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Computed Tomography-guided Percutaneous Pelvic Bone Biopsy: Technical Success, Diagnostic Performance, and Safety

Bilgisayarlı Tomografi Kılavuzluğunda Perkütan Pelvik Kemik Biyopsisi: Teknik Başarı, Tanısal Performans ve Güvenilirlik

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Computed Tomography-guided Percutaneous Pelvic Bone Biopsy: Technical Success, Diagnostic Performance, and Safety

ABSTRACT

Objective: To evaluate the technical success, diagnostic performance, and complications of CT-guided pelvic bone biopsies.

Material and Method: Fifty patients (32 women, 18 men; mean age: 57.5 ± 15.5 years; range: 20–91) who underwent CT-guided pelvic bone biopsy (sacrum, ilium, ischium, pubis, proximal femur) between 2017 and 2024 were included. Biopsies were performed by interventional radiologists with a minimum of five years of experience. Lesion size, location, type (lytic, sclerotic, or mixed), pathology results, technical success, diagnostic performance, and complications were recorded from patient files and the Picture Archiving and Communication System (PACS). Complications were classified as minor or major according to the Society of Interventional Radiology (SIR) guidelines.

Results: Technical success was 100% (50/50). Pathology revealed malignancy in 25 (50%) patients, benignity in 15 (30%), and nondiagnostic results in 10 (20%), yielding a diagnostic performance of 80%. Nondiagnostic lesions were significantly smaller than malignant (*p=0.002*) and benign (*p<0.001*) ones. Lesion types were lytic in 16 (32%), sclerotic in 17 (34%), and mixed in 17 (34%) cases. When pathology results were grouped as diagnostic (malignant or benign) vs. nondiagnostic, a significant association was found with lesion type (*p=0.025*); 70% of nondiagnostic lesions were sclerotic. Minor complications occurred in 5 (10%) patients, including moderate pain (n=2), transient hypotension (n=1), ecchymosis (n=1), and localized iliopsoas hematoma (n=1). No major complications were observed.

Conclusion: CT-guided pelvic bone biopsy is a safe procedure with high technical success and diagnostic yield. Smaller and sclerotic lesions are more likely to result in nondiagnostic outcomes.

Keywords: Complication, Image-Guided Biopsy, Multidetector Computed Tomography.

ÖZET

Amaç: BT kılavuzluğunda gerçekleştirilen pelvik kemik biyopsilerinin teknik başarısını, tanısal performansını ve komplikasyonlarını değerlendirmek.

Gereç ve Yöntem: 2017–2024 yılları arasında BT eşliğinde pelvik kemik (sakrum, ilium, iskium, pubis, femur proksimali) biyopsisi yapılan 50 hasta (32 kadın, 18 erkek; yaş ortalaması 57,5 ± 15,5; aralık 20–91) çalışmaya dahil edildi. Biyopsiler, en az 5 yıl deneyimli girişimsel radyologlar tarafından gerçekleştirildi. Lezyon boyutu, lokasyonu, tipi (litik, sklerotik, mikst), patoloji sonuçları, teknik başarı, tanısal performans ve komplikasyonlar hasta dosyalarından ve Picture Archiving and Communication System (PACS) üzerinden kaydedildi. Komplikasyonlar, Society of Interventional Radiology (SIR) rehberine göre minör veya majör olarak sınıflandırıldı.

Bulgular: Teknik başarı %100 (50/50) idi. Patoloji sonuçları 25 (%50) malign, 15 (%30) benign ve 10 (%20) nondiagnostik olarak raporlandı; tanısal performans %80 olarak hesaplandı. Nondiagnostik lezyonlar, malign (*p=0,002*) ve benign (*p<0,001*) lezyonlara kıyasla anlamlı derecede daha küçüktü. Lezyonların 16'sı litik (%32), 17'si sklerotik (%34) ve 17'si mikst (%34) tipteydi. Lezyon tipi ile tanısal sonuçlar (diagnostik vs. nondiagnostik) arasında anlamlı ilişki saptandı (*p=0,025*); nondiagnostik lezyonların %70'i sklerotikti. İki hastada ağrı, bir hastada geçici hipotansiyon, bir hastada cilt altı ekimoz ve bir hastada kendini sınırlayan iliopsoas hematomu olmak üzere toplam beş (%10) hastada minör komplikasyon izlenmiş olup, hiçbir hastada majör komplikasyon gelişmedi.

