23 Soft Tissue, Nerves, and Muscle

Elizabeth Montgomery, M.D.

Soft Tissue

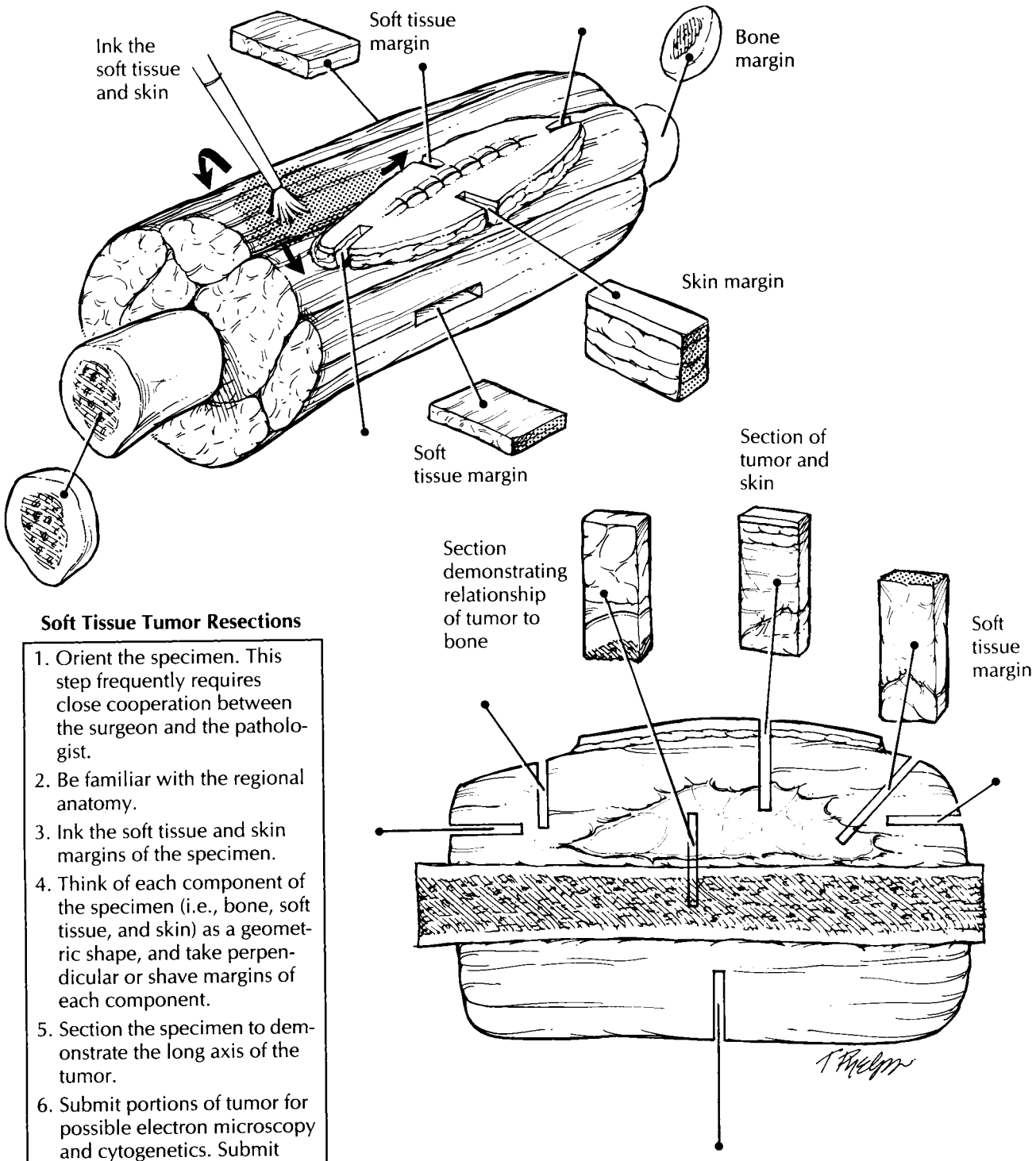
Soft tissue resections are often complex specimens containing soft tissues, skin, and sometimes even bone. The general approach to these specimens is a simple one, and it parallels that outlined for complex head and neck specimens in Chapter 8. First, identify the various components of the specimen (soft tissue, bone, and skin). Second, think of each component as a geometric shape. Third, approach each component separately. Fourth, look for relationships between any lesions and each component.

