J Rehabil Med 2011; 43: 257–263

ORIGINAL REPORT

FREQUENCY OF DISCRIMINATIVE SENSORY LOSS IN THE HAND AFTER STROKE IN A REHABILITATION SETTING

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Objective: **Somatosensory loss following stroke is common, with negative consequences for functional outcome. However, existing studies typically do not include quantitative measures of discriminative sensibility. The aim of this study was to quantify the proportion of stroke patients presenting with discriminative sensory loss of the hand in the post-acute rehabilitation phase.**

Design: **Prospective cohort study of stroke survivors presenting for rehabilitation.**

Patients: **Fifty-one consecutive patients admitted to a metropolitan rehabilitation centre over a continuous 12-month period who met selection criteria.**

Methods: **Quantitative measures of touch discrimination and limb position sense, with high re-test reliability, good discriminative test properties and objective criteria of abnormality, were employed. Both upper limbs were tested, in counterbalanced order.**

Results: **Impaired touch discrimination was identified in the hand contralateral to the lesion in 47% of patients, and in the ipsilesional hand in 16%. Forty-nine percent showed impaired limb position sense in the contralesional limb and 20% in the ipsilesional limb. Sixty-seven percent demonstrated impairment of at least one modality in the contralesional limb. Ipsilesional impairment was less severe.**

Conclusion: **Discriminative sensory impairment was quantified in the contralesional hand in approximately half of stroke patients presenting for rehabilitation. A clinically significant number also experienced impairment in the ipsilesional "unaffected" hand.**

Key words: somatosensory disorders; prevalence; stroke; hand; frequency.

J Rehabil Med 2011; 43: 257–263

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Submitted December 22, 2009; accepted October 29, 2010

INTRODUCTION

Somatosensory loss following stroke is common, with adverse functional consequences. Somatosensory loss is identified in several stroke outcome studies as contributing to inferior results in level of function, performance of daily activities, quality of life, duration of rehabilitation, and discharge destination (1–4). Groups with hemiparesis, hemihypesthesia and/or hemianopsia compared with hemiparesis alone show significantly poorer function (2) and time to maximal recovery (5, 6). Although motor severity is a strong predictor of outcome, additional somatosensory deficits significantly affected time and likelihood of achieving higher levels of function in personal and instrumental activities of daily living (ADL), as observed in a prospective cohort of 459 patients (1). Similarly, sensory impairment was negatively related to independence, mobility and recovery 2–4 weeks after hemiparetic stroke (7). Smith et al. (8) found that a smaller percentage of patients with proprioceptive and motor deficits compared with motor deficits alone achieved independence in personal ADL (25% vs 78%) and fewer were discharged home (60% vs 92%). Poor prognosis has also been found in studies using somatosensory evoked potentials (9).

Impairment of body sensations is a significant loss in its own right and has detrimental effects on exploration of the immediate environment, safety, identification of sensory features of objects through touch, sexual and leisure activities, spontaneous use of hands and motor recovery (see (4, 10) for review). Motor control in the upper limb is affected by somatosensory impairment. In particular, ability to sustain an appropriate level of force during grasp without vision (11), precision grip (12), object manipulation (13) and reacquisition of skilled movements (14) may be affected. Measuring the prevalence and severity of sensory loss, particularly in patients who present for rehabilitation, and accurate detection of this loss is therefore imperative. Better understanding of impairments and outcomes can establish clinical pathways and facilitate better allocation and timing of rehabilitation services (1).

Clinical manifestations of cortical and subcortical somatosensory loss reveal a range of impairments from anaesthetic syndromes to disorders in cortical "perceptive" syndromes (4, 15, 16). Typically, the body half contralateral to the lesion is affected, although usually the hemianaesthesia is not evenly distributed. Impairment of somatosensory discrimination, the focus of this investigation, is the more characteristic clinical scenario (4, 17, 18). Discrimination loss commonly involves impairment of one or more of the following: localization of tactile stimuli; 2-point discrimination; texture discrimination;

appreciation of size, shape and form of objects though touch; discrimination of limb position, discrimination of direction and extent of limb movement; and weight discrimination (4, 16, 17). Characterization of these discriminative impairments is based on clinical description, correlations of lesion site with impairments, sensory evoked potential studies and quantitative psychophysical studies with humans.

