Tuntarattanapong P, Iamthanaporn K, Watatham K, Sookjarern C, Hongnaparak T, Yuenyongviwat V. Do cemented standard-length femoral stems have enough longevity for the pathological fractures of the femoral neck with metastatic lesions? A retrospective study. *Orthopedic Reviews*. 2023;15. doi:10.52965/001c.77877

General

Do cemented standard-length femoral stems have enough longevity for the pathological fractures of the femoral neck with metastatic lesions? A retrospective study

Pakjai Tuntarattanapong[1], Khanin Iamthanaporn[1], Kraisong Watatham[1], Chanon Sookjarern[1], Theerawit Hongnaparak[1], Varah Yuenyongviwat[1a]

[1] Department of Orthopedics, Faculty of Medicine, Prince of Songkla University, Songkhla, 90110, Thailand.

Keywords: Metastatic bone, Pathological fractures, Femoral neck, Hemiarthroplasty

https://doi.org/10.52965/001c.77877

Orthopedic Reviews

Vol. 15, 2023

Background

Cemented long-stem hip arthroplasty is a treatment of choice for the pathological fractures of the femoral neck with metastatic lesions and the prevention of further fracture caused by metastasis progression.

Objective

The present study was an evaluation of the outcome after treatment of metastatic femoral neck fractures with cemented standard-length hemiarthroplasty.

Methods

We retrospectively studied 23 patients in whom the pathological fractures of the femoral neck with metastatic lesions were diagnosed. All patients underwent hemiarthroplasty with cemented standard-length femoral stems. The demographic data of the patients and clinical outcomes were obtained from an electronic medical database. Metastasis progression-free survival time was analyzed via the Kaplan–Meier curve.

Results

The mean age of the patients was 51.5 ± 11.7 years. The median duration of follow-up was 6.8 months (interquartile range, 5–22.6 months). Four patients exhibited tumor progression according to radiographic evaluation, but no patients had new fractures in the same bone or needed reoperation. The Kaplan–Meier curve revealed that 88.2% (74.2,100) of femurs demonstrated 1 year radiographic progression-free survival and 73.5% (49.4,100) demonstrated 2 year progression-free survival.

Conclusions

Our study demonstrated that the use of cemented standard-length stems in hemiarthroplasty for pathological fractures of the femoral neck with metastatic lesions is safe, and the rate of reoperation was low. We believe that this prosthesis is optimum for treatment in this group of patients because the length of survival in patients is expected to be short and the rate of metastasis progression in the same bone is low.

BACKGROUND

Nowadays, patients with metastatic cancer have a longer life expectancy than usual because of advances in treatments such as chemotherapy, radiotherapy, and targeted therapy. Of patients with advanced-stage cancer, 50% have bone metastases.[1,2] Some patients develop pathological fractures, which contribute to morbidity and poor quality of

a Corresponding author
Address: Department of Orthopedics, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand
Phone: (66)74451601 Fax; (66)74451603
Email: varahortho@gmail.com

life.[3,4] One-third of metastatic lesions develop in the proximal femur, and the pathological fracture of the femoral neck is common in such cases.[1,2,5] For these fractures, hip replacement is essential because the potential for healing after internal fixation is poor.[6]

Hemiarthroplasty with cemented long stems is one of the treatments of choice for the pathological fracture of the femoral neck with metastatic lesions. This prosthesis helps prevent subsequence pathological fracture when new metastasis occurs at the femoral diaphysis and if existing metastatic lesions have not been detected.[5-7] However, the procedure requires extensive reaming, and a higher volume of bone cement than in hemiarthroplasty with cemented standard-length stems is needed. Additionally, severe adverse events, such as intraoperative hypotension, arrhythmia, cardiac arrest, fat embolism, massive bleeding, the need for prolonged intubation, coma, and death, have been reported.[8-10]

The use of cemented long femoral stems in hemiarthroplasty has been challenged by recent studies that have demonstrated a low incidence of new metastatic lesions after hemiarthroplasty with cemented standard-length stems.[8,11,12] We consequently hypothesized that a cemented standard-length stem would be sufficient treatment of pathological fractures of the femoral neck with metastatic lesions. Compared with long-stem prostheses, the advantages of this standard prosthesis are lower cost, decreased operative time, and less invasiveness. However, the outcomes of the use of cemented standard-length stems in hemiarthroplasty in these patients have not been extensively reported.

This study aimed to evaluate the following clinical outcomes after hemiarthroplasty with cemented standard-length stems for the pathological fractures of the femoral neck with metastatic lesions: (1) incidence of new fractures, (2) incidence of reoperation, and (3) incidence of tumor progression. The results of this study can be used to guide future decisions regarding the use of the standard-length stems.

