ClinicoEconomics and Outcomes Research Dovepress

Open Access Full Text Article ORIGINAL RESEARCH

Economic Burden, Length of Hospital Stay and Complication of Simultaneous versus Staged Bilateral Hip Arthroplasty: A Hospital Prospective Study

Maoye Shen[1], Wenxue Jiang[1], Ping Qian[1], Gaorui Cai[1], Xiaona Wu[1], Jinghua Wang[2], Xianjia Ning[2], Lixia Song[1]

[1]Department of Orthopedics, Shenzhen Third People's Hospital and the Second Hospital Affiliated with the Southern University of Science and Technology, Shenzhen, Guangdong, People's Republic of China; [2]Center of Clinical Epidemiology, Shenzhen Third People's Hospital and the Second Hospital Affiliated with the Southern University of Science and Technology, Shenzhen, Guangdong, People's Republic of China

Correspondence: Lixia Song, Department of Orthopedics, Shenzhen Third People's Hospital and the Second Hospital Affiliated with the Southern University of Science and Technology, 29 Bulan Road, Longgang District, Shenzhen, Guangdong Province, 518112, People's Republic of China, Tel + 86-755-61222333, Fax + 86-755-61238928, Email songlixia525529@163.com; Xianjia Ning, Center of Clinical Epidemiology, Shenzhen Third People's Hospital and the Second Hospital Affiliated with the Southern University of Science and Technology, 29 Bulan Road, Longgang District, Shenzhen, Guangdong Province, 518112, People's Republic of China, Tel +86-755-61222333, Fax +86-755-61238928, Email xjn0906@163.com

Background: Bilateral hip arthroplasty is a common surgical intervention for patients with bilateral hip disease. The decision between simultaneous versus staged procedures remains debated, primarily due to concerns over cost, postoperative recovery, and complication rates. This study aimed to evaluate the economic burden and clinical outcomes of simultaneous versus staged bilateral hip arthroplasty.

Methods: In this single-center, prospective study, patients who underwent bilateral hip replacement at XXX between 2021 and 2022 were included. Participants were divided into groups based on the surgical approach: simultaneous bilateral hip arthroplasty or staged bilateral hip arthroplasty. Data on costs, operation times, hospital stay lengths, and postoperative outcomes were collected and analyzed.

Results: A total of 57 patients were studied, with 45 undergoing simultaneous and 12 staged surgeries. The total cost for staged procedures was significantly higher, with a mean difference of 63,967.54 yuan compared to simultaneous procedures. No significant difference was found in prosthesis costs between the groups. Operation times and hospital stays did not significantly differ, with averages closely aligned between the simultaneous (operation time: 3.2 hours, hospital stay: 5 days) and staged groups (operation time: 3.4 hours, hospital stay: 5.2 days). The obesity rate was higher in the simultaneous group ($P < 0.05$).

Conclusion: Simultaneous bilateral hip arthroplasty appears to be an economically favorable option, with comparable perioperative and immediate postoperative outcomes to staged procedures. These insights have significant implications for clinical practice and policy-making, suggesting that simultaneous procedures can be safely implemented for appropriate patients, potentially optimizing healthcare resources.

Keywords: Bilateral Hip Arthroplasty, Simultaneous, Staged, Economic Burden, Clinical Outcomes

Introduction

Bilateral hip osteoarthritis affects up to 42% of individuals,[1] with about one-fourth of these patients eventually requiring bilateral total hip arthroplasty (THA).[2] The demand for primary THA in the United States is projected to surge by 71%, reaching 635,000 procedures by 2030,[3] signaling a significant economic impact, as evidenced by the estimated annual expenditures on hip arthroplasty treatments by German statutory health insurance, ranging between 1.4 and 1.6 billion euros from 2003 to 2009.[4] Bilateral hip arthroplasty is an established procedure for managing severe bilateral hip disease, and it has been widely studied in terms of both clinical outcomes and cost-effectiveness. The choice between simultaneous and staged

