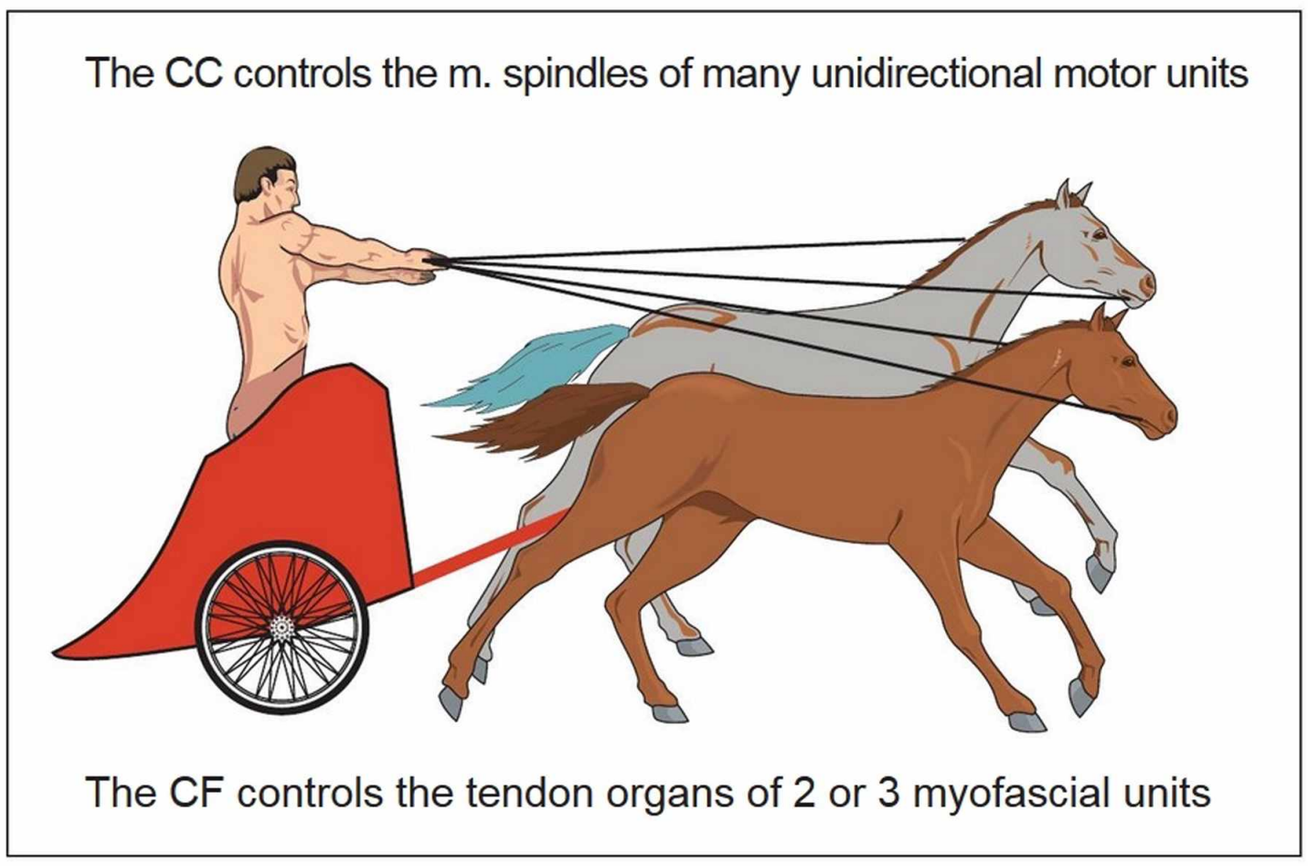
PHYSIOLOGY: CENTRES of FUSION



From CC to Centre of Fusion (CF)

Fig. 1.15. Centre of Coordination (CC) and Centre of Fusion (CF).

The brain programmes directional movement that is then adapted to the motor variables by:

- the muscle spindles, which refer to the CC of each myofascial unit
- the Golgi tendon organs, which refer to the CF located in the retinacula (In Latin, retinaculum = reins).

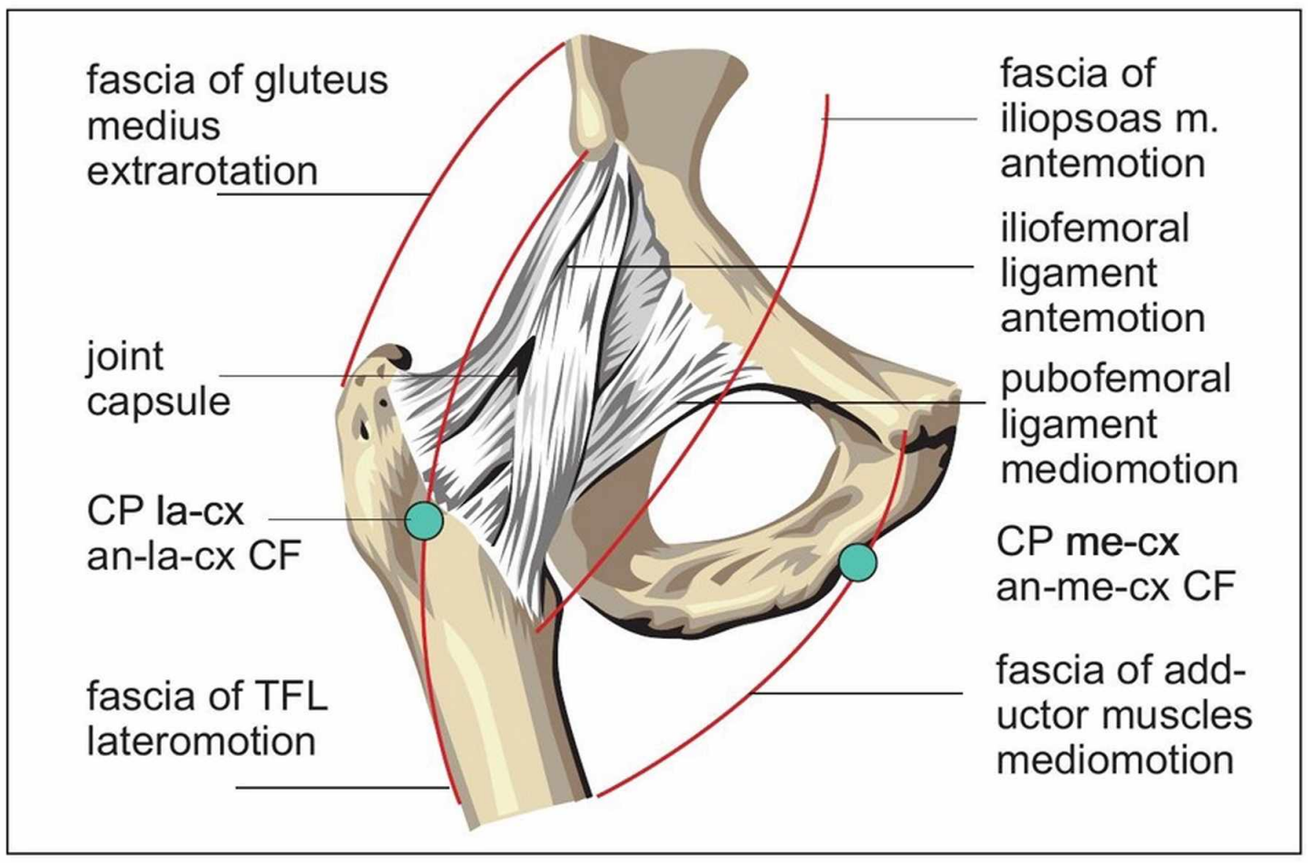


Fig. 1.16. Centres of Fusion (CF) and Centres of Perception (CP).

We can perceive the movement of a joint in the three spatial planes due to the afferents coming from the periarticular ligaments and from the fasciae surrounding the muscles and tendons that are performing the movement, and not due to the afferents from the joint capsule. For this reason, the Centres of Perception overlap the Centres of Fusion.

