

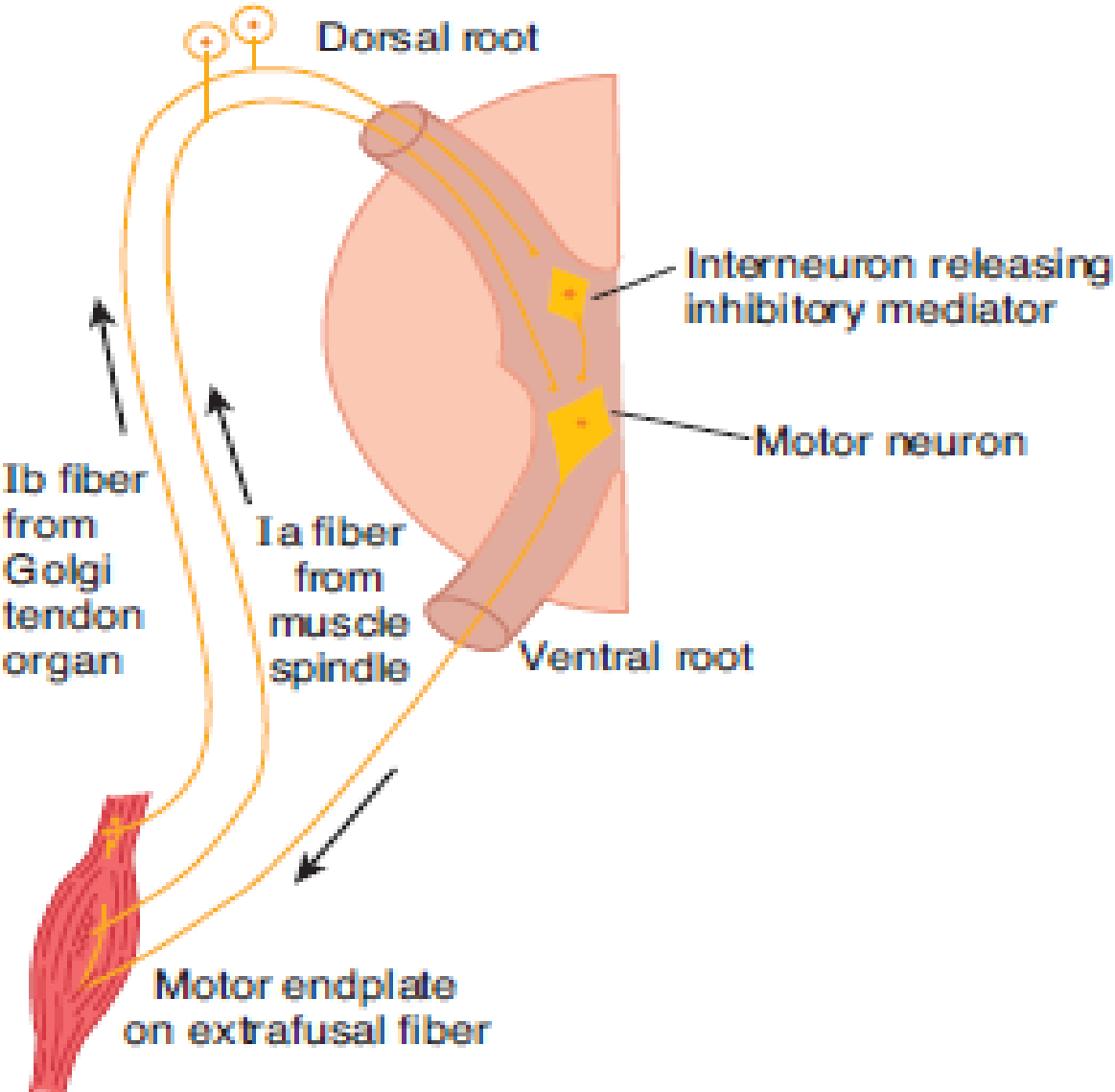
XXVII. Examination of reflexes in man  
XXVIII. Recording of Achilles' tendon reflex

