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## Premature wear of the hip prosthesis as an early mechanical complication qualified for revision surgery – a rare case report and clinical implications

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### Abstract

**Background:** Mechanical complications of total hip arthroplasty (THA) are potential issues that may arise following the primary THA. Improper placement of THA can lead to misalignment of the joint axis, resulting in instability, pain, and walking difficulties. Among the relatively rare postoperative mechanical complications, premature wear of prosthesis components is included. This wear can lead to catastrophic prosthesis dislocation, necessitating surgical revision of the THA.

**Aim of the study:** The aim of this paper is to present an intriguing case description of a patient with premature THA wear classified as an early postoperative mechanical complication, warranting revision THA surgery. The likely cause of premature wear of the

implanted acetabular cup was excessive prosthesis use associated with intense physical activity and a high level of patient fitness.

**Care report:** The paper presents the medical history and treatment course of a 33-year-old active patient who underwent uncemented left hip THA surgery due to diagnosed coxarthrosis caused by congenital dysplasia. After 5 years, premature wear of the implanted acetabular cup occurred. The likely cause was excessive prosthesis exploitation related to intensive physical activity and a high level of patient fitness. A year after the first revision surgery, THA dislocation occurred, resulting in the necessity of a second revision with replacement of the acetabular cup, polyethylene inserts and femoral head of the endoprosthesis.

**Summary:** Premature wear of THA poses a significant clinical challenge. Functional limitations, associated with the loss of hip joint stability, lead to difficulties in performing basic activities, further decreasing the patient's quality of life. It is also worth emphasizing that the treatment process for premature THA wear is associated with the possibility of surgical complications and a prolonged recovery period.

**Keywords:** hip arthrosis, hip joint prosthesis, premature acetabular wear, mechanical complications, case report, clinical implications.

## Introduction

Degenerative hip joint disease, also known as hip arthritis, is a condition associated with progressive damage to the joint cartilage within the hip joint [1]. It is one of the most common causes of joint pain and limited mobility in older individuals [2]. The occurrence of this condition in younger age groups is relatively rare and is often attributed to genetic factors, previous joint injuries, or abnormal joint biomechanics [3,4]. In the early stages of the disease, non-operative treatment is recommended, primarily involving systematic physiotherapy [5,6]. Management also includes reducing joint loads, weight loss, the use of pain-relieving and anti-inflammatory medications, and avoiding factors that worsen symptoms [7]. In cases of advanced disease, when conservative treatment provides no relief, surgical intervention may be necessary [8].

Nevertheless, like any surgical procedure, total hip arthroplasty (THA) is associated with the risk of complications [9]. It is important to emphasize that the risk of these complications can be reduced through advances in prosthetic technology, the experience of surgeons, and strict adherence to rehabilitation and postoperative care guidelines [10]. Mechanical damage to the hip prosthesis is a potential complication that can occur after primary THA [11]. Prosthesis components, such as metal, ceramic, or polyethylene components, may become loose, causing pain, joint instability, and functional limitations. Hip prostheses may fracture due to injury or overloading [12].

Another risk is the corrosion of THA materials and allergic reactions leading to the release of metal particles into surrounding tissues [13,14]. Improper placement of THA can result in the incorrect alignment of the joint axis, leading to instability, pain, and walking difficulties [15]. In some cases, especially when the prosthesis includes a hinge, there may be an issue with its functionality, leading to movement difficulties and discomfort. Premature wear of prosthesis components, primarily the acetabular cup, is considered one of the relatively rare mechanical complications post-surgery [16]. This wear can lead to catastrophic

dislocation of the prosthesis, causing loss of function, pain, joint instability, and the need for THA surgical revision [17].

