12 Amputations and Large Resections

The most common reasons for amputations are peripheral vascular disease, trauma, and occasionally tumors. Some amputation specimens may be requested by the patient (e.g., some religions require burial of the limb).

RELEVANT CLINICAL HISTORY (IN ADDITION TO AGE AND GENDER)

TABLE 12–1. RELEVANT CLINICAL HISTORY

HISTORY RELEVANT TO ALL SPECIMENS	HISTORY RELEVANT FOR AMPUTATION SPECIMENS
Clinical indication for the procedure	Joint disease (e.g., gout or rheumatoid arthritis)
Any unusual features of the clinical presentation	Reason for the amputation (e.g., vascular disease associated with diabetes, avascular necrosis, malignancy, pathologic fracture, traumatic amputation)
Organs resected or biopsied (including location and number of lesions present)	Prior malignancy (e.g., primary bone tumor, metastases to bone, or tumors such as lymphoma that involve bone marrow)
Gross appearance of the organ/tissue/lesions sampled as observed by the surgeon, if unusual	Prior treatment (e.g., vascular grafts, treatment of malignant tumors)
Prior surgery or biopsies and the pathologic diagnoses	Radiologic findings (e.g., incidental mass or found on studies for nonspecific symptoms of weight loss or malaise)
Prior malignancies (type, location, stage)	
Prior treatment (radiation therapy, chemotherapy, drug use that can change the histologic appearance of tissues)	
Immune system status	
Current or recent pregnancy	

GENERAL GROSS DESCRIPTION

The description of all amputations includes the following:

- Structures present:
  - Left lower leg below-the-knee amputation, right foot, left index finger, etc.

- Dimensions of each structure (e.g., upper leg, lower leg, foot) including length and maximum circumference of limbs.
- **Type of procedure:** Disarticulation (cartilage-covered joint surface present) vs. amputation (exposed bone surface present)
- **Type of resection margin:** Smooth (surgical) or irregular (traumatic) resection margin.
- **Soft tissue at resection margin:** Condition (e.g., grossly viable vs. necrotic or ulcerated). Distance of skin and soft tissue from bony resection margin.
- **Skin:** Color, lesions (ulcers, areas of discoloration, bruising, gangrene) or identifying marks (e.g., scars, tattoos).
- **Lesions:** Bone fractures, blood vessels (atherosclerosis, thrombosis), osteomyelitis, tumor (if present), previous amputation sites.
- **Prior surgical procedures:** Amputations, vascular grafts, etc.
- **Decalcification:** Decalcification must be documented as this procedure can alter the histologic appearance and immunogenicity of tissues and is required for appropriate billing.

TRAUMATIC AMPUTATIONS

Traumatic amputations may involve litigation and the pathologic examination may become legal evidence. It is helpful to photograph such specimens for documentation. Process as described for amputations for vascular insufficiency. The presence and extent of peripheral vascular disease may be of clinical value if present.

DIGITS – NON-TUMOR

Fingers and toes are usually removed due to vascular insufficiency (toes) or trauma (usually fingers).

1. Describe including the features listed above.
2. Submit one section of soft tissue margin and an additional section of any skin lesions.
3. Fix entire specimen overnight.
4. Decalcify the following day.
5. When the bone is sufficiently decalcified, take one section of bone at the resection margin and one additional section of bone if there is a question of osteomyelitis (e.g., bone below a deep ulcer bed).

MICROSCOPIC SECTIONS

- **Skin and soft tissue:** One section of margin and additional section(s) to evaluate any skin lesions.
- **Bone:** One section of the resection margin. Additional section(s) of bone beneath deep ulcers if there is a question of osteomyelitis.

SAMPLE DICTATION

Received fresh labeled with the patient's name and unit number and "toes" are two digits amputated through the first metatarsal bone with a smooth resection margin and measuring 2 × 2 × 1.5 cm and 1.5 × 1.5 × 1 cm. The larger digit has a deep ulcer on the plantar surface (1 × 1 cm) that grossly appears to extend to the underlying bone. The skin of the smaller digit has a purple/black color, but no ulceration is present. The nails are unremarkable. The resection margins consist of unremarkable bone and soft tissue. The bone is fixed and decalcified prior to submission.

