e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 454-460

Original Research Article

Postoperative Complications Following Total Hip Arthroplasty: A Retrospective Analysis

Rajkumar Ashvinbhai Amrutiya[1], Parth Bharatkumar Patel[2], Dev S. Parikh[3], Ujwala Bhanarkar[4]

[1]Ex-Resident, Department of Orthopaedics, GCS Medical College, Hospital and Research Centre, Ahmedabad, Gujarat, India

[2]Professor, Department of Orthopaedics, Nootan Medical College & Research Centre, Visnagar, Gujarat, India

[3]3rd Year Resident, Department of Orthopaedics, GCS Medical College, Hospital and Research Centre, Ahmedabad, Gujarat, India

[4]Associate Professor, Department of Anatomy, All India Institute of Medical Sciences, Kalyani, West Bengal, India

Received: 05-12-2025 / Revised: 15-01-2026 / Accepted: 10-02-2026

Corresponding author: Dr. Dev S. Parikh

Conflict of interest: Nil

Abstract

Background: Total hip arthroplasty (THA) is among the most frequently performed orthopedic procedures worldwide, providing substantial improvements in pain relief and functional restoration for patients with end-stage hip joint disease. Despite significant advances in surgical techniques, implant technology, and perioperative care protocols, postoperative complications remain a considerable clinical concern affecting patient outcomes, healthcare utilization, and long-term prosthetic survivorship. Comprehensive characterization of complication patterns and their associated risk factors is essential for optimizing patient selection and perioperative management strategies.

Methods: This retrospective cohort study analyzed medical records of 712 consecutive patients who underwent primary THA at a tertiary orthopedic center. Demographic variables, surgical parameters, comorbidity profiles, and postoperative complications occurring within 90 days and one year were systematically documented. Univariate and multivariable logistic regression analyses were performed to identify independent risk factors associated with overall and specific complications.

Results: The overall 90-day complication rate was 14.3% (n = 102), while the one-year complication rate was 18.8% (n = 134). The most frequent complications included periprosthetic joint infection (PJI; 2.9%), venous thromboembolism (VTE; 3.4%), dislocation (3.1%), and periprosthetic fracture (1.8%). Independent risk factors for overall complications included age ≥75 years (OR: 2.14; 95% CI: 1.38–3.32; p = 0.001), BMI ≥35 kg/m² (OR: 2.47; 95% CI: 1.51–4.04; p < 0.001), diabetes mellitus (OR: 1.89; 95% CI: 1.19–3.01; p = 0.007), ASA classification ≥III (OR: 2.08; 95% CI: 1.32–3.28; p = 0.002), and operative time exceeding 120 minutes (OR: 1.76; 95% CI: 1.12–2.78; p = 0.015).

Conclusion: Postoperative complications following primary THA occur in a clinically significant proportion of patients. Modifiable risk factors including obesity and prolonged operative time, alongside non-modifiable factors such as advanced age and comorbidity burden, significantly predict adverse outcomes. Targeted perioperative optimization strategies may reduce complication rates and improve overall surgical outcomes.

Keywords: Total Hip Arthroplasty; Postoperative Complications; Periprosthetic Joint Infection; Venous Thromboembolism; Dislocation; Risk Factors; Retrospective Study.

DOI: 10.25258/ijcpr.18.2.71

Introduction

Total hip arthroplasty represents one of the most successful and cost-effective surgical interventions in modern medicine, providing substantial pain relief, functional improvement, and enhanced quality of life for patients suffering from disabling hip joint pathology [1]. Globally, more than one million THA procedures are performed annually, with volumes projected to increase significantly over the coming decades driven by population aging, rising prevalence of osteoarthritis, and expanding surgical indications [2]. The procedure has evolved considerably since its pioneering

development by Sir John Charnley in the 1960s, with contemporary innovations in bearing surfaces, fixation methods, surgical approaches, and perioperative care pathways contributing to improved outcomes and prosthetic longevity [3].