So far, there are studies analyzing clinical and cost-effectiveness aspects of THA, especially considering the decreasing average age of patients and the increased risk of revision. A retrospective review of 572 patients undergoing THA revision from 2015 to 2018 divided patients into two groups: revisions within the first 3 years and revisions after 3 years from the primary THA surgery. The study results showed that patients undergoing earlier revisions had a significantly higher risk of bone-related complications (e.g., fractures) or other complications compared to those undergoing later revisions, which were typically associated with mechanical implant damage. The operation time was significantly shorter for earlier revisions, but clinical outcomes were worse, especially regarding physical function and perceived pain. The conclusion is that the time to re-revision did not significantly impact clinical outcomes, but earlier revisions were associated with higher pain levels and poorer physical function in patients after one year of observation. Researchers recommend considering long-term monitoring of patients after THA, especially in the case of earlier revisions, to ensure a more effective approach to care [18].

A review of publications from the last decade identified a total of 9952 THA revisions, with aseptic loosening (23.19%), prosthesis instability (22.43%), and periprosthetic infection (22.13%) identified as the primary causes of failures. Additional analysis, considering BMI and age at the time of complication onset, revealed a significantly higher re-revision rate in obese patients compared to those with normal body weight. Furthermore, individuals undergoing THA revision before the age of 55 are more susceptible to subsequent revisions. This study provides valuable insights into understanding the causes of failures in THA revisions, particularly in relation to obesity and patient age [19].

### **Aim of the study**

The aim of this paper is to present an intriguing case description of a patient with premature THA wear classified as an early postoperative mechanical complication, warranting revision THA surgery. The likely cause of premature wear of the implanted acetabular cup was excessive prosthesis use associated with intense physical activity and a high level of patient fitness. The paper also discusses the clinical implications of premature THA wear, leading to the necessity of undergoing revision THA surgery, and addresses preventive techniques aimed at minimizing the risk of such complications. It is essential to emphasize that during manuscript preparation, CARE guidelines for reporting case descriptions were applied to ensure proper accuracy, transparency, and usefulness of the paper.

### **Case report**

The paper presents the medical history and treatment course of a young patient with complicated THA implantation over a 6-year period post-operation. The complication in the 5th year after THA involved the wear of the polyethylene insert of the hip prosthesis, while in the 6th year, it entailed dislocation of the hip prosthesis with damage to the acetabular cup. Both complications necessitated revision surgeries.

### **Total replacement of the left hip joint using a cementless femoral stem**

In 2016, a 33-year-old patient was admitted to the Orthopedics and Traumatology Department of the 4th Military Clinical Hospital in Wrocław due to degenerative changes in the left hip joint. Primary diagnosis: M16.0 – Primary, bilateral coxarthrosis. The patient complained of pain and worsening gait (significant deterioration for 1.5 years). Radiological

examination confirmed advanced coxarthrosis on the left side, characterized by joint space narrowing, especially in the upper range, increased subchondral sclerosis, and osteophytes on the joint surfaces. The head of the left femur was deformed with the presence of degenerative cysts and signs of upper-lateral migration. Additionally, minor degenerative changes in the right hip joint were observed, not requiring surgical treatment. The patient had hip dysplasia detected during childhood (**Fig. 1**).

