INTRODUCTION

Direct examination of diseased and normal tissue is the definitive method of diagnosing many human diseases. Identification of musculoskeletal tumors, estimation of cell characteristics and activity, and examination of the relationships of one intralesional tissue type to another are essential to effective surgical management. While some obviously benign neoplasms may be sequentially observed for progression, or simply excised, others, such as giant cell tumors of bone, require positive identification and removal with at least a thin border of normal tissue. As this surgery must frequently be followed by an immediate reconstructive procedure, preliminary tissue diagnosis allows appropriate preoperative planning.

Usually osteomyelitis can be diagnosed by simple clinical evaluation and radiographic confirmation. A needle aspiration provides the culture sample. At time, however, aspiration is unsuccessful; the cultures do not grow. Under these circumstances the diagnosis becomes uncertain and the possibility of neoplasm must be considered. This important differentiation must then be made by biopsy. Some unusual infections, such as those caused by mycobacteria, fungi, or anaerobes, may optimally be identified by biopsy.

Changes in the appearance and density of trabecular bone are the best guide to the medical management of certain diseases. Repeated biopsy may be necessary to prove that osteoporosis is responding to a treatment program or that the marrow contains fewer blast forms during treatment of some forms of hematopoetic tumors. A convenient, inexpensive way of obtaining this serial information is of great value.

Similarly, the determination of cell type of obviously metastatic lesions when the primary site is unknown may be the best guide to the optimal chemotherapeutic program. Again, biopsy is the most direct method to make this decision. A “negative” biopsy, the determination that a lump is not a malignant tumor, is one of the most rewarding of surgical procedures. A simple, effective biopsy technique is extremely valuable in this regard.

Without a doubt, direct tissue examination is of primary importance in both the diagnosis and treatment of many important human diseases.
INSTRUMENTATION

The CORB Biopsy Needle (Fig. 1) incorporates all the advantages of conventional needle biopsy while overcoming most of the objections to this technique performed with previously available instruments.

This instrument consists of two thin-walled, well-fitted, concentric, telescoping, stainless steel tubes. Saw teeth on the tip of the outer tube (Fig. 2A) face counterclockwise, while similar saw teeth on the tip of the inner tube face clockwise (Fig. 2B). When the tubes are rotated in opposing directions, the passing teeth act like the blades of scissors (Fig. 2C) and cleanly cut an inner core of soft tissue. When bone is encountered, the teeth act as a counterrotating saw and progress steadily through cortical or trabecular bone (Fig. 3).
A gear box (Fig. 4) utilizes the rotational power of the nitrogen or electric power drill to provide the described counterrotation of the cutter tubes.

A smooth, thin-walled cannula and fitted blunt obturator are combined to provide a protective guiding probe (Fig. 5). This can be inserted through normal soft tissue near the lesion (taking care to avoid damage to neurovascular structures) and thus provides entry for the CORB Biopsy Needle itself. A plunger is provided to push the tissue sample core out of the central canal of the instrument.
**SURGICAL TECHNIQUE**

Prior to biopsy the patient must be fully informed regarding the need for a biopsy, general features of the operation, and the possible complications. Informed consent should be obtained before the patient has received any analgesics or any form of anesthesia. Specific complications or risks to be mentioned should include at least: chance of excessive bleeding, potential damage to neurovascular structures, inability to obtain a satisfactory specimen, possible device failure or breakage, and risk of infection.

Since the procedure is usually performed as an outpatient service, some time is reserved to chat with the patient, re-explain the procedure, and allay fears. Nearly all soft tissue or bone biopsies can be done easily under local anesthesia, but occasionally intravenous Valium (diazepam) or Demerol (meperidine) may be used to help the anxious individual.

A laboratory specimen supply kit should be assembled prior to biopsy and culture. Supplies including bottles, tubes and laboratory slips should be prepared. Fresh electron-microscopy specimen containers, histocompatibility surface antigen material and culture material for pyogens, mycobacilli, fungi and anaerobes should be at hand. This greatly decreases the time during which the image intensifier room must be occupied. Since transportation of fresh tissue and culture specimens is so important, prearrangements in this regard may save the stray specimen.

After careful prebiopsy preparation, the patient is positioned on the intensifier table (Fig. 6). All participants don protective aprons, and the patient is also appropriately shielded. Two primary objectives must be continuously considered. First, the operative field and sterile supply area must be accessible to the surgeon at all times. While we have used a variety of needle orientations, usually a generally horizontal direction for the longitudinal axis of the instrument seems to be best. Second, provision must be made to obtain three-dimensional perspective for the surgeon and radiologist. For the limbs, this is best accomplished by draping the limb free and utilizing limb rotation while observing the position of the tip of the needle. If this is not possible, a C-arm intensifier can be rotated relative to the patient’s trunk to obtain the same information.
A standard surgical skin preparation should be completed, making sure that sufficient area is included so that alternate approaches to the lesion can be made. It is convenient to prepare two sterile areas. One should include the region around the point of needle insertion and enough of the intensifier table to allow for a few instruments to remain within a hand’s reach. The CORB Biopsy Needle box, power tool and supply equipment, anesthesia equipment, and supplies are best positioned on a separate sterile field prepared on a rolling utility cart.

