Original Article

Patient Satisfaction With Treatment Outcomes After Surgery and/or Radiotherapy for Spinal Metastases

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BACKGROUND: Patient satisfaction is infrequently investigated despite its importance in assessing efficacy and patient comprehension. The purpose of this study was to investigate patient satisfaction with treatment outcomes after surgery and/or radiotherapy for spinal metastases and to evaluate how health-related quality of life (HRQOL) is related to patient satisfaction. **METHODS:** Patients with spinal metastases treated with surgery and/or radiotherapy were enrolled in a prospective, international, observational study. Demographic, histologic, treatment, and HRQOL data were collected. HRQOL was evaluated with the Numeric Rating Scale pain score, the 3-level version of the EuroQol 5-Dimension (EQ-5D-3L) instrument, and the Spine Oncology Study Group Outcomes Questionnaire (SOSGOQ2.0). Patient satisfaction was derived from the SOSGOQ2.0 at 6, 12, and 26 weeks after treatment. Patients were classified as satisfied, neutral, or dissatisfied. **RESULTS:** Twelve weeks after treatment, 183 of the surgically treated patients (84%) were satisfied, and only 11 (5%) were dissatisfied; in contrast, 101 of the patients treated with radiotherapy alone (77%) were satisfied, and only 7 (5%) were dissatisfied. Significant improvements in pain, physical function, mental health, social function, leg function, and EQ-5D were associated with satisfaction after surgery. Satisfaction after radiotherapy was associated with significant improvements in pain, mental health, and overall SOSGOQ2.0 scores. Dissatisfaction after treatment was associated with lower baseline values for leg strength and lower social functioning scores for surgically treated patients and with lower social functioning scores and being single for patients treated with radiotherapy. **CONCLUSIONS:** High levels of satisfaction with treatment outcomes are observed after surgery and/or radiotherapy for spinal metastases. Posttreatment satisfaction is associated with significant improvements in pain and different dimensions of HRQOL. ***Cancer* 2019;125:4269-4277**.

KEYWORDS: metastases, patient-reported outcomes, quality of life, radiotherapy, satisfaction, spine, surgery.

INTRODUCTION

The effectiveness and outcomes of cancer treatments are historically based on the evaluation of clinician-reported outcomes and measures such as morbidity and survival. Over the last few decades, patient-reported health-related quality of life (HRQOL) measures have been recognized as some of the most important tools for evaluating treatments.[1] Another aspect of the patient perspective that is gaining attention, and might even be the ultimate patient-reported outcome, is patient satisfaction with the treatment's outcomes. Yet, patient satisfaction is not evaluated in the majority of HRQOL measures, and existing satisfaction measures focus on satisfaction with overall care rather than satisfaction with treatment outcomes.[2,3]

The patient perspective is especially relevant in the treatment of patients with spinal metastases because of the palliative intent of the procedures. Although radiation and/or surgery have been shown to effectively relieve symptoms and improve HRQOL for patients with spinal metastases,[4-6] the level of satisfaction with these treatment outcomes is

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largely unknown.[7,8] Understanding patient factors that affect treatment satisfaction is important for enhancing patient decision making and for determining further areas of importance to optimize treatment outcomes. Other disciplines have studied patient satisfaction, but to the best of our knowledge, this is the first study to prospectively investigate the degree of patient satisfaction with treatment outcomes after surgery and/or radiotherapy for spinal metastases and, furthermore, to evaluate how HRQOL is related to patient satisfaction.

MATERIALS AND METHODS

Study Design

This study was part of an international, multicenter, observational cohort study conducted by the AOSpine Knowledge Forum Tumor, which included patients between the ages of 18 and 75 years who were treated with surgery with or without radiotherapy or with radiotherapy alone for spinal metastases (Epidemiology, Process and Outcomes of Spine Oncology [EPOSO]; ClinicalTrials.gov identifier NCT01825161). Patients were not eligible for inclusion if they were diagnosed with a primary spinal bone tumor or central nervous system tumor. The protocol was approved by the ethics board of each of the participating sites, and all patients provided written informed consent.

Demographic, diagnostic, treatment, adverse event, and HRQOL data were prospectively collected. HRQOL was evaluated with the Numeric Rating Scale pain score, the 3-level version of the EuroQol 5-Dimension (EQ-5D-3L) instrument, and the Spine Oncology Study Group Outcomes Questionnaire (SOSGOQ2.0)[9] at the baseline and 6, 12, and 26 weeks after treatment.

