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PHYSIOTHERAPY IN POSTOPERATIVE RECOVERY THROUGH TOTAL ARTHROPLASTY OF SECONDARY COXARTHROSIS

Silviu Gabriel CIOROIU[1]

Abstract: *Total hip arthroplasty is a surgical intervention that replaces the affected joint with an artificial implant. This being recommended in case of damage to the targeted joint and the installation of acute pain.Currently, the procedure is most commonly performed in orthopedics, although results and patient satisfaction in the short or long term vary widely The purpose of the research is to restore the movement capacity of the lower limb following the operation through a good documentation of the condition and the postoperative effects on the functioning mechanism at the articular level and by finding the kinetotherapeutic methods and means that correspond to an effective recovery.*

Key words: *arthroplasty; secondary coxarthrosis; kinetic exercises; individualized recovery program.*

1. Introduction

Hip arthroplasty originated in Berlin in the late 19th century. The earliest documented attempt at femoral head replacement dates from 1891 when Themistocles Gluck used an ivory prosthesis fixed with screws and cement. Although this procedure was not as successful as expected, it has been shown that the human body is tolerant to a foreign body [10].

Philip Wiles in 1938 brought to London the notion of attaching the femoral head to a rod and thus developed the first concept of acetabular drilling from which the total hip arthroplasty was born [18].

The operation is still in continuous growth and development; among the new possibilities are articular surfaces made of materials with less friction, more resistant materials and minimally invasive techniques [8].

A study conducted in 2009 shows that, in the most industrialized countries, total hip arthroplasty has an incidence of more than 150 procedures per 100,000 inhabitants per year. In terms of artificial implants, called hip replacements, the number of cases is increasing by 25% between 2000 and 2009 and continues to increase due to the genetic factor of aging of the human body [12].

First of all, its history proves that, since

[1] Department of Physical education and special motor skills, *Transilvania* University of Braşov, Romania

the 19th century, the problems affecting hip joint and implicitly with these walking, received special attention as they were and will remain conditions that leave their mark in a negative way and unbalance everyday life.

Secondly, due to the chosen specialization and future career in this field, I have a desire to help people who are affected socially and/or at work due to deficiencies or degenerative diseases that prevent them from leading a normal life. Motricity is among the main capacities of the human body with which it helps to carry out other essential actions such as: feeding, personal hygiene, developing intelligence.

1.1. Anatomy of the coxo-femoral joint

The lower or pelvic limbs are attached to the infero-lateral parts of the trunk, the pelvic girdle entering the skeletal constitution of the pelvis. They are adapted to bipedal support and locomotion, which is why they have a solid skeleton, connected by strong joints, while also possessing well-developed muscle groups. In front of the trunk, it is limited by the inguinal fold interposed between the abdomen and the thigh (anteriorly), the genitofemoral groove that separates the thigh from the perineum (medially), the iliac crest and the interfemoral groove (posteriorly) [14].

Looking anatomically at the structure of the lower limb, we can state that it is formed by the bones of the pelvic girdle, which consists of two coxal bones and the bones of the lower limb itself. The lower limb is made up of three segments: the thigh skeleton, the calf skeleton and the foot skeleton [14].

The hip joint connects the femur to the coxal bone; femoral head entering the acetabular hole of the pelvic girdle. The joint is a diarthrosis and has the following structural components:

- Joint capsule;
- Joint cavity;
- Articular surfaces.

The main purpose of the coxofemoral joint is to support the weight of the body/trunk, while facilitating the transmission of driving force and load from the axial skeleton to the lower extremities, enabling mobility [9].

The hip (coxo-femoral) joint is a synovial joint of high mobility, triaxial, where movements are performed perpendicular to each other in several planes and around several axes [12].

Looking at the spatial orientation and location of the femoral head of the lower limb, three main axes are determined:

- The transverse axis with the help of which the movement of flexion and extension of the joint is carried out;
- The longitudinal axis that contributes to internal and external rotation;
- Sagittal axis with adduction and abduction movements of the segment in question.

