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## IncurSION of Lumbrical Muscles within Carpal Tunnel: A Cadaveric Study.

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### ABSTRACT

The aim of the present study is to document the incurSION of lumbrical muscles within carpal tunnels. The study was carried on 54 hands of both sexes of different age groups used for routine dissection in Anatomy department at Sri Siddhartha Medical College (SSMC). Proximal extent of the origin and their relation to the Carpal tunnel was observed. In 2 hands (3.7%) of 2 different bodies, the 1st lumbrical had an additional origin arising from the forearm from the tendon of Flexor Digitorum Superficialis of the index finger. The proximal attachment of the third lumbrical in right hand (50%) and first lumbrical in left hand (34.62%) extended into the carpal tunnel was observed in larger percentages of cases. As proximal attachment of the lumbricals can extend into the carpal tunnel it may predispose to the development of carpal tunnel syndrome, especially in those individuals whose occupation requires repetitive finger movements.

**Keywords:** Lumbrical Muscles, Carpal Tunnel, Intrinsic Muscles

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## INTRODUCTION

Much of the versatility of the human hand depends upon its intrinsic musculature. The lumbrical muscles constitute an important part of the intrinsic musculature of the hand. The lumbrical muscles usually arise from the tendons of flexor digitorum profundus and insert into the extensor expansion.

As an integral part of the intrinsic musculature, the lumbricals are important for delicate digital movements. They flex the metacarpophalangeal joints and extend the interphalangeal joints. The holding of a pen or a pencil in the hand while writing, typically demonstrates the action of the lumbricals with the metacarpophalangeal joints flexed and the interphalangeal joints extended. Lumbricals may significantly contribute to the aetiology of carpal tunnel syndrome.

In patient with carpal tunnel syndrome (CTS) proximal origin of lumbricals is a significant finding. In persons with repetitive hand movements and proximal origin of lumbricals can result in hypertrophy of lumbricals and compression of median nerve [1]. Cobb et al. in 1994 have described that lumbrical muscle incursion into the carpal tunnel (CT) during finger flexion is a normal occurrence [2].

Thus, the lumbrical muscle plays a very important role in hand movements and then variations are very significant and should be noted. Hence a detailed study of the origin of lumbricals and their relation to CT was undertaken.

## MATERIALS AND METHODS

The study was carried on 54 hands of both sexes of different age groups used for routine dissection in Anatomy department at Sri Siddhartha Medical College (SSMC), Tumkur, Karnataka. The lumbrical muscles which were situated at the distal end of the flexor digitorum profundus tendons were carefully observed for their origins and nerve supply. The tendons of each of the lumbrical muscle were traced up to their insertion. Proximal extent and their incursion into the Carpal tunnel were observed.

### Observations

In the 54 hands which were dissected, the following observations were made. In most of the cases, the origin of the first lumbrical muscle resembled the usual pattern i.e. arise from the flexor digitorum profundus tendon of index finger. In 2 hands (3.7%) of 2 different bodies, the 1<sup>st</sup> lumbrical had an additional origin arising from the forearm from the tendon of Flexor Digitorum Superficialis of the index finger (Fig .1). The additional origin was also unipennate. The accessory first lumbrical was innervated by a twig from the lateral branch of the median nerve (Fig .2).

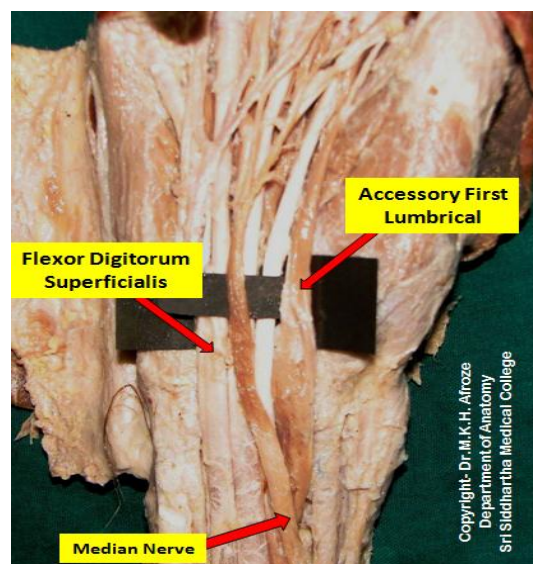


Figure 1: Shows the origin of accessory lumbrical from flexor digitorum superficialis

