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Recovery after patella fracture - case report

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Abstract

Introduction:

The aim of this study is to present the rehabilitation process of a patient after a comminuted patellar fracture, with particular emphasis on the physiotherapeutic methods applied and their impact on the recovery of knee joint function. The study is a case report and includes an analysis of successive stages of rehabilitation, including pain and edema reduction, restoration of range of motion, muscle strengthening, and functional re-education.

The results obtained indicate that an individually tailored physiotherapy program plays a key role in the treatment process and enables the patient's gradual return to sports activity.

Materials and methods:

Comprehensive review of the literature available on PubMed, Google Scholar, Polona, online collections of journals from medical universities, database by searching the keywords "patella fracture", "rehabilitation after fracture", "patella injury".

Conclusion:

This case demonstrates the complexity of rehabilitation. When carried out in the manner described below, it ensures a rapid return of the patient to pre-injury functionality, which is the primary goal in patient care. By combining different physiotherapeutic methods, we can achieve

satisfactory results in restoring functionality quickly. Collaboration among various specialists is crucial in working towards this shared goal.

Key words: patella fracture, rehabilitation after fracture, patella injury, physiotherapy,

1. Introduction:

The patella is the largest sesamoid bone in the human body and plays a key role in the biomechanics of the knee joint by increasing the force of the quadriceps femoris muscle and stabilizing the movement path during knee extension. Patellar fractures constitute a relatively small percentage of all fractures; however, their functional consequences can be significant, especially in young and physically active individuals [1].

Physiotherapy is an integral component of the treatment of patients after a patellar fracture. Its aim is not only to restore the full range of motion in the knee joint but also to rebuild muscle strength, improve stability and coordination, and prepare the patient to return to daily activities. Proper rehabilitation planning, taking into account the stage of tissue healing and the individual needs of the patient, is crucial for the final treatment outcome.

2. Etiology and mechanism of patella fracture

Patella injuries account for 1% of all musculoskeletal injuries. They occur most often between the ages of 20 and 50, with a predominance in males. They may result from direct impact on the joint, in the event of a blow or fall, causing a comminuted or longitudinal fracture (of the distal or lateral edges), as well as open fractures causing damage to the joint surface. Indirect

injuries, on the other hand, result in transverse fractures and damage to the knee extensor apparatus. A hematoma forms inside the knee joint, and injuries to the articular cartilage and damage to the femoral condyles occur [5].

3. Types and symptoms of patella fractures

There are three types of patella fractures: transverse (mainly as a result of indirect fracture). These account for approximately 50–80% of patella fractures. This involves a fracture in the middle of the patella or 1/3 of the lower edge, a marginal fracture, i.e., detachment of the medial or lateral edge of the patella, as well as a vertical fracture, i.e., longitudinal fracture of the patella [2].

The initial symptom of a patella fracture is increasing pain, as well as difficulty in actively flexing and extending the knee joint. This applies to situations where the knee extensor apparatus is damaged. A fractured patella is deformed. There is also visible widening of the knee joint contours caused by hematoma [2].

4. Standards for the treatment of patella fractures

The diagnosis is based on medical history, physical examination, and X-ray imaging of the joint. although computed tomography (CT) is increasingly recognized for its value in assessing complex fractures. Non-surgical treatment is used in cases of non-displaced comminuted and transverse fractures with the extensor apparatus intact. Immobilization in the form of a plaster cast is applied to the extended knee joint for approximately 6 weeks. However, it should be remembered that patella fractures without displacement account for a low percentage of injuries [2].

Surgical treatment is recommended for patella fractures with simultaneous damage to the knee extensor apparatus, or in the case of open fractures. It is necessary to reposition the resulting fragments and stabilize them. Surgical fixation depending on the fracture type and patient factors may include tension band wiring, screw fixation, or plate osteosynthesis [1]. Kirchner

wires reinforced with a Weber strap are used to fix the patella fracture. Cortical screws can also be used to increase the strength of the fixation. Surgical treatment using the Gruca method is also effective. It involves fixation of the fractured patella using a steel wire. This method does not require immobilization of the limb, thus allowing for earlier initiation of isometric exercises and mobilization of the patella. This allows for rapid verticalization of the patient and significantly improves treatment outcomes [2].

