THE PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE - ITS CLINICAL IMPORTANCE IN CARPAL TUNNEL RELEASE – A CADAVER STUDY

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CERTIFICATE

This is to certify that this dissertation in "**THE PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE - ITS CLINICAL IMPORTANCE IN CARPAL TUNNEL RELEASE – A CADAVER STUDY",** is a genuine work done by **Dr. M.D.Thenmozhi,** during the period of 2007 – 2010. This has been submitted in partial fulfillment of the award of M.Ch Degree in Plastic Surgery (Branch III) by the Tamilnadu Dr.M.G.R. Medical University, Chennai.

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I solemnly declare that the dissertation titled "**THE PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE - ITS CLINICAL IMPORTANCE IN CARPAL TUNNEL RELEASE – A CADAVER STUDY"** has been prepared by me.

This is submitted to the **Tamilnadu Dr.M.G.R.Medical University**, Chennai in partial fulfillment of the requirements for the award of M.Ch Degree in Plastic Surgery to be held in August 2010.

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THE PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE - ITS CLINICAL IMPORTANCE IN CARPAL TUNNEL RELEASE – A CADAVER STUDY

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the median nerve at the wrist. In patients with carpal tunnel syndrome, the median nerve under the flexor retinaculum is tightly packed with the long flexor tendons of the fingers with their surrounding synovial sheaths. The decompression of median nerve by sectioning the transverse carpal ligament (flexor retinaculum) is well accepted as the treatment of choice for patients with carpal tunnel syndrome. .

It is assumed that most of the postoperative complications are due to injuries to the distal branches of the median nerve. The palmar cutaneous branch of the median nerve was one of the main branches of median nerve that can easily get injured during open carpal tunnel release. The precise zone of sensation in the palm is difficult to define, due to the extensive overlap of sensory supply from the main median nerve. The evolution of the technique of carpal tunnel release reflects growing awareness of the cutaneous innervations of the palm and its implication on postoperative scar tenderness.

There are many variations of the distal branches from the median nerve at the wrist. Anatomic studies of this region have fundamental clinical implications to prevent injuries to important wrist structures, especially in newer operative scoping techniques and short incisions for carpal tunnel surgery. Knowledge of the variations of the median nerve at the wrist is significant for the surgical treatment of the carpal tunnel syndrome.

The palmar cutaneous branch of the median nerve (PCBMN) has received the most attention in past reports addressing local complications during carpal tunnel release. Several anatomical dissections have demonstrated the course of this nerve and underscored its vulnerability during surgical approaches to the carpal tunnel near the thenar crease. **The purpose of this study** is to determine the various anomalies of palmar cutaneous branch of median nerve at the wrist and its implications in the management of Open Carpal Tunnel Release.

As surgery is necessary for median nerve decompression, the surgical technique should be less traumatic and minimally invasive for both the median nerve and the palmar skin to prevent the postoperative sequelae and achieve a good postoperative course without persistent symptoms.

AIMS OF THE STUDY

- To study and trace the anatomic course of palmar cutaneous branch of the median nerve.
- To analyze the variations of palmar cutaneous branch of the median nerve.
- To assess the other sensory nerve contributions to the palm.
- To analyze the post operative sequelae following accidental division of palmar cutaneous branch of median nerve in carpal tunnel release.

REVIEW OF THE LITERATURE

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the median nerve at the wrist. First described case of median neuropathy at the wrist is by Sir. JAMES PAGET in 1854. In 1938, the Neurologist Moersch coined the term "carpal tunnel syndrome," but it was not until years later, with George Phalen's monumental work in the 1950s, 1960s, and 1970s, that CTS became a well defined clinical entity.

In George Phalen's review of hundreds of hands afflicted with a similar constellation of symptoms, he concluded that "the median nerve was easily compressed by any condition that increases the volume of the structures within the carpal tunnel."

For the past years, transecting the TCL (transverse carpal ligament) under direct visualization (open carpal tunnel release) has been accepted as a reliable treatment for patients with CTS refractory to nonoperative measures.

The carpal tunnel is a well-defined, inelastic channel located in the volar wrist. It is oval in shape and extends from the distal volar wrist crease to the mid-palm, just proximal to the superficial palmar arch.

The carpal tunnel is bordered ulnarly by the hook of the hamate, triquetrum, and pisiform, radially by the trapezium, scaphoid, and flexor carpi radialis, dorsally by the concave arch of the carpal bones and metacarpal bases of the central rays and anteriorly by the transverse carpal ligament (TCL).

The Transverse Carpal Ligament (TCL) measures 1 to 3 mm in thickness throughout its length and is 3 to 4 cm wide. Nine extrinsic flexor tendons pass through the carpal tunnel (flexor digitorum profundus, flexor digitorum superficialis, and the flexor pollicis longus), along with the median nerve that typically lies volar and radial to the tendons.

The Palmar Cutaneous Branch of the Median Nerve (PCBMN) originates from the volar-radial portion of the median nerve approximately 5 cm proximal to the wrist crease. It travels with its parent nerve for a distance of 2 cm, before branching off in between the flexor carpai radialis and Palmaris longus.

One centimeter proximal to the wrist crease, the PCBMN penetrates the ante brachial fascia into the subcutaneous layer to provide sensation to the proximal radial palmar skin. In the carpal tunnel the median nerve was the most volar lying just below the transverse carpal ligament. The flexor tendons lie dorsal to it.

CARPAL TUNNEL SYNDROME (CTS)

The Carpal tunnel syndrome (CTS) is caused predominantly by a compression of the median nerve at the wrist because of edema or hypertrophy of the flexor synovium. Pain is due to nerve ischemia. Lifetime risk of acquiring CTS is 10%. The annual incidence in adults is 0.1%. The prevalence is 2.7%.

If untreated, the CTS can result in thenar atrophy, chronic hand weakness and numbness in the radial aspect of the hand. The patients complain of intermittent pins and needles and paraesthesia in the median nerve distribution of the hand. The pain is worst at the night. They may awaken with a burning pain and tingling that may be relieved by hanging the hands down. These patients have weakness of thumb abduction against resistance. There is diminished ability to perceive painful stimuli on the palmar aspect of index finger.

Abnormalities in the motor examination are rare and usually occur only after significant sensory loss. Weakness of the abductor pollicis brevis (APB) is the most sensitive motor sign for CTS. Thenar atrophy is a rare finding and may be present in severe, chronic cases of CTS. Electro diagnostic testing is commonly performed.

PHALENS SIGN- Hyper flexion of the wrist for 60 seconds may produce pain and paraesthesia in the nerve distribution. A recent review showed the average sensitivity and specificity of the Phalen sign to be 68% and 73%, respectively.

REVERSE PHALENS SIGN- Opposite maneuver of Phalens.

TINELS SIGN- Tapping the volar wrist over the median nerve may produce paresthesia in the median nerve distribution of the hand. Pooled data show the sensitivity and specificity of the Tinel sign to be 50% and 77%, respectively.

FLICK SIGN- Shaking or flicking one's hands for relief during maximal symptoms has been shown to have a sensitivity of 47% and specificity of 62%.

Causes of carpal tunnel syndrome

1. Repetitive strain injury.
2. Oedema from trauma.
3. Pregnancy, Oral contraceptives intake.
4. Obesity
5. Renal failure patients on dialysis.
6. Hypothyroid, Acromegaly.
7. Gout, Rheumatoid arthritis, Amyloidosis,
8. Tuberculosis.

Differential Diagnosis

1. Cervical spondylosis.
2. Cervical Disc protrusion.
3. Tendonitis.
4. Tenosynovitis.
5. Polyneuropathy.
6. Brachial neuralgia.
7. Proximal median neuropathy.

Work up:

The sensory examination of the involved hand may include both threshold tests (monofilament or vibrometry) and innervations density tests (two-point discrimination**).** Electro diagnostic testing is commonly performed in the evaluation of CTS and includes both nerve conduction velocity (NCV) and electromyography (EMG).

Normal NCV values vary, but are generally thought to be a distal motor latency of less than 4.5 msec and a distal sensory latency of less than 3.5 msec.

An EMG of the thenar intrinsic musculature can be used to evaluate the severity or chronicity of median nerve dysfunction. It is important to note that while electro diagnostic testing represents an

important diagnostic tool, negative results do not absolutely exclude the diagnosis of CTS.

Other investigations:

1. X-rays
2. Ultra sonogram
3. Dynamic MRI

Treatment:

1. Rest, Immobilization and NSAIDS.
2. Local Corticosteroids Injection.
3. Surgery - Open and Endoscopic Surgery.

ANATOMY OF THE MEDIAN NERVE

It is one of the five main nerves originating from the brachial plexus. The median nerve was formed from parts of the medial and lateral cords of the brachial plexus, and continues down the arm to enter the forearm with the brachial artery. It originates from the brachial plexus with roots from C5, C6, C7, C8, & T1. The median nerve was the only nerve that passes through the carpal tunnel, where it may be compressed to cause carpal tunnel syndrome.

Course in the upper arm and cubital fossa:

After receiving inputs from both the lateral and medial roots of the corresponding cords of the brachial plexus, the median nerve courses with brachial artery on medial side of arm between biceps brachii and brachialis. At first lateral to the artery, it then crosses anteriorly to run medial to the artery in the distal arm and into the cubital fossa. Inside the cubital fossa, the median nerve passes medial to the brachial artery, in front of the point of insertion of the brachialis muscle and deep to the biceps. The median nerve gives off an articular branch in the upper arm as it passes near the elbow joint.

Course and branches in the forearm

The median nerve emerges from the cubital fossa and passes between the two heads of pronator teres. It then travels between flexor digitorum superficialis and flexor digitorum profundus before emerging between flexor digitorum superficialis and flexor carpi radialis. The unbranched portion of the median nerve (which arises from the cubital fossa) innervates muscles of superficial and intermediate groups of the anterior compartment except flexor carpi ulnaris. The median nerve does give off two branches as it courses through the forearm:

The anterior interosseous branch courses with the anterior interosseous artery and innervates all the muscles of the anterior compartment of the forearm except the flexor carpi ulnaris and the medial (ulnar) half of flexor digitorum profundus. Its ends with it's innervation of pronator quadratus.

The palmar cutaneous branch of the median nerve arises at the distal part of the forearm. It supplies sensory fibers to the lateral aspect of the skin of the palm.

The median nerve becomes superficial in the forearm 5 cm proximal to the wrist along the radial border of the flexor digitorum

superficialis. It continues distally deep to the Palmaris longus and slightly radially. The nerve is ulnar to flexor carpi radialis and antero ulnar to the flexor pollicis longus.

In the very distal forearm, the nerve is palmar to the flexor digitorum superficialis. It enters the carpal tunnel deep to the flexor retinaculum. This level of entry corresponds to the volar flexor crease of the wrist. Before it enters the carpal tunnel the median nerve gives off the palmar cutaneous branch. The other distal branches of the median nerve are the three common digital nerves and the recurrent motor nerve. At the level of the carpal tunnel the topography of the median nerve was as follows.

Within the epineurium, the nerve fascicles are arranged according to their distribution. The motor fibres are anterior. The sensory fibres for the web spaces and the radial three and half digits are located systematically from lateral to medial in progressive sequence within the nerve.

The recurrent motor branch supplies the thenar muscle and it arises distal to the carpal ligament and runs proximally and radially in the reverse direction. It divides into a superficial branch which supplies the

flexor pollicis brevis and abductor pollicis brevis and a deep branch to the opponens pollicis. It rarely supplies the dorsal interosseous muscle.

