



## MUSCULOSKELETAL TUMOR BIOPSY: II. CHOOSING THE APPROPRIATE TECHNIQUE

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**T**he primary goal of biopsy is to obtain adequate tissue to establish a diagnosis.<sup>1</sup> Yet, many other factors need to be considered, and the primary goal should be achieved while minimizing the risk of morbidity to the patient. If one considers the primary goal alone, the biopsy itself requires few skills.<sup>2</sup> Given the potential morbidity and mortality associated with a poorly performed biopsy, it is apparent that significant experience and planning are required to minimize complications.<sup>3</sup>

The hazards of a poorly performed biopsy have been the subject of several articles, yet such biopsies continue to cause a significant amount of morbidity.<sup>4-6</sup> A poorly performed biopsy can significantly compromise the subsequent management and long-term outcome of the patient. In a study addressing the hazards associated with biopsy, Mankin and colleagues reported that 19% of biopsies were problematic, resulting in a changed treatment plan, and 10% of biopsies had a substantial change in long-term outcome as a result of problems.<sup>4</sup> Consequences of a poorly performed biopsy include alteration in treatment, need for an amputation in a patient who would otherwise be managed with limb salvage, delays in treatment, additional and more extensive subsequent surgeries, and possibly increased risk of local recurrence and an adverse effect on the patient's overall survival.<sup>4,5,7</sup>

Understanding the principles of the biopsy and approaching all lesions as if they may be malignant optimize subsequent management, permitting limb salvage and avoiding unnecessary amputations.<sup>8,9</sup> Irrespective of which biopsy method is chosen, open versus closed, some general principles apply.

### **1 Principle Number 1: Avoid approaches that go through the most tenuous skin. (AKA: Do not go to the top of the mountain.)**

Orthopedic surgeons are accustomed to draining abscesses through an incision centered over the area of maximum fluctuance (Figure 1). The biopsy of musculoskeletal tumors should avoid this site. The area of maximum tenting of the skin is vulnerable to poor wound healing because it is under tension, causing tissue ischemia, and is less likely to heal than skin that is not under tension (Figure 2).<sup>1,8</sup> This is especially true for



**Figure 1.** A 29-year-old man with a large soft-tissue mass in the anteromedial aspect of the proximal right thigh underwent open biopsy. Note the thin, shiny skin and drainage from the proximal portion of the incision on the 5th postoperative day.

patients undergoing neoadjuvant chemotherapy or radiation therapy, who are at increased risk of wound complications even under ideal circumstances.<sup>10</sup>

### **2 Principle Number 2: Incisions in the extremities should be longitudinal, not transverse.**

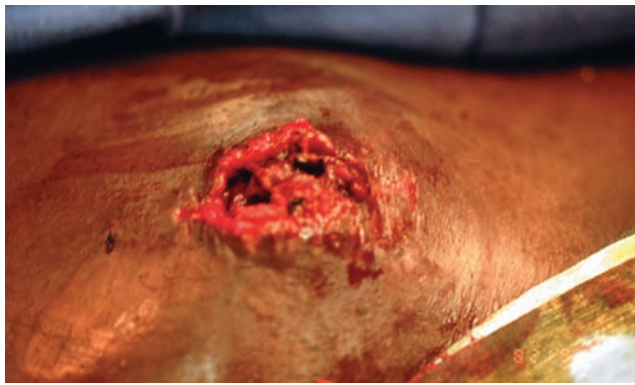
The location and orientation of the biopsy site are critical. The biopsy should be performed in such a way as to not compromise subsequent definitive resections.<sup>3,9</sup> All open biopsy and core biopsy tracts should be located such that they can be excised en bloc at the time of definitive resection (Figure 3).<sup>2,3,9</sup>



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**Figure 2.** The appearance of the biopsy site on postoperative day 17. The skin in this area was compromised and tented owing to the underlying soft-tissue tumor. The biopsy proved to be nondiagnostic, as only necrotic tumor was obtained and wound dehiscence and infection ensued. A repeat biopsy established the diagnosis of an extraskeletal Ewing's sarcoma. The infection and open wound complicated the patient's management.



**Figure 3.** A male 18-year-old, diagnosed with a high-grade conventional osteosarcoma involving the proximal tibia, after an open biopsy was performed (biopsy incision marked as line B). Note that the biopsy tract is longitudinal and in line with the incision planned for definitive resection and can be completely excised with the tumor. Following preoperative chemotherapy, en bloc resection of the proximal tibia with the biopsy tract was performed (Figure 6).

