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Knee arthroplasty in the elderly

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Abstract

Background: One of the many problems related to geriatric patients are degenerative changes in joints. In this article authors discuss about the knee joint endoprosthesis. During preparations of this publishment special attention was paid to the following aspects: role and the meaning of preventing actions, explanation the clue and main goal of the surgery intervention, and it's simplified course. Subsequently there are short description of the knee joint with its most relevant to the fallowing subject structures. Furthermore the quantity of respective surgical procedure was given to approximate the scale of subject. Next paragraphs

explaining why endoprothesis is the best way for dealing with this kind of problems, and the significance of the physiotherapist in whole process both before, and after surgery.

Materials and methods: Analysis of available literature and articles in PubMed, ResearchGate and other scientific platforms related to discussed subject, using words: geriatrics, endoprothesis, knee arthroplasty, knee joint.

Results: Gonarthrosis is a significant social problem. Endoprosthesis plastic surgery is performed on those patients who struggle badly in activities of daily living because of advanced articulations disorders. The main diagnoses underlying the primary knee replacement were primary bilateral gonarthrosis and other primary gonarthrosis accounted. The analysis of sources devoted to these issues includes people after 65 years old (mostly women) which occurs a low level of physical activity, the burden of metabolic disease such as diabetes (type 2). Authors demonstrated a correlation between excessive body weight, and insufficient production of synovial fluid, it's damage and in the final phase lost which is a direct reason for pain. The following thesis was proven based on the source material: thanks to arthroplasty the patients quality of life as improved by around 90 percent. When the physiotherapist is involved in the whole process, both in the pre- and post-surgery phase it is possible to obtain much better therapeutic effects.

Conclusions: Knee arthroplasty can help restore independence to patients in their daily activities. The introduction of artificial foreign bodies into the pond to replace the damaged leads to an improvement in the quality of life of sick patients. The introduction of intensive rehabilitation, patient education and pharmacological treatment after arthroplasty allows for reduction of pain and faster recovery. There are many types of rehabilitation after knee replacement surgery, so the therapy plan has to be adapted to the individual patient.

Key words: geriatrics, endoprothesis, knee arthroplasty, knee joint

1. Introduction

Arthroplasty of the join is a procedure involving the insertion of artificial foreign elements into the joint replacing those which have been damaged [1]. This treatment is among the most common therapeutic activities in knee joint osteoarthritis for most vulnerable to damage and pathologies. The main assumption of this treatment is to cure degenerative

changes, thus restoring patients' autonomy in everyday activities, in particular by reducing pain and motor restrictions. The improvement of the quality of life is, however, strictly dependent on the proper improvement procedure both before and after surgery. Intensively carried out rehabilitation procedure after the surgery has a beneficial effect on functioning in everyday life [2, 3].

Degeneration of the knee joint is initially reduced by means of conservative treatment, i.e. rehabilitation, education of patients and pharmacotherapeutic methods, whereas if they are exacerbated, total hip replacement is performed [4].

The indications for knee arthroplasty are primarily the occurrence of primary degenerative pathologies of the joint, the patient's disability to move without using orthopedic equipment, as well as his consent to perform this surgery [5].

However, this treatment can not always be carried out. This situation occurs when the patient suffered injuries to the lower limbs and underwent surgery in the field of surgery. Exclusion is also knee joint infections, diseases that cause reduced mobility, mental and/or physical, genetic diseases and the patient's lack of consent to perform alloplasty. Another contraindication is the presence of a partial joint endoprosthesis [1, 4].

2. Construction of the knee joint

The knee joint is a hinge joint modified by rotation. It is formed by three bones: femur, tibia and patella. The acetabula of the joint is formed by the joint surfaces of the upper condyles of the tibia bone. The acetabula is deepened by the patella and meniscuses. The joint head is formed by the femur, and specifically by the femoral condyles. In the knee joint there are two meniscus: medial and lateral. The meniscus are of the half-moon shape and are made of fibrous cartilage. They are located between the tibia and femoral bone, thus dividing the knee joint into two parts, the so-called floors. It is known to distinguish the upper and lower floor. In the upper floor there are movements in the sagittal plane: bending and straightening. In the lower floor there are movements in the transverse plane, i.e. movements of the external rotation and internal rotation. Rotational movements do not occur during the maximum flexion and during the maximum extension [6, 7, 8, 9].

