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LUMBRICAL MUSCLES MORPHOLOGY AND ITS VARIATIONS - A CADAVERIC STUDY

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ABSTRACT

Background: The hand is a prehensile organ capable of grasping and executing precise movements for skilled tasks, serving as a primary tactile tool. This capability arises from improved neuromuscular coordination and a greater cortical representation of the hand within the brain's sensory-motor cortex.[1]

Materials and Methods: The current research focuses on the structural analysis of the lumbrical muscles in the hand through cadaveric dissections, examining their variations. It involves a total of 70 upper limbs from adult human cadavers, which consist of 17 cadavers (11 males and 6 females) along with 36 disarticulated limbs from both genders available in the Department of Anatomy, Guntur Medical College, Guntur for a period of 2 years (From April 2022 to March 2024).

Results: The variability of the length of the hand is greater in male adult hands than in female adult hands. This is not correlated with the limb length and the total height of the individual due to the inherent difficulties. All four lumbrical muscles are present in 69 out of 70 hands. The fourth lumbrical is absent in one adult female's left hand.

Conclusion: The study highlights a high prevalence of morphological variations and anomalies in the lumbrical muscles of the hand, with only 21 out of 70 hands exhibiting normal anatomy. The fourth lumbrical muscle showed the highest frequency of abnormalities, including partial or complete absence and unipennate origins.

Keywords: Accessory belly, Hypertrophied, misplaced insertion, Split insertion, Unipennate muscle.

INTRODUCTION

The hand is a prehensile organ capable of grasping and executing precise movements for skilled tasks, serving as a primary tactile tool. This capability arises from improved neuromuscular coordination and a greater cortical representation of the hand within the brain's sensory-motor cortex.[1] Ultimately, the human hand represents a significant evolutionary change. Tasks such as writing, sewing, and other intricate activities depend on the lumbricals' ability to facilitate flexion at the Metacarpophalangeal (MCP) joints and extension at the interphalangeal joints.[2] From a philosophical standpoint, one could argue that a civilization's development can be reflected in the functionality of its lumbar muscles.[3]

The Flexor Digitorum Profundus (FDP) has four tendons that give rise to the lumbricals, which are worm-like muscles in the hand. These lumbricals, classified as intrinsic muscles of the hand, are vital for the intricate movements of the fingers.[5] They originate from the FDP tendons in the palm and extend to the deep transverse metacarpal ligament in the front. Each lumbrical develops a small tendon that connects to the edge of the dorsal digital expansion as it reaches the dorsal aspect of the proximal phalanx.6 The first and second lumbricals arise from the palmar surfaces of the tendons associated with the index and middle fingers,

respectively.[7] Meanwhile, the third and fourth lumbricals originate from the middle and ring fingers, as well as from the ring and little fingers. Although anatomical variations of the lumbricals have been documented in standard anatomy textbooks and surgical literature, a review of their basic anatomy can be beneficial.[8] These muscles travel radially along the MCP joint, forming a tendon at the dorsal surface of the proximal phalanx that connects to the radial edge of the dorsal digitorum expansion, initiating a wing tendon.[9] The first and second lumbricals serve as muscular flaps that shield the median nerve and its palmar branches. Given the frequent occurrence of hand injuries in road traffic accidents, understanding the anatomical variations of the lumbricals is crucial for hand surgeons. A range of outcomes has been noted in the literature, from total absence of the lumbricals to diminished volume or the presence of additional slips. Chronic subischaemia can develop as a result of lumbrical muscle hypertrophy that compresses the radial and ulnar collateral arteries.[10] There exists considerable variation in the neurovascular structures of the hand across different population groups, and occasional heterogeneous cases are observed.[11] Recognizing the significance of these variations in population, this study was conducted to investigate the morphological patterns of lumbrical muscles and their anatomical variations in the hands, along with discussing their clinical relevance.[12] This information may be beneficial to anatomists as well as orthopedic and microvascular surgeons.

Objectives

1. The objective of the study is to dissect and expose the lumbrical muscles in the hand.
2. To study the origin, insertion, form, nerve supply and arterial supply of the lumbrical muscles.
3. To identify and record the morphological variations and abnormalities of the lumbrical muscles during the above study.
4. To compare the observations of the present study with the observations of authors who conducted similar studies previously.

