

XXVII. Examination of reflexes in man
XXVIII. Recording of Achilles' tendon reflex

practical
(autumn 2018: 1. – 3. week)

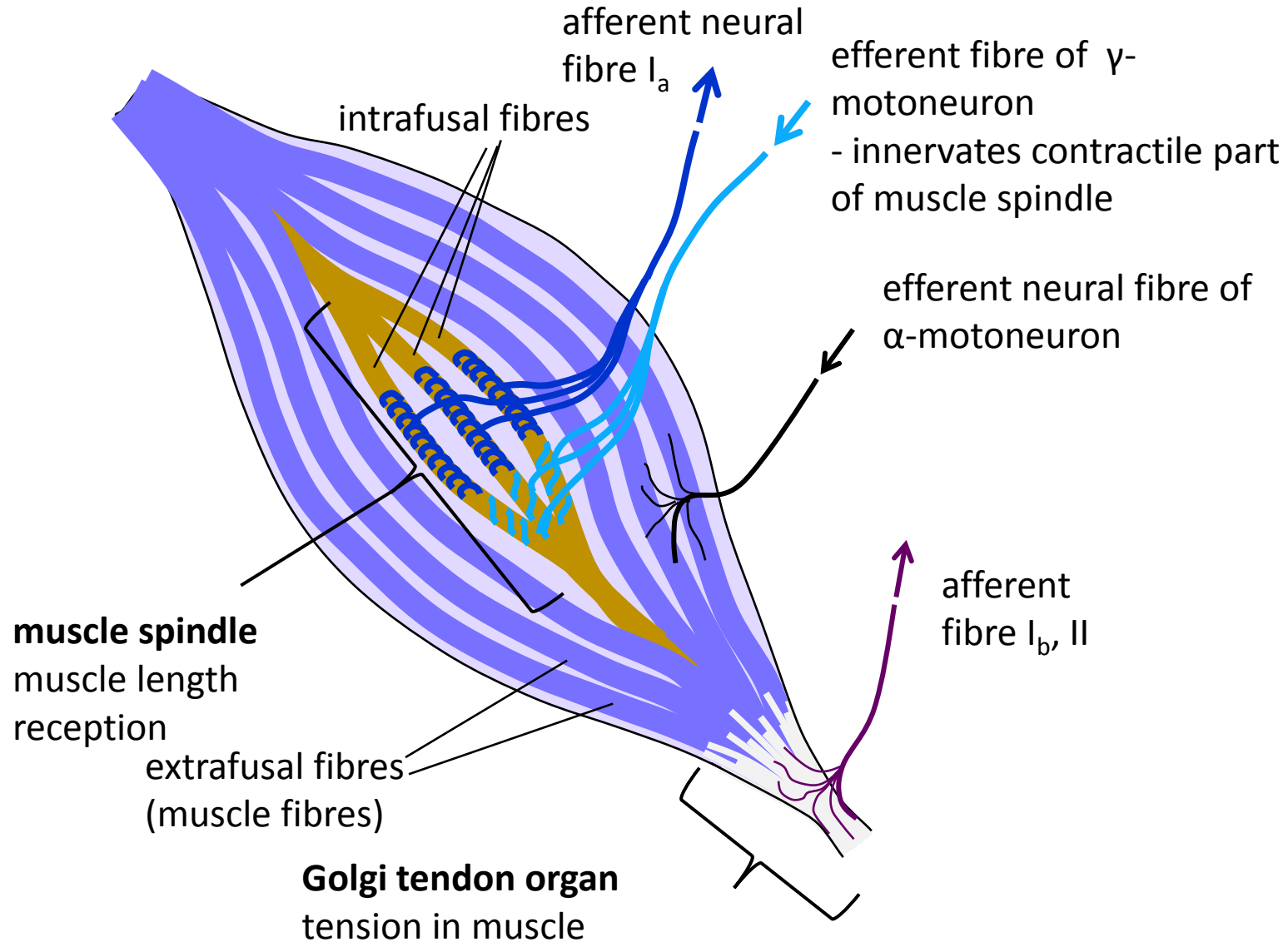
Reflexes

- **Reflex:** is an involuntary response of organism triggered by stimulation of receptors.
- **Reflex arch:** consists of 1.receptor, 2. afferent pathway, 3. centre, 4. efferent pathway and 5. effectors organ.
- Particular reflexes have anatomically **strictly defined reflex arches**, e.g. pathway and centre.
- According to the character of reflex response to certain stimulus we can topically diagnose and point out the place of nervous system disablement.
- **Function:** correction of changes or protection against damage.

