

Theoretical part

Vertigo and nystagmus

Dizziness, also called vertigo, is a subjective unpleasant feeling of unsteadiness or movement of one's surroundings. Vertigo is often accompanied by objective symptoms such as loss of balance, nystagmus, sweating, paleness, increased heart and breathing rate and subjectively by nausea (feeling of involuntary urge to vomit). Nystagmus is an involuntary rhythmic eyeball movement and consists of two components: slow deviation of the eyeballs to one side and a fast jerk to the opposite side. Nystagmus is also called "dancing eyes". The slow component is caused by irritation of the vestibular system and the fast component represents compensation mediated by the brainstem. Pathologic nystagmus is caused by a pathology in the vestibular system or in cerebellum. On the other hand, two physiological causes of nystagmus have been distinguished: optokinetic nystagmus and postrotatory nystagmus. Optokinetic nystagmus will be explained in electrooculography and postrotatory nystagmus is tested in this practice.

The following parameters are evaluated in nystagmus in clinical practice:

1. direction – e.g. to the left or right in horizontal nystagmus (left/right-beating nystagmus), down or up in vertical nystagmus (down/up-beating nystagmus). The direction of nystagmus is defined by the direction of its quick phase.
2. frequency – fast or slow nystagmus;
3. amplitude – coarse or fine nystagmus;
4. plane – horizontal, vertical, diagonal, rotatory nystagmus;
5. degree – nystagmus present only during gaze in the direction of fast component (1st degree), present also when person is looking in front of him/her (2nd degree), or present even during gaze in the direction of slow component (3rd degree).

Post-rotational nystagmus and vertigo

Nystagmus and vertigo may be examined either after rotation on a swivel chair or also in a standing subject after performing active rotation. The post-rotational effects, however, are less marked in the latter case. Nystagmus in the horizontal plane is produced by rotation of a subject with the head inclined frontally by about 30 degrees. In this head position the horizontal canals are exactly in the plane of rotation. Rapid turning sets the endolymph in the canals in motion. The inertia of the fluid keeps it moving in the same direction for some time after a sudden stop of rotation. The fluid moves past the now stationary cristae, producing the illusion of continued movement (vertigo). The excitatory impulses from the semicircular canals also travel to the nuclei controlling eye movement (producing nystagmus), to the spinal cord (causing unsteadiness of stance and gait, with a tendency to fall in the direction of rotation), and to the autonomic centres in the reticular formation (producing nausea or even vomiting). Vertical, diagonal or rotatory nystagmus is produced with combined activation of different semicircular canals. In rotatory nystagmus deviation of the eye around the sagittal axis is observed.

Hautant's test

This test is used for differential diagnosis of vestibular, cervicogenic, and ischemic dysfunction. In a subject with eyes closed, tonic deviations of arms outstretched are observed.

Protocol

Recruitment and summation in skeletal muscle

Method

Principle of the method

The nerve stimulation for diagnostic purposes is carried out by brief rectangular pulses (usually between 0.1 and 1 ms). The intensity of stimuli can be set in mV or mA (the latter method appears more suitable for precise stimulation).

A stimulation electrode has two poles: the negative cathode and the positive anode. The electrical signal is initiated by depolarization of the nerve under the cathode. The tissue under the anode becomes hyperpolarized. In the case of bipolar stimulation with a bar electrode, both poles are placed along the nerve about 2–3 cm apart with the cathode nearer to the examined muscle. In the case of unipolar stimulation, the cathode is situated above the nerve and the anode at a distant site. In this practical you will electrically stimulate the nerve in the forearm. Electrical current runs locally through the tissue, between the poles of the bar electrode. The maximum electric current applied is 20 mA (in contrast to the 80–100 mA used in clinical electrophysiology). The mechanical response of muscles will be recorded with a piezoelectric force transducer.

Procedure

Equipment: The PowerLab recording system, bar stimulation electrode, force transducer, soapy water solution, conductive gel, Velcro fastener, adhesive tape

Caution:

Although the current and voltage are quite low in this practical, they easily demonstrate the phenomena studied. Nevertheless, stimulation may be perceived in hypersensitive subjects as an uncomfortable sensation that would quickly fade. Subjects with cardiac pacemakers or with neurological or cardiological problems should not volunteer in this practical. It is prohibited to carry out stimulation on other parts of the body than those described above.

Recruitment

1. Clean the volar side of the wrist of the examined subject with soap solution and dry it.
2. Switch off the Isolated Stimulator on the PowerLab front panel (switch pointing down).
3. Start the acquisition program Recruitment by double-clicking on the icon.
4. In the menu *Setup – Stimulator panel* open the mini-window with stimulus parameters (Fig. 1): stimulation frequency (Max Repeat Rate) 0.5 Hz, stimulus duration (Pulse Width) 0.2 ms, stimulus intensity (Current) 2 mA.

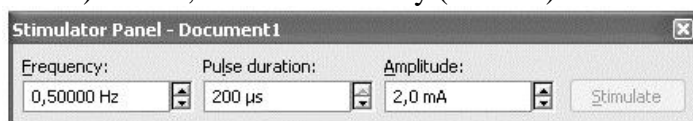


Figure: Mini-window of Stimulator Panel

- Put a small amount of gel on both silver contacts of the bar electrode. Place the electrode at the volar side of wrist of the subject between the tendons of the flexor carpi radialis and palmaris longus (see Fig. 2). Both contacts must lie over the median nerve with the cathode closer to the thenar. The red dot on the electrode indicates the anode (the impulse is generated by the cathode). In this phase of the experiment the bar electrode is held by the examined subject.

