Title
Primary musculoskeletal neoplasms: effectiveness of core-needle biopsy.

Journal
Radiology, 212(3)

ISSN
0033-8419

Authors
Yao, L
Nelson, SD
Seeger, LL
et al.

Publication Date
1999-09-01

DOI
10.1148/radiology.212.3.r99se19682

Peer reviewed

Lawrence Yao, MD
Scott D. Nelson, MD
Leanne L. Seeger, MD
Jeffrey J. Eckardt, MD
Frederick R. Eilber, MD

Index terms:
Biopsies, **.1261[2]
Desmoid, 49.3132
Lipoma and lipomatosis, **.31[2]
Liposarcoma, 40.371
Lung neoplasms, 60.31, 60.32, 60.33
Lymphoma, 60.34

Radiology 1999; 212:682–686

[1] From the Department of Radiology, Georgetown University Medical Center, MRI, 2nd Fl, CCC Bldg, 3800 Reservoir Rd, NW, Washington, DC 20007 (L.Y.) and the Departments of Pathology (S.D.N.), Radiological Sciences (L.L.S.), Orthopaedic Surgery (J.J.E.), and General Surgery (F.R.E.), UCLA Center for the Health Sciences University of California, Los Angeles. Received October 15, 1998; revision requested November 11; revision received December 15; accepted April 22, 1999. **Address reprint requests to** L.Y. (e-mail: *yaol@gunet.georgetown.edu*).

[2] **. Multiple body systems

Author contributions:
Guarantor of integrity of entire study, L.Y.; study concepts, L.Y., S.D.N., J.J.E., F.R.E.; study design, L.Y., S.D.N.; definition of intellectual content, L.Y.; literature research, L.Y.; clinical studies, all authors; data acquisition, L.Y., S.D.N., L.L.S.; data analysis, L.Y.; statistical analysis, L.Y.; manuscript preparation, L.Y.; manuscript editing, L.Y., S.D.N.; manuscript review, L.Y., S.D.N., L.L.S.

Primary Musculoskeletal Neoplasms: Effectiveness of Core-Needle Biopsy[1]

PURPOSE: To analyze the effectiveness of core-needle biopsy for evaluation of possible primary musculoskeletal neoplasms, which often are evaluated with open biopsy.

MATERIALS AND METHODS: Core-needle biopsy was performed at a tertiary care institution in 141 patients suspected of having a mesenchymal neoplasm. In 85 patients, the lesion was in soft tissue; in 56 patients, the lesion was in bone. Eighty-nine patients had a malignant lesion, and 52 had a benign lesion. Twenty-eight patients had undergone previous surgery.

RESULTS: In 105 (74%) patients, core-needle biopsy results were concordant with results from specimens subsequently obtained at surgery with respect to tumor histologic features and grade, or they provided sufficient diagnostic information to obviate surgery. In 36 (26%) patients, inaccurate core-needle biopsy results were obtained: In nine, results were imprecise about exact histologic features; in three, results were correct about histologic features but incorrect about tumor grade. In 25 (18%) patients, open biopsy was performed after core-needle biopsy. The accuracy and rate of performance of open biopsy for soft-tissue lesions were not significantly different from those for bone lesions.

CONCLUSION: Percutaneous core-needle biopsy can be an effective alternative to open biopsy in the evaluation of possible mesenchymal neoplasms of either bone or soft tissue. Needle biopsy of such lesions, however, is best performed as part of a multidisciplinary team approach to tumor management.

In the management of mesenchymal tumors, treatment decisions and prognosis are dependent not only on a diagnosis of malignancy or benignity but also on the histologic features and grade of the tumor. Immunohistochemistry and, occasionally, ultrastructural studies may be necessary for specific diagnosis. Furthermore, these tumors often are spatially heterogeneous with respect to tumor grade and histologic features, and tumor necrosis may be widespread. For these reasons, the limited sampling that is possible at needle biopsy may be a source of problems or may limit confidence in diagnosis. Hence, patients with masses suspected to be primary neoplasms of the bone or soft tissue are often referred directly for open biopsy.