High division of the median nerve is also called bifid median nerve. This can subject the nerve to injury during forearm dissection and it can go unrecognised. The variant nerve may pass through the muscle mass or anterior to the Flexor digitorum superficialis. In these cases the ulnar branch is commonly injured, causing loss of sensibility over the ulnar aspect of middle finger and the radial aspect of ring finger.

The recurrent motor branch may be absent in some cases, called as "the all ulnar hand". This nerve may have a subligamentous origin, multiple branching or may arise from the ulnar nerve. It may also have a transligamentous passage. When these anomalies are present, injuries during OCTR (Open Carpal Tunnel Release) can occur frequently.

Riche Cannieu Anastomosis is between recurrent motor branch and ulnar nerve branch to flexor pollicis brevis. Martin Gruber Anastomosis is a variant and anomalous communication that contains motor, sensory and mixed function fascicles. It is anastamosis between median nerve or anterior interosseous nerve to the ulnar nerve in the torearm.

ANATOMY OF THE PALMAR CUTANEOUS BRANCH OF THE MEDIAN NERVE (PCBMN)

It is the last major branch of the median nerve in the forearm. It has no motor branches. It gives sensation to the base of thenar eminence. It arises from the anterolateral aspect of the median nerve, 5 to 7 cm, proximal to the wrist, in the vicinity of the radial margin of the Flexor digitorum superficialis. Usually only one branch arises 5.5cm, proximal to the radial styloid. Before branching, the nerve continues in or adjacent to the epineurium of the median nerve for 16 to 25 mm, before separating from the main branch.

The nerve passes distally along the ulnar aspect of the flexor carpi radialis adherent to the undersurface of the ante brachial fascia. At the proximal edge of transverse carpal ligament the nerve deviates ulnarly and enters its own short fibrous tunnel in the ligament. The tunnel is 9 to 16mm long.

The nerve pierces the transverse carpal ligament in line with the ring finger and enters the ligament, dividing into ulnar and medial branches. It supplies the skin of proximal two fifth of the palm, and medial side of thenar eminence. Sometimes the nerve can be on the radial

aspect of the flexor carpi radialis. This nerve may be absent sometimes. Here the function is taken over by the palmar cutaneous branch of the ulnar nerve.

Surgery adjacent to the ulnar border of the flexor carpi radialis can injure the nerve. Isolated compression of the nerve can occur due to abnormal Palmaris longus tendon. To avoid injury to the PCBMN during OCTR, the incision on the carpal ligament should be a curved longitudinal incision on the ulnar side of the axis of the ring finger.

OPEN CARPAL TUNNEL RELEASE (OCTR) SURGERY

Surgical management of patients with CTS is indicated if symptoms persist despite nonoperative treatment. It may also be indicated in patients who present initially with advanced findings, such as constant finger numbness, thenar weakness or atrophy, or with electro diagnostic evidence of thenar denervation. As demonstrated, there have been several different approaches to decompressing the carpal tunnel over the years, from OCTR, to more limited-open approaches using commercially available products, to endoscopic techniques.

As described by Sir. James Learmonth in 1933, OCTR has become the gold standard surgical treatment for patients with CTS. It has produced uniformly excellent results with high patient satisfaction and a low complication rate.

Some investigators, however, have suggested that OCTR is associated with a high enough incidence of postoperative palmar discomfort, scar tenderness, and weakness that endoscopic release should be considered as a viable alternative. No matter what ever the operative method, transecting the TCL is the essential step in each of them to increase the volume and decrease the pressure around the median nerve in the carpal tunnel.

Indeed, Magnetic resonance images (MRI) studies have shown that transecting the TCL causes a 24% increase in the volume of the carpal tunnel, as it changes from an oval to more circular cross-section, and shifts the median nerve anteriorly by 3.5 mm. Although several different methods have been successfully used to achieve this end, transecting the TCL with a scalpel under direct visualization (OCTR) remains the mainstay of surgical management.

Technique

OCTR affords the surgeon full inspection of the TCL, the possible presence of intraligamentus motor nerve branch to the thenar muscles, and the contents of the carpal tunnel. The length of the incision that is made during an OCTR depends on both patient and surgeon factors.

Over time, this incision has been minimized in general, and most hand surgeons today perform primary OCTRs through a 2 to 4 cm incision, which ends approximately 2 cm distal to the wrist crease regardless of the length of incision.

Set-Up

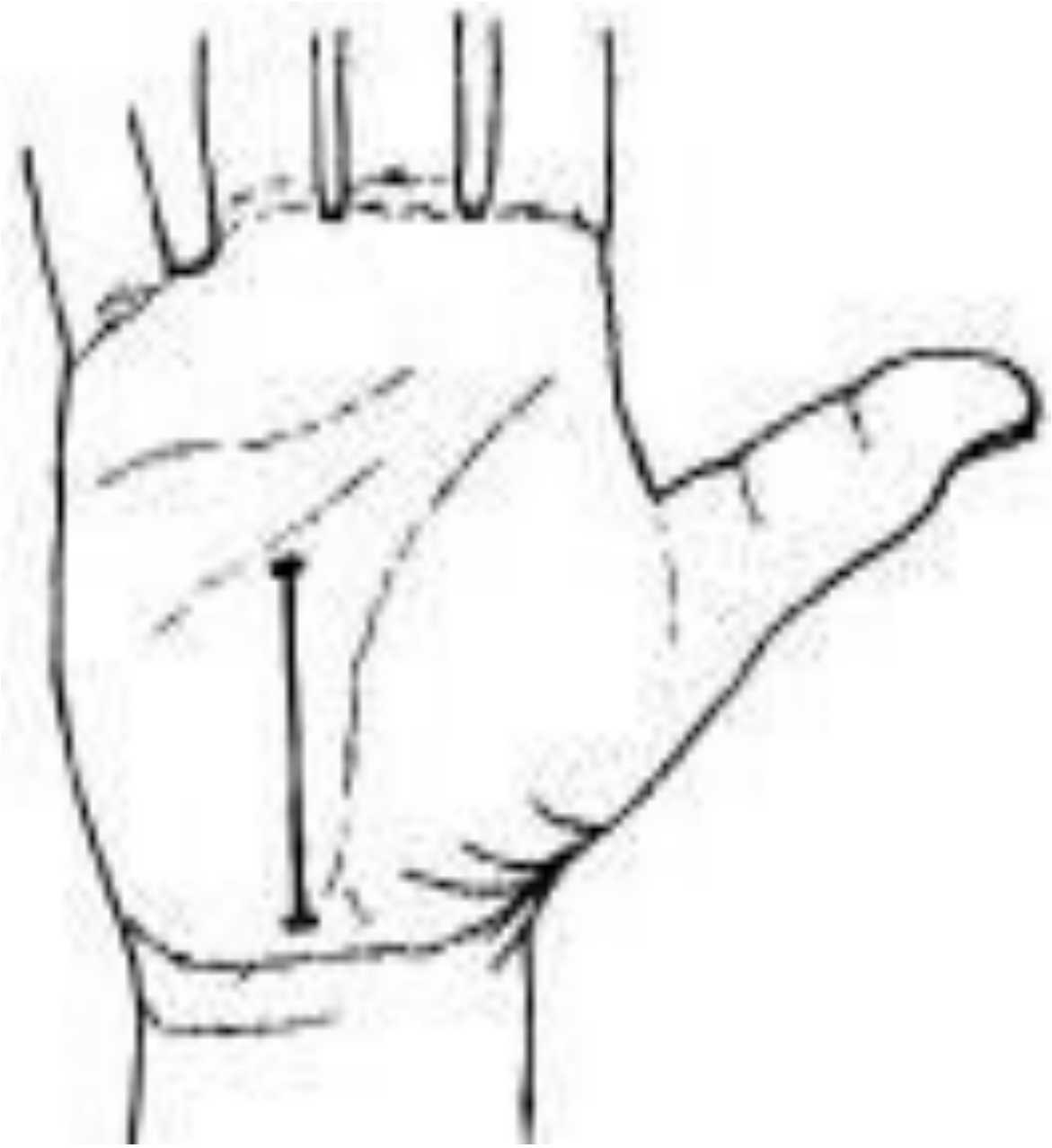
The patient is brought to the operating room and a tourniquet is placed on his or her forearm to minimize intra-operative bleeding.

Choice of Anesthesia is surgeon dependent and local, regional, or general anesthesia may all be used. After administration of anesthesia, the carpal tunnel and surrounding subcutaneous tissue is infiltrated with a mixture of 10 ml of bupivacaine and lignocaine.

Skin Incision

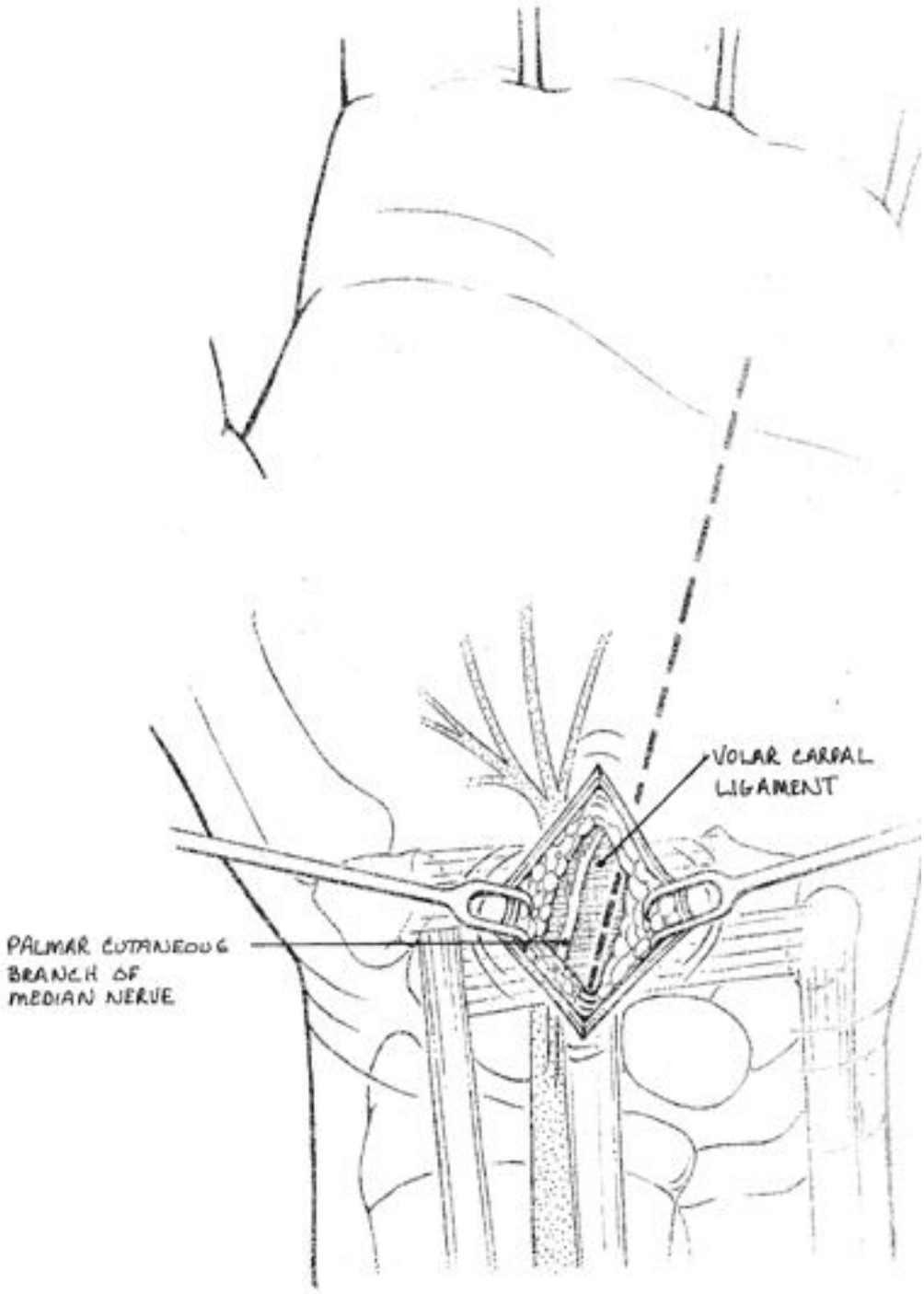
After washing and draping the extremity, a longitudinal incision placed along the axis of the radial border of the ring finger, approximately 2 mm ulnar to the thenar crease, is generally regarded as the safest location for an OCTR incision. Most hand surgeons avoid transverse palmar incisions because of inadequate exposure and potential injury to the palmar cutaneous nerve branch of the median nerve.

