A. R. Buhaienko
ORCID https://orcid.org/0009-0002-1921-2129
E. V. Babych
ORCID https://orcid.org/0009-0007-3110-4186
Yu. O. Solodovnikova
ORCID https://orcid.org/0000-0002-2544-9766

Odesa National Medical University

OPTIMIZATION OF STUDYING SENSORY DISORDERS BY MEDICAL STUDENTS

А. Р. Бугаєнко, Е. В. Бабич, Ю. О. Солодовнікова

Одеський національний медичний університет

ВИВЧЕННЯ РОЗЛАДІВ ЧУТЛИВОСТІ СТУДЕНТАМИ-МЕДИКАМИ

Abstract. Objective assessment of tactile and pain sensitivity often poses challenges to medical students due to the subjective nature of the patient's sensations during receptor stimulation. Comparing the patient's self-assessment of sensitivity disorders with the physician's evaluation during an objective examination could provide a clearer picture of existing sensitivity disorders. To this end, a self-assessment method was proposed. Moreover, the correlation between the results of this method and the objective examination could reduce the time required for patient evaluation.

The aim: To investigate the correspondence between the results of the self-assessment of pain and tactile sensitivity by the patient and the objective examination by the physician.

Methods and Materials: We have assessed pain and tactile sensitivity in 53 patients (31 males, 22 females) aged 22 to 75 years (mean age 43.5 ± 14.8) with sensitivity disorders impairments associated with central and peripheral nervous system pathology: peripheral neuropathies – 33 (62.26%), multiple sclerosis – 12 (22.64%), consequences of stroke – 5 (9.43%), intramedullary spinal cord tumors – 2 (3.77%), and syringomyelia – 1 (1.89%). Standardized maps with options for sensitivity disturbances in various anatomical regions were used during the study. Patients marked the areas of altered pain and tactile sensitivity, which were compared by the physician with the results of the clinical-neurological examination.

Results: The self-assessment methods aligned with the results of the objective examination in 36 patients (67.92%), partially in 10 (18.86%), and did not align in 7 (13.2%). The chi-square test (χ^2) showed a statistically significant difference between groups of central and peripheral nervous system injuries regarding the conformity of the self-assessment methodology ($\chi^2 = 13.3$, p = 0.001).

Conclusions: The self-assessment method for pain and tactile sensitivity can be applied in routine practice for patients with peripheral nervous system involvement, unlike patients with central nervous system lesions, who require additional objective examination.

Key words: pain sensitivity; tactile sensitivity; neurological examination; standardized maps of sensitivity disorders; medical students.

Анотація. Об'єктивне дослідження тактильної та больової чутливості часто викликає труднощі у студентів-медиків через суб'єктивність відчуттів пацієнта при подразненні рецепторів. Порівняння власної оцінки пацієнтом порушень чутливості та результатів огляду дало би більш чітку картину наявних чутливих розладів. Із цієюметою було запропоновано використання методики самооцінки. Окрім того, відповідність результатів даної методики об`єктивному огляду може скоротити час обстеження пацієнта.

Мета: дослідити відповідність результатів методики самооцінки больової і тактильної чутливості пацієнтом та об'єктивного дослідження лікарем.

Методи і матеріали: було оцінено больову і тактильну чутливість у 53 пацієнтів (чоловіки – 31, жінки – 22) віком від 22 до 75 років (середній вік – 43,5 ± 14,8) із порушеннями чутливості при патології центральної та периферичної нервової системи: периферичні невропатії – 33 (62,26%), розсіяний склероз – 12 (22,64%), наслідки інсульту – 5 (9,43%), інтрамедулярна пухлина спинного мозку – 2 (3,77%), сирингомієлія – 1 (1,89%). Під час дослідження було використано стандартизовані карти з варіантами порушень чутливості в різних анатомічних ділянках. Пацієнти відзначали зони зміненої больової та тактильної чутливості, яку лікар співвідносив із результатами клініко-неврологічного обстеження.

