

Outpatient Percutaneous Biopsy of the Iliac Crest: Methods, Morbidity, and Patient Acceptance

STEPHEN F. HODGSON, M.D., *Division of Endocrinology/Metabolism and Internal Medicine*; KENNETH A. JOHNSON, M.D., *Department of Orthopedics*; JOAN M. MUHS, B.S.N., EDWARD G. LUFKIN, M.D., *Division of Endocrinology/Metabolism and Internal Medicine*; JAMES T. MCCARTHY, M.D., *Division of Nephrology and Internal Medicine*

Bone histology and histomorphometry have become important in the diagnosis and management of metabolic bone disease, but the invasive nature of the biopsy procedure has limited its use. We describe an outpatient technique for obtaining one or more transiliac bone biopsy specimens. Thirty-eight women with osteoporosis, each of whom had sustained one or more spinal compression fractures, underwent two separate bone biopsies during which two 7.5-mm transiliac cores of bone were removed. No morbidity (such as infection or hemorrhage) was encountered. Subjective responses to the level of pain were surveyed by questionnaire. At the time of biopsy, 46% of the study subjects experienced no or only mild discomfort, and 24% judged their pain to be severe. At 16 hours after biopsy, 64% had no or mild pain and 8% experienced severe pain. At 7 days after biopsy, 79% experienced no or mild pain but 9% judged their pain to be severe. In four patients, temporary ambulatory disability occurred but resolved spontaneously in 7 to 10 days. We conclude that the described outpatient bone biopsy procedure is safe, efficient, and generally acceptable to patients.

Bone histology and histomorphometry have played essential roles in the study of human bone physiology and are becoming increasingly important in the diagnosis and management of human metabolic bone diseases. Many physicians, however, consider bone biopsy excessively invasive and a potential source of morbidity and disability; thus, this procedure is usually reserved for only the most severe and refractory disease states. In most cases then, the advantages inherent in the examination of abnormal tissue are disregarded in favor of less invasive, but also less sensitive, clinical procedures.

Clearly, the optimal use of bone histology is dependent on the development of biopsy techniques that are safe, simple to perform, and efficient. Ideally, these conditions dictate that the surgical procedure be painless, cause no short- or long-term disability, and produce one or more nonfragmented bone samples of sufficient size to allow

examination of multiple sections. Furthermore, it should be inexpensive to perform and should not necessitate special surgical skills or the use of a dedicated operating theater.

In 1977, Johnson and associates¹ described a procedure for obtaining transiliac crest bone biopsy specimens that provided generally satisfactory results and fulfilled most of the foregoing conditions. Their procedure, however, was performed in a surgical or parasurgical setting and necessitated hospitalization of the patient. We have modified that procedure in accordance with the aforementioned criteria and herein describe a percutaneous method of obtaining transiliac bone samples with use of local anesthesia in an outpatient setting. The associated morbidity, rate of occurrence of complications, and patient acceptance of this procedure are also discussed.

MATERIAL AND METHODS

Assessment Before Biopsy.—All candidates for iliac crest biopsy must not be taking anticoagulant or antiplatelet medications and must have no allergies to any chemical agents used in the procedure. In addition, if information about the dynamic characteristics of bone turnover (such as the rate of bone formation or bone mineralization) is

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Address reprint requests to Dr. S. F. Hodgson, Division of Endocrinology/Metabolism, Mayo Clinic, Rochester, MN 55905.

needed, the patient must receive tetracycline as a bone label on two occasions. The following schedule for tetracycline labeling has been found useful: demeclocycline, 150 mg orally four times daily on days 1, 2, and 3; no label on days 4 through 17; and demeclocycline, 150 mg orally four times daily on days 18, 19, and 20. Biopsy may then be done anytime between days 22 and 27.

Positioning and Preparation of the Patient.—The standard designated biopsy site is in the anterior aspect of the ilium, 2 cm posterior and 2 cm inferior to the antero-superior iliac spine (Fig. 1). Because the biopsy surface has an inferior and posterior orientation when the patient is in the supine position, the pelvis must be elevated and medially rotated to bring the outer bony table into a more perpendicular axis. This positioning is accomplished by placing a small pillow under the buttock on the side from which the biopsy specimen is to be obtained. The ipsilateral leg is then gently flexed at the knee, and the hip is slightly flexed and abducted to relax the tendinous origins of the gluteus medius and tensor fascia lata muscles that overlie the biopsy site. This position is secured by placing other pillows under the knee and thigh, and additional pillows may be placed under the ipsilateral shoulder and back, as needed for patient comfort. The skin overlying the anterior aspect of the ilium is then prepared and draped according to standard preoperative procedures.

