International Journal of Research in Orthopaedics
Wangjiraphan N et al. Int J Res Orthop. 2024 Sep;10(5):902-907
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20242380

Functional outcomes of displaced metastatic fractures of proximal femur: comparison between prosthetic replacement and intramedullary nailing

Noppadol Wangjiraphan[1]*, Ukrit Songpaiboon

Department of Orthopaedic Surgery, Lampang Hospital, Lampang, Thailand

Received: 05 July 2024
Revised: 03 August 2024
Accepted: 06 August 2024

***Correspondence:**
Dr. Noppadol Wangjiraphan,
E-mail: joegeanlong@hotmail.com

ABSTRACT

Background: Surgical treatments for proximal femur metastasis include prosthetic replacement (PR) and intramedullary nailing (IMN). Controversy persists regarding the most appropriate surgical option, and previous studies have mixed outcomes of patients with both displaced and impending fractures. This study aimed to assess the early functional outcomes in patients undergoing PR or IMN specifically for displaced metastatic fractures.
Methods: A retrospective cohort study was conducted on patients with displaced metastatic proximal femur fractures treated surgically between January 2013 and March 2023. Patients with metastases confined to the femoral head or neck without trochanteric extension, which is not an indication for IMN, were excluded. Patients were divided into PR and IMN groups. Functional outcomes were assessed using the Musculoskeletal Tumor Society (MSTS) score at three months postoperatively.
Results: Seventeen patients (10 females, 7 males; mean age 63.1±10.7 years) were treated with PR, and 31 patients (18 females, 13 males, mean age 61.4±11.3 years) were treated with IMN. Preoperative MSTS scores were similar between PR and IMN groups (3.8±2.6 vs. 2.9±1.6, p=0.179). Postoperatively, PR group had significantly higher MSTS scores (16.6±7.0 vs. 12.8±5.1, p=0.045), with better scores in function (p=0.028), supports (p=0.005), and walking (p=0.032). PR group had longer operative time (142 vs. 90 min) and greater blood loss (650 vs. 200 ml) compared to IMN group.
Conclusions: Patients with displaced proximal femur fractures from metastatic lesions had significantly higher MSTS scores with PR than with IMN at three months postoperatively.

Keywords: Displaced, Metastatic fracture, Proximal femur, Outcome, MSTS score

INTRODUCTION

Metastatic bone disease represents a significant concern in health care, exhibiting a prevalence rate of 7.8% among common cancer cases in Thailand.[1] Within the spectrum of bone metastasis locations, the proximal femur is identified as the third most frequent site, subsequent to the spine and pelvis.[2] Specifically, among metastatic tumors of the femur, 50% are located in the femoral neck, 30% in the subtrochanteric region, and 20% in the intertrochanteric region. These metastatic lesions are associated with severe bone pain and a high incidence of pathological fractures.[3] Surgical intervention and the selection of the appropriate technique depend on the patient's overall health, evaluation of the extent of bone involvement at the local and regional levels, and life expectancy. Surgical options include hip replacement or internal fixation.[4] Hip replacement is recommended for cases involving the cervicocephalic or cervical regions, especially when the acetabulum is affected. In contrast, a clear agreement on the choice between intramedullary nailing (IMN) and prosthetic replacement (PR) for intertrochanteric and subtrochanteric

lesions remains elusive. There is a significant divergence in views among oncological orthopaedic surgeons regarding the optimal surgical strategy.[5] The focus of surgical preferences in previous literature has generally been on the durability of implants and functional outcomes; however, consistent functional follow-ups have rarely been analyzed in past research.[6] Moreover, patients in all previous studies were a mix of those with both displaced pathologic fractures and impending fractures. No study has exclusively investigated cases of displaced pathologic fractures. Additionally, there is a noticeable shortage of comparative studies in Thailand that address this issue. The objective of this study was to compare the early functional outcomes, using the Musculoskeletal Tumor Society (MSTS) score, in patients undergoing IMN or PR for displaced metastatic fractures of the proximal femur.[7]

METHODS

A retrospective cohort study was conducted among patients with displaced pathologic fractures of the proximal femur secondary to metastases who received surgical treatment at Lampang Hospital between January 2013 and March 2023. The inclusion criteria were metastasis of the proximal femur proven by histological report, displaced pathologic fractures, and preoperative and postoperative clinical evaluation. The exclusion criteria were metastases of the femoral head or neck without trochanteric extension, which is not an indication for intramedullary fixation, and death or loss of follow-up at three months postoperatively. Patients were divided into PR group and IMN group.

