper half of the metacarpal region at the posterior-medial aspect.

Venugopalan (1994) described that on the posterior aspect of the limb. On a line with the inter-digital space, only 1.2 cm (½ inch) above the fetlock, the common medial volar digital nerve of both digit could be blocked in case of bovine.

Ommer and Harshan (1995) reported that the median nerve could be blocked, most superficial point, immediately below the medial radial tuberocity at

the groove between the caudal border of radius and flexor carpi radialis muscle in cattle.

Ghosh (1998) reported that the median nerve formed a loop with the musculocutaneous nerve at the origin through which axillary artery passed. It descended downward along the medial aspect of the arm, crossed the elbow and reached beneath the pronator teres muscle. It passed between the radius and flexor carpi radialis, descended further down through carpal sheath, reached the lower third of metacarpus and divided into lateral and medial branches. Each of these branches were sub-divided into axial and abaxial divisions. The abaxial division of the lateral branch joined with a branch of ulnar nerve and continued downward as posterior lateral abaxial digital nerve. The abaxial division of medial branch continued downward as posterior medial abaxial digital nerve. The axial division of both the lateral and medial branches of median nerve united again to form a single trunk. It continued down in between of the digits as posterior common axial digital nerve.

B. Quantitative studies on the nerve trunks :

Rao *et al.* (1972) reported about the average number of fascicles, area of fascicles and total number of fibre of the phrenic nerve of buffalo. There was as many as 14 fascicles in phrenic nerve (at the post cardiac level) with the height count 4, 214 nyelinated fibres. The mean value of the area of fascicles was 0.721 sq. mm.

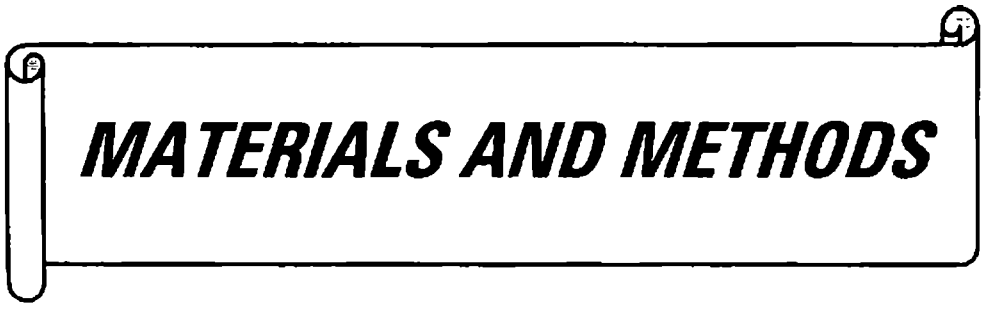
Biedenbach *et al.* (1975) analysed that axon spectra in ethmoidal nerve and lingual branches of trigeminal nerve in cat. The number of myelinated axous was composed of small myelined axous. It was composed of 1,400 fibres.

Rao and Prakash (1976) observed that the lingual rams of trigeminal nerve at its three different levels. A) before it had been joined by the chorda tympani b) after it had been joined by the chorda tympani c) at the level of the upper third cheek tooth. They found that the lingual nerve (before joined by chorda tympani) contained total of 12, 919 ± 907.40 myelinated fibre and 10.40 ± 1.74 fascicles with total fascicular area of 0.354 ± 0.09 sq. mm.

The lingual nerve (after being joined by the chorda tympani) contained total of 14,987 ± 966.30 myelinated fibres, 14.20 ± 1.94 fascicles whose total fascicular area was 0.570 ± 0.07 sq. mm. The nerve, at the level of upper 3rd cheek tooth, contained 9828 ± 566.20 myelinated fibre 14.40 ± 2.50 fascicles whose total fascicular area was 0.40 ± 0.13 sq. mm.

Prakash *et al.* (1980) observed in the buffalo that the pudendal nerve was originated by the union of ventral branch of 2nd, 3rd and 4th sacral spinal nerves. The number of fasciculi, area and arrangement the total number of fibre were studied. There were 32 fasciculi in the pudendal nerve at the level of ischial arch. The total count of the myelinated nerve fibres was 9734, the average area of the fasciculi was 2.46 sq. mm.

CHAPTER - 3



In this investigation six fore limbs of adult cows and six fore limbs of buffalo calves were utilized. Breed, age, sex and weight of the animals were not considered. Out of the six limbs of each species three were from left side and three were from right side. The specimens were collected from healthy cows from the local slaughter house. The specimens of apparently healthy buffalo calves were collected from the embalmed animals in the Department of Anatomy, Histology & Embryology, W. B. U. A. F. Sc.

Collection of fore limbs :

A. The fore limbs of cows were collected from the local slaughter house and were preserved in 10% formalin solution.

B. In case of buffalo calves, the animals were put to deep sedation with 6% chloral hydrate solution. The carotid artery was exposed (under surgical asepsis) at the jugular furrow to complete the bleeding.

In each of the animals the concerned fore limbs were separated from the body by making an incision at the cranio-lateral aspect of thorax behind the proximal end of scapula, posterior to the long head of triceps and tensor fascia anti brachii and olecranon process of ulna. The incision was extended dorsally upto the spine and ventrally to pectoral region. The incision was continued through the latissimus dorsi, trapezius, rhomboideus and superficial pectoral muscle. The elbow was pulled forward and serratus muscles were incised to revert the whole limb upside down exposing the medial aspect of shoulder region as well as the brachial plexus.

Most of the branches coming out of the brachial plexus were carefully exposed. All the three nerves (radial nerve, ulnar nerve and median nerve) were separated carefully and thorough dissection was performed along their distribution below the carpus upto the level of digits keeping all the surrounding structure intact as far as possible.

The area of the study was concentrated from the level of carpus to the digits. In some specimens windows were made from the external surface of the

skin on the metacarpus close to the knee joint to expose the radial, ulnar and median nerve respectively for the study of the surface anatomy.

In the dissected specimens branching of all the three nerves were located and recorded by close-up photography. The specific points of branching of the said nerves were marked by measuring the whole length of metacarpus and the point of branching in relation to the longitudinal length of the bone (metacarpus).

Collection of material :

The portions of the nerve trunks were collected from all the nerves under this investigation (radial and median) before their subdivisions below the carpus. The nerve trunk of ulnar nerve was collected above the carpus before it divided into superficial and deep branch of ulnar nerve (Plate-1, 2, 3 and 4).

Histological procedure :

The nerve trunks were preserved in 10% formalin solution. They were cut into pieces 1-2 cm in length and kept over night under running tap water for proper removal of the fixative. Then all the tissues were dehydrated through ascending grade of alcohols and cleared in cedar wood oil. The cleared and transparent nerves were subjected to the routine paraffin embedding technique to obtain 3-5 micron thick sections. Then the slides were prepared from the sections and were stained by following Hematoxylin and Eosin staining procedure (Lilli and Fullmar 1976).

Determination of the size of the nerve fasciculi :

The stained slides were examined under light microscope. The number of fasciculi of each nerve trunk were counted. The average diameter of fasciculi of each nerve trunk was calculated with the help of ocular micrometer and stage micrometer. The nerve fibres in the fasciculi of those nerve trunks were counted from randomly selected fasciculi with the help of close-circuit television attached with a trinocular microscope.

The shrinkage or swelling which might have occurred during the course of processing of the tissue was not considered. Photomicrographs with different magnifications were taken from the stained slides.

Plate 1 : Collection of material of radial nerve from buffalo.

Plate 2 : Collection of material of radial nerve from cow.

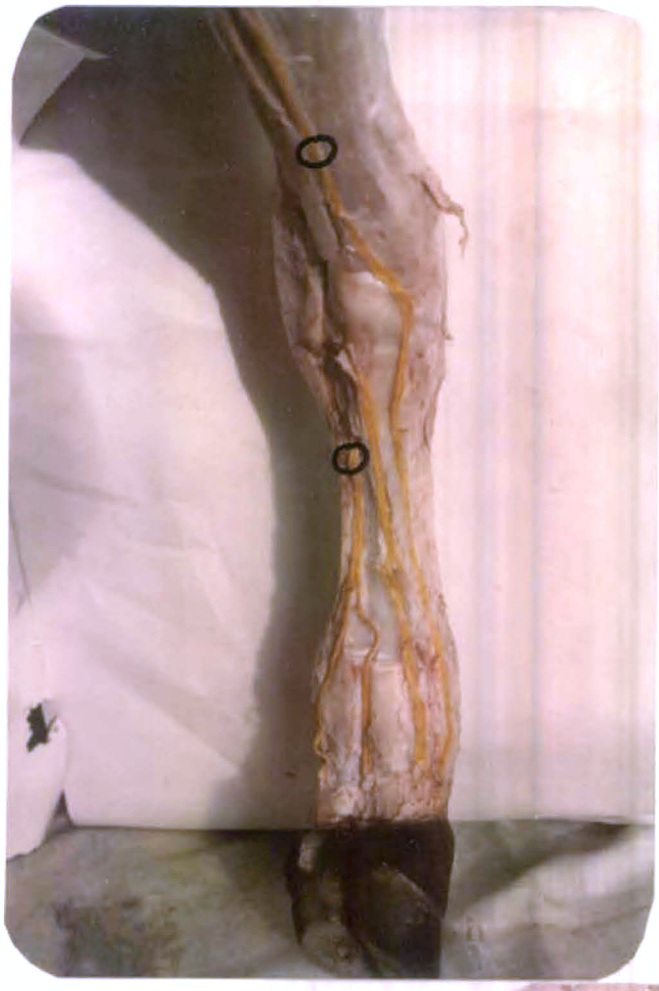
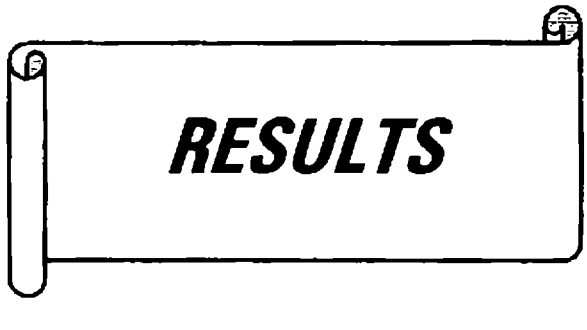


Plate 3 : Collection of material of median and ulnar nerve from buffalo.