Patellectomy total or partial may be considered in cases of comminuted fractures or when previous fixation has failed as atypically as a salvage procedure. Total patellectomy is associated with an approximately 50% reduction in quadriceps strength [23].

5. Standards for patella fracture rehabilitation

In most cases, rehabilitation of bone fractures is based mainly on the use of physical treatments. These belong to a group of treatments that use naturally occurring physical factors. This is a common form of treatment for bone fractures, both during and after the removal of a plaster cast.

Treatments that have a positive effect on accelerating bone healing include magnetic fields, laser therapy, electrostimulation, and ultrasound.

The magnetic field affects the collagen in the bone tissue. The electric currents induced during the action of the magnetic field affect the collagen on the basis of the piezoelectric phenomenon, causing its mechanical deformation. This has a positive effect on the formation of callus, thanks to which bone healing is more effective [6].

Laser therapy improves bone healing, as observed in studies conducted under a microscope. The laser caused faster vascularization and callus formation at the fracture site [6].

Electrostimulation with direct current contributes to faster bone growth. Research on this topic is not fully understood, but it has been found that direct current reduces oxygen tension, and a decrease in pH has been observed at the cathode. These changes contribute to the faster formation of new bone tissue. There is also evidence of faster production of proteoglycans and collagen [7].

According to scientific research, ultrasound causes upregulation of signaling pathways in osteoblasts. Ultrasound stimulation signals the formation of new blood vessels and the differentiation of bone cells [7].

As part of rehabilitation, exercises aimed at strengthening the muscles in the area of the fracture are recommended. Usually, in the initial stage, these are weight-bearing exercises, weight-bearing exercises with resistance, free exercises, and finally active exercises with resistance [8].

6. Case report

The case description concerns a 16-year-old goalkeeper who suffered a knee joint injury.
The incident took place during a soccer match. When the player attempted to slide tackle an opponent, a player from the opposing team struck the inside of the goalkeeper's knee with his knee. The goalkeeper's right knee shifted laterally by several centimeters. The first symptoms appeared when he tried to move his lower limb. The limb was immobilized, and after a few minutes, pain appeared. The player was immediately transported to a children's hospital.
After an X-ray was taken, it turned out that the patella was a comminuted fracture. Internal fixation of the patella with a Kirschner wire was performed. The operation went without complications. Immediately after the operation, the patient was fitted with a plaster cast.

The patient was mobilized on the first day after the operation. During his stay in the hospital, while wearing the plaster cast, the patient was advised to perform flexion and extension movements in the hip joint of the operated limb. The patient was discharged from the hospital after 3 days. According to the doctor's recommendations, the leg was to be gradually loaded only after two weeks, when the plaster cast was removed, while knee flexion and extension movements were to be introduced in the fourth week. Before leaving the hospital, the patient was provided with crutches and educated on the correct way to walk while relieving weight from the operated limb. He received a referral to a physiotherapist. After the patient returned home, his rehabilitation continued.

The patient began rehabilitation after about two weeks. After conducting an interview and examination, it was found that the patient had significant limited mobility in the knee joint. The most limited movement was flexion, during which pain occurred. In addition, deterioration in the stability of the operated knee joint was noted. This is associated with reduced strength of

the quadriceps muscle, which scored 2.5 in the Lovett test. The patient developed an incorrect gait pattern, sitting down and standing up cautiously, putting little weight on the operated limb. The main goal of rehabilitation was to strengthen muscle strength and return to pre-injury fitness as quickly as possible.

As part of physical therapy, the patient underwent 10 treatments using a magnetic field and laser. In addition, manual therapy was performed, as well as weight-bearing and general fitness exercises.

After rehabilitation, the patient returned to full fitness and was able to play soccer again.

After 10 months, the orthopedist removed the metal fusion elements. The operation went smoothly, and the patient left the hospital after 2 days. During the first week, the patient experienced pain in the knee joint without any limitation of mobility. According to the doctor's recommendations, the patient should strengthen the medial part of the quadriceps muscle to prevent lateral displacement of the patella during knee flexion.