Loss of protective, proprioceptive and touch sensations is common after stroke, with a frequency of 60% or more reported in many studies (see (4) for review) (7, 18–20). Individual studies vary widely in reported frequency, from 11% (21) to 85% (18). Independent summaries suggest that sensory loss occurs in half of all patients (4, 22, 23). Of the studies that report on presence of sensory loss in stroke survivors, few have been specifically designed to systematically investigate the proportion of stroke patients with sensory loss in a defined sample at a given time. Moreover, measures are frequently subjective, potentially contributing to the wide variation in findings. They typically include light touch, pain and 2-point discrimination. Measures of functional tactile discrimination ability, such as texture discrimination are rarely employed, despite reports that discriminative sensory loss is most characteristic of the impairment experienced following stroke (4, 16, 18, 24). Measures of proprioceptive discrimination are more common, but often insensitive. For example, the ability is sampled by indicating whether the finger is up or down following an imposed movement. Recent studies have employed more standardized clinically-based measures that assess sensory loss across a range of modalities (7, 19, 20).

One study quantitatively assessed touch and proprioceptive discrimination after acute stroke (one week post-stroke), reporting an overall frequency of 85% (18). Loss was present even in those with intact sensory function on routine neurological examination. Discriminative sensation measured intact in only 3 of 25 patients initially diagnosed with pure motor stroke using conventional sensory tests. The frequency of *discriminative* sensory loss in the post-acute rehabilitation phase requires systematic investigation using quantitative measures.

Identification of stroke-related impairments are important in defining individual rehabilitation goals (1, 25). Yet, systematic quantification of sensory loss has been comparatively overlooked in rehabilitation (4, 26) despite the fact that 90% of doctors and therapists regard sensory assessment as clinically significant in determining prognosis. Therapists also consider it important for treatment and education (27). A retrospective survey of records in 400 patients suggests that 25% have diminished sensation, but that "somatosensory examinations are at best subjective and perfunctory and more often absent" (17). Moreover, discriminative loss is often not adequately detected using conventional sensory testing (18). Furthermore, "best available" clinical measures of texture discrimination and limb position sense were found to be either inaccurate or insensitive relative to quantitative standardized tests of these abilities (28).

The lack of knowledge about frequency of discriminative somatosensory loss in the post-acute rehabilitation phase, particularly when assessed with quantitative measures that have strong empirical foundations, has clinical significance given the negative impact of sensory loss on functional outcome. We therefore aimed to employ quantitative, norm-referenced, reliable measures to characterize the frequency of tactile (29) and proprioceptive (30) discrimination loss in the upper limbs of a consecutive sample of stroke patients presenting for rehabilitation.

METHODS

Participants

Stroke patients admitted to a major metropolitan rehabilitation hospital in Melbourne, Australia over a continuous period of one year were sampled. Of the 76 patients admitted with a diagnosis of stroke, 51 met the selection criteria and agreed to be included. They were medically stable, had adequate comprehension of instructions and perceptual ability for testing, and had no peripheral neuropathy or history of other neurological conditions. All were assessed as free of unilateral neglect using clinical observation and standard neuropsychological assessments (shape cancellation (31) and line bisection (32)). The stroke group was heterogeneous and included patients with and without reported somatosensory loss, as suggested by clinical examination. All participants gave voluntary informed consent and procedures were approved by hospital and university human ethics committees (in accordance with ethical standards on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983).

