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Satisfaction After Joint-preservation Surgery in Patients With Musculoskeletal Knee Sarcoma Based on Various Scores

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Abstract. *Background/Aim: At our institute, we prioritize joint-preservation whenever possible in cases of musculoskeletal knee sarcoma. This study aimed to evaluate patient satisfaction after joint-preservation surgery using different scales. Patients and Methods: Surveys were mailed to 62 patients with musculoskeletal knee sarcoma. We analyzed the responders' data based on the Musculoskeletal Tumor Society (MSTS) score, Toronto Extremity Salvage Score (TESS), and three component scores (physical, mental, and role/social) of the 36-Item Short-Form Health Survey according to whether they belonged to patients in the joint-preservation or in the joint-replacement groups. Results: The survey response rate was 67.7%. MSTS and TESS scores were higher in the patients in the joint-preservation group than in the joint-replacement group, although the differences lacked statistical significance. Conclusion: Better physical outcomes improve patient satisfaction, as demonstrated by the high satisfaction in the group with joint-preservation.*

Salvage surgery should focus on saving the knee joint because a joint-replacement, whether prosthetic or allograft, can never be superior to the intact knee (1). In addition, sparing the articular end of the affected bone when resecting primary bone sarcomas enables patients to retain their native joints and ligaments. Moreover, this approach may result in superior proprioception and joint function after reconstruction (2).

The purpose of leaving a wide surgical margin is to reduce the risk of local recurrence, but additional resection of normal tissue can jeopardize vital structures, including ligaments, tendons, and physes, and can cause restricted limb function and limb-length discrepancies (3). Thus, the traditional 2-3 cm margin has been questioned, and methods using a reduced margin with partial epiphyseal preservation have been reported (3-6). Not only does this result in better functional outcomes for patients, but it also achieves acceptable local disease control.

In our institute, we have decided to prioritize joint-preservation whenever possible in patients with musculoskeletal knee sarcoma. Thus, we have developed novel surgical procedures using frozen autografts for reconstruction (7, 8) and distraction osteogenesis (9). These procedures have provided excellent functional and oncological outcomes (7, 8, 10-14). However, we have only assessed the function using the Musculoskeletal Tumour Society (MSTS) score (15) (an investigator-initiated outcome), and we have no data on patient-reported outcomes, like the Toronto Extremity Salvage Score (TESS) (16) and the 36-Item Short-Form Health Survey (SF-36; Japanese version 1.2) of the medical outcomes study (17, 18), which are equally important measures of clinical treatment (19).

We designed this study to evaluate patient satisfaction and patient-based outcomes after joint-preservation surgery for musculoskeletal knee sarcoma.

Patients and Methods

This was a single-center, case–control study of patients treated for musculoskeletal knee sarcoma between January 1999 and December 2015. In this study, because we aimed to evaluate patient satisfaction with knee joint-preservation, we excluded patients unsuitable for knee joint surgery assessment (those who underwent amputation, those with life-threatening conditions, or those who could not be contacted). Then, we compared the data between the joint-preservation and the joint-replacement groups. Additionally, we used data from representative healthy Japanese sample cohorts who answered the SF-36 as normal healthy controls. The Medical Ethics Committee of our institute approved this study (approval number: 1862) and all patients signed informed consents.

We mailed surveys to all eligible patients and evaluated their replies based on a 100-point scale to rate postoperative satisfaction (0, least; 100, most; 60, acceptance lowest point), MSTS score, TESS, and three component summaries from SF-36. The three

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Key Words: Patient satisfaction, patient-based outcome, musculoskeletal sarcoma, osteosarcoma, joint-preservation.