Cassette #1: Larger digit, ulcer, 1 frag, RSS.
Cassette #2: Larger digit, skin at margin, 1 frag, RSS.
Cassette #3: Larger digit, bone below ulcer, 1 frag, RSS.
Cassette #4: Larger digit, bone at margin, 1 frag, RSS.
Cassette #5: Smaller digit, representative skin and soft tissue at tip, 1 frag, RSS.
Cassette #6: Smaller digit, skin at margin, 1 frag, RSS.
Cassette #7: Smaller digit, bone at margin, 1 frag, RSS.

LOWER EXTREMITY – NON-TUMOR

Vascular Insufficiency

Vascular insufficiency is the most common reason for amputations. Often there will be prior amputations (e.g., several toes) and skin lesions (ulcers or frank gangrene). To document the disease process, dissect and examine the vessels of the leg.

Dissection of the Vessels of the Lower Extremity

See Figure 12-1.

1. Make a skin incision that starts just behind the medial malleolus and extends proximally in an oblique manner to reach the posterior aspect of the leg, and thence straight upwards to the line of resection.
2. Identify the posterior tibial neurovascular bundle behind the medial malleolus. Sever the distal ends and proceed to strip the vessels upwards, dissecting the muscle and subcutaneous tissue away from the vessels. Stop when the junction of the posterior tibial and popliteal arteries is reached at the interosseous membrane between the tibia and fibula.
3. Return to the ankle region and extend the original incision distally and then laterally to traverse the dorsum of the foot just distal to the ankle. Reflect the skin flap to expose the anterior compartment of the leg.
4. Identify the anterior tibial neurovascular bundle at the ankle (the anterior tibial artery becomes the dorsalis pedis artery and traverses the dorsum of the foot at this site). Sever the distal ends and reflect proximally as for the posterior tibial. When the interosseous membrane is reached, dissect bluntly around the vessel to free it. Then return to the posterior aspect of the leg and pull the anterior tibial vessels through the interosseous membrane.
5. Complete the removal of the vessels by continuing the reflection of the popliteal artery to the lines of resection.