Thus the biopsy tract should be located and aligned along the surgical excision tract of the future limb-salvage resection.<sup>2</sup>

In the extremities, the incision should be oriented longitudinally; transverse biopsy lesions are to be avoided (*proper*: Figure 3; *improper*: Figures 4 and 5).<sup>1,9,11</sup> When the biopsy tract, including the skin, is excised, wound closure is simplified with longitudinally oriented defects rather than transverse ones (Figure 6). Suboptimal biopsy positioning also complicates subsequent amputations by contaminating flaps used for closure.<sup>1,8,11</sup>

**3 Principle Number 3: Obtain adequate tissue for diagnosis with the least morbidity.** Insufficient tissue for diagnosis has been reported in as many as 25% to 33% of biopsies performed, varying widely between biopsy methods.<sup>5,10</sup> The major disadvantage of closed biopsy technique, compared with open, is the



**Figure 4.** This patient underwent an excisional biopsy of a suspected lipoma. The mass proved to be a high-grade soft-tissue sarcoma. The oblique biopsy incision led to potential contamination of the posterior compartment of the arm.

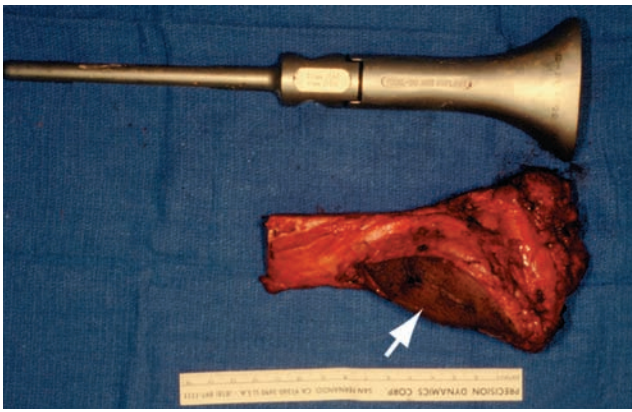


**Figure 5.** An example of a poorly performed biopsy of a soft-tissue tumor in the distal anterior thigh. The incision is transverse, crossing into the medial and lateral compartments of the thigh. The drain site is proximal to the incision (arrow).

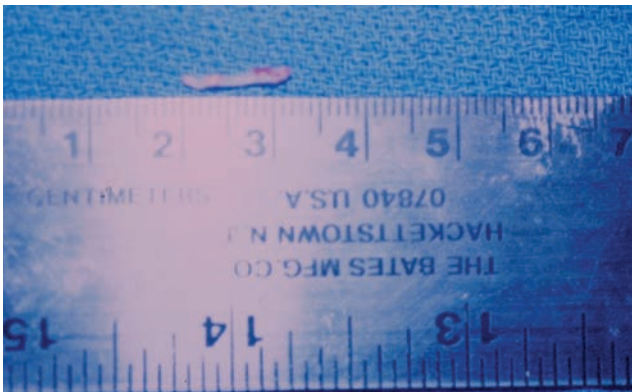
small amount of tumor retrieved.<sup>5</sup> However, by making 2 or 3 passes, adequate tissue for diagnosis can be readily obtained (Figure 7).<sup>12,13</sup> Also, by directing the biopsy needle to various parts of the tumor, the risk of sampling error is minimized.<sup>14</sup>

In an open biopsy, a wedge of tissue measuring about 1 cm in all dimensions is usually adequate for diagnosis.<sup>15</sup> It is important to not limit the biopsy sampling to just what appears grossly as "tumor." The pseudocapsule may appear to resemble a tumor but will not provide sufficient material for histologic diagnosis.<sup>10,15</sup> It is important to make sure that the biopsy obtains tissue from the interface of tumor and normal tissue.<sup>10</sup> The tissue from the periphery is generally preferred over the central portion of the tumor, as the latter is more likely to undergo ischemic necrosis and not have viable tumor cells.<sup>3,8,15</sup> Reviewing imaging before biopsy will maximize yield.<sup>2</sup> To ensure that adequate tissue was obtained for diagnosis, intraoperative frozen sections should be sent to the pathology service to avoid repeat surgical biopsy.<sup>2,10,11</sup>

In the event that an extraosseous component of a bone lesion is present, it is not necessary to biopsy the bone containing a malignant tumor.<sup>2,3,16</sup> This extraosseous biopsy will give a representative sample of the whole lesion for



**Figure 6.** The resected proximal tibia for osteosarcoma (Figure 3) with the biopsy tract (arrow) seen next to the trial endoprosthesis.

