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Original article

Reproducibility of sub-acromial impingement tests, including a new clinical manoeuver

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ABSTRACT

Background: The Neer, Hawkins, and Yocum clinical tests detect sub-acromial impingement as a pathogenic process of degenerative rotator cuff disease. Their reproducibility has been little investigated.
Objectives: We tested the reproducibility of the Neer, Hawkins, and Yocum clinical tests for detecting this sub-acromial impingement and also an original clinical manoeuver, the countertest with elevation with lateral rotation (CELR), which is a test of sub-acromial impingement.
Methods: Patients with shoulder pain due to degenerative rotator cuff disease were prospectively included. They were assessed with the Neer, Hawkins and Yocum tests as well as the CELR twice at a 1 week interval. Intra- and inter-observer reproducibility was assessed by percentage agreement and the kappa coefficient of concordance with 95% confidence intervals (CIs). Concordance was poor with kappa ≤ 0.4, moderate > 0.4, and good > 0.61. It was considered suitable for clinical use with kappa > 0.4.
Results: We included 34 patients (mean [SD] age 60 [11] years; 26 females). For intra-observer reproducibility, agreement was 80% to 88%. By the kappa coefficient, intra-observer reproducibility was poor for the Neer test and moderate for the Hawkins test (0.56 [95% CI 0;0.9]) and Yocum test (0.48 [0;0.8]) and CELR (0.6 [0.2;0.9]). For inter-observer reproducibility, agreement was 73% to 88%. By the kappa coefficient, inter-observer reproducibility was poor for the Yocum test, moderate for the Hawkins test (0.54 [0.2;0.8]) and CELR (0.58 [0.2;0.8]), and good for the Neer test (0.64 [0.2;0.9]).
Conclusion: The Hawkins test and CELR had a balanced profile of reproducibility suitable for clinical practice. We underline the potential interest of CELR, an original manoeuver.

1. Introduction

There is a consensus on the role of clinical examination as the first step in the care of patients with shoulder pain due to degenerative rotator cuff disease [1–3]. Clinical examination includes case history, inspection and palpation, mobilization and clinical tests of the shoulder. Clinical tests for degenerative rotator cuff disease are of 2 types [4,5]: rotator cuff testing and tests of sub-acromial impingement. Rotator cuff testing aims to detect tendon lesions. It gives some evidence for the presence or absence of tendinopathy or tendon tears and their location in the rotator cuff. The diagnostic value of rotator cuff testing has been well-investigated [6,7]. With their performance and ease of use, the Jobe test and resisted lateral rotation and belly-press tests have been recommended to detect supraspinatus, infraspinatus, and subscapularis tears, respectively [1].

Clinical tests of sub-acromial impingement do not strictly aim at lesion diagnosis [4,5]. They are designed to detect sub-acromial impingement, a pathogenic process of the disease. Clinical tests of sub-acromial impingement commonly used are the Neer, Hawkins, and Yocum tests [8–10]. Unfortunately, their performance has been investigated only as a marker of rotator cuff lesions [6,7]. The main criteria for this purpose were sensitivity, specificity, predictive values and likelihood ratios, with tendinopathy or tear as a reference, but these are not specific markers of the pathogenic process of sub-acromial impingement. Indeed, sub-acromial impingement is not the unique causative factor of degenerative rotator cuff disease featuring tendinopathy with or without tear [11].

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Reproducibility is another criterion of assessment and contributes to the value of physical tests [12]. It is independent of the reference needed to establish sensitivity, specificity, predictive values and likelihood ratios. Reproducibility could indicate the technical accuracy of sub-acromial impingement tests. However, the reproducibility of the Neer, Hawkins and Yocum tests has been little investigated [13–21].

The goal of the study was to investigate the reproducibility of the Neer, Hawkins and Yocum tests. We also included an original clinical manoeuver as the first stage of its development.

2. Patients and methods

2.1. Design

This was a cross-sectional descriptive study. Response criteria for clinical tests and data collection were planned before the study start. The study was carried out under conditions of usual care in our unit. Participants gave their written consent to be in the study.

2.2. Patients

We prospectively included patients referred to our unit for rehabilitation because of shoulder pain due to degenerative rotator cuff disease. Inclusion criteria were age $>$ 40 years; shoulder pain duration $>$ 1 month; normal passive range of motion; one or more positive clinical test results for rotator cuff testing or sub-acromial impingement detection; and absence of glenohumeral arthropathy or calcification on X-ray imaging. We excluded patients with previous surgery of the shoulder, shoulder instability, humeral fracture, local steroid injections in the preceding 30 days, inflammatory joint disease and neoplastic disorders. Other exclusion criteria were evidence of a painful acromioclavicular joint during palpation, neurological or cervical disease on physical examination and not signing a written consent.