Sonuç: BT eşliğinde pelvik kemik biyopsisi, yüksek teknik başarı ve tanısal performans ile güvenli bir yöntemdir. Küçük ve sklerotik lezyonlarda nondiagnostik sonuç olasılığı daha yüksektir.

Anahtar Sözcükler: Çok Kesitli Bilgisayarlı Tomografi, Görüntüleme Eşliğinde Biyopsi, Komplikasyonlar.

Introduction

Despite significant advancements in modern imaging technologies, percutaneous image-guided or surgical biopsy remains the gold standard for establishing a definitive diagnosis in focal bone lesions that cannot be reliably characterized through imaging alone. Among these approaches, image-guided percutaneous bone biopsy has emerged as the preferred first-line diagnostic method, offering a minimally invasive alternative to open surgical biopsy for histopathological or microbiological analysis (1,2). Image-guided techniques provide several key advantages, including preservation of bone architecture, reduced trauma to adjacent soft tissues, avoidance of general anesthesia, shorter hospital stays, lower procedural costs, and reduced complication rates and tumor seeding risks (3–6).

Although magnetic resonance imaging (MRI) is superior in characterizing bone marrow pathology and musculoskeletal tumors, MRI-guided biopsy is rarely feasible in routine practice due to limited accessibility, logistical challenges, and difficulty in real-time needle guidance. Similarly, ultrasound guidance is primarily reserved for superficial bone lesions with prominent soft-tissue components. In contrast, many bone lesions—particularly those in the pelvis—lack a distinct soft-tissue component and are located in deep or complex anatomical regions. In such cases, computed tomography (CT) guidance provides clear advantages in terms of anatomical visualization, trajectory planning, and real-time confirmation of needle placement (7). Among the various image-guided modalities, CT-guided bone biopsy has become a cornerstone in interventional radiology practice. Its utility stems not only from its high spatial and contrast resolution, which facilitates accurate targeting even in small or sclerotic lesions, but also from its ability to navigate complex anatomy and safely access deep-seated regions such as the pelvis, spine, or posterior ribs. Unlike open surgical biopsy, CT guidance allows for real-time trajectory adjustment to avoid critical structures, minimizing patient risk while maximizing diagnostic yield. Moreover, it offers significant procedural flexibility, particularly in patients with comorbidities who are unsuitable for more invasive interventions. Owing to its reliability, safety, and wide applicability, CT-guided bone biopsy is now one of the most frequently performed procedures in interventional radiology, underscoring the expanding role of interventional radiologists in diagnosis, risk stratification, and multidisciplinary clinical decision-making.

Although CT-guided percutaneous bone biopsy is generally considered a safe procedure, reported complication rates range from 0% to 15.6% (4,8,9). Furthermore, despite its high diagnostic yield, nondiagnostic results have been observed in 2% to 31% of cases, often due to lesion characteristics or sampling limitations (10,11). Given the increasing frequency of these procedures in clinical practice, interventional radiologists must not only ensure technical proficiency but also be aware of the factors that may influence diagnostic success and complication risk. While several studies have evaluated bone biopsy in general, research specifically focusing on pelvic bone lesions remains relatively scarce—especially those examining the technical success, diagnostic performance, safety, and lesion-specific factors affecting diagnostic yield in this anatomically challenging region (12–14). Therefore, the aim of this study is to evaluate the technical success, diagnostic performance, associated complications, and potential predictors of nondiagnostic outcomes in CT-guided percutaneous pelvic bone biopsies performed at our institution between 2017 and 2024.