MATERIALS AND METHODS

The current research focuses on the structural analysis of the lumbrical muscles in the hand through cadaveric dissections, examining their variations. It involves a total of 70 upper limbs from adult human cadavers, which consist of 17 cadavers (11 males and 6 females) along with 36 disarticulated limbs from both genders available in the Department of Anatomy, Guntur Medical College, Guntur for a period of 2 years (From April 2022 to March 2024). Ethical committee clearance obtained for this study.

Total 70 limbs are analysed, and several specimens are documented with photographs.

The cadavers are preserved in the preservation tanks in the department of Anatomy, which are usually allotted for undergraduate and post-graduate students for dissection purposes.

Preparation of cadaver.

Dissection is carried out in embalmed cadavers. All the flaps are reflected by cutting through the dense fibro fatty superficial fascia, taking care to preserve the palmaris brevis muscle, palmar cutaneous branches of the ulnar nerve and median nerve, and superficial palmar branch of the radial artery. Superficial fascia is removed piecemeal to expose the palmar aponeurosis. In the interval between four slips of palmar aponeurosis, palmar digital branches of the median nerve and ulnar nerve are exposed along with palmar digital branches of the superficial palmar arch.

To expose the superficial palmar arch and its branches, theplamar aponeurosis is cut at its apex and reflected distally towards the fingers. The deep fascia covering the thenar eminence is cut open, and the thenar muscles are studied. Likewise, the deep fascia covering the hypothenar eminence is cut open, and all the hypothenar muscles are studied. The ulnar nerve and its branches and the ulnar artery are also exposed. The flexor retinaculum is cut open, and the synovial sheaths of the flexor digitorum superificialis, flexor digitorum profundus and flexor pollicis longus are studied. The median nerve and its branches are studied. Now, the lumbrical muscles are exposed. They are carefully cleaned, and their innervations are preserved.

All the skin flaps are reflected, and the dorsal venous arch and dorsal cutaneous branches of the ulnar nerve and radial nerve are observed. The superficial fascia is removed piecemeal to expose the deep fascia. The deep fascia is cut open, and the four tendons of the extensor digitorum are studied. The tendons of extensor digitorum going to the dorsum of the medial four fingers are followed up tothemetacarpophalangeal joint. At the distal end of the meta carpal, the tendon of extensor digitorum expands to form a hood that covers the back & sides of the head of the metacarpal and proximal phalanx. Now, the insertions of the lumbrical muscles are traced and cleaned into the dorsal digital expansion.

PROCEDURE OF RECORDING DATA

In the hand, the lumbrical muscles from origin to insertion, nerve supply and neurovascular hila are exposed. A verniercalipers and a steel tape are used to measure the various parameters of the muscles in the hand as suggested by Mehata and Gardner.

With the help of verniercalipers, the following lengths are recorded.

a) Origin length is measured from the most proximal point of attachment to the distal point of attachment on the same /adjoining FDP tendons.
b) Muscle belly length is measured from the most proximal point of attachment of origin to the distal point where muscle fibres end.

c) Tendon length is measured from the proximal point where the muscle fibres end in a tendon to its distal point of insertion.
d) Total length is calculated by adding the muscle belly length and the tendon length. It is measured from the most proximal point of origin to the point where the muscle fibres joined to dorsal digital expansion.

If the muscle had split insertion, the length of the tendon inserted into the corresponding digit was measured.

A steel tape is used to measure the following parameters.

a) Finger length is measured in mm from a point in the web to the tip of the corresponding finger.
b) The total length of the hand is measured from a midpoint on a line from the scaphoid tubercle to the pisiform bone to the tip of the middle finger.

RESULTS

Table 1: Comparison of percentage of normal subjects and those with variations and anomalies of the lumbrical muscles in the hands of adult cadavers

Age Group	No. of Subjects (cadavers)	No. of hands	Normal subjects	Normal hands	No. of subjects with variations and anomalies	No. of hands with variations and anomalies
Adults	17	34 R 17 L 17	1 5.9%	10 29.4% R3 L7	16 94% B8 U8	24 70.6% R14 L10
		36 (DL)		10 27.8% R7 L3		26 72.2% R15 L11

R- Right, L – Left, B- B-Bilateral, U- Unilateral, DL - disarticulated limbs

In the present study, seventy human adult hands (17 cadavers and 36 disarticulated limbs) are dissected to study the pattern of normal and anomalous attachments of the lumbrical muscles with their nerve supply and neurovascular hila. In total, 70 limbs are observed and studied. The observations are analysed and tabulated. The lumbrical muscles in the 34 upper limbs of the cadavers of known sex are compared with the 36 disarticulated limbs in which the sex is not known.