Hip stability occurs due to several causes:

a. The form of the acetabular cavity in which the upper end of the femur articulates with the pelvis by means of this cavity;

b. Acetabular labrum – fibrocartilaginous collar that surrounds the acetabular; has the following functions:

-Transmission of the load;

-Maintaining negative pressure (“to close the vacuum”) to increase hip stability;

- Regulation of the hydrodynamic

properties of the synovial fluid [19].

The joint is surrounded by a fibrous capsule, which is attached to the edges of the labrum and the transverse ligament on the acetabular. It extends on the femur to attach anteriorly to the intratrochanteric line but does not extend as well posteriorly, being attached to the midpoint of the intratrochanteric ridge. There are circular fibers (internal) and longitudinal fibers (external). The orbicular area represents a set of internal circular fibers that form a collar around the neck of the femur and partially blend with the pubofemoral and ischiofemoral ligaments.

Ligaments that thicken the joint capsule:

- Bigelow's/ iliofemoral ligament (strongest) – is inverted V/Y shaped, arises from the anterior half of the anterior inferior iliac spine and the acetabular rim with divergent limbs attached to the superior and inferior ends of the intertrochanteric line;
- the pubofemoral ligament - from the iliopubic eminence and obturator ridge to the capsule in the lower part of the neck of the femur;
- Ischiofemoral ligament (weakest) – arises from the body of the ischium posteriorly and below the acetabular with fibers directed laterally and upwards to attach to the posterosuperior part of the base of the femoral neck, covering the posterior aspect of the hip joint [22].

1.2. Biomechanics of the lower limb

The biomechanics of the lower limb as a whole is complex. The pelvis, hip, thigh, knee, calf, ankle and foot act as a kinematic chain, especially in supporting the body, in the orthostatic position and walking, but also in other movements such as: sitting, kneeling, lifting on tiptoe, kicking when jumping, falling to the feet. Other movements such as: abduction and adduction, internal and external rotation, circumduction or kicking, pushing and even grabbing with the foot are segmental movements of the lower limb [6].

The importance of a healthy hip in any sporting activity is accentuated by the role it plays in movement and supporting the body. Understanding the biomechanics of the hip joint is vital in advancing a diagnosis and treatment for many pathological conditions. The principles of biomechanics provide valuable insight into understanding the mechanism of a condition [2].

The pelvic girdle and thigh muscles can perform the following thigh movements:

- thigh flexion: psoasiliacus, quadriceps and tailor;
- extension of the thigh: gluteus maximus, semimembranosus;
- thigh abduction: femoral square, piriformis, gluteus minimus, gluteus medius, tailor and tensor fascia lata;
- adduction of the thigh: pectineus, adductors and gracile;
- external rotation: psoasiliacus, internal and external obturator, quadratus femoris, pyramidalis, gluteus maximus, tailor, pectineus and adductors;
- internal rotation: tensor fascia lata and gluteus minimus [12].

1.3. Pathology

The localization of degenerative rheumatism at the level of the hip joint is called coxarthrosis or coxofemoral arthrosis [13].

Total hip arthroplasty (THR) is a surgical procedure that involves surgically removing the hip joint (cartilage and

bone), replacing the femoral head and acetabular surface with artificial components, made of metal alloys, and placing high-performance load-bearing surfaces between the metal parts [20].

Hip arthroplasty is necessary if the joint suffers irreversible damage caused by:

-osteoarthritis / coxarthrosis - degenerative disease of the joints that can cause damage to the articular cartilage and the adjacent bone at the hip level;

-rheumatoid arthritis – causes inflammation of the synovial membrane of the joint;

-traumatic arthritis – caused by an injury [25].

In 45% of cases, coxarthrosis is primitive, having no detectable cause. Secondary coxarthrosis can have various causes:

-congenital anomalies of the hip: subluxation and congenital coxofemoral dysplasia (the most common), acetabular protrusion, coxa plana, etc.;

- aseptic osteonecrosis of the femoral head;

-changes in the angle of inclination (coxa vara or coxa vaga);

- older coccyx [13].

