Evaluation of the Adult Patient (Aged >40 Years) With a Destructive Bone Lesion

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Abstract

More than one half of cancer patients are likely to develop bone metastasis; thus, most orthopaedic surgeons will be presented with an adult patient with a destructive bone lesion. Proper management requires comprehensive patient evaluation, including history, physical examination, laboratory studies, and radiographic staging. Biopsy should be done in the patient with a possible malignant or metastatic tumor. The differential diagnosis of destructive bone lesions in patients aged >40 years includes metastatic bone disease, multiple myeloma, lymphoma, and, less commonly, primary bone tumors. Inaccurate diagnosis and improper treatment may adversely affect limb or life. Adherence to oncologic principles during the evaluation process aids in minimizing a negative outcome.

Most destructive bone lesions in adult patients are the result of malignant tumors. The incidence rates of cancer in all sites and deaths resulting from cancer for both men and women have stabilized in the past 10 years. Even so, more than 1.47 million new patients with cancer and >562,000 cancer-related deaths were predicted for 2009. More than 50% of patients with cancer are likely to develop bone metastasis; thus, most orthopaedic surgeons will see this problem in their practices. As the use of chemotherapeutic and biologic treatments of various cancers results in longer life span, patients will be living longer with bone metastasis. This reality underscores the need for orthopaedic surgeons to know how to properly evaluate patients with metastatic bone disease. In contrast, fewer than 2,400 patients present with primary bone and joint malignancies each year, and it is crucial to understand the different treatment methods and goals for patients with these tumors. The clinical evaluation of a patient aged >40 years who presents with a destructive bone lesion includes a careful history, physical examination, imaging workup, biopsy strategy, and final staging. The differential diagnosis includes metastatic bone disease, multiple myeloma, lymphoma, primary malignant bone tumor, destructive benign bone lesion, and nonneoplastic conditions. Metastatic carcinoma is the most common diagnosis of a destructive bone lesion in patients aged >40 years. Osteomyelitis and manifestations of metabolic bone disease can also produce destructive lesions, and they should be included in the differential diagnosis. However, we focus primarily on neoplastic conditions. Most important to note is that primary malignant bone tumors do oc-
in this age group, although less commonly than the other conditions discussed.

The goals of treatment in patients with metastatic bone disease and those with primary malignant bone tumors are usually quite different. For patients with metastatic bone disease, the goal of treatment is palliative, with a focus on improving function and decreasing pain; for patients with primary malignant bone tumor, the goal is curative. It is important to recognize the difference between these two categories of lesions and to treat each patient appropriately. A careful, stepwise approach to the treatment of the adult patient with a destructive bone lesion is needed to minimize the possibility of compromising life or limb. Pitfalls can be avoided by taking great care in diagnosing and managing certain conditions.

### Presentation and Patient History

Progressive pain is the most common presentation in patients with destructive bone lesions (Table 1). The patient may report that the pain was initially temporally related to an injury or to overuse but that it did not resolve with symptomatic treatment such as nonsteroidal anti-inflammatory drugs, ice, or decreased activity. It is important to ask detailed questions about the nature, timing, intensity, and duration of the patient’s pain. Pain classically occurs at rest and at night, as well as on weight bearing. A malignant lesion may be painful in and of itself, but tumor-induced osteolysis can also result in a weakened biomechanical construct that is prone to painful microfractures with activity.1,4

The physician should query the patient about symptoms of spinal cord or nerve root compression, such as saddle anesthesia, incontinence, and myelopathic manifestations. Primary sacropelvic tumors such as chordrosarcoma and chordoma can present with a change in bowel habits or numbness in the lower extremities. Patients should be asked whether they require assistive devices for ambulation. A patient may present with constitutional symptoms such as fatigue, loss of appetite, or unintended weight loss. It is appropriate to ask about smoking history, exposure to chemicals (ie, asbestos), and diet.

The clinician should ask about symptoms related to possible primary sites of disease that commonly metastasize to the bone. For example, shortness of breath, pleuritic chest pain, hemoptysis (lung); intolerance to hot or cold (thyroid); and urinary pain and changes in frequency (prostate) or rectal bleeding and/or change in bowel habits (colorectal) can suggest underlying abnormalities. The physician should ascertain whether the patient has noted any new or changing skin lesions, which are suggestive of melanoma, or enlarging soft-tissue masses.

