The Role of Intramedullary Nailing and Arthroplasty in the Treatment of Metastatic Carcinoma of the Proximal Femur: A Propensity Score-Matched Study

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Abstract

Objectives: To investigate the selection, clinical efficacy and prognosis of surgical treatment for proximal femoral metastases and compare the effectiveness of the intramedullary nail and joint replacement to treat proximal femoral metastases.

Methods: This study retrospectively enrolled 60 patients with proximal femur metastases treated from 2006 to January 2016. Outcomes among patients of the two surgical methods by collecting medical records, intraoperative blood loss, operative time, VAS score, MSTS score, ECOG score, postoperative complications, and overall survival time.

RESULTS: The amount of bleeding and the average operation time were significantly different in the nailing group and the hip replacement group. The postoperative VAS score, MSTS score, and ECOG score were also significantly different.

CONCLUSION: Intramedullary nailing is preferred for patients with a short survival time, and a better quality of life is achieved early in patients with a limited survival time. Hip replacement is appropriate for patients who are expected to have a long survival time.

Introduction

Currently, the worldwide incidence of malignant tumors is increasing annually. The progression of medical science has helped improve the malignant tumor survival rate, which has also led to the increased incidence of bone metastases. In addition to metastasizing to the lungs and liver, bone is the most common distant metastatic site of tumors.[1] Previous autopsy examinations showed that 60% to 80% of patients with malignant tumors had secondary bone metastases, of which 90% were prostate, lung, mammary, kidney, thyroid and colorectal malignancies.[2] The femur is the most common metastatic site of the long bone, and one-third of cases of metastasis occur in the proximal femur. The following factors provide favorable conditions for bone metastasis of malignant tumors: the reticular distribution of the bone trabecula, a location close to the capillary sinus and the rich blood supply and slow blood flow.[3-8] Previous reports have shown that most bone metastases from malignant tumors represent osteolytic changes, with osteolytic lesions accounting for approximately 52%.[9] The proximal femur has a high-intensity biomechanical load, and the proximal femur with metastasis is prone to pathological fractures. One study suggests that 50% of pathological fractures of the proximal femur are located in the neck of the femur, 30% in the subtrochanteric region and 20% in the intertrochanteric region.[10] After pathological fractures of the proximal femur, the dysfunction of the lower limb combined with severe pain results in a significant decrease in the patient's quality of life. After pathological fractures occur, the patient is bedridden for a long time, causing a series of complications, such as hypostatic pneumonia and lower limb venous thrombosis; these complications further affect the treatment and prognosis of the patient in the later period and affect the survival period of the patient. In recent years, with improvements in the treatment of malignant tumors and the application of various targeted drugs, the survival time of patients with metastatic carcinoma has been prolonged, and the risk of pathological fracture has increased in patients with metastatic carcinoma of the proximal femur. At present, most clinicians prefer surgical treatment for metastatic carcinoma of the proximal femur.[11-12] The reasons for the surgical treatment of bone metastases are as follows: to reduce the patient's pain as early as possible during survival, to prevent the occurrence of pathological fractures or to restore the continuity of pathological fractures, to provide firm fixation for patients to get out of bed as early as possible, to restore the ability of self-care as early as possible, to improve the quality of life, and to provide conditions for treatment follow-up in patients with metastatic carcinoma of the proximal femur within the limited survival time. The advantage of surgery is that it not only clears the tumor lesion and controls the local tumor but also provides the patient with stable internal fixation. Only treatments such as radiotherapy, chemotherapy and targeted treatment can kill the tumor lesion, but they do not achieve internal fixation. At present, the main surgical methods are as follows: 1. curettage + intramedullary nail fixation + bone cement filling; 2. tumor lesion resection + customized tumor artificial hemiarthroplasty; and 3. curettage + bone cement filling + plate and screw internal fixation. There are many complications that occur after internal fixation with the use of plates and screws, so the use of plates and screws is gradually decreasing. Currently, the first two kinds of surgery listed are mostly used. However, the choice of surgical procedure for the treatment of proximal femoral metastases is still a controversial issue. A good outcome can be achieved only after surgery. Many factors influence the choice of surgical procedure, such as the patient's general condition, survival time, primary tumor, location and number of metastases.[13-15]

Materials And Method

This study data were collected from the Department of Orthopedics, the Third Affiliated Hospital of Kunming Medical University (Yunnan Provincial Cancer Hospital) from 2006 to 2016, and the patients received either "smear removal + intramedullary nail fixation + bone cement filling" or "tumor lesion resection + customized tumor artificial half-hip joint replacement." A propensity score-matched study in patients with proximal femoral metastases treated with hemiarthroplasty was carried out to explore the surgical treatment of metastatic carcinoma of the proximal femur, its clinical effect, and the prognostic analysis. The curative effects of intramedullary nail placement and arthroplasty for the treatment of metastatic carcinoma of the proximal femur were compared, and the factors that affected the survival rate of patients were analyzed retrospectively.

