Treatment of Bone Tumors in the Femoral Trochanteric Area

Apichat Asavamongkolgul MD*,
Samran Thanakarasombat MD**

** Department of Orthopedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*
*** Division of Orthopedic Surgery, Singburi Hospital, Singburi, Thailand*

Objective: *To report the management of bone tumor in the femoral trochanteric area in terms of safety, functional outcome and patient satisfaction.*
Material and Method: *Thirty-eight patients with impending or pathological fracture at the trochanteric region of the femur were treated surgically at the Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital from 1998 to 2007. Thirteen males and 25 females with a mean age of 49.7 years, 11 patients had benign bone tumors (5 fibrous dysplasia, 3 chondroblastoma and 1 each of aneurysmal bone cyst, bone island and intraosseous hemangioma). Twenty-seven patients had metastatic lesions (10 breast, 3 lung, 2 hepatocellular, 2 colon, 2 prostate and 1 each of multiple myeloma, gastric, cervix, thyroid, nasopharynx, bladder, secondary sarcoma and of unknown origin). Twenty-six patients presented an impending fracture and the remainder had a pathological fracture. All patients were treated with curettage in conjunction with a sliding hip compression screw and plate, except one patient with bone deformity from fibrous dysplasia who had an adjunct valgus osteotomy. Eleven patients were augmented with bone grafting, 19 with bone cement and 8 patients had no augmentation.*
Results: *The mean follow-up time was 3 years. The mean operative time and estimated blood loss was 98 minutes and 542 ml respectively. Two complications were found in this series and successfully managed. There was no serious intra or perioperative complication. The mean functional score was 79.5 percent in metastatic group and 89.7 percent in benign bone group.*
Conclusion: *In the present study, the outcomes of intralesional curettage and stabilization with a sliding hip compression screw and plate for bone tumors in the femoral trachanteric area were safe and only 2 treatable complications were found. Most patients had less pain after the operation and could ambulate independently with gait support and all satisfied with the results.*

Keywords: *Bone tumor, Trochanteric area, Femur, Surgery*

J Med Assoc Thai 2012; 95 (Suppl. 9): S129-S137
Full text. e-Journal: *http://jmat.mat.or.th*

Bone tumors involving the femoral trochanteric area are one of the most common problems and challenging fields in musculoskeletal oncology. The trochanteric area is the important region that transfers force of body weight from the trunk to the lower extremity. Due to high stress in this area, the risk of fracture in patients with bone destruction at the trochanteric area is high. Mirel reported a scoring system to predict the possibility of fracture and treatment in a metastatic bone lesion of the extremities[1]. This classification is based on the degree of pain, size of lesion, feature of tumor nature and anatomical location. The trochanteric area is classified as having the highest score of the anatomical location factor and patient with this particular lesion might need a prophylactic surgical stabilization.

The most common techniques for the management of the benign bone tumor in this area are intralesional curettage, bone grafting and internal fixation. Concerning for filling the bony defect, bone grafting is the treatment of choice. There are many techniques to be used in bone grafting including; non-vascularised autogenous fibular strut grafts, allogenic cortical strut grafts with or without autogenous cancellous bone graft, and calcium phosphate bone substitute[2-5]. In metastatic bone tumor, bone cement is usually used for packing in the defect and providing immediate stability[6,7]. For bone fixation in malignant lesion, a variety of methods of fixation have been reported for stabilization of impending or pathological

Correspondence to:
Asavamongkolkul A, Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
Phone: 0-2419-7968, Fax: 0-2412-8172
E-mail: siaas@mahidol.ac.th

fracture of the proximal femur[2,8-10].

It was the aim of the present study to report the results of 38 patients with an impending or pathological fracture from tumors at the femoral trochanteric area who were treated by intralesional curettage to remove the tumor followed by bone or cement packing in conjunction with a sliding hip compression screw and plate fixation which was a simple technique, safe and providing good outcomes to the patients.

Material and Method

The present study was carried out as a retrospective study of consecutive 38 patients, with bone tumor causing an impending or pathological fracture at the femoral trochanteric area. All medical, results of investigation and pathological reports of the patients were reviewed. All patients were treated at the Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, during 1998 to 2007.

