DIAGNOSTIC SYSTEM FOR FUNCTIONAL STUDIES IN PATIENTS WITH OSTEOARTHRITIS OF THE KNEE JOINT

Petya Subeva
South-West University "Neofit Rilski", Department of Kinesitherapy, Faculty of Public Health, Healthcare and Sports, Blagoevgrad, Bulgaria, petqsubevaa1995@abv.bg
Mariya Gramatikova
South-West University "Neofit Rilski", Department of Kinesitherapy, Faculty of Public Health, Healthcare and Sports, Blagoevgrad, Bulgaria, mari_gramatikova@swu.bg

Abstract: Osteoarthritis of the knee joint is one of the most common joint-degenerative diseases. Its frequency increases with age. It is caused by both internal and external risk factors. Osteoarthritis in the knee joint is typically identified through the observation of pathological changes, which may include damage to the articular cartilage, abnormal bone formation, reactive changes in the synovial membrane, and the presence of pathological synovial fluid. Degenerative changes in the joint progress gradually. Functional patient dysfunction also progresses and often leads to disability. The disease is diagnosed with clinical and X-ray examinations: magnetic resonance, bone scintigraphy, arthroscopy and others. In the future, markers of articular cartilage destruction products in body fluids will be the key to determining the time of onset of the disease, its progression and the progress of treatment. High hopes in the treatment of osteoarthritis of the knee joint are related to gene therapy (Kwiatkowski, Płomiński, 2004). Conservative treatment includes: specialized kinesitherapy programs, weight loss in combination with topical or oral non-steroidal anti-inflammatory drugs (Katz, Arant, Loeser, 2021). The aim of this study is to prepare a diagnostic system of modern methods for functional tests, to assess the condition of patients with osteoarthritis of the knee joint. The following methods of functional tests are considered: centimetry (measuring centimeter displacement of the lower limb circumference to monitor changes in swelling and muscle hypo/hypertrophy); goniometry (measuring the volume of movement in the knee joint in flexion and extension with a goniometer); pain assessment on a visual-analog scale (VAS from 0 to 10); manual muscle test – for muscle strength assessment; knee functional assessment questionnaire (Knee Society Knee Score); rotation test for edema testing; measurement of Q-angle (patellofemoral angle); knee flexion catheter test; eccentric step test (15cm ladder). The dysfunctions that are characteristic of osteoarthritis of the knee joint include pain, swelling, limited range of motion in the knee joint, myo-articular contractures, muscle imbalance, muscle hypotrophy, altered patellar femoral Q-angle, dynamic instability, impaired neuromuscular control, locomotive dysfunction (walking, climbing, and descending stairs), and others. The correct selection of functional tests is essential for the effective conduct of kinesitherapy to assess the available dysfunction as well as the progression of recovery. Functional studies can also serve as a corrective measure for the physiotherapy program, in cases where no improvement is observed in some of the evaluated indicators. A diagnostic system for functional tests has been prepared in patients with osteoarthritis of the knee joint. The diagnostic system provides objective information about the patient's current condition before, during and after kinesitherapy. It is an indicator of the correct selection of kinesitherapy methods, dosage, and the effectiveness of the procedures. The study examined various innovative functional tests for osteoarthritis of the knee joint. Each of the tests has its own methodology and specificity.
Keywords: gonarthrosis, osteoarthrosis, knee joint, functional studies, tests, methods

1. INTRODUCTION

Knee osteoarthritis (KO) is one of the most common progressive and degenerative diseases of the musculoskeletal system. The frequency increases with age. The development of the disease is caused by both internal and external risk factors. Osteoarthritis of the knee joint is most often characterized by changes, including damage to articular cartilage, abnormal bone formation, reactive changes in the synovial membrane, and pathological synovial fluid. It is known that in the development of the disease process, the main event is the reparative reaction of chondrocytes, which is due to an increase in the synthesis of the main types of collagen (type II, and lower grade types IX, VI, XI), as well as proteoglycans at the cellular level. The end result of the pathological process in osteoarthritis is an imbalance between the synthesis of articular cartilage and the damage leading to its loss. Any cause or process that causes the breakdown of cartilage affects the appearance and progression of osteoarthritis in the knee joint. The disease is diagnosed on the basis of clinical and X-ray examinations. Magnetic resonance imaging, bone scintigraphy, and arthroscopy are also important. In the future, markers of articular cartilage destruction products in body fluids will be the key to determining the time of onset of the disease, its progression, and the progress of treatment. High hopes in the treatment of osteoarthritis of the knee joint are related to gene therapy (Kwiatkowski,