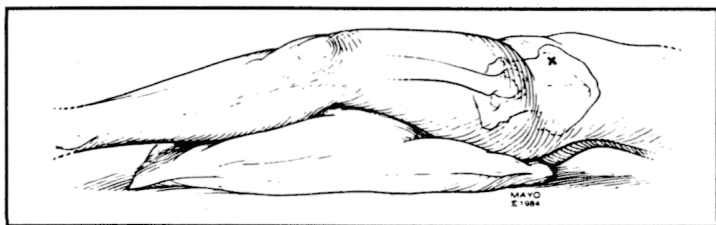


Fig. 1. Positioning of patient for obtaining biopsy specimen of iliac crest. Pelvis is rotated away from the operator, hip and knee are flexed, and hip is slightly abducted. Biopsy site is indicated by an X.

Localization of Biopsy Site.—By using the thumb, index finger, and second finger, a triangular area on the ilium can be defined. One finger is placed on the antero-superior iliac spine, and the adjacent finger is positioned approximately 5 cm posteriorly along the iliac crest. The thumb is then placed inferior to, and equidistant from, the previously positioned fingers. These three points define the triangular boundaries of the area that is to be anesthetized (Fig. 2). The center of this area overlies the biopsy site.

Instruments.—The instruments used for the biopsy procedure are a pointed obturator, a guide sleeve, a trephine with a threaded extension, a blunt extractor

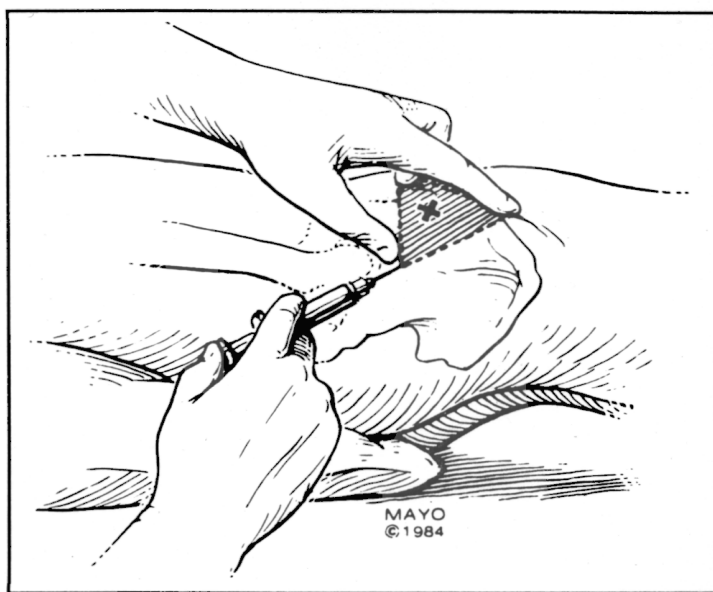


Fig. 2. Localization of biopsy site (X) and identification of area to be anesthetized (lined area). See text for details.

(available from Zimmer Co., Warsaw, Indiana), and a surgical rotary-drive power source.

Anesthesia.—No preanesthetic medications are needed. The choice of local anesthetic agent is not of critical importance and may be modified in accordance with personal preference and individual patient considerations. We conventionally use lidocaine, a fast-acting and relatively painless local anesthetic agent, to infiltrate the skin. Bupivacaine hydrochloride, a longer acting and less allergenic agent, is used to anesthetize the deeper layers. The skin over the previously described triangular area is thoroughly infiltrated with 2 to 3 ml of 1% lidocaine by means of a 3.8-cm (1.5-inch), 25-gauge hypodermic needle. A small wheal of skin just medial to the iliac crest is also superficially infiltrated with the anesthetic agent. The subcutaneous layers overlying the lateral aspect of the ilium are infiltrated from the skin to the periosteum by using approximately 20 ml of 0.25% bupivacaine hydrochloride delivered through an 8.9-cm (3.5-inch), 21-gauge spinal needle (Fig. 3 A). The medial surface of the ilium is anesthetized by placing this spinal needle through the previously anesthetized wheal of skin just medial to the iliac crest, approximately 2 cm posterior to the iliac spine. The needle is then reflected with the free hand so that the tip lies on the medial surface of the ilium near the biopsy site and within the potential space bounded laterally by the ilium and medially by the iliac muscle (Fig. 3 B). The periosteum is thoroughly infiltrated with 10 to 15 ml of the anesthetic agent. Fifteen minutes are allowed to elapse before proceeding with the biopsy in order to ensure maximal patient comfort.