Despite these advances, postoperative complications following THA remain a persistent clinical challenge. Reported complication rates vary considerably across studies, ranging from 5% to 26% depending on the definitions employed, follow-up duration, and patient population characteristics [4]. Major complications include periprosthetic joint infection, venous thromboembolism, prosthetic dislocation, periprosthetic fracture, aseptic loosening, nerve injury, and heterotopic ossification, each carrying distinct pathophysiological mechanisms, temporal patterns, and management implications [5]. These adverse events not only compromise individual patient outcomes but also impose substantial economic burden on healthcare systems through prolonged hospitalization, revision surgery, and rehabilitation requirements [6].

Periprosthetic joint infection constitutes one of the most devastating complications, occurring in approximately 1–3% of primary THA cases, with significant morbidity, mortality, and healthcare costs associated with its treatment [7]. Venous thromboembolism, encompassing both deep vein thrombosis and pulmonary embolism, represents another major concern despite routine thromboprophylaxis protocols, with reported incidence rates of 1.5–5% in contemporary series [8]. Prosthetic dislocation, occurring in 1–5% of primary procedures, remains a leading cause of early revision surgery and patient dissatisfaction [9].

The identification and characterization of modifiable and non-modifiable risk factors for postoperative complications have been the subject of extensive investigation. Patient-related factors including advanced age, obesity, diabetes mellitus, immunosuppression, cardiovascular disease, and American Society of Anesthesiologists (ASA) physical status classification have been consistently associated with increased complication risk [10]. Surgical factors such as operative approach, fixation type, operative time, surgeon experience, and institutional procedural volume have similarly been implicated [11]. However, the relative contributions and interactions among these variables remain incompletely characterized, particularly within specific institutional contexts and contemporary practice environments [12].

Recent studies have emphasized the importance of enhanced recovery after surgery (ERAS) protocols, preoperative medical optimization, and patient-specific risk stratification in mitigating complication rates [13]. Nevertheless, considerable variability persists in complication profiles across centers, suggesting that institution-specific analyses remain valuable for identifying local patterns, benchmarking performance, and guiding quality improvement initiatives [14].

The aim of this study was to comprehensively characterize the incidence, spectrum, and timing of postoperative complications following primary THA in a single high-volume tertiary center, and to identify independent patient-related and surgery-related risk factors associated with adverse outcomes within a 12-month postoperative period.

Materials and Methods

Study Design and Setting: This retrospective cohort study was conducted at the Department of Orthopedic at tertiary care hospital.

Study Population: All consecutive adult patients (aged ≥18 years) who underwent elective primary unilateral THA between January 2018 and December 2023 were identified through the institutional surgical database. Inclusion criteria comprised patients undergoing THA for primary osteoarthritis, avascular necrosis, femoral neck fracture (delayed arthroplasty), or inflammatory arthropathy. Exclusion criteria included revision arthroplasty, bilateral simultaneous procedures, tumor-related prosthetic reconstruction, patients with incomplete medical records, and those lost to follow-up prior to the 12-month postoperative assessment.

Data Collection: Demographic and clinical variables were systematically extracted from electronic medical records and operative reports. Variables collected included age, sex, body mass index (BMI), smoking status, alcohol use, comorbidities (diabetes mellitus, hypertension, cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, and autoimmune conditions), ASA classification, preoperative hemoglobin level, and preoperative Harris Hip Score (HHS). Surgical variables recorded included primary diagnosis, surgical approach (posterior, direct anterior, or lateral), fixation type (cemented, uncemented, or hybrid), implant bearing surface, operative time, estimated blood loss, transfusion requirement, type of anesthesia, and surgeon seniority level.

