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Alt Ekstrimitenin Artroplastileri Sonrası Sık Gözüken Komplikasyonlar, Tedavi Yaklaşımları ve Bunları Nasıl Minimize Ederiz

Common Post Lower Limb Arthroplasty Complications, Management Approaches and How to Minimize the Risks

[1]Levent BAYAM, [2]Efstathios DRAMPALOS, [1]Mehmet ERDEM

1- Sakarya University Training and Research Hospital, Sakarya, Turkey
2-Forth Valley Royal Hospital, Larbert, UK

Levent Bayam: https://orcid.org/0000-0001-5149-0829
Efstathios Drampalos: https://orcid.org/0000-0002-6634-9892
Mehmet Erdem: https://orcid.org/0000-0002-9683-1882

ÖZ
Hem diz ve hem de kalça artroplastileri, ortopedinin oldukta başarılı ameliyatlarıdır. Mükemmel ve uzun yaşam sonuçları vardır. Artan ameliyat sayılarına ve başarı oranlarına rağmen, genel ve ciddi komplikasyonları da artış göstermektedir. Literatürden yaptığımız derlemede, kalça ve diz artroplastilerinin yaygın komplikasyonları olan enfeksiyon, dislokasyon, periprostatik kırıklar, septik gevşeme ve ven tromboembolisini taradık. Bu komplikasyonlar çok dramatik problemlere neden olabilmekte ve dikkatli tedavi gerekmektedir. Bu komplikasyonları minimuma indirgemek icin gerekenler, kendini geliştirmiş tecrübeli ortopedik cerrahlar ve konusunda özelleşmiş, uygun çevresel ortama sahip bir takım ve uygunluğu ispatlanmış protezlerin kullanılmasıdır.
Anahtar Kelimeler: Artroplasti, diz, kalça, komplikasyon

ABSTRACT
Both knee and hip replacements are very successful operations of orthopaedic surgery. They have excellent outcome with long survivorship. Despite the success rate of both joint replacements and with increasing numbers, general complications and some serious complications have also been increasing. We reviewed the common complications of lower limb arthroplasty in the literature including infection, dislocation, periprosthetic fractures, aseptic loosening and venous thromboembolism. Sometimes, those can cause devastating problems and require careful treatments. To minimise these complications, the requirements are skilled and experienced orthopaedic surgeons and teams in specialised units with appropriate environment and proven implants.
Keywords: Arthroplasty, complications, hip, knee

Sorumlu Yazar / Corresponding Author:
Levent Bayam
Sakarya University Training and Research Hospital, Sakarya, Turkey
Mobile: 05350147479
Email: levbayam@hotmail.co.uk

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INTRODUCTION

Knee and hip replacements are two of the most successful operations in the orthopaedic history.[1-4] They are considered as cost-effective and reliable operations.[1, 2] They have excellent and satisfactory outcome with long survivorship, at least 90% over 10 years.[1, 3] The number of total arthroplasty performance has been projected to increase even further in the next 10 to 15 years.[5] These operations are very effective for pain relief, functional restoration and improved quality of life in patients especially suffering from osteoarthritis or inflammatory arthritis of the hip.[2-4]

For both for knee and hip replacement, there are cemented and uncemented options. In the recent years, uncemented hip replacement are getting more popularity, especially in young and fit patients whilst cemented knee replacement is still very common.

Despite the success rate of both joint replacements complications can also arise. Those may cause serious health, emotional and cost problems for both patients, doctors and health systems. In this article, we have included 5 common complications: infection, dislocation, periprosthetic fractures, thromboembolism (DVT, PE) and aseptic loosening, their management principles and discussion of minimizing them.

METHODS

The authors searched Medline selectively for relevant publications including annual reports from international registries.

Infection: Although infection is not very often, the outcome could be devastating. The rate was around 1 % in many publications and it was less than 2% for both knee and hip replacements [6, 7] (0.76% to 1.24% for hip, 0.88% to 1.28% for knee).[7] It can be classified as early and late. Early postoperative infection can be diagnosed when patients present with infection symptoms within four weeks following arthroplasty.[6] Biofilm is effective in infection mechanism which is a layer between the implant and bone and represents a basic survival environment of micro -organisms. After the first contact with the implant, micro-organisms immediately adhere to its surface and mature biofilms take four weeks to develop.[8]

