

Spine Metastasis Practice Patterns among Korean, Chinese, and Japanese Radiation Oncologists: A Multinational Online Survey Study

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ABSTRACT

This online survey of practising radiation oncologists from Korea, China and Japan was conducted to investigate the current practices in radiotherapy (RT) for spine metastasis and to compare these practices across the three countries. The questionnaire included nine general information questions and two clinical scenarios (representing 'typical' and 'good' prognosis spine metastasis), with seven questions for each scenario. An anonymous web-based survey using Google Docs® was undertaken from 2 September 2014 to 9 April 2015. A total of 54 Korean, 107 Chinese and 104 Japanese radiation oncologists participated in the study. The first scenario involved a typical case of spine metastasis (~25% expected 1-year survival rate), and the preferred fractionation scheme was 10 fractions of 3 Gy, though the pattern was slightly different in each country. The second scenario involved a good prognosis case (>50% expected 1-year survival rate), and 10 fractions of 3 Gy was the preferred practice in all three countries (however, use of a larger fraction dose with a smaller fraction number was more common in Korea). A more conformal RT technique was more prominent in China and Korea, especially for patients with a good prognosis. Avoidance of reirradiation was notable in China. In summary, a preference for multiple fractionation in RT for spine metastasis was observed in the majority of Korean, Chinese and Japanese radiation oncologists, although there were slight differences in practice preferences, especially for patients with a favorable prognosis.

KEYWORDS: data collection, spine, neoplasm, metastasis, radiotherapy, physician's practice patterns

INTRODUCTION

Although cancer incidence is increasing as a result of expanded screening and increased average life expectancy, overall, cancer mortality continues to decrease, even in patients with distal metastasis

because of increased knowledge and improved cancer management techniques [1, 2]. Consequently, the prevalence of bone metastasis continues to increase, with the spine as the most common site.

In the field of oncology, spine metastasis remains a major problem with regard to pain, pathologic fracture, local control, avoidance of additional treatment, quality of life, and survival prolongation [3, 4]. Radiotherapy (RT) is the preferred option in spine metastasis management because of its demonstrated efficacy for pain palliation and for making further aggressive treatment unnecessary [5].

Although RT has a favorable palliative effect for symptoms of spine metastasis, several questions (including the fractionation number, RT technique, and use of steroids) remain unresolved. In particular, the fractionation scheme can vary from single to more than 10 fractions in RT for spine metastasis [6–9].

In meta-analyses as well as in randomized controlled trials, it has been established that one single fraction of 8–10 Gy shows similar favorable symptom palliation to that of multiple fractions of 20–30 Gy [5, 10–13]. However, reirradiation is needed more frequently when a single fraction is performed. Globally, most radiation oncologists prefer multiple fractionated RT regimens for spine metastasis, despite the results from the above-mentioned trials [6–9].

We conducted this online survey study of radiation oncologists from Korea, China and Japan to evaluate the current RT practices for spine metastasis and to compare practices between the three countries.

MATERIALS AND METHODS

Participants and survey

The subjects of this patterns of care study (PCS) were practising radiation oncologists representing the Korean Society of Radiation Oncology (KOSRO), the Chinese Society of Therapeutic Radiation Oncology (CSTRO) and the Japanese Society for Radiation Oncology (JASTRO). An anonymous web-based survey using Google Docs® (Google, Mountain View, CA, USA) was administered from 2 September 2014 to 9 April 2015. The survey was preceded by an email to all individual radiation oncologists from the databases of KOSRO in Korea, the Japanese Radiation Oncology Study Group (JROSG) in Japan, and CSTRO in China. In total, 54 Korean radiation oncologists representing 81 KOSRO institutions, 107 radiation oncologists from 48 Chinese institutions, and 104 radiation oncologists from 79 Japanese institutions (70% of whom were from the JROSG institution) responded to the survey.

Questionnaire

The questionnaire consisted of two parts: general information and two clinical scenarios (Supplementary file). General information consisted of nine questions on the potential factors influencing practice choices, including the nationality of the respondent. The first scenario involved a case of spine metastasis with epidural and paraspinal soft-tissue mass formation, with mild weakness of the lower extremities on both sides (with an expected poor outcome). The second scenario involved a case of single spine metastasis with neither spine body compression nor spinal canal involvement (with a good prognosis). Three questions were given for each scenario, and an additional four questions were asked regarding a situation of local tumor progression of spine metastasis after initial RT. This allowed for evaluation of patterns of reirradiation in each scenario. The questionnaire was developed through discussion among four Korean radiation oncologists and was reviewed and translated by

representatives of the CSTRO. The same questionnaire was used in a previous study with Korean Radiation Oncologists and has been previously published [14].

