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Scientific/Clinical Article

Upper limb neurodynamic test 1 in patients with clinical diagnosis of carpal tunnel syndrome: A diagnostic accuracy study

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ABSTRACT

Study Design: Diagnostic accuracy.
Introduction: Upper limb neurodynamic test 1 (ULNT1) is used to evaluate the mechanical sensitivity especially in the peripheral nerves of the upper limbs. The reproduction of typical symptoms in the affected hand improves the estimation of the probability of carpal tunnel syndrome (CTS). However the test has not been evaluated sufficiently to determine its real usefulness. In the present study the diagnostic accuracy of ULNT1 as a clinical test for CTS was determined.
Methods: We used the ULNT1 as the index test and nerve conduction as the reference standard. 120 subjects, (240 hands), with a medical diagnosis of CTS were evaluated. The study population was a consecutive series of participants. Sensitivity, specificity, positive and negative predictive values, accuracy, and positive likelihood ratio were calculated.
Results: ULNT1 was found to have a sensitivity of 93 % and a specificity of 6.67 %. The positive likelihood ratio was 1.04 and the negative likelihood ratio was 1.00. The positive predictive value was 86.9 % and the negative predictive value was 12.5%.
Discussion: Acute or relatively mild CTS cases may not be accurately identified through nerve conduction tests. The findings of this study coincide with other studies in the finding that ULNT1 has a significant diagnostic and clinical screening value for CTS in people at-risk, or with upper limb symptoms.
Conclusion(s): This research suggests the use of ULNT1 as a screening test for CTS, followed by tests that are more specific.
Level of Evidence: III-2.

Introduction

Carpal tunnel syndrome (CTS) is considered to be the most common nerve entrapment among lesions occurring in the peripheral nerves of the upper limbs.[1] In the United States, it has been estimated that the costs associated with CTS exceed 2 billion dollars a year.[2] In addition, people with physician-diagnosed CTS have substantially more sick leave than the general population.[3] Severe pain and depression have been associated with this condition, along with functional limitations.[4,5]

Prevalence has been estimated between 1.5% and 5.8% in the general population.[6] Occupation has proven to be a very important risk factor for suffering the disorder,[7-9] and high proportions of CTS are observed among construction (8.2%), poultry (8.9%), and dairy workers (16.6%).[10,11] It is associated with work involving repetitive manual tasks, movements of the wrist that require great strength, pressure on the wrist, physical activities with wrist strain, and low job satisfaction.[12,13]

Symptoms of CTS include hand pain and tingling, pain or numbness in the thumb, index finger, middle finger, and radial side of the ring finger, and reduced grip strength and function of the affected hand.[14] The clinical examination consists of history, physical examination, and manual tests.

To date, no diagnostic test research has shown both high sensitivity and high specificity for identifying this disorder.[15]

The average sensitivity of Tinel's sign is about 50%, and the sensitivity of Phalen's test is 68%. The average specificity of Tinel's sign is 77%, with 73% for Phalen's test.[16]

Phalen's and Tinel's provocative tests have been categorized as highly recommended due to their positive likelihood ratio (LR) above 2.0. The average calculated + LR for Phalen's test in a literature review was found to be 2.68, with 2.95 for Tinel's sign and

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2.28 for the modified compression test. A mean negative LR of more than 0.5 resulted from 2 or more studies with high scores (8 of 12) on the MacDermid rating scale.[17]

There is also a documented need to optimize diagnostic criteria for CTS in epidemiologic research.[18]

Upper limb neurodynamic tests (ULNTs) are used to evaluate the mechanical sensitivity of the nervous system, especially in the peripheral nerves of the upper limbs.[19] These tests are considered useful because they determine mechanical function and can even discriminate between normal subjects, patients with shoulder pain secondary to musculoskeletal injuries, and patients with a high probability of neuropathic pain.[20] From this perspective, these tests can contribute greatly to a structural differential diagnosis in CTS cases.

In clinical practice, nerve conduction studies with an 85% sensitivity and 95% specificity are used, along with a physical examination, to determine the degree of nerve involvement in CTS.[21]

Clinical research of the syndrome is continuously exploring new diagnostic techniques. Modified clinical test assessments,[22] symptom questionnaires,[23] ultrasound,[24] and sonoelastography[25] have been developed as aids in diagnosing CTS.