Płomiński, 2004). Conservative treatment includes: specialized kinesitherapy, weight loss in combination with topical or oral non-steroidal anti-inflammatory drugs (NSAIDs). Intra-articular steroid injections provide short-term pain relief, and Duloxetine has shown efficacy. The use of opiates should be avoided. For patients with advanced symptoms and structural disabilities, surgical treatment is required (knee arthroplasty). There are still racial and ethnic differences in the use and results of joint replacement. (Katz, Arant, Loeser, 2021). Specialized exercises and kinesitherapy methods should be selected based on the individual patient's condition (Skou, Roos, 2019). Over the last 20 years, the options for intra-articular treatments have been limited to analgesics, glucocorticoids, hyaluronic acid, and a small number of unproven alternative therapies. Targeted biological drugs for inflammatory processes are utilized to treat rheumatoid arthritis, but they are not commonly used in the treatment of knee osteoarthritis. (Jones, Togashi, Wilson, Heckmann, Vangsness, 2019). The number of operations for total knee arthroplasty is expected to increase, and an effective conservative rehabilitation program is needed based on improving the range of motion. This program should start with knee replacement exercises, followed by flexion exercises and swelling reduction before beginning a muscle strengthening program. (Benner, Shelbourne, Bauman, Norris, Gray, 2019). For long-term effects, structured patient training on the disease, treatment options, self-control, maintaining motivation, and adhering to the kinesitherapy program are essential. (Skou, Roos, 2019).

2. MATERIALS AND METHODS

To conduct functional assessment and monitor the dynamics of recovery and correction of kinesiotherapy for an injured knee, it is essential to select an analytical test battery of functional indicators and studies that correspond to the dysfunction. (Gramatikova, 2021).

Purpose: The goal of this study is to create a diagnostic system using modern functional testing methods to evaluate the condition of patients who have knee joint osteoarthritis.

Research methodology: The methods utilized in this study to achieve the goal are: Analysis of Literary Sources (Deductive Method) and Expert Assessment. In order to evaluate the status of different aspects involved in the knee recovery process, the following methods have been incorporated after conducting a thorough analysis of literary sources and expert evaluation in the diagnostic system designed for functional assessment of patients diagnosed with knee joint osteoarthritis:

Centimetry is a technique utilized to measure the circumference of the lower limb. (Gramatikova, 2017). The test is conducted using a standard medical measuring device. The circumference of the knee is measured at the following locations: at the joint crease (Photo 1), 8 cm proximal to the patella to assess muscle hypotrophy for m. vastus medialis, 18 cm proximal to the patella to monitor m. rectus femoris, and through the most convex part of m. triceps surae. The laps are measured two or three times (depending on the number of days for kinesitherapy). The study was conducted at the beginning of kinesitherapy (on the 1st day) and after 10 days of daily kinesitherapy. The measurement is taken for both the damaged and the strong lower limb. In cases where both knee joints are damaged, the measurement is compared to the less affected knee. If there is swelling, it is indicated with a "+", and if there is muscular hypotension, it is indicated with a "-".

Ph. 1 – KJ Centimetry

Ph. 2 – Phlexia goniometry in KJ

Goniometry (angglometry) - study of the volume of movement in the knee joint, using a standard SFTR methodology (Dimitrova, Popov, 2006). The measurement is performed using a specialized goniometer (angle

meter), and the results are reported in degrees. Passive and active flexion (Photo 2) and passive and active extension are measured in the knee joint (KJ). It was studied twice at the start of kinesitherapy (on the 1st day) and after 10 days - daily administration of kinesitherapy.

Pain test (Koleva, Georgieva, 2016) uses a visual analog scale (Ph. 3) that includes a digital, color or picture image of an analog scale to assess pain. It is a 10 cm long line where "0" is no pain, and "10" is the strongest possible pain. The patient is assessing their pain intensity on a scale of 1 to 10. The measurement is recorded in centimeters after the patient indicates on the "spot" scale the level of pain they are currently experiencing. The result can be interpreted as follows:

- from 1 cm to 3 cm the pain is weak;
- from 3 cm to 6 cm – moderate;
- from 6 cm to 10 cm – strong.

The results were reported twice, once at the start of kinesitherapy (on the 1st day) and after 10 days - daily administration of kinesitherapy.

Ph. 3 – Visual analog pain scale

Manual muscle test (MMT) – used to establish muscle strength flexors and extensors (Ph. 4) in the knee joint (Bonev, Todorov, 1976) in 6 degrees:

Rating 5 N (normal) – normal. We evaluate a muscle that makes a characteristic movement of it in full range of motion against gravity and substantial manual resistance. Such a muscle (muscle group) has 100% normality.

Rating 4 G (good) – good. We evaluate a muscle that performs a characteristic movement in full range of motion against gravity and, on average, significant manual resistance. Such a muscle (muscle group) has 75% of the strength of a normal muscle.

Rating 3 F (fair) – satisfactory. We evaluate a muscle that makes a characteristic movement of it in full volume against gravity, but without applying resistance. Such a muscle (muscle group) has 50% of the strength of normal muscle.

Rating 2 P (voor) – weak. We evaluate a muscle that makes a characteristic movement for it in full volume with eliminated gravity. Such a muscle (muscle group) has 25% of the strength of normal muscle.

Rating 1 T (trace) – trace (tapping). We evaluate a muscle that exhibits a visible or palpable contraction when attempting to perform a characteristic movement. This type of muscle (muscle group) has only 10% of the strength of a normal muscle.

Rating 0 (nula) – zero. We evaluate a muscle that does not exhibit any visible or palpable contraction when attempting to perform a characteristic movement.

