

Review Article

The sensory stimulation programme and neurological Status in stroke: A comprehensive review

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Abstract

Human brain has a large capacity for automatic simultaneous processing and integration of sensory information. A sensory system consists of sensory neurons (including the sensory receptor cells), neural pathways, and parts of the brain involved in sensory perception. The combined information from different sensory organs facilitates our ability to detect, discriminate, and recognize sensory stimuli. Many research studies have shown that sensory stimulation program is effective in traumatic brain injury, amnesia, unconsciousness, stroke etc. Depending upon the condition and diagnosis of the patients, the program protocol needs to be decided. The present review focus on the effectiveness of sensory stimulation programme (SSP) on neurological status of patients with stroke. The SSP covered stimulation of all five sensory modalities including tactile, gustatory, olfactory, auditory, and visual senses. Thus it may conclude that the SSP may be helpful to stimulation of all sensory modalities in human being.

Keyword: Sensory Stimulation Programme, gustatory, olfactory, auditory, and visual senses.

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1. Introduction

The greatest gift by god to a human being is their sense organs. We enjoy life if our sense organs sense every beautiful sensation and convey to the brain. The sensory nervous system is a part of the nervous system responsible for processing sensory information. A sensory system consists of sensory neurons (including the sensory receptor cells), neural pathways, and parts of the brain involved in sensory perception. Commonly recognized sensory systems are those for vision, hearing, touch, taste, smell, and balance. In short, senses are transducers from the physical world to the realm of the mind where we interpret the information, creating our perception of the world around us.

Brain plasticity refers to the ability of the brain to restructure itself, form new connections, or adjust the strength of existing connections. Stimulation of sensory organs stimulates the brain cells. So sensory stimulations program is considered as an effective rehabilitation program in many of the disease conditions related to brain and nervous system. Many research studies have shown that sensory stimulation program is effective in traumatic brain injury, amnesia, unconsciousness, stroke

etc. Depend on the condition and diagnosis of the patients the program protocol needs to be decided [1].

Sensory system and stimulation: In this study, the researcher has selected the five sensory stimulation i.e. visual stimulation, auditory stimulation, olfactory stimulation, tactile stimulation and gustatory stimulation. According to Johansson BB, the brain has a large capacity for automatic simultaneous processing and integration of sensory information [1]. Combining information from different sensory modalities facilitates our ability to detect, discriminate, and recognize sensory stimuli, and learning is often optimal in a multisensory environment.

Previous studies have proven that hemispheric stroke often causes impairment in upright stance and gait. Adequate postural control is a prerequisite for stabilizing the body in upright positions during voluntary movements and for mobility. These abilities are essential for activities of daily living (ADL). A recent report suggested that sensory stimulation may improve functional outcome after stroke [2]. Stroke patients given sensory stimulation recovered faster and to a greater extent than did control patients. Group differences in

mobility, balance, and ADL 3 months after stroke onset were significant.

An article by Pornnipa et al defines sensory stimulation as a form of treatment that may increase the patients' responsiveness. If a healthcare professional or a family member systematically applies stimulation to the patients' five sensory modalities will help to regain the neurological status faster. This SSP should be intensive enough to reach the heightened threshold of damaged reticular neurons and, as a result, to activate cortical activity [3].

After a vigorous review of the literature, researcher prepared the following protocol as an intervention in this study. The SSP covered all five sensory modalities, namely, Tactile, Gustatory, Olfactory, Auditory, and Visual senses.

The stimulus was selected after keeping in mind all age group people and was harmless to human beings but provokes the sensory organs effectively.

- **Olfactory stimulation:** The protocol includes applying a drop of lavender oil on the pillow and on neck and shoulder using a cotton swab in the morning as well as in the evening for 28 days.
- **Auditory stimulation:** The investigators will speak directly to the patients while implementing the intervention program. Besides providing verbal communication researcher is providing Shehanoi music for 30 minutes twice daily in the morning and in the evening.
- **Visual stimulation:** Visual stimulation will be applied by stimulating visual attention and tracking eyes to visual cues; by using a mirror. The protocol involves placing the affected limb behind a mirror, which is sited so, the reflection of the opposing limb appears in place of the hidden limb. While moving the unaffected arm, participant watches its mirror image as it was the affected arm, and viewing the mirror reflection facilitates ipsilateral motor cortex excitability. Mirror stimulation facilitated employment of a motor copy strategy involving bimanual movements and later "forced use" of the affected arm. Mirror stimulation is given twice daily at morning and evening for 10 minutes for 28 days.
- **Tactile stimulation:** Retrograde massage of affected limbs using coconut oil for lubrication scented with lavender oil daily for 28 days. The massage will be done using effleurage and petrissage type strokes. Effleurage is applied with a flat hand, using the full Palmer and finger surface, in a gliding manner in petrissage, C of the hand is used to push down into the muscle, grasp the muscle, pull it directly up off the bone, and release the tissue in a somewhat backward half-circle motion. Along with massage ROM Exercise of the affected area for 28 days will be given.
- **Gustatory stimulation:** The protocol includes sour cold drink lemon juice 50% twice daily. (Figure no 01).



Figure no 01: The sensory stimulation programme (SSP) covered all five sensory modalities, namely, tactile, gustatory, olfactory, auditory, and visual senses.

Central nervous functions stimulation: One of the ways music enhances brain function is by stimulating the formation of certain brain chemicals. Listening to music increases the neurotransmitter dopamine. This is the brain's "motivation molecule" and an integral part of the pleasure-reward system. It's the same brain chemical responsible for the feel-good states obtained from eating chocolate, orgasm, and runner's high. Listening to music has also been linked to improved cognition, including attention span, memory, organization, and ability to solve problems. Many studies conclude that music therapy has a positive effect on mood in post-stroke patients and may be beneficial for mood improvement with stroke [4].

Visual stimulation by using a mirror is effective in problems such as complex regional pain syndrome, phantom limb pain, stroke and focal dystonia. Ramachandran and Rogers-Ramachandran first devised the technique in an attempt to help those with phantom limb pain resolve what they termed a 'learned paralysis' of the painful phantom limb [5]. Mirror stimulation has been shown to increase cortical and spinal motor excitability, possibly through the effect on the mirror neuron system. Mirror neurons accounts for about 20% of all the neurons present in a human brain. These mirror neurons are responsible for laterality reconstruction i.e., ability to differentiate between the left and the right side. An imaging experiment demonstrated that inversion of the visual image of a hand can elicit lateralized cortical activations. In other words, when a right hand is used but perceived as a left hand, this leads to an additional activation of the right hemisphere (and vice versa). As recovery mechanisms are known to be most prominent within the first 3 months after stroke, it is reasonable to assume that Mirror stimulation might be most effective when applied within this time window.

Special sense and functions: The sense of smell like the sense of taste is part of our chemosensory system or the chemical senses. Ability to smell comes from specialized

sensory cells, called olfactory sensory neurons, which are found in a small patch of tissue high inside the nose. Smell is the only one of the five physical senses that is directly linked to the limbic lobe of the brain - our emotional control center. Anxiety, depression, fear, anger, and joy all physically originate from this region. A certain fragrance can evoke memories and emotions before we are even consciously aware of it. When smells are concerned, we react first and think later. All other physical senses are routed through the thalamus, which acts as the switchboard for the brain, passing stimuli onto the cerebral cortex (the conscious thought center) and other parts of the brain.

An article was written by Paula Mullins from Peninsula briefs that long before the days of drugs and laboratory-developed beauty creams, plant oils were one of the numerous discoveries brought to Europe by the Crusaders in the middle ages. Paula also states that because the odoriferous molecules of essential oils are extremely volatile, they diffuse through the skin in the same way as other gases. They have the ability to penetrate right into the deep layers of the skin and travel to various organs, glands, and tissues of the body. When they have passed through the epidermis they seep into the small capillaries in the dermis and are carried all around the body. When inhaled, essential oil particles are taken directly to the roof of the nose, where information about the aromas, via the olfactory bulb, is forwarded to the area of the brain associated with smell. Certain essential oils increase circulation and are said to assist cell regeneration. Some essential oils are relaxing and stimulating [6].

Increased levels of cortisol and stress neurotransmitters and lowered levels of serotonin and dopamine all equal more stress. Massage not only has the opposite effects on cortisol, serotonin, and dopamine levels, but it decreases frontal right lobe activity in the brain and increases activity in the left. Among the many benefits of massage therapy are those related to the body's production and regulation of neurohormones. These hormones produced by the nervous system which affects an individual's behavior and general well-being. It has long been suspected that massage therapy offers a number of mood enhancing benefits. Now scientific studies back this up. The research conducted at the TOUCH Research Institute at the University of Miami revealed that massage increases the availability of all neurohormones affecting brain chemistry.

The massage tends to elevate levels of dopamine, a neurohormone released by the hypothalamus. Dopamine influences fine motor activity like painting or playing a musical instrument. It affects intuition, inspiration, joy, and enthusiasm. Those lacking in dopamine will likely exhibit clumsiness, poor focus, and be easily distracted. Massage can also raise the availability of serotonin, a neurohormone that regulates behavior in terms of emotions, acting to quell irritability and cravings for sex and food. Those low in serotonin often have difficulty sleeping and tend to suffer from depression and

obsessive-compulsive disorders. Research has shown that massage can achieve a number of positive results. For example, a 15 minute seated massage can elevate epinephrine (adrenaline) levels by stimulating the sympathetic nervous system. This can increase a person's alertness. A slower, longer, deeper, and more rhythmic massage can, on the other hand, reduce epinephrine levels, creating a feeling of relaxation, and facilitating deep sleep [7].

Studies have shown that a sour bolus improves swallowing response in neurogenic dysphagic patients [8]. The hypothesis given for the impact of taste on swallowing function is that "taste is an important oral sensory stimulus that might increase the pre-swallow sensory input to the cortex and brain stem, thus lowering the swallowing threshold." Lowering the swallowing threshold, i.e., the level of stimulation at which a swallow will be triggered, could decrease the residence time in the mouth and speed up the pharyngeal swallow. Many studies have been conducted using sensory stimulation. After vigorous reviews on the effect of these stimulations, the researcher has selected the topic for the study.

Conclusion

The SSP is useful technique in patients of stroke because this is an experimental therapy that aims to utilize neural plasticity mechanisms to aid in the recovery of somatosensory function (after stroke or cognitive ageing).

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