**INCISION**

A dilute local anesthetic is injected into the skin, subcutaneous tissue, deep soft tissues, and the periosteum along the proposed course of the biopsy instrument. A short image intensification observation of this regular or “spinal” anesthesia needle provides a provisional guide for the initial insertion of the biopsy probe.

A 0.5 to 1.0 centimeter incision (Fig. 7) is made, and the CORB Biopsy Needle protective probe is introduced, manually, adjacent and parallel to the previously observed needle. A side-to-side translational motion of the probe as it is advanced separates the muscle and fascial fibers and allows safe progression of the device. In addition, this side-to-side motion tends to move nerves and vessels to the side. When the probe tip is located where the biopsy is to begin (verified by direct observation, and documented by permanent radiographs), the obturator is removed and the instrument itself is inserted through the cannula.
The cannula should be held securely in position until the biopsy itself begins. Essentially any available rotational gas or electric power tool with a Jacob’s or Trinkle chuck can then be attached to the power shaft of the CORB Biopsy Needle. When the power supply is properly attached, the gear box is grasped firmly (Fig. 8) and the power tool is started in a forward, clockwise direction at a rotational speed of approximately 200-300 RPM. The biopsy needle is allowed to advance gently and slowly through both soft tissue and bone. (It is helpful for an assistant to continue to hold the cannula in position.) When the needle has obtained a sufficient composite soft and hard tissue sample, the gear box is detached from the cutter tubes. The outer cutter tube is manually rotated clockwise two turns to twist off the specimen at the tip of the needle. The usual core is approximately two centimeters in length. If a longer specimen is required to obtain a representational sample of a large lesion, the blunt obturator can be reintroduced, the assembled probe advanced approximately two centimeters, and the instrument itself reintroduced. When the instrument has been located at the greatest desirable depth a radiograph is taken to document (Fig. 9) its passage.
If it is desirable to obtain additional biopsy material from an area adjacent to the course of the biopsy needle, or from the depths of the wound (Fig. 10), a curette or pituitary rongeur may be introduced along the biopsy needle path and even through the window in the bone.

**WOUND CLOSURE**

Excellent culture specimens may be obtained by introducing sterile applicators through the cannula into the lesion. A syringe and 18 gauge spinal needle allow pure liquid culture specimens to be taken from the intramedullary space.
RADIOGRAPHIC REVIEW

CASE 1
A 53 year old white male fractured his left distal femur two years prior to admission. At that time, he was told he had a “benign tumor”, and underwent open reduction and internal fixation. He remained in good health until six months prior to readmission, when he began to notice steadily increasing pain in the left thigh. Admission radiographs showed a large, lytic lesion of the distal femur. A CORB Needle biopsy demonstrated fibrosarcoma.

A small, well circumscribed lytic lesion of the proximal femoral shaft was also noted. Needle biopsy of this also demonstrated fibrosarcoma. On the basis of the biopsy, a hip disarticulation rather than amputation at the proximal femoral shaft was performed.

The patient is doing well on chemotherapy six months postoperatively.

Fig. 11
AP view of left femur, showing expansile lytic lesion and evidence of previous internal fixation.

Fig. 12
CORB Biopsy Needle in place in middle of the lesion. Positioning may be assured by rotating the patient’s leg.

Fig. 13
Small, “punched out” lesion of proximal left femoral shaft.

Fig. 14
CORB Biopsy Needle in lesion.
CASE 2
A 23 year old white male had pain in his distal left thigh after a roller skating accident six months prior to admission. The pain grew steadily worse, and he was referred to the University of Michigan for diagnosis and therapy. Admission radiographs showed a malignant bone tumor, and a CORB Needle biopsy demonstrated osteosarcoma. Computerized tomography demonstrated intramedullary extension 13 cm up the femoral shaft. High A-K amputation was performed, and the patient was discharged on chemotherapy.

Fig. 15
Gross specimen.

Fig. 16
Biopsy showing fibrosarcoma.

Fig. 17
AP view of left knee showing destructive, sclerotic tumor breaking through the periosteal region along the medial border of the femur.

Fig. 18
Lateral view, showing that sclerosis is primarily within bone rather than soft tissue.
Obturator within sheath of biopsy needle, used for radiographic localization.

CT scan through level of femoral condyles; showing replacement of medullary bone by dense; sclerotic tumor tissue.

A CORB Biopsy Needle has replaced the obturator, and tissue sample is about to be taken.
Fig. 22
A curette may be used to obtain more samples through the CORB Biopsy Needle track.

Fig. 23
Histology typical for osteosarcoma.
**CASE 3**

A 55 year old white woman had a long history of low back pain, for which she underwent a lumbar laminectomy six months prior to admission. She failed to improve, and on myelography had a complete L4-5 block. On repeat surgery, an epidural mass was resected, and was reported to be chondrosarcoma. Her pain continued, and she was referred to the University of Michigan for further evaluation.