Patient Satisfaction

The core set of SOSGOQ2.0 questions evaluates 5 domains, including physical function, pain, neurological function, mental health, and social function. After treatment, the SOSGOQ2.0 is extended by 7 questions reflecting the different domains and evaluating patient satisfaction.

Patient satisfaction was derived from item 21 of the SOSGOQ2.0. It evaluates on a 5-point response scale the following: "Are you satisfied with the results of your spine tumor management?" The response categories were condensed to patients who were somewhat satisfied or very satisfied being classified as satisfied and patients who were very dissatisfied or somewhat dissatisfied being classified as dissatisfied to ensure adequate numbers in the different categories. Patients who were neither satisfied nor dissatisfied were regarded as neutral.

For this study, patients were included in the analysis if they received treatment between August 2013 and February 2018, had data available regarding satisfaction, and had at least 6 months of follow-up or died before that time point.

Statistical Analysis

Standard descriptive statistics were used to represent demographic data (means and SDs or medians and ranges for continuous variables and absolute numbers and frequency distributions for categorical variables). The Student t test, the chi-square test, and the Fisher exact test were used to compare differences in means and proportions between patients who underwent surgery with or without radiotherapy and patients who underwent radiotherapy alone. The Cochran-Armitage test for trend was applied to examine linear trends in ordinal data. The primary endpoint of satisfaction was evaluated 12 weeks after treatment, with the information at 6 weeks after treatment carried forward in case of missing values at 12 weeks to minimize the loss of data (last observation carried forward [LOCF]). A sensitivity analysis was performed with a per-protocol analysis, which excluded patients with missing information at the primary endpoint of 12 weeks. Mixed effect models were used to test for differences in HRQOL between satisfied and dissatisfied patients within the surgery or radiotherapy group. Patients classified as neutral were included in the group of dissatisfied patients for the mixed effect models. All statistical analyses were performed with SAS (version 9.4; SAS Institute, Inc, Cary, North Carolina). Significance was defined as $P < .05$.

RESULTS

With the LOCF approach, satisfaction data were available for 351 patients at 12 weeks, including 219 patients treated with surgery with or without radiotherapy and 132 patients treated with radiotherapy alone. For 88 of these 351 patients, the satisfaction information was carried forward from the 6-week visit.

The mean age at the time of treatment was 59.2 years (SD, 10.3 years); 54.7% were female; and the most common primary tumors were breast cancer (27%), lung cancer (17%), and renal cell cancer (16%). Of the patients who underwent surgery with or without radiotherapy, 104 were treated with surgery alone, and 115 received adjuvant radiotherapy. Adjuvant conventional

external-beam radiotherapy (EBRT) was given to 48 patients (41.7%); 53 (46.1%) received postoperative stereotactic body radiotherapy (SBRT); and for 14 patients (12.2%), the radiation modality was unknown. Of the 132 patients treated with radiotherapy alone, 51 (39%) were treated with conventional EBRT, and 81 (61%) were treated with SBRT.

The median number of operated vertebral levels was 5, and the mean operating time was 243 minutes (SD, 119 minutes). A posterior surgical approach was performed in 82% of the patients (n = 180), an anterior approach was performed in 4% (n = 9), and a combined anterior-posterior approach was performed in 3% (n = 7). A palliative procedure with stabilization and limited decompression was performed in 45 patients (21%), intralesional curettage (subtotal or gross total) was performed in 82 patients (37%), and an en bloc procedure was performed in 18 patients (8%). Cement augmentation was used in the minority of patients with vertebroplasty in 19, kyphoplasty in 6, and another type of cement augmentation in 4.

Of the patients treated with radiotherapy alone, 81 (62%) underwent SBRT, and 51 (39%) underwent conventional EBRT, with a median number of treated levels of 1 (interquartile range, 1-3). The median total dose in the conventional EBRT group was 20 Gy in 5 fractions, and the median total dose in the SBRT group was 24 Gy in 2 fractions. The baseline characteristics of both treatment groups are summarized in Table 1.

Satisfaction With Treatment Outcomes

At 12 weeks after surgery, 183 patients (84%) were satisfied, 25 (11%) were neither satisfied nor dissatisfied, and 11 (5%) were dissatisfied with the results of their spine tumor management. Dissatisfaction after surgery was associated with a lower level of education ($P = .012$), discharge to home without family or home care support ($P = .029$), the occurrence of an intraoperative adverse event ($P = .012$), and a trend toward a worse baseline performance status ($P = .056$). The occurrence of a postoperative adverse event was not associated with dissatisfaction ($P = .949$). A significant difference in the 1-year overall survival rate was found between satisfied and dissatisfied patients ($P = .0285$), with satisfied patients surviving longer than dissatisfied patients. No significant difference in the 3-month overall survival rate was observed between satisfied and dissatisfied patients.