Table 2: Showing normal bilateral and unilateral variations and anomalies of the lumbrical muscles in the hands of 11 male subjects

S.No.	Allotted label of subject	Hand Nos (Allotted)		Normal hands		Variations and anomalies			
						Bilateral		Unilateral	
		R	L	R	L	R	L	R	L
1	C1	H1	H2	-	-	H1	H2	-	-
2	C.2	H3	H4	-	-	H3	H4	-	-
3	C.3	H5	H6	-	-	H5	H6	-	-
4	C.5	H9	H10	H9	-	-	-	-	H10
5	C.6	H11	H12	-	-	H11	H12	-	-
6	C.9	H17	H18	-	-	H17	H18	-	-
7	C.11	H21	H22	-	H22	-	-	H21	-
8	C.14	H27	H28	-	H28	-	-	H27	-
9	C.15	H29	H30	-	H30	-	-	H29	-
10	C.16	H31	H32	-	H32	-	-	H31	-
11	C.17	H33	H34	-	H34	-	-	H33	-
Total	11	22		1	5	5		5	1

R-Right, L- Left, C- Cadaver, H- Hand

In the males, only one right hand and 5 left hands have all four normal lumbrical muscles. The variations and anomalies are bilateral in 5 out of 11 male cadavers, and they are unilateral in the rest, five of them on the right side and one on the left side. No male (0/11) cadaver has all the normal four lumbrical muscles bilaterally. Among the 6 female cadavers, only one hand C12 has bilateral normal four lumbrical muscles. 3 cadavers out of 5 have bilateral variations and anomalies. The other two cadavers have unilateral variations.

Table 3: Percentage of variations and abnormalities in the lumbrical muscles of adult cadavers

Age Group	First Lumbrical			Second Lumbrical			Third Lumbrical			Fourth Lumbrical		
	R	L	Total	R	L	Total	R	L	Total	R	L	Total
Adults 70 limbs	7 10% O 5 I 2	7 10% O 3 I 4	14 20% O 8 I 6	10 14.2% O 8 I 2	12 17% O 7 I 5	22 31.2% O 15 I 7	9 12.8% I 9	11 15.7% I 11	20 28.5% I 20	12 17.1% I 12	11 15.7% I 11	23 32.8% I 23

R…. Right L……. Left O…… Origin I …… Insertion

Table 4: Individual variations and anomalies of the lumbrical muscles in adult cadavers

Lumrbical muscle	Normal	Abnormal addl. forearm origin	Misplaced insertion	Partial absence	Complete absence	Split insertion
	Adult	Adult	Adult	Adult	Adult	Adult
First	**56/70 80%**	0	0	0	0	0
Second	**46/70 65.7%**	3 4.2%	0	0	0	2 2.8%
Third	**47/70 67.2%**	0	2 2.8%	1 1.4%	0	15 21.4%
Fourth	37/70 52.8%	0	5 7.2%	4 5.6%	1 1.4%	12 17.1%

Table 5: Range and average measurement of lumbrical muscles in mm of both sexes

Lumbrical muscle	Length of origin		Length of muscle belly range and average		Length of the tendon range and average		Total length range and average		Finger length range and average	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
First	25-31 28.3	30-34 32	54-58 55.6	51-64 56.6	13-16 14.6	12-17 13.5	68-72 70.2	64-77 70.1	54-66 61.8	60-65 62.5
Second	21-30 26.3	23-30 29.1	39-64 52.8	50-62 54.3	9-20 14.6	10-20 13.6	54-73 67.4	61-80 68.9	66-75 70.5	64-74 68.1
Third	20-26 22.1	14-22 16.8	41-61 50.6	48-50 48.8	10-21 14	10-22 15.5	51-73 64.6	59-72 64.3	61-7 66.5	72-78 75.3
Fourth	13-22 17.8	19-23 20.3	31-49 41.5	20-50 32.1	6-12 10.3	8-15 10.5	43-59 51.8	30-58 42.6	50-56 53.6	44.61 52.1

Average length of the male hand …159 mm range (152-166)
Average length of the female hand … 153mm range (150-158)
NOTE: Normal insertions of muscles are not included in this table.