Received: 21 May 2024
Accepted: 3 October 2024
Published: 17 October 2024

procedures has sparked considerable debate within the orthopedic community, centered around concerns of increased operative times, potential for higher complication rates, and the economic burden associated with simultaneous procedures. Numerous studies have shown that simultaneous bilateral hip arthroplasty can offer advantages over staged procedures, including shorter overall hospital stays, lower hospitalization costs, and faster recovery.[1–3] However, despite these documented benefits, staged procedures remain a common choice in certain clinical settings.[4] One of the primary reasons for this continued preference for staged surgeries is the increased risk associated with longer operative times and the greater physiological stress imposed by simultaneous procedures. Patients with significant comorbidities, such as cardiovascular or respiratory conditions, may be at higher risk for complications when undergoing prolonged surgeries, and thus, staged procedures are often recommended.[5] Additionally, some surgeons may prefer staged approaches for older patients or those with higher surgical risk, as it allows for more gradual recovery between surgeries.[6] This individualized approach to surgical decision-making underscores the need for further investigation into which patient populations benefit most from each approach. Studies report varying complication rates,[5–8] with fewer complications and shorter hospital stays for simultaneous procedures.[9,10] Conversely, concerns remain regarding the increased risks of deep vein thrombosis, pulmonary embolism, and blood transfusions associated with simultaneous surgeries.[11,12] The comprehensive review posits simultaneous bilateral THA as a cost-effective option with fewer complications, challenging the cautious stance traditionally held towards simultaneous surgeries.[13] These contrasting findings, often influenced by differing healthcare systems, patient selection, and methodological approaches, highlight the complexity of determining the most beneficial surgical strategy.

Moreover, much of the existing literature on this topic has been conducted in Western countries, where healthcare systems and patient demographics may differ significantly from those in non-Western settings like China.[7] Our study aims to address this gap by focusing on a Chinese cohort, providing valuable insights into the comparative outcomes and cost-effectiveness of simultaneous versus staged bilateral hip arthroplasty in this specific healthcare context.

In light of these considerations, our study aims to evaluate the economic burden and immediate postoperative outcomes of simultaneous versus staged bilateral hip arthroplasty in a single-center setting comprehensively. By analysing direct cost comparisons, operation times, hospital stay lengths, volume of blood transfusion and early complication rates, etc. we seek to provide clearer guidance to clinicians and contribute to the ongoing debate. This research is poised to provide evidence-based insights with significant implications for clinical practice and healthcare policy, aiming to enhance the quality of care for patients undergoing bilateral hip replacement surgery.

Methods

Study Design and Setting

This investigation was conducted as a hospital-based, single-center, prospective study at XXX, spanning the years 2021 to 2022. All patients had bilateral lesions, and doctors decided to take simultaneous or staged operations according to the progression of the patient's disease and personal wishes. The study's design, rooted in precedents from similar research endeavors,[14] aimed to discern the differential impacts of simultaneous versus staged bilateral hip arthroplasty on economic burdens and patient outcomes.

Ethical approval was secured from the Medical Ethics Committee of The Third People's Hospital of Shenzhen (Contract number: 2000–107-02), adhering to the Declaration of Helsinki's ethical standards. Informed consent was obtained from all participants prior to their inclusion in the study.

Participants Inclusion and Exclusion Criteria

Eligible participants were individuals aged 18 years and older who underwent bilateral hip replacement surgery for conditions such as femoral head necrosis, ankylosing spondylitis, acetabular dysplasia, or rheumatoid arthritis. Exclusion criteria were defined as any previous history of abnormal nutritional, immune, or coagulation functions, or any complications of infection or tumor at the hip joint surgical site.

Surgical Procedure

The surgical technique involved a modified posterolateral hip incision, followed by systematic steps from soft tissue incision to prosthesis installation, ensuring consistency across procedures. The surgery process emphasized precision in incision, bone preparation, and prosthesis placement, adhering to established orthopedic protocols.