Physiology II - practice

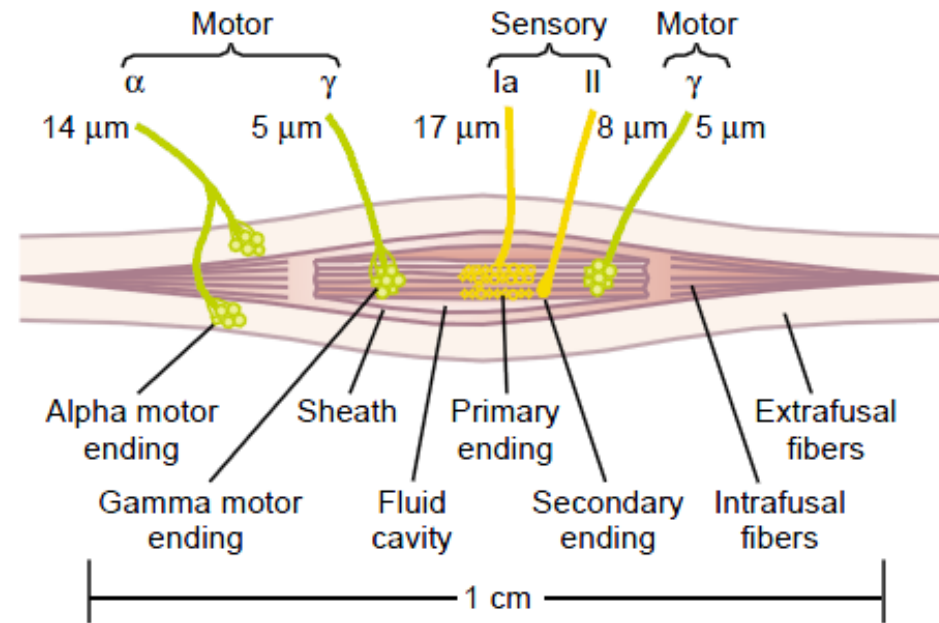
# Reflexes

- **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.
- **When examining reflexes the following items are considered:**
  - 1. Electability of a reflex, 2. Quantitative changes in the response and
  - 3. Qualitative changes.

