Ten dermatomes are enough! Information in a 10-dermatome ASIA sensory score is comparable to the full (28-dermatome) score

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ABSTRACT

Objective: The light touch (LT) and pin prick (PP) examination for spinal cord injury (SCI) described in the International Standards is time consuming and tedious for patients and examiners, and redundant from a measurement standpoint. The redundancy suggests that fewer dermatomes need to be tested. This study compares a short (10-dermatome) score for each sensory scale to the long (28-dermatome) score.

Design: Retrospective analysis of existing database.

Participants/methods: Data consisted of sensory scores at discharge from rehabilitation of 1213 patients with traumatic SCI. Bilateral short LT and PP scores were derived from the long score using the following dermatomes: C4, C6, C8, T4, T6, T10, L2, L4, S1 and S3. The sample was randomly split into two groups. A Graded Response Model was applied to data from the first group to calibrate the sensory items. Data from the second group was utilized to develop maximum likelihood estimates (MLE) of sensory function. The MLE scores for the short scales were then regressed upon MLE scores for the long scales.

Results: The random split of the data created two approximately equal size groups: a calibration group (n = 621) with 51.2% of the entire sample and a predictive group (n = 592) with 48.8%. For PP scores the short scale predicted 97.8% of the variance of the long scale. For LT scores the short scale predicted 96.6% of the variance of the long scale.

Conclusion: MLE scores from the short sensory scales provide excellent estimates of sensory function in traumatic SCI. Further research is needed to determine the sensitivity of these scales.

INTRODUCTION

The sensory examination for SCI in the ASIA/ISCoS standards is long and tedious to perform. It can take 30 minutes or more to complete sensory testing in a patient with a cervical incomplete injury. This leads to examiner and patient fatigue, and may be partly responsible for the lower reliability of the sensory scores in incomplete patients. Evaluation of the metric properties of the sensory scores indicates that there is a high degree of redundancy in the scales. This provides an opportunity for item reduction with little loss of information. The purpose of this study was to compare a 10-dermatome sensory scale to the full 28-dermatome scale.
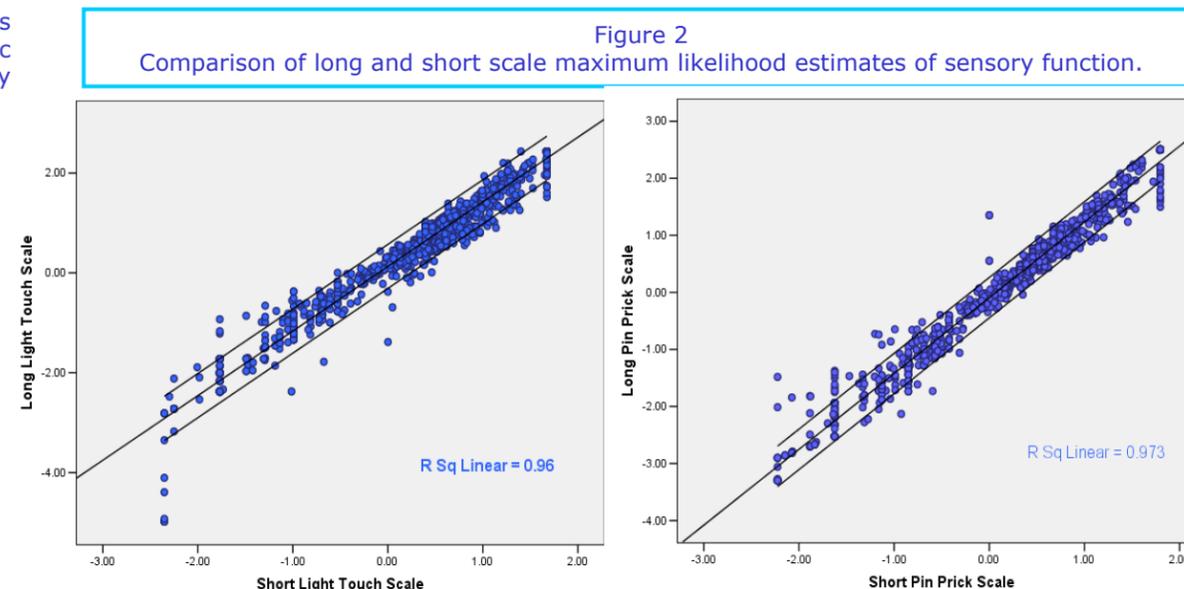
SUBJECTS & METHODS

Subjects consisted of 1213 patients with traumatic SCI discharged from inpatient rehabilitation between July 1996 and January 2006. The sample had a mean age of 46.3 ±16.4 years, 76% male 20% complete tetraplegia, 28% incomplete tetraplegia, 25% complete paraplegia, and 27% incomplete paraplegia.

Total light touch and pin prick scores at discharge were compared to 10-dermatome scores, using dermatomes indicated in figure 1.

The calibration group data for both the long and short the light touch and pin prick scales were analyzed with the graded response model using Multilog 7.0. The item parameters thus produced were used to calculate MLE scores for the response vectors in the predictive group. The MLE scores were further analyzed with linear regression using SPSS 13.0. In both cases the short scale was regressed upon the long scale.

Figure 1
Dermatome chart

RESULTS

Figure 2
Comparison of long and short scale maximum likelihood estimates of sensory function.

R Sq Linear = 0.96

R Sq Linear = 0.973

DISCUSSION

These results indicate that for estimating sensory function after traumatic SCI, a reduced set of dermatomes can be used with almost no loss of information. The advantages of a 10-dermatome sensory scale are reduced time (and cost) for evaluation, and reduced patient and examiner burden.

The MLE scores used in this study were developed from the application of the Graded Response Model and show the advantages of item response theory in capturing information with shorter scales. The ability to capture 96% of the variance with 36% of the items comes from having all 56 items arranged along a continuum and applying the known item characteristics to the response vectors of the second group.

The dermatomes were selected because they had clear anatomic landmarks. The choice of 10 dermatomes was somewhat arbitrary – this corresponds to the number of muscles tested – and further reduction may be possible. However utilizing IRT the choice of dermatomes could be tailored to the individual patient if the determination of the level of injury is required.

However it will be important to test this reduced scale for sensitivity to change first. The 10-dermatome scale does not include S4-5, or testing of anal sensation. These areas will need to be tested to determine if a patient has a complete or incomplete injury. Also, the reduced scale is meant to evaluate overall sensation below the injury level, and would not be useful for detecting individual dermatome improvements at the level of injury.

CONCLUSION

There is sufficient information in the 10 dermatome test to adequately measure sensory function. The choice of the dermatomes could be tailored to the individual patient or to the research protocol needs.

REFERENCES

Samejima F. Estimation of Latent Ability using a response pattern of graded scores. *Psychometric Monograph* 1969;17.