Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

A Preliminary Study on the Factors Affecting the Outcomes of Computed Tomography-Guided Percutaneous Core Needle Biopsy for Bone Tumors

Xiaoliang Wang
Tianjin Hospital
Zhenye Sun
Tianjin Hospital
Zhilin Ji
Tianjin Hospital
Jingyu Zhang
Tianjin Hospital
Guangyi Xiong
Tianjin Hospital
Jinwei Liu
Tianjin Hospital
Wei Wang
Tianjin Hospital
Shuhui Dong
Tianjin Hospital
Xianghong Meng
ichbinhunger@163.com

Tianjin Hospital

Research Article

Keywords: computed tomography-guided biopsy, bone tumors, percutaneous core needle biopsy, marginal sclerosis, internal sclerosis, biopsy success rate, sclerotic rim, 9-gauge trephine biopsy needle

Posted Date: August 6th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10172200/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background/Objectives: To determine whether internal or marginal sclerosis in bone tumors affects the success rate of computed tomography (CT)-guided percutaneous core needle biopsy

Methods: Overall, 479 patients with bone tumors underwent CT-guided percutaneous core needle biopsy with a 9-gauge (9G) trephine biopsy needle. Based on imaging findings, tumors were classified as non-sclerotic, internally sclerotic, or marginally sclerotic. Internal sclerosis was subdivided into diffuse and heterogeneous internal sclerosis; marginal sclerosis was subdivided into mild and marked marginal sclerosis according to sclerotic-rim thickness. Biopsy success rates among the non-sclerotic, internal sclerosis, and marginal sclerosis groups were compared using the pairwise chi-square test with Bonferroni correction. The chi-square test compared success rates between the diffuse and heterogeneous internal sclerosis subgroups and between the mild and marked marginal sclerosis subgroups. Univariate binary logistic regression identified factors influencing biopsy success.

Results: Biopsy success differed significantly between the non-sclerotic and marginal sclerosis groups ($\chi^2 = 19.330$, $P < 0.001$), with a lower success rate in the marginal sclerosis group. No significant differences were found between the non-sclerotic and internal sclerosis groups ($\chi^2 = 0.106$, $P = 0.318$), internal sclerosis and marginal sclerosis groups ($\chi^2 = 0.108$, $P = 0.324$), diffuse and heterogeneous internal sclerosis subgroups ($\chi^2 = 0.630$, $P = 0.401$), or mild and marked marginal sclerosis subgroups ($\chi^2 = 0.165$, $P = 0.495$). Marginal sclerosis was associated with CT-guided percutaneous core needle biopsy failure (OR = 0.178, $P < 0.001$).

Conclusions: CT-guided percutaneous core needle biopsy with a 9G trephine biopsy needle achieved a high biopsy success rate in bone tumors. Marginal sclerosis was associated with biopsy failure, whereas internal sclerosis did not significantly affect biopsy outcomes.

1. Introduction

Bone tumors, encompassing both primary and metastatic lesions, are relatively common, and malignant bone tumors are associated with poor clinical outcomes. In China, the incidence of malignant bone tumors is approximately 1.87 per 100,000 population, accounting for 0.63% of all malignancies, whereas the mortality rate is 1.38 per 100,000 population, representing 0.78% of all cancer-related deaths [1]. The 5-year survival rate remains approximately 25% [2, 3]. Therefore, accurate and timely diagnosis of bone tumors, together with determination of their biological nature and origin, is crucial for guiding appropriate treatment, improving patient survival, and maximizing preservation of limb function.

Computed tomography (CT)-guided percutaneous core needle biopsy is the preferred technique for establishing a definitive diagnosis of bone tumors. As a minimally invasive approach, it offers several advantages over open biopsy, including preservation of skeletal integrity, minimal soft-tissue injury, avoidance of general anesthesia, shorter hospital stays, lower healthcare costs, fewer postoperative complications, and a very low risk of tumor seeding [4–6]. The primary purpose is to obtain adequate

tissue for pathological diagnosis, thereby helping clinicians formulate appropriate treatment strategies. Previous studies have reported that several factors may affect the diagnostic yield of bone tumor biopsy, including tumor histology, lesion location, biopsy needle selection, and the degree of lesion sclerosis [7–9]. In clinical practice, we have observed that the presence of a sclerotic rim surrounding a bone tumor may also influence the success rate of CT-guided percutaneous core needle biopsy. Nonetheless, evidence regarding this potential association remains limited.

Therefore, this retrospective study was conducted to evaluate the effects of internal sclerosis and marginal sclerosis on the success rate of CT-guided percutaneous core needle biopsy in patients with bone tumors.

2. Materials and Methods

2.1 The Ethical approval

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Tianjin Hospital (Approval No. tjyy2504). Because this was a retrospective analysis of existing data involving no additional patient intervention and all data were anonymized before analysis, the Ethics Committee waived the requirement for informed consent.