The results obtained do not always match the described degrees. In these cases, halves (pros and cons) are used, which are added to the degrees. This allows for a – accurate and accurate estimate. There are also several support assessments:

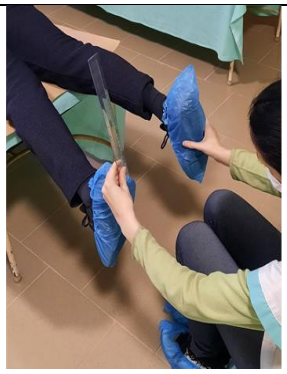
Rating 3 *" + "* - When a motion is performed against gravity with light resistance

Rating *3 " – "* - When a motion is performed against gravity but not in full volume

Rating 2 *" + "* - The movement can be against gravity using 50% of the volume. Beginning of antigravity.

Ph. 4 - MMT of m.quadrips femoris – grade 5, 4	*Ph. 5 – Diving test*
	

Knee functional knee assessment questionnaire (*Knee society knee score*) (Grueva, Popov, 2012).
The questionnaire includes: pain assessment from 0 to 50 points; knee movement volume – maximum – 25 points (5 º = 1 point); stability assessment (maximum displacement in a position) – ventrodorzally from 0 to 10 points, mediolaterally from 0 to 15 points; assessment of a flexion contracture from 2 to 15 points and an extensive deficit of up to 15 points; assessment of deformation in the front plane (valgus) from 0 to 3 m./ degree (other – 20 points). Total pain (if the number is negative, the result is taken as 0). Study of the walking function – from 0 to 50 points, stairs – from 0 to 50 points. Subtraction of the total so far – cane 5 tons, two canes – 10 tons, crutch or walker 20 tons.
Dent test (identification – test) Ph. 5 (for the examination of the presence of swelling in the KJ - The patient is in a occipital bed. Both limbs are tested. The knee is passively bent, taking into account the dent on the lateral side of the patellar tendon. In complete knee flexion, the dent must remain. The disappearance of it indicates swelling and results in a positive test. This test can prove the presence of even minimal swelling. Test is reported twice, once at the start of kinesitherapy (on the 1st day) and after 10 days - daily administration of kinesitherapy. (Grueva, Popov, 2012).
Patelofemoral Corner Measurement Test (Q – Knee Corner) Grueva, Popov, 2012 (. Q - The angle (quadriceps angle) is concluded between the quadriceps (mostly lig. patellae and m. rectus femoris). The measurement of the Q-angle can be performed through physical examination (Ph. 6) and X-ray, provided that the quadriceps are relaxed. When measuring the Q-angle, it should be equal to 0˚. Before measuring this angle, the researcher must ensure that the axis of the lower limb is perpendicular to the two spina iliaca anterior superior (SIAS). Next, a line is drawn with a pencil from the SIAS to the midpoint of the patella on the same side, and another line is drawn from the same point to the tibial tuberosity. The measurement is performed using a goniometer.
The center of the goniometer is placed on the center of the patella. The fixed arm should be directed towards the spina iliaca anterior superior, while the movable arm should be directed towards the tibial tuberosity. The results were reported in degrees twice once at the start of kinesitherapy (on the 1st day) and after 10 days - daily administration of kinesitherapy. The Q-angle is measured - both lower limbs.

		
Ph. 6 – Measurement of the palatefemoral Q angle	*Ph. 7 – Flexion contracture test*	*Ph. 8 - Eccentric step test*

Test for knee flexion contracture (Grueva, Popov, 2012) The patient is lying in bed with their lower legs positioned outside the edge of the couch. (The height of the heels is being compared (Ph. 7). A difference of 1 cm corresponds to approximately 1˚, depending on the length of the lower leg. The presence of edema can also cause the test to be positive.

A 20 cm line is used to perform the study. The difference in heel height between the legs is compared. The results were reported in centimeters twice once at the start of kinesitherapy (on the 1st day) and after 10 days - daily administration of kinesitherapy.

Eccentric step test (Grueva, Popov, 2012) - The patient is standing on a 15 cm high step. The hands are placed on the hips. The patient then descends using the injured limb first (thus testing the healthy limb first), followed by the opposite leg (testing for damage) (Ph. 8). The test is considered positive if it provokes pain.

3. DISCUSSION

The study examines various modern functional tests in gonarthrosis. Each of the tests has its own specific characteristics. Prior to conducting the research, it is necessary to prepare a declaration of informed consent, which must be completed by each of the individuals being examined. The necessary information regarding concurrent illnesses and current health, as well as any changes in symptoms or the appearance of new ones, is provided. After ten days of applying the kinesitherapy program, functional tests are readministered to determine the progress of the patient's recovery.

4. CONCLUSION

Functional tests in osteoarthritis of the knee joint give us objective information about the patient's current condition at the beginning and end of therapy. A selection of functional studies and tests prepared as a diagnostic system for functional evaluation and for monitoring the dynamics of knee complex recovery in patients with osteoarthritis of the knee joint has been made. The effectiveness of the applied kinesitherapeutic program is evaluated through a diagnostic system.

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