The most common symptoms of coxarthrosis are:

- Joint stiffness;

- Pain, edema and/or tenderness in the hip joint;

- Joint pains;

-Inability to move the hip to perform routine activities [23].

1.4. Diagnosis and treatment

The diagnosis of patients requiring hip replacement surgery is based on symptoms of advanced coxofemoral osteoarthritis. This aspect highlights a limitation of flexion motion below 70°, high percentage of 50% loss of motion of internal and external rotation even in the elderly [5].

All these clarifications of the factors can be evaluated by an orthopedic specialist, as a parallel to the evaluation from the point of view of the physical examination, as well as the radiological examination.

Pain scale – tracks the level of chronic and progressive pain. These are also associated with rheumatic diseases.

Patients with hip arthritis will report that if they sit for an extended period of time, when they stand up to walk, the hip feels dislocated or painful for the first few steps; this feeling usually passes quickly after a few minutes of walking.

- Physical examination – the most important aspect of the physical examination in patients with hip disease is to assess their gait pattern. The region should then be palpated to identify tender focal areas such as over the greater trochanter, the sciatic nerve, or the anterior hip capsule. The degrees of hip motion should then be determined.

- Radiological examination – radiography of the hip is the most useful study in the evaluation of joint pathology. Standard anteroposterior radiography (AP) and computed tomography (CT) can be used in the discovery of non-traumatic pathologies of the hip, their assessment being very easy [10].

The goals of treatment are to relieve pain, preserve joint function, and prepare for surgery. A 3-4 week course of NSAIDs and mild restrictions on weight-bearing activities are the treatments of choice for early-stage disease. Hip replacement surgery or total hip arthroplasty is the treatment of choice for action in an advanced stadium [1].

2. Methods and Means of Recovery of Prosthetic Secondary Coxarthrosis

Kinetology or kinetotherapy is a form of movement therapy, which through static or dynamic exercise programs has the following goals: restoring diminished functions, achieving compensatory mechanisms in situations of functional readaptation.

Physiotherapy aims at recovery totally lost by using therapeutic means, with the goal of improving the patient's life, to create motor independence, as well to improve the ability to self service.

General treatment goals kinetotherapeutic are the following:

- Relaxation;
- Correcting posture and body alignment;
- Increasing joint mobility;
- Increasing muscle strength;
- Increasing muscle resistance;
- Re-education of coordination and balance;
- Exercise training;
- Respiratory re-education;
- Re-education of sensitivity [3].

2.1. Transcutaneous electrical stimulation nervous system (TENS)

TENS is a method of pain relief that involves the use of a mild electric current. Electrical impulses can reduce pain signals that travel to the spinal cord and brain, which can help relieve pain and relax muscles. They can also stimulate the production of endorphins, which are the body's natural pain relievers [25].

TENS is the application of electric current through electrodes placed on the skin. It can be applied with varying frequencies from low (<10 Hz) to high (> 50 Hz). Intensity can also be varied from sensory to motor intensity. Sensory intensity is when the patient feels a strong but comfortable sensation without motor contraction [4].

TENS is one of the most commonly used methods of pain management after hip and knee replacement. Pain management is a significant factor in post-replacement rehabilitation, as pain relief is usually the reason a person chooses this treatment path in the first place [17].

2.2. Low frequency laser therapy

The term "laser" is an acronym that represents: Light amplification by stimulated the emission of radiation, being an optical device that generates a bright beam.

This device by amplifying the light, makes a radiation stimulated emission.

The procedure of low laser level therapy (LLLT) is often used in kinetotherapeutic practice. This procedure offers the possibility to treat different musculoskeletal disorders. It offers a strong therapeutic effect, relieving muscle or joint pain.

In addition to using the laser procedure, other specific methods can be used:

- Techniques to reduce inflammation;
- Administration of analgesics;
- Tissue regeneration procedure [19].

Low frequency laser therapy proves to be effective in pain control and tissue repair after surgery. It can also be used as

a physical modality for postoperative joint arthroplasty due to its safety for patients with metal implants with or without bone cement [7].

