Comparison of Sarcoma Biopsies between Referral Centers and Treating Centers: An Analysis of the Musculoskeletal Tumor Registry (MsTR)

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INTRODUCTION:

Inappropriate biopsy and inadequate excision of sarcomas prior to referral to specialty centers present potential risks, oncologic complications, and wound coverage challenges. The Musculoskeletal Tumor Registry (MsTR) is a centralized record of patient, tumor, treatment, and outcomes data on musculoskeletal malignancies in the pelvis, spine, and extremities. This is the first report of patient data from the MsTR and aims to examine the patterns of biopsy for bone and soft tissue sarcoma, specifically the types of biopsies performed at referring versus treating centers and the proportion of attempted excisions prior to referral.

METHODS:

Between 2016 and 2025, a total of 889 patients at 7 centers were included in the analysis, of which 273 (30.7%) had biopsies performed at the referring center. Of the biopsies performed at the referring center, 54.2% were incisional or excisional biopsies. Of a total of 244 bone sarcomas, 12 (4.9%) had an incisional or excisional biopsy prior to referral. There were 645 soft tissue sarcomas and 136 (21.1%) had an incisional or excisional biopsy prior to referral. 85/94 (90.4%) of the excisional biopsies done prior to referral had positive margins or margins that were not possible to assess. Core needle biopsy was more commonly performed at treating centers (74.0% vs 44.7%, $p<0.001$), whereas excisional biopsy was more commonly performed at referral centers (35.5% vs 9.6%, $p<0.001$). This is an analysis of all patients in the MsTR with a diagnosis of a bone or soft tissue sarcoma and a completed “Disease and Treatment Summary” smartform including a known biopsy date and type. Study variables included demographic information, tumor characteristics, and biopsy details.

Frequency distributions were calculated, and bivariate analyses were conducted to examine associations between patient, tumor, or biopsy characteristics and institution type. Separate analyses limited to excisional biopsies were performed. Pearson’s chi-square test, Fisher’s exact test, or independent two-sample t-tests were used to assess statistical significance, as appropriate. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS:

Between 2016 and 2025, a total of 889 patients at 7 centers were included in the analysis, of which 273 (30.7%) had biopsies performed at the referring center. Of the biopsies performed at the referring center, 54.2% were incisional or excisional biopsies. Of a total of 244 bone sarcomas, 12 (4.9%) had an incisional or excisional biopsy prior to referral. There were 645 soft tissue sarcomas and 136 (21.1%) had an incisional or excisional biopsy prior to referral. 85/94 (90.4%) of the excisional biopsies done prior to referral had positive margins or margins that were not possible to assess. Core needle biopsy was more commonly performed at treating centers (74.0% vs 44.7%, $p<0.001$), whereas excisional biopsy was more commonly performed at referral centers (35.5% vs 9.6%, $p<0.001$).

DISCUSSION AND CONCLUSION: Inappropriate excisions of unrecognized sarcomas (“whoops” procedures) are known to negatively impact patient care and can result in diagnostic delays, additional interventions, increased need for soft tissue reconstruction, and increased concern for local recurrence. The MsTR is a resource that can provide comprehensive multi-institutional data on the extent of this problem and allow for national benchmarking and comparisons between institutions. We found that the overall rates of incisional biopsies or attempted excisions prior to referral to a sarcoma specialist were 4.9% in bone tumors and 21.1% in soft tissue tumors. This will serve as a benchmark for future comparison as we attempt to lower this number as a society through improving access and educating referring providers.

Table 1: Overall Proportions of Biopsies by Institution Type

	Institution Type of Performed Biopsy			
	Treating institution (N = 672)	Referring institution (N = 299)	Total (N = 971)	P Value
Mean Age at Diagnostic Biopsy				
Mean (SD)	53.21 (21.40)	58.27 (18.68)	54.77 (20.72)	<0.001
Median (IQR)	56.70 (36.95, 70.38)	62.29 (46.95, 71.92)	59.03 (39.64, 70.96)	
Age at Diagnostic Biopsy				
0-19	70 (10.42%)	9 (3.01%)	79 (8.14%)	0.002
20-29	52 (7.74%)	24 (8.03%)	76 (7.83%)	
30-39	68 (10.12%)	23 (7.69%)	91 (9.37%)	
40-49	87 (12.95%)	31 (10.37%)	118 (12.15%)	
50-59	92 (13.69%)	46 (15.38%)	138 (14.21%)	
60-69	129 (19.20%)	78 (26.09%)	207 (21.32%)	
70-79	112 (16.67%)	60 (20.07%)	172 (17.71%)	
>=80	62 (9.23%)	28 (9.36%)	90 (9.27%)	
Sex				
Female	302 (44.94%)	141 (47.16%)	443 (45.62%)	0.52
Male	370 (55.06%)	158 (52.84%)	528 (54.38%)	
Biopsy Method				
Fine Needle Aspiration (FNA)	7 (1.14%)	3 (1.10%)	10 (1.12%)	<0.001
Core needle biopsy	456 (74.03%)	122 (44.69%)	578 (65.02%)	
Incisional biopsy	94 (15.26%)	51 (18.68%)	145 (16.31%)	
Excisional biopsy	59 (9.58%)	97 (35.53%)	156 (17.55%)	
Missing	56	26	82	
Tumor Type				
Bone Tumor	231 (34.38%)	41 (13.71%)	272 (28.01%)	<0.001
Soft Tissue	441 (65.63%)	258 (86.29%)	699 (71.99%)	
Final Diagnosis of Bone Tumor				
Chondrosarcoma	64 (28.07%)	21 (51.22%)	85 (31.60%)	0.10
Chordoma	1 (0.44%)	0 (0.00%)	1 (0.37%)	
Ewing's Sarcoma	21 (9.21%)	2 (4.88%)	23 (8.55%)	
Giant Cell	33 (14.47%)	3 (7.32%)	36 (13.38%)	
Osteosarcoma	89 (39.04%)	11 (26.83%)	100 (37.17%)	
Other	20 (8.77%)	4 (9.76%)	24 (8.92%)	
Missing	444	258	702	
Final Diagnosis of Soft Tissue Tumor				
Fibrosarcoma	114 (26.45%)	67 (26.69%)	181 (26.54%)	0.012
Leiomyosarcoma	18 (4.18%)	19 (7.57%)	37 (5.43%)	
Liposarcoma	94 (21.81%)	34 (13.55%)	128 (18.77%)	
Neural Sarcoma	16 (3.71%)	15 (5.98%)	31 (4.55%)	
Rhabdomyosarcoma	9 (2.09%)	6 (2.39%)	15 (2.20%)	
Synovial Sarcoma	17 (3.94%)	19 (7.57%)	36 (5.28%)	
Uncertain differentiation	32 (7.42%)	24 (9.56%)	56 (8.21%)	
Undifferentiated Sarcoma	127 (29.47%)	61 (24.30%)	188 (27.57%)	
Vascular Sarcoma	4 (0.93%)	6 (2.39%)	10 (1.47%)	
Missing	241	48	289	
Grade				
Benign	30 (4.92%)	2 (0.75%)	32 (3.65%)	0.049
G1	80 (13.11%)	39 (14.66%)	119 (13.58%)	
G2	173 (28.36%)	80 (30.08%)	253 (28.88%)	
G3	274 (44.92%)	119 (44.74%)	393 (44.86%)	
GX	53 (8.69%)	26 (9.77%)	79 (9.02%)	
Missing	62	33	95	

