47 Clinical Tests for Evaluation of Motor Function of the Knee

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47.1 Introduction

Injuries of the lower extremities are accompanied by a phase of reduced loading capacity of the knee structures and mostly with distinct losses of muscle mass and muscle strength [1]. Due to the lack of relevant information concerning the knee joint in functional loading situations, dynamic tests are highly recommended in recent sports medicine textbooks and articles [2]. The majority of the clinical tests of motor function give quantitative measures (e.g., time, height, distance) of abilities of the injured limb or important information about the rehabilitation process. The use of motor tests gives exclusive information about the knee, because in a usual clinical examination, correlations between the motor behavior in walking, running, jumping, and pivoting movements and results of the usual classic examination methods have not been found [3]. Motor function tests are frequently used in clinical practice because they do not require a lot of space or special equipment [4].

The clinical motor tests of the lower limbs are also very important to evaluate the effectiveness of the rehabilitation process after a complex surgery of the knee joint. Anterior cruciate ligament (ACL) rehabilitation programs have suffered a dramatic improvement in the last years. Most of the patients can now begin an active lifestyle after only 24 weeks of rehabilitation. To ensure that a patient has a satisfactory functional level, which will allow a safe return to a level of activity similar to that presented previously to an injury, we need concrete data to assess the motor capacity of the rehabilitated patient [5].

Nowadays, osteoarthritis is the most common knee disorder. Due to the stiffness, pain, and reduced muscle strength, it is a common cause of disability in older adults. With progression of the osteoarthritis of the knee, daily activities such as walking, getting in and out of a bath, and doing simple household chores become very difficult [6]. To evaluate the grade of disabilities caused by an osteoarthritic knee or the result of the applied treatment, we should use the clinical dynamic motor tests. In this chapter, we will detail the most used motor dynamic tests for evaluating orthopedic patients.

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47.2 Clinical History

A complete medical history must be performed prior to physical examination of the knee. During our academic training, we learned to characterize pain in terms of type, intensity, frequency, location, aggravating factors, and relief factors. Regarding the knee, there is extremely important information in the clinical history, such as the trauma mechanism, the course of the disease's development, and the patient's age. In addition to these, there are details that are often ignored by doctors who work in the treatment of pain, but which should be incorporated into the clinical evaluation of a patient with pain complaints, such as eating habits, stress level, and quality of sleep.

When investigating a complaint, we should always try to clarify.

- The trauma mechanism (if present)
  If the problem is due to direct trauma, torsional trauma, or excessive effort.
- The functional limitation caused by the health problem
  If the patient is unable to walk, he/she needs crutches, or is even unable to mobilize the knee.
- The problem development course
  We must investigate whether the problem had an acute development after trauma or another specific or insidious event. Or if it had an insidious course, evolving gradually.
- Previous treatments (medications, physiotherapy, immobilization, surgery, etc.)
- The patient's current level of physical activity
  We must have a clear notion of the patient's level of sporting and functional activity, as well as expectations after treatment.
- Presence of systemic inflammatory diseases (gout, seronegative arthritis, etc.)
- The patient's diet
  New studies indicate that an inflammatory diet can accelerate the progression of degenerative diseases such as osteoarthritis and lead to a higher prevalence of pain and functional limitations in our patients [7, 8].
- The presence of clinical signs of metabolic syndrome
  Signs such as hypertension, diabetes, increased abdominal circumference, and dyslipidemia are directly related to the quality of the subchondral bone of the knee [9]. These changes generate changes in the trabecular architecture of the subchondral bone, causing it to decrease its impact absorption capacity. Consequently, there is an overload of the knee joint cartilage, favoring the appearance of a cartilaginous lesion and pain in that joint [10, 11].
- Presence of depression or high stress levels
  The presence of depression or high levels of stress directly affect the threshold of sensitivity to pain and the result of the treatment employed. Patients with depressive symptoms show worse results in relation to pain relief and joint function after infiltration with hyaluronic acid in knees with osteoarthritis [12].
- Sleep quality
  Another point that we always evaluate in our patients is the quality of sleep. There is a direct relationship between the quality of sleep and the level of pain in patients with knee osteoarthritis [13].

47.3 Inspection

The first part of our patient's inspection begins even before the doctor's appointment. The doctor should assess the patient's gait looking for lameness and movement abnormalities and also assess the relationship of the knee to the adjacent joints and observe the use of some type of orthosis. After collecting the clinical history, with better exposure of the lower limbs, a new gait assessment should be performed (Fig. 47.1).