A longitudinal incision in the base of the palm is used. The incision is made in line with the flexed ring finger. The intersection of this longitudinal line with the Kaplan line (a line parallel to the ulnar aspect of the extended thumb) marks the distal extent of the incision. Proximally, the incision ends a few millimeters distal to the distal wrist flexion crease.



Surgical incision for an open carpal tunnel release is depicted. The incision can be extended proximally across the wrist flexion crease for a more extended exposure.

- Following the incision, the subcutaneous fat is retracted radially and ulnarly, exposing the superficial palmar fascia. The superficial palmar fascia is divided sharply in line with the skin incision. Retractors are placed deeper to expose the TCL.
- A blunt, curved hemostat clamp or similar instrument can be passed deep to the distal edge of the TCL to help confirm position and to protect the contents of the carpal canal. The TCL is divided sharply along its ulnar aspect. Distally, the superficial palmar arch marks the end of the TCL and must be protected. Proximally, the ligament is transected to the level of the distal wrist crease under direct vision.
- Blunt dissecting scissors are used to spread superficial and deep to the ante brachial fascia. Angled retractors are placed proximally under the skin flap so that the ante brachial fascia can now be divided for 2-3 cm proximally under direct vision, using the blunt scissors partially opened in a pushing fashion.
- If visualization is poor, the skin incision may need to be extended proximally. If the incision needs to extend across the distal wrist crease, it should be angled.
- Tenolysis, neurolysis, synovectomy, or reconstruction of the TCL is not routinely performed.



Incision showing palmar cutaneous branch of median nerve

- Prior to closure, the tourniquet is deflated and hemostasis is obtained with bipolar electrocautery. No deep sutures are used. The skin is closed with 4-0 nylon. A soft, sterile dressing is applied.

Postoperative splinting has been recommended to prevent prolapse of nerve, entrapment of nerve in scar tissue, or tendon bowstringing. However, splinting has not been demonstrated to have any beneficial effect and can increase pain and scar tenderness.

The precise zone of sensation in the palm is difficult to define, due to the extensive overlap of sensory supply from the main median nerve. The evolution of the technique of carpal tunnel release reflects growing awareness of the cutaneous innervations of the palm and its implication on postoperative scar tenderness.

The palmar cutaneous branch of the median nerve (PCBMN) has received the most attention in past reports addressing local complications during carpal tunnel release. Several anatomical dissections have demonstrated the course of this nerve and underscored its vulnerability during surgical approaches to the carpal tunnel near the thenar crease.

ENDOSCOPIC CARPAL TUNNEL RELEASE

Since the first carpal tunnel surgery performed in 1924 by Herbert Galloway, numerous advances have been made to refine this procedure. In general, carpal tunnel release can be performed using open or endoscopic procedures. The classic open carpal tunnel release technique involves complete division of the transverse carpal ligament and the deep fascia of the forearm under direct visualization. Most surgeons prefer the open technique due to its lower level of difficulty and shorter operative time. In the majority of patients, open release techniques lead to symptomatic relief with low complication rate. However, scar tenderness and grip weakness may occur after open release. In an attempt to reduce postoperative morbidity, endoscopic carpal tunnel release (ECTR) was developed in late 1980s.

The Agee single portal and Chow two portal carpal tunnel release utilize smaller incisions and require less dissection of the subcutaneous tissue and structures overlying the transverse carpal ligament. Further, with endoscopic release techniques, there may be less scar tenderness. Proponents suggest an earlier return to work and activities of daily living compared to the open procedure. However, at follow-up, there was no difference in patient satisfaction between the endoscopic and open release

group.The ECTR was carried out under either regional or general anaesthesia as a day surgery. Regional anaesthesia included abrachial plexus block and Bier's block. Patients who underwent simultaneous bilateral endoscopic carpal tunnel release required general anaesthesia. With tourniquet at the upper arm, the modified two-portal Chow's technique was carried out using a single retrograde knife for the division of the transverse carpal ligament. The procedure was performed using a 4mm, 30-degree inverse endoscope. Since this is a new procedure, there is still a great deal that remains to be investigated. It is important to determine whether in the future ECTR will allow for the same results of open carpal tunnel release, which are quite good.

Both preoperative and postoperative objective assessments of grip strength, two-point discrimination, pinch strength, range of motion of the wrist joint (dorsiflexion, palmar flexion, ulnar deviation and radial deviation) were carried out independently by hand therapist. Postoperative pillar pain, scar tenderness, presence of Tinel sign and Phalen sign, resolution of symptoms, patient's satisfaction and return to work status were also evaluated. All patients were assessed at two weeks, six weeks, three months, six months, nine months and one year postoperatively.

There are many variations of the distal branches from the median nerve at the wrist. Anatomic studies of this region have fundamental clinical implications to prevent injuries to important wrist structures, especially in newer operative scoping techniques and short incisions for carpal tunnel surgery.

Variations of the median nerve at the wrist are significant for the surgical treatment of the carpal tunnel syndrome; the median nerve and PCBMN have received the most attention in past reports addressing local complications during carpal tunnel release.

A thorough and detailed knowledge on the anatomy and normal variations of all wrist components, particularly of the median nerve is needed. The purpose of this study is to analyze the anatomical course of the palmar cutaneous nerve in cadaveric studies. .

As surgery is necessary for median nerve decompression, the surgical technique should be less traumatic and minimally invasive for both the median nerve and palmar skin to prevent the postoperative sequelae and achieve a good postoperative course without persistent symptoms.

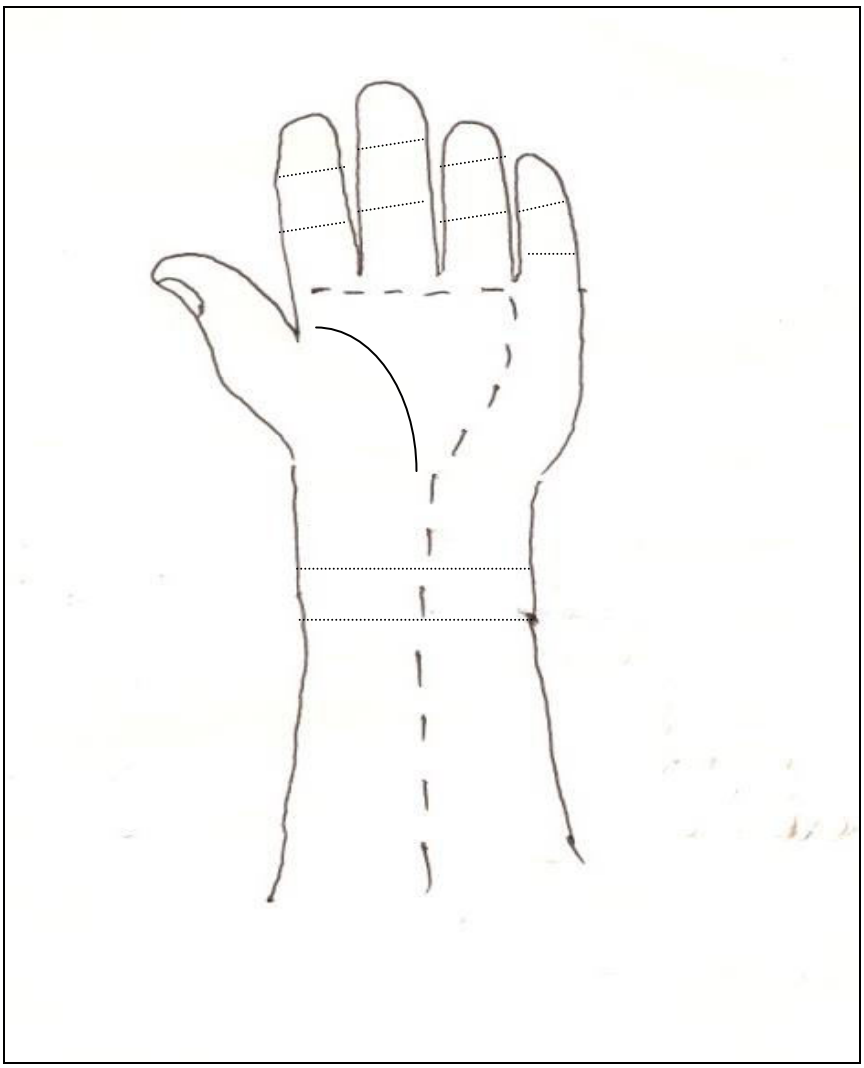
MATERIALS AND METHODS

24 hands of 12 cadavers were dissected. The incision was made from mid-forearm, extending vertically up to distal wrist crease. The incision turned towards the ulnar half of ring finger up to distal palmar crease. Then the incision turned towards the ulnar aspect of thumb.

The incision was deepened. The palmar cutaneous branch of median nerve was traced from midforearm and traced along its course. The median nerve was identified between the tendon of flexor Carpi radialis and Palmaris longus (PL) and then was picked up. Each PCN was identified using blunt dissection, and was traced proximally to its intraneural origin from the median nerve.

Each PCBMN was then carefully dissected distally, dividing the skin overlying its course and tracing individual branches radially, and towards the ulnar side until its termination in the undersurface of the skin. The variations and other sensory nerve contributions were noted. The findings were recorded, photographed and tabulated.

INCISION FOR CADAVAR DISSECTION TO FIND PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE



ANALYSIS OF CADAVER DISSECTION

(12 cadavers-24 hands)

We analyzed in detail the anatomical distribution of the PCBMN in adult's cadavers (10 male, 2 female).

