

Study of Variant Lumbricals of Hand

Sawant SP*

Abstract

Aim: To study the Lumbricals of Hand. **Materials and Methods:** 100 upper limbs of 50 donated embalmed cadavers (45 males & 5 females) of age group ranging from 70 to 80 years were dissected in the department of Anatomy at K. J. Somaiya Medical College, Sion, Mumbai, INDIA. The study was carried out to document the variations in the origin, insertion, innervations and the extension of lumbrical muscle. The variant lumbricals were observed in 20 specimens. The neurovascular pattern in the palm was also observed. The photographs of the variation of the lumbricals were taken for proper documentation. **Observations:** The normal lumbricals were observed in 80% of the specimens and the remaining 20% specimens showed the variations like double first lumbrical, bipennate second lumbrical, absence of third lumbrical, hypertrophied first lumbrical. In 30% specimens, the first three lumbricals are supplied by median nerve while in 20% specimens the last three lumbricals are supplied by ulnar nerve. **Conclusion:** The variant lumbricals may cause carpal tunnel syndrome by compressing the median nerve. Hypertrophy of the lumbricals could compress the radial and ulnar arteries of the fingers, causing chronic sub ischemia. Hence the existence of variant lumbricals should be kept in mind by surgeons operating on hand.

Key words

Lumbricals, Bifid, Hypertrophy, Bipennate, Proximal, Carpal Tunnel Syndrome, Hand Surgeons

Corresponding Author

Sawant SP, Professor & Head, Department of Anatomy, K. J. Somaiya Medical College and Research centre, Mumbai-22.

Contact No.: +919322061220.

Email: drspsawant@gmail.com

How to cite this Article

Sawant SP. Study of Variant Lumbricals of Hand. Somaiya Medical Journal. Volume 2 Number 1. 2015;7-14.

Introduction

The lumbricals are intrinsic muscles of the hand that flex the metacarpophalangeal joints and extend the interphalangeal joints.¹ There are four of these small, worm-like muscles on each hand. These muscles are unusual in that they have no bony attachment. Instead they attach proximally to the tendons of flexor digitorum profundus and distally to the extensor expansions.² The first lumbrical is unipennate. It originates from the radial side of the most radial tendon of the flexor digitorum profundus (corresponding to the index finger). It passes posteriorly, along the radial side of the index finger, to insert on to the extensor expansion near the metacarpophalangeal joint. The second lumbrical is also unipennate. It originates from the radial side of the second most radial tendon of the flexor digitorum profundus (which corresponds to the middle finger). It passes posteriorly along the radial side of the middle finger and inserts on to the extensor expansion near the metacarpophalangeal joint. The third lumbrical is bipennate. One head originates on the radial side of the flexor digitorum profundus tendon corresponding to the ring finger, while the other originates on the ulnar side of the tendon for the middle finger. The muscle passes posteriorly, along the radial side of the ring finger, to insert on its extensor expansion. The fourth lumbrical is bipennate. One head originates on the radial side of the flexor digitorum profundus tendon corresponding to the little finger, while the other originates on the ulnar side of the tendon for the ring finger. The muscle passes posteriorly, along the radial side of the little finger, to insert on its extensor expansion.³ The first and second

lumbricals (the radial two) are innervated by the median nerve. The third and fourth lumbricals (the ulnar two) are innervated by the deep branch of the ulnar nerve. This is the usual innervation of the lumbricals (occurring in 60% of individuals). However 1:3 (median:ulnar - 20% of individuals) and 3:1 (median:ulnar - 20% of individuals) also exist. The lumbrical innervation always follows the innervation pattern of the associated muscle unit of flexor digitorum profundus (i.e. if the muscle units supplying the tendon to the middle finger are innervated by the median nerve, the second lumbrical will also be innervated by the median nerve).⁴ There are four separate sources of blood supply for these muscles: the superficial palmar arch, the common palmar digital artery, the deep palmar arch, and the dorsal digital artery. The lumbrical muscles, with the help of the interosseous muscles, simultaneously flex the metacarpophalangeal joints while extending both interphalangeal joints of the digit on which it inserts. The lumbricals are used during an upstroke in writing. As a part of the intrinsic musculature, the lumbricals are important for delicate digital movements. They are said to flex the metacarpophalangeal joints and extend the interphalangeal joints. These are quite unique in their position as they connect the flexors of the digits to the extensors and that both of its attachments are mobile. These play a vital role in the precision movements of the hands, along with thenar, hypothenar, and interossei muscles. There are also lumbrical muscles of the foot that have a similar action, though these are of less clinical concern. Hence, philosophically it may be said that the actions of the