# Diagram illustrating the pathways responsible for the stretch reflex and the inverse stretch reflex

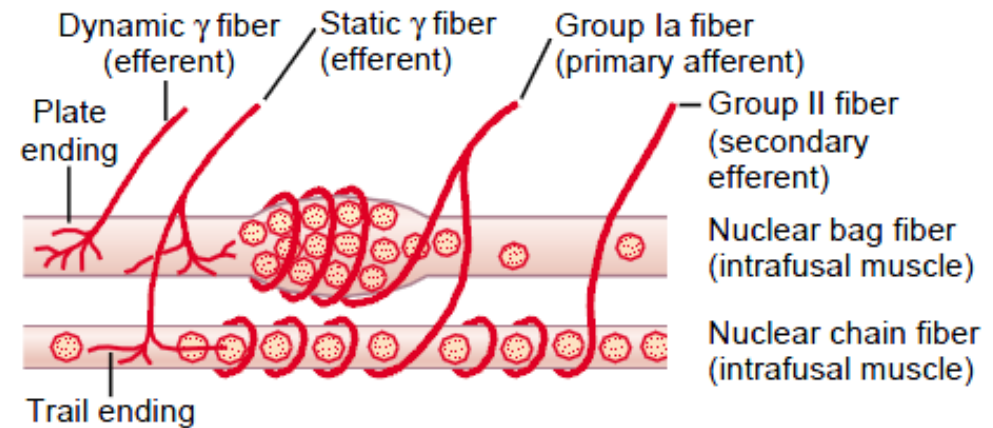


# Muscle spindle



**Figure 54-2**

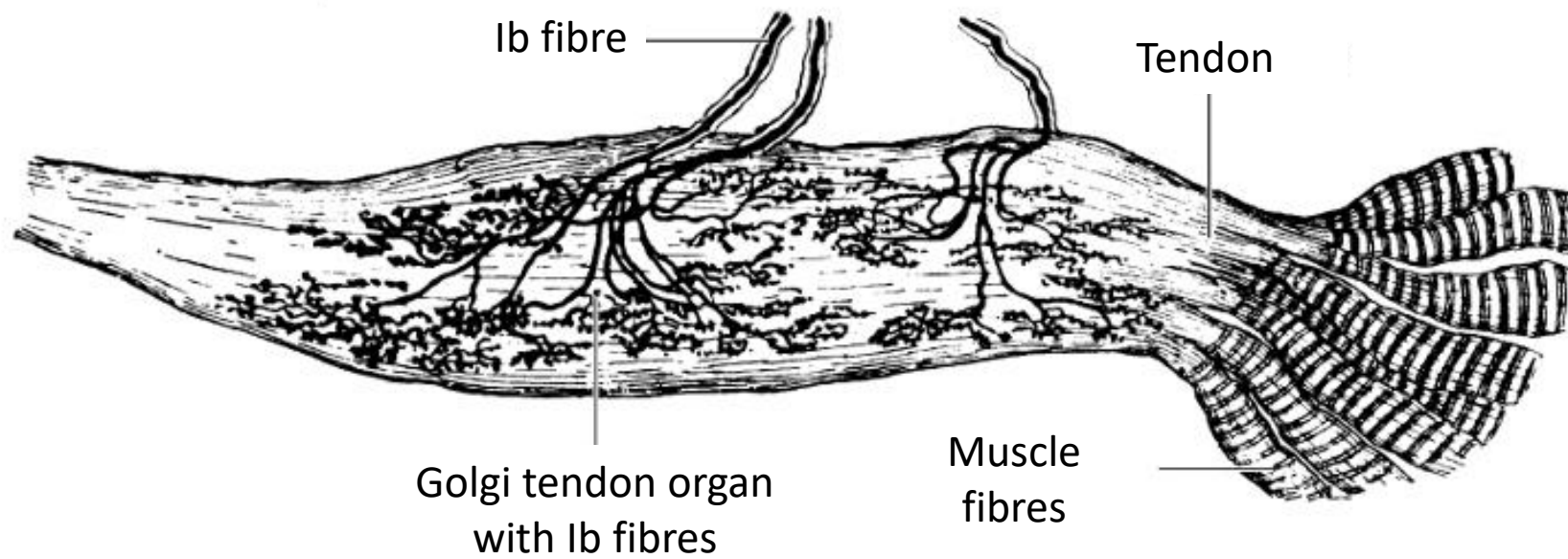
Muscle spindle, showing its relation to the large extrafusal skeletal muscle fibers. Note also both motor and sensory innervation of the muscle spindle.



**Figure 54-3**

Details of nerve connections from the nuclear bag and nuclear chain muscle spindle fibers. (Modified from Stein RB: Peripheral control of movement. *Physiol Rev* 54:225, 1974.)

# Golgi tendon organ



- 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.
- In the Jendrassik's manoeuvre the patient firmly hooks his hands and vigorously tries to distend them.
- Sometimes it is necessary to distract the subject's attention by asking him to perform a simple calculation (repeated subtraction of a number).

# Types of reflexes

- 1- 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)

## **A) 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- Mediotplantar reflex.

## **B) Exteroceptive reflexes (cutaneous and mucous):**

- 1- Corneal and conjunctival reflexes, 2- Palatal reflex, 3- Epigastric, mesogastric, hypogastric reflexes and 4- Plantar reflex.



## **C) Sensory reflexes:**

- 1- Pupillary responses:
  - a- Response to light
  - b- Response to convergence
  - c- Response on pain
- 2- Twinkle reflex

## **Equipment:**

- Percussion hammer, wooden spatula, cotton wool and torch.

## **Procedure:**

- According to our practical book: **PHYSIOLOGY AND NEUROSCIENCES PRACTICALS 2013.**

# 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.

- 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.

