Clinical Relevance Of Morphological Variations In Origin And Insertion Of Lumbricals Of Hand In South Gujarat Population

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Abstracts: **Background & objectives:** Lumbrical muscles, though small in size, have a significantly greater role to play in the intricate movements of the fingers.The great functional significance and morphological variations of lumbrical muscles as described in the literature, prompted us to undertake a detailed study of these muscles to know more about it and its significant value in the design of surgical procedures. **Methods:** We dissected lumbricals of hands of 40 human adult cadavers which were available from the Department of Anatomy. In the present study, variation in origin (include architecture), insertion (include split insertions, misplaced insertions or absence of muscles), the lengths of muscle belly and tendon of all lumbricals were studied and noted. **Results:** We found variations were more common on the right side. The second lumbrical was bipennate in 12.5% cases. The third lumbrical showed split insertion in 15% cases. The fourth lumbrical showed misplaced insertion in 10% cases. The proximal attachment of lumbricals can extend into the carpal tunnel (specially first and second) in 15% cases. **Conclusion:** The study provides valuable information to surgeons thus avoiding complications from local anesthetic, surgical and other invasive procedures. [Modasiya U et al NJIRM 2013; 4(6) : 50-53]

Key Words: Lumbrical, carpal tunnel syndrome, split insertion, misplaced insertion, bipennate.

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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 hands. The lumbricals of the upper limb are four small muscles resembling the shape of earthworms and hence they are named so. They are numbered from lateral to medial side. The lumbricals take their origin in the palm from the four tendons of the flexor digitorum profundus and pass distally along the radial side of the corresponding metacarpo-phalangeal joint, in front of the deep transverse metacarpal ligament. Each muscle forms a narrow tendon and runs in a lumbrical canal, and on reaching the dorsal surface of the proximal phalanx, joins the radial margin of the dorsal digital expansion as the distal wing tendon. The first and second lumbricals are unipennate, and are supplied by the median nerve, while the third and fourth lumbricals are bipennate and are supplied by a deep branch of the ulnar nerve. Lumbricals produce flexion at metacarpophalangeal joint and extension at interphalangeal joints[1].

Pinching the index finger against the thumb without a lumbrical would result in a nail-to-nail contact; the addition of the lumbricals increases the interphalangeal joint extension resulting in pulp-to-pulp pinch. These muscles also play a significant role in proprioception[2].

Functional length means the length trough the entire range of motion between the extremes. Functional lengths of tendons of lumbricals are important which permits successful application of principles of transplantation of tendons of a given functional length for a motion requiring approximately the same functional length. Functional length of lumbrical of middle finger may reach about 3.5 to 4.5 cm, with correspondingly less figures for the other fingers[3]. A large number of variations in the attachments of the lumbricals have been described in the literature, ranging from complete absence to reduction in their numbers or presence of accessory slips[4].

Because of the increased hand injuries in road traffic accidents, the knowledge of occurrence of such anatomical variation of lumbricals is very important for the hand surgeons. The present study is undertaken to observe and record the variation in the attachments of lumbricals in cadavers of south gujarat population.

Material and Methods: We studied frequency of variation of lumbricals in 40 human adult cadavers which were available from the Department of

Anatomy, SMIMER Medical College, Surat, Gujarat over a period of three years. The dissection was carried out according to the Cunningham's manual of practical anatomy[5].

Measurements were taken with hand in a neutral position by using the sliding caliper for measuring the following length,

a) Of total muscle(TL), from the most proximal point of the origin to the point of merger of tendon at the curved proximal point in the dorsal digital expansion or the distal end of insertion
b) Of muscle belly, from the most proximal point of origin to the distal point where muscular fibers ended
c) Of the tendon, from the most proximal point of its appearance to its distal ends in insertion.

Measurements were carried out twice to exclude observer error and the means of the recorded values were determined.

The following parameters were noted:

1. Site of origin and insertion of the lumbricals.
2. The architecture of the muscles was noted i.e. unipennate or bipennate pattern.
3. The total length of muscle, length of muscle belly and tendon length of all lumbricals.

Analysis of the data was done using Microsoft excel. Student's t test was used for statistical analyses. A P value of less than 0.05 was considered statistically significant. For the dissection of the cadavers, and materials which were used in the study, required permissions were taken from respective offices and departments of the institute and all the methods were followed in-line with international ethics and values.