Design

Testing of tactile and proprioceptive discrimination was conducted on both hands for each of the stroke patients. The Tactile Discrimination Test (TDT) (29) was administered before the Wrist Position Sense Test (WPST) (30), with a short rest period between. Combined testing time for the TDT and WPST for both hands was 40–60 min, with rests interspersed as needed. Twenty-six participants were first tested with the hand ipsilateral to the lesion. The others were tested first with the contralesional hand. Classification of the "affected" or contralesional hand was obtained from the medical history and diagnostic investigations of site of lesion (including computed tomography (CT) scan).

Apparatus and testing procedure

The TDT used finely graded plastic surfaces marked by ridges at set spatial intervals (29). Surfaces were originally developed in neurophysiological studies with monkeys and psychophysical studies with humans and have been developed by us for use with stroke patients (29). Surfaces were presented in sets of 3, with 2 identical and 1 different. Differences in any given set were defined relative to an anchor stimulus and expressed as a percentage difference in the spatial intervals. Differences ranged from those that can just be discriminated by healthy subjects through to very large differences. Arrangement of surfaces within a set was randomized with respect to the position of the odd surface, whether it was rougher or smoother than the comparison, and by how much. Sets were presented on plates guided through a frame situated on a board behind a curtain.

Using standard instruction and a 3-alternative forced choice paradigm, subjects were required to indicate the odd texture in each set. Five different sets that spanned the range of textures were each presented 10 times with vision occluded, in a predetermined random order. Subjects tactually explored each set of surfaces with their preferred finger. Free exploration of surfaces and repetition were allowed. If active finger movement was restricted, the examiner guided the finger across surfaces in a standard manner. Testing required 15–20 min, with rests provided as required.

Responses were recorded as correct or incorrect for each set of surfaces. Probability of correct response for the tested hand was calculated and standardized using the cumulative normal function. A straight line was fitted to standardized values using the method of least squares and used to calculate the discrimination limen (29). The limen was the percentage increase in spatial period of the texture that corresponded to a 0.67 probability of correct response. This method of quantification took into account the chance probability of success for each of the stimuli presented (29).

The WPST quantified capacity to indicate wrist position following imposed wrist movements (30). The test device comprised two protractor scales, with markings at 1º intervals, and splints for the forearm and hand. The forearm splint was fixed in a central position aligning forearm and hand. The hand splint was attached to a lever, allowing freedom of movement at the wrist. Subjects' vision of their wrist position and of the examiner's lever manipulations were occluded by the box. A pointer, aligned with the axis of movement at the wrist and attached to the top of the box above a protractor scale, enabled subjects to indicate judgment of wrist position.

During testing the examiner passively moved the subject's hand to 20 different wrist positions in a predetermined random sequence. The subject indicated the angle that best matched the test position by aligning the pointer on the top protractor scale with the imagined line linking the middle of the wrist to the index finger. A pre-test position was presented to ascertain comprehension of instructions and adequacy of visual acuity and visuo-spatial skills. Testing took approximately 5 min for each hand.

The angle indicated by subjects was read to the nearest scale marking and compared with the scale value aligned with the lever to determine the error. Mean absolute error over the 20 positions was the index of limb position sense.

Data analysis

Presence of impairment was defined relative to the criterion of abnormality identified in our normative studies for the TDT (29) and the WPST (30). Impairment was defined for the contralesional and ipsilesional hands using both a conservative criterion of abnormality, the 100th percentile (worst score) from the normative sample, and a more typical criterion, the 95th percentile. Severity of impairment was also defined relative to age-matched normative sample and the range of deficit scores in larger samples of stroke survivors. The age of the normative sample (mean 52 years; standard deviation (SD) 13 years) (29, 30) was similar to the stroke sample investigated in this study.

RESULTS

Fifty-one stroke patients were recruited (mean age 52 years, SD 14 years). Background details are presented in Table I. Of the remaining 25 who did not participate, 16 did not meet selection criteria, 6 were discharged within 3 weeks of admission and 3 had major emotional and family problems that made participation inappropriate or incomplete.

