The Importance of Somatosensory Deficits in Neurological Disease

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Abstract

The identification of impaired somatosensory function in neurological disease or injury is fundamentally important to optimizing prosthetic devices intending to replace somatosensory function. We performed a systematic review to determine the importance of somatosensory function in four neurologic conditions: stroke, spinal cord injury, traumatic brain injury, and multiple sclerosis. The majority of the results from our systematic review report the importance of somatosensory function from the clinician’s perspective, highlighting that only limited research has been dedicated towards understanding the importance of somatosensory loss from the patient’s perspective. [Patient perspective is essential for proper design of prosthetic devices to restore somatosensory function]

Introduction

Somatosensation involves the perception of touch, temperature, body and limb position and movement (proprioception). Although somatosensation is an integral part of neurologic function, motor function has certainly garnered far more attention in the literature. A brief search of published literature showed approximately five times more articles addressing motor function than somatosensory function. This imbalance is further highlighted by a survey of physicians which revealed that many do not regard the somatosensory exam as an important aspect of neurological exam[1]. The advent and evolution of neural prosthetic devices to restore or replace neurologic function has helped to fuel the question of whether the importance of motor outcomes far outweighs somatosensory outcomes in functional recovery? Further, when designing devices, what evidence exists for the need to improve somatosensory deficits from the clinician’s perspective and from the patient’s perspective? Our goal was to determine the importance of somatosensory deficits from both the patient and clinician’s perspective. We performed a systematic review of the literature evaluating the importance of somatosensory deficits in four neurologic conditions: stroke, spinal cord injury (SCI), traumatic brain injury (TBI) and multiple sclerosis (MS). We report on the diagnostic tools used to identify somatosensory deficits, their incidence, prognosis and recovery, and the impact they have on quality of life.

Materials and Methods

Literature Search

Published articles were searched using the OVID Medline database. The search included articles that contained the terms multiple sclerosis, stroke, traumatic brain injury, spinal cord injury or accepted variants of these terms (e.g. cerebrovascular accident). These articles were then screened to ensure they contained the terms somatosensory loss (or accepted variants e.g. somatosensory impairment) in addition to the terms quality of life and/or disability. Articles containing terms such as vision, hearing and taste (or variants of these terms) were eliminated by using the “NOT” Boolean operator. After the articles were pulled, their bibliographies were searched by hand to identify other appropriate references that may not have been identified in the electronic search.

Inclusion/Exclusion Criteria

Articles were included if they addressed the importance of somatosensory function in the context of one of the four neurological conditions outlined. We included articles on diagnosis, prognosis, recovery and patient quality of life. Articles focused on pain were excluded. Case studies were also excluded from the present review.

Data Collection

Each article chosen for inclusion was reviewed completely. Information extracted from each article included: author names, title, sample size, type of somatosensory assessment performed, other assessments used, reported incidence of deficit, information on recovery and information on quality of life. All relevant information was then tabulated into a spreadsheet. Given the heterogeneity of the articles, many did not have information in all the categories listed.

Results

Search Results

The search parameters returned a total of 384 articles. Subsequent review of titles and abstracts as well as searching paper references yielded a final number of 71 papers that were deemed relevant. Of the 71 articles, 33 addressed stroke, 7 SCI, 10 TBI and 21 MS. For each of the different neurological disorders evaluated, the majority of papers found dealt with the importance of the somatosensory system from a clinician’s perspective. These included aspects of the somatosensory system related to diagnosis, prognosis and recovery. Only a few articles focused on the impact of sensory deficits on patient quality of life.

Diagnosis

A wide variety of techniques were used to diagnose the extent of sensory impairment in study participants. The use of somatosensory evoked potentials (SEPs) was a commonly used technique in the literature, highlighting SEPs as an acceptable method of diagnosing the severity of neurologic injury in stroke[2-5]. A number of other diagnostic techniques were also used and discussed including: pin-prick tests[6, 7], two-point discrimination[2, 8], vibration and heat threshold testing[6, 9-13], position sense[7, 8, 10, 13-16], tactile discrimination[17] and the Rivermead Assessment of Somatosensory Performance[11, 18, 19].

