ORIGINAL ARTICLE

Correlation between Moberg Pick-Up *test and sensation threshold test after median nerve reconstruction*

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ABSTRACT

Functional assessment of sensitivity is essential to analyzing the status, recovery, and effectiveness of the treatment program for patients who have suffered losses due to physical and/or sensory disability after peripheral nerve injuries. Such losses of sensation lead to a significant loss of hand function. **Objective:** The purpose of the present study was to establish a correlation between functional and sensory threshold tests after a peripheral nerve lesion in the hand. **Method:** Fourteen men aged 18 to 40 years, who had bruises and cut injuries at the volar region of the wrist resulting in median nerve lesion, were selected for study. All the subjects were at least 1-year post-surgery. An esthesiometer SORRI® and a modified Moberg pick-up test were used. The test was divided into two phases, one with eyes open and the other with eyes closed. Also, the same test was performed by two different examiners. It was a "blinded" test that was performed three times, being repeated by the examiners according to a random sequence kept during the entire evaluation. Mean age and standard deviation were obtained during analysis in which Pearson's coefficient was calculated and the non-parametric Mann-Whitney test was applied at 5% significance. **Results:** The mean age was 27.14 years with a standard deviation of 6.43 years, with the lesions being more frequently seen in men aged 21 to 30 years. Also, 64% of the cases involved lesion of the dominant hand. Pearson's coefficient (r) regarding the correlation between sensory threshold test and Moberg pick-up test ranged from 0.5 to 0.7, which was statistically significant. Confidence intervals and *p*-values obtained from the Mann-Whitney test showed no statistically significant differences. **Conclusion:** One can conclude, therefore, that despite lacking standardized measures, the Moberg pick-up test correlated with the functional test. However, further studies are needed to support validation and reliability of the two methods.

Keywords: hand, peripheral nerve injuries, rehabilitation

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INTRODUCTION

Evaluating cutaneous sensitivity is essential in analyzing the state, recovery, and effectiveness of the treatment in patients who suffered losses due to motor and/or sensory deficiency after peripheral nerve injuries.[1,2] These injuries interrupt the transmission of sensations causing loss of sensitivity and a significant loss of hand function.[3,4,5]

Despite frequent use, isolated sensory tests such as those that evaluate the threshold of pressure, pain, temperature, and vibration do not accurately reflect the function of the hand, that is also dependent on the motor innervation and muscular function.[6]

Due to the limitations of conventional methods, in 1958,[7] Eric Moberg developed a test to quantify the ability of the hand. The objective was to investigate the functionality of the hand, since tactile discrimination and sensory perception jointly determine the fine motor ability.[8,9,10] Moberg defines functional sensation as *tactile gnosis*, specifically sensitivity present at the fingertips, which allows a significant awareness of the outside world.[11]

However, the Moberg Pick-Up test is still contested due to its methodological standardization, normalization of scoring, reliability, and validity, strongly recommended by the world literature.[12-17] This makes conventional tests indispensable for evaluating cutaneous sensitivity, since they are still important indicators in the monitoring of a conservative treatment and surgical results, and in the determination of movement disabilities.[18]

The Semmes-Weinstein® monofilaments are a standard and traditional method accepted in the literature as a clinical sensitivity test that measures the thresholds of cutaneous pressure.[19] They offer a simple and accurate test to map out the key-sensitive areas of peripheral innervation, and are a reliable and valid instrument.[20]

In Brazil, in 1985, Sorri-Bauru® was set to develop a model with fishing nylon to standardize a Brazilian sensory test with reduced cost. This model was developed based on the Semmes-Weinstein® monofilaments, being used in the country to detect and monitor nerve function, initially in Hansen's disease and currently also in peripheral nerve injuries.[21]

Our initial hypothesis suggests that the sensory threshold test based on the Semmes-Weinstein® monofilaments correlates with the Moberg Pick-up test, and may help in quantifying the evaluation, thus allowing the delineation of a pathology baseline, predetermining the rehabilitation potential, planning and evaluating the treatment program, and defining the final functional capacity.[22]

OBJECTIVE

The objective of this study was to analyze the relationship between the sensitivity measurements of the cutaneous pressure thresholds measured by the SORRI® esthesiometer with the functional sensitivity measured by the modified Moberg Pick-up test, after reconstruction of the median nerve.

METHOD

Ethical cautions

The study was made at the *Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo - HCFMRP*-USP *(Clinics Hospital of the Medical School of Ribeirão Preto of the University of São Paulo),* in the years 2006-2007, and approved by the HCFMRP-USP Ethics in Research Committee, by HCRP Process nº. 14553/2005. The recruited subjects were instructed on the objectives and procedures of the study and signed a Free and Informed Consent Form.