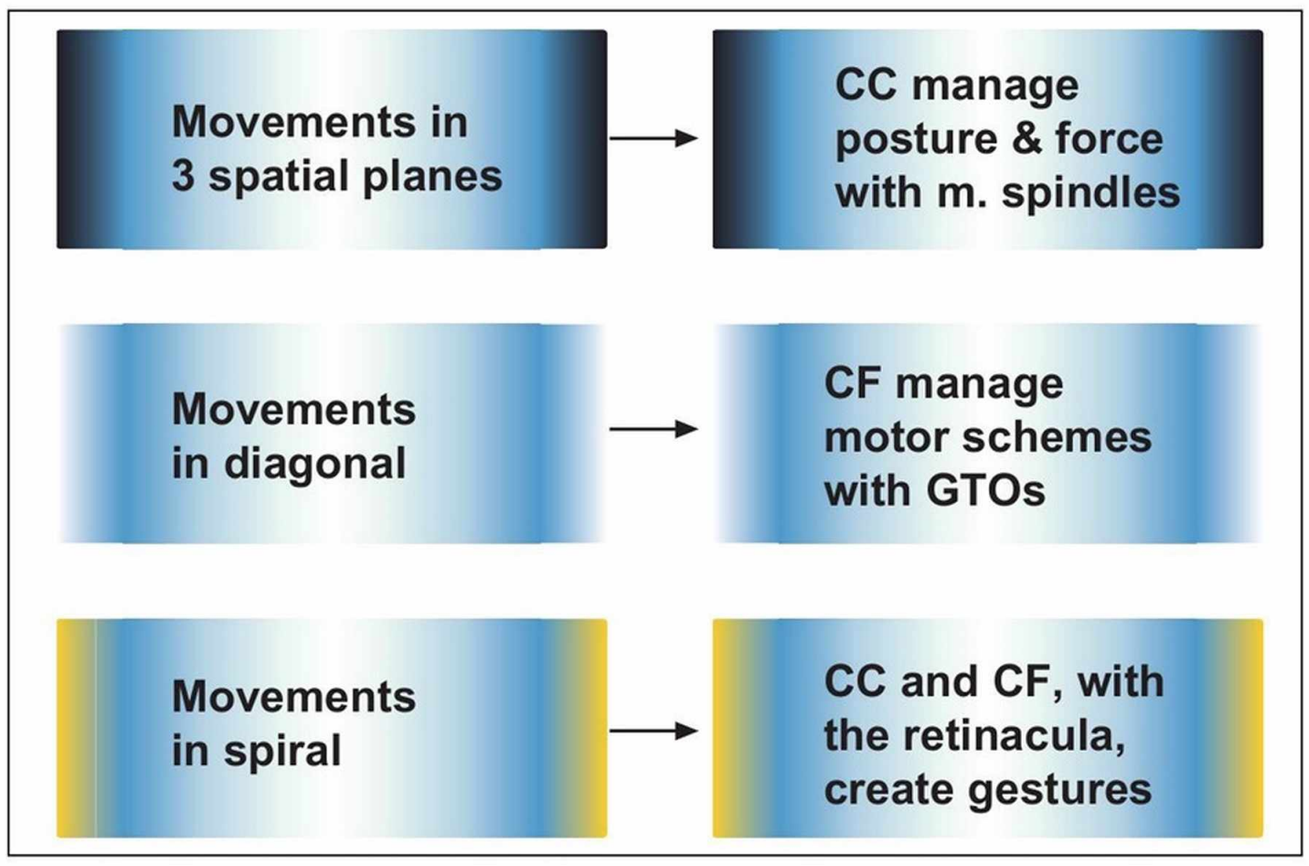
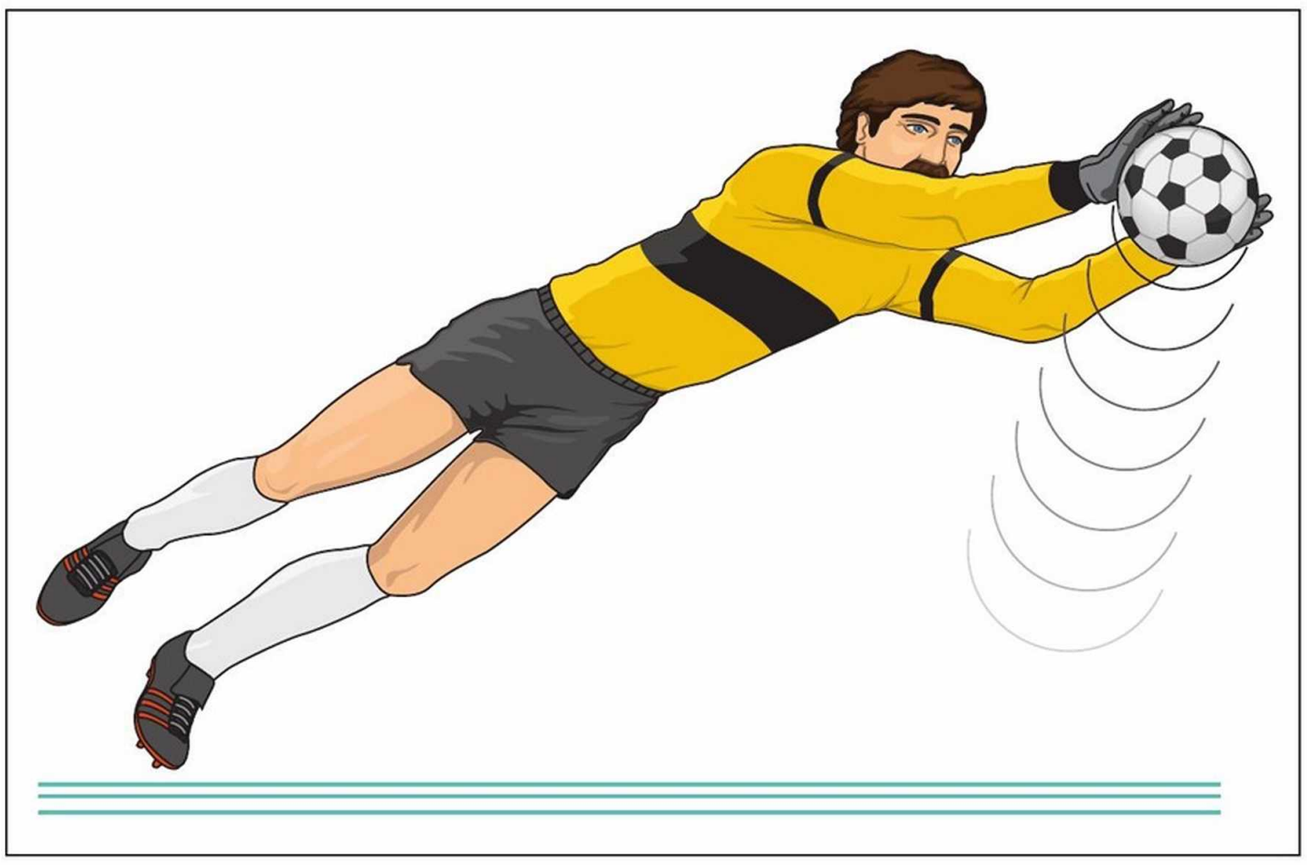


Fig. 1.17. Peripheral management of movement.

Muscle spindles and Golgi tendon organs are not simply receptors. They are also essential for peripheral motor coordination.
Pre-activation of the intrafusal fibres verifies whether there is a mirrored relationship between the muscular forces and the position of the tendons.
"The monosynaptic alpha-gamma circuit allows for the pre-activation of the muscles that act on a joint" (Carlsen A.N. 2008).

PHYSIOLOGY: CENTRES of FUSION



From CC to Centre of Fusion (CF)

Fig. 1.18. Global peripheral motor coordination.

Whenever a goalkeeper has to leap towards the soccer ball, his attention is principally focused on his hands and the other segments adapt accordingly.
The synchrony of these segments cannot be managed by the brain in such a short time. Only the interaction of the fascia on the muscle spindles and tendon organs can manage all the variables involved in a global, complex movement.

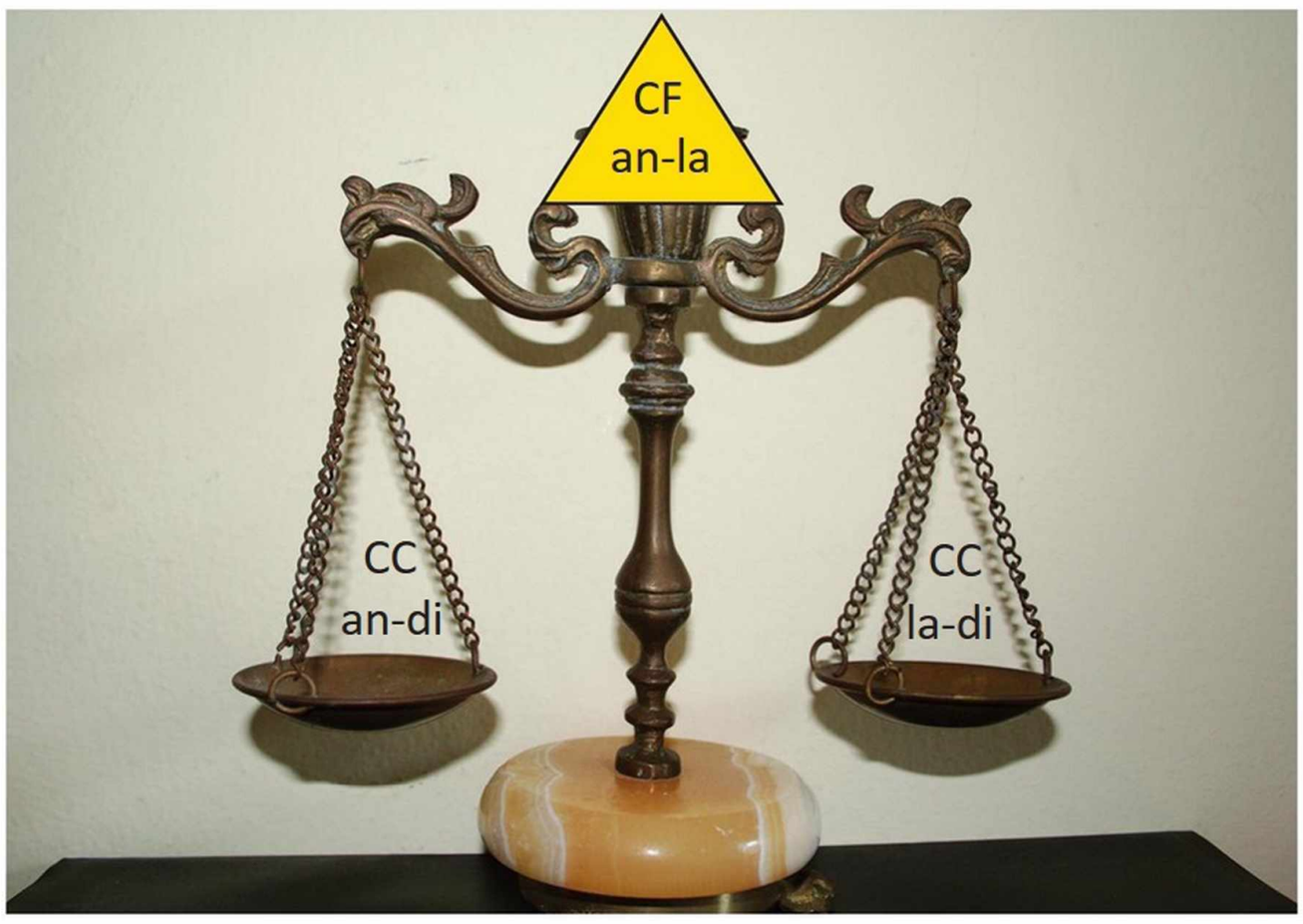


Fig. 1.19. Role of the Centre of Fusion.

