Original Article

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A Comparative Study on the Outcome of Cemented and Cementless Stems during Total Hip Arthroplasty Conversion in Patients with Failed Osteosynthesis of Proximal Femur Fracture

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Purpose: Cementless femoral fixation has become widely adopted throughout the United States for primary total hip arthroplasty (THA). However, femoral fixation in conversion THA (convTHA) presents unique challenges, and optimal strategies have not been extensively studied. This study investigated differences in outcomes for cemented versus cementless femoral fixation in convTHA for patients with failed osteosynthesis after proximal femur fracture.

Materials and Methods: Data was retrospectively collected for 75 patients who underwent convTHA after previous proximal femur fracture. Based on type of femoral fixation type at time of conversion, patients were sorted into two cohorts, cemented (n=19) or cementless (n=56). Demographic, surgical, and outcome variables, including revision and complication rates, were collected and compared between the cemented and cementless cohorts. Statistical analyses were performed using multivariate regression analyses.

Results: As compared to the cemented cohort, patients for whom cementless implants were chosen tended to be younger (P<0.01), male (P=0.03), and non-white (P<0.01). The cementless cohort had shorter surgical time (149.64 minutes vs. 197.16 minutes, P=0.01). No differences were noted in anesthesia type (P=0.93), surgical approach (P=0.84), or use of dual mobility implants (P=0.93). Multivariable logistic regression analysis revealed that there was no difference in length of stay (LOS), revision rate, complication rate, or discharge disposition between the cemented and cementless cohorts.

Conclusion: Our results revealed shorter operative times with cementless femoral fixation in convTHA, but no significant difference in LOS, discharge disposition, revision rate, or complication rate when compared with cemented fixation.

Keywords: Conversion, Total hip arthroplasty, Femoral fixation, Cemented stem, Cementless stem

INTRODUCTION

Primary total hip arthroplasty (THA) is commonly performed for arthritic hip conditions to improve pain and function[1]. Although the procedure for a native hip joint is considered among the most successful medical interventions with excellent outcomes, conversion THA (convTHA) procedures remain less predictable given the added surgical complexity in the setting of a previously revised hip joint. Thus, convTHA can be thought of as similar to the more challenging revision THA[2-5]. Considerable variability within the wider

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category of convTHA exists, and further understanding of the various perioperative factors specific to the procedure and their correlation with postoperative outcomes are needed. In particular, the optimal strategy for femoral stem fixation remains unclear among convTHA performed as a salvage procedure for failed osteosynthesis of femoral fractures.

Initiated by the improved intraoperative efficiency, decreased rates of revision in younger patients, and cost savings of several hundred dollars per surgical case[6], femoral stem fixation in primary THA experienced a transition from cemented to cementless fixation strategy over the past few decades[7-9]. This widespread implementation is highlighted by the utilization of cementless fixation procedures in up to 98% of THA patients younger than seventy years in the United States in 2018[2]. Interestingly, a 2018 Australian registry comparing cemented and cementless fixation strategies found no difference in mortality among patients over eighty years old when adjusted for patient-specific risk factors. However, among the same population, cemented fixation was associated with lower revision rates at all postoperative time points, reduced rates of aseptic loosening, higher health cost savings, and higher reliability in the first decade post-surgery, compared to cementless fixation[8,10]. Currently, the choice for cemented versus cementless fixation for femoral fixation remains surgeon and patient dependent.

The optimal femoral fixation strategy for the unique population of patients undergoing convTHA with previous fracture has not been well studied. Following failed osteosynthesis, convTHA poses substantial variability depending on the presence of implants requiring removal, proximal femoral bone stock, surgical approach utilized, increased operative time and transfusion requirements compared to primary THA,

