Reliability of the Passive Knee Flexion and Extension Tests in Healthy Subjects

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Abstract

Objective: Information on the reliability of the passive knee extension (PKE) and passive knee flexion (PKF) tests is still incomplete. Moreover, standardization of the 2 test procedures could be enhanced. The present study investigates interrater and test-retest reliability of the modified versions of the PKE and PKF tests to establish whether the level of reliability is sufficiently high to justify their use in scientific studies and clinical practice.
Methods: A total of 14 healthy subjects met the selection criteria. The 2 tests were carried out successively by each of the 3 clinicians/raters involved in the study, and each test was repeated 3 times. Two series of such measurements were performed. To evaluate interrater and test-retest reliability of the 2 tests, we calculated the intraclass correlation coefficients (ICCs), the standard errors of measurement, and the smallest detectable differences.
Results: The PKE and PKF tests showed excellent and good reliability, respectively. Mean ICCs for the PKE were greater than those for the PKF. Mean ICCs for the interrater reliability (0.88-0.93) were higher than those for test-retest reliability (0.84-0.93). No mean ICCs lower than 0.84 were found (test-retest for PKF). The lowest ICCs of 0.73 and 0.75 were registered for the test-retest reliability of PKF in the case of rater 1.
Conclusion: These results show excellent and good interrater and test-retest reliability of the PKE and PKF, respectively. The PKE test seems to be slightly more reliable. These findings may help clinicians when using these tests. For research purposes, investigators must critically evaluate whether the presented amount of error is acceptable for a specific setting. (J Manipulative Physiol Ther 2010;33:659-665)
Key Indexing Terms: *Muscle, Skeletal; Muscle Tonus; Reproducibility of Results*

An important issue in research methodology is estimation of the amount of measurement error, as well as identification of its sources. To address this, researchers test various aspects of the reliability of measurements.

Both in research and in clinical practice, the functional tests used to evaluate muscle tightness,[1,2] flexibility,[3,4] or stiffness[5] constitute popular diagnostic tools. In this study, they are referred to as muscle tightness tests. Of these, the passive knee extension (PKE) test and the passive knee flexion (PKF) test are routinely used.

Investigators tend to use the PKE test to diagnose sport injuries and to verify the effectiveness of hamstring stretching protocols.[3,4,6-8] Certain aspects of reliability of this test were evaluated by Ford and colleagues.[6] Gajdosik and Lusin[1] provide data on the reliability of the active version of the knee extension test. Similarly, little information is available on the reliability of the knee flexion test (both passive[9] and active[2]); this is surprising because it is an essential component of the femoral nerve neurodynamic test,[10] is used as a diagnostic tool in neuromuscular therapy[11] and dysfunction of the lumbo-pelvic-hip complex,[12] and can help to determine the effects of rectus femoris stretching programs.[9]

Information on the reliability of the PKE and PKF tests is still incomplete and standardization of the 2 test procedures is not yet optimal. Therefore, we attempted to standardize them by introducing certain modifications (see below) to the versions used in the past. The present study investigates the interrater and test-retest reliability of the modified versions of the PKE and PKF tests in order to establish whether the achieved level of reliability is sufficiently high to justify their use in scientific studies and clinical practice.

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Methods

Subjects

A total of 30 subjects (aged 18-30 years) formed the sample of convenience. All were students of the University of Physical Education, Katowice, Poland, and thus had a relatively uniform, healthy, and active lifestyle. Of these, 14 subjects (7 female; age, 22.5 ± 2.9 years; height, 175.6 ± 8.9 cm; weight, 68.6 ± 16.2 kg) met the criteria for selection and were included in the study. The inclusion criteria were increased tightness of the hamstrings greater than 10° in the PKE test and increased tightness of the rectus femoris muscle less than 50° in the PKF test. The exclusion criteria were as follows: pain in the low back, pelvis, and lower extremities on the day of the investigation; history of more serious pain and/or injuries of the lumbo-pelvic-hip complex and lower extremities persisting more than 1 month or requiring medical intervention or hospitalization; history of surgical interventions in the lumbo-pelvic-hip complex and/or lower extremities; post-exercise muscle acidification; significant overall fatigue and general malaise on the day of investigation and at least 2 days before; and limited ability to relax when performing the muscle tightness tests. To verify these criteria we conducted a short interview and performed the PKE and PKF tests in a simplified way using only a goniometer without a force gauge, and without strict placement and stabilization as described below.