Table I. *Correlation between responder and non-responder according to each variable.*

				X^2 test	Logistic analysis		
		Responder	Non-responder	*p*-Value	OR	95%CI	*p*-Value
Joint	Preservation	25	8	0.15	3.409	0.934-12.442	0.063*
	Replacement	17	12		1		
Age (years)	<30	29	18	0.072*	0.225	0.037-1.372	0.106
	≥30	13	2		1		
Tumor location	Femur	24	8	0.207	2.735	0.792-9.451	0.112
	tibia/fibula	18	12		1		
Chemotherapy	Y	32	17	0.426	1.267	0.230-6.970	0.785
	N	10	3		1		
Reoperation	Y	17	11	0.283	0.783	0.202-3.033	0.724
	N	25	9		1		
Outcome	CDF	29	11	0.28	2.163	0.604-7.745	0.236
	NED, AWD	13	9		1		
Follow-up terms (years)	≥5	21	9	0.713	1.852	0.497-6.903	0.359
	<5	21	11		1		

Y: Yes; N: no; OR: odds ratio; CI: confidence interval; *0.05≤*p*<0.1.

component summaries included physical, mental, and role/social component portions (PCS, MCS, and RCS). Each summary had Japanese standard scores for each age bracket, based on data from 2007 for healthy Japanese individuals (17).

We primarily evaluated the association of the patients' joint statuses (preservation or replacement), their satisfaction, and the results of each score. We also assessed the roles of age (<30 or ≥30 years), tumor location (femur or tibia), chemotherapy (yes/no), reoperation (yes/no), outcome (CDF or NED/AWD), and follow up term (<5 or ≥5 years) on the satisfaction. We defined a score of ≥90 as indicating satisfaction and a score of <90 as indicating dissatisfaction because we wanted our satisfaction aim to be high.

Statistical analysis. Statistical analyses involved chi-square tests, Student's *t*-tests, and logistic analysis, as appropriate, and were performed using the IBM SPSS software, version 19.0 (IBM, Armonk, NY, USA). *p*-Values <0.05 were considered statistically significant, and *p*-values <0.1 but ≥0.05 were considered marginally significant.

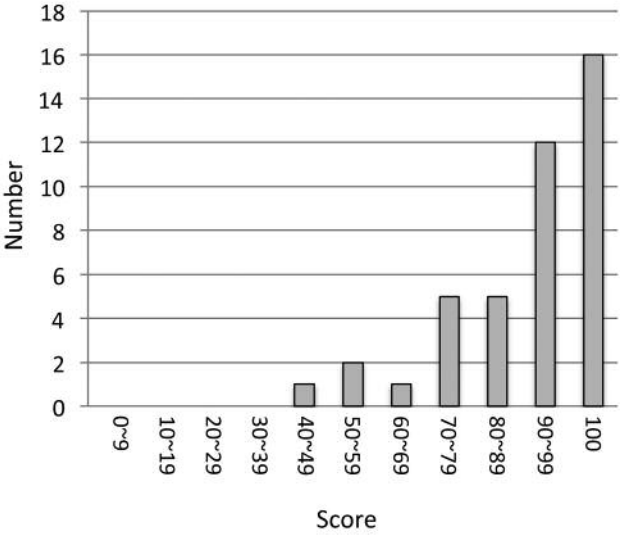

Figure 1. *Distribution of patient satisfaction scores.*

Results

Overall, 116 patients with musculoskeletal knee sarcomas underwent surgery during the study period. After excluding those who underwent limb amputation or who met any of the other exclusion criteria we mailed surveys to the 62 remaining patients. The response rate was 67.7% (42/62) with 31 patients treated for osteosarcoma. Differences were found in joint status (p=0.063) and age (p=0.072) between respondents and non-respondents, but the demographic and clinical characteristics were broadly similar (Table I).

The patient satisfaction questionnaire produced a mean patient satisfaction score of 87.8 (40-100) and 28 (66.7%) patients had a scored >90 points. Figure 1 presents the distribution of patient satisfaction scores. We found that joint status and reoperation were correlated with patient satisfaction. In those with joint-preservation, the univariate analysis showed a significant effect on increased satisfaction (p=0.026), but the multivariate analysis showed only a marginal significance (p=0.097). In patients who underwent reoperation, both the univariate and multivariate analysis indicated marginally significant effects of increased satisfaction (univariate analysis, p=0.050; multivariate analysis, p=0.086) (Table II).