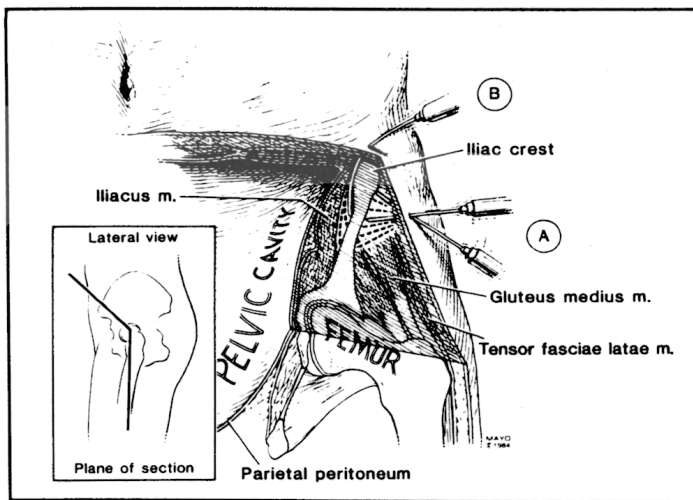


Fig. 3. Method of anesthetizing lateral (A) and medial (B) surfaces of ilium before biopsy specimen is obtained. For anesthetizing the medial surface (B), the anesthetizing needle must be reflected with a free hand (not shown in diagram).

Biopsy Techniques.—The biopsy site is again identified (as in Fig. 2), and a 1.5-cm stab incision is made (Fig. 4) and extended down through the deep fascia, along the direction of its fibers, to the periosteum. A pointed obturator (Fig. 5) is inserted into the guide sleeve and then inserted into the incision until its tip comes in contact with the ilium. The tip of the obturator is moved from side to side to free adhering structures from the bony surface. The sleeve is then pushed over the obturator until it rests firmly on the bony surface; it is held in place with

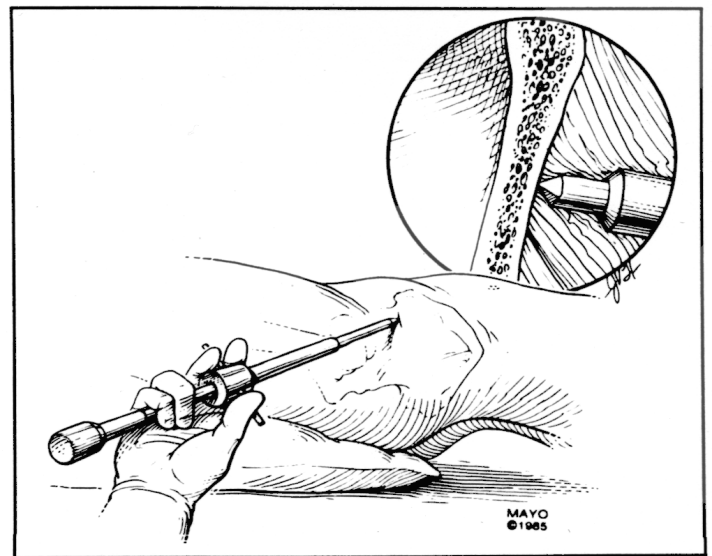


Fig. 5. Positioning of guide sleeve and obturator at iliac biopsy site.

the thumb of the free hand. Because the bony surface faces slightly posteriorly and inferiorly, the obturator should be positioned in an anterior and somewhat superior direction, so that it "points up at the umbilicus."