Examination of Reflexes

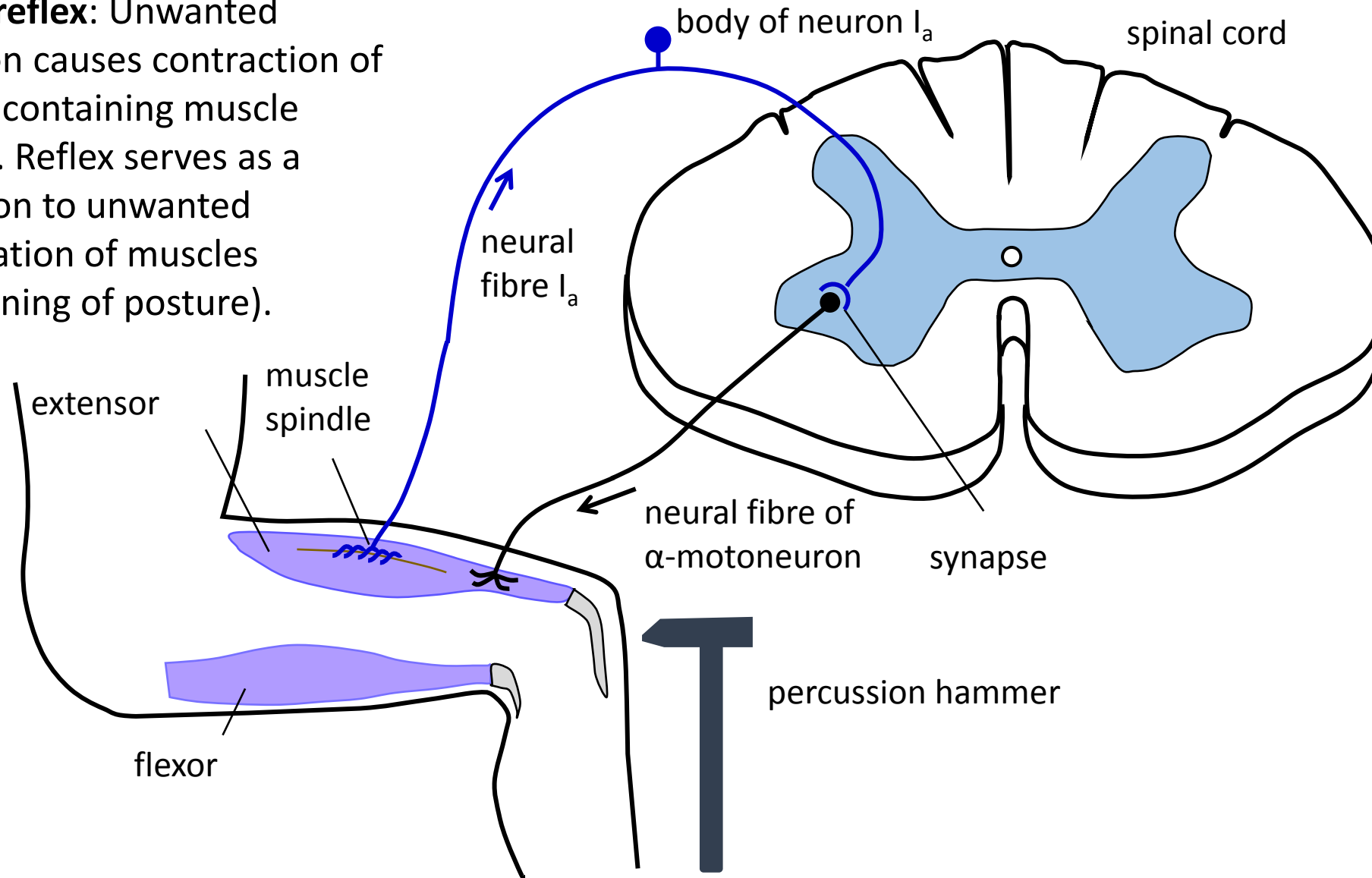
- When examining reflexes the following items are considered:
 - Electability of a reflex
 - Quantitative changes in the response
 - Qualitative changes
- **Proprioceptor reflexes** (stretch reflexes)
 - Most reflexes are elicited by fast, springy tapping the corresponding receptor area with a percussion hammer.
 - The tapping of the hammer should be adequately strong, fast, and precise, but not painful.
 - Muscles involved in the muscle response must be sufficiently relaxed.
- Facilitating manoeuvre consisting in a voluntary contraction of antagonistic muscles, should be used if the reflex can not be elicited even in a correct procedure.
- Sometimes it is necessary to distract the subject's attention by asking him to perform a simple calculation (repeated subtraction of a number) or use Jendrassik's manoeuvre.