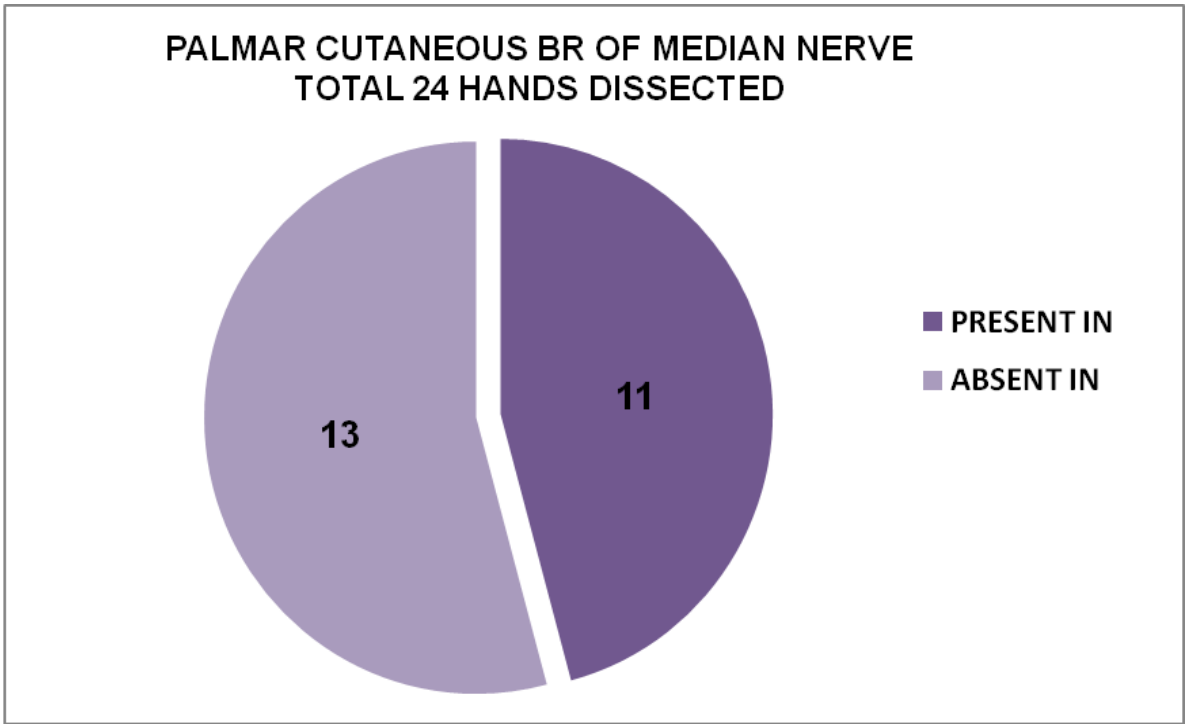
- The Palmar Cutaneous branch of Median nerve was present only in 11 out of 24 hands.
- The Palmar Cutaneous branch of Median nerve was absent on both hands in 3 bodies.
- It was present bilaterally only in two bodies.
- In 7 out of 12 bodies, it was present unilaterally (in 5 it was present on right side & in 2 it was present on left side).
- In cadavers, palmar cutaneous branch was present in 11 hands and additional contributions from branch directly from Median nerve in 4 hands, branch from median nerve and common digital nerve F2, F3 in 3 hands, branch from common digital nerve F1, F2 in 3 hands, branch from common digital nerve (CDN) F2, F3 – one hand.
- In cadavers where median nerve was absent in 13 hands, the sensory contribution was from median nerve in 9 hands, branch from median nerve and common digital nerve F2, F3 in 2 hands,

branch from median nerve and common digital nerve F3, F4 in 2 hands.

- The Palmar Cutaneous branch of Median nerve could not be traced beyond thenar eminence in all the cases.
- In no case, it was divided into medial & lateral branches as described in anatomy text books.

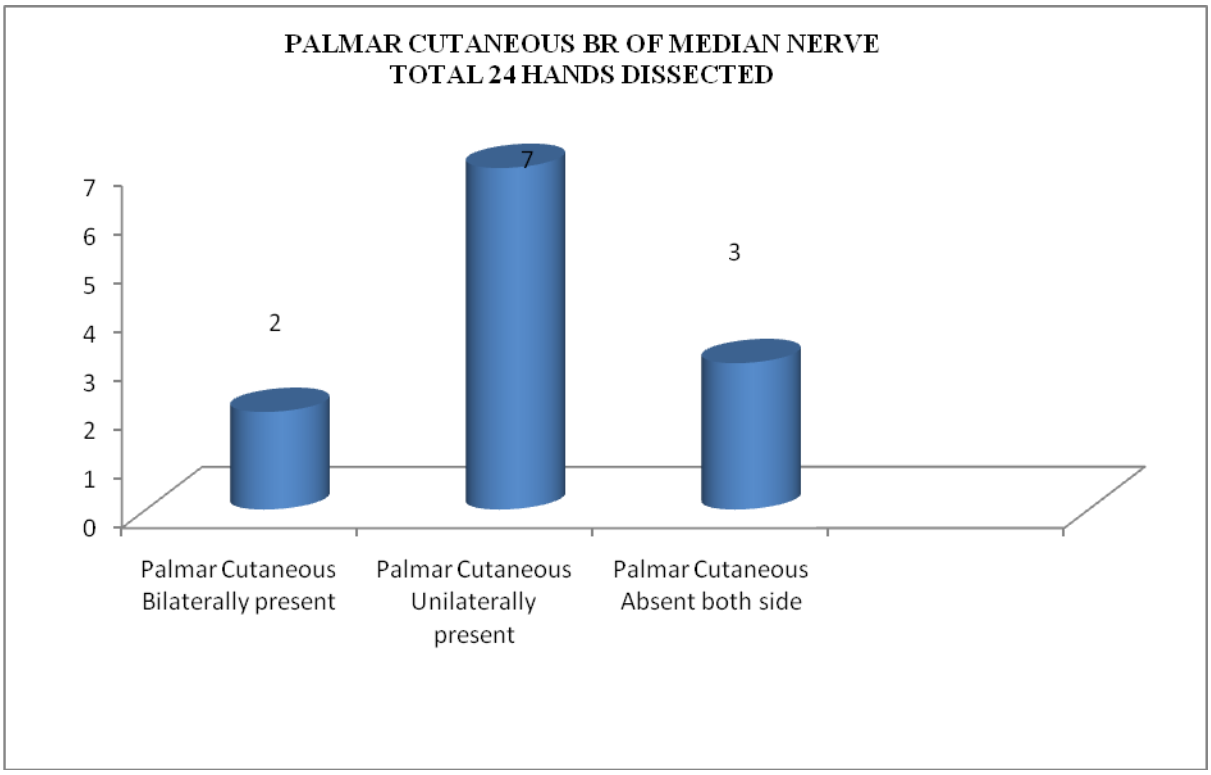
PALMAR CUTANEOUS BR OF MEDIAN NERVE TOTAL 24 HANDS DISSECTED	
PRESENT IN	11
ABSENT IN	13

Our cadaver dissection revealed that palmar cutaneous branch of median nerve was present in 11 hands out of 24 hands.



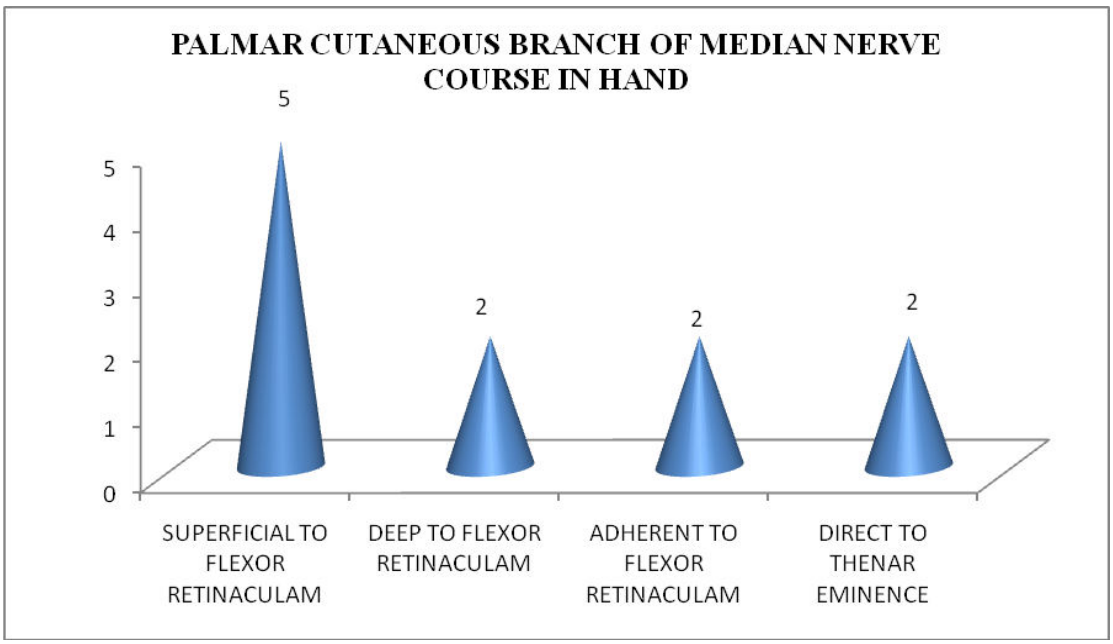
PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE IN 12 CADAVERS	
Bilaterally present	2
Unilaterally present	7
Absent both side	3
Total cadavers	12

In 12 cadavers dissected, the palmar cutaneous branch was present bilaterally in only 2 bodies. Present unilaterally in 7 bodies. The nerve was totally absent on both sides in 3 bodies.



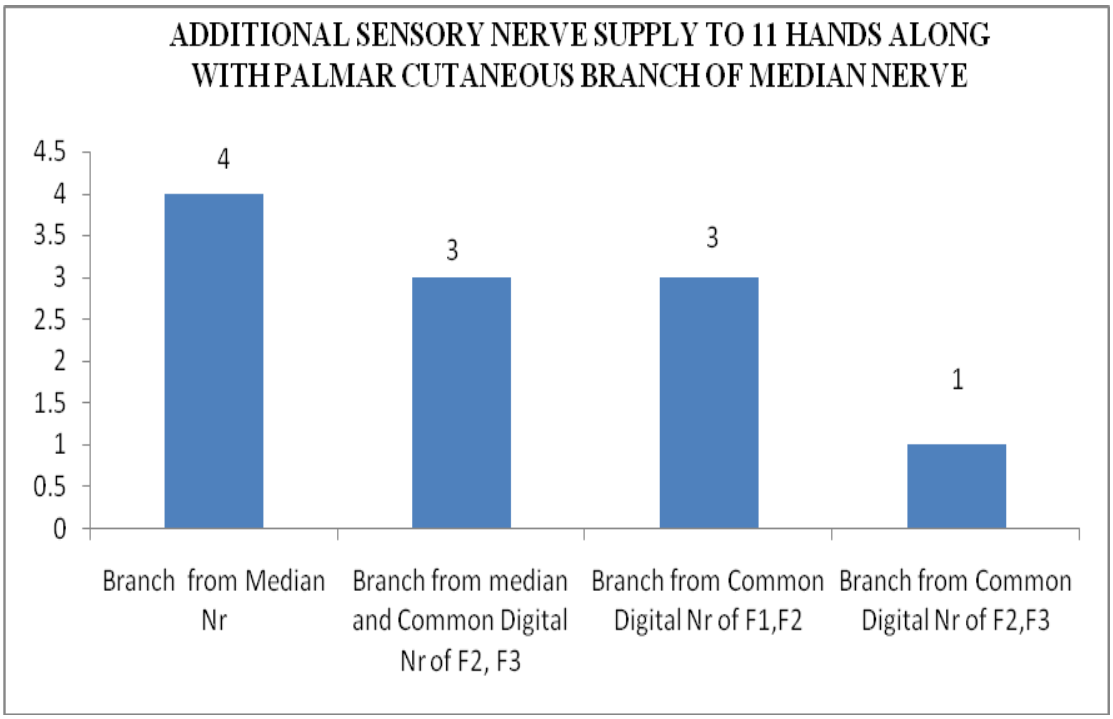
PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE COURSE IN HAND	
SUPERFICIAL TO FLEXOR RETINACULAM	5
DEEP TO FLEXOR RETINACULAM	2
ADHERENT TO FLEXOR RETINACULAM	2
DIRECT TO THENAR EMINENCE	2

Usually the palmar cutaneous branch of median nerve passes superficial to flexor retinaculum. In our cadaver dissection, in 5 cases it was passing superficial to flexor retinaculum. In Two cases passed deep to flexor retinaculam. It was adherent to flexor retinaculam in 2 cases. It passed directly to Thenar eminence in two cases.