All surgeries were performed by four general orthopedic surgeons and one oncological orthopedic surgeon. The choice of surgeries for PR or IMN was based on multiple factors, such as the extent of cortical destruction, radiological pattern of the lesion, patient preference, and surgeon's preference. In the IMN group, reconstruction was performed using Gamma3 long nail (Stryker, USA) in 23 cases, ITST long nail (Zimmer Biomet, USA) in 5 cases, Gamma3 trochanteric nail (Stryker, USA) in 2 cases, and Zimmer Natural Nail (Zimmer Biomet, USA) in 1 case.

The femoral canal was reamed, and the nail with the largest possible diameter was inserted. The cavity with the metastatic lesion was thoroughly curetted, and bone cement was used as structural support to fill the void following curettage (Figure 1). Postoperatively, partial weight bearing as tolerated was initiated in the first or second postoperative day using a walker.

In the PR group, cemented mega prostheses (Beijing Montagne Medical Device, China) were used in 6 patients, cemented MP reconstruction prostheses (Waldemar Link GmbH, Germany) in 5 patients, cemented Avenir prostheses (Zimmer Biomet, USA) in 3 patients, and cemented CPT prostheses (Zimmer Biomet, USA) in 3 patients. Bipolar head components were used in all patients (Figure 2 and 3). The tendons of the gluteus medius and vastus lateralis muscles were reattached using the vascular graft, and the hip capsule was closed in all patients. These patients were allowed full weight bearing during the first postoperative day. Patients initially used a walker and progressed to using crutches and subsequently without support, as tolerated.

Functional outcomes were assessed using the MSTS score at three months postoperatively.[7] This functional evaluation system assigns numerical values (0-5) to each of six categories: pain, function, emotional acceptance, need for external support, walking ability, and gait. Patient demographics, clinical and operative data, and postoperative complications were collected. Data were compared between the two groups using the t-test, Mann-Whitney U test, and exact probability test. The statistical analyses were performed using STATA version 13.0 (Stata Corp LP, College Station, Texas, USA), and a p value of <0.05 was considered significant. The research protocol was approved by the institutional review board (EC Code 21/62).

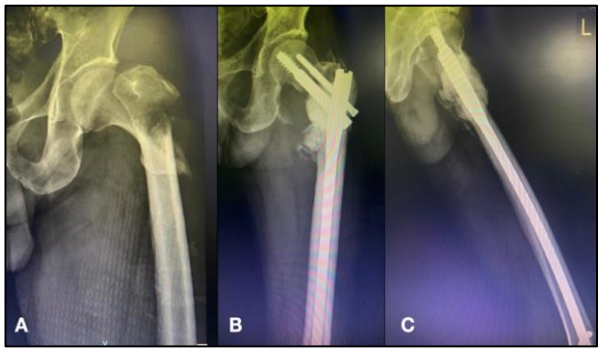

Figure 1: A 64-year-old man had a pertrochanteric fracture of the femur. (A) Received fixation with a cephalomedullary nail and bone cement; (B and C) the tissue diagnosis revealed urothelial carcinoma metastasis from the urinary bladder.

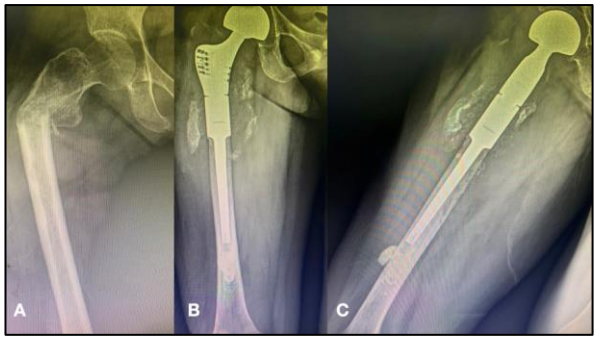

Figure 2: (A) 54-year-old woman had been diagnosed with breast cancer for 6 years. She had a subtrochanteric fracture of the femur; (B and C) underwent tumor removal and reconstruction with a cemented mega prosthesis.

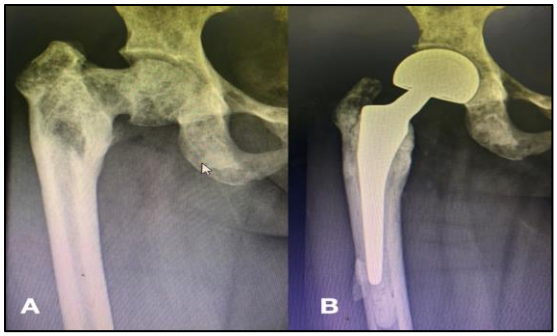

Figure 3: (A) 37-year-old woman was diagnosed with breast cancer one year ago. She had a cervico-trochanteric fracture of the femur; (B) received reconstruction with a cemented bipolar hemiarthroplasty.