The Centre of Fusion (CF) regulates the increase in strength of one myofascial unit as the strength of another mf unit simultaneously decreases. In other words, it can tip the scales towards one mf unit or the other. For example, as the thumb abducts the an-la-di CF has to progressively inhibit the motor units of flexor pollicis brevis while increasing recruitment of the motor units of abductor pollicis.

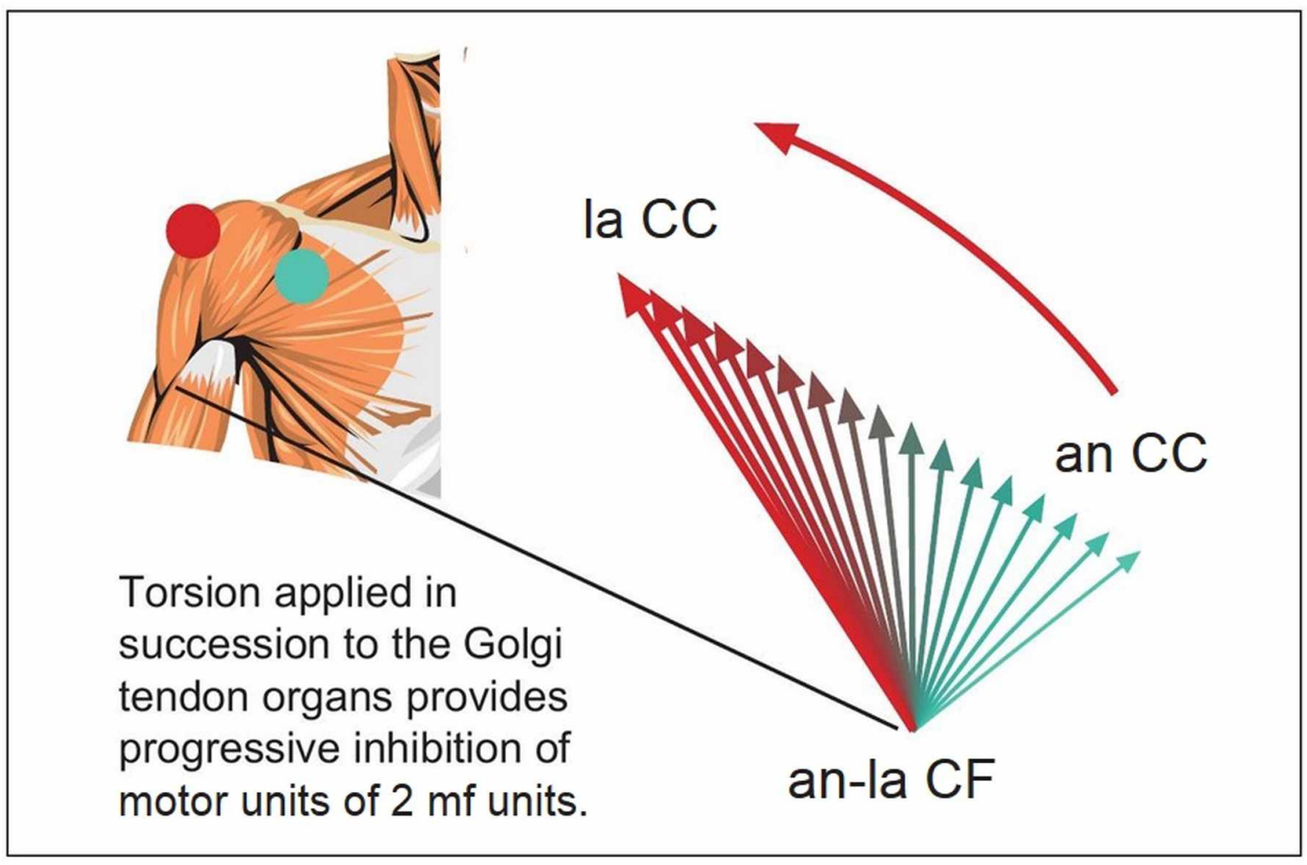
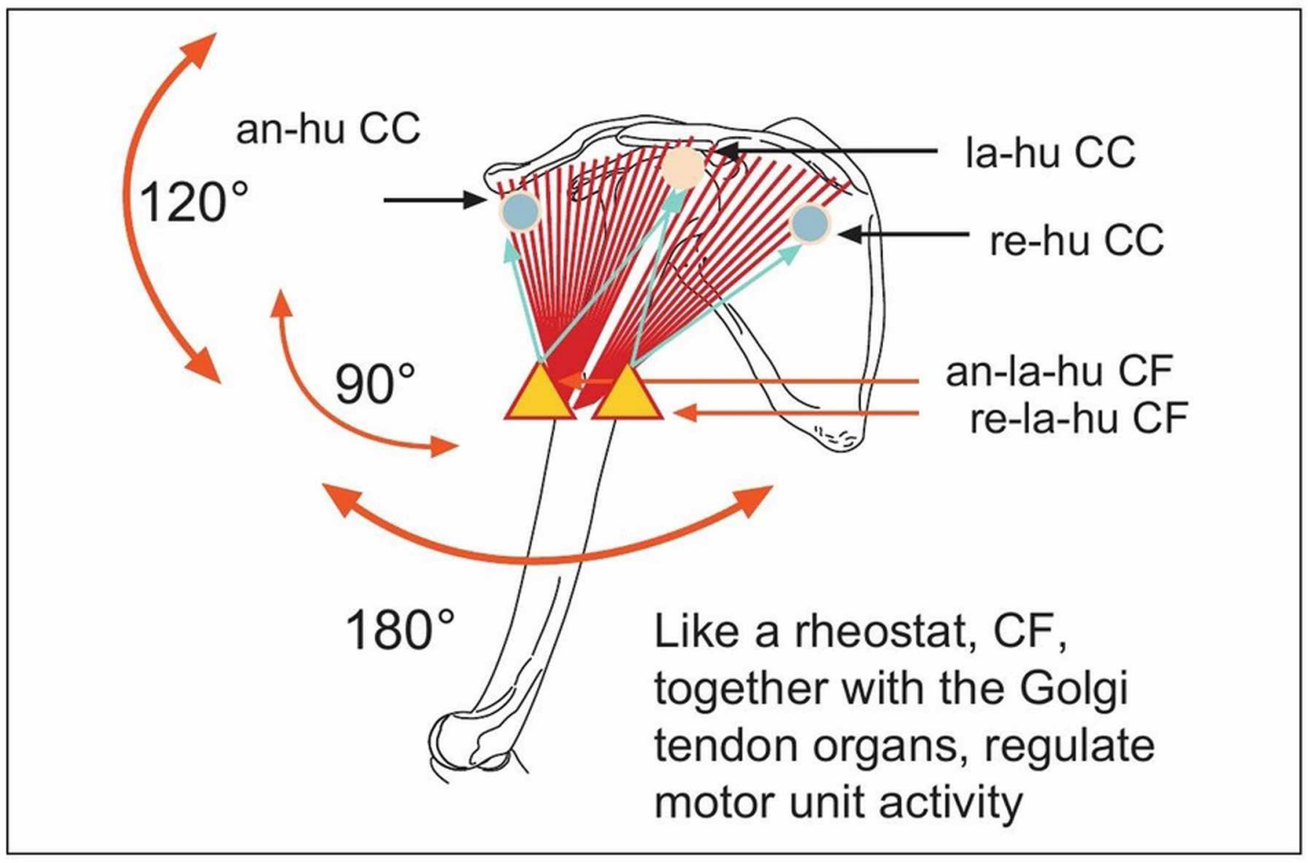


Fig. 1.20. The Centre of Fusion.

Centres of Fusion (CF) are located near the tendons of two or three mf units. Via the Golgi tendon organs (GTO), a CF controls the increase in activity of one mf unit and the decrease in activity of the other mf unit. For example, in order to move the humerus from the anterior position to the lateral position, GTOs progressively inhibit the mf unit of antemotion while simultaneously facilitating muscle fibre activation in the mf unit of lateromotion.

PHYSIOLOGY: CENTRES of FUSION



Names and locations of the CF

Fig. 1.21. Action of CF through various degrees of movement.

One CF regulates the excursion of a joint through the 90° between two planes; two adjacent CF regulate the excursion of a joint through 180°, for example, as occurs in the shoulder.

A CF also has to manage the decreasing activity of the motor units in a mf unit. The motor units of the an-hu mf unit are all activated simultaneously, but GTOs regulate their intervention throughout the approximately 120° of antemotion.