Statistical analysis

The Chi-square test and/or Fisher's exact test was used for comparisons between factors, including respondent nationality and patterns of practice for spine metastasis. The fraction number was classified into one of three categories: <5 fractions, 5–10 fractions and >10 fractions. To evaluate the preference for more conformal RT delivery (with a small fraction number and higher fraction size), in this study stereotactic body RT (SBRT) was defined as conformal delivery of >10 Gy in one fraction and/or ≥ 6 Gy fraction size with a fraction number of four or less. All data were analyzed using SPSS Statistics 23.0 for Windows (IBM, Armonk, NY, USA), and $P < 0.05$ was considered to indicate statistical significance.

RESULTS

Respondents

All responses from the three countries were analyzed, except for the data from three Chinese radiation oncologists, which could not be assessed.

General information concerning the respondents and differences by country is shown in Table 1. Most Korean radiation oncologist respondents worked for educational/university hospitals (practice type of entire Korean institutions: private 14.8%, public 7.4%, education/university 77.8%), but >60% of Chinese radiation oncologists practiced in public hospitals. Generally, there was a tendency for the institutions of the Chinese respondents to have a larger number of patients per day and per year receiving palliative spine RT. Also, the number of radiation oncologist specialist co-workers was larger in China. Three-quarters of Chinese respondents practised with >10 radiation oncologist specialists. The question on radiation oncology specialty permitted multiple answers. Lung and thorax was the most common specialty in Korea and the second most common in Japan. Head and neck was the most common specialty in Japanese respondents. Most Chinese respondents did not respond to this question.

Preferred RT pattern according to scenario

Figure 1 displays the patterns of fractionation by country for each scenario and reirradiation situation.

For Scenario 1, which described a typical case of spine metastasis from non-small cell lung cancer, with an ~25% expected 1-year survival, the preferred practice pattern was slightly different in each country. In all countries, the preferred fractionation scheme was 10 fractions of 3 Gy. There was a tendency toward a longer fractionation preference in China and a shorter fractionation preference in Japan. In the reirradiation situation of Scenario 1, a preference for multiple fractionation was again found in China. Preference of multiple fractionation was also found in Japan. (as opposed to the initial treatment situation).

In Scenario 2, which described a favorable case of spine metastasis from renal cell carcinoma, with >50% expected 1-year survival, the preferred practice pattern was different in each country, with larger differences than for Scenario 1. Though the preference of 10

Table 1. General information concerning the respondents and the differences between nationalities

	Korea (n = 54, %)	Japan (n = 104, %)	China (n = 104, %)	P
Practice type				
Private	2 (3.7)	10 (9.6)	1 (1.0)	<0.001
Public	5 (9.3)	38 (36.5)	66 (63.5)	
Education/ University	47 (87.0)	56 (53.8)	37 (35.6)	
Country of training				
Domestic	54 (100.0)	104 (100.0)	101 (97.1)	0.23
International			3 (2.9)	
Average number of daily patients				
<50	15 (27.8)	36 (34.6)	14 (13.5)	<0.001
50–100	18 (33.3)	46 (44.2)	22 (21.2)	
101–200	5 (9.3)	21 (20.2)	22 (21.2)	
201–300	5 (9.3)		2 (1.9)	
>300	9 (16.7)	1 (1.0)	44 (42.3)	
Not answered	2 (3.7)			
Average number of annual patients receiving palliative spine RT				
<30	7 (13.0)	31 (29.8)	8 (7.8)	0.006
31–50	11 (20.4)	29 (27.9)	12 (11.7)	
51–100	13 (24.1)	26 (25.0)	30 (29.1)	
101–200	7 (13.0)	9 (8.7)	21 (20.4)	
>200	14 (25.9)	9 (8.7)	32 (31.1)	
Not answered	2 (3.7)		1 (0.1)	
Number of co-workers as radiation oncologist specialists				
1	7 (13.0)	16 (15.4)		<0.001
2	12 (22.2)	29 (27.9)		
3–5	20 (37.0)	33 (31.7)	4 (3.8)	
6–10	10 (18.5)	21 (20.2)	22 (21.2)	
>10	5 (9.3)	5 (4.8)	78 (75.0)	
Not answered				
Years practising as a radiation oncologist specialist				
<5		4 (3.8)	19 (18.4)	<0.001
5–9	21 (38.9)	16 (15.4)	30 (29.1)	
10–14	13 (24.1)	24 (23.1)	25 (24.3)	
≥15	20 (37.0)	60 (57.7)	29 (28.2)	
Not answered				