RESULTS

Between January 2013 and March 2023, 51 patients with displaced metastatic fracture of proximal femur received surgical treatment at our hospital. Five patients were excluded because of death within 3 months and all of them received IMN. Thus, 48 patients were enrolled in the study. The mean age was 60.9±11.6 years (range 33-83). Twenty-six cases were female (54.2%). Most of the primary tumors were lung (28 cases, 58.3%), breast (13 cases, 27.1%), and digestive system (5 cases, 10.4%). A total of 17 patients were treated with PR (10 females and 7 males; mean age, 63.1±10.7 years) and 31 patients were stabilized with IMN (18 females and 13 males; mean age, 61.4±11.3 years) (Table 1). Between the IMN and PR groups, there was no significant difference in preoperative patient characteristics in terms of age, sex, body mass index, primary tumor, and fracture location.

The median operative time in the PR group was significantly longer than in the IMN group, with times of 142 minutes (IQR 117-165) compared to 90 minutes (IQR 65-120). Similarly, the PR group experienced significantly greater median intraoperative blood loss, measuring 650 ml (IQR 300−800) as opposed to 200 ml (IQR 100-500) in the IMN group (p=0.002). In the IMN group, one patient experienced postoperative pneumonia, and another experienced fixation failure. In the PR group, one patient developed a superficial surgical site infection, and no patients experienced hip dislocations (Table 2).

The mean preoperative MSTS score was 3.2±2.0. There was no significant difference between the PR group and the IMN group (3.8±2.6 vs 2.9±1.6, p=0.179). However, at three months postoperatively, the mean MSTS score was 14.1±6.0. The mean MSTS scores in the PR group were significantly higher than those in the IMN group (16.6±7.0 vs 12.8±5.1, p=0.045). Notably, when examining the six categories of the MSTS scoring system, prosthetic replacement yielded higher scores in terms of function (p=0.028), supports (p=0.005), and walking (p=0.032) (Table 3).

Table 1: Demographic data compare between the prosthetic replacement group and the intramedullary nailing group (n=48).

Data	Prosthetic replacement (n=17)	Intramedullary nailing (n=31)	P value
Gender N (%)			
Female	10 (58.8%)	18 (58.1%)	1.000
Male	7 (41.2%)	13 (41.9%)	
Age (year) mean ±SD	63.1±10.7	61.4±11.3	0.602
Range	37−83	33−83	
BMI (kg/sqm) mean ±SD	21.5±3.9	21.6±4.8	0.995
Range	16.0−29.7	12.3−97.7	
Primary tumor N (%)			
Lung	8 (47.0%)	10 (32.3%)	0.387
Breast	4 (23.5%)	9 (29.1%)	
Prostate	2 (11.8%)	0 (0%)	
Digestive system	1 (5.9%)	4 (12.9%)	
Kidney	1 (5.9%)	1 (3.2%)	
Soft tissue	1 (5.9%)	1 (3.2%)	
Multiple myeloma	0 (0%)	4 (12.9%)	
Ovary	0 (0%)	1 (3.2%)	
Urinary bladder	0 (0%)	1 (3.2%)	
Fracture location N (%)			
Neck with trochanteric extension	8 (47.1%)	6 (19.4%)	0.138
Intertrochanteric	4 (23.5%)	9 (29.0%)	
Subtrochanteric	5 (29.4%)	16 (51.6%)	

Table 2: Intraoperative and postoperative data comparison between the prosthetic replacement group and the intramedullary nailing group (n=48).

Data	Prosthetic replacement (n=17)	Intramedullary nailing (n=31)	P value
Operative time (minutes)			
Median (IQR)	142 (117, 165)	9 0(65, 120)	0.002
Mean ±SD	137±41	96±39	
Min−max	60−200	50−200	
Blood loss (ml)			
Median (IQR)	650 (300, 800)	2 00(100, 500)	0.003
Mean±SD	569±233	382±411	
Min−max	2800−00	101−0,800	
Surgical site infection N (%)	1 (5.9%)	0 (0%)	0.354
Pneumonitis N (%)	0 (0%)	1 (3.2%)	1.000
Hip dislocation N (%)	0 (0%)	0 (0%)	1.000
Implant failure N (%)	0 (0%)	1 (3.2%)	1.000

Table 3. MSTS score comparison between the prosthetic replacement group and the intramedullary nailing group (n=48).