2.2 Study population and inclusion/exclusion criteria

A retrospective review was performed of 655 consecutive patients admitted to Tianjin Hospital between February 2023 and January 2025 who underwent biopsy of bone or soft-tissue mass lesions. Cases were excluded according to the following criteria: 51 patients who underwent ultrasound-guided biopsy; 63 patients who underwent CT-guided biopsy of soft-tissue tumors; 17 patients with implants adjacent to the lesion; 17 patients with pathological fractures; and 22 patients who were unable to complete the biopsy because of patient refusal, coagulation abnormalities, or other reasons. To minimize potential confounding, CT images were reviewed, and six patients with bone tumors exhibiting both internal sclerosis and marginal sclerosis were excluded. Ultimately, 479 patients were included in the study. All biopsies were performed by the same clinical team: operator 1 (XL W, radiologist, 14 years of experience), operator 2 (ZL J, radiologist, 3 years of experience), operator 3 (JY Z, orthopedic surgeon, 16 years of experience), operator 4 (JW L, orthopedic surgeon, 11 years of experience), and operator 5 (W W, orthopedic surgeon, 4 years of experience). The patient selection process is illustrated in Fig. 1.

2.3 CT imaging and percutaneous core needle biopsy procedure

All patients underwent CT examination using a 64-slice CT scanner (Discovery CT750 HD; GE Healthcare, USA). The scanner underwent routine quality control assessments by service engineers every 3 months to ensure optimal image quality. The scanning range extended 3 cm beyond both the superior and

inferior margins of the lesion. Scanning parameters were as follows: tube voltage, 100 kV; effective tube current, 70 mA; pitch, 1.0; reconstruction slice thickness, 0.625 mm; reconstruction interval, 0.625 mm; and large-body field of view. Based on the CT images, the skin entry site was determined and marked.

Local anesthesia was administered with 2% lidocaine hydrochloride (Shanghai Hefeng Pharmaceutical Co., Ltd., China). Along the planned needle trajectory, the soft tissues extending from the skin entry site to the bone cortex or lesion margin were infiltrated with local anesthetic. Biopsy specimens were obtained using a disposable 9-gauge (9G) trephine biopsy needle (PAG0915; STERYLAB S.r.l., Italy) (Fig. 2). The specimens were fixed in formalin and submitted to the Department of Pathology for histopathological assessment. All pathological assessments were performed by the same team of experienced bone and soft-tissue pathologists (GY X, pathologist with 16 years of experience; SH D, pathologist with 14 years of experience). For patients who subsequently underwent surgical resection at our institution, the postoperative pathological diagnosis was regarded as the reference standard.

Biopsy results were categorized into three groups. A result was classified as diagnostic when a definitive pathological diagnosis could be established from the biopsy specimen. A result was classified as adequate when a definitive diagnosis could not be established, but the lesion could be reliably categorized as benign or malignant. A result was classified as non-diagnostic when neither a definitive diagnosis nor a lesion classification as benign or malignant could be made. For this study, diagnostic and adequate results were considered successful biopsies, whereas non-diagnostic results were considered failed biopsies.

2.4 Data analysis

The degree of sclerosis in each bone tumor was assessed independently by two radiologists with experience in diagnosing bone and soft-tissue tumors (XL W, radiologist, 14 years of experience; ZL J, radiologist, 3 years of experience). When disagreement occurred, a senior radiologist (XH M, radiologist, 16 years of experience) reviewed the images and made the final determination. The assessment criteria were based on the method described by Ni et al. [10]. CT images were reviewed to estimate the proportion of tumor volume exhibiting a density greater than that of the adjacent normal cancellous bone. Lesions in which ≥ 50% of the tumor volume exhibited increased density were classified as having internal sclerosis, whereas lesions surrounded by a peripheral sclerotic rim were classified as having marginal sclerosis. To minimize potential confounding, tumors exhibiting both internal sclerosis and marginal sclerosis were excluded from the subgroup analyses. The remaining cases were categorized into three groups: the internal sclerosis group (tumors with internal sclerosis but no sclerotic rim), the marginal sclerosis group (tumors with a sclerotic rim but no internal sclerosis), and the non-sclerotic group (tumors with neither internal sclerosis nor marginal sclerosis).

The internal sclerosis group was further subdivided, based on intratumoral sclerosis distribution, into diffuse internal sclerosis and heterogeneous internal sclerosis subgroups. In the marginal sclerosis group, the thickness of the sclerotic rim was measured at the 12-, 3-, 6-, and 9-o'clock positions on CT

images, and the mean value was calculated. A mean sclerotic rim thickness of ≥ 2 mm was defined as marked marginal sclerosis, whereas a mean thickness of < 2 mm was defined as mild marginal sclerosis. Accordingly, tumors in the marginal sclerosis group were further categorized into mild and marked marginal sclerosis subgroups (Fig. 3).

2.5 Complication assessment

Procedure-related complications associated with CT-guided percutaneous core needle biopsy were documented, recorded, and graded according to the modified Society of Interventional Radiology Adverse Event Classification System (SIR AE) [11]. The severity of each complication was assessed using the SIR AE classification system.

