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CASE REPORT / ПРИКАЗ БОЛЕСНИКА

Upper extremity sensory training after stroke

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SUMMARY
Introduction Stroke is one of the leading causes for disability worldwide. After stroke, the majority of stroke survivors experience significant arm-hand impairments and a decreased use of the paretic arm and hand in daily life. Tactile sensibility of the hand is essential for identifying objects and for motor performance. Despite important sensory contributions to normal and abnormal movement, research has predominantly focused on motor aspects of stroke recovery. In this paper, we present the effect of sensory stimulation program on arm sensation and motor recovery in subacute stroke.
Case outline In a 65 years old woman the sensibility stimulation program was administered in subacute phase of post-stroke rehabilitation, six weeks after stroke, involving active and passive somatosensory intervention, motor control, coordination, strength and balance exercises. The rehabilitation protocol was applied for four weeks, five times a week. On discharge, the results of physiotherapy assessment showed full recovery of her right arm and hand.
Conclusion This case report shows that precise assessment, problems identification and problem oriented somatosensory interventions can improve, in a short time, functional motor performance of the arm involved in rehabilitation after stroke.
Keywords: sensory training; effectiveness; stroke; upper extremity; motor control

INTRODUCTION

Stroke is defined as the sudden onset of neurological signs and symptoms resulting from a disturbance of blood supply to the brain [1]. The number of people living with stroke is estimated to increase by 27% between 2017–2047 in the European Union, mainly because of population aging and improved survival rates [2]. Clinically, a variety of focal deficits are possible, including changes in the level of consciousness and impairments of sensory, motor, cognitive, perceptual and language functions. Proprioception, superficial touch and temperature sensation losses are common [3] and the sensory impairments may affect the patient's ability to control and coordinate movement [1]. The proprioceptive senses, including static position sense and movement sense or kinesthesia, are critical for accurate movement, but are often impaired following stroke [4, 5]. These deficits significantly contribute to the patient's motor disability and largely determine the degree of recovery [6, 7].

Deficits in somatic sensations (body senses such as touch, temperature, pain, and proprioception) after stroke are common with prevalence rates variously reported to be 11–85% [8]. Approximately 50% of stroke patients have hand sensory impairments, especially in tactile and proprioceptive discrimination [9, 10]. Sensation is essential for safety even if there is adequate motor recovery [11]. Findings particularly suggest the importance of somatosensory function after stroke for recovery of precision grip force control [12], safety and dexterity in the paretic hand [13] and functional independence in activities of daily living (ADL) [14, 15].

The current findings showed that active and passive sensory retraining may be an effective intervention for improving the light touch threshold of the hand, dexterity, upper extremity (UE) motor function [10, 16] to improve the ADL in stroke patients with impaired sensory motor abilities [17]. The quality of evidence is low to moderate [18, 19] so further research is required to determine the effectiveness of sensory training in stroke rehabilitation.

CASE REPORT

The patient, a 65-year-old right-handed English teacher, sustained a left ischemic stroke in 2019. She had received hospitalization service and was discharged from the hospital two weeks after the acute moment. Physical therapy treatment consisted of early verticalization and mobility exercise. She was able to walk on her own at the time of discharge from the hospital. Six weeks after the stroke, she was admitted to a rehabilitation facility as inpatient for a four-week rehabilitation program. At the moment of the treatment, she was taking antihypertensive therapy. At clinical examination she presented normal muscular tone and mild muscle weakness at her right side (4 on manual muscle testing or higher) and significant weakness of her right hand intrinsic and all thumb muscles (2 to 3 on manual muscle testing). Motricity index (MI) was used to evaluate arm motor ability (pinch grip, elbow flexion, shoulder abduction)

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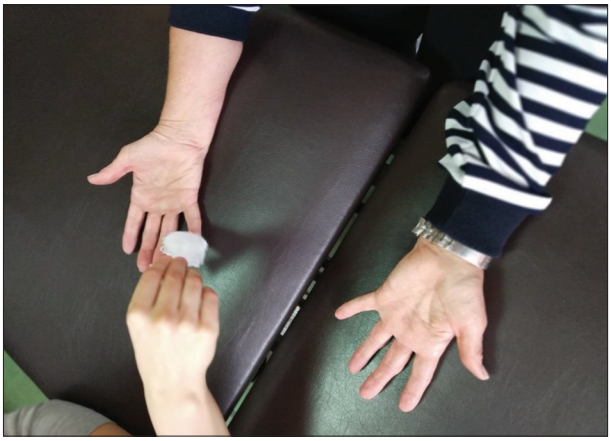