Subjects

The sample was formed from a data survey made at the Medical Archive Service at HCFMRP-USP between 2005 and 2006. The Hospital's computerized archive system produced a list of 40 patients.

As inclusion criteria, the patient should show active movement of the fingers necessary for pinching, have undergone surgery to repair the injured median nerve, and have a sensory threshold of the hand with diminished protective sensation in the hand, necessary to perform the Moberg Pick-up test.

After verifying the necessary criteria and inviting the subjects through letters, there were 27 patients left, only 14 of which completed the study (Figure 1).

Procedures

The materials used were the Bauru SORRI® esthesiometer; colored ballpoint pens; procedure gloves; a 4 mm thick acrylic plate 30 x 60 cm with a box at the center that was 20 x 15 cm, 2 cm in height, and lined with a blue E.V.A® foam sheet; and the modified Moberg Pick-up test, which is composed of 12 metallic objects: a wingnut; a hexagonal screw; a key; a steel nail; a large hexagonal nut; a small coin (1 cent of a *real*); a large coin (1 *real*); a smooth washer; a safety pin; paper clips; a small hexagonal nut; a square nut; a TIMEX-TRIATHLON® chronometer; and a blindfold.

The SORRI® esthesiometer is composed of 6 monofilament nylon threads of the same length and increasing diameters, with each filament firmly fixed to a plastic support. The kit has the following colors arranged according to filament thickness: green (0.05 g), blue (0.2 g), violet (2.0 g), dark red (4.0 g), orange (10.0 g), magenta (300 g). The green filament indicates the threshold of normal sensitivity, the blue filament indicates reduced threshold for fine discrimination or light touch, and the violet filament indicates reduced threshold for protective sensitivity discrimination. They were used to verify the hand sensitivity of this study's sample subjects.

The modified Moberg Pick-up test is composed of 12 metallic objects randomly arranged on an acrylic plate that contains a box at the center, in addition to a blindfold and a chronometer.

The initial procedure was to evaluate the cutaneous sensitivity threshold using the Bauru SORRI® esthesiometer. After defining the minimum sensitivity threshold in the dermatome of the median nerve, the patient performed the functional modified Moberg Pick-up test, in which patients are instructed to put on special procedure gloves that have the first three fingers free to touch the objects listed for the test.

The functional modified Moberg Pick-up test was made in two phases, the first with eyes open and the second with eyes closed and each phase was performed with a different rater. The subjects were instructed to pick up only one object at a time and not drag them. The first phase, initially, was done with the non-dominant hand. The subjects should pick up the objects, one by one, and place them inside the box as fast as they could with their time measured by a chronometer. The first phase was done three times, with a break of a few minutes between the series, and afterwards, repeated with the dominant hand three more times. In the second phase, the subjects should wear a blindfold and identify each object with the three free fingers, again starting with the non-dominant hand. The recognition was repeated with the dominant hand and done three times with each hand.

The test was applied in two phases by two raters trained beforehand. The sequence of raters was random and maintained throughout