Результати: результати самооцінки відповідали результатам об'єктивного обстеження у 36 пацієнтів (67,92%), частково відповідали – у 10 (18,86%) і не відповідали – у 7 (13,2%). Тест хі-квадрат (χ^2) показав статистично значущу

відмінність між групами центральних та периферичних уражень нервової системи щодо відповідності методиці само-оцінки (χ² = 13,3, p = 0,001).

Висновки: методика самооцінки больової і тактильної чутливості може бути застосована в рутинній практиці у пацієнтів з ураженням периферичної нервової системи на відміну від пацієнтів із центральним ураженням, які потребують додаткового об'єктивного обстеження.

Ключові слова: больова чутливість, тактильна чутливість, неврологічне обстеження, стандартизовані карти порушень чутливості, студенти-медики.

Introduction. The somatosensory system receives and processes information generated during an individual's perception of the environment [11]. It has always been one of the most challenging and demanding parts of a neurological examination. Still, nevertheless, it is of great importance as its disorders accompany quite a constellation of central and peripheral nervous system lesions [6,10,8]. Types of sensitivity can be divided into two big categories: general and special. General sensitivity, in turn, is subdivided into simple (which includes superficial and deep) and complex–three-dimensional spatial perception (stereognosis), two-dimensional spatial perception (graphesthesia), localization perception, and discrimination sensitivity. Superficial sensitivity includes processing the information of touch, pain, and temperature [5]. During the evaluation of the last ones, subjective data on sensations experienced by the patient during the doctor's stimulation of the receptor apparatus on symmetrical skin areas following dermatomes and peripheral nerve innervation zones can be obtained. Dermatomes of tactile sensitivity overlap more extensively than dermatomes of pain and temperature, so such deficits are usually less noticeable with damage to one or two adjacent nerve roots. In contrast, pain and temperature sensitivity disorders are much more pronounced [3]. Assessment of such a variety of modalities requires not only specific methods, and in some cases even tools, but also a great anatomy knowledge and topographical presentation of neurological disorders.

In clinical practice, objective examination is often conducted using touches to symmetrical areas of the skin with stimuli of appropriate mechanical characteristics. The touches should have the same intensity and frequency. A more precise examination method is the Frey method, which uses a set of filaments of varying thicknesses, with stimulus intensity increasing progressively from the first to the tenth filament. The pain threshold is assessed by altering the pressure of the prick [14]. These objective examination methods often pose challenges due to the subjectivity of the patient's sensations during receptor stimulation by the physician. Comparing the patient's self-assessment of sensitivity disorders with the examination results would provide a clearer picture of existing sensitive disorders.

Among the methods that are used for more precise sensory system function evaluation, self-assessment plays a significant role. To decrease the level of subjectivity a diversity of questionnaires is used [2,15]. However, most of them are aimed at assessing the level of pain and its influence on life quality. Still, such disorders as hypoalgesia and hypoaesthesia lack attention. Therefore, we propose the use of the self-assessment methodology for superficial sensitivity disorders. The correspondence of the methodology's results to the objective examination may be of great help to young neurologists as well as reduce the time required for patient assessment.

The aim. To investigate the correspondence between the results of the self-assessment of pain and tactile sensitivity by the patient and the objective examination by the physician.

Methods and materials. Pain and tactile sensitivity were assessed on 53 patients (31 men, 22 women) aged 22 to 75 years (mean age 43.5 ± 14.8) with sensitivity disorders in the context of central and peripheral nervous system pathologies. The distribution of pathologies included: peripheral neuropathies - 33 (62.26%), multiple sclerosis – 12 (22.64%), consequences of stroke - 5 (9.43%), intramedullary spinal cord tumors - 2 (3.77%), and syringomyelia - 1 (1.89%). All patients underwent an objective neurological examination and self-assessment of sensitivity disorders using standardized maps. For the objective assessment of pain sensitivity, we used a needle cleansed with antiseptic, part of the neurological hammer equipment. For tactile sensitivity, we used a cotton applicator. Pain and tactile sensitivity were tested by touching of identical intensity and frequency to symmetrical areas of the skin with appropriate stimuli.

