

The Percutaneous Needle Biopsy Is Safe and Recommended in the Diagnosis of Musculoskeletal Masses

Outcomes Analysis of 155 Patients at a Sarcoma Referral Center

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BACKGROUND. The purpose of this study was to analyze the role of percutaneous core needle biopsy in the diagnosis of musculoskeletal sarcomas.

METHODS. One hundred eighty-five biopsy procedures were performed on 161 musculoskeletal tissue masses suspected of being a sarcoma in 155 patients who underwent subsequent tumor resection. A percutaneous core needle biopsy was performed on all masses either in the clinic or under radiologic guidance. If an adequate diagnosis could not be made on the basis of this biopsy specimen, an open incisional biopsy was performed.

RESULTS. One hundred seventy-three core needle biopsy procedures were performed: 90 without radiologic guidance, 55 computed tomography guided, and 28 fluoroscopically guided. Twelve open incisional biopsies were performed. Eighty-three sarcomas, 67 benign mesenchymal tumors, and 11 metastatic epithelial tumors were identified. Analysis of the data reveals that only 7.4% of the masses required open biopsy. In 88.2% of the masses, a single percutaneous biopsy procedure was adequate, and no additional biopsy was necessary. There was a 1.1% rate of complications; none caused a change in the patient's treatment plan. There was a 1.1% rate of major diagnostic errors, none of which ultimately impacted on the patient's outcome. There were no unnecessary amputations. Percutaneous needle biopsy showed a positive predictive value of 100%, a negative predictive value of 82%, a sensitivity of 81.8%, and a specificity of 100%. The accuracy of a single-needle biopsy procedure to identify benign versus malignant lesions, exact grade, and exact pathology was 92.4%, 88.6%, and 72.7%, respectively.

CONCLUSIONS. The percutaneous needle biopsy was found to be extremely effective and safe for the diagnosis of musculoskeletal masses. This method allowed 88% of patients with suspected sarcomas to undergo a single-needle biopsy procedure before the initiation of definitive treatment. Patients undergoing percutaneous needle biopsy had lower rates of major diagnostic errors and complications than previously described for open biopsy. Open biopsy offered limited additional information when preceded by a needle biopsy, given that these tumors were difficult to identify even after final resection. *Cancer* 2000;89:2677-86.

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Tissue diagnosis of a musculoskeletal mass is necessary before the institution of definitive treatment. An open incisional biopsy traditionally has been the means used to ensure that adequate tissue is

obtained for evaluation by a pathologist. A definitive diagnosis then is made on the basis of the tumor histology and the clinical and radiographic information obtained by the musculoskeletal oncologist. Open incisional biopsies have a complication rate of 16%, and 8.2% of all patients who have had a biopsy have their treatment plan affected by these complications.¹ In addition, 1.2% of all patients who have had a biopsy undergo unnecessary amputations because of diagnostic errors that are based on results of the open biopsy.¹ These complications were thought to be acceptable when weighed against the importance of obtaining an adequate sample. Nonetheless, from a patient care perspective, a less invasive biopsy method would be preferable.

It has long been believed that a needle biopsy of a musculoskeletal neoplasm does not provide adequate tissue for a definitive diagnosis. This belief is based on the agreement among pathologists that mesenchymal tumors are among the most difficult of pathologies to accurately diagnose. Thus, although fine-needle aspiration biopsy (FNAB) is the modality of choice for obtaining tissue when an epithelial tumor is suspected, needle biopsy is not widely used for mesenchymal tumors. In a pattern-of-care survey by the American College of Surgeons that involved 3457 patients with sarcomas treated from 1983 to 1984, only 9% underwent a needle biopsy.² An informal survey at the 1999 American Academy of Orthopedic Surgeons annual meeting indicated that only 40% of respondents were using needle biopsy for diagnosis of mesenchymal tumors. Although this suggests increased use of needle biopsy over the last 15 years, it continues to indicate an underutilization of this technique.

Many publications have looked at the use of both FNAB (22–25 gauge) and core needle biopsy (8–14 gauge) in the initial diagnostic evaluation of bone and soft tissue tumors (Table 1).^{2–21} These articles have focused on the sensitivity, specificity, positive and negative predictive values, and accuracy of these procedures. The utility of FNAB was the subject of a recent editorial by Akerman, who concluded that the benefits of FNAB in the definitive diagnosis of a soft tissue sarcoma outweigh the limitations.²² Results for FNAB, however, vary substantially from institution to institution. Barth et al. in a direct comparison of FNAB and core needle biopsy reported the core needle biopsy to be more accurate.⁶ Several authors reported a high accuracy for FNAB in studies that were burdened by high numbers of benign cases or clinical patient follow-up.^{3,7,12,13,20} Regardless of the technique used, the accuracy of the biopsy is increased by having more benign cases in the study. This is due to the ease with which benign tumors are diagnosed in comparison to