Table 1. Continued

	Korea (n = 54, %)	Japan (n = 104, %)	China (n = 104, %)	P
Specialty of radiation oncology (repeated choice)				
Head and neck	24 (44.4)	47 (45.2)	1 (1.0)	
Central nervous system	15 (27.8)	34 (32.7)	6 (5.8)	
Lung and thorax	33 (61.1)	46 (44.2)	7 (6.7)	
Breast	21 (38.9)	39 (37.5)	5 (4.8)	
Gastrointestinal	26 (48.1)	32 (30.8)	2 (1.9)	
Genitourinary	21 (38.9)	42 (40.4)	5 (4.8)	
Gynecology	22 (40.7)	35 (33.7)	3 (2.9)	
Pediatric	9 (16.7)	12 (11.5)	1 (1.0)	
Hematologic	14 (26.0)	23 (22.1)		
Benign or other	11 (20.3)	14 (13.5)	3 (2.9)	
Not answered		4 (3.8)	82 (78.8)	

fractions of 3 Gy was still dominant in all three countries, a larger fraction size with shorter fractionation stood out in Korea. In contrast, there was a preference for longer fractionation in Japan and China. In the reirradiation situation of Scenario 2, the preference for fractionation was relatively similar for all three countries, but multiple fractionation was slightly preferred in Japan and China.

Preference of SBRT in spine metastasis

The use of SBRT in each country for each scenario and reirradiation situation is displayed in Fig. 2. There was no selection of SBRT in the initial treatment for Scenario 1. In the reirradiation situation in Scenario 1, 4 of 50 Korean respondents and 1 of 97 Japanese respondents selected SBRT. There was no selection of SBRT in respondents from China.

In the initial treatment of Scenario 2, 17 of 53 respondents in Korea, 4 of 104 in Japan, and 1 of 93 in China preferred SBRT for the treatment of spine metastasis. In the reirradiation situation, 6 of 41 Korean and 2 of 96 Japanese respondents preferred SBRT, whereas no respondents from China selected SBRT.

Preferred RT technique and steroid usage pattern

The results for preferred initial and reirradiation techniques and use of steroids in spine metastasis scenarios for each country are displayed in Table 2.

For the first scenario, there was a significant difference in preferred RT technique between the three countries ($P < 0.001$).