With the general approach outlined above in mind, start the dissection by orienting the specimen. Do not hesitate to ask the surgeon to help with this step. Large muscle bundles move easily relative to one another. A margin that looks close in fact may have been covered by a large bundle of muscle that has shifted. The only way to be sure that tissue has not shifted is to discuss the specimen with the surgeon. Next, make sure that you know the anatomy. The origin of a sarcoma from a nerve can be missed if one is not familiar with the anatomic location of the major nerves in the specimen. After the specimen has been oriented and the anatomy determined, identify the various components of the specimen (soft tissue, bone, skin, etc.). This step helps ensure that important components of the specimen are not left out of the dissection.

Next, measure the overall dimensions of the specimen, and document the size of each individual component. The external appearance of each component can then be described. In particular, note the size and position of any biopsy sites.

The next step is to sample the margins. The evaluation of the margins of a large complex specimen is simplified by thinking of each component of the specimen as a geometric shape. As illustrated in Chapter 8, the soft tissue can usually be thought of as a cube, the bone as a cylinder, and, if present, the skin as a square sheet. Ink the specimen, and take sections to demonstrate the margins of each of the components. It may be impractical to ink the entire specimen, but the closest margins (identified visually or by palpation) should be inked. There are usually six soft tissue margins (a cube has six sides), and these can be taken as perpendicular margins. These margins usually include the anterior, posterior, medial, lateral, inferior, and superior surfaces. Similarly, there are usually four skin margins (a square has four sides), and these can be taken as perpendicular margins. If a margin consists of a fascial layer, periosteum, or other anatomic barrier such as the diaphragm, this should be specified. The bone (the ends of a cylinder), vascular, and neural margins can be taken as parallel (shave) sections, but perpendicular rather than en face margins are suggested in general.

The specimen can now be sectioned. Determine the location and long axis of the tumor by palpating the specimen and reviewing the preoperative computed tomography (CT) scans. Section the specimen using a long sharp knife in the plane that will demonstrate the largest cross section of the tumor. Carefully document the size (try to give three dimensions), consistency, and color of the tumor. Measure twice, because size is one of the most important predictors of outcome for patients with a soft tissue tumor. It is important to document the epicenter of the tumor



Soft Tissue Tumor Resections

1. Orient the specimen. This step frequently requires close cooperation between the surgeon and the pathologist.
2. Be familiar with the regional anatomy.
3. Ink the soft tissue and skin margins of the specimen.
4. Think of each component of the specimen (i.e., bone, soft tissue, and skin) as a geometric shape, and take perpendicular or shave margins of each component.
5. Section the specimen to demonstrate the long axis of the tumor.
6. Submit portions of tumor for possible electron microscopy and cytogenetics. Submit sections to demonstrate the relationship of the tumor to each of the components of the specimen. Include one section of tumor for every 1 cm of tumor diameter. Submit the indicated margin sections and any lymph nodes.

(e.g., dermal, subcutaneous, fascial, subfascial, intramuscular, visceral, or a combination). Also note whether the tumor is centered on or extends into major vessels, nerves, or joint spaces. These features are important for staging and for identifying the site of origin of the tumor. Also note any cysts and areas of necrosis (estimate the percent if necrosis is identified), hemorrhage, calcification, myxoid change, bone formation, or cartilage, and whether the edge of the tumor is encapsulated, pushing, or infiltrative. It may be helpful to correlate the gross appearance of the tumor with radiographic findings. For example, if calcifications are seen in a particular area of the tumor on CT scan, then that area should be identified grossly.

Next, document the distance of the tumor to each of the margins and the relationship of the tumor to each of the various components of the specimen. It is important to measure margins that are less than 2 cm from the tumor. Areas where the margins are more than 5 cm clear need not be sampled (except in cases of angiosarcoma or epithelioid sarcoma, which are prone to subclinical satellite spread). Document the number of lymph nodes present, and sample each for histology. Lymph nodes may not be included, as only a small number of sarcoma types are likely to have lymph node deposits (e.g., angiosarcoma, epithelioid sarcoma, synovial sarcoma, clear cell sarcoma).