the diagnosis of malignant ones. The use of clinical patient follow-up is inferior to comparison of the biopsy tissue to a surgical specimen. First, it suggests the authors were studying all patients biopsied and not strictly those suspected of having a malignant sarcoma, in which a resection is routinely performed. Second, it is not possible to calculate accurate statistics for pathology when there is no pathologic comparison. Kumar et al. reported good results but had more than half the eligible patients excluded due to “either lacked clinical details and/or radiology or had cell poor or hemodiluted aspirates.”¹⁵ Akerman et al. reported good results when the primary goal of the study was to demonstrate that FNAB aspirates permitted flow cytometric DNA analysis.¹¹ Finally, several authors have reported disappointing results for FNAB.^{8,14,19}

In contrast, many articles from multiple institutions show consistently good results for the core needle biopsy.^{4,5,6,9,21} These articles strongly support the use of the core needle biopsy. However, this technique still has not been broadly accepted. This may be because studies have focused on the success of the technique at identifying pathology, rather than the effect of the technique on the overall patient outcome. We refer to this as the patient care perspective. No patient outcome data for needle biopsy were found in either Ovid, Medline, or an article reference search for the years 1960–1999.

We report our experience with percutaneous needle biopsy in the preoperative evaluation of musculoskeletal masses at a sarcoma referral center. Emphasis is placed on the effect of the biopsy on the patient's clinical course. Comparisons will be made between our data and prior published data analyzing both core needle and open biopsy techniques.

MATERIALS AND TECHNIQUES

A computerized surgical database was used to identify all patients who underwent resection of a musculoskeletal mass at our institution. Patient eligibility for this retrospective analysis between 1992 and 1997 was based on review of the pathologic and clinical records. Only patients suspected of having sarcomas at the initial patient visit were included; patients with a prior known history of carcinoma were excluded. In addition, patients were included only if they had undergone both a core needle biopsy and a definitive resection at this institution. This ensured that all statistical comparisons were based on the histologic findings of a single pathologist.

Since 1992, this institution has used a standard protocol (Fig. 1) to evaluate patients suspected of having a musculoskeletal sarcoma. The same surgical

TABLE 1
Summary of the Efficacy of Fine-Needle Aspiration Biopsy and Core Needle Biopsy in the Diagnosis of Bone and Soft Tissue Tumors

Reference	Year	Location	No. of biopsies	Tissue type	Biopsy type	Comparison	Benign path follow-up	PPV (%)	NPV (%)	Sensitivity (%)	Specificity (%)	Accuracy (%)	Inadequate tissue (%)	Complications	Note
3	1986	Asturias, Spain	117	Soft	FNAB ^a	N/S	N/S	96.8	100	100	96.5		0	0	
4	1990	Marsden, U.K.	52	Soft	CNB	Benign vs. malignant Sarcoma Grade	Resection	100		98		98	3.8	0	
5	1992	Marsden, U.K.	25	Soft	CNB	Benign vs. malignant Pathology	Resection		100	100	100	85	8	0	
6	1991	NIH, U.S.	27	Soft	CNB	Pathology	Clinical	100	100	100	91	96	3.7	0	
7	1988	Harofeh, Israel	25	Soft	FNAB	Pathology	Clinical	100	100	86	36	64	36	0	
8	1986	UCLA, U.S.	136	Soft	FNAB	Pathology	Clinical	100	94	96	100	98	12	0	
9	1983	MD and U.S.	19	Bone	FNAB/CNB	Benign vs. malignant Pathology	Clinical	100	100	95	95	82	17	0	d
10	1983	MD and U.S.	222	Bone	FNAB/CNB	Pathology	Resection					64/83	0	0	
11	1987	Lund, Sweden	29	Bone/soft	FNAB	Benign vs. malignant Pathology	Resection	100	100	100	100	B/M	17	0	e
12	1984	Wuhan, China	54	Bone	FNAB	Pathology Grade	Resection					76	n/s	0	
13	1985	Lund, Sweden	365	Soft	FNAB	Benign vs. malignant	Clinical	85.7	97	89.2	96	96/90	5.4	n/s	
14	1981	Kg Gigs, India	62	Bone	FNAB	Benign vs. malignant	Resection	100				82	n/s	n/s	
15	1992	Kidwai, India	79	Bone	FNAB	Benign vs. malignant	Resection					94	n/s	n/s	
16	1979	USC, U.S.	472	Bone/soft	CNB	N/S	Resection					66/76	n/s	1	f
17	1982	MD and U.S.	39	Soft	CNB	Benign vs. malignant	Clinical					83	n/s	0	
18	1979	MD and U.S.	34	Bone	FNAB/CNB	Pathology	Resection					85.3	8.8	0	
19	1980	Lund, Sweden	187	Soft	FNAB	Benign vs. malignant	Clinical					85	8.4	0	
20	1987	UCLA, U.S.	29	Bone	FNAB	Benign vs. malignant	Clinical					100	0	0	
21	1997	MSKCC, U.S.	60	Soft	CNB	Pathology Grade	N/S	100	79	93	100	66	7	0	g
						Benign vs. malignant						88			
												95			

