Degenerative changes to small and large joints of the human organism are the most common diseases of the locomotor system. The prolongation of human life resulted in the fact that almost every human of an older age suffers from ailments related to the locomotor system as a result of degenerative changes. Changes to the joints caused by degeneration can be found throughout the human population to a lesser or greater degree depending on the race, climate and conditions of life [1]. Degenerative joint diseases (arthroses) belong to the group of persistent chronic processes manifested in the progressive deterioration of articular cartilage and tissue support and they are accompanied by proliferative processes on the bone tissue of joints [2]. The incidence of degenerative joint diseases in the human population is very high taking the fourth place among the causes of diseases, i.e. of medical treatment of the human population in western countries, after cardiovascular, cerebrovascular and lung diseases. In 2003, 42.1 million people underwent medical treatment in the US as the result of degenerative diseases, while it is anticipated that the number of patients will considerably increase in 2030 and amount up to 67 million. Medical treatment costs of such a large number of patients are enormous thus significantly burdening health systems of countries throughout the world as well as of our country. In the US alone 233.5 billion dollars were spent in 1997 to treat the patients with degenerative disorders of locomotor system, in 2003 the sum amounted to 321.8 billion dollars, with the tendency of constant growth.

**Etiology**

Depending on etiological factors arthroses are distinguished as primary and secondary.

Primary arthroses – The actual cause of degenerative changes with no apparent cause, i.e. due to aging, has not been completely clarified until today, that is why they are called essential arthroses. They begin without any known cause and more or less represent the normal process of aging. They usually occur...
Stiffness is characterized by a limited range of motion in diseased joints, often accompanied by crepitations and popping sounds, which is of a low intensity at the onset of a disease, but it gets worse (contracture) as degenerative changes develop and affect all hip structures in the latest stage.

Deformity - Due to numerous osteophytes, distended bursa and tendon constriction and muscles spasm, large swollen joints are formed, which are difficult to be recognized in the region of the hip.

Degenerative changes to the hip lead to walking abnormalities (limp) caused by pain and constriction on extremities. After a certain period of time, the difficulty to move and pain result in muscular hypotrophy, which additionally contributes to the reduction of movement.

Diagnosis - is made based on anamnestic data in the presence of persistent pain, difficulty in moving and stiffness apart from general symptoms. Laboratory analyses show NAD (no appreciable disease), except of the potential increase in cell number of punctured synovial fluid. In case of primary arthroses X-ray examination shows no significant changes to the affected joints in the early stage of disease. On the contrary, in case of secondary arthroses, i.e. posttraumatic conditions, inflammatory diseases, disruption of joint statics (congenial disruption, Perthes disease etc.) there are deviations from findings usual for the patient’s age. As the disease progresses the first changes are found on the cartilage, which result in constriction of joint ends on X-ray. It is necessary to emphasize that radiological changes on bones are not in direct correlation with a subjective discomfort of the patient. In some patients this subjective discomfort is more distinct than in those having significant degenerative changes visible on X-ray.

All previously quoted causes of secondary arthroses, which have differential diagnostic value relative to primary (idiopathic) arthroses, should be taken into consideration (rheumatoid arthritis, inflammatory, specific and nonspecific, joint diseases, metabolic illnesses, some arthropathies, aseptic necroses (especially hip), tumors etc.)

Considering the prevalence of degenerative diseases, no wonder they are the reason for a high number of working days lost, while the medical treatment applied in order to lessen discomfort and increase the functional ability of a patient is also one of the biggest item in total costs allocated to health insurance. The patient’s ability to work depends mainly on the process localization, functional overload as well as on subjective discomfort. It depends on working place and way of performing the job, with emphasis on non-physiological body posture (body bending during work, kneeling, seating, crouch, continuous load of spinal column when carrying weight and similar).

**Treatment**

Generally speaking the aim of treating degenerative changes is to ease pain and muscular spasm, improve the function of diseased part of the human organism,

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**Abbreviations**

- THA – total hip arthroplasty
- NAD – no appreciable disease
- PRP – platelet rich plasma
- BMAC – bone marrow aspiration concentrate
- AATB – American Association of Tissue Banks
- EAMST – European Association of Musculo-Skeletal Transplantation
- EATB – European Association of Tissue banks

after the age of 40 years and their frequency grows by aging. The frequency of degenerative changes is significantly influenced by heredity factor, body composition, they are also more frequent after meno and andro-pause which is explained by a decrease in secretion of sex hormones. In addition, certain jobs speed up the onset of arthritic changes to joints, especially at places where vibrations and counter-strokes are involved (workers on pneumatic drills, blacksmiths, farmers etc.)

Secondary arthroses – They result from various static disruptions, posttraumatic conditions, inflammatory processes etc. At the beginning a pathological process takes place at the level of articular cartilage and the further development of degenerative changes induces reactive changes on articular bone ends, which are usually mono or biarticular, having larger significance if they occur in lower extremities.