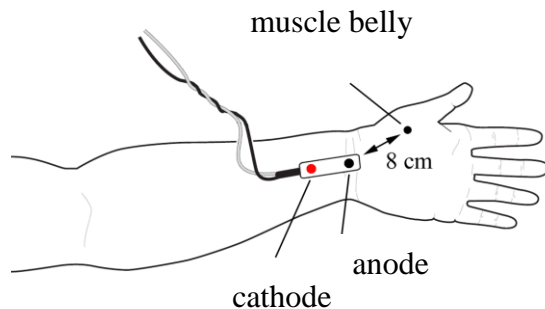


Figure: Schematic picture of stimulation electrode position

- Set the Isolated Stimulator to the ON position (switch pointing up).
- Since the subjective perception of stimulation varies, adjust the stimulation parameters according to the instructions of the examined subject.
- Check the correct position of the bar electrode as follows: click START (do not record yet). Thereby a single stimulus of 2 mA is applied, perceived as a moderate sensation. Note that somatosensory neurons have a lower threshold for activation in comparison with motor neurons. Increase the intensity of stimuli in 2 mA steps until a clear motor response of the thenar muscles (abductor and flexor pollicis brevis, opponens pollicis) is observed. Attach the electrode by means of the velcro fastener. If the electrode is placed more to the ulnar side, an undesirable contraction of the muscles innervated by the ulnar nerve may appear.
- Turn the examined hand into a semiprone position so that the muscle contraction would move the thumb vertically down. Place the forearm comfortably on the desk and ask the subject to relax all muscles. Put the fingers except the thumb under the plastic plate of the stand. Place the thumb gently on the metal bands of the force transducer and fix it to the metal bands (not to the plastic plate) by adhesive tape or velcro.
- In the mini-window *Stimulator panel* set the stimulation frequency to 2.5 Hz and the stimulus intensity to 1 mA. The subject should not observe the monitor. Turn on the recording mode and press the button START. A train of four stimuli is now applied with a delay of 200 ms (indicated at the bottom channel *Stimulation*). The signal from the force transducer appears on the upper channel *Force*. The programme is recorded for a pre-set interval of 1 sec. In order to continue the stimulation, the button START must be pressed again. Each time you change the current, add a comment.
- Increase the current by 1 mA and click START. Keep increasing the stimulus intensity until the first muscle contraction appears. Then, lower it by 2 mA and continue with 0.5 mA increases until the *threshold intensity* (as a rule 3–8 mA) is achieved. Afterwards continue with increases of 1 mA up to 20 mA. Avoid any stimulation which leads to discomfort in the examined subject.
- Save the record labelled “recruitment xy” where xy are the initials of the subject. Save as type Data Chart File (*.adicht).
- Make a record of maximal intensity (I_{max}), the lowest intensity which has elicited full contractile response (of maximal force). Take a similar record of the threshold intensity

(I_t), the lowest intensity which has elicited a contractile response. Both values are used in the next protocol.

14. Close the acquisition programme Recruitment.

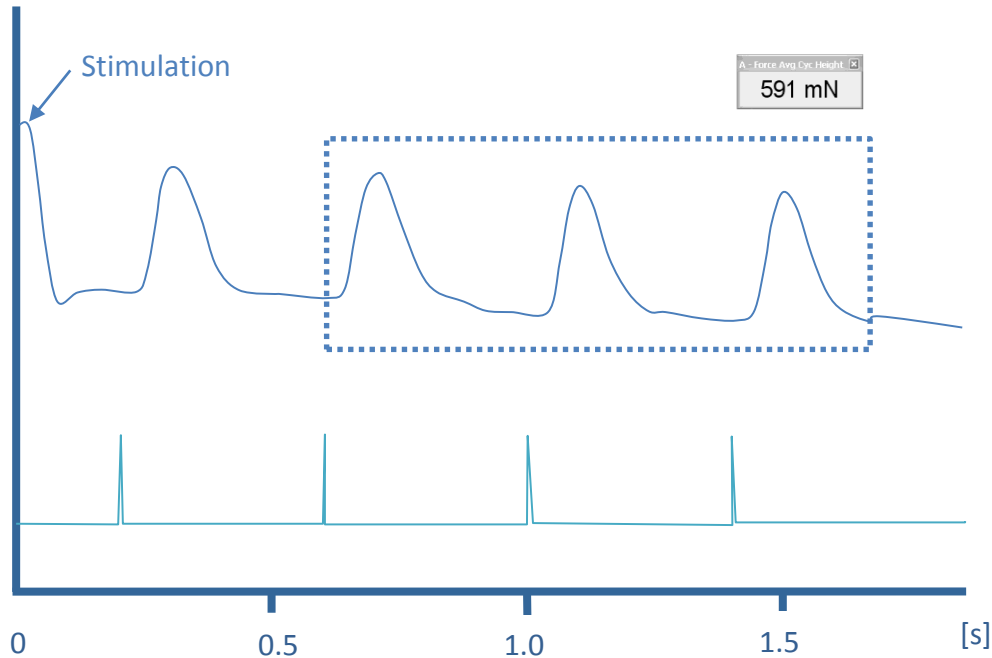
Summation

1. The procedure described in paragraphs 1–9 of the previous exercise remains the same except for opening the acquisition programme by double-clicking on the icon Summation.
2. In the mini-window *Stimulator panel* the parameters of stimulation appear: stimulation frequency 2 Hz, stimulus duration 0.2 ms, stimulus intensity 2 mA.
3. Set up the stimulus intensity to I_{\max} from the foregoing protocol. Switch on the saving mode.
4. Press START, two pulses of pre-set parameters are triggered and indicated on the bottom channel *Stimulation*. The first stimulus occurs with 200 ms delay after the onset of recording. The second simultaneous signal appears on the upper channel "*Force*". The programme is automatically recorded for 1 sec. For further stimulation press START again.
5. Repeat stimulation at 7, 10, 15 and 20 Hz. Each time you increase the stimulation frequency, add a comment.
6. At 20 Hz decrease the intensity of stimulation to I_t and click START. Add a comment.
7. Set the number of stimuli to 25 in the menu *Setup – Stimulator – Repeats* and close the window. In the menu *Setup – Sampling – Fixed duration* set the duration of the record to 4 seconds and close the window.
8. Adjust the frequency to 2 Hz and the intensity to I_{\max} . Click START. The record of the triggered train of pulses automatically stops after 4 sec. Add comments about the intensity and frequency of stimulation.
9. Repeat the protocol from paragraph 8 using frequency 7, 10, 15 and 20 Hz. After the last stimulation, decrease the intensity to I_t , click START and add a comment.
10. Switch off the stimulator and save the record under "summation xy" where xy are the initials of the subject, type Data Chart File (*.adicht).
11. Close the acquisition programme summary.