PPV: positive predictive value; NPV: negative predictive value; FNAB: fine-needle aspiration biopsy; N/S: not specified; CNB: core needle biopsy; NIH: National Institutes of Health; USC: University of South Carolina; UCLA: University of California at Los Angeles; MD: Maryland; MSKCC: Memorial Sloan-Kettering Cancer Center.
^a Began with FNAB and preceded to CNB in one biopsy session.
^b Accuracy was calculated for benign (B) and malignant (M) masses separately.
^c Accuracy was calculated for bone (B) and soft tissue (S) masses separately.
^d All patients with previously irradiated skeletons.
^e FNAB provides adequate tissue for DNA plasty.
^f Not a sarcoma referral center.
^g Compared CNB with open biopsy in a retrospective, nonrandomized manner.

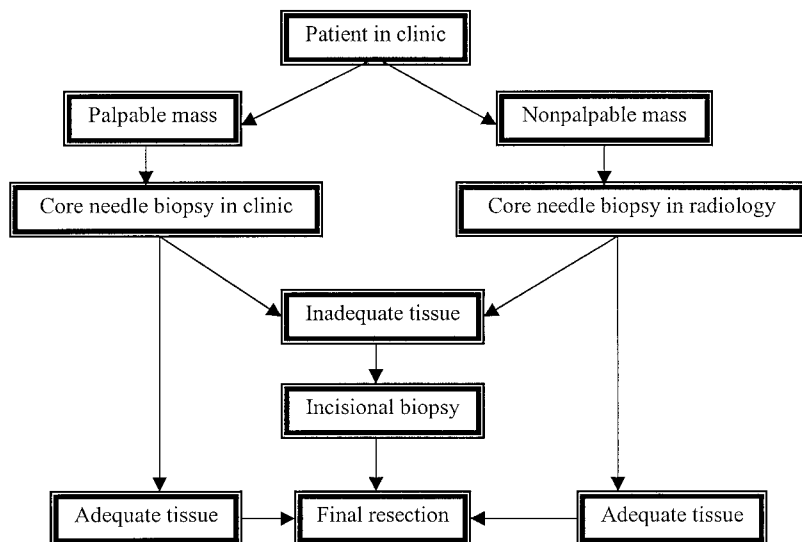


FIGURE 1. Biopsy protocol.

team or radiologist performs all biopsies, and the same musculoskeletal pathologist reviews all specimens. Informed consent was obtained before the performance of all procedures. A core needle biopsy is performed in the office during the first visit on all patients presenting with a palpable mass. In patients with nonpalpable masses (typically confined to bone or the pelvis), a needle biopsy is performed under radiologic guidance within 24 hours. The biopsy specimen is reviewed by a trained musculoskeletal pathologist or orthopedic oncologist to ensure that adequate tissue has been obtained. If the initial specimen fails to provide adequate tissue and it is thought a better specimen could be obtained under radiologic guidance, a second needle biopsy is performed. When the sample is inadequate, and it is thought that an additional needle biopsy is not going to be of benefit, an open biopsy is performed.

Percutaneous core needle biopsy of palpable masses is performed under sterile conditions in the outpatient clinic. After the patient is prepped and draped, local anesthesia is accomplished by injecting 1% plain lidocaine into the skin at the site chosen for the biopsy. The biopsy then is performed by an orthopedic oncologist, using 3–5 passes with a spring-loaded, 14-gauge core biopsy needle. For all biopsies, the needle enters the same skin puncture site and then is passed in different directions. This ensures a diverse sampling of different regions of the tumor. The BIP Biopsy Instrument (Biomedical Instruments and Products; Niagara Falls, NY) is used (Fig. 2). It is a double-action, spring-loaded, reusable device that allows one to remove the specimen without removing the needle from the gun. The instrument inserts the needle and captures a piece of tissue with the press of