2.3. Thermotherapy

Thermotherapy uses as a factor therapeutic temperature with values included between 40-80°C with different media, water, air heated, sand, sunbathing, mud.

Steam bath or moist heat can be general or partial. The general bathroom is made in a special room or closet. The patient is instructed to sit on the stool with the body in the special cabinet, leaving only the head outside. Cold compresses are applied to the forehead, around the neck and chest. At the beginning the temperature is between 38-40°C, gradually the temperature increases up to 50-55°C. The patient can be hydrated with tea, water to increase sweating. The steam bath is applied for a maximum period of 30 minutes depending on the patient and purpose, as follows:

- short duration 3-5 minutes are used ca preparatory heating procedures;
-duration 10-15 minutes used in the case circulation disorders;
- after 15 minutes it is administered to those with obesity, diabetes, trauma posttraumatic and rheumatic.

Sunbathing is exposure partial or total body exposure to direct sunlight. Attention, the body must be lubricated with special solutions or oils. Sunbathing begins on the first day with 5-10 minutes on each side of the body, after which 10-15 minutes retreat to the shade. This is repeated 3 times in the time interval from 7-11 in the morning and from 16.30-19 in the evening. Sunbathing is indicated in all diseases except T.B.C., HTA, ischemic heart disease or cancer.

Hyperthermic mud baths. The layer of 7-10 mm sludge at a temperature of 47° C for 20-30 minutes. The thermal gradient is high, the conductivity is low, the heat transfer to the skin is slow. The caloric shock is intense, which leads to the appearance of the thermocirculatory reflex.

Anointing with mud (anointing) is a naturist cure used on the coast and uses mud processed from coastal lakes. The mud is applied to the skin and exposed to the sun in an upright position. Keep the mud on the skin until it changes color from black to gray, about 30 minutes to an hour, then remove the mud by showering or bathing in the sea, followed by swimming, running or moving on the spot. Muds are used in rheumatic, degenerative, pre- and post-operative orthopedic conditions, sequelae as well as chronic and sub-acute gynecological conditions (including sterility), peripheral motor neuron injuries, hypofunctional endocrine diseases, perivisceritis, dermatological conditions [11].

3. Material and Methods

The research subject was initially diagnosed with a secondary coxarthrosis in the left hip acquired as a result of trauma in adolescence and underwent surgery with the final discharge diagnosis of left secondary coxarthrosis with total hip arthroplasty.

The case study was carried out at the subject's home and took place over a period of approximately 3 months.

In the recovery program, materials were used such as: ball with spikes, elastic band, training ladder, foam ball, bosu ball, 1kg sandbags, whistle, chair; installations such as: trellis, parallel bars, recovery ladder and also the machines used in electrotherapy.

Evaluation tests of the research subject

a. Joint balance – "performed on the coxo-femoral joint;

b. muscle balance - "represents a system of manual examination techniques for evaluating the face of each muscle or muscle group.

Muscle Balance Rating:

Strength 0: the muscle does not contract;

Force 1: considered outlined if it has the following characteristics: sensing the contraction by palpating the muscle, the tendon; observing a tremor; the inability to mobilize the segment; only the superficial, palpable muscles can be assessed;

Strength 2: considered mediocre if the muscle mobilizes the segment by eliminating gravity;

Force 3: considered acceptable if the segment is mobilized against gravity, without counter-resistance and if it indicates the minimum functional capacity for maintenance;

Strength 4: considered good if the muscle shows the ability to completely move the segment against gravity, against an average resistance;

Strength 5: it is normal if the muscle can perform the movement in its full amplitude against an external force [2].

The Stinchfield test, a painful response caused by an increased applied force in the hip joint, confirms the existence of intra-articular pathologies.

The position from which the test is performed is supine with the lower limbs extended. The patient is asked to actively raise the outstretched limb into 20-30° flexion while the physical therapist applies light resistance. The result is negative if the patient does not feel any pain in the coxo-femoral joint and can use all his strength in lifting the limb. The positive answer is given by feeling a pain in the hip, buttock or thigh.