Proprioreceptors in the muscle



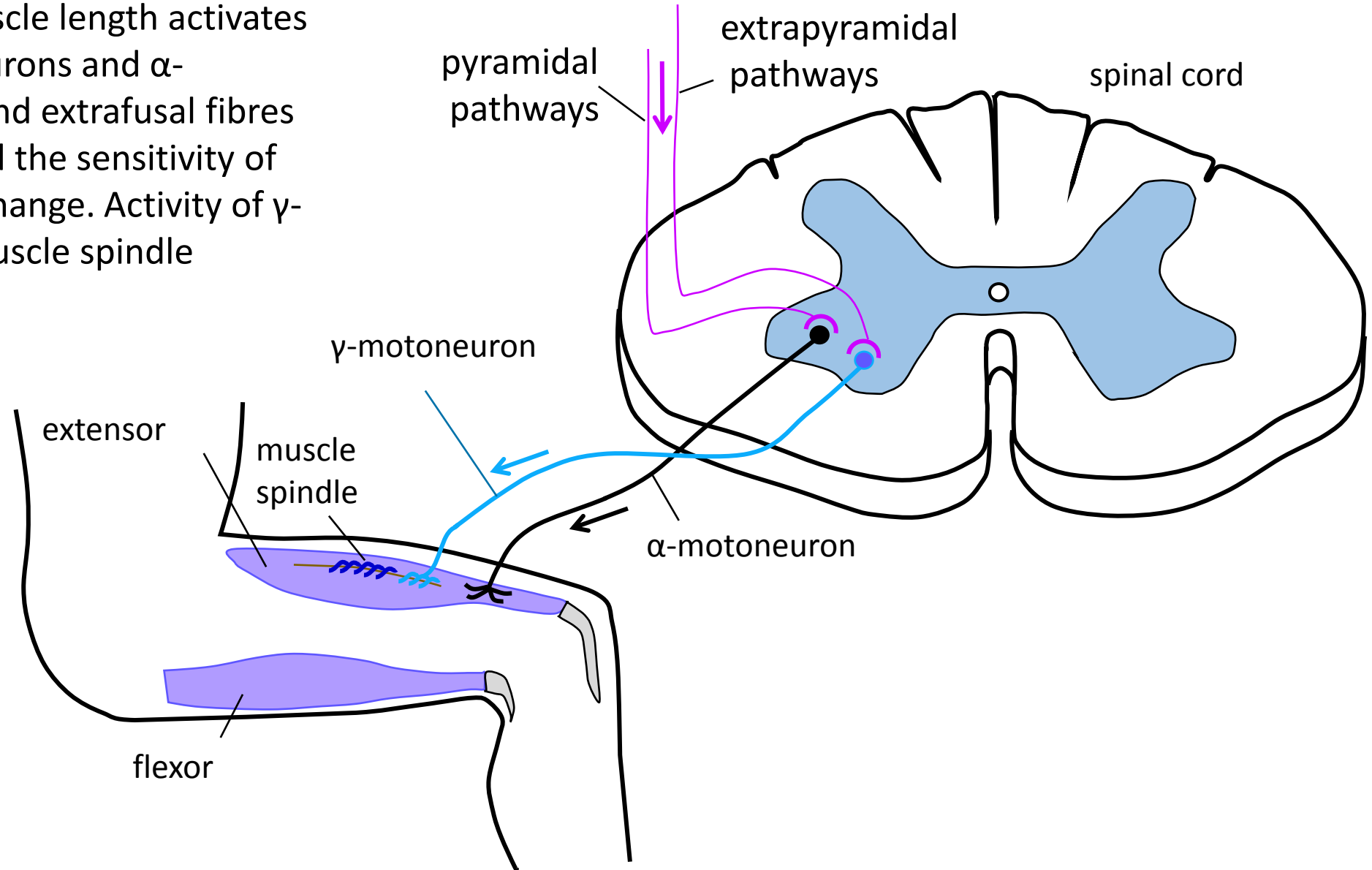
Stretch reflex

Stretch reflex: Unwanted extension causes contraction of muscle (containing muscle spindle). Reflex serves as a correction to unwanted prolongation of muscles (maintaining of posture).