MSTS score	Prosthetic replacement (n=17)	Intramedullary nailing (n=31)	P value
Preoperative score			
Mean±SD	3.8±2.6	2.9±1.6	0.179
Range	0−10	1-6	
3-month postoperative score			
Total score			
Mean±SD	16.6±7.0	12.8±5.1	0.045
Range	2-27	26-5	
Categorized score (mean±SD)			
Pain (0−5)	3.9±1.1	4.4±0.7	0.111
Function (0−5)	2.9±1.4	1.9±1.4	0.028
Emotional (0−5)	3.4±1.3	3.1±0.8	0.328
Support (0−5)	1.5±1.8	0.4±1.0	0.005
Walking (0−5)	2.6±1.6	1.6±1.4	0.032
Gait (0−5)	2.2±1.3	1.5±1.2	0.059

DISCUSSION

The primary objective of surgically treating metastatic lesions in the proximal femur is to enhance functional status while minimizing recovery time. The key surgical methods are prosthetic replacement and IMN fixation. At present, there is insufficient evidence to favor one treatment method over the other. Typically, clinical experience guides surgeons in their decision-making process when managing these patients. In this study, it was found that three months following surgical treatment for displaced metastatic fractures of the proximal femur, the mean MSTS scores in the PR group were significantly higher compared to the IMN group, particularly in the function, supports, and walking categories of the MSTS scoring system. This outcome may be attributed to the ability of PR to provide immediate stability and pain relief, thereby facilitating early mobilization.[8] However, our findings diverge from those of Yu et al, who conducted a retrospective study involving 58 patients with displaced fractures and 30 patients with impending fractures of proximal femur metastasis.[6] They observed that the IMN group achieved higher MSTS scores six weeks post-surgery, attributed to the lack of muscle resection around the hip. In contrast, the PR group exhibited higher scores six months post-surgery, with no significant differences observed between the groups at three months postoperatively. Consequently, Yu et al, recommended PR for patients with a longer life expectancy seeking a higher quality of life, and IMN for those with limited survival time who would benefit from shorter recovery periods. Similarly, Hindiskere et al. retrospectively reviewed 70 patients who underwent surgery for proximal femur metastasis, comprising 34 patients with displaced fractures and 36 with impending fractures.[9] Their findings indicated no significant differences in postoperative MSTS scores between the groups at 6-month and 1-year follow-ups. They advocated for the use of PR to enhance durability and improve quality of life, even in patients with shorter life expectancy. The mean preoperative MSTS score in our study was 3.2, which is notably lower than the scores reported by Yu et al at 7.9, and by Guzik et al at 7.7. 6,10

This discrepancy is likely due to the fact that all our patients had displaced pathologic fractures, were non-ambulatory, and experienced severe pain, whereas displaced fractures accounted for 66% and 80% of the patients in the studies by Yu and Guzik, respectively. Three months post-surgery, our study reported an average MSTS score of 14.1, which is lower than the scores of 24.8 and 19.9 reported by Yu et al. and Guzik et al, respectively. 6,10 This difference can be attributed to the absence of patients with impending fractures in our cohort, while impending fractures were present in 34% and 20% of the patients in the Yu and Guzik studies, respectively. Generally, patients with impending fractures who undergo prophylactic fixation tend to experience faster recovery compared to those with displaced fractures.

The PR group had a significantly longer operative time and higher intraoperative blood loss than the IMN group (142 vs. 90 minutes, and 650 vs 200 ml, respectively). These findings coincide with those reported by Yu et al, who observed higher operative times (143 vs 99 minutes) and blood loss (932 vs 345 ml) in the PR group compared to the IMN group.6 Similarly, Gusho et al. revealed that the PR group experienced more operative time (151 vs. 93 minutes) and blood loss (500 vs. 150 ml) than the IMN group.11 In contrast, Hindiskere et al. demonstrated comparable operative times (229 vs 201 minutes) and blood loss (1,498 vs 1,199 ml) between the PR group and the IMN group.9 They explained that the prolonged surgical time and higher blood loss compared to other studies were due to thorough curettage of the metastatic lesion with curative intent being performed in all patients. Additionally, wide resection with soft tissue reconstruction (involving the gluteus medius and maximus, hip joint capsule, and vastus lateralis) was achieved in 42% of cases in the PR group. Patients treated for bone metastasis in the proximal femur are at risk of requiring revision surgery and suffering complications, no matter which implant is used. A recent systematic review demonstrated that patients undergoing prosthetic replacement experienced higher incidences of non-surgical complications, with a dislocation rate of 6.7% and an infection rate of 3.5%.[12] This could be attributed to the extensive dissection of soft tissues involved in endoprosthetic reconstructions. On the other hand, patients who received internal fixation were more susceptible to implant or fixation failure, with a rate of 6.2%, and more likely to require revision surgeries. In our study, the rates of postoperative complications were comparable between the two groups. None of the patients in either group experienced surgical site infections, hip dislocations, or fixation failures. These findings could be attributed to the relatively small sample size and brief follow-up period of the study. This study had several limitations. First, the study featured a relatively short follow-up period, which is common for this group of patients in rural areas. Second, there was a small number of patients, due to the exclusion of those with impending fractures. Third, the retrospective design precluded tracking every patient until the end of their lifespan. Fourth, the selection of treatments was not randomized but depended entirely on mutual agreements between the surgeon and the patients. The strength of this study, on the other hand, was that the endpoints included the MSTS score. This score is a valid tool, both subjective and objective, for evaluating the outcomes of surgical treatments in patients with extremity tumors.[13] Moreover, we focused exclusively on the displaced pathologic fractures that no previous literature had studied in this manner. Additionally, this is the first study conducted at a tertiary hospital in Thailand's rural regions to explore the clinical outcomes of surgical treatments for displaced pathologic fractures due to metastatic lesions in the proximal femur. The study results could be applied to other hospitals in comparable provincial settings.

