

Resection Arthrodesis of the Knee for Osteosarcoma: An Alternative When Mobile Joint Reconstruction Is Not Feasible

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Background: Wide resection and mobile joint reconstruction are preferable for treating an osteosarcoma around the knee. In certain situations, resection arthrodesis or an amputation is suggested.

Methods: During the past decade, 86 patients with an osteosarcoma around the knee were treated surgically in our institution. Wide resection and endoprosthetic reconstruction were performed in 35 patients, resection arthrodesis was performed in 36 patients, and an amputation was performed in 15 patients. The oncological and functional results were compared. Special attention was paid to the indications, techniques, and complications of patients receiving resection arthrodesis.

Results: Extensive tumor involvement was the main reason, followed by inappropriate previous treatment, for precluding mobile joint reconstruction. The local recurrence rates were similar among the 3 groups (11.4% for the endoprosthetic group, 11.1% for the arthrodesis group, and 6.7% for the amputation group). The 5-year survival rate was 39% for the arthrodesis group, which was significantly lower than that of the endoprosthetic group (60%, $p = 0.040$), although it was higher than that of the amputation group (13%, $p = 0.056$). Major complications were found in 7 patients receiving resection arthrodesis (7/24, 29%), and these included nonunion, infection, and allograft fracture. Functional results for the arthrodesis patients were inferior to those of the endoprosthetic patients, but most patients were grateful for preservation of the limb despite certain handicaps.

Conclusions: The importance of early and proper planning of treatment cannot be overstressed when treating osteosarcomas. Resection arthrodesis offers a durable reconstruction alternative to amputation in a special group of patients when extensive resection precludes mobile joint reconstruction.
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Key words: resection arthrodesis, endoprosthetic reconstruction, amputation, osteosarcoma.

In the past 3 decades, a multidisciplinary approach has converted osteosarcoma from a disease with a poor prognosis to one in which about 60% of patients are cured.^(1,2) Adjuvant chemotherapy has

decreased the extent of local tumor invasion and increased the relapse-free survival period of these patients.^(3,4) Despite these approaches, surgery remains the vital modality of treating primary

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osteosarcomas.⁽⁵⁾ Better adjuvant therapy, advancements in diagnostic imaging techniques, improved implant design, and innovative surgical techniques have led surgeons to consider limb salvage surgery as an alternative to amputation. Currently, about 75%~95% of limb osteosarcomas are treated with limb-salvage surgery, with the few indications for amputation including neurovascular involvement and soft-tissue contamination from a pathological fracture, a biopsy hematoma, or an inappropriately placed biopsy site.^(6,7)

The defects resulting from tumor resection can be reconstructed using various approaches.^(8,9) At present, there is no single generally accepted satisfactory method for reconstructing massive osseous and soft tissue defects after wide resection of a malignant bone tumor. When patients or orthopedists are given a choice, they prefer limb salvage procedures that allow for knee motion. Endoprosthetic replacement has been the preferred technique for treating osteosarcomas around the knee joint.⁽¹⁰⁻¹²⁾ However, functional mobile knee reconstruction requires active knee extension. When the quadriceps must be resected with the tumor, the extensor mechanism should be reconstructed or the patient should have knee arthrodesis.

Being in a developing country in Asia, we have encountered more patients with advanced osteosarcomas with extensive bone and soft tissue involvement, as well as referral patients with a previous biopsy and/or treatment from nonmusculoskeletal tumor surgeons. In addition, Asian people often reject amputation as a treatment modality. Because of the extensive involvement of tumors and/or the necessity for massive resection, arthrodesis seems to be the only alternative to amputation after a wide resection of an osteosarcoma in these patients. This study reports the results of using fresh-frozen intercalary allografts in achieving resection arthrodesis after wide resection of an osteosarcoma around the knee joint in a special group of patients for whom a standard modular-type prosthetic replacement was not possible. Special emphases are placed on the surgical techniques, graft healing, complications, and long-term results. The oncological and functional results of this special group of patients were compared with those who received amputation or endoprosthetic reconstruction during the same period.