It is important to ask whether there is a personal history of cancer. A patient may not think to tell the clinician about cancers that she or he presumes to be cured (eg, breast, cervical, thyroid, prostate, kidney, lymphoma). Primary carcinomas from these sites can take 10 to 15 years to metastasize, so it is important for the physician to ask about these specific cancers. In addition, treatment of prior cancers with radiation or chemotherapy can predispose patients to

### Table 1

<table>
<thead>
<tr>
<th>Key Points in the History and Physical Examination of an Adult With a Destructive Bone Lesion</th>
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<tbody>
<tr>
<td>History</td>
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<tr>
<td>Progressive, unrelenting pain</td>
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<tr>
<td>Pain that does not resolve with symptomatic treatment</td>
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<td>Pain classically at rest, at night, and on weight bearing</td>
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<tr>
<td>Constitutional symptoms (eg, fatigue, loss of appetite, weight loss)</td>
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<tr>
<td>Inquire about the use of ambulatory assistive devices</td>
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<tr>
<td>Inquire about smoking history, chemical exposure (eg, asbestos), diet</td>
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<tr>
<td>Inquire about shortness of breath, pleuritic chest pain/hemoptysis, hot/cold intolerance, urinary pain/frequency, change in bowel habits/rectal bleeding</td>
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<tr>
<td>Inquire about new/changing skin lesions or enlarging soft-tissue masses</td>
</tr>
<tr>
<td>Document dates of most recent mammogram, Pap smear, prostate examination, colonoscopy</td>
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<tr>
<td>Inquire about the use of ambulatory assistive devices</td>
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subsequent cancers, such as sarcoma or leukemia, respectively. As appropriate, the patient should be asked about the dates of her or his most recent mammogram, Pap smear, prostate examination, or colonoscopy. Pertinent family history should be obtained because certain cancers can be hereditary (eg, breast, colon).

**Physical Examination**

The patient with a destructive bone lesion may or may not have obvious physical findings, depending on the site and/or extent of the lesion. Each patient should be carefully evaluated for the presence of swelling or a soft-tissue mass in the extremities, chest wall, or abdomen/pelvis. The patient may present with a limp, decreased joint range of motion, or neurologic compromise. The most common site of skeletal metastasis is the thoracic spine; sensory or motor deficit may be the first presenting sign. Reflexes should be thoroughly evaluated and a rectal examination performed. Possible primary sites of disease must be checked in patients with presumed bone metastasis, including the breast, prostate, thyroid, and abdomen. Costovertebral angle tenderness may be suggestive of a kidney mass. Careful lymphatic evaluation in the cervical, axillary, and inguinal regions can detect lymphoma. A stool guaiac test should be performed.

**Laboratory Studies**

Laboratory studies are not often definitive for a diagnosis of a primary malignant bone tumor or metastatic disease. However, they may be helpful in focusing the treatment once a particular diagnosis has been suggested (eg, lymphoma, breast cancer, lung cancer). A complete blood count, urinalysis, and chemistry panel that includes blood urea nitrogen, creatinine, lactate dehydrogenase, albumin, calcium, phosphorus, and alkaline phosphatase values should be performed. Determination of erythrocyte sedimentation rate and C-reactive protein level may be helpful when osteomyelitis is included in the differential diagnosis. Patients with advanced metastatic cancer and those with multiple myeloma may be anemic. They may also have hypercalcemia and a low albumin level, the latter as a result of poor nutritional status. Laboratory results have implications for systemic care of the patient. Leukemia can present with a markedly elevated white blood cell count and an abnormal differential. Metabolic diseases may be identified by abnormal serum or urine calcium and phosphorus values, necessitating further workup for osteomalacia, rickets, and hyperparathyroidism. A markedly elevated alkaline phosphatase level may suggest Paget disease. Microscopic hematuria is often found in patients with renal cell carcinoma. When multiple myeloma is suspected, a serum and urine electrophoresis with immunofixation may confirm the diagnosis. In this disease, β2 microglobulin and lactate dehydrogenase levels are also elevated. Patients with multiple myeloma may also present with impaired renal function because of the presence of Bence Jones protein. Specific blood tests or markers can be ordered to evaluate primary sites of disease, such as thyroid function tests, prostate-specific antigen, carcinoembryonic antigen (colon, pancreas), and cancer antigen 125 (ovaries).