lumbricals of the hand are the indices of civilization of a race.¹ Evolution of grasping ability of the human being contributed by lumbricals may be attributed to the ecological context of such skills in the frogs.⁵ Hence, human hand is a revolution in evolution. The lumbrical muscles, especially the 1st and 2nd lumbricals, are used as muscle flaps for the coverage of the median nerve and its palmar branches. Hypertrophy of the lumbrical muscles causes compression of the radial and ulnar collateral arteries, leading to chronic sub-ischemia.⁶ Hence the present study is carried out to document the variations in the lumbricals.

Materials and Methods

100 upper limbs of 50 donated embalmed cadavers (45 males & 5 females) of age group ranging from 70 to 80 years were dissected in the department of Anatomy at K. J. Somaiya Medical College, Sion, Mumbai, INDIA. A longitudinal incision was made from the distal end of the flexor retinaculum, up to the level of the metacarpophalangeal joint of the middle finger. The superficial fascia, the deep fascia and the flexor retinaculum were dissected and reflected. Then the tendons of flexor digitorum superficialis, flexor digitorum profundus, branches of median nerve and superficial palmar arch were retracted. The lumbrical muscles were carefully observed and isolated. They were then followed to their tendons which pass to the lateral side of the base of each finger and later, the tendons of each of the lumbrical muscles were traced up to their insertions. The study was carried out to check for the variations in the origin, insertion, innervations and the

extension of lumbrical muscle. The variant Lumbricals were observed in 20 specimens. The neurovascular pattern in the palm was also observed. The photographs of the variation of the Lumbricals were taken for proper documentation.

Observations

The normal lumbricals were observed in 80% of the specimens and the remaining 20% specimens showed the variations like double first lumbrical, bipennate second lumbrical, absence of third lumbrical, hypertrophied first lumbrical. In 30% specimens the first three lumbricals are supplied by median nerve while in 20% specimens the last three lumbricals are supplied by ulnar nerve.

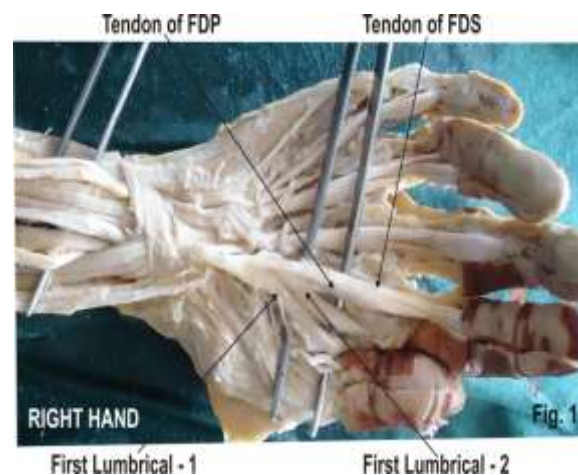


Figure 1: showing photographic presentation of an accessory belly of first lumbrical originating from the radial side of the most radial tendon of the flexor digitorum profundus.