METHODS

Between 1991 and 2000, 86 patients with an osteosarcoma around the knee region were treated at Chang Gung Memorial Hospital-Linkou. Fifty-five patients were male and 31 were female. The ages of the patients at the time of surgery ranged from 8 to 45 (mean, 17) years. The preoperative evaluation was similar for all patients. They received preoperative staging evaluation, including plain radiographs of the lesion in 2 planes, computed tomography (CT) or magnetic resonance imaging (MRI) of the lesion, plain chest radiographs, and a chest CT examination. Patients were staged according to the Musculoskeletal Tumor Society Staging System.⁽¹³⁾

Limb salvage surgery was considered if the neurovascular bundles were not involved and there was no distant metastasis at the initial evaluation. When a limb salvage procedure was feasible, various reconstructive options and the functional consequences of each method were discussed with the patient and family. When possible, we preferred an endoprosthetic reconstruction after wide resection of the tumor. Resection arthrodesis was suggested when the need for extensive resection precluded mobile joint reconstruction (Fig. 1). Two to 4 courses of preoperative chemotherapy using various chemotherapeutic agents (including high-dose methotrexate, doxorubicin, cisplatin, ifosfamide, cyclophosphamide, and bleomycin) were administered in every patient. Restaging was performed before definitive surgery.

The surgical procedure was normally performed through an anteromedial or anterolateral approach. The tumor was removed with as wide a margin as possible of bone and soft tissues accompanied by excision of the biopsy scar. The defect was reconstructed with a modular-type tumor prosthesis in 35 patients and arthrodesis in 36 patients. Fifteen patients had to receive an amputation above the knee or hip disarticulation due to extensive involvement by the tumor and the presence of distant metastasis. Resection arthrodesis was achieved with the use of an intercalary allograft and fixed with a long intramedullary nail supplemented with a long lengthening plate. Application of screws to the allografts was especially avoided unless rotational instability was observed during surgery. A cuff of autogenous cancellous bone harvested from the patella and the



Fig. 1 (A, B) Preoperative radiograph showing an osteosarcoma at the proximal tibia with extensive soft-tissue involvement.

resected opposite condyle were routinely applied to host-allograft junctions. The knee was aligned at 10~15° of flexion and a 0~5° valgus position. Local rotational or free muscle flaps and skin grafts were liberally used to ensure adequate soft tissue coverage of the allograft and non-tension wound closure. Patients were allowed protective weight bearing with crutches after removal of the suction drains. Increased weight bearing was permitted as bone union progressed.

All patients received postoperative chemotherapy. Following chemotherapy, patients were evaluated at regular intervals with a physical examination, chest radiograph, and chest CT when indicated. Follow-up radiographs of the limb were made at 3-month intervals for the first year and then at 6-month intervals as part of the patient's routine oncological follow-up. Patient records and radiographs were reviewed to determine perioperative morbidity and long-term results.

The functional results were evaluated according to the grading system recommended by the Musculoskeletal Tumor Society.⁽¹⁴⁾ The system assigns numerical values (0~5) for each of 6 categories including pain, function, emotional acceptance, use of walking support, walking ability, and gait for the lower extremities. An overall rating was achieved by combining the individual rating for each parameter. Radiographs were evaluated for union, bone graft incorporation, and any complication such as allograft fracture for arthrodesis patients, and for the presence of prosthetic loosening, wearing, breakage, or dislodgement in prosthetic reconstruction patients. Union of the host-allograft junction was considered when the patient had no symptoms related to the junction site and either the junction line was no longer visible or it was bridged with periosteal bone (Fig. 2).



Fig. 2 (A, B) Postoperative radiograph showing good union of the junction sites.

Statistical analysis

Survival of the patients was estimated using the

Kaplan-Meier method. When investigating the significance of the tumor and patient characteristics, survival time was counted from the time of diagnosis. When surgical factors and factors linked to local recurrence were analyzed, survival time was counted from the date of surgery. Local recurrence, survival, and complications were compared among groups by the log-rank test. The demographic data and functional results were compared using the Kruskal-Wallis test or analysis of variance (ANOVA) test. Significance was set at $p < 0.05$.

RESULTS

Demographic data and tumor characteristics of each group are shown in Table 1. The demographic data were similar for the 3 groups, except that most of the arthrodesis patients were in stage IIB with a significantly longer resection length when compared to the endoprosthetic patients ($p = 0.01$), and most of the patients who received an amputation had lung metastasis at the initial evaluation.