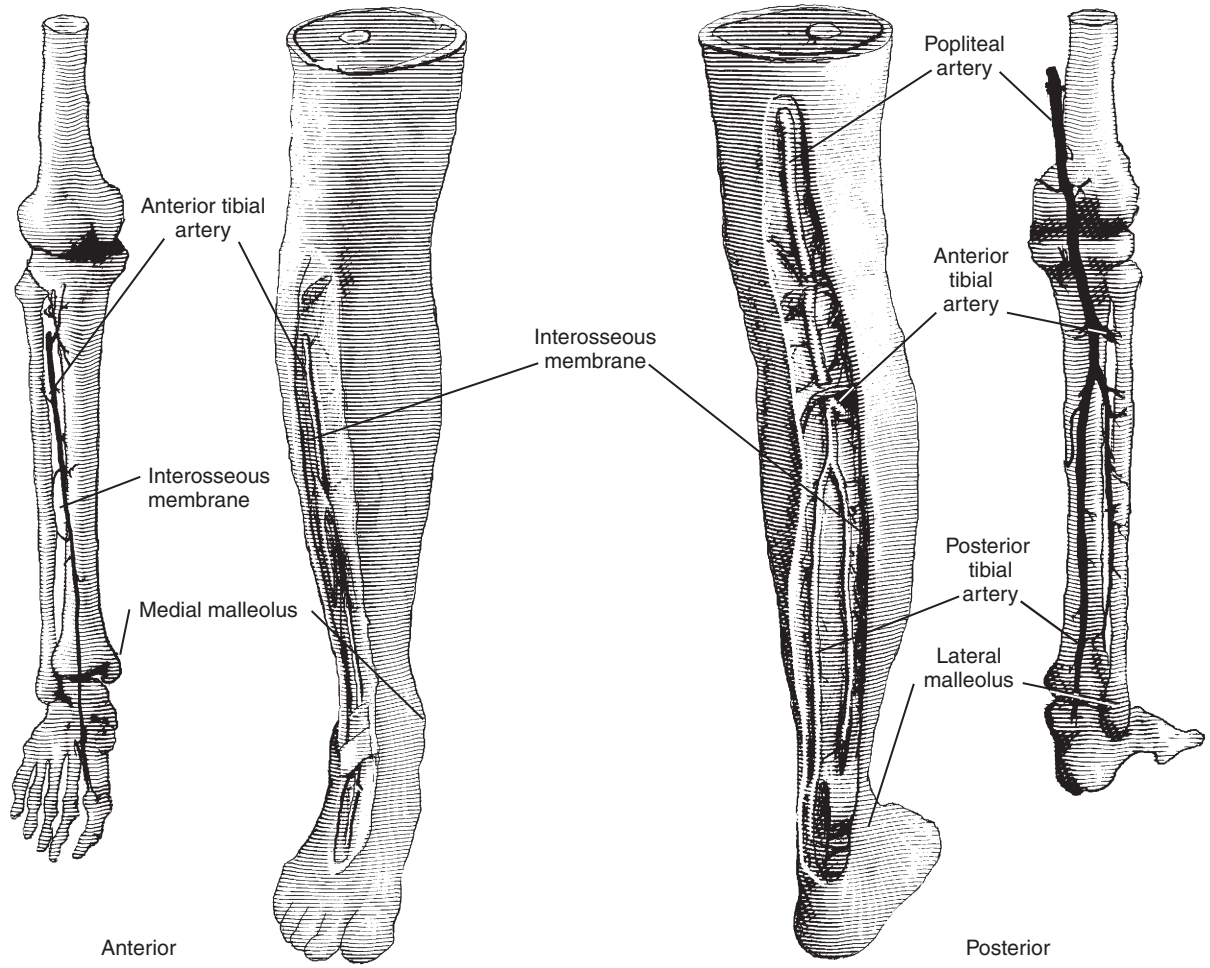
Usually the vessels will be densely calcified and will require decalcification before cutting.

PROCESSING THE SPECIMEN

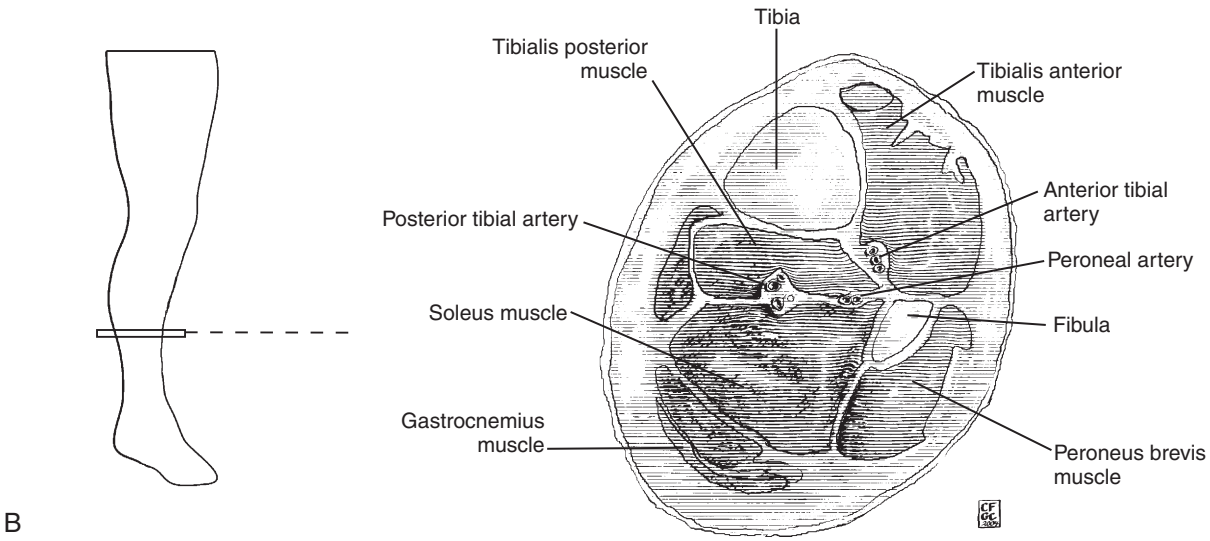
1. Record the measurements and features described in the first section.
2. Dissect out the anterior and posterior vessels and any grafts, if present (see above). If vein grafts are present, describe their anatomic relationships to other vessels, the status of the anastomosis (intact, patent, obstructed) and the presence or absence of thrombi.
3. Take skin and soft tissue sections from the margin and from any lesions present. Take a cross section of the soft tissue of one of the grossly normal toes to look for small vessel disease. Bone sections need not be taken if there are no gross lesions. If there is a suspicion of bone involvement (osteomyelitis), that section of bone is resected with the bone saw for fixation and decalcification.