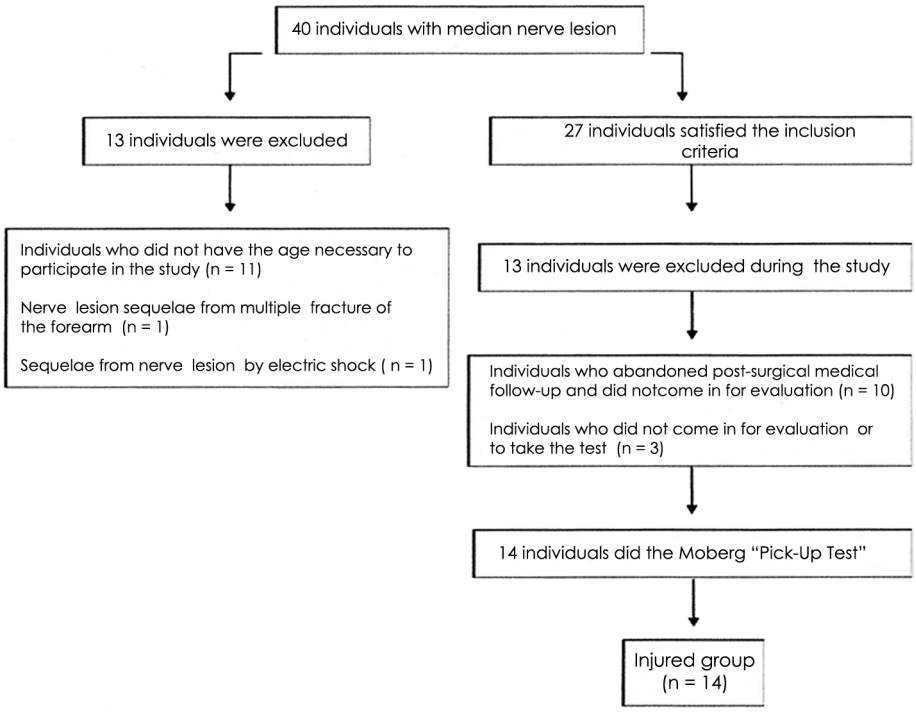

Figure 1. Flowchart delineating the sample

the analysis. The time between the phases lasted about 30 minutes.

Statistical Analysis

The average and the standard deviation of the subjects' ages were calculated for the descriptive analysis of the data.

The Pearson correlation coefficient (r) was calculated to compare between the esthesiometer monofilament sizes and the average of three tests made with eyes open and closed, and dominant/non-dominant hands for the two raters who applied the modified Moberg Pick-up test. The agreement between the values found by both raters was also verified.

To verify the normality of the values found in the functional modified Moberg Pick Up test the Mann-Whitney non-parametric test was applied with a significance level $\alpha = 0.05$.

RESULTS

The sample was made of 14 subjects, all male, aged ≥ 19 years [maximum age = 38 years; average (± standard deviation) = 27.14 years (± 6.43)], with the main frequency ranging from 21 to 30 years, which represented 50% of the sample.

Table 1 shows the percentages observed in the sample of subjects injured according to the injured hand and its dominance. It was observed that the majority, 78% of the subjects, had their right hand injured, with 64% having that same hand as dominant.

The Pearson correlation coefficient (r) between the esthesiometer measurements and the average of total times from the Pick-up test with eyes closed using the dominant hand in both raters show moderate agreement, values between 0.6 and 0.7, with *p*-value < 0.05, described in Table 2.

It was confirmed that in the phase with eyes closed and dominant hand, the recognition values of the objects increased as the thickness of the esthesiometer's monofilaments increased. This data can be seen in Figures 2 and 3.

To compare the results obtained by the two raters in the modified Moberg Pick-Up tests, a calculation of the Pearson linear correlation (r) was made, showing that there was strong agreement (r > 0.75) between the two raters in the evaluation of the non-dominant hand with eyes open or closed and strong agreement (r > 0.90) in the dominant hand with eyes open and closed evaluation (*p*-value ≤ 0.001). This data is shown in Figure 4.

In addition, the Mann-Whitney non-parametric test was used to verify the confidence intervals and *p*-values between the average times of the Moberg tests when conducted by Rater 1 and Rater 2, as described in Table 3.

The confidence intervals and *p*-values of the Mann-Whitney tests did not indicate statistically significant differences between the average Moberg times, when these tests were conducted by Rater 1 and Rater 2, keeping the same conditions of the subjects as for their eyes and dominance. The *p*-value results were always greater than the maximum significance level (0.05) usually considered in statistical tests.

DISCUSSION

In 1983, Dellon et al.[6] were concerned with the hand function after a nerve injury and seeing the need for a careful evaluation, they studied the hand function through the recognition of objects with the Moberg Pick-up test. The authors compared the average time to recognize objects and the cutaneous pressure threshold with the Semmes-Weinstein monofilaments, finding a value similar to the one in the present study with an r = 0.696 ($p \leq 0.002$). In agreement with our findings, they observed a direct relationship between the cutaneous

Table 1. Distribution of subjects according to the injured hand and its dominance

	Injured hand		Dominance	
Left	3	21%	5	35%
Right	11	78%	9	64%

Table 2. Correlations and corresponding *p*-values between the average Moberg times and the corresponding esthesiometer test values

	R1O N	R1O D	R1C N	R1O D	R2O N	R2O D	R2C N	R2C D
r	0.216	0.467	-0.103	0.652	0.302	0.385	0.132	0.700
p	0.458	0.092	0.725	0.011	0.294	0.174	0.653	0.005

R1, R2: Rater; O: Eyes open; C: Eyes closed; N: Non-dominant hand; D: Dominant hand