The joint capsule of the knee joint is made of two layers. The outer layer is made of a fibrous membrane, while the inner layer is made of synovial membrane. Between the two layers there is a fat pad [6, 7]. Due to the fact that the knee joint carries heavy loads, its

ligament apparatus is very extensive. A distinction is made in the knee joint ligaments between internal and external ligaments.

Extracapsular ligaments include [6]:

- Medial (tibial) collateral ligaments
- Fibular collateral ligament
- Oblique popliteal ligaments
- Arcuate popliteal ligament
- Patellar ligament

Intracapsular ligaments include [6]:

- Anterior cruciate ligament
- Posterior cruciate ligament
- Posterior meniscofemoral ligment
- Anterior meniscofemoral ligament
- Transverse ligament

In addition to the ligament apparatus, the knee joint also stabilizes the muscles. They are responsible for making moves in the joint.

Due to the fact that the knee joint is the largest joint of the human body, it is necessary to have a large network of vessels supplying this joint. The system of blood vessels of the knee has nine tributaries. The main arteries that supply the pond include the popliteal artery branches. In addition, the pond supplies branches from the anterior and posterior tibial arteries, as well as from the femoral artery [7, 10].

3. Frequency of the knee arthroplasty surgery

In 2015, 18 930 knee arthroplasty were performed in Poland: 1717 total plastic replacements, 186 partial arthroplasty, of which 197 revision treatments without exchanging implant elements. In 2016, 21 240 total knee arthroplasty were performed: 19,555 total plastic replacement, 1,495 partial arthroplasty, 190 revision surgeries without replacement of implant

components. In 2017 the numbers are even bigger, the numbers of knee arthroplasty are growing [11, 12, 13].

In 2017, 85 488 arthroplasty were performed in Poland, of which 27 653 were total knee replacements. 25 425 were a total plastic replacements of the knee, 1 966 partial arthroplasty of the knee and 262 revision procedures were performed without exchanging knee implant elements. Most operations were carried out in the Masovian, Silesian and Lesser Poland Voivodeships. On the basis of the data entered by the service providers to the Central Base of the Endoprosthesis (CBE) for the main diagnoses underlying the primary knee replacement, were primary bilateral gonarthrosis and other primary gonarthrosis accounted. People with these diagnoses are almost 95% of all persons who underwent primary knee replacement in 2017. The most common reason for revision after knee replacement was the mechanical complications of internal joint prostheses. This diagnosis occurred in almost 52% of people who underwent revision operations. Total endoprosthetics accounted for 95% in the case of primary surgery, while among the revision operations there is no such a big difference between the number of total and partial total replacements. Attention is drawn to the fact that 73% of knee arthroplasty implants were performed in women. Among all types of total knee replacement, the most common primary prosthesis are of the right joint and they were performed in women. Cement endoprosthesis accounted for over 86% of all knee joint prostheses implanted in 2017. In 2017, no relationship was found between age and the type of implanted endoprosthesis. The majority of uncemented endoprostheses were implanted in the case of people aged 60-69 – 1,186 such endoprosthesis were performed [13].

4. Causes of knee joint endoprosthesis

One of the most common causes of knee arthroplasty is degenerative changes that affect over 60% of people over 65 years of age. They lead to disability and a significant decline in the quality of life of older people. Gonarthrosis is a huge problem in society. The reason is the ever increasing life expectancy of people. Risk factors include, among others: older age, female gender, obesity, microtrauma and overload, diabetes. The reason for degenerative changes is the disturbance of the balance between the synthesis of articular cartilage and its damage, which causes its loss. The main symptom of gonarthrosis is pain in the anterior or medial part of the knee joint. There are also reduced ranges of mobility.

Initially pain occurs during movements, but over time begins to appear more often. The treatment of degenerative changes in the knee joints depends on the severity of the disease. At the beginning, conservative treatment is used, but in the advanced stage it is insufficient. Then, surgical treatment is implemented, which is now considered the "gold standard". Research confirms that this method is very effective. It was demonstrated that the quality of life of people undergoing surgery increased by 90%. In addition, physical fitness improved, ranges of mobility increased, stability was restored and pain was reduced. The indication for the procedure is the lack of the effects of conservative treatment and severe pain [14, 15, 16, 17, 18, 19].

Another reason for endoprosthesis are fractures. It is now believed that implantation of the endoprosthesis is only acceptable when it is not possible to reconstruct the knee joint surface. Studies have been carried out to show the efficacy of endoprosthesis treatment in the case of complex supracondylar fractures of the femur [20, 21].