Of the patients treated with radiotherapy alone, 101 (77%) were satisfied, 24 (18%) were neither satisfied nor dissatisfied, and 7 (5%) were dissatisfied at 12 weeks after radiotherapy. Patients who were dissatisfied after radiotherapy were more likely to be living alone than patients who were satisfied after surgery ($P = .011$). The occurrence of an adverse event after radiotherapy was not associated with dissatisfaction ($P = .340$). The sensitivity analysis confirmed the results from the primary analyses. There was no statistical difference in satisfaction rates between the cohort undergoing surgery with or without radiotherapy and the cohort undergoing radiotherapy alone at 12 weeks after treatment. No significant difference in 1-year overall survival between satisfied and dissatisfied patients was observed.

HRQOL and Treatment Satisfaction

At baseline, patients who were dissatisfied after surgery were more likely to present with more severe leg weakness ($P = .012$) and a trend toward lower social functioning scores ($P = .074$) in comparison with patients who were satisfied. Baseline HRQOL scores of satisfied and dissatisfied patients did not demonstrate statistically significant differences in pain, physical function, mental health, or overall quality of life. At 12 weeks post-surgery, a mean adjusted increase of 17.7 points (95% CI, 12.0-23.5; $P < .001$) in overall SOSGOQ2.0 score was observed for satisfied patients compared to an increase of 0.9 points (95% CI, -13.8 ± 15.7; $P = 1.000$) in patients who were dissatisfied. During follow-up, satisfied patients experienced greater and significant improvements in almost all HRQOL domains and overall HRQOL in comparison with nonsignificant improvements in dissatisfied patients (Table 2). More specifically, patients who were dissatisfied after surgery demonstrated worse mental health, social function, physical function, and pain scores at 12 weeks after surgery.

Among patients treated with radiotherapy alone, no differences in baseline HRQOL scores were observed between satisfied and dissatisfied patients except for a trend toward lower social functioning scores ($P = .070$) and more severe arm weakness ($P = .080$). Patients who were satisfied after radiotherapy were demonstrated to have significant improvements in pain at 12 weeks after radiotherapy (12.3; 95% CI, 4.1-20.6; $P < .001$) in contrast to deterioration of pain scores for patients who were dissatisfied (–9.9; 95% CI, –24.7 to 4.9; $P = .483$). Patients who were satisfied after radiotherapy maintained their baseline HRQOL or experienced moderate improvements in HRQOL in contrast to deterioration of HRQOL in patients who were dissatisfied (Table 3).

TABLE 1. Baseline Characteristics per Treatment Group of the Analysis Population

Characteristic	Surgery With or Without Radiotherapy (n = 219)			Radiotherapy Alone (n = 131)		
	Satisfied	Dissatisfied	*P*	Satisfied	Dissatisfied	*P*
Age at surgery/radiotherapy	183	36	.208[a]	101	31	.597[a]
Mean (SD), y	58.2 (10.2)	59.7 (12.4)		60.3 (9.1)	60.5 (11.5)	
Sex, No. (%)	183	36	.932[b]	101	31	.160[b]
Female	98 (53.6)	19 (52.8)		54 (53.5)	21 (67.7)	
Male	85 (46.4)	17 (47.2)		47 (46.5)	10 (32.3)	
ECOG classification, No. (%)	181	36	.056[c]	100	30	.388[c]
0	20 (11.0)	2 (5.6)		43 (43.0)	9 (30.0)	
1	79 (43.6)	9 (25.0)		49 (49.0)	18 (60.0)	
2	39 (21.5)	15 (41.7)		3 (3.0)	2 (6.7)	
3	31 (17.1)	6 (16.7)		5 (5.0)	1 (3.3)	
4	12 (6.6)	4 (11.1)		0 (0.0)	0 (0.0)	
Site of the primary cancer, No. (%)	183	36	.268[b]	101	31	.941[d]
Breast	39 (21.3)	7 (19.4)		37 (36.6)	12 (38.7)	
Lung	32 (17.5)	10 (27.8)		13 (12.9)	3 (9.7)	
Prostate	13 (7.1)	4 (11.1)		15 (14.9)	6 (19.4)	
Kidney	36 (19.7)	2 (5.6)		14 (13.9)	5 (16.1)	
Other	63 (34.5)	13 (36.1)		22 (21.8)	5 (16.1)	
Presence of other metastases	139	29	.694[b]	101	31	.856[b]
None	72 (52)	14 (48)		19 (18.8)	4 (12.9)	
Brain	10 (7.2)	3 (10.3)		11 (10.9)	3 (9.7)	
Visceral	57 (41)	12 (41.4)		36 (35.6)	13 (41.9)	
ASIA Impairment Scale, No. (%)	183	36	.223[c]	101	30	.875[c]
A-C	13 (7.1)	2 (5.6)		0 (0.0)	0 (0.0)	
D	55 (30.1)	7 (19.4)		4 (4.0)	1 (3.3)	
E	115 (62.8)	27 (75.0)		97 (96.0)	29 (96.7)	
Bilsky Epidural Spinal Cord Compression Scale	177	35	.389[b]	91	29	.335[d]
0-1C	95 (53.7)	16 (45.7)		86 (94.5)	29 (100.0)	
2-3	82 (46.3)	19 (54.3)		5 (5.5)	0 (0.0)	
Education degree achieved, No. (%)	108	21	**.012**[c]	93	29	.827[c]
Primary/middle/high school	28 (26)	12 (57.2)		29 (31.2)	9 (31.0)	
Technical or trade degree	20 (18.5)	3 (14.3)		11 (11.8)	4 (13.8)	
College degree	44 (40.7)	4 (19.0)		40 (43.0)	10 (34.5)	
Graduate degree	16 (14.8)	2 (9.5)		13 (14.0)	6 (20.7)	
Current marital status, No. (%)	183	36	.237[b]	101	31	**.011**[d]
Single	28 (15.3)	7 (19.4)		10 (9.9)	10 (32.3)	
Living with a partner	133 (72.7)	28 (77.8)		82 (81.2)	20 (64.5)	
Unknown	22 (12.0)	1 (2.8)		9 (8.9)	1 (3.2)	