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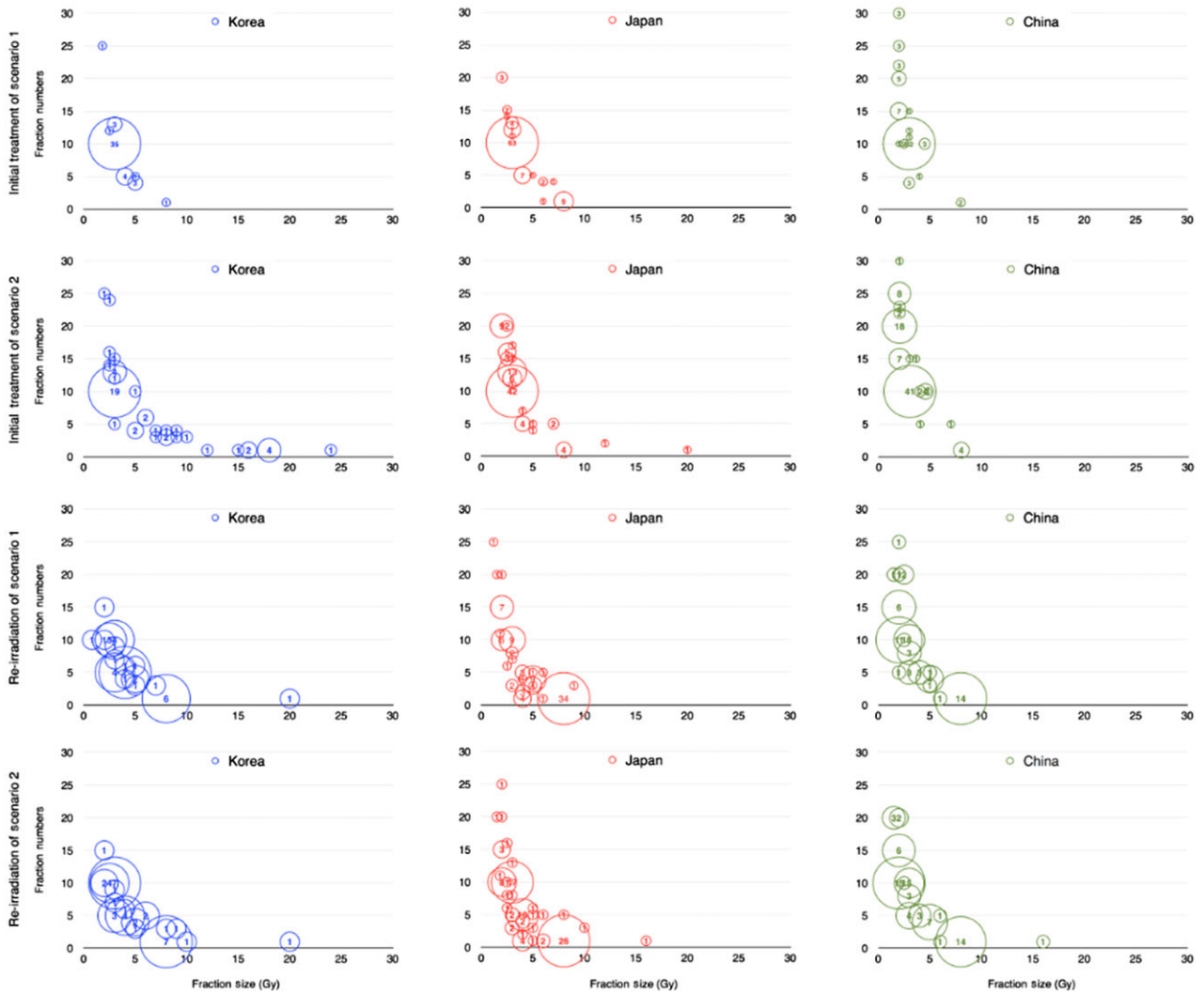


Fig. 1. Patterns of fractionation by country. Circle size and number represent the number of respondents with the preferred fractionation scheme. Many radiation oncologists preferred a multiple fraction regimen in all situations, with this regimen being the most common in China.

Although anteroposterior (AP)/posteroanterior (PA) parallel opposed fields were generally preferred in all countries, the percentages were somewhat different (29.5% in Korea, 74.0% in Japan, 33.0% in China). Intensity-modulated radiotherapy (IMRT) was preferred in China (23.3%), while <5% of respondents selected it in Korea and Japan. There was no difference in steroid use for this scenario between the three countries, and approximately three-quarters of respondents stated that they would use steroids.

Given a local progression situation in Scenario 1, >60% of respondents in Korea and Japan answered that they would perform reirradiation; in contrast, only 23.5% of Chinese respondents indicated they would commence RT again. The preferred RT technique differed significantly between countries: AP/PA parallel opposed fields was the most common method for respondents from Japan (45.9%), but more than half of the respondents from Korea and China said that they would use IMRT in this situation. There was

also a statistically significant difference regarding the use of steroids ($P = 0.04$), with most respondents from Korea and Japan selecting 'yes', but more than three-quarters of Chinese respondents selecting 'no'.

For the second scenario, there was a clear difference in practice patterns compared with the first scenario. IMRT was the preferred technique in this case in Korea (41.7%) and China (31.3%), but AP/PA parallel opposed fields was still the most selected technique in Japan (65.4%). There was also a significant difference in steroid use ($P < 0.001$): <20% of Korean and Japanese respondents said that they would prescribe steroids; in contrast, >50% of Chinese respondents indicated that they would prescribe steroids.