In contradistinction to fine-needle aspiration biopsy, larger-gauge percutaneous cutting-needle or core-needle biopsy yields solid specimens that are amenable to histologic analysis. In one series (1), core-needle biopsy of soft-tissue sarcoma was successful in allowing establishment of a histologically accurate diagnosis in 70% (42 of 60) of cases. The accuracy of core-needle biopsy in terms of correct histologic features in another combined series (2) of soft-tissue and bone tumors was 84% (52 of 62). Some authors (2,3) have suggested that core-needle biopsy may be more effective for evaluation of primary tumors of bone than for evaluation of tumors of the soft tissue. In one early series (4), however, the success rate of large-gauge trephine core biopsy of 16 primary bone tumors was only 44%.

In this study, we analyzed the effectiveness of imaging-guided core-needle biopsy of possible mesenchymal neoplasms of bone and soft tissue in patients examined at a tertiary care center specializing in orthopedic oncology.

TABLE 1
Histologic Results in 56 Patients with Bone Lesion

Diagnosis	No. of Patients
Giant cell tumor	11
Osteosarcoma	10
Lymphoma	9
Plasmacytoma	4
Ewing tumor	3
Chondroblastoma	2
Chondrosarcoma	3
Metastasis	2
Osteomyelitis	2
Aneurysmal bone cyst	1
Enchondroma	1
Fibrous dysplasia	1
Fibrosarcoma	1
Hemangioma	1
High-grade undifferentiated sarcoma	1
Kaposi sarcoma	1
Malignant fibrous histiocytoma	1
Osteofibrous dysplasia	1
Paget sarcoma	1

TABLE 2
Histologic Results in 85 Patients with Soft-Tissue Lesion

Diagnosis	No. of Patients
Liposarcoma	20
Malignant fibrous histiocytoma	8
Lipoma or lipoma variant	6
Lymphoma	6
Desmoid	5
Hemangioma	5
Pigmented villonodular synovitis	4
Leiomyosarcoma	3
Metastatic carcinoma	3
Synovial sarcoma	3
Ganglion	2
Mesenchymal chondrosarcoma	2
Myositis ossificans	2
Myxoid chondrosarcoma	1
Elastofibroma dorsi	1
Extraskeletal Ewing tumor	1
Fat necrosis	1
Fibroma	1
Hemangioendothelioma	1
Angiosarcoma	1
Dermatofibrosarcoma protuberans	1
Lymphocele	1
Muscle injury	1
Myxoma	1
Neurofibroma	1
Neurofibrosarcoma	1
Osteosarcoma	1
Schwannoma	1
Treatment-related fibrosis	1

MATERIALS AND METHODS

This study included 141 patients (80 male and 61 female patients) who underwent percutaneous core-needle biopsy of a soft-tissue or bone lesion in whom the putative diagnosis was a mesenchymal neoplasm. Patients were excluded in whom the diagnosis prior to biopsy was metastatic carcinoma and who had a history of a known primary carcinoma with high metastatic potential or multifocal skeletal disease as demonstrated at bone scintigraphy. Also excluded were patients in whom the diagnosis was infection, which was determined on the basis of clinical, physical, and laboratory findings.

Patients were consecutively encountered during 6 years at a single tertiary care institution. The mean age of the patients was 44 years (range, 9–83 years). In 89 patients, the lesion was malignant; in 52, the lesion was benign. In 85 patients, the lesion arose in soft tissue; in 56, the lesion arose in bone. In 28 patients, the lesions had been previously resected, and these patients were suspected of having recurrent disease. The final histologic diagnoses are presented in Tables 1 and 2. The anatomic distribution of lesions is presented in Table 3.

One of two musculoskeletal radiologists (L.Y., L.L.S.) performed all needle biopsies after obtaining informed consent for the procedure from the patient. The biopsy approach was chosen after review of imaging studies obtained at outside institutions, which often included magnetic resonance (MR) images, and in consultation with the referring orthopedic oncologist, such that the biopsy track would not compromise the anticipated surgical approach to the lesion. All procedures were performed with administration of local anesthesia alone, without conscious sedation. In all but 19 patients, the biopsy was performed with computed tomographic (CT) or combined CT and fluoroscopic guidance (in a CT- and fluoroscopy-capable interventional radiology suite). Among the patients who underwent biopsy without CT guidance, the bone lesion in 13 was sampled with fluoroscopic guidance alone, the soft-tissue lesion in four was sampled with ultrasonographic guidance, and the superficial soft-tissue lesion in two was sampled without imaging guidance.