METHODS

In this retrospective study, we retrieved data from electronic medical records of patients who underwent hip hemiarthroplasty for pathological fractures of the femoral neck with metastatic lesions from 2001 to 2017 in a tertiary care hospital. Patients with incomplete clinical or radiographic data were excluded. The local Ethics Committee and Institutional Review Board approved this study. The ethics committee waived the requirement for consent, and the hospital granted permission to collect data from the database. All methods were performed in accordance with the the Declaration of Helsinki.

All patients underwent a posterolateral approach for the procedure. The femoral head was removed, and the femoral neck was cut at a level above the lesser trochanter, with the specific measurement ranging from 0.5-1.5 cm depending on the preoperative template. Following this, the metastatic lesion was curetted, and the femoral canal was broached. The bone plug was then placed below the tip of the femoral stem by 1 cm. Finally, a standard length cemented polished tapered stem (ranging from 105-152 mm) was inserted after bone cement was placed in the femoral canal using a cement gun.

Intraoperative tissue from the fracture site was sent to pathological study to confirm a diagnosis of metastasis in every case. Every patient received postoperative radiation 2 weeks after the operation and had follow-up visits at least twice during the first year for outcome assessment and evaluation of disease progression. The total number of follow-up visits depended on the walking status (with or without gait aids) of each patient and the feasibility of transportation.

We recorded patients' demographics data, such as gender, age, side of the hemiarthroplasty, primary malignancy, duration of follow-up, and clinical outcomes. The progression of the disease was evaluated by two independent orthopedic oncologist surgeons (PJ and KI). To assess the femoral metastatic lesion, a whole femur x-ray was conducted preoperatively and during follow-up visits at 6 weeks, 3 months, and every 6 months thereafter. The type of progression of disease was evaluated according to the classification by Alvi et al.[8]: (1) local progression of the main lesion originally identified; (2) local progression of discrete, separate lesions originally identified; and (3) occurrence of an entirely new, previously unrecognized lesion.[6] Other events such as new fracture, reoperation, and tumor progression were also documented and analyzed.

STATISTICAL ANALYSIS

Statistical analysis was conducted using R software 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria). Categorical variables were calculated as percentages. Progression-free survival time was analyzed using Kaplan–Meier curves. The Kaplan-Meier curve was determined from the operative date until 2 years postoperatively. Statistical significance was represented by $p < 0.05$.

RESULTS

A total of 23 patients underwent hip hemiarthroplasty with cemented standard-length stems after a metastasis-related fracture of the femoral neck. The mean age of patients was 51.5 ± 11.7 years, and the median duration of follow-up time was 6.8 months (interquartile range: 5–22.6 months). Thirteen patients passed away during the study period, and 10 patients were lost to follow-up without a clear reason. Breast cancer was the most common primary malignancy, followed by lung and thyroid cancer. In 73.9% of patients, the primary malignancy was recognized before fracture; in 26.1% of patients, the primary malignancy was found after the first presentation with pathological fracture. In this study, only 39.1% of patients received bisphosphonates before fracture to prevent skeletal-related events. All patients had a metastatic lesion that was confined only to the proximal part of the femur. Table 1 shows the demographic data.

Table 1. Characteristics of the patients

Characteristic	Number of cases (23)	
Gender	Female Male	16 (69.6%) 7 (30.4%)
Primary malignancy	Breast Lung Thyroid Prostate Kidney Esophagus	13 (56.5%) 4 (17.4%) 3 (13.0%) 1 (4.3%) 1 (4.3%) 1 (4.3%)
Side	Left Right	12 (52.2%) 11 (47.8%)
Received bisphosphonate before fracture	Yes No	9 (39.1%) 14 (60.9%)
Primary site of malignancy recognized before fracture	Yes No	17 (73.9%) 6 (26.1%)
Postoperative walking status	No gait aid With gait aid Sitting	9 (39.1%) 8 (34.8%) 6 (26.1%)

Table 2. Characteristics of progressive bone lesions in four patients

Classification	Primary cancer	Site of lesion	Time to progression (months)
1	Breast	Diaphysis (stem)	5
1	Breast	Diaphysis (distal to stem)	5
3	Thyroid	Diaphysis (stem)	23
3	Breast	Diaphysis (distal to stem)	42

The progression of metastatic lesions was detected on postoperative follow-up in four patients. Two patients exhibited local progression of the originally identified main lesion (type 1 of Alvi et al.'s classification), and two patients exhibited an occurrence of an entirely new, previously unrecognized lesion (type 3; Table 2).[8]

The Kaplan–Meier curve revealed that 88.2% (74.2,100) of femurs demonstrated 1 year radiographic progression-free survival and 73.5% (49.4,100) demonstrated 2 year progression-free survival (Fig. 1). Hence, the rate of progression-free survival time in patients with bone metastases was high. Moreover, none of the patients required a second operation or developed a new fracture.