Variant Lumbricals of Hand

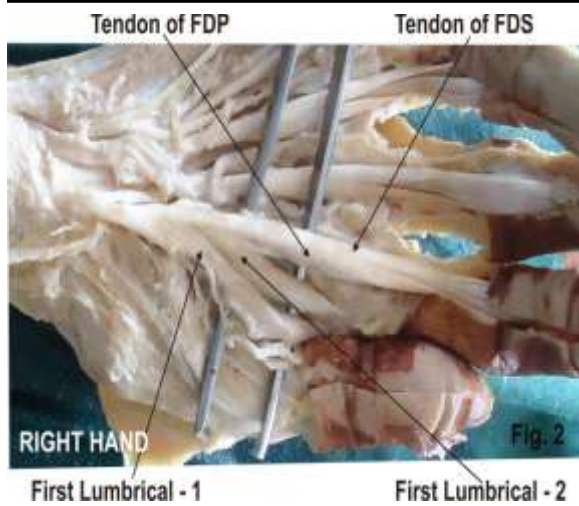


Figure 2: showing photographic presentation of The two bellies of the first lumbrical joined with each other to insert on the extensor expansion at the metacarpophalangeal joint.

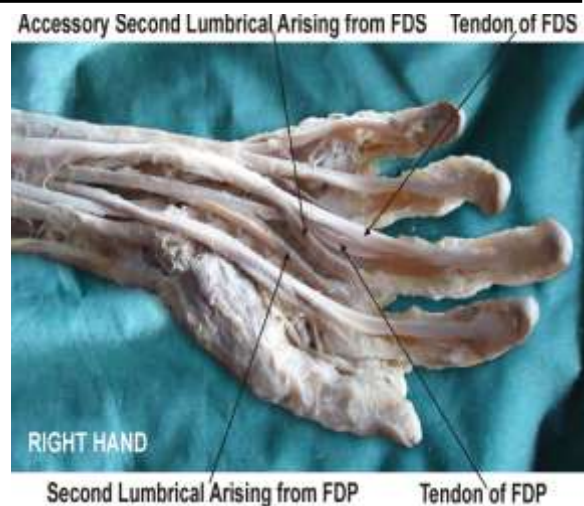


Figure 4: showing photographic presentation of Double Second Lumbrical. The accessory lumbrical arising from the tendon of Flexor Digitorum Superficialis.

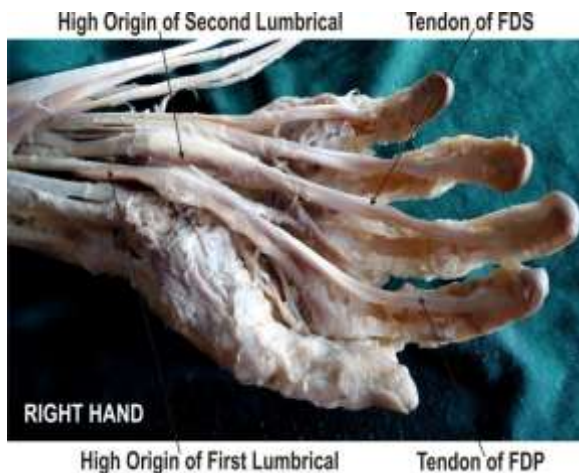


Figure 3: showing photographic presentation of High origin of the first and second lumbricals.

Table 1- Showing the Pattern of Variations of Lumbricals of the Hand.

Pattern of lumbricals	No. of Specimens	%
Normal origin	80	80
High origin of lumbricals	6	6
Double First Lumbrical	8	8
Bipennate Second Lumbrical	2	2
Absent Third Lumbrical	2	2
Hypertrophied Lumbrical	2	2

Table 2- Showing the Pattern of Variations of Lumbricals of the Hand.

Nerve Supply of lumbricals	No. of Specimens	%
Normal	50	50
First three lumbricals by median nerve	30	30
Last three lumbricals by ulnar nerve	20	20

Discussion

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 hands. Lumbricals as a part of the intrinsic musculature are important for its delicate digital movements. They are quite unique as they connect the flexors of the digits to the extensors. Variations in the origin and insertion of the lumbricals are common.⁷