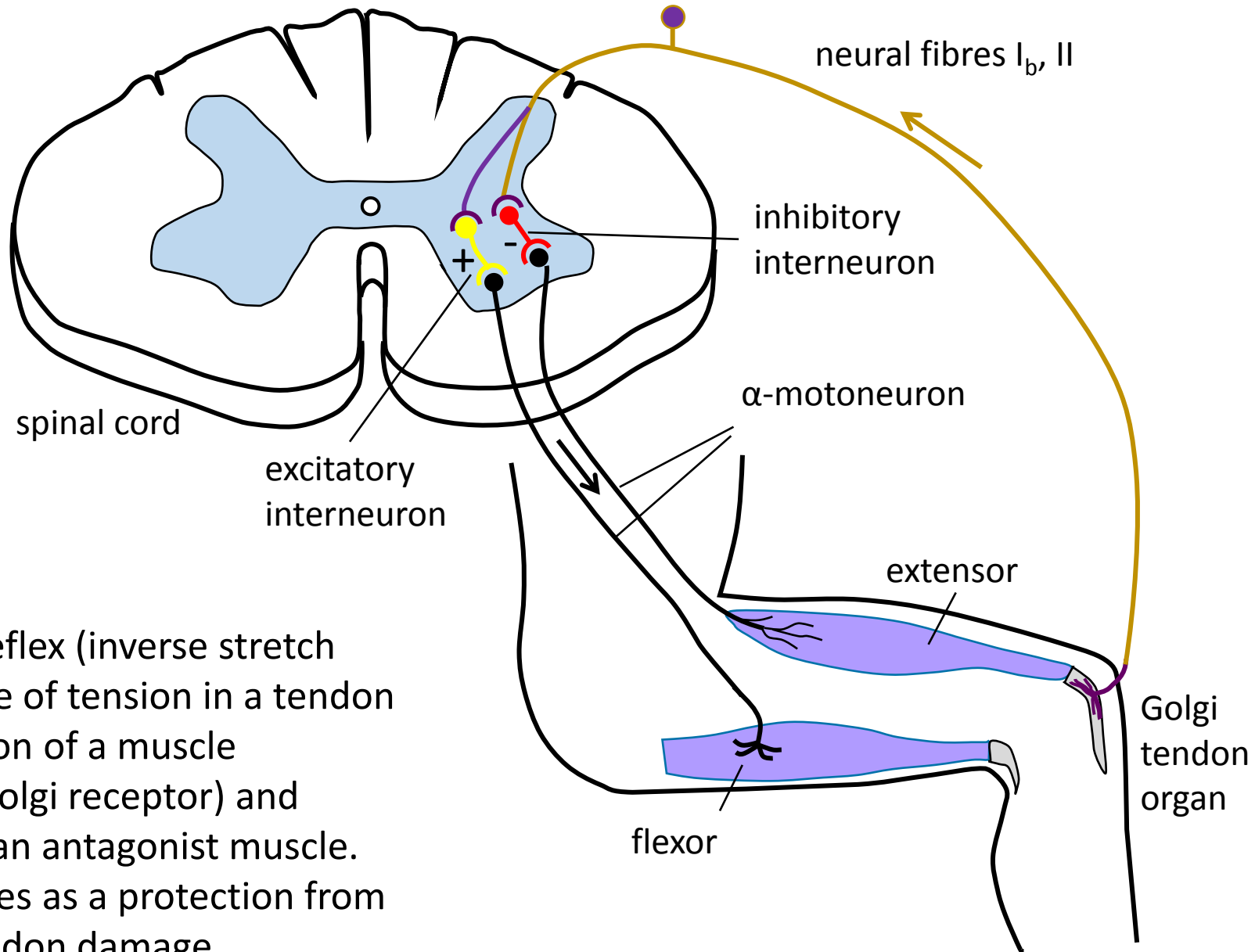


Correction of muscle spindle sensitivity

The desired change of muscle length activates simultaneously γ -motoneurons and α -motoneurons. Intrafusal and extrafusal fibres extend simultaneously and the sensitivity of muscle spindle does not change. Activity of γ -motoneurons regulates muscle spindle sensitivity.



Golgi tendon reflex, inverse stretch reflex



Golgi tendon reflex (inverse stretch reflex): Increase of tension in a tendon causes relaxation of a muscle (containing a Golgi receptor) and contraction of an antagonist muscle. This reflex serves as a protection from muscle and tendon damage.