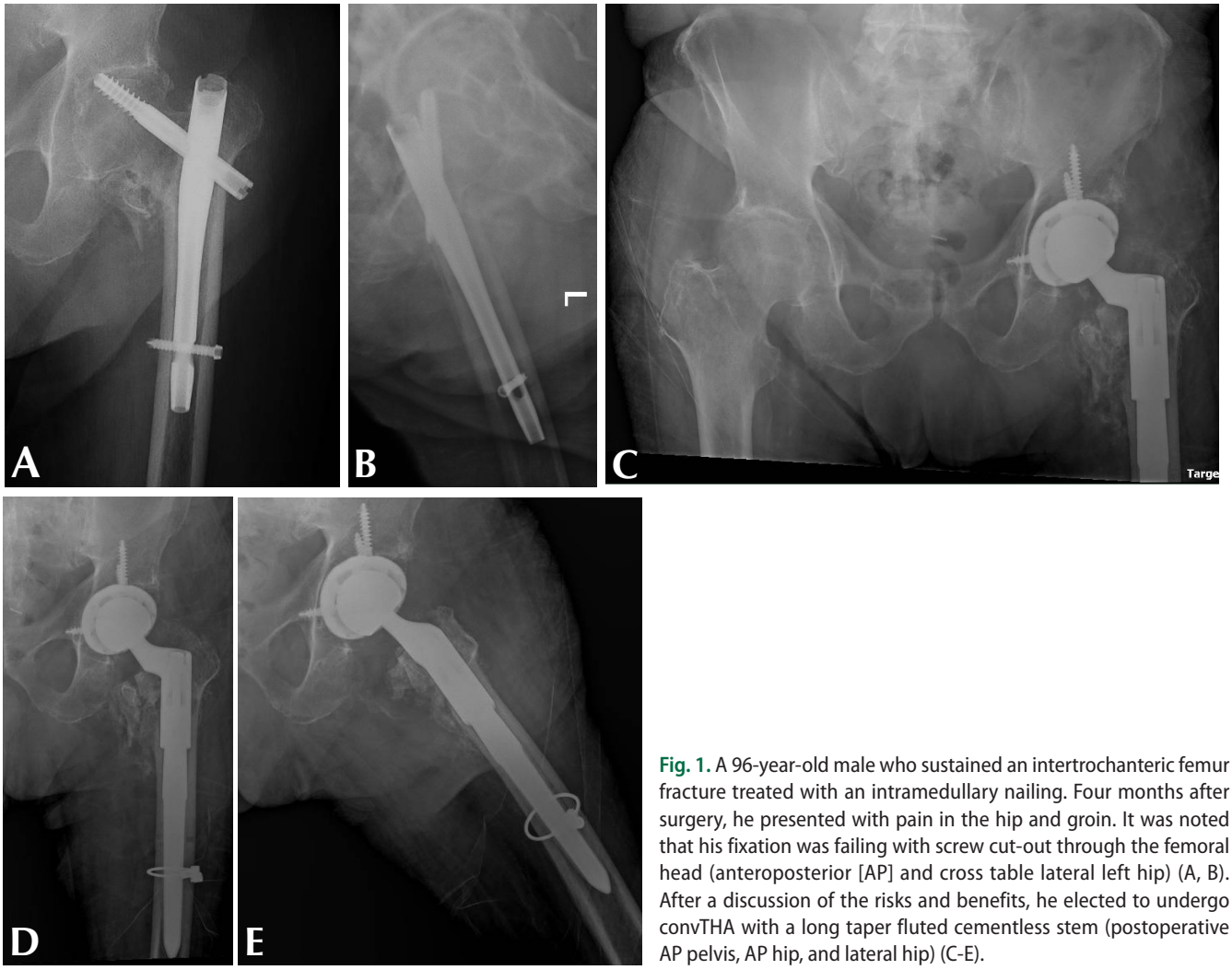

Fig. 1. A 96-year-old male who sustained an intertrochanteric femur fracture treated with an intramedullary nailing. Four months after surgery, he presented with pain in the hip and groin. It was noted that his fixation was failing with screw cut-out through the femoral head (anteroposterior [AP] and cross table lateral left hip) (A, B). After a discussion of the risks and benefits, he elected to undergo convTHA with a long taper fluted cementless stem (postoperative AP pelvis, AP hip, and lateral hip) (C-E).