For soft-tissue lesions, three to eight biopsy specimens were routinely obtained by using an automated 14-gauge cutting needle (Quickcore, Cook, Bloomington, Ind; or Temno, Bauer Medical, Clearwater, Fla) or a 16-gauge suction-coring biopsy needle (Surecut; TSK Laboratory, Tochigi City, Japan). For lesions that were more than 1 cm below the surface of the skin, multiple biopsy samples were obtained through a single puncture site by using a 12-gauge blunt introducer (Hawkins; MD Tech, Gainesville, Fla) and a coaxial technique. For soft-tissue lesions suspected of being vascular in origin, a 17-gauge introducer (Cook or Bauer Medical) and an 18-gauge automated cutting needle (Cook or Bauer Medical) were used. For bone biopsies in which the cortex was intact, intralesional needle placement was facilitated with either a 12-gauge Ackerman needle (Cook) or a Craig vertebral body biopsy set (Baxter International, Deerfield, Ill) (which yields 3.5-mm-diameter core samples). Multiple samples were then obtained coaxially by using either a trephine (Ackerman needle, Cook; or Craig biopsy set, Baxter International) or a 14-gauge automated cutting needle (Cook or Bauer Medical), depending on the degree of lesion mineralization. Specimens were sent in buffered formalin and, in cases of possible lymphoma, saline solution for histologic analysis. Aspirates were not routinely sent for cytologic examination.

Follow-up data on study subjects were obtained by one of the authors (L.Y., S.D.N., L.L.S.) from the computerized hospital and radiology information systems, as well as from the weekly management conference notes of the multidisciplinary musculoskeletal oncology group. For each patient, tumor histologic features and tumor grade (high or low) were recorded for the percutaneous biopsy results and were compared with subsequent results from pathologic examination of surgical specimens. Examination of pathologic specimens was performed by one of two pathologists (including S.D.N.) experienced in musculoskeletal tumor analysis. The number of patients who required open biopsy after percutaneous biopsy was tabulated. In 30 patients, treatment decisions were made on the basis of percutaneous biopsy results, and no surgery was performed. The diagnoses in this group included lymphoma in 10 patients, plasmacytoma in four, metastasis in two, desmoid tumor in two, and other in 12.

On the basis of follow-up clinical and pathologic information, needle biopsy results were classified by consensus (L.Y., S.D.N.) as diagnostically accurate or inaccurate. Accurate needle biopsy results were in agreement with subsequent pathologic examination results of surgical specimens with respect to both tumor histologic features and grade, or they provided adequate information to indicate treatment without surgery. Clinical follow-up in untreated patients was 6–52 months. For purposes of determining accuracy, tumor grade was considered to be either high

(grade II–III out of III) or low (grade I out of III). Inaccurate needle biopsy results differed from subsequent surgical pathologic results with regard to detection of malignancy, tumor grade, or specific histologic features.

Needle biopsy results were further classified as effective or ineffective. Effective needle biopsy results were accurate with respect to malignancy and grade but not necessarily with respect to exact histologic features and formed the basis for appropriate treatment decision making while obviating open biopsy. Any needle biopsy that was followed by open biopsy was classified as ineffective. Furthermore, any needle biopsy that resulted in incorrect histologic features that could potentially prompt inappropriate management was considered to be ineffective, even if no harm was actually done.

An analysis of the accuracy and effectiveness of needle biopsy results was performed according to patient subgroups, to examine possible determinants of effectiveness: soft-tissue versus skeletal origin, benign versus malignant lesion, and whether there was prior surgical treatment of the lesion. These differences in rates were tested by using the χ^2 statistic with continuity correction or, when appropriate, the Fisher exact test.

TABLE 3
Lesion Location

Location	No. of Patients
Soft-tissue lesions	
Thigh	37
Forequarter*	15
Leg or foot	15
Buttock	10
Retroperitoneum	4
Pelvis	2
Chest	1
Neck	1
Bone lesions	
Lower extremity	26
Pelvis	13
Upper extremity	10
Spine or sacrum	6
Rib	1

* Forequarter is the upper extremity, including the scapula and shoulder girdle musculature.

RESULTS

Accuracy of Needle Biopsy

According to the definition given in the Materials and Methods, the results of core-needle biopsy in 105 (74%) of 141 patients were accurate, and the results in 36 (26%) were inaccurate. The histologic diagnoses for patients in whom needle biopsy results were inaccurate are given in Table 4. In 36 patients with inaccurate biopsy results, adequate information regarding the benign or malignant nature of the lesion was obtained in nine, but the results were imprecise with regard to exact histologic features. In three of the 36 patients with inaccurate biopsy results, the findings were correct with regard to tumor histologic features but were incorrect with regard to tumor grade. If these findings are included as conditional true-positives, the accuracy for needle biopsy would be 83% (117 of 141). In only one patient did the biopsy yield results that were falsely positive for malignancy: a case of chronic osteomyelitis of the clavicle that was interpreted as possible lymphoma at both needle and open biopsy.