Frequency of tactile discrimination impairment

The proportion of stroke patients with tactile discrimination impairment in the contralesional hand was 47.1%, using the conservative 46 percent spatial increase (PSI) criterion of abnormality identified in our normative study (29) (Table II). This objectively defined criterion of abnormality included all scores from the normal sample. Impairment was also identified in the ipsilesional hand for 15.7% of the 51 patients using this criterion. Patients with ipsilesional impairment also had impairment in the expected contralesional hand, except for one individual. The impairment was less severe compared with the contralesional side. Using the 95th percentile criterion of abnormality, i.e. 37.3 PSI across both hands (29), 60.8% demonstrated impairment in the contralesional hand and 31.4% in the ipsilesional hand. Performance scores are displayed graphically in Fig. 1. A performance ceiling at 100 PSI was observed in 12 patients.

Frequency of proprioceptive discrimination impairment

Contralesional impairment was identified in 49.0% of patients (Table II), using the conservative criterion of 11º mean error (30). In addition 19.6% exhibited ipsilesional impairment.

Table I. *Demographic and clinical characteristics of the patients (*n *= 51)*

Age, years, median (IQR) [range]	56 (42–63) [18–79]
Gender, male/female, *n*	36/15
Hand dominance[a], right/left, *n*	47/4
Hemisphere of lesion, right/left, *n*	30/21
Stroke type, *n*	
Infarct	42
Haemorrhage	9
First stroke, yes/no, *n*	41/10
Time post-stroke[b], days, median (IQR)	49.5 (35.0–72.5)
Lesion location, *n*	
Cortical	15
Subcortical	9
Mixed	9
Brainstem	3
Cerebellum	2
Unknown	13
Oxford classification, *n*	
PACS	33
TACS	10
POCS	5
LACS	3

[a]Based on Annette questionnaire of hand dominance (33).
[b]Time post-stroke: period between index stroke and sensory assessment.
IQR: interquartile range; PACS: partial anterior circulation syndrome; TACS: total anterior circulation syndrome; POCS: posterior circulation syndrome; LACS: lacunar syndrome.

Table II. *Prevalence of tactile and proprioceptive discrimination impairment in the upper limb in stroke patients admitted for rehabilitation*

Impairment criterion	TDT criterion value: PSI limen	TDT Contralesional hand (%)	TDT Ipsilesional hand (%)	WPST criterion value: degree error	WPST Contralesional hand (%)	WPST Ipsilesional hand (%)	TDT or WPST Contralesional hand (%)	TDT and WPST Contralesional hand (%)
100th percentile	46.0	47.1	15.7	11.0	49.0	19.6	66.7	29.4
95th percentile	37.3	60.8	31.4	9.5	58.8	35.3	82.4	39.2
Severe	>79.1	33.3	0.0	>24.4	11.8	0.0	33.3	11.8
Moderate	58.3–79.1	9.8	3.9	17.1–24.4	11.8	2.0	21.6	0.0
Mild	37.3–58.2	17.6	27.5	9.5–17.0	37.3	33.3	49.0	5.9

TDT: Tactile Discrimination Test (29); PSI: percent spatial increase; WPST: Wrist Position Sense Test (30); Severe: the most impaired third of the standardized deficit scale of impairment on the TDT or WPST, i.e. <–66.67 standardized deficit score (SDS); Moderate: the middle third of the scale, i.e. –33.33 to –66.67 SDS; Mild: the third of the deficit scale closest to the criterion of abnormality, i.e. 0 to –33.33 SDS. The corresponding criterion values for the TDT and WPST are indicated in the table.