To establish diagnosis, in addition to patient's symptoms, there are some criteria which include abnormal serology such as erythrocyte sedimentation rate [ESR]>30 mm/hour and C-reactive protein [CRP]>1 mg/dL, strong clinical and radiological suspicion of periprosthetic infection, positive joint aspiration culture, evidence of purulence during the subsequent surgical intervention, and positive intraoperative culture. Meanwhile, there are other serologic tests including procalcitonin and interleukin (IL)-6 which can be used to determine periprosthetic infection state.[6]

However, aspiration is a standard and especially tissue culture is necessary for definite diagnosis, which must be obtained before antibiotic application and should contain various tissues such as synovium, synovial fluid, intramedullary tissue, granular tissue and bone.[6] Bone scintigraphy with 99mTc can be used to increase the accuracy of diagnosis and has an excellent sensitivity, but its specificity is low.[6, 8] On the other hand, positron emission tomography (PET) is a fast, safe, high-quality imaging for detection of periprosthetic infection with high sensitivity and specificity.[8]

Most common agent of peri-prosthetic infection is *Staphylococcus aureus*, followed by coagulase-negative *Staphylococcus* and *Streptococcus* for total knee replacement.[1, 3, 9] Delayed infections may present with subtler symptoms which are for example joint pain and early loosening. These are caused by low-virulent organisms (coagulase-negative staphylococci or *Cutibacterium species*).[8]

Treatment strategies to treat the infection included antibiotic suppression mostly following debridement, one or two stage revision surgeries, arthrodesis or as a final treatment; amputation.[6] Two-stage approach involves removal of all arthroplasty components, cement, debridement, irrigation and implantation of antibiotic-impregnated cement in the joint. This is accompanied with intravenous antibiotics per sensitivity for a six to eight-week period.[10] Figure 1 shows first stage revision surgery of an infected hip arthroplasty.

Effective treatment involves various specialists with different approaches such as orthopaedic and plastic surgeons, infectious disease physicians and microbiologists. For satisfactory outcome, interdisciplinary approach is crucial.[8]

Dislocation: Arthroplasty dislocation is described as complete loss of articulation contact between two artificial joint components (Figure 2). Dislocation is a common complication during the first post arthroplasty period. It varies from 0.2% to 10% in some series for primary hip arthroplasty. However, it may increase up to 28% in revised hips[4] (Figure 3). Dislocation itself is a reason to revise arthroplasty. Whilst this is a major problem for hip arthroplasty, following knee arthroplasty, it is very rare but a dreadful event as a serious form of instability.[11]

Whilst Swedish nation-wide mean rate[12] is reported to be 0.6%, the report from Scottish National arthroplasty non-voluntary registry showed an annual incidence of dislocation of 1.9% after total hip arthroplasty.[12]

The risks for dislocation can be attributed to the patient, the surgeon or the implant. Dislocation rates increase in patients with neuromuscular conditions such as cerebral palsy, dementia and Parkinson's disease and patient's age is important especially when older than 80 years old.[4] On the technical side, surgical approach (anterior, posterior, lateral, antero or postero-lateral, positioning of the acetabular and femoral component, soft-tissue tension, and surgeon's experience are all key factors.

Regarding the implant, its design may contribute to instability. Especially, head-to-neck ratio plays a significant role for impingement and range of motion. Jumping distance for smaller head (22mm) is much less and contribute dislocation with higher range of motion biomechanically. However, larger heads do not warrant stabilisation[14] and increased head size (>36) and range of motion promotes secondary impingement with resulting contact between proximal femur and pelvic bone.[4]

Initial treatment of dislocation is closed reduction. If unsuccessful, open reduction is the next step and revision is required in case of instability. All those steps accompanied by a rehabilitation programme.[12]

Periprosthetic Fractures: Periprosthetic fractures (PF) are considered fractures associated with an or-

thopedic implant and due to increasing number of joint arthroplasties, mainly hips and knees, the number of worldwide PF is also rising.[15] Intraoperative fractures may sometimes be occult at around 8%, particularly during THA in acetabulum and during TKA in supracondylar femur.[15, 16] The rate of PF is higher for uncemented THA during the operation and it is around 1.7%. Intraarticular PF during TKA ranges from 0.3% to 3.13%.[15] PF happens more often as a result of low-energy trauma. and risk factors are significant comorbidities, osteoporosis/ osteopenia, rheumatoid arthritis (RA) and revision surgery.[15, 17]

Bone loss of the acetabulum is evaluated using the Paprosky classification which is based on the amount of hip center migration and the integrity of four acetabular supporting structures as evaluated on preoperative AP radiographs of the pelvis.[18] The Paprosky classification is divided into three types with increasing severity of bone loss. Pelvic discontinuity is the far end of bone loss for hip arthroplasty and it is described as separation of superior part of pelvis from inferior one.[19]