and high rate of intraoperative fractures and complication[11]. Consequently, the aim of this manuscript was to investigate the overall outcomes for cemented convTHA in comparison to cementless femoral stems. We hypothesize that, in convTHA, there is no difference in outcomes between cemented and cementless femoral stem fixation.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board (IRB) of Columbia University Irving Medical Center (No. AAAU7939). The written informed consent was waived by the IRB due to the retrospective nature of the study. The data was retrospectively collected from patients who underwent convTHA at a single tertiary urban academic institution between January 2015 and May 2022. Each patient had a previous proximal femur fracture that was treated with either percutaneous screw fixation or closed vs open reduction and internal fixation (with short and long intramedullary nailing [IMN] or sliding hip screw [SHS]). Inclusion criteria included any patient who underwent convTHA performed by four different fellowship trained surgeons during the aforementioned study period. Patients who underwent convTHA with prior surgical intervention consisting of any procedures other than surgical fracture treatment with a fixation device, such as hemiarthroplasties, hip arthroscopies, and osteotomies were excluded. Based on type of femoral fixation

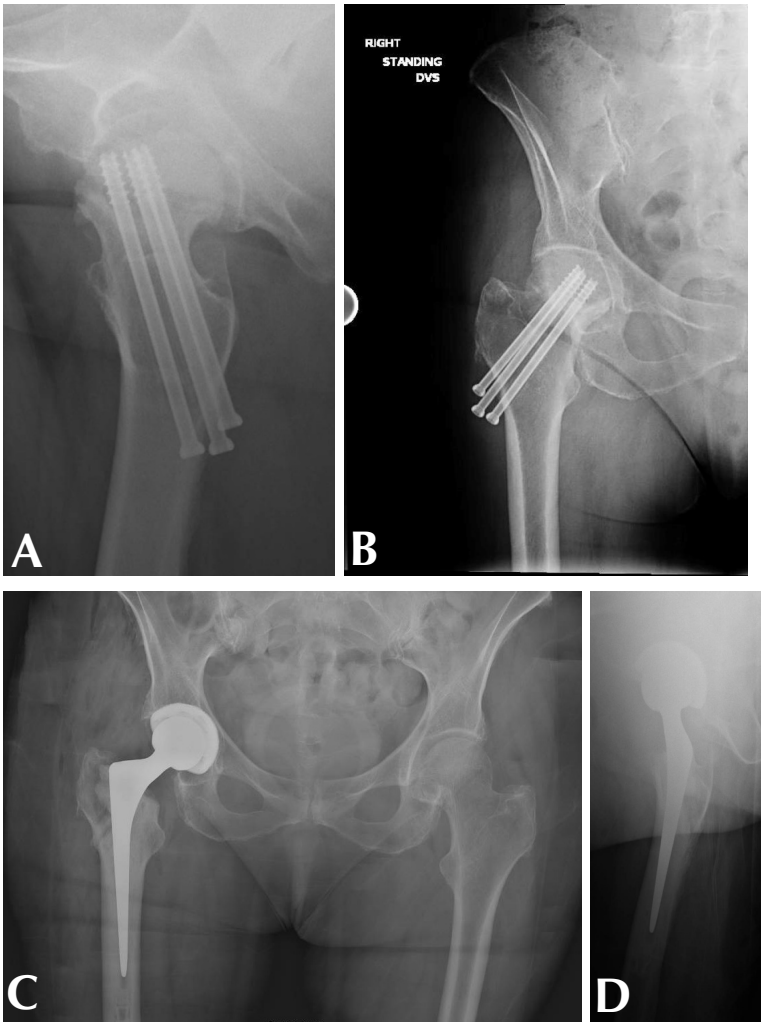

Fig. 2. A 75-year-old female who sustained a nondisplaced femoral neck fracture that was treated with percutaneous screw fixation. Over a year after surgery, she developed avascular necrosis/nonunion of the femoral head which was symptomatic (anteroposterior [AP] and lateral right hip radiographs) (A, B). After a discussion of the risks and benefits, she elected to undergo convTHA with a cemented stem (AP pelvis and cross table lateral right hip) (C, D). DVS: dose verification system.

type at time of conversion, patients were then sorted into two cohorts, cemented or cementless. Demographic and patient variables including gender, age, race, body mass index (BMI), and the American Society of Anesthesiologists (ASA) physical status score were collected and compared between the cohorts. Conversion indications included nonunion, avascular necrosis, post-traumatic arthritis (including from lag-screw cutout), and aseptic loosening. At the time of convTHA, the choice of cemented or cementless femoral fixation was at the discretion of the treating surgeon and selected on an individual patient basis. Case scenarios demonstrating cemented or cementless fixation are seen in Fig. 1 and 2. Primarily, implants were selected in order to bypass the most distal cortical screw hole from prior implants. However, in some cases (i.e., conversion from long IMN), this was not always possible. As evaluation of proximal femur bone loss with the Paprosky classification was not routinely noted in the operative notes, it was not considered in this analysis.