Results

Recruitment

Measure and compare the contraction force while increasing the stimulation intensity. In the force channel select the 2nd, 3rd and 4th contraction as shown in the figure below.



Graph: An example of recording. Black rectangle represents choice for average amplitude evaluation – force of muscle contraction. Corresponding value in mN appears in mini-window. Arrow shows an artefact from force sensor caused by starting the recording. At time 200 ms, the first of four stimulations starts.

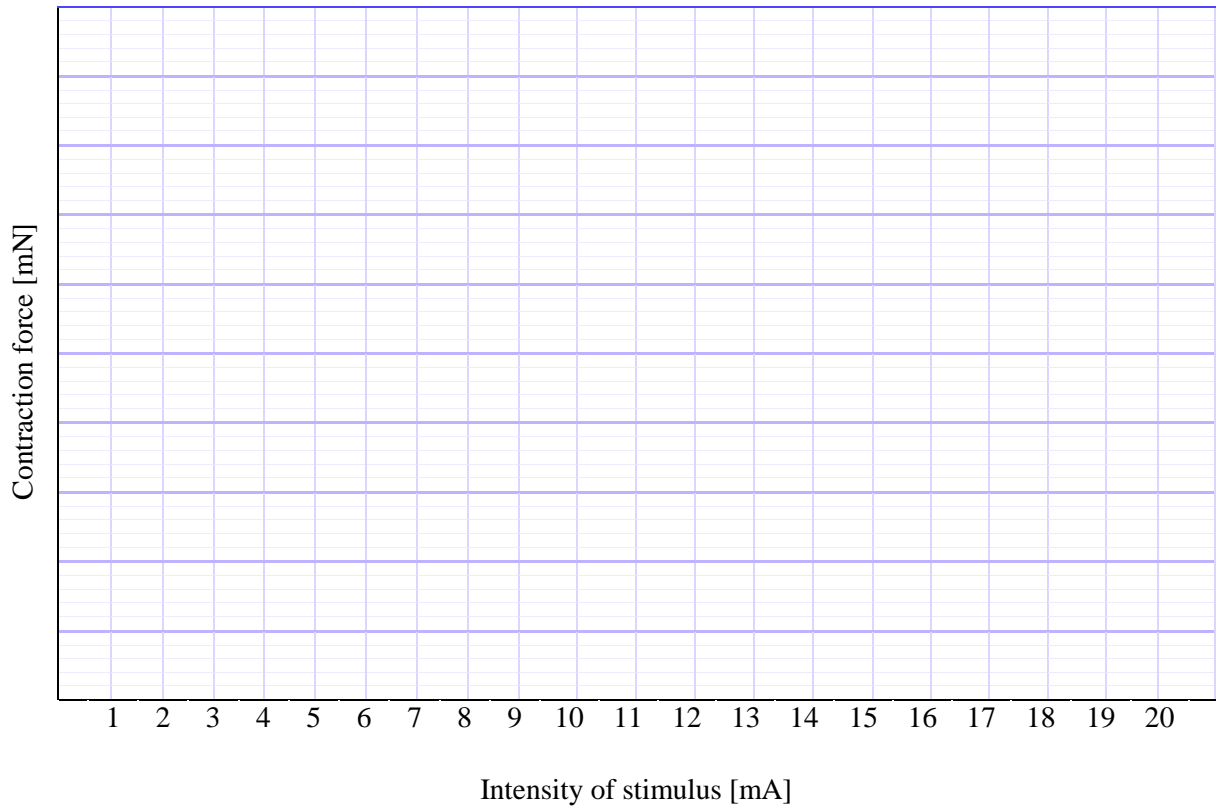
Table 1: Measured force of muscle contraction.

stimul. [mA]	force [mN]	stimul. [mA]	force [mN]	stimul. [mA]	force [mN]	stimul. [mA]	force [mN]
1		6		11		16	
2		7		12		17	
3		8		13		18	
4		9		14		19	
5		10		15		20	

name

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study group



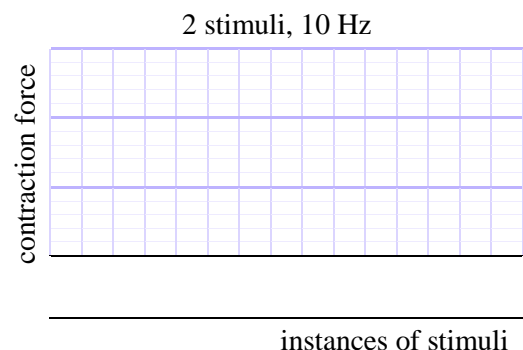
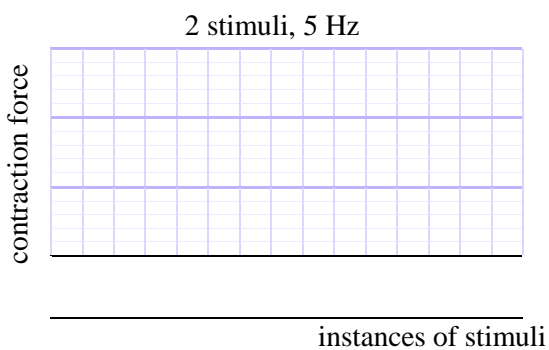
Graph: Dependence of force on intensity (based on Table 1)

Threshold stimulus: $I_t = \dots\dots\dots$ mA.

Maximal stimulus: $I_{max} = \dots\dots\dots$ mA. **Maximal force of contraction** $F_{max} = \dots\dots\dots$ mN.