Abbreviations: ASIA, American Spinal Injury Association; ECOG, Eastern Cooperative Oncology Group.
[a]Wilcoxon rank sum test.
[b]Chi-square test.
[c]Cochran-Armitage test for trend.
[d]Fisher exact test.

Satisfaction Over Time

During 6 months of follow-up, 75% of the surgically treated patients reported only satisfaction with treatment outcomes, 12% reported only dissatisfaction, and 13% reported both satisfaction and dissatisfaction. In comparison, of the patients treated with radiotherapy alone, 64% reported only satisfaction with treatment outcomes, 10% reported only dissatisfaction, and 26% reported both satisfaction and dissatisfaction.

DISCUSSION

The patient perspective is essential to evaluating surgery and/or radiotherapy for the treatment of spinal metastases, especially when the treatment objectives are symptom relief and improvement in HRQOL. At 12 weeks after treatment, we demonstrated that among the patients who underwent surgery with or without radiotherapy and the patients who underwent radiotherapy alone for the treatment of spinal metastases, 84% and 77%, respectively, were satisfied with their treatment results. Only 5% of the patients reported dissatisfaction at 12 weeks after treatment. Previously, Fujibayashi et al[7] reported a similar satisfaction rate of 81% based on an evaluation of 21 patients and 16 family members after surgical treatment for spinal metastases. Moreover, Kato et al[8] reported a satisfaction rate of 95% after en bloc spondylectomy with curative intent for spinal metastases in 47 patients and 67 family members. However, both

TABLE 2. Mixed Effect Models for Patients Treated With Surgery With or Without Radiotherapy