The Vancouver classification divides periprosthetic femoral fractures into types A, B, and C according to localization; proximal, distal and below stem (Figure 4). Further categorizes type A into two subtypes (AG and AL) and type B fractures into three subtypes (B1, B2, and B3 according to bone quality and stem security).[15] Periprosthetic fractures around the knee can be classified according to the anatomic location into femoral, tibial, or patellar fractures.[20]

Treatment depends on the stability, arthroplasty type and bone quality. Mostly, these complications are treated non-operatively. On the other hand, when revision is required, the best outcome is obtained with experienced arthroplasty surgeons. For example, use of cemented acetabular cup in elderly osteoporotic patients is better choice to avoid periprosthetic fractures.[19] Surgeons' familiarity and experience with the implant, cemented vs. uncemented, hemispherical vs. elliptical cups is critical for long term outcome.

Aseptic loosening: Aseptic loosening is the failure of the bond between an implant and bone where there is no clinical and laboratory evidence of infection. It is generally a late complication. Aseptic loosening for hip can be the result of inadequate initial fixation, mechanical loss of fixation over time, or biologic loss of fixation caused by particle-induced osteolysis around the implant.[21] In the knee, reasons for aseptic loosening include wear particle exposure, implant alignment cement mantle thickness, resurfacing the patella, implant design.[22]

The pathogenesis includes a chain of inflammatory process and is followed by an osteolytic process (Figures 5-A and B). The response was thought to be initiated by debris particles. These are generated from the prosthetic joint articular surface. At cellular level, polymethylmethacrylate (PMMA) and polyethylene particles (<20 μm) induced a response from cytokine and leads to release of of tumor necrosis factor (TNF), IL-1, IL-6, prostaglandin (PG)E2, matrix metalloproteinases, and other factors.[21] The key biological response in this event is activation of the receptor activator of nuclear factor-κB (RANK)/ RANK ligand (RANKL). The cells involved in these reactions are macrophages, fibroblasts, giant cells, neutrophils, lymphocytes, and osteoclasts. Increased osteoclastic activity leads to osteolysis. Eventually, wear debris from the prosthetic joint articular surface abides the main factor in implant survival.[21]

A previous study on cemented Charnley total hip arthroplasty showed patients with higher activities or male patients demonstrated higher rate of femoral demarcation, thereby, less satisfaction. Also, trochanteric non-union was correlated with higher degree femoral bone-cement demarcation.[23] To reduce the risk of aseptic loosening, as well as surgical team's experience, good bone coverage of implant and its stability, and avoiding excessive drilling and rasping are important factors.[24]

Postoperative venous thromboembolism (VTE): This is another common and serious complication following especially lower limb arthroplasty and includes deep vein thrombosis (DVT) and pulmonary embolism (PE). It is potentially a life-threatening complication.[25] Even so, it is a preventable cause of in-hospital death and there is very big difference in its incidence between with and without prophylaxis.[26]

It is so common that the incidence of imaging-confirmed asymptomatic DVT was known to vary from 42% to 57% after hip arthroplasty, and from 41% to 85% after knee arthroplasty whilst the incidence of PE varies from 0.9% to 28% after hip arthroplasty, and from 1.5% to 10% after knee arthroplasty.[25]

Another study reported overall 1.9% of symptomatic VTE. It was 1.7% in patients undergoing total knee replacement and 1.3% in patients undergoing total hip replacement.[27] However, clinically significant VTE is less common.[25] These rates could be reduced

to 1-10% with routine use of pharmacological thromboprophylaxis.[27]

Virchow's triad is effective in the development of VTE in patients with orthopaedic operations due to venous blood stasis because of use of tourniquet, immobilization, increased hypercoagulability because of use of polymethylmethacrylate (PMMA) bone cement.[26] VTE prophylaxis methods are divided into mechanical and pharmacological. Mechanical method includes mobilization, graduated compression stockings, intermittent pneumatic compression device and venous foot pumps whilst pharmacological method includes aspirin, unfractionated heparin, low molecular weight heparin (LMWH), vitamin K antagonists, and oral anticoagulants.[26]

DISCUSSION AND CONCLUSION

Projected volume of primary total joint arthroplasty predicts an ongoing increase in the number of arthroplasty every year.[5] This required trained, skilled and experienced orthopaedic surgeons and teams to manage these requirements. A study assessing surgeons' experience identified a threshold of 35 cases a year to optimize the risk of dislocation and revision, below which there were increased risks.[28]

