The microscopic concept of ‘tissues’, first introduced some 350 years ago, may also have been inspired by macroscopic anatomy, e.g., with respect to tendons of Mm. Flexores Digitor…

Poster · October 2023

DOI: 10.13140/RG.2.2.24437.35044

1 author:

K. J. van Zwieten
Hasselt University
215 PUBLICATIONS **252** CITATIONS

The *microscopic* concept of 'tissues', first introduced some 350 years ago, may also have been inspired by *macroscopic* anatomy, e.g., with respect to tendons of Mm. Flexores Digitorum ('FDP' & 'FDS') in the finger

K. J. van Zwieten

Department of Anatomy, Faculty of Medicine and Life Sciences, University of Hasselt, Campus Diepenbeek, Bldg. D., Agoralaan, 3590 Diepenbeek, Belgium. koosjaap.vanzwieten@uhasselt.be

Introduction

The year 2023 marks the 350 years' commemoration of Grew's book [1] on Plant Anatomy (Fig. 1) followed by a 2nd book [2], after which Grew was named *'Father of Histology'* [3]

We illustrate his concept of living "tissues", starting from the fact that not only in *microscopic* but also in *macroscopic anatomy*, comparison with weaving can be made.

Stating the problem, case studies

Recent papers [4]-[6] underline the importance of basic anatomy in the treatment of finger flexor-tendon-sheaths lesions in rock climbing *viz.* during so-called ***crimp grips*** (Fig. 2).

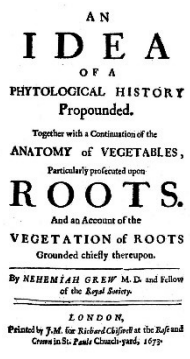

AN
IDEA
OF A
PHYTOLOGICAL HISTORY
Propounded.
Together with a Continuation of the
ANATOMY of VEGETABLES,
Particularly profecuted upon
ROOTS.
And an Account of the
VEGETATION of ROOTS
Grounded chiefly thereupon.
By NEHEMIAH GREW M.D. and Fellow of the Royal Society.
LONDON,
Printed by J.M. for Richard Chiswell at the Rofs and Crown in St. Paul's Church-yard, 1673.

Figure 1 Frontpage of [1]

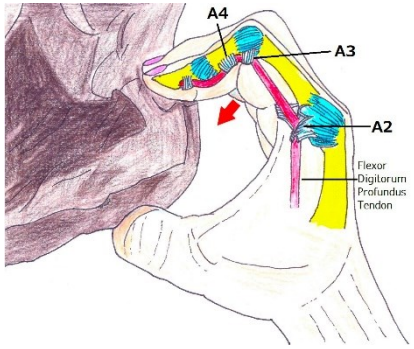


Figure 2 "Crimp grip", after Ref.[4], adapted

Pathomechanics

Annular (A) and Cruciform (C) collagenous reinforcements of finger tendon-sheaths act as strong pulleys guiding the flexor tendons' gliding, unless *too much force (arrow)* is exerted, as Fig. 2 shows. Here, pulley A2 is torn, while A3 & A4 are 'at risk' - located around the "P.I.P." region, see Fig. 3 (blue square).

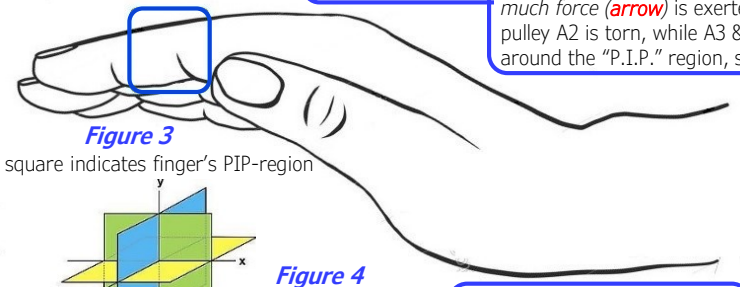


Figure 3

Blue square indicates finger's PIP-region

Figure 4 Three orthogonal planes [7]

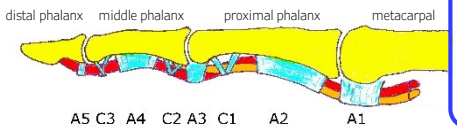


Figure 5 Osteo-tendinous diagram, after Ref. [5], adapted

Macroscopic anatomy

Opening all A's and C's reveals the peculiar but normal position of the FDP-tendon, 'perforating' the FDS-tendon, Figs. 6 & 7 [9, 10] They are known as ***perforans*** and ***perforatus*** A ***'weaver's-effect'*** is unmistakable.