	Satisfied				Dissatisfied				*P* for Satisfied vs Dissatisfied[b]
	No.	Mean (95% CI)	Change (95% CI)	Adjusted *P*[a]	No.	Mean (95% CI)	Change (95% CI)	Adjusted *P*[a]	
SOSGOQ2.0: overall									
Baseline	172	51.6 (49.8 to 53.3)			32	50.9 (46.8 to 54.9)			1.000
6 wk	142	63.4 (60.5 to 66.4)	11.9 (6.7 to 17.0)	**<.001**	30	51.7 (45.1 to 58.2)	0.8 (–10.8 to 12.4)	1.000	**.046**
12 wk	127	69.2 (66.4 to 72.0)	17.6 (12.4 to 22.8)	**<.001**	19	50.8 (43.7 to 57.8)	–0.1 (–13.0 to 12.9)	1.000	**<.001**
26 wk	102	71.3 (68.5 to 74.2)	19.8 (14.6 to 24.9)	**<.001**	11	54.2 (46.5 to 62.0)	3.4 (–10.5 to 17.3)	.999	**.003**
SOSGOQ2.0: pain									
Baseline	172	36.2 (33.5 to 38.8)			32	37.7 (31.5 to 43.8)			1.000
6 wk	143	58.0 (54.7 to 61.4)	21.8 (15.3 to 28.3)	**<.001**	31	44.0 (36.6 to 51.4)	6.3 (–8.3 to 20.9)	.926	**.028**
12 wk	128	65.1 (61.7 to 68.5)	28.9 (22.3 to 35.5)	**<.001**	19	42.9 (34.4 to 51.5)	5.3 (–10.9 to 21.4)	.988	**<.001**
26 wk	103	65.1 (61.3 to 68.9)	28.9 (21.7 to 36.2)	**<.001**	12	44.1 (33.2 to 54.9)	6.4 (–13.2 to 26.0)	.988	**.015**
SOSGOQ2.0: physical									
Baseline	173	50.0 (46.3 to 53.7)			33	47.6 (39.0 to 56.2)			1.000
6 wk	144	54.6 (51.1 to 58.1)	4.6 (–2.3 to 11.5)	.502	31	41.1 (33.4 to 48.8)	–6.5 (–21.9 to 8.9)	.936	**.058**
12 wk	130	63.8 (60.3 to 67.2)	13.7 (7.1 to 20.3)	**<.001**	19	44.4 (35.7 to 53.1)	–3.2 (–19.4 to 13.0)	1.000	**.003**
26 wk	102	68.1 (64.5 to 71.7)	18.1 (11.3 to 24.9)	**<.001**	12	53.7 (44.4 to 63.1)	6.1 (–11.0 to 23.3)	.978	.138
SOSGOQ2.0: mental									
Baseline	173	61.3 (57.8 to 64.8)			33	58.4 (50.3 to 66.5)			1.000
6 wk	145	70.2 (66.3 to 74.1)	8.9 (2.5 to 15.3)	**<.001**	31	58.5 (49.9 to 67.1)	0.1 (–14.0 to 14.1)	1.000	.311
12 wk	129	73.3 (69.5 to 77.1)	12.0 (5.2 to 18.8)	**<.001**	19	55.0 (45.3 to 64.6)	–3.4 (–20.4 to 13.5)	1.000	**.022**
26 wk	103	74.6 (70.8 to 78.5)	13.3 (6.3 to 20.4)	**<.001**	12	59.2 (48.4 to 70.0)	0.8 (–18.2 to 19.9)	1.000	.202
SOSGOQ2.0: social									
Baseline	173	56.5 (52.3 to 60.7)			33	49.5 (40.8 to 58.3)			.894
6 wk	150	68.1 (64.3 to 71.9)	11.6 (5.2 to 18.1)	**<.001**	31	54.9 (47.3 to 62.5)	5.4 (–9.1 to 19.9)	.973	**.038**
12 wk	134	72.6 (68.9 to 76.4)	16.2 (9.8 to 22.5)	**<.001**	22	54.7 (46.8 to 62.7)	5.2 (–10.2 to 20.6)	.986	**.001**
26 wk	108	74.0 (70.1 to 77.9)	17.6 (10.8 to 24.4)	**<.001**	13	53.5 (44.1 to 62.9)	4.0 (–13.7 to 21.7)	.999	**.002**
EQ-5D (3L)									
Baseline	169	0.49 (0.45 to 0.53)			33	0.44 (0.34 to 0.53)			.994
6 wk	144	0.66 (0.62 to 0.69)	0.17 (0.10 to 0.24)	**<.001**	32	0.50 (0.42 to 0.57)	0.06 (–0.09 to 0.21)	.962	**.006**
12 wk	129	0.74 (0.71 to 0.76)	0.25 (0.18 to 0.32)	**<.001**	19	0.57 (0.50 to 0.65)	0.14 (–0.03 to 0.31)	.221	**.003**
26 wk	103	0.70 (0.66 to 0.73)	0.21 (0.13 to 0.29)	**<.001**	12	0.62 (0.52 to 0.71)	0.18 (–0.02 to 0.38)	.139	.877

Abbreviations: 3L, 3-level version; EQ-5D, EuroQol 5-Dimension; SOSGOQ2.0, Spine Oncology Study Group Outcomes Questionnaire.
[a]Adjusted *P* values Tukey-Kramer for comparisons of changes with the baseline value per group.
[b]*P* values for comparisons of the mean values of both groups.