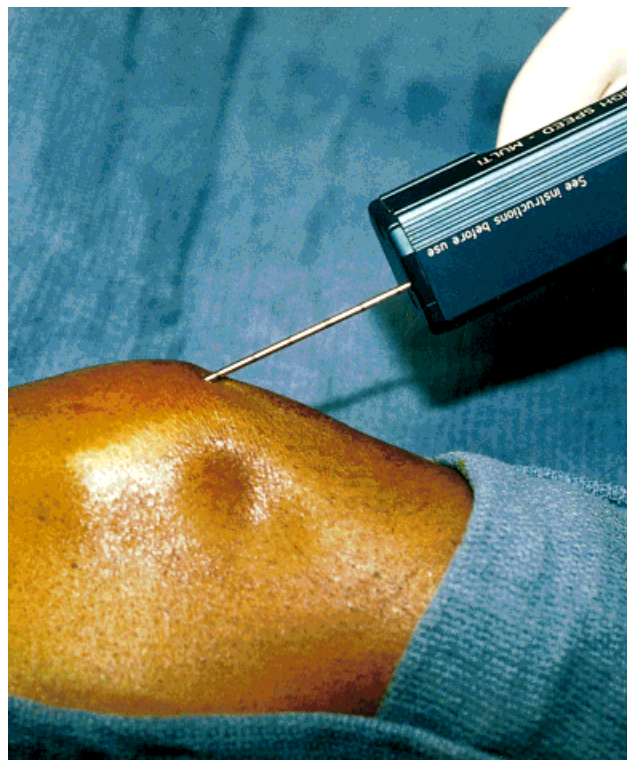


FIGURE 2. BIP biopsy instrument (Biomedical Instruments and Products).

a single button. The manufacture-recommended uses for this device include soft tissue masses and tumors of the liver, kidney, prostate, and spleen. The biopsy needle collects a specimen for which the circumference is 2.1 mm and the length is 19 mm (total area, 104 mm²) with each pass (Fig. 3). The specimen then is placed in saline solution and delivered to the pathology lab. Hand pressure over the biopsy site is applied

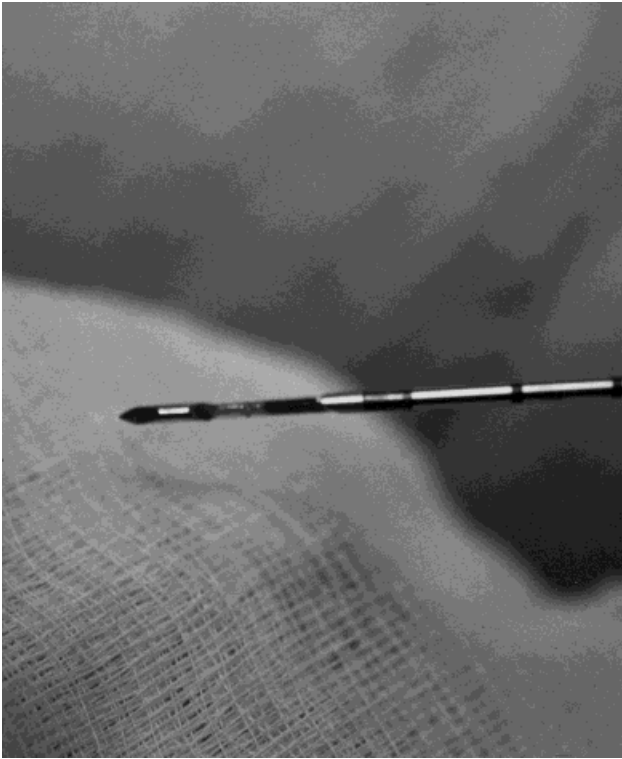


FIGURE 3. Specimen in the needle of the BIP biopsy instrument.



FIGURE 4. Ostycut bone needle used in radiologic guided biopsies.

for 5 minutes, after which a sterile gauze occlusive dressing is applied. Sutures are usually unnecessary.

Nonpalpable masses are referred to an interventional radiologist, who consults with the orthopedic oncology team to determine the most appropriate approach for the biopsy needle pass. The anatomic approach for the biopsy is chosen in anticipation of an attempted limb-sparing surgery. After selection of the biopsy site, all patients are injected with lidocaine for local anesthesia of the skin. In addition, all patients receive intravenous sedation; the most commonly used agents for intravenous sedation are meperidine or fentanyl along with midazolam. All patients are hemodynamically monitored with a continuous pulse oximeter and an automated blood pressure cuff. Soft tissue masses are biopsied with a 14- or 15-gauge Medi-Tech needle (Boston Scientific Corporation, Wauwatosa, WI). Lesions confined to bone are biopsied with a 14–17-gauge Ostycut bone needle (Bard/Angiomed, Berlin, Germany; Fig. 4), or an 8–11-gauge Temno bone needle (Bauer Medical, Clearwater, FL). During the biopsy, a pathologist performs routine cytologic and touch prep examination of the specimen to determine that an adequate tissue sample has been obtained. If the cytologic examination reveals that no diagnostic material is present, additional cores of tissue (up to 12) are obtained. Some of these may be

used for electron microscopy or flow cytometry. After biopsy, patients are observed in the recovery room for 2 hours before being discharged.