2.3. Assessment

Patients were assessed twice at a 1-week interval without beginning any new treatment. At the first visit, clinical, pain and disability data were systematically recorded. Clinical tests of sub-acromial impingement were performed by 2 independent investigators who were blinded to each other's findings. At the second visit, clinical tests were performed again by one of the investigators, always the same investigator. Patients also underwent ultrasonography (US) examination of the shoulder.

Clinical data collected for all patients at inclusion were sex, age, dominant side, pain duration, levels of pain and disability, and results of clinical tests of sub-acromial impingement. Pain was assessed on a 0- to 100-point visual analog scale (VAS). Disability was assessed on the 0- to 100-point Shoulder Pain And Disability Index (SPADI) outcome measure [22].

2.4. Clinical tests of sub-acromial impingement

The 2 examiners involved in the study were physicians experienced in musculoskeletal disorders. At the first visit, examiner 1 performed the first clinical examination, followed by examiner 2, at about a 30-min interval. At the second visit, examiner 1 performed the examination alone. For clinical tests of sub-acromial impingement, the patient was in a standing position. The Neer test, the proposed countertest with elevation in lateral rotation (CELR) and Yocum and Hawkins tests were performed in succession by examiners.

The Neer test consisted of passive antero-lateral elevation of the patient's arm in the scapular plane, elbow extended, and shoulder in medial rotation with the thumb down [8]. Shoulder pain between 60 and 120 degrees of passive antero-lateral elevation indicated a positive result.

The Hawkins test was performed with the patient's arm first passively positioned at 90 degrees of forward flexion and the elbow at 90 degrees of flexion [9]. Then passive medial rotation of the shoulder was performed. Shoulder pain during passive medial rotation indicated a positive result.

The Yocum test was performed with the patient's hand positioned on the opposite shoulder [10]. The patient was asked to actively elevate the elbow over the horizontal shoulder plane. Shoulder pain during active elevation indicated a positive result.

We proposed the CELR to enhance the specificity of detecting the sub-acromial impingement pathogenic process in patients with shoulder pain due to degenerative rotator cuff disorders [23]. The CELR contains 2 parts. First, the arm positioned in medial rotation is passively elevated in the antero-lateral scapular plane (Fig. 1). With the presence of shoulder pain in the first part, the second part of the test is performed, consisting of passive elevation of the arm not in medial rotation but in lateral rotation. The result is considered positive when shoulder pain is no longer produced by the second passive elevation. Therefore, the test is a test of negativity. A positive CELR result corresponds to a painful first part of the test without any pain during the second part. Other situations indicate a negative result. Both examiners performed the CELR for all patients at the first visit and examiner 1 at the second visit.

2.5. Ultrasonography

US was performed by a radiologist trained in musculoskeletal diseases and US. US involved use of a dedicated 7–15 MHz probe. For the supraspinatus, infraspinatus and subscapularis tendons and long head of the biceps brachii tendon, the US classification was normal tendon, tendinopathy including partial-thickness tear, and full-thickness tear. Effusion in the sub-acromial bursa was also recorded. A normal tendon corresponded to a normal-shaped homogenous hyperechogenic tendon [24]. Tendinopathy was considered with a thickened or heterogenous tendon with or without partial tear. Full-thickness tear corresponded to discontinuation of the tendon or its flatness with loss of the normal convexity of its superior aspect.

2.6. Statistical analysis

Quantitative variables are presented as mean (SD). Categorical variables are presented as number (percentage). The reproducibility of clinical tests was estimated by percentage of agreement and the kappa coefficient of concordance with 95% confidence intervals (CIs) [25]. Intra-observer reproducibility corresponded to the percentage of agreement and kappa coefficient for the same assessor between the 2 visits. Inter-observer reproducibility corresponded to the percentage of agreement and kappa coefficient between the 2 assessors at the first visit. The kappa coefficient was the primary outcome. Concordance was considered poor with kappa $\leq$ 0.4, moderate $>$ 0.4, good $>$ 0.61, and very good $>$ 0.81. It was considered suitable for clinical use with kappa $>$ 0.4.

3. Results

We included 34 patients with degenerative rotator cuff disease (mean [SD] age 60 [11] years; 26 females) (see Table 1 for clinical characteristics): 20 had full-thickness tear: 11 involving supraspi-

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