With the assumption of a local progression situation in Scenario 2, Chinese respondents were also unwilling to use reirradiation; the percentage of refusal was slightly lower than that for Scenario 1. IMRT was the most preferred reirradiation technique in all

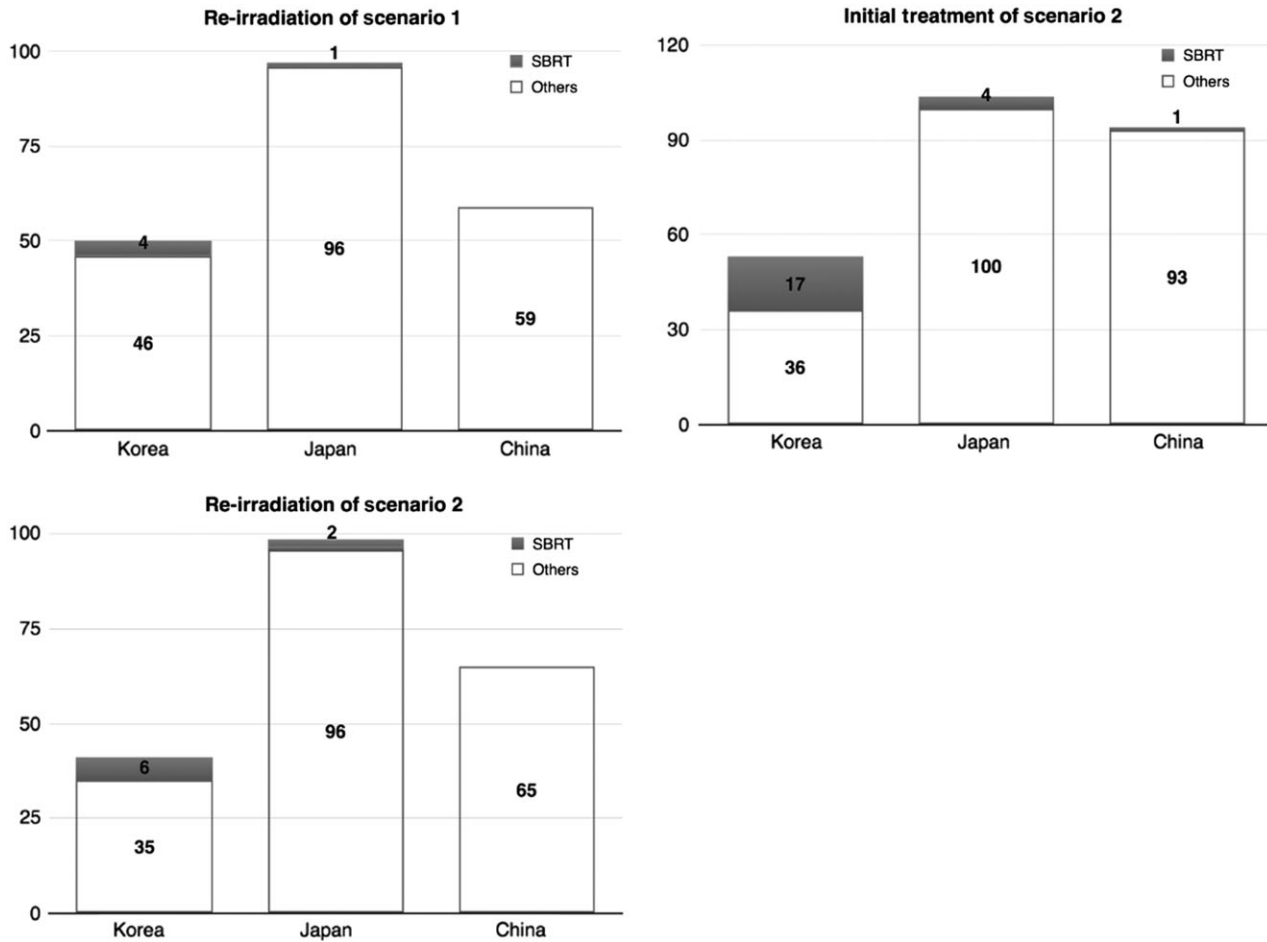


Fig. 2. The use of stereotactic body radiotherapy (SBRT) for spine metastasis by country. SBRT is preferred in Korea, especially in Scenario 2 (representing favorable prognosis).

countries, though the percentage varied (76.3% in Korea, 38.4% in Japan, 59.7% in China). AP/PA parallel opposed fields was still preferred by a considerable portion of Japanese respondents (38.4%) in this situation. More than 60% of all respondents answered that steroids should be used in this situation in all countries, but the percentage was significantly different between countries ($P = 0.02$).

Factors potentially related to the pattern of fractionation

Table 3 shows factors potentially related to fractionation patterns. In the initial treatment, respondent nationality was the only significant factor related to fractionation number for both Scenario 1 and Scenario 2.