There were 13 males and 25 females with a mean age of 49.7 years, ranged from 12 to 81 years (Table 1). Eleven patients had benign bone tumors (5 fibrous dysplasia, 3 chondroblastoma and one each of aneurysmal bone cyst, bone island and intraosseous hamangioma). Twenty-seven patients had metastatic lesions (10 breast cancer, 3 lung cancer, 2 hepatocellular cancer, 2 colon cancer, 2 prostate cancer and 1 each of multiple myeloma, gastric cancer, cervix cancer, thyroid cancer, nasopharyngeal cancer, bladder cancer, secondary sarcoma and unknown origin cancer). Twenty-six patients presented with an impending fracture and the others had pathological fractures. Concerning the diagnosis of impending fracture, the authors used Harrington et al's criteria which were 1) a destructive lesion involving more than 50 percent of the cortical bone circumferentially, 2) a lytic lesion of the proximal femur larger than 2.5 cm and 3) a lesion of the proximal femur associated with avulsion of the lesser trochanter[11].

All patients were treated with intralesional curettage in conjunction with a 135° sliding hip compression screw and plate (Synthes, Switzerland). The technique which has been described by Shih et al[2] was used in the present study. For benign lesions, bony defects after tumor removal were filled up with the use of autogenous iliac bone graft or chip allograft following curettage of the tumor (Fig. 1A and 1B). One patient with a fibrous dysplasia also underwent an adjunct valgus osteotomy before internal fixation was performed. Nineteen of 27 patients with metastatic bone tumor had bone cement augmentation following tumor removal; another 8 patients had only internal fixation without cement augmentation (Fig. 2A and 2B).

Fig. 1A Radiograph of a 16 year-old-girl showing a chondroblastoma at right trochanter causing an impending fracture (arrows)

Fig. 1B One-year postoperative radiograph after curettage in conjunction with a sliding hip compression screw and plate and filled a defect with bone graft

None of the patients needed postoperative immobilization. Adequate analgesics were given to all patients. The patients with benign bone tumor were allowed to ambulate with progressive partial weight bearing immediately after surgery and to become fully

Fig. 2A Radiograph of a 63 year-old-woman showing a multiple myeloma at right subtrochanteric area causing a pathologic fracture

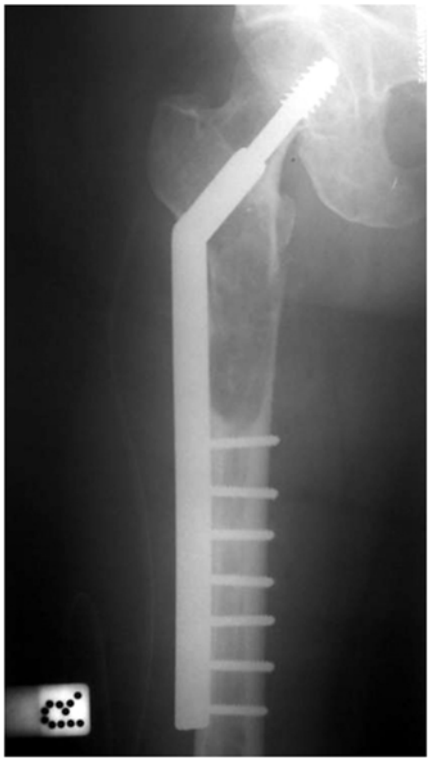

Fig. 2B Immediate postoperative radiograph after curettage in conjunction with a sliding hip compression screw and plate without cement augmentation

weight bearing after 6-8 weeks. The patients with metastatic lesion were encouraged to ambulate immediately following the operation to prevent associated postoperative complications and were

Fig. 2C 4-month postoperative radiograph revealed proper alignment of the hardware and progressive intraosseous bone formation at the lytic lesion

allowed to walk as tolerated with walking aids. The functional outcomes of the patients were assessed by using telephone interview and by using a questionnaire from the functional evaluation form of the Musculoskeletal Tumor Society classification system every 3 months after the surgery[12] (Fig. 3). Then the outcomes were analyzed and compared in descriptive fashion.

