



## Research Paper

## No consensus on implant choice for oligometastatic disease of the femoral head and neck

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## ABSTRACT

**Objectives:** Metastatic disease involving the femoral head and neck is often treated with a hemiarthroplasty or total hip arthroplasty (THA) to prevent pathologic fracture but there are no outcome studies demonstrating superiority of one option over the other.

**Methods:** This investigation was designed as a survey of the current members of the Musculoskeletal Tumor Society (MSTS). The survey contained seven clinical vignettes with identical imaging of a pathologic lesion of the femoral head and neck. The primary outcome measured was decision to treat the lesion with hemiarthroplasty or THA. Secondary outcomes included method of fixation of the femoral/acetabular components and head type utilized.

**Results:** A total of 93 members (30.0%) of the MSTS completed the survey. Across all clinical vignettes, 73.3% ( $p < 0.001$ ) of the responses were in favor of hemiarthroplasty; however, there was no significant difference between hemiarthroplasty and THA in Cases 1 & 2 ( $p = 0.08$ ,  $p = 0.6$ , respectively); the cases representing younger patients with a more favorable histologic diagnosis. When THA was selected the majority of respondents preferred hybrid or cementless fixation construct (56.1% and 27.0%, respectively,  $p < 0.001$ ). When hemiarthroplasty was selected respondents selected a cemented, bipolar construct (86.4% and 64.2%, respectively,  $p < 0.001$ ).

**Conclusions:** When treating metastatic lesions of the femoral head and neck orthopaedic oncologists do not agree on reconstructing with THA versus hemiarthroplasty for patients with younger age and favorable histology. This investigation highlights the controversy of this clinical decision and indicates the need for a collaborative prospective trial among this specific patient population in order to determine the optimal treatment method.

## 1. Introduction

The proximal femur is the most common location of appendicular skeletal metastases [1]. While lesions affecting the intertrochanteric and subtrochanteric region are typically treated with prophylactic intramedullary nails to prevent pathologic fracture or endoprosthetic reconstruction in the case of severe destruction [2], disease involving the femoral head and neck has historically been treated with a hemiarthroplasty [3]. There has been increasing evidence that certain patients with non-pathologic adult hip fractures may have better long term outcomes when treated with total hip arthroplasty (THA) versus

hemiarthroplasty [4–7].

Given the increased 5-year survival of patients with cancers that commonly metastasize to bone including lung, breast, prostate, thyroid and kidney cancer [8], the prevalence of metastatic bone disease is increasing. Some surgeons now favor using THA versus hemiarthroplasty in an attempt to improve the long term outcome of patients with skeletal metastatic disease. Currently, there are no outcome studies championing one option over the other in this clinical scenario. There is also no outcomes based research to guide head choice (monopolar or bipolar) in hemiarthroplasty, or choice of fixation (biologic or cemented) in this patient population. This investigation

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seeks to identify the current practices of orthopaedic oncologists with regard to implant choices when treating metastatic lesions of the femoral head and neck. We hypothesized there would be disagreement regarding optimal treatment in a variety of clinical scenarios. We hope to use this information to identify the areas of substantial disagreement that may be addressed by future investigations.

## 2. Materials and methods

This investigation was designed as an online survey of the 310 current members of the Musculoskeletal Tumor Society (MSTS) using a commercial internet survey tool (SurveyMonkey®, Palo Alto, CA, USA). The investigation was reviewed by our Institutional Review Board and assigned a status of exempt. The Research and Executive Committees of the MSTS each reviewed and approved the content of the survey.

### 2.1. Survey contents

Surgeon respondents were asked to provide their demographic information including location of practice, additional areas of fellowship training, additional fields of active orthopaedic practice, practice environment, membership status within MSTS, and age. The survey then presented each surgeon with seven clinical vignettes with identical imaging of a pathologic lesion of the femoral head and neck (Fig. 1, Table 1). The baseline clinical vignette is a 68 year-old female with one month of right groin pain exacerbated by weight bearing and biopsy proven metastatic breast cancer to the proximal femur (only site of metastatic disease) with a plan for surgical treatment followed by postoperative radiation. The subsequent vignettes individually altered patient age, histologic type, and extent of metastatic disease from the baseline in order to better isolate which factors the respondents gave greatest importance. Respondents were asked to choose between the treatment options of: cemented hemiarthroplasty, uncemented hemiarthroplasty, uncemented THA, THA with cemented stem and uncemented acetabular liner (hybrid THA), and THA with both components cemented. Depending on the choice of procedure, respondents were then asked to rank why a hemiarthroplasty or THA was chosen. For hemiarthroplasty, the six options were: less operative time, less blood loss, concern for acetabular fixation, decreased risk of dislocation, decreased implant cost, and patient survival is not sufficiently long to warrant THA. If the surgeon respondent chose THA, the three options to rank were: improved pain and functional outcome, avoid risk of