No infections resulted from needle biopsy. There also were no hematomas that required transfusion or evacuation or that altered subsequent surgical management.

Rate of Performance of Open Biopsy

Twenty-five (18%) patients underwent open biopsy after core-needle biopsy. In two of these patients, open biopsy was performed when the results of the needle biopsy were consistent with the final diagnosis but the level of confidence achieved with the material from needle biopsy was insufficient. One of these patients had an unusual parosteal lipoma of the ilium with associated cortical perforation and marrow edema; the other had a hemangioendothelioma of the calf that was thought to represent synovial sarcoma.

The results of open biopsy in four patients were concordant with the results of needle biopsy but were at variance with the final diagnoses after definitive surgical excision. These included the hemangioendothelioma of the leg mentioned in the preceding paragraph; a chondroblastic osteosarcoma of the sacrum, which was interpreted as a mesenchymal chondrosarcoma; an osteosarcoma of the femur, which was interpreted as aneurysmal bone cyst; and the chronic osteomyelitis of the clavicle mentioned earlier.

Open biopsy results in one patient were discordant with the final diagnosis with respect to tumor grade. A high-grade fibrosarcoma of the femur was interpreted as low grade at open biopsy, which was performed after the needle biopsy results were interpreted as indicative of benign histiocytoma.

Open biopsy results in two patients were inaccurate, although subsequent needle biopsy results were diagnostic: A sclerotic lesion of the ischium was inter-

TABLE 4
Final Diagnoses for 36 Inaccurate Biopsy Results

Diagnosis	No. of Patients
Histologic result	
Malignant fibrous histiocytoma	2
Osteosarcoma*	2
Chondroblastoma*	1
Chronic osteomyelitis*	1
Elastofibroma dorsi	1
Fibrosarcoma*	1
Hemangioendothelioma*	1
Hemangioma	1
Lipoma	1
Liposarcoma	1
Plantar fibroma	1
Synovial sarcoma	1
Grade	
Liposarcoma	2
Chondrosarcoma	1
Nondiagnostic biopsy result	
Non-Hodgkin lymphoma	3
Liposarcoma	2
Metastatic carcinoma	2
Malignant fibrous histiocytoma	2
Osteosarcoma	2
Pigmented villonodular synovitis	2
Ewing tumor	1
Ganglion	1
Giant cell tumor	1
Hemangioma	1
Mesenchymal chondrosarcoma	1
Paget sarcoma	1

* Open biopsy results also were inaccurate.

TABLE 5
Final Diagnoses for 25 Needle Biopsies Followed by Open Biopsy

Diagnosis	No. of Patients
Non-Hodgkin lymphoma	3
Malignant fibrous histiocytoma	3
Liposarcoma	2
Mesenchymal chondrosarcoma*	2
Metastatic carcinoma	2
Pigmented villonodular synovitis	2
Osteosarcoma*	2
Chondroblastoma*	1
Chronic osteomyelitis*	1
Fibrosarcoma*	1
Ganglion	1
Giant cell tumor	1
Hemangioendothelioma†	1
Hemangioma	1
Parosteal lipoma‡	1
Paget sarcoma	1

* Open biopsy results were inaccurate.
† Needle biopsy diagnosis proved to be accurate.
‡ Open biopsy results were inaccurate, but needle biopsy diagnosis proved to be accurate.

TABLE 6
Outcome of Needle Biopsy by Patient Subgroups

Subgroup	Accurate*	Effective*	Open Biopsy Performed	Total
Benign	39 (75)	43 (83)	8 (15)	52
Malignant	66 (74)	69 (78)	17 (19)	89
Prior surgery	20 (71)	22 (79)	4 (14)	28
No prior surgery	85 (75)	90 (80)	21 (19)	113
Bone lesion	41 (73)	42 (75)	12 (21)	56
Soft-tissue lesion	64 (75)	70 (82)	13 (15)	85
All cases	105 (75)	112 (79)	25 (18)	141

Note.—Number in parentheses is the percentage.
* Term defined in Materials and Methods.