5. Physiotherapy before knee arthroplasty

Indications for endoprosthesis are advanced degenerative changes in the knee joint, which are particularly severe in the elderly. The use of non-pharmacological methods, which include physiotherapy, reduces the perceived symptoms. The program of rehabilitation of older people who have been qualified for knee endoprosthesis surgery should be started just before the surgery. For the purposes of pre-operative physiotherapy pain should be reduced, the range of movement maintained and so muscular strength in the knee joint, and the right orthopedic supplies chosen if the elderly needs it [22, 23, 24].

The reduction of pain can be obtained using pharmacological methods, however, it is also worth paying attention to various physiotherapy treatments that affect the reduction of pain. These include: electrotherapy (including treatments using galvanic therapy, interference current, TENS and diadynamic therapy), thermotherapy, magnetotherapy, or laser therapy (low- and high-energy). The fascial methods and Kinesiotaping are also recommended [22, 25, 26].

An important part of pre-operative physiotherapy is maintaining the range of motion and muscle strength in the knee joint. Weakness of the quadriceps muscle of the thigh, which is the strongest extensor of the knee joint, causes disturbances in the walking pattern and can

also lead to flexion contracture in the knee joint. Various forms of kinesitherapy are used here: passive exercises, relieving exercises, active, post-isometric muscle relaxation or isometric exercises [22, 24].

Before the surgery, when the patient is already admitted to the department, rehabilitation involves learning exercises that will be performed after the procedure and learning to walk on crutches [25].

When planning a program to improve older people, it should be remembered to select each treatment and physical activity individually to the patient's state of health. Older people have many additional diseases such as hypertension or diabetes – the use of some treatments or inappropriate physical training is not recommended. The implementation of appropriate physiotherapeutic procedures prior to surgery may affect the patient's shortened stay after surgery in the hospital. It also allows to recover faster after surgery [26].

6. Kinesitherapy (exercises) after knee arthroplasty

In the process of improving the patient after knee arthroplasty, kinesitherapy is an important element. It is recommended that it should be introduced already on the first day after the surgery. It is also important to choose the appropriate exercises for a given patient because each patient has a different physical fitness, efficiency, as well as comorbid diseases. In the rehabilitation program for people after knee arthroplasty, it is recommended to introduce passive exercise on postoperative knee, unweighting exercises, self-assisted knee exercises, post-isometric relaxation of the knee joint muscles as well as isometric exercises of the lower limb. At a later stage, active-free exercises and exercises with gradually dose resistance are introduced [17, 27]. Already on the first day after surgery, it is recommended to perform a verticalization of patients. Gradually, a walk with crutches with graded limb load is introduced. Then, walk along the stairs is recommended. Full loading of the operated limb is recommended between 6 and 8 weeks after surgery [28]. However, it is recommended to use crutches for the third month for better belaying [29]. All exercises individually tailored to each patient are aimed at strengthening muscle strength in the limb after arthroplasty. Not to forget about the ranges of joint mobility, which are very limited after the procedure. Kinesitherapeutic procedures should gradually increase the range of motion in the joint [30]. When introducing further exercises, special attention should be paid to the feelings of the

patient during their performance. Do not perform exercises that cause pain. During rehabilitation after knee arthroplasty, it is worth introducing very varied exercises [5]. Starting from low positions, it is worth using Swiss balls, rehabilitation gums or other accessories. Then, exercises in the gym are introduced, where various types of balls, shapes as well as gums and sensoromotor cushions are used. The next stage are exercises in a standing position, where it is worth using gymnastic ladders and surfaces of different structure. However, it should be remembered that these exercises should be introduced gradually, because the body of each patient has a different regeneration time.

7. Physical therapy after knee arthroplasty

The main task of using physical therapy after knee replacement surgery is restoring the dynamics and efficiency of this joint. Rehabilitation allows to reduce the sensation of pain, helps in regaining functional strength and influences the restoration of independence after the operation. Treatments such as cryotherapy, laser therapy, iontophoresis or magnetotherapy reduce edema, alleviate pain and result in accelerated regeneration of soft tissues [31].

Cryotherapy involves the use of cold, compressed air or liquid nitrogen. The treatment causes initial contraction of the peripheral blood vessels and muscles, which results in a slower blood flow. Then there is a defensive reaction of the organism, which manifests itself in the dilatation of blood vessels, which results in the acceleration of blood flow. This process increases the supply of oxygen and nutrients to the body's cells. The result of the treatment is to reduce pain, relieve inflammation, accelerate tissue regeneration, relax muscles and activate the nervous system. In cryotherapy, which is performed in the case of a person after knee arthroplasty, the temperature used is between -160 °C and -180 °C. The duration of the procedure is about 3 minutes. The treatment should be performed in 10-20 series.