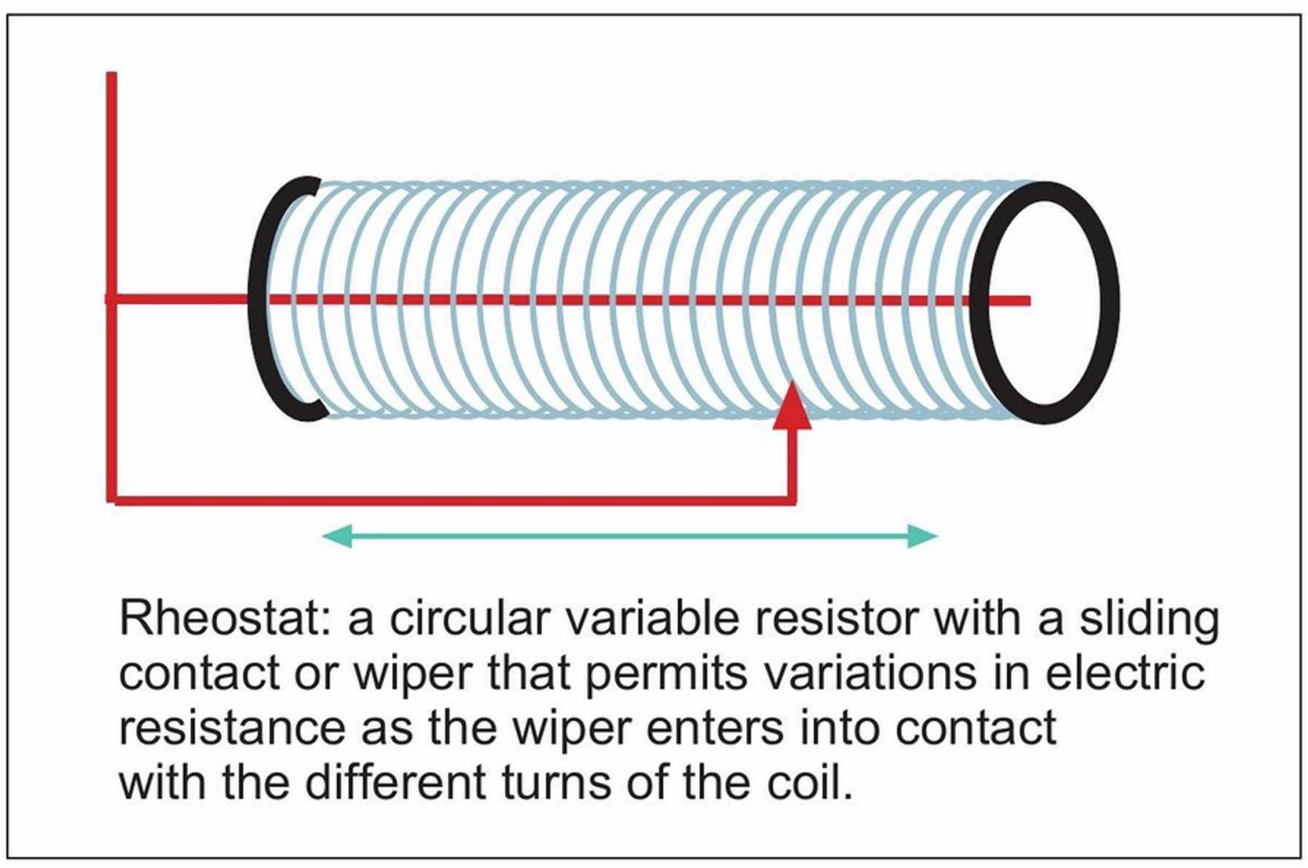


Fig. 1.22. Muscles like a rheostat.

The muscle fibres of deltoid, pectoralis major, latissimus dorsi, etc., are arranged like the coil of a rheostat. During the execution of a motor scheme, some motor units of these muscles are inhibited by the GTOs, while other fibres are activated by the alpha fibres. Without this graduated intervention, a jack-knife effect would occur and the limbs would move from one plane to another with sudden, jerky movements.

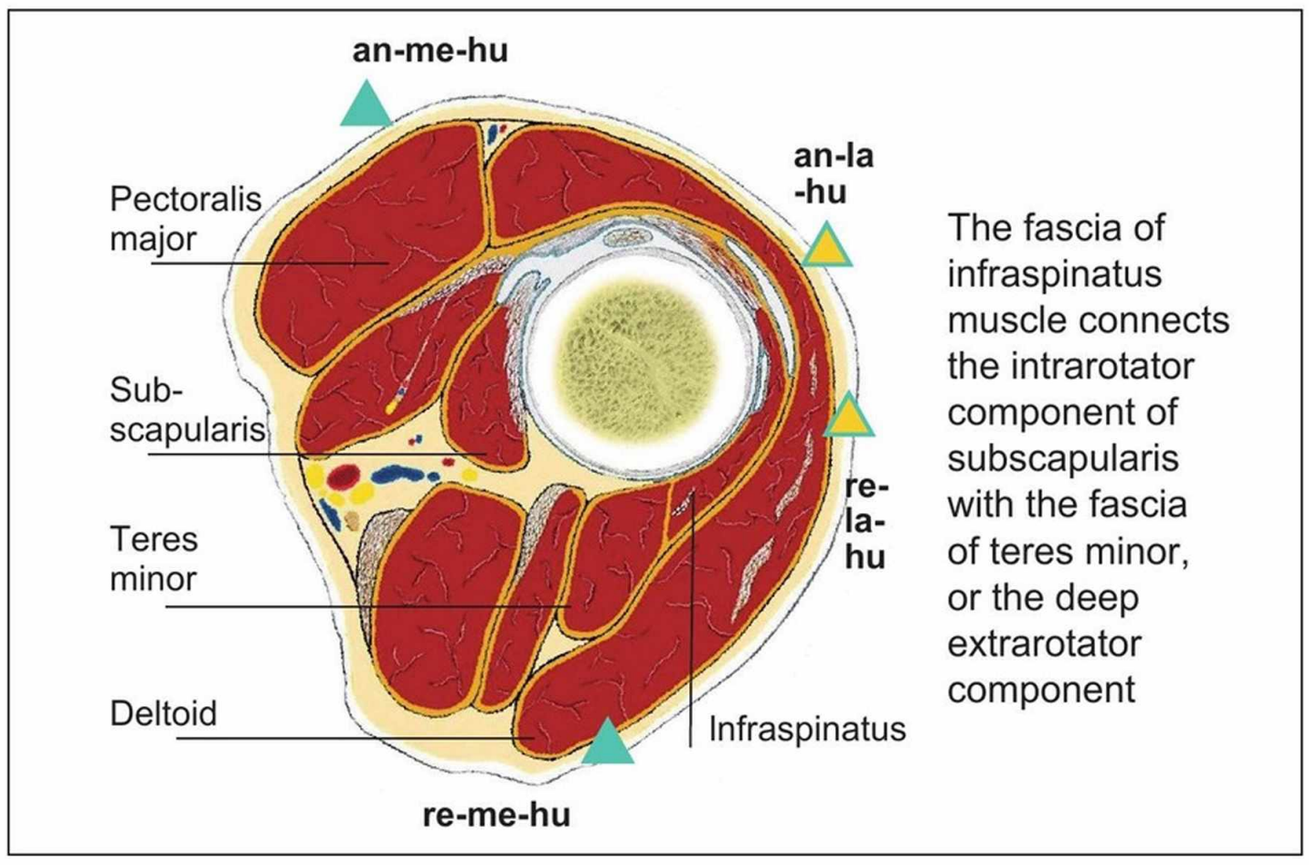


Fig. 1.23. Motor schemes and the rotator component.

This cross section of the shoulder, at the centre of the glenoid cavity, highlights the Centres of Fusion of re-me-hu, re-la-hu, an-la-hu and an-me-hu. These CF are connected to the fasciae that unite intrarotation of the humerus to extrarotation of the humerus. This demonstrates how the rotator component is always present in the CF.