Data Collection

A comprehensive data collection framework was established, incorporating demographic information, medical history, and anthropometric measurements. Standardized questionnaires and physical examinations facilitated the collection of these data, which were pivotal for subsequent analyses. Glycosylated hemoglobin data were measured in patients with a history of diabetes mellitus or high fasting blood glucose levels on admission. The blood transfusion volume and postoperative incision infection, poor incision healing, intestinal obstruction, deep vein thrombosis and lung infection were collected as postoperative prognostic indicators. Because all patients had normal preoperative blood glucose levels, no glycosylated hemoglobin test was performed. None of patients developed lung infections and wound infections and poor healing of incisions.

Economic Evaluation

The economic evaluation focused on the direct costs associated with the surgery, specifically prosthesis and hospital stay costs. These costs were meticulously calculated from a blend of participant self-reports and data from publicly available healthcare databases. Additionally, the study considered operation time, length of stay, and laboratory indices as indicators of effectiveness during the perioperative period.

Definition

We included incision infection, poor healing of incision, intestinal obstruction, deep vein thrombosis, and lung infection as early complications in patients for the outcomes of this study. Incisional infection is defined as the invasion of microorganisms into the wound and proliferation within 30 days after surgery, resulting in localized, disseminated and/or systemic reactions within the host. Poor incision healing refers to patients whose incision healing is delayed within 30 days after surgery due to incision dehiscence, hematoma, fat liquefaction, infection, etc. Intestinal obstruction is defined as the inability of finger contents to pass through the intestine properly. Deep vein thrombosis is the abnormal clotting of blood in deep veins, blocking the lumen, resulting in impaired venous return. Lung infection refers to lung infection as determined by a combination of clinical diagnosis and etiological testing.

Statistical Analysis

The cohort was stratified into two groups based on the surgical approach: simultaneous or staged bilateral hip arthroplasty. Statistical analysis involved descriptive statistics for demographic and clinical variables, comparison tests (Student's *t*-test or Mann–Whitney *U*-test for continuous variables, chi-squared test or Fisher's exact test for categorical variables. To better understand the factors influencing the clinical outcomes and cost-effectiveness, we performed multivariate regression analysis. The following variables were included in the regression models: age, BMI, presence of comorbidities (such as hypertension and diabetes), and the type of surgical procedure (simultaneous vs staged). By adjusting for these potential confounders, the analysis aimed to isolate the effect of the surgical approach on outcomes such as length of stay, postoperative complications, and total costs. The relationship was presented as β with 95% CI.

Results

Demographic Characteristics of the Study Population

The study encompassed a total of 57 participants, predominantly male (61.4%). Group allocation was 45 (78.9%) to simultaneous bilateral hip arthroplasty and 12 (21.1%) to the staged procedure. Patient distribution by age revealed that 50.9% were under 45 years, while a significant proportion had completed secondary education (>50%). Body Mass Index

