

## Sexual Dimorphism in Lumbrical Muscles in Cadaveric Hands: A Morphometric Study

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### Abstract

**Background:** To know about morphometry and comparison between parameters of lumbrical muscles in both sexes of human hands.

**Methodology:** This study was conducted in the Department of Anatomy in ESIC Medical College and Hospital, Bihta, Patna, Bihar, India with 40 forearms & hands (20 right & 20 left) of human embalmed cadavers of both sexes with the age range of approximately between 30-60 years. 12 cadavers were male (24 hands) and 8 cadavers were female (16 hands). The study was carried out during the routine dissection for undergraduate medical students in the department of Anatomy. With the help of scale, thread and digital vernier caliper, the following parameters were measured for Morphometric study: Length of muscle belly, Length of tendon, Breadth of muscle, and Width (Thickness) of muscle.

**Results:** The present study was carried out in 40 hands irrespective of side of hands out of which 24 hands were of male and 16 hands were of female. The length of lumbrical muscles was found significantly different in all the lumbrical muscles. In male hands, range of tendon length was from 0.7cm to 2.0cm, with mean value of 1.2cm. In female hands, range was from 0.8cm to 1.3cm, with mean value of 1.0cm. On applying Unpaired T test, it was found significant statistically. In male hands, range of breadth was from 0.3cm to 1.8cm, with mean value of 0.96cm. In female hands, range was from 0.5cm to 1.2cm, with mean value of 0.82cm. On applying Unpaired T test, it was found significant statistically. Thickness of all lumbrical muscles was non-significant statistically.

**Conclusion:** In this study, it was found that length of lumbrical muscles was found significantly different in all the lumbrical muscles. Tendon length and breadth of 1<sup>st</sup> lumbrical muscle was found significantly different in both the genders, while it was non-significantly different in all other lumbrical muscles. Thickness of all the lumbrical muscles was non-significantly different on comparing both the genders. The observations of the present study will be useful to anatomists, orthopedic and plastic surgeons.

**Keywords:** Lumbrical Muscles, Tendon, Extensor, Metacarpals, Phalanges.

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## Background

The lumbricals are deep muscles of the hand that flex the metacarpophalangeal joints and extend the interphalangeal joints. It has four, small, worm-like muscles on each hand. These muscles are unusual in that they do not attach to bone. Instead, they attach proximally to the tendons of flexor digitorum profundus and distally to the extensor expansions [1]. This muscle's small cross-sectional area and measurements of the muscle's strength in biomechanical studies suggest that this is a relatively weak muscle. This is especially true when the lumbrical is compared to the interosseous muscle, which has a similar function but is considerably stronger. The high number of muscle spindles in the lumbricals suggests that these muscles may have an important role in proprioceptive monitoring of the fingers. Furthermore, anatomical factors and the allocation of spindle fibers among the lumbricals suggests that this muscle is more involved in sensory feedback, which is important for precision pinch movements and precise manipulation of objects [2].

The lumbrical muscle is unique among the muscles of human body. It's almost parallel fibers arise from tendon of flexor muscle for finger and insert into the tendon of an extensor muscle. This slender muscle has fascinated the anatomists and has been subject of controversy since the days of Galen [3]. Normally 1st and 2nd lumbricals are unipennate. They arise from the radial sides of flexor digitorum profundus (FDP) tendons for index and middle fingers. They are supplied by branches from Median nerve. 3rd and 4th lumbricals are bipennate. They arise from adjacent sides of FDP tendons for middle & ring and ring & little fingers. They are supplied by deep branch of ulnar nerve. Then they pass distally along the radial side of MCP joints anterior to deep transverse metacarpal ligament. The narrow tendon of insertion joins the extensor expansion (EE) of respective

fingers as distal wing tendons. Through EE, they are inserted into dorsal surfaces of bases of middle and distal phalanges.

Human hand possesses three basic grips-Power, Hook & Precision. Power and Hook grips are primitive while Precision grip is characteristic of human. In precision grip, fingertips & thumb are used to hold finer objects like pen, pencil or needle for skilful manipulation. This grip enriches human culture in arts and crafts. This is contributed by a high degree of neuromuscular co-ordination & a larger cortical representation of the hand in sensory & motor cortex in human brain. Evolution of grasping ability of human being contributed by lumbrical muscles is attributed to the ecological context of such skills in the frogs [4]. Hence human hand is revolution in evolution. According to a study done by D Leyk *et al*, they found considerable differences in hand-grip strength between young male and female adults. The mean maximal hand-grip force differs by more than 200 N, with only a small overlap of strength distribution and no significant influence of hand size [5]. So, this study has been undertaken to know about morphometry and comparison between parameters of lumbrical muscles in both sexes of human hands.