Traumas of joints and their adjacency such as intraarticular fractures, osteochondritis dissecans, free articulated body and similar, considerably add to an onset of degenerative changes, especially when treatment is inadequate.

Arthritic changes to hip joint result from both congenital and acquired disruption of joint statics, altered dynamic ratio of articular surfaces such as with congenital hip displacement, conditions after Perthes disease and epiphysiolysis and others.

Inflammatory joint diseases - nonspecific arthritis is nowadays relatively rare thanks to efficient antibiotic therapy, but it occurs with certain immunodeficiency disorders. An increase in specific joint inflammations has recently been registered, especially tuberculosis, which is explained by deteriorated life conditions and nutrition, greater number of stressful situations, etc.

In addition, arthritic changes develop to a large extent into rheumatoid arthritis, femur head aseptic necrosis, non treated gout cases, with frequent hemorrhage with hemophilia, certain internal diseases (Addison, Paget, Gaucher, rachitis and other) etc.

**Clinical picture**

The reason why patients seek medical help for the first time is pain, which usually occurs in primary arthrosis after certain physical effort such as longer walking (especially on rough ground), running, carrying load, performing heavy physical work, etc. Patients usually deny the existence of trauma or they mention some low-intensity injuries. The pain can be intensified by exposure to a variety of weather factors, such as cold or humidity.
preventing joint contractions, i.e. encouraging patients to resume their daily routine and professional activities. In most cases it is a conservative way of treatment i.e. medicamentous and physical therapy, whereas surgical treatment (orthopedic) is assigned only with exceptionally advanced types of disease when there are distinct destructive changes to musculoskeletal system or in conditions where there is a necessity for static anomalies correction of affected extremities (in certain congenital and posttraumatic conditions).

Conservative treatment depends on the stage of clinical manifestations. Medicamentous treatment includes giving antirheumatics (nonsteroidal), antiflogistics (salicylates) and miotonolitics per os or parenterally, whereas local antirheumatic balms or corticosteroid drugs are applied either intraarticularly or locally in combination with anesthetics. Such local intraarticular therapy is not recommended for adolescent patients, because it can cause processes of joint cartilage destruction. Lately, the routine procedure assumes intraarticular application of plasma enhanced by thrombocytes (platelet rich plasma (PRP) or Orthokin) and stem cells taken from the bone marrow aspiration (Bone marrow aspiration concentrate - BMAC). The bone marrow taken from the pelvic crest or tibia upper end has a great potential in healing cartilage and bone flaw as it has a significant number of mesenchymal cells and several growth factors. Platelet rich plasma also contains several growth factors released from thrombocytes which can also stimulate mesenchymal bone marrow cells to multiply and differentiate in other tissues [3–5].

Physical therapy is simultaneously combined with medicamentous treatment and involves kinestherapy, hydrotherapy, various electrotherapy procedures. The main goal of this therapy is preservation i.e. restoration of joint and spine functions (dynamic balance). It needs to be emphasized that physical therapy is necessary, and if it fails to achieve some subjective improvement, then some of surgical methods are applied.

Arthroplasty - is a surgical procedure during which severely degenerative altered joints, where destruction of articular hip surfaces is present, are replaced with implants. Implantation of mostly total prostheses adds to the disappearance of pain, repairing of joint function which results in the improvement of living and working activities. There are some limiting factors because all implants represent foreign bodies in human organism, so there is the question of biomechanical and biological acceptance of prostheses, as well as of the “survival” length of embedded implants. Recently, technological progress and improvement of prostheses, tolerance period and implant functionality is growing, which is especially true for hip and knee prostheses. Total hip replacement is believed to be one of the most successful orthopedic interventions [6, 7]. In cases when only femoral part of the joint, i.e. the head of the femur is replaced we speak about hemiarthroplasty.

The first prosthesis of femur head made of ivory was implanted in 1891 by Professor Themistocles Glück in Germany, when he replaced the femur head dilapidated due to tuberculosis process. In 1925 the American surgeon Marius Smith-Petersen [8] introduced the mould arthroplasty made of glass, and the first who used “metal-on-metal” prostheses was English surgeon George McKee in 1953, with a high survival rate, i.e. the survival rate amounted to 74% after 28 years. The father of modern arthroplasty is an orthopedic surgeon Sir John Charnley who designed his prosthesis in the early sixties of the last century, on whose principles all modern total hip prostheses are based [9].

Technological progress and improvement of implants all over the world, both in developed countries and in our country as well, have led to an enormous increase in the replacement of degenerative altered hips during last thirty years. In the last decade, here as well as throughout developed countries of Europe and America, the number of both primary and revision arthroplasty procedures grew rapidly [10]. The reasons for this lie in the fact that a long period from previous primary arthroplasty procedures has passed up to now; the life span has extended, and the number of local complications such as prostheses luxation, infections, etc also grows with an increase in the number of procedures.