Both of the protocols described above are considered a single-needle biopsy procedure. Although multiple passes of the needle were made to ensure that adequate tissue was obtained, the protocol was performed during a single patient encounter.

All biopsy specimens were reviewed by the same surgical pathologist (B.M.S.). The amount of material collected permitted the use of detailed immunohistochemical stains that provided additional information about the tumors. Final diagnoses were made after a multidisciplinary review of the patients clinical history, radiologic data, and histology results. Patients in whom a diagnosis could not be reached underwent additional biopsy, either a repeat needle biopsy or an open biopsy. After definitive diagnosis, an individualized treatment plan was designed for each patient; this typically included preoperative chemotherapy followed by a definitive surgical resection. All surgical specimens were reviewed by the original pathologist, permitting direct comparison with the original biopsy specimen. For each patient, the histologic diagnosis, histologic grade, and relevant clinical data were tabulated for the original biopsy (or biopsies) and final specimen. Statistical data reported here were based on



FIGURE 5. Computed tomography guided vertebral body biopsy.

a comparison of the original pathology reports of the biopsy specimen with information obtained at the final resection.

RESULTS

One hundred eighty-five biopsy procedures were performed on 161 musculoskeletal masses in 155 patients in the 5-year study period. The most common location was the proximal lower extremities; however, the distribution was anatomically diverse (Table 2). The total includes 90 core needle biopsy procedures performed in clinic; 83 biopsy procedures performed under radiologic guidance (55 under computerized tomography [CT] and 28 under fluoroscopy; Fig. 5); and 12 open incisional biopsies performed in the operating room. Although all patients had a presumptive diagnosis of sarcoma, the final tumor diagnosis included 83 sarcomas, 67 benign mesenchymal tumors, and 11 metastatic epithelial tumors.

In 88.2% (142 of 161) of the masses, a single percutaneous needle biopsy procedure was adequate for diagnosis and institution of definitive treatment. In 4.3% (7 of 161) of the masses, multiple needle biopsy procedures were performed. None of these patients required an open biopsy. Only 7.4% (12 of 161) of the masses required an open biopsy.

TABLE 2
Anatomic Location of Masses Biopsied

Total masses (n = 161)			
Bone (n = 83)		Soft tissue (n = 78)	
Femur	20	Thigh	37
Tibia	14	Leg	11
Pelvis	13	Buttocks	8
Hip	12	Shoulder	8
Scapula	7	Popliteal fossa	5
Knee	4	Forearm	5
Humerus	4	Biceps	2
Sacrum	4	Chest wall	2
Foot	3		
Fibula	2		

TABLE 3
Results of Needle Biopsy at Washington Cancer Institute

	Percentage
Positive predictive value	100
Negative predictive value	82
Sensitivity	82
Specificity	100

TABLE 4
Accuracy (%) of Biopsies at Washington Cancer Institute

Biopsy type	Benign vs. malignant	Exact grade	Exact pathology
Single-needle biopsy	92.4	88.6	72.7
Multiple biopsies needle/open	84.6	69.2	50
Open biopsy	83.3	66.7	50

On the basis of direct comparison of the biopsy specimen and the final resection specimens, we calculated the positive and negative predictive values, sensitivity, and specificity of the core needle biopsy (Table 3). We also calculated the overall accuracy for a single-needle biopsy, multiple needle biopsies, and open biopsy and stratified that accuracy on the basis of the malignancy of the tumor, the tumor grade, and final pathology (Table 4).

Two complications (rate of 1.1%) occurred related to a needle biopsy. Neither affected the treatment plan or the overall patient outcome. The first patient reported to the emergency department several hours after a biopsy in the femoral triangle. He was discovered to have symptomatic anemia due to a thigh hematoma. Surgical exploration revealed a partial tear in a small arterial branch off the medial femoral circumflex artery. This artery was ligated, and the patient recovered without any other difficulties. The second

patient had persistent drainage after a needle biopsy was performed on a hemorrhagic sarcoma of the posterior compartment of the leg. This biopsy tract was sutured and healed after 4 days. Due to failure of the needle biopsy to provide an adequate diagnosis, this same patient required an open biopsy. After the open biopsy, she developed a drainage that lasted for 47 days. This tract eventually sealed while the patient was on neoadjuvant chemotherapy, and she underwent a successful limb-sparing procedure. Both patients remain alive, free of disease, and without functional deficits.