For the self-assessment methodology of pain and tactile sensitivity, standardized maps with options for sensitivity disorders in different anatomical regions were used (fig. 1). Patients marked areas of altered pain and tactile sensitivity on the maps, which the doctor then correlated with the results of the clinical-neurological examination and recorded in three categories: yes, no, partially. Partially was defined as the patient's incomplete depiction of the area of sensitivity disorders based on standardized maps. The chi-square test was used for statistical data analysis, and calculations were performed using the software Jamovi, version 2.3.28 for Windows.

Results. Table 1 and Diagram 1 present the concordance results between the patient's self-assessment methodology of pain and tactile sensitivity and the physician's objective examination in patients with peripheral and central nervous system disorders. The self-assessment methods aligned with
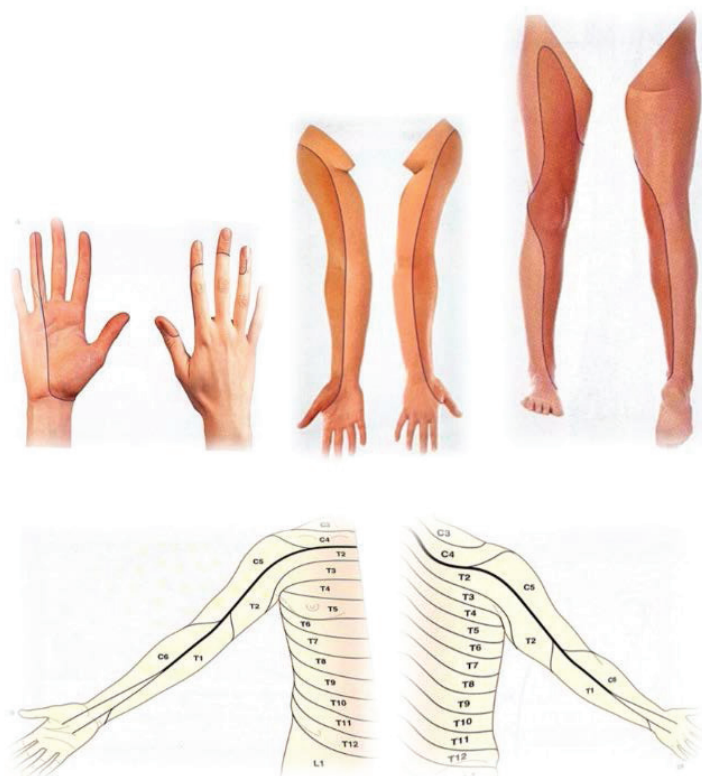
Fig. 1. Standardized maps depicting different anatomical regions with potential sensitivity disorders [12]

the results of the objective examination in 36 patients (67.92%), partially in 10 (18.86%), and did not align in 7 (13.2%). The chi-square test (χ^2) showed a statistically significant difference between groups of central and peripheral nervous system injuries regarding the conformity of the self-assessment methodology (χ^2 = 13.3, p = 0.001). Discrepancies between the neurological examination results and the self-assessment were noted only in patients with central nervous system injuries. The majority of these patients had multiple sclerosis – 6 (30%), while only 1 (5%) had other central nervous system disorder - consequences of stroke (Table 2).

Discussion. Examining a somatosensory system may pose challenges not only to students who start their careers as neurologists but also to experienced physicians. Many methods and recommendations were created to increase the accuracy of a diagnosis [4]. The application of self-assessment methods is not new and such tools are widely used in neurology, surgery, and oncology in the form of questionnaires [13]. Peripheral nervous system injury results in a more complete anatomical structure lesion, which better corresponds with topographical representation. However, the interpretation may not have a single meaning in patients with a combination of nerve root impingement and peripheral nerve injury. Not to forget that approximately 45% of patients with single-level radiculopathy show no sensory

abnormalities [1]. In this case, additional tools such as nerve conduction studies, somatosensory-evoked potentials, etc. may come in handy [7].