Plate 4 : Collection of material of median and ulnar nerve from cow (ulnar nerve not seen).

CHAPTER - 4



After exposing the brachial plexus at the medial aspect of the shoulder joint in the experimental animals (*i.e.* cattle and buffalo), the radial nerve, ulnar nerve and median nerve were identified and dissection was made along the course of the nerve (Plate-5 and 6).

The exact topographic position of all the three nerves along with their branches were studied from the level of knee joint in the animals under this experiment on comparative basis. Histological observation were also made simultaneously to access their fascicular arrangement, thickness and fibre counts.

A. Gross distribution of the nerves and their surface anatomical position :

1. Radial nerve :

It was found to be originated from the brachial plexus as a thick branch in both the animals (cattle and buffalo). It descended caudo-ventrally and reached the musculospiral groove of humerus in company with the radial artery along the anterior border of the lateral head of triceps. On the way it gave branches at various level to innervate triceps, tensor fascia antibrachii, anconeas and subsequently the extensor muscles. Finally it continued as a cutaneous branch along the antero-medial aspect of the forearm. It communicated with the median nerve at this region. The radial nerve was seen to descend downward at the antero-medial aspect of metacarpus with the dorsal common digital vein. The branching followed the general pattern. It turned anteriorly to gain the dorsal aspect of the metacarpus. The nerve reached to the medial extensor tendon and crossed it. At that region, it divided into two terminal branches. In the middle third of metacarpus, it divided finally to form anterior medial abaxial digital nerve to supply the anterior medial abaxial part of the digit and the anterior common axial digital nerve with the branches of the median nerve to supply the corresponding aspect of medial digit (Fig. 2; Plate –8).

In case of buffalo, the distribution and branching pattern of the radial nerve below the carpus followed the same course as seen in case of cattle (Fig. 1; Plate-7).

In the cattle, the average length of metacarpal bone were found to be 16.13 cm and the point of division of radial nerve were found at the middle of metacarpus measuring about 8.46 cm above the fetlock joint. The nerve trunk before its division was found lying a little medial to the dorso-median longitudinal groove of the metacarpal bone. In buffalo, the average length of metacarpal bone was 17.14 cm and division of radial nerve were found to be 8.67 cm above the fetlock joint.

Surface anatomy :

In cattle, radial nerve was palpable from outside by fingertips. It was felt as a flat cord descending downward medial to medial extensor tendon beneath the skin. For determination of the actual position of the nerve, a window was made at the subcarpal region *i.e.* 2.5 cm below the radial carpal bone. The nerve trunk was clearly detected under the skin and subcutaneous tissue through the window (Plate – 13). In buffalo, the nerve was detected at the same position as in the cattle (Plate-11).

2. Ulnar nerve :

In cattle, ulnar nerve and median nerve extended conjointly from the brachial plexus and quickly separated caudally while passing downward along the posterior aspect of axillary artery. In the elbow joint, it was found to be present in between olecranon process and medial condyle of humerus. It passed downward between the two heads of flexor carpi ulnaris and ran under it and superficial digital flexor. It passed down the posterior border of the aforesaid muscles, inclined laterally to reach under the tendon of ulnaris lateralis and divided into superficial and deep branches. On the way, it innervated the elbow joint and flexor group of muscles. The superficial branch descended downwards just lateral to accessory carpal bony prominence and turned slight anteriorily to pass downward through the lateral aspect of the metacarpus. It continued as anterior

lateral abaxial digital nerve to supply the corresponding aspect of the digit. This branch of ulnar nerve was more flat in appearance as compared to the deep branch. The initial course of deep branch of ulnar nerve was placed on the medial side of accessory carpal bony prominence and later on passed downwards on the lateral side of the suspensory ligament. Then it came to the distal third of the metacarpus and joined with a branch of median nerve to continue downward as posterior lateral abaxial digital nerve and innervated the caudal aspect of the lateral digit. In some cases, very thin communication in between the posterior lateral abaxial digital nerve and anterior lateral abaxial digital nerve below the pastern joint were detected (Fig. 4; Plate – 10).

On the other hand, in buffalo the branching pattern and distribution of the ulnar nerve was found to be more or less similar to that of cattle, except some minor differences. In this species, contribution from the median nerve to the deep branch of ulnar nerve for the formation of posterior lateral abaxial digital nerve, could not be detected. The deep branch of the ulnar nerve was found to continue alone (Fig. 3; Plate – 9).

In the experimental animals (cattle), the total length of metacarpal bone was 16.13 cm and the distance of union of the branch of median nerve with the ulnar nerve from the fetlock joint was 13.8 cm.

Surface anatomy :

In cattle, the deep branch of ulnar nerve was found to be placed in between the prominence of the accessory carpal and the suspensory ligament just below the carpal joint. The nerve was seen through the window 2 – 2.5 cm below the knee joint at the postero-lateral aspect under the subcutaneous tissue. The window was made below the groove formed during flexion of this joint (Plate – 15).

At the same level, just 2–3 cm lateral to the deep branch, the superficial branch of the ulnar nerve could be located easily at the lateral aspect of the accessory carpal prominence.

In the buffalo windows were made in the similar positions as they were made in cattle for the location of the superficial and deep branches of ulnar nerve.

The deep branch of ulnar nerve was found through the window (Plate-12) in this species, the nerve trunks were placed in more deeper position due to the thickness of the skin and subcutaneous tissue.

3. Median nerve :

In cattle, this large nerve extended from the brachial plexus along with the ulnar nerve. At the beginning the nerve accompanied the musculocutaneous nerve at its cranial aspect. Then it crossed the axillary artery little above the elbow joint and descended further downward, passed behind and below the pronetor teres. The nerve continued in between the radial bone and flexor carpi radialis muscle and passed downward through the caudal aspect of the carpal sheath and reached the metacarpus. At this level this nerve was found with the median artery as a single stump. In 30% specimens it was found that the nerve divided into four branches at a time. In the rest of the specimens the nerve divided into two branches at the beginning (one lateral and one medial) and each primary division subdivided into an axial and an abaxial nerve. The abaxial branch of medial one continued downward as the posterior medial abaxial digital nerve and the abaxial division of the lateral branch was found to join with a branch of ulnar nerve to continue as the posterior lateral abaxial digital nerve. The axial branches of both the lateral and medial divisions of median nerve reunited to form a single trunk. It continued downward in between the digits as posterior common axial digital nerve to supply the corresponding aspect of the digit (Fig. 4; Plate-10).

In the buffalo, the branching pattern of the median nerve was almost same as found in the cattle with small variation at the distal part. In the experimental animals, under the present study, the abaxial division of the lateral branch of median nerve was found to be absent and therefore did not contributed any fibre to the deep branch of ulnar nerve. Again in some cases, the axial branches ran side by side while passing over the fetlock without making any true union between them. However, both the branches *i.e.* the posterior lateral abaxial digital nerve and posterior common digital nerve innervated the corresponding aspect of the digit (Fig. 3; Plate-9).

In the cattle, the average length of metacarpal bone and the point of branching of the median nerve from the fetlock joint were measured and the results were 16.13 and 9.37 cm respectively.

In buffalo, the average length of metacarpal bone and the point of division of the median nerve from fetlock joint were 17.14 and 9.16 cm respectively.

Surface anatomy :

The position of the windows of both the species could be assessed by palpating the suspensory ligament. The median nerve was felt 2–2.5 cm below the carpal joint on the medial aspect of the suspensory ligament and the deep branch of ulnar nerve was felt lateral to the suspensory ligament, lateral side of median window (Plate-13).

The surface window was made 2 cm below the level of intermediate carpal at the medial aspect of suspensory ligament (*i.e.* at the posterior aspect of the knee joint) The nerve trunk was clearly visible through the window in the form of a thick cord (Plate-15).

In buffalo, the position of the window made for the median nerve was same as done in the cattle and the nerve was detected at a deeper level (Plate-12).

B. Quantitative studies on the nerve trunks :

1. Radial nerve :

This nerve in cattle was the thinnest out of three digital nerves. It contained 29.83 ± 1.424 number of fasciculi within it. The average area of the fasciculi was 0.63 ± 0.078 mm^2, the average total number of fibre was found to be 8,463 ± 431.15 and the density of fibre was 13433/sq. mm (Plate-16).