Material and Method

This study was initiated following approval from the Pamukkale University Non-Interventional Research Ethics Committee of our institution (Date: 24.04.2025, No: E-60116787-020-683857), and it was conducted in accordance with the principles of the Declaration of Helsinki. Although the requirement for informed consent was waived due to the retrospective design of the study, all patients had previously provided written informed consent as part of routine clinical practice after being thoroughly informed by the radiologist performing the biopsy about the procedure and its potential complications. Fifty patients (32 women, 18 men; mean age 57.5 ± 15.5 years, range 20–91) with lesions located in the pelvic bones that could not be definitively diagnosed through radiodiagnostic imaging, who were referred to our clinic for biopsy and underwent CT-guided bone lesion biopsy, were

included in the study. Biopsied lesion sizes, locations, and natures (lytic, sclerotic, and mixed), biopsy results, technical success, diagnostic performance, and procedure-related complications were reviewed and recorded from patient files and the PACS (Picture Archiving and Communication System). Based on the literature, the pelvic bones were defined as the ilium, ischium, pubis, sacrum, and proximal femur (15). Patients whose biopsy results were reported as nondiagnostic were further evaluated and categorized as those who underwent repeat biopsy, those referred for surgical biopsy, those followed up without any additional intervention, and those lost to follow-up. For these patients, the results of repeat CT-guided percutaneous pelvic bone biopsies, open surgical biopsy findings, and any changes in the nature or size of the lesions during follow-up were investigated through patient records and the PACS system.

Prebiopsy Preparation and Management

For all patients, a complete blood count and coagulation studies were conducted on the same day before the biopsy. Acceptable laboratory criteria before the procedure included platelets >50,000/ml and International Normalized Ratio (INR) < 1.5. Before the biopsy, patients' use of anticoagulant and antiplatelet medications was assessed, and necessary adjustments were made in accordance with the Society of Interventional Radiology (SIR) guidelines (16,17). Additionally, patients were assessed for prilocaine or lidocaine allergies, postural limitations affecting positioning, and infection or inflammation at the biopsy site. In cases of suspected sarcoma or planned surgery, a pre-procedural evaluation was conducted with the orthopedic team/physician to assess the risk of tumor seeding along the needle tract (3). In routine practice, the procedure was performed under local anesthesia; however, in patients with severe anxiety or when deemed necessary, the biopsy was performed under conscious sedation (Fentanyl, 25–50 µg [maximum 100 µg]; Midazolam, 0.5–1 mg [maximum 5 mg]) with the support of the anesthesia team (18,19). All biopsies were performed with two interventional radiologists with a minimum of five years of experience.

Biopsy Procedure

Patients were positioned on the CT table (Brilliance 16-slice CT scanner, Philips Healthcare, Amsterdam, Netherlands) in a supine, prone, or lateral decubitus position according to the biopsy plan. As a general principle, the biopsy trajectory was planned to pass through the fewest compartments and to reach the lesion via the shortest possible route. In patients with multiple lesions of similar nature, the largest or the safest lesion in terms of procedural risk was selected for biopsy. The procedure site was disinfected using a 10% povidone-iodine solution following standard sterilization protocols and was then covered with sterile drapes. Local anesthesia was administered using 10–20 cc of 2% prilocaine hydrochloride injected with a 21-gauge needle into the skin, subcutaneous fat, muscle tissue (if applicable), and down to the periosteum. Due to the high density of nerve fibers and significant pain sensitivity in the periosteum, the majority of the anesthetic was used for periosteal injection. In cases where the periosteum could not be reached with a standard needle, a 21-gauge spinal needle was used. A small skin incision was made with a scalpel at the entry point, and the biopsy needle was inserted. The needle tip position was confirmed via CT once it reached the lesion border. Subsequently, the inner stylet of an 11G bone biopsy needle (Bon-Core Trephine Bone Biopsy Needle, Egemen International, İzmir, Türkiye) was removed, and the needle was advanced manually or with the aid of a sterile surgical hammer in hard or sclerotic lesions. The obtained samples were placed in 10% formalin and sent to pathology along with a summary of relevant clinical information. In cases where the lesion had a soft tissue component, additional tissue samples were obtained using a 14G automated biopsy gun (Maxcore, Bard, Covington, GA, USA) with at least two passes (Figures I and II).

Following the procedure, CT imaging was performed to check for potential complications such as bleeding, and patients were monitored in our unit for 4–6 hours. Post-procedural complications were classified according to SIR guidelines. Complications that required no treatment or only nominal therapy were categorized as minor, while those necessitating hospitalization or major therapy, leading to permanent sequelae, resulting in death, prolonging hospital

stay, or causing an unplanned increase in patient care were classified as major complications (20).