Results

The mean follow-up time was 3 years, ranged from 2 months to 13 years. None had any fatal perioperative complication. The mean operative time was 98 minutes, ranged from 30 to 150 minutes and the mean estimated blood loss was 542 ml, ranged from 100 to 1,600 ml (Table 1). All patients with benign bone tumor were continuously free of disease until the end of the present study. Twenty-three of 27 patients with metastatic diseases passed away by the disease with an average age of 19.5 months, ranged from 2 to 59 months, while the others were still alive even though they still had the diseases.

Demographic and Functional Evaluation Form

Name		Diagnosis	Type of Surgery
HN		Site	
Sex	D.O.B.*	Stage	Type of Reconstruction
Date of Surgery		Date of Last Follow-up	
Date of Interview			

The Functional Analysis of the Musculoskeletal Tumor Society Classification [12]

	Pain	Function	Emotional Acceptance	Supports	Walking	Gait
5	None	No Restriction	Enthused	None	Unlimited	Normal
4	____	_____	Intermediate	____	_____	____
3	Modest	Recreational Restriction	Satisfied	Brace	Limited	Minor Cosmetic
2	____	_____	Intermediate	____	_____	____
1	Moderate	Partial Disability	Accepts	1 Cane Crutch	Inside Only	Major Cosmetic Minor HCAP
0	Severe	Total Disability	Dislikes	2 Canes Crutches	Unable Unaided	Major HCAP

Total Score _____

Maximum Score ___30___

% Rating _____

D.O.B.* = date of birth

Fig. 3 The patient data and functional evaluation form

Table 1. Patients' information

Patient No.	Sex	Disease	Fracture Type	Age (yr)	Type of Surgery	Operative Time (hr:min)	Blood Loss (ml)	Follow-up Time (y:m) /Status	Functional Percentage	Remarks
1	F	ABC	I	20	DHS+BG2	2:30	600	13:0/CDF	92	AVN at 5 yrs
2	F	Fibrous dysplasia	I	22	DHS+BG2	1:50	100	7:6/CDF	90	
3	M	Fibrous dysplasia	D	26	DHS+BG1	1:30	1,500	2:6/CDF	87	Adjunct VO
4	F	Fibrous dysplasia	I	45	DHS+BG2	2:0	100	2:9/CDF	93	
5	F	Fibrous dysplasia	I	32	DHS+BG2	2:30	400	9:0/CDF	90	
6	M	Fibrous dysplasia	P	28	DHS+BG1	2:30	1,200	1:0/CDF	90	
7	F	Chondroblastoma	I	15	DHS+BG1	1:55	500	7:0/CDF	90	
8	F	Chondroblastoma	I	17	DHS+BG1	2:0	900	8:5/NED	95	LR at 3 yrs
9	F	Chondroblastoma	I	12	DHS+BG2	2:0	700	6:2/CDF	90	
10	F	Bone island	P	71	DHS+BG1	3:0	450	5:6/CDF	85	
11	M	Intraosseous hemangioma	P	30	DHS+BG2	2:05	800	2:10/CDF	85	
12	F	Breast cancer	I	57	DHS+BC	2:0	300	1:6/DOD	NA	
13	F	Breast cancer	P	75	DHS+BC	1:30	600	0:9/DOD	NA	
14	F	Lung cancer	I	68	DHS+BC	1:30	200	0:6/DOD	NA	
15	F	Gastric cancer	I	41	DHS+BC	1:15	400	0:5/DOD	NA	
16	F	Multiple myeloma	P	63	DHS	1:15	1,000	3:0/DOD	50	
17	F	Cervix cancer	I	66	DHS+BC	1:10	200	1:2/DOD	NA	
18	F	Breast cancer	I	53	DHS+BC	1:0	300	0:2/DOD	NA	
19	F	Caecum cancer	P	48	DHS+BC	2:0	1,500	6:0/NED	83	
20	M	Lung cancer	P	44	DHS+BC	1:0	500	1:1/DOD	25	
21	M	Thyroid cancer	I	70	DHS+BC	1:15	300	1:0/DOD	77	
22	M	Unknown cancer	I	73	DHS+BC	2:0	700	3:6/DOD	75	
23	F	Breast cancer	I	46	DHS+BC	2:0	800	2:2/DOD	NA	
24	F	Breast cancer	I	54	DHS+BC	1:30	100	1:5/DOD	NA	
25	F	Breast cancer	I	38	DHS+BC	0:30	200	1:10/AWD	85	
26	M	Hepatocellular cancer	P	57	DHS+BC	1:30	1,600	0:8/DOD	NA	
27	M	Nasopharyngeal cancer	I	58	DHS+BC	1:30	300	1:0/DOD	90	
28	F	Breast cancer	I	69	DHS	1:0	100	2:6/DOD	85	
29	F	Lung cancer	P	68	DHS+BC	1:0	150	0:5/DOD	80	
30	F	Colon cancer	I	58	DHS+BC	1:30	400	1:3/DOD	87	
31	F	Breast cancer	I	47	DHS	1:30	300	4:11/DOD	95	
32	M	Prostate cancer	I	74	DHS	1:20	100	6:5/CDF	92	
33	M	Prostate cancer	I	64	DHS	1:0	100	0:5/DOD	82	
34	F	Breast cancer	I	40	DHS	0:30	200	2:1/AWD	NA	