In the buffalo, this nerve was also found to be thinnest out of three nerves. It contained 33 ± 1.74 number of fasciculi. The average total area of fasciculi on buffalo was 0.65 ± 0.051 sq. mm. The average total fibre count of this nerve was 10,461 ± 732.27. The over all density of this nerve was 16,093/sq. mm (Plate-17 and Table-1).

2. Ulnar nerve :

The ulnar nerve of cattle contained average 34 ± 0.66 number of fasciculi which ranged from 29 – 38. The overall total area of fasciculi was 0.68 ± 0.087 sq. mm. The average total fibre count and density of nerve fibre per sq. mm were 9,896 ± 467.8 and 14,552 respectively (Plate-18).

In buffalo, the nerve contained average 45 ± 2.40 number of fasciculi, which ranged from 37–51. The average total area of fasciculi was 0.95 ± 0.079 and the average total fibre count was 14,735 ± 1028. The density of fibre per sq. mm was 15,510 (Plate-19 and Table-1).

3. Median nerve :

The median nerve of cattle was the thickest out of three nerves. It contained average 54 ± 2.134 fasciculi which ranged from 48 to 63. The average area of fasciculi was 1.209 ± 0.085 sq. mm and the total number of fibre was 19,684 ± 934.2. The density of fibre per sq. mm was 16,281 (Plate-20).

In buffalo, this nerve was also found to be the thickest among the three nerves. The number of fasciculi ranged from 56 to 65 and the average was 59.8 ± 2.44. The average fascicular area was 1.33 ± 0.066 sq. mm. The total average number of fibre was 23305 ± 1136 and the density of the fibre was 17522/sq. mm (Plate-21 and Table-1).

Table-1 :Fibre and fascicular count of the nerve trunks.

	Number of fasciculi	Total area of fasciculi (sq.mm)	Total number of fibre	Density (fibre per sq mm)
Cattle				
1. Radial nerve (28 – 34)	29.83 ± 1.424	0.63 ± 0.078	8463 ± 431.5	13433
2. Ulnar nerve (29 – 38)	34 ± 0.667	0.68 ± 0.087	9896 ± 467.8	14552
3. Median nerve (48 – 63)	54 ± 2.134	1.209 ± 0.085	19648 ± 934.2	16281
Buffalo				
1. Radial nerve (27 – 39)	33 ± 1.74	0.65 ± 0.518	10461 ± 732.27	16093
2. Ulnar nerve (37 – 51)	45 ± 2.40	0.95 ± 0.079	14735 ± 1028	15510
3. Median nerve (56 – 65)	59 ± 2.44	1.33 ± 0.066	23305 ± 1136.26	17522

Plate 5 :The course of radial, median and ulnar nerve from brachial plexus up to digit buffalo.

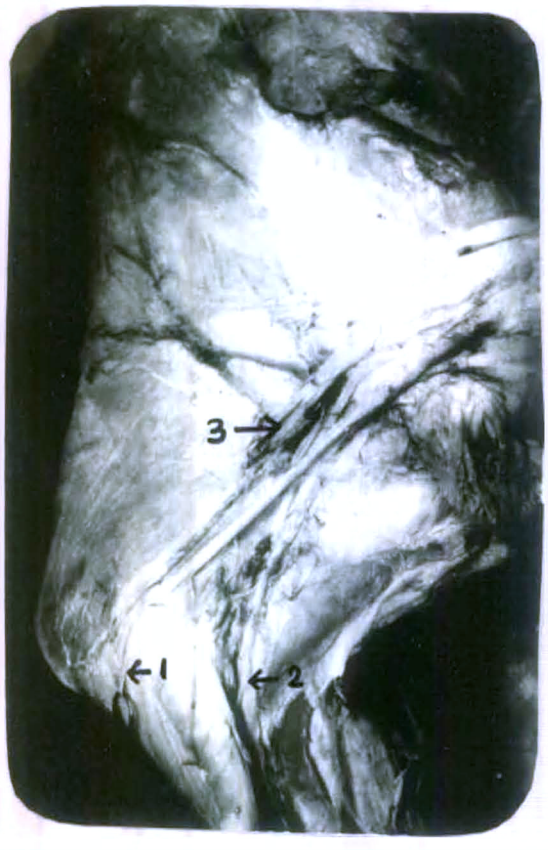


Plate 6 :The radial, median and ulnar nerve in close view.

1. Ulnar nerve
2. Median nerve
3. Radial nerve

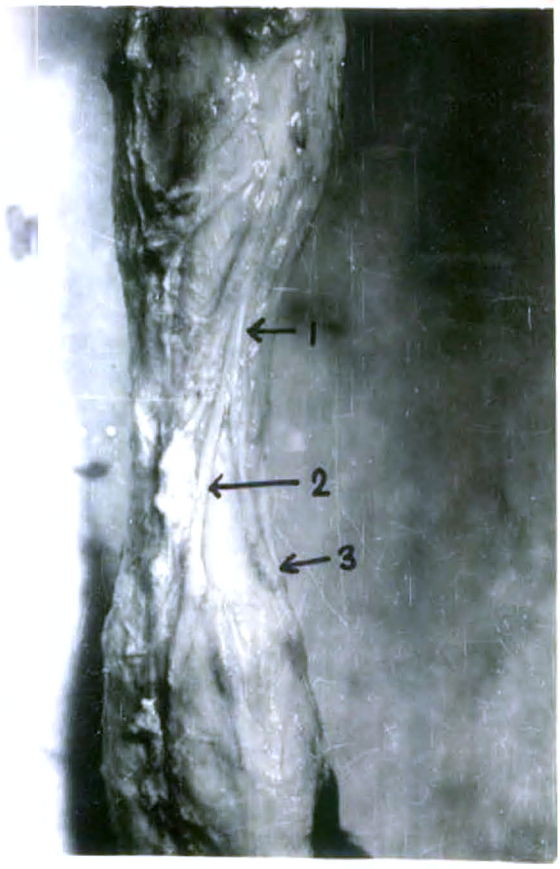


Plate 7 : Dorso-medial view of right limb at sub-carpal region (Buffalo)

1. Radial nerve
2. Anterior common axial digital nerve
3. Anterior medial abaxial digital nerve

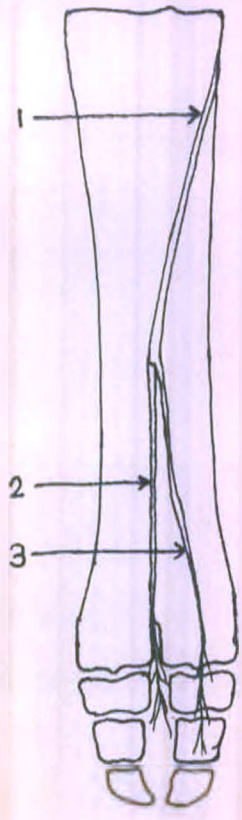


Fig. 1 : Schematic diagram of radial nerve and its branches

1. Radial nerve
2. Anterior common axial digital nerve
3. Anterior medial abaxial digital nerve

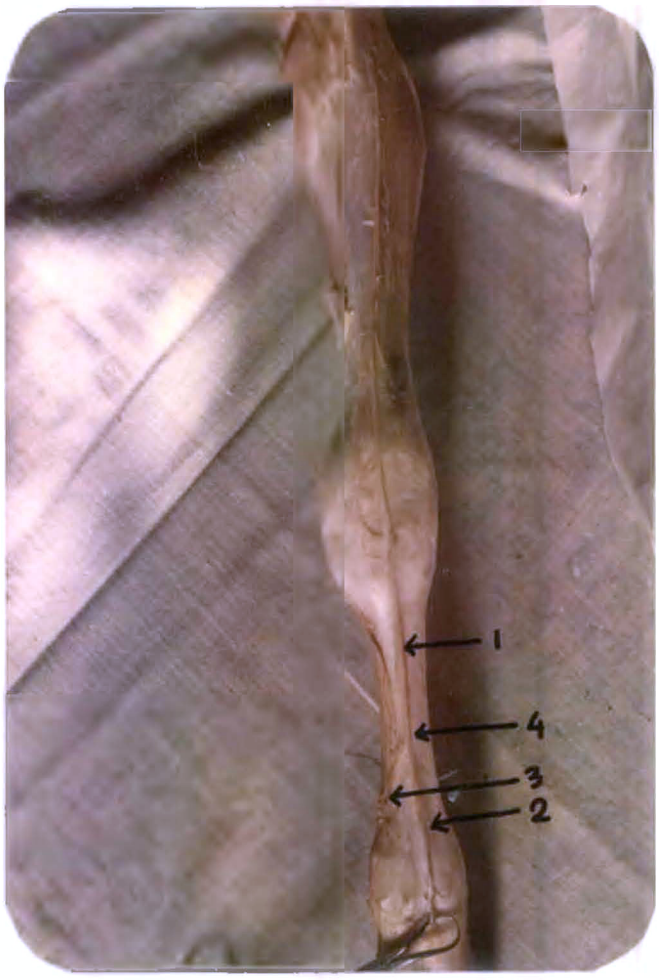


Plate 8 : Dorsal aspect of left forelimb (cattle)

1. Radial nerve
2. Anterior common axial digital nerve
3. Anterior medial abaxial digital nerve
4. Point of branching of radial nerve and its branches.