The obturator is then withdrawn, and the trephine is inserted in its place (Fig. 6). A low-speed power source should be used to drive the trephine (for example, a Black & Decker variable-speed surgical drill). The trephine is then rotated through the ilium and can be felt to pass

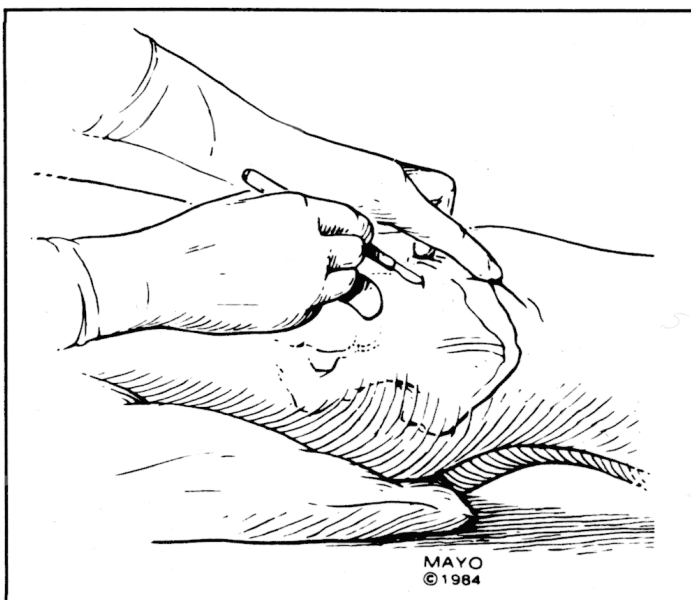


Fig. 4. Site of incision for iliac crest biopsy.

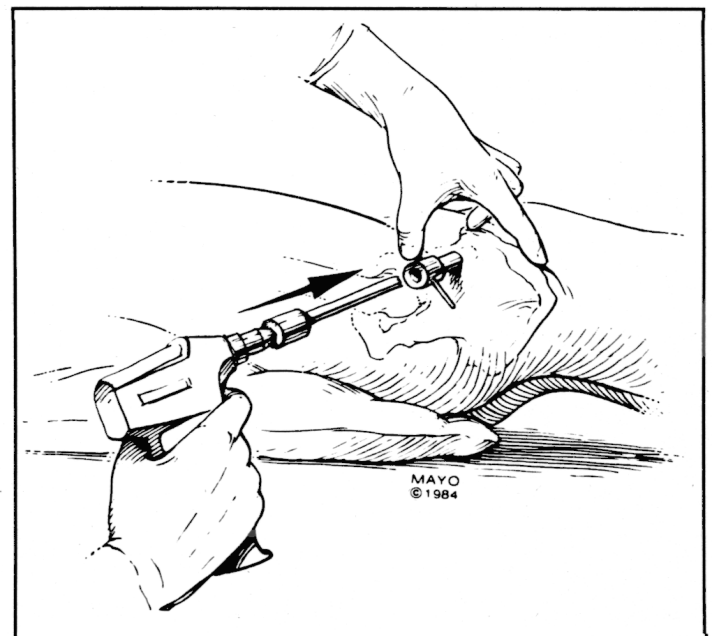


Fig. 6. Insertion of trephine into guide sleeve after obturator has been withdrawn from iliac biopsy site.

successively through the outer cortex, the cancellous bone, and finally the inner cortex (Fig. 7). If rotation is interrupted before the ilium is completely penetrated, the specimen may be fractured or lost. Once the trephine has been felt to pass completely through the ilium, the power source is stopped, and the trephine is rotated manually through two complete revolutions. This procedure ensures that the medial surface of the specimen is freed from its periosteal attachments. A small air vent, located at the base of the trephine, prevents pressure buildup as the biopsy specimen enters the trephine. Retention of the specimen is aided by placing a finger over the vent before the trephine is withdrawn. The teeth of the trephine are designed to minimize or eliminate damage to the iliac muscle during the procedure.