Surgical variables included anesthesia type, surgical approach, time from previous fixation to THA, time from removal of hardware (ROH) to THA (if staged), implant type (at time of index surgery), use of dual mobility bearing surface, and surgical duration. Outcome variables included hospital length of stay (LOS), revision rate, and complication rate.

Statistical analysis was performed using IBM SPSS Statistics (ver. 28.0; IBM Corp.). Differences in continuous and categorical variables were assessed by *t*-test and chi-square tests, respectively. Once statistically significant differences in predictive variables were identified between the cohorts, a multivariate logistic regression analysis accounting for these variables was conducted to determine significant differences in outcome variables. A $P<0.05$ was used for statistical significance.

RESULTS

Eighty-two patients underwent conversion hip arthroplasty during the study period. Seven patients who had previously undergone hip hemiarthroplasty were excluded, leaving 75 patients in the final analysis. Nineteen patients underwent cemented femoral fixation, and 56 underwent cementless fixation with no significant difference noted in the average follow-up period (cemented, 25.42 months; cementless, 24.82 months; $P=0.73$). Among the cementless cohort, 37 patients (66.1%) had a femoral component with metaphyseal fixation, while 19 (33.9%) had a component with diaphyseal fixation ($P=0.93$). There were no constrained implants utilized between the two cohorts. Demographic and patient variables of the cemented and cementless cohorts are listed in Table 1. The cementless cohort was younger ($P<0.01$), had more males ($P=0.03$), and had fewer white patients as compared to the cemented cohort ($P<0.01$). There was no difference noted between the cohorts in terms of BMI, indication for conversion, or ASA score.

Among surgical variables, the cementless cohort had a significantly shorter surgical time (149.64 minutes vs. 197.16 minutes, $P=0.01$) as compared to the cemented cohort. However, there were no differences noted with respect to anesthesia type ($P=0.93$), surgical approach ($P=0.84$), duration from index surgery to THA ($P=0.30$), staged ROH to THA ($P=0.86$) (Table 2), or intraoperative estimated blood loss ($P=0.10$). Furthermore, in terms of the types of implants that were used in the initial fixation ($P=0.22$), the two cohorts were not significantly different. Among the cemented cohort,

Table 1. Patient Demographics

	Cemented (n=19)	Cementless (n=56)	*P*-value
Sex (distribution)			0.03
Female	84.2	55.6	
Male	15.8	44.4	
Age (yr)	79.79±10.74	65.31±15.52	<0.01
Race (distribution)			<0.01
White	68.4	50.0	
Black or African American	0.0	14.3	
Asian	0.0	5.4	
Other race	10.5	7.1	
Unknown	21.1	23.2	
BMI (kg/m^2)	26.19±5.31	25.95±5.06	0.88
Indication for conversion			0.20
AVN	36.8	28.6	
Nonunion	15.8	23.2	
Post-traumatic arthritis	47.4	48.2	
ASA score			0.33
1	0.0	5.8	
2	47.4	50.0	
3	52.6	44.2	

Values are presented as % or mean±standard deviation.
BMI: body mass index, AVN: avascular necrosis, ASA score: American Society of Anesthesiologists (ASA) physical status score.

Table 2. Comparison of Surgical Variables

	Cemented (n=19)	Cementless (n=56)	*P*-value
Anesthesia type			0.93
General	15.8	13.0	
Spinal	84.2	87.0	
Approach			0.84
Anterior	52.6	60.7	
Posterior	47.4	39.3	
Duration fixation-THA (day)	1,241.88±2,232.08	629.00±682.14	0.30
Duration ROH-THA (day)	18.89±87.13	15.94±68.44	0.86
Prior implant			0.22
Percutaneous fixation	15.8	48.2	
Short IMN	10.5	20.0	
Long IMN	31.6	9.1	
SHS	42.1	21.4	
Implant manufacturers utilized for convTHA	Zimmer – 8 Smith & Nephew – 5 Stryker – 5 Link – 1	Zimmer – 20 Smith & Nephew – 17 Stryker – 8 DePuy – 8 Link – 2 Exacttech – 1	
Revision-style femoral implants	4 (21.1)	15 (26.8)	0.62
Dual mobility	21.1	26.8	0.93
Cerclage cable	6 (31.6)	8 (14.3)	
Prophylactic	2	6	
Intra-operative Fx.	3	1	
Trochanter nonunion	1	1	
Surgical time (min)	197.16±70.08	149.64±39.76	0.01
Estimated blood loss (mL)	516.67±345.56	366.52±163.92	0.10