   The metatarsal-phalangeal joint of the great toe is dissected open and examined for evidence of joint disease (see in Chapter 14, "Synovium," for gross differential diagnosis of joint disease).

   The marrow can be removed from the cut section of the bone and prepared as for a rib marrow squeeze if there is a clinical suspicion of disease involving the marrow.
4. Fix the tissue sections and blood vessels in small formalin containers with appropriate labels (e.g., "anterior vessels and margin," "posterior vessels and skin lesion"). The remainder of the specimen is kept unfixed but refrigerated.
5. The following day the soft tissue is submitted for processing (one cassette of margin, cassette[s] of lesion[s], cassette of soft tissue of toe). The vessels are decalcified.
6. The next day the vessels and grafts are serially sectioned. Record the location and extent of occlusions (calcified plaque, thrombosis). Submit multiple cross sections in two separate cassettes from the anterior and from the posterior vessels of the areas of greatest occlusion. If a graft is present, submit areas of obstruction and the vein-artery anastomotic site.



A



B

Figure 12–1. Dissection of the lower extremity.

MICROSCOPIC SECTIONS

- **Skin and soft tissue:** One section of margin and additional section(s) to evaluate any skin lesions.
- **Cross section of toe:** One cross section (to evaluate small vessel disease).
- **Bone:** Only submit section(s) of bone if there is a question of osteomyelitis or if bony lesions are present. The margin need not be submitted.
- **Vessels and grafts:** Submit one cassette each of anterior and posterior vessels showing area(s) of greatest occlusion. Submit area of greatest occlusion of grafts and the vein-artery anastomotic site.
- **Bone marrow:** Only submitted if there is a clinical suspicion of disease affecting the bone marrow.
- **Joint:** Only submitted if there is clinical suspicion or gross evidence of disease affecting the joints (e.g., gout).

SAMPLE DICTATION

Received fresh labeled with the patient's name and unit number and "leg" is a right lower extremity amputated through the tibia and fibula with a smooth resection margin (length of leg 37 cm; circumference of calf 40 cm; foot 26 × 9 cm). The fourth and fifth digits have been previously amputated. The skin is diffusely mottled purple and red. There are ulcerations present on the lateral aspect of the foot (3 × 1 cm) and on the plantar surface of the great toe (1 × 1 cm). The anterior vessels are diffusely calcified with luminal obstructions of up to 80%. The posterior vessels are diffusely calcified with luminal obstructions of up to 50%. The metatarsal-phalangeal joint of the great toe consists of smooth glistening white cartilage and is grossly unremarkable. The bone and soft tissue at the resection margin are unremarkable. A cross section of the third digit is fixed and decalcified prior to submission.

Cassette #1: Skin, ulcers, 2 frags, RSS.
Cassette #2: Skin and soft tissue at margin, 1 frag, RSS.
Cassette #3: Cross section of third digit, 1 frag, RSS.
Cassette #4: Anterior vessels, 1 frag, RSS.
Cassette #5: Posterior vessels, 1 frag, RSS.