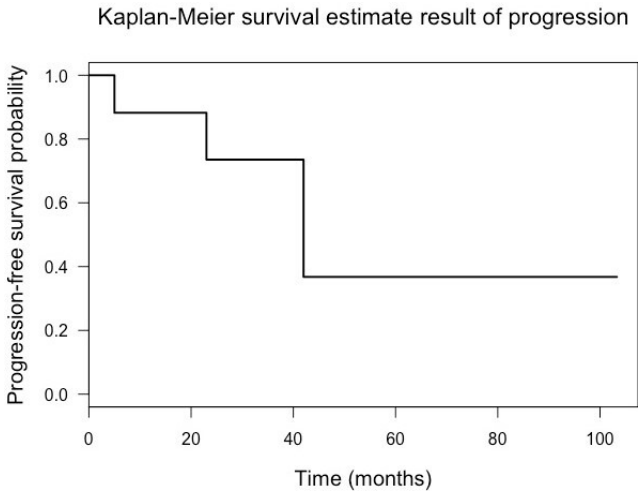

Figure 1. Progression-free survival time

DISCUSSION

If a fracture occurs at the area of metastasis in the proximal femur, a cemented long-stem hip prosthesis remains the optimal treatment option because this prosthesis protects the entire femur from future fractures if metastasis progresses or if new distal metastases develop.[13] However, the implantation of long-stem prostheses is costlier, is more invasive, and carries a higher intraoperative risk than does that of standard-length prostheses.[9,10] Furthermore, new metastatic lesions may necessitate reoperation in the same femur, and the likelihood of such new metastases is unknown.[11] Thus, we evaluated the outcomes after the pathological fractures of the femoral neck with metastatic lesions were treated with hemiarthroplasty with standard-length stems. In four patients, metastasis progressed, but over a median 6.8 month period, none of our patients had a new fracture or required reoperation in the same femur. According to a previous study, the incidence of reoperation for oncological reasons (proximal lesion progression or new distal lesions) in patients with cemented standard-length femoral stems was 2.86% (median follow-up, 487 days)[11]; however, the rates of reoperation for metastasis progression did not differ between patients with standard-length stem prostheses and those with long-stem prosthesis.[11]

Of our patients, 17.39% exhibited metastasis progression after hip arthroplasty; this rate was higher than in previous studies. Xing et al. reported a lower rate of tumor progression in the operated femur after the patients underwent hip arthroplasty for current or impending pathological hip fractures: only 7.77% of patients exhibited progression of metastases or had new distal lesions.[11] Yu et al. demonstrated a higher rate (25.8%) of local recurrence of metastatic lesions in the proximal femur with pathological fractures that were treated with endoprosthetic reconstruction.[14] We hypothesized that the rates of progression in our study and that of Yu et al.[14] were higher than that in the study of Xing et al.[11] because we and Yu et al.[14] included only pathological fractures, whereas Xing et al.[11] included also impending fractures in bones that still contained tumors for which the potential for progression was lower.

This study had several limitations. First, the number of patients with variation in solid tumor type was small; thus, our findings might not be applicable to all types of malignancy or different kinds of malignancy, such as hematological malignancies. Second, the follow-up period (median, 6.8 months) was not long, and in some patients, metastases may have developed later; however, the Kaplan–Meier curve demonstrated good rates of 1–2 year radiographic progression-free survival of the femur. Third, the mean follow-up time of 6.8 months in our study is relatively short due to several patients being lost to follow-up for various reasons, such as passing away or being too ill to attend follow-up appointments. However, it is worth noting that our study is comparable to previous research studies in this aspect, as the majority of studies on this topic also had relatively short follow-up times ranging from 8.3-10.1 months.[14,15] Fourth, Some patients were lost to follow-up without a clear reason, which limits our ability to determine if there was any disease recurrence or progression up until the end of their lives. Finally, adjuvant treatment protocols varied between patients because the types of malignancies also varied; additionally, during the 16-year period from which the data were collected, adjuvant treatment was changing and improving. Further multicenter studies of patients with specific types of malignancies who underwent novel adjuvant protocols should be conducted.