Values are presented as % only, mean±standard deviation, number only, or number (%).
THA: total hip arthroplasty, ROH: removal of hardware, IMN: intramedullary nailing, SHS: sliding hip screw, convTHA: conversion THA, Fx.: fracture.

Table 3. Comparison of Outcome Variables

	Cemented (n=19)	Cementless (n=56)	*P*-value
Length of stay (day)	3.21±2.34	2.68±2.51	0.42
Discharge disposition			0.002
Home	36.8	78.6	
Facility	63.2	21.4	
Revisions	3 (15.8)	4 (7.1)	<0.01
Dislocation	1	1	
Periprosthetic fracture	1	1	
Infection	1	2	
Complications	6 (31.6)	11 (19.6)	0.28
Dislocation	1	1	
Periprosthetic fracture	1	2	
Wound dehiscence	2	4	
Hematoma/seroma	1	2	
Infection	1	2	
Duration of follow-up (mo)	25.42±28.08	24.82±25.85	0.73

Values are presented as mean±standard deviation, % only, number (%), or number only.

15.8% had prior percutaneous fixation (vs. 48.2% in the cementless cohort), 42.1% had prior IMN (vs. 29.1% in the cementless cohort), and 42.1% (vs. 21.4%) had prior SHS. Fourteen patients in total required cerclage wire cabling. Among those patients, four cerclages were utilized in the setting of intra-operative fracture (3 cemented/1 cementless), eight were placed prophylactically (2 cemented/6 cementless), and two were placed to fixate greater/lesser trochanter nonunion that resulted from prior surgery (1 cemented/1 cementless). There was no difference found in either the utilization of dual mobility implants (P=0.93), or in revision-style femoral implants (P=0.62).

The results of the outcome variables are summarized in Table 3. Seven patients underwent revision surgery during the follow-up period. Three patients had revisions within one month of surgery, while two were revised in less than two months. The remaining two patients were revised at six and fourteen months

Table 4. Multivariable Regression Analysis

Outcome variable	Cemented		
	OR	95% CI	*P*-value
Length of stay	3.10	0.28-14.21	0.59
Discharge disposition	0.96	0.13-23.53	0.92
Revision	2.34	0.53-13.00	0.26
Complication	3.11	0.34-26.82	0.80

OR: odds ratio, CI: confidence interval.

postoperatively. At the final follow-up visit, all other patients had stable femoral constructs without evidence of loosening or failure on plain radiographs. On univariate analysis, there was no significant difference in LOS noted between the cohorts (P=0.42). The cementless cohort had a lower revision rate (7.1% vs. 15.8%, P<0.01) and complication rate (19.6% vs. 31.6%, P=0.28) as compared to the cemented cohort, and exhibited a higher rate of discharge home (78.6% vs. 36.8%). However, on multivariate analysis controlling for the statistically significant patient and surgical variables, logistic regression revealed no statistically significant difference in LOS, revision rate, complication rate, or discharge disposition between the cemented and cementless cohorts (Table 4).

DISCUSSION

The goal of this study was to investigate any differences in outcomes between cemented and cementless femoral fixation in convTHA for patients with previous proximal femur fracture treated with surgical fixation. Among surgical variables, our results revealed that the cementless cohort had shorter operative times as compared to the cemented cohort. There was no significant difference noted in the rate of complications and revisions between the two groups when accounting for potentially significant confounders on multivariable regression analysis. There was also no difference between the two cohorts in regards to hospital LOS.