7. Hospital rehabilitation

A patient who has undergone surgery to repair a broken bone stays in hospital for an average of 3–6 days if the procedure has been completed without complications. A drain is inserted to prevent blood from accumulating inside the joint. The first 24 hours after surgery are mainly devoted to the body's regeneration, and the patient remains in bed. The lower limb, whose patella has been fused, is positioned several centimeters higher so that blood can circulate freely.

In the following days, the patient's condition improves. Initially, these are bedside exercises, which mainly include synergistic, isometric, and cardiorespiratory exercises. These exercises are recommended throughout the entire rehabilitation period [8].

Synergistic exercises are exercises based on the coordinated movement of different muscle groups in order to strengthen the performance of a basic movement. The movement results from the simultaneous work of the agonist muscles, which are directly responsible for it, and the antagonist muscles, which are relaxed at the same time. In addition, muscle synergy involves variable tension of the agonist muscles depending on the amount of resistance. These exercises do not strengthen the muscles, but only inhibit their atrophy in situations of immobilization, e.g., by a plaster cast [9].

There are two main types of synergies: absolute and relative. Absolute synergies are innate movements that occur in every human being. An example of such synergy is the tension of the rectus abdominis muscle when bending the head while lying on your back. Relative synergisms are acquired synergisms that vary from person to person. These differences mean that when a given muscle group is activated, there may be differences in tension in distant muscle groups. An example of relative synergism is the tension of the gluteus maximus muscle during knee flexion. Synergistic exercises should be performed in a full range of motion against submaximal resistance. The number of repetitions should be adjusted to the patient, leading to muscle fatigue [9].

In patients after patella fracture, synergistic exercises for the quadriceps femoris muscle are recommended. Examples of such synergy are adduction and abduction movements in the hip joint with resistance, and also the flexion and extension in the ankle joint, these exercises apply to the limb on the side of the muscle to be activated [9].

Isometric exercises are recommended to strengthen the patient's muscle strength. These are exercises based on muscle tension, without changing the length of the muscle. The muscle contraction should last 6–10 seconds and be repeated 10 times, in 10 sets per day. The contraction strength should be above 70% of the patient's maximum capacity. These exercises do not generate movement in the joint, so they can be performed immediately after surgery. In addition, by working the muscle pump, they improve blood flow, thereby reducing swelling [10].

In patients with a patella fracture, due to immobilization in a plaster cast, it is best to use isometric exercises for the triceps surae muscle by resting the feet on a bed board and pressing it without lifting the heels, for the quadriceps muscle of the thigh by raising the limb several centimeters above the ground while lying on your front, and for the gluteal muscles by clenching the buttocks [11].

8. Home rehabilitation

The primary goal of patient rehabilitation is to return to full fitness. This can be achieved by increasing the mobility of the knee joint, developing adequate joint stabilization, and reducing

pain. The process of recovery after a bone fracture can be divided into three stages, which differ over the course of several weeks.

In the first to third week after surgery, measures are taken to reduce pain and inflammation and to accelerate the bone healing process. Magnetic fields and laser therapy may be used. During this period, synergistic and isometric exercises are mainly used. They are designed to increase the muscle strength of the limb in order to improve knee stability and prevent muscle mass loss.

In weeks 3–6, when the cast has been removed, self-assisted and free exercises can be started, with a gradual increase in the load on the limb. In addition, the patella should be mobilized in all directions to stimulate the receptors and relax the fascia. The physical therapy treatments performed in the first stage are continued.

In weeks 6–8, transverse massage is performed to improve blood circulation in the tissues and make them more elastic. Increasing the strength of the quadriceps muscle is possible thanks to the introduction of exercises on a dynamometric platform. The exercises should be performed in a full range of motion, even after applying load [12].

Weeks 1–3:

An electromagnetic field reduces the time of bone fusion. In addition, it regulates the production of proteoglycans and collagen, increasing the saturation of bone tissue with these substances. The most effective in treating bone healing is a variable field, which includes a pulsed electromagnetic field (PEMF) [13,14]. A pulsed field with a frequency of 50 Hz and an intensity of 1.8 mT, as well as a rectangular pulse shape, most effectively accelerates the fusion process (calcium uptake increases) [15]. The magnetic field can be applied immediately after applying a cast, as it passes through all structures deep into the tissues [16].