Summation

Draw the record obtained in stimulation frequency 5, 10, 15 and 20 Hz, both in a series of 2 and 25 stimuli. Do not forget to draw instances of electrical stimulus with the right time consequence Stimulus-contraction. Describe the graphs (muscle twitch, superposition, summation, complete or incomplete tetanus).

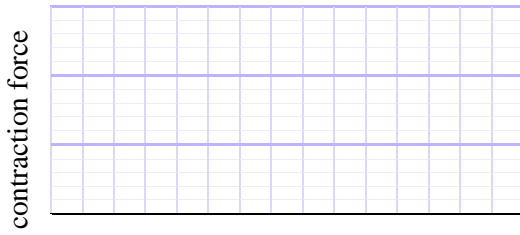


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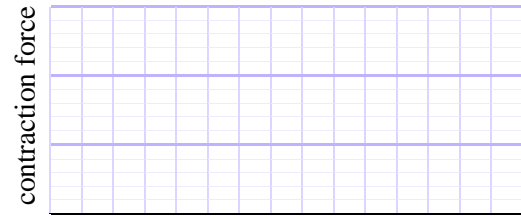
study group

2 stimuli, 15 Hz



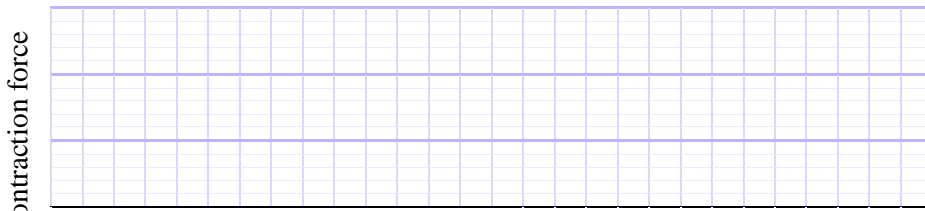
instances of stimuli

2 stimuli, 20 Hz



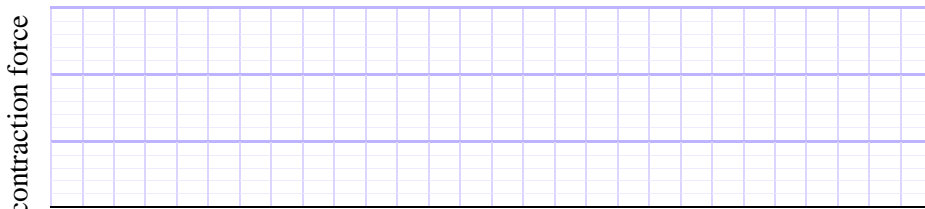
instances of stimuli

25 stimuli, 7 Hz



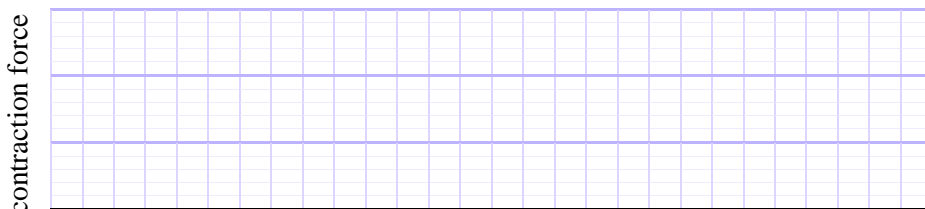
instances of stimuli

25 stimuli, 10 Hz



instances of stimuli

25 stimuli, 15 Hz

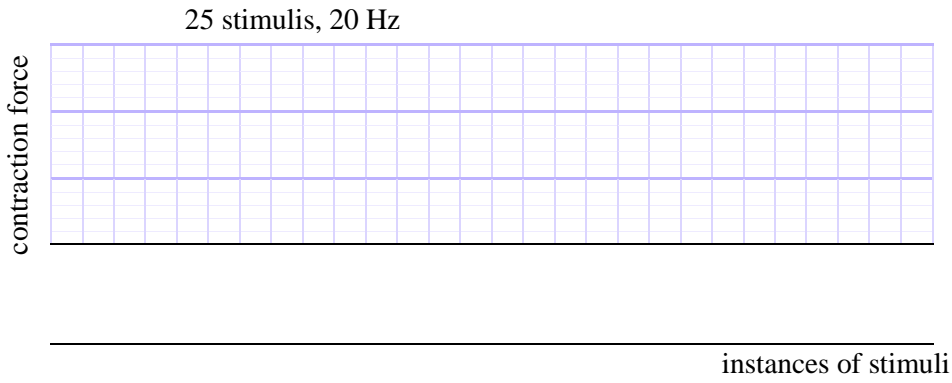


instances of stimuli

name

number

study group



Conclusion

Explain mechanism of amplification of the skeletal muscle contraction, and compare with cardiac muscle. Explain the molecular basis.

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Explain dependence of intensity on contraction force. Discuss results of your measurement.

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At what frequency of impulses did you observe the superposition and summation in skeletal muscle?

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Describe conditions of incomplete and complete tetanus formation.

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Protocol

Reflexes

Methods

Equipment:

Percussion hammer, wooden spatula, cotton wool wisp, torch

Procedure

Most reflexes are elicited by tapping the corresponding receptor area with a percussion hammer. It is recommended to train the tapping, e.g. on a desk, in order to get an adequately strong (not painful), fast and precise tap. The reflex hammer should be swung in the examiner's hand rather than being clenched.

The examined part of body needs to be sufficiently relaxed. This is usually achieved by supporting the examined leg in semiflexion or semipronation. If the reflex cannot be elicited even in a correct procedure, one can try to improve the elicibility using a s.-c. facilitating manoeuvre consisting of a voluntary contraction of antagonistic muscles. In 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).