There were 25 males and 11 females in the arthrodesis group. Their ages ranged from 10 to 36 (mean, 17) years. All tumors were in stage IIB. The tumors were located in the proximal tibia in 10 patients and in the distal femur in 26 patients. Indications for resection arthrodesis included (1) extensive tumor involvement with wide resection involving removal of a significant portion of the knee musculature, ligaments, and bone such that preservation of natural joint function was not possi-

ble (25 patients, 69%); (2) a recurrent or residual tumor due to previous inadequate treatment by non-musculoskeletal tumor surgeons (3 patients, 8%); (3) soft tissue contamination from a pathological fracture during chemotherapy (2 patients, 5.6%); (4) a biopsy hematoma (2 patients, 5.6%); and (5) an inappropriately placed biopsy site or poorly performed biopsy (4 patients, 11%). The average length of resection was 19 (range, 13~28) cm. The operative margin was wide in 28 patients, and marginal in 8 patients. The average operative time was 4.5 h, and blood loss was 980 ml. Twelve cases were excluded from the final evaluation due to expiry within 2 years after surgery, leaving 24 patients for the final functional evaluation. The average follow-up period for the 24 patients was 5.4 (range, 2.3~9.6) years.

Oncological results

In the most-recent follow-up, 14 patients were currently alive without disease, 3 were alive with lung metastases, and 19 had died of their disease in the arthrodesis group. For the endoprosthetic reconstruction patients, 21 were currently alive without disease, 2 were alive with metastatic lesions in the lung, and 12 had died of their disease. Most (13/15, 87%) patients in the amputation group had died of lung metastasis within 2 years. Only 2 patients had long-term survival. The 5-year survival rate was 39% (14/36) for the resection arthrodesis group, which was higher than that of the amputation group (13%, $p = 0.056$), but significantly lower than that of the endoprosthetic group (60%, $p = 0.040$) (Fig. 3), reflecting the different degrees of disease advancement at the time of treatment.

The local recurrence rates were 6.7% (1/15) for the amputation group, 11.1% (4/36) for the arthrodesis group, and 11.4% (4/35) for the endoprosthetic group. Patients with local recurrence eventually received an amputation above the knee or hip disarticulation and died of lung metastasis.

Functional results

Twelve patients had died of lung metastasis within 2 years after resection arthrodesis. Demographic data of the remaining 24 patients with more than 2 years of follow-up are shown in Table 2. Resection arthrodesis was effective in achieving a pain-free extremity. The overall functional scores ranged from 6 to 26 (mean, 23) points. Functional

Table 1. Demographic Data and Tumor Characteristics of Patients with Endoprosthetic Reconstruction, Resection Arthrodesis, and Amputation

	Endoprosthesis (n = 35)	Arthrodesis (n = 36)	Amputation (n = 15)
Age (years)	11~45 (17)	10~36 (17)	8~35 (19)
Gender (M: F)	23: 12	25: 11	7: 8
Location (DF: PT)*	28: 7	26: 10	11: 4
Stage	IIA:IIB, 5: 30	IIB	IIB:III,5:10
Resection margin*	26: 9	28: 8	13: 2
Resection length (cm)	11~24 (16.6)	13~28 (19.3)	-
Local recurrence	4/35 (11.4%)	4/36 (11.1%)	1/15 (6.7%)
5-Year survival	21 (60%)	14 (39%)	2 (16.7%)
Functional results	6~26 (23)	6~29 (24)	-
Complications	10/27 (37%)	7/24 (29%)	-

Abbreviations: DF: distal femur; PT: proximal tibia.
 Resection margin: wide margin: marginal margin.