Statistical Analysis

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 25.0. Continuous variables were presented as mean, standard deviation, minimum, and maximum values, while categorical variables were expressed as frequencies and percentages. The distribution of continuous variables was assessed using the Shapiro–Wilk test, and since normality was not observed across all groups, the Kruskal–Wallis test was used to compare continuous variables among the three pathology-based subgroups (malignant, benign, and nondiagnostic). Pairwise comparisons of significantly different variables were performed using the Mann–Whitney U test. The Chi-square test was used to analyze associations between categorical variables, including the relationship between lesion type (lytic, sclerotic, or mixed) and diagnostic outcome, which was regrouped as either "diagnostic" (malignant or benign) or "nondiagnostic." A *p-value of* ≤ 0.05 was considered statistically significant in all analyses.

Results

All targeted lesions were successfully accessed under imaging guidance, and tissue samples were obtained in all cases, resulting in a technical success rate of 100% (50/50).

Table I. Summary of Patient Age, Lesion Size, Type, and Location According to Histopathological Diagnosis

	Malign Group	Benign Group	Nondiagnostic Group	Total
Age	59.1 ± 16.7	56.4 ± 15.9	55.3 ± 13.4	57.5 ± 15.5
Average Lesion Size (mm)	33.1 ± 16.6	39.4 ± 12.8	16.4 ± 5.3	31.6 ± 15.9
Lesion Type				
Lytic	14 (28%)	1 (2%)	1 (2%)	16 (32%)
Sclerotic	4 (8%)	6 (12%)	7 (14%)	17 (34%)
Mixed	7 (14%)	8 (16%)	2 (4%)	17 (34%)
Lesion Location				
İlium	12 (24%)	6 (12%)	5 (10%)	23 (46%)
İschium	2 (4%)	1 (2%)	1 (2%)	4 (8%)
Pubis	1 (2%)	2 (4%)	0 (0%)	3 (6%)
Sacrum	5 (10%)	1 (2%)	3 (6%)	9 (18%)
Proximal femur	5 (10%)	5 (10%)	1 (2%)	11 (22%)
Total	25 (50%)	15 (30%)	10 (20%)	50 (100%)

There was no statistically significant difference in the mean ages of patients whose pathology results were reported as malignant (59.1 ± 16.7), benign (56.4 ± 15.9), or nondiagnostic (55.3 ± 13.4) (*p=0.662*). Among the biopsied lesions, pathology results revealed malignancy in 25 out of 50 cases (50%), benignity in 15 cases (30%), and were nondiagnostic in 10 cases (20%), yielding an overall diagnostic performance of 80%. The mean lesion sizes were 33.1 ± 16.6 mm in the malignant group, 39.4 ± 12.8 mm in the benign group, and 16.4 ± 5.3 mm in the nondiagnostic group. While there was no statistically significant difference in lesion size between the malignant and benign groups (*p=0.076*), the average size of lesions in the nondiagnostic group was significantly smaller compared to both the malignant (*p=0.002*) and benign (*p<0.001*) groups (Table I).

Table II. Histopathological Distribution of Malignant Biopsy Diagnoses

No.	Histopathological Diagnoses of Malignant Lesions	Number
1	Breast Carcinoma Metastasis	4
2	Prostate Adenocarcinoma Metastasis	3
3	Adenocarcinoma Metastasis (Primary Site Not Specified)	2
4	Malignant Epithelial Tumor Metastasis (Primary Site Not Specified)	2
5	Squamous Cell Carcinoma Metastasis (Primary Site Not Specified)	2
6	Chondrosarcoma	2
7	Lymphoma	2
8	Small Cell Lung Carcinoma Metastasis	1
9	Lung Squamous Cell Carcinoma Metastasis	1
10	Lung Adenocarcinoma Metastasis	1
11	Acute Myeloid Leukemia (AML) Infiltration	1
12	Gastric Adenocarcinoma Metastasis	1
13	Nasopharyngeal Carcinoma Metastasis	1
14	Solitary Plasmacytoma	1
15	Renal Cell Carcinoma Metastasis	1
Total		25