2.6 Statistical analysis

Statistical analyses were performed using SPSS version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables with a normal distribution were expressed as mean ± standard deviation (mean ± SD). Biopsy success rates were compared among the internal sclerosis, marginal sclerosis, and non-sclerotic groups using the chi-square test. Within the internal sclerosis group, success rates were compared between the diffuse and heterogeneous subgroups using the chi-square test; within the marginal sclerosis group, they were compared between the mild and marked subgroups using the chi-square test. All statistical tests were two-sided, and a P value < 0.05 was considered statistically significant. Pairwise comparisons among the three groups were performed using the chi-square test with Bonferroni correction, with a significance threshold of P < 0.017. Univariate binary logistic regression was performed to identify factors associated with biopsy success, and P < 0.05 was considered statistically significant.

3. Results

3.1 Patient characteristics and biopsy outcomes

Overall, 479 patients were included in this study. No significant difference in sex distribution was observed among the three groups (P = 0.312). Nevertheless, patients in the marginal sclerosis group were significantly younger than those in the internal sclerosis and non-sclerotic groups (P < 0.001) (Table 1). In total, 458 biopsies were classified as successful, including 352 diagnostic cases and 106 adequate cases, whereas 21 biopsies were classified as failures, yielding an overall biopsy success rate of 95.62%. Among the diagnostic cases, metastatic tumors were the most common diagnosis, accounting for 30.97% (109/352) of cases, followed by enchondroma (13.64%, 48/352), giant cell tumor of bone (8.52%, 30/352), and plasma cell myeloma (7.67%, 27/352). Of the 352 diagnostic cases, benign, malignant, and intermediate lesions accounted for 38.64% (136/352), 50.00% (176/352), and 11.36% (40/352), respectively.

3.2 Comparison of biopsy success rates among the sclerosis groups and subgroups

The biopsy success rate was significantly lower in the marginal sclerosis group than in the non-sclerotic group (P < 0.001) (Table 1). Biopsy success rates did not differ significantly between the diffuse internal sclerosis and heterogeneous internal sclerosis subgroups (P = 0.401) or between the mild marginal sclerosis and marked marginal sclerosis subgroups (P = 0.495) (Table 2).

3.3 Univariate binary logistic regression analysis

Univariate binary logistic regression analysis showed that sex (P = 0.452), age (P = 0.566), and internal sclerosis (P = 0.517) were not significantly associated with biopsy success. Conversely, marginal sclerosis was a significant predictor of biopsy failure (P < 0.001) (Table 3).

3.4 Complications

A total of 46 patients experienced procedure-related adverse events, corresponding to an overall complication rate of 9.48%. Of these, 43 were classified as minor adverse events, all consisting of mild intraprocedural bleeding. These events were managed with local compression, and no clinically significant postprocedural bleeding was observed during follow-up.

Three patients experienced moderate adverse events. In one patient with a rib lesion, a small pneumothorax developed after the biopsy procedure. Follow-up imaging demonstrated gradual spontaneous resolution, and complete resolution of the pneumothorax was confirmed 5 days after the procedure. The remaining two patients experienced relatively heavy intraprocedural bleeding that required compression bandaging; no clinically significant postprocedural bleeding was observed in either patient. One patient was diagnosed with a metastatic tumor based on the biopsy specimen, whereas the other had a non-diagnostic biopsy result and subsequently underwent surgical treatment. The final pathological diagnosis in this patient was hemangioma. No severe adverse events occurred during the study period.

Table 1
Patient characteristics and biopsy outcomes in patients who underwent CT-guided percutaneous core needle biopsy of bone tumors

Variable	Internal sclerosis group	Marginal sclerosis group	Non-sclerotic group	χ2/H value	P value
Sex				2.327	0.312
Male	32	38	188		
Female	36	25	160		
Age, years	51.50(33.00, 60.00)	36.00(21.00, 60.00)	58.00(40.25, 67.00)	24.493	<0.001
Biopsy success rate (successful/total)	94.12%(64/68)	85.71%(54/63)	97.70% (64/348)	19.418	<0.001
Internal sclerosis group vs. marginal sclerosis group				2.583	0.108
Internal sclerosis group vs. non-sclerotic group				2.608	0.106
Marginal sclerosis group vs. non-sclerotic group				19.330	<0.001

Table 2
Comparison of biopsy success rates among the subgroups of the internal sclerosis and marginal sclerosis groups

Subgroups	Successful	Failed	χ^2 value	*P* value
Internal sclerosis group			0.630	0.401
Heterogeneous internal sclerosis	29	1		
Diffuse internal sclerosis	35	3		
Marginal sclerosis group			0.165	0.495
Mild marginal sclerosis	45	7		
Marked marginal sclerosis	9	2		

Table 3
Univariate binary logistic regression analysis

Variable	Univariate binary logistic regression analysis	
	OR(95% CI)	*P* value
Sex	1.413(0.575–3.474)	0.452
Age, years	0.994(0.972–1.016)	0.566
Internal sclerosis	0.690(0.225–2.117)	0.517
Marginal sclerosis	0.178(0.072–0.443)	<0.001

CI, confidence interval; OR, odds ratio.