**Imaging Studies**

**Lesion Appearance**

The most common destructive lesions in patients aged >40 years are related to systemic diseases such as bone metastasis, multiple myeloma, and lymphoma. Primary bone tumors have unique characteristics depending on the specific diagnosis. Most bone lesions that manifest in systemic disease are osteolytic (Figure 1). These include lymphoma, multiple myeloma, and bone metastasis from the lung, kidney, thyroid, and colon. The cortical and medullary portions of the bone are destroyed, with no visible matrix present. Osteolytic cortical metastases are found most commonly in patients with lung cancer. Osteoblastic lesions are present in patients with metastatic breast or prostate cancer. These lesions can be confused radiographically with osteosarcoma or chondrosarcoma, both of which produce a mineralized matrix. Patients with end-stage prostate cancer can have osteolytic bone lesions, but usually the diagnosis is not in question. Bone metastases from breast cancer can have a mixed osteolytic and os-
Batson vertebral plexus is likely the pathway by which prostate cancer cells distribute preferentially to the pelvis and spine. This plexus involves a longitudinal set of veins that run parallel to the vertebral column and allow retrograde flow to bypass the caval system. Metastatic disease generally spares the intervertebral disk; this knowledge is helpful in differentiating metastatic disease from osteomyelitis. Metastatic bone lesions noted distal to the elbow or knee are referred to as acral metastases. These lesions most commonly originate in the lung. Avulsion of the lesser trochanter implies a pathologic process within the femoral neck and is suggestive of a high risk of fracture.

**Radiographic Workup**

The most important initial imaging strategy is to obtain plain radiographs in two planes for any painful lesion. Referred pain should be considered; knee or hip symptoms may be the result of vertebral lesions, and knee pain may stem from a proximal femoral lesion. When surgical intervention is planned, the entire bone must be imaged to aid in proper surgical selection. For instance, a short-stemmed hip prosthesis might be the wrong implant in the patient with extensive mid and/or distal femoral disease. For a patient with a known diagnosis of multiple myeloma or bone metastasis, plain radiographs may indicate the need for surgical management if they reveal a destructive lesion or lesions causing an actual or impending pathologic fracture. Additional three-dimensional imaging of the bone lesion is generally not necessary unless the diagnosis is a primary malignant bone tumor, such as an osteosarcoma or a chondrosarcoma. A notable exception is when vertebral disease requires more precise definition in preparation for radiation or surgical treatment. It is also difficult to differentiate vertebral osteoporosis from metastatic bone disease on radiographs in the patient with a compression fracture. In this situation, a CT scan or magnetic resonance image can delineate pedicle destruction or a soft-tissue mass, both of which suggest a neoplastic process.

Additional imaging studies are necessary to adequately determine the stage of disease in a patient with a possible primary bone tumor and to identify the primary site of disease in a patient with metastatic bone disease. A CT scan of the chest, abdomen, and pelvis is appropriate in a patient whose diagnosis is uncertain. In one study, CT identified the primary site of disease in 28% of patients with metastatic bone disease. CT also may be helpful in identifying metastatic lesions to the viscera or spine in patients with primary bone sarcomas or metastatic bone disease. A technetium Tc-99m total body bone scan is helpful in identifying additional bony sites of disease (Figure 2). This imaging study detects osteoblastic activity; thus, it may indicate a false-negative result in the patient with multiple myeloma or, occasionally, in the patient with renal cell carcinoma metastasis or any other lesion with minimal osteoblastic response. Conversely, a pathologic fracture site may be positive, even though the underlying prefracture lesion may have been negative. A skeletal survey (ie, radiographs of the long bones, pelvis, spine, and skull) should be performed for the patient with a presumed or known diagnosis of multiple myeloma. These imaging strategies for patients with a destructive metastatic bone lesion identify the primary site in 85% of cases.