Although 5–10 fractions was the most preferred scheme in all three countries in both scenarios, the percentage selecting ≤ 5 fractions differed slightly between countries. These short fractions were more preferred in Korea and Japan than in China for Scenario 1. In Scenario 2, more than 40% of Korean respondents preferred ≤ 5 fractions, and >40% of Japanese and Chinese respondents preferred >10 fractions. According to practice type, respondents from educational/university hospitals showed a slight preference for longer

fractionation schemes in Scenario 2 ($P = 0.02$). There was a tendency toward multiple fraction preference and avoidance of reirradiation, especially in Scenario 1 ($P = 0.05$).

In the reirradiation situation, ≤ 5 fractions was the preferred scheme in all countries, but the percentage selecting this was slightly lower for Chinese respondents [this was statistically significant in Scenario 1 ($P = 0.03$)]. Shorter fractionation was slightly preferred in the institutions treating >200 patients per day ($P = 0.03$).

DISCUSSION

The present PCS is the first study investigating RT practice patterns for spine metastasis and comparing practices in Korea, China and Japan. We confirmed that a considerable proportion of radiation oncologists prefer multiple fractionation regimens (specifically, 10 fractions of 3 Gy) in all three countries.

Despite the consistent findings of randomized controlled trials and guideline recommendations [11, 13, 15, 16], multiple fractionation regimens remain preferred in the countries considered in this study. The preference for multiple fractionation regimens is even more evident in the favorable prognosis case, Scenario 2, in China and Japan.

Table 2. Preferred initial/reirradiation technique and use of steroids for spine metastasis scenarios for each country

			Korea (<i>n</i> = 54, %)	Japan (<i>n</i> = 104, %)	China (<i>n</i> = 104, %)	<i>P</i>		
Scenario 1	RT technique	PA	15 (34.1)	22 (21.2)	24 (23.3)	<0.001		
		AP/PA	14 (31.8)	77 (74.0)	34 (33.0)			
		3D-CRT	13 (29.5)	4 (3.8)	21 (20.4)			
		IMRT	2 (4.5)	1 (1.0)	24 (23.3)			
	Steroid	Yes	37 (72.5)	80 (76.9)	77 (76.2)		0.83	
		No	14 (27.5)	24 (23.1)	24 (23.8)			
	Reirradiation	Yes	31 (62.0)	71 (68.3)	24 (23.5)		<0.001	
		No	19 (38.0)	33 (31.7)	78 (76.5)			
	RT technique in reirradiation	PA	5 (13.2)	19 (19.4)	10 (14.5)		<0.001	
		AP/PA	6 (15.8)	45 (45.9)	8 (11.6)			
		3D-CRT	5 (13.2)	8 (8.2)	13 (18.8)			
		IMRT	22 (57.9)	26 (26.5)	38 (55.1)			
	Steroid in reirradiation	Yes	34 (85.0)	77 (77.8)	66 (91.7)		0.04	
		No	6 (12.5)	22 (22.2)	6 (8.3)			
	Scenario 2	RT technique	PA	6 (12.5)	16 (15.4)		26 (26.3)	<0.001
			AP/PA	10 (20.8)	68 (65.4)		17 (17.2)	
3D-CRT			12 (25.0)	7 (6.7)	25 (25.3)			
IMRT			20 (41.7)	13 (12.5)	31 (31.3)			
Steroid		Yes	10 (18.9)	14 (13.5)	55 (56.1)	<0.001		
		No	43 (81.1)	90 (86.5)	43 (43.9)			
Reirradiation		Yes	32 (60.4)	65 (62.5)	45 (45.9)	0.045		
		No	21 (39.6)	39 (37.5)	53 (54.1)			
RT technique in reirradiation		PA	2 (5.3)	16 (16.2)	6 (8.3)	<0.001		
		AP/PA	4 (10.5)	38 (38.4)	14 (19.4)			
		3D-CRT	3 (7.9)	7 (7.1)	9 (12.5)			
		IMRT	29 (76.3)	38 (38.4)	43 (59.7)			
Steroid in reirradiation		Yes	29 (69.0)	75 (75.0)	65 (89.0)	0.02		
		No	13 (31.0)	25 (25.0)	8 (11.0)			

RT = radiotherapy, PA = posteroanterior, AP/PA = anteroposterior/posteroanterior parallel opposite, 3D-CRT = 3D conformal RT, IMRT = intensity-modulated RT.