Table 1. Cont.

Patient No.	Sex	Disease	Fracture Type	Age(yr)	Type of Surgery	Operative Time (hr:min)	Blood Loss (ml)	Follow-up Time (y:m) /Status	Functional Percentage	Remarks
35	M	Hepatocellular cancer	I	57	DHS	1:45	1,600	0:6/DOD	50	
36	M	Secondary sarcoma	P	67	DHS+BC	2:0	400	0:3/DOD	25	
37	M	Bladder cancer	P	81	DHS	2:0	300	0:6/DOD	80	
38	F	Breast cancer	P	38	DHS+BC	2:30	700	2:4/DOD	78	
Average	NA	NA	NA	49.7	NA	1:38	542	3:0	79.5	

F-Female, M-Male
ABC-aneurysmal bone cyst
Fracture type: I-impending fracture; P-pathological fracture; D-deformity
DHS-dynamic hip screw; BG1-autogenous bone graft; BG2-chip allograft; BC-bone cement
Oncologic status: CDF-continuous disease free; NED-no evidence of disease; AWD-alive with disease; DOD-died of disease
AVN-Avalgual Next Necrosis of the Femeral Head; VO-valgus osteotomy; LR-Local Recurrence
NA-not applicable

Two of 11 patients (18 percent) with benign bone tumor had complications. One patient with pathologic fracture of base of the femoral neck from aneurysmal bone cyst developed avascular necrosis of the femoral head at 5 years postoperatively. She was performed a cementless total hip prosthesis and had excellent function without any complication at 8 years follow-up. Another patient with chondroblastoma had a local recurrence at 3 years postoperatively and underwent re-curettage and bone grafting. She was free from tumor and also had excellent function at 5.5 years postoperatively.

According to the Musculoskeletal Tumor Society functional analysis classification[12], the mean functional score of all patients was 79.5 percent, ranged from 25 to 95 percent. Patients with metastatic disease had lower mean scores (72.9 percent) than patients with benign disease (89.7 percent). However, postoperative pain was markedly reduced in all patients and most patients could ambulate independently with walking aids except for two patients with metastatic lung disease and secondary sarcoma. However, they could ambulate with the use of a wheelchair. All patients with benign bone tumor could walk independently 3 months after the surgery.

Discussion

The goals of the treatment for patients with bone tumor are not only to combat the disease, but also to maintain patients' quality of life. Furthermore cost of treatment and demanding of surgical techniques have to be concerned. The goals for the treatment of the patients with metastatic bone diseases should be adapted according to the diseases and their staging to provide pain relief and the maximum level of quality of life in their relatively short remaining life expectancy[13]. Most of the patients with trochanteric tumor usually presented with an impending or pathologic fractures. These patients are usually referred for surgical treatment to prevent pathological fractures. However, surgical treatment might not be justified in some metastatic patients as their condition were too ill or not fit for the operation.