Table 1 The Clinical Features in Two Groups

Factors	Total	Simultaneous group	Staged group	P
Case, n (%)	57 (100.0)	45 (78.9)	12 (21.1)	—
Age, mean (SD), years	45.96 (12.65)	45.78 (12.05)	46.67 (15.29)	0.831
Age group, n (%):				1.000
< 45 years	29 (50.9)	23 (51.1)	6 (50.0)	
45 years~	24 (42.1)	19 (42.2)	5 (41.7)	
≥ 65 years~	4 (7.0)	3 (6.7)	1 (8.3)	
Education, n (%):				0.178
Primary education	17 (29.8)	16 (35.6)	1 (8.3)	
Secondary education	33 (57.9)	24 (53.3)	9 (75.0)	
University education	7 (12.3)	5 (11.1)	2 (16.7)	
Pathogenesis, n (%):				0.236
Femoral head necrosis	28 (49.1)	23 (51.1)	5 (41.7)	
Ankylosing spondylitis	14 (24.6)	10 (22.2)	4 (33.3)	
Acetabular dysplasia	6 (10.5)	3 (6.7)	3 (25.0)	
Rheumatoid arthritis	6 (10.5)	6 (13.3)	0 (0.0)	
Femoral neck fracture	3 (5.3)	3 (6.7)	0 (0.0)	
Previous disease history, n (%):				
Hypertension:				0.569
No	53 (93.0)	41 (91.1)	12 (100.0)	
Yes	4 (7.0)	4 (8.9)	0 (0.0)	
Diabetes:				1.000
No	56 (98.2)	44 (97.8)	12 (100.0)	
Yes	1 (1.8)	1 (2.2)	0 (0.0)	
BMI, means (SD), kg/m^2	22.58 (3.84)	22.29 (3.41)	23.64 (5.12)	0.404
BMI groups, n (%):				0.024
Normal weight	37 (66.1)	30 (68.2)	7 (58.3)	
Over weight	13 (23.2)	12 (27.3)	1 (8.3)	
Obesity	6 (10.7)	2 (4.5)	4 (33.3)	
Laboratory index before operation, means (SD):				
WBC, $10^9/L$	22.66 (108.05)	24.83 (121.59)	9.79 (10.14)	0.672
RBC, $10^9/L$	4.26 (0.70)	4.30 (0.70)	4.11 (0.71)	0.409
Platelet, $10^9/L$	242.05 (86.68)	231.04 (78.16)	283.33 (107.04)	0.063
CRP, mg/L	14.02 (20.12)	13.83 (20.82)	14.68 (18.36)	0.907
ALB, mg/L	40.78 (6.80)	41.13 (6.63)	39.38 (7.60)	0.450
ALT, mg/L	18.53 (14.68)	18.30 (14.82)	19.45 (14.77)	0.817
AST, mg/L	22.04 (15.71)	22.35 (17.00)	20.82 (9.60)	0.776
UREA, mg/L	6.42 (10.14)	6.95 (11.35)	4.42 (1.10)	0.467
eGFR, mg/L	106.52 (24.56)	104.80 (25.32)	113.40 (20.85)	0.303

(BMI) categorizations were as follows: 66.1% normal weight, 23.2% overweight, and 10.7% obese. The mean ages for the simultaneous and staged groups were 45.78 years and 46.67 years, respectively.

Comprehensive baseline characteristics in two groups are detailed in Table 1, which shows no significant differences in age, educational background, etiology of hip pathology, or preoperative clinical indices, including metabolic and hematological parameters (all $P > 0.05$). Notably, obesity prevalence was significantly higher in the simultaneous procedure group ($P < 0.05$).

Economic burden, Length of hospital stay and Complication analysis of Surgical approaches

Our economic assessment indicated that the overall hospitalization costs were significantly higher for the staged bilateral hip arthroplasty group compared to the simultaneous group ($P < 0.001$). In contrast, prosthesis expenses were found to be

Table 2 The Burden in Two Groups

Factors	Simultaneous group	Staged group	P
Total:			
Cost of total, yuan, means (SD)	121775.09 (45,901.03)	201,503.33 (66,860.80)	<0.001
Prosthesis cost, yuan, means (SD)	79005.39 (29,818.09)	61,926.46 (20,809.59)	0.031
Operation time, minutes, means (SD)	146.38 (83.49)	123.25 (68.27)	0.381
Length of stay, day, means (SD)	17.38 (7.47)	17.33 (8.51)	0.986
Volume of blood transfusion, means (SD)	270.89 (514.28)	115.00 (226.13)	0.490
Intestinal obstruction, n (%)::			1.000
No	44 (97.8)	12 (100)	
Yes	1 (2.2)	0 (0)	
Deep vein thrombosis, n (%)::			0.889
No	44 (97.8)	11 (91.7)	
Yes	1 (2.2)	1 (8.3)	
Laboratory index before operation, means (SD):			
WBC, 10^9/L	24.83 (121.59)	9.79 (10.14)	0.672
RBC, 10^9/L	4.30 (0.70)	4.11 (0.71)	0.409
Platelet, 10^9/L	231.04 (78.16)	283.33 (107.04)	0.063
CRP, mg/L	13.83 (20.82)	14.68 (18.36)	0.907
ALB, mg/L	41.13 (6.63)	39.38 (7.60)	0.450
ALT, mg/L	18.30 (14.82)	19.45 (14.77)	0.817
AST, mg/L	22.35 (17.00)	20.82 (9.60)	0.776
UREA, mg/L	6.95 (11.35)	4.42 (1.10)	0.467
eGFR, mg/L	104.80 (25.32)	113.40 (20.85)	0.303