PHYSIOLOGY: CENTRES of FUSION

Names and locations of the CF

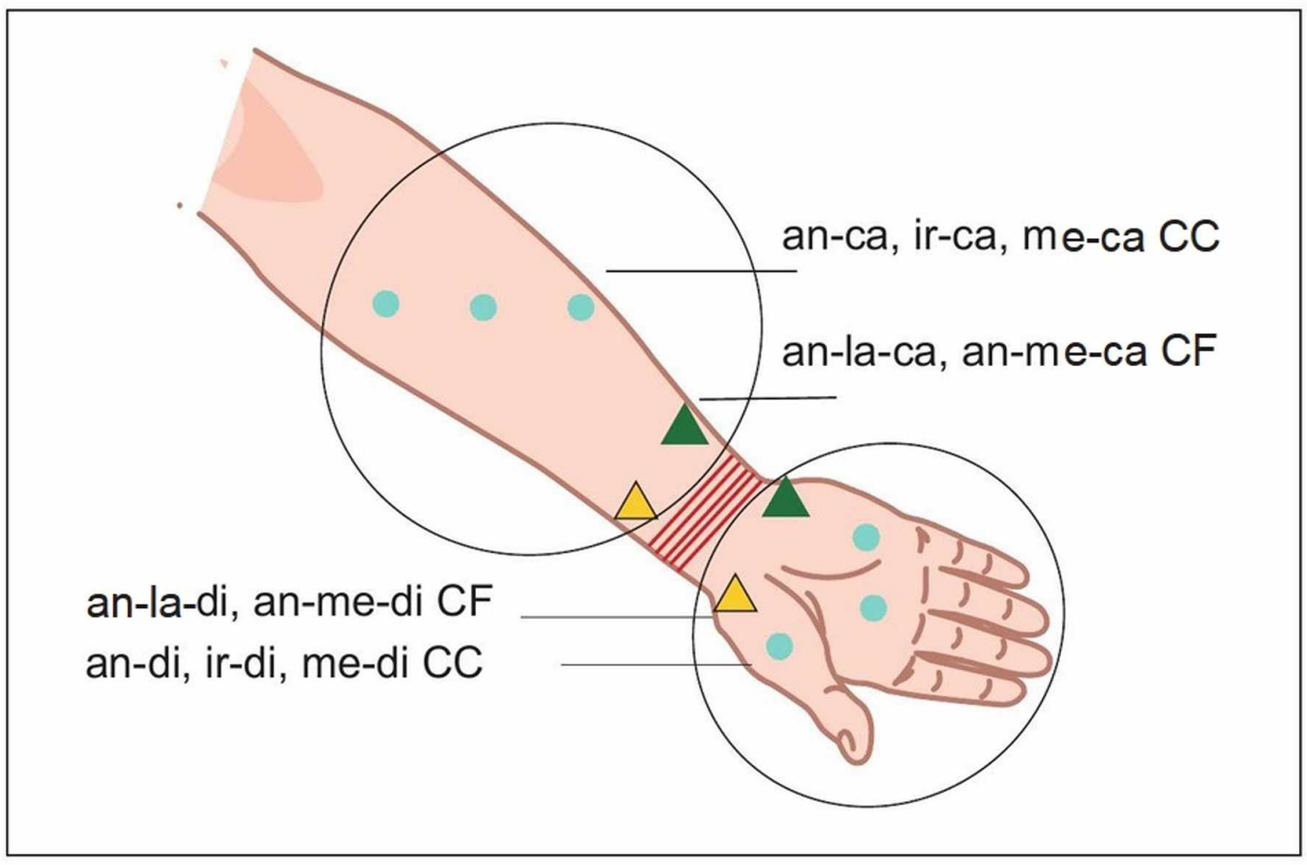


Fig. 1.24. Location of the CF.

The CF of the hands and feet are located in the distal part of the retinacula of the wrist and ankle, whereas the CC are over the muscle bellies.

The CF of the forearm and lower leg are in the proximal part of the retinacula of the wrist and ankle, whereas the CC are over the muscle bellies.

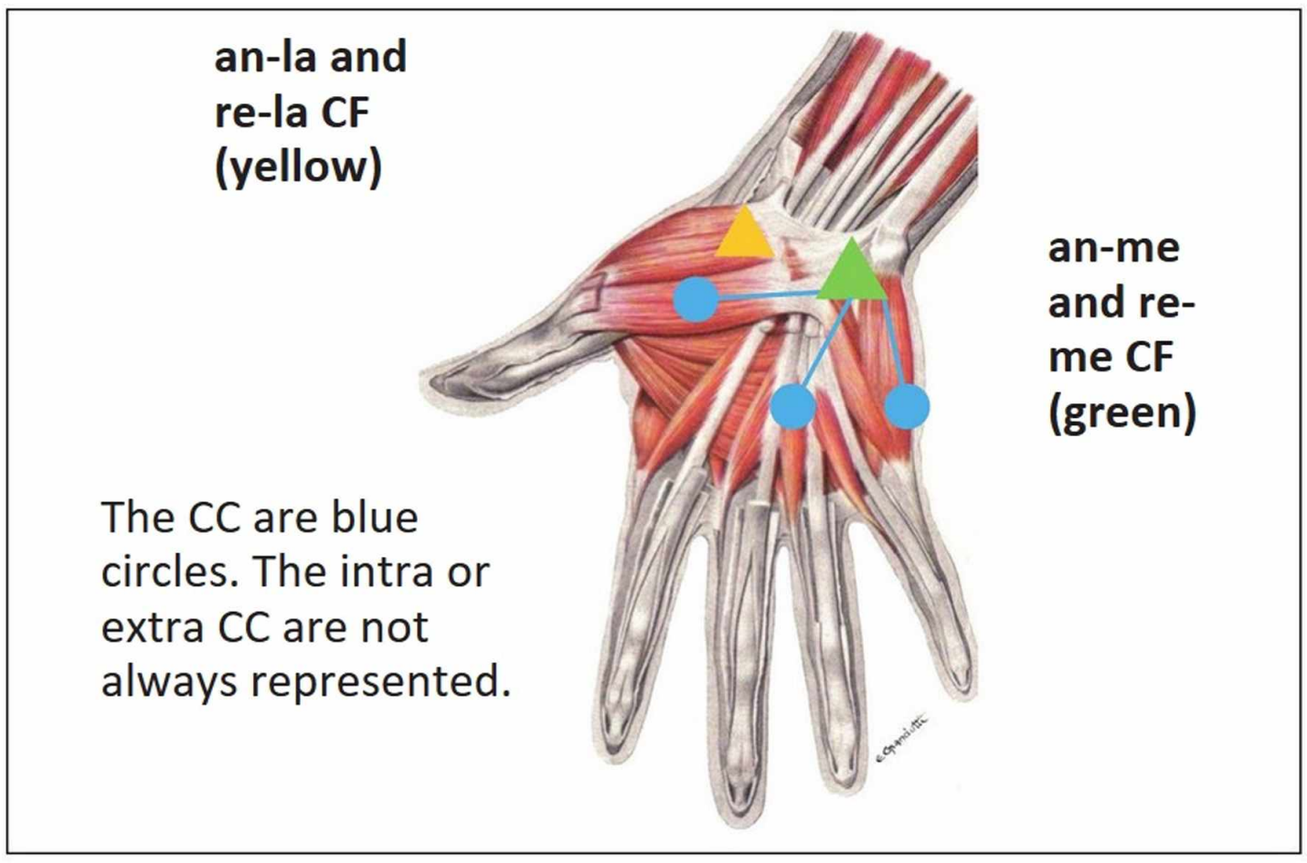


Fig. 1.25. Representation of the Centres of Fusion or CF.

Throughout this book, the CF are represented by a triangle because they coordinate the intervention of three mf units. Yellow triangles represent the ante-lateral and retro-lateral CF (an-la and re-la), whereas green triangles represent the medial CF (an-me and re-me). Blue circles indicate the CC of the two or three mf units that are controlled by the CF.

(Modified from G. Chiarugi and L. Bucciante, Istituzioni di anatomia dell'uomo. Piccin)

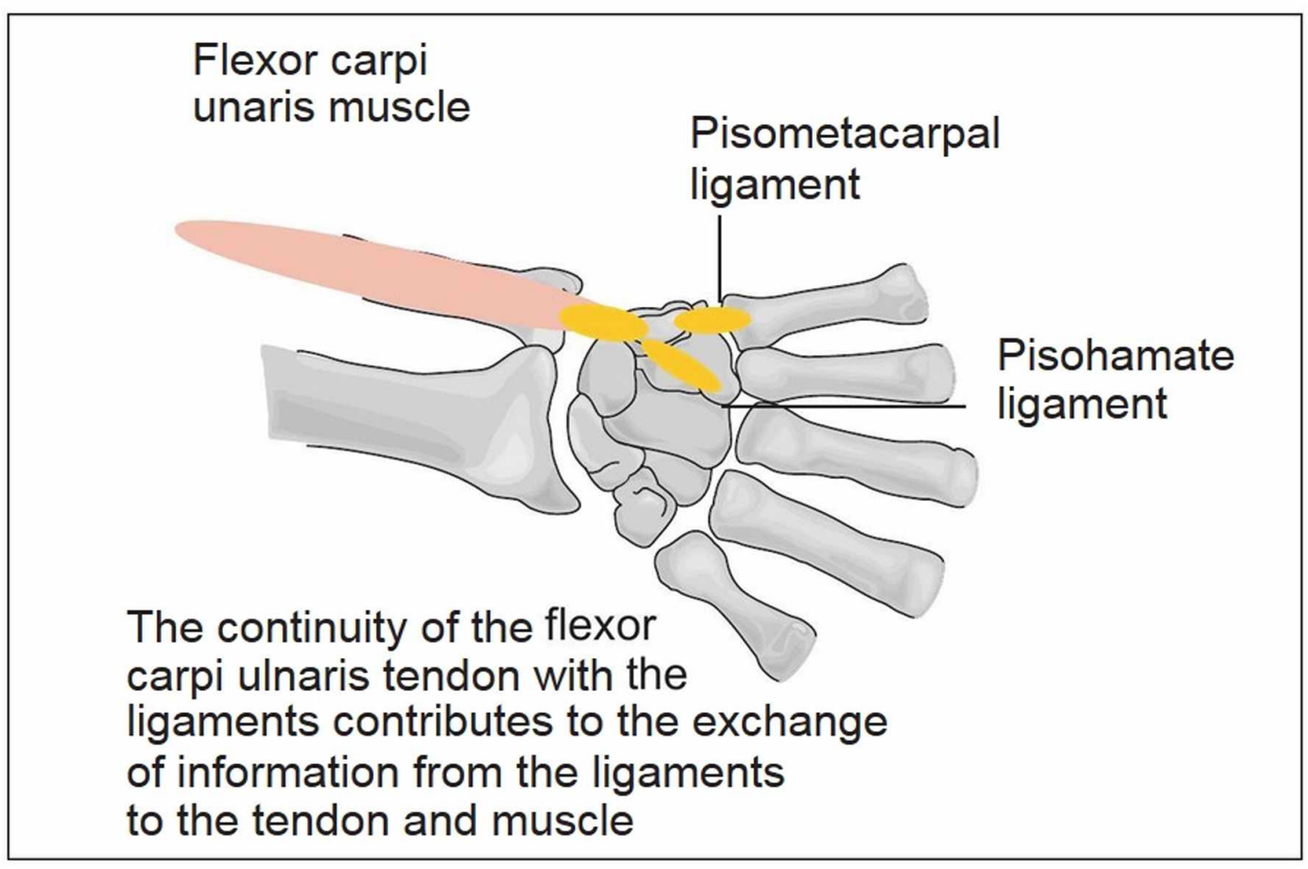
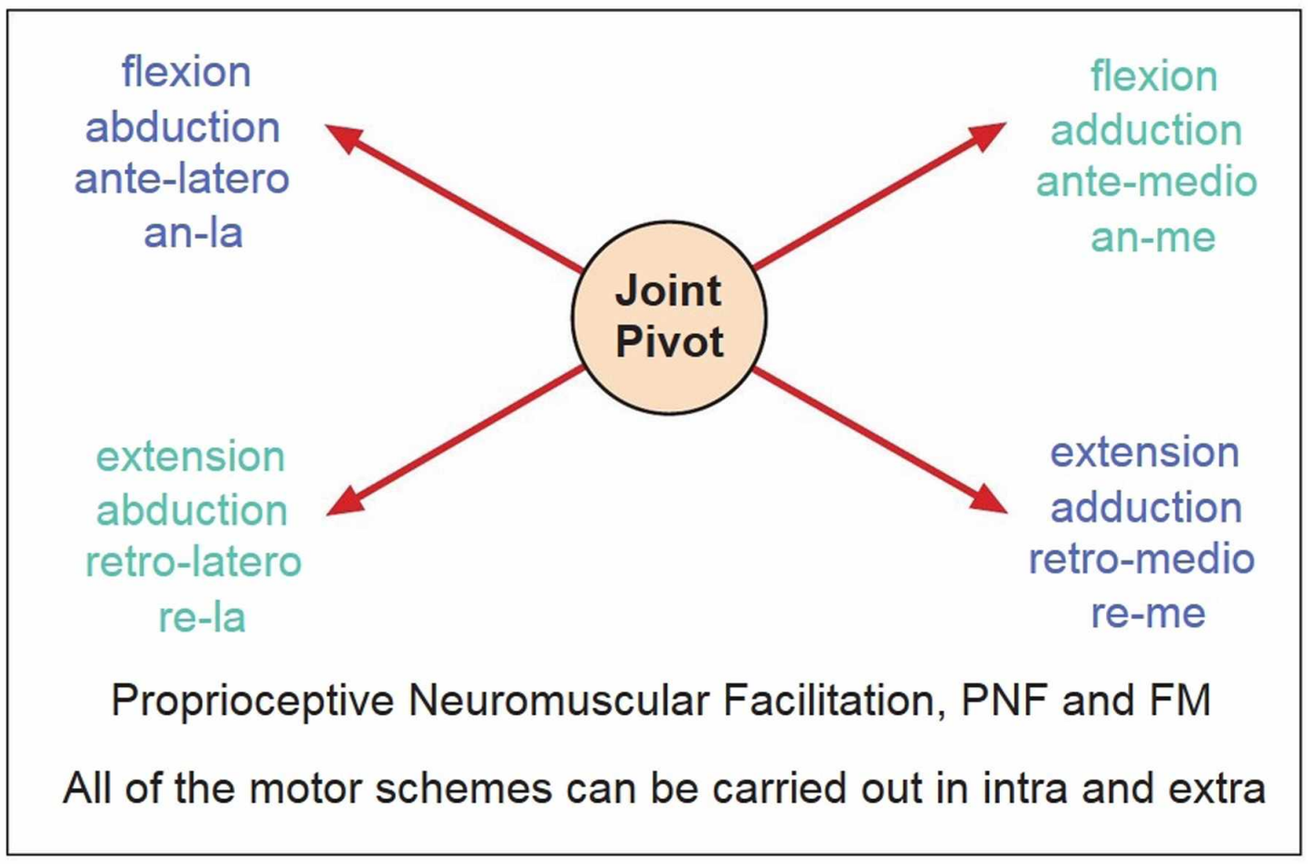