The femoral trochanteric region needs a strong framework of bony architecture to supports and transfers force from the trunk to the lower extremity. Any defect can affect the strength of the construct and framework not only in this particular area but also in other locations[14,15]. Internal fixation with or without augmentation in this region must be strong enough to withstand the stresses[2-7,16-19]. Shih et al reported the

use of a sliding hip screw augmenting with bone graft combination including a deep frozen allogenic cortical strut and autogenous bone in the femoral and trochanteric benign lesions. Good bony incorporation was demonstrated on the radiographs by 3 to 6 months. All patients had excellent functional results without any complication[2]. Jaffe et al treated 7 patients with benign lesions at femoral head and neck by the use of curettage and an autogenous fibular strut graft in conjunction with a sliding hip screw. Five patients had excellent functional results, 1 was good and 1 was fair function. One complication of avascular necrosis of the femoral head developed in a patient with a pathologic fracture of the femoral neck through an aneurysmal bone cyst. A bipolar total hip arthroplasty was performed and the patient had fair functional outcomes. Other problems were temporary minor muscle weakness related to the harvestion of the fibular graft[16]. Two patients with benign bone lesions (5.3 percent) in this series had complications, including an avascular necrosis of the femoral head following pathological fracture of base of the femoral neck and a local recurrence in the patient with chondroblastoma. Both patients were successfully treated by a cementless total hip replacement and re-curettage with bone grafting respectively. The mean functional score in the benign tumor group was in good to excellent results.

When comparing the amount of blood loss between both groups, there was slightly more blood loss in the benign group than in the metastatic group (average 659.1 ml and 494.4 ml, respectively). The thermal reaction and bone-cement interface from cement augmentation could affect the coagulation of the surrounding bleeding vessels and cause less blood loss in the metastatic group. Another reason was that one patient in the benign group was treated with osteotomy and more blood loss (1,500 ml) from this extensive procedure could be expected.

In the present series, bone cement augmentation was performed in 19 of 27 patients with metastatic bone disease, but other patients had no cement augmentation. The advantages of bone cement provided immediate stability and reduced hardware failure[11,14,15]. During the past few decades, the life expectancy of patients with metastatic lesions has much improved because of the recent advances in treatment. Therefore, the reconstructive procedure requires greater reliability in order to prevent mechanical failure during the prolonged survival of the patient. Many implants, such as a cephalomedullary and 3rd generation intramedullary nail, were reported as successful for stabilization with long durability from mechanical advantage and bone cement augmentation and could prevent the failure of the hardware after stabilization[8-10,14,19]. However, intra and perioperative death from a massive pulmonary fat embolization was carefully reported[8]. Venting technique during prophylactic nailing of metastatic femoral lesions had been reported to decrease intramedullary pressure and the risk of fat and tumor embolization. The risk of tumor spreading into extraskeletal tissue might however increase[20]. All patients with metastatic lesion in the present study who expired from the disease, there was no report of fixation failure or having a postoperative complication.

Conclusion

Most of our patients had fair to excellent functional results following the surgery. A higher percentage of average functional score was found in the benign bone tumor group than the malignant bone tumor group. There was no serious perioperative complication. All patients could ambulate independently with walking aids except for 2 patients with metastatic tumors who ambulated with wheelchair-bound.

Acknowlegdement

The authors wish to thank Ms. Rapeeporn Chonlateeroj and Ms. Nareewit Chaichan for data collection.

Potential conflicts of interest

None.

References

1. Mirels H. Metastatic disease in long bones. A proposed scoring system for diagnosing impending pathologic fractures. Clin Orthop Relat Res 1989; 249: 256-64.
2. Shih HN, Cheng CY, Chen YJ, Huang TJ, Hsu RW. Treatment of the femoral neck amd trochanteric benign lesions. Clin Orthop Relat Res 1996; 328: 220-6.
3. Jaffe KA, Launer EP, Scholl BM. Use of a fibular allograft strut in the treatment of benign lesions of the proximal femur. Am J Orthop 2002; 31: 575-8.
4. George B, Abudu A, Grimer RJ, Carter SR, Tillman RM. The treatment of benign lesions of the proximal femur with non-vascularised autologous fibular strut grafts. J Bone Joint Surg Br 2008; 90: 648-51.
5. Paloski MD, Griesser MJ, Jacobson ME, Scharschmidt TJ. Chondroblastoma: a rare cause