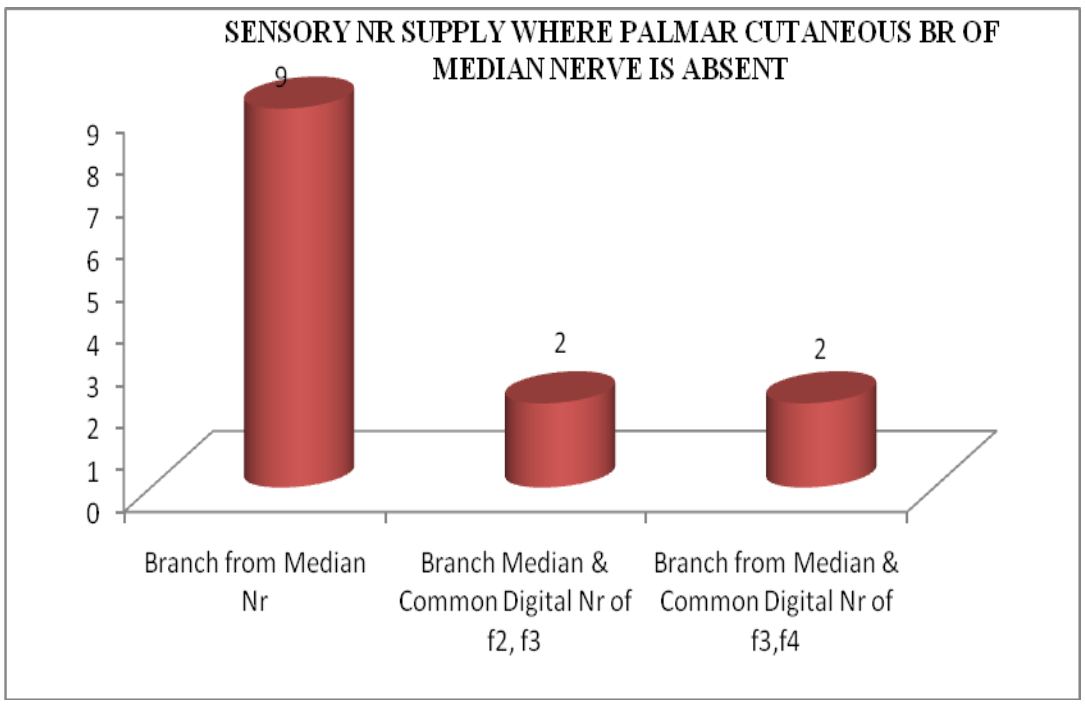
ADDITIONAL SENSORY NERVE SUPPLY TO 11 HANDS ALONG WITH PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE	
Branch from Median Nr	**4**
Branch from median and Common Digital Nr of F2, F3	**3**
Branch from Common Digital Nr of F1,F2	**3**
Branch from Common Digital Nr of F2,F3	**1**

In cadavers, palmar cutaneous branch was present in 11 hands and additional contributions from a branch directly from Median nerve in 4 hands, branch from median nerve and common digital nerve F2, F3 in 3 hands, branch from common digital nerve F1, F2 in 3 hands, branch from common digital nerve (CDN) F2, F3 – one hand.

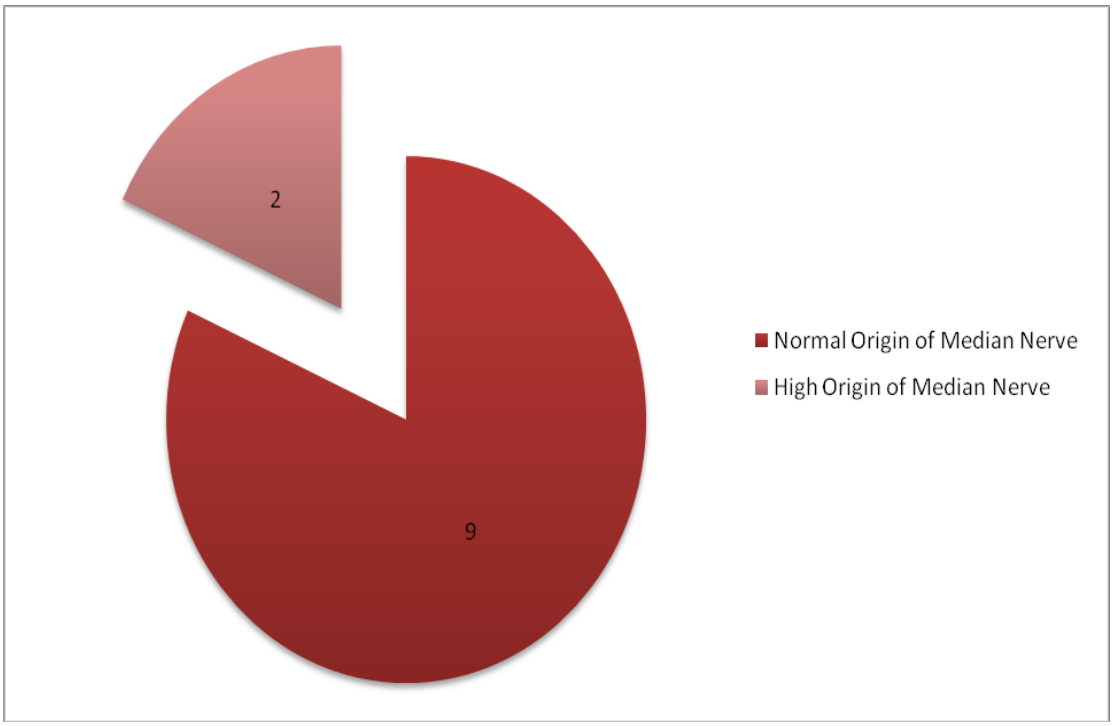


SENSORY NR SUPPLY WHERE PALMAR CUTANEOUS BR OF MEDIAN NERVE WAS ABSENT	
Branch from Median Nr	**9**
Branch Median & Common Digital Nr of f2, f3	**2**
Branch from Median & Common Digital Nr of f3,f4	**2**

In cadavers where median nerve was absent in 13 hands, the sensory contribution was from median nerve in 9 hands, branch from median nerve and common digital nerve F2, F3 in 2 hands, branch from median nerve and common digital nerve F3, F4 in 2 hands.



Total Hands of Cadavers		**24**
Median Nerve Absent in		**13**
Median Nerve present in	**Normal Origin of Median Nerve**	**9**
	High Origin of Median Nerve	**2**



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 1

- **Palmar Cutaneous Branch of Median Nerve** was absent.
- Sensory supply from branch from median nerve and branch from Common Digital nerve to F2 & F3.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 1

- Palmar cutaneous branch of median nerve present unilaterally on left side, passing superficial to flexor retinaculum.
- Palm proximal to radial 3 ½ fingers supplied by a direct branch from median nerve and branch(s) from Common Digital nerve to F2 & F3.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

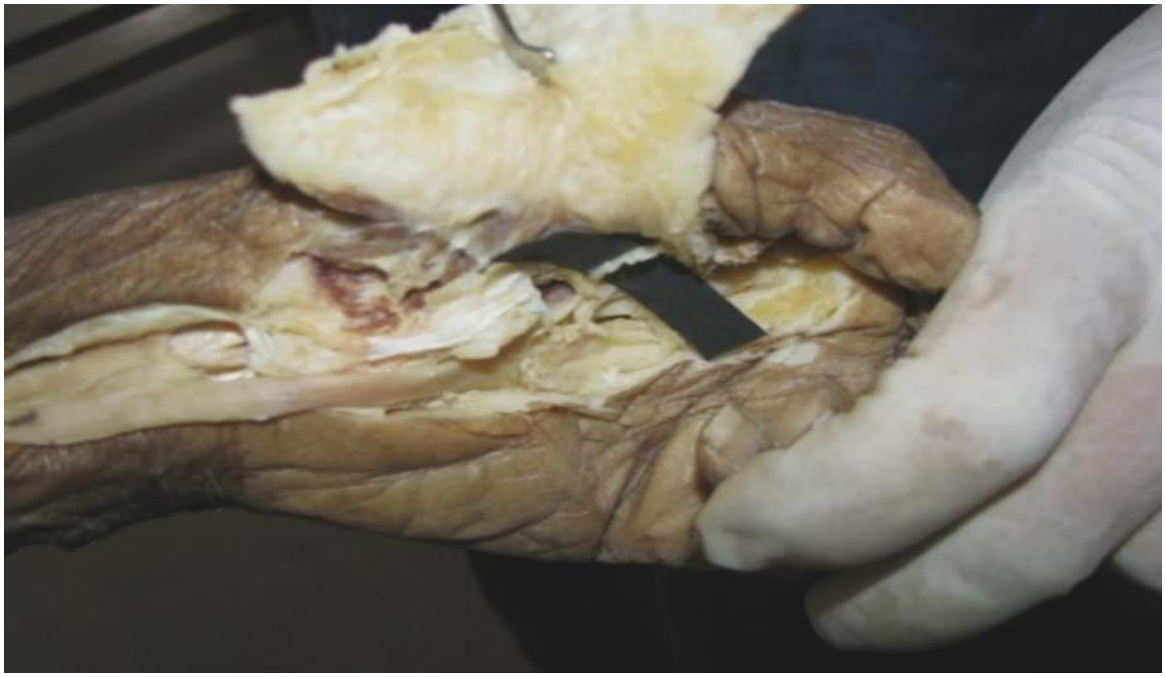
RIGHT HAND OF BODY NO 2

- Palmar cutaneous branch of median nerve was absent on right side.
- Sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 2

- Palmar cutaneous branch of median nerve was absent on left side.
- Sensory supply from direct branch from median nerve.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 3

Palmar cutaneous branch of median nerve was present. It passes superficial to flexor retinaculum. Sensory supply additionally from common digital nerve of f1 and f2.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 3

Palmar cutaneous branch of median nerve was present. It passes superficial to flexor retinaculum. Sensory supply additionally from common digital nerve of F1 & F2.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

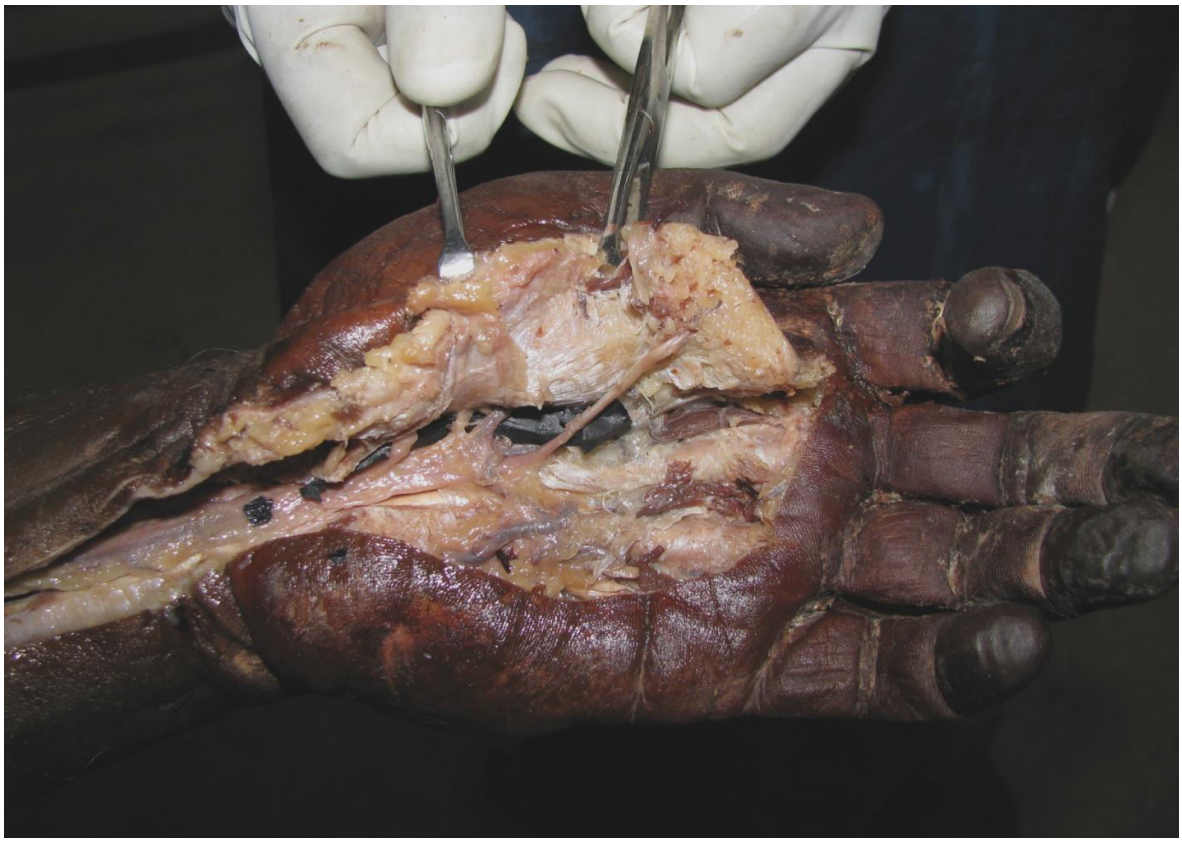
RIGHT HAND OF BODY NO-4

Palmar cutaneous branch of median nerve was present. It passes superficial to flexor retinaculum. Sensory supply additionally from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO-4