Fig. 1.26. Distal-proximal coordination of the CF in the hand.

There are sensory organs in the ligaments of the hand that are similar to Golgi organs. Their connection with the alpha fibres at the spinal cord level demonstrates the distal-proximal motor coordination of the hand muscles on the forearm muscles. "Electromyography revealed that contraction of the forearm muscles occurred after stimulation of the wrist ligaments" (Hagert E. 2008).

PHYSIOLOGY: CENTRES of FUSION



Names and locations of the CF

Fig. 1.27. From Neuromuscular Facilitation to Fascial Manipulation

Motor schemes or patterns have already been described by H. Kabat (1971). He noted that movements performed in diagonals and spirals facilitate both irradiation and recovery more efficiently.

FM integrates Kabat's intuitions and modifies the names of Kabat's patterns by utilizing terminology that describes directions according to the spatial planes.

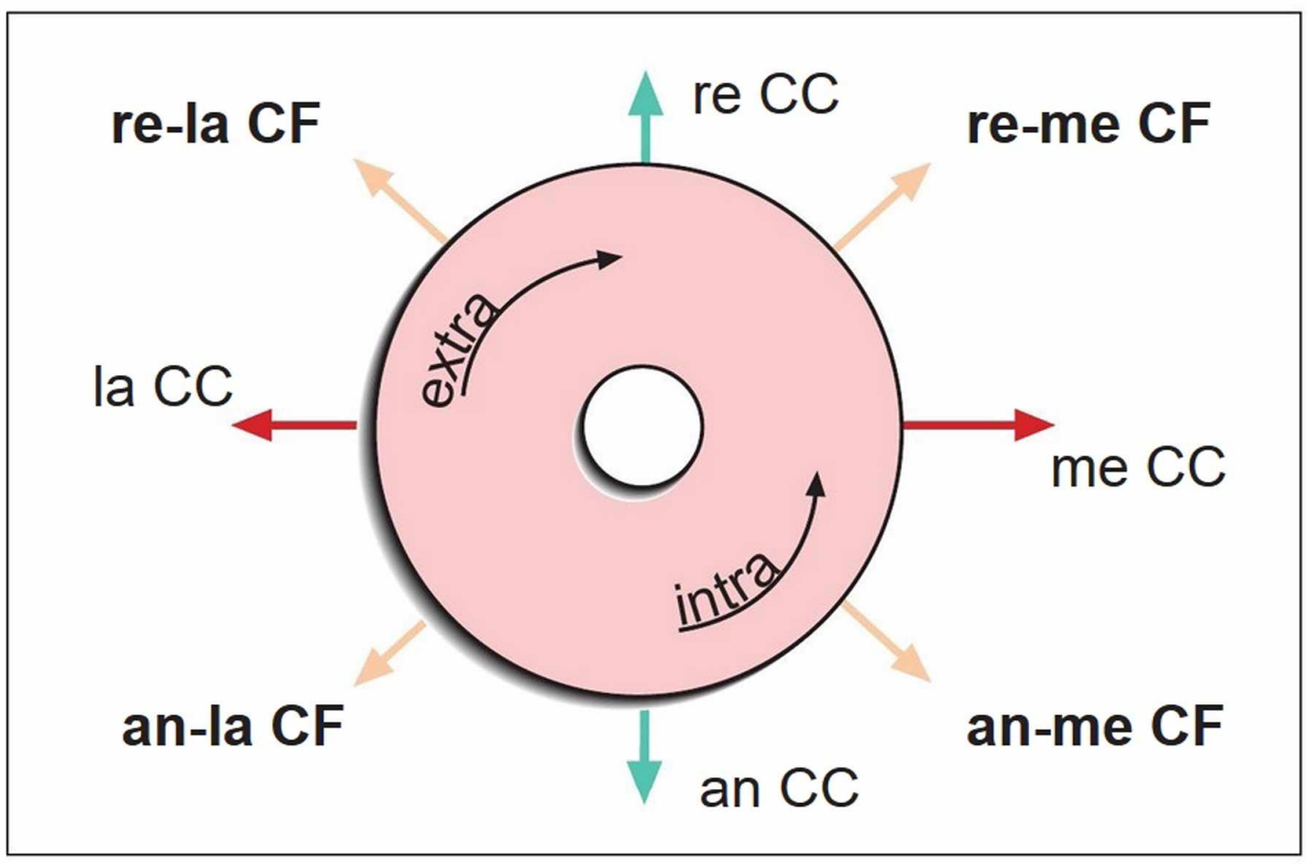


Fig. 1.28. Formation of the names of CF in the limbs.

If we consider a cross section of the arm or the thigh, it can be seen that the CC are arranged in diametrically opposite positions.

The CF are located in an intermediate position and they take on the name of the two CC between which they are positioned. The name of the CC on the sagittal plane is placed first, followed by the CC on the frontal plane. The horizontal plane CC (ir and er) are not mentioned.