Although the term “major diagnostic error” traditionally is used for errors in the histopathologic diagnosis that affect the treatment plan for the patient, we use the term to refer to any errors in histopathology, radiologic studies, or preoperative planning that adversely affected the treatment plan for the patient. We believe this definition more accurately represents the factors that may affect a patient’s treatment plan. Even with this broader definition, there were only two such errors (rate of 1.1%) in our study group. In neither case was the patient’s ultimate clinical outcome affected by the diagnostic error. In both patients, a needle biopsy and an open biopsy were performed because of a high index of suspicion that the original tissue diagnosis was incorrect. In both patients, neither biopsy techniques revealed the correct diagnosis.

The first patient’s initial diagnosis was a giant cell tumor determined by needle biopsy. At the time of surgical resection (consisting of an intralesional resection/curettage and cryosurgery of the tumor cavity), an open incisional biopsy of the tumor was performed. Frozen section evaluation revealed the presence of spindle cells. The planned procedure was aborted, pending review of the biopsy specimen. The final diagnosis was low grade spindle cell sarcoma of uncertain etiology. The patient underwent a wide resection of the distal femur along with endoprosthetic reconstruction. Detailed analysis of the resection specimen revealed that the tumor consisted of a low grade bone sarcoma with giant cells, with small foci of a high grade osteosarcoma variant. The patient underwent adjuvant chemotherapy and remains free of all disease; however, 5 months after the operation, she developed a prosthetic infection that required an above-knee amputation. The infection was unrelated to the biopsies performed before the definitive surgical procedure. This was considered a major diagnosis error because at this institution, patients with high grade sarcomas are given preoperative chemotherapy, which was not offered here.

The second patient’s initial diagnosis was a pseudosarcomatous fasciitis of the posterior thigh de-

termined by needle biopsy. At the time of surgical resection, an open incisional biopsy was performed, and frozen section analysis revealed the presence of spindle cells. The permanent sections revealed a low to intermediate grade fibrosarcoma. Detailed review of the patient’s imaging studies, including a CT scan and magnetic resonance imaging of the thigh, failed to reveal any evidence of sciatic nerve involvement. An attempt at wide resection was made, but macroscopic tumor involvement of the sciatic nerve was recognized intraoperatively, and the attempt at resection was abandoned. The diagnosis was changed again, based on an examination of a section of the tumor removed from along the sciatic nerve; the final diagnosis was intermediate to high grade malignant fibrous histiocytoma. Neoadjuvant chemotherapy was administered, and the patient underwent a definitive anterior flap hemipelvectomy. Adjuvant chemotherapy and external-beam radiation therapies were administered. The patient remains free of disease and is ambulatory with a prosthesis. The amputation was not related to complications resulting from either biopsy but was dictated by the anatomic location of the tumor.

Overall, there were no unnecessary amputations attributable to either biopsy technique. In total, there were only 6 amputations (3.7% of definitive surgeries) and 15 prosthetic implants (9.3% of definitive surgeries) performed. All these procedures were necessary because of the anatomic location of the tumor and tumor extent.

DISCUSSION

Despite the presence of considerable data establishing its efficacy at identifying mesenchymal tumors, core needle biopsy continues to be underutilized for the diagnosis of musculoskeletal masses. The sensitivity and specificity of a needle biopsy in our series are consistent with those previously published (Table 5). Some authors have reported a higher sensitivity and negative predictive value. This is likely due to our study design. We have only reported patients that have gone on to open biopsy or surgical resection, in an effort to have a pathologic comparison of the biopsy techniques. We could have readily increased the sensitivity by including the numerous patients that because of a low index of suspicion for malignancy underwent a single biopsy procedure and were observed clinically.

For this report, we also evaluated the results of performing a needle biopsy from a patient care perspective. Two previous reports have used this approach, both of which were based on questionnaires of physicians performing the biopsies at several institutions.^{1,23} In the more recent of these evaluations, 85

TABLE 5
Comparison of Results of This Study with the Previously Published Data Presented in Table 1

Study	Year	No. of biopsies	Adequate tissue (%)	Complications (%)	PPV (%)	NPV (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)
WCI	1992-97	185	90.1	1.1	100	82	72.7-92	82	100
Prior data	1979-97	19-472	83-100	0-1	100	79-100	64-100	93-100	91-100

WCI: Washington Cancer Institute; PPV: positive predictive value; NPV: negative predictive value.

TABLE 6
Comparison of Core Needle Biopsy Complications from This Study with Previously Published Open Biopsy Complications

	Needle biopsy (%)	Open biopsy (%)
Complications	1.1	16
Treatment plan affected by complications	0	8.2
Major diagnostic errors	1.1	4.8 (tx cntrs); 13.6 (overall)
Outcome affected by major diagnostic errors	0	2.0
Unnecessary amputations	0	1.2

needle biopsies were reported.¹ The authors concluded that although needle biopsy is not as reliable as open biopsy, a limb-sparing procedure is less often abandoned as a result of complicating factors arising from a needle biopsy than from an open biopsy. The relative paucity of needle biopsies, the different methods of data collection used by the various reporting institutions, and the inclusion of both tertiary sarcoma centers and referring community institutions all contribute to uncontrollable flaws in these data. Our study, by contrast, is based on a single multidisciplinary sarcoma team based at one institution. Our experience with biopsies clearly indicates that a needle biopsy is not only safer but also more effective than an open biopsy, even when compared with the open biopsy data previously reported in the literature (Table 6).