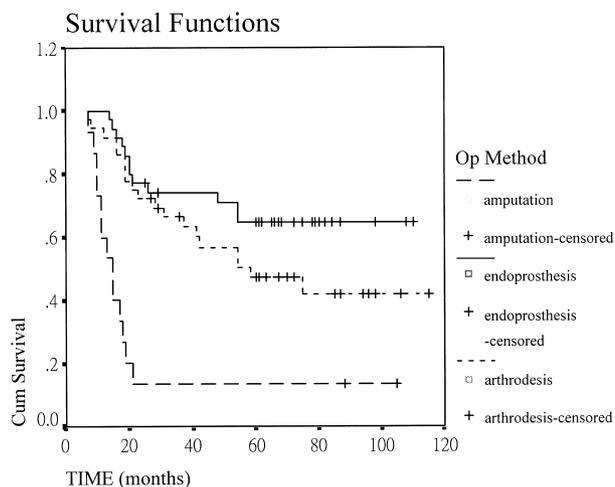


Fig. 3 Comparison of patients' survival curves of different treatment groups indicating that the tumors had different advancement statuses at the time of treatment.

results were graded as being good to excellent in 19 (79%) patients. Except for the 2 patients (nos. 1 and 10) with hip disarticulation for local recurrence and the patient (no. 2) receiving repeated debridement and removal of part of the allograft (6 points), only 2 patients were considered to have low scores (patient no. 3 with 13 points and patient no. 16 with 15 points). During the most-recent follow-up, most patients had achieved a good functional activity level and had accepted the handicap associated with a stiff knee joint. Nineteen patients had no pain or only occasional mild pain. Eight of the 14 disease-free patients had returned to work. These patients were satisfied with the results of the reconstructive procedure.

Eight patients died of lung metastasis within 2 years after endoprosthetic reconstruction. The overall functional scores ranged from 6 to 29 (mean, 24)

Table 2. Clinical Data and Results of 24 Patients Who Received Resection Arthrodesis for an Osteosarcoma around the Knee Region

	Age (yr) and gender	Allograft Location	Allograft length (cm)	Follow-up period (mon)	Prognosis	Radiographic union (mon)		Functional results						Complications	
						CCJ	MMJ	P	F	EA	S	W	G		
1	17 F	LDF	20	41	DOD	12	8		Hip disarticulation						Local recurrence
2	16 F	RPT	17	115	DF	12	7	1*	1*	1*	1*	1*	1*	1*	Infection
3	18 M	RDF	19	110	DF	12	5	3*	3*	3*	1*	2*	1*	Fracture of the allograft	
4	36 F	RDF	21	28	DOD	13	6	4	3	4	5	4	3		
5	16 M	LDF	25	31	DOD	12	6	4	3	4	4	3	4		
6	16 M	LDF	28	37	DOD	10	8	5	3	5	4	4	4		
7	16 M	LPT	18	98	DF	9	4	4	4	5	5	4	4		
8	14 M	LDF	14	96	DF	10	6	5	3	4	5	4	4		
9	14 M	RDF	18	94	DF	9	7	4	4	5	5	4	4		
10	18 F	RDF	15	54	DOD	12	8		Hip disarticulation						Local recurrence
11	13 M	RDF	15	87	DF	14	7	5	3	5	5	4	4		
12	18 M	LDF	17	87	DF	9	4	5	3	5	5	4	4		
13	28 F	RDF	15	85	DF	10	7	4*	3*	4*	4*	3*	3*	Infection	
14	14 F	LDF	23	60	DF	-	6	4*	4*	4*	4*	4*	4*	Nonunion at the junction	
15	19 M	RPT	16	55	LM	11	6	5	3	4	4	4	3	Peroneal palsy	
16	14 M	RPT	16	72	DF	12	5	3*	3*	2*	3*	3*	1*	Fracture allograft	
17	16 M	RPT	19	70	DF	11	6	5	4	5	4	4	4		
18	18 F	RDF	16	67	DF	9	6	4	4	5	5	4	4		
19	27 M	RDF	17	36	DOD	10	7	5	3	4	5	4	4		
20	15 M	LPT	19	27	DOD	12	8	4	3	4	5	3	3		
21	15 M	LDF	23	54	LM	11	6	5	3	4	5	4	4		
22	15 M	RDF	18	42	LM	12	6	4	4	4	5	3	4		
23	16 M	LDF	17	61	DF	10	7	5	4	5	5	4	3		
24	17 M	LDF	21	63	DF	-	-	4*	3*	4*	4*	4*	3*	Nonunion of both junctions	

Abbreviations: RDF: right distal femur; LDF: left distal femur; RPT: right proximal tibia; LPT: left proximal tibia; DOD: died of disease; DF: disease free; LM: lung metastasis; CCJ: corticocortical junction; MMJ: metaphyseo-metaphyseal junction; P: pain; F: function; EA: emotional acceptance; S: supports; W: walking; G: gait.