Of the biopsied lesions, 23/50 (46%) were located in the ilium, 11/50 (22%) in the proximal femur, 9/50 (18%) in the sacrum, 4/50 (8%) in the ischium, and 3/50 (6%) in the pubis. In terms of lesion type, 16/50 (32%) were lytic, 17/50 (34%) were sclerotic, and 17/50 (34%) were mixed (lytic–sclerotic). When pathology results were regrouped as diagnostic (malignant or benign) or nondiagnostic, lesion type was found to be significantly associated with diagnostic outcome

(*p=0.025*). While the majority of diagnostic cases involved lytic (15/16) or mixed-type (15/17) lesions, 7 of the 10 nondiagnostic lesions were sclerotic (Table I).

Table III. Histopathological Distribution of Benign Biopsy Diagnoses

No.	Histopathological Diagnoses of Benign Lesions	Number
1	Enchondroma	4
2	Fibrous Dysplasia	3
3	Degenerative Changes	2
4	Osteomyelitis	2
5	Non-ossifying Fibroma (NOF)	1
6	Paget's Disease	1
7	Osteonecrosis	1
8	Osteoid Osteoma	1
Total		15

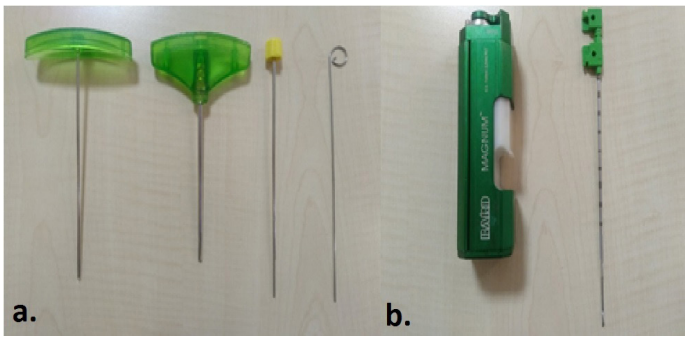

Figure I. (a) 11 Gauge Trephine needle set (Bon-Core Trephine Bone Biopsy Needle, Egemen International, İzmir, Turkey) used for bone biopsy. (b) Automatic biopsy gun (Maxcore, Bard, Covington, GA, USA) and 14 Gauge needle used for bone tumors with a soft tissue component.

Among the lesions reported as malignant (25/50), the most common pathology was metastasis, observed in 76% (19/25) of cases (Figures III and IV). In addition, lymphoma was detected in two patients, acute myeloid leukemia (AML) infiltration in one patient, and solitary plasmacytoma in one patient. Two patients were diagnosed with chondrosarcoma. The most frequent metastases were from the breast (4/19) and prostate (3/19), with two cases each of adenocarcinoma, malignant epithelial tumor, and squamous cell carcinoma metastases of unknown primary origin (Table II). Benign biopsy results included enchondroma (4/15), fibrous dysplasia (3/15), degenerative changes (2/15), osteomyelitis (2/15), and one case each of non-ossifying fibroma (NOF), Paget's disease, osteonecrosis, and osteoid osteoma (Table III).