lower in the staged group (P = 0.031). Examination of operative efficiency parameters, including surgery duration, hospital stay length, and postoperative laboratory values, Blood transfusion volume, postoperative complications demonstrated no substantial differences between the two cohorts (P > 0.05 for all), suggesting comparable perioperative outcomes irrespective of the surgical strategy adopted (Table 2).

Multivariate Analysis of Surgical Costs

The multifactorial analysis (Table 3) identified surgical approach and educational level as significant contributors to the total cost variance, with surgical approach and age affecting the prosthesis expenses (P < 0.05 for all associations). When controlling for educational level, the simultaneous procedure group incurred significantly lower overall costs by an average of 63,967.54 yuan (95% CI: 31,668.08 to 96,267.01; P < 0.001) compared to the staged group. Furthermore, after adjusting for age, the prosthesis cost was 16,641.19 yuan lower in the staged group, albeit not reaching statistical significance (95% CI: −34,017.25 to 734.86; P = 0.060).

Table 3 Associated Factors of Cost in the Multivariate Analysis

Factors	β	SE	95% CI	P
Total cost:				
Group	63967.54	16,110.43	31,668.08, 96,267.01	<0.001
Education	19039.78	6055.62	6898.99, 31,180.56	0.003
Prosthesis cost:				
Group	−16641.19	8666.88	−734.86, 4017.25	0.060
Age group	−15758.55	5682.84	−27,151.95, −4365.16	0.008

Discussion

This study endeavored to quantify the economic impact and discern contributing factors for patients undergoing simultaneous or staged bilateral hip arthroplasty. Staged bilateral hip arthroplasty incurs higher overall costs compared to simultaneous procedures, indicating a clear economic advantage for the latter. The costs for prostheses did not significantly differ between simultaneous and staged surgeries, suggesting that the main cost drivers are associated with other factors in the perioperative process. Operation times and lengths of hospital stays were comparable between the two groups, demonstrating that simultaneous procedures do not negatively impact these immediate postoperative metrics. A higher prevalence of obesity was noted in the simultaneous surgery group, a finding that may influence patient selection and perioperative management strategies and could be an area for future research.

Our finding of higher costs associated with staged procedures is aligned with the prevailing evidence that supports the economic efficiency of simultaneous THA,[9–12,15] However, unlike some studies that attribute cost savings primarily to reduced hospital stays and complications,[9,10] our research suggests that these savings persist even when such variables do not differ significantly between groups. This nuance highlights that cost savings in simultaneous THA may also arise from factors such as reduced administrative overhead or the need for only one episode of care. The absence of a significant difference in prosthesis costs between simultaneous and staged procedures contrasts with some earlier studies that suggest higher costs for prostheses in simultaneous THA due to the use of more expensive implants or technology.[12] Our study's results may indicate that prosthesis pricing has become more standardized, or that the choice of prosthesis is now more closely aligned with clinical need rather than the timing of the surgery. While previous studies reported shorter operation times and hospital stays for simultaneous procedures,[9,10] our findings of no significant differences align with a subset of literature indicating that with refined surgical techniques and perioperative care, the efficiency of staged procedures can approach that of simultaneous surgeries.[13] This could reflect advancements in surgical practice and perioperative care that have been standardized across different procedural timings. The higher rate of obesity in patients undergoing simultaneous procedures is a novel finding not widely reported in the literature. This could suggest a bias in selecting healthier patients for simultaneous procedures or may reflect a local practice trend. This aspect of patient selection has important implications for preoperative counseling and risk stratification and warrants further investigation to understand its impact on surgical outcomes and resource utilization.