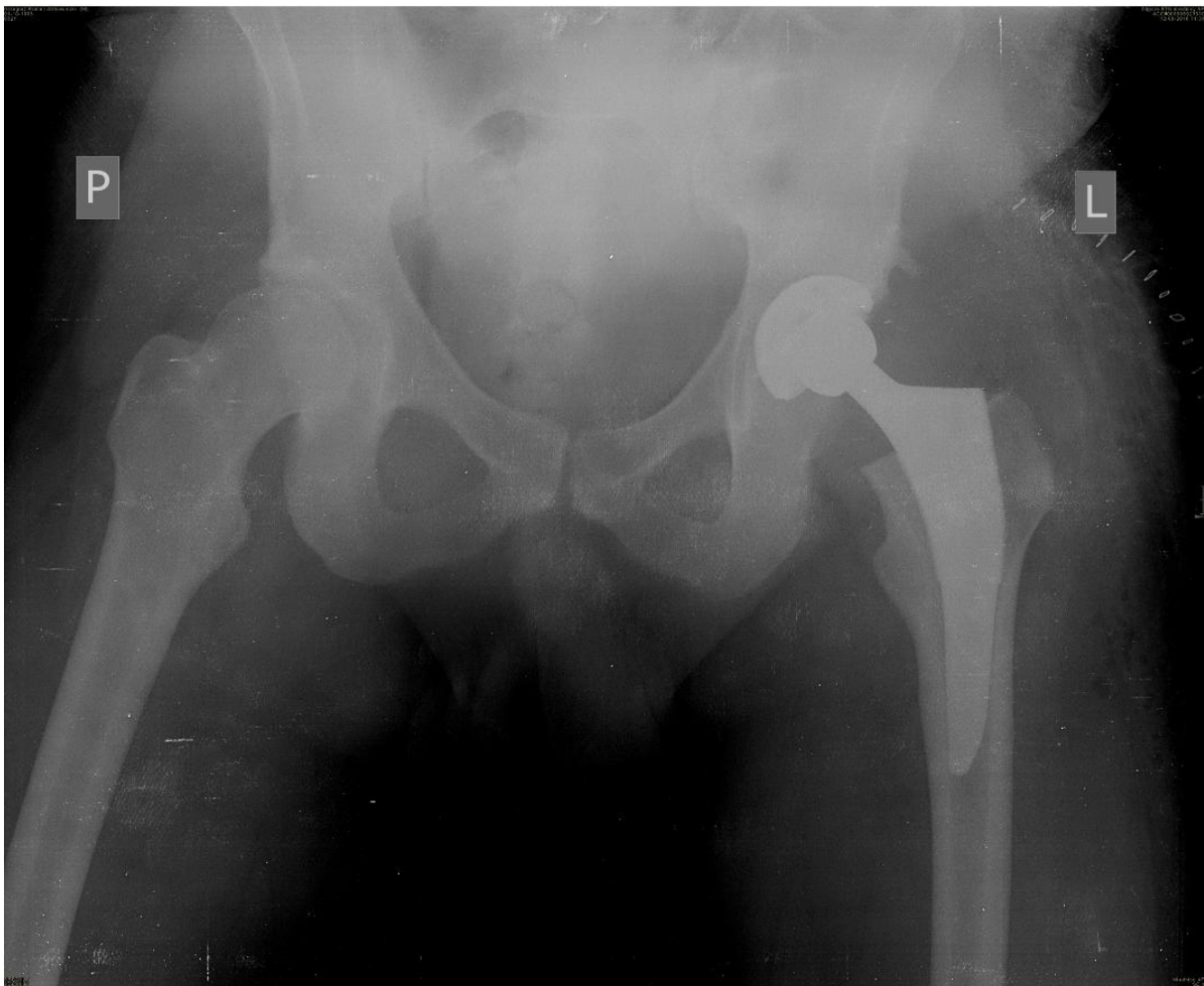


**Figure 1.** The degeneration of the left hip following hip dysplasia with a flattened acetabulum and deformed femoral head – the patient qualified for total hip arthroplasty.

The current illness was arterial hypertension. The patient had not undergone major surgeries before, denied any drug allergies. At the time of the examination, the patient was conscious and in logical contact. The body structure was normal, with clean skin and no pathological eruptions. Subcutaneous tissue was well-formed, without edema. The neck had normal mobility, was non-painful, and lymph nodes were not enlarged. The chest was properly arched, with normal vesicular murmurs auscultated over the lung fields, and respiratory rate was 16/min. The heart rate was regular at 68/min, with properly accented tones, blood pressure 162/79. The abdomen was arched at the chest level, palpation revealed no pathological resistance, lively peristalsis, negative Chełmoński sign, negative Jaworski sign, and bilaterally negative Goldflam sign. The nervous system showed no overt pathology, with the absence of meningeal signs. Normal active and passive mobility in the left hip joint was observed. Minor pain complaints were reported in the entire limb. The skin over the joint was unchanged, properly warmed, and colored.