Data screening criteria

1 Inclusion criteria

(1) Clinical and imaging diagnoses of metastatic carcinoma of the proximal femur, with pain in the proximal femur as the main clinical manifestation;

(2) The Mirels score (see table below) was 9 or more points, or pathological fracture occurred;

(3) The expected survival time was >3 months;

(4) Fair general body condition; patients could tolerate the operation;

(5) The informed consent form was signed, and surgery was performed;

(6) All patients received routine chemotherapy and other comprehensive treatments according to the original scheme;

(7) Patients who could return to the hospital regularly after the operation for review, and patients who could be followed in a clinic or by telephone.

2 Exclusion criteria

(1) Primary bone tumors;

(2) The patient's general condition was poor, or there were serious systemic diseases so that the patients could not undergo anesthesia or surgery;

(3) Patients and their families refused surgical treatment;

(4) The postoperative treatment plan could not be completed according to the treatment plan;

(5) Rejected for objective reasons, patients who did not have complete clinical data or patients lost to follow-up.

Grouping and Surgical Methods

Patients were divided into two groups:

(1) Intramedullary nail fixation group (nailing group): the patients were treated with curettage + intramedullary nail fixation + bone cement filling.

(2) Joint replacement group: the patients were treated with tumor segment resection + customized tumor artificial hemiarthroplasty.

Research method

1 Preoperative examination

All patients required routine examination before the operation, including routine blood, urine, and stool examinations; liver and kidney function, electrolyte, and coagulation measurements; dynamic electrocardiogram; lung function tests; and DR, CT, MRI, and SPECT. PET-CT examination was utilized if permitted by the economic condition of the patient. If the patient had a history of hypertension or hyperglycemia, blood pressure and blood sugar were measured before the operation.

2 Preoperative and postoperative treatments

Antibiotics were injected intravenously 30 minutes before the surgery, and all the examination results, including routine blood, liver and kidney function, electrolytes, and infection indicators, were reviewed. Postoperatively, the affected limbs were elevated, and negative pressure drainage was continued. The antibiotics were continued for 5 to 7 days after the operation. When the color of the drainage fluid was pale and amounted to less than 30 ml for 3 consecutive days, the tube was removed. Patients were instructed to perform early limb functional exercises to prevent the adhesion of muscles and nerves, to strengthen the muscles of the lower limbs, and to avoid atrophy of the lower limb muscles.

3 Follow-up content and indicators for observation

3.1 Follow-up content

All the patients included in the study as well as their respective surgery times and intraoperative bleeding levels and whether they experienced postoperative hospital follow-up, follow-up by telephone or outpatient follow-up were recorded. The follow-up assessments included those of pain, limb function, quality of life, complications, and survival in the patients.

Table 1
The Revised Musculoskeletal Tumor Society Rating Scale

Score	Pain	Function	Emotional	Supports	Walking	Gait
5	No pain	No restriction	Enthused	None	Unlimited	Normal
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
3	Modest	Recreational restriction	Satisfied	Brace	Limited	Minor cosmetic
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
1	Moderate	Partial restriction	Accepts	One cane or crutch	Inside only	Major cosmetic
0	Severe disabling	Total restriction	Dislikes	Two canes or crutches	Not independent	Major handicap

3.2 Observation indicators

(1) VAS scores were used to assess pain before as well as 1, 3, 6 and 12 months after the operations, and the VAS score ranged from 0-10. The higher the VAS score of the patient was, the more severe the pain.[16]

(2) The MSTS score was used to test the functional status of an affected limb before and 1, 3, 6, and 12 months after the operations[17] (Table 1).

(3) The ECOG score was used to test the quality of life of the patients before and 1, 3, 6 and 12 months after the operation (Table 2).

(4) The presence of intraoperative hemorrhage, operative time, postoperative complications and survival time were recorded.