Result: We found variations were common on right hand lumbricals (65%) than left hand (57.5%). In the present study, the right hand lumbricals 14(35%) were normal, 7(17.5%) hands showed a proximal origin, 4(10%) of the second lumbricals were bipennate, 2(5%) of the fourth lumbricals were unipennate, 7(17.5%) of the third lumbricals showed split insertion(Fig 1), 2(5%) of the fourth lumbricals showed split insertion and 4(10%) of the fourth lumbrical tendons were inserted on the ulnar side of the ring finger(Fig 1; Table 1).

Figure 1 Split insertion of 3rd lumbrical (a) and 4th lumbrical (b) inserted on ulnar side of ring finger in right hand [FDP-Flexor Digitorum Profundus]

On the left hand lumbricals 17(42.5%) were normal, 5(12.5%) hands showed a proximal origin, 6(15%) of the second lumbricals were bipennate(Fig 2), 1(2.5%) of the third lumbricals were unipennate, 5(12.5%) of the third lumbricals showed split insertion, 2(5%) of the fourth lumbricals showed split insertion and 4(10%) of the fourth lumbrical tendons were inserted on the ulnar side of the ring finger(Fig 2;Table 1).

Table: 1 Comparison of lumbricals of right and left hands observed in 40 cadavers

Lumbricals	Right (%)	Left (%)
Normal	14(35%)	17(42.5%)
Proximal Origin	7(17.5%)	5(12.5%)
Bipenate 2nd lumbrical origin	4(10%)	6(15%)
Unipenate 3rd lumbrical origin	0	1(2.5%)
Unipenate 4th lumbrical origin	2(5%)	0
Split insertion of 3rd Lumbrical	7(17.5%)	5(12.5%)
Split insertion of 4th Lumbrical	2(5%)	2(5%)
Insertion of 4th lumbrical on ulnar side of ring finger	4(10%)	4(10%)

On analyzing our results mean total length of first right lumbrical was 69.12±14.89, while mean total length of left first lumbrical was 68.56±14.70. Difference between total length of first right and left lumbrical was statistically insignificant (P=0.390). Mean difference of total length of second, third and fourth right and left lumbricals were statistically insignificant (P>0.05) (Table 2). The values of muscle belly length and tendon length of all the lumbricals of the right and left side hands were compared.(Table-2) On applying the test of significance, these values were found to be statistically insignificant (P>0.05).

Figure 2 Bipennate origin of 2nd lumbrical (a) and 4th lumbrical (b) inserted on ulnar side of ring finger in left hand [FDP-Flexor Digitorum Profundus]

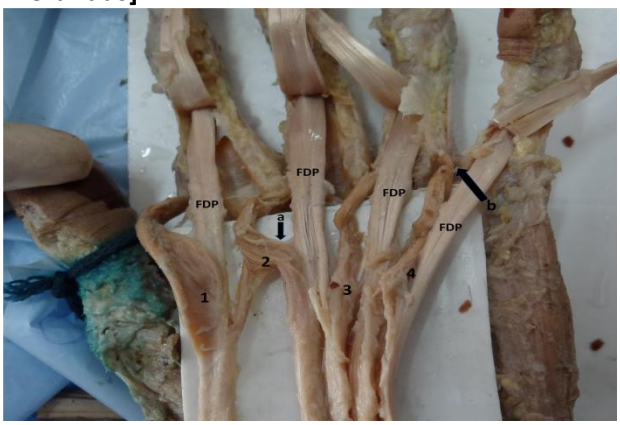

Table 2: Comparison in measurements of lumbricals in right hands (n=40) and left hands (n=40)

No.	Right hand		Left hand		't'	p
	Mean	SD	Mean	SD		
Total muscle length in mm						
1	69.12	14.88	68.57	14.70	0.868	0.390
2	60.92	13.49	59.57	13.18	0.694	0.491
3	52.72	12.36	51.25	11.81	0.586	0.560
4	45.5	11.47	43.8	11.05	0.501	0.618
Muscle belly length in mm						
1	55.65	11.18	55.6	11.56	0.984	0.331
2	50.55	10.66	49.67	10.92	0.717	0.477
3	44.62	10.33	43.45	10.03	0.607	0.547
4	39.55	9.46	38.27	9.62	0.552	0.584
Tendon length in mm						
1	13.47	4.06	12.97	3.48	0.556	0.581
2	10.37	3.12	10.07	2.62	0.643	0.523
3	8.1	2.45	7.8	2.15	0.562	0.576
4	5.95	2.31	5.52	1.88	0.370	0.712