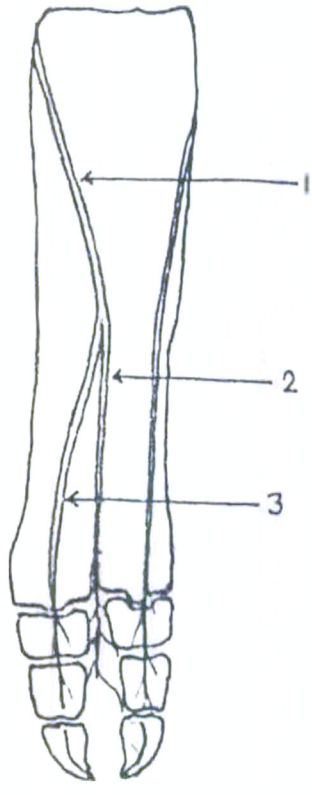


Fig. 2 : Schematic diagram of radial nerve and its branches

1. Radial nerve
2. Anterior common axial digital nerve
3. Anterior medial abaxial digital nerve

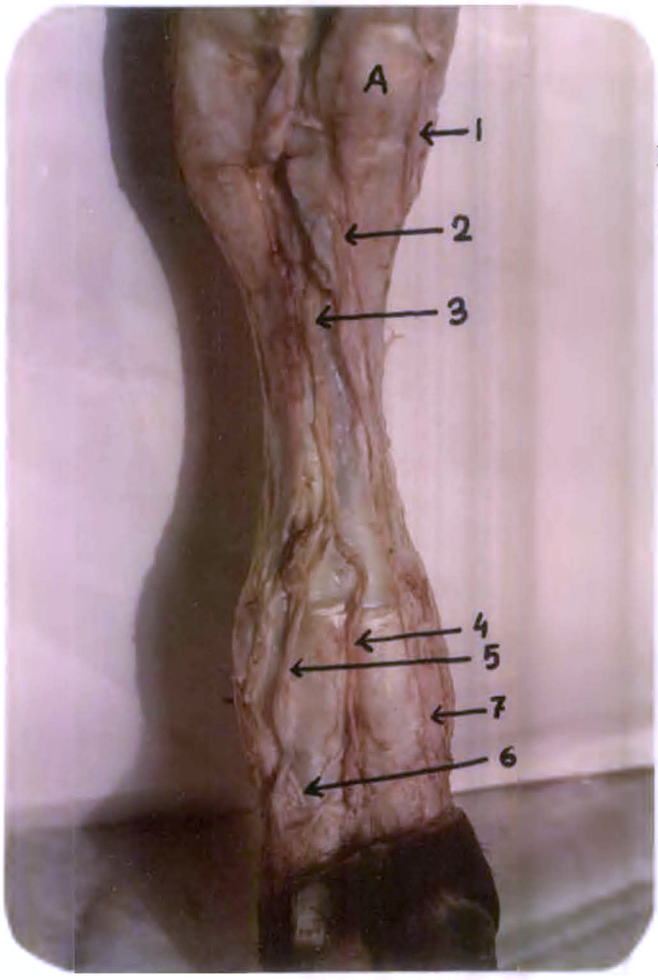


Plate 9 : Palmar aspect of right forelimb at metacarpal region (Buffalo)

A. Accessory carpal bony prominance.
1. Superficial branch of ulnar nerve
2. Deep branch of ulnar nerve
3. Medial nerve and median artery (forming a single stump)
4. Posterior common axial digital nerve
5. Median veins
6. Posterior medial abaxial digital nerve
7. Posterior lateral abaxial digital nerve

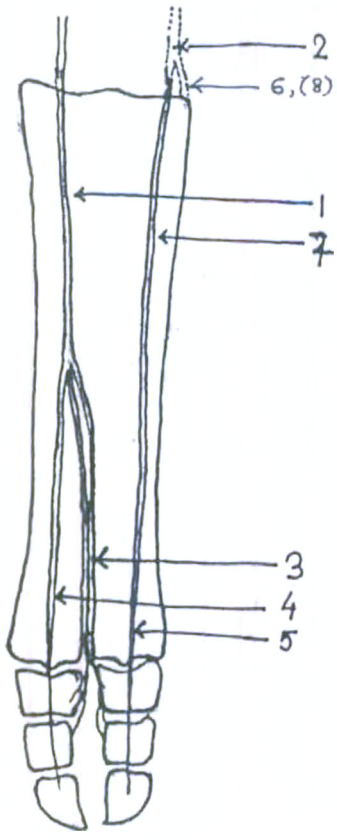


Fig. 3 : Schematic diagram of median nerve and ulnar nerve.

1. Median nerve
2. Ulnar nerve
3. Posterior common axial digital nerve
4. Posterior medial abaxial digital nerve
5. Posterior lateral abaxial digital nerve
6. Superficial branch of ulnar nerve
7. Deep branch of ulnar nerve

(8.) Anterior lateral abaxial digital nerve.

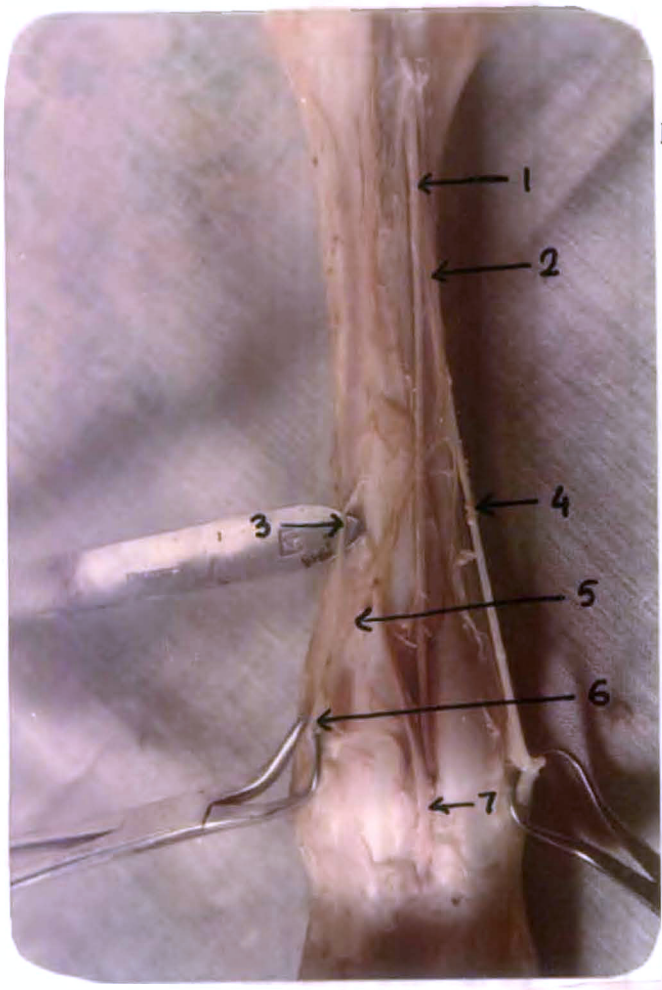


Plate 10 : Palmar aspect of left forelimb at metacarpal region (cattle).

1. Median vein
2. Median nerve
3. Deep branch of ulnar nerve
4. Posterior medial abaxial digital nerve
5. Communicating branch of median nerve with the ulnar nerve
6. Posterior lateral abaxial digital nerve
7. Posterior common axial digital nerve

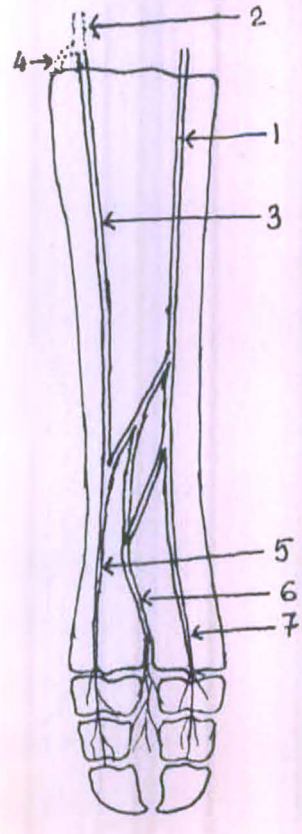


Fig. 4 : Schematic diagram of median and ulnar nerve of cattle.

1. Median nerve
2. Ulner nerve
3. Deep branch of ulnar nerve
4. Superficial branch of ulnar nerve
5. Posterior lateral abaxial digital nerve
6. Posterior common axial digital nerve
7. Posterior medial axial digital nerve.