Table 2
ECOG performance status

Grade	ECOG
0	Full active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work
2	Ambulatory and capable of all selfcare but unable to carry out any work activities. Up and about more than 50% of walking hours
3	Capable of only limited selfcare, confined to bed or chair more than 50% of walking hours
4	Completely disabled. Cannot carry on any selfcare. Totally confined to bed or chair
5	Dead

Statistical methods

The propensity matching score[18] was used to create two comparable groups. The intramedullary nailing group was considered the "treatment group", and the hip replacement group was considered the "control group". The patient's sex and age, location of the metastases, presence or absence of pathological fractures, number of metastases, primary tumor type, primary surgery type, preoperative VAS score, preoperative ECOG score, and preoperative MSTS score were used for the logistic regression analysis of covariates to estimate propensity scores for each eligible case. The logistic regression procedure created a probability score for each subject. Then, he nearest neighbor was matched unsubstituted,[19-21] the tolerance was matched to 0.03, and the score was manually matched.

Data analysis was performed using SPSS 24.0 software. The continuous data were reported as the mean ± standard deviation and were compared with t-tests; the classified data were expressed as the count and percentage and were compared with the chi-square test. $P<0.05$ was statistically significant. The Kaplan-Meier log-rank test was used to analyze the survival rate of patients with single-factor analysis. Cox regression multiple factor analysis was used to analyze the factors affecting the survival rate of patients with proximal femoral metastases.

Results

The general condition of the selected patients

We collected data from a total of 60 patients with proximal femur metastases treated with "curettage + intramedullary nailing + bone cement filling" or "tumor resection + customized artificial hemiarthroplasty" at the Third Affiliated Hospital of Kunming Medical University (Yunnan Province Tumor Hospital). Among them, 34 patients received " curettage + intramedullary nailing + bone cement filling", and 26 patients received " tumor resection + customized artificial hemiarthroplasty". The patients' sex and age, number of metastases, site of metastasis, presence or absence of pathological fractures, primary tumor type, whether the primary tumor received surgical treatment, preoperative VAS score, preoperative ECOG score, and preoperative MSTS score were used as covariant scores to assess the propensity. The 26 patients who received "tumor resection and customized artificial hemiarthroplasty" were considered the control group and were included in the propensity matching analysis; the matching capacity was 0.03. Additionally, 20 of the 34 patients who underwent intramedullary nailing were paired with 20 patients in the arthroplasty group by comparing the propensity scores of the two groups. According to the propensity matching analysis, there was no significant difference in the demographic or preoperative parameters between the two paired groups (Table 3).

Table 3
Comparison of the general data and preoperative data between the joint replacement group and the nailing group

Group	Joint replacement	Intramedullary nail fixation	P value
Total	20	20	-
Sex			
Male	10	8	0.525
Female	10	12	
Age	54.2±12.1	52.6±8.1	0.625
Number of metastatic lesions			0.943
Single	8	9	
<3	3	3	
>3	9	8	
Femoral metastatic site			0.684
Femoral neck	2	1	
Below the femoral neck	3	5	
Middle of the femur	15	14	
Pathological fracture			0.327
Yes	14	11	
No	6	9	
Primary surgery			0.749
Yes	8	9	
No	12	11	
Primary tumor type			0.626
Lung cancer	13	11	
Breast cancer	4	5	
Colorectal cancer	1	1	
Kidney cancer	0	1	
Esophageal cancer	0	1	
Unknown metastatic cancer	1	0	
Thyroid cancer	0	1	

Prostate cancer	1	0	
Preoperative VAS score	7.15±1.1	6.80±1.3	0.375
Preoperative MSTS score	2.96±4.6	4.30±4.9	0.376
Preoperative ECOG score	3.50±0.5	3.75±0.4	0.108

Intraoperative bleeding and operation time

1 Intraoperative bleeding: 450 ml-2200 ml in the arthroplasty group; the mean was (1047.5±519.2) ml, which was significantly higher than the 150 ml-1250 ml in the nailing group. The mean was (705.0±347.1) ml, $P < 0.05$, in the intramedullary nail internal fixation group and the joint replacement group, and the difference in intraoperative blood loss was statistically significant (Table 4).

2 Operative time: 2-4.5 h in the arthroplasty group; the mean was (3.15±0.86) h. In the intramedullary nail internal fixation group, the operative time was 1.5-4.0 h, with an average of (2.55±0.63) h. The P value was less than 0.05. There was a significant difference in the operative time between the intramedullary nail and the arthroplasty groups (Table 4).