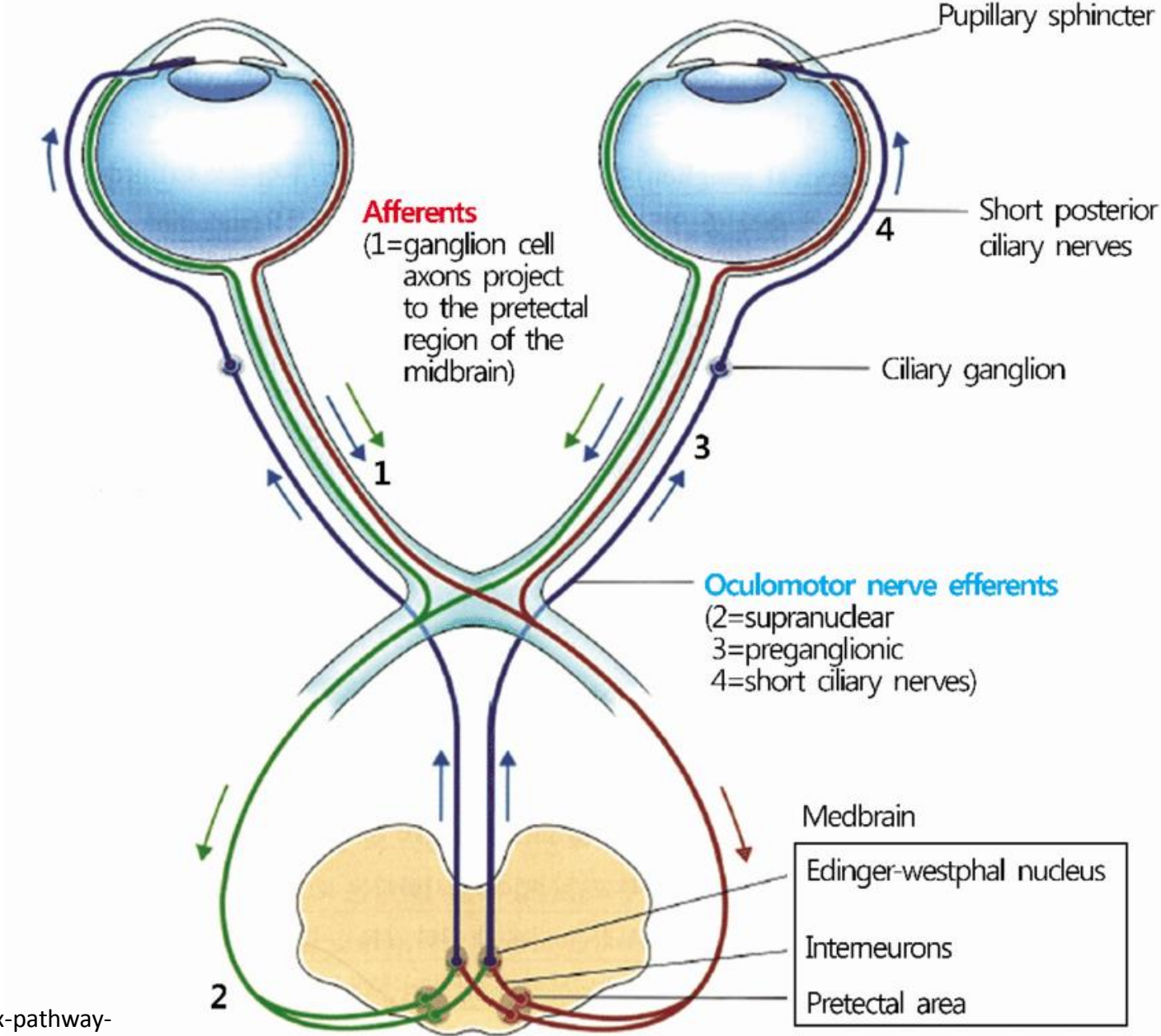
Reflexes in practicals

- According to the number of synapses: a- monosynaptic reflexes
b- polysynaptic reflexes
- 2- According to the receptor: a- exteroceptive reflexes
b- interoceptive reflexes
c- proprioceptive reflexes
- 3- According to the center: a- extracentral reflexes - axonal reflexes
- ganglionic reflexes
b- central reflexes - spinal reflexes
- brain reflexes
- 4- According to the effector: a- somatic reflexes
b- autonomic reflexes
- 5- According to the genesis: a- unconditioned reflex (congenital)
b- conditioned reflexes (acquired)