Table 2: Excisional Soft Tissue Biopsies by Institution Type

	Institution Type of Performed Biopsy			
	Treating institution (N = 45)	Referring institution (N = 91)	Total (N = 136)	P Value
Mean Age at Diagnostic Biopsy				
Mean (SD)	59.33 (18.19)	59.06 (19.99)	59.15 (19.34)	0.94
Median (IQR)	61.61 (48.32, 73.26)	62.04 (47.81, 75.15))	61.89 (47.81, 75.02)	
Age at Diagnostic Biopsy				
0-19	1 (2.22%)	4 (4.40%)	5 (3.68%)	0.43
20-29	1 (2.22%)	6 (6.59%)	7 (5.15%)	
30-39	7 (15.56%)	4 (4.40%)	11 (8.09%)	
40-49	4 (8.89%)	13 (14.29%)	17 (12.50%)	
50-59	7 (15.56%)	14 (15.38%)	21 (15.44%)	
60-69	10 (22.22%)	24 (26.37%)	34 (25.00%)	
70-79	9 (20.00%)	13 (14.29%)	22 (16.18%)	
>=80	6 (13.33%)	13 (14.29%)	19 (13.97%)	
Sex				
Female	23 (51.11%)	49 (53.85%)	72 (52.94%)	0.76
Male	22 (48.89%)	42 (46.15%)	64 (47.06%)	
Soft Tissue Tumor Extremity Location				
Axial	1 (2.22%)	1 (1.12%)	2 (1.49%)	0.32
Lower extremity	33 (73.33%)	56 (62.92%)	89 (66.42%)	
Upper extremity	11 (24.44%)	32 (35.96%)	43 (32.09%)	
Missing	0	2	2	
Grade				
Benign	4 (9.30%)	0 (0.00%)	4 (3.05%)	0.06
G1	5 (11.63%)	17 (19.32%)	22 (16.79%)	
G2	12 (27.91%)	26 (29.55%)	38 (29.01%)	
G3	17 (39.53%)	38 (43.18%)	55 (41.98%)	
GX	5 (11.63%)	7 (7.95%)	12 (9.16%)	
Missing	2	3	5	
Greatest Dimension of Tumor				
Less than 5 cm	22 (50.00%)	59 (66.29%)	81 (60.90%)	<0.001
Greater than 5 cm and less than or equal to 10 cm	5 (11.36%)	21 (23.60%)	26 (19.55%)	
Greater than 10 cm and less than or equal to 15 cm	6 (13.64%)	6 (6.74%)	12 (9.02%)	
Greater than 15 cm	11 (25.00%)	2 (2.25%)	13 (9.77%)	
Not Applicable	0 (0.00%)	1 (1.12%)	1 (0.75%)	
Missing	1	2	3	
Tumor Depth				
Deep	26 (65.00%)	25 (28.74%)	51 (40.16%)	<0.001
Superficial	14 (35.00%)	60 (68.97%)	74 (58.27%)	
Superficial & deep	0 (0.00%)	2 (2.30%)	2 (1.57%)	
Missing	5	4	9	
Excision Biopsy Margin				
R0 - negative	19 (45.24%)	8 (9.09%)	27 (20.77%)	<0.001
R1 - microscopic	12 (28.57%)	33 (37.50%)	45 (34.62%)	
R2 - macroscopic	4 (9.52%)	33 (37.50%)	37 (28.46%)	
RX - cannot be assessed	7 (16.67%)	14 (15.91%)	21 (16.15%)	
Missing	3	3	6	
Final Surgical Margin				
Wide (R0, >1 mm, no residual tumor)	23 (53.49%)	62 (73.81%)	85 (66.93%)	0.017
Marginal (R0, <1 mm)	14 (32.56%)	11 (13.10%)	25 (19.69%)	
Microscopic positive (R1)	6 (13.95%)	7 (8.33%)	13 (10.24%)	
Macroscopic positive (R2)	0 (0.00%)	4 (4.76%)	4 (3.15%)	
Missing	2	7	9	