Figure 1. Light touch evaluation with a piece of cotton wool

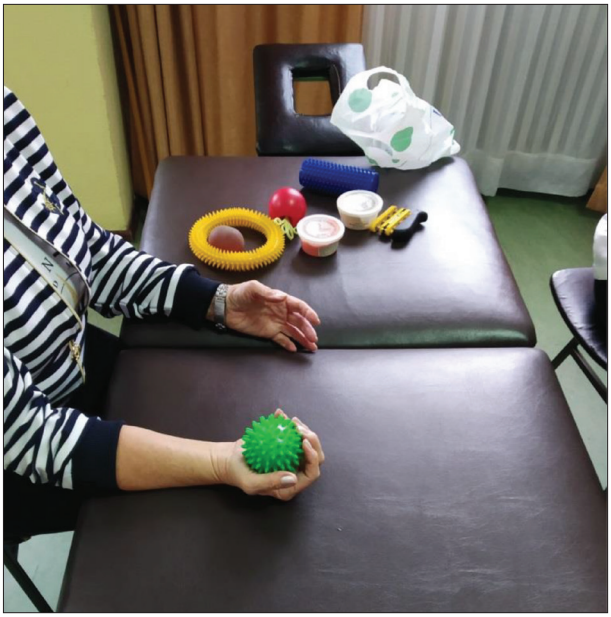

Figure 2. Spiky ball manipulation

[20, 21] and scored L: 100 R: 88/100. Despite satisfactory muscle strength, she was unable to perform functional movements. Tri-digital and pinch grips were impossible and hook and lumbrical grasp were incomplete. The opposition of the thumb to the other fingers was possible but the fingers were not well directed. It was difficult to pick-up small objects. No weakness over LE. The patient's body structure and function impairments include impaired proprioception, kinesthesia and light touch sensation of her right hand. The perception of light touch was preserved but diminished compared to the left hand and precise localization of stimulus was lost. Mislocalization of touch sensations was present in the entire right palm and forearm. Joint position and arm motion reproduction was impossible. The right LE sensibility was intact.

Passive range of motion was in functional range. During finger to nose test right hand dysmetria was noted. Dysdiadochokinesia of the right hand. Romberg test was negative. Tandem stance test: right leg back-positive at five seconds and left leg back-negative but shaky. Tandem walking test with eyes open: unstable. Single leg stance: right three seconds, left 10 seconds.