4. Discussion

This study investigated how tumor sclerosis affects the success rate of CT-guided percutaneous core-needle biopsy for bone tumors. The results showed that internal sclerosis did not significantly affect biopsy success, whereas marginal sclerosis was associated with a lower biopsy success rate.

4.1 Factors contributing to the high biopsy success rate

Previous studies have reported considerable variability in the diagnostic performance of CT-guided percutaneous core-needle biopsy, with diagnostic yields ranging from 49% to 98% and false-negative rates ranging from 2% to 8% [11]. In this study, the overall biopsy success rate was 95.62%, which is relatively high. All biopsies were performed using a 9G trephine biopsy needle. Ferreira et al. [16] reported that fine-needle aspiration biopsy may achieve a higher diagnostic yield than percutaneous core-needle biopsy when performed alone. However, several studies have reported that larger-diameter biopsy needles are generally associated with improved diagnostic performance and higher biopsy success rates [17, 18]. Compared with the biopsy needles used in many previous studies, the 9G trephine biopsy needle used here has a relatively large bore diameter, which may have contributed to the high biopsy success rate observed.

4.2 Internal sclerosis does not significantly affect biopsy success

Previous studies have suggested that sclerotic bone lesions are associated with lower biopsy success rates [8, 9, 19–21], possibly because the sclerotic components visible on CT images contain relatively few viable tumor cells for pathological assessment. Here, all available preoperative imaging findings were carefully reviewed during the biopsy procedure. For tumors with heterogeneous internal sclerosis, the stylet was removed immediately after the needle tip reached the lesion margin, and tissue sampling was continued. This technique facilitated the acquisition of non-sclerotic tissue adjacent to the sclerotic region, ensuring that the biopsy specimen contained both sclerotic and non-sclerotic tissue. For tumors

with diffuse internal sclerosis, tissue samples were preferentially obtained from areas demonstrating a relatively lower degree of sclerosis whenever feasible. Similarly, Donners et al. [22] reported satisfactory biopsy outcomes for sclerotic bone lesions with CT attenuation values below 610 HU. In another study, Donners et al. [23] successfully used magnetic resonance imaging guidance to facilitate CT-guided biopsy of metastatic castration-resistant prostate cancer lesions lacking obvious osteolytic components, further demonstrating that diagnostically adequate tissue can be obtained from tumors with internal sclerosis when appropriate targeting strategies are employed. Consistent with these findings, no significant difference in biopsy success rate was observed between bone tumors with internal sclerosis and those without sclerosis in this study. Therefore, CT-guided percutaneous core needle biopsy may provide diagnostically adequate specimens for both lesion types when appropriate sampling techniques are used.

4.3 Marginal sclerosis reduces biopsy success rate

A sclerotic rim surrounding a bone tumor generally indicates relatively inactive biological behavior and is an important imaging feature for differentiating benign from malignant lesions [24]. Nonetheless, the effect of marginal sclerosis on biopsy outcomes has received little attention. Here, marginal sclerosis was associated with a significantly lower biopsy success rate. Interestingly, no significant difference was observed between the mild and marked marginal sclerosis subgroups, suggesting that the presence of marginal sclerosis itself, rather than the thickness of the sclerotic rim, may adversely affect tissue acquisition. Several mechanisms may explain this finding. First, biopsy specimens from tumors with marginal sclerosis may consist predominantly of normal bone tissue outside the sclerotic rim, thereby providing limited diagnostic information. In contrast, tumors without a sclerotic rim are more likely to yield tissue infiltrated by tumor cells and, therefore, have a higher biopsy success rate. Second, the sclerotic rim may form an intact bone fragment during needle penetration, obstructing the biopsy-needle lumen and preventing diagnostically useful tissue from entering the sampling channel.

4.4 Complications

The overall complication rate in this study was 9.48%, substantially lower than the 30.3% rate reported previously [11]. One possible explanation is that all procedures in this study involved bone tumors, whereas complications such as pneumothorax are primarily associated with biopsies of rib lesions and other lesions adjacent to the thoracic cavity. Bleeding was the most common complication in our cohort and was likely related to lesion vascularity. No severe adverse events occurred during the study period, further supporting the safety of CT-guided percutaneous core needle biopsy.

4.5 Study limitations

Some limitations should be acknowledged. First, the number of tumors with internal sclerosis and marginal sclerosis was relatively small. Only 11 tumors were classified as having marked marginal sclerosis, which may have limited statistical power and introduced potential bias. Second, all biopsies were performed manually using a 9G trephine biopsy needle, without assistance from powered drilling devices. Powered instruments may improve tissue acquisition in tumors with marginal sclerosis and

warrant further investigation. Finally, previous studies have shown that rapid on-site evaluation (ROSE) of biopsy specimens can provide an immediate assessment of specimen adequacy and significantly reduce biopsy failure rates [25]. Whether ROSE can improve the success rate of CT-guided biopsy in tumors with marginal sclerosis should be investigated in future studies.