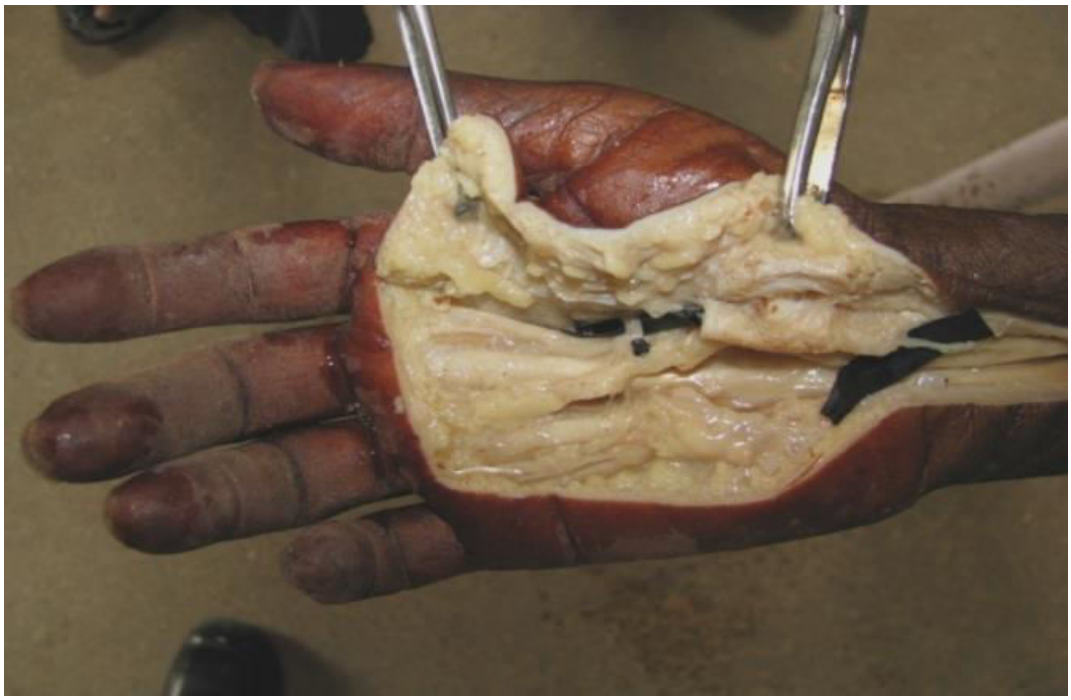
Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 5

- Palmar cutaneous branch of median nerve was present on right side.
- Additional sensory supply from a branch from Common Digital Nr of F2, F3 on right side.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 5

- Palmar cutaneous branch of median nerve was present on left side.
- Additional sensory supply from a branch directly from Median nerve supplies skin proximal to radial 3 ½ fingers on left side.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 6

- High division of Palmar Cutaneous branch of Median nerve at mid forearm level.
- Direct branches from Median nerve & Common Digital Nr of F2, F3 supplying radial side of palm.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 6

- Palmar cutaneous branch of median nerve was absent.
- Sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

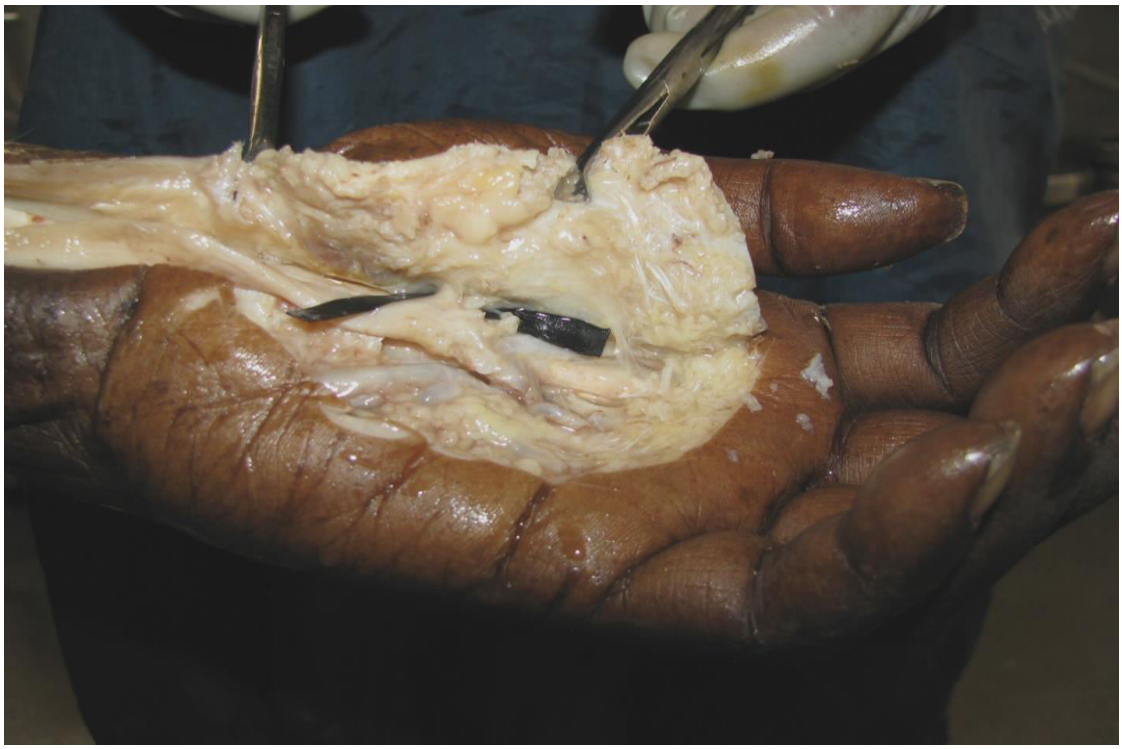
RIGHT HAND OF BODY NO 7

Palmar cutaneous branch of median nerve was present .It passes deep to flexor retinaculum. Additional sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 7

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 8

Palmar cutaneous branch of median nerve was present. It passes superficial to flexor retinaculum. Sensory supply additionally from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

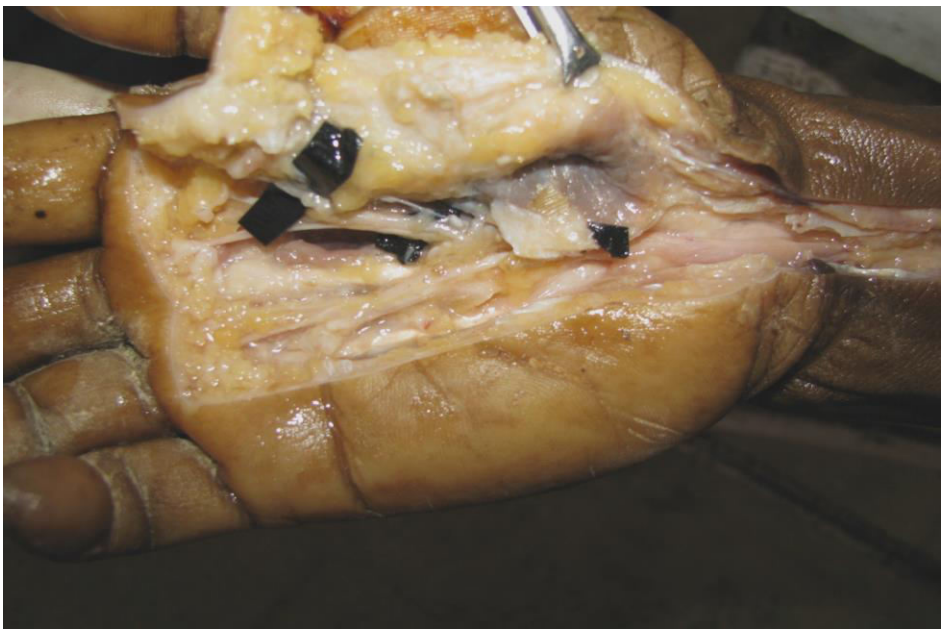
LEFT HAND OF BODY NO 8

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 9

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 9

- Palmar cutaneous branch of Median nerve passing directly to thenar eminence without crossing flexor retinaculum.
- Radial side of palm supplied by digital nerves of thumb- common digital nerve of F1 & F2

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 10

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

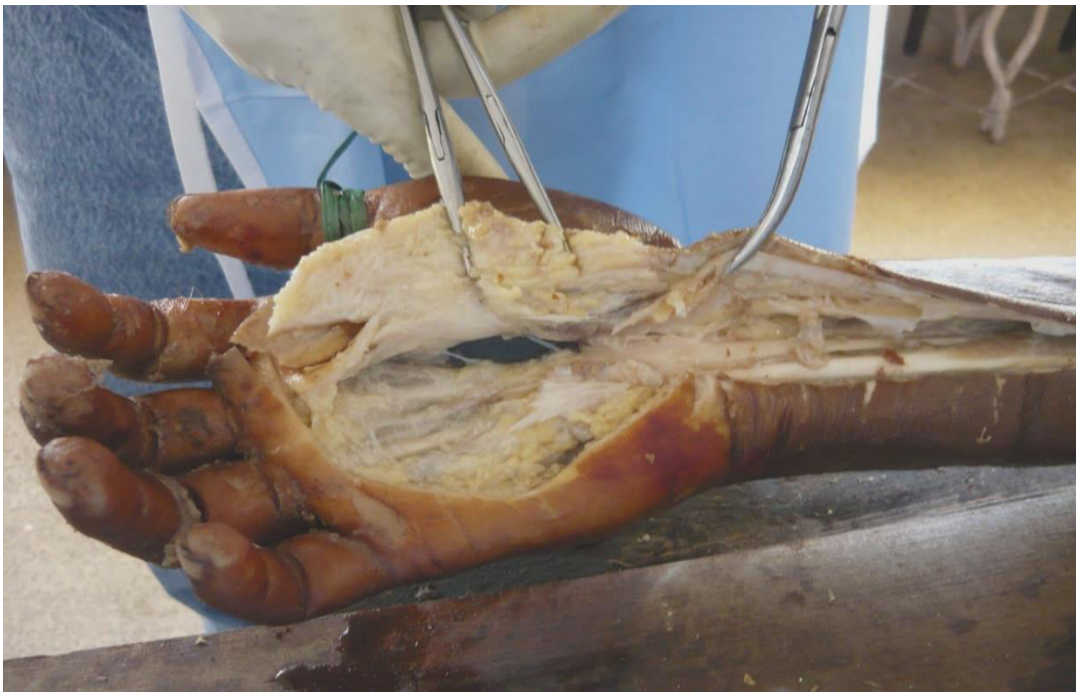
LEFT HAND OF BODY NO 10

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch from median nerve.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO 11