In patients with CNS disorders and multiple sclerosis in particular, the observed discrepancy can be explained by the numerous lesions of the white matter in the brain and spinal cord, where all nerve fascicles are tightly arranged, often manifesting as mosaic sensitivity disorders [9]. Such presentation may lead to various biases during the objective assessment, decreasing the confidence level of examination results. Moreover, MS lesions exhibit temporal and spatial variability, with some areas experiencing active inflammation and demyelination, while others undergo repair and remyelination. This dynamic process contributes to fluctuating sensory symptoms that may not align with the static findings of an objective clinical examination. The result is a potential bias in assessment, as clinicians may over-rely on patient reports or fail to account for areas of subclinical activity.

With the significant level of concordance between objective examination and patient self-assessment in those with peripheral nervous system disorders, we recommend a broader application of standardized maps in daily practice for sensory disorders evaluation. Patients' involvement in the diagnostic process may reduce biases connected with the subjective character of patients' sensation assessment

Table 1

Results of the concordance between the self-assessment methodology of pain and tactile sensitivity by patients and the objective examination by the physician.

Disorder	Concordance between objective examination and standardized maps of sensitivity disorders			
	no	**yes**	**partially**	**total**
Peripheral nervous system	0 (0%)	26 (49,05%)	7 (13,2%)	33 (62,26%)
Central nervous system	7 (13,2%)	10 (18,87%)	3 (5,66%)	20 (37,74%)
Total	7 (13,2%)	36 (67,92 %)	10 (18,86%)	53 (100%)

Table 2

Concordance results between the self-assessment methodology of pain and tactile sensitivity and the objective examination by the physician in patients with multiple sclerosis and other central nervous system injuries.

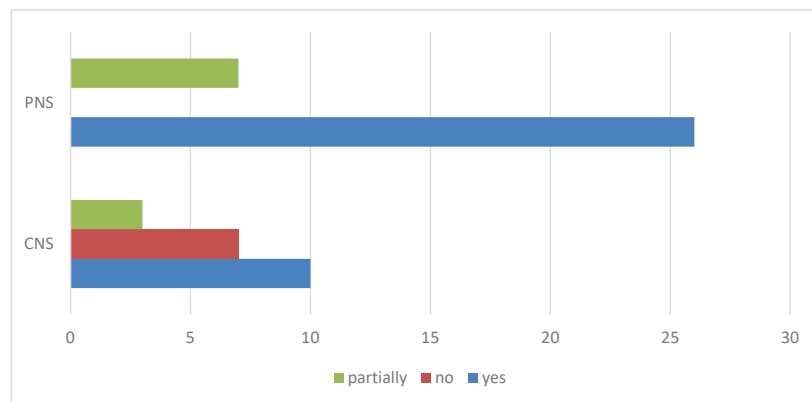| Disorder	Concordance between objective examination and standardized maps of sensitivity disorders			
	no	**yes**	**partially**	**total**
Multiple sclerosis	6 (30%)	5 (25%)	1 (5%)	12 (60%)
Other central nervous system disorders	1 (5%)	5 (25%)	2 (10%)	8 (40%)
Total	7 (35%)	10 (50%)	3 (15%)	20 (100%)

Fig. 2. Results of the concordance between the self-assessment methodology of pain and tactile sensitivity by patients and the objective examination by the physician

and, in addition, can save time for a physician during neurological examination. On the other hand, patients with polymorphic sensory disorders like multiple sclerosis should be evaluated by the clinician for more precise results. In this case, standardized self-assessment maps may serve as a supplement.

The abovementioned methodology may become a useful tool for medical students and neurological residents and serve as an effective learning aid, facilitating a deeper understanding of sensory system assessment. Students could analyze and compare the maps with clinical findings to develop diagnostic hypotheses. In patients with multiple central lesions

and confusing examination results, such maps may help to understand better the disease presentation and improve students' knowledge of CNS lesions topography. In addition, this approach can also enhance the comfort of the students and healthcare providers with special needs while examining the patients as it may shorten the time of examination.

Conclusions. The study results support using the self-assessment methodology in patients with peripheral nervous system disorders due to the high percentage of alignment with the objective examination. In contrast, patients with multiple sclerosis experience polymorphic sensitivity

disorders, making standardized self-assessment maps a supplementary tool to neurological examination.