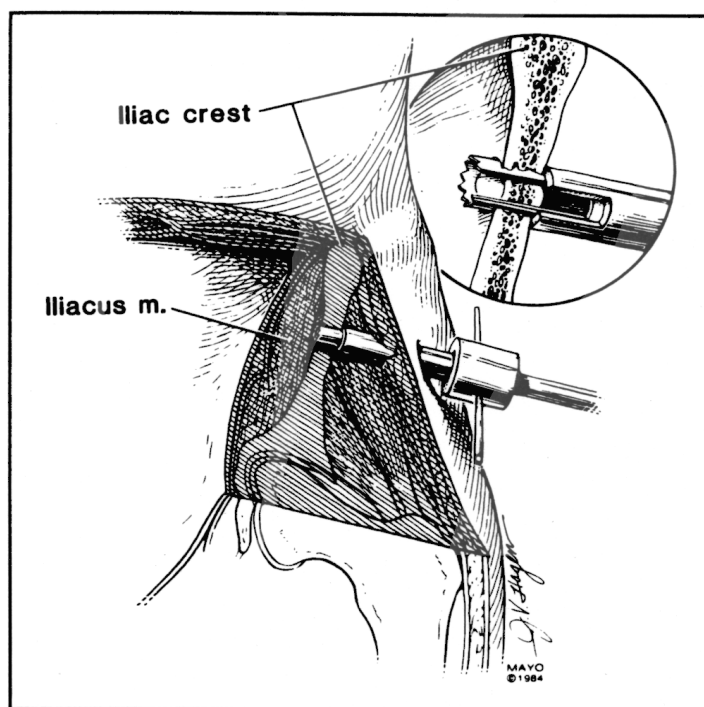


Fig. 7. Rotation of trephine through ilium for obtaining biopsy specimen. See text for details.

The threaded extension of the trephine (which joins the trephine to the drill chuck) is removed, and the blunt extractor is then inserted into the proximal end of the trephine and struck sharply to remove the specimen, which is immediately placed in a solution of 70% ethanol. If an additional bone sample is needed, the obturator can be reinserted into the sleeve, an adjacent site can be identified, and another biopsy specimen can be obtained.

The sleeve is then removed from the biopsy site, and the wound is closed by using a single layer of interrupted

3-0 chromic sutures. Manual pressure is exerted over the wound for 5 minutes to promote hemostasis, after which the patient is allowed to rest for 30 minutes before ambulation is resumed. The entire procedure involves approximately 20 minutes of physician time.

Assessment of Morbidity and Patient Acceptance.—The operative morbidity and patient acceptance of this biopsy procedure were assessed in 38 women with postmenopausal osteoporosis (mean age, 66.1 years), each of whom underwent two separate biopsies at intervals of 6 or 18 months as part of a long-term therapeutic trial for osteoporosis. All patients had had one or more spinal compression fractures, and three had sustained previous hip fractures. Although 27 of the 76 biopsies (36%) were performed by an orthopedic surgeon in an auxiliary operating theater, most of the procedures, including at least one biopsy in each patient, were done by an internist in a nonsurgical outpatient facility. At each biopsy, two adjacent 7.5-mm bone samples were obtained from each patient. After the biopsy procedure, all patients were observed in the Clinical Study Unit overnight, and the records were reviewed for changes in temperature and any adverse effects that were noted by the physician. Records of use of analgesics provided another means of assessment of pain during the first 16 to 20 postoperative hours. After the second biopsy, each patient was sent a questionnaire that had been designed to elicit the subjective perception of biopsy-related pain and disability and to determine the frequency and severity of biopsy-related episodes of inflammation and infection. The patients were asked to grade the level of pain at four time intervals: at the time of biopsy, 2 hours after biopsy (upon return to the Clinical Study Unit), approximately 16 hours after biopsy (upon arising the subsequent morning), and 7 days after biopsy. Responses to questions were subjective, and no effort was made to define the various levels of pain. A scale of 0 (no pain) to 5 (most severe pain) was used.

RESULTS

The tabulation of results clearly showed that patients avoided responding to the intermediate grades of pain; therefore, the pain scale was consolidated into only three levels: mild (grades 0 and 1), moderate (grades 2 and 3), and severe (grades 4 and 5) (Fig. 8).