The variability of the length of the hand is more in male adult hands than in female adult hands. This is not correlated with the limb length and the total height of the individual due to the inherent difficulties. All the four lumbrical muscles are present in 69 out of 70 hands. The fourth lumbrical is absent in one adult female's left hand.

FIRST LUMBRICAL MUSCLE:

The first lumbrical muscle is present in all the 70 hands. Its belly is larger than that of the other lumbrical muscles. Its origin and insertion conform with the textbook pattern in only 56 hands, that is, 80% and 14 hands showed variations. 8 varied in origin and 6 varied in insertion. The muscle arises from the FDP1 tendon in all the cases, but it had an additional origin from the FDS tendon in 8 hands (11%). Of the 6 variations in insertion, in 4 hands, the muscle had an additional insertion into the radial side of the base of the proximal phalanx of the same finger, besides its usual insertion into the radial side of the dorsdal digital expansion of that finger (DDE1). In the other 2 hands, some of the tendon fibers are also inserted into the fibrous flexor sheath of the same finger.

The total length of the muscle varied in the male adult hands from 68mm to 72mm and in the female adult hands from 64 to 77mm. The range of the "belly length" is from 54mm to 58mm in males and 51mm to 64mm in females. The "origin length" varied from 25mm to 31mm in males and 30mm to 34mm in females. The range of "tendon length" is 13 to 16mm in males and 12 to 17mm in females. The length of the "index Finger" varied from 54 to 66mm in males and 60mm to 65mm in females, and its average length is 61.8mm in males and 62.5mm in females. The percentage of all variations and abnormalities in the first lumbrical muscle showed 20% in adult cadavers. The muscle received its innervations from the radial digital branch of the median nerve, and it entered the muscle on its ventral or palmar surface. A neurovascular hilus is seen in 42 out of 70 hands (60%)

SECOND LUMBRICAL MUSCLE:

The muscle is present in all the hands and adhered to the textbook pattern in 45 hands (64%). It showed variation in attachment in 22 hands (31%). In 3 hands (4%), it has an anomalous additional head of origin in the forearm. On one right hand, this muscle has shown two variations, one in origin and another one in insertion. Hence, it is regarded as one. In 15 hands, the muscle varied in origin, and in 7 hands, it varied in insertion. In all the cases of variation in origin, the muscle has an additional head of origin from the ulnar side of the F.D.P. tendon. There are 7 variations in insertion, out of which in 5 hands the muscle has an additional slip of insertion into the base of the first phalanx of the index finger besides its usual insertion into the D.D..E. of that finger (6%). The other variation observed is split insertion in the left hand of 2 adult males. In these 2 hands, the muscle belly is divided into two halves distally. The radial half is inserted abnormally into DDE1.

The ulnar half is inserted into the DDE2 on its radial side.

In 3 hands (4%), the usual origin of this muscle from the radial side of the F.D.P2 tendon abnormally extended into the forearm deep to the flexor retinaculum. This head of origin is regarded as anomalous because it is situated in the proximal segment of the limb.The "total length" of the muscle varied in males from 54 to 73mm and in females from 61 to 80mm.

The "belly length" is from 39 to 64mm in males and 50 to 62mm in females. The "origin length" varied from 21 to 30mm in males and 23 to 30mm in females. The range of "tendon length" is from 9 to 20mm in males and from 10 to 20mm in females. The length of the middle finger varied from 66 to 75mm in males and 64 to 74mm in females. The average length of the middle finger is 70.5mm in males and 68.1mm in females. The percentage of all variations and abnormalities in the case of the second lumbrical muscle showed 31.4% in adults. The muscle receives its nerve supply from the digital branch of the median nerve, supplying the adjacent sides of the index and the middle finger. The nerve entered this muscle on its ventral or palmar surface in all hands. A neurovascular hilus is seen in 7 muscles only (10%).

THIRD LUMBRICAL MUSCLE:

The muscle has normal attachments and conforms to the textbook pattern in 47 hands (67.0%). The muscle showed variations in insertion in 20 hands and anomalous insertion in 2 hands (3.0%). In one hand, it has a unipennate origin from the FDP3 tendon (the absence of normal origin from the FDP2 tendon is equal to the partial absence of the muscle). Among the variations in insertions, 15 are split insertions (22.0%).