The “Trendelenburg sign” test can be used to evaluate this pathology. This is a simple test that provides a quick assessment and shows the level as a functional diagnosis.

The patient will be asked to stand on one leg for 30 seconds without leaning to one side. The therapist observes the patient to see if the pelvis remains level during the single leg stance.

As a description of the use of the "Trendelenburg sign" test, it is positive if, at the time of distribution of the unilateral general center of mass, the pelvis will be positioned on the affected side. This aspect is also identified at the time of the normal movement of the individual's organism as: a compensation that takes place through the lateral bending movement of the trunk towards the anatomical part of the body involved in the movement phase on the affected extremity. A positive result indicates an atrophy of the hip abductor muscles [19].

3.2. Individualized recovery program

The recovery plan is staggered over 3 months (12 weeks), in the first three weeks 6 sessions/week (excluding Sunday) were performed at the patient's home with a duration of 60 minutes/session. Afterwards, in the remaining weeks continue with only 3 physical therapy sessions/week on Mondays, Wednesdays and Fridays.

Recovery program

Phase I (week 1-3) – combating pain; increasing the mobility and stability of the affected coxo-femoral joint

To combat post-operative pain, the patient performs electrotherapy sessions (ultrasound, T.E.N.S, diadynamic current and Tecar therapy) according to the recommendations of the specialist doctor, relaxation massage at the end of each session and kinetic bands are applied to stimulate blood flow in the affected area and for lymphatic drainage.

Phase II (week 4-7) – increase in muscle tone; re-education of walking

In this stage, the duration of the electrotherapy sessions is reduced and the intensity of the exercises is increased.

Phase III (week 8 – 12) – developing muscle strength and regaining functional independence.

On Mondays, physiotherapy sessions are held in the shallow pool.

4. Results and Discussions

The articular and muscular balances of the coxo-femoral joint were evaluated through initial, intermediate and final tests.

The results recorded after rigorous examination of the subject during the recovery program marked a starting point for the degree of mobility at the coxofemoral joint level of 30° in flexion and 5° in extension at the initial testing. After a relatively short period of application of the recovery program, an improvement is observed with an increase of 40° in flexion and only 3° in extension. Thus, the intermediate testing values reach 70° for flexion and 8° for extension. At the final test, 95° in flexion is obtained, which denotes a progress of 65° in flexion, and a progress of 9° in extension, reaching the value of 14°.

Regarding the mobility in the abduction and adduction movement, positive increases are observed between the three tests. The abduction movement at baseline shows us a value of 10°, with a progression of 10° to the intermediate assessment, reaching 20°. After completing the specific exercises, at the final testing there was a 20° progress from the intermediate to the final testing, recording a value of 40°, being an optimal result.

The adduction movement has an initial value of 5°, increasing by 5° at the intermediate test, obtaining a value of 10°. At the end of the program, the value reaches 18°, being a considerable progress of 13° in the coxo-femoral joint.

This progress indicates to us that the recovery program applied was effective, figure 1, table 1.