We also compared the results of the MSTS score, TESS, and SF-36 between the patients in the joint-preservation group and those in the joint-replacement group. In terms of the MSTS score

Table II. *Correlation of patient satisfaction according to each variable.*

		Patient satisfaction		X^2 test	Logistic analysis		
		≥90	<90	*p*-Value	OR	95%CI	*p*-Value
Joint	Preservation	20	5	0.026**	4.787	0.754-30.381	0.097*
	Replacement	8	9		1		
Age (years)	<30	20	9	0.637	3.08	0.371-25.552	0.297
	≥30	8	5		1		
Tumor location	Femur	17	7	0.508	1.737	0.356-8.464	0.495
	tibia/fibula	11	7		1		
Chemotherapy	Y	20	12	0.306	0.378	0.038-3.718	0.404
	N	8	2		1		
Reoperation	Y	11	10	0.050*	0.18	0.025-1.275	0.086*
	N	17	4		1		
Outcome	CDF	21	8	0.238	2.673	0.518-13.786	0.24
	NED, AWD	7	6		1		
Follow-up terms (years)	≥5	12	9	0.19	1.377	0.205-9.255	0.742
	<5	16	5		1		

Y: Yes; N: no; OR: odds ratio; CI: confidence interval; *$0.05 \leq p < 0.1$, **$p < 0.05$.

Table III. *Comparison of the QOL between the joint-preservation and replacement groups using MSTS score, TESS, and SF-36.*

Parameter	Joint-preservation group (n=25)		Joint-replacement group (n=17)		Student's *t*-test	Logistic analysis		
	Mean	SD	Mean	SD	*p*-Value	OR	95%CI	*p*-Value
MSTS score	84	23.8	79.8	15.1	0.52	N/A	N/A	N/A
TESS	81.7	22.1	77.7	17.9	0.542	N/A	N/A	N/A
PCS	40.6	16.3	32.7	12	0.102	1.07	1.011-1.133	0.020**
MCS	59.9	10.4	54	8.23	0.055*	1.063	0.974-1.161	0.173
RCS	39.5	16.2	48.8	14.5	0.056*	0.932	0.874-0.993	0.030**

QOL: Quality of life; MSTS: Musculoskeletal Tumor Society; TESS: Toronto Extremity Salvage Score; SF-36: 36-Item Short-Form Health Survey; PCS: physical component summary; MCS: mental component summary; RCS: role-social component summary; SD: standard deviation; OR: odds ratio; CI: confidential interval; *$0.05 \leq p < 0.1$, **$p < 0.05$.

and TESS, the mean value was higher for patients in the joint-preservation group (without a significant difference) than for those in the joint-replacement group. In terms of the PCS, our multivariate analysis indicated a significant satisfactory effect on the patients in the joint-preservation group ($p=0.020$). The univariate analysis for MCS indicated a marginally significant difference in the joint-preservation group ($p=0.055$). In addition, the univariate analysis for RCS indicated a marginally significant difference; the multivariate analysis indicated a significant difference between the patients in the joint-replacement group (univariate analysis, $p=0.056$; multivariate analysis, $p=0.030$) and those in the joint-preservation group (Table III).

Our comparison between the joint-preservation and joint-replacement groups in terms of their Japanese standard scores matching age to the average age of each group using SF-36 showed that the mean ages of the joint-preservation and joint-replacement groups were 24.8 years and 33.1 years. We compared component summaries according to the surgical group with age-matched healthy Japanese cohorts. In the joint-preservation group, PCS and RCS were significantly lower than in controls ($p<0.001$, $p=0.001$), and MCS was significantly higher ($p<0.001$). In the joint-replacement group, PCS was significantly lower than in controls ($p<0.001$), and MCS was marginally higher ($p=0.054$) than in controls, but RCSs were similar to those in controls (Table IV).

Discussion

Postoperative outcome assessments in patients with musculoskeletal tumors are usually evaluated using the MSTS score, the TESS, or the SF-36. Physical and mental elements are evaluated as investigator-initiated outcomes in

Table IV. *Comparison of the QOL between surgical and Japanese sample cohorts using SF-36 summary scores.*

Parameter	Joint-preservation group Mean age: 24.8 years (n=25)		Representative healthy Japanese sample cohort Age: 20-29 (n=269)		Student's *t*-test *p*-Value
	Mean	SD	Mean	SD	
PCS	40.6	16.3	55.2	8.2	<0.001**
MCS	59.9	10.4	49.8	10.1	<0.001**
RCS	39.5	16.2	47.5	11.3	0.001**
Parameter	Joint-replacement group Mean age: 33.1 years (n=17)		Representative healthy Japanese sample cohort Age: 30-39 (n=394)		Student's *t*-test *p*-Value
	Mean	SD	Mean	SD	
PCS	32.7	12	52.7	8.3	<0.001**
MCS	54	8.23	49.6	9.2	0.054*
RCS	48.8	14.5	50	9.2	0.6