5. Conclusion

CT-guided percutaneous core needle biopsy using a 9G trephine biopsy needle achieved a high success rate in patients with bone tumors. Marginal sclerosis was identified as a significant factor associated with biopsy failure and should therefore be carefully considered during the biopsy procedure. In such cases, ROSE of the biopsy specimens may help improve the success rate. In contrast, internal sclerosis did not significantly affect biopsy success.

Abbreviations

9G: 9-gauge; AE: adverse event; CI: confidence interval; CT: computed tomography; OR: odds ratio; ROSE: rapid on-site evaluation; SD: standard deviation; SIR AE: Society of Interventional Radiology Adverse Event Classification System

Declarations

Ethics approval and consent to participate

This study was approved by the institutional review board(Approval No. tjyy2504, Medical Ethics Review Committee, Tianjin Hospital Medical Ethics Committee, Tianjin Hospital, China), and we obtained written informed consent from each patient, this study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The author(s) declared no potential conflicts of interest with respect to the research, author- ship, and/or publication of this article.

Funding

We hereby declare that during the writing of the paper titled "A Preliminary Study on the Factors Affecting the Outcomes of Computed Tomography-Guided Percutaneous Core Needle Biopsy for Bone Tumors", the research expenses were supported by the hospital-level project of Tianjin Hospital, titled "The auxiliary application of deep learning in improving the success rate of CT guided bone tumor biopsy" (Approval No. tjyy2504). This declaration is hereby made.

Authors' contributions

Xl Wang, Xh M contributed to the conception and design of the study; Xl W, Zy S performed the CT machine operation during the biopsy procedures; Xl W,Zl J, Jy Z, Jw L, W W carried out the CT-guided puncture biopsies; Gy X, Sh D conducted the pathological examination of the biopsy specimens; Zy S, Zl J was responsible for data collection and statistical analysis; Xh M performed the final review and revision of the manuscript. All authors reviewed the manuscript

Acknowledgements

Authors would like to express my gratitude to the medical personnel who assisted in the diagnosis and treatment of these patients. Their support made our research endeavours possible. And we would like to thank Editage (www.editage.cn) for English language editing.

References

1. Zheng RS, et al. [Cancer incidence and mortality in China, 2022]. Zhonghua Zhong Liu Za Zhi. 2024;46(3):221–31.
2. Xu Y, et al. Twenty-year outcome of prevalence, incidence, mortality and survival rate in patients with malignant bone tumors. Int J Cancer. 2024;154(2):226–40.
3. Siegel RL, et al. Cancer statistics, 2025. CA Cancer J Clin. 2025;75(1):10–45.
4. Ariizumi T, et al. Diagnostic accuracy of fine needle aspiration cytology and core needle biopsy in bone and soft tissue tumor: A comparative study of the image-guided and blindly performed procedure. Ann Diagn Pathol. 2022;59:151936.
5. Gami A, et al. Does an excision of needle bone biopsy tract affect the prognosis in patients with primary bone tumor? J Orthop. 2024;48:13–9.
6. Mills MK, et al. Concepts in Musculoskeletal Bone and Soft Tissue Biopsy. Semin Musculoskelet Radiol. 2021;25(6):711–24.
7. Yoon GH, et al. Analysis of Factors Potentially Influencing Diagnostic Yield Among Computed Tomography-Guided Biopsies for Bone Lesions. J Comput Assist Tomogr. 2022;46(5):762–9.
8. Wu JS, et al. Bone and soft-tissue lesions: what factors affect diagnostic yield of image-guided core-needle biopsy? Radiology. 2008;248(3):962–70.