The treatment plan included surgical intervention following qualification, postoperative care, and rehabilitation. On August 10, 2016, an uncemented Trilock left hip total hip arthroplasty (THA) procedure was performed. Type of surgery: 81.513 - Total primary hip joint replacement using a metaphyseal stem. A posterior-lateral approach was

utilized. After incising the short rotators, access to the joint was achieved. The hip joint was dislocated, the femoral head was excised, and remnants of the joint capsule were removed. The acetabular socket was widened and deepened using reamers, creating a uniformly leaking surface. The medullary cavity of the femur was prepared using rasps. Irrigation with an antibiotic solution and hemostasis control were performed. The acetabular cup was inserted, properly covered, and seated stably. The liner was placed, and after rasping again, the neck length was fitted, the average length with correct alignment of the joint components, and a stable joint with a full range of motion was confirmed. Sizers were removed, the stem was inserted, and the head was seated. The dislocation was reduced (**Fig. 2**). A drain was placed in the joint, layered sutures were applied, and a sterile dressing was used. Postoperative and intraoperative treatment proceeded without complications. On August 18, 2016, the patient, in good general and local condition, was discharged home with recommendations: walking with crutches and unloading the operated limb for 6 weeks, performing prescribed rehabilitation exercises, changing dressings every 2 days, reporting for suture removal on days 10-12 post-surgery, using thromboprophylaxis (Clexane 0.4 ml 1x1 subcutaneously for 35 days), taking pain relief medications as needed, and attending a follow-up appointment at the orthopedic clinic in 6 weeks based on the issued referral.



**Figure 2.** Follow-up X-ray after implantation of the total hip arthroplasty – normal image. Non-cemented prosthesis with Pressfit acetabular shell and polyethylene liner. The Pressfit stem is inserted on the femoral shaft.

### **Revision surgery of the hip endoprosthesis due to mechanical wear**

In 2021, the same patient, now 38 years old, was admitted to the same department due to the wear of the polyethylene insert in THA. Primary diagnosis: T84.0 – Mechanical complication of internal joint prostheses (**Figs. 3 and 4**). The patient was conscious and in logical contact. They had a normal body structure, clean skin without pathological eruptions, and overly developed subcutaneous tissue, with no swelling. The neck exhibited normal mobility, was painless, and lymph nodes were not enlarged. The chest was well-formed, with an efficient circulatory and respiratory system during the examination. Lung fields were auscultated with a normal vesicular murmur, and the respiratory rate was 16/min. The heart rate was regular at 80/min, with tones properly accentuated, and blood pressure measured 140/80. The abdomen was well-formed at the chest level, palpation revealed no pathological resistance, and there was lively peristalsis. Additionally, there were negative findings for Chelmonski's sign, Jaworski's sign, and bilateral Goldflam's sign. The nervous system showed no evident pathology, and there were no signs of meningeal irritation. The patient had previously undergone canal treatment. Their height was 176 cm, and the body weight was 100 kg. The skin was clean without eruptions, and there were no noticeable neurological or vascular deficits in the limb periphery. A scar from the surgery was observed. The range of hip motion was up to 110 degrees, with external rotation being painless and accompanied by a palpable skipping sensation.



**Figure 3.** X-ray showing minor wear at the apex of the polyethylene liner before the revision surgery.



**Figure 4.** Mechanically damaged polyethylene liner of the acetabular prosthesis.

The patient was qualified for surgical treatment. On March 9, 2021, a revision surgery of the left hip and replacement of the polyethylene insert and head of the THA were performed. Perioperative antibiotic therapy was administered (Cefazolin 2g iv. 30 minutes before the start of the procedure), along with low molecular weight heparin for thromboprophylaxis throughout the hospital stay. A sample for culture was collected during the surgery. Rehabilitation according to the established protocol commenced on the first postoperative day. Intra- and postoperative treatment proceeded without complications. On March 21, 2021, the patient, in good general and local condition, was discharged from the clinic (**Fig. 5**). Subsequent radiological examinations revealed a slight re-wear at the peak of the polyethylene insert, similar to the previous damage but to a lesser extent. This increased the attentiveness of the treating physician and resulted in recommendations to reduce the load on the insert and decrease the intensity of physical exertion (**Fig. 6**).



