

Instructions for exercises.

Note: At the end of the instructions, you will find a table which must be filled in to complete the exercise.

Nervous system - sensation and perception. Sense organs

1. Hearing tests:

Whispered voice test of hearing acuity

Noise source location test

Tuning fork tests: Weber, Schwabach and Rinne tests

2. Exteroceptive sensation tests:

Tactile sensation test

Temperature sensation test

3. Proprioceptive sensation tests

Joint position and motion sense test

Vibration sense test

4. Cortical sensation tests

Sensory discrimination test

Topognosis test

Graphesthesia test

Stereognosis test

Hearing tests

Whispered voice test of hearing acuity

Speech is the most natural and acoustically valuable stimulus to the ear.

This is an indicative test which makes it possible to detect a noticeable hearing loss or deafness.

Execution: Each ear is tested separately. The patient stands sideways to the examiner at a distance of about 6 meters and the ear not being tested is blocked. The examiner whispers words and the patient repeats them aloud. In the case of hearing loss, the examiner approaches the patient gradually and evaluates the distance (in meters) from which the pronounced words are audible.

Noise source location test

Equipment needed: a timer and another noise source

Location of the noise source in space is the result of the integration of stimuli from both ears. If the noise source is not located directly in front of the test patient, it reaches each ear at different times.

Directional hearing is an expression of the auditory stimuli integration at the cortical level and depends on such factors as sound intensity. An increase in sound intensity improves the accuracy when determining the direction of its source.

Execution: In several attempts, with his/her eyes covered, the patient determines the noise source of the timer, indicating its location by using a clock face image with the patient's head located in the middle.

Tuning fork tests

Equipment needed: laryngological tuning forks

The Weber test

consists in placing a vibrating tuning fork on the top of the head or in the middle of the forehead.

Normal audibility should be reported equally on both sides - the sound in the "head".

If the sound of the tuning fork is heard better in one ear, it is referred to as lateralisation.

If lateralisation occurs in the normal ear, it indicates a sensorineural impairment.

If lateralisation concerns the defective ear, it indicates a conductive hearing loss.

The Schwabach test

consists in comparing the bone conduction of the patient and the examiner, here considered as a reference point (assuming that he/she has normal hearing). It involves comparing the duration for which the vibrating tuning fork placed on the mastoid process is heard by the patient and then by the examiner.

The normal duration for which the low and medium frequency sounds are heard is 20 – 30 seconds.

If suffering from conductive hearing loss, the patient hears the fork at least 15 seconds longer than the examiner; "prolonged Schwabach".

If suffering from receptive hearing loss, the patient hears the fork for a shorter time than the examiner; "shortened Schwabach".

The Rinne test

consists in comparing the duration for which the fork is heard by air and bone conduction in the tested ear.

A vibrating fork is applied to the mastoid process. When the patient ceases to hear vibrations, the fork is applied to the external acoustic meatus. The sound should still be heard, which is recorded as "positive Rinne". This is a normal result.

If the vibrations are not heard by air, it indicates sound conduction disorders: "negative Rinne".

In the case of receptive hearing loss, the audibility of the tuning fork by air conduction is better than by bone conduction, but the duration of hearing, both by air and bone conduction, is much shorter than in patients with normal hearing ("small positive Rinne").

Exteroceptive sensation test

Tactile sensation test

Tactile sensation is caused by skin deformation.

Equipment needed: cotton, a cotton swab or an esthesiometer, a gel pen.

Compare the density of distribution of the tactile sensation receptors in various areas of the skin.

Execution: Mark squares with sides of 1 cm on the patient's skin in a few of the following places:

- fingertip
- front and back of the hand
- neck

The patient closes his/her eyes and turns his/her head, and the examiner touches every 1 mm of the skin in the marked places with the esthesiometer or cotton swab. The examiner counts in his/her head the number of times the mechanical stimulus (touch) was triggered, and the patient counts how many stimuli he/she has responded to. On this basis, it is possible to calculate the percentage of sensations felt.

Interpretation: By comparing the sensitivity of different areas to touch, it is possible to determine which areas of the skin are the most and the least sensitive to touch in the patient. Explain why.

Temperature sensation test

Equipment needed: a Blix rod, a container with warm water, a container with water and ice, a gel pen.

Aim of the test: to identify and determine the density of distribution of the heat and cold sensation receptors in three different places on the skin.

Execution: Students test each other. Draw a square with sides of 1 cm on the skin in the following three areas:

1) fingertip, 2) back of the forearm, 3) neck. Before the test is conducted, the Blix rod gets dipped in a container of cold water and ice (cold receptors test) and in a container of warm water (heat receptor test). The patient has his/her eyes closed. The examiner touches the skin within the square (approx. 30 – 40 times at intervals of approx. 1mm) counting the number of taps in his/her mind. The examiner counts the number of times the feeling of cold/heat is evoked in his/her mind.