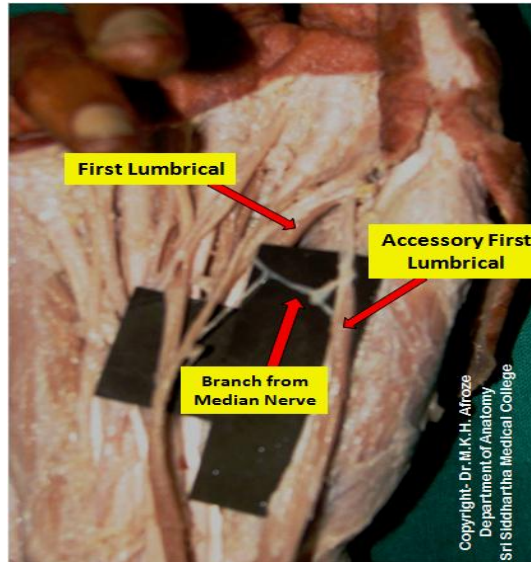


Figure 2: Nerve supply of the accessory lumbrical

The extent of proximal attachment of lumbricals into the carpal tunnel is shown in Table 1. It was observed that the proximal attachment of the third lumbrical in right hand (50%) and first lumbrical in left hand (34.62%), extended into the carpal tunnel in a larger percentage of cases (Fig. 3 and 4).

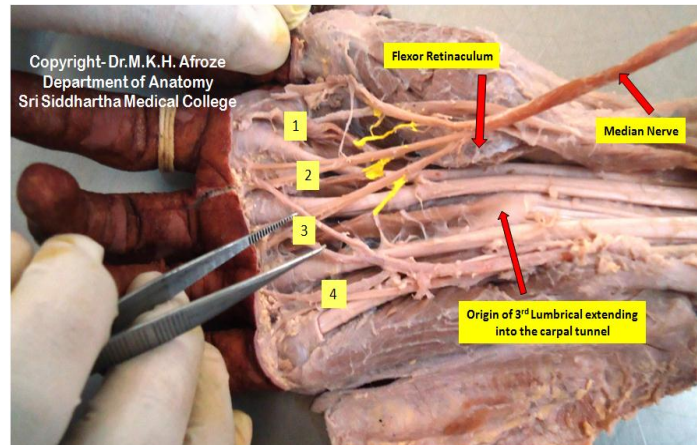


Figure 3: Shows the origin of third lumbrical extending into the carpal tunnel

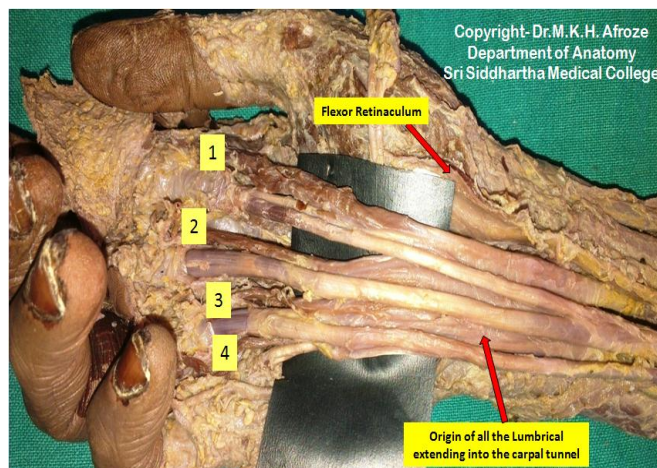


Figure 4: Shows the origin of all the lumbrical extending into the carpal tunnel

There were no variations found in the insertion. All the lumbricals were inserted into the dorsal digital expansion of the corresponding fingers.

## DISCUSSION

The pre-eminent position that man enjoys amongst all animals, is partly due to the functional specialization of the human hand that can perform very intricate and highly skilled movements with great precision. The intrinsic muscles of hand are responsible for greatly coordinated intricate movements of the digits. Lumbricals and interossei along with the long flexors bring about a coordinated action so that there is normal arc of flexion at the digits, and all three of its joints are angulated to the same degree.

The first lumbrical in all cases were unipennate. In two hands (3.7%) from two different cadavers, the 1<sup>st</sup> lumbrical had an additional origin arising from the forearm from the FDS tendon of the index finger. This additional origin was unipennate.

It took origin in the forearm from the radial side of the tendon of flexor digitorum superficialis (FDS) to the index finger. It joined the first lumbrical in the palm & was inserted into the dorsal digital expansion on the radial side of the index finger. The accessory first lumbrical was innervated by a twig from the lateral branch of the median nerve.

Variation of the lumbrical muscles have been reported in the literature by various authors. Mehta and Gardner (1961) studied the lumbricals of the human hand and described the anomalous origin of accessory lumbrical from flexor pollicis longus, flexor digitorum superficialis, opponens pollicis, palmar carpal ligament in 2.7% cases [3].