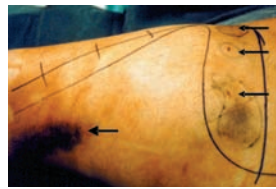


**Figure 7.** Gross appearance of tissue obtained using Tru-Cut biopsy needle.

diagnosis. Not violating the bone cortex minimizes the risk of subsequent fracture and makes it easier to obtain hemostasis.<sup>2</sup>

**4 Principle Number 4: Achieve meticulous hemostasis.** After biopsy, some bleeding will occur, irrespective of the technique used.<sup>2,10,17</sup> The resultant bleeding from the tumor has the potential for seeding previously uninvolved areas, making subsequent local control difficult and at times impossible.<sup>2</sup> A history of bleeding disorders or use of anticoagulation medications should be obtained prior to biopsy and appropriate steps taken to facilitate proper coagulation. In cases when the bone is biopsied, hemostasis can be facilitated with the use of polymethylmethacrylate, bone wax, or other suitable substances.<sup>3,8</sup>

A hematoma is considered contaminated. Consequently a widespread infiltrating hematoma may contaminate an entire extremity (Figure 8).<sup>2,11</sup> For open biopsies, suturing the wound in layers is recommended.<sup>15</sup> If hemostasis is difficult to achieve, a drain is often indicated. The drain tract should be considered potentially contaminated with tumor cells and should be placed in a position that allows it to be resected with the biopsy en bloc with the tumor at the



**Figure 8.** This image demonstrates the result of multiple approaches to the proximal femur by an interventional radiologist. Three smaller arrows point to the multiple penetration sites. Note the extensive hematoma at the biopsy sites and distally as well as the violation of multiple compartments of the thigh. The larger distal arrow points to a distant hematoma.



**Figure 9.** This patient, with high-grade osteosarcoma, underwent open biopsy through a deltopectoral incision—this had the potential to contaminate the pectoral muscles and chest wall. An appropriate approach would be through the anterior one third of the deltoid.

time of definitive resection.<sup>3</sup> Generally, this means in line and a short distance distal to the incision (Figure 8).<sup>1-3,11</sup>

Maximal efforts should be directed toward obtaining hemostasis prior to wound closure.<sup>1,8,15</sup>

**5 Principle Number 5: Do not cross-contaminate compartments.** The biopsy should be performed so as to not contaminate compartments not already involved by the tumor.<sup>8,10,11</sup> Transverse incisions are likely to spread across compartments (Figures 4 and 5). Sarcomas grow along compartment lines rather than across them. For example, a deep-seated tumor in the posterior calf usually involves only the posterior compartment. A transverse biopsy can spread tumor into the anterior or lateral compartment. As a result, additional tissue may need to be excised, and this may compromise the patient's functional outcome.

Surgical approaches commonly used in general orthopedics may be relatively contraindicated as surgical approaches for musculoskeletal biopsies.<sup>3</sup> For example, a tumor involving the proximal humerus should not be approached through the deltopectoral interval. Doing so runs the risk of seeding tumor along the pectoralis major and chest wall (Figure 9). Rather, the biopsy should be placed through the anterior one third of the deltoid.<sup>2</sup> At the time of definitive resection, a portion of the anterior deltoid can be excised with the tumor without significant functional compromise and with improved local control.<sup>3</sup>

Deep incisions or closed biopsies should go through a single compartment rather than contaminating intermuscular planes.<sup>1,11</sup> A lesion should be approached by a route contaminating only such tissues as can be subsequently resected en bloc with the tumor at the time of limb-sparing surgery (Figure 3).<sup>2,8</sup>

## CONCLUSIONS

The definition of biopsy is the removal and examination of a sample of tissue from a living body for diagnostic

purposes, but this definition does not address the issues that need to be taken into account in order to avoid the significant morbidity and mortality associated with improper biopsy technique. The surgeon should consider the biopsy of a musculoskeletal tumor as the first stage of a potential limb-sparing operation. This view emphasizes the considerable thought and experience required in the performance of a biopsy in order to avoid unnecessary complications. In cases in which a malignancy is part of the differential diagnosis, consultation with an experienced musculoskeletal oncologist should be considered.<sup>4,5</sup>

### **AUTHORS' DISCLOSURE STATEMENT & ACKNOWLEDGMENTS**

The authors report no actual or potential conflict of interest in relation to this article.

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