Outcome Measures: The primary outcome was the occurrence of any postoperative complication within 90 days and within one year of surgery. Complications were classified as medical or surgical. Surgical complications included periprosthetic joint infection (defined per Musculoskeletal Infection Society criteria), prosthetic dislocation, and periprosthetic fracture, and wound dehiscence, hematoma requiring

drainage, nerve palsy, and heterotopic ossification requiring intervention. Medical complications included venous thromboembolism (deep vein thrombosis confirmed by duplex ultrasonography or pulmonary embolism confirmed by computed tomography pulmonary angiography), cardiovascular events (myocardial infarction, cerebrovascular accident, or acute cardiac arrhythmia), acute kidney injury, pneumonia, urinary tract infection, and mortality.

Perioperative Protocols: All patients received standardized perioperative care including preoperative medical optimization assessment, single-dose intravenous antibiotic prophylaxis (cefazolin 2 g) administered within 60 minutes prior to incision, chemical thromboprophylaxis with low-molecular-weight heparin for 35 days postoperatively, and standardized ERAS pathways including multimodal analgesia, early mobilization within 24 hours, and structured physiotherapy programs.

Statistical Analysis: Continuous variables were expressed as mean ± standard deviation or median with interquartile range as appropriate, and compared between groups using independent samples t-tests or Mann-Whitney U tests. Categorical variables were presented as frequencies and percentages and compared using chi-square tests or Fisher's exact tests. Variables demonstrating significance at $p < 0.10$ on univariate analysis were entered into a multivariable logistic regression model using backward stepwise elimination to identify independent predictors of overall complications. Model calibration was assessed using the Hosmer-Lemeshow goodness-of-fit test, and discrimination was evaluated by the area under the receiver operating characteristic curve (AUC). All statistical analyses were two-tailed with significance set at $p < 0.05$, performed using SPSS version 28.0 (IBM Corp., Armonk, NY, USA).

Results

Study Population Characteristics: A total of 786 primary THA procedures were performed during the study period. After applying exclusion criteria, 712 patients were included in the final analysis (retention rate: 90.6%). The mean age was 67.4 ± 10.8 years, with 412 patients (57.9%) being female. The mean BMI was 29.3 ± 5.4 kg/m². The primary surgical indication was osteoarthritis in 548 cases (77.0%), avascular necrosis in 82 (11.5%), femoral neck fracture in 51 (7.2%), and inflammatory arthropathy in 31 (4.4%). The posterior approach was used in 438 cases (61.5%), the direct anterior approach in 196 (27.5%), and the lateral approach in 78 (11.0%). Uncemented fixation was employed in 524 procedures (73.6%). Detailed baseline characteristics stratified by complication status are presented in Table 1.

Table 1: Baseline Patient and Surgical Characteristics Stratified by Complication Status (Within One Year)

Variable	Complications (n = 134)	No Complications (n = 578)	p-value
Age (years), mean ± SD	71.6 ± 9.4	66.4 ± 10.7	< 0.001
Age ≥75 years, n (%)	58 (43.3)	142 (24.6)	< 0.001
Female sex, n (%)	82 (61.2)	330 (57.1)	0.381
BMI (kg/m²), mean ± SD	31.8 ± 5.9	28.7 ± 5.1	< 0.001
BMI ≥35 kg/m², n (%)	42 (31.3)	84 (14.5)	< 0.001
Current smoker, n (%)	32 (23.9)	88 (15.2)	0.014
Diabetes mellitus, n (%)	46 (34.3)	112 (19.4)	< 0.001
Hypertension, n (%)	78 (58.2)	286 (49.5)	0.065
Cardiovascular disease, n (%)	34 (25.4)	92 (15.9)	0.009
CKD (eGFR <60), n (%)	18 (13.4)	42 (7.3)	0.019
ASA ≥III, n (%)	64 (47.8)	158 (27.3)	< 0.001
Preop hemoglobin (g/dL), mean ± SD	12.1 ± 1.6	13.2 ± 1.4	< 0.001
Posterior approach, n (%)	92 (68.7)	346 (59.9)	0.055
Operative time (min), mean ± SD	108.4 ± 28.6	89.2 ± 22.4	< 0.001
Operative time >120 min, n (%)	44 (32.8)	102 (17.6)	< 0.001
Estimated blood loss (mL), mean ± SD	482 ± 218	362 ± 174	< 0.001
Transfusion required, n (%)	38 (28.4)	72 (12.5)	< 0.001

Complication Spectrum and Timing: The overall one-year complication rate was 18.8% (n = 134), with 102 complications (14.3%) occurring within the first 90 days and an additional 32 complications (4.5%) identified between 91 days and one year. The detailed complication spectrum is presented in Table 2.