Reflexes in practicals

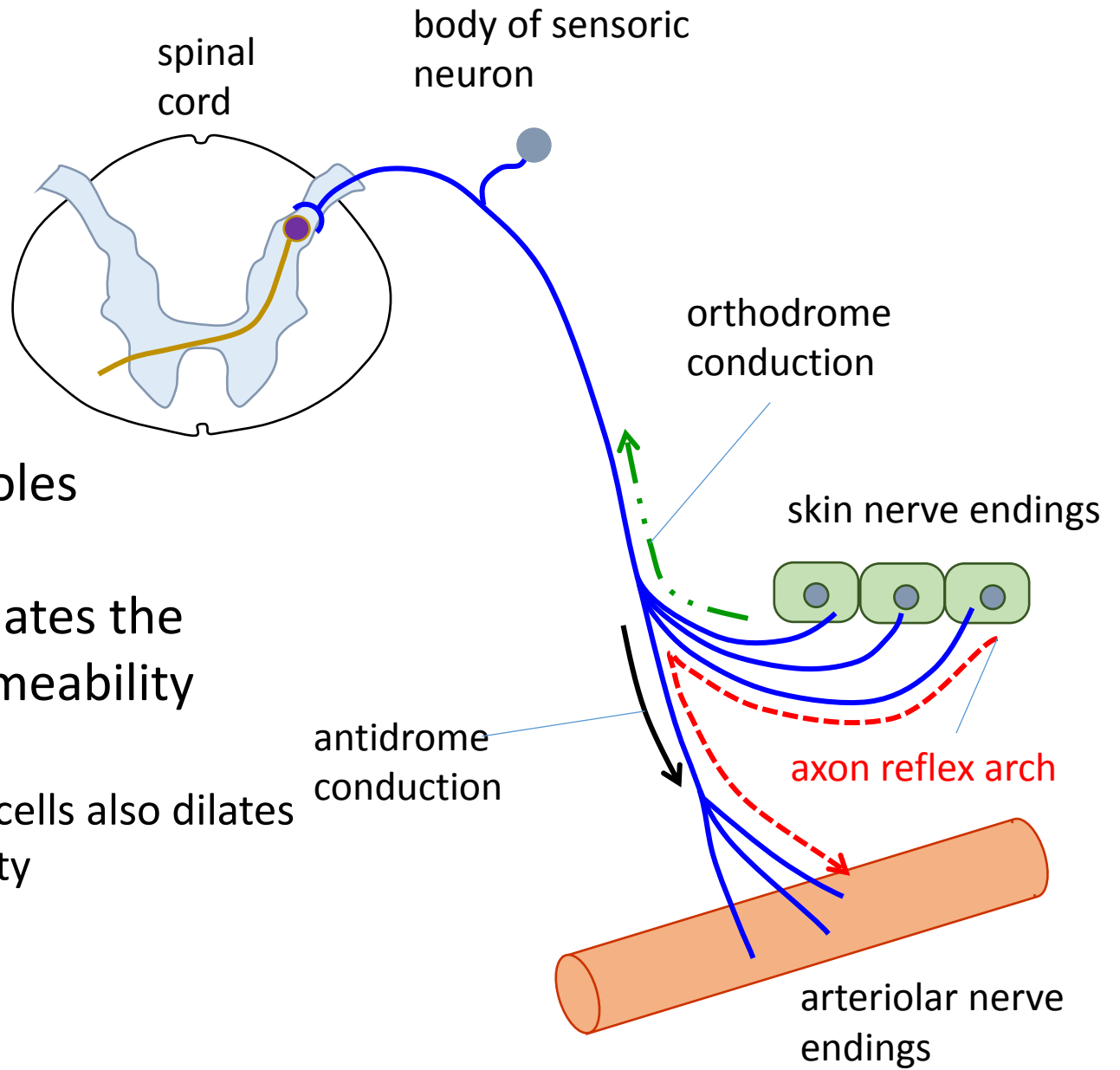
- **Proprioceptive (myotatic, stretch) reflexes:**
 - 1- masseter reflex, 2- Nasopalpebral reflex, 3- Bicipital reflex, 4-Styloradial reflex, 5- Triceps reflex, 6- Patellar reflex, 7- Achilles' tendon reflex and 8- Mediolplantar reflex.
- **Exteroceptive reflexes (cutaneous and mucous):**
 - 1- Corneal and conjunctival reflexes, 2- Palatal reflex, 3- Epigastric, mesogastric, hypogastric reflexes and 4- Plantar reflex.
- **Sensory reflexes:**
 - 1- Pupillary responses: a- Response to light, b- Response to convergence, c- Response on pain
 - 2- Twinkle reflex

Pupillary responses



Axon reflex (extracentral)

- The impulses generated in the sensory nerve are transmitted anti-directionally (upstream) to other branches of the sensory fiber
- When irritating the skin receptors, the pulse is converted to nearby arterioles innervated by the same fiber
- Substance P from the nerve endings dilates the arteriolar and increases the vascular permeability (red dermatographismus)
 - In addition histamine released from mast cells also dilates the vessels and increases their permeability



XXVIII. Recording of Achilles' tendon reflex

Recording of Achilles' tendon reflex

Aim:

To learn how to register electrical and mechanical response of Achilles' tendon reflex.

After measuring of particular values get an idea about time sequence of electrophysiological processes of reflex response, which start with stimulation of appropriate receptors and ends up in muscle relaxation.

- Achilles tendon reflex (or ankle jerk) as a proprioceptive reflex is elicited by tapping the tendon of the soleus muscle with a reflex hammer. The rapid stretch of muscle activates the muscle spindles and evokes an increased discharge of action potentials from the spindles.
- The volley of action potentials in the primary sensors Ia fibres monosynaptically excites the alpha motoneurons which in turn activate soleus muscle, where the reflex begins.
- Contraction of muscle is preceded by membrane depolarisation of activated muscle fibres which generate the so called ***compound muscle action potential (CMAP)***. This potential may be recorded by means of surface electrodes (electromyographically). Two parameters of electromyogram (EMG) are of interest: the duration of the signal and the interval of its delay, the latency period.