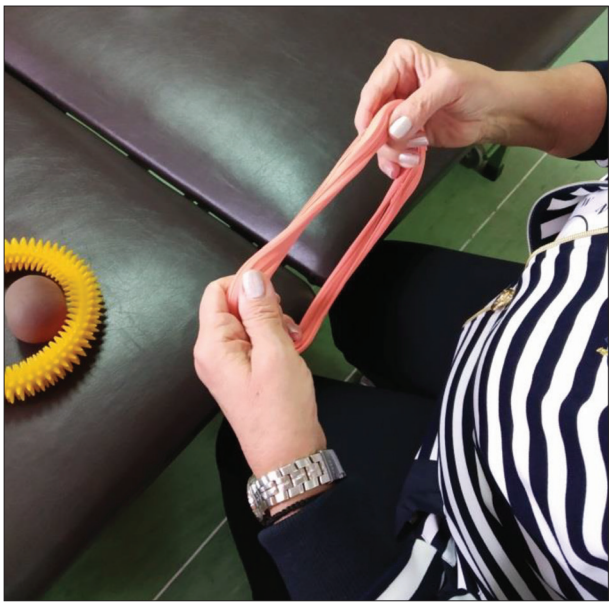

Figure 3. Strengthening exercises using red color putty

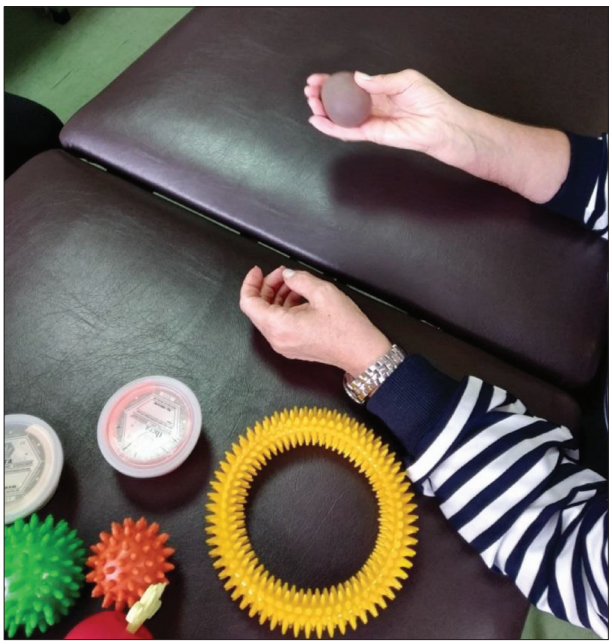

Figure 4. Opposition of thumb and fingers using silicone ball for resistance

The patient presented independent with ambulation and all basic ADLs. Physical function according to The Stroke Impact Scale 16 (SIS-16) was scored 68/80 [22]. The ability to use the right hand in bilateral activities was reduced. She mostly performed activities with her left UE. She could not take or hold a cup in her right hand. She could not hold a pen or sign. It was frustrating she could not hold a pen or sign because holding a pen and chalk was fundamental to her teaching profession. Reported participation restriction was regarding her paid work. There were no cognitive or speech impairments.

Short-term goals were to improve sensibility, to hold a cup of water in her right hand and to drink from it, to write short sentences and sign, to be stable in single leg stance.

Long-term goal was to return to work.

Physiotherapy treatment program consisted of sensory stimulation, motor control, strength and balance exercises. We placed different objects in her right hand while she was looking and then with her eyes closed. She tried to identify objects as they were placed in her hand again, one at a time. "Washing" and "dusting table" with a towel, wool socks and pieces of cloth of different textures. For texture identification, we made the patient recognize the difference in texture (cotton, velvet, cloth, paper towel, sponge, wool sock, sandpaper) by touch only. We applied stimulations with a cotton ball to both and then to her right forearm, wrist, hand and digits, volar and dorsal surfaces. She tried to identify and precisely localize the stimulus with her eyes closed. We also practiced hand movements into containers with rice, dry beans and corn. The patient had the task to feel an object (coin, eraser, paper clip) and then to try to find a matching object in the container. With her eyes closed and had someone else move her hand while holding a pencil, she tried to identify what letter, number or drawing was made.

Each exercise in a treatment session was chosen to target a specific functional skill such as reaching, grasping and manipulating an object (ring, balls, pen, key, roller, plastic glass, clothespins). Grasp stability and adequate grips force were practiced. For manipulation we used spiky massage balls, roller and ring. We instructed the patient to grasp plastic cup and to try to determine how much pressure she was putting on to hold it. We practiced that the patient takes a plastic cup, holds it in her right hand and brings it to her mouth as if she was going to drink from it, then we put first one and later two tangerines in a cup. The same task was performed with a cup half-filled with water. The patient was encouraged to count successful attempts. The tip-to-tip pinch, three-jaw chuck (digital) and the key (lateral) pinch were practiced. We taught her to hold a pen first, to monitor the pressure of holding it and to allow movements required for writing. Writing was practiced: first lines and shapes, then letters, signature, words and sentences. During the last week of rehabilitation, we practiced writing on the board: instead of blackboard we glued a sheet of paper to the wall and instead of chalk we used a thick felt pen.

Other exercises included bimanual alternative movements: clapping hands, playing the piano, thumb opposition and reposition.

The Romberg stance, tandem stance and single leg stance balance exercises were performed. Tandem walking and fast walk with a stop at command were practiced.