Because each of the 38 patients underwent two separate biopsies, the following discussion of results includes 76 study subjects. At the time of biopsy, 35 of the 76 patients (46%) experienced mild discomfort (grade 0, 5%; grade 1, 41%), and 18 (24%) had severe pain (grade 4, 8%; grade 5, 16%) (Fig. 8). Two patients who complained of severe pain, however, qualified their re-

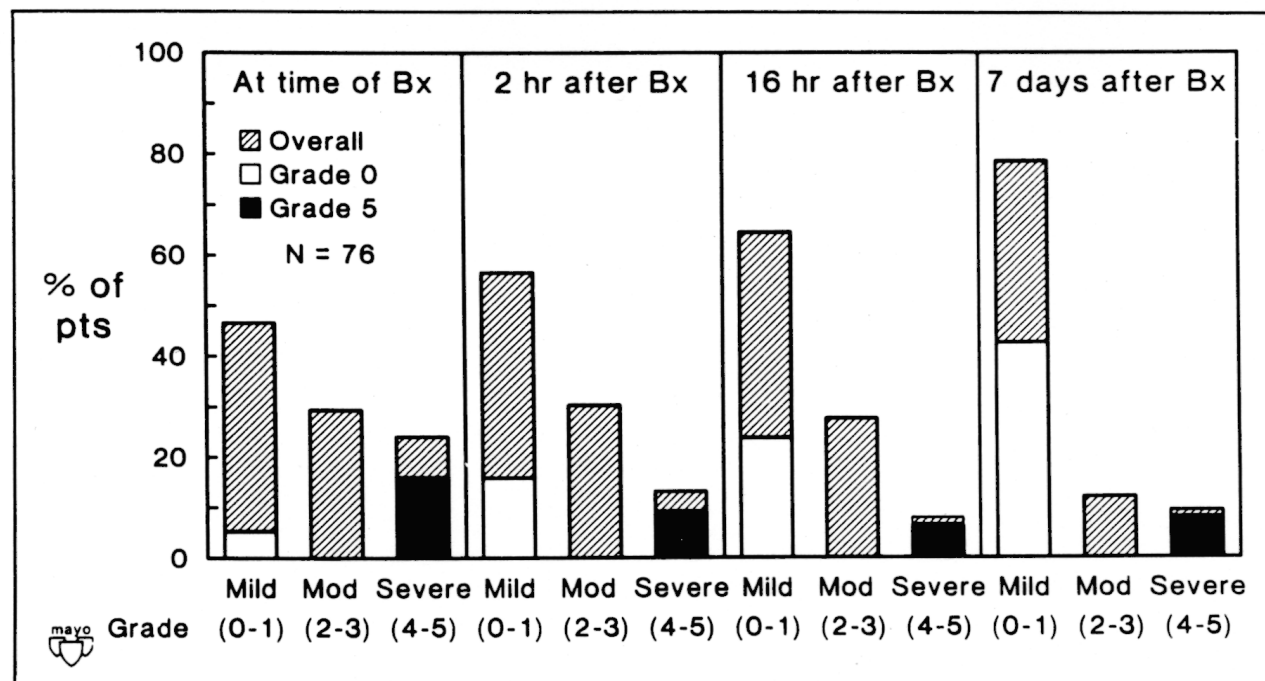


Fig. 8. Patient's subjective assessment of pain during and at various intervals after removal of two 7.5-mm transiliac bone samples. Bx = biopsy.

sponses with the notation that their discomfort occurred during administration of the anesthetic agent and specifically not during the incision or the removal of the bone specimen. At 2 and 16 hours after the biopsy, the number of patients who experienced severe discomfort decreased to 10 (13%) and 6 (8%), respectively, and those who experienced only mild discomfort progressively increased to 43 (56%) and 49 (64%), respectively. The effects of anesthesia were variably present at 2 hours but were completely absent at 16 hours after biopsy. Although at 7 days after biopsy 60 patients (79%) felt only mild discomfort (42% had no pain), 7 (9%) had discomfort that they considered severe. Of the seven patients who indicated persistent severe discomfort, however, three attributed their pain to sites distant from the biopsy (knee, contralateral back, and ipsilateral groin); thus, the actual relationship between the discomfort and the biopsy could not be determined.

Twenty-nine patients (38%) used analgesics after the biopsy procedure, in contrast with 20 patients (26%) who chronically used analgesics for musculoskeletal pain before biopsy. Only propoxyphene and acetaminophen were used, and no narcotics were requested by the patients.

After the biopsy procedure, 57 patients (75%) had no immediate ambulatory disability, but 19 (25%) could not

ambulate during the first 5 or 6 hours. All patients who were ambulatory before biopsy were ambulatory at the time of dismissal from the Clinical Study Unit (that is, within 20 hours after biopsy). Fifteen patients (20%), however, indicated that they had some lingering, but minor, discomfort during ambulation for a few days after biopsy, and 5% briefly used a cane (two patients) or crutches (two patients) for ambulatory support. No one experienced total or partial ambulatory disability for more than 7 to 10 days.