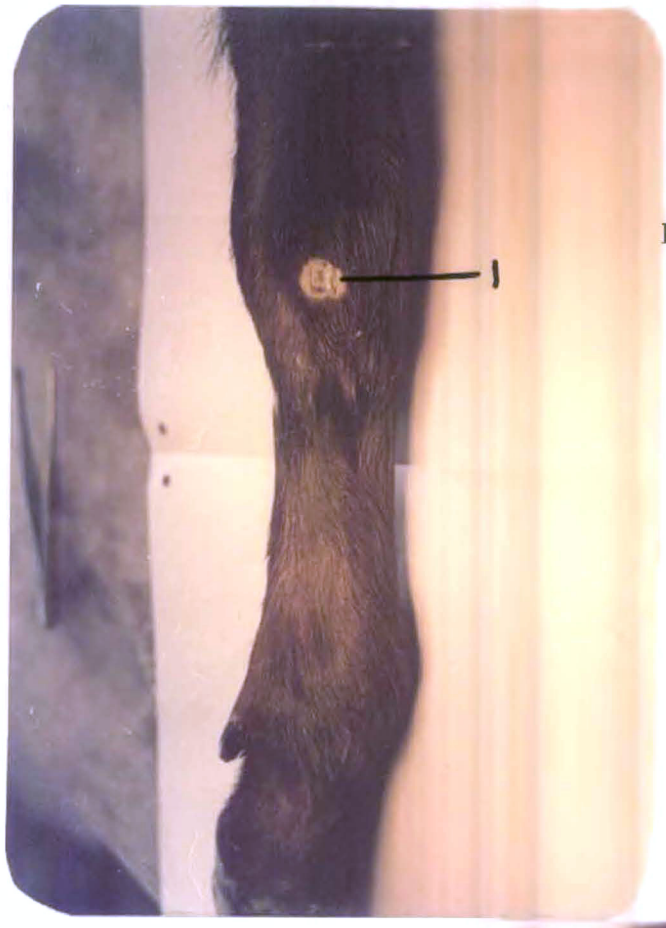


Plate 11 : Medial aspect of forelimb (Buffalo)

1. Showing the radial nerve through the window.

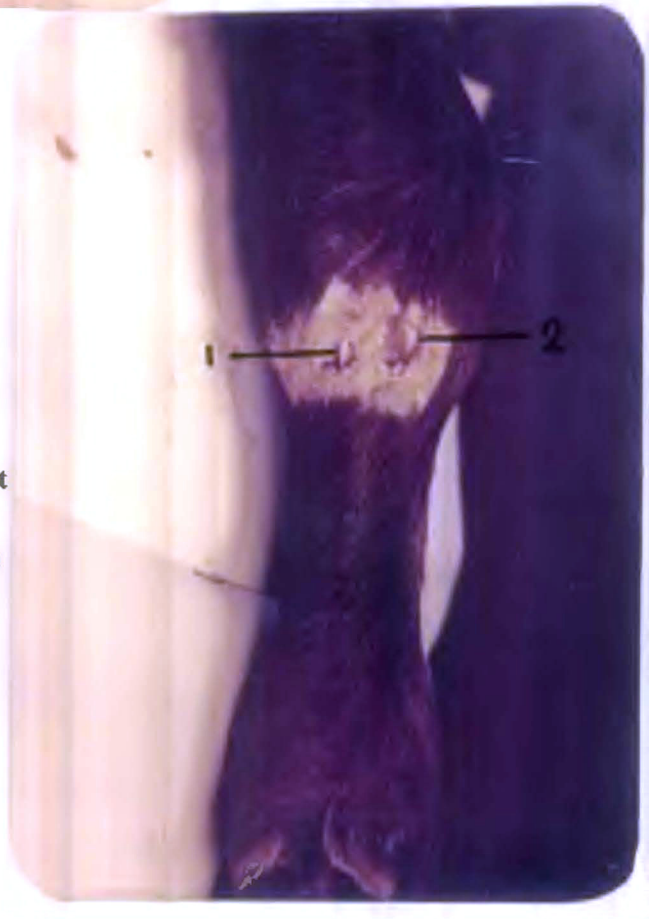


Plate 12 : Palmar aspect of right forelimb (Buffalo)

1. Showing the deep branch of ulnar nerve through the window
2. Showing the median nerve through the window.

Plate 13 : Palmaro-medial aspect of right forelimb (Buffalo)

1. Window for the radial nerve
2. Window for the median nerve
3. Window for the deep branch of ulnar nerve

Plate 14 : Medial aspect of left forelimb (cattle).

1. Window showing the radial nerve.

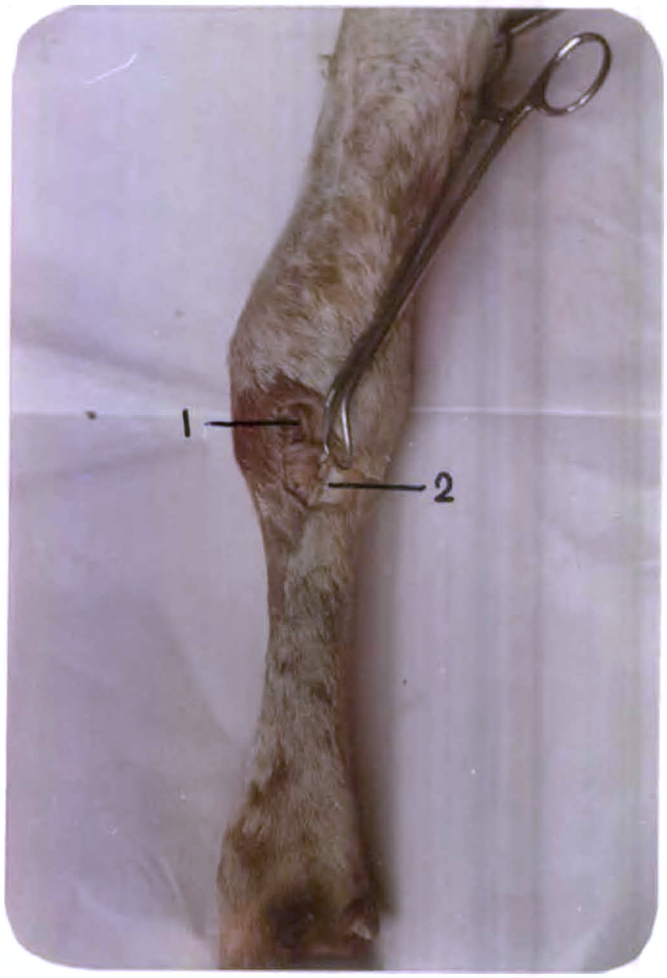


Plate 15 : Palmar aspect of left forelimb (cattle)

1. **Window for the median nerve**
2. **Window for the deep branch of ulnar nerve**

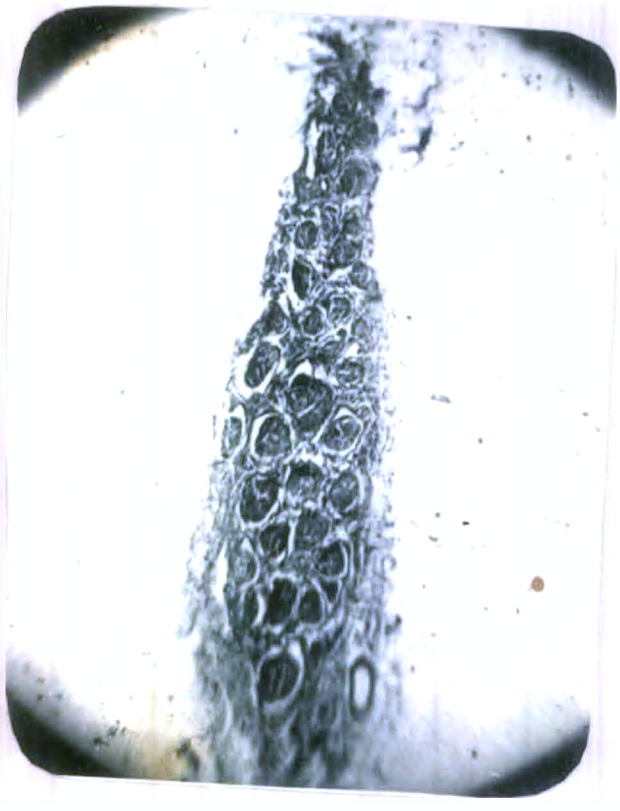


Plate 16 : The cross section of the radial nerve of cattle, H & E Stain, 40X.

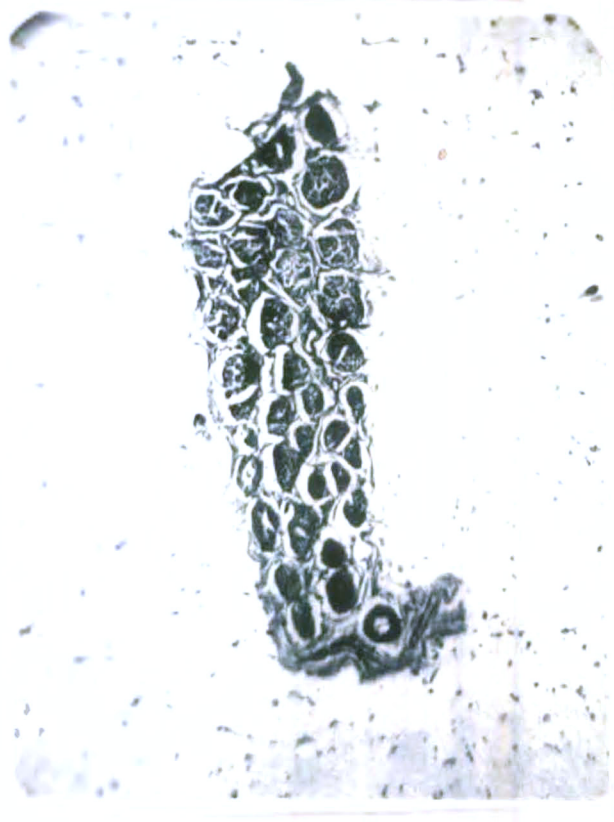


Plate 17 : The cross section of the radial nerve of buffalo, H & E Stain, 40X.