Fig. 47.1 Gait assessment being performed

Still with the patient in an orthostatic position, we assessed possible valgus or varus deformities of the knee, the position of the patella, and the presence of excessive pronation or supination of the foot. The skin is observed looking for edema, erythema, ecchymosis, or scars that indicate previous surgery or trauma. Muscle asymmetries can also be verified at this stage of the exam, where we also evaluate the popliteal region, in the search for masses and tumors.

47.4 Range of Motion

The evaluation of the knee range of motion begins with the patient in seated position. We start analyzing the active range of motion, and if there is any limitation, we do a passive evaluation. We search for a flexion range around 140°, and the comparison with the contralateral knee is always mandatory [14].

47.5 Palpation

The sequential palpation of the structures of the knee can find the correct location of the lesion in the majority of the cases. We also look for the presence of phlogistic signs. Heat, pain, and flushing may indicate exacerbated inflammatory activity, suggesting complementary laboratory tests [14].

47.6 Motor Tests of the Knee

47.6.1 Five-Time Sit-to-Stand Test (FTSST)

The patient is asked to sit in a chair with his/her arms folded across his/her chest. Then, the test taker is asked to do five repetitions of standing from seated position and return to sit as soon as possible without the use of the arms. We start measuring the time when the patient starts the movement and stop the count at the end of the fifth repetition (Figs. 47.2, 47.3, and 47.4).

The sit-to-stand movement is essential to assess not only the mobility of our patients but also their degree of independence. There is a high degree of dependence when this function is impaired. In addition, unsatisfactory results are related to an increased risk of falls and fractures in the elderly [4].

47.6.2 Five-Meter Walk Test (5mWT)

In this test, we mark the time it takes the patient to walk a distance of 5 m that must be somehow marked on the floor of the examination site. It is

Fig. 47.2 Sequence demonstrating the sit-to-stand movement analysis

Fig. 47.3 Sequence demonstrating the sit-to-stand movement analysis

important to have an area before and after the 5 m that will be evaluated, so that the patient can accelerate and decelerate with tranquility and the time is measured at maximum speed. We can also calculate the patient's speed (m/s) by dividing the distance covered (5 m) by the time interval in which the patient completed the test [15].

47.6.3 Ascend/Descend Four Stairs

Having a safe and well-lit staircase, we can perform this test that gives us a lot of information regarding the patient's neuromotor function. We ask the test taker to go up four steps, turn around when he/she reaches the fourth step, and go down as quickly as possible. Time is recorded for future comparison [6] (Figs. 47.5, 47.6, and 47.7).

47.6.4 Maximal Hop for Distance

Hopping is the movement when we perform the body projection and the landing with the same lower limb. We ask the patient to maintain balance on one foot and, keeping the contralateral hip and knee flexed at approximately 90° and the hands on the hips, project his/her body as far as possible, then landing on the same foot. It is very important not to use the swing of the contralateral lower limb and arms to assist movement. After landing, the test taker can place both feet on the ground to maintain balance. The distance between the starting and ending positions of the foot is measured and saved for future comparisons [5] (Figs. 47.8 and 47.9).

Fig. 47.4 Sequence demonstrating the sit-to-stand movement analysis

47.6.5 Maximal Controlled Leap

This test is very important, as this movement is present in the vast majority of sports. We ask patients to maintain balance with just one foot of support. He/she must maintain the contralateral knee and hip in approximately 90° of flexion and the hands on the hip. The patient projects the body forward with the force of the lower limb that is supported on the floor and lands with the other foot. It is very important that the test taker only extends the knee near the moment of landing and maintains total balance in approximately 1 s after the landing. The distance between the starting position of the foot and the final position of the landing foot is measured and saved for future analysis [5] (Figs. 47.10 and 47.11).

Fig. 47.5 Ascend/descend 4 stairs

47.6.6 Single-Legged Drop-Jump Landing Test

To perform the single-legged drop-jump landing test, we ask the patient to stand on a step of approximately 20 cm. We ask him/her to take a short takeoff with both feet and land with just one foot. After landing, it is important for the test

Fig. 47.6 Ascend/descend 4 stairs

Fig. 47.7 Ascend/descend 4 stairs

taker to stabilize the position by maintaining balance on just one foot and making as little movement as possible. The hands should be on the hips during the whole test, and the eyes should be fixing a point in the wall [16] (Figs. 47.12 and 47.13).