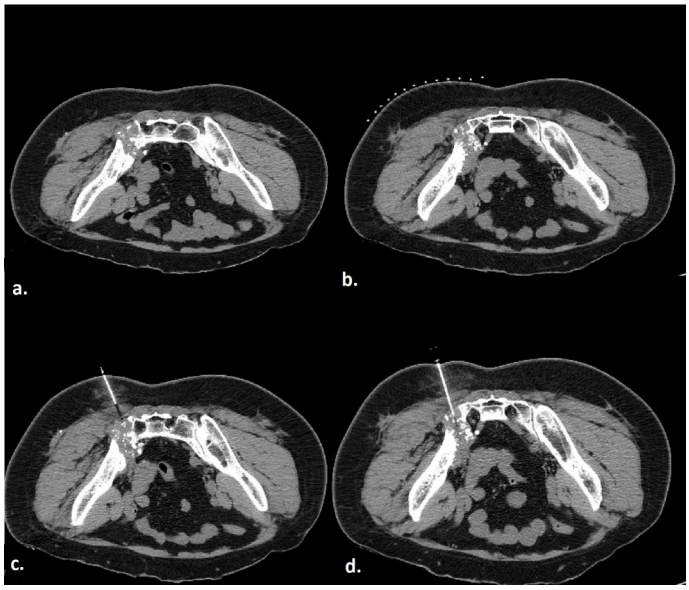

Figure II. Procedural steps of CT-guided bone biopsy. (a) An expansile lytic-sclerotic (mixed-type) mass lesion involving the joint space and causing bone destruction in the right sacroiliac junction. (b) A guide marker placed at the appropriate level in the prone position to determine the skin entry point corresponding to the lesion location. (c) Reference image obtained after injecting 2% prilocaine hydrochloride into the skin, subcutaneous tissue, adjacent soft tissue-muscle planes and periosteum. (d) Biopsy needle insertion into the lesion and sample collection. The pathological diagnosis of the lesion was reported as chondrosarcoma.

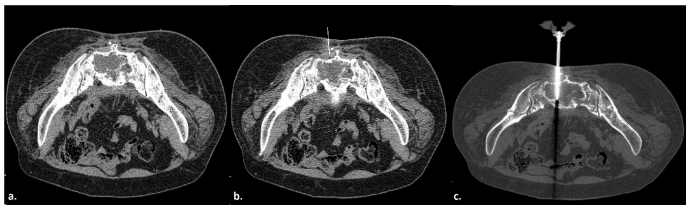

Figure III. a) In the prone position, a lytic lesion is observed in the midline of the sacrum in a follow-up patient with a history of nephrectomy due to renal cell carcinoma. b) Injection of 2% prilocaine hydrochloride into the skin, subcutaneous tissue, periosteum and adjacent soft tissues near the lesion. c) Entry into the lesion with a bone biopsy needle and sample collection. The pathological diagnosis of the lesion was reported as metastasis of renal cell carcinoma

Among the ten patients whose biopsy results were reported as nondiagnostic, four underwent repeat biopsy and two underwent surgical biopsy

during follow-up. Two patients were placed under surveillance, while no follow-up data were available in the system for the remaining two. Among the four patients who underwent repeat biopsy, one result remained nondiagnostic, one was reported as degenerative changes, one as prostate carcinoma metastasis, and one as low-grade chondrosarcoma/enchondroma. Of the two patients who underwent surgical biopsy, one was reported as showing necrosis, hemorrhage, and fibrous tissue, while the other was reported as having osteonecrosis, chronic active inflammation, and degeneration. Follow-up imaging was available for two patients under surveillance at 6 months and 2 years post-procedure, respectively, and in both cases, no significant changes were observed in lesion size or characteristics (Figure V).

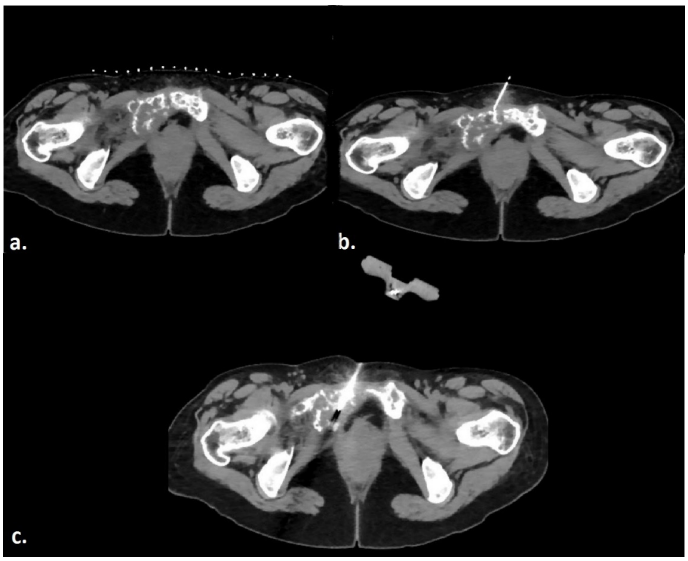

Figure IV. a) An expansile, lytic–sclerotic (mixed type) lesion observed in the right ischium on follow-up imaging of a patient diagnosed with lung adenocarcinoma, and a marker used for guidance to access the lesion in the supine position; b) Injection of 2% prilocaine hydrochloride into the skin, periosteum and subcutaneous tissue; c) Access to the lesion with a bone biopsy needle and tissue sampling. The lesion was reported as a metastasis on pathological examination.