* Functional score after treatment of complications at the most-recent follow-up.

points for the remaining 27 patients with more than 2 years of follow-up at the most-recent evaluation, which did not significantly differ ($p = 0.7$) from those of the arthrodesis patients. The functional results were graded as good to excellent in 22 (81.5%) endoprosthetic patients. Aching or pain after long-distance walking was a frequent complaint. Most patients lived a more-sedentary life due to feelings of weakness and instability. Patients were also advised to protect their prostheses due to the frequent complication of prosthetic fracture at the junction of the intramedullary stem and body. Most patients were emotionally enthusiastic or satisfied with their reconstructive procedure.

Neither of the 2 patients with long-term survival in the amputation group wore an orthosis. They walked with 2 crutches and had limitations in functional activity. Although they felt grateful for having survived the cancer, they also regretted that they had not received earlier treatment which resulted in amputation being the only choice.

Complications

Major complications were found in 7 arthrodesis patients (7/24, 29%), including 2 with nonunions, 2 with allograft fractures, 2 with deep infections, and 1 with peroneal nerve palsy. Nonunion was noted at the corticocortical junction in 1 patient (no. 14) and at both junctions in the other patient (no. 24). The former was successfully treated with an autogenous cancellous bone graft at the host-allograft junction. The latter was treated with repeated autogenous cancellous bone grafting with a residual visible gap at the corticocortical junction. One traumatic fracture through the corticocortical junction with implant failure was noted (no. 16). The fracture healed after exchange of the implanted hardware and a local cancellous bone graft. Another patient showed a fracture through the allograft with no obvious injury (no. 3). Resorption of the allograft was found. An exchange allograft and reimplantation of the hardware were performed with a supplementary autogenous cancellous bone graft. The patient suffered from moderate pain and had poor function after treatment. Repeated debridement followed by soft-tissue transfer to cover the allograft was performed to control the deep infection. One infection resolved after this procedure (patient no. 13). The other patient (no. 2) still suffered from repeated wound problems and presented

with pain and restriction of daily life. One patient (patient #15) suffered from peroneal palsy after resection of the proximal tibia tumor. No disease transmission was found to be caused by the allograft during the most-recent check-up.

Major complications were encountered in 10 (10/27, 37%) endoprosthetic patients. The complication rate did not significantly differ ($p = 0.20$) from that of the arthrodesis patients. Fracture of the prosthesis at the junction between intramedullary stem and body was the most-frequent mode of prosthetic failure (4 patients, 14.8%), necessitating revision of the prostheses at a mean of 34 months postoperatively. Late deep infection developed in 1 patient. Removal of the prosthesis, staged reimplantation, and free-flap coverage were performed. A persistent discharging sinus was noted without definite signs of prosthetic loosening. Loosening of the prosthesis was noted in 2 patients at 3 and 4.5 years after surgery, respectively. The failed component was replaced by a larger segmental prosthesis. Dislodgement of the modular component was noted in 2 patients and was treated with open reduction. Excessive wear of the polyethylene component was noted in 1 patient.

DISCUSSION

Both patients and orthopedists would prefer limb-salvage procedures that allow for knee motion if they have the chance to choose. The low incidence (41%) of osteosarcomas around the knee region being treated with mobile joint reconstruction reflects the fact that most of our patients had delayed seeking treatment and/or had had problematic previous treatment. All tumors treated with arthrodesis were in advanced stage IIB. Local invasion of 25 tumors was so extensive that a wide resection would have resulted in a long segmental defect of the bone and nearly total resection of the extensors of the knee. Two patients experienced a pathological fracture during preoperative chemotherapy. An extended resection margin had to be used to prevent soft-tissue contamination. Mobile joint reconstruction was not performed in the other 9 patients due to problematic previous treatment. Despite extensive efforts made in orthopedic residency training programs and public education regarding the hazards associated with a biopsy of musculoskeletal tumors, poorly done biop-

sies and ill-planned treatments are not infrequently encountered. Mankin et al.⁽¹⁵⁾ revisited the issue of complications associated with biopsies and reported that the same problems which they had described at the time of their original study (1982) were still present at the time of their later study (1996). The importance of early and properly planned treatment cannot be overstressed. This aspect needs to be given more attention than it has been in the past since most of these patients could have received a greater amount of physiological reconstruction if they had been treated earlier or if they had not had previous problematic treatment.