The use of fluorodeoxyglucose-positron emission tomography is not warranted for staging when a diagnosis has not been made. However, this modality has been shown to be
helpful in combination with CT scans for determining the extent of disease in patients with lymphoma, and it can be used to monitor treatment response.7

**Differential Diagnosis**

Metastatic bone disease is at the top of the list in the differential diagnosis of an adult patient aged >40 years with a destructive lesion. Multiple myeloma and lymphoma are the next most likely possibilities. Much farther down the list are primary malignant bone tumors, including chondrosarcoma, malignant fibrous histiocytoma (MFH), chordoma, and osteosarcoma. The patient with a history of prior radiation treatment or Paget disease may rarely develop a secondary sarcoma in those specific anatomic sites. Destructive benign bone lesions, such as giant cell tumor, can also occur in adults. Nonneoplastic conditions, including hyperparathyroidism, osteoporosis (eg, pelvic stress fracture, sacral stress fracture), osteomyelitis, metabolic bone disease, and Gorham vanishing bone disease, can cause osteolytic lesions or pathologic fracture (Figure 3).

### Biopsy Considerations

Unless the diagnosis of a destructive bone lesion is absolutely certain, biopsy must be performed to obtain diagnostic tissue.2 Surgical stabilization of a presumed bone metastasis can compromise a patient’s limb if the diagnosis is found to be a primary bone sarcoma. There are multiple ways to perform a biopsy, including image-guided fine-needle aspiration, core biopsy, and open incisional biopsy. For the patient who presents at an institution staffed by musculoskeletal radiologists and pathologists experienced at obtaining and evaluating small samples of tissue, fine-needle aspiration or core biopsy can be done with minimal inconvenience to the patient and without general anesthesia. Needle biopsy reduces the potential for contamination of the tumor site.8

Proper oncologic principles should be followed when performing an open incisional biopsy. The incision should be as small as possible and should be oriented in a longitudinal fashion with minimal disruption to the surrounding tissues. Hemostasis should be maintained during the procedure with the use of electrocautery or bone wax so that a drain is not necessary. In 1996, Mankin et al8 described the potential complications related to biopsies that are not performed in an oncologically safe manner. These complications include diagnostic errors, change in the treatment plan, increased local recurrence, and unnecessary amputation. The lesional tissue is often studied with immunohistochemical stains, which can suggest a specific diagnosis, such as lung cancer (thyroid transcription factor-1 [TTF-1]), thyroid cancer (TTF-1, thyroglobulin), breast cancer (estrogen receptor/progesterone receptor), prostate cancer (prostate-specific antigen, prostate-specific acid phosphatase), melanoma (S-100 protein, HMB45), or lymphoma (CD20, CD45, CD3, CD30).

Once a diagnosis has been established and the imaging workup has been completed, the surgeon can identify the stage of the primary malignant bone tumor (Table 2). All patients with metastatic bone disease, multiple myeloma, or systemic lymphoma are considered to have American Joint Com-
Committee on Cancer stage IV disease. For the patient with primary malignancy of bone or in any other situation in which the evaluating surgeon feels uncomfortable administering the treatment, the patient should be referred to a center with experts in musculoskeletal oncology.

Further evaluation is needed in some situations. For example, a patient who presents with multiple destructive bone lesions in the setting of extensive lymphadenopathy may require a lymph node biopsy to enable the surgeon to make the diagnosis of lymphoma. Similarly, an older patient may present with multiple vertebral lesions, and a staging workup may reveal a large spiculated lung mass that should raise suspicion of lung cancer. If there is a more easily accessible bone lesion in the clavicle, the clavicle lesion should be sampled to make the diagnosis of metastatic lung cancer.

Common Scenarios

A stepwise evaluation is presented below for four common scenarios.

A thorough history, physical examination, and laboratory evaluation should be performed prior to beginning each evaluation. The steps do not have to be completed in the order in which they are listed. For instance, in certain situations, a biopsy might be performed before complete staging.

No History of Cancer: Solitary Destructive Bone Lesion

The surgeon should obtain radiographs of the lesion. As part of the imaging staging workup, a CT scan of the chest, abdomen, and pelvis should be ordered, and a bone scan should be done. Needle or open biopsy of the solitary bone lesion should be performed.

Even without a history of cancer, patients aged >40 years are likely to have metastatic bone disease. Whether the workup reveals extensive visceral disease or a likely primary site (eg, spiculated lung lesion, large renal mass), a solitary bone lesion requires a biopsy (Figure 4).