## Methodology

This study was conducted in the Department of Anatomy in ESIC Medical College and Hospital, Bihta, Patna, Bihar, India with 40 forearms & hands (20 right & 20 left) of human embalmed cadavers of both sexes with the age range of approximately between 30-60 years. 12 cadavers were male (24 hands) and 8 cadavers were female (16 hands). The study was carried out during the routine dissection for undergraduate medical students in the department of Anatomy. Material used for morphometry was scale, thread, marker pencil, digital vernier calliper, scalpel, blades, tooth and blunt forceps, scissor. As a guide for dissection,

Cunningham's manual of practical anatomy [3] was used.

The dissection was carried out as follows: A longitudinal incision was taken from the distal end of the flexor retinaculum, up to the level of the metacarpophalangeal joint of the middle finger. The skin, the superficial fascia, the deep fascia and the flexor retinaculum were dissected and reflected. Then, the palmar aponeurosis and the slips which pass from its distal margin to each of the fingers was dissected and reflected.

Then, the tendons of the flexor digitorum superficialis and the flexor digitorum

profundus were reflected distally. The lumbrical muscles which were situated at the distal end of the flexor digitorum profundus tendons were carefully observed. The lumbrical muscles were followed to their tendons which pass with the proper digital vessels and nerves 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 insertion.

With the help of scale, thread and digital vernier caliper, the following parameters were measured for Morphometric study: Length of muscle belly, Length of tendon, Breadth of muscle, and Width (Thickness) of muscle.



**Figure 1 and 2: Showing all lumbricals of hands to measure**

## Results

The present study was carried out in 40 hands irrespective of side of hands out of which 24 hands were of male and 16 hands were of female. Male and female hands comparison of length of lumbrical muscles was done as followed:

1st lumbrical - In male hands, range of length was from 5.6cm to 8.8cm, with mean value of 7.1cm. In female hands, range was from 5.4cm to 6.7cm, with mean value of 6.2cm. On applying Unpaired T test it was found highly significant statistically. (P value<0.01)

2nd lumbrical - In male hands, range was from 5.5cm to 8.5cm, with mean value of 7.2cm. In female hands, range was from 5.0cm to 6.6cm, with mean value of

6.2cm. On applying Unpaired T test it was found highly significant statistically. (P value<0.01)

3rd lumbrical - In male hands, range was from 5.1cm to 8.5cm, with mean value of 6.8cm. In female hands, range was from 5.0cm to 6.3cm, with mean value of 5.98cm. On applying Unpaired T test it was found highly significant statistically. (P value 0.01)

4th lumbrical - In male hands, range was from 4.8cm to 8.0cm, with mean value of 6.4cm. In female hands, range was from 4.5cm to 6.3cm, with mean value of 5.7cm. On applying Unpaired T test it was found significant statistically. (P value 0.02)

**Table 1: Length of lumbrical muscles (in cms)**

Lumbrical	Male	Female	p-value
1	7.1	6.2	<0.01
2	7.2	6.2	<0.01
3	6.8	5.98	0.01
4	6.4	5.7	0.02

Tendon length of lumbrical muscles was done as followed:

1st lumbrical - In male hands, range of tendon length was from 0.7cm to 2.0cm, with mean value of 1.2cm. In female hands, range was from 0.8cm to 1.3cm, with mean value of 1.0cm. On applying Unpaired T test it was found significant statistically. (P value 0.02)

2nd lumbrical - In male hands, range was from 0.9cm to 2.0cm, with mean value of 1.35cm. In female hands, range was from 1.0cm to 1.6cm, with mean value of 1.15cm. On applying Unpaired T test it was found non-significant statistically. (P

value 0.10)

3rd lumbrical - In male hands, range was from 0.7cm to 1.8cm, with mean value of 1.10cm. In female hands, range was from 0.9cm to 1.2cm, with mean value of 1.05cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.25)

4th lumbrical - In male hands, range was from 0.5cm to 1.9cm, with mean value of 1.10cm. In female hands, range was from 0.8cm to 1.0cm, with mean value of 0.92cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.16)

**Table 2: Tendon length of lumbrical muscles (in cms)**

Lumbrical	Male	Female	p-value
1	1.2	1.0	0.02
2	1.35	1.15	0.10
3	1.10	1.05	0.25
4	1.10	0.92	0.16

Breadth of lumbrical muscles was done as followed:

1st lumbrical - In male hands, range of breadth was from 0.3cm to 1.8cm, with mean value of 0.96cm. In female hands, range was from 0.5cm to 1.2cm, with mean value of 0.82cm. On applying Unpaired T test it was found significant statistically. (P value 0.1)

2nd lumbrical - In male hands, range was from 0.5cm to 1.5cm, with mean value of 0.86cm. In female hands, range was from 0.4cm to 1.1cm, with mean value of 0.90cm. On applying Unpaired T test it was found non-significant statistically. (P

value 0.45).