AMPUTATIONS OR LARGE RESECTIONS FOR TUMOR

Large tumor resections are unusual and usually involve either tumors of bone or cartilage or soft tissue tumors involving major neurovascular bundles.[1-4] See in Chapter 14, "Bone Resections for Tumors" and Chapter 32 for additional information about these specimens.

If bone is present, radiographs of the specimen are helpful to document the bony structures present and to identify areas of destruction of normal bone or abnormal bone formation for sampling. Tumors involving bone may require sectioning (either longitudinal or cross sections) with an electric hand-saw or a band saw. If the distal limb is not involved, separating this part of the specimen may simplify dissection and fixation.

Diagrams are often useful to document complex specimens and can be used to designate the location of tissue blocks. Polaroid photographs and photocopies have also been used for this purpose.[1]

Describe the specimen as outlined above in the general section. Identify the muscles, nerves, and arteries present at the margin of the specimen and the sites of any prior biopsies. The best way to process the specimen will depend on the type and location of the tumor. Tumors involving nerve bundles may be best demonstrated by partial dissection of nerve trunks.

Describe the tumor, including size, appearance (color, necrosis, bone formation, cartilage formation), location (tissue compartment), relationship to surrounding structures (bone, vessels, nerves, muscle), center of tumor (epiphysis, metaphysis, diaphysis, intramedullary, periosteal), erosion of cortex, extension into soft tissue (compression or true invasion), extension through epiphyseal plate, extension into or across joint space, vascular involvement, skip metastases, distance from each margin.

After all soft tissue sections have been removed, tumors involving bone can be decalcified after fixation. Over-decalcification resulting in loss of histologic detail should be avoided by periodically checking the specimen to minimize exposure. Bone dust may create histologic artifacts (i.e., bone fragments within the marrow space). To avoid this, small sections of bone should be decalcified, the decalcified tissue thinly sectioned with a scalpel, and the tissue sections embedded so that the surface away from that cut by the saw is used to prepare tissue for slides.

All margins, usually perpendicular, must be evaluated including soft tissue, blood vessels, nerves, and bone. Bone margins can be removed with a bone saw and decalcified separately.

SPECIAL STUDIES

- **Untreated tumors:** Most amputations are performed for sarcomas, bone tumors, or other unusual tumors. It is often helpful to save tumor for rapid formalin fixation, electron microscopy, snap freezing, and cytogenetics.
- **Treated tumors:** If the tumor has been previously diagnosed and special studies performed, and the patient has received preoperative chemotherapy and/or radiation therapy, the tumor may be largely necrotic and additional studies may not be possible. However, a complete cross-section of the tumor (using multiple cassettes with locations indicated on a diagram) may be helpful to evaluate the extent of necrosis in response to treatment for osteosarcoma and Ewing sarcoma (see Chapter 14).

MICROSCOPIC SECTIONS

- **Tumor:** At least one section per cm including areas of intratumoral heterogeneity, relationship to adjacent normal structures, and relationship to margins. A diagram with a section code is usually needed.
- **Margins:** All margins including soft tissue and bone are sampled using perpendicular sections.
- **Normal structures:** Representative sections of normal structures (e.g., blood vessels, major nerve bundles).
- **Lymph nodes:** Submit all lymph nodes found (see Chapter 27).

REFERENCES

1. Olson DR. Specimen photocopying for surgical pathology reports. Am J Clin Pathol 70:94-95, 1978.
2. Barnes L, Johnson JT. Pathologic and Clinical Consideration in the Evaluation of Major Head and Neck Specimens Resected for Cancer, Path Ann (Part 1) 21:173-250, 1986 and Path Ann (Part 2), 21:83-110, 1986. (*Head and neck*.).
3. Weatherby RP, Krishnan KU. Practical aspects of handling orthopedic specimens in the surgical pathology laboratory, Path Annual, 17. part 2:1-31, 1982. (*Bone resections with tumors*.).
4. Patterson K. The pathologic handling of skeletal tumors. Am J Clin Pathol 109(Suppl 1):S53-S66, 1998.