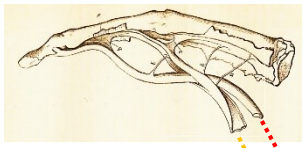


Figure 6

Perforans & *Perforatus*, see text

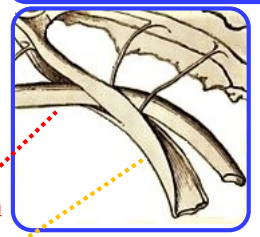


Figure 7 Detail

Research question

In normal finger function the Cruciform (C) pulleys play their roles too. In order to elucidate their position, relative to the deep (FDP), as well as superficial (FDS) flexor tendons, HR-MRI slices in 3 orthogonal planes (Fig. 4) at PIP-level in an anatomical specimen of an otherwise normal finger were produced, afterwards followed by 3-D reconstructions [8].

Normal finger's osteo-ligamentous-tendinous diagram Fig. 5 shows, relative to its osteology (yellow), all annular and cruciform structures (blue) plus finger long flexor tendons. In orange: FDS (tendon flexor digitorum superficialis), in red FDP (tendon of the m. flexor digitorum profundus).

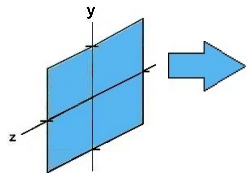
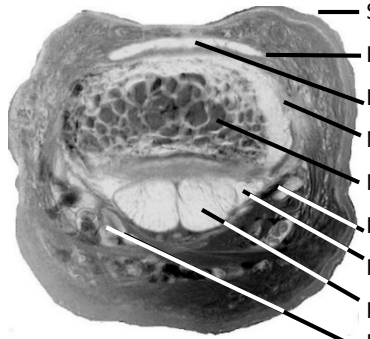
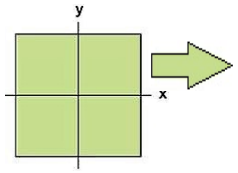


Figure 8

Transverse slice





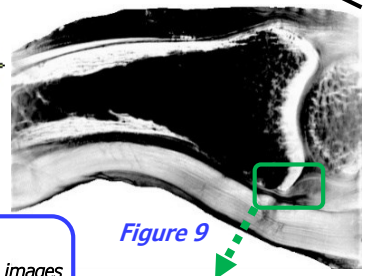


Figure 9

HR-MRI Results

Most resulting ***HR-MRI 2-D images*** were already published [11]. In this poster, b/w shades are inverted w/b. Transverse slicing classically reveals a wealth of details (Fig. 8). Sagittal slices (Figs. 9 & 10) confirm the unique findings by Lutter et al. (2023) *viz.* P.I.P. - volar plate zones 1, 2, 3 [6]. Frontal slice (Fig. 11) reveals the typical "undulating" passage of FDP-tendon at P.I.P.-level (Fig. 5), as does ***3-D reconstruction*** too (Fig. 12) [12]. FDP & FDS [8] are "suspended" by C2

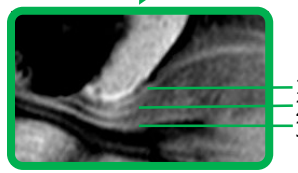
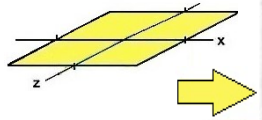


Figure 10

Figs. 9 & 10 : Sagittal slices



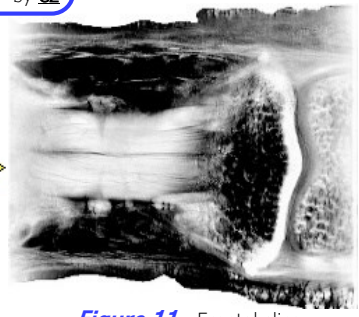


Figure 11 Frontal slice

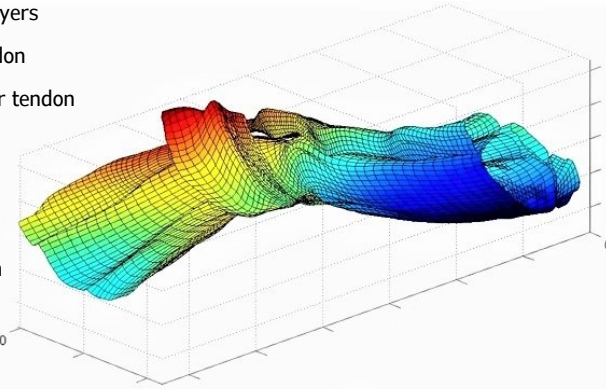


Figure 12 3-D reconstruction: FDP & FDS 'suspended' by C2

Discussion and Conclusion

On the occasion of 350 years commemoration of Grew's Plant Anatomy (1673), followed by a book (1682) that introduced a first comparison with weaving techniques, this sentence reads as follows:

15. §. SO THAT the moſt unfeigned and proper reſemblance we can at preſent, make of the whole *Body* of a *Plant*, is, To a piece of *fine Bone-Lace*, when the Women are working it upon the *Cuſhion*, For the *Pith*, *Inſertions*, and *Parenchyma* of the *Barque*, are all extream Fine and Perfect *Lace-Work*: the *Fibres* of the *Pith* running *Horizontally*, as do the *Threds* in a Piece of *Lace*;

Apart from such resemblances, the 'weaver's effect' as observed **macroscopically** in the finger's "perforans" tendon piercing the "perforatus" tendon, may have led to this comparison too. Further, it is not unthinkable from these pre-rationalist days [13] that Grew (son of a clergyman) was inspired by the awareness that the creator is weaving, just "as the weaver effects an artistic texture with the shuttle" [13], as is also suggested by other descriptions of his work [14]. Moreover, [14]-[17] explain the feminine noun riqmâh (רקמה) as "**woven** or embroidered" stuff.

To conclude, our case-driven research illustrates that HR-MRI is an excellent method to visualize details of 3-D finger anatomy that are easily overlooked in most simplistic anatomical diagrams.

References

1. Grew N, 1673, An idea of a phytological history propounded together with a continuation of the anatomy of vegetables, etc. Printed by J.M. for Richard Chiswell, London.
2. Grew N, 1682, The anatomy of plants: with an idea of a philosophical history of plants, and several other lectures, read before the Royal Society. W. Rawlins, London.
3. Barclay GF, 2015, Anatomy and Morphology of Seed Plants. In: eLS. John Wiley & Sons, Ltd: Chichester. DOI: 10.1002/9780470015902.a0002068.pub2
4. https://gripped.com/indoor-climbing/the-dreaded-finger-pulley-injury/
5. Schneeberger BS, Schweitzer MD, 2016, Pulley Ruptures in Rock Climbers: Outcome of Conservative Treatment With the Pulley-Protection Splint. Wild Environ Med, 27, 211-218.
6. Lutter C et al., 2023, Dynamic study of the finger interphalangeal joint volar plate - motion analysis with MR cinematography and histologic comparison. Skeletal Radiol, 52, 1493 1501.
7. https://www.ck12.org/book/cbse_maths_book_class_11/section/14.2/ Creative Commons Attribution-NonCommercial 3.0. Minor changes were added, to be used in our Figs. 8–11 as well.
8. Lippens P et al., 2001, Computer Reconstruction of Human Tendon Architecture Based on NMR Images. J Morph, 248, 3, 255.
9. Gupta A, Tamai M, 2021, The grasping Hand, Structural and Functional Anatomy of the Hand and Upper Extremity. Georg Thieme Verlag KG.
10. Marshall J, 1853, On Certain Elastic Structures Connected with the Deep Flexor Tendons of the Fingers and Toes. Br Foreign Med Chir Rev, 21, 225-235. Creative Commons Attribution.
11. van Zwieten KJ et al., 2019, Anatomical evidence supports recent hypothesis on the pathogenesis of Dupuytren's contracture. Clin Pathophysiol, 3, 71-79.
12. Dinç U et al., 2021, Morphological features of the chiasma tendinum and its relation with surface landmarks and pulleys: a cadaveric study. Surg Radiol Anat, 43, 1623-1633.
13. Jäger A, 1878, Das Eindringen des modernen kirchenfeindlichen Zeitgeistes in Oesterreich unter Karl VI. und Maria Theresia. Zeitschrift für katholische Theologie, 2, 2, 259-311.
14. Sutton L, 2019, Reading Psalm 139 as a Literary Unit: a Bodily Interpretation from the Perspective of Space. MA Dissertation, Faculty of Humanities, University of Pretoria, Pretoria.
15. Mackenzie P, 2022, Nehemiah Grew, the illustrator. The Royal Society, Notes and Records. DOI:10.1098/rsnr.2022.0020, downloadable from https://royalsocietypublishing.org/
16. https://www.sefaria.org/Psalms.139.16?lang=bi
17. https://bibleapps.com/hebrew/7553.htm