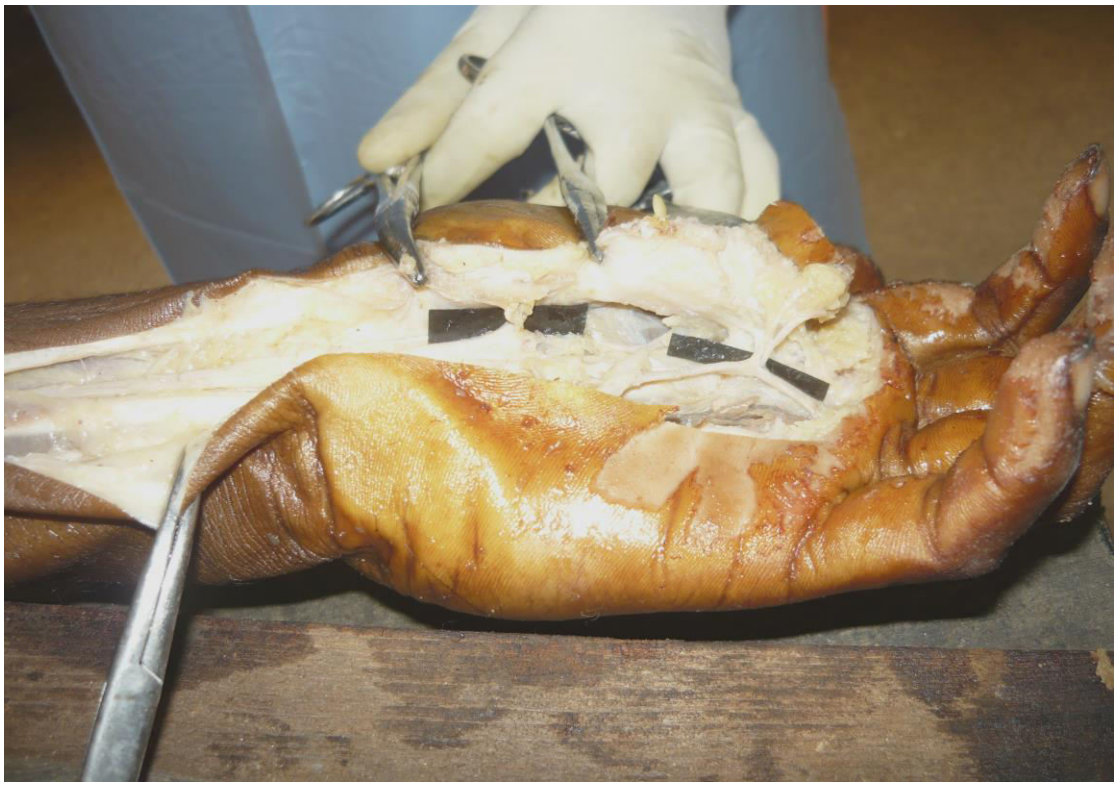
Absent palmar cutaneous branch of median nerve. Sensory supply from direct branch from median nerve and common digital nerve of F2 and F3.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO 11

Palmar cutaneous branch of median nerve was absent.Sensory supply by direct branch from median nerve and common digital nerve of F3 and F4.



PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

RIGHT HAND OF BODY NO -12

Palmar cutaneous nerve of median nerve was present (high origin). It passes superficial to flexor retinaculum. Sensory supply from direct branch from median nerve and common digital nerve of F2and F3.

PHOTOS OF DISSECTION OF PALMAR CUTANEOUS BRANCH OF MEDIAN NERVE

LEFT HAND OF BODY NO -12

Palmar cutaneous branch of median nerve was absent. Sensory supply from direct branch of median nerve and common digital nerve of F2and F3

DISCUSSION

The anatomy of the palmar cutaneous branch of median nerve (PCBMN) at the wrist has been documented by many authors. Usually the median nerve passes below the flexor retinaculum and gives off the PCBMN, 5 cms proximal to flexor retinaculum which distributes to the skin over the lateral part of the palm.

In patients with carpal tunnel syndrome, the median nerve under the flexor retinaculum is tightly packed with the long flexor tendons of the finger with their surrounding Synovial sheaths. The decompression of median nerve by sectioning the transverse carpal ligament (flexor retinaculum) is well accepted, as the treatment of choice for patients with carpal tunnel syndrome.

In 1972, Carroll and Green called for attention to the possibility of PCBMN damage as a source of painful dysaesthesia following surgery for carpal tunnel syndrome. Taliesin recommended a curved longitudinal incision located on the ulnar side of the long axis of the ring-finger ray. Hobbs concluded that the incision on the transverse carpal ligament should be located on the ulnar side of the long axis of the middle finger to prevent damage to the PCN.

These studies have influenced surgeons to shift their incisions more toward the ulna in the interthenar area. Neuroma of the PCBMN is a common complication of anterior wrist surgery after carpal tunnel decompression. To avoid injury to the PCN, a comprehensive evaluation of its distribution in the wrist region is essential.

The sensory innervation of the palm proximal to the radial 3 ½ fingers is by the Palmar Cutaneous branch of Median nerve. This branch of Median nerve arises about 5 cm proximal to the flexor retinaculum passes superficial or deep to it. It divides into medial & lateral branches.

The lateral branch innervates the Thenar eminence. The medial branch innervates the palm proximal to index, middle & radial half of the ring finger. Hence, in carpal tunnel syndrome there is no sensory disturbance of the palm and the sensory disturbance is confined only to the radial 3 ½ fingers. This is the accepted view, at present.

In Carpal Tunnel Syndrome, the Palmar Cutaneous branch of Median nerve was not affected; if it passes superficial to flexor retinaculum.

We happened to operate on a series of carpal tunnel syndromes recently. We did not find the Palmar Cutaneous branch of Median nerve in any case even though we made a conscious effort to find it. This

created a doubt in our mind whether the Palmar Cutaneous branch of Median nerve as described in Anatomy text books really exists.

To clear this doubt it was decided to do cadaver dissection. Thereby the common complication of dividing the palmar cutaneous branch, of Median nerve, by limiting the incision can be cleared.

To understand this, we analyzed in detail the anatomical distribution of the PCN in adult cadavers (10 male, 2 female).

- The Palmar Cutaneous branch of Median nerve was present only in 11 out of 24 hands.
- The Palmar Cutaneous branch of Median nerve was absent on both hands in 3 bodies.
- It was present bilaterally only in two bodies.
- In 7 out of 12 bodies, it was present unilaterally (in 5 it was present on right side & in 2 it was present on left side).
- In cadavers, palmar cutaneous branch was present in 11 hands and additional contributions from branch directly from Median nerve in 4 hands, branch from median nerve and common digital nerve F2, F3 in 3 hands, branch from common digital nerve F1, F2 in 3 hands, branch from common digital nerve (CDN) F2, F3 – one hand.

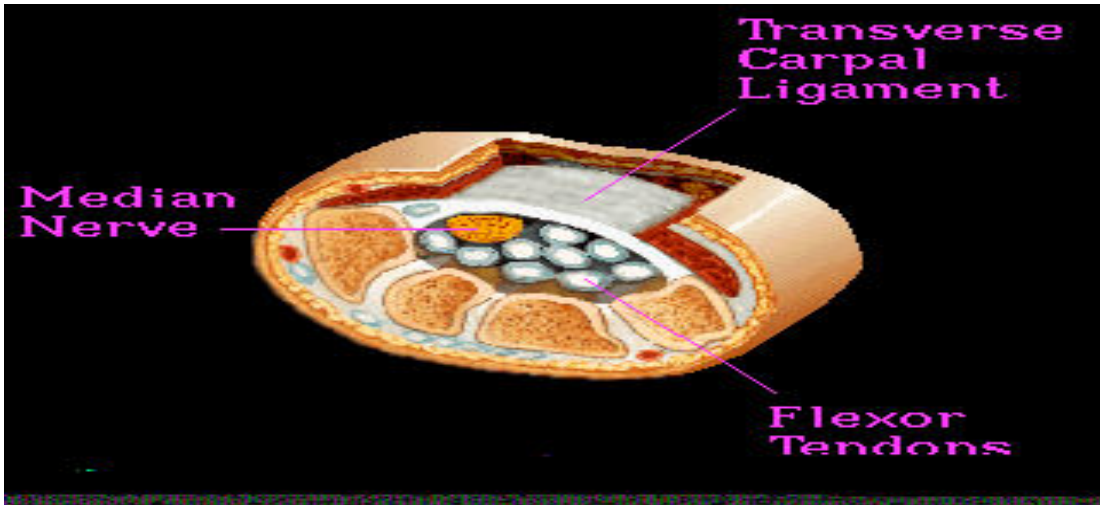
- In cadavers where median nerve was absent in 13 hands, the sensory contribution was from median nerve in 9 hands, branch from median nerve and common digital nerve F2, F3 in 2 hands, branch from median nerve and common digital nerve F3, F4 in 2 hands.
- The Palmar Cutaneous branch of Median nerve could not be traced beyond thenar eminence in all the cases.
- In no case, it was divided into medial & lateral branches as described in anatomy text books.

CLINICAL IMPLICATIONS OF THE PRESENT STUDY

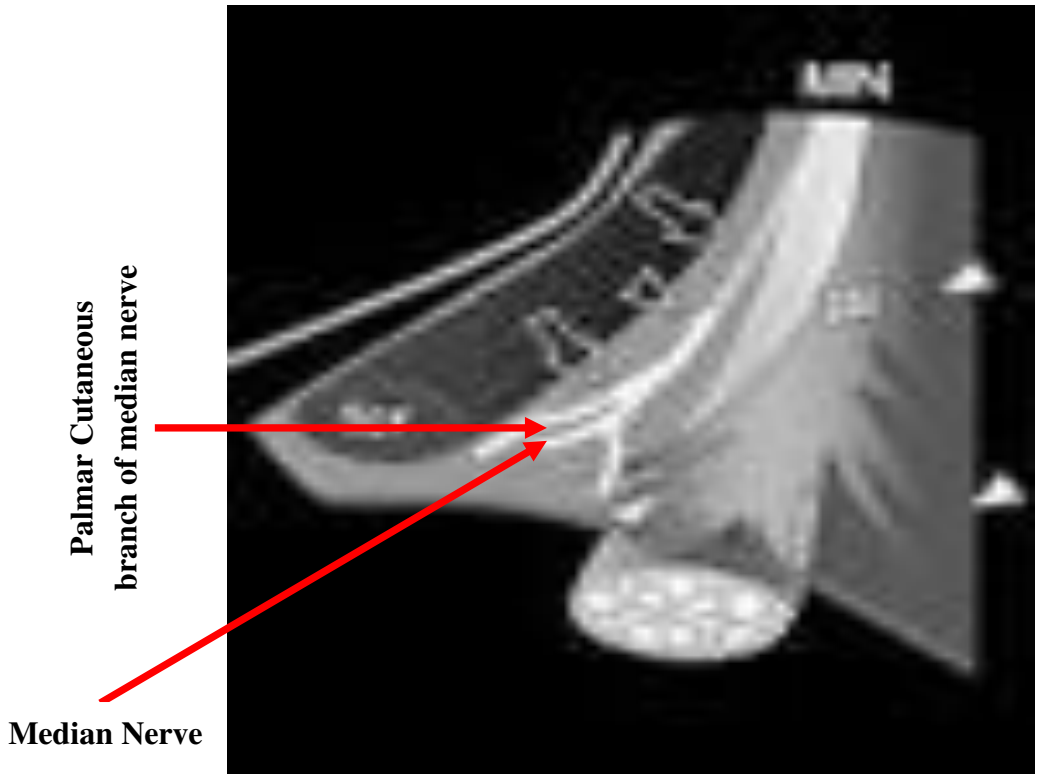
- Palmar Cutaneous branch of Median nerve could commonly be present unilaterally.
- It could even be absent bilaterally in some cases.
- If present, it is commonly found adherent to flexor retinaculum, either superficial or deep.
- Accidental division of Palmar Cutaneous branch of Median nerve may cause sensory loss confined only to thenar eminence.
- While making incisions & undermining skin on radial part of palm, one has to be careful not to injure sensory branches that may arise from common digital nerves.