SD: Standard deviation; PCS: physical component summary; MCS: mental component summary; RCS: role-social component summary. *$0.05 \leq p < 0.1$; **$p < 0.05$.

the MSTS score (15), activities of daily living (physical elements) are evaluated as a patient-reported outcome in the TESS (16), and physical, mental, and social elements are evaluated as patient-reported outcomes in the SF-36 (17, 18). These surveys allow various operative methods to be evaluated, including the comparisons between limb salvage and amputation outcomes (20-25). Reports on the evaluation of rotation-plasty also exist (26, 27), but few reports have focused on joint-preservation evaluation (10, 11, 28). Betz *et al*. evaluated six cases of joint-preservation using the MSTS score and TESS (28), and we also reported evaluations of knee joint-preservation based on the MSTS score (10, 11). However, patient-reported outcomes are increasingly important to the development of clinical treatment strategies (19, 29), and we noted a lack of reports on patient-reported outcomes for knee joint-preservation. We found it surprising that a simple and clear method for evaluating patient-reported satisfaction with outcomes was lacking, and set out to use patient self-scoring and grading of satisfaction.

We defined, as satisfied the group of patient, rating outcomes of ≥90 and as dissatisfied the group with rating outcomes of <90. Then, to identify the factors affecting the average satisfaction score (87.8 points), we analyzed the patients' outcome goals: maintaining limb function in the affected leg was the second most important goal of patients, and this was consistent with our finding that satisfaction tended to be higher in the joint-preservation group.

Most scores (MSTS score, TESS, PCS, and MCS) were higher in the joint-preservation group than in the joint-replacement group, but we found the differences to lack statistical significance. However, isolated PCS and MCS scores showed significantly high values. And, in all, we confirmed that joint-preservation surgery can promote good function and patient satisfaction.

We found that the RCS was correlated with satisfaction and with belonging to the joint-replacement group. When comparing age-matched healthy Japanese cohorts with those in the joint-preservation (mean age, 24.8 years) and replacement (mean age, 33.1 years) groups, the healthy cohorts showed significantly higher scores than the patients in the joint-preservation group, but we found no significant differences between the cohorts and joint-replacement groups. The average age of our patients suggests that many were undergoing transitional life phases (education, employment, and marital status changes). It is possible that treatments during these periods have a strong effect on patients. However, RCS tends to increase with age until around 50 years (30), and Veenstra *et al*. (31) and Hillman *et al*. (32) reported relatively high levels of quality of life and psychosocial functioning in patients with adult bone cancer who underwent rotation-plasties. Moreover, Felder-Puig R *et al*. showed how young patients with bone cancer adapt well after treatment and are not necessarily at risk of developing long-term emotional or social problems (33). Also, Koopman HM *et al*. reported that the health-related quality of life scores of children and adolescents improved 3-8 years after treatment (34). Therefore, we expect the RCS in our group of patients with joint-preservation to improve with time.

This study had certain limitations. First, the timing of the questionnaire evaluation varied from patient to patient, and it only evaluated one point in the final observation. This was also only a retrospective cohort study conducted with a small number of patients from a single institute. Further studies should, therefore, be performed with more patients.

In conclusion, better physical outcomes translate into patient satisfaction improvements, as demonstrated by the high satisfaction in the group with joint-preservation. The

role/social component disadvantages incurred by young people undergoing joint-preservation operations can be expected to improve with the passage of time.

Conflicts of Interest

The Authors report no conflicts of interest regarding this study.

Authors' Contributions

All listed Authors substantially contributed to the following aspects of the manuscript: KA, NY, KH, AT, SK, SM, KI, and HT participated in diagnosing and treating the patient and in acquisition of data. KA, HI, YA, TH and YT collected the findings and drafted the manuscript. NY and HT revised the manuscript. All authors read and approved the final manuscript. Dr. Norio Yamamoto and Dr. Hiroyuki Tsuchiya guarantee the integrity of this work.

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