Table 2: Spectrum and Timing of Postoperative Complications (N = 712)

Complication	0–90 Days, n (%)	91–365 Days, n (%)	Total, n (%)
Surgical Complications			
Periprosthetic joint infection	12 (1.7)	9 (1.3)	21 (2.9)
Prosthetic dislocation	16 (2.2)	6 (0.8)	22 (3.1)
Periprosthetic fracture	8 (1.1)	5 (0.7)	13 (1.8)
Wound complications	10 (1.4)	2 (0.3)	12 (1.7)
Hematoma requiring drainage	6 (0.8)	0 (0.0)	6 (0.8)
Nerve palsy	5 (0.7)	1 (0.1)	6 (0.8)
Heterotopic ossification (symptomatic)	0 (0.0)	4 (0.6)	4 (0.6)
Medical Complications			
Deep vein thrombosis	16 (2.2)	2 (0.3)	18 (2.5)
Pulmonary embolism	6 (0.8)	0 (0.0)	6 (0.8)
Cardiovascular events	8 (1.1)	1 (0.1)	9 (1.3)
Pneumonia	6 (0.8)	0 (0.0)	6 (0.8)
Urinary tract infection	8 (1.1)	1 (0.1)	9 (1.3)
Acute kidney injury	4 (0.6)	0 (0.0)	4 (0.6)
Mortality (all-cause)	3 (0.4)	1 (0.1)	4 (0.6)
Total events	102 (14.3)*	32 (4.5)*	134 (18.8)*

***Some patients experienced more than one complication; totals reflect unique patients with any complication.**

Independent Risk Factors for Complications: Multivariable logistic regression analysis identified five independent predictors of overall one-year postoperative complications, as shown in Table 3. The model demonstrated adequate calibration (Hosmer-Lemeshow $p = 0.412$) and acceptable discrimination (AUC = 0.78; 95% CI: 0.74–0.82).

Table 3: Multivariable Logistic Regression: Independent Predictors of One-Year Postoperative Complications

Risk Factor	Adjusted OR	95% CI	p-value
Age ≥75 years	2.14	1.38–3.32	0.001
BMI ≥35 kg/m²	2.47	1.51–4.04	< 0.001
Diabetes mellitus	1.89	1.19–3.01	0.007
ASA classification ≥III	2.08	1.32–3.28	0.002
Operative time >120 minutes	1.76	1.12–2.78	0.015
Current smoking	1.52	0.94–2.46	0.087
Cardiovascular disease	1.44	0.88–2.36	0.148
Preoperative anemia (Hb <12 g/dL)	1.58	0.98–2.54	0.061
Posterior approach	1.34	0.86–2.10	0.196

Discussion

This retrospective analysis of 712 primary THA procedures provides a comprehensive characterization of postoperative complication patterns and associated risk factors within a contemporary institutional practice environment. The observed overall one-year complication rate of 18.8% falls within the range reported in large-scale registry and database studies, affirming that complications following THA remain a clinically significant concern despite substantial improvements in perioperative care [15]. Importantly, the predominance of complications within the first 90 days (75.4% of total events) underscores the critical importance of early postoperative surveillance and rapid recognition protocols. The periprosthetic joint infection rate of 2.9% in our cohort is slightly above the commonly cited range of 1–2% reported in national registry data [16]. This marginally elevated rate may reflect the tertiary referral nature of our institution, which treats a disproportionate number of patients with complex comorbidity profiles, and the inclusion of both superficial and deep infections within our definition. Our findings are consistent with the work of Pulido et al., who reported a PJI rate of 2.2% in a large single-center series and identified diabetes mellitus and obesity as primary modifiable risk factors [17].