- According to different sites of stimulation two kinds of reflexes may be obtained.
- ***T-reflex*** is triggered by simple tapping the tendon with the reflex hammer and thus, is subject to various irregularities. As a result the amplitudes of responses are not identical.
- ***H-reflex*** is triggered by an electric pulse of submaximal intensity. The latter method employs surface electrodes placed on fossa poplitea close to tibial nerve. The amplitudes of responses are almost identical. H-reflex is routinely employed as a diagnostic tool in neurology.

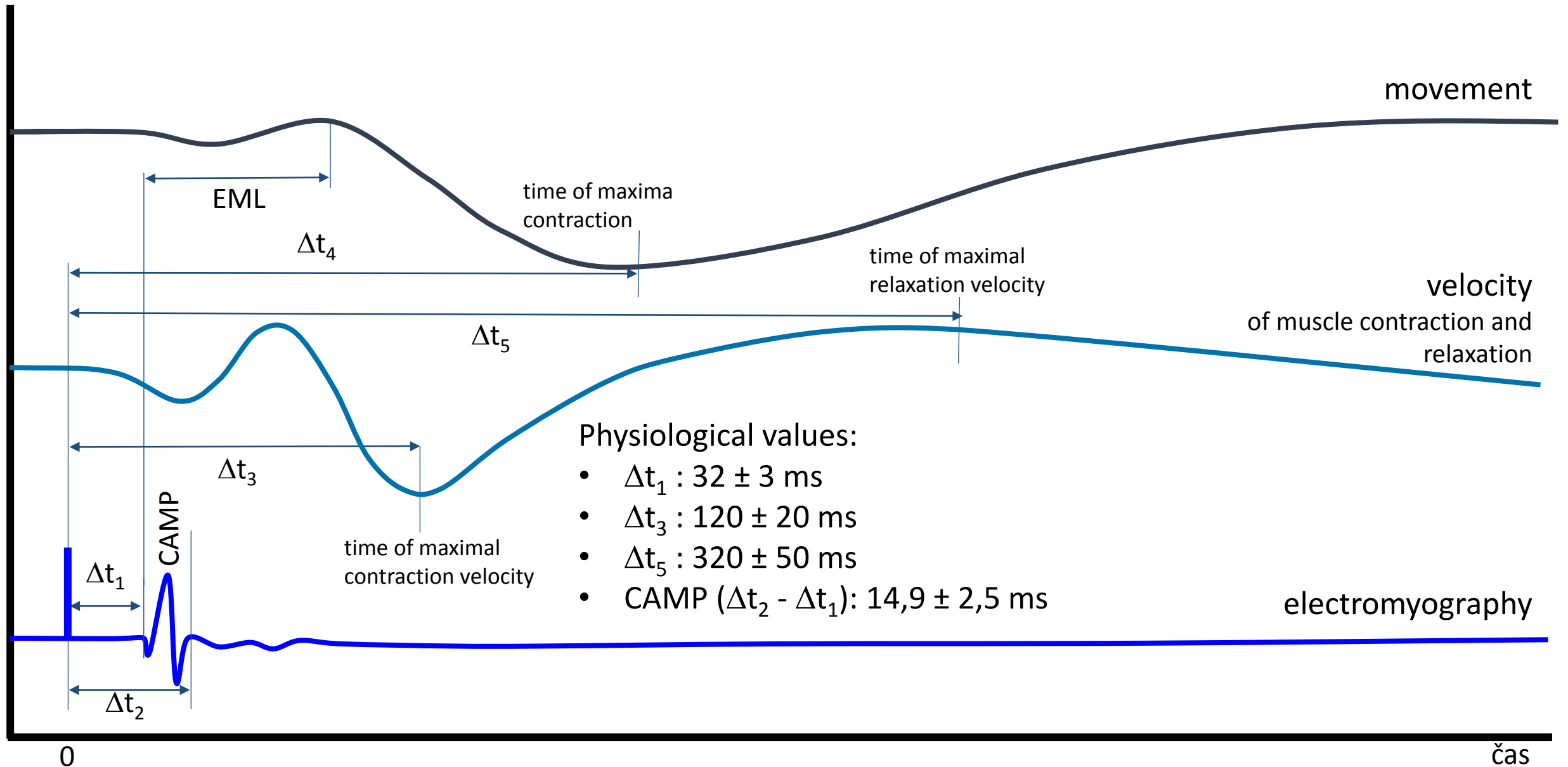
Methods

- The mechanical response of the muscle, contraction and relaxation, may be recorded with a joint goniometer fixed on the calf and the foot. The muscle contraction changes the angle formed by the attached boxes, thereby the deflexion of the fibers and eventually the amount of light converted to electric signal. The first derivative of the signal yields the velocity of contraction and relaxation.
- The measurement of Achilles tendon reflex was formerly used to assess indirectly the thyroid function. Prolongation of the mechanical response (specifically the time when the velocity of muscle relaxation reaches its maximal value) is symptomatic for thyroid hypofunction, where as it is abbreviated in hyperthyroidism.