Local recurrence is a marker of inadequacy of local treatment or high local and systemic aggressiveness of the tumor. Picci et al.⁽¹⁶⁾ reported that the quality of the surgical margins, the site of the biopsy as well as complications related to the biopsy procedure, and the local response to preoperative chemotherapy were the most important prognostic factors for local control following a limb salvage operation. In our series, the local recurrence rate was acceptable for the limb salvage procedures (11.1% for arthrodesis patients and 11.4% for endoprosthetic patients). However, there is a different interpretation of these figures. For the arthrodesis patients, the local recurrence rate was expected to be high due to the extensive involvement by tumors or contamination due to previous surgery. However, the local recurrence rate was not as high as expected because a generously wide surgical margin without compromise could be achieved when performing resection arthrodesis. In contrast, the application of mobile joint reconstruction is inevitably associated with a reduction in surgical margins to preserve as much motor for knee motion as possible. This can increase the incidence of local recurrence. This figure implies that some of the limbs originally assumed to be treated by amputation might have been salvaged with resection arthrodesis. This is important to our patients, to whom amputation was unacceptable to their beliefs concerning their body image.

However, this improved rate of local recurrence did not translate into improved survival. Only 14 of 36 (39%) arthrodesis patients were disease-free at an average follow-up of 5.4 years. This reflects the fact that patients which fit the indications for arthrodesis were advanced in disease processes, as compared to the 60% 5-year survival rate of endoprosthetic

patients. Local recurrence is reported to be associated with distant metastasis in most cases.^(17,18) Our experience confirmed that with respect to the end results, local recurrence was the most-disastrous complication. These patients eventually required hip disarticulation, and all subsequently died of lung metastasis.

Arthrodesis was originally proposed to restore limb function particularly in young patients with partial or complete loss of their extensor apparatus. An immovable knee in good alignment and position is considered to be an appropriate sacrifice in order to achieve a stable, pain-free limb. Considering the average of a 19-cm (more than 50% of the entire femur length due to the shorter stature of Oriental people) resection length and the amount of soft tissue that had to be removed in our patients, resection arthrodesis of the knee appeared to be the most-appropriate reconstructive alternative to amputation. Direct comparison of the results of resection arthrodesis with endoprosthetic reconstruction in our series is not appropriate due to differences in the disease processes and indications. However, 19 (79%) resection arthrodesis patients achieved good functional results, which is comparable to that of endoprosthetic patients (81.5%). This result confirms the study conducted by Harris et al.,⁽¹⁹⁾ who reported that patients functioned similarly and walked with comparable velocities, efficiencies, and rates of consumption of oxygen whether they had been treated with arthrodesis or arthroplasty. Patients who received an arthrodesis had a more-stable limb and performed the most-demanding physical work, but they had difficulty in sitting. However, endoprosthetic patients have to live a more-sedentary life due to feelings of weakness and instability. In addition, because of the small size of Oriental people, a prosthetic fracture at the junction of the intramedullary stem and the prosthetic body is frequently encountered. These patients are thus advised to lead sedentary lives to protect the prosthesis.

Benevenia et al.⁽²⁰⁾ declared that the major functional shortcoming of arthrodesis is emotional acceptance. This was not observed in our patients. Levels of acceptance (emotional adjustment) did not differ between the arthrodesis and endoprosthetic patients. Most arthrodesis patients were satisfied with their painless, strong, and stable lower limbs, and were psychologically enthused with their choice. This

reflects a patient's expectations as well as gratitude for having survived cancer. Especially in a country where amputation is unacceptable to the concept of body image, they were very positive and grateful for having preserved the limb.