The reproduction of typical symptoms in the affected hand during ULNT1 improves the estimation of the probability of CTS. This aids the early and differential diagnosis of median nerve compression at the carpal tunnel level. For this test, Vanti et al[26] estimated sensitivity at 91.67%, specificity at 15%, positive LR at 1.0784, negative LR at 0.5556, and the post-test probability for negative tests at 40%. However, ULNT1 has not been tested sufficiently to determine its real usefulness.[17]

In the present study, the diagnostic accuracy of ULNT1 as a clinical test for CTS was determined, thus defining its diagnostic value as a screening test to be implemented in the health surveillance examinations and monitoring of people under hazardous conditions, or who present upper limb neurologic symptoms compatible with CTS.

Methods

Study design

A diagnostic accuracy study. Data collection was planned previously. We used ULNT1 as the index test and nerve conduction as the reference standard. This study lasted 18 months, from January 2013 to August 2014.

Participants

Study population

About 118 subjects (230 hands), with a medical diagnosis of CTS and no specification of unilateral or bilateral involvement, were evaluated between the months of August 2013 and February 2014, at a health services institution.

The inclusion criteria were female and male patients aged 18-86 years, referred with a clinical diagnosis of CTS. Exclusion criteria were pathologies of the upper limbs and cervical spine that might limit the range of motion of the left or right upper extremities[27]; patients with a history of rheumatoid arthritis, anterior shoulder dislocation, complex regional pain syndrome, Raynaud's syndrome, breast cancer, or rotator cuff injuries; and patients with cervical spinal stenosis, or cognitive deficits.

Recruitment

The study population was a consecutive series of participants defined by the selection criteria, with a clinical diagnosis of CTS, attending the health institution for a nerve conduction test.

This study was previously approved by the ethics committee of the Universidad del Rosario's School of Medicine and Health Sciences. All subjects were informed about the research and were asked to sign an informed consent form. Nerve conduction study results were blinded to both the examiner and the patient. Because ULNT1 is testing the mechanosensitivity of the nerve, the performance of electrodiagnostic tests could have increased this sensitivity before ULNT1. To prevent this increased sensitivity, ULNT1 was applied 20 minutes after the nerve conduction test.

Test methods

The evaluation team was made up of 2 physiotherapists who took the patient's history and performed the clinical tests, including ULNT1, and a physiatrist who performed the nerve conduction studies.

To determine the diagnostic accuracy of ULNT1, an evaluation form that included the following components was used:

1. History: Demographics, biomechanical demands, and occupation.
2. Because the primary symptoms reported by the CTS population could be similar to those of cervical radiculopathy (upper extremity pain, numbness, and weakness),[28] the physical examination included Spurling's test and the distraction test to exclude participants who might have had cervical radiculopathy.
3. Reference standard method: A physiatrist used the technique and recommendations outlined by the American Association of Electrodiagnostic Medicine[29] for the study of motor and sensory nerve conduction.
   The classification recommended by the Association of Electrodiagnostic Medicine and used in this study was normal (grade 0); very mild (grade 1), CTS demonstrable only with the most sensitive tests; mild (grade 2), sensory nerve conduction velocity slow on finger or wrist measurement, normal terminal motor latency; moderate (grade 3), sensory potential preserved with motor slowing, distal motor latency to abductor pollicis brevis (APB) <6.5 milliseconds; severe (grade 4), sensory potentials absent but motor response preserved, distal motor latency to APB <6.5 milliseconds; very severe (grade 5), terminal latency to APB >6.5 milliseconds; and extremely severe (grade 6), sensory and motor potentials effectively unrecordable (surface motor potential from APB <0.2 mV amplitude).
4. Index test: ULNT1 for median nerve was graded according to Wainner's criteria,[22] and symptoms were located as proposed by Lohkamp and Small.[30] The decrease in range of motion was measured with a goniometer.

Each patient initially underwent nerve conduction study. Twenty minutes later, 2 physiotherapists specializing in manual therapy, with 12 years of experience, took the patient's history and performed Spurling's test and the distraction test. One of the physiotherapists performed all ULNT1 tests.

The procedure used for measuring range of motion was as follows[31]: the ulnar styloid process, medial epicondyle of the humerus, and anterior aspect of the acromion process were marked to use as reference points for the elbow joint angle measurements. One physiotherapist performed the test, whereas another registered the measurements to avoid bias. The axis was placed on the medial epicondyle with the stationary arm pointing to the acromion and the moveable arm to the ulnar styloid process.

For all tests, participants lay supine without a pillow, arms along the body, and legs straight. Tests were carried out slowly, and participants were instructed to indicate the point at which it was too uncomfortable to continue with the movement (point of pain tolerance). Angle measurements were then taken at this point. The