TABLE 7
Distribution of Cases by Subgroups

Subgroup	Bone Lesion	Soft-Tissue Lesion	Total
Benign	20 (36)	32 (38)	52
Malignant	36 (64)	53 (62)	89
Prior surgery	8 (14)	20 (24)	28
No prior surgery	48 (86)	65 (76)	113
All cases	56	85	141

Note.—Number in parentheses is the percentage.

preted as Paget disease but proved to be B-cell lymphoma, and a recurrent liposarcoma of the proximal thigh was negative for malignancy at open biopsy but positive at CT-guided needle biopsy.

Given these seven diagnostic errors, the accuracy of open biopsy in this series was 72% (18 of 25). The histologic diagnoses for patients in whom open biopsy was performed are given in Table 5.

Effectiveness of Needle Biopsy

By using the definitions outlined in the Materials and Methods, where a needle biopsy followed by an open biopsy was considered to be ineffective regardless of the accuracy or results and where inaccurate needle biopsy results were considered to be effective if they were adequate to guide treatment, needle biopsy results were effective in 112 (79%) patients and ineffective in 29 (21%).

For the inaccurate biopsy results in 12 of 36 patients, treatment decisions were determined without performance of open biopsy. The effectiveness in these 12 patients was classified as follows: In nine patients, the results were classified as effective. In seven of these nine patients, needle biopsy results were correct with regard to malignancy, but there was a minor discordance with regard to specific histologic features. Appropriate excisions (of an angiolipoma and an elastofibroma) were performed in two of these seven patients, and appropriate wide resections were performed in the other five (lipoma-like liposarcoma, hemangioma of bone, high-grade liposarcoma, synovial sarcoma, and plantar fibroma). In two of the nine patients, there was concordance between biopsy results and histologic features but discordance with respect to tumor grade. In these patients, the treatment plan was unaltered: A large recurrent chondrosarcoma was diagnosed as low grade at needle biopsy but showed a focal grade II–III tumor after internal hemipelvectomy; a large, recurrent, fatty tumor of the thigh showed possible lipoma-like liposarcoma at needle biopsy, but, after wide resection, the final diagnosis was intermuscular lipoma with occasional atypical cells.

In three of the 12 patients who underwent needle biopsy but did not undergo subsequent open biopsy, the results were classified as ineffective. One patient had myxoid liposarcoma that was interpreted as low-grade myxoid liposarcoma at needle biopsy but showed focal grade II–III elements after wide excision; no chemotherapy was administered. A second patient had a large osteosarcoma of the pelvis and acetabulum, with osteoblastoma-like features at imaging. This lesion was misdiagnosed as osteoblastoma on the basis of needle biopsy results, and the patient underwent hemipelvectomy without preoperative chemotherapy. Finally, a third patient had a presumed recurrent Ewing tumor of the pelvis. This patient, who was in frail medical condition and was a poor surgical candidate, underwent palliative treatment with radiation therapy alone after nondiagnostic needle biopsy results were obtained.

Patient Subgroups

In the 56 patients with bone tumor, the results of core-needle biopsy were accurate in 41 (73%) and effective in 42 (75%). In the 85 patients with soft-tissue tumor, the results of core-needle biopsy were accurate in 64 (75%) and effective in 70 (82%). Open biopsy was performed in 12 (21%) patients after needle biopsy of bone tumor and in 13 (15%) after needle biopsy of soft-tissue tumor. There were no significant differences between soft-tissue and bone tumors in terms of accuracy ($P = .94$) and effectiveness ($P = .40$) of needle biopsy results and the rate of open biopsy ($P = .48$).

From the perspective of accuracy, effectiveness, and rate of performance of open biopsy, there were no significant differences between patients who did or did not undergo prior surgery ($P = .87$, $P > .99$, and $P = .78$, respectively) or between benign and malignant lesions ($P > .99$, $P = .61$, and $P = .74$, respectively). These results are summarized in Table 6.

Of the 28 patients who had undergone previous surgery, eight had a benign lesion, and 20 had a malignant lesion. The distribution according to subgroups (surgery vs no surgery, benign vs malignant) is given in Table 7. There were no significant associations between the site of tumor origin and the frequency of prior surgery ($P = .26$) or malignancy ($P > .99$).