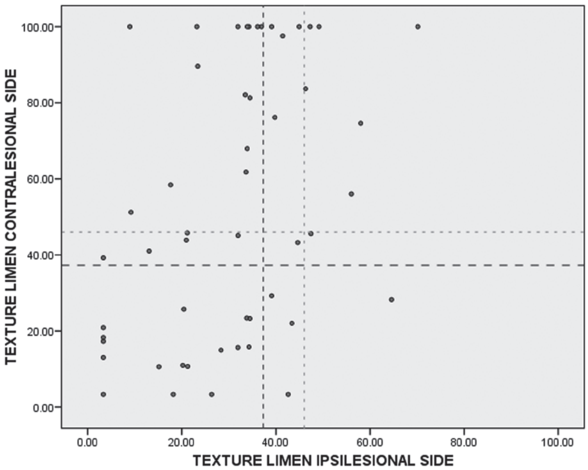

Fig. 1. Texture discrimination limen for contralesional and ipsilesional hands of the stroke sample. Proportion of the sample with impairment in one or both hands is indicated relative to the criterion of abnormality lines. Dashed lines indicate the 95th percentile criterion of abnormality for the Tactile Discrimination Test (29) and the dotted line the 100th percentile criterion. Impaired performance for the contralesional hand is indicated above the horizontal lines, and for the ipsilesional hand to the right of the vertical lines.

Those with ipsilesional impairment according to the 100th percentile criterion also had contralesional impairment, except for 4 patients who had mild ipsilesional impairment and no observable contralesional impairment (Fig. 2). Using the 95th percentile criterion of 9.5º mean error, 58.8% showed contralesional impairment and 35.3% showed ipsilesional impairment. Distributions of scores for both sides are displayed in Fig. 2.

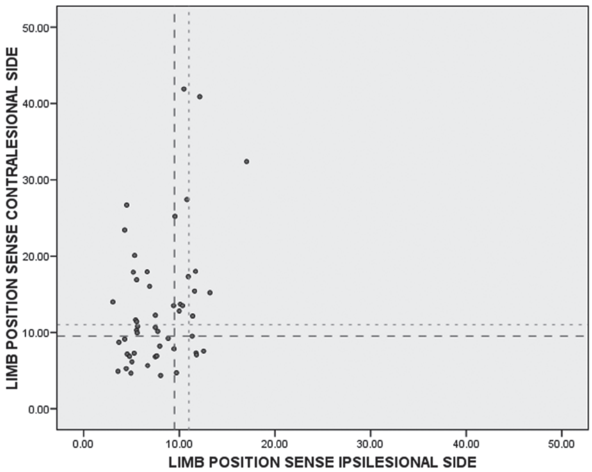

Fig. 2. Limb position sense mean absolute error scores for contralesional and ipsilesional wrists of the stroke sample. Proportion of the sample with impairment in one or both limbs is indicated relative to the criterion of abnormality lines. Dashed lines indicate the 95th percentile criterion of abnormality for the Wrist Position Sense Test (30) and the dotted line the 100th percentile criterion. Impaired performance for the contralesional limb is indicated above the horizontal lines, and for the ipsilesional limb to the right of the vertical lines.

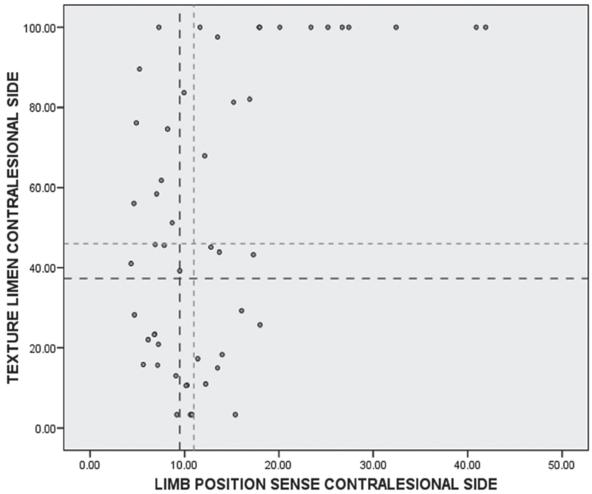

Fig. 3. Texture discrimination limen and limb position sense mean error scores for contralesional limbs of the stroke sample. Proportion of the sample with impairment in one or both modalities is indicated relative to the criterion of abnormality lines. Dashed lines indicate the 95th percentile criterion of abnormality and the dotted line the 100th percentile criterion. Impaired performance on the Tactile Discrimination Test (29) is indicated above the horizontal lines, and on the Wrist Position Sense Test (30) to the right of the vertical lines.