To minimise the infection risks, laminar flow theatres, and improved theatre discipline and appropriate orthopaedic theatre staffing as an essential part of practice for any orthopaedic unit undertaking joint replacement surgery are the other requirements for optimal arthroplasty conditions.[29]

Early diagnosis is crucial to treat these complications. Administration of prophylactic antibiotics reduces the incidence of infection after primary arthroplasty.[6] Preoperative optimization of patients including weight reduction, stop smoking and controlling cardiovascular disease and psychotic disorders are recommended.[24]

To prevent dislocation, as well as surgeon's experience, for example, cup orientation in hip replacement should be anteversion of 15 +/- 10 degrees and lateral opening of 40 +/- 10 degrees was for lower rate of dislocation, while outside this range, dislocation rate is much higher.[30] The other factors to reconstruct hip joint kinematics are cup inclination, ante version, rotational center of hip, offset and leg length.[4]

With the advancement in technology, computer assisted navigation arthroplasty and robotic systems have been gaining popularity.[31] Their advantages include increased accuracy, better alignments of components, better kinematics and potentially better functional outcome and some studies also claimed decreased revision rates with navigated knee arthroplasty in comparison with traditional instrumented knee arthroplasty.[32] However, longer learning curve, increased cost, prolonged operation time with increased risk of complications are their disadvantages.[31, 33, 34] Besides, there should be a balance between the benefit and disadvantages of new approaches. Additionally, studies so far did not show any significant differences of clinical function, position, and survivorship of the components between conventional approach and computer assisted systems in long-term follow-up over 12 years for knee replacement.[35] On the other hand, it appears that we will see more navigation and robotic systems involvement for arthroplasty operations in the near future.

Finally, 'getting it right first time' by using the most reliable implants with proven survivorship[29] is one of the main key factors in the success of arthroplasty.

Ethics Committee Approval: Our study was a review article. No ethics committee permission is required.

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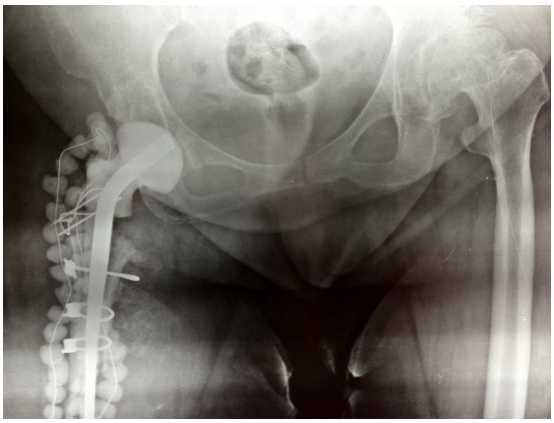

Figure 1. X-ray shows first stage revision surgery after removal of all implant and implantation of antibiotic-impregnated cement.

Figure 2. Hip dislocation is seen after primary hip arthroplasty.

Figure 3. Dislocation (is more common especially) after revision surgery.

Figure 4. Periprosthetic fracture; Vancouver type B.

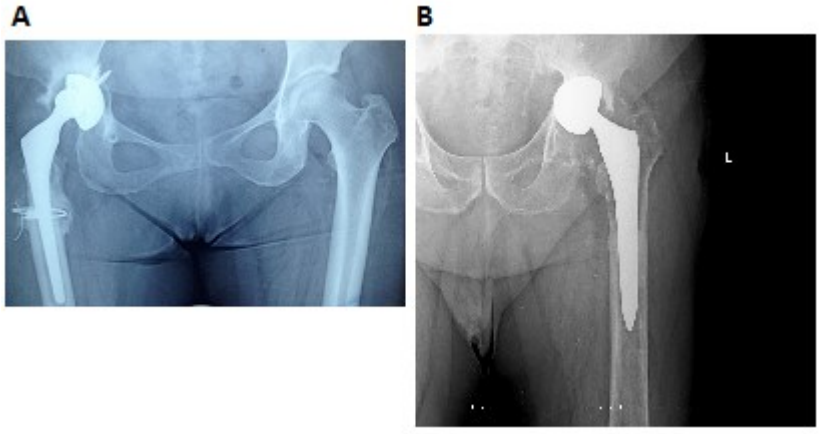

Figure 5. A: Aseptic loosening of acetabular cup; **B:** X-ray shows aseptic loosening and superior migration of acetabular cup and osteolysis of proximal femur.