The association between obesity (BMI ≥35 kg/m²) and complications identified in our multivariable analysis aligns with extensive evidence linking adiposity to increased surgical site infection risk, wound complications, and mechanical implant-related adverse events [18]. The prosthetic dislocation rate of 3.1% is consistent with

contemporary reports, particularly given the predominant use of the posterior approach (61.5%) in our cohort. The posterior approach has been historically associated with higher dislocation rates compared to the direct anterior and anterolateral approaches, attributed to disruption of the posterior capsule and short external rotator muscles [19]. Recent adoption of capsular repair techniques and larger femoral head sizes has reduced this differential, though it remains a relevant consideration in surgical planning. Zijlstra et al. demonstrated that the use of 36-mm femoral heads and posterior capsular repair reduced dislocation rates to below 2% in their series [20].

The venous thromboembolism rate of 3.4% (including 2.5% DVT and 0.8% PE) is noteworthy despite universal thromboprophylaxis administration. This finding resonates with data from the EPCAT II trial and subsequent meta-analyses, which have demonstrated that while extended thromboprophylaxis significantly reduces VTE incidence, residual risk remains, particularly in patients with advanced age, obesity, and reduced postoperative mobility [21]. The implementation of ERAS protocols emphasizing early mobilization, as practiced in our institution, has been shown to contribute to VTE risk reduction, though its independent contribution is difficult to isolate from concurrent pharmacological prophylaxis effects [22].

The identification of advanced age (≥75 years), elevated BMI, diabetes mellitus, higher ASA classification, and prolonged operative time as independent predictors of complications corroborates findings from multiple large database analyses. Singh et al., utilizing the National Surgical Quality Improvement Program (NSQIP) database, reported similar associations, emphasizing the compounding effect of multiple comorbidities on complication risk [23].

The association between prolonged operative time and complications likely reflects a combination of increased tissue exposure, greater blood loss, elevated infection risk, and the potential confounding effect of surgical complexity and technical difficulty [24].

The all-cause mortality rate of 0.6% (four patients) within one year is consistent with contemporary benchmark data. A systematic review by Hunt et al. reported 90-day mortality rates ranging from 0.2% to 0.7% following elective primary THA, with cardiovascular events and pulmonary embolism representing the predominant causes [25]. In our cohort, two of the four deaths were attributed to cardiovascular events, one to fatal pulmonary embolism, and one to sepsis secondary to PJI, reflecting the typical mortality profile in this population. Several study limitations must be acknowledged. The retrospective design introduces inherent risks of information bias and incomplete ascertainment of complications, particularly those managed at external facilities. The single-center design, while providing institutional consistency, may limit generalizability to other practice settings and patient populations.

The non-randomized allocation of surgical approaches and fixation techniques introduces potential confounding that cannot be fully addressed through statistical adjustment alone. Furthermore, functional outcomes such as Harris Hip Score improvements and patient-reported outcome measures were not systematically analyzed in this study, limiting the ability to correlate complication occurrence with functional recovery trajectories [26].

Conclusion

This comprehensive retrospective analysis demonstrates that postoperative complications following primary total hip arthroplasty affect approximately one in five patients within the first postoperative year, with the majority of adverse events concentrated within the initial 90-day period. Periprosthetic joint infection, venous thromboembolism, and prosthetic dislocation represent the most clinically significant complications encountered.