DISCUSSION

Our findings indicate that percutaneous core-needle biopsy results were highly effective for help in the diagnosis of masses suspected to be primary musculoskeletal neoplasms and appeared to be equally effective for evaluation of lesions of either bone or soft tissue. In our series, core biopsy results were accurate in 74% of patients and effective in 79%. This accuracy reflects concordance for both histologic features and tumor grade. The effectiveness of core-needle biopsy was not significantly different for benign versus malignant lesions or for recurrent versus nonrecurrent lesions.

These accuracies for core-needle biopsy are comparable to those of similar studies. In the multicenter survey by Mankin et al (5) of bone and soft-tissue tumors in patients referred to major treatment centers, the accuracy of core-needle biopsy was 69% (43 of 62). In the experience of Heslin et al (1), core-needle biopsy findings resulted in the correct histologic diagnosis in 70% (42 of 60) of soft-tissue masses. In a combined series of suspected mesenchymal tumors of soft tissue and bone reported by Skrzynski et al (2), the accuracy of core-needle biopsy results for correct histologic features and tumor grade was 77% (48 of 62).

Our results reflect the effectiveness of

core-needle biopsy in the setting of an integrated, multidisciplinary, musculoskeletal tumor practice. The contribution of such an approach to improved outcomes is supported by results reported in the literature (5). An appropriate biopsy approach should be consistent with the anticipated surgical approach to the lesion. There is a small but well-documented risk of seeding the biopsy track with tumor cells that can compromise the success of definitive treatment, and the biopsy track should optimally be included in any surgical resection.

If the confidence in a needle biopsy–based diagnosis is not sufficiently high to facilitate the often difficult management decisions posed in cases of suspected mesenchymal neoplasm, performance of open biopsy may be warranted even when the needle biopsy result is correct. For this reason, the effectiveness of percutaneous needle biopsy should account for the rate of subsequent open biopsy. Open biopsy after core-needle biopsy was necessary in 18% of the patients in our series. This rate was slightly but not significantly higher for tumors that involved bone, as compared with those that involved soft tissue (21% and 15%, respectively). This overall rate of the performance of open biopsy could be biased. Although the results of needle biopsy may obviate open biopsy, lingering uncertainty in diagnosis may prompt the evaluation of frozen sections during a subsequent excisional procedure. Such ''conditional excisions'' were not considered to be open biopsies in our analysis. These procedures usually constituted the definitive treatment for typically benign but clinically problematic masses, and needle biopsy was of assistance in treatment decision making in such cases.

According to the criteria we used for needle biopsy, the results of open biopsy had a surprisingly low accuracy (72%) in our series. Open biopsy, when used as a front-line diagnostic strategy, yields results with a reported (2) accuracy of 96% (48 of 50). This difference undoubtedly reflects selection bias, because only those patients with problematic or confusing needle biopsy results underwent open biopsy in our series. Nevertheless, an accuracy of 100% for open biopsy is likely too high in theoretic analyses of cost-effectiveness (6).

Some authors (2) have suggested that percutaneous needle biopsies are more effective for bone tumors than for soft-tissue tumors. The more specific manifestation of bone tumors on radiographs may narrow the differential diagnosis for the pathologist. However, MR imaging now provides greater specificity in the evaluation of soft-tissue masses prior to biopsy. From our perspective, technical factors probably are the most critical to the outcome of needle biopsy. Large-gauge core-needle biopsy, performed with a coaxial technique, of soft-tissue masses can yield a generous quantity of tissue quickly and with little morbidity. The ability to obtain multiple biopsy specimens is intrinsically more limited with bone lesions, especially those that are sclerotic, even when a large-gauge coaxial tool is used. An equivalent specimen yield may necessitate additional cortical approaches, something we routinely avoid to minimize procedure time and patient discomfort.

Although fine-needle aspiration biopsy of suspected bone metastases (6,7) yields accurate results and is cost-effective, the utility of cytologic diagnosis for primary mesenchymal tumors is more questionable. Published data are difficult to interpret, because studies often differ in their definitions of effectiveness. A diagnostic accuracy as high as 76% (51 of 67) has been reported (3) for the fine-needle aspiration biopsy diagnosis of primary bone tumor. In the same report, however, a large but unspecified proportion of fine-needle aspiration biopsies were followed by open surgical biopsies. Such needle biopsies would be considered ineffective according to our criteria. The diagnostic accuracy of fine-needle aspiration biopsy in another series (8) of 101 primary bone tumors was 61%, but the effective accuracy was 41%. In a series (9) of 117 soft-tissue tumors, fine-needle aspiration biopsy results were diagnostically adequate in 63%. However, in another series (10) of 52 sarcomas (46 soft-tissue and six bone lesions), fine-needle aspiration biopsy resulted in a correct histologic diagnosis in only 21% of cases. A prospective and paired analysis (11) of soft-tissue tumors confirmed a higher accuracy for core-needle biopsy results than for fine-needle aspiration biopsy results. Hence, as an evaluation method for possible primary musculoskeletal tumors, fine-needle aspiration biopsy might be cost-effective only if performed without imaging guidance, perhaps as part of the initial office examination.