Frequency of impairment in tactile and/or proprioceptive discrimination

Contralesional impairment in at least 1 modality was present in 66.7%, while 29.4% showed both tactile and proprioceptive impairment relative to the conservative 100th percentile criterion of abnormality. When the 95th percentile criterion was employed, 82.4% showed impairment in either modality, and 39.2% in both modalities (Fig. 3).

Severity of impairment

Impaired scores ranged from just beyond the criterion of abnormality to very severe impairment. We have defined severity of impairment as a standardized deficit score (SDS) relative to the range of deficit scores observed in a larger sample of stroke survivors (unpublished data). Using this scale, for texture discrimination impairment of the affected hand, the largest proportion (33.3%) had severe impairment, while for limb position sense most (37.3%) had mild impairment and only 11.8% had severe proprioceptive impairment (Table II).

DISCUSSION

Discriminative sensory impairment was quantitatively defined in the contralesional upper limb in approximately half of stroke patients who presented for rehabilitation: 47% had impaired tactile discrimination and 49% impaired limb position sense. Sixty-seven percent demonstrated contralesional impairment in at least one modality, while 29% showed impairment in both. A clinically and epidemiologically significant number also demonstrated impairment in the ipsilesional limb: 16% for tactile discrimination and 20% for proprioceptive discrimination. Severity of ipsilesional impairment was usually relatively minor in comparison with the contralesional limb.

These estimates are based on a sample of 67% of all stroke patients admitted for rehabilitation to a metropolitan rehabilitation hospital during 1 year. Of the 76 patients admitted, 6 were discharged within 3 weeks or did not attend and were therefore not available for inclusion. Although some patients could not be included in the test sample, a similar number of these patients seem likely to have somatosensory deficits as patients were excluded for a wide range of reasons. Alternatively, inclusion of patients who had not met selection criteria (e.g. adequate comprehension of instructions and perceptual ability for testing, and no evidence of unilateral neglect) would tend to result in an overestimation of somatosensory deficits as neglect and inadequate comprehension would be likely to impair test performance. Exclusion for neglect is particularly important as it would confound the testing of somatosensation. Unfortunately, many previous studies have either not reported whether neglect was excluded or have included those with neglect.

The frequency of impaired tactile and proprioceptive discrimination in the contralesional upper limb of the continuous 12-month sample of stroke patients falls in the midrange of previous results (see (4) for review), confirming a significant proportion of somatosensory discrimination impairment with quantitative, norm-referenced measures of tactile and proprioceptive discrimination. The finding is also consistent with independent summaries that suggest sensory loss occurs in approximately half of all patients (4, 22). Although previous studies typically measured touch detection and employed gross scales when measuring proprioception, the overall frequency was comparable. The present findings extend the literature on the frequency of somatosensory impairment by using quantitative, norm-referenced measures of tactile and proprioceptive discrimination in a sample of stroke patients presenting for rehabilitation over a 1-year period.

In the single other study that quantified relative frequency of *discriminative* sensory loss and employed quantitative measures, 85% of patients in the acute (< 7 days) phase post-stroke had impaired sensation (18). The frequency in that study may be inflated relative to the post-acute phase due to transient loss or disturbance in sensation, which have been reported early after stroke, usually within the first week (4). However, closer inspection of raw data from the study indicates that although 85% showed impairment of one or other modality, tactile discrimination was only impaired in 49% and proprioceptive discrimination in 28% of patients. Thus the percentage for texture discrimination was very similar to our findings in a post-acute rehabilitation sample, while fewer patients exhibited proprioceptive impairment. These findings may also be influenced by the measures used. The tactile discrimination measure used by Kim & Choi-Kwon (18) was a modification of our TDT test (29), comprising similar stimuli but a different scoring method. In comparison the proprioception measure employed by Kim & Choi-Kwon involved a more restricted range and number of stimuli and may therefore have been less sensitive in detecting impairment. When impairment was evaluated in either modality, we found more comparable overall proportions, i.e. 67% when the more conservation criterion of abnormality was used and 82% when the 95th percentile criterion was employed.

