

Readme Hand muscles attachments: A Geometrical model

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The dataset consists of two separate datasets: morphological and morphometric dataset and exact position of muscle lines origins, insertions and CSAs dataset and Matlab code used to calculate lines end and via points.

Morphological and morphometric dataset based on dissections

The morphological and morphometric dataset consist morphological drawings (Figure 6 to 9) and tables 1 to 3 of morphometric dimensions available as xlsx:

Table 1: dimensions of intrinsic hand muscle thenar and hypothenar group

See `table1.xlsx`

Table 2: dimensions of intrinsic hand muscle central group

See `table2.xlsx`

Table 3: dimensions of extrinsic hand muscles selected flexors and extensors

See `table3.xlsx`

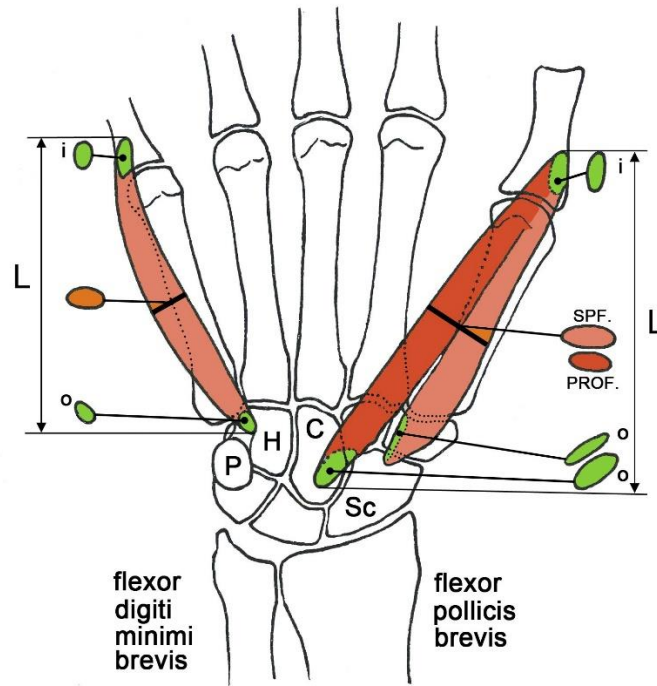


Figure 1: Origins and insertions of two short flexors of the thenar and hypothenar muscle group.
 Notes: L – muscle length, P – pisiform bone, H – hamate bone, C – capitate bone, Sc – scaphoid bone, o – muscle origin, i – muscle insertion, SPF – superficial muscle head, PROF – deep muscle head.

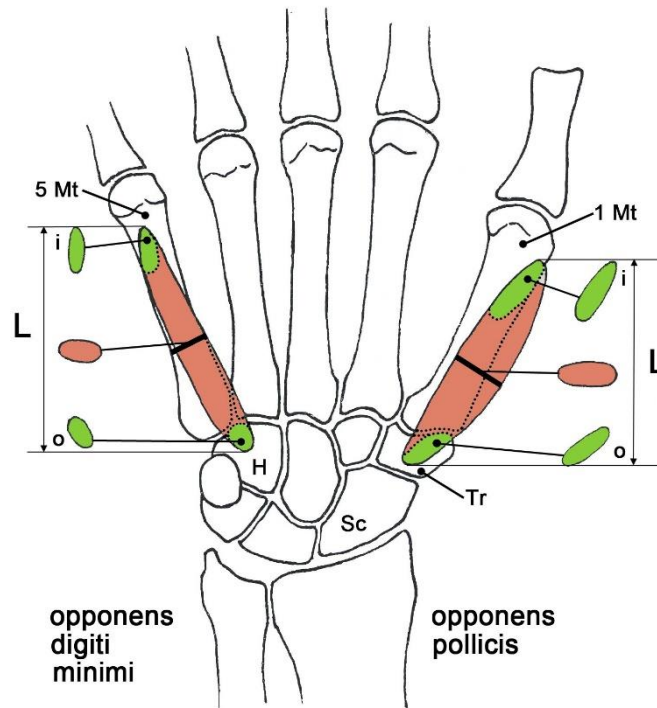


Figure 2: Origins and insertions of two muscles opposing the thumb (opponens pollicis) and the little finger (opponens digiti minimi). Notes: H – hamate bone, Sc – scaphoid bone, Tr – triquetrum bone, 1 Mt – first metacarpal bone, o – muscle origin, i – muscle insertion, L – muscle length.