of femoral neck fracture in a teenager. Am J Orthop (Belle Mead NJ) 2011; 40: E177-81.
6. Wedin R, Bauer HC, Rutqvist LE. Surgical treatment for skeletal breast cancer metastases: a population-based study of 641 patients. Cancer 2001; 92: 257-62.
7. Ippolito V, Saccalani M, Ianni L, Spaggiari L, Cavina F, Modonesi F, et al. Bone metastases in the hip region: surgical treatment. Chir Organi Mov 2003; 88: 159-64.
8. Assal M, Zanone X, Peter RE. Osteosynthesis of metastatic lesions of the proximal femur with a solid femoral nail and interlocking spiral blade inserted without reaming. J Orthop Trauma 2000; 14: 394-7.
9. Chrobok A, Spindel J, Mrozek T, Miszczyk L, Koczy B, Tomasik P, et al. Partial long-stem resection Austin-Moore hip endoprosthesis in the treatment of metastases to the proximal femur. Ortop Traumatol Rehabil 2005; 7: 600-3.
10. Kinkel S, Stecher J, Gotterbarm T, Bruckner T, Holz U. Compound osteosynthesis for osteolyses and pathological fractures of the proximal femur. Orthopedics 2009; 32: 403.
11. Harrington KD, Sim FH, Enis JE, Johnston JO, Diok HM, Gristina AG. Methylmethacrylate as an adjunct in internal fixation of pathological fractures. Experience with three hundred and seventy-five cases. J Bone Joint Surg Am 1976; 58: 1047-55.
12. 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; 241-6.
13. Wangsaturaka P, Asavamongkolkul A, Waikakul S, Phimolsarnti R. The results of surgical management of bone metastasis involving the periacetabular area: Siriraj experience. J Med Assoc Thai 2007; 90: 1006-13.
14. Capanna R, Campanacci DA. The treatment of metastases in the appendicular skeleton. J Bone Joint Surg Br 2001; 83: 471-81.
15. Asavamongkolkul A, Pongkunakorn A, Harnroongroj T. Stability of subchondral bone defect reconstruction at distal femur: comparison between polymethylmethacrylate alone and steinmann pin reinforcement of polymethyl-methacrylate. J Med Assoc Thai 2003; 86: 626-33.
16. Jaffe KA, Dunham WK. Treatment of benign lesions of the femoral head and neck. Clin Orthop Relat Res 1990; 134-7.
17. Glancy GL, Brugioni DJ, Eilert RE, Chang FM. Autograft versus allograft for benign lesions in children. Clin Orthop Relat Res 1991; 28-33.
18. Enneking WF, Gearen PF. Fibrous dysplasia of the femoral neck. Treatment by cortical bone-grafting. J Bone Joint Surg Am 1986; 68: 1415-22.
19. Persson BM, Wouters HW. Curettage and acrylic cementation in surgery of giant cell tumors of bone. Clin Orthop Relat Res 1976; 125-33.
20. Roth SE, Rebello MM, Kreder H, Whyne CM. Pressurization of the metastatic femur during prophylactic intramedullary nail fixation. J Trauma 2004; 57: 333-9.

ผลการรักษาเนื้องอกกระดูกบริเวณกระดูกต้นขาส่วนโทรแคนเตอร์

อภิชาติ อัศวมงคลกุล, สำราญ ธนัครสมบัติ

วัตถุประสงค์: *เพื่อศึกษาผลการผ่าตัดเนื้องอกกระดูกบริเวณกระดูกต้นขาส่วนโทรแคนเตอร์ โดยการขูดเนื้องอกและทดแทนโดยการปลูกกระดูกหรือบูรณะด้วยซีเมนต์กระดูก จากนั้นดามกระดูกด้วยโลหะชนิดสกรูและแผ่นดามกระดูกที่สามารถเคลื่อนได้ โดยติดตามข้อมูลที่สำคัญระหว่างการผ่าตัดและปัญหาแทรกซ้อนหลังผ่าตัด การใช้งานของขาข้างที่มีพยาธิสภาพภายหลังผ่าตัด และการดำเนินโรคของผู้ป่วย*