**Figure 5.** Follow-up X-ray after the replacement of the polyethylene liner of the acetabular prosthesis – normal image.





**Figure 6.** Follow-up X-ray showing a worn polyethylene liner of the acetabular prosthesis – the patient qualified for revision surgery to replace the polyethylene liner of the acetabular component.

### **Revision surgery of the hip endoprosthesis due to prosthesis dislocation**

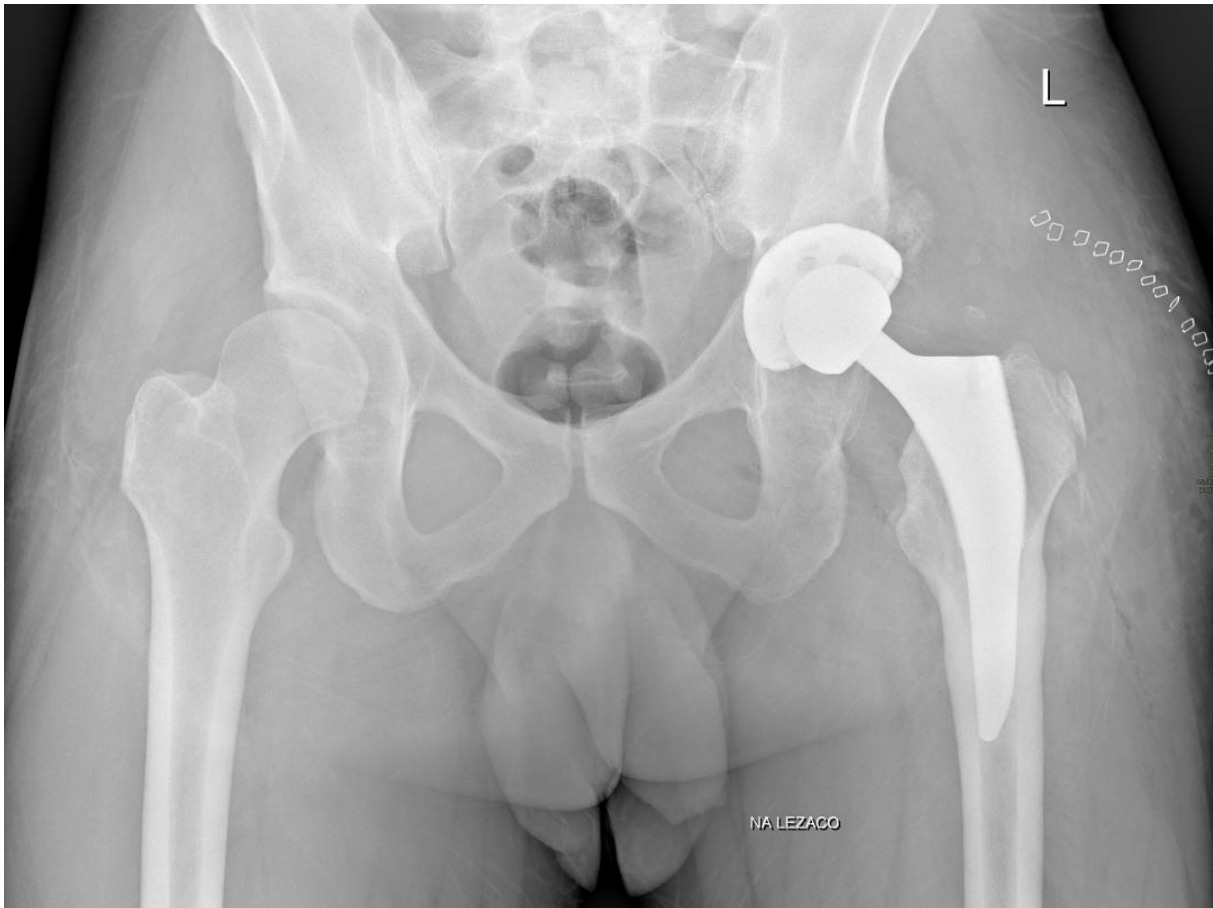
In 2022, the same patient, now 39 years old, was admitted to the same department due to dislocation of the left THA with damage to the acetabular implant. Primary diagnosis: T84.0 – Mechanical complication of internal joint prostheses (**Fig. 7**). The femoral component was displaced superiorly by approximately 28 mm, wedged about 5 mm into the pelvic bone in the region of the supraacetabular groove, resulting in a bone defect measuring 25 x 27 mm. Periosteal reactions and features of heterotopic ossification around the femoral head were observed. At the lower pole of the acetabular component, a band of bone structure attenuation up to approximately 7 mm wide, possibly indicative of loosening, was visible. Additionally, radiological signs of L5/S1 discopathy with a vacuum phenomenon were detected, along with a 10 mm anterior slip of L5 with bilateral spondylolysis.