Finally, the tumor itself can be sampled. First, submit a representative piece in glutaraldehyde for possible electron microscopy. Next, as clinically indicated, submit fresh tissue for cytogenetics or other special studies. These studies may be particularly important in the pediatric patient (see Chapter 39). Finally, submit sections for routine histology. These should include sections that demonstrate the relationship of the tumor to each component of the specimen, sections that demonstrate the relationship of the tumor to the closest margins, and sections from any foci within the tumor that look different from other areas of the tumor. A useful rule of thumb is that one section should be submitted for every 1 cm of the maximum diameter of the tumor. As you take these sections, keep in mind that important indications of tumor grade (cellularity, necrosis, mitoses, etc.) and differentiation may be present only focally in large masses.

Important Issues to Address in Your Surgical Pathology Report on Soft Tissue Tumors

- What procedure was performed, and what structures/organs are present?
- What are the size, type, and histologic grade of the neoplasm?
- Does the neoplasm extend into skin, muscle, periosteum, bone, a joint space, major vessels, or major nerves?
- Are any margins involved? List distance from margins closer than 2 cm.
- Are there any satellite lesions?
- Is there evidence of metastatic disease? Record the number of lymph nodes examined and the presence or absence of lymph node metastases.

Nerve and Muscle Biopsies

Nerve and muscle biopsies are subject to a variety of artifacts if they are not properly handled. Furthermore, the interpretation of nerve and muscle pathology frequently requires special studies, including electron microscopy and histochemistry. For these reasons, nerve and muscle biopsies are best handled directly by specialized laboratories. Each laboratory usually has its own protocol for handling these biopsies. A detailed discussion of these specimens is, therefore, beyond the scope of this book. However, you should be aware of a few basics in processing these specimens, in case you do not have access to a specialized neuromuscular laboratory when the biopsy is done.

Muscle biopsies are usually obtained as two strips of muscle approximately 3.0×0.5 cm, taken parallel to the direction of the muscle fibers. A portion of tissue should be stretched to its normal *in situ* length, pinned to a card, and placed immediately (in the operating room) in 4% buffered glutaraldehyde. Do *not* mince this piece for electron microscopy. The remainder of the biopsy should be transported in saline-moistened gauze (do not soak) to the pathology laboratory. A portion of the biopsy should then be immediately fresh-frozen and the remainder fixed in formalin. To ensure that the fiber size in the biopsy reflects the *in situ* diameter and to reduce artifacts caused by the extreme contractility of the tissue, this piece of muscle should also be stretched to its normal

in situ length in the direction of the fibers. This can be accomplished with a special muscle clamp or simply by pinning the stretched biopsy to a stiff index card. Be careful not to overstretch the tissue, as this can cause artifacts as well. Muscle biopsies frozen in liquid nitrogen tend to develop ice crystal artifacts, so it is best to freeze the tissue in 2-methyl-butane (isopentane) cooled to dry ice temperature or below. When submitting muscle biopsies in formalin for histology, remember to submit both longitudinal and cross sections.

Diagnostic nerve biopsies to determine the cause of a neuropathy are usually obtained as 3- to 5-cm-long strips of the sural nerve. As was true for muscle biopsies, these should be processed immediately by a specialized neuromuscular laboratory. You should handle these biopsies only when they cannot be handled by a specialized laboratory. Do not stretch these biopsies! Instead, the biopsy is usually cut into four pieces. One piece should be submitted in 4% glutaraldehyde for electron microscopy, one submitted in formalin for routine microscopy, another fresh-frozen and stored at −70°C, and the fourth saved fresh in saline-moistened gauze for the neuromuscular laboratory. If you have to cut a nerve, be careful not to squash it while cutting. Pressure on the nerve can induce the artifactual appearance of demyelinization. As was true for muscle biopsies, the sections submitted for histology should include both longitudinal and cross sections.

If a nerve biopsy is performed simply to document the transection of a nerve, the specimen should be entirely submitted in formalin for routine paraffin embedding and sectioning.