Table 4
Intraoperative bleeding and operation time

	Joint replacement	**Intramedullary nail fixation**	**P value**
Blood loss (ml)	1047.5±519.2	705.0±347.1	0.019
Operation time (h)	3.15±0.86	2.55±0.63	0.016

Pain, limb function, quality of life and complications

1 Preoperative and postoperative VAS scores

There was no significant difference in the preoperative VAS scores between the nailing group and the arthroplasty group. The mean 1-month postoperative VAS score was 4.95±0.5 in the arthroplasty group. The mean VAS score was 3.45±0.5 ($P < 0.05$) in patients who underwent intramedullary nailing. There were significant differences in the VAS scores between the intramedullary nail and the arthroplasty groups 1 month after arthroplasty. The mean VAS score was 2.42±0.5 in the joint replacement group and 1.75±0.8 in the intramedullary nailing group ($P < 0.05$) 3 months after the operation. The mean VAS score was 0.94±0.2 in the arthroplasty group and 1.31±0.9 in the intramedullary nailing group ($P > 0.05$). There was no significant difference in VAS score between the intramedullary nailing group and the joint replacement group 6 months after surgery. The mean VAS score was 0.56±0.5 12 months after the operation and 3.70±2.2 in the intramedullary nailing group ($P < 0.05$), and the mean VAS score was 0.56±0.5 in the intramedullary nailing group. The difference was statistically significant (Table 5).

2 Preoperative and postoperative MSTS scores

There was no significant difference in MSTS scores between the patients with IMN and the patients with arthroplasty before the operation. The MSTS score was 4.42±0.7 1 month after arthroplasty. The average MSTS score in the nailing group was 8.55±1.4 ($P < 0.05$), and the difference was statistically significant.

The MSTS score was 14.05±1.7 in the joint replacement group 3 months postoperatively. The MSTS score of the nailing group was 15.75±1.7 ($P < 0.05$), and the difference was statistically significant.

There was no significant difference in MSTS scores between the IMN and the arthroplasty groups 6 months after surgery. The mean MSTS score was 21.33±0.9 12 months after the operation in the arthroplasty group and was 11.70±6.3 in the intramedullary nailing group ($P < 0.05$). The difference was statistically significant (Table 5).

Table 5
Preoperative and postoperative VAS scores, MSTS scores, ECOG scores, and complications

	Joint replacement	Intramedullary nail fixation	P value
VAS score			
Preoperative	7.15±1.1	6.80±1.3	0.375
1 month after surgery	4.95±0.5	3.45±0.5	0.000
3 months after surgery	2.42±0.5	1.75±0.8	0.003
6 months after surgery	0.94±0.2	1.31±0.9	0.102
12 months after surgery	0.56±0.5	3.70±2.2	0.001
MSTS score			
Preoperative	2.96±4.6	4.30±4.9	0.376
1 month after surgery	4.42±0.7	8.55±1.4	0.000
3 months after surgery	14.05±1.7	15.75±1.7	0.005
6 months after surgery	18.94±2.3	17.31±5.1	0.255
12 months after surgery	21.33±0.9	11.70±6.3	0.000
ECOG score			
Preoperative	3.50±0.5	3.75±0.4	0.108
1 month after surgery	2.79±0.6	2.40±0.5	0.039
3 months after surgery	2.26±0.6	1.75±0.6	0.007
6 months after surgery	1.47±0.5	1.69±0.6	0.298
12 months after surgery	1.89±0.9	3.00±1.1	0.027
Complications			0.449
Pulmonary embolism	1	0	
DVT	1	2	
Infection			
Surgical infection	2	1	
Pulmonary infection	2	0	

3 Preoperative and postoperative ECOG scores

There was no significant difference in preoperative ECOG scores between the nailing group and the arthroplasty group. The ECOG score was 2.79±0.6 1 month after arthroplasty in the arthroplasty group and was 2.40±0.5 in the intramedullary nailing group ($P < 0.05$). The ECOG scores of the two groups were significantly different 1 month after the operation; the ECOG scores 3 months after joint replacement were 2.26±0.6 in the arthroplasty group and 1.75±0.6 in the intramedullary nailing group ($P < 0.05$), and the difference was statistically significant.

There was no significant difference in ECOG scores between the IMN and the arthroplasty groups 6 months after surgery. The ECOG scores were 1.89±0.9 12 months postoperation in the arthroplasty group and 3.00±1.1 in the nailing group ($P < 0.05$), and the difference was statistically significant (Table 5).