Our complication rate of 1.1% (2 of 185 biopsies) is one of the lowest reported rates in the literature. Of significance, neither of these two complications affected the patient's treatment plan or overall outcome. In addition to these complications, there were two major diagnostic errors. Despite our expectation of a high number of these errors because of our broader definition, this rate is also lower than that previously reported.^{1,23} In both cases, neither the needle nor open biopsy technique revealed the correct diagnosis. This correlates with the data presented in Table 4 that suggest that open biopsy offers minimal information beyond that revealed by needle biopsy. We believe that this diagnostic challenge is intrinsic to the very

nature of these particular tumors. Sarcomas that have characteristic histologic or immunohistochemical profiles are readily identified by the tissue that is collected by a core needle biopsy. However, a low percentage of tumors may have misleading features or may lack any identifiable characteristic that can lead to a correct diagnosis. This problem is not related to the method of biopsy because such tumors remain unidentifiable even after final resection of the entire tumor.

When performing a biopsy for any mass, the surgeon has two goals. The first, and most important, is to establish a correct diagnosis so that a definitive treatment plan may be developed. Second, the technique used to establish the diagnosis must be carefully planned to avoid any complications or tissue contamination that could jeopardize a limb-sparing procedure for the patient. Complications can be minimized by performing a biopsy in the least invasive manner possible. Our experience, along with that of other investigators reported in the literature, conclusively demonstrates that a single core needle biopsy can provide adequate tissue to make a correct diagnosis in most patients suspected of having a bone or soft tissue sarcoma. An open biopsy was performed on only two patients per year in our study. In addition, a core needle biopsy avoids the need for an incision, thereby drastically reducing the amount of potentially contaminated tissue that must be removed at the time of surgical resection. This greatly increases the probability that the surgical team will be able to perform a limb-sparing procedure.

On the basis of the results of this study, we believe that open incisional biopsy, long thought to be the "gold standard" for the diagnosis of sarcomas, must be questioned as the preferred diagnostic tool. The number of open biopsies performed in our series is too low to enable us to draw meaningful conclusions regarding the safety or efficacy of this procedure; however, the literature clearly documents the pitfalls that can accompany an open biopsy. Furthermore, although we did not perform a formal analysis of the costs of core versus open biopsy, a needle biopsy, performed

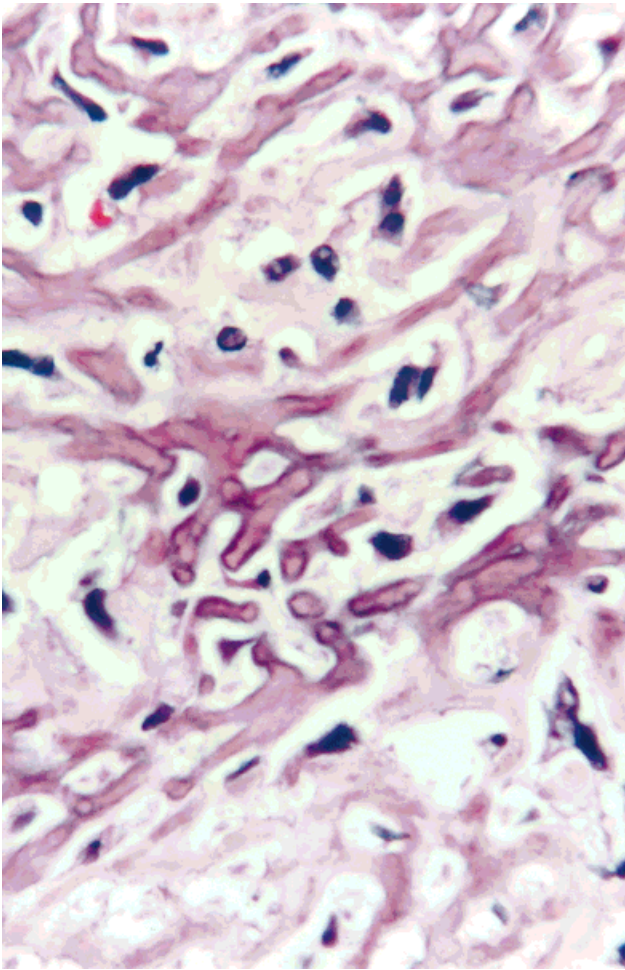


FIGURE 6. Core needle biopsy of a high grade osteosarcoma: lace-like osteoid and atypical hyperchromatic spindle cells.

on an outpatient basis in the clinic or radiology suite, seems to be more cost-effective than an open biopsy, which must be performed in an operating room with the assistance of an anesthesiologist. We believe that open incisional biopsies should be reserved for patients with contraindications for a needle biopsy (based on anatomic location) or for those in whom a previous attempt at needle biopsy failed to provide adequate diagnostic tissue. Even then, such biopsies should be performed only by a trained surgical team that is prepared to institute and perform the definitive treatment for the tumor.