Interpretation: The test result is given as a percentage; the number of taps / the number of sensations. A summary of the results involves a comparison of the results related to different areas in different people as well as an answer to the following questions:

Is the density of cold and heat receptors the same?

If not, what is the difference, depending on the tested area?

Proprioceptive sensation tests

Joint position and motion sense test

The test is conducted with the patient keeping his/her eyes closed.

The examiner performs a passive movement with the limbs/fingertips of the patient. All movements should be slow and gentle, and the adjacent fingers are moved away using the other hand to avoid touch. It is important to prevent the patient from simultaneously performing active movements with his/her fingers, which would help him to determine their position. The patient should determine what part of the body has been moved and in what direction.

A healthy patient unmistakably determines the position of the limb (fingers) by saying that, e.g., the hand of an upper limb is directed downwards or upwards and the middle finger of the right hand is bent.

Vibration sense test

Vibration is received by stimulating the skin surface with rhythmic compressions. Touch receptors, especially Pacinian corpuscles, are involved in the reception, and the conduction process takes place through posterior columns.

Equipment needed: a laryngological tuning fork

Execution: The test is conducted using a vibrating tuning fork, with its base applied to the projecting bone parts located just under the skin. When applied to the skin, the vibrating fork causes a buzzing or a vibrating sensation.

Cortical sensation tests

Sensory discrimination test

Sensory discrimination – the ability to distinguish between the two concurrently operating sensory stimuli. The measure of sensory discrimination is the shortest distance between the points at which the patient is able to distinguish between two stimuli – this is the sensory resolution threshold.

Equipment needed: a compass esthesiometer, millimeter graduation.

Execution: The patient has his/her eyes covered. The skin of the patient is gently touched with different leg spans of the esthesiometer and he/she is asked if the touch has been felt in one or two places. Touching the skin with the two ends of the esthesiometer must be simultaneous and the intervals between individual attempts in the same area of the skin should be approx. 10 seconds long because if the attempts are performed too frequently, they cause fatigue and impair the ability to distinguish between them.

The test should start with a leg span which would make the patient recognize the touch in two places, then the span should be reduced until he/she determines that only one place has been stimulated. The span is measured by applying the ends of the esthesiometer to a millimeter graduation.

It is necessary to compare the sensory resolution threshold for a variety of places and explain the reason for the differences.

Exemplary average values of the sensory resolution threshold:

tip of the tongue – approx. 1.5 mm

fingertips – approx. 2 mm

the forehead – approx. 3-4 mm

back of the hand – approx. 15 mm

neck – approx. 35 mm

back – approx. 65 mm

Topognosis – recognition of a sensation's location

The patients uses his her finger to indicate the place where he/she has recognized the sensory stimulus applied by the examiner (touch, jab).

Dermolexy - ability to identify characters (letters, numbers) written on the skin with a finger or a blunt instrument.

Stereognosis (spatial sensation) - ability to recognize the form of an object in the absence of visual information.

Equipment needed: everyday use objects, e.g. a key, coin, cotton, pen, etc.

The patient, with his/her eyes closed, should recognize the form of an object held in his/her hand by touching or handling the object with his/her fingers.

The following sources have been used in the compilation:

1. Kompendium neurologii. Red. R. Podemski, Via Medica, wyd. III, 2014
2. Fizjologia człowieka z elementami fizjologii stosowanej i klinicznej. Red. W. Traczyk, A. Trzebski. Wyd. III, PZWL, 2007
3. Ćwiczenia z fizjologii człowieka. D. Rosołowska-Huszcz, J. Gromadzka-Ostrowska. Wyd. SGGW, 2008
4. Instrukcje do ćwiczeń z fizjologii. Red. B. Szabuniewicz. PZWL, 1959

Fill in the table after completing the tasks:

Hearing tests		
Tuning fork tests		
type of test	test result	conclusions

The Schwabach test		
	for the examiner	for the patient
Duration of hearing the fork vibrations		

Exteroceptive sensation test			
Tactile sensation tests			
Location on the skin	Number of stimuli	Number of stim	Percentage of stimuli felt
1. fingertip			
2. front part of the hand			
3. back part of the hand			
4. neck			
Conclusions:			

Temperature sensation test						
tested area	number of stimuli		number of sensations		Percentage of stimuli felt	
	of cold	of heat	of cold	of heat	of cold	of heat
1. fingertip						
2. back part of the forearm						
3. neck						
Conclusions:						

Sensory discrimination tests	
tested area	sensory resolution threshold
1. fingertips	
2. back part of the hand	
3. neck	
Conclusions:	