Clinically, anomalous lumbrical muscle origins may be one of the causes of Carpal Tunnel Syndrome (CTS), a condition which occurs when the anomalous muscle belly compresses the median nerve or may be due to hypertrophy of the lumbricals.

Koizumi, Bhagath Kumar Potu and Soubhagya R Nayak reported cases of the presence of an accessory belly of first lumbrical in 2002, 2007 and 2008 respectively [4-6]. Bhagath Kumar Potu observed that the flexor digitorum profundus (FDP) tendon of right middle finger had an accessory belly arising from the undersurface of the flexor digitorum superficialis (FDS). The origin of the first lumbrical was seen arising both from the FDP tendon & the tendon of the accessory belly, which has potential to cause compression of the median nerve in carpal tunnel [5].

The carpal tunnel is a tight osseo-ligamentous space bordered dorsally by the concave arch of the carpus and the transverse carpal ligament (TCL) on the palmar aspect. Carpal tunnel syndrome is manifested by characteristic signs and symptoms resulting from an entrapment neuropathy of the median nerve at the wrist. In most cases, no specific cause can be disclosed; these cases are usually termed "idiopathic" or "primary". Secondary carpal tunnel syndrome can be caused by various conditions [7] (Table 2).

Cobb et al (1994) have described that lumbrical muscle incursion into the carpal tunnel (CT) during finger flexion is a normal occurrence [2].

In the present study, the origin of the lumbricals was observed to encroach into the carpal tunnel in the extended position of finger (Table 1). It was observed that the proximal attachment of the third lumbrical in right hand (50%) and first lumbrical in left hand (34.62%), extended into the carpal tunnel in a larger percentage of cases. Similar study was done by Joshi S.D et al, he mentioned that the second lumbrical was most commonly found (30-37%) in the carpal tunnel followed by first (22-26%), third and fourth (14-22%) [8-10].

**Table 1: The percentage extent of proximal attachment of lumbricals into the Carpal tunnel and upto the distal margin of flexor retinaculum in the extended position of the fingers**

Proximal Extent	Right lumbricals (%)				Left lumbricals (%)			
	I	II	III	IV	I	II	III	IV
Up to the distal margin of Carpal tunnel	57.14	57.14	32.14	35.71	46.15	50	53.84	57.69
Into the Carpal tunnel	25	25	50	46.42	34.62	30.76	26.92	23.07

**Table 2: Overview of causes of carpal tunnel syndrome**

Anatomical	Physiological
<p><b>Decreased size</b></p> <ul style="list-style-type: none"> <li>• Structural small-sized carpal tunnel</li> <li>• Abnormalities of carpal bones</li> <li>• Acromegaly</li> <li>• Extension/flexion of the wrist</li> </ul> <p><b>Increased content</b></p> <ul style="list-style-type: none"> <li>• Fracture of carpal bones</li> <li>• (Sub)luxation of carpal bones</li> <li>• Osteoarthritis (osteophytes)</li> <li>• Musculotendinous variants</li> <li>• Anomalous muscles(e.g. muscles like lumbricals extending into CT)</li> <li>• Persistent median artery</li> <li>• Hematoma</li> <li>• Hypertrophied synovium</li> </ul>	<p><b>Neuropathic conditions</b></p> <ul style="list-style-type: none"> <li>• Diabetes</li> <li>• Alcoholism</li> <li>• Double crush</li> <li>• Industrial solvents</li> <li>• Medication</li> </ul> <p><b>Inflammatory pathology</b></p> <ul style="list-style-type: none"> <li>• Rheumatoid arthritis</li> <li>• Gout</li> <li>• Nonspecific</li> <li>• Infectious synovitis</li> <li>• Overuse</li> </ul> <p><b>Alteration of fluid balance</b></p> <ul style="list-style-type: none"> <li>• Pregnancy</li> <li>• Menopause</li> <li>• Eclampsia</li> <li>• Thyroid disorders</li> <li>• Renal failure</li> <li>• Hemodialysis</li> <li>• Obesity</li> <li>• Raynaud’s disease</li> <li>• Lupus erythematosus</li> <li>• Scleroderma</li> <li>• Amyloidosis</li> <li>• Paget’s disease</li> </ul> <p><b>External forces</b></p> <ul style="list-style-type: none"> <li>• Vibration</li> <li>• Direct pressure</li> </ul>

**CONCLUSION**

The Clinician must aware constantly of such possibilities, although preoperative diagnosis may be difficult. Treatment depends on the intraoperative findings & may include incision of the flexor retinaculum, release of the origin of the respective muscle involved and resection of the involved muscle.

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