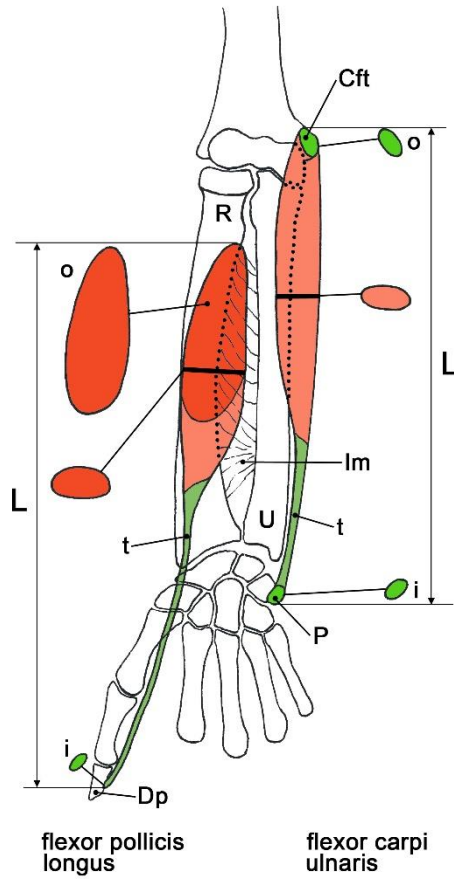
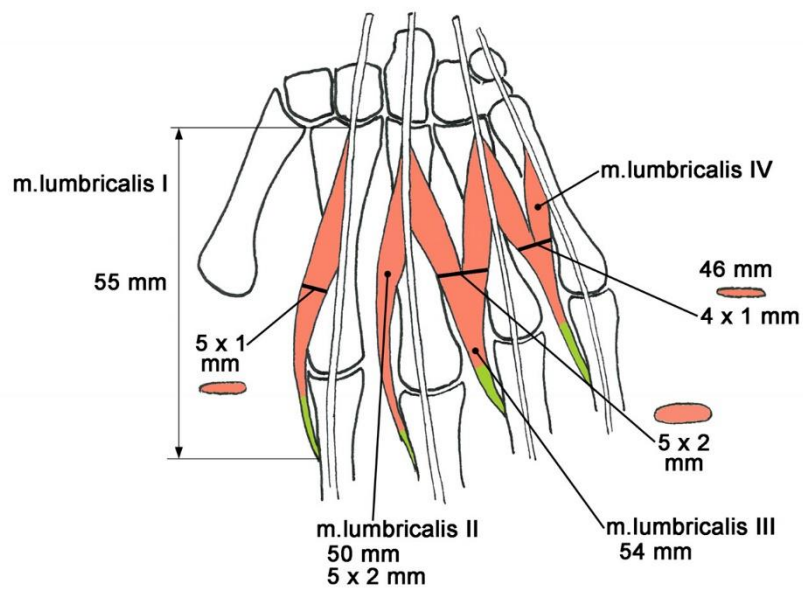


Figure 3: Origins and insertions of two extrinsic hand muscles – flexor pollicis longus and flexor carpi ulnaris. Notes: L – muscle length, t – tendon, o – origin, i – insertion, P – pisiform bone, CFT – common flexor tendon, Im – interosseous membrane, R – radius, U – ulna, Dp – distal phalanx.



MM.LUMBRICALES

Figure 4: Measurements of length and biological cross section area for four lumbricales, tendons in green

Exact position of muscle lines origins, insertions and CSAs dataset

The exact positions of muscle lines origins, insertions and CSAs dataset divided into `muscle_paths_hand.zip`, `muscle_paths_shoulder.zip`, `muscle_paths_shoulder_deltoideus.zip`, `ligament_paths.zip` contains:

- all the attachment and intermediate surfaces extracted from MRI in binary stl format,
- calculated lines' end and via points in plain text csv files denoted by extension "asc"

Data for individual muscles are organized into corresponding folders. Each folder contains:

- origin and insertion surfaces in stl files denoted by "O" and "I" in name respectively
- optionally intermediate CSA surfaces denoted by "T" or "V" resp. "C" in name, to specify connectivity surfaces are in order O-I, O-T-I or O-V-C-I
- asc files with points' coordinates, denoted again by letter for corresponding surface and by number denoting number of points

Points' order specifies their connectivity calculated based on Euclidean matching problem i.e. first points in `abductor_digiti_minimi_0_6_cnrds.asc` is paired with first point in `abductor_digiti_minimi_T_6_cnrds.asc` etc. Coordinates are in *cm*, data for individual axes are sorted naturally X, Y, Z. Coordinate system origin is illustrated in Figure 5.