The preference for multiple fractionation regimens for bone metastasis is not limited to the three countries considered. In many PCSs, the majority of radiation oncologists have chosen multiple fractionation regimens to palliate symptoms of bone metastasis [6–9]. The results of an international PCS conducted by three global radiation oncologist specialty organizations (the American Society

for Radiation Oncology, the Canadian Association of Radiation Oncology, and the Royal Australian and New Zealand College of Radiologists) also showed that 5–10 fractions is the most favored regimen in painful bone metastasis [6].

We propose several explanations for this multiple fractionation preference: the possibility of RT-related fracture with or without

Table 3. Factors potentially related to fractionation pattern

Situation	Factors	Scenario 1 (n, %)				Scenario 2 (n, %)				
		≤5 fx	6–10 fx	≥11 fx	P	≤5 fx	6–10 fx	≥11 fx	P	
Initial	Nationality	Korean	9 (17.6)	36 (70.6)	6 (11.8)	0.005	20 (37.7)	24 (45.3)	9 (17.0)	<0.001
		Japanese	19 (18.4)	66 (64.1)	18 (17.5)		7 (6.7)	49 (47.1)	48 (46.2)	
		Chinese	6 (6.1)	68 (68.7)	25 (25.3)		4 (4.3)	49 (52.7)	40 (43.0)	
	Practice type	Private	2 (16.7)	8 (66.7)	2 (16.7)	0.92		10 (76.9)	3 (23.1)	0.02
		Public	14 (13.3)	73 (69.5)	18 (17.1)		8 (8.0)	56 (56.0)	36 (36.0)	
		Edu/Univ	18 (13.2)	89 (65.4)	29 (21.3)		23 (16.8)	56 (40.9)	58 (42.3)	
	No. of daily RT	>200	7 (12.3)	39 (68.4)	11 (19.3)	0.97	8 (15.4)	29 (55.8)	15 (28.8)	0.20
		≤200	27 (13.9)	129 (66.5)	38 (19.6)		21 (10.7)	93 (47.4)	82 (41.8)	
	No. of yearly spine RT	>100	11 (12.6)	57 (65.5)	19 (21.8)	0.81	14 (17.1)	43 (52.4)	25 (30.5)	0.07
		≤100	23 (14.1)	110 (67.5)	30 (18.4)		16 (9.6)	78 (47.0)	72 (43.4)	
	No. of RO specialists	>5	12 (8.9)	95 (70.4)	28 (20.7)	0.08	15 (13.2)	66 (51.2)	48 (37.2)	0.77
		≤5	22 (18.6)	75 (63.6)	21 (17.8)		16 (33.3)	56 (46.3)	49 (40.5)	
Years practising as RO specialist	<10 yrs	7 (8.1)	60 (69.8)	19 (22.1)	0.18	7 (8.1)	60 (69.8)	19 (22.1)	0.18	
	≥10 yrs	27 (16.3)	109 (65.7)	30 (18.1)		27 (16.3)	109 (65.7)	30 (18.1)		
Reirradiation	ReRT	22 (17.5)	85 (67.5)	19 (15.1)	0.05	24 (17.0)	94 (66.7)	23 (16.3)	0.10	
	No reRT	11 (8.8)	84 (67.2)	30 (24.0)		10 (9.1)	74 (67.3)	26 (23.6)		
ReRT	Nationality	Korean	23 (62.2)	13 (35.1)	1 (2.7)	0.03	23 (57.5)	16 (40.0)	1 (2.5)	0.13
		Japanese	65 (67.7)	20 (20.8)	11 (11.5)		57 (59.4)	30 (31.3)	9 (9.4)	
		Chinese	28 (47.5)	20 (33.9)	11 (18.6)		30 (46.2)	24 (36.9)	11 (16.9)	
	Practice type	Private	8 (72.7)	3 (27.3)		0.28	7 (58.3)	5 (41.7)		0.74
		Public	38 (51.4)	25 (33.8)	11 (14.9)		41 (50.6)	30 (37.0)	10 (12.3)	
		Edu/Univ	70 (65.4)	25 (23.4)	12 (11.2)		62 (57.4)	35 (32.4)	11 (10.2)	
	No. of daily RT	>200	25 (64.1)	13 (33.3)	1 (2.6)	0.09	25 (62.5)	15 (37.5)		0.03
		≤200	89 (58.9)	40 (26.5)	22 (14.6)		83 (52.2)	55 (34.6)	21 (13.2)	
	No. of yearly spine RT	>100	40 (65.6)	15 (24.6)	6 (9.8)	0.67	41 (63.1)	18 (27.7)		0.27
		≤100	76 (58.5)	37 (28.5)	17 (13.1)		69 (51.1)	51 (37.8)	15 (11.1)	
	No. of RO specialists	>5	54 (57.4)	26 (27.7)	14 (14.9)	0.48	56 (57.7)	32 (33.0)	9 (9.3)	0.73
		≤5	62 (63.3)	27 (27.6)	9 (9.2)		54 (51.9)	38 (36.5)	12 (11.5)	
Years practising as RO specialist	<10 yrs	31 (50.0)	21 (33.9)	10 (16.1)	0.12	32 (50.0)	24 (35.3)	10 (14.7)	0.34	
	≥10 yrs	85 (65.4)	32 (24.6)	13 (10.0)		76 (54.7)	46 (34.6)	11 (8.3)		