Laser therapy consists in irradiating tissues with laser light. By using low-intensity laser light, energy can be delivered to the tissues, which supports regeneration and accelerates healing and anti-oedematous effects. In addition, the treatment has anti-inflammatory and analgesic properties. Patients after knee replacement surgery use a contact method that uses an infrared probe. The treatment should be performed in 10-15 series of treatments once a day. Laser therapy is used independently of exercises [32, 33, 34].

Magnetotherapy is a procedure involving the use of a pulsating low frequency magnetic field. It should be remembered that a high frequency magnetic field cannot be used at the site of the operated joint. The use of multivariate low-intensity magnetic field does not affect the endoprosthesis properties. Magnetotherapy reduces the sensation of pain, has anti-inflammatory properties, accelerates wound healing and improves tissue trophism. During the procedure it is recommended to use the parameters: 1-5 Hz, 3 mT. The execution time is about 10-15 minutes. The treatment should be performed in a series of 10-15 treatments once a day. The magnetic field of relatively low frequency may be used from 7-8 days [33, 35, 36, 37].

8. Discussion

Society in many developing and developed countries is increasingly ageing. This results in an inevitable increase in the incidence of age-related diseases. This is a big challenge for modern medicine as well as physiotherapy. One of the diseases that can be found more and more frequently in society is osteoarthritis. It can occur most frequently in hip and knee joints [38]. The treatment of osteoarthritis often has three main objectives:

1) reduction of pain,

2) improvement of activities of daily living,

3) return to physical fitness allowing to practice sport in a recreational form.

In order to achieve the above three goals, it is often decided to perform knee joint endoprosthetic surgery [39].

As mentioned earlier in this article, in Poland the frequency of knee joint endoprosthetic procedures has been increasing over the last few years. What is important, in 2018 almost 30 thousand knee joint endoprosthetic surgeries were performed, including 27 533 total endoprosthetic, 2 239 partial endoprosthetic and 178 revision procedures without replacement of the implant elements. The most frequent knee replacements caused by gonarthrosis occurred in the Masovian, Greater Poland, Lesser and Silesian Voivodeship. The reason for the revision procedure, however, as in the previous year, were mechanical internal complications of joint replacements [13, 40].

The number of knee joint alloplasty procedures would not be possible without proper preparation for this procedure, appropriate operation and rehabilitation after it. The work of the entire medical staff contributes to the success of the operation when also there is taken a good functional assessment of the joints to ensure that the knee joint is working after the procedure properly. Functional scales such as HSS Knee Score and Staffelstein-Score (SS) are used for this purpose [41]. Słupik et al. in their research conducted on 24 people emphasize that the two aforementioned scales stand out among others. An example of this is the ability to subjectively assess pain, assessment of daily-living activities and objective assessment of joint function [42]. However, when comparing the sensitivity of both scales, the same authors point out in other studies that neither one nor the other scale is an ideal method of assessing – for example – pain [41]. On the other hand, in the 2009 study Słupik et al. achieved good results using the HSS Knee Score and Staffelstein-Score, therefore the conclusions stress that these scales may be a reliable source of information about the patient's condition, but they require further research on a wider group of people [43].

Endoprosthetic surgery is, therefore, a multi-purpose procedure, which is associated with a variety of physiotherapeutic methods that allow patients to return to social life. Ridan et al. used e. g. isometric exercises, CPM splint and PNF method during the examination of 40 patients after knee joint alloplasty [4]. However, these are not the only possible elements of rehabilitation.

All thing considered, there are many ways in which a patient can return to full fitness and freedom in everyday life after a knee joint replacement [5]. Exercises must be adapted to the physical fitness of the patient and the capacity of the body and, what's more, the rehabilitation objectives must be achievable, measurable, specific, timed and realistic. When they comply with the SMART principle, they contribute to the rapid recovery of the patient [44].

9. Conclusions

1. Knee arthroplasty can help restore independence to patients in their daily activities.

2. The introduction of artificial foreign bodies into the pond to replace the damaged leads to an improvement in the quality of life of sick patients.

3. The introduction of intensive rehabilitation, patient education and pharmacological treatment after arthroplasty allows for reduction of pain and faster recovery.

4. There are many types of rehabilitation after knee replacement surgery, so the therapy plan has to be adapted to the individual patient.

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