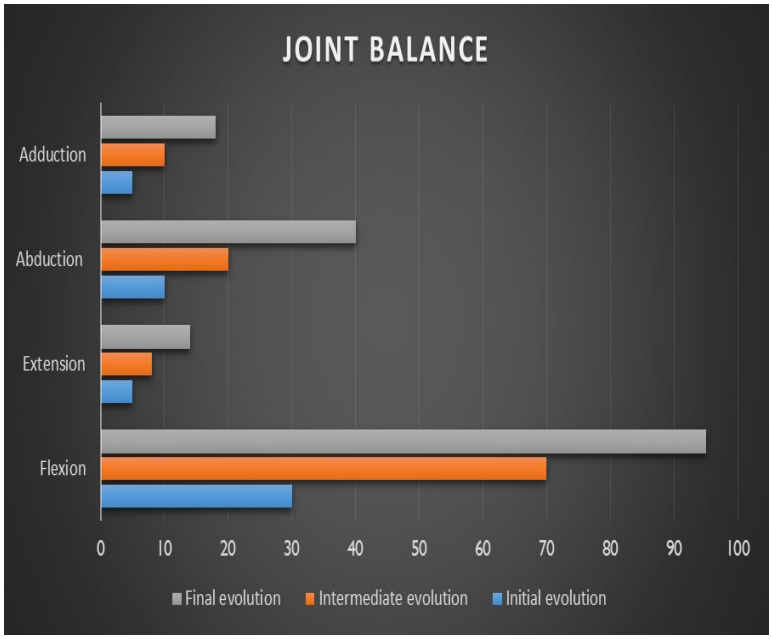

Fig. 1. *Representation of joint balance values.*

Evolution of joint balance Table 1

Movement	Initial evolution	Intermediate evolution	Final evoluțion
Flexion	30°	70°	95°
Extension	5°	8°	14°
Abduction	10°	20°	40°
Adduction	5°	10°	18°

Following the application of the three tests for the assessment of muscle balance during the research, the following values were obtained:

At the initial testing – for all categories of movements: flexion, extension, abduction and adduction, the value of F2 was recorded. The F2 value is a weak value of 25%, which represents the force of all muscle groups to mobilize the segment involved in the research, but with the elimination of gravity. This aspect required support of the segment by the physiotherapist.

In the intermediate testing – in the flexion movement and the abduction movement, F4 was recorded, which shows a good progress, with a percentage of 75%, and in the extension movement and the adduction movement, the value is F3, being an acceptable progress of 50%.

At the final testing – the value of F4 was obtained for the extension and adduction movement with an increase from the initial F2 to the final F4, from a percentage of 25%, obtaining 75%. This aspect shows us good strength with full segment mobilization against medium resistance. In

flexion and abduction movements, the final value of F5 is recorded.

This is a normal value, with a percentage of 100%, and indicates the ability to perform full range motion against an external force equal to the value of the normal force. These values registered in considerable progress from 25% to 100% underline the fact that the applied kinetic program had optimal performance, figure 2, table 2.

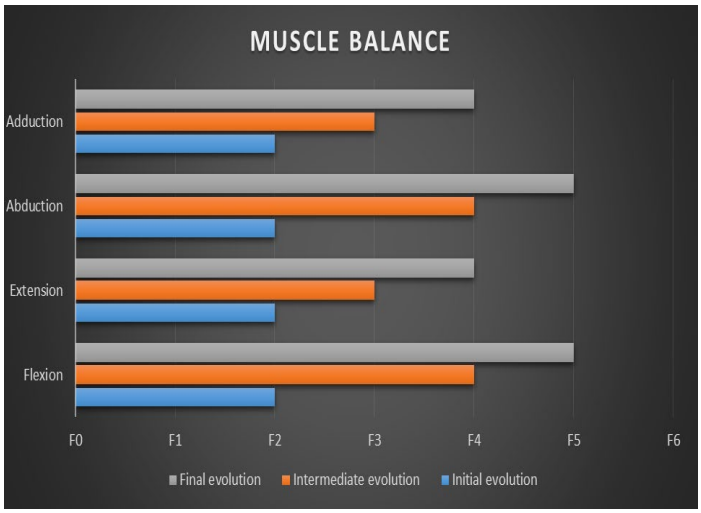

Fig. 2. *Representation of muscle balance values.*

Evolution of joint balance Table 2

Movement	Initial evolution	Intermediate evolution	Final evolution
Flexion	F2	F4	F5
Extension	F2	F3	F4
Abduction	F2	F4	F5
Adduction	F2	F3	F4

5. Conclusions

A correct recovery plan developed based on the patient's general health status and an early intervention can stop the occurrence of complications that may occur at the level of the affected joint and, of course, are essential in restoring the total functionality of the segment.

During the 3 months of recovery, all the specific objectives of physical therapy were achieved (from easy to difficult, from simple to complex) which led to the patient's reintegration into social life and the re-education of one of the most important components - walking.

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