All participants gave informed consent. The study was approved by the Ethical Research Committee, University of Physical Education, Katowice, Poland.

On the day of testing, one subject failed to demonstrate adequate tightness of the rectus femoris muscle, probably because of the close-to-limit result achieved during the preliminary qualification. A second subject could not relax properly when performing the PKE test. For the first subject it was not possible to perform the PKF test but there was no obstacle to performing the PKE test, whereas for the second subject the situation was the opposite. Therefore, data from 13 subjects performing the PKE test and 13 subjects performing the PKF test were analyzed.

Raters

Three physiotherapists were involved as raters. Rater 1 is a university lecturer with approximately 12 years of experience in functional diagnostics of the musculoskeletal system (the first 5 years were spent running his own practice). Rater 2 is also a university lecturer with approximately 12 years professional experience (5 years ago he began to split his time between teaching and clinical work). Rater 3 is a PhD student with 6 years experience in (full-time) practical clinical work. All raters were familiar with the test procedures and all were involved in attempts to enhance standardization of the tests before the start of the present study. For 1 month they all spent approximately 2 hours twice a week training together, as well as practising the tests individually.

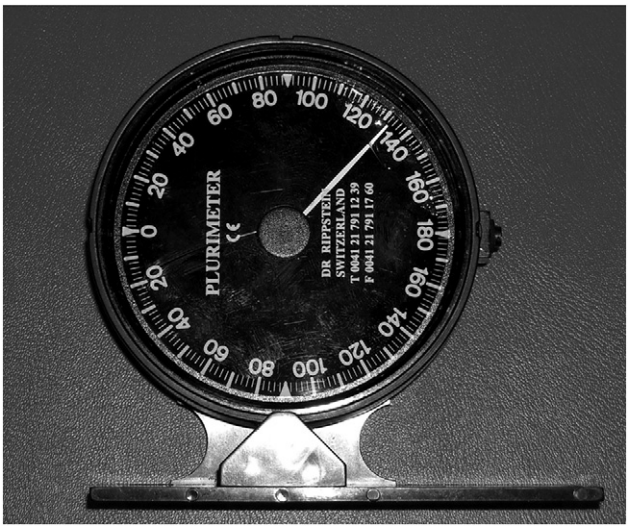

Fig 1. *The goniometer used as the key measure in the study.*

Equipment

In the present study, the goniometer (Rippstein V-Plurimeter, Pirettes, Switzerland) was used as the key measure (Fig 1). Resolution of the readout was ±1°. As angular displacements are properly measured by means of a protractor, and the goniometer is basically a type of protractor, we rely on the face validity of this measurement.

The Advanced Force Gauge (Mecmesin, Slinfold, West Sussex, UK) was used to measure the amount of force needed to produce passive extension/flexion of the knee. Therefore, it was possible to carry out consecutive repetitions of the given test with the same force as in the first repetition. This helped to standardize the point at which the goniometer readout was taken.

Procedure

On the day of recruitment, the subjects were tested against the inclusion/exclusion criteria and received all the necessary information. On the day of measurements, a short 5-minute warm-up took place using a stationary bike with a low load. To evaluate the test-retest reliability, 2 series of measurements were carried out. One series included the 2 tests performed successively by the 3 raters, and each test was repeated 3 times. We randomized the order of the raters performing the role of primary rater (PR, see below) and assisting rater (AR), the order of the tests (PKE and PKF), and the order of which lower extremity was used to start the test (right and left). As an example, Figure 2 shows the structure of the first series. The second series proceeded in