47.6.7 Y-Balance

The Y-balance test is used to assess muscle control, stability, and mobility of the lower limbs. The patient is asked to maintain balance in a single limb over the crossing of three lines marked on the floor, the first anteriorly, the second posterolateral, and the third posteromedial. Maintaining their hands on their hips, the test taker is asked to touch the tip of the foot that is out of contact with the ground as far as possible on all three lines marked on the ground. The examinee must maintain balance in only one member throughout the test. We then mark the distance reached on each line. Assessing the markings with the contralateral examination, we considered asymmetries equal to or greater than

Fig. 47.8 Maximal hop for distance test. Start position

Fig. 47.10 Maximal controlled leap. Start position

Fig. 47.9 Maximal hop for distance test. Final position

Fig. 47.11 Maximal controlled leap. Final position

Fig. 47.12 Single-legged drop-jump landing test, initial position

Fig. 47.13 Single-legged drop-jump landing test, final position

Fig. 47.14 Y-balance

Fig. 47.15 Y-balance

4 cm as a sign of neuromotor deficit [17] (Figs. 47.14, 47.15, and 47.16).

47.6.8 Modified T-Test

To perform this motor test, four cones (a, b, c, d) are used, arranged in a T shape with distances shown in Fig. 47.17. The test taker starts the examination on cone A and moves as fast as possible to the cone B, where he/she should touch the base of the cone with his/her right hand. Always looking forward and without crossing his/her legs, the patient moves laterally towards cone C on his/her left, touching the base of the cone with his/her left hand. In the next step, he/she must make a lateral displacement to cone D, touching the base of this cone with his/her right hand and returning as quickly as possible to cone B. After touching the base of cone B with his/her right hand, the patient must return to cone A always looking forward. If the test taker does not look forward or cross his/her legs during the activity, the test will not be considered valid and must be repeated [18] (Fig. 47.17).

Fig. 47.16 Y-balance

47.6.9 Ninety-Degree Medial Rotation Hop for Distance (MRH)

For the medial rotation hop for distance test, the patient is asked to stand in the tested lower limb with the medial side of the foot indicating the direction in which the body should be projected. The test taker is then asked to perform one single-leg jump, trying to reach the maximum distance. During the jump, the test taker must also rotate the trunk 90° in the medial direction and land with the foot facing forward. There may be a slight variation of up to 10° in the position of the foot with the indicated plane. If the variation is greater, the test should be repeated [19] (Figs. 47.18, 47.19, and 47.20).

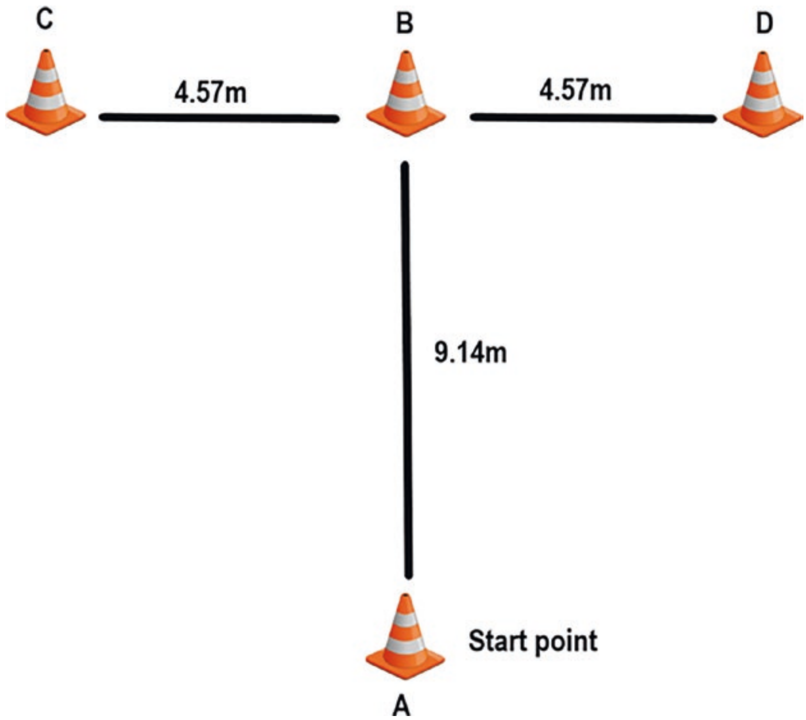

Fig. 47.17 Modified T-test cone arrangement

Fig. 47.18 90° medial rotation hop for distance (MRH). Sequence

Fig. 47.19 90° medial rotation hop for distance (MRH). Sequence

Fig. 47.20 90° medial rotation hop for distance (MRH). Sequence

47.7 Conclusion

The clinical tests for evaluation of motor function of the knee are complex and should be done by the examiner during the instructions prior to the test. The doctor should use the tests according to the patient's neuromotor ability and relating to the movements present during sports practice that is desired by the patient after complete recovery.

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