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Original article

Tactile sensitivity thresholds for the radial hemi-pulp of the index: A comparison between the Semmes-Weinstein and Cochet-Bonnet tests in 25 healthy subjects

Sensibilité de l'hémipulpe radiale de l'index : comparaison des tests de Semmes-Weinstein versus Cochet-Bonnet chez 25 sujets sains

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ABSTRACT

The purpose of this work was to determine whether the Cochet-Bonnet (CB) corneal sensitivity test has a lower cutaneous pulp sensitivity threshold than the Semmes-Weinstein (SW) monofilament test. Tactile sensitivity thresholds for the radial hemi-pulp of the index finger of 25 healthy adult subjects aged 30 years on average were measured using SW and CB esthesiometers. The sensitivity threshold of the radial hemi-pulp of the index was lower with the CB test than with the SW test. The sensitivity and specificity of the CB test on palm wounds still needs to be determined to rule out nerve damage.

RÉSUMÉ

Le but de ce travail était de vérifier si le test de sensibilité de la cornée de Cochet-Bonnet (CB) présentait un seuil de sensibilité cutané pulpaire plus bas que celui du test des monofilaments de Semmes-Weinstein (SW). Le seuil de sensibilité cutanée tactile de l'hémipulpe radiale de l'index de 25 sujets sains adultes âgés en moyenne de 30 ans a été mesuré à l'aide des esthésiomètres de SW et de CB. Le seuil de sensibilité de l'hémipulpe radiale de l'index était plus bas avec le test de CB qu'avec le test de SW. Reste à tester la sensibilité et la spécificité du test de CB sur des plaies de la paume de la main pour vérifier l'absence de lésions nerveuses.

1. Introduction

Undiagnosed nerve damage following an open wound of the hand is fairly common [1,2]. The consequences such as sensory deficit, neuroma and Type I complex regional pain syndrome can be severe [3].

In the presence of a wound to the palm, several methods have been proposed to evaluate cutaneous sensitivity and look for sensory deficits. Although it is used most often, the cotton wisp test has less than 100% sensitivity and specificity [4]. Some authors have recently shown that the sensitivity and specificity of other common tests also do not reach 100% (static Weber test, dynamic Weber test, Semmes-Weinstein monofilament test) [5]. Most authors still believe that any hand wound in the vicinity of a nerve path must be explored surgically [6].

The aim of this study was to verify whether the Cochet-Bonnet test, which was developed to measure the corneal sensitivity, had a

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lower cutaneous sensitivity threshold than the Semmes-Weinstein monofilament test when applied to the radial hemi-pulp of the index finger of healthy subjects.

The primary hypothesis was that the cutaneous sensitivity threshold in the Semmes-Weinstein test was higher than the Cochet-Bonnet test. The secondary hypothesis was that the duration of the Semmes-Weinstein test was longer than the Cochet-Bonnet test.

2. Material and methods

The study included 25 healthy adult subjects under 40 years of age [7]. The average age was 30 years old (range: 23 to 38 years). There were 14 women and 11 men. All were right-handed except for one left-handed person. None had a history of a medical or surgical pathology of upper limbs.

The protocol consisted of evaluating the tactile cutaneous sensitivity threshold of the radial collateral hemi-pulp of the index finger by an independent observer using two esthesiometer tests, the Semmes-Weinstein [8] and the Cochet-Bonnet [9].

The Semmes-Weinstein test consisted of determining the thinnest monofilament perceived from a kit of 20 monofilaments calibrated to apply 0.0045 to 447.0 g of force (Baseline Tactile Semmes-Weinstein® Monofilament®, Patterson Medical™, Warrenville, Illinois, USA). The monofilaments (Fig. 1a) were applied one after the other perpendicularly to the hemi-pulp until the wire bent slightly for 1.5 seconds. The measurement time (approach, pressure, removal of the monofilament) should not exceed 3 seconds. The test started with the thinnest monofilament (lowest pressure) and ended when a minimum of 3 positive responses from 5 trials was collected.

The Cochet-Bonnet test consisted of determining the longest perceived monofilament from a 0.12-mm diameter pen calibrated to apply 0.006 to 0.618 g of force (Luneau Cochet-Bonnet Aesthesiometer®, Western Ophthalmics Corporation™, Lynnwood, Washington, USA). The monofilament (Fig. 1b) was applied perpendicularly to the hemi-pulp until the thread bent slightly for 1.5 seconds. The measurement time (approach, pressure, removal of the monofilament) should not exceed 3 seconds. The test started with the longest monofilament length (lowest pressure) and ended when a minimum of 3 positive responses from 5 trials was collected.