Recommendations and Future Perspectives. The methodology has proved to be a helpful supplement for sensory disorders evaluation, especially among patients with peripheral nervous system injury. Therefore, we highly recommend adopting it into the education process of medical students and neurological residents, as well as the daily practice of healthcare providers. Moreover, this approach may enhance the comfort of students with special needs by shortening the time of a patient's examination. The study has its limitations due to a small amount of participants therefore bigger research should be performed to increase the level of confirmation.

References

1. Al Nezari, N. H., Schneiders, A. G., & Hendrick, P. A. (2013). Neurological examination of the peripheral nervous system to diagnose lumbar spinal disc herniation with suspected radiculopathy: a systematic review and meta-analysis. The spine journal : official journal of the North American Spine Society, 13(6), 657–674. https://doi.org/10.1016/j.spinee.2013.02.007

2. Attal, N., Bouhassira, D., & Baron, R. (2018). Diagnosis and assessment of neuropathic pain through questionnaires. The Lancet. Neurology, 17(5), 456–466. https://doi.org/10.1016/S1474-4422(18)30071-1

3. Baehr, M., Frotscher, M. (2019). Topical Diagnosis in Neurology: Anatomy, Physiology, Signs, Symptoms. Thieme; 6th edition.

4. Bender, C., Dove, L., & Schmid, A. B. (2023). Does Your Bedside Neurological Examination for Suspected Peripheral Neuropathies Measure Up?. The Journal of orthopaedic and sports physical therapy, 53(3), 107–112. https://doi.org/10.2519/jospt.2022.11281

5. Blumenfeld, H. (2010). Neuroanatomy through clinical cases. Oxford University Press; 2nd edition.

6. Brun, C., Traverse, É., Granger, É., & Mercier, C. (2021). Somatosensory deficits and neural correlates in cerebral palsy: a scoping review. Developmental medicine and child neurology, 63(12), 1382–1393. https://doi.org/10.1111/dmcn.14963

7. De Stefano, G., & Truini, A. (2024). An overview of diagnosis and assessment methods for neuropathic pain. Presse medicale (Paris, France : 1983), 53(2), 104234. https://doi.org/10.1016/j.lpm.2024.104234

8. Erickson, M., Lawrence, M., Jansen, C. W. S., Coker, D., Amadio, P., & Cleary, C. (2019). Hand Pain and Sensory Deficits: Carpal Tunnel Syndrome. The Journal of orthopaedic and sports physical therapy, 49(5), CPG1–CPG85. https://doi.org/10.2519/jospt.2019.0301

9. Ivaniuk, A., Solodovnikova, Y., Marusich, T., & Son, A. (2021). The impairment of the functional system and fatigue at the onset of the disease predict reaching disability milestones in relapsing-remitting multiple sclerosis differently in female and male patients. Acta neurologica Belgica, 121(6), 1699–1706. https://doi.org/10.1007/s13760-020-01478-0

10. Kessner, S. S., Bingel, U., & Thomalla, G. (2016). Somatosensory deficits after stroke: a scoping review. Topics in stroke rehabilitation, 23(2), 136–146. https://doi.org/10.1080/10749357.2015.1116822

11. Klingner, C. M., & Witte, O. W. (2018). Somatosensory deficits. *Handbook of clinical neurology, 151*, 185–206. https://doi.org/10.1016/B978-0-444-63622-5.00009-7

12. O'Brien, M. D. et al. (2000). Aids to the examination of the peripheral nervous system. Saunders Ltd.; 4th edition.

13. Toyka, K. V., Claßen, J., Schneider, L., Saur, D. (2020). E-Book: The Neurological Examination German Society for Neurology. Manual of the Neurological Examination for Neurologists in Training (version 3.0).

14. Welte-Jzyk, C., Pfau, D. B., Hartmann, A., & Daubländer, M. (2018). Somatosensory profiles of patients with chronic myogenic temporomandibular disorders in relation to their painDETECT score. BMC oral health, 18(1), 138. https://doi.org/10.1186/s12903-018-0601-8