4 Postoperative complications

Pulmonary embolism occurred in one patient in the arthroplasty group. The patient died on the first day after surgery, and one patient with deep vein thrombosis was treated with anticoagulant therapy; the condition improved. There were 4 cases of postoperative infection, including 2 cases of intraoperative infection. After antibiotic treatment, the incision healed well. Pulmonary infection occurred in 2 patients. Sensitive antibiotics were selected according to the sputum culture results, and lung infection was improved after treatment. Deep venous thrombosis was found in 2 patients in the nailing group. After treatment with anticoagulant therapy, the thrombus disappeared in the blood vessels of the lower limb. One patient developed a surgical site infection, and the infection was controlled effectively by selecting sensitive antibiotics based on the results of a bacterial sensitivity culture test. The chi-square test showed that there was no significant difference in the incidence of postoperative complications between the intramedullary nailing group and the arthroplasty group ($P<0.05$) (Table 5).

Survival analysis

1 Univariate analysis

The Kaplan-Meier analysis with the log-rank method was used to compare the sex, age, location, ECOG score, number of metastatic lesions, location of the metastases, pathological fractures, primary tumors, surgical methods, survival rate, and survival. The curve for the survival rate is shown in Figure 2.

The results showed that there was no significant difference in the sex, age, preoperative ECOG score, whether primary surgery was performed, and survival time in patients with metastatic cancer of the proximal femur. There was a statistically significant difference in the effect of the number of pathological fractures and metastases on survival time.

2 Multifactor analysis

To quantitatively analyze the effect of each observation index on prognosis intensity and direction, the role of the prognostic factors was analyzed comprehensively, and we used Cox regression multiple factor analysis to analyze the factors that affected the survival rate of patients with proximal femoral metastases. The Cox regression equation was used to analyze all the covariates.

A multiple Cox risk proportional regression model was carried out for sex, age, location, ECOG score, number of metastatic lesions, pathological fracture of the femur, primary tumor and operative method, and the results of the Cox regression multifactor analysis were obtained (Table 6). The results suggest that the primary tumor type, the number of metastases, and the pathological fracture are independent factors influencing the survival of patients with metastatic carcinoma of the proximal femur.

Discussion

It has been confirmed that one of the severe complications of metastatic carcinoma of the proximal femur is the presence of a pathological fracture, and once it occurs, severe pain and lower limb dysfunction lead to a significant decrease in the quality of life of patients, and the survival time is also significantly shortened.[22-23] After metastatic carcinoma of the proximal femur is complicated by the presence of a pathological fracture, the operation becomes difficult, and the cost of treatment increases significantly. Therefore, it is necessary to adopt preventive internal fixation surgery for patients with metastatic carcinoma of the proximal femur who are about to have pathological fractures. After a retrospective study, Mirels developed a scoring system to assess the risk of pathological fractures in patients with metastatic carcinoma of the proximal femur.[3] The study concluded that when the Mirels score was greater than 9, surgical treatment was needed to prevent the occurrence of pathological fractures. Pathological fractures differ from nonpathological fractures, which require a longer healing time; studies have shown that only 35% of pathological fractures can heal during survival, and 50% of pathological fractures simply cannot heal at all.[24] Therefore, the weight-bearing capacity of the proximal femur is often provided by the implant itself.

The advantage of surgery is that it not only removes tumor lesions to control local tumors but also provides patients with stable internal fixation, while radiotherapy, chemotherapy, targeted treatment and so on can only kill tumor lesions but cannot achieve internal fixation.

The surgical methods commonly used for treatment include the following three types:

1. tumor segment resection + custom tumor artificial semi-hip arthroplasty; 2. lesion removal + intramedullary nail internal fixation + bone cement filling; and 3. lesion resection + steel plate screw fixation. However, the surgical treatment of patients with metastatic carcinoma of the proximal femur has evolved over the past 30 years from the use of plate fixation to the use of intramedullary nail internal fixation and joint prosthesis replacement.[4, 25-26] However, there is still substantial controversy regarding the choice of surgical method for metastatic cancer of the proximal femur.[27-29] Some scholars believe that "lesion removal + intramedullary nail internal fixation + bone cement filling" for the imminent possibility of pathological fracture is the best choice for the treatment of metastatic carcinoma of the proximal femur.[30-31] Some researchers have also shown that joint replacement therapy cannot be limited