TABLE 3. Mixed Effect Models for Patients Treated With Radiotherapy Alone

	Satisfied				Not Satisfied				*P* for Satisfied vs Dissatisfied[b]
	No.	Mean (95% CI)	*P*	Adjusted *P*[a]	No.	Mean (95% CI)	Change (95% CI)	Adjusted *P*[a]	
SOSGOQ2.0: overall									
Baseline	98	68.0 (66.1 to 69.8)			31	68.4 (65.1 to 71.8)			1.000
6 wk	89	71.0 (68.6 to 73.3)	3.0 (–1.0 to 6.9)	.327	25	68.4 (64.1 to 72.8)	–0.0 (–7.3 to 7.3)	1.000	.992
12 wk	79	73.5 (70.8 to 76.1)	5.5 (0.8 to 10.1)	**.009**	25	61.2 (56.4 to 66.0)	–7.2 (–15.5 to 1.1)	.146	**.001**
26 wk	69	71.9 (68.6 to 75.2)	3.9 (–1.6 to 9.4)	.402	18	66.9 (60.6 to 73.2)	–1.5 (–12.1 to 9.0)	1.000	.927
SOSGOQ2.0: pain									
Baseline	99	59.4 (55.6 to 63.3)			31	61.5 (54.6 to 68.4)			1.000
6 wk	89	67.5 (63.9 to 71.1)	8.1 (1.1 to 15.1)	**.011**	25	61.9 (55.2 to 68.6)	0.4 (–12.5 to 13.2)	1.000	.902
12 wk	79	71.7 (67.8 to 75.6)	12.3 (4.1 to 20.6)	**<.001**	25	51.6 (44.6 to 58.7)	–9.9 (–24.7 to 4.9)	.483	**<.001**
26 wk	69	67.6 (63.2 to 72.0)	8.2 (–0.1 to 16.5)	.053	18	59.1 (50.5 to 67.6)	–2.4 (–18.1 to 13.3)	1.000	.754
SOSGOQ2.0: physical									
Baseline	99	75.5 (72.3 to 78.8)			31	75.3 (69.4 to 81.2)			1.000
6 wk	89	73.3 (69.7 to 76.8)	–2.3 (–6.8 to 2.3)	.838	26	74.4 (67.9 to 80.8)	–0.9 (–9.1 to 7.3)	1.000	1.000
12 wk	83	75.5 (72.1 to 78.9)	–0.0 (–5.5 to 5.5)	1.000	25	65.2 (59.1 to 71.4)	–10.1 (–20.0 to –0.1)	**.044**	.123
26 wk	70	70.3 (65.8 to 74.8)	–5.2 (–12.4 to 2.0)	.362	18	67.7 (58.9 to 76.5)	–7.6 (–21.7 to 6.4)	.756	1.000
SOSGOQ2.0: mental									
Baseline	99	60.3 (55.6 to 65.0)			31	60.1 (51.6 to 68.5)			1.000
6 wk	89	65.9 (61.5 to 70.4)	5.6 (–0.4 to 11.7)	.091	25	59.6 (51.3 to 68.0)	–0.4 (–11.7 to 10.8)	1.000	.947
12 wk	79	67.1 (62.8 to 71.4)	6.8 (0.6 to 12.9)	**.018**	25	61.7 (53.9 to 69.4)	1.6 (–9.4 to 12.6)	1.000	.969
26 wk	69	68.1 (63.2 to 73.0)	7.8 (–0.7 to 16.2)	.097	18	66.2 (56.7 to 75.6)	6.1 (–10.0 to 22.2)	.967	1.000
SOSGOQ2.0: social									
Baseline	100	75.8 (70.3 to 81.3)			31	69.7 (61.4 to 78.0)			.937
6 wk	90	76.4 (70.9 to 81.8)	0.6 (–5.3 to 6.5)	1.000	26	71.5 (63.2 to 79.7)	1.7 (–9.1 to 12.5)	1.000	.983
12 wk	83	78.4 (73.1 to 83.7)	2.6 (–3.5 to 8.7)	.925	25	59.5 (51.5 to 67.4)	–10.2 (–21.2 to 0.8)	.091	**<.001**
26 wk	71	79.7 (74.3 to 85.2)	3.9 (–2.3 to 10.2)	.567	18	67.8 (59.4 to 76.3)	–1.9 (–13.9 to 10.1)	1.000	.219
EQ-5D (3L)									
Baseline	94	0.72 (0.68 to 0.76)			31	0.70 (0.63 to 0.77)			1.000
6 wk	88	0.78 (0.75 to 0.80)	0.05 (–0.01 to 0.12)	.191	26	0.72 (0.67 to 0.77)	0.02 (–0.09 to 0.13)	1.000	.724
12 wk	83	0.76 (0.73 to 0.80)	0.04 (–0.03 to 0.11)	.693	24	0.67 (0.61 to 0.74)	–0.03 (–0.15 to 0.10)	1.000	.343
26 wk	69	0.74 (0.70 to 0.78)	0.02 (–0.06 to 0.10)	.997	18	0.72 (0.64 to 0.79)	0.02 (–0.14 to 0.17)	1.000	1.000

Abbreviations: 3L, 3-level version; EQ-5D, EuroQol 5-Dimension; SOSGOQ2.0, Spine Oncology Study Group Outcomes Questionnaire. a= Adjusted P value by Tukey-Kramer for comparison of change to baseline value per group.