Examined reflexes

Proprioceptive (myotatic, stretch) reflexes

- **Masseter or jaw jerk reflex:** the mouth is slightly open; a tap is applied to the spatula leaning against lower teeth or to the examiner's thumb placed on the subject's chin and tap on it. Closure of the jaws is observed eventually.
- **Glabellar r.:** a slight tap on the nose root leads to closure of eyelids.
- **Biceps r.:** a tap on the thumb positioned on the bicipital aponeurosis, the so-called lacertus fibrosus, evokes flexion of the forearm.
- **Brachioradialis r.:** examined forearm is in supinated position, tapping the processus styloides radii elicits pronation of the hand.
- **Triceps r.:** the upper extremity is supported by a hand over the elbow and the triceps tendon is tapped over the olecranon ulnae – extension of the forearm is produced.
- **Patellar or knee jerk r.:** the subject puts one leg over the other or the examiner holds it in his/her hand just above the knee. Tapping the tendon below the patella brings about extension of the shin. The most frequently tested reflex.
- **Achilles or ankle jerk r.:** the subject kneels with one leg on a chair, or the examiner supports his/her leg in flexion. Tapping the Achilles tendon produces plantar flexion of the foot.
- **Medioplantar r.:** tapping on the middle of the sole elicits plantar flexion.

Exteroceptive reflexes (cutaneous and mucous)

- **Corneal and conjunctival rr.:** touching slightly the cornea or conjunctiva with cotton wool wisp causes the eyelids to close.
- **Palatal r.:** touching the soft palate with the spatula leads to elevation of the soft palate.
- **Epigastric, mesogastric, hypogastric rr.:** the skin of the proper part of abdomen is slightly scratched with the end of the percussion hammer handle from the side to the centre whereby a rapid contraction of abdominal muscles is produced.
- **Plantar r.:** lateral plantar edge is firmly scratched with the percussion hammer handle – a plantar flexion of toes appears. In case pyramidal tracts are injured, the s.-c. Babinski phenomenon appears, i.e. dorsal flexion and a fan-like stretching of toes.

Sensory reflexes

- **Pupillary responses:** The pupils react to different stimuli either with a constriction (miosis) or dilatation (mydriasis). The speed of the response and its magnitude is checked on both sides.
 - **Response to light:** when the eye is shaded (by the palm) the pupil dilates, at illumination it constricts. This is called direct response. Both pupils respond at the same time – the s.-c. consensual (indirect) response.
 - **Response to convergence:** the subject looks at the examiner's finger that is suddenly brought near to the subject's nose. In looking at a near object (convergence) the pupils constrict, while when looking at a distant one (divergence) they dilate (cranial nerve III).
 - **Response to pain:** a strong painful stimulus (e.g. pinching the skin strongly) produces a dilatation and then a constriction of pupils.
 - The response to light and to convergence is a common part of medical examination. In some nervous disturbances the response to light disappears, while that on convergence remains normal – this is the Argyll– Robertson sign.
 - **Twinkle reflex:** when the examiner's palm is quickly moved close to the subject's eye, the eyelids close.

name number study group

Table: Reflexes. C: cervical, Th: thoracic, L: lumbal, S: sacral spinal cord segment

Reflex	Afferent pathway	Reflex centre	Efferent pathway
Proprioceptive reflexes			
Masseter (Jaw jerk reflex)	n.mandibularis	pons Varoli	n.mandibularis
Glabellar	n. ophthalmicus	pons Varoli	n.facialis
Biceps	n.musculocutaneus	C5	n.musculocutaneus
Brachioradialis	n.medianus	C6	n.musculocutaneus
Triceps	n.radialis	C7	n.radialis
Patellar (Knee jerk reflex)	<i>n.femoralis</i>	L2-4	n.femoralis
Achilles reflex (Ankle jerk reflex)	n.tibialis	L5-S2	n.tibialis
Medioplantar	n.tibialis	L5-S2	n.tibialis
Exteroceptive reflexes			
Corneal	n.ophthalmicus	pons Varoli	n.faciális
Palatal	n.maxillaris	pons Varoli	n. vagus, n.accessorius
Epigastric, Mesogastric and Hypogastric	nn.intercostales	Th 7-9 Th 9-10 Th 10-12 L5-S2	nn.intercostales n.tibialis
Plantar	n. tibialis	L5-S2	n. tibialis
Sensory reflexes			
Pupillary light reflex	n.opticus	mesencephalon	n.oculomotorius
Twinkle	n.opticus	tectum	n.facialis

Table: A reflex activity grading scale is used among physicians in order to assess and evaluate the reflexes.

Grade	Description
0	Absent
1 or +	Hypoactive
2 or ++	Normal
3 or +++	Hyperactive without clonus
4 or ++++	Hyperactive with clonus

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Results

Table: Fill in the blanks by using the reflex grade scale

Reflex	Right side	Left side	Reflex	Right side	Left side
Jaw jerk			Palatal		
Glabellar			Epigastric		
Biceps			Mesogastric		
Brachioradialis			Hypogastric		
Triceps			Plantar		
Patellar			Direct response to light		
Achilles reflex			Indirect response to light		
Medioplantar			Response to convergence		
Corneal			Twinkle reflex		

Discussion

Discuss results

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Explain possibilities causing inability to elicit the reflex.

