



Electromyographic (EMG) Activity of Functional Subdivisions in Human Multitendoned Finger Muscles

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1. Introduction

The primary action of the muscle Flexor Digitorum Profundus (FDP) is to flex the distal phalanges of the index, middle, ring, and little fingers. FDP contributes to the flexion of all four digits because it has four tendons, each of which attaches to a separate digit. Despite this multi-tendoned arrangement it is possible to move each digit relatively independently of the others. It is possible to see some anatomical compartmentalization of the muscle but it is not known if there are four completely separate parts each controlling the movement of a single digit. The aim of this research was to examine the EMG activity produced by different parts of FDP while participants made separate flexion and extension movements of each of the digits.

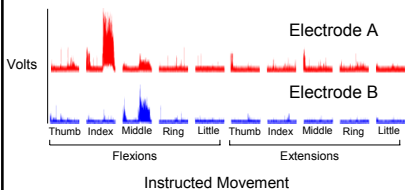
2. Methods

- Participants:** Studies were conducted on four right-handed volunteers.
- Electrode Placement:** 2 or 4 fine-wire electrodes were placed into FDP in a single recording session. Each electrode was inserted through the medio-ventral aspect of the forearm using a hypodermic needle. Once the electrode was in place the needle was removed. The approximate position of the electrode in the muscle was determined by identifying which digit, when flexed, produced the most EMG activity. In each recording session electrodes were intentionally placed in parts of the muscle that were related to the isolated flexion of different digits.
- Data Acquisition:** EMG activity from each electrode was sampled at a minimum of 5.5 kHz and band-pass filtered (300 Hz - 3kHz).
- Isometric Finger "Movement" task:** Participants placed each digit of their left hand into an apparatus that measured the flexion and extension forces at the distal phalanx of each digit. On a single trial participants received visual instructions, via an LED display, informing them with which digit to produce a force and whether to produce a flexion or extension force. The task was to produce a minimum force of 1N in the correct digit while producing less than 1N in either direction in the other four digits.

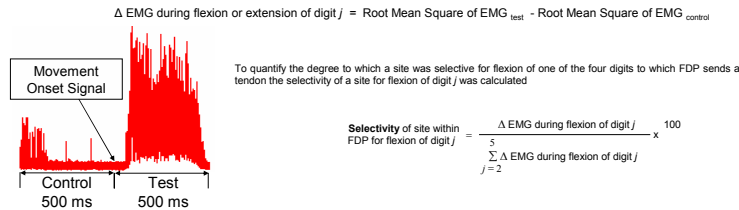


3. Multi-trial averaged rectified EMG simultaneously recorded from two sites within FDP

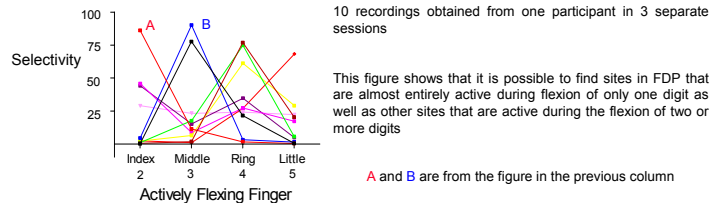
Electrode A was primarily active during flexion of digits 2 and 3 while Electrode B was active during flexion of digit 3



4. Determining the degree of compartmentalization within FDP

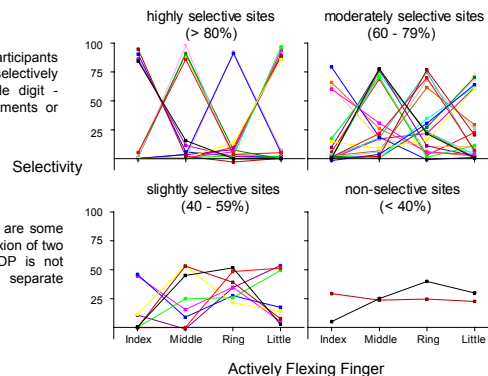


5. There are regions of FDP that are selective for flexion of each of the four digits



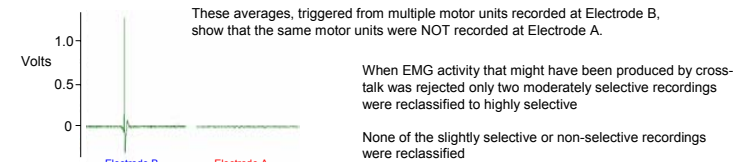
6. Some areas of FDP are more selective for flexion of a single digit than others

Individual recordings from all four participants show that different parts of FDP are selectively active during the flexion of a single digit - suggesting the presence of compartments or functional subdivisions within FDP

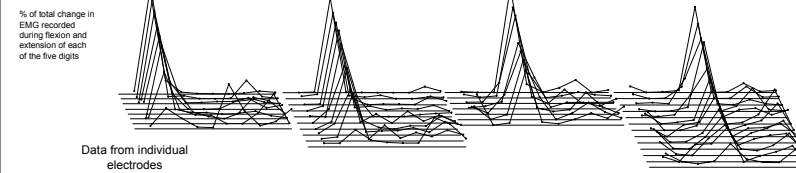
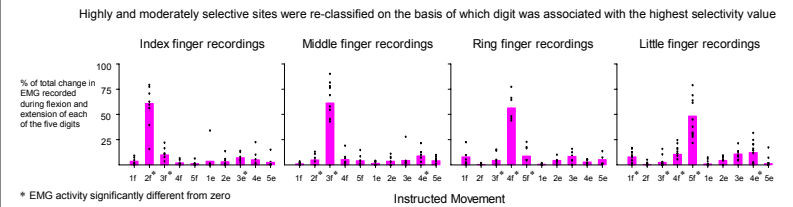


BUT these data also show that there are some parts of FDP that are active during flexion of two or more digits - suggesting that FDP is not organized into four completely separate compartments

7. Slightly selective and non-selective recordings are unlikely to be the result of cross-talk from an adjacent part of the muscle



8. Parts of FDP that are Highly or Moderately selective for flexion of a particular digit also produced significant EMG activity when an adjacent digit flexed or extended



9. Conclusions

In normal human subjects FDP has a separate functional subdivision for the index, middle, ring, and little fingers. These functional subdivisions are primarily active during flexion of a single digit but also produce EMG activity during flexion and extension of an adjacent digit. Relatively less selective recordings suggest that the human FDP may not be completely compartmentalized.