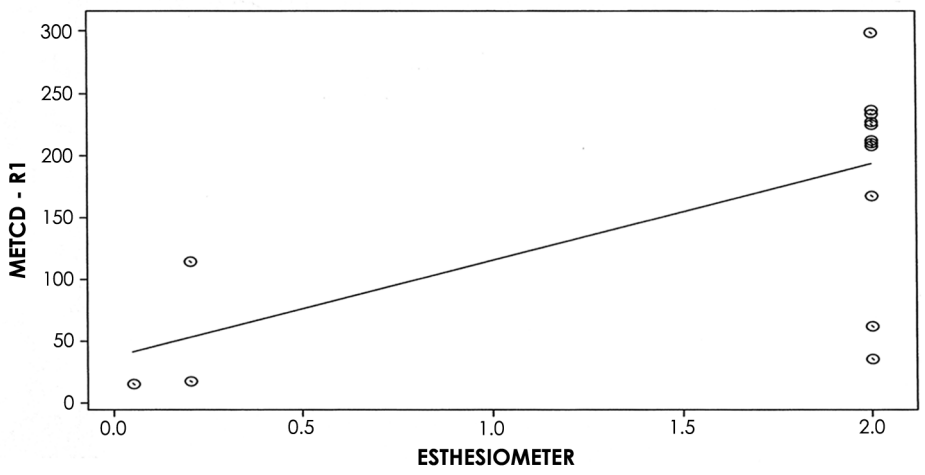

Figure 2. Diagram of the dispersion of points corresponding to values in the Bauru-Sorri® scale with the corresponding Moberg average times with eyes closed, dominant hand for Rater 1 (METCD-R1)

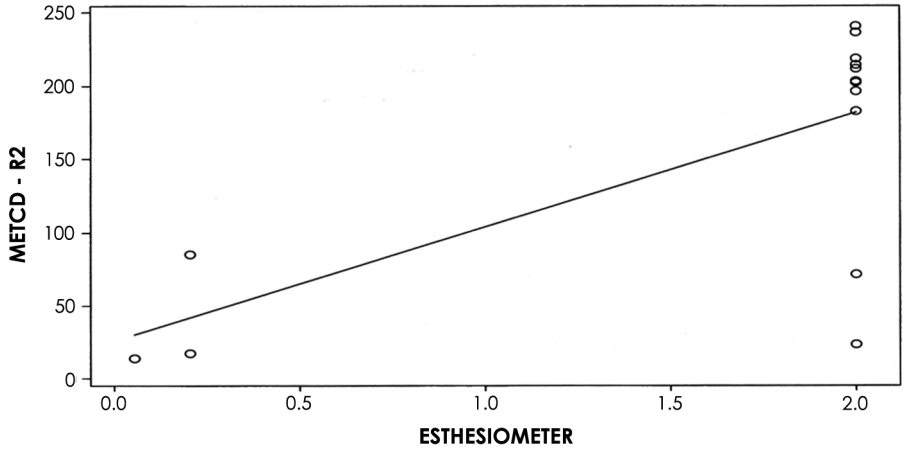

Figure 3. Diagram of dispersion of points corresponding to values in the Bauru-Sorri® scale with the corresponding Moberg average times with eyes closed, dominant hand for Rater 2 (METCD-R2)

pressure threshold and the average time to recognize objects.

However, in 1992, Novak et al.[23] made a study on sensory recovery after a nerve injury, evaluating 14 patients, with an average age of 41 years, two years after surgery and correlated the recognition of 16 small objects with the cutaneous pressure threshold using the Semmes-Weinstein monofilaments. The authors found a weak relationship with a Spearman coefficient of 0.55 ($p < 0.042$).

Again, in 1993, Novak et al.[24] studied the establishment of reliability in the sensitivity evaluation of 14 blind individuals (11 braille readers) and 16 with normal eyesight, but with some type of nerve impairment. They used only eight small objects and two raters for the tests. The intra-class correlation coefficient of all the tests made between the raters was between 0.768 and 0.999. However, in contrast with the previous study, there was a linear relation between the recognition of the objects and the cutaneous pressure threshold made with the Semmes-Weinstein monofilaments, with a coefficient close to what was presented by the present study r = -0.690 for the first rater and r = -0.674 for the second rater.

In the present study the sample was made up of 14 males, young, productive, ≥ 19 years [maximum age = 38 years; average (± standard deviation) = 27.14 years (± 6.43)], corroborating the demographic characteristics shown by other studies made in Brazil.[1,25]

Despite the time to recognize the objects with eyes closed and dominant hand having been greater than the other times, there was no interference in the data, for the Pearson correlation (r) between the esthesiometer readings and the Moberg Pick-up total average time made with eyes closed using the dominant hand for both raters had a moderate reading between 0.6 and 0.7 (p-value < 0.05).

In addition, the confidence intervals and p-values of the Mann-Whitney tests did not indicate statistically significant differences between the Moberg average times, when the tests were conducted by both raters.