During and after the procedure, minor complications were observed in 5 out of 50 patients (10%). These included moderate pain managed with oral analgesics in two patients, transient hypotension in one patient, and subcutaneous ecchymosis in one patient. Additionally, in one patient, a self-limiting intramuscular hematoma was detected in the iliopsoas muscle along the biopsy tract on imaging performed for unrelated reasons on the eighth day post-procedure. No major complications were observed in any patient.

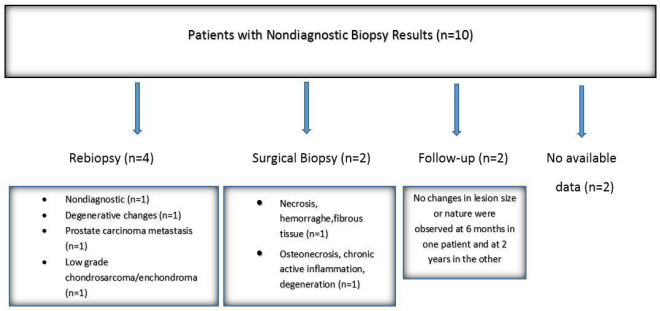

Figure V. Clinical Follow-up of Patients with Non diagnostic Biopsy Results

Discussion

Our study demonstrated that CT-guided pelvic bone biopsy is a highly effective and safe diagnostic procedure, with a technical success rate of 100% and a diagnostic yield of 80%. Importantly, nondiagnostic outcomes were significantly associated with smaller lesion size and sclerotic morphology—factors that may hinder adequate tissue sampling. The absence of major complications further supports the procedure's safety profile. These findings reinforce the utility of CT-guided biopsy as a first-line diagnostic tool for pelvic bone lesions, while also highlighting the challenges posed by specific lesion characteristics.

The overall diagnostic yield in our study was 80%, which falls within the broad range of 69% to 98% reported in prior studies of CT-guided musculoskeletal biopsies (10,11,21). For example, Wu et al. (2008) reported a diagnostic success rate of 88% in a large cohort including various skeletal sites, while Didolkar et al. (2013) found a lower rate of 76% specifically for pelvic and spinal lesions. Our results are comparable, especially considering the anatomical complexity of pelvic bone biopsies and the high proportion of sclerotic or small lesions in our sample. Among the 50 biopsied lesions, 10 (20%) yielded nondiagnostic histopathological results. These lesions were significantly smaller than both malignant ($p=0.002$) and benign ($p<0.001$) lesions, suggesting that lesion size plays a critical role in diagnostic success. When pathology results were

regrouped as diagnostic (malignant or benign) versus nondiagnostic, a statistically significant association was observed with lesion type (*p=0.025*). Notably, 70% of nondiagnostic lesions were sclerotic, whereas most diagnostic lesions were either lytic or mixed. These findings are consistent with previous studies identifying sclerotic morphology and small lesion size as major challenges in bone biopsy. In the study published by Spinnato et al. in 2023, lesion size was identified as the most critical factor influencing diagnostic yield (22). The authors reported that lesions larger than 3 cm had a significantly higher diagnostic yield compared to smaller lesions. Additionally, sclerotic or osteoblastic lesions were found to have a lower diagnostic accuracy than osteolytic or mixed lesions. Moreover, Cohen et al. (2016) emphasized that nondiagnostic rates are higher in sclerotic lesions due to sampling difficulty, and Sung et al. (2009) found lesion density and lack of soft tissue components to be independent risk factors for nondiagnostic outcomes. Additionally, in a study published by Donners et al. in 2022, the authors reported that targeting areas with predominantly mild sclerosis and lower CT attenuation in cancer patients with sclerotic bone disease can improve tumor tissue yield, suggesting that sampling from less dense, mildly sclerotic regions of the lesion has a positive impact on diagnostic outcomes (23). In line with our results, previous studies have reported that malignant bone lesions—particularly those that are lytic, demonstrate cortical destruction, or contain soft-tissue components—are generally more likely to yield diagnostic samples (24,25). Although the likelihood of nondiagnostic histopathological results increases with greater lesion density and sclerotic appearance, such bone lesions are also more likely to be non-malignant. In our study, among the eight nondiagnostic lesions with available follow-up or histopathological data, only two were ultimately confirmed as malignant—one prostate carcinoma metastasis and one low-grade chondrosarcoma/enchondroma—while the others were benign or stable. However, it is important to note that sclerotic bone lesions may be associated with malignancy, particularly in the context of prostate or breast cancer metastases, which are characteristically osteoblastic (26,27). Although coaxial battery-powered biopsy systems have been shown to improve tissue acquisition in sclerotic lesions, we used manual techniques exclusively in our study (25). The lack of drill-assisted systems may have contributed to the nondiagnostic results in some sclerotic cases. Nevertheless, we believe that the significantly smaller size of nondiagnostic lesions was the primary factor limiting diagnostic yield, likely more so than lesion type or biopsy method alone.