by local bone destruction; this type of therapy for proximal femoral fractures in metastatic carcinoma of the proximal femur is a good choice, but care should be taken to prevent the postoperative occurrence of complications such as ganglion dislocation.[28-29] This study showed that the early postoperative VAS and ECOG scores were lower in the intramedullary nail internal fixation group than in the joint replacement group and that the MSTS score was higher in the intramedullary nail internal fixation group than in the joint replacement group.[24] This result was consistent with the results of research by Potter BK and others. Studies by Ricco AI et al. have shown that intramedullary nail internal fixation can achieve better function early after surgery, and patients are satisfied with their early quality of life.[32] With the increase in patient survival time, the VAS and ECOG scores in the intramedullary nail internal fixation group were higher than those in the joint replacement group 1 year after the operation, and the MSTS score was lower in the intramedullary nail internal fixation group than in the joint replacement group. Because intramedullary nail internal fixation could not be performed completely with joint replacement, the femoral lesion could be removed thoroughly, and the patients' VAS, MSTS, and ECOG scores decreased due to the progression of the femoral metastatic tumor. Previous studies have shown that the quality of life of patients with intramedullary nail internal fixation begins to decline six months after surgery, which is consistent with our findings.[33] As the patient's lifetime lengthens, the risk of failure of intramedullary nail internal fixation increases.[34-35] This can also lead to a decline in the quality of life of patients. Complications occurred during the perioperative period in 9 patients in this study. There were 6 patients with complication in the nailing group and 3 patients in the joint replacement group. The chi-square test showed no significant difference in the incidence of postoperative complications in the two groups (P=0.449). In this study, no patients had internal fixation failure during their survival time, and studies have shown that the risk of failure of intramedullary nail internal fixation is approximately 20% and that the risk of failure of joint replacement is almost 0.[25, 29-30, 36-40] This study did not find that the failure of implants was related to our relatively short follow-up time. Zacherl and others believe that when patients survive for more than 3 years, the risk of failure of internal fixation with intramedullary nails increases significantly. Previous studies have shown that the probability of dislocation after hip arthroplasty in patients with proximal femoral metastasis is approximately 1% to 12%.[41-44] No dislocation of the hip joint was found in this study. During the course of the operation, part of the hip SAC was retained and repaired so that no prosthesis dislocation occurred.[18] In the hip arthroplasty group, 1 patient died during the perioperative period, and the patient was diagnosed with lung cancer and proximal metastatic carcinoma of the left femur before the operation; the patients were treated with lung embolism, leading to death. Previous studies have found that patients with metastatic carcinoma of the proximal femur may experience severe cardiopulmonary complications during the perioperative period after hip arthroplasty, and their mortality rate is close to 10%.[18, 44] In this study, 3 patients experienced deep vein thrombosis (DVT), and malignant tumor patients with advanced blood in a high coagulation state due to pathological fractures or severe pain were associated with long-term bed rest coupled with the trauma of major surgery, thus increasing the risk of DVT:[12] 1 patient in the intramedullary nail internal fixation group and 2 patients in the joint replacement group. Since most patients with bone metastatic carcinoma have undergone radiotherapy or chemotherapy, these patients have significantly reduced immunity, and the risk of wound infection after surgery is higher than that of patients undergoing radiotherapy and chemotherapy.[45]

This study showed that there was no statistically significant difference in the survival rate of patients with metastatic carcinoma of the proximal femur according to a single-factor analysis for sex, age, the preoperative ECOG score, whether the primary focus was surgery and the type of surgery. The difference between the number of metastatic lesions and the effect of pathological fractures on the survival rate was statistically significant. The more portions of the malignant tumor that metastasized, the shorter the survival time. The survival time of patients without pathological fractures was longer than that of patients with pathological fractures. The results of our research are in line with those of previous studies. Katzer and others reported that for patients who did not undergo pathological fractures, their survival time was approximately 5.9 months longer than that of patients undergoing surgical treatment after a pathological fracture.[46] Previous studies have shown that for the pathological type of primary tumor, the higher the degree of malignancy is, the faster the progression and the shorter the survival time in patients with metastatic carcinoma of the proximal femur. Piccioli A et al. found that patients with proximal femoral metastases in lung cancer had a shorter survival time than patients with proximal femoral metastases.[33]