More recently, a few studies have reported on sensory impairment in the post-acute and chronic phase. Although most studies were not specifically designed to investigate prevalence or discriminative loss, they tested touch detection and localization, limb position across multiple body locations, pressure and temperature using clinically-oriented tests that have been standardized and provide quantitative scores. Consistent with our findings, they report impaired tactile sensation in approximately half of those tested (7, 20). Impaired touch detection or localization was reported in 66% (45% detection/65% localization) (7) and 65% (65% surface touch; 41% surface localization) (20) of those tested. Impaired proprioception was reported in 27% (7) and 52% (20), triggering the suggestion that "tactile sensation is more impaired than proprioception" (7). When somatosensory impairment is defined as presence of impairment in one or more modalities, a frequency of approximately 66% is reported in all 3 studies. Our findings are also consistent with discriminative validity studies using the TDT and WPST in which patients were sourced from 3 major rehabilitation hospitals in Melbourne metropolitan area across different time periods (29, 30).

Variation across studies may be influenced by measures used, body parts tested and samples investigated. For example, Tyson et al. (7) tested proprioception across multiple joints using the Rivermead Assessment of Sensory Performance (RASP), which applies a simple "up" or "down" movement of the joint and requires subjects to indicate when the joint moves and the direction of movement. While this test is designed to "operationalize the clinical assessment of sensation in people with neurological conditions" (7) it is still a relatively insensitive measure of impairment, scored by summing the number of times the movement/direction was felt at each joint. In a direct comparison of proprioceptive performance in a single stroke sample using clinical assessment (similar to above method, with 10 trials per joint) and norm-referenced, quantitative measures, only 23% demonstrated impairment on the "best available" clinical test of limb position sense, while 49% of the same sample was diagnosed as impaired using the WPST measure (28). Although the clinically detected impairment rate was similar to that reported by Tyson et al. (7), impairment was missed in 29% of the sample, suggesting that the clinical measure is less sensitive (28). Winward et al. report proprioceptive impairment in a similar 46–52% of their sample using the RASP (20). However, their sample may have been more selective, being based on 100 of 465 patients screened across 3 hospitals (20). Similarly, detection and localization of touch at multiple body locations using the "neurometer" (20) is very different to discrimination of precisely defined textured surfaces used in the current study. Interestingly, while the measures differed, the relative proportion of the sample impaired was similar across all 3 studies.

We found ipsilesional hand impairment in addition to the expected contralesional impairment in a small, but clinically significant, number of patients (16–20%), consistent with previous studies (4). All patients with an identified ipsilesional impairment had only unilateral lesions, as reported in the history and confirmed by computed tomography scan. Presence of confounding impairments, such as cognitive and perceptual impairments, was controlled through the selection process and the test designs of the TDT and WPST (30). Ipsilateral impairment has been reported after unilateral brain damage for both motor and somatosensory (19, 34) functions. The frequency of ipsilesional hand impairment was relatively consistent with previous findings of 20–30%, based on tests of two-point discrimination, point localization, pressure discrimination, tactual object recognition and proprioception (18, 34). Kim & Choi-Kwon (18) reported ipsilateral impairment for point localization (25%) and stereognosis (10%), but not texture or proprioception discrimination in acute patients with unilateral stroke. This finding is surprising, as similar measures to the current study were employed. Unfortunately, direct comparison of scores for the TDT is not possible as Kim et al., did not use the same scoring technique. Furthermore, the proprioception test employed only 8 positions and may be less sensitive than the WPST for detecting relatively mild ipsilesional impairment. This inference is consistent with the finding that ipsilesional wrist position impairment was missed in all patients by clinical measures compared with quantitative measures (35). Connell et al. (19) reported ipsilesional loss in 17%, mostly for temperature and pain in the lower extremities.