วัสดุและวิธีการ: *เป็นการศึกษาย้อนหลังของผู้ป่วนจำนวน 33 ราย ที่ได้รับการวินิจฉัยเป็นเนื้องอกกระดูกบริเวณกระดูกต้นขาส่วนโทรแคนเตอร์ ซึ่งได้รับการผ่าตัดที่โรงพยาบาลศิริราช ระหว่างปี พ.ศ. 2541-2550 ผู้ป่วยมีอายุเฉลี่ย 49.7 ปี เป็นชาย 13 ราย เป็นหญิง 25 ราย ผู้ป่วย 11 ราย มีเนื้องอกกระดูกชนิดไม่ร้าย และผู้ป่วย 27 ราย เป็นมะเร็งกระดูกทุติยภูมิที่กระจายมาจากอวัยะอื่น ผู้ป่วย 26 ราย มีเนื้องอกทำลายกระดูกเกือบหัก และผู้ป่วย 12 ราย มีกระดูกหักผ่านรอยโรค ผู้ป่วยทุกรายได้รับการผ่าตัดขูดเนื้องอก และดามด้วยโลหะชนิดสกรูและแผ่นดามกระดูกที่สามารถเลื่อนได้ โดยผู้ป่วยที่เป็นเนื้องอกกระดูกชนิดไม่ร้ายจะได้รับการปลูกกระดูก และผู้ป่วยที่เป็นมะเร็งกระดูกทุติยภูมิจำนวน 19 ราย ได้รับการบูรณะด้วยซีเมนต์กระดูก ข้อมูลที่สำคัญของผู้ป่วยได้รับการบันทึกในระหว่างและหลังผ่าตัดรวมทั้งการใช้งานของรยางค์ส่วนขาตามแบบบันทึกของ the Musculoskeletal Tumor Society functional classification*

ผลการศึกษา: *ผู้ป่วยมีระยะติดตามเฉลี่ย 3 ปี (2 เดือน ถึง 13 ปี) ค่าเฉลี่ยเวลาการผ่าตัด 98 นาที (30 ถึง 150 นาที) ค่าเฉลี่ยการเสียเลือดระหว่างผ่าตัด 542 มล (100 ถึง 1,600 มล) ผู้ป่วยที่มีเนื้องอกกระดูกชนิดไม่ร้ายยังคงมีชีวิตตามปกติ พบผู้ป่วย 2 ราย มีปัญหาแทรกซ้อนหลังผ่าตัดโดยเกิดหัวกระดูกต้นขาตายจากการขาดเลือด 1 ราย และเนื้องอกเกิดขึ้นใหม่ 1 ราย จากผลการศึกษาครั้งนี้ไม่พบการเสียชีวิตในระหว่างผ่าตัด และขณะที่รับการรักษา รวมถึงปัญหาแทรกซ้อนภายหลังผ่าตัดในผู้ป่วยที่เป็นมะเร็งทุติยภูมิ โดยผู้ป่วยเนื้องอกกระดูกชนิดไม่ร้ายมีค่าเฉลี่ยการใช้งานดีกว่าผู้ป่วยมะเร็งกระดูกทุติยภูมิ 6 ร้อยละ 89.7 และ 72.9 ตามลำดับ) ผู้ป่วยส่วนใหญ่สามารถลุกเดินได้ภายหลังการผ่าตัด โดยใช้เครื่องช่วยพยุงเดินในช่วงแรก มีผู้ป่วย 2 รายที่เป็นมะเร็งกระดูกทุติยภูมิจำเป็นต้องใช้รถเข็น*

สรุป: *การศึกษานี้พบว่าการผ่าตัดขูดเนื้องอกและทดแทนกระดูกที่ขูดออก โดยการปลูกกระดูกหรือบูรณะด้วยซีเมนต์กระดูก จากนั้นดามกระดูกด้วยโลหะชนิดสกรูและแผ่นดามกระดูกที่สามารถเลื่อนได้ ในผู้ป่วยที่เป็นเนื้องอกกระดูกบริเวณกระดูกต้นขาส่วนโทรแคนเตอร์ มีความปลอดภัย พบอัตราการเกิดโรคซ้ำต่ำในผู้ป่วยที่เป็นเนื้องอกชนิดไม่ร้าย ผู้ป่วยมีความเจ็บปวดน้อยภายหลังผ่าตัดและสามารถเดินได้ใกล้เคียงปกติ*