Discussion: Muscles are subject to variations either in the form of its origin, insertion, absence of muscle or presence of an accessory belly. Usually accessory muscles do not cause symptoms but they become a surgical problem when they produce symptoms or are difficult to differentiate from soft tissue tumors. So these variations are of academic interest. In the present series first lumbrical, in all cases was unipennate, whereas it was found that 12.5% of cases, the 2nd lumbrical in both hands were bipennate. Various studies show the percentage of bipennate second lumbrical is more than the absence of muscle. In a study conducted by Joshi et al[6], second lumbrical was bipennate in 45% of cases, while Ajmani[7] showed that it was bipennate in 24% of cases & Ashwini M Mutalik et al (2011)[8], showed that 3.3% of the 2nd lumbrical in both the hands were bipennate. In present study, 2(5%) of the fourth lumbricals were unipennate in right hand, 1(2.5%) of the third lumbricals were unipennate in left hand.

Siegel DB [9] ,found that in cases of the carpal tunnel syndrome and in those in which repetitive hand motions were performed, the lumbricals had significantly larger and proximal origin in the carpal tunnel, which could be the cause of the carpal tunnel syndrome and result in hypertrophy and compression of the median nerve. Hypertrophy of the lumbrical muscle in digital vascularization disease can cause compression of radial and ulnar collateral arterial system producing chronic subischemia or white finger[10]. Entin [11] grouped causes of carpal tunnel syndrome into three categories: those reducing the capacity of the tunnel; those increasing the volume of its contents; and those forming part of a systemic condition. In the present study, 7(17.5%) right hands showed a proximal origin, 5(12.5%) left hands showed a proximal origin. In a study conducted by Ashwini M Mutalik et al [8] , 26.6% of the cadavers in the right hand and 16.6% in the left hand had the proximal origin of the lumbricals while Joshi SD et al[6], 20% hands showed proximal attachment in 70 normal hands. To find out the CTS due to lumbricals muscle incursion in Carpal tunnel, Cobb et al[12] described 'fist test'. In this test, person is asked to keep the hand in sustained fist position for 45 seconds it would result in numbness in the area of distribution of median nerve. Our finding in the present study was that abnormal and proximal origin extended into the carpal tunnel. They will increase the volume of carpel tunnel contents and may lead to the CTS.

In a study which was conducted on the variations in the lumbricals, it was found that the absence of the 4th lumbrical was very common and that it was absent in 3% of the cases & Ashwini M Mutalik et al[8], revealed 1.4% and 5.3% of the cases to have the absence of the 4th lumbrical. In contrast to this study, in present study the authors revealed none of cases to have absence of the 4th lumbrical. In present study, 3rd lumbrical showed split insertion

in 15% cases and 4th lumbrical in 5%cases.The fourth lumbrical inserted on ulnar side of ring finger in 10% of cases. Our study compare with other studies mentioned in bellow (Table 3), it was found that our finding were consistent.

Table 3: Comparative study of split and misplaced insertion of lumbricals by different authors

Authors	No.	2nd		3rd		4th	
		Split insertion	Misplaced insertion	Split insertion	Misplaced insertion	Split insertion	Misplaced insertion
Basu and Hazary (1960)[13]	72	2(2.8%)	--	15(20.8%)	9(12.5%)	8(11.2%)	4(5.6%)
Mehta and Gardner (1961)[14]	75	1(1.3%)	--	29(38.7%)	7(9.3%)	6(8%)	6(8%)
J.D. Singh, P. B. Raju and Shamer Singh (1975)[15]	107	--	--	29(27.1%)	2(1.86%)	27(25.2%)	10(9.34%)
A M Mutalik(2011)[8]	60	--	--	7(13.3%)	1(1.66%)	1(1.66)	5(9.95%)
Present Study	80	--	--	12(15%)	--	4(5%)	8(10%)

Ashwini M Mutalik et al[8], found that the length of the 1st lumbrical of the left hand was more than that of the right hand (P = 0.049). In contrast to this study, we found that difference between total length of first right and left lumbrical was statistically insignificant (P=0.390).

Conclusion: These types of variations are interesting not only to anatomists, but also to orthopedic surgeons, physiotherapists and radiologists. Hence the clinician must be aware constantly of such possibilities, although preoperative diagnosis may be difficult. We believe that the anatomical muscular variations found in this study may be significant in preoperative diagnosis and in the hand surgery.

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