The statistical analysis consisted in comparing two matched discontinuous quantitative variables. First, we measured the mean cutaneous sensitivity threshold by the application force (in grams) of a Semmes-Weinstein monofilament versus Cochet-Bonnet in the 25 subjects. Second, we averaged the time to complete each of the two monofilament tests. Given the small numbers in our sample, so-called "frequentist" methods, expressed as *P*-values, have only weak power. Instead, we used Bayesian analysis methods, which consist in calculating the probability of observing a difference, as this method has better power. This calculation generates a probability between 0 and 1, which is more precise than a binary outcome ($P < $ or $P > 0.05$). A probability of a difference in credibility intervals between the 2 groups of more than 90% corresponded to a large difference, of more than 95% to a very large difference, and of more than 97.5% to the equivalent of one significant difference. All the analyses were carried out using the software R (version 3.2.2).

3. Results

The results of each subject and test are presented in Table 1.

The mean tactile sensitivity threshold was 0.0388 g with Semmes-Weinstein monofilaments with a 95% confidence interval of [0.0301; 0.04745] (Fig. 2). The mean tactile sensitivity threshold was 0.0168 g with the Cochet-Bonnet monofilament with a 95% confidence interval of [0.0081; 0.0255] (Fig. 1). The probability that the skin sensitivity threshold with Semmes-Weinstein monofilament was greater than that of Cochet-Bonnet monofilament was 99%, the equivalent of a significant difference.

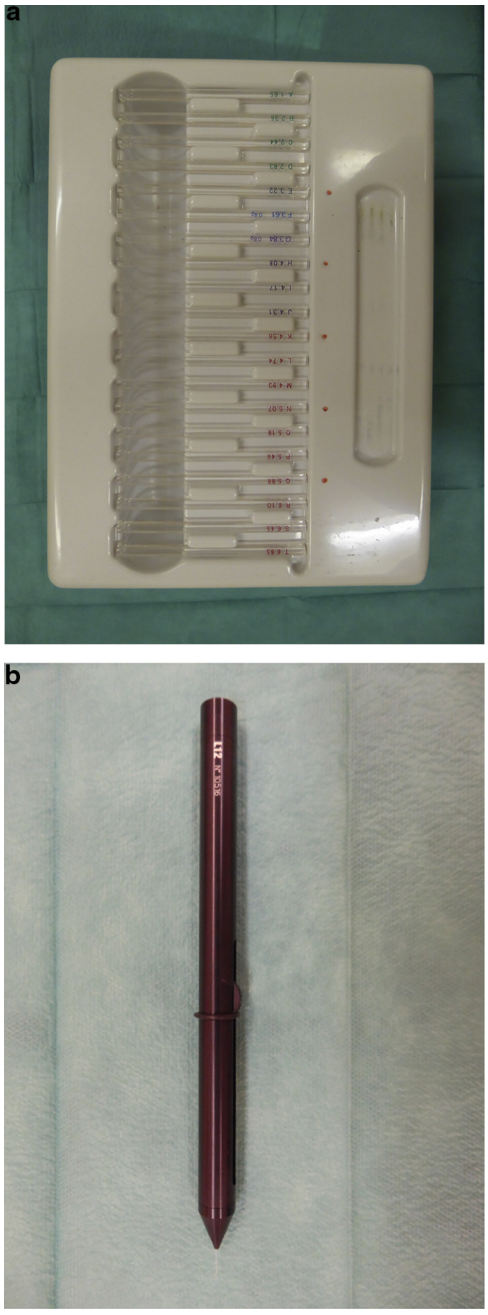

Fig. 1. Material for the two tests of tactile cutaneous sensitivity threshold of the radial collateral hemi-pulp of the index finger. Semmes-Weinstein test–a kit of 20 monofilaments calibrated to apply a force of 0.0045 to 447.0 g (a). Cochet-Bonnet test–a monofilament from a 0.12-mm diameter pen calibrated to apply a force of 0.006 to 0.618 g (b).

The mean duration of the test was 29.78 seconds with Semmes-Weinstein monofilaments with a 95% confidence interval of [27.84; 31.72]. The mean duration of the test was 21.66 seconds with the Cochet-Bonnet monofilament with a confidence interval of [19.72; 23.60]. The probability that the duration of the Semmes-Weinstein

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