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Protocol

Achilles reflex test

Method

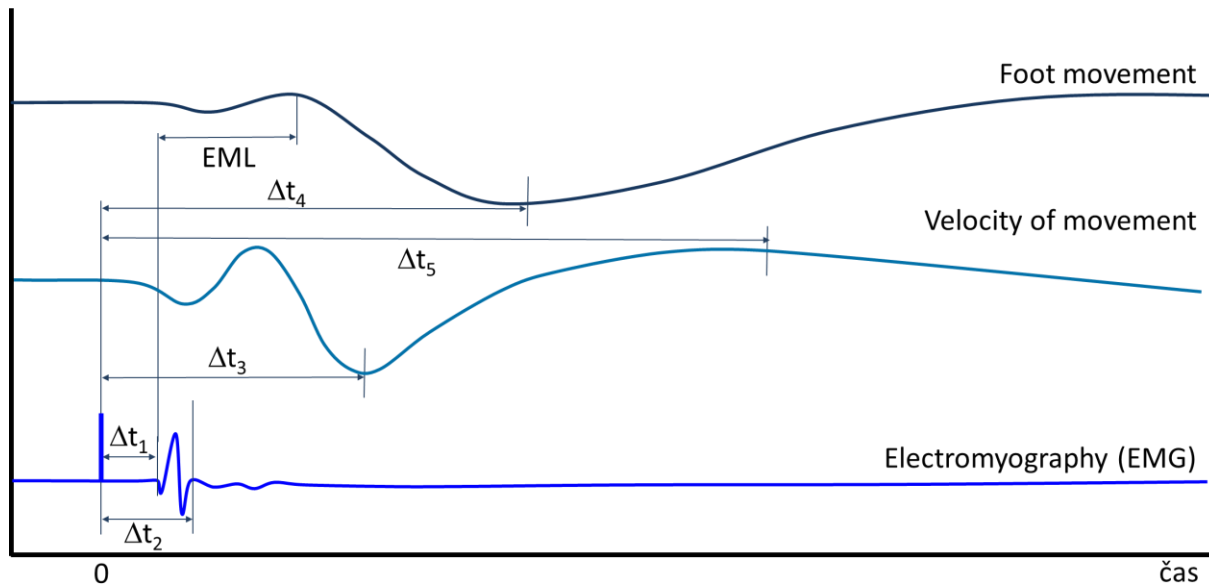
Equipment:

PowerLab system, electrodes, goniometer, gel, alcohol, cotton pads, reflex hammer – trigger

Description of the recording:

The time of the stimulation is the same 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 as an isoelectric line. Small, incidental deviations are caused by instabilities in the mutual position of the electrode and the skin while 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 schema below). The triphasic curve represents CMAP. Its shape depends on the position of the electrodes. The duration of CMAP is given by the interval $t_2 - t_1$. Physiological values: $t_1 = 32 \pm 3$ ms (depends mainly on age and height of the subject), CMAP duration = 14 ± 2.5 ms. The mechanical component of the Achilles tendon reflex (channel 1, Movement) consists of a broad negative wave with a peak latency of t_4 . The descending part of this wave corresponds to contraction, while the peak of the wave at time t_4 corresponds to the end of contraction and the ascending part of curve to relaxation of the muscle. Channel 2 (Velocity) displays the 1st 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 with 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).

latence	description	Physiological values
Δt_1	Beginning of the electrical muscle activity	32 ± 3 ms
Δt_2	End of the electrical muscle activity	
Δt_3	Time of maximal muscle contraction velocity	75 – 105 ms
Δt_4	Time of maximal muscle contraction	
Δt_5	Time of maximal muscle relaxation velocity	280 – 360 ms
CAMP = $\Delta t_2 - \Delta t_1$	Duration of electrical muscle activity	14.9 ± 2.5 ms



Procedure

1. The examined subject sits barefoot with one calf laid bare. Fasten the goniometric boxes to the medial side of the foot and the calf by means of the elastic velcro fasteners. The box with the cable is placed on the calf in such a way that both boxes form a 90° angle and the fibre optics trace the ankle.
2. Fill the surface disc electrodes with conductive gel and fix them with adhesive tape on the skin above the muscle cleaned by alcohol. The yellow electrode must be placed approximately halfway on the line connecting the centre of the fossa poplitea and inner ankle. The black, reference electrode is about 5 cm below and laterally from the yellow one. The green (ground) electrode should be placed between the active electrode and fossa poplitea.
3. The subject comfortably kneels with the examined leg on a wooden chair.
4. Start the acquisition programme Achilles tendon by double clicking on the desktop icon.
5. Click the START button. Tap gently the tendon of Achilles with the reflex hammer (you will hear a tick due to the contact closure in the hammer). The record starts and automatically stops after 0.5 sec. 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), the 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).
6. Take a record of about 12 reflex responses, evoked at about 5 sec intervals.
7. Click the STOP button and save the record under the label "Achilles tendon XY" (XY being the initials of the subject). Save as Data Chart File (*.adicht).

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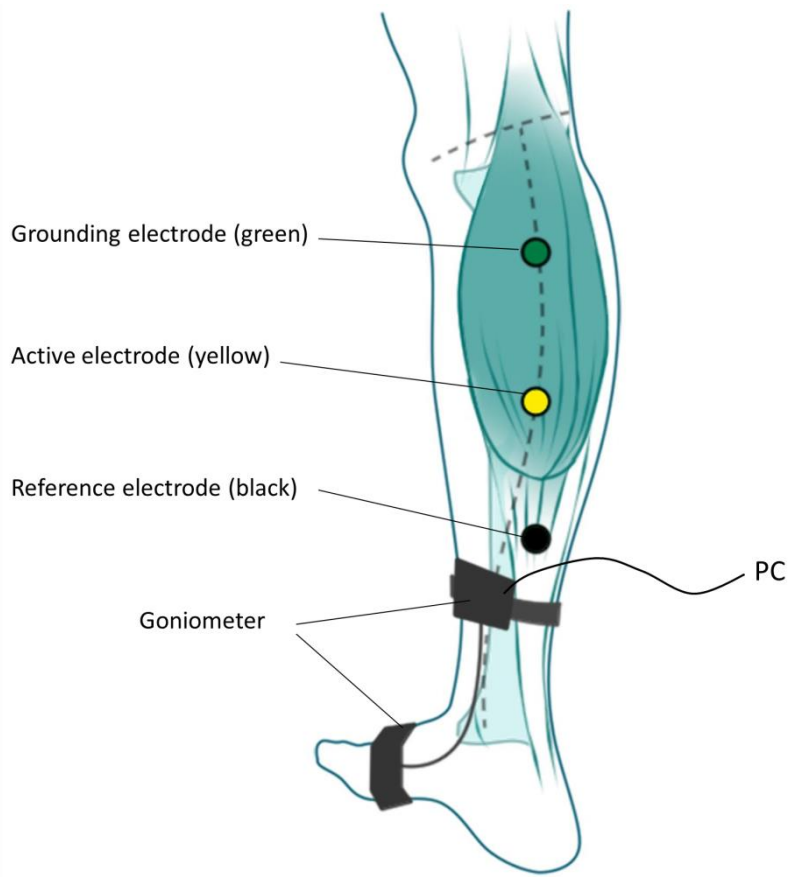


Figure: electrode placement

Results

Measure t_{1-5} in five selected artefact-free sweeps; put the data in a table; calculate the mean values of the measured intervals and CMAP duration.