Patients with proximal femoral metastases undergoing surgical treatment can achieve stable internal fixation. The lower limb function can be restored as soon as possible, and the quality of life of the patient is significantly improved.[47-48] Sarahrudi K, et al., suggest that intramedullary nailing is the best option for the treatment of proximal femoral metastases.[30-49] Capanna R et al. studied the surface: joint replacement for the treatment of proximal femoral metastases is also a good choice.[49-50] Previous studies on the choice of surgical methods for the treatment of proximal femoral metastases were affected by many factors. Factors such as general condition and uncertain survival, primary tumor, and other parts of the metastasis affect the surgical approach and the choice of implants.[16-18] Dijstra S studies have shown that after surgical treatment of proximal femoral metastases, the most important risk factor for treatment failure is postoperative survival.[25] As the level of medical diagnosis and treatment continues to increase, the survival time of patients with metastatic cancer of the proximal femur is also gradually increasing, which will lead to a further increase in the risk of internal fixation failure. Some authors believe that hip replacement surgery is the best choice for patients with proximal femoral metastases with longer expected survival time.[42, 51] Even studies have suggested that joint replacement is the best treatment for patients with single-renal metastasis of kidney cancer, because these patients may have a long survival time.[52] This study showed that the intramedullary nailing and the hip replacement had no statistically significant effect on the survival rate of patients with proximal femoral metastases. Previous studies have shown that intramedullary nailing for the treatment of proximal femoral metastases, the risk of internal fixation failure after 3 years after surgery will increase significantly. In our study, 47.5% of patients survived for 1 year, 22.5% survived for 2 years, and 2.5% survived for 3 years. This indicates that intramedullary nailing for the treatment of proximal femoral metastases has a lower risk of internal fixation failure during patient survival. Surgical treatment of patients with proximal femoral metastases, intramedullary nailing surgery, small trauma, early postoperative surgery is better than joint replacement. As the patient's survival time prolongs, the surgical outcome of joint replacement surgery is better. Moreover, as patients' survival time prolongs, the risk of internal fixation failure in intramedullary nail fixation will increase. The advantages of joint replacement compared with intramedullary nail fixation include complete resection of the proximal femoral metastases and less postoperative complications. Therefore, we believe that intramedullary nailing is more suitable for patients with short survival time and a better quality of life early in patients with limited survival time. Joint replacement is more appropriate for patients who are expected to have a long survival time.

Conclusion

1 .After surgical treatment in patients with metastatic cancer of the proximal femur, patients’ pain symptoms were alleviated, limb functions were improved, and quality of life was remarkably improved.

2. The individual selection of surgical procedures is needed for patients with proximal femoral metastases.

3. Intramedullary nailing is expected to be more suitable than joint replacement for patients with a short survival time and to attain a better quality of life early in terms of the patient's limited survival time. Joint replacement is more appropriate for patients who are expected to have a long survival time.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by the ethics committee of Tumor Hospital of Yunnan Province. Because of the retrospective nature of the study, patient consent for inclusion was waived.

Consent for publication

Not applicable

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

The study concept and design was the responsibility of ZY. JY, JC, ZT, RW and DY searched the references. CW and SL acquired the data as well as new ideas from the references and completed the analyses. KL and SK interpreted this information. Manuscript preparation was undertaken by KL, SK, TY, YY, DL, SL and FY. YY, YZ, LH performed a manuscript review. All authors read and approved the final manuscript.