9. Spinnato P et al. Percutaneous CT-Guided Bone Biopsies: Indications, Feasibility and Diagnostic Yield in the Different Skeletal Sites-From the Skull to the Toe. Diagnostics (Basel), 2023. 13(14).
10. Ni Mhuircheartaigh J, et al. Diagnostic yield of percutaneous biopsy for sclerotic bone lesions: Influence of mean Hounsfield units. Clin Imaging. 2017;46:53–6.
11. Patzer TS et al. Navigating Biopsy Safety: Complication Rates Under Ultrasound and CT Guidance. Diagnostics (Basel), 2025. 15(20).
12. Burke MC, et al. Initial experience with dual-energy computed tomography-guided bone biopsies of bone lesions that are occult on monoenergetic CT. Skeletal Radiol. 2019;48(4):605–13.
13. Hegde V, et al. Is Core Needle Biopsy Reliable in Differentiating Between Aggressive Benign and Malignant Radiolucent Bone Tumors? Clin Orthop Relat Res. 2018;476(3):568–77.
14. Mitsuyoshi G, et al. Accurate diagnosis of musculoskeletal lesions by core needle biopsy. J Surg Oncol. 2006;94(1):21–7.
15. Kilpatrick SE, et al. Is fine-needle aspiration biopsy a practical alternative to open biopsy for the primary diagnosis of sarcoma? Experience with 140 patients. Am J Clin Pathol. 2001;115(1):59–68.
16. Ferreira FBMD, et al. Image-Guided Percutaneous Needle Biopsy for Benign and Malignant Bone Tumors: Systematic Review and Meta-Analysis. J Vasc Interv Radiol. 2023;34(4):623–e6322.
17. Chang IJ, et al. CT-guided percutaneous biopsy of sclerotic bone lesions: diagnostic outcomes. Skeletal Radiol. 2018;47(5):661–9.
18. Guedes A, Nakagawa SA. Biopsy of bone tumors: a literature review. Rev Assoc Med Bras (1992), 2024. 70(suppl 1): p. e2024S131.
19. Li Y, et al. Factors influencing diagnostic yield of CT-guided percutaneous core needle biopsy for bone lesions. Clin Radiol. 2014;69(1):e43–7.
20. Wermelskirchen S, et al. CT Texture Analysis in Breast Cancer Patients Undergoing CT-Guided Bone Biopsy: Correlations With Histopathology. Breast Cancer (Auckl). 2025;19:11782234241305886.
21. Gataa KG, et al. Factors affecting the success of CT-guided core biopsy of musculoskeletal lesions with a 13-G needle. Skeletal Radiol. 2024;53(4):725–31.
22. Donners R, et al. Optimising CT-guided biopsies of sclerotic bone lesions in cancer patients. Eur Radiol. 2022;32(10):6820–9.
23. Donners R, et al. Multiparametric bone MRI targeting aides lesion selection for CT-guided sclerotic bone biopsies in metastatic castrate resistant prostate cancer. Cancer Imaging. 2023;23(1):121.
24. Caracciolo JT, et al. A Modified Lodwick-Madewell Grading System for the Evaluation of Lytic Bone Lesions. AJR Am J Roentgenol. 2016;207(1):150–6.
25. Ambrosi F, et al. Public health impact of a diagnostic improvement intervention supported by Rapid On-Site Evaluation (ROSE) in thoracic CT-guided biopsies: a pre-post study. Pathologica. 2025;117(4):320–6.