Advanced age, morbid obesity, diabetes mellitus, high ASA classification, and prolonged operative time were identified as independent predictors of adverse outcomes. These findings emphasize the critical importance of rigorous preoperative risk stratification, targeted optimization of modifiable risk factors including weight management and glycemic control, vigilant early postoperative monitoring, and ongoing refinement of surgical techniques and perioperative care protocols. Implementation of comprehensive, multidisciplinary preoperative optimization programs and institution-specific complication surveillance systems may contribute to meaningful reductions in complication rates and improvement in overall quality of care for patients undergoing total hip arthroplasty.

References

1. Learmonth ID, Young C, Rorabeck C. The operation of the century: total hip replacement. Lancet. 2007;370(9597):1508–1519. DOI: 10.1016/S0140-6736(07)60457-7. PMID: 17964352.
2. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. 2007; 89(4):780–785. DOI: 10.2106/JBJS.F.00222. PMID: 17403800.

3. Knight SR, Aujla R, Biswas SP. Total hip arthroplasty—over 100 years of operative history. Orthop Rev (Pavia). 2011;3(2):e16. DOI: 10.4081/or.2011.e16. PMID: 22355482.
4. Husted H, Otte KS, Kristensen BB, Ørsnes T, Kehlet H. Readmissions after fast-track hip and knee arthroplasty. Arch Orthop Trauma Surg. 2010;130(9):1185–1191. DOI: 10.1007/s00402-010-1131-2. PMID: 20535614.
5. Pivec R, Johnson AJ, Mears SC, Mont MA. Hip arthroplasty. Lancet. 2012;380(9855):1768–1777. DOI: 10.1016/S0140-6736(12)60607-2. PMID: 23021846.
6. Bozic KJ, Katz P, Cisternas M, Ono L, Ries MD, Showstack J. Hospital resource utilization for primary and revision total hip arthroplasty. J Bone Joint Surg Am. 2005;87(3):570–576. DOI: 10.2106/JBJS.D.02121. PMID: 15741624.
7. Tande AJ, Patel R. Prosthetic joint infection. Clin Microbiol Rev. 2014;27(2):302–345. DOI: 10.1128/CMR.00111-13. PMID: 24696437.
8. Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, et al. Prevention of VTE in orthopedic surgery patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012;141(2 Suppl):e278S–e325S. DOI: 10.1378/chest.11-2404. PMID: 22315265.
9. Bozic KJ, Kurtz SM, Lau E, Ong K, Vail TP, Berry DJ. The epidemiology of revision total hip arthroplasty in the United States. J Bone Joint Surg Am. 2009;91(1):128–133. DOI: 10.2106/JBJS.H.00155. PMID: 19122087.
10. Memtsoudis SG, Besculides MC, Gaber L, Liu S, González Della Valle A. Risk factors for pulmonary embolism after hip and knee arthroplasty: a population-based study. Int Orthop. 2009;33(6):1739–1745. DOI: 10.1007/s00264-008-0659-z. PMID: 18989668.
11. Pugely AJ, Martin CT, Gao Y, Mendoza-Lattes S, Callaghan JJ. Differences in short-term complications between spinal and general anesthesia for primary total knee arthroplasty. J Bone Joint Surg Am. 2013;95(3):193–199. DOI: 10.2106/JBJS.K.01682. PMID: 23269359.
12. Katz JN, Losina E, Barrett J, Phillips CB, Mahomed NN, Lew RA, et al. Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States Medicare population. J Bone Joint Surg Am. 2001;83(11):1622–1629. DOI: 10.2106/00004623-200111000-00002. PMID: 11701783.
13. Kehlet H, Thienpont E. Fast-track hip and knee arthroplasty. Lancet. 2013;381(9878):1600–1602. DOI: 10.1016/S0140-6736(13)61003-X. PMID: 23663938.
14. Parvizi J, Mui A, Purtill JJ, Sharkey PF, Hozack WJ, Rothman RH. Total joint arthroplasty: when do fatal or near-fatal complications occur? J Bone Joint Surg Am. 2007;89(1):27–32. DOI: 10.2106/JBJS.E.01443. PMID: 17200306.
15. Gwam CU, Mistry JB, Mohamed NS, Thomas M, Biber JC, Waters JH, et al. Current epidemiology of revision total hip arthroplasty in the United States: National Inpatient Sample 2009 to 2013. J Arthroplasty. 2017;32(7):2088–2092. DOI: 10.1016/j.arth.2017.02.046. PMID: 28336249.
16. Kurtz SM, Lau E, Watson H, Schmier JK, Parvizi J. Economic burden of periprosthetic joint infection in the United States. J Arthroplasty. 2012;27(8 Suppl):61–65.e1. DOI: 10.1016/j.arth.2012.02.022. PMID: 22554729.
17. Pulido L, Ghanem E, Joshi A, Purtill JJ, Parvizi J. Periprosthetic joint infection: the incidence, timing, and predisposing factors. Clin Orthop Relat Res. 2008;466(7):1710–1715. DOI: 10.1007/s11999-008-0209-4. PMID: 18421542.
18. Springer BD, Carter JT, McLawhorn AS, Scharf K, Roslin M, Kallies KJ, et al. Obesity and the role of bariatric surgery in the surgical management of osteoarthritis of the hip and knee: a review of the literature. Surg Obes Relat Dis. 2017;13(1):111–118. DOI: 10.1016/j.soard.2016.09.011. PMID: 27989522.
19. Kwon MS, Kuskowski M, Mulhall KJ, Macaulay W, Brown TE, Saleh KJ. Does surgical approach affect total hip arthroplasty dislocation rates? Clin Orthop Relat Res. 2006;447:34–38. DOI: 10.1097/01.blo.0000218746.84494.df. PMID: 16741471.
20. Zijlstra WP, De Hartog B, Van Steenbergen LN, Scheurs BW, Nelissen RGHH. Effect of femoral head size and surgical approach on risk of revision for dislocation after total hip arthroplasty. Acta Orthop. 2017;88(4):395–401. DOI: 10.1080/17453674.2017.1317515. PMID: 28440699.
21. Anderson DR, Dunbar M, Murnaghan J, Kahn SR, Gross P, Forsythe M, et al. Aspirin or rivaroxaban for VTE prophylaxis after hip or knee arthroplasty. N Engl J Med. 2018;378(8):699–707. DOI: 10.1056/NEJMoa1712746. PMID: 29466159.
22. Zhu S, Qian W, Jiang C, Ye C, Chen X. Enhanced recovery after surgery for hip and knee arthroplasty: a systematic review and meta-analysis. Postgrad Med J. 2017;93(1106):736–742. DOI: 10.1136/postgradmedj-2017-134991. PMID: 28751437.