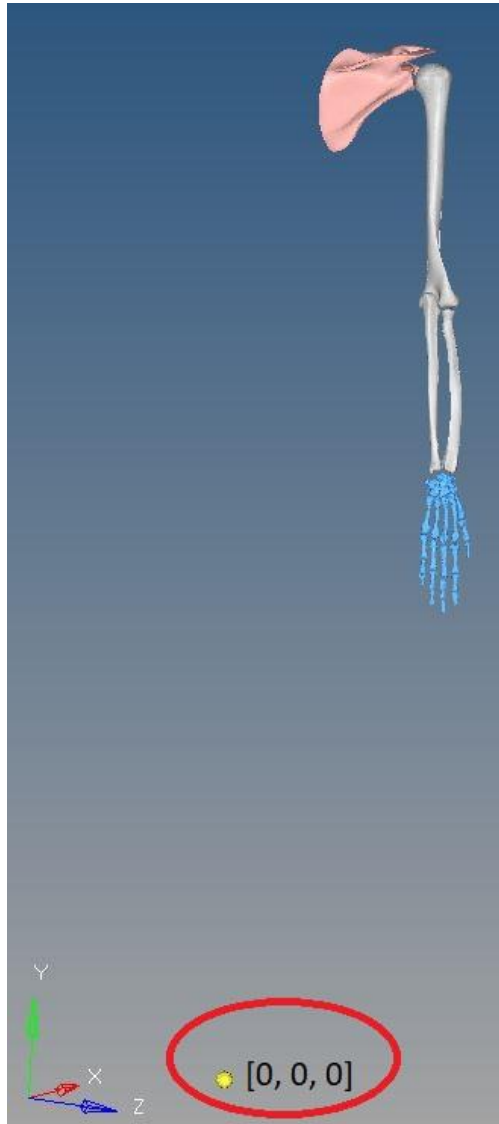


Figure 5 Coordinate system of MRI scans

Additionally, positions of points for some muscles transformed to local coordinate systems of appropriate bones are summarized in tables 5 to 6. Coordinate systems for individual segments can be found in Table 4 and Figures 6 to 8.:

Table 4: The LCS of individual segments – position of origin, axes orientation. Notes: COG – center of gravity; CSA – cross section area.

LCS	Position of origin	Axes orientation		
		x	y	z
Carpals	COG of segment	palmar	proximal	lateral
Finger phalanx	COG of segment	palmar	proximal	lateral
Humerus	centre of humeral head	lateral	proximal	posterior
Ulna	trochlear notch, on the right edge	medial	distal	posterior
Radius	in the center of CSA of bone, in the level of radial tuberosity	proximal	medial	posterior

Table 5: origins/insertions intrinsic hand muscles thenar and hypothenar group

See [table5.xlsx](#)

Table 6: origins/insertions intrinsic hand muscles central group

See [table6.xlsx](#)

Table 7: origins/insertions extrinsic hand muscles selected flexors and extensors

See [table7.xlsx](#)

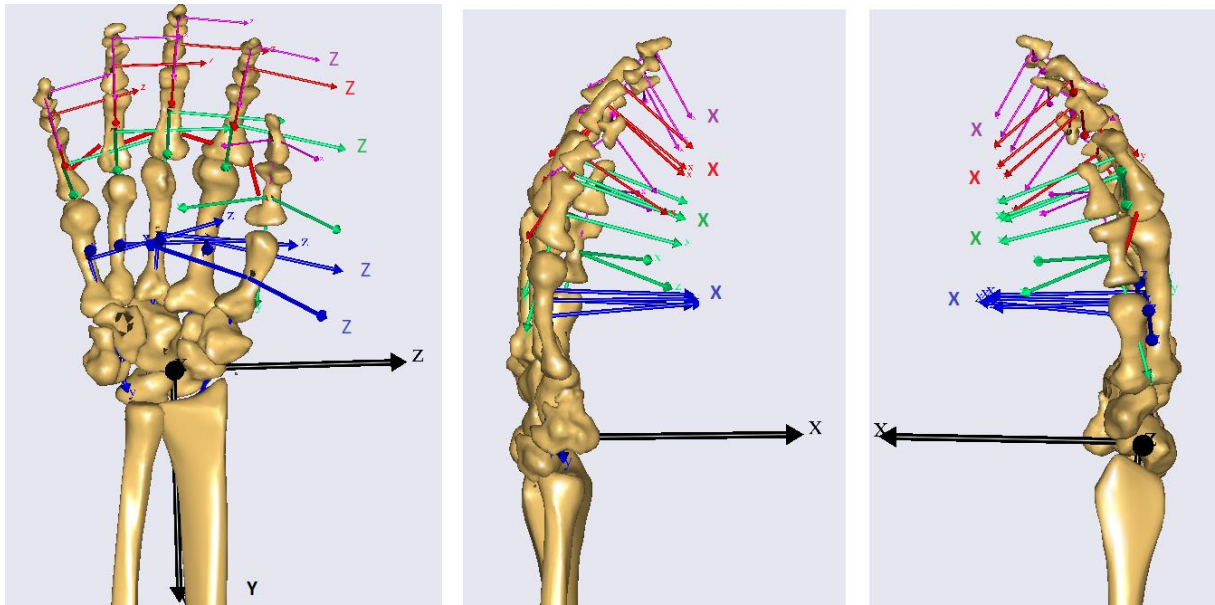


Figure 6: The local coordinate system of carpals and individual bones of the right hand. From the left: palmar view, pinky side view (medial), thumb side view (lateral). Notes: violet – distal phalanx, red – middle (intermediate) phalanx, green – proximal phalanx, blue – metacarpal phalanx, black – carpals.