[a]Adjusted *P* values Tukey-Kramer for comparisons of changes with the baseline value per group.

[b]*P* values for comparisons of the mean values of both groups.

studies used a cross-sectional study design with overall questionnaire response rates of 52% and 58%, respectively, and they performed the evaluation at an average of 32.7 and 58 months after surgery, respectively. In comparison, our overall questionnaire response rates were 69% at 6 weeks and 61% at 12 weeks. When we excluded patients who died during follow-up, our response rates were 76% at 6 weeks and 74% at 12 weeks. These questionnaire completions rates are remarkable given the complexity around the follow-up of oncology patients.

Interestingly, the satisfaction rates found in our study after surgical treatment are markedly higher than the reported satisfaction rates after surgery for adult spinal deformity and lumbar spinal stenosis of 75.8% and 62.4%, respectively.[10,11] In agreement with our results, both studies showed an association between significant improvements in HRQOL and satisfaction with treatment outcomes.[10,11] In addition, Hamilton et al[10] also showed no relation between the occurrence of adverse events (major or minor) and satisfaction. The high rates of satisfaction in both cohorts are in line with results after other palliative cancer treatments despite high morbidity rates and poor overall survival.[12] Surgery for spinal metastases is, despite the advances in surgical techniques, often invasive surgery as reflected by reported adverse event rates of up to 76%.[13] The reported incidence of adverse events with radiotherapy is similar, yet the adverse event profile is substantially less severe in comparison with surgical adverse events.[14] In the current study, posttreatment adverse events were reported in 33% of the surgically treated patients and in 12% of the radiotherapy patients. The occurrence of an adverse event, with the exception of the occurrence of an intraoperative adverse event, was in neither of the groups associated with dissatisfaction after treatment. This may be explained by the severity of an intraoperative adverse event in comparison with the severity of the majority of postoperative adverse events. Despite the high risk of adverse events and the poor prospects of overall survival, the benefit of the procedures to the patients should not be underestimated, as is emphasized by the satisfaction rates and improvements in HRQOL demonstrated in this study.

Our study demonstrated that patients who were satisfied after surgery experienced significant improvements in HRQOL in contrast to nonsignificant improvements in HRQOL in dissatisfied patients. On the other hand, patients who were satisfied after radiotherapy experienced significant improvements in pain but not in other HRQOL domains. Despite this difference in HRQOL outcomes between surgery and radiotherapy, satisfaction rates between the 2 treatment groups were not significantly different. This may be explained by how satisfaction with treatment outcomes was previously defined as the valuation of the results of a treatment in comparison with pretreatment expectations and in light of patients' preferences.[15] Counseling patients toward appropriate expectations may, therefore, be crucial in further optimizing HRQOL and satisfaction with treatment outcomes[16] and may explain the similarity of satisfaction rates after surgery and radiotherapy despite the difference in HRQOL outcomes. Pretreatment expectations were, however, not evaluated in the current study.

Dissatisfaction after radiotherapy and/or surgery was associated with lower baseline social functioning scores, being single, and being discharged home without family or home care support. In addition, lower mental health and social functioning were observed at 12 weeks after treatment in dissatisfied patients. The amount of social support is a factor known to be associated with HRQOL outcomes.[17] Social life and the ability to participate in social life may help or hamper the recovery process of a treatment and influence HRQOL and posttreatment satisfaction.[17] Close involvement of patient support services and posthospital care, in addition to treatment-related care, may help to further improve HRQOL outcomes. Besides social functioning, more severe pretreatment neurological deficits of the arms or legs were also associated with dissatisfaction after surgery and/or radiotherapy. Neurological deficits have a debilitating effect on HRQOL and functional status; therefore, these patients may have had higher expectations of the functional outcomes and could be harder to satisfy.[18]