Minor complications were observed in 5 out of 50 patients (10%), including moderate pain in two patients, and transient hypotension, subcutaneous ecchymosis, and a self-limiting intramuscular hematoma in the iliopsoas muscle in one patient each. Consistent with our findings, previous studies have reported lower complication rates for percutaneous bone biopsy compared to surgical biopsy, with rates ranging from 0% to 15.6% (4,8,9,28). As in our study, pain is the most frequently observed minor complication, while others include bleeding, needle breakage, infection, neurological injury, pneumothorax, and tumor seeding along the needle tract. Notably, no major complications requiring hospitalization or significant intervention, as defined by the Society of Interventional Radiology (SIR) guidelines, occurred during or after the procedures. We believe that this favorable safety profile and the absence of major complications can be attributed to several key factors: the experience of the interventional radiologists performing the procedures; the use of CT guidance throughout all procedural steps; the adjustment of anticoagulant and antiplatelet therapy in accordance with current guidelines to reduce the risk of post-procedural hemorrhage and other complications; and the implementation of thorough pre-procedural clinical evaluation and questioning (e.g., assessment of postural limitations or presence of infection at the procedure site). Furthermore, meticulous procedural planning—including the selection of the shortest and safest access route to the lesion, and in cases of multiple lesions, targeting the one with the lowest risk of complications—likely contributed to the absence of major adverse events.

This study has several limitations. First, it was a retrospective, single-center study and is therefore subject to the inherent limitations of such study

designs. In addition, the patient population was relatively limited. Pathological evaluations performed at large, highly specialized centers dedicated to oncology or musculoskeletal tumors may offer higher diagnostic accuracy, and the lack of such specialization in our setting may have contributed to our nondiagnostic rate. Another limitation is the absence of follow-up data for some patients whose biopsy results were reported as nondiagnostic. Furthermore, for some lesions reported as benign, pre-procedural imaging was not performed at our institution, and the level of radiological assessment conducted at the referring centers is unknown. It is possible that if these lesions had been evaluated by experienced musculoskeletal radiologists at our center, a confident diagnosis might have been made without the need for biopsy. This, in turn, may have influenced the proportion of benign biopsy results in our study.

Conclusion

CT-guided bone biopsy is a safe, effective, and feasible diagnostic procedure with high technical success and diagnostic performance, and a low complication rate when performed by interventional radiologists. In our study, smaller lesion size was significantly associated with nondiagnostic biopsy outcomes. Most malignant lesions were lytic, benign lesions were predominantly of mixed type, and the majority of nondiagnostic lesions were sclerotic. These findings highlight the importance of considering lesion characteristics when planning the procedure. Interventional radiologists should be particularly cautious with small and sclerotic lesions, which carry a higher risk of nondiagnostic results, and adjust their approach accordingly to optimize diagnostic yield. Finally, close follow-up of biopsy results, re-biopsy when necessary, and referral to surgical biopsy for patients with inconclusive repeat procedures and high-risk lesions may help improve diagnostic accuracy and patient management.

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