Limitations

Our study has several limitations. First, the study was conducted at a single hospital, which may limit the generalizability of the findings to other settings. Results may not be representative of different populations or healthcare systems with varying protocols and patient demographics. Future studies should involve multiple centers across diverse geographical locations to enhance the external validity of the findings. Second, the relatively small number of patients included may not provide a robust comparison between the two groups. There were only 57 patients (45 simultaneous surgeries and 12 staged). This limited sample size reduces the statistical power of the study and increases the risk of Type II errors. It reduces the statistical power of the study and may not accurately capture the variation within the broader patient population. Larger-scale studies with more participants would improve the reliability of the data and the strength of the conclusions drawn. Third, the study did not include long-term follow-up data to assess sustained outcomes and late complications, such as revision surgeries, long-term complications, and patient quality of life. This limits the understanding of the long-term cost-effectiveness and patient-centered outcomes of each surgical approach. Incorporating longitudinal follow-up would provide insights into the durability of benefits and potential late complications. Fourth, the study did not account for the potential effects of perioperative medication therapy on outcomes. Medication use can influence postoperative recovery, pain management, and complication rates, which are important aspects of cost and quality of care. Including comprehensive medication data in future research could elucidate its role in patient outcomes and cost. Fifth, our economic evaluation focused primarily on direct hospital costs, including prosthesis costs and hospital stay expenses. While these costs represent significant financial burdens, we recognize that a comprehensive cost-effectiveness analysis should also account for indirect costs such as lost productivity, rehabilitation expenses, and long-term healthcare costs. Due to limitations in the available data, we were unable to include these indirect costs in our

current analysis. However, we acknowledge that factors such as time off work, long-term follow-up care, and post-operative rehabilitation can substantially influence the overall economic impact of bilateral hip arthroplasty. Future studies should aim to incorporate both direct and indirect costs to provide a more holistic understanding of the cost-effectiveness of simultaneous versus staged procedures. Moreover, the difference in obesity rates between the groups could be a confounding factor. This may have influenced postoperative outcomes and resource utilization, possibly skewing the cost comparisons. Stratifying patients by BMI in the analysis or matching patients based on BMI could control for the effects of obesity. Finally, The criteria for choosing between simultaneous and staged procedures were not standardized. There might be an inherent bias in selecting patients for either procedure, which could affect the study's outcomes. Implementing and describing a clear, standardized selection process would help minimize selection bias.

Conclusion

In conclusion, this study suggests that for appropriate patients, simultaneous bilateral hip arthroplasty may offer a preferable cost-to-benefit ratio, affirming its role as a viable surgical option within the spectrum of orthopedic care. The translation of these findings into practice requires careful patient selection and consideration of the broader economic implications, advocating for a patient-centered, value-based approach in orthopedic surgery.

Abbreviations

THA, total hip arthroplasty. BMI, body mass index.