In the evaluation of primary musculoskeletal neoplasms, the cost-benefit ratio of core-needle biopsy appears to be favorable (2,6). A needle biopsy can be performed expeditiously, and, in cases of a large mass, imaging guidance may not be essential (2). Our preference has been to use CT guidance. In conjunction with preprocedural MR imaging, CT facilitates appropriate sampling of heterogeneous lesions and helps select a trajectory that is safe and consistent with the anticipated surgical approach. With the confidence in approach and localization afforded by CT, large-gauge needle biopsy can be performed quickly and without the use of sedation, factors that further reduce costs.

In summary, our experience indicates that percutaneous core-needle biopsy is effective for the diagnostic evaluation of suspected primary musculoskeletal neoplasms, whether of bone or soft tissue. Open biopsy can be obviated in the majority of cases. Although percutaneous core-needle biopsy of a suspected primary musculoskeletal neoplasm is potentially safe, accurate, and cost-efficient, it is still less accurate and more demanding than needle biopsy of a suspected metastasis. Biopsy of a suspected primary musculoskeletal mass should be used judiciously and preferably as part of a multidisciplinary team approach to orthopedic tumor management.

Acknowledgments: We thank Cecilia Yap, BS, for her dedicated assistance in data collection and organization and Xin Li, MS, for his innovative integration of the computer information systems that were used in retrieval of patient data.

References

1. Heslin MJ, Lewis JJ, Woodruss JM, Brennan MF. Core needle biopsy for diagnosis of extremity soft tissue sarcoma. Ann Surg Oncol 1997; 4:425–431.
2. Skrzynski C, Biermann JS, Montag A, Simon MA. Diagnostic accuracy and charge-savings of outpatient core needle biopsy compared with open biopsy of musculoskeletal tumors. J Bone Joint Surg [Am] 1996; 78:644–649.
3. Kreichbergs A, Bauer HCF, Brosio O, Lindholm J, Skoog L, Soderlund V. Cytological diagnosis of bone tumors. J Bone Joint Surg [Br] 1996; 78:258–263.
4. Tehranzadeh J, Freiberger RH, Ghelman B. Closed skeletal needle biopsy: review of 120 cases. AJR 1983; 140:113–115.
5. Mankin HJ, Mankin CJ, Simon MA. The hazards of the biopsy, revisited: members of the Musculoskeletal Tumor Society. J Bone Joint Surg [Am] 1996; 78:656–663.
6. Fraser-Hill MA, Renfrew DL, Hilsenrath PE. Percutaneous needle biopsy of musculoskeletal lesions. II. Cost-effectiveness. AJR 1992; 158:813–818.
7. Fraser-Hill MA, Renfrew DL. Percutaneous needle biopsy of musculoskeletal lesions. I. Effective accuracy and diagnostic utility. AJR 1992; 158:809–812.
8. Layfield LJ, Armstrong K, Zaleski S, Eckardt J. Diagnostic accuracy and clinical utility of fine-needle aspiration cytology in the diagnosis of clinically primary bone lesions. Diagn Cytopathol 1993; 9:168–173.
9. Bennert KW, Abdul-Karim FW. Fine needle aspiration cytology versus needle core biopsy of soft tissue tumors: a comparison. Acta Cytol 1994; 38:381–384.
10. Costa MJ, Campman SC, Davis RL, Howell LP. Fine-needle aspiration cytology of sarcoma: retrospective review of diagnostic utility and specificity. Diagn Cytopathol 1996; 15:23–32.
11. Barth RJ Jr, Merino MJ, Solomon D, Yang JC, Baker AR. A prospective study of the value of core needle biopsy and fine needle aspiration in the diagnosis of soft tissue masses. Surgery 1992; 112:536–543.