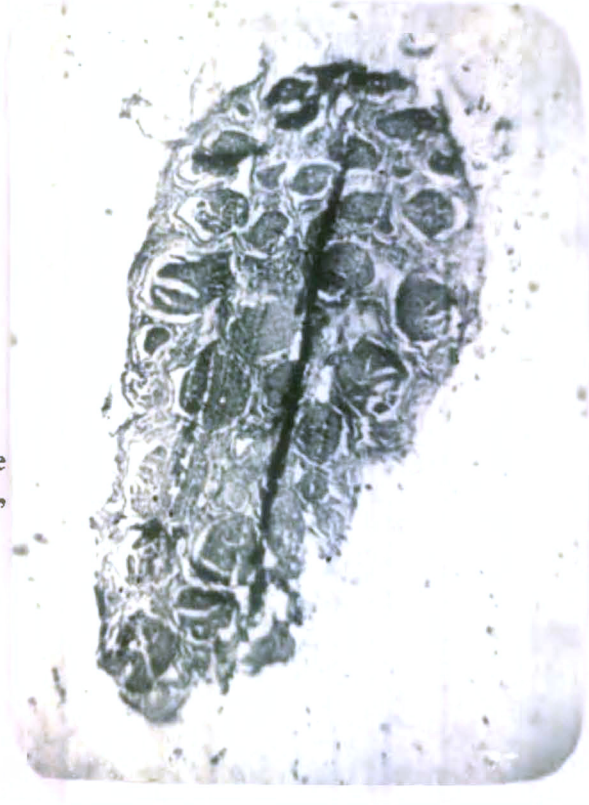


Plate 18 : The cross section of the ulnar nerve of cattle, H & E Stain, 40X.

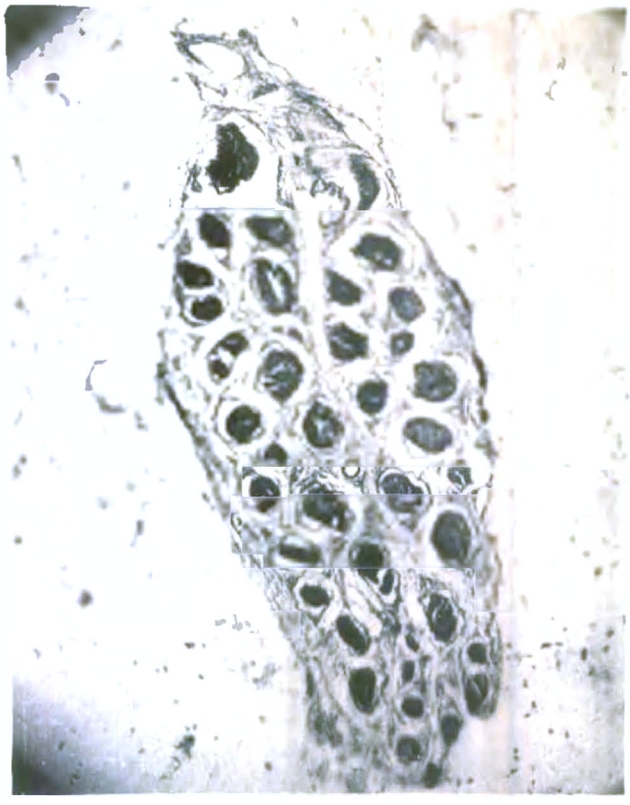


Plate 19 : The cross section of the ulnar nerve of buffalo, H & E Stain, 40X.

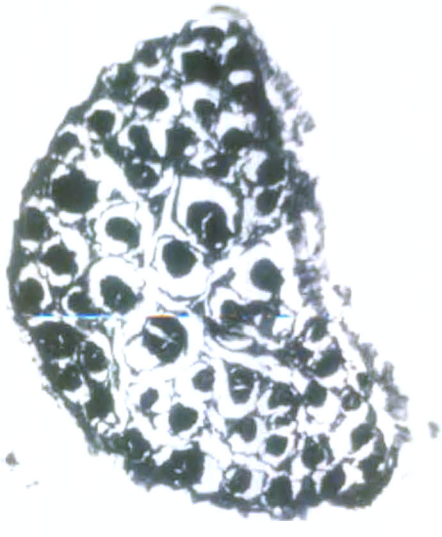


Plate 20 : The cross section of [illegible] H & E Stain, 40X.

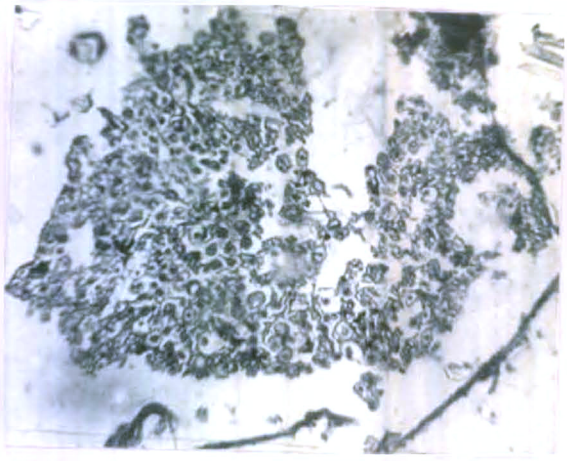


Plate 21 : The cross section of ulnar nerve showing the myelinated nerve fibre within a fasciculi of cattle, H & E Stain, 100X.

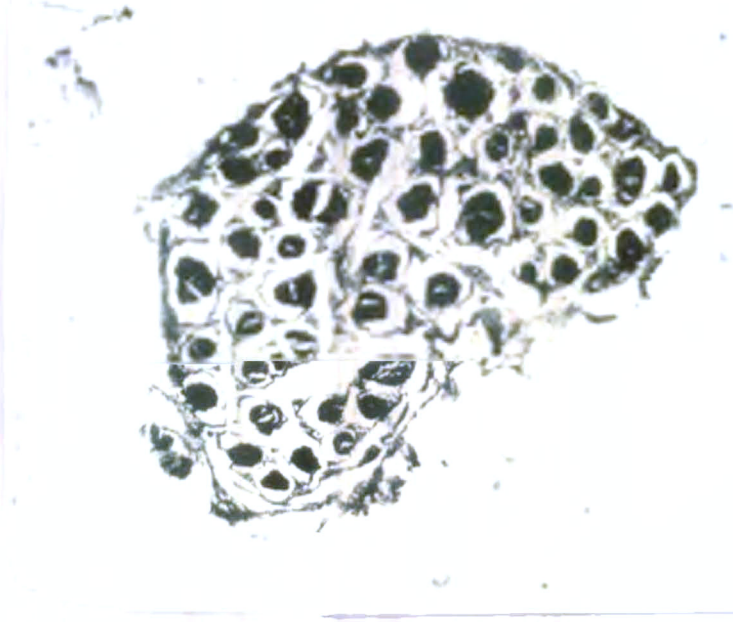


Plate 22 : The cross section of median nerve of buffalo, H & E Stain, 40X.

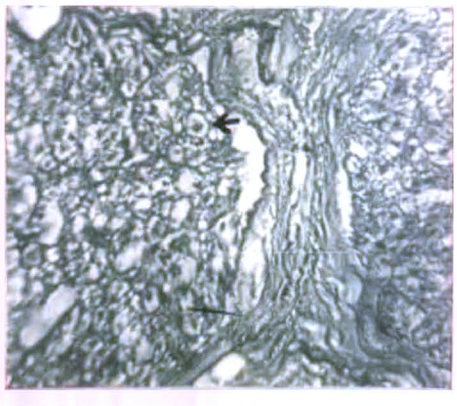


Plate 23 : The cross section showing the Myelinated nerve fibre, H&E Stain, 400X.