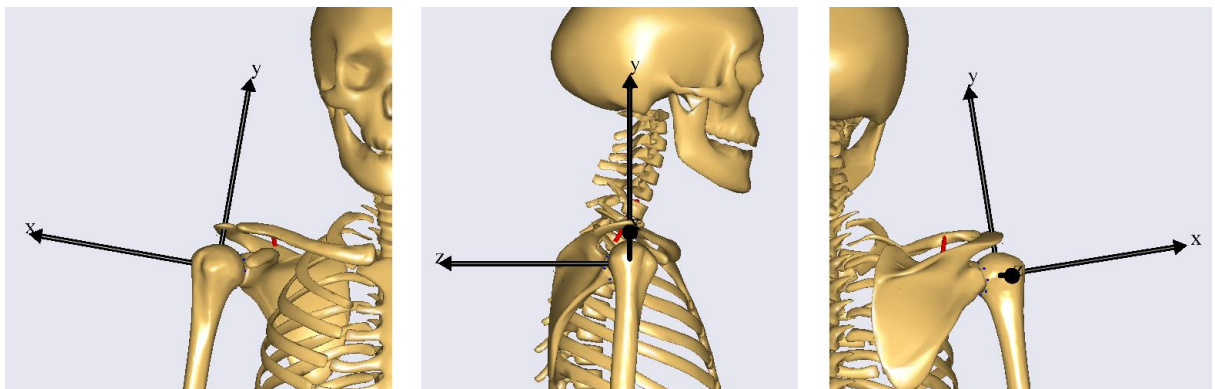


Figure 7: The local coordinate system of humerus. From the left: front view, right-side view, back view.

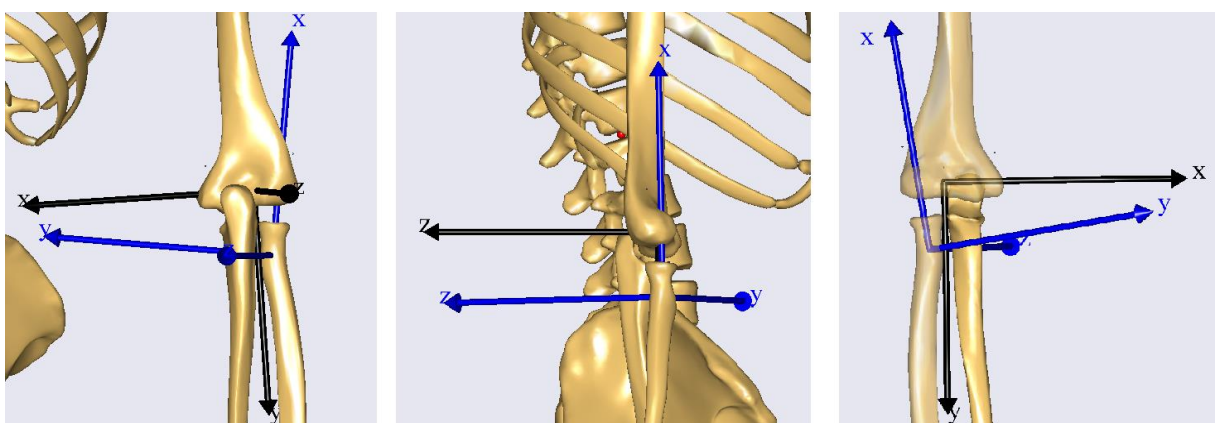


Figure 8: The local coordinate systems of ulna and radius. From the left: back view, right-side view, front view (transparent view of humerus and radius). Notes: black – ulna, blue – radius

Matlab code for calculating lines end and via points

Matlab code has single entry point `main.m` where you can specify input file, output folder and whether you want to display figures with plots of results. The input file is in `.yaml` format and contains:

- **Name**: name of the muscle to be used for output
- **K**: number of lines to use, can be a list
- **Surfs**: list of surfaces in desired order of connection saved as `stl` files, all with common coordinate system

Example of input file is included, see `abductor_digiti_minimi.yaml`.

Acknowledgments

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