3rd lumbrical - In male hands, range was from 0.4cm to 1.6cm, with mean value of 0.76cm. In female hands, range was from 0.4cm to 1.0 cm, with mean value of 0.73cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.81).

4th lumbrical - In male hands, range was from 0.4cm to 1.6cm, with mean value of 0.80cm. In female hands, range was from 0.3cm to 1.3cm, with mean value of 0.75cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.95)

**Table 3: Breadth of lumbrical muscles (in cms)**

Lumbrical	Male	Female	p-value
1	0.96	0.82	0.10
2	0.86	0.90	0.45
3	0.76	0.73	0.81
4	0.80	0.75	0.95

Thickness of lumbrical muscles was done as followed:

1st lumbrical - In male hands, range of thickness was from 0.3cm to 1.4cm, with mean value of 0.65cm. In female hands, range was from 0.2cm to 0.9cm, with mean value of 0.58cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.30)

2nd lumbrical - In male hands, range was from 0.4cm to 1.7cm, with mean value of 0.67cm. In female hands, range was from 0.3cm to 1.0cm, with mean value of 0.60cm. On applying Unpaired T test it was found non-significant statistically. (P

value 0.65)

3rd lumbrical - In male hands, range was from 0.2cm to 1.5cm, with mean value of 0.50cm. In female hands, range was from 0.2cm to 0.7cm, with mean value of 0.48cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.59)

4th lumbrical - In male hands, range was from 0.3cm to 1.3cm, with mean value of 0.51cm. In female hands, range was from 0.4 cm to 0.9 cm, with mean value of 0.50 cm. On applying Unpaired T test it was found non-significant statistically. (P value 0.96)

**Table 4: Thickness of lumbrical muscles (in cms)**

Lumbrical	Male	Female	p-value
1	0.65	0.58	0.30
2	0.67	0.60	0.65
3	0.50	0.48	0.59
4	0.51	0.50	0.96

## Discussion

Lumbricals of the hand are worm like muscles arising from the four tendons of flexor digitorum profundus (FDP). They are four in number, first and second lumbrical arise from radial sides and palmar surface of tendons to index and middle fingers. The third and fourth lumbricals arise from adjacent sides of the tendons of middle and ring finger, ring and little finger respectively. They pass radially along the metacarpophalangeal joint (MCP) forming a tendon and at the level of dorsal surface of proximal phalanx, joining the radial margin of the dorsal digitorum expansion forming wing tendon [6]. The lumbricals of the upper limb are 4 small muscles resembling earthworms hence the name. They are

numbered 1 to 4 from lateral to medial side. They arise from bare areas of tendons of flexor digitorum profundus (FDP) about the middle of the palm. The narrow tendon of insertion joins the radial margins of extensor expansion (EE) as distal wing tendons [6].

In our study, length of lumbrical muscles was found significant in all the lumbrical muscles. Tendon length and breadth of 1<sup>st</sup> lumbrical muscle was found significant in both the genders, while it was non-significant in all other lumbrical muscles. Thickness of all the lumbrical muscles was non-significant on comparing both the genders. Variations in the lumbrical muscle have been reported as early as 1961 by Mehta *et al.* They reported

anomalous and additional origin of lumbricals from palm (adjacent FDP, same FDS & metacarpal) and forearm (belly of FDP, FDS & FPL) [7]. Similar variation in the palm was reported by Trivedi S *et al* who observed a case of unusual origin of first lumbrical from the first tendon of FDS instead of FDP [8].

Mutalik AM [9] has noted that the length of 1st lumbrical of left hand is more than that of right hand. (P value 0.049). She has also reported that breadth of 4th lumbrical of left hand is more than that of right hand. (P value 0.044). Singh *et al.*, [10] have stated that 3rd and 4th lumbricals are more variable than the first and second lumbricals. First and second lumbricals are known to have a very little variation if any. They have also advocated that amongst the various types of anomalous insertions reported by previous authors, split insertion has been described to be commonest and has been seen most frequently in third lumbrical muscle.

### Conclusion

In this study, it was found that length of lumbrical muscles was found significantly different in all the lumbrical muscles. Tendon length and breadth of 1<sup>st</sup> lumbrical muscle was found significantly different in both the genders, while it was non-significantly different in all other lumbrical muscles. Thickness of all the lumbrical muscles was non-significantly different on comparing both the genders. The observations of the present study will be useful to anatomists, orthopedic and plastic surgeons.

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