Though promising, the high satisfaction rates after surgery and radiotherapy reported in this study merit further consideration. Satisfaction was measured with a 5-point response scale, with the majority of satisfied people reporting that they were very satisfied with the results of their spine tumor management. A ceiling effect of the satisfaction scale should be considered because the high satisfaction rates may not necessarily reflect only positive outcomes.[18] Furthermore, the number of dissatisfied and neither satisfied nor dissatisfied patients may reflect a lower level of dissatisfaction because patients may express dissatisfaction only after a profoundly negative experience.[15,18] In addition, the low number of dissatisfied patients also limited the ability to detect statistically significant changes in HRQOL among these patients. Although our response rates can be considered high in light of the study population, approximately 25% did not complete the

satisfaction questions. Moreover, 12 of our patients died, and 7 were lost to follow-up or withdrew consent within the first 12 weeks after treatment. Satisfaction with treatment outcomes for these patients might have been different from that for the patients who completed the HRQOL questionnaires, and this potentially could have resulted in an overestimation of satisfaction. The LOCF approach was used to minimize this.

In conclusion, high rates of patient satisfaction with outcomes of surgery with or without radiotherapy or radiotherapy alone for spinal metastases were reported. No differences in satisfaction rates were found between the 2 treatment groups despite a greater effect of surgery with or without radiotherapy in comparison with radiotherapy alone on HRQOL. Dissatisfaction after radiotherapy and/or surgery was associated with no improvement in or a deterioration of HRQOL, being single, and being discharged home without family or homecare support. Dissatisfied patients reported worse mental health, social function, physical function, and pain scores at 12 weeks after treatment. Future studies evaluating patient satisfaction should try to identify prognostic factors associated with dissatisfaction or satisfaction with treatment outcomes. Ideally, these risk factors can be addressed before treatment or shortly after treatment (eg, enhanced patient support services) to improve satisfaction rates and overall HRQOL.

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CONFLICT OF INTEREST DISCLOSURES

Anne L. Versteeg reports consulting and travel accommodations from AOSpine International. Arjun Sahgal reports past educational seminars with Elekta AB, BrainLAB, Medtronic Kyphon, Accuray, Inc, and Varian Medical Systems; a research grant from Elekta AB; advisory/consulting roles with AbbVie, Merck, Roche, VieCure, and BrainLAB; travel accommodations and expenses from Elekta, BrainLAB, and Varian; and membership in the Elekta MR Linac Research Consortium and the International Stereotactic Radiosurgery Society. Laurence D. Rhines reports educational commitments to Stryker outside the submitted work. Daniel M. Sciubba reports consulting for and royalties from Medtronic, DePuy Synthes, Stryker, Nuvasive, Globus, Baxter, and K2M outside the submitted work. Paul M. Arnold reports travel accommodations and expenses from AOSpine North America; intellectual property rights and interests, equity, and a position of responsibility in Evoke Medical; equity in Z-Plasty; consulting fees from Stryker Orthopaedics, Ulrich, SpineGuard, and InVivo Therapeutics; and consulting fees, travel accommodations, and expenses from Stryker Spine, Spinewave, Medtronic outside the submitted work. Stefano Boriani reports educational commitments to K2M Stryker and Nuvasive outside the submitted work. Chetan Bettegowda reports acting as a consultant for DePuy Synthes outside the submitted work. Ziya L. Gokaslan reports research support from AOSpine North America and stock ownership in Spinal Kinetics outside the submitted work. Charles G. Fisher reports consulting for and royalties from Medtronic, personal fees from Nuvasive, research grants from the Orthopaedic Research and Education Foundation, and fellowship support paid to his institution from AOSpine and Medtronic outside the submitted work. The other authors made no disclosures.

AUTHOR CONTRIBUTIONS

Anne L. Versteeg: Study design, analysis, data interpretation, and writing of the manuscript. **Arjun Sahgal:** Study design, data collection, analysis, data interpretation, and writing of the manuscript. **Norio Kawahara:** Study design and writing of the manuscript. **Laurence D. Rhines:** Study design, data collection, and writing of the manuscript. **Daniel M. Sciubba:** Data collection and writing of the manuscript. **Michael H. Weber:** Data collection and writing of the manuscript. **Áron Lazary:** Study design, data collection, and writing of the manuscript. **Michael G. Fehlings:** Data collection and writing of the manuscript. **James M. Schuster:** Data collection and writing of the manuscript. **Michelle J. Clarke:** Data collection and writing of the manuscript. **Paul M. Arnold:** Data collection and writing of the manuscript. **Stefano Boriani:** Study design, data collection, and writing of the manuscript. **Chetan Bettegowda:** Study design, data collection, and writing of the manuscript. **Ziya L. Gokaslan:** Study design, data collection, and writing of the manuscript. **Charles G. Fisher:** Study design, data collection, analysis, data interpretation, and writing of the manuscript.

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