**Table 1**  
Summary of clinical vignettes presented to respondents.

Vignette	Age	Histology	Metastasis			Plan for radiation
			Solitary bone	Multiple bone	Bone and visceral	
1	68	Breast	X			X
2	55	Breast	X			X
3	80	Breast	X			X
4	68	Breast		X		X
5	68	Breast			X	X
6	68	Lung	X			X
7	68	Lung			X	X

future acetabular resurfacing procedure, and patient survival is sufficiently long to warrant THA. Respondents were also asked to choose between a monopolar or bipolar head type for their hemiarthroplasty reconstruction, if chosen.

### 2.2. Outcomes

The primary outcome measured was the decision to treat with hemiarthroplasty or THA. Secondary outcomes measured included the method of component fixation (cemented or cementless) and use of monopolar or bipolar heads in hemiarthroplasty. The primary outcome was analyzed by age of the surgeon respondent, whether the respondent had completed an adult reconstruction fellowship, and whether the respondent had an elective adult arthroplasty practice.

### 2.3. Statistical analysis

Chi-squared tests, or Fisher's exact test when appropriate, were used to evaluate significance of the primary and secondary outcomes. Physician responses to the most important reasons for choosing a particular treatment were ranked via lowest mean score. Pairwise Kappa statistics were used to determine the inter-rater reliability between each vignette on the primary treatment decision of hemiarthroplasty compared to THA. P-values less than 0.05 were considered statistically significant. Due to small sample sizes, p-values were not adjusted for multiple comparisons and inflation of type I error. All analyses were conducted using SAS v9.4 (SAS Institutes, Cary, NC)



Fig. 1. Plain AP hip radiograph and coronal computed tomography (CT) scan provided with each clinical vignette.

**Table 2**  
Summary of reconstructive decision, use of cement in THA and hemiarthroplasty, and head choice in hemiarthroplasty.

Treatment	Vignette number							Total	%
	1	2	3	4	5	6	7		
<b>Reconstructive decision</b>									
THA	38	49	16	30	17	19	5	174	26.7
Hemiarthroplasty	55	44	77	63	76	74	88	477	73.3
p =	0.08	0.6	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
<b>THA</b>									
Press Fit	38	49	16	30	17	19	5	174	
Hybrid	12	15	2	8	5	3	2	47	27.0
Cemented	20	28	11	16	10	12	2	99	56.9
p =	0.02	< 0.001	0.01	0.06	0.056	0.02	0.82	< 0.001	
<b>Hemiarthroplasty</b>									
Cemented	55	44	77	63	76	74	88	477	
Press Fit	47	35	67	56	66	66	75	412	86.4
p =	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Bipolar	8	9	10	7	10	8	13	65	13.6
Monopolar	40	36	47	43	44	44	52	306	64.2
p =	< 0.001	< 0.001	0.052	0.004	0.17	0.1	0.09	< 0.001	35.8

**3. Results**

A total of 93 members (30.0%) of the MSTs completed the survey. All age groups between 30 and 70+ were represented, as well as all regions of the United States and 8 International countries. There were 9 respondents (9.7%) who completed arthroplasty fellowships, and 45 (48.4%) with an active arthroplasty practice.

When comparing the primary outcome of hemiarthroplasty compared with THA, most respondents chose hemiarthroplasty (73.3%) across all vignettes (Table 2). However, the reconstructive option chosen by the respondents varied substantially depending on the clinical presentation. The responses in the cases of the younger patients with oligometastatic (one or two sites) skeletal disease and a favorable histologic subtype (cases 1 and 2) indicated a lack of agreement between treatment with THA or hemiarthroplasty, with 40.9% and 52.7% of respondents choosing THA, respectively. Furthermore, although statistically significant in favor of hemiarthroplasty in case 4, 32.3% of respondents chose THA (p < 0.001). Kappa analysis of the primary outcome indicated that for respondents choosing a THA for case 1, there was substantial inter-observer agreement for choosing a THA in cases 2 and 4 (Table 3). Age of the surgeon respondent, completion of an arthroplasty fellowship, or maintaining an elective arthroplasty practice was rarely a predictor of treatment decision (Table 4).