No major infections were encountered. Seven patients (9%) reported the presence of minor serosanguineous or purulent drainage that resolved spontaneously in each case, was not associated with fever, and did not necessitate the use of antibiotics or the attention of a physician. Minor local hypoesthesia in the perioperative site was noted by 22 patients (29%), none of whom considered it an appreciable problem. Hemostasis was easily attained in all patients, and no postoperative bleeding occurred.

In response to a question about return to complete normalcy after the biopsy, 20 patients (26%) replied that they felt completely normal on the first day and 49 (64%) by the end of the first week, but 27 (36%) thought that return to normalcy took longer than 1 week. No patient reported failure to achieve a perception of normalcy. All patients had at least two follow-up examinations at

6-month intervals after the conclusion of the study, and no adverse effects of the bone biopsy had been noted during that time.

DISCUSSION

Several bone biopsy techniques have been described, and their relative merits and disadvantages have been extensively reviewed.¹⁻⁵ Because physicians generally agree that the anterior aspect of the ilium is the preferred biopsy site, the fundamental variations among biopsy techniques are only the size of the trephine and the approach—vertical or lateral (transiliac)—for obtaining the specimen. In general, biopsy specimens of small volume are less traumatic but prone to both compression artifacts and large sampling errors,^{2,3,5} and biopsy specimens obtained by means of the vertical approach have only a single cortical surface, which, because of its regional anatomic relationships, is not considered representative.²

The 7.5-mm trephine used in the transiliac procedure described in this report can produce intact bone specimens that have two representative cortical surfaces and are large enough to allow multiple sections to be made for light and fluorescence microscopy. Furthermore, multiple samples can be obtained with use of this technique; thus, at least one unfractured and complete biopsy specimen can consistently be produced if the physician is experienced and careful.

No morbidity was encountered during our study. This finding reflects a high degree of safety and compares favorably with the general experience reported by Duncan and associates,⁶ whose survey of more than 14,000 biopsies, performed by numerous physicians who used a variety of techniques, revealed the occurrence of only 82 complications including hemorrhage (in 35 patients), neuropathy (in 13), wound infection (in 10), fracture (in 6), osteomyelitis (in 1), and pain of more than 7 days' duration (in 17). The incidence of pain in our group was considerably higher than that reported by Duncan and co-workers,⁶ perhaps because we obtained two biopsy specimens and removed a relatively large volume of bone from each patient. Major differences in the methods used for determining pain, however, preclude accurate comparison of the two studies. In general, the level of pain experienced by our patients during and after the procedure was considered acceptable. Nevertheless, pain was the primary negative factor in the patient's overall acceptance of bone biopsy as a necessary clinical procedure. In our assessment of patient acceptance, only

subjective responses to a level of pain were recorded. All our patients had experienced one or more fractures before biopsy, and several had had chronic preexisting pain. Therefore, the estimated frequency of pain in our study group may be exaggerated and may reflect, in part, pain that was unrelated to the bone biopsy. Furthermore, all patients in this study group underwent a second biopsy even though they had the option to refuse to do so, an indication of their general acceptance of the procedure.

During the course of this study, two sources of pain became apparent: (1) injection of the bupivacaine hydrochloride into the skin and (2) the biopsy procedure itself—a full 15-minute wait was necessary for achieving the maximal anesthetic effect. Anesthetic and operative pain were virtually eliminated by using lidocaine for the initial infiltration of the skin and by allowing an appropriate time interval between induction of anesthesia and incision and biopsy. In general, patients preferred to undergo biopsy in the less austere surroundings of the outpatient clinic, and no technical disadvantages were encountered in this setting. Furthermore, operating room costs were avoided. No differences in morbidity or complication rates were noted when the biopsies were performed by physicians who had not received special surgical training.

On the basis of these studies, we conclude that outpatient percutaneous iliac crest bone biopsy is safe, generally acceptable to patients as a standard clinical procedure, and efficient; moreover, it produces high-quality bone samples. The use of this and similar biopsy procedures should lead to increased applications for bone histology in the diagnosis and management of metabolic bone diseases.

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