Incidence

The incidence of somatosensory deficits demonstrated wide variation, even within a given medical condition. For instance, somatosensory loss in stroke had a reported incidence varying from as low as 7% to as high as 85% depending on the study [11, 20]. Most commonly, the incidence of somatosensory loss for stroke was reported ranging between 40 and 60% [7, 12-14, 18, 19].

In SCI studies, not surprisingly, the sensory impairment varied
depending on the reported American Spinal Injury Association (ASIA) neurological classification of injury. In patients with an ASIA B classification, the incidence of loss for pin-prick and light touch sensation was 92 and 65 percent respectively. In those classified with ASIA C and D injuries, loss was 73 and 23 percent. Another study showed that under current rehabilitation paradigms, 19 percent of patients demonstrated an increase in somatosensory deficits over time which were typically associated with the development of spinal cord cysts.

We were unable to obtain a single article containing the incidence of somatosensory deficits following traumatic brain injury.

In the MS literature, the most commonly reported incidence of somatosensory dysfunction was between 40 and 70 percent. However, some studies reported incidences far lower or far higher than this range. One study found vibrational senses were more greatly impacted than that of thermal recognition. 

### Prognosis and Recovery

In stroke, two studies have highlighted the use of somatosensory evaluation to gauge not only the severity of the injury, but the likelihood of recovery. Similarly, other groups have reported that the severity of somatosensory loss was related to the extent of motor recovery. More specifically, it was shown that a reduction in somatosensory function could be correlated with a reduction in hand dexterity or balance. Additionally, stimulation of the somatosensory system via acupuncture or electrical stimulation showed an ability to increase recovery of both motor and somatosensation.

In SCI, SEPs have been able to determine the extent of spinal cord damage and to predict rehabilitation outcomes in hand function. The majority of the papers identified regarding somatosensory deficits in TBI were concerned prognosis and recovery. SEP measurement of somatosensory function was able to predict functional motor and sensory outcomes. Most notably, poor SEP results predicted poor overall outcomes in patients with TBI. Longitudinal SEP recordings were also suggested as a reasonable method for which clinicians to gauge long-term clinical and functional outcome.

In MS impaired proprioception and position sense was shown to negatively impact balance and gross motor behaviour. Tactile and vibration loss was seen as a poor prognostic indicator and associated with the disruption of sexual, bowel and bladder function. Prognostically, SEPs in MS have been shown to have importance due to their ability to track MS progression.

### Quality of Life

Perhaps one of the most important aspects of this review is the impact of somatosensory deficits on quality of life. In stroke, quality of life (QOL) has been linked to somatosensory loss and level of disability. During rehabilitation programs stroke patients reported an increase in QOL. Stroke patients receiving sensory stimulation reported a better QOL, thought to be related to improved somatosensory recovery. Some authors have noted that typically awareness of somatosensory deficits among stroke patients is high. However, individuals with stroke who lack of awareness of their somatosensory deficits tend to have lower functional ability upon hospital discharge.

In SCI, regaining sensory function as it related to sexual function was deemed to be very important by paraplegics. Similarly, it was shown that sexual dysfunction caused by sensory loss was related to a lower patient QOL in individuals with SCI. Further, the importance of sensory deficits with regard to bowel and bladder function was also identified as being important.

We found no articles regarding somatosensation and QOL in TBI. In MS, sensory deficits associated with impaired sexual, bowel and bladder function had a negative impact on patient QOL.

### Discussions

There is a relatively high incidence of somatosensory deficits in the patient groups evaluated in the present systematic review. Many of the studies reviewed indicated deficits were of prognostic significance with respect to motor function and overall recovery. These findings provide support to the clinical importance of somatosensory deficits.

Despite this, we found few studies evaluating the impact of somatosensory loss on overall function or quality of life. Evaluating not only standard clinical measures of somatosensory loss, but also patient’s perceptions of the importance of somatosensory function is important as we move forward with developing neural prosthetic devices.

### Conclusions

Overall, the literature implies that regaining somatosensory function has some importance to functional sensory and motor outcomes. Our systematic review has identified some gaps in the current literature. Future research needs to more clearly identify the extent of patient desire for the recovery of somatosensation, as this will affect the viability of neural prosthetic devices aimed at restoring sensation.

### References


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