The position of the mouse cursor – a cross – shows the time Δt in the box in seconds, EML is the time shown in the box representing the time difference between the marker and the position of the cursor.

Table: Fill in the table with the obtained experimental and calculated values.

	1	2	3	4	5	average	Physiological values
Δt_1							
Δt_2							
Δt_3							
Δt_4							
Δt_5							
EML							
CAMP $\Delta t_2, \Delta t_1$							

Discussion

Comment the obtained results and compare them with physiological values.

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Suggest a cause of prolonged as well as shortened t_5

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Suggest a pathological situation where one would not be able to elicit the ankle jerk reflex.

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Protocol

Stabilometric examination of erect posture

Methods

Equipment:

Stabilometer, PC with Stabilometry software, two vibration stimulators, foam surface

Caution: It is absolutely necessary that the experimental subject not look at the monitor during recording and that he/she fully focus on correct performance of the task. The subject should not speak and should try to suppress any voluntary movement!!!

Stabilometry:

1. Start the acquisition programme by double-clicking on 1. the icon LIGHTSWAY. Maximize the window by clicking on the square symbol in the right upper corner.
2. Click on the third icon from the left (a green flash with the letter N). Fill in the name, sex, weight (kg) and height (cm) of the examined subject. As the saving time choose 20 seconds.
3. Fill in the first five comments: (1) normal conditions, (2) closed eyes, (3) closed eyes + foam surface. Leave the fourth comment blank. Confirm by clicking OK. Three buttons appear on the screen: START, RESULTS, and CENTER.
4. The examined person steps on the stabilometer without shoes, with the tips of the feet directed at the output cable, and the back of the subject is turned away from the PC monitor. If the signal is out of range in any axis, the subject's position on the stabilometer must be adjusted, so that the red point representing the COP position is at the cross point of the coordinates.
5. Tests will be performed while moments of supporting forces are recorded for 20 s in each test. During each test try to evaluate the subject's posture visually. Recording of each test will be started by clicking on the START button and will be terminated automatically. During each recording the START button disappears and occurs again after the test has been finished.
 - a) **Normal conditions:** Subject's feet are 10 cm from each other, eyes open, and the head is straight ahead.
 - b) **Eyes closed:** The subject closes his/her eyes and keeps the feet 10 cm away from each other and the head straight ahead.
 - c) **Attenuation of tactile afferentation from feet:** The subject leaves the stabilometer. Lay a foam surface on the stabilometer plate. The subject steps on the foam surface, puts his/her feet together, and after a short adaptation closes his/her eyes. Having finished the test, the subject opens his/her eyes and leaves the stabilometer.
6. Press the button RESULTS to get a summary of results. Stabilometric parameters and statokinesigrams are displayed for each test. The red point on the statokinesigram curve represents the final position of COP achieved during recording. The blue point indicates the initial position.
7. The data need not be saved or printed.

Romberg's test

The procedure is exactly the same but as examined postures Romberg's test will be used instead.

- **Romberg 1** – Subject's feet are 10 cm from each other, eyes open, and the head is straight ahead
- **Romberg 2** – Subject's feet are placed together, eyes open, and the head is straight ahead
- **Romberg 3** – Subject's feet are placed together, eyes closed, and the head is straight ahead
- **Romberg 4** – Subject's feet are placed together, eyes closed, and the head is tilted to right
- **Romberg 5** – Subject's feet are placed together, eyes closed, and the head is tilted to left

Results

In a stabilometric test the motion of COP is recorded within the X and Y coordinates of the horizontal plane during a time period, producing a statokinesigram. The cross point of the coordinates is situated in the centre of the stabilometer plate, positive values representing deviations to the right and forward on the X and Y coordinates, respectively. The following parameters characterize the stabilometry examination:

- 1) Mean COP X, Y (mm) is the mean value of X coordinates and the mean value of Y coordinates of all points of the statokinesigram. It depends not only on the position of the subject on the stabilometer plate but also on the inclination of his/her body.
- 2) Mean distance from the centre (mm) is the average deviation of COP position from the mean COP X, Y in left-right (X) and front-back (Y) directions. It is proportional to the size of the area defined with the movement trajectory.
- 3) Mean velocity (mm/s) represents the average speed achieved by moving COP. It characterizes the extent of muscular effort in maintaining the erect posture.
- 4) X, Y-axis movement (mm) is the total length of the path that the COP followed in the left-right (X) and front-back (Y) directions. It provides information about the prevailing direction of the movement and is directly proportional to the actual length of the trajectory.

All these parameters (with the exception of Mean COP X, Y) describe the overall stability. Increased values indicate decreased postural stability. In our practical the parameters enable us to assess the role of afferent systems in the process of postural control.