CONCLUSION

The MSTS scores for patients with displaced pathologic fractures in the proximal femur due to metastatic lesions, treated with prosthetic replacement, were significantly higher than those treated with intramedullary nailing three months postoperatively.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Phanphaisarn A, Patumanond J, Settakorn J, Chaiyawat P, Klangjorhor J, Pruksakorn D. Prevalence and survival patterns of patients with bone metastasis from common cancers in Thailand. Asian Pac J Cancer Prev. 2016;17(9):4335-40.
2. Piccioli A, Rossi B, Scaramuzzo L, Spinelli MS, Yang Z, Maccauro G. Intramedullary nailing for treatment of pathologic femoral fractures due to metastases. Injury. 2014;45(2):412-7.
3. Feng H, Wang J, Xu J, Chen W, Zhang Y. The surgical management and treatment of metastatic lesions in the proximal femur: A mini review. Medicine (Baltimore). 2016;95(28):3892.
4. Meynard P, Seguineau A, Laumonerie P, Fabre T, Foltran D, Niglis L, et al. Surgical management of proximal femoral metastasis: Fixation or hip replacement? A 309 case series. Orthop Traumatol Surg Res. 2020;106(6):1013−23.
5. Steensma M, Healey JH. Trends in the surgical treatment of pathologic proximal femur fractures among Musculoskeletal Tumor Society members. Clin Orthop Relat Res. 2013;471(6):2000−6.
6. Yu Z, Xiong Y, Shi R, Min L, Zhang W, Liu H, 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):107-14.
7. Enneking WF, Dunham W, Gebhardt MC, Malawar M, Pritchard DJ. A system for the functional evaluation of reconstructive procedures after surgical

treatment of tumors of the musculoskeletal system. Clin Orthop Relat Res. 1993;(286):241-6.
8. Gao H, Liu Z, Wang B, Guo A. Clinical and functional comparison of endoprosthetic replacement with intramedullary nailing for treating proximal femur metastasis. Chin J Cancer Res. 2016;28(2):209-14.
9. Hindiskere S, Kim HS, Kim Y, Han I. Surgery for proximal femur metastases: endoprosthesis reconstruction or intramedullary nailing? Ann Joint. 2021;6:27.
10. Guzik G. Oncological and functional results after surgical treatment of bone metastases at the proximal femur. BMC Surg. 2018;18(1):5.
11. Gusho CA, Clayton B, Mehta N, Hmeidan W, Colman MW, Gitelis S, et al. Internal fixation versus endoprosthetic replacement of the proximal femur for metastatic bone disease: Single institutional outcomes. J Orthop. 2021;28:86-90.
12. Di Martino A, Martinelli N, Loppini M, Piccioli A, Denaro V. Is endoprosthesis safer than internal fixation for metastatic disease of the proximal femur? A systematic review. Injury. 2017;48(3):48-54.
13. Rizzo A, Paderno M, Saccomanno MF, Milano F, Milano G. The Musculoskeletal Tumor Society Scoring system is a valid subjective and objective tool to evaluate outcomes of surgical treatment of patients affected by upper and lower extremity tumors. Musculoskelet Surg. 2024;108:201-14.

Cite this article as: Wangjiraphan N, Songpaiboon U. Functional outcomes of displaced metastatic fractures of proximal femur: comparison between prosthetic replacement and intramedullary nailing. Int J Res Orthop 2024;10:902-7.