Depending on the loss of bone mass, i.e. defects in the bone continuity, age, living requirements, three basic types of prosthesis are routinely applied nowadays: cemented, where a contact of both components with a bone is accomplished by means of cement; cementless, where there is a contact of metal components directly to the bone, and hybrid, where usually a metal cap is implanted into acetabulum at the same time cementing the femoral part of prosthesis in the femoral canal. It is possible to have a case when polyethylene cap is cemented in the acetabulum and cementless component of the prosthesis is implanted in the femur, i.e. there is a

Figure 1. Cementless hip prosthesis

Slika 1. Bes cementna proteza kuka
direct contact between metal-bone when it is called contra-hybrid. Depending on the contact of acetabular and femoral components (femoral head) there are the following types of prostheses: metal-polyethylene, metal - metal, ceramic - ceramic and ceramic-polyethylene [11–14]. Two types of prosthesis are used for hemiarthroplasty of the hip joint: Moore’s prosthesis and biarticular prosthesis.

Generally speaking, cementless prostheses are implanted in the patients up to 65 years of age where quality of bone tissue is good according to the Rulebook of Serbian Republic Fund of Health Insurance (Figure 1). Hybrid total prostheses are implanted in the patients between the ages of 65 and 75 years, and cemented ones in the patients over the age of 75 years (Figure 2). Hemiarthroplasty is applied in cases of elderly patients (over 75 years of age) with fracture of the femoral neck where the expected lifespan is not long.

Prof. Dr. M. Došen performed the first total hip replacement surgery at the Department of Orthopedic Surgery and Traumatology in Novi Sad in 1970 and it was among the first in the Socialist Federal Republic of Yugoslavia [15]. Primary and revision arthroplasty procedures are routinely performed on a daily basis, and thousands of cases have been treated ever since. Out of 4,661 arthroplasty procedures performed at this Department in the period from 2006 to 2015, 1,516 were cemented prostheses, 1,389 were cementless and 475 were hybrid prostheses. In addition, 470 revision hip arthroplasty procedures were performed and five segmental (tumor) prostheses were implanted. Due to the fracture of the femoral neck 819 hemiarthroplasty procedures were done (765 Moore prostheses and 54 biarticular ones).

It has been possible to perform such a large number of arthroplasty procedures thanks to long tradition in performing these procedures, well-educated and skillful orthopedic surgeons, operating room and ward nurses as well as physiotherapists and the whole staff taking part in the treatment of such patients and high quality of pre-, peri- and post-operative anesthesia. During the majority of arthroplasty procedures, especially the revision ones, cell saver was used because of heavy blood loss over a certain period of time, and thus most of the patients who underwent arthroplasty procedures at the Department did not receive blood transfusion but only their own processed blood [16]. The patients also received multimodal postoperative analgesia together with local application of conductive blocks as a routine which significantly contributed to their fast and efficient recovery [17]. Good peri- and postoperative care by anesthesiologists allows some orthopedic surgeons to apply a concept of fast recovery (“fast tracking”) to their patients with total knee and hip replacement, which means early verticalization of the patient, i.e. a few hours after the intervention. Most surgical patients at the Department are verticalized and start with early physical treatment a day after surgery.

The Department of Orthopedic Surgery and Traumatology, Clinical Centre of Vojvodina in Novi Sad differs from the majority of its counterparts in the Republic of Serbia because we perform arthroplasty procedures, mini invasive surgery and computer-assisted surgery to hip joint, i.e. navigational surgery. Mini invasive surgery technique has been applied as a routine at the Department for some time already, and in combination with good peri- and postoperative protocol and forced verticalization it results in a shorter hospitalization and faster recovery after implantation of both total hip joint and knee prostheses. Several computer assisted hip and knee arthroplasty procedures that were performed at the Department proved to be a good method, but due to high price of equipment and the length of surgery, they have not become part of routine procedures [18, 19].

During last fifteen years, the number of revision arthroplasty procedures has grown rapidly both here and throughout developed countries of Europe and America. The reason for this lies in the fact that up to now a long period from previous primary arthroplasty procedures has passed, life span has extended, and the higher number of procedures results in the higher number of local complications such as prostheses luxation, infections, etc. [20–22]. Every repeated surgery, especially rearthroplasty procedure, is much more demanding both for a surgeon and for the patient, as it is accompanied with a lot of local and general complications.
problems. This particularly applies to cases when there is a loss of bone mass no matter whether it is situated on the ilium or on thigh bone. This type of surgery is long-lasting, blood loss is huge and the recovery itself, i.e., hospitalization is longer in comparison to primary hip arthroplasty. Treatment costs for these patients are significantly higher, not only because of hospitalization duration, greater consumption of all drugs, but also because of implants that are twice or four times more expensive in comparison to primary prostheses. Moreover, especially in cases where there is bone mass loss it is essential to have the bone bank.