American Joint Committee on Cancer Classification System for Primary Bone Tumors

<table>
<thead>
<tr>
<th>Stage</th>
<th>Grade</th>
<th>Size/Depth</th>
<th>Regional Node</th>
<th>Metastasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>G1, G2</td>
<td>T1 (&lt;8 cm)</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>IB</td>
<td>G1, G2</td>
<td>T2 (&gt;8 cm)</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>IIA</td>
<td>G3, G4</td>
<td>T1 (&lt;8 cm)</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>IIB</td>
<td>G3, G4</td>
<td>T2 (&gt;8 cm)</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>III</td>
<td>Any</td>
<td>T3 (discontinuous tumor or skip metastasis)</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>IVA</td>
<td>Any</td>
<td>Any</td>
<td>N1</td>
<td>M0</td>
</tr>
<tr>
<td>IVB</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
<td>M1</td>
</tr>
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a G1 = well differentiated, G2 = moderately differentiated, G3 = poorly differentiated, G4 = undifferentiated
b N0 = no nodal metastasis, N1 = nodal metastasis
c M0 = no distant metastasis, M1 = distant metastasis


History of Cancer: Solitary Destructive Bone Lesion

Radiographs of the lesion should be obtained. The imaging staging workup should include a CT scan of the chest, abdomen, and pelvis as well as a bone scan. Needle or open biopsy of the solitary bone lesion should be performed.

The patient with a history of cancer is even more likely to have bone metastasis when she or he presents with a destructive solitary bone lesion. The standard staging workup should be performed. Biopsy should be performed to establish a histologic diagnosis.

History of Cancer: Multiple Visceral Metastases and Bone Lesions

The patient with a history of cancer and with multiple visceral metastases and bone lesions can be treated surgically for the destructive bone lesion without undergoing preoperative biopsy. During the surgical procedure, tissue from the lesion (eg, reamings) can be sent to the pathology department for documentation of the specific disease. However, if the particular destructive bone lesion that is causing pain or placing the patient at risk for fracture has a radiographic appearance that is strongly suggestive of a primary bone sarcoma, a biopsy should be performed even though it is not likely to alter the overall prognosis.

Possible Pathologic Femur Fracture

In the patient who presents with a femoral fracture, the surgeon should obtain a careful history of how the fracture occurred. For example, pathologic fracture is more likely if there was antecedent pain or if the fracture occurred after a low-energy injury. If skeletal traction is helpful in relieving pain and maintaining bone length while the workup is be-
ing performed, a tibial traction pin should be placed following images of the proximal tibia. Femoral radiographs should be carefully evaluated for an underlying lesion. A CT scan of the chest, abdomen, and pelvis should be ordered. CT of the primary bone site should also be done for the purpose of staging and to better evaluate the bone site. In this situation, CT is done rather than MRI because the patient may be in too much pain to undergo MRI.

Depending on the outcome of the aforementioned steps, the surgeon should perform a needle biopsy of the fracture site or an open biopsy with a frozen section in the operating room. Both of these techniques must be done by an expert musculoskeletal pathologist, who can differentiate a lesion from fracture hematoma or callus.

When a definitive diagnosis of metastatic disease, myeloma, or lymphoma is obtained, surgical stabilization with a locked intramedullary femoral reconstruction nail can be performed. If the frozen section is equivocal, definitive treatment should be postponed until a final diagnosis is made. If the frozen section is consistent with sarcoma, the surgeon should postpone the definitive surgery and proceed with neoadjuvant therapy. If the staging workup revealed numerous visceral and bone lesions, it is reasonable to proceed with surgical stabilization, and tissue can be sent for permanent pathologic section.

**Key Points Regarding Specific Diagnoses**

Metastatic bone disease is the most common cause of a destructive bone lesion in patients aged >40 years (Figure 5). The most common primary sites of this cancer are the breast, prostate, lung, thyroid, and kidney. Effective primary treatments for patients with breast, prostate, and thyroid cancer include chemotherapy, hormonal agents, and radioactive iodine (for the thyroid). Patients with bone metastasis from these sites can live for longer than 10 years with their disease. Patients with lung cancer that metastasizes to bone typically have a shorter life span (<6 months), which can affect the choice of surgical treatment.