23. Singh JA, Jensen MR, Harmsen WS, Gabriel SE, Lewallen DG. Cardiac and thromboembolic complications and mortality in patients undergoing total hip and total knee arthroplasty. Ann Rheum Dis. 2011;70(12): 2082–2088. DOI: 10.1136/ard.2010.148726. PMID: 22021865.
24. Peersman G, Laskin R, Davis J, Peterson MGE. Prolonged operative time correlates with increased infection rate after total knee arthroplasty. HSS J. 2006;2(1):70–72. DOI: 10.1007/s11420-005-0130-2. PMID: 187518 50.
25. Hunt LP, Ben-Shlomo Y, Clark EM, Dieppe P, Judge A, MacGregor AJ, et al. 90-day mortality after 409,096 total hip replacements for osteoarthritis, from the National Joint Registry for England and Wales: a retrospective analysis. Lancet. 2013;382(98 98):1097–1104. DOI: 10.1016/S0140-6736(13)61749-3. PMID: 24075049.
26. Rolfson O, Bohm E, Franklin P, Lyman S, Denissen G, Dawson J, et al. Patient-reported outcome measures in arthroplasty registries. Acta Orthop. 2016;87(Suppl 1):3–8. DOI: 10.1080/17453674.2016.1181815. PMID: 271 68175.