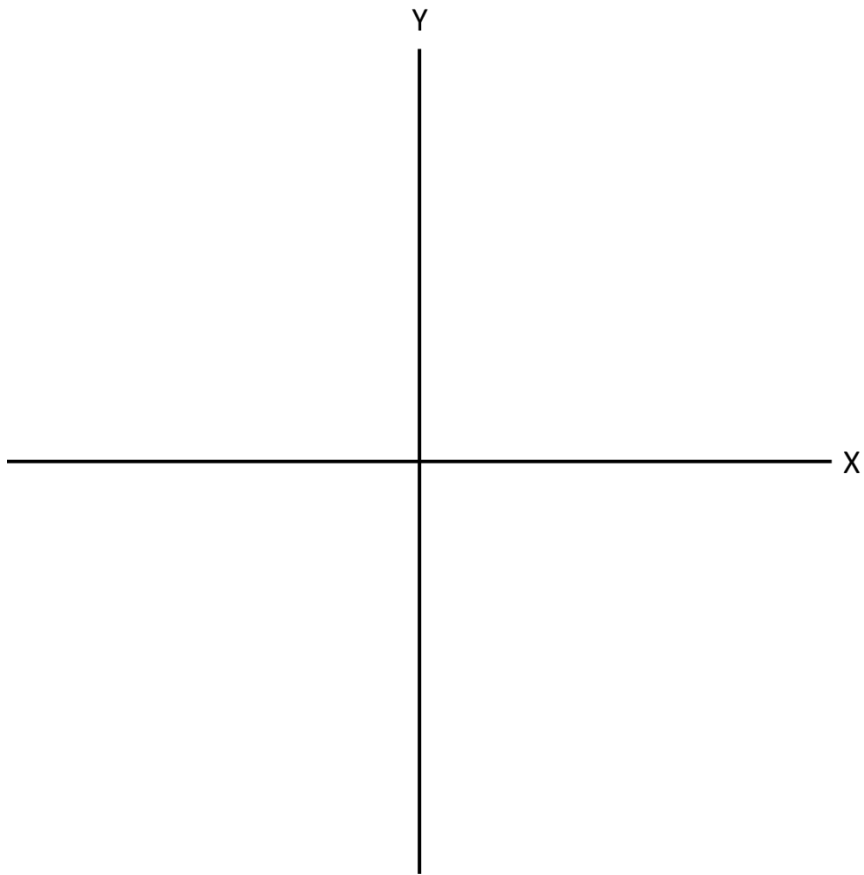
Draw all your records onto **one** graph. Use different colours to distinguish the examination conditions.

name

number

study group

Stabilometry:



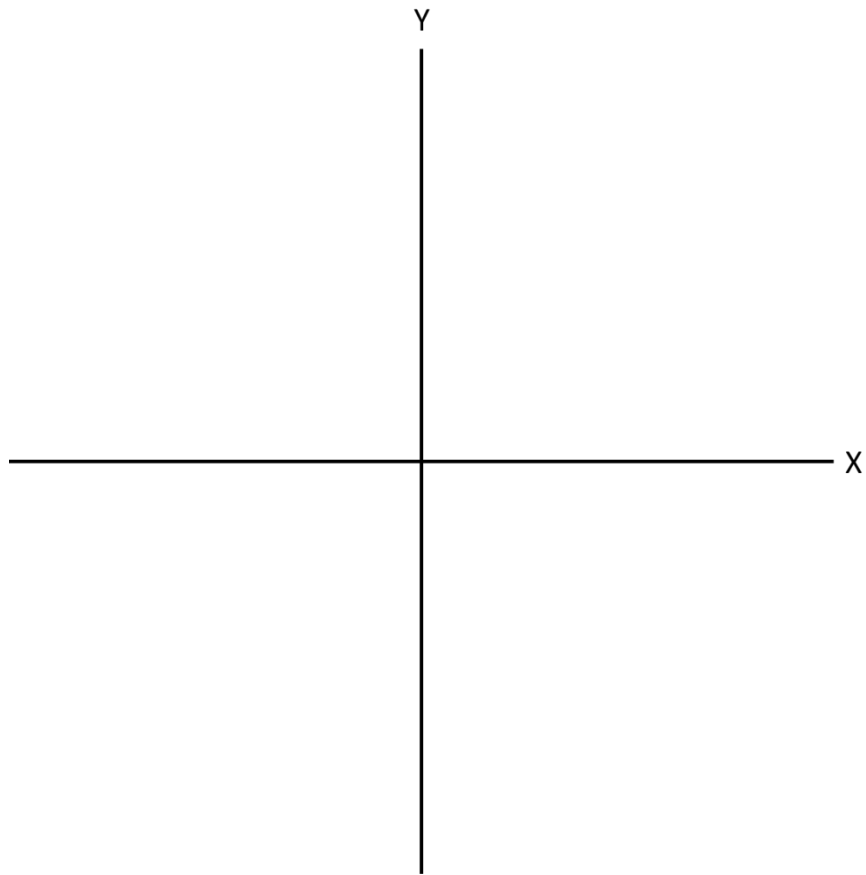
	mean velocity	movement in X	movement in Y
Normal conditions			
Closed eyes			
Closed eyes + foam surface			

name

number

study group

Romberg's test:



	mean velocity	movement in X	movement in Y
Romberg I			
Romberg II			
Romberg III			
Romberg VI			
Romberg V			

name

number

study group

Discussion

Describe and explain the effects of closing one's eyes and standing on a foam surface with an erect posture.

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.....
.....

Explain the purpose of standing with the feet together and head tilting to the side during Romberg's test

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.....
.....
.....

Protocol

Vertigo and nystagmus

Methods

Note: During all five experiments, students stand around the experimental subject and care for his/her safety (in order to prevent the subject from falling down after rotation)!!! Depending on the subjective feelings of the examined person, experiments can be performed either on one subject only or each experiment on different subject.

1. The examined subject with eyes closed and head inclined frontally by about 30 degrees is seated in the swivel chair. Rotate the chair 10 times for 10 s. The rotation is suddenly stopped and the movements of the subject's eyeballs are palpated through his/her eyelids.
2. Repeat rotation in the same way. After rotation, still with eyes closed, the subject is quickly raised with the help of the examiners. Ask the subject to stretch his/her arms forwards. Observe the direction of arm deviation and of the tendency to fall (Hautant's test). Discover subjective feelings (vertigo, nausea) in the examined person.

Results

1. Post-rotational nystagmus:

Direction of rotation:.....

Direction of nystagmus:.....

2. Hautant's test:

Direction of rotation:.....

Tendency to fall (direction):.....

Direction of arm deviation:.....