As there was some doubt about the tissue diagnosis, a CORB Needle biopsy of L5 was performed. This demonstrated a malignant myxoid tumor consistent with chondrosarcoma. Extension of the tumor precluded surgery, and the patient received radiation therapy.

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**Fig. 24**

AP view of lumbosacral spine, demonstrating partial destruction of L5 with expansile lytic lesion of the right sacrum.

**Fig. 25**

A CORB Biopsy Needle obturator in position. This is the only case thus far of a CORB Needle spinal biopsy.

**Fig. 26**

Histologic section consistent with chondrosarcoma.
CASE 4
A 72 year old white female with a 17-year history of Paget’s disease of the spine and pelvis complained of progressive back and left bony pelvis pain for six months. Radiographs of the pelvis demonstrated a large, lytic lesion of the left iliac bone superimposed on Paget’s disease. The remainder of the work-up was negative. As there is some probability of sarcomatous degeneration of Paget’s disease, a CORB Needle biopsy was performed. This demonstrated metastatic adenocarcinoma. The patient refused further evaluation, and palliative radiotherapy was performed.

Fig. 27
Paget’s disease of pelvis; with lytic destructive lesion of left ilium thought to be osteosarcoma or chondrosarcoma.

Fig. 28
CORB Biopsy Needle in place.

Fig. 29
Biopsy showed Paget’s disease and metastatic adenocarcinoma from unknown primary site.
**CASE 5**

A 42 year old white female had a 15-month history of progressive burning foot pain and 50 pound weight loss. She also had severe weakness. On admission evaluation, osteoblastic lesions of the pelvis and right shoulder were seen in radiographs. CORB Needle biopsy demonstrated multiple myeloma, an unusual diagnosis in view of the sclerotic nature of the lesions. The nervous system symptoms were attributed to a demyelinating neuropathy consistent with multiple myeloma.

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**Fig. 30**

Sclerotic lesion of left humeral head. Up to 5% of patients with myeloma have uniformly sclerotic lesions like this one.

**Fig. 31**

CORB Biopsy Needle in place.

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**Fig. 32**

Curette penetrating lesion through biopsy needle track. Notice localization of curette through the use of projections in internal and external rotation.
CASE 6
A 47 year old white female was diagnosed as having a plasmacytoma of the right distal femur two years prior to admission. The patient had allograft replacement of the distal femur and long-stem total knee arthroplasty. She also was treated with melphalan and prednisone. She did well for two years, but then complained of left knee pain. A destructive lesion of the left tibia was found radiographically. CORB Needle biopsy showed plasmacytoma.

Fig. 33
Spherocentric total knee arthroplasty on the right.

Fig. 34
AP radiograph of destructive tibial lesion (plasmacytoma).

Fig. 35
Lateral laminogram of left proximal tibia showing destructive lesion with pathologic fracture.

Fig. 36
Obturator in place.
CASE 7
A 47 year old white female had an ameloblastoma resected from the right maxilla 18 months prior to admission. On routine follow-up examination, a lytic lesion of the proximal left femur was found. CORB

Needle biopsy demonstrated an epithelial neoplasm consistent with ameloblastoma. She subsequently sustained a pathologic fracture after a fall. She is being treated with radiation therapy.
Fig. 41
CORB Biopsy Needle in place.

Fig. 42
Additional tissue is obtained by placing a pituitary rongeur in the needle track.

Fig. 43
Histologic slide of ameloblastoma.
CASE 8
An 85 year old man with known transitional cell carcinoma of the bladder awoke one morning, got out of bed, and felt a snapping sensation of his left femur. A pathologic fracture was discovered and internally fixed. He was then referred to the University of Michigan for follow up. A CORB Needle biopsy of the femoral shaft showed metastatic transitional cell carcinoma. A Kuntscher nail was used to replace the previous fixation device, and methyl methacrylate was placed at the fracture site.

Fig. 44
Pathologic fracture with internal fixation of the left femur.

Fig. 45
CORB Needle biopsy demonstrating transitional cell carcinoma.

Fig. 46
Placement of Kuntscher nail and methacrylate at fracture site.

Fig. 47
Histologic section of transitional cell carcinoma metastatic to bone.
**CASE 9**

This 61 year old man was well until he developed pain in the right hip. On physical examination he had two palpable cervical nodes. Biopsy of these showed large cell (histiocytic) lymphoma. A femoral lesion was demonstrated radiographically. As extension to bone implies a graver prognosis and alternate therapy, a CORB Needle biopsy was performed. This showed large cell lymphome of the right femur.

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**Fig. 48**
Destructive lesion of femoral neck.

**Fig. 49**
Frog leg lateral projection more clearly defining the tumor.

**Fig. 50**
CORB Needle in place.
The diagnosis was confirmed by electron microscopy. Notice the large, irregular nuclei with prominent nucleoli consistent with large cell lymphoma (9,000 X).

Fig. 51
Light microscopy diagnosed lymphoma.

Fig. 52
The diagnosis was confirmed by electron microscopy. Notice the large, irregular nuclei with prominent nucleoli consistent with large cell lymphoma (9,000 X).
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