**Figure 7.** Worn polyethylene liner and worn acetabular shell with dislocation of the head and stem upwards – the patient qualified for another revision of the entire acetabular component.

The patient was eligible for surgical treatment. On November 18, 2022, a repeated (second) THA revision surgery was performed, involving the replacement of the acetabular implant, polyethylene insert, and femoral head of the endoprosthesis. Medical procedures performed during the surgery: 00.703 – Revision hip joint operation – replacement of the acetabulum and femoral head prosthesis. Using a posterior-lateral incision in the scar from the previous left hip joint surgery, the surgical team layeredly prepared, predominantly sharply, to access the THA components. The area was extensively affected by metallosis, with dislocation of the endoprosthesis, forming a pseudopelvis on the pelvic bone at the level of the anatomical acetabulum, loosening, and partial fragmentation of the polyethylene insert. There was mechanical damage to the acetabular implant with a defect in the upper part corresponding to the size of the THA head. Bacterial cultures were collected for examination. Most of the tissues affected by metal infiltration were excised, exposing the entire acetabulum. The polyethylene insert was removed, and the endoprosthesis head was taken off. The acetabular implant was detached from the pelvis using chisels, preserving the bone bed. The acetabulum was enlarged to a size 56 using reamers, followed by abundant pulsatile irrigation, and a provisional implant size 58 was inserted (it remained stable). The final acetabular implant was then placed (remaining stable). The defect in the upper edge of the acetabulum was filled with frozen cancellous bone graft. A trial insert of size 58/36 and a matched head of size 36/+8 were implanted. The prosthetic components were assembled tightly. The provisional elements were removed, the acetabular mounting hole was sealed, and the final

components were implanted according to the measurements. After achieving stability with the reduction, the prosthesis was stabilized (**Fig. 8**). Bleeding was checked, and wound irrigation was performed. A suction drain was placed in the wound bed, and layered sutures + LIA were applied. The entire area was secured with a dressing. Rehabilitation began postoperatively following the established protocol. The intra- and postoperative treatment proceeded without complications. The patient, in good general and local condition, was discharged from the hospital on November 22, 2022. As of now, the patient's condition is regularly monitored at the local orthopedic outpatient clinic.



**Figure 8.** Follow-up X-ray after replacement with a larger acetabular shell along with a polyethylene liner, seated using the Pressfit method – verification of the correct image.

### **Implication for clinical practice**

The premature wear of THA poses a significant clinical challenge, generating diverse implications for the patient. Among the most crucial aspects are the painful symptoms, which can be significant and may affect reduced daily activity and decreased quality of life. Functional limitations, associated with the loss of hip joint stability, lead to difficulties in performing basic activities, further lowering the quality of life (QOL). The necessity of undergoing revision THA not only impacts the patient's physical aspects but also has psychosocial implications, inducing stress, anxiety, and concerns related to the next stage of treatment. Furthermore, clinical implications also encompass healthcare costs, both for the patient and the healthcare system. The treatment process, rehabilitation, hospitalization, and post-hospital care generate significant expenses that can affect the financial stability of both the patient and medical institutions or national healthcare systems.