Isotonic strengthening exercises with mild resistance: manual, putty (beige, red) springs, silicone balls (red and green), 10–15 repetition, 1–2 series, in progression 2–3 series. Power (hook, fist, spherical, cylinder) and precision grips exercises using putty and silicone balls for resistance were administered. This exercise program (45 min) was applied once a day on weekdays for four weeks.

The final assessment: Subjectively, she reported a complete sensibility in her right hand. SIS-16 score: 77/80. Objectively, sensibility improved: she accurately recognized the location of applied stimuli. She could recognize and repeat position and movement in hand and finger joints. MI: L100, R 100. She could sign and write short sentences. She could write on a piece of paper taped to the wall. She could hold a glass it in her right hand and drink from it. She could drink coffee from a small cup. The tandem walking was stable. Single leg stance: 10 seconds bilateral.

Written consent for publication of this article has been obtained by the patient.

DISCUSSION

Even though the fact that patients often complain about somatosensory disturbances, true prevalence of somatosensory impairment in stroke patients can be underestimated in clinical practice because motor symptoms usually raise greater awareness in the therapists while accompanying somatosensory deficits may be overlooked [9, 23]. Despite the importance of sensory contributions to normal and abnormal movement, research has predominantly focused on motor aspects of stroke recovery. There is lack of evidence that UE somatosensory training improves somatosensory impairment, motor control, function and participation after stroke. Also, the poor quality of current evidences assessing the effectiveness of sensory training after stroke suggests the need for further research [18, 19]. Our patient's experience provided a unique opportunity to study the course and extent of UE motor recovery when sensibility disturbance is recognized and adequately treated. This case report points the importance of sensory information for motor function. Physiotherapy assessment revealed a somatosensory loss in right arm, a mild muscle weakness of right hand, thumb, fingers and right underarm, disturbance of motor control and fine coordination, difficulties in participating in instrumental ADLs and balance deficit. As she could not write, our patient could not do her job of a teacher. The decision that our rehabilitation protocol should involve sensory training was based on the results of physiotherapy assessment and current evidence. Precise assessment and identification of the problems were the first, and selection and application of adequate therapeutic interventions, the second step.

In similar study, findings showed that sensory retraining may be an effective adjunctive intervention for improving the light touch threshold of the hand, dexterity and upper limb motor function in chronic stroke survivors [16]. Serrada et al. [19] concluded in 2019. that the further high-quality research is required to determine the effectiveness of sensory retraining in stroke rehabilitation.

The rehabilitation protocol in our study mainly involved sensory and motor control training. Each evaluation test at discharge from rehabilitation unit showed quantitative and qualitative improvement. The level of manual ability of right arm in ADLs improved. This case report will provide an increased understanding of contributions of sensorimotor integration and sensorimotor learning to skilled hand movements post-stroke.

Conflict of interest: None declared.

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Стимулација сензибилитета руке после можданог удара

Весна Самарџић

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САЖЕТАК

Увод Мождани удар је водећи узрок онеспособљености у свету. После удара већина преживелих има значајна оштећења руке/шаке и редуковану употребу паретичног екстремитета у свакодневном животу. Очуван осећај у пределу шаке је основа за препознавање додиром и за покрет. Упркос значају сензибилитета за нормалан покрет, истраживања су претежно усмерена на моторни аспект опоравка после можданог удара.

У овом раду представљамо утицај програма сензорне стимулације на сензибилитет и моторику руке у субакутној фази рехабилитације после можданог удара.

Приказ болесника Код 65-годишње жене примењен је програм стимулације сензибилитета у субакутној фази опоравка, шест недеља после можданог удара. Програм се састојао из пасивних и активних интервенција стимулације сензибилитета, вежби моторне контроле, координације, јачања и баланса. Програм терапијских вежби се примењивао током четворонедељне рехабилитације, пет пута недељно. На отпусту су резултати физиотерапеутске процене показали потпун опоравак руке.

Закључак Резултати нашег истраживања су показали да прецизна процена, препознавање проблема и примена одговарајућих интервенција стимулације сензибилитета могу за кратко време унапредити моторну функцију паретичне руке после можданог удара.

Кључне речи: стимулација сензибилитета; учинковитост; рука; мождани удар; моторна контрола