Low-level laser therapy is also used to accelerate bone healing. It stimulates collagen and protein production and osteoblast synthesis. Studies conducted in 2008 show that after 5 weeks of LLLT therapy, bone density in the study group was twice as high as in the control group [17]. The recommended dose is 6–12 J/cm², but it must not exceed 200 J [18].

Weeks 3–6:

Self-assisted exercises involve performing a movement with the healthy limb that simultaneously assists the movement of the other limb. These exercises are designed to increase

the range of motion in the joint and prepare the patient for free exercises. In order to improve flexion in the knee joint, the patient lies face down in the UGUL, with the leg of the healthy limb bent, the cuffs are placed on 1/3 of the shin, one end of the cord is connected to the cuff of the exercised limb, and the other to the cuff of the healthy limb. The cord runs through a pulley suspended above the patient's head. When the healthy limb is extended, the operated limb bends [11].

Active exercises, initially performed with weight relief, are designed to prevent muscle atrophy, increase range of motion, and thus prevent contractures. They consist of active movement of the limb while relieving it of weight. It is then recommended that the patient begin free active exercises, which are performed by overcoming only the weight of the exercised body part. In order to increase muscle strength, active exercises with weights are used. The number of repetitions and the weight are determined individually for each patient [11].

Manual therapy can be implemented after the plaster cast has been removed. In order to achieve the full effect of the therapy, a variety of techniques are used. Initially, when the movement of the knee joint is still limited, patella mobilization can be used. In the first period of rehabilitation, mobilizations are performed on the straightened joint, then on the bent joint, as well as mobilization with movement developed by Mulligan. The patient can perform self-mobilization at home by gently moving the patella in all directions. Fascial techniques can be used to remove restrictions in the joint, achieving tissue relaxation [19].

In 6–8 weeks it is worth introducing exercises on a dynamometric platform. A variety of exercises performed on the platform, combined with static and dynamic exercises, contribute to improving therapy results by improving neuromuscular control. In a study conducted on 120 patients after knee arthroscopy (with microfractures of the articular cartilage), 60 of whom underwent rehabilitation on a dynamometric platform, it was shown that after 3 months of rehabilitation, muscle strength in the Lovett test was greater in patients who additionally exercised on the platform than in patients who only performed isometric and dynamic exercises of the muscles surrounding the knee joint [20].

After removal of the metal fixation, low-intensity pulsed ultrasound (LIPUS) is recommended. It is a non-invasive and safe method of treating fractures. The use of LIPUS causes tissue regeneration in acute and subacute conditions through the production of osteocalcin and organic

phosphatase [13]. Clinical studies show that bone healing time after the use of low-intensity ultrasound is reduced by up to 12 months [21].

Russian electrostimulation is used to increase the strength of the quadriceps muscle, in particular the medial head, to prevent lateral displacement of the patella. Studies have shown that both ESR and isometric exercises increase muscle mass and strength. The carrier wave in the analysis was 2500 Hz, 50 pulses per second, sawtooth wave, contraction time 15 seconds, pause time 15 seconds. The authors of the study suggest that ESR should be implemented into therapy as early as possible in order to achieve faster therapeutic effects [22].

9. Summary

A patient with a patella fracture requires long-term rehabilitation. The patient's recovery process can be divided into two stages.
The first stage involves measures to reduce pain, swelling, and inflammation. The next stage focuses on restoring the range of motion and muscle strength of the operated limb to its pre-injury state. Throughout the rehabilitation process, it is important to remember about treatments that stimulate bone tissue to heal. This is a long-term process, which is why these treatments are recommended throughout the entire rehabilitation process.

The treatments presented in this paper are in line with the latest reports on the treatment of fractures. Rehabilitation carried out in the manner described above guarantees a quick return of the patient to their pre-injury fitness, which is the primary goal in the treatment of patients.

10. Disclosure

Supplementary Materials

Not applicable

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