Long-term treatment and rehabilitation after revision hip joint surgery require a coordinated approach from medical staff, which additionally increases costs and burdens the resources of the healthcare system. It is also worth emphasizing that the process of treating premature THA wear is associated with the possibility of surgical complications and a prolonged recovery period. The patient may need long-term care and monitoring from specialists to ensure effective rehabilitation and minimize potential complications. The entirety of this process affects the overall health picture of the patient, both physically and mentally, making it challenging to achieve full functionality and improve the QOL of patients, especially young individuals in their productive years.

The work by Krumme et al. [20] emphasizes that total hip arthroplasty (THA) is considered one of the most significant achievements in 20th-century surgery. Future projections indicate that by 2030, the number of primary THAs will increase by 171%, and revision THAs will increase by 142% during the same period. While intraoperative and postoperative complications are not common, when they occur, they can significantly increase the risk of deteriorating the patient's health. Understanding the unique anatomy and needs of each patient raises awareness among surgeons about the necessity of avoiding damage to soft tissues or bones, optimizing the placement of the prosthesis, and reducing the risk of infection. Researchers draw attention to common causes of early revision of hip endoprostheses, such as periprosthetic joint infection, sciatic or femoral nerve injury, damage to hip abductors, gluteus medius, and minimus muscles. The authors present specific technical strategies aimed at avoiding these complications related to the technical aspects of THA surgery, such as improper cup positioning or inadequate spinopelvic parameters, as well as psoas or trochanteric impingement, aseptic loosening, and osteolysis. The application of a systematic approach to primary THA and the use of these techniques will assist surgeons in avoiding complications in revision THA.

The recent study by Descamps et al. [21] from 2023, published in the prestigious *Journal of Orthopaedics and Traumatology*, aimed to examine the impact of immediate revision THA on subsequent infection and complication rates. The researchers utilized data from an institutional database, identifying 14,076 primary THAs performed between 2010 and 2020. Out of these, 42 underwent immediate revision. Infections were assessed 2 years after the primary total hip arthroplasty, and the study meticulously analyzed the causes and types of revision, duration of both primary and revision surgeries, outcomes of the hospital infection control program, implant type, changes in implants, complications, and preoperative and intraoperative antibiotic prophylaxis. The study results revealed no infections within 2 years after primary THA. The primary reasons for immediate revision were limb length discrepancies (88%) and dislocations (7.1%). In most cases, limb length discrepancies were present before revision. The average duration of surgery was  $48 \pm 14$  minutes for the primary procedure and  $23.6 \pm 9$  minutes for revision THA. The time between the first incision and skin closure ranged from 1 to 3 hours. None of the patients were extubated between the two procedures. Two patients had a hospital infection control program score of 2, 13 had a score of 1, and 27 had a score of 0. The study's conclusions indicate that immediate revision is safe for correcting clinical and radiological disturbances without an increased risk of complications or infections.

On the other hand, Shen et al. [22] in their cohort study involving 402 patients, analyzed the etiology, complications, and the risk of early aseptic revision THA within 90 days. Patient data were compared with a control group of individuals with previous primary joint replacements. Individuals undergoing revision due to infection, those with less than a 2-year observation period, and those below 18 years of age were excluded. Complication rates within 90 days and the rate of repeat revision within 2 years were significantly higher in the

early revision group. The most common reasons necessitating revision THA were dislocation, fracture, and mechanical loosening of the prosthesis. The study's conclusions affirmed that early aseptic revision THA is associated with a significantly higher risk of complications within 90 days and a rate of repeat revision within 2 years compared to the control group of patients without THA revision.