Figures

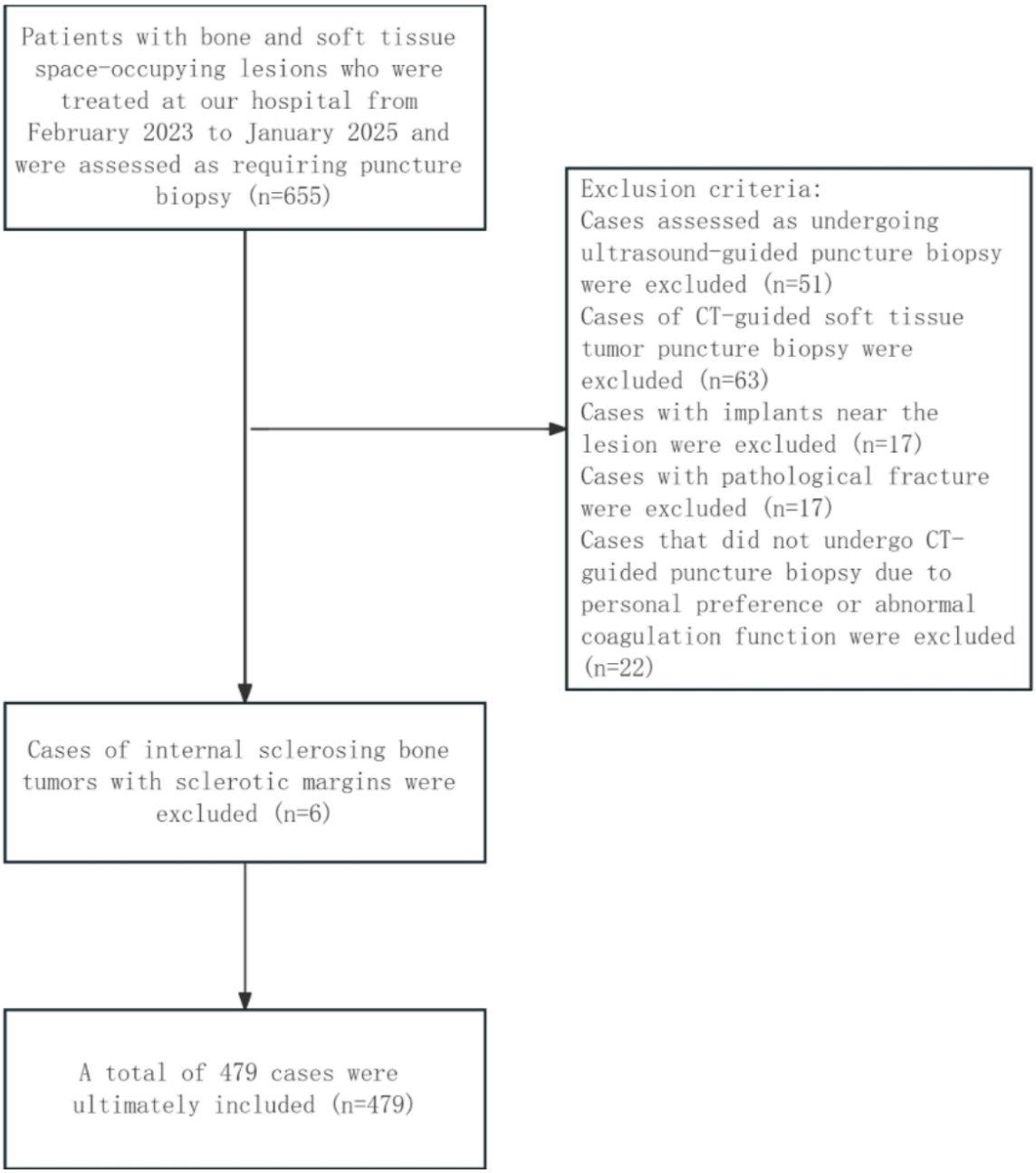


Figure 1

Flowchart illustrating the inclusion and exclusion criteria for patients who underwent CT-guided percutaneous core needle biopsy of bone tumors.

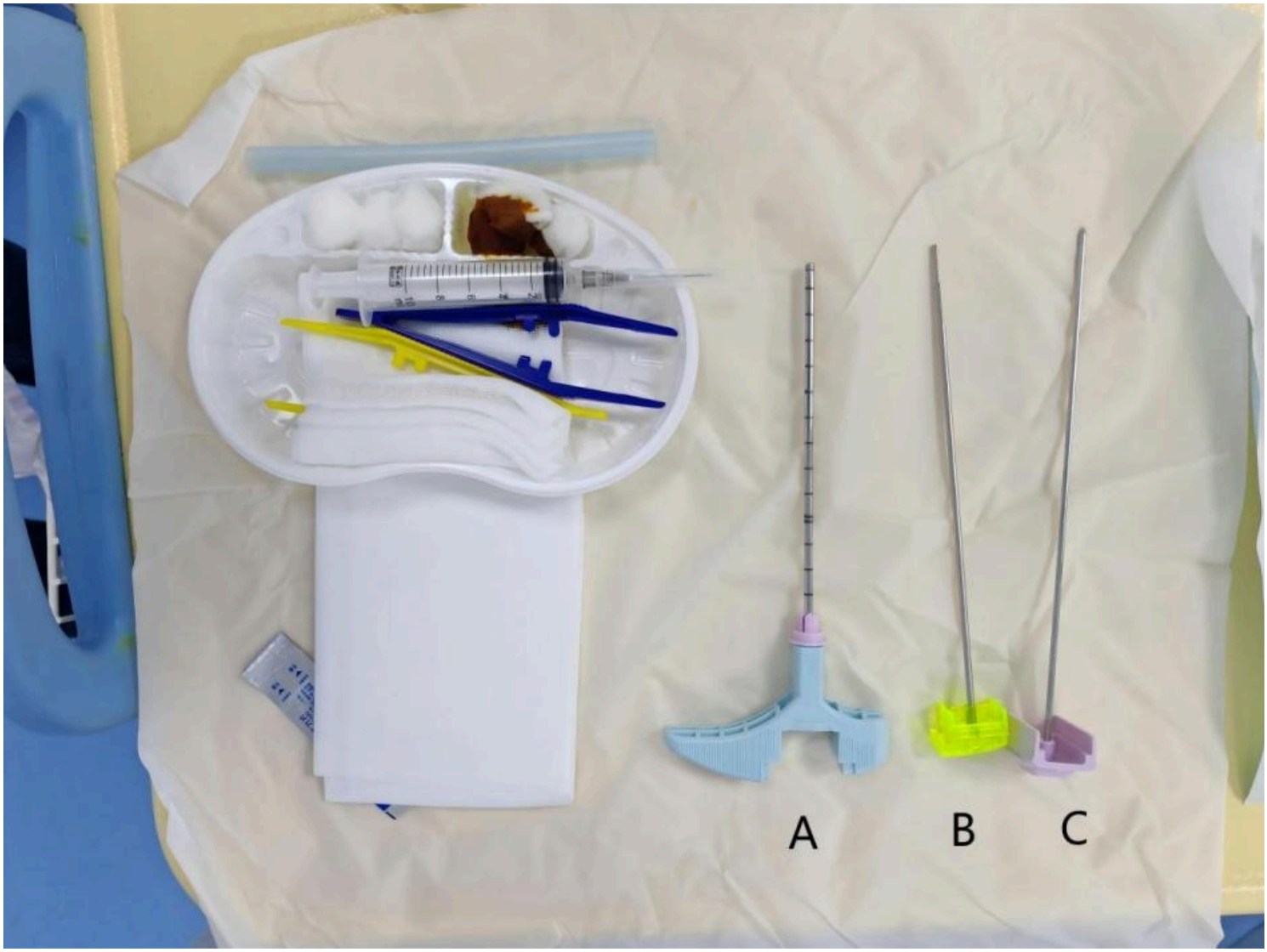


Figure 2

Components of the 9G trephine biopsy needle used for CT-guided percutaneous core needle biopsy. (A) handle, (B) hollow cannula, and (C) solid stylet.