Lumbrical muscle variation has been reported in the literature by various authors.^{8,9,10,11,12} Mehta et al described the anomalous origin of first lumbrical in 2.7% cases they studied.⁶ In the present study we observed the high origin of first lumbrical in 6% specimens. Additional lumbricals are occurring more frequently than a reduction in their number. In the present study we observed the double first lumbrical and bipennate second lumbrical in 10% specimens. Origin of lumbricals may be displaced proximally arising from flexor carpi radialis, flexor digitorum superficialis, flexor digitorum profundus or flexor pollicis longus. Accessory belly of first lumbrical may arise from flexor pollicis longus, flexor

digitorum superficialis, first metacarpal, opponens pollicis or palmar carpal ligament.¹³ In literature it has been found that the additional fibers from the forearm merged at varying points with the belly coming from the palmar origin and in no case reached the insertion of extensor expansion independently. Hence these are termed as additional forearm origin and not as double lumbricals.¹⁰ Further more Koizumi et al. mentioned that the first lumbrical muscle and the distal muscle belly for the index finger of the FDS have an intimate relationship with each other, and have a common phylogenetic origin.¹⁰ The articular system in the digits is connected by mechanical links and lumbrical muscles are one of the links of this system that produces dynamic controlled extension of interphalangeal joints. Haines studied flexor muscles of the forearm and hand in the mammals and lizards; he suggested that the FDS in mammals is homologous with the intrinsic muscles of the palm, and that it shifts its origin proximally in forearm.¹⁵ The presence of an additional muscle belly for the first lumbrical was seen in present study which has a phylogenetical significance and the occurrence of such an anomalous muscle belly may compress the median nerve in carpal tunnel. Anomalous and additional lumbrical muscle can cause carpal tunnel syndrome by compressing the median nerve.¹⁶ Similar observation was seen in a study done by Singh et al. as a bipennate origin of first lumbrical, extending from the distal part of forearm and had split insertion.¹¹ Additionally, notification of such muscular variants assumes importance in event of surgical intervention.¹⁷ In the present study 80% of the lumbricals had a

normal origin but some showed a proximal anomalous origin beneath the flexor retinaculum. Similar report has been reported by a study done by Siegel et al. with the incidence of 26.6% and opined that, it may cause compression of median nerve in carpal tunnel.¹⁸ It is also found that in case of carpal tunnel syndrome and in those in which repetitive hand motions were performed, the lumbricals had a significantly larger and proximal origin in the carpal tunnel which could be the cause of the carpal tunnel syndrome.¹⁹ Hypertrophy of the lumbrical muscles which could cause the compression of radial and ulnar arteries of the fingers likely to cause chronic sub ischemia.¹¹ The lumbricals also shows variations in being unipennate or bipennate. The present study showed the presence of bipennate second lumbrical in 2% of the specimens. The significance and etiology of such variant second lumbrical was not found in literature. If the first lumbrical is bipennate instead of unipennate then two heads usually arise from the flexor digitorum profundus and flexor pollicis longus.²⁰ In the present study, two specimens showed rare anomaly of absence of third lumbrical. This is very rare variation. A study done by Braithwaite et al, documented the absence of fourth lumbrical but with no clinical significance for this observation.²¹ A study by Kurzumi et al concluded that evidence of absence of 4th lumbrical was the most frequent absent of the lumbricals.¹⁰ In the present study 30% specimens showed the nerve supply of first three lumbricals by median nerve and 20% specimens showed the nerve supply of the last three lumbricals by ulnar nerve.

Clinicians and hand surgeons should be aware of such variations.

Conclusion

In the present study, though we observed presence of lumbricals with their normal attachment and morphology in majority of cases, a rare variations like their high origin, bipinnate second lumbricals, absence of third lumbrical and hypertrophied lumbricals along with variant nerve supply were observed. These unusual variations assume wide range of clinical implications. Therefore, clinicians and hand surgeons should be aware of enormous variations in lumbricals during various surgical procedures of hand. Further, hypertrophied lumbricals can cause compression of the radial and ulnar digital arteries leading to chronic ischemia. Hence, a complete knowledge of possible variations of lumbricals is utmost essential.

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Acknowledgements

None

Sources of Support

None

Conflicts of interest

None but the corresponding author is specialty editor for Anatomy.

Article received	: 03/03/2015
Article reviewed	: 15/03/2015
Article accepted	: 21/03/2015
Article published	: 21/04/2015