CONCLUSION

Our study demonstrated that the use of cemented standard-length prostheses in hemiarthroplasty for pathological fractures in the femoral neck with metastatic lesions is safe, and no patients necessitated reoperation in the mean follow-up of 6.8 months. We believe that this prosthesis is optimum for the treatment of pathologic femoral neck fracture with metastasis confined to the proximal femur, because the length of expected survival in affected patients is short and the rate of metastatic progression in the same bone is low.

LIST OF ABBREVIATIONS

None.

AUTHOR CONTRIBUTIONS

PT designed the study, performed the analysis and manuscript preparation; VY performed the analysis and manuscript preparation; KI designed the study and collected data; KW, CS, TH collected data. All authors have read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee and Institutional Review Board.

Human Research Ethics committee provided informed consent waiver of ethics committee.

CONSENT FOR PUBLICATION

Not Applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated during this current study are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

REFERENCES

1. Hage WD, Aboulafia AJ, Aboulafia DM. Incidence, location, and diagnostic evaluation of metastatic bone disease. *Orthop Clin North Am*. 2000;31(4):515-528. doi:10.1016/s0030-5898(05)70171-1

2. Peterson JR, Decilveo AP, O'Connor IT, Golub I, Wittig JC. What Are the Functional Results and Complications With Long Stem Hemiarthroplasty in Patients With Metastases to the Proximal Femur? *Clin Orthop Relat Res*. 2017;475(3):745-756. doi:10.1007/s11999-016-4810-7

3. Harris K, Chow E, Zhang L, et al. Patients' and health care professionals' evaluation of health-related quality of life issues in bone metastases. *Eur J Cancer*. 2009;45(14):2510-2518. doi:10.1016/j.ejca.2009.05.024

4. Coleman RE. Clinical features of metastatic bone disease and risk of skeletal morbidity. *Clin Cancer Res*. 2006;12(20 Pt 2):6243s-6249s. doi:10.1158/1078-0432.ccr-06-0931

5. Swanson KC, Pritchard DJ, Sim FH. Surgical treatment of metastatic disease of the femur. *J Am Acad Orthop Surg*. 2000;8(1):56-65. doi:10.5435/00124635-200001000-00006

6. Scolaro JA, Lackman RD. Surgical management of metastatic long bone fractures: principles and techniques. *J Am Acad Orthop Surg*. 2014;22(2):90-100. doi:10.5435/jaaos-22-02-90

7. Harrington KD. Orthopedic surgical management of skeletal complications of malignancy. *Cancer*. 1997;80(8 Suppl):1614-1627.

8. Alvi HM, Damron TA. Prophylactic stabilization for bone metastases, myeloma, or lymphoma: do we need to protect the entire bone? *Clin Orthop Relat Res*. 2013;471(3):706-714. doi:10.1007/s11999-012-2656-1

9. Price SL, Farukhi AM, Jones KB, Aoki SK, Randall LR. Complications of cemented long-stem hip arthroplasty in metastatic bone disease revisited. *Clin Orthop Relat Res*. 2013;471(10):3303-3307. doi:10.1007/s11999-013-3113-5

10. Patterson BM, Healey JH, Cornell CN, Sharrock NE. Cardiac arrest during hip arthroplasty with a cemented long-stem component. A report of seven cases. *J Bone Joint Surg Am*. 1991;73(2):271-277. doi:10.2106/00004623-199173020-00015

11. Xing Z, Moon BS, Satcher RL, Lin PP, Lewis VO. A long femoral stem is not always required in hip arthroplasty for patients with proximal femur metastases. *Clin Orthop Relat Res*. 2013;471(5):1622-1627. doi:10.1007/s11999-013-2790-4

12. Moon B, Lin P, Satcher R, Bird J, Lewis V. Intramedullary nailing of femoral diaphyseal metastases: is it necessary to protect the femoral neck? *Clin Orthop Relat Res*. 2015;473(4):1499-1502. doi:10.1007/s11999-014-4064-1

13. Chrobok A, Spindel J, Mrozek T, et al. Partial long-stem resection Austin-Moore hip endoprosthesis in the treatment of metastases to the proximal femur. *Ortop Traumatol Rehabil*. 2005;7(6):600-603.

14. Yu Z, Xiong Y, Shi R, et al. Surgical management of metastatic lesions of the proximal femur with pathological fractures using intramedullary nailing or endoprosthetic replacement. *Mol Clin Oncol*. 2018;8(1):107-114. doi:10.3892/mco.2017.1503

15. Kim YI, Kang HG, Lee JM, Kim JH, Kim SK, Kim HS. Percutaneous Palliative Surgery for Femoral Neck Metastasis Using Hollow Perforated Screw Fixation and Bone Cement. *JBJS Open Access*. 2017;2(2):e0018. doi:10.2106/jbjs.oa.16.00018