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Figures

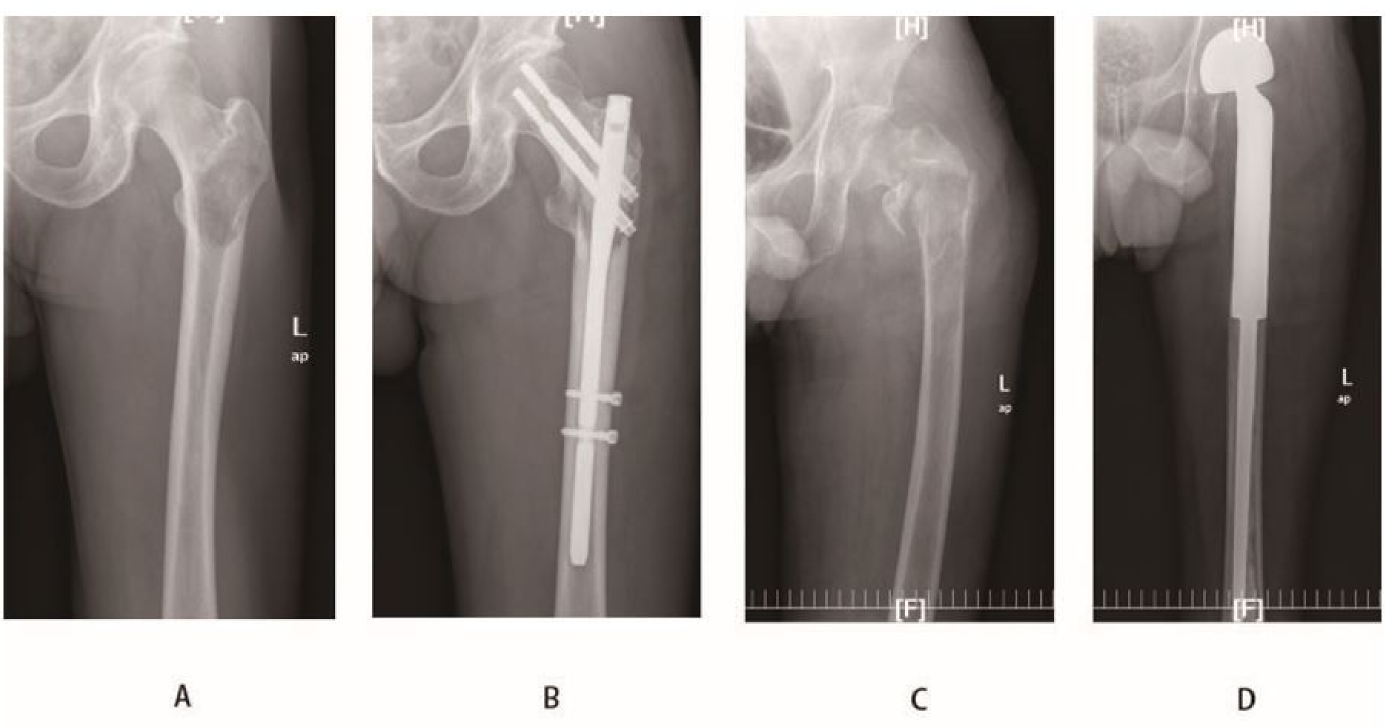

Figure 1

A Preoperative. B Curettage + intramedullary nail fixation + bone cement filling. C Preoperative. D tumor segment resection + customized tumor artificial hemiarthroplasty.

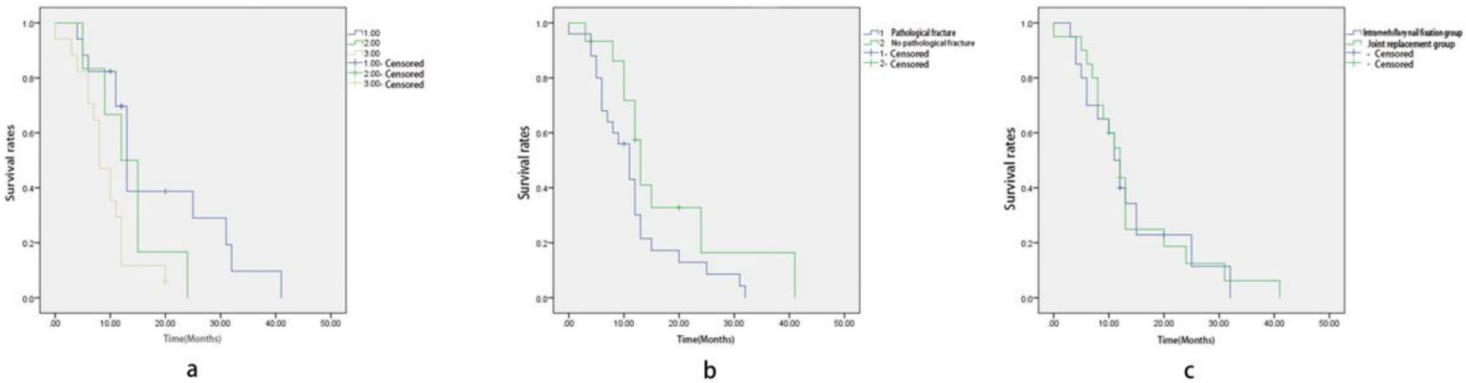

Figure 2

a. Kaplan-Meyer analysis of number of metastases. b. Kaplan-Meyer analysis of whether pathological fracture. c. Kaplan-Meyer analysis of intramedullary nail fixation group and joint replacement group.