Description of the recording:

- Time of the stimulation is common for all channels and is displayed on channel 3 (EMG) by a vertical line as time 0.
- The electrical component of the reflex (EMG, channel 3) begins at the isoelectric line.
- Small, incidental deviations are caused by instabilities in mutual position of the electrode and the the skin during tapping the tendon.
- A positive deflection (downward directed) appears with a latency t_1 .
- A negative deflection (upward directed) and the second positive deflection follow (see the Fig.)
- The triphasic curve represents CMAP. Its shape depends on position of the electrodes.
- Duration of CMAP is given by the interval t_2-t_1 .
- Physiological values: $t_1 = 32 \pm 3\text{ms}$, CMAP duration = $14 \pm 2.5\text{ms}$.

Polygraphic record of the Achilles tendon reflex



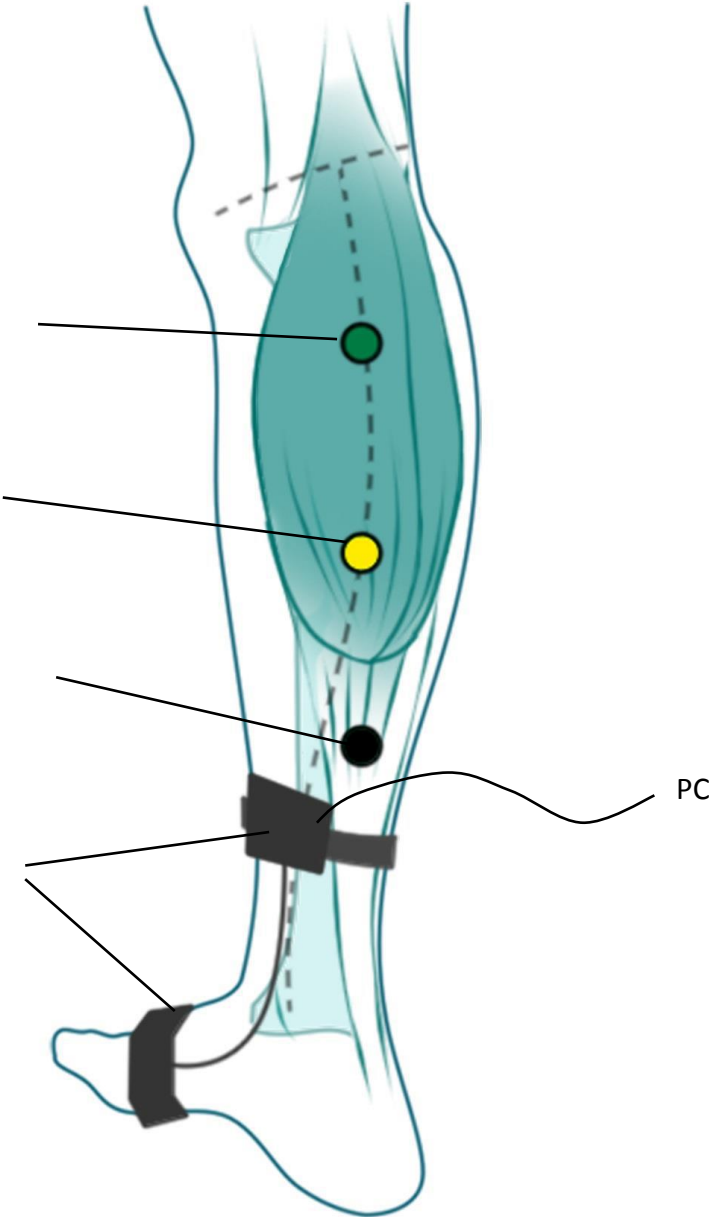
Position of goniometer and electrodes

ground electrode (green)

active electrode (yellow)

reference electrode (black)

goniometer
(a box with a cable located on the medial side of the calf)



- Write results from 5 records in the table

record	1	2	3	4	5	mean	phys. values (ms)
Δt_1							32 ± 3
Δt_2							
Δt_3							120 ± 20
Δt_4							
Δt_5							320 ± 50
CAMP							$14,9 \pm 2,5$

Interesting links

Stretch reflexes <https://www.youtube.com/watch?v=0sqClzuotWo>

Babinski and plantar reflex:

<https://www.youtube.com/watch?v=HnX4bH1WRHQ>

https://www.youtube.com/watch?v=iV_a2WSbdM8

Reflexes used in brain dead examination:

<https://www.youtube.com/watch?v=Nty6bICZlyA>

From 8:40 min <https://www.youtube.com/watch?v=qiZBGFwv4E&t=524s>

Vestibuloocular reflex

https://www.youtube.com/watch?v=j_R0LcPnZ_w

Pupillary reflex

<https://www.youtube.com/watch?v=aM0ipmW3ikc>