In all the hands with split insertion, the belly of the muscle is split into two, each half ended in a tendon of insertion, and they were inserted into the DDE of the middle and ring fingers. The slip to the middle finger is an additional insertion, and the slip to the ring finger is a normal insertion. In 4 hands, the other variation of insertion is an additional insertion, in which a part of the tendon is inserted into the base of the proximal phalanx of the ring finger (corresponding digit) besides its usual insertion into the radial side of the DDE3 of the same digit. In two hands, the muscle has abnormal insertion into the ulnar side of the middle finger. The insertion is regarded as a "misplaced insertion" by other workers.

The total length of the muscle varied from 51 to 73mm in male hands and 59 to 72mm in female hands. The range of "belly length" of the muscle varied from 41 to 61mm in males and 48 to 50mm in females. The "origin length" varied from 20 to 26mm in males and 14 to 22mm in females. The range of "tendon length" is from 10 to 21mm in males and 10 to 22mm in females. The length of the ring finger varied from 61 to 70mm in males and 72 to 78mm in females, and its average length is 66.5 mm in males and 75.3mm in females. The percentage of all variations and abnormalities in the third lumbrical muscle showed 28.4% in adult cadavers.

In all the hands, the muscle is supplied by a twig from the deep branch of the ulnar nerve, which entered the muscle on its dorsal aspect. In 13 hands, the muscle has an additional nerve supply from the medial digital branch of the median nerve, which entered the muscle on its ventral or palmar surface. Only two out of 70hands showed a neurovascular hilus (3.0%)

FOURTH LUMBRICAL MUSCLE:

This muscle is the most variable in the series. In 37 hands, it adhered to the textbook pattern (52%). It is absent in the one adult female's left hand and partly absent in 4 hands.

In 24 hands 34% it showed variations in insertion, and in 5 hands (7%), it showed anomalous insertion (Misplaced insertion) into the DDE of the ring finger. Among the variations of insertions, 12 are split insertions. In these, the muscle belly is split into two and is inserted into the dorsal digital expansion of the ring and little fingers (DDE3, DDE4). The radial slip of the tendon of insertion joining the DDE3 is an additional insertion. In the other variations of this muscle, its tendon of insertion has an additional bony insertion into the radial side of the base of the proximal phalanx, besides its usual insertion into the DDE of the little finger. In 4 out of 70 hands, the muscle is partly absent. In two of these, the fibers arising from the ulnar side of the FDP3 tendon are absent, and in the other two hands, the fibers arising from the radial side of the FDP4 tendon are absent. In one hand, the fibers arose only from the FDP4 tendon, and they are inserted into the DDE of the ring finger (misplaced insertion). In this hand, the muscle showed two anomalies: one is the partial absence of origin, and the other is an anomalous insertion into the ring finger. On one hand, the fourth lumbrical muscle has unipennate origin from the FDP tendon (partial absence of origin). This muscle of the same hand has a combination of an anomaly and a variation as in this adult female left hand, the fourth lumbrical muscle is not present, an anomaly of its total absence.

The "total length" of the muscle varied from 43 to 59mm. in the male hands and 30 to 58mm in the female hands. The range of "belly length" is from 31 to 49mm in males and 20 to 50mm in females. The "origin length" varied from 13 to 22mm in males and 19 to 23mm in females. The range of "tendon length" is from 6 to 12mm in males and 8 to 15mm in females. The length of the little finger varied from 50 to 56mm in males and 44 to 61mm in females, and its average length is 53.6mm in males and 52.1mm in females. The percentage of all variations and abnormalities in the fourth lumbrical muscle showed 32.8% in adult cadavers. The muscle in all hands is innervated by the deep branch of the ulnar nerve, which enters the muscle on its deeper

surface. In only one muscle, a neurovascular hilus is observed.

Table 7: Nerve supply and neurovascular hila of the lumbrical muscles (study of 70 hands)

Lumbrical muscle	Normal nerve supply	Additional nerve supply	Neurovascular hila presence
First	70 100%	0	42 60% R28 L14
Second	70 100%	0	7 10% R4 L3
Third	70 100%	13* 19% R6 L7	2 3% R1 L1
Fourth	70 100%	0	1 1% R1

Figure 1: Left hand showing split insertion of the second lumbrical muscle

Figure 3: Left hand showing split insertion of the third lumbrical muscle

Figure 2: Left hand showing proximal origin of the second lumbrical muscle

Figure 4: Left hand showing split insertion of the third lumbrical muscle

Figure 5: Left hand showing complete absence of the fourth lumbrical muscle

Figure 6: Right hand showing (unipennate) partial absence of the fourth lumbrical muscle