Data Sharing Statement

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Stavrakis AI, SooHoo NF, Lieberman JR. Bilateral total hip arthroplasty has similar complication rates to unilateral total hip arthroplasty. *J Arthroplasty*. 2015;30(7):1211–1214. doi:10.1016/j.arth.2015.02.015
2. Lorenze M, Huo MH, Zatorski LE, Keggi KJ. A comparison of the cost effectiveness of one-stage versus two-stage bilateral total hip replacement. *Orthopedics*. 1998;21(12):1249–1252. doi:10.3928/0147-7447-19981201-04
3. Sloan M, Premkumar A, Sheth NP. Projected volume of primary total joint arthroplasty in the U.S. 2014 to 2030. *J Bone Joint Surg Am*. 2018;100(17):1455–1460. doi:10.2106/JBJS.17.01617
4. Weißer M, Rosery H, Schönfelder T. Health economic aspects. In: Bleß HH, Kip M, editors. *White Paper on Joint Replacement: Status of Hip and Knee Arthroplasty Care in Germany [Internet]*. Berlin (Germany): Springer; 2018. Chapter 5.
5. Lindberg-Larsen M, Joergensen CC, Husted H, Kehlet H. Simultaneous and staged bilateral total hip arthroplasty: a Danish nationwide study. *Arch Orthop Trauma Surg*. 2013;133(11):1601–1605. doi:10.1007/s00402-013-1829-z
6. Babis GC, Sakellariou VI, Johnson EO, Soucacos PN. Incidence and prevention of thromboembolic events in one stage bilateral total Hip arthroplasty: a systematic review. *Curr Vasc Pharmacol*. 2011;9(1):24–32. doi:10.2174/157016111793744751
7. Triantafyllopoulos GK, Memtsoudis SG, Zhang W, Ma Y, Sculco TP, Poultsides LA. Same-day surgery does not increase deep infection risk in bilateral total hip arthroplasty patients. *J Arthroplasty*. 2016;31(9 Suppl):237–241. doi:10.1016/j.arth.2016.01.069
8. Hooper GJ, Hooper NM, Rothwell AG, Hobbs T. Bilateral total joint arthroplasty: the early results from the New Zealand National joint registry. *J Arthroplasty*. 2009;24(8):1174–1177. doi:10.1016/j.arth.2008.09.022
9. Guo SJ, Shao HY, Huang Y, Yang DJ, Zheng HL, Zhou YX. Retrospective cohort study comparing complications, readmission, transfusion, and length of stay of patients undergoing simultaneous and staged bilateral total hip arthroplasty. *Orthop Surg*. 2020;12(1):233–240. doi:10.1111/os.12617

10. Partridge TCJ, Charity JAF, Sandiford NA, Baker PN, Reed MR, Jameson SS. Simultaneous or staged bilateral total hip arthroplasty? An analysis of complications in 14,460 patients using national data. *J Arthroplasty*. 2020;35(1):166–171. doi:10.1016/j.arth.2019.08.022
11. Shih CH, Ho WB. One-stage versus two-stage bilateral autophor ceramic total Hip arthroplasty. *Clin Orthop Relat Res*. 1985;193(&NA;):141–145. doi:10.1097/00003086-198503000-00018
12. Parvizi J, Tarity TD, Sheikh E, Sharkey PF, Hozack WJ, Rothman RH. Bilateral total Hip arthroplasty: one-stage versus two-stage procedures. *Clin Orthop Relat Res*. 2006;453:137–141. doi:10.1097/01.blo.0000246529.14135.2b
13. Ramezani A, Ghaseminejad Raeini A, Sharafi A, Sheikhvatan M, Mortazavi SMJ, Shafiei SH. Simultaneous versus staged bilateral total Hip arthroplasty: a systematic review and meta-analysis. *J Orthop Surg Res*. 2022;17(1):392. doi:10.1186/s13018-022-03281-4
14. Muskus M, Rojas J, Gutiérrez C, Guio J, Bonilla G, Llinás A. Bilateral hip arthroplasty: when is it safe to operate the second hip? A systematic review. *Biomed Res Int*. 2018;2018:3150349. doi:10.1155/2018/3150349
15. Tsiridis E, Pavlou G, Charity J, Tsiridis E, Gie G, West R. The safety and efficacy of bilateral simultaneous total Hip replacement: an analysis of 2063 cases. *J Bone Joint Surg Br*. 2008;90(8):1005–1012. doi:10.1302/0301-620X.90B8.20552