## ***Equipment:***

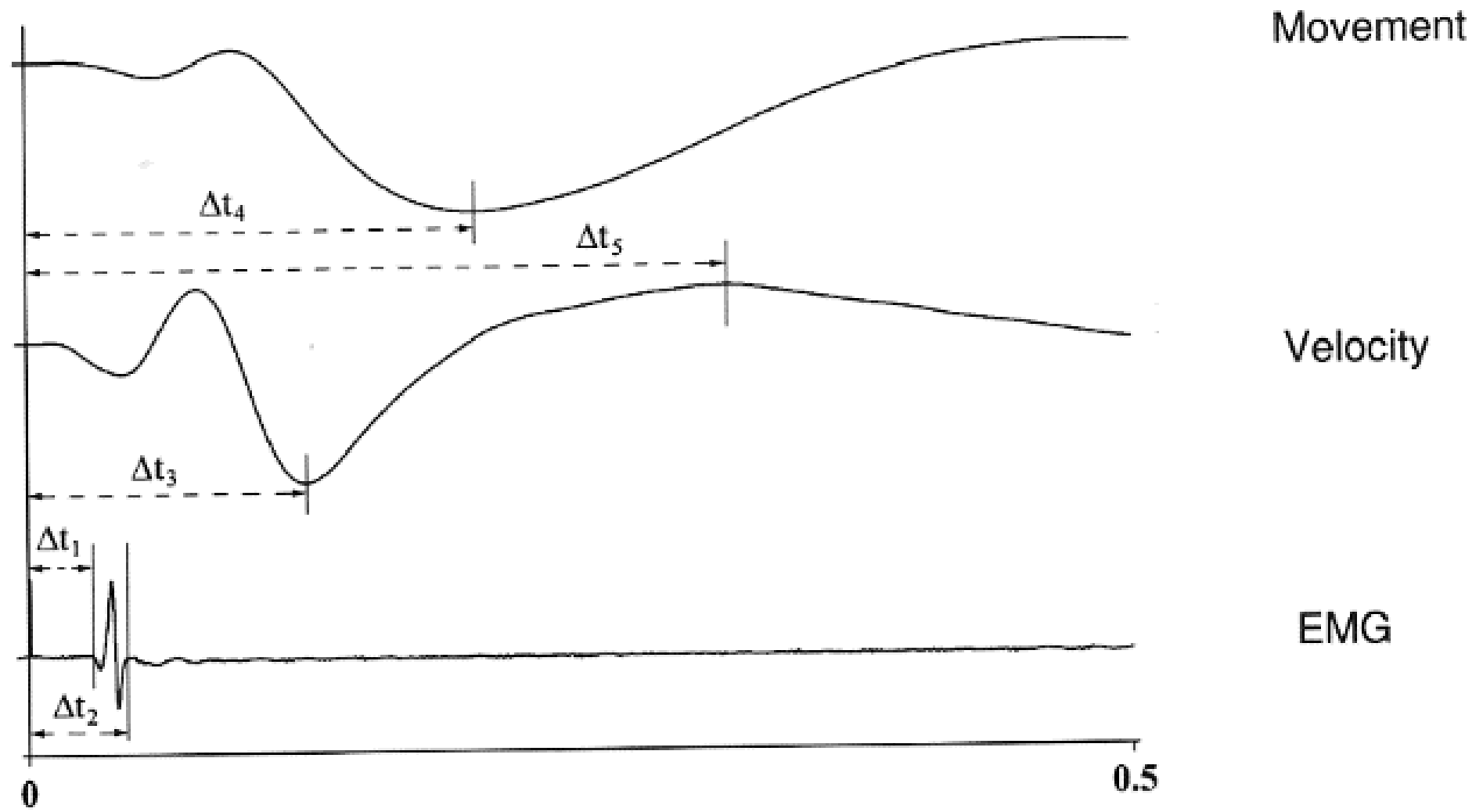
- 1- PwerLab system, 2- electrodes, 3- goniometers, 4- gel, 5- alcohol, 6- cotton and 7- reflex hammer.

## ***Procedure:***

- Look at “PHYSIOLOGY AND NEUROSCIENCE PRACTIKALS 2013”

## ***Results:***

- The mechanical response recorded by the goniometer, i.e. the change of angle corresponding to the movement of the foot, is displayed on channel 1 (Movement), velocity of the movement appears on channel 2 (Velocity) and the third channel (EMG) shows the electrical response, i.e. the compound muscle action potential (CMAP).



## 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 =  $14 \pm 2.5\text{ms}$ .



- The mechanical component of the Achilles tendon reflex (channel 1, Movement) consists of a broad negative wave with a peak latency  $t_4$ . The descending part of this wave corresponds to contraction, the peak of the wave at time  $t_4$  to the end of contraction and the ascending part of curve to relaxation of the muscle.
- Channel 2 (Velocity) displays first derivative of the data from the channel 1, i.e. the velocity of muscle contraction and relaxation. The curve begins with a few stimulation artefacts and culminates by a deep depression at time  $t_3$ , when the velocity of muscle contraction reaches its maximal value. The peak of the following upward directed wave at time  $t_5$  corresponds to the moment when the velocity of muscle relaxation reaches its maximal value.
- Range of physiological  $t_5$  values: 280 – 360 ms.