Figure 7: Right hand showing additional nerve supply (branch of median nerve) to the third lumbrical muscle

Figure 8: Right hand showing arterial supply of first and second lumbrical muscles

DISCUSSION

The elevated status that humans hold among animal species is partly attributed to the unique specialization of the human hand, which allows for complex and highly skilled precision movements.[10] In the current study, the first and second lumbricals showed less variability compared to the third and fourth lumbricals. Mehta HJ and Gardner WU found that the variations in the insertions of the lumbricals were greater than those in their origins.[11] The third and fourth lumbricals typically originate from a single tendon rather than two separate tendons. Occasionally, lumbricals may arise from the forearm, a metacarpal, or from the superficial flexor tendons instead of the deep ones. Similarly, Perkins RE and Hast MH noted that the first, third, and fourth lumbricals originate from the flexor pollicis longus.[13] The findings of this study align with previous research where a 100% normal insertion of the first lumbrical was reported.

Many research studies suggest that the incidence of a bipennate second lumbrical is greater than that of the absence of this muscle. Mehta HJ and Gardner WU identified the bipennate origin of the second lumbrical in 6 of 75 hands examined.[11] Furthermore, Mutalik AM and Ajmani ML found that the second lumbrical was bipennate in 3.3% and 24% of cases in both hands, respectively.[14,15] In the same vein, Koizumi M et al.. and Potu B et al.. reported similar findings. Although unipennate origin is less common, it has been documented by several researchers.[16,17] The current study observed a unipennate variation in the 4th lumbrical in 1 out of 25 specimens (4%). However, Woods J noted a unipennate origin in four out of 102 hands studied.[18] Thus, the current research aligns with their findings.

In the present study, the third lumbrical exhibited a typical origin and nerve supply in all cases; however, split insertions of the third lumbrical were noted in 3 (6%) of the hands, with a minor variation

possibly attributed to the differing number of hands examined. Likewise, Woods J documented only one split insertion among 72 hands.[18] Although it is rare, multiple clinicians have reported split insertion of the second lumbrical. Mehta HJ and Gardner WU have similarly noted a split insertion of the second lumbrical in one out of 75 instances11. Eyler Don LK and Markee EJ also found that the second lumbrical was generally inserted normally.[19]

In a current study examining variations in the lumbricals, it was observed that the absence of the fourth lumbrical occurred in 4% of cases, consistent with findings from Mutalik AM, which indicated an absence rate of 1.4% to 5.3% for the fourth lumbrical.[14] This study found an accessory belly on the second lumbrical in one out of 70 hands, which holds phylogenetic relevance. The presence of this additional muscle may exert pressure on the median nerve within the carpal tunnel. This pressure from an enlarged and supplementary lumbrical muscle could lead to carpal tunnel syndrome. Similar findings were reported by Potu et al., who identified the accessory belly of the second lumbrical at the proximal border of the flexor retinaculum, originating from the ulnar aspect of the FDP tendon for the index finger.[17] The current study also identified parameters for an accessory belly of the first lumbrical, noting variations in hypertrophy and unipennate structures among the lumbricals. Conversely, Sawant SP documented an additional origin for the accessory belly of the first lumbrical, which arises from the radial side of the FDP tendon of the index finger.[20]

Misplaced insertions, like when the lumbrical is attached to the ulnar side of the adjacent extensor expansion, are also quite common.[18] The origin and significance of the misplaced insertion are not well understood. As noted by Cruveilhier J, the third lumbrical should normally be inserted correctly; however, it was incorrectly positioned in EE2 (the extensor expansion of the middle finger).

CONCLUSION

The study highlights a high prevalence of morphological variations and anomalies in the lumbrical muscles of the hand, with only 22 out of 70 hands exhibiting normal anatomy. The fourth lumbrical muscle showed the highest frequency of abnormalities, including partial or complete absence and unipennate origins. Variations in origin, insertion, and split insertions were more common in the third and fourth lumbricals, while the first and second lumbricals frequently displayed anomalous origins. Additional nerve supply was observed in 19% of cases, primarily in the third lumbrical. These findings underscore the complexity and variability of lumbrical muscle anatomy, which may have implications for hand function, surgical interventions, and clinical diagnostics.

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