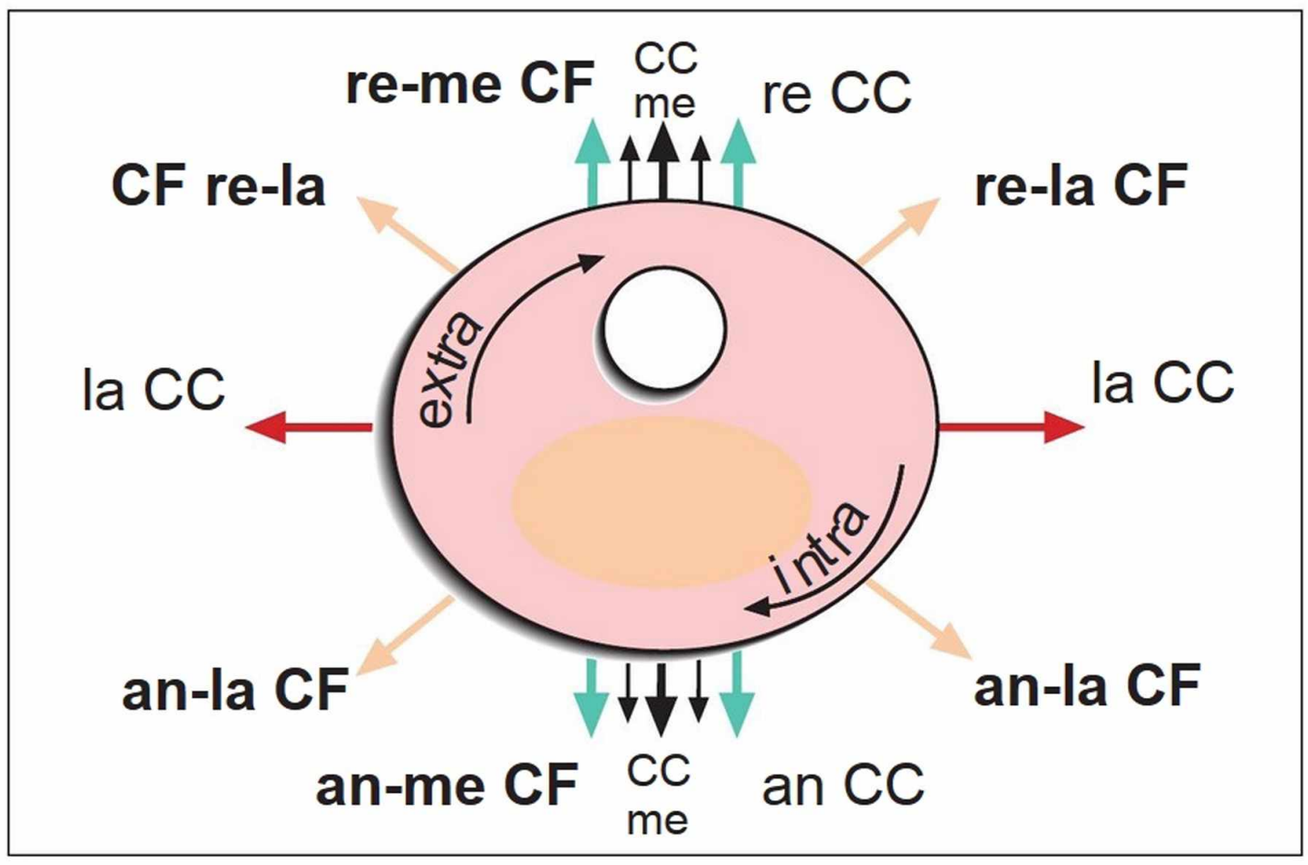


Fig. 1.29. Formation of the names of CF in the trunk.

The right side of the trunk is in continuity with the two limbs on the right, and the left side of the trunk with those on the left. Therefore, in the trunk there are four CF on the right side that have a mirrored relationship with the four CF on the left side.

In this way, both the an-la and re-la CF are found on the right and left, and both the re-me and an-me CF are also found on the right and left.

Fig. 1.30. Retinaculum of the flexors lying beneath the tendon of palmaris longus.

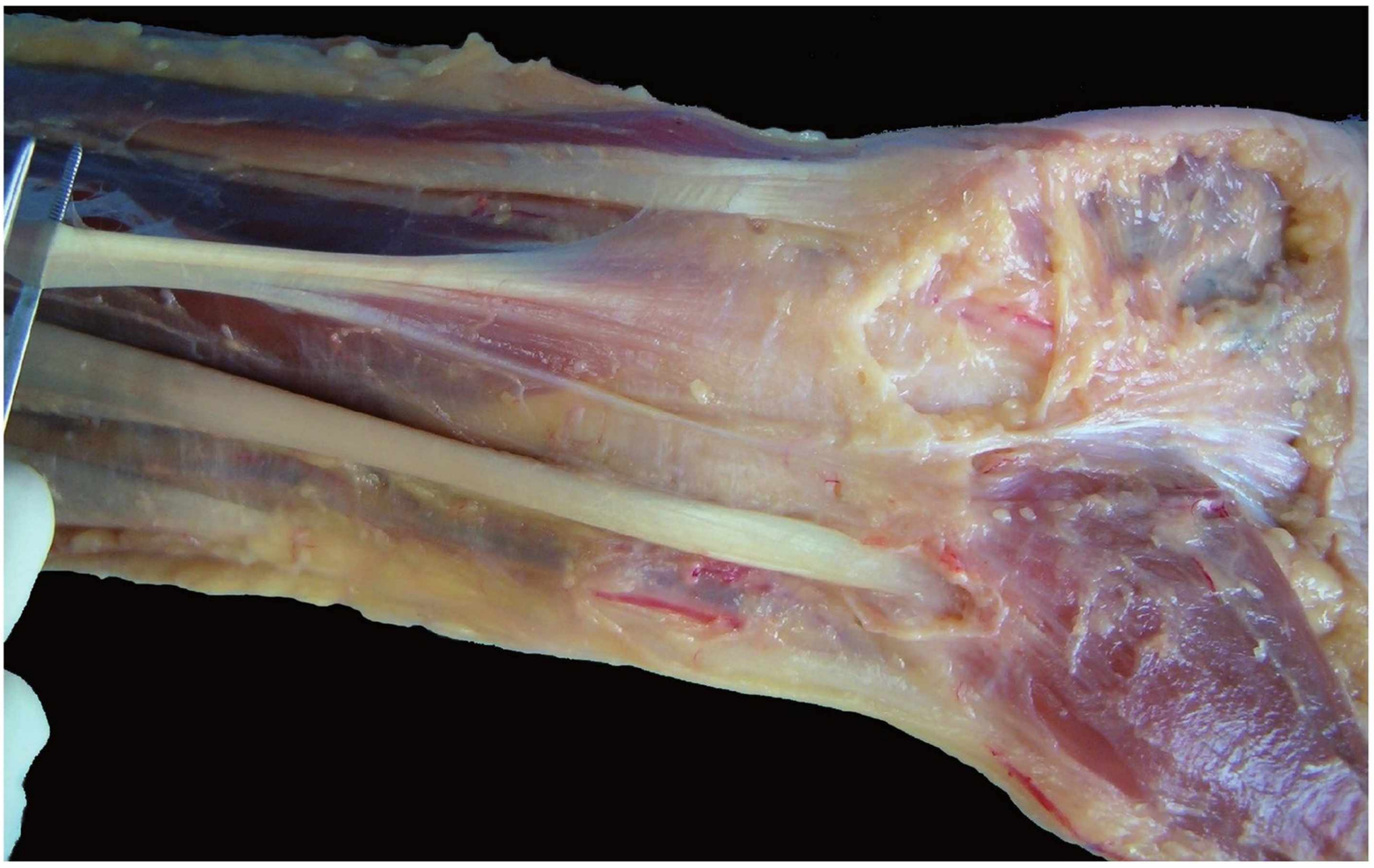


Fig. 1.31. Variation of the tendon of palmaris longus. Here it has become a tensor of the flexor retinaculum.

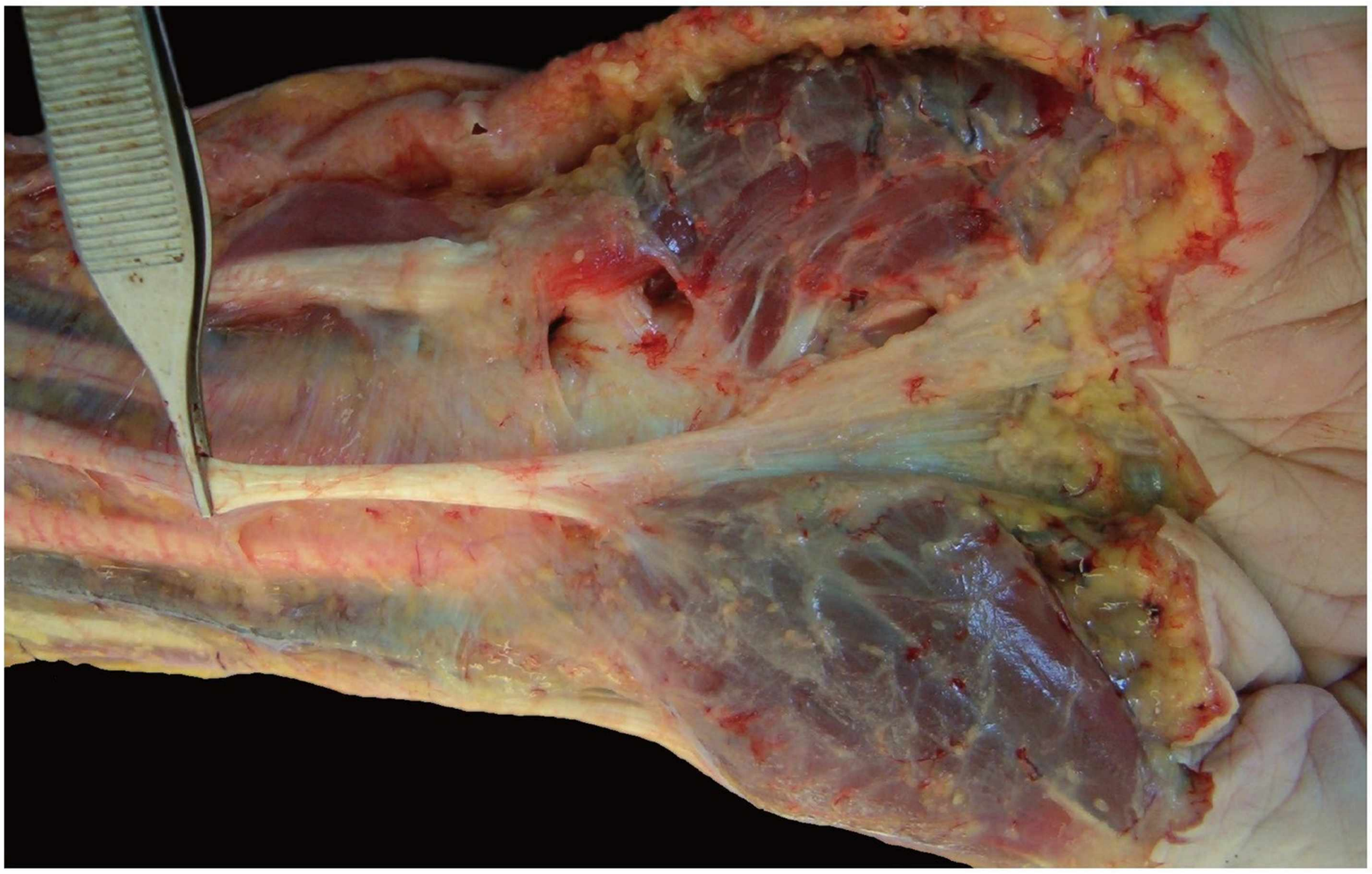


Fig. 1.32. Traction on the tendon of palmaris longus is transmitted to the fascia of the thenar eminence.