Depending on the bone mass loss, i.e., defects in the bone continuity, age, living requirements etc. cementless and cemented prostheses or a combination of two i.e. hybrid prostheses (Figure 3) are implanted in revision arthroplasty. The basic principle is that only the loose part of the prosthesis is replaced. Usually it is a case of aseptic loosening of prosthesis components, although septic process develops in few cases [23–25]. In most cases it is a low-grade infection which occurs only after some time (a year or more) and it is very rarely manifested as purulent process immediately after surgery [26]. In these cases the replacement of prosthetic components can be performed in two-step or one-step procedure, the former being more frequent. If there is a bone defect, bone allografts of various forms are placed i.e. as massive ones, in the form of tiny grafts (3–5 mm) or ground ones. The number of complications after such surgical procedures is significantly higher than after primary arthroplasty procedures. Verticalization of such patient is slower, the support on the operated extremity is from full to partial, depending on the usage of bone allografts and type of implant. Rerarthroplasty procedures to hip joint are a huge health and economic problem as well because of expensive implants, drugs and treatments and long-term incapacity for work.

Transplantation surgery of bone and joint system is still not developed enough in our country, but nevertheless it is applied in revision hip and knee arthroplasty procedures, in reconstructive surgeries on ligaments and tendons (chronic instability of knee and shoulder joint, tendon defects), in tumor and spinal surgery, in joint arthrodeses etc. Non vascularized transplants are often applied routinely, which are associated with problems such as revascularization and remodeling of bone, ligament and tendon tissue since these processes should be synchronous and follow one another. In developed industrialized countries allotransplants from bone banks have been used routinely for more than three decades now.

Immune response of the human body to the bone and tendon transplants is very moderate due to a well-known fact that these tissues are in condition of hypovascularity and have weak antigenic properties. The problem of transplant rejection is therefore manifested to a much lesser extent than in other branches of transplant surgery. Some studies have shown that immunological processes that occur in transplantation of bone tissue are predominantly of cellular type, whereas it is still not clear what causes a blockade of humoral immunity.

Due to weak antigenic properties of tissues during these procedures in routine usage it is not necessary to perform a detailed tissue-typing, or to apply immunosuppressive therapy, but it is enough to determine the blood compatibility. The success of transplant surgery in osteoarticular pathology depends also on the size of transplant itself, while it is a well-known fact that faster revascularization and remodeling are achieved with smaller grafts. On the other hand, larger grafts provide an opportunity of easier implantation and fixation, thus satisfying basic biomechanical conditions, which adds to faster and better physical treatment i.e. postoperative results [27].

Having in mind the growing demand for allografts, the necessity of forming bone banks is imposed. Their main task is to provide sufficient quantities of clinically safe bone and ligamentous allotransplants having adequate biological and biomechanical qualities essential for their clinical implementation [28]. Allotransplants from a bone bank must be free of all potentially harmful, transmissible diseases, but at the same time they must preserve their osteogenic potential and mechanical hardness, necessary for a successful clinical implementation of bone allotransplant [29]. In order to avoid transmission of bacterial or fungal infections from allotransplant donor to a recipient, while working in a bone bank the standard of American Association of Tissue Banks (AATB) or European Association of Musculo-Skeletal Transplantation (EAMST)/European Association of Tissue Banks (EATB) must be strictly followed, which means cautious donor selection, compliance with strict rules when taking, storing and implanting allotransplants [30, 31]. There is a prevailing opinion that the application of fresh frozen or frozen lyophilized grafts, together with previous virological and bacteriological examination of donor and graft itself, provides best postoperative results.

The Department of Orthopedic Surgery and Traumatology, Clinical Centre of Vojvodina, Novi Sad, started to apply massive cortico-spongyous allografts in 1992. The entire project of the bone bank, with the permission of Ethics committee at the time, was conducted by Prof. Dr Aleksandar Jovanović with his assistants Dr. M. Milankov and Dr. D. Savić. The bone bank was established in 2008 at the Department of Orthopedic Surgery and Traumatology by providing a deep freezer with temperature of ~80°C and all necessary equipment, when transplant program came into operation at the Clinical Centre of Vojvodina in Novi Sad. By establishing the bone bank, bone and ligamentous allotransplants, both from cadaver donors (within transplant program) and alive donors (head of the femur after arthroplasty procedures to hip joint), have been applied for the last 8 years. During the last 15 years, 671 revision hip arthroplasty procedures have been performed at the Department, mainly due to loosening of prosthesis components and in cases of bone mass loss. The demand for allografts has constantly been on the rise so there is a need to incorporate more people in organ donation and to improve the transplant program in the country.
References


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