The most important reason reported for choosing hemiarthroplasty was decreased risk of dislocation in 6 of 7 cases, while improved pain and functional outcome was the most important reason cited for selecting THA in all cases.

When hemiarthroplasty was selected as the treatment of choice, respondents chose to cement the femoral stem in 86.4% of cases, significantly more than press fit in all cases (p < 0.001, Table 2). When total hip arthroplasty was selected, respondents chose a hybrid fixation strategy (cemented femur, press fit acetabulum) in 56.9% of cases, and uncemented fixation in 27.0% of cases. There were no significant

**Table 3**  
Agreement between choosing THA for each clinical vignette compared head-to-head utilizing a pairwise Kappa Statistic.

Case	1	2	3	4	5	6
1						
2	0.72 (0.59–0.86)					
3	0.36 (0.19–0.54)	0.23 (0.09–0.37)				
4	0.77 (0.64–0.90)	0.60 (0.45–0.75)	0.44 (0.24–0.63)			
5	0.44 (0.27–0.61)	0.33 (0.20–0.47)	0.67 (0.47–0.87)	0.58 (0.41–0.76)		
6	0.49 (0.33–0.66)	0.37 (0.23–0.52)	0.54 (0.32–0.76)	0.54 (0.35–0.72)	0.66 (0.46–0.85)	
7	0.15 (0.03–0.28)	0.10 (0.01–0.18)	0.43 (0.17–0.69)	0.15 (0–0.31)	0.41 (0.15–0.66)	0.36 (0.13–0.60)

**Table 4**  
Sub-group analysis comparing the percentage of respondents choosing THA over hemiarthroplasty by age, fellowship type and elective practice (in addition to oncology).

Vignette	n =	1	2	3	4	5	6	7
<b>Overall</b>	93	40.9	52.7	17.2	32.3	18.3	20.4	5.38
<b>Age</b>								
30–39	32	43.8	62.5	12.5	28.1	12.5	15.6	6.3
40–49	23	34.8	34.8	8.7	30.4	13.0	13.0	4.3
50–59	21	33.3	42.9	14.3	28.6	19.0	19.0	0.0
60–69	12	66.7	75.0	58.3	58.3	50.0	50.0	16.7
70+	5	20	60.0	0.0	20.0	0.0	20.0	0.0
p =		0.30	0.21	0.01	0.39	0.07	0.13	0.37
<b>Fellowship</b>								
Arthroplasty	9	44.4	66.7	44.4	44.4	33.3	33.3	11.1
Non-arthroplasty	84	40.5	51.2	14.3	31.0	16.7	19.0	4.8
p =		0.99	0.49	0.04	0.46	0.36	0.38	0.41
<b>Elective practice</b>								
Arthroplasty	45	48.9	55.6	24.4	37.8	24.4	26.7	11.1
Non-arthroplasty	48	33.3	50.0	10.4	27.1	12.5	14.6	0.0
p =		0.13	0.59	0.07	0.27	0.14	0.15	0.02

differences based on age of the respondent, completion of an arthroplasty fellowship, or maintaining an elective arthroplasty practice.

When a hemiarthroplasty was chosen, respondents reported using bipolar rather than monopolar heads in 64.2% of cases (p < 0.001, Table 2). This was statistically significant in cases 1, 2 and 4 (p < 0.001). In the cases of patients with a more dismal prognosis (all others), the head implant chosen did not reach statistical significance. Age of the respondent, completion of an arthroplasty fellowship, or maintaining an elective arthroplasty practice were not statistically significant predictors of implant choice.

#### 4. Discussion

The orthopaedic literature regarding metastasis involving the femoral head and neck lacks outcome studies to guide treating physicians. The abundance of positive long-term outcome studies in the arthroplasty literature regarding THA [9,10] and the growing body of evidence in the trauma literature recommending THA for adult displaced femoral neck fractures [4–7] have led many surgeons to extrapolate this data in consideration of THA for metastatic lesions of the femoral head and neck. As prospective clinical trials are expensive and time-consuming, it seems prudent to demonstrate a rationale through disagreement on the subject before embarking on such an investigation—much like the PARITY (prophylactic antibiotic regimens in tumor surgery) survey [11] first showed uncertainty in best clinical evidence which lead to the multicenter randomized controlled trial currently underway.