CONCLUSIONS

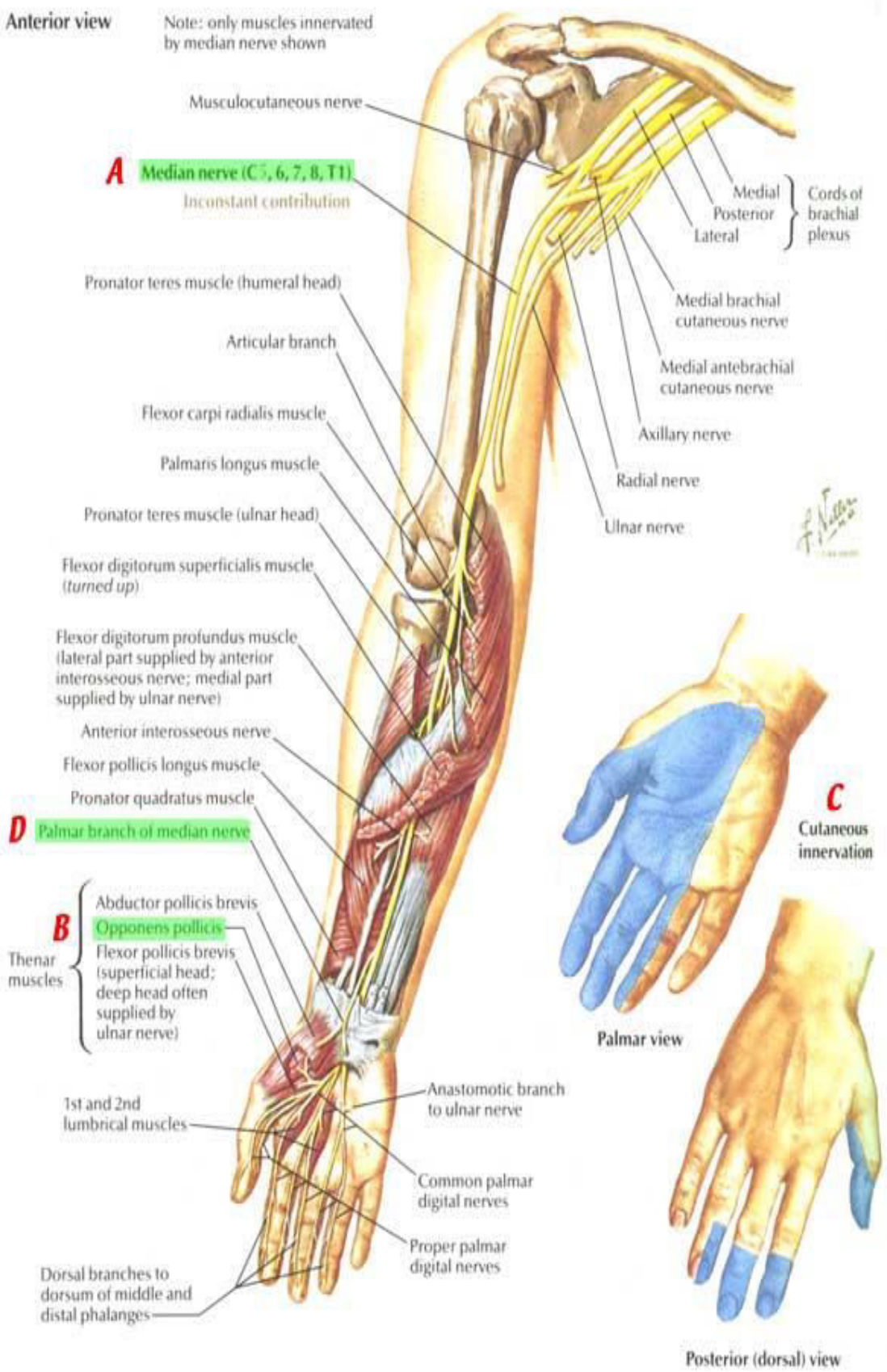
- Palmar Cutaneous branch of Median nerve is not a myth.
- But it is not present as it is described in text books.
- It is not a constant branch of Median nerve.
- It could be absent unilaterally or bilaterally.
- Our dissections show that PCBMN supplies mainly thenar eminence.
- So, accidental division of Palmar Cutaneous Branch of Median Nerve may not cause sensory loss in the palm as there are additional contributions from branches from median nerve and common digital nerves.



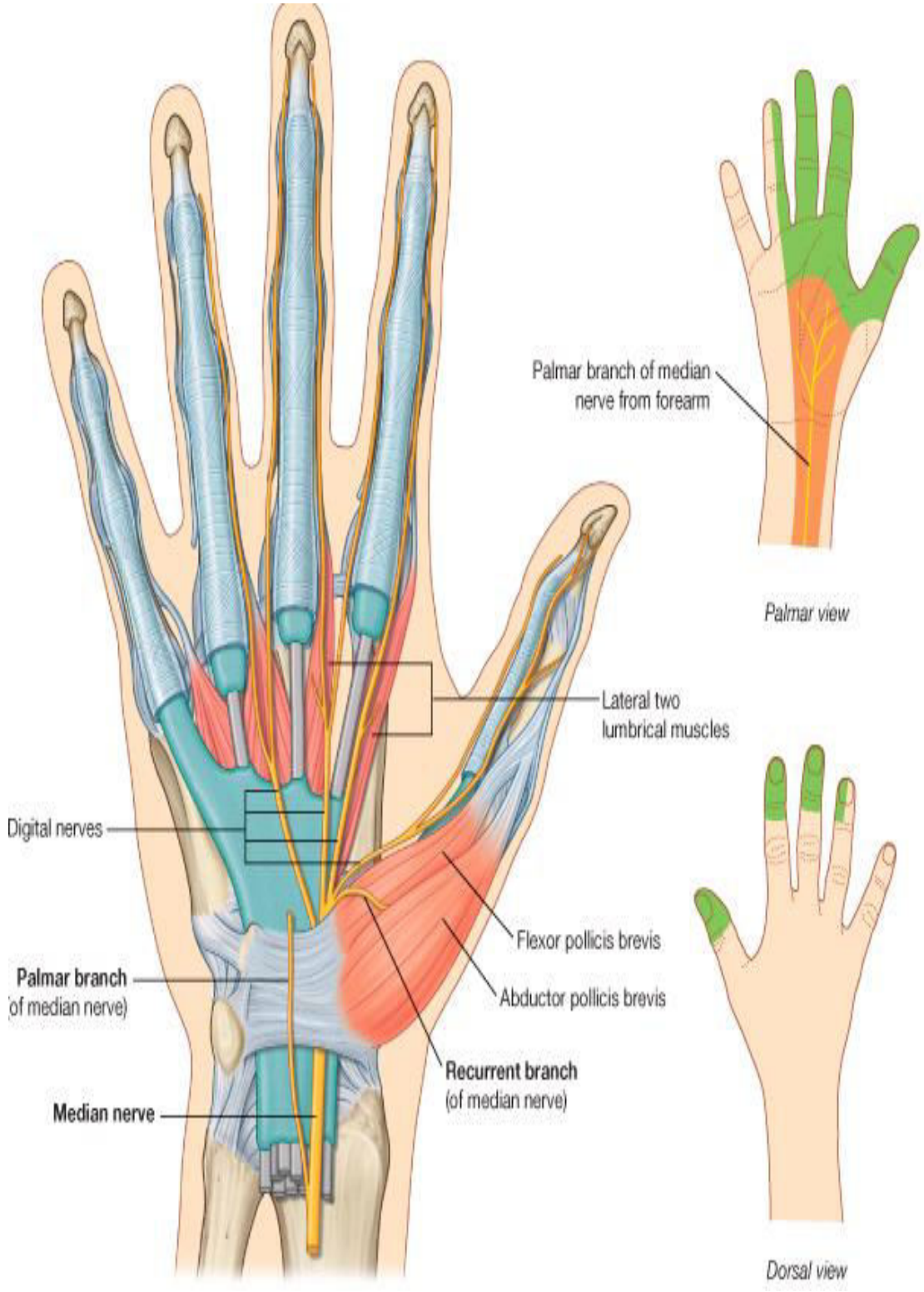
MRI showing median nerve in carpal tunnel



High resolution Ultra sonogram –arrows showing median nerve and its palmar cutaneous branch.



Course and branches of median nerve in the upper limb



Course of median nerve in hand

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MASTER CHART

Body No.	Palmar Cut. branch Rt hand	Palmar Cut. branch Lt hand	Sensory supply Rt Hand	Sensory supply - Lt Hand
1	Absent	Present Superficial to flexor retinaculm	Br from Median & Comn Digital Nr of f3,f4	Br . Median & Comn Digital Nr of f2, f3
2	Absent	Absent	Br from Median Nr	Br from Median Nr
3	Present Superficial to flexor retinaculum	Present - Direct to Thenar area	Comn Digital Nr of f1,f2	Br from Comn Digital Nr of F1, F2
4	Present Superficial to flexor retinaculum	Absent	Br from Median Nr	Br from Median Nr
5	Present -adherent to flexor retinaculum	Present – deep to flexor Retinaculum	Br from CDN f2, f3	Br from Median Nr
6	Present -Adherent to FR, high division	Absent	Br from Median & Digital Nr of f2, f3	Br from Median Nr

Body No.	Palmar Cut. Branch Rt hand	Palmar Cut. branch Lt hand	Sensory supply Rt Hand	Sensory supply - Lt Hand
7	Present deep to Flexor Retinaculm	Absent	Br from Median Nr	Br from Median Nr
8	Present, Suprficial to Flexor Retinculm	Absent	Br from Median Nr	Br from Median Nr
9	Absent	Present direct to Thenar	Br from Median Nr	Br from CDN F1, F2
10	Absent	Absent	Br from Median Nr	Br from Median Nr
11	Absent	Absent	Br from Median Common & Digital Nr of F3,F4	Br from Median & Digital Nr of F2, F3
12	Present, superficial to Flexor Retinaculm	Absent	Br from Median & Digital Nr of F2,F3	Br from Median & Digital Nr of F2, F3

ABBREVIATIONS

1. PL - Palmaris Longus
2. CTS – Carpal Tunnel Syndrome
3. PCBMN – Palmar Cutaneous branch of median
4. TCL – Transverse Carpal Ligament
5. APB – Abductor Pollicis Brevis
6. NCV – Nerve Conduction Velocity
7. EMG – Electromyography
8. OCTR – Open Carpel Tunnel release
9. MRI – Magnetic Resonance images
10. NSAIDS – Non Steroidal Anti Inflammatory Drugs
11. CDN – Common digital nerve
12. FR – Flexor Retinaculam