Our study found that the cementless cohort was younger, had a higher proportion of male patients, and had fewer white patients as compared to the cemented cohort. However, no significant differences between cohorts were found in regards to BMI, ASA score, indication for conversion, anesthesia type, surgical approach, and durations between index surgery to THA and ROH to THA. Younger patients and male patients tend to have better bone quality which allows for better bony ingrowth when using cementless fixation. Our results are consistent with broader preferences to use cementless femoral fixation in these patients with better bone mineral quality[12,13]. The use of cementless femoral fixation in younger patients is also consistent with registry data from 2018 reporting up to 98% utilization in American patients under seventy years old[8]. The association of race and bone quality may explain our results of why there were more white patients in the cemented cohort. The literature suggests that African American patients have higher bone density and better bone quality, while white female patients in particular have lower bone mineral density[13-15].

This study found shorter operative times in the cementless cohort as compared to the cemented cohort, which is likely from not having to perform the additional step of cementation. Although the cementless cohort had overall lower complication and revision rates in the univariable analysis, there was no significant difference in the multivariable analysis when patient and surgical factors were taken into consideration. This suggests that the differences in revision and complication rates between the cemented and cementless cohorts are likely due, in part, to underlying patient factors such as the older average age of the cemented patients.

There were several limitations in our study, including those associated with all retrospective reviews. These results may be prone to selection bias given that the choice of cemented or cementless femoral fixation was at the discretion of the treating surgeon and selected on an individual patient basis. Notably, although no differences were noted in LOS, revision rate, complication rate, or discharge disposition between the cemented and cementless cohorts when controlled through multivariate analysis, the cemented fixation cohort average age was skewed older than the cementless cohort. Additionally, the sample size of the two cohorts was small and, as such, a subgroup analysis could not be performed. While these numbers are certainly inadequate for this outcome, and given the nature of this study as a retrospective consecutive series, it is an observational analysis based on a single center experience. Furthermore, we unfortunately cannot control the total number of patients meeting the inclusion criteria. Differences in postoperative outcomes may be further identified in future studies with greater con-

fidence. Even though our study showed no overall difference in revision and complication rates in the multivariate analysis between the two cohorts, the direct comparison of cemented to cementless femoral fixation for convTHA by the limited existing literature may suggest a greater patient benefit from cementation[16,17]. A previous study compared clinical outcomes for cemented vs uncemented convTHA for patients with prior intertrochanteric hip fracture treated with proximal femoral nail fixation[18]. The authors determined that the cemented cohort had lower complication rates, revision rates, and better functional outcomes as measured by the Harris Hip Score. Although the results of these studies are contradictory to our own results, the present study includes a more heterogenous group with all prior fixation devices (e.g., SHS, IMN, percutaneous screw fixation) and may suggest that uncemented fixation is equivalent to cementless fixation when there is sufficient proximal femoral bone stock.

Additionally, follow-up is limited to short-term outcomes in this study and does not include radiographic measures nor Patient Reported Outcome (PRO) scores. Given the time period for this study and funding constraints, especially during the COVID-19 pandemic (during which some of these cases were performed), collection of PRO measures was inconsistent throughout our institution. As a result, there is insufficient PRO data available to comment on patient satisfaction or function following these cases in these two cohorts. Multiple attempts were made during the data collection of this manuscript to assess medium- or long-term PROs. While the study team was unsuccessful in obtaining and reporting this data in a meaningful way, future studies should certainly endeavor to include that data. Nonetheless, this study adds to the limited body of available literature assessing femoral fixation in convTHA. Future studies remain necessary for further assessment of the findings reported in this analysis.

