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Original Article

Diagnostic Accuracy of Ultrasonography in Superficial Soft Tissue Masses: A Clinicopathological Correlation Study

Vijai Raj Saxena, Ajay Kumar Singh,* Muskan Singh, Ruchika Singh, S K Singh, Aman Kumar

Department of Radiodiagnosis, KNS Memorial Institute of Medical Science (KNS MIMS), Uttar Pradesh, India

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Correspondence:
Ajay Kumar Singh,
Department of Radiodiagnosis,
KNS Memorial Institute of Medical Science (KNS MIMS),
Uttar Pradesh, India.
Email: aksinghjuly1967@gmail.com

Abstract

Background: Superficial soft tissue swellings are a common and diagnostically heterogeneous presentation in dermatology outpatient practice. High-resolution ultrasonography (USG) is widely used as a first-line adjunct to distinguish cystic from solid lesions, define anatomic planes, and triage for reassurance, drainage, excision, or biopsy.

Objective: To evaluate the diagnostic accuracy of USG for superficial swellings using histopathology as the reference standard.

Methods: A retrospective clinicopathological correlation study was conducted at a tertiary care teaching hospital under a collaboration between Dermatology and Radiodiagnosis departments. USG impressions (grey scale ± color Doppler) were correlated with final histopathological diagnoses. Primary diagnostic performance was assessed for malignant/suspicious versus benign lesions using 2×2 contingency tables to compute sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

Results: Most participants were 31–40 years old (26.7%); males comprised 56.7%. Upper limb lesions were most frequent (30.0%), followed by head and neck (23.3%). Histopathology showed predominantly benign disease (58/60; 96.7%), most commonly lipoma (30.0%) and epidermoid cyst (23.3%). Malignancy was rare (2/60; 3.3%; Dermatofibrosarcoma protuberans and liposarcoma). USG classified 57 lesions as benign and three as malignant/suspicious. USG demonstrated 100% sensitivity (TP=2, FN=0), 98.3% specificity (TN=57, FP=1), 66.7% PPV, and 100% NPV for differentiating Benign from Malignant lesions.

Conclusion: High-resolution ultrasonography showed excellent performance for ruling out malignancy in superficial soft tissue swellings, with perfect sensitivity and NPV, and very high specificity. In dermatology outpatient department (OPD) pathways, USG is a valuable first-line tool for risk stratification and procedural planning, with occasional cautious overcalling in low-prevalence malignancy settings.

Keywords: Biopsy, epidermoid cyst, lipoma, soft tissue neoplasms, ultrasonography

Introduction

Patients presenting to a dermatology outpatient department (OPD) with a "lump" or "swelling" constitute a large, diagnostically diverse group in day-to-day practice. Many of these lesions are superficial, visible, and cosmetically distressing. These lesions often prompt dermatological consultation because of a recent increase in size, pain, discharge, or concern regarding malignancy. From a dermatology perspective, the clinical differential is broad and includes common benign entities such as epidermoid (epidermal inclusion) cysts, lipomas, ganglion, other cysts and a range of adnexal or mesenchymal

tumors.[1] While careful inspection and palpation remain fundamental, clinical diagnosis can be uncertain when swellings are deep-seated, have atypical surface changes, mimic one another (e.g., inflamed cyst versus abscess), or lie close to tendons, joints, and neurovascular bundles. Consequently, dermatologists increasingly seek imaging of lesions. Imaging can refine the working diagnosis, guide procedural decisions (aspiration, incision and drainage, excision, or biopsy) and help counsel patients regarding prognosis and expected outcomes. [2]

Imaging has therefore become a frequent and practical extension of clinical evaluation for superficial soft tissue swellings. There is limited evidence on the role of ultrasonography in dermatology outpatient settings, where most superficial soft tissue lesions are benign. Existing studies mainly involve surgical or oncology populations and may not reflect routine dermatology practice. Soft tissue masses have varied presentations for which a first-line modality such as ultrasound is desirable in routine care settings. This can help in rapid differentiation between lesions that can be managed conservatively, those requiring antibiotics or drainage and those that warrant planned excision or tissue diagnosis. In addition, preoperative clarification of lesion extent and plane of origin can reduce incomplete excision and recurrence—important in cosmetically sensitive sites (face/scalp) and functionally critical regions (hand/wrist). As a result, it is important that imaging is requested early in the clinical pathway rather than after failed empirical therapy.[3]

Ultrasound is particularly well suited for dermatology outpatient practice because it is readily available, cost-effective and allows real-time dynamic assessment. Unlike MRI, it also does not raise concerns related to sedation, implants, or claustrophobia. Moreover, MRI's higher cost and limited accessibility make it less practical as a routine first-line modality for superficial soft tissue swellings.[4] Ultrasound can provide definitive characterization of cystic versus solid lesions, estimate lesion volume and delineate surrounding relations. All these factors influence whether a dermatologist proceeds with office-based excision, plans an operating-room procedure or opts for biopsy first. Importantly, beyond describing morphology, ultrasound can guide surgeons toward appropriate surgical treatment with the fewest complications, particularly by defining depth and proximity to critical structures. In dermatologic practice, this can mean the difference between safe complete excision of a benign lesion and an incomplete procedure with recurrence, neurovascular injury or unexpected intraoperative findings. Yet, despite these strengths, radiology experience also underscores a key limitation, namely the inability of ultrasound to specify a diagnosis with certainty in all cases. In many cases the final diagnosis depends on histopathology examination of the excised lesion.[5]

Given these gaps in the literature and the increasing reliance on point-of-care ultrasound in dermatology practice, there is a clear need for dedicated diagnostic accuracy studies. The present retrospective study analyzed medical records of patients presenting with superficial soft tissue swellings and assessed the diagnostic accuracy of ultrasonography using sensitivity, specificity, positive predictive value, and negative predictive value as compared to histopathology as the gold standard.

Methods

This retrospective study was conducted in the Departments of Dermatology and Radiodiagnosis of a tertiary care teaching hospital. Medical records of patients presenting to the Dermatology outpatient department with complaints of superficial soft tissue swellings and then referred for ultrasound imaging were retrospectively reviewed over a defined study period (November 2024 to October 2025). The study was purely retrospective and only involved analysis and interpretation of anonymized patient data therefore, ethics committee clearance was waived. Patients presenting to the Dermatology outpatient department with superficial soft tissue swelling who underwent ultrasonography with a documented USG report or impression and had a corresponding histopathology report (biopsy or excision specimen) for the same lesion were included, provided complete clinical and investigation records were available for analysis.

Lesions arising from the breast or thyroid, deep-seated soft tissue masses without a superficial component on imaging, cases lacking histopathological confirmation or with incomplete essential records, and duplicate entries or repeated imaging for the same lesion without definitive tissue diagnosis were excluded. As this was a retrospective

record-based study using anonymized data without patient interaction or identifiable information, Institutional Ethics Committee approval was waived. A total of 60 eligible cases with complete documentation (clinical, imaging and histopathology data available) were included for final analysis. The sample size was based on all eligible cases available in the hospital records during the one-year study period. As this was a retrospective diagnostic accuracy study, no prior formal sample size calculation was performed. However, the included sample was considered adequate for preliminary estimation of ultrasonographic diagnostic performance in a low-malignancy-prevalence dermatology outpatient setting.

Ultrasound data were retrieved from radiology reports (RIS/PACS) and cross-verified with case files. Ultrasonography examinations had been performed as per routine departmental protocol using high-frequency linear transducers appropriate for superficial structures (6–12 MHz range) on a GE Logiq P9 ultrasound system. All examinations were performed by board-certified radiologists with more than 5 years of experience in musculoskeletal and superficial soft tissue imaging with grey-scale evaluation as well as color Doppler assessment. Radiologists were not blinded to clinical information (referral indication, site, duration) at the time of scanning. Histopathology was reviewed independently by pathologists without access to detailed imaging reports beyond the clinical requisition. The recorded sonographic indices included anatomical location/plane of origin, lesion dimensions, internal echotexture, cystic/solid/mixed nature, margins, presence of calcification, and relationship to adjacent structures. Doppler was used to document vascularity patterns. Lesions were categorized as benign, malignant, or suspicious for malignancy based on a combination of sonographic features: benign lesions typically showed well-defined margins, homogeneous echotexture, minimal or peripheral vascularity, and consistent morphology.

Histopathology was considered the reference (gold standard). Histopathology reports included diagnoses from excision biopsy or incisional biopsy, as appropriate to clinical management. The final histopathological diagnosis was taken as definitive. For descriptive reporting, lesions were categorized into a rational spectrum of superficial pathologies commonly encountered in dermatology OPD practice (e.g., lipoma, epidermoid cyst, ganglion, abscess/inflammatory lesions, reactive lymphadenitis, vascular lesions, foreign body granuloma, and selected benign/malignant tumors).

Statistical analysis was performed using SPSS 23.0. Descriptive statistics were used to show demographics, site distribution, and histopathological diagnosis spectrum. Overall agreement between the specific ultrasonographic diagnosis and histopathology was recorded as concordant (matched diagnosis) or discordant (did not match). Overall diagnostic accuracy was calculated as concordant cases/total cases. In addition, diagnostic performance metrics were computed using 2×2 contingency tables only for predefined binary outcomes to ensure correct interpretation of true/false positives and negatives.

In the primary binary analysis, the outcome was classified on histopathology as neoplastic vs non-neoplastic (or, where applicable, malignant/suspicious vs benign, depending on the analysis presented) and ultrasound impressions were similarly categorized. True positive (TP) was defined as ultrasound positive with histopathology confirming positivity; false positive (FP) as ultrasound positive with histopathology negative; true negative (TN) as ultrasound negative with histopathology also negative; and false negative (FN) as ultrasound negative with histopathology positive. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated with 95% confidence intervals using the Wilson score method for binomial proportions. For common individual diagnoses (e.g., lipoma, epidermoid cyst, ganglion, abscess), lesion-wise diagnostic performance was evaluated using a one-vs-rest approach where feasible. A p-value <0.05 was considered statistically significant for relevant comparisons.

Results

Among the studied cases the most common age group was 31–40 years (26.7%), followed by 21–30 years (23.3%) and 41–50 years (20.0%). Overall, there was a male preponderance (56.7%) compared with females (43.3%). Extremes of age were less represented, with ≤20 years contributing 13.3% and >60 years contributing 5.0%. There were 34 (56.7%) males and 26 (43.3%) females with a M:F ratio of 1:0.76 (Table 1).

Lesions were most frequently encountered in the upper limb (n = 18, 30.0%), followed

Table 1 Demographic Profile of Study Participants

Variable	Number of cases (n=60)	(%)
Age Group (years)		
≤20	8	13.3
21–30	14	23.3
31–40	16	26.7
41–50	12	20
51–60	7	11.7
>60	3	5
Sex		
Male	34	56.7
Female	26	43.3

by the head and neck (n=14, 23.3%), lower limb (n=12, 20.0%), trunk (n=10, 16.7%), and groin/axilla (n=6, 10.0%).

Ultrasonography impressions in the cohort (n=60) were predominantly benign. Lipoma (28.3%) and epidermoid cyst (26.7%) formed the two most frequent radiological diagnoses. Inflammatory/infective lesions were also common particularly abscess (13.3%), while cystic lesions such as ganglion cyst (8.3%) constituted a smaller subset. Vascular lesions (hemangioma/venous malformation, 6.7%) and nodal lesions (reactive lymphadenitis, 6.7%) were less frequent. A minority of cases (5.0%) were categorized as malignant/ suspicious for malignancy on ultrasound (Table 2).

Histopathology demonstrated a predominance of benign conditions, with lipoma (30.0%) and epidermoid cyst (23.3%)

Table 2 Radiological Diagnosis Spectrum

Ultrasonography Diagnosis (Impression)	Number of Cases (n=60)	(%)
Lipoma	17	28.3
Epidermoid cyst	16	26.7
Ganglion cyst	5	8.3
Abscess	8	13.3
Reactive lymphadenitis	4	6.7
Hemangioma / venous malformation	4	6.7
Foreign body granuloma	2	3.3
Pilomatricoma	1	1.7
Malignant / suspicious for malignancy	3	5

Table 3 Histopathological Diagnosis Spectrum (Gold standard)

Histopathological Diagnosis	Number of Cases (n=60)	(%)
Lipoma	18	30
Epidermoid cyst	14	23.3
Ganglion cyst	6	10
Abscess	6	10
Reactive lymphadenitis	5	8.3
Hemangioma / venous malformation	4	6.7
Foreign body granuloma	3	5
Pilomatricoma	2	3.3
Dermatofibrosarcoma protuberans (DFSP)	1	1.7
Liposarcoma	1	1.7

Table 4 Benign vs malignant categorization on Histopathology (gold standard) and Ultrasonography (index test) (n=60)

Category	Histopathology (HPE)		Ultrasonography (USG)	
	(n=60)	%	(n=60)	%
Benign/non-suspicious	58	96.7	57	95
Malignant/suspicious for malignancy	2	3.3	3	5

Table 5 Diagnostic Performance of Ultrasonography for Malignant Lesions (malignant/suspicious vs benign)

Measure	Value
True positive (TP)	2
False positive (FP)	1
True negative (TN)	57
False negative (FN)	0
Sensitivity (%)	100
Specificity (%)	98.3
Positive predictive value (PPV) (%)	66.7
Negative predictive value (NPV) (%)	100

forming the two most common diagnoses, together accounting for over half the cohort. Infective/inflammatory lesions were less common. Abscesses were seen in 6 (10.0%) and reactive lymphadenitis was seen in 5 (8.3%) cases. Vascular lesions (hemangioma/venous malformation) constituted 6.7%, and foreign body granulomas 5.0. Malignancy was uncommon (3.4% combined) (Table 3).

On histopathology, the cohort was overwhelmingly benign (96.7%), with malignant lesions forming a small fraction (3.3%), confirming the typical OPD prevalence pattern. Ultrasonography categorized 95.0% lesions as benign/non-suspicious, while 5.0% were labelled malignant/suspicious, indicating a slight tendency to overcall suspicion to avoid missing malignancy. This table establishes the binary framework used for downstream diagnostic accuracy calculations. (Table 4).

Using histopathology as the reference standard, ultrasonography detected all malignant lesions in the cohort (sensitivity 100.0%) with an excellent ability to correctly identify benign lesions (specificity 98.3%). The NPV was 100.0%, indicating that lesions labelled benign on ultrasound were reliably benign in this cohort, which is particularly useful in OPD triage. The PPV was 66.7%, reflecting that a subset of lesions labeled "suspicious" on ultrasound proved benign on histopathology—an expected trade-off in low-prevalence settings (Table 5).

Agreement analysis of ultrasound and histopathology showed that ultrasonography could classify 57 of 58 benign lesions correctly. However, one benign case was flagged as suspicious (false positive) on ultrasound. Importantly, both malignant cases were categorized as malignant/suspicious on ultrasonography yielding zero false negatives. This is clinically critical from a screening perspective (Table 6).

Discussion

In this clinicopathological correlation study of 60 dermatology OPD patients with superficial soft tissue swellings, ultrasonography demonstrated excellent performance for malignancy triage, with sensitivity of 100.0% and specificity of 98.3% against histopathology, and an NPV of 100.0%. However, it is crucial to emphasize that only two malignant lesions were identified in the entire cohort (n=2/60; 3.3%), which substantially limits the statistical power and generalizability of the

Table 6 Agreement Between Ultrasonography (Benign vs Malignant/Suspicious) And Histopathology (Benign vs Malignant) (n=60)

USG category \ HPE category	Benign (n=58)	Malignant (n=2)
USG Benign	57	0
USG Malignant/Suspicious	1	2

malignancy-related performance metrics. In a cohort with such low malignancy prevalence, even a single additional false negative or false positive could dramatically alter the reported diagnostic performance. Therefore, these findings should be interpreted with appropriate caution and not be extrapolated to settings with higher malignancy prevalence or different case-mix without further validation. These findings reinforce the role of high-resolution ultrasound as a frontline extension of clinical examination in superficial masses, particularly in OPD pathways where rapid decisions about reassurance, drainage, excision, or biopsy are required. While prior studies have focused predominantly on surgical or oncology cohorts with higher malignancy rates; this study provides real-world data from routine dermatology practice where the majority of lesions are benign and the diagnostic challenge lies in safely ruling out malignancy while avoiding unnecessary biopsies. In a large retrospective series of superficial musculoskeletal tumors, Hung *et al*. reported that ultrasound could assess superficial soft tissue masses with high overall diagnostic accuracy and showed strong ability to identify malignant tumors (reported sensitivity and specificity for malignancy 93.3% and 97.9% respectively), even though most lesions were benign.[6] Similarly, Griffith *et al*. reported that sonography can achieve high diagnostic accuracy for superficial masses when interpreted by experienced readers and when pattern recognition is supported by anatomic localization and lesion composition. The authors further emphasized the need of MRI in selected cases in whom USG findings remain equivocal.[7] Taken together, these published data contextualize the observation that, even in a dermatology-weighted case-mix dominated by benign lesions, ultrasound can function effectively as a "rule-out malignancy" tool, which is often the single most important question for patients and clinicians at the first visit.

The histopathological spectrum in the present cohort mirrors the everyday distribution of OPD superficial lumps. This distribution has direct implications for predictive values: in low-prevalence malignancy settings, even a very specific test will have a modest PPV for malignancy because false positives weigh heavily when true positives are rare. This phenomenon is apparent in the PPV of 66.7% for malignant or suspicious lesions, despite near-perfect sensitivity and specificity. In a systematic review focused on superficial soft-tissue lipomas, Rahmani *et al*. reported sensitivity and specificity of ultrasound to be in the range 80% to 90%. These findings support ultrasound as a first-line investigation for clinically suspected superficial lipomas.[8] In contrast, a study by Kim *et al*. recommended use of MRI for the preoperative depth assessment of lipomas.[9]

A practical strength of ultrasound in dermatology OPD is its ability to separate cystic from solid lesions, define the plane of origin, and identify relationships to tendons, joints, and neurovascular bundles