Multiple retrospective studies (Level III/IV) of single institutional experiences exist on the treatment of proximal femoral metastasis [3,12–20]. Many of these reports detail other treatment options (IMN, ORIF, endoprosthetic reconstruction) and include metastasis from the femoral head through the subtrochanteric regions. They are heterogeneous in their conclusions but do tend to support hemiarthroplasty and THA as reconstructive options of femoral head and neck metastasis due to lower complication rates when compared with ORIF (15, 19, 20) and overall low revision rates (12–20). However, given the multitude of treatment variables and included pathology they do not argue superiority of THA compared with hemiarthroplasty, or vice versa.

Studies that have examined outcomes of hemiarthroplasty versus THA have been undertaken for larger endoprosthetic proximal femur replacement implants. Ogilvie et al. [21] examined the functional outcome of endoprosthetic proximal femoral replacement for primary bone tumors in 33 patients, 12 of which had the acetabulum resurfaced, and found the functional outcome similar between bipolar and total hip reconstruction. Menendez et al. [17] found higher rates of dislocation and revision in total hip endoprosthetic reconstruction. However, given the additional complexity of abductor reattachment in endoprosthetic reconstruction and the concomitant soft tissue disruption associated with wider resection of primary bone tumors, these studies are not expected to reflect the anticipated outcomes of hemiarthroplasty and THA done for proximal metastasis in the femoral head and neck utilizing “primary” arthroplasty components.

A recent study by Steensma et al. also employed an online survey of the MSTs to investigate treatment preferences with regard to metastatic lesions of the peritrochanteric proximal femur [22]. Their survey presented subtrochanteric and intertrochanteric pathologic fractures with methods of fixation including intramedullary nailing (IMN), open reduction internal fixation (ORIF), long stem cemented hemiarthroplasty, and proximal femoral replacement. They concluded that IMN and arthroplasty techniques were heavily favored over ORIF, but also noted the major differences in opinion and lack of evidence to support an optimal treatment strategy.

This investigation reveals broad variability in the optimal treatment strategy of femoral metastasis of the head and neck. In the simulated patient vignette with the best prognosis (the 55 year old woman with isolated breast cancer metastasis) there was a near equal split between surgeon respondents choosing hemiarthroplasty and THA. Many choosing hemiarthroplasty felt the risk of dislocation was an important reason to choose this treatment option, while those choosing total hip reasoned better pain and functional outcome was more important. Conversely, there was excellent agreement regarding the patient with widely metastatic lung cancer, with nearly 95% of respondents choosing hemiarthroplasty. This finding indicates that the former patient type warrants further investigation as to which treatment will optimize the functional and oncologic outcome.

The secondary outcomes investigated revealed a large majority of surgeon respondents preferred cemented fixation of the femoral stems

in both hemiarthroplasty and THA in these scenarios. This may have been due to the plan for postoperative radiation in all cases, but was not specifically investigated. A majority of orthopaedic oncologists also preferred bipolar reconstruction, especially in those cases with younger patients with skeletal metastases only and favorable histologic subtypes. We found that the age of the respondent, completion of an arthroplasty fellowship, and an active arthroplasty practice rarely had a significant effect on treatment choice with regard to the primary and secondary outcomes.

Using an online survey to gather information on current practice has limitations. Hypothetical clinical vignettes with proposed treatment options are vastly simplified versions of complex decision making algorithms. For example, this survey focused on age of the patient, extent of metastasis, and two pathologic subtypes. There are numerous other patient specific factors that were not included which may cause a surgeon to choose one treatment over another. Additionally, this survey had respondents choose between essentially two surgical treatment options. There were no other choices available for non-surgical or alternative (prophylactic internal fixation) treatments. These limitations may have skewed the results. Secondly, surveys of substantial length can lead to survey fatigue and result in misclassification of responses [23]. Limiting the information presented in the vignettes and treatment options was done to control for this limitation and ideally allow the participants to complete the survey in 10 min or less. Finally, while our response rate of 30% is robust in that it includes 93 subjects, it does not include the majority of the membership of the MSTs. This response rate is, however, on par with the findings of a large study of surveys in organizational research [24] noting a response rate of 35.7% among 490 studies.

While survey responses do not support efficacy of treatment, this study highlights a substantial disagreement among MSTs members regarding how to optimally treat the patient with skeletal metastatic disease in the femoral head and neck and a favorable prognosis. In order to improve the quality of care across our specialty for patients with metastatic lesions of the femoral head and neck, a multi-institutional prospective trial should be organized to evaluate the cost, patient-reported, functional and oncologic outcomes, and complications of hemiarthroplasty compared with THA.

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#### Conflict of interest statement

The authors declare there are no conflicts of interest.

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