Providing an intriguing perspective based on 29 years of experience, the team of Shon et al. [23], exhaustively described the evolution of THA concerning the procedure's effectiveness and the durability of materials. Researchers emphasize that key areas for the future of THA include the use of superior materials, including alternative bearings (highly cross-linked polyethylene or ceramics), which yield excellent results in the medium and long term. The current direction of development focuses on improving the functional outcomes of prostheses, taking into account the lifestyle of individual patient populations and predicting the intended use of the prosthesis, contributing to the personalization of THA utility. Surgeons specializing in THA must be aware of advancements in surgical techniques, implant selection, and the continuous improvement of functional outcomes to maximize the durability of the prosthesis and prevent premature wear. Currently considered a groundbreaking procedure in the history of medicine, THA confirms its effectiveness in treating degenerative hip joint conditions. Studies affirm the application of current THA as a viable option, even for young patients with advanced symptoms. The future of THA should focus not only on improving physical function but also on daily QOL.

It is worth noting the conclusions drawn from the scoping review conducted by researchers under the leadership of Negm et al. [24], who attempted to identify the causes of mechanical damage to THA in patients aged 55 years or younger. No structural causes or risk factors related to participation in sports activities or BMI were identified. Prosthetic injuries pose a technical challenge requiring specialized approaches, which can be difficult even for experienced surgeons. It should be noted that the functional outcome is often worse for this group of patients after surgery compared to those undergoing revision due to prosthesis loosening. This, in turn, indicates that patients aged 55 or younger qualifying for THA should undergo thorough preoperative assessment, taking into account risk factors such as sports activity or BMI. Patients and potential THA candidates should be effectively educated about possible complications and the need for long-term prosthesis monitoring. On the other hand, scientific research and developmental efforts aimed at technological improvements in THA should consider the specific needs of younger, more active patients who exert more stress on prostheses, with the goal of minimizing the risk of premature wear, reducing mechanical damage, and increasing implant durability.

## **Summary**

Certainly, premature wear of THA is a rarely described mechanical complication following such procedures, especially when it occurs with dislocation of the same hip within a one-year interval from the first revision THA surgery. This presents a dual complicated mechanical damage to the same prosthesis in a relatively short period. This wear can lead to critical dislocation and misalignment of the prosthesis, resulting in loss of prosthesis function, pain, joint instability, and the need for surgical revision. Several potential causes of material wear have been identified, especially in the area where the components of the prosthesis come into contact. In the case of prostheses containing metallic, ceramic, or polyethylene components, this process can be accelerated. Improper placement of THA during the initial surgery can lead to uneven distribution of loads, which, in turn, may result in faster material wear and deterioration of THA components. If THA components are not properly matched,

excessive friction and wear may occur, especially in the area of contact between the prosthesis ball and the socket.

Excessive intensity in the rehabilitation process and the desire for a quick return to full functionality after THA pose a risk of mechanical damage to prosthesis components. In the early postoperative period, it is necessary to exercise moderation and caution to allow proper tissue healing, prosthesis stabilization, and to avoid excessive joint loading. Intensive exercises and loading can lead to increased wear of materials such as metal, ceramics, or polyethylene used in prosthesis components. Inappropriately high loads can also cause improper seating of the prosthesis, which, in turn, may disturb the biomechanical axis of the joint and contribute to mechanical damage to THA.

In the case of confirmed premature prosthesis wear, the medical team may consider various treatment options, especially immediate revision surgery. Modifying the rehabilitation plan by adjusting it to the changing clinical situation of the patient, aiming to avoid excessive loading, and focusing on strengthening exercises with minimal stress on the prosthesis is a top priority. Modifications or restrictions on certain activities that may lead to excessive prosthesis wear are introduced. In some cases, pain relievers or anti-inflammatory medications may be administered to alleviate symptoms and control the inflammatory process. In the case of advanced prosthesis wear, consulting with an orthopedic surgeon to assess the need for revision surgery may be necessary. In the initial phase, a key aspect is differentiating between mechanical and aseptic complications after THA.

**Author's Contribution:**

Conceptualization, WSz, and WT; methodology, WSz, and WT; XX; writing - rough preparation, WSz; writing - review and editing, WT; visualization, WSz; supervision, WT; project administration, WSz; receiving funding, WT All authors have read and agreed with the published version of the manuscript.

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