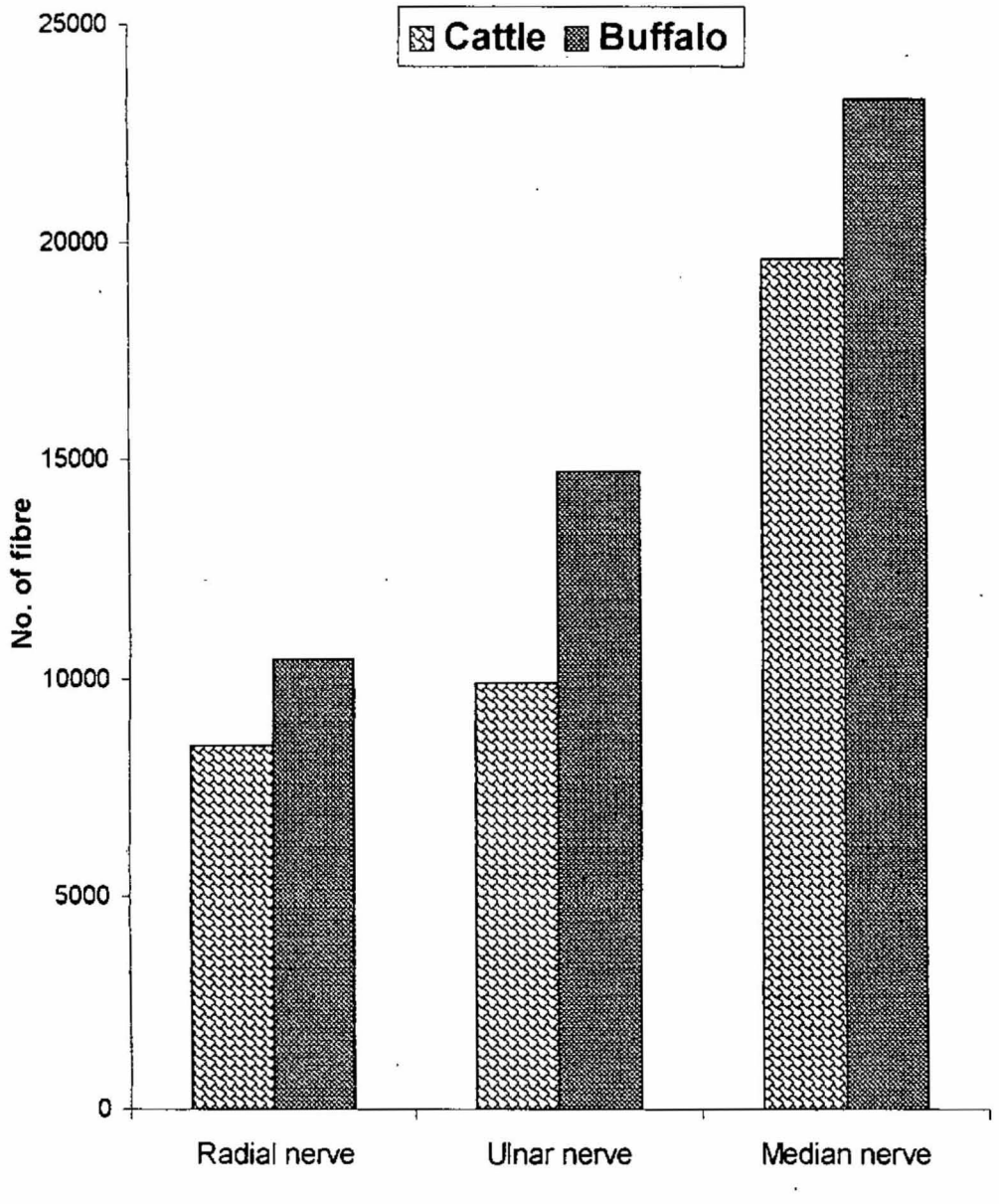


Fig. 5 : Comparative bar diagram, illustrating total number of fibre of radial, ulnar and median nerve in cattle and buffalo.

CHAPTER - 5

The forelimb of cattle and buffalo below knee joint is innervated by various branches of radial, median and ulnar nerves. In this chapter discussion has been made under the sub-heading A. Gross distribution of the nerves and their anatomical positions and B. Quantitative studies on the nerve trunks on the basis of the experimental results and available literatures.

A. Gross distribution of nerve and their anatomical position :

Radial nerve :

In the present study, it was found that the pattern of origin, course and the distribution at the sub-carpal region of radial nerve in buffalo appeared to be in general agreement with that of cow. This is in accordance to the statement of Denoix (1982) who reported that the pattern of the nerves, supplying the bovine foot fits the basic mammalian pattern, numerous variations in the nerves were found, but a basic pattern was established.

The radial nerve of cow and buffalo both were seen to descend downward at the antero-medial aspect of the metacarpal bone with the common digital vain. It divided at the middle third of the metacarpus to form the anterior medial abaxial digital nerve and anterior common axial digital nerve to supply the corresponding digital areas.

Taylor (1960) mentioned that in bovine the radial nerve ran over the dorso-medial aspect of the metacarpal bone in company with the metacarpal vain to gain the medial border of the medial extensor tendon situated half-way down the metacarpus and then crossed the tendon and divided into the axial dorsal nerves of the third and fourth digit. At about the middle of the metacarpus, the dorsal metacarpal nerve supplied a medial branch which continued downward as the abaxial dorsal nerve of the third digit.

Raghavan (1964) stated that the radial nerve descended to the metacarpus and terminated at about the middle of the metacarpus by dividing into anterior

common digital nerve and anterio-medial proper digital nerve. Of these, anterio-internal proper digital nerve descended along the internal side of the medial digit, while the anterior common digital nerve arrived at the upper part of the interdigital space and divided into two anterior digital nerves. Ghoshal and Getty (1967) and Dyce *et al* (1987) also had same type of opinion. The above result was also supported by Ghosh (1998) who stated that the radial nerve passed down to the middle of the metacarpus and finally divided to form anterior common digital and anterior medial abaxial digital nerve to supply the corresponding aspect of the digit.

It was observed that the average length of the metacarpal bone cow and buffalo were 16.13 and 17.14 cm respectively. The division of the radial nerve took place 8.46 cm above the fetlock joint in cow. In the buffalo the point of division was 8.67 cm above the fetlock joint.

From the above observation, it was found that the division of radial nerve occurred at the middle or slightly above the middle of the metacarpal bone. Similar observations were recorded by workers like Taylor (1960), Raghavan (1964), Soma (1971).

However, no data on the point of bifurcation of this nerve in buffalo could be detected.

Surface anatomy :

In both the experimental animals, cow and buffalo, the radial nerve was palpable on the medial aspect of the medial extensor tendon from outside by finger tips, at the sub-carpal region *i.e.* 2 – 2.5 cm below the carpal joint. The medial extensor tendon was also felt by palpation. This findings is in agreement with the findings of Getty (1964) and Soma (1971) in cattle; who have mentioned that the radial nerve could be located and blocked at the proximal one third of the metacarpal region.

Habel (1970) and Dyce *et al.* (1987) reported that the superficial branch of radial nerve accompanying the accessory cephalic vein could be palpable where they climbed over the margin of the extensor tendons which also give the moral support to the present observation.

The anatomical position of the radial nerve in relation to the body surface was confirmed by making windows 2.5 cm below the radial carpal bone in both groups of animal. The nerve was clearly visible (Plates-11, 13) through the openings. This observation was in virtual agreement with the statement of Getty (1964) as has been mentioned earlier.

However, for blocking this nerve various authors suggested different injection site. Taylor (1960) reported that the analgesia might be produced by the injection at the middle third of metacarpus in bovine. Singh *et al.* (1979) detected the nerve at the elbow joint in buffalo. Elmore (1981) mentioned that the site of injection was the proximal area on dorsal surface of pastern joint, at the middle of the inter digital space to a depth of 5 cm, in bovine. Venugopalan (1994) stated that the point of injection was about 7.5 cm above the fetlock joint, drawing a vertical line with the inter digital space.

Ulnar nerve :

At the metacarpal region, the ulnar nerve continued as two separate branches, superficial and deep. The superficial branch of the ulnar nerve descended downwards just lateral to the accessory carpal prominence and continued as anterior lateral abaxial digital nerve in the groove between the interosseus and metacarpal bone to supply the corresponding aspect of the digit. The course of this nerve was found to be almost same. In cattle, the deep branch of ulnar nerve descended at the medial aspect of accessory carpal prominence and passed along the lateral side of the suspensory ligament. After lower third region of the metacarpus it is found that the communicating branch of median nerve joined with this branch to form the posterior lateral abaxial digital nerve. The nerve supplied the posterior lateral abaxial part of digit and dew-claw also. Such was also the findings in bovine (Taylor 1969, Raghavan 1964, Ghoshal & Getty 1967, Habel 1970 and Dyce *et al* 1987).

In case of buffalo, the deep branch of ulnar nerve descended also medial to the accessory carpal prominence and passed downward lateral to the suspensory ligament. In this investigation, the communicating branch of the median nerve

with the ulnar nerve is not detected. Literature on the distribution pattern of the deep branch of the ulnar nerve in buffalo could not be found.

Surface Anatomy :

The deep branch of the ulnar nerve was located under the skin and viewed through the window 2-2.5 cm below the knee joint at the postero-lateral aspect. At the same level, but 2-3 cm lateral to the deep branch the superficial branch of ulnar nerve could be located.

Habel (1970) and Soma (1971) reported that the dorsal branch of ulnar nerve could be blocked between the interosseus and metacarpal bone on the middle of metacarpal bone on its lateral aspect.

Dyce et al (1987) has suggested various sites for blocking the deep branch of ulnar nerve.

Venugopalan (1994) stated that lateral volar digital nerve of the anterior aspect of bovine forelimb. 5 cm above the fetlock joint.

Jalaluddin & Rao (1972) stated that in the buffalo ulnar nerve could be blocked by injecting the needle from the palmer surface at the lateral site at the right angle to the long axis of the metacarpus.

Purohit et al (1987) stated that in camel, the deep branch of ulnar nerve could be blocked 1.5 cm deep in channel formed by the lateral border and the lateral edge of deep flexor tendon.