neurologic progression; financial compensation; training and/or educational experience; concern for symptom redevelopment; and fear of the need for reirradiation. There was a clear difference in the patterns of fractionation for bone metastasis when comparing country, location of training, and practice site in the previously mentioned international studies [6, 7, 17, 18].

As reported in other PCSs, nationality was the most important indicator for patterns of fractionation for spine metastasis in this study. The difference was markedly apparent in the case of a patient with a favorable prognosis. The respondent nationality had a complex influence on the results of this study. Almost every respondent was trained in and practiced in their own country. Insurance systems covering medical expenses are very different in each country—for example, IMRT for reirradiation of bone metastasis is fully covered by national insurance in Korea, but not in Japan. Nationality is undoubtedly related to multiple aspects (including training, education and financial compensation) that could affect practice patterns.

Concern regarding the need for and risks of reirradiation is another important factor affecting RT patterns for spine metastasis. Need for reirradiation reflects patient suffering due to redevelopment of pain related to bone metastasis progression. Reirradiation is clearly related to a higher risk of normal tissue complications, so the decision to use it is not made lightly. For the scenarios in this present study, overall, only ~60% of respondents answered that they would use reirradiation in a case of progression of bone metastasis; this number was even lower in China, with 20–40% of respondents recommending reirradiation. It is generally accepted that the necessity for reirradiation is inversely related to the total dose of the initial RT for bone metastasis, despite minor controversies [18]. The preference for multiple fractionation in patients with a favorable prognosis might be related to these factors. In addition, there is a tendency toward an inverse relationship between multiple fractionation and the need for reirradiation.

Interestingly, the pattern of RT in Korea is slightly different from that of other countries for favorable prognosis patients. In Korea, SBRT (defined as conformal delivery of >10 Gy at one fraction and/or ≥ 6 Gy fraction size with a fraction number of four or less) is notably preferred [14, 19, 20]. From this point of view, the desire to maximize local control and maintain long-term symptom palliation might not vary between countries, even though there were differences in fractionation patterns between the three countries.

Steroid use, another important issue in the management of spine metastasis, was generally accepted in patients showing spinal cord compression in all three countries. In bone-confined metastasis without spinal canal involvement, however, some discrepancies were noted. Chinese radiation oncologists favored steroid usage, whereas radiation oncologists from the other two countries did not. Consensus guidelines and larger prospective trials on steroid usage in the management of spine metastasis are needed to manage those patients more optimally.

This study has several limitations: the number of respondents was small, and the relatively low response rate of the three countries may not represent the actual practice patterns precisely. In addition, our scenario-based questions might not accurately reflect clinical practice circumstances. Although the results of the present study

might be restricted by these limitations, the findings provide some insights into the practice patterns for bone metastasis.

In conclusion, multiple fractionation in spine metastasis is still preferred by the majority of radiation oncologists from all three countries participating in this PCS. This phenomenon is pronounced in patients with a good prognosis. To evaluate the role of high-dose RT, including SBRT, and of steroid use on spine metastasis with favorable prognosis, randomized controlled trials comparing it with short or single-fraction RT should be conducted. Until the results from those studies are available, however, the findings of previous randomized trial results demonstrating the advantages of short-fractionation RT should be respected. Practice guidelines and continuing education by radiation oncologist societies may be helpful for maintaining the quality of spine metastasis management.

SUPPLEMENTARY DATA

Supplementary data is available at *Journal of Radiation Research* online.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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