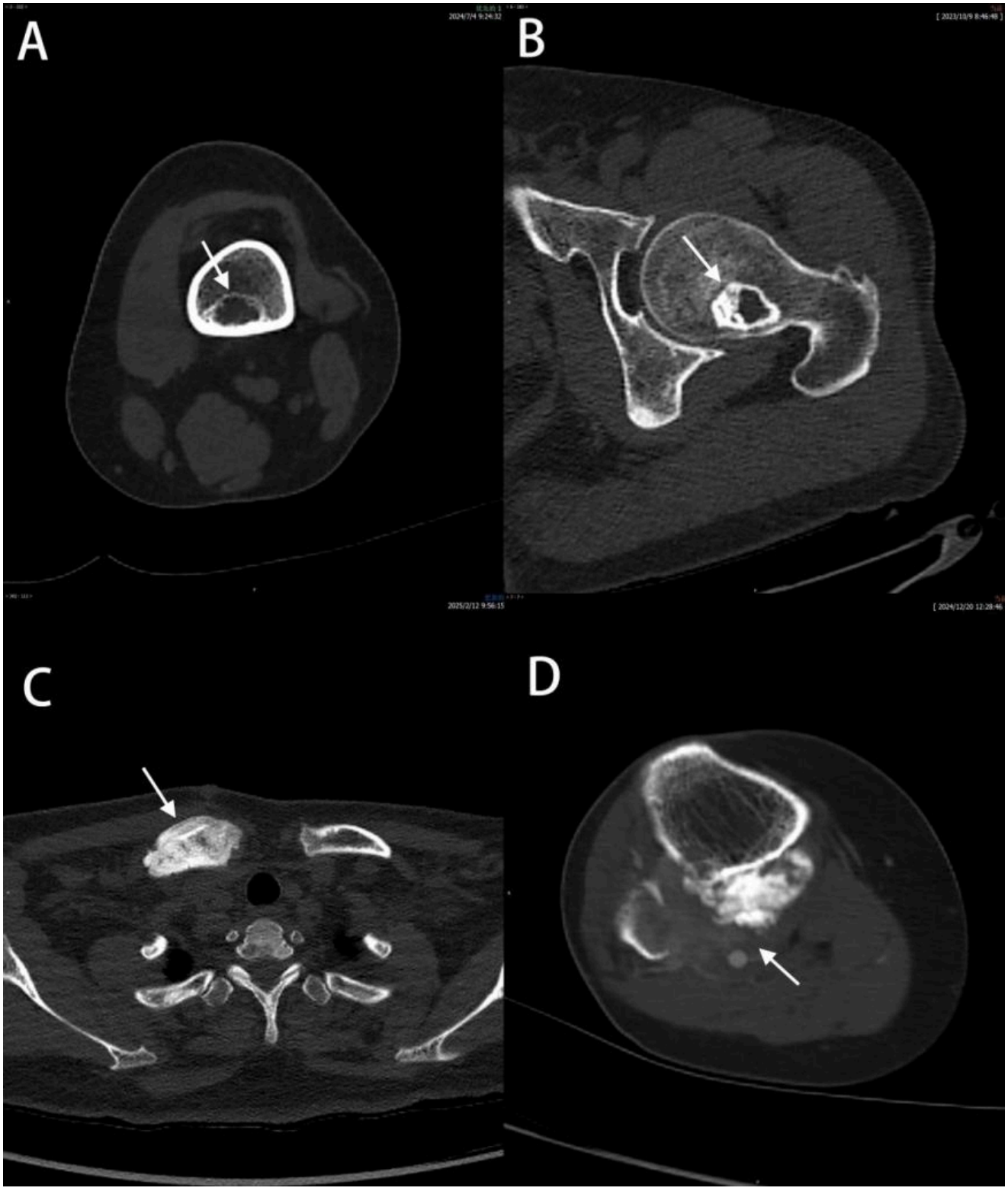


Figure 3

Subgroup classification of bone tumors with marginal sclerosis and internal sclerosis. (A) A lesion in the distal left femur showing a sclerotic rim with a mean thickness of 1.46 mm, classified as a tumor with mild marginal sclerosis. (B) A lesion in the left femoral head-neck region showing a sclerotic rim with a mean thickness of 3.02 mm, classified as a tumor with marked marginal sclerosis. (C) A lesion in the right clavicle with a density greater than that of the adjacent normal cancellous bone and a

homogeneous distribution of sclerosis, classified as a tumor with diffuse internal sclerosis. (D) A lesion in the proximal right tibia in which most areas show a density greater than that of the adjacent normal cancellous bone, with a heterogeneous distribution of sclerosis and visible soft-tissue density components, classified as a tumor with heterogeneous internal sclerosis.