Some have argued that FNAB alone is sufficient to diagnose a tumor.²² The published results of fine-needle aspiration, however, vary from excellent to unreliable.²⁻²¹ The distinct advantage of a core needle biopsy is that it provides a chunk of tissue that allows the pathologist to examine the tumor architecture and interrelation of its cells (Figs. 6 and 7). This is not

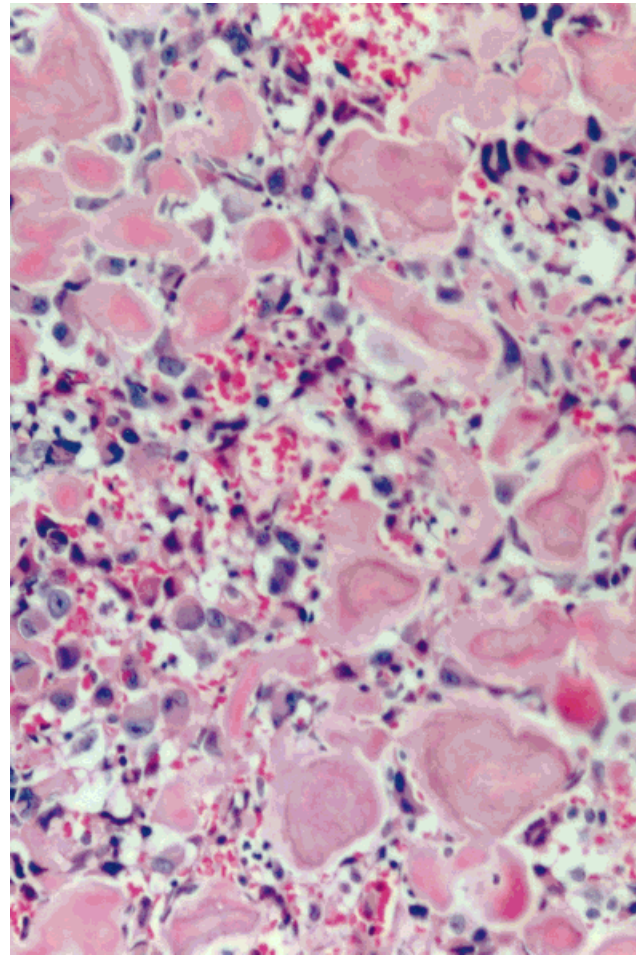


FIGURE 7. Core needle biopsy of a high grade osteosarcoma: irregular trabeculae of primitive osteoid and atypical epithelioid osteoblast-like cells.

possible with FNAB, in which only cells that are not structurally connected to each other are aspirated. In addition, a specimen taken from a core needle biopsy can be subject to all of the special tests or stains available to the pathologist to help determine the diagnosis. When weighed against the minimal difference in invasiveness, the added benefit of additional tissue makes the core needle biopsy more attractive than a FNAB for patients suspected of having a sarcoma. Our institution does perform FNAB for new masses in patients with a known history of a carcinoma, because this technique is very reliable in confirming the presence of metastatic disease.

Percutaneous core needle biopsy is extremely effective and safe for the diagnosis of musculoskeletal masses. This method allowed 90% of patients with a suspected bone or soft tissue sarcoma in our series to undergo a single, minimally invasive procedure before the institution of a definitive treatment plan. Patients in whom a core needle biopsy did not lead to a diag-

nosis were more likely to have an atypical tumor that defied complete classification, even after examination of the final resection specimen, than those in whom a single biopsy was sufficient. Overall, patients in our study had lower rates of major errors and complications than those previously associated with open biopsy. The use of a core needle biopsy presented no impediments to the optimal treatment of the patient and did not result in any unnecessary amputations. We emphasize again that open biopsy offered limited additional information over a needle biopsy as a result of the intrinsic nature of these difficult to diagnose tumors.

Patients suspected of having sarcomas should be evaluated by a skilled multidisciplinary team, because the diagnosis must be based on a consideration of the clinical, radiographic, and histologic findings. We recommend the use of a core needle biopsy in the initial diagnostic evaluation of all patients suspected of having a sarcoma.

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