There are various reconstruction methods to achieve arthrodesis, each of which has its own advantages and disadvantages. Arthrodesis achieved with an intercalary allograft is commonly seen to have high complications, such as infection, nonunion, and allograft fracture. Ruggier et al.⁽²¹⁾ reported a 63% complication rate for patients after a limb salvage procedure, with 73% of the complications requiring reoperation. Mankin et al.⁽²²⁾ reported a 40% 10-year survival rate with allograft arthrodesis, which is significantly lower compared with those of intercalary (85%) and alloprosthetic (70%) composites. In our series, minor complications (such as minor wound problems and transient peroneal palsy) were frequently encountered. However, the major complication rate (29%) was relatively low. These results are comparable to those reported by Weiner et al.⁽²³⁾ We attributed this low complication rate to various reasons. First, we liberally used local or free flaps to ensure adequate soft-tissue coverage of the entire allograft and tension-free wound closure. This was supported by several recent series that reported markedly decreased infection rates after the liberal use of local or free muscle flaps to provide allograft coverage and tension-free wound closure.^(24,25) Avoiding postoperative infection with primary flap coverage also increases the likelihood of bone union and decreases the risk of fracture. Relatively rigid fixation and routine application of an autogenous bone graft at the graft-host junction to achieve bone bridging add further stability to the graft-host junction. This is believed to have contributed to the relatively low non-union rate found in this series. Allografts are very sensitive to stress-concentrating defects; especially screw holes. The low incidence of allograft fractures might have partly been due to avoiding screw holes on the allograft as much as was possible, and partly due to the more-sedentary life style of Oriental people.

In conclusion, problematic biopsies and inadequate treatments were the main reasons besides extensive local tumor involvement leading to preclusion of mobile joint reconstruction. The importance of early and properly planned treatment should be

reemphasized. Resection arthrodesis is an acceptable alternative to amputation when mobile joint reconstruction is not feasible due to the necessity of extensive resection of the tumor. A reasonably wide margin can be achieved when performing resection arthrodesis resulting in a low local recurrence rate. The functional results were acceptable with a reasonably low complication rate.

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以切除後關節融合術治療膝關節附近之惡性骨肉瘤

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背景：肢體保留手術加上腫瘤型人工關節重建為目前治療膝關節附近的惡性骨肉瘤中最被廣泛接受的方法。但有一些病人卻因特殊的情況，而不得不接受切除後關節融合術或截肢的治療。

方法：在1991到2000年間，共有86位膝關節附近惡性骨肉瘤的病人在林口長庚醫院接受手術治療。其中有35位病人接受肢體保留手術加上腫瘤型人工關節重建，36位病人接受切除後關節融合術治療，15位病人接受截肢治療。我們比較接受不同方法治療病人的腫瘤預後和肢體功能，尤其著重於探討病人為什麼必須接受關節融合術的原因、關節融合術技術的改進、及這些改進對降低併發症的貢獻。

結果：腫瘤侵犯範圍太大和不適當的先前治療（包括非骨腫瘤醫師治療後再發、不適當的切片位置、切片後血腫及錯誤診斷）為病人必須接受切除後關節融合術的兩大主因。局部復發率在人工關節重建組為11.4%，在關節融合組為11.1%，在截肢組為6.7%。顯示關節融合組因不必考慮關節功能，可以有較大範圍的切除，反而使得局部復發率沒有預期的高。五年存活率在人工關節組為60%，在關節融合組為39%，在截肢組為13%。顯示接受關節融合或截肢的病人通常都太晚接受治療。29%的關節融合組的病人產生併發症，比以其他方法做關節融合的併發症為低，可能原因包括使用局部皮瓣包覆異體骨以降低感染率、在異體骨與自體骨接縫處大量的自體骨移植以增加骨癒合率、及在異體骨上不釘螺絲孔以免降低異體骨的強度等。關節融合病人術後雖然喪失了關節活動，但卻有一個不痛又穩定的肢體，也免去面臨截肢的厄運。

結論：對惡性骨肉瘤的治療，沒有比早期治療和從組織切片開始專業而有計劃的治療更重要的事了。若惡性骨肉瘤得以早期照正規方法治療，通常可以保留一個功能幾近正常的肢體。若因種種因素，使得腫瘤切除後以人工關節重建的方法無法執行時，關節融合術是個可以考量的方法。切除後關節融合術雖然喪失了關節活動，卻可以保留一個不痛又穩定的肢體，比起截肢又更勝一籌。

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關鍵字：肢體保留手術，腫瘤型人工關節重建，切除後關節融合術，截肢，惡性骨肉瘤。

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