Median nerve :

This nerve reached the caudal aspect of the metacarpus by passing through the carpal sheath with the median artery and in most of the specimen, it was found that the nerve divided into two divisions (lateral and medial) a little above the middle of metacarpal bone. Each division again subdivided into axial and abaxial branches. However in some specimen it was found that the nerve divided into four branches at a time. This is in accordance with the finding of Taylor (1960) who reported that in bovine all the volar part of third digit, the axial part of the fourth digit and abaxial part of the lateral side was supplied by the median nerve. It

descended down the metacarpus and deeply embedded in the local fascia along with the medial border of the flexor tendon related to the superficial volar metacarpal artery. In the first part of its course it might be deep into the tendon. On reaching the distal third of the metacarpus, the nerve divided in variable manner, typically into medial and lateral branches. These eventually form three volar digital nerves and part of a fourth.

Habel (1970) also mentioned that the median nerve at metacarpal bone divided into variable manner in three volar and a part of the fourth digit incase of bovine species.

Raghavan (1964) and Ghoshal and Getty (1967) described that the nerve descended along the palmer surface of metacarpus and divided in the distal half into medial and lateral branch. Each of the branches again divided into internal and external divisions. In the cow, the abaxial branch of median division continued downward as posterior medial abaxial digital nerve. The abaxial branch of lateral division continued downward as posterior lateral abaxial digital nerve after getting a contribution from the ulnar nerve. The axial branches of both the lateral and medial divisions reunited together to form a single trunk and continued downward as posterior common axial digital nerve. This finding is in virtual agreement with the statement of Taylor (1960), Raghavan (1964) and Ghoshal and Gettly (1967) who have described the distribution of the terminal branches of medial nerve at the volar aspect of the forelimb of cow.

The branching pattern of the buffalo was not identical to that of cow. The abaxial branch of lateral division of the median was found to be absent in this species therefore. Instead of four, the median nerve provided only three terminal branches to innervate the volar aspects of the corresponding digits. Unlike that of cow, the axial branches do not reunite each other, but descend down side by side for the innervation of volar aspect of the inter digital space. Literature regarding the anatomical positions of the nerve in buffalo was not found.

The primary division of median took place 9.3 cm about these fetlock joint and 9.16 cm above the fetlock joint in the buffalo.

Surface Anatomy :

The main nerve trunk was located through a small surgical window made 2cm below the intermediate carpal at the medial aspect of the suspensory ligament in both cow and buffalo. This observation in agreement with the Dyce *et al.* (1987) was stated that the median nerve could be block in between the medial border of deep digital flexor and interosseus just above the mid-metacarpal bone.

Purohit *et al.* (1987) also stated that in camel the volar nerve which was the continuation of median nerve could be blocked in the upper half of metacarpal region at the posterior medial aspect.

According to Ommer & Harshan (1995) also reported that the median nerve could be blocked at the most superficial point immediately below the medial radial tuberocity at the groove between the caudal border of radius and flexor carpi radialis muscle in cattle.

The surface window was made 2 cm below the level of intermediate carpal bone at the medial aspect at the suspensory ligament. That position of the window could be used as the site of anaesthesia for median nerve. Though this was contrary to the findings of Taylor (1960) and Soma (1971) who reported this site of injection for blocking of the median nerve to be inconvenient.

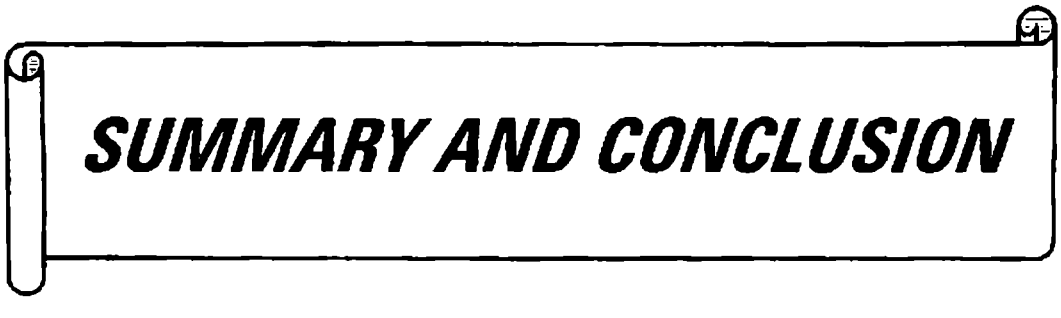
B. Quantitative studies on the nerve trunks :

The average total number of fasciculi were found to be 29.83, 34.0 and 54.0 in radial, ulnar and median nerve respectively in cattle. The average total fascicular area in the said nerves were 0.63, 0.68 and 1.209 sq. mm respectively. The total number of fibres were 8,463 in radial nerve, 9,896 in ulnar nerve and 19,684 in median nerve. The density of fibres in all the three nerves were 13,433/sq. mm, 14552/sq.mm and 16,281/sq.mm respectively. In case of buffalo, the average total number of fasciculi were found to be 33, 45 and 59.8 in radial nerve, ulnar nerve and median nerve respectively. The average total fascicular area in the aforesaid nerves were 0.65, 0.95 and 1.33 sq. mm respectively. The total number of fibres were 10,461 in radial nerve, 14,735 in ulnar nerve and 23,305 in median nerve. The density of all the three nerves were 16,093, 15,510 and 17,522 respectively.

Although no data on the similar parameters of radial, ulnar and median nerves in Indian cattle and buffalo was available, these findings were in virtual agreement with the findings of Rao *et al.* (1972) in phernic nerve of buffalo, Rao and Prakash (1976) in the lingual ramus of tringeminal nerve in buffalo. They had mentioned that phernic nerve of buffalo contained 14 fasciculi at the post cardiac level. The total myelinated fibre in the nerve was 4, 114. The fascicular area was 0.72 sq. mm. The similar values in the lingual ramus of trigeminal nerve were 10.4, 12,919 and 0.35 sq. mm respectively. The similar values were found by Prakash *et al.* (1980) who observed that in pudendal nerve the average number of fasciculi was 32 at the level of ischial arch, the count of myelinated fibre was 9734 and average fascicular area was 2.46 sq. mm.

Biedenbech *et al.* (1975) made similar type of observation in the ethmoidal and lingual branch of tringeminal nerve in cat. They recorded that the number of myelinated axons were 4,000 in lingual nerve and 1,400 in ethmoidal nerve.

CHAPTER - 6



SUMMARY AND CONCLUSION

Knowledge on the distribution pattern of radial, median and ulnar nerve below knee joint is essential for approach of any type of surgical intervention and general treatment.

In the present study, an attempt had been made to study the surface anatomical position of radial, ulnar and median nerve with their subsequent branches (digital nerves) below the knee joint in cow and buffalo on comparative basis along with their quantitative histological studies.

Equal number of animals with their both the forelimbs were utilized for this study. The limbs were dissected and the distribution of the nerves were observed in relation to the surrounding structures. In some specimens windows were made from the external surface of the skin on the sub-carpal region to locate the aforesaid nerves. The nerve trunks were collected for the preparation of histological studies.

At the metacarpal region the radial nerve descended at the antero-medial aspect of metacarpus. In the middle third of the metacarpus about 8.46 cm above the fetlock joint it divided into anterior median abaxial digital nerve and anterior common axial digital nerve. They were distributed in antero-medial and inter digital area respectively. It was observed that the distribution of the radial nerve of buffalo was similar to that of cow.

The ulnar nerve divided into two branches above the carpal joint and descended as the superficial and deep branches. The superficial branch slightly turned anteriorly and passed downwards as the anterior lateral abaxial digital nerve and supplied the corresponding aspect of the digit. The deep branch of ulnar nerve descended on the lateral aspect of the suspensory ligament. In case of cow, at the distal third of the metacarpus, it was communicated with the lateral branch of the medial nerve and continued as the posterior lateral abaxial digital nerve. In case of buffalo, the nerve was found to descend down alone.

The median nerve was the thickest amongst the three nerves. It descended at the medial aspect of the suspensory ligament in the metacarpal region. At about 9.37 cm above the fetlock it either divided into two primary and two secondary branches or divided into four branches at a time. The medial abaxial branch continued as the posterior medial abaxial digital nerve. The lateral abaxial communicated with the deep branch of ulnar nerve and the rest two axial branches joined together and formed the posterior common digital nerve in the cow. In case of buffalo, a small difference was observed. The lateral abaxial branch of the median nerve, which contributed for the formation of posterior lateral abaxial digital nerve in cow, was found to be absent. In this species it was also observed that the axial branches of the median nerve ran parallel towards the inter-digital space without making any true communication between them.

Anatomical positions of the nerves in relation to the body surface were precisely pointed out by making windows at the skin. In case of radial nerve, the window was made 2-2.5 cm below the carpal at the antero-medial aspect of the metacarpus. For the main stump of the median nerve a small aperture was made at the medial border of suspensory ligament, 2 cm below the carpal joint. The deep branch of ulnar nerve was also found by making as window at the lateral aspect of the suspensory ligament 2 cm below the carpal joint in both the groups of animals.

On microscopic study it was observed that in the cow the radial nerve had about 8463 fibers divided into 30 fasciculi on an average. The similar values in ulnar nerve was 9896 and 34 respectively and the median nerve being the thickest contained 19648 fibers in 54 fasciculi on an average.

In the buffalo, the average total nerve fiber count in radial nerve was 10461 and the number of fasciculi was 33. The ulnar nerve had 14735 fibers in 45 fasciculi and median nerve had total 23305 fibers divided in about 60 fasciculi on an average.

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