In spite of the limitations relative to the normalization of data, the Moberg Pick-up is a good test to analyze the function of the hand, especially when injuries in the median innervation territory are involved.[2,3,7]

The present study based the development of its methods on the study by Ng et al.,[2] which proposed a standard protocol for the application of the Moberg Pick-up test. Nevertheless, in the development of this study it was necessary to adopt a different material for the platform in order to make it stronger. An E.V.A® sheet was added to the interior of the box at the center to avoid the use of sounds in the discrimination of the objects. The tests began with the evaluation of the non-dominant hand to try to minimize the learning effect, since the test was repeated three times for each hand and with two raters.

Although the methodology was adapted, the results corroborated those of Ng et al.[2] in age distribution-53% of the individuals were aged 21-30 years-as well as in inter-rater reliability, evaluated by the Pearson correlation coefficient with r = 0.6 for the test with eyes open and r = 0.8 for the test with eyes closed.

The analysis of the sample confirmed the initial hypothesis of a correlation between the esthesiometry and the modified Moberg Pick-up test after a median peripheral nerve injury.

Compared to other tests that rate the functional ability of the hand, the Moberg Pick-up test has numerous advantages.[3] The test requires relatively simple equipment and rates the dominant and non-dominant hands separately. Besides, it has a second phase in which the subjects repeat the test with their eyes closed rating the sensory acuity of the digital pulps.[3]

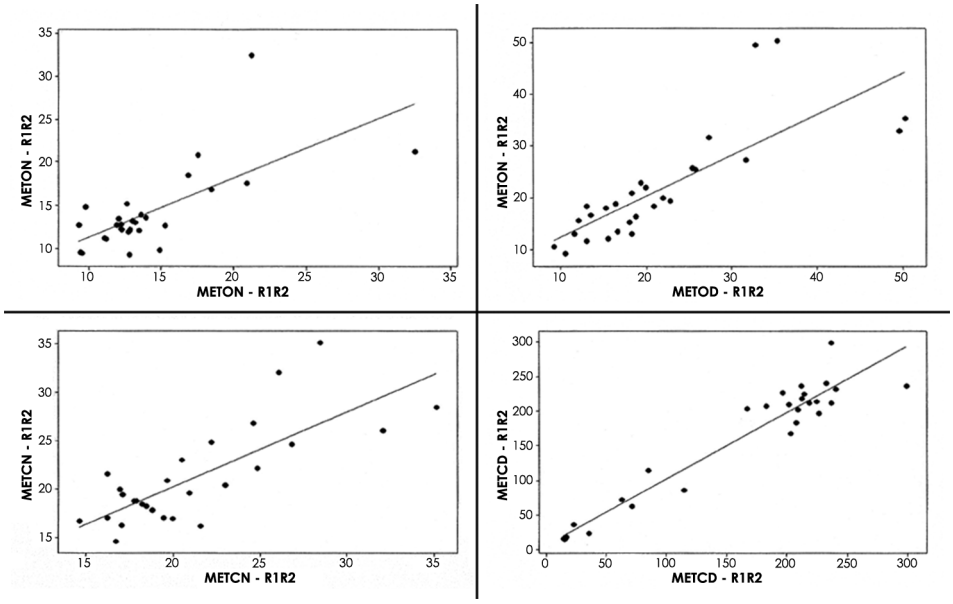

Figure 4. Diagram of dispersion of points corresponding to values in the Pearson Correlation Coefficient test of the average values between Raters 1 and 2 (R1 and R2), eyes open with non-dominant and dominant hand (METON and METOD), and eyes closed non-dominant and dominant hand (METCN and METCD)

Table 3. Confidence intervals and *p*-values of the Mann-Whitney tests of the differences between the medians of average times of the Moberg tests when conducted by Rater 1 and Rater 2, in the same situations as to the eyes and hands of the subjects

Compared groups		Confidence interval of 95%	*p*-value
R 1O N	R 2O N	(-1.228, 3.219)	0.3953
R 1O D	R2O D	(- 5.37, 7.43)	0.5200
R 1C N	R 2C N	(-2.738, 3.407)	0.9817
R 1C D	R 2CD	(-44.7, 80.3)	0.6295

R1, R2: Rater; O: Eyes open; C: Eyes closed; N: Non-dominant hand; D: Dominant hand

Despite the evident advantages of the Moberg Pick-up test, there are still very few studies that systematically evaluate its variables, such as the effects of age, gender, and dominance,[3] which indicates the need for new studies with enough methodological rigor to guarantee the validity and reliability[17] of the sensitivity ratings currently seen in the world literature.

CONCLUSION

According to the data shown in this study, a correlation is evident between the Moberg Pick-up test and the sensitivity test through the SORRI® esthesiometer in median nerve lesions.

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