CONCLUSION

In conclusion, this study investigated differences in outcomes between cemented and cementless fixation used in convTHA for patients with failed osteosynthesis of proximal femur fractures. Our findings revealed that cementless fixation procedures are associated with shorter operative times with no significant difference in LOS, discharge disposition, revisions or complications rates. We hope that these findings can assist surgical planning for convTHA and managing postoperative outcomes in patients with failed osteosynthesis.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Nogier A, Tourabaly I, Ramos-Pascual S, et al. High rates of satisfaction and return to dance in current or former professional ballet dancers after total hip arthroplasty with a muscle-sparing direct anterior approach using custom femoral stems. Orthop J Sports Med. 2023;11:23259671231155143. https://doi.org/10.1177/23259671231155143
2. Douglas SJ, Remily EA, Sax OC, Pervaiz SS, Delanois RE, Johnson AJ. How does conversion total hip arthroplasty compare to primary? J Arthroplasty. 2021;36(7S):S155-9. https://doi.org/10.1016/j.arth.2020.12.023
3. Lipof JS, Haws BE, Quinzi DA, Ricciardi BF, Judd KT. Patient reported outcomes after conversion vs. primary total hip arthroplasty: a propensity matched analysis. Iowa Orthop J. 2022;42:47-52.
4. Baghoolizadeh M, Schwarzkopf R. The Lawrence D. Dorr surgical techniques & technologies award: conversion total hip arthroplasty: is it a primary or revision hip arthroplasty. J Arthroplasty. 2016;31(9 Suppl):16-21. https://doi.org/10.1016/j.arth.2015.06.024
5. Sarpong NO, Grosso MJ, Lakra A, Held MB, Herndon CL, Cooper HJ. Hemiarthroplasty conversion: a comparison to primary and revision total hip arthroplasty. J Arthroplasty. 2019;34:1168-73. https://doi.org/10.1016/j.arth.2019.02.043
6. Barrack RL, Castro F, Guinn S. Cost of implanting a cemented versus cementless femoral stem. J Arthroplasty. 1996;11:373-6. https://doi.org/10.1016/s0883-5403(96)80025-8
7. Charnley J. The long-term results of low-friction arthroplasty of the hip performed as a primary intervention. J Bone Joint Surg Br. 1972;54:61-76.
8. Blankstein M, Lentine B, Nelms NJ. The use of cement in hip arthroplasty: a contemporary perspective. J Am Acad Orthop Surg. 2020;28:e586-94. https://doi.org/10.5435/jaaos-

d-19-00604
9. Kheir MM, Drayer NJ, Chen AF. An update on cementless femoral fixation in total hip arthroplasty. J Bone Joint Surg Am. 2020;102:1646-61. https://doi.org/10.2106/jbjs.19.01397
10. Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). 2018 Hip, knee & shoulder arthroplasty annual report. AOANJRR; 2018.
11. Lee YK, Kim JT, Alkitaini AA, Kim KC, Ha YC, Koo KH. Conversion hip arthroplasty in failed fixation of intertrochanteric fracture: a propensity score matching study. J Arthroplasty. 2017;32:1593-8. https://doi.org/10.1016/j.arth.2016.12.018
12. Maier GS, Kolbow K, Lazovic D, Maus U. The importance of bone mineral density in hip arthroplasty: results of a survey asking orthopaedic surgeons about their opinions and attitudes concerning osteoporosis and hip arthroplasty. Adv Orthop. 2016;2016:8079354. https://doi.org/10.1155/2016/8079354
13. Peacock M, Buckwalter KA, Persohn S, Hangartner TN, Econs MJ, Hui S. Race and sex differences in bone mineral density and geometry at the femur. Bone. 2009;45:218-25. https://doi.org/10.1016/j.bone.2009.04.236
14. Johannesdottir F, Putman MS, Burnett-Bowie SM, Finkelstein JS, Yu EW, Bouxsein ML. Age-related changes in bone density, microarchitecture, and strength in postmenopausal black and white women: the SWAN longitudinal HR-pQCT study. J Bone Miner Res. 2022;37:41-51. https://doi.org/10.1002/jbmr.4460
15. Aloia JF, Mikhail M, Usera G, Dhaliwal R, Islam S. Trabecular bone score (TBS) in postmenopausal African American women. Osteoporos Int. 2015;26:1155-61. https://doi.org/10.1007/s00198-014-2928-6
16. Thalody HS, Post ZD, Lutz RW, Czymek M, Ong AC, Ponzio DY. Primary cementless femoral stems in conversion hip arthroplasty after failed fixation of intertrochanteric fractures. Orthopedics. 2024;47:e6-12. https://doi.org/10.3928/01477447-20230517-04
17. Yu M, Yu M, Zhang Y, et al. Implant survival of cemented arthroplasty following failed fixation of proximal femoral fractures in patients aged 30-60 years: a retrospective study with a median follow-up of 10 years. BMC Musculoskelet Disord. 2022;23:637. https://doi.org/10.1186/s12891-022-05587-0
18. Huang T, Zhang S, Liu X, et al. Mid-term outcomes of cemented or uncemented total hip arthroplasty for failed proximal femoral nail antirotation following intertrochanteric femur fractures: a retrospective observational study. Geriatr Orthop Surg Rehabil. 2022;13:21514593221132400. https://doi.org/10.1177/21514593221132400