Patients presented with the full range of severity across both measures. Contralesional tactile discrimination deficit ranged from no impairment to maximum standardized deficit scores. The pattern of impairment severity was reversed for tactile and proprioceptive discrimination: 33% in the top third of the standardized deficit scale indicated severe tactile impairment, but only 12% showed severe proprioceptive impairment. The severity of ipsilesional impairment was lower than contralesional, with most scores in the lower third of the standardized deficit scale. Less severe impairment is consistent with previous reports (34). Although the prevalence of ipsilateral impairment is lower than the contralateral impairment, it does occur with substantial frequency and needs to be recognized in clinical practice. Furthermore, for tactile discrimination, 10% showed impairment in the middle third of the scale, indicating a moderate level of impairment. These findings illustrate the importance of evaluating scores in terms of normative standards and not merely comparing the sensitivity of homologous body parts, as has been the practice in most clinical settings. If it is assumed from the outset that the more sensitive of the two hands is normal and, therefore, represents a baseline of comparison for the other hand, this would preclude discovery of a bilateral sensory impairment, unless grossly apparent. In addition, when retraining discrimination function in the contralateral hand ipsilateral loss has implications for the accuracy of feedback provided by that hand and may indicate a need for training both sides.

Limitations of the study

The present findings were obtained from post-acute stroke survivors who are medically stable and suitable for inpatient or outpatient rehabilitation. Survivors who are medically unstable or discharged from the acute hospital to nursing homes, slow stream rehabilitation or home are not represented. Generalization of findings to the wider population of stroke patients who present for rehabilitation needs to be tempered by the fact that the sample was drawn from a single metropolitan rehabilitation centre. In addition, the absence of an independent criterion for evaluating the representativeness of the sample precludes that alternative for clarifying the extent of generalizability. Nevertheless, the present findings, based on a consecutive sample of stroke patients admitted to a rehabilitation setting that services a local metropolitan region, are comparable to those reported in a discriminative validity study of stroke patients sampled across 3 different rehabilitation settings in metropolitan Melbourne (29, 30). Within the limitations outlined, this similarity supports the conclusion that our findings are indicative of the prevalence of sensory discrimination impairment in a metropolitan rehabilitation setting. Background information on site of lesion was sourced from history and radiological report rather than directly from CT or MRI images and we did not have a common measure of neurological severity as a point of reference for our sample. Our future studies will address these problems.

Clinical message

In conclusion, a clinically significant proportion (~50%) of patients is likely to present to rehabilitation settings with impaired somatosensory discrimination following stroke, as evidenced using quantitative measures of tactile and proprioceptive discrimination. The findings of this study add to the literature by reporting the specific frequency of somatosensory discrimination impairment using quantitative, objective measures of tactile and proprioceptive discrimination in a sample of stroke survivors presenting for rehabilitation. The high frequency of tactile and proprioceptive discrimination impairments, and the impact of these impairments on daily activities and rehabilitation outcome, reinforces the importance of adequately detecting these impairments and addressing them in rehabilitation. Systematic investigation of the prevalence of somatosensory impairment after stroke in a large, representative sample is indicated.

ACKNOWLEDGEMENTS

Data from some of the patients included in this study have been included in studies of test development (29, 30). However, the frequency of impairment in this consecutive sample has not been reported previously, except for a preliminary report in abstract form.

Funding: This work was supported by the National Health and Medical Research Council (NHMRC) of Australia (project grant number 307902, and Career Development Award number 307905 to LMC); an Australian Research Council Future Fellowship awarded to LMC (number FT0992299); the National Stroke Research Institute of Australia and by the Victorian Government's Operational Infrastructure Support Program.

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