Bone metastases from most sites are sensitive to localized external beam radiation performed as primary local treatment or as a postoperative adjuvant; this treatment is administered to decrease the likelihood of disease progression and to relieve pain. Renal cell carcinoma is more resistant to radiation and chemotherapy than are the other cancers listed above. New antiangiogenic agents in clinical trials show some promise for increasing overall survival in patients with metastatic renal cell carcinoma, but surgical treatment is often required in bone lesions of the extremities. Bisphosphonates are now used for most patients with bone metastasis, and these agents have been shown to decrease the number of adverse skeletal events in patients with breast cancer.

It is important to remember that it is the osteoclast, not the tumor cell, that resorbs the underlying bone. Osteoclast differentiation and subsequent activation occurs most commonly via the receptor activator of nuclear factor-κB (RANK) and RANK ligand (RANKL) pathway, which can be directly or indirectly stimulated by tumor-secreted factors. The most vascular lesions are bone metastases from the kidney and thyroid. Preoperative embolization of bone lesions in patients with these
cancers can minimize potentially dangerous intraoperative blood loss\textsuperscript{15} (Figure 6).

Multiple myeloma is a systemic disease that affects the bone marrow. Occasionally, patients have solitary lesions without marrow involvement, called plasmacytomas. The bone lesions in myeloma are identified by skeletal survey and present as round, punched-out osteolytic areas in the extremities, pelvis, and spine (Figure 7). Patients frequently present with pathologic fracture, especially in the spine. Bone marrow biopsy is an important part of staging multiple myeloma. Nonsurgical treatment involves cytotoxic chemotherapy along with corticosteroids, autologous stem cell transplantation, and external beam radiation. Vertebroplasty and kyphoplasty are frequently used to treat painful pathologic compression fractures.\textsuperscript{16} Bone lesions often involve the entire femur or humerus; thus, intramedullary devices are key in surgical treatment.\textsuperscript{17} The 5-year survival rate for patients with multiple myeloma is 34\%.\textsuperscript{1}

Lymphoma is a systemic disease with frequent bone involvement. There are multiple subtypes, but the non-Hodgkin (B cell) variant is most common in the bone. Rarely, the disease can affect a solitary bony site with no other manifestations. Identifying the lesion can be difficult because plain radiographs often appear to be normal or demonstrate subtle permeative destruction (Figure 8). Because lymphoma is a small round blue cell lesion, it is more likely to cause a large soft-tissue mass and appear as relatively innocuous bone destruction on plain radiographs. Needle biopsies of lymphoma have a higher than normal nondiagnostic rate because the specimens are frequently crushed, and more extensive tissue is required for flow cytometry analysis. Chemotherapy is the primary treatment modality for lymphoma. Occasionally, external beam radiation is required in a site with extensive bone destruction. With effective treatment, bone stock is restored, and surgical intervention typically is not necessary. The 5-year survival rate for patients with disseminated non-Hodgkin B cell lymphoma is 64\%.\textsuperscript{1}

Primary malignant bone tumors, such as chondrosarcoma, chordoma, osteosarcoma, and MFH can occur in the patient aged >40 years.\textsuperscript{18} Chondrosarcoma and chordoma occur regularly in adults, whereas MFH can occur at any age. Osteosarcoma occurs primarily in children, although it has a bimodal incidence peak. The skeletal location and radiographic appearance of these tumors vary. Following a full radiographic workup, a biopsy should be performed to determine the final diagnosis. Chondrosarcoma occurs most commonly in the pelvis and can be overlooked in the older patient with mild hip arthritis. It has an osteolytic appearance with intramedullary calcifications and can occur as an intramedullary or surface lesion (Figure 4). Chondrosarcoma is managed with wide surgical resection because chemotherapy and radiation are not effective.

Chordomas occur primarily in the sacrum, with a subset appearing in the skull base and mobile spine. These are central osteolytic lesions with occasional calcifications and a distinctive histologic appearance. Chordomas are managed with wide surgical resection and adjuvant radi-
ation when a clear margin cannot be obtained. There is no effective chemotherapy for this disease.

Osteosarcoma occurs primarily in the metaphysis of long bones and has a classic radiographic appearance of bone formation and destruction. MFH occurs in the same locations but is usually purely osteolytic in appearance. Both osteosarcoma and MFH are managed with neoadjuvant chemotherapy followed by wide surgical resection and postoperative chemotherapy.

**Pitfalls**

Several common pitfalls should be avoided in the evaluation of an adult patient with a destructive bone lesion. First, a negative bone scan should not be interpreted as indicating that there are no additional lesions. The patient may have multiple myeloma or aggressive osteolytic metastasis, and a skeletal survey should be performed if myeloma is suspected. Second, the entire femur must be imaged before a patient is taken to the operating room for stabilization of a pathologic femoral neck fracture. This is relevant for any long bone lesions for which a diaphyseal or distal lesion might influence the choice of prosthesis. Third, biopsy should be done before placing a locked intramedullary femoral nail in a patient with a solitary femoral diaphyseal lesion and impending fracture (Figure 4). For example, suppose that the lesion contains some mineralization and that the patient has a history of prostate cancer treated 10 years previously. It would be dangerous to presume that this solitary lesion is metastatic prostate cancer. Instead, biopsy should be performed to avoid potential contamination of a dedifferentiated chondrosarcoma. Finally, lack of careful evaluation of an osteolytic acetabular lesion in an older patient with hip pain can lead to an incorrect diagnosis of degenerative joint disease rather than chondrosarcoma. It would be a mistake to perform total hip replacement in such a patient without evaluating for primary bone malignancy.

**Figure 7**

AP radiograph of the pelvis in a 40-year-old man demonstrating a destructive lesion in the left ilium (arrows). The workup revealed a positive serum and urine protein electrophoresis, and bone marrow biopsy was consistent with multiple myeloma. A skeletal survey revealed multiple bone lesions, and a needle biopsy of the left ilium lesion revealed numerous plasma cells.

**Figure 8**

A, AP radiograph of the left distal femur in a 44-year-old man demonstrating a probable enchondroma but no other obvious abnormalities. Coronal T1-weighted (B) and short tau inversion recovery (C) magnetic resonance images demonstrating extensive marrow infiltration suspicious for malignancy. Open biopsy was required, and the patient was diagnosed with diffuse B cell (non-Hodgkin) lymphoma.

**Treatment Overview**

The comprehensive treatment of patients with metastatic bone disease or...
Improvements in the use of chemotherapy agents, biologic therapies, bisphosphonates, radiation therapy, and interventional techniques (eg, radiofrequency ablation, cryoablation) can ameliorate various diseases and enhance the quality of life or prolong life. Improved understanding of the biomechanics of long bones and vertebrae affected by cancer metastasis allows the surgeon to predict the risk of pathologic fracture and act accordingly. Surgical stabilization of long bones and the spine in patients with metastatic disease involves specific oncologic principles that may differ from standard fracture care. The goals of management are palliative, and the focus is on decreasing pain and improving function (ie, immediate weight bearing) as well as on avoiding more than one surgical procedure at any given metastatic site when possible. The use of methylmethacrylate, intramedullary fixation, megaprostheses, and new spinal surgical approaches may enhance the likelihood of achieving these goals (Figure 9). In contrast, the goal in the treatment of patients with primary malignancies of bone is curative.

Summary

A logical, stepwise evaluation is required to obtain the correct diagnosis and proceed with appropriate treatment in the patient aged >40 years with a destructive bone lesion. The process starts with a thorough history and physical examination, followed by focused laboratory testing and radiographic staging. If the diagnosis is not certain after completing these steps, a diagnostic biopsy of the lesion is required. The differential diagnosis of a destructive bone lesion in a patient aged >40 years includes metastatic bone disease, multiple myeloma, lymphoma, and, less likely, primary malignant bone tumors. Although primary bone tumors are less likely to occur in this age group, an optimal outcome can occur if the wrong surgical treatment is initiated based on inadequate data. Careful attention to the evaluation process increases the likelihood of initiating appropriate treatment. If the workup suggests that the destructive bone lesion is a primary malignant bone tumor or if another diagnosis is made that is outside the scope of practice of the evaluating surgeon (ie, orthopaedic surgeon without focused oncologic training), the surgeon should refer the patient to a center in which there are experts in musculoskeletal oncology.

References

Citation numbers printed in bold type indicate references published within the past 5 years.


Figure 9

A, AP radiograph of the right humerus in a 60-year-old man with metastatic renal cell carcinoma. The patient had persistent pain despite external beam radiation, and the disease progressed despite systemic therapy. A purely osteolytic lesion affecting >50% of the cortex is evident. B, AP radiograph obtained after curettage and cement augmentation of the osteolytic lesion and stabilization of the humerus with an intramedullary locked rod.