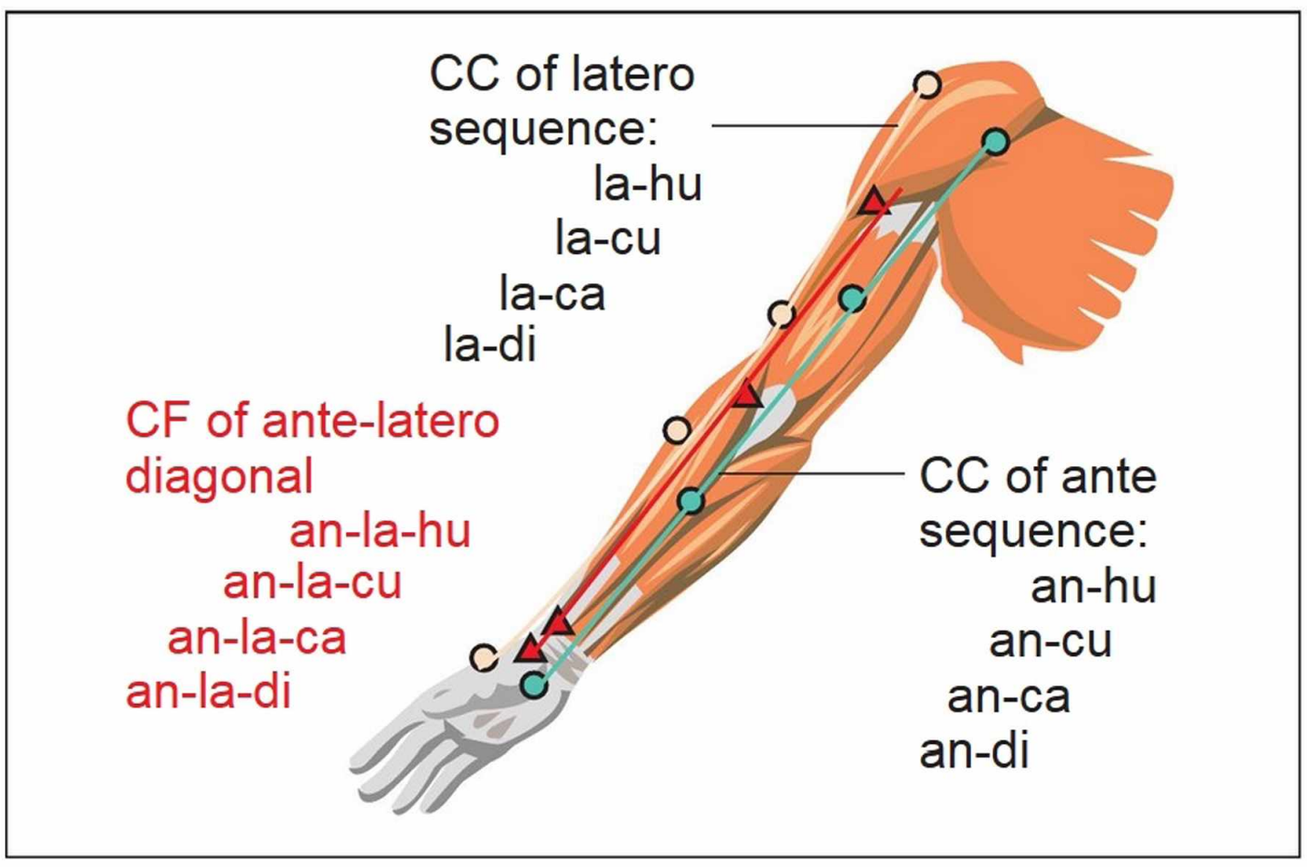
Fig. 1.33. Flexor carpi ulnaris is stretched in order to highlight its traction on the fascia of the hypothenar eminence.

DIAGONALS and MOTOR SCHEMES

This section is divided into:

- anatomy of the diagonals
- Kabat's motor schemes & mf diagonals
- reflex pain and diagonals
- comparison with acupuncture

DIAGONALS & MOTOR SCHEMES



Anatomy of the diagonals

Fig. 1.34. From segmental to global.

The CF and their active role at the level of a single joint (segmental motor scheme) have been analysed in the previous pages.

The CF united by a diagonal in order to carry out a global motor scheme, in a limb or in the trunk, will now be analysed.

The diagonals follow a pathway that extends between two sequences.

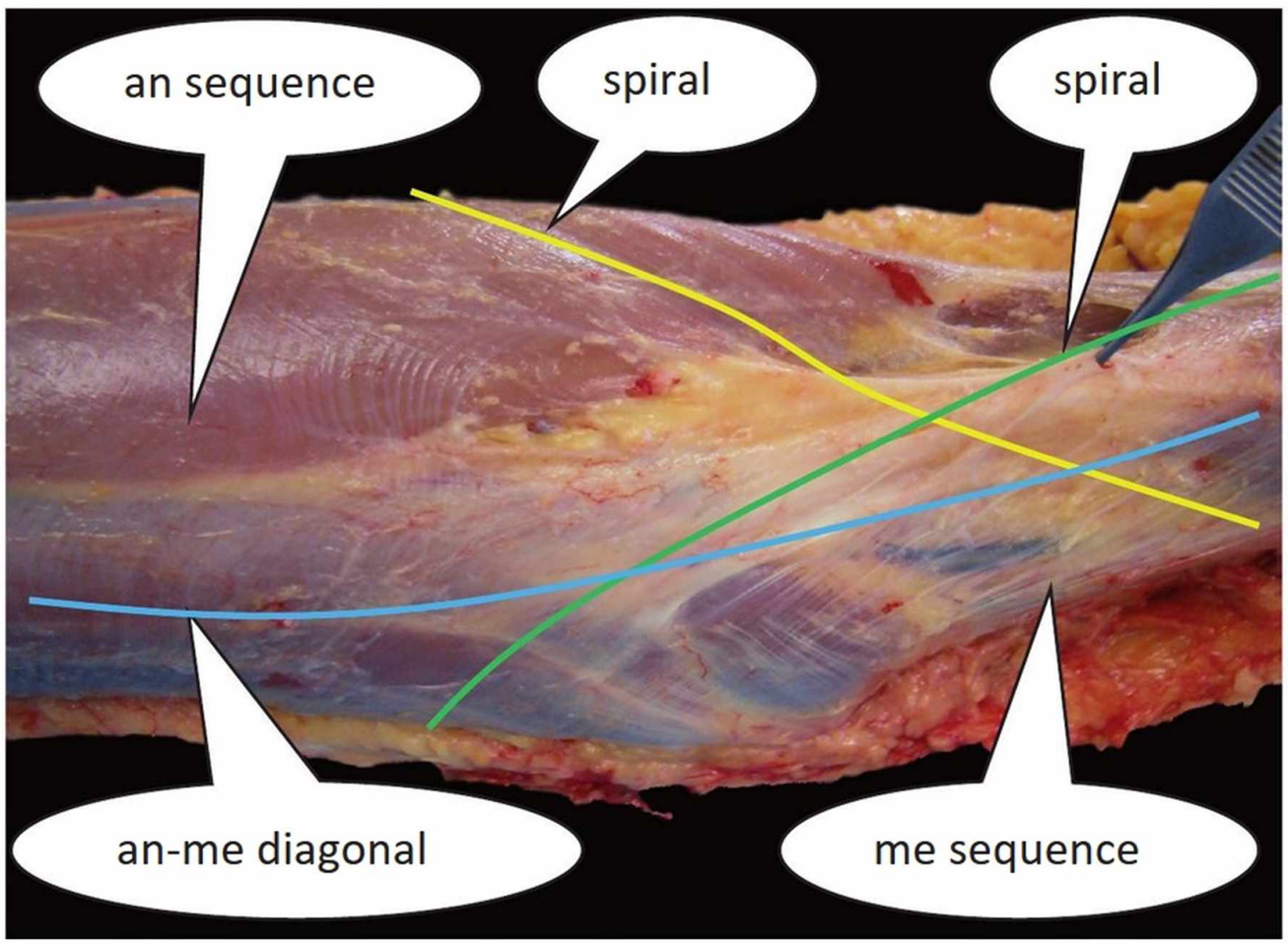


Fig. 1.35. Physiology of sequences, diagonals and spirals.

Via a proximal-distal stretch, the mf sequences synchronise the activity of the CC of the unidirectional mf units.

The diagonals synchronise the activity of several unidirectional CF via a distal-proximal stretch.

The spirals synchronise the agonist CF of a joint with the antagonist CF of the adjacent joint.