Sensation

Introduction

Cutaneous (tactile) sensation involves various peripheral receptors that detect vibration, pressure, skin stretch, hair follicle motion and thermal changes. They include Meissner, Merkel and Ruffini endings and Pacinian corpuscles. Proprioception is the appreciation of joint position in relation to the external environment and can be either voluntary or involuntary (Sargent 2000). It is regulated by receptors found in muscles (muscle spindles), joints (joint receptors) and tendons (golgi tendon organs).

Loss of protective, proprioceptive and touch (cutaneous) sensations following stroke is common – almost 50% of stroke survivors are assessed as having sensory deficits (NSF, 2009). Most often, deficits occur in discrimination and interpretation of sensory experiences, such as texture discrimination, stereognosis and recognition of passive movement. Specific impairments of pain, temperature and touch detection also occur (Carey et al, 1993).

Research indicates that sensory function of the hand can be significantly improved in chronic hemiplegia by systematic retraining over a relatively short period (Yekutiel and Guttman, 1993). The gains generally lead to improvements in specific discrimination impairments, and spontaneous generalisation has been thought to be unlikely to occur (Carey et al, 1993) although Peurala et al (2002) have reported improvement in sensation may also improve activity. A recent systematic review noted that whilst individual studies report benefits further research is required to clarify which populations benefit and via what form of training (Schabrun and Hillier, 2010). It is unclear whether sensory re-education techniques inform people with stroke of how to use their remaining sensation more advantageously, or whether the techniques actually change the physiological basis for sensation. There is evidence that non-specific cutaneous stimulation can improve activity but it is unclear if it has a consistent effect on improving sensation itself (Schabrun and Hillier, 2010).

Functional implications:

Sensory impairments of the upper limb can lead to the following:

- Safety concerns
- Impaired spontaneous use of hand/s
- Inability to sustain grasp
- Reduced object manipulation
- Impaired ability to reacquire skilled movements
- Learned non-use phenomenon (Carey et al, 1993, Yekutiel and Guttman, 1993)

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NSF Guidelines

6.2.3 Loss of Sensation

a.) Sensory-specific training can be provided to stroke survivors who have sensory loss (Yekutiel and Guttman, 1993, Carey et al, 1993, Byl et al, 2003, Hillier and Dunsford 2008)

b.) Sensory training designed to facilitate transfer can also be provided to stroke survivors who have sensory loss (C, Carey et al 2005)

The following was in the original guideline, and the evidence still remains:

a.) Cutaneous electrical stimulation in conjunction with conventional therapy (Peurala et al, 2002, Schabrun and Hillier 2010)

Suggested assessment

Generally, assessment of light touch, temperature, pressure, two point discrimination, proprioception and stereognosis are carried out but there is no standardised assessment format and these tests are largely subjective (Carey 1995).

A suggested hierarchy (adapted from Fess 1990, in Shumway-Cook and Woollacott, 2001) includes the following stimuli applied randomly ten times (five to each upper limb in prescribed areas that focus on distal and palmar surfaces), scoring one for each accurate response, and only proceeding if 50% or more is attained at previous level):

- **Light touch detection**: via Semmes-Weinstein monofilaments to deliver known pressure - “do you feel this” (yes/no).
  - Can increase sensitivity using full range of monofilaments, or can simplify and just use a tissue.
- **Localisation**: same stimuli but different request - “where do you feel this” (point or describe). Can include sensory inattention/extinction test by including bilateral stimuli randomly throughout this level – response should acknowledge two sites.
- **Temperature discrimination**: via two test tubes of icy water and hot tap water (35-40°) – “is this hot or cold” (hot/cold)
- **Light touch discrimination**: via toothpick and tissue – “is this sharp or blunt” (sharp/blunt)

More advanced testing can include:

- **Two point discrimination**: via callipers – “do you feel one or two points” (record minimum detectable distance - remember this differs for different receptor fields)
- **Texture quantification**: offer stroke survivor five different fabrics of different texture from coarse hessian to fine silk – “order these fabrics from roughest to smoothest”
- **Can do this with five grades of sandpaper.**
- **Object recognition** (stereognosis): offer stroke survivor five small objects including plastic lego brick, wooden bead, 50c piece, metal paper clip, piece of chalk – “what is this object” and/or “what temperature/texture/shape/material”.
• **Proprioception**: Distal proprioception test – “is your thumb pointing up or down” (externally manipulate thumb into flexion or extension, randomly five times)
• Limb Copying – “can you put your other hand in this position” (externally manipulate affected digits/wrist into five random positions for less-affected hand to copy).

**Practice Suggestions**

The inclusion of sensory retraining protocols within stroke rehabilitation is recommended where the overall clinical assessment indicates sensory impairment is a major contributing factor in the activity restriction/s of the stroke survivor.

These may take the form of *education* (the stroke survivor learns to understand the nature and implications of their sensory loss), *specific practise* in the hierarchy of sensory appreciation (detection, discrimination, recognition, proprioception) and *related functional tasks* that require the use of sensory input to complete dextrous functions. The focus is on mastery of each stage, immediate feedback and reinforcement, reiteration of all components and goal setting. Sensory retraining techniques which are carried out in an enriched environment, are interesting, active and demanding, and are “socially stimulating” are far more likely to result in neuroplastic changes (Yekutiel, 2000). When practising sensory tasks, the aim is to assist the client with their own discovery of different sensations. The unaffected hand is often used to facilitate this learning process. The focus is also on the abilities rather than the disabilities of the stroke survivors; working collaboratively with them to achieve client-focused goals; and to share knowledge and control.

Refer further to the specific practice sheet for details.

**Considerations**

• Time-consuming
• High attentional demand for stroke survivors
• Motivation also important
• Need to confirm that sensory loss is contributing impairment to activity restrictions

**References**


Shumway-Cook A & Woollacott M. Motor control: Theory and practical applications. 2nd edn, 2001; Lippincott Williams & Wilkins, Philadelphia.

Yekutiel M & Guttman E. A controlled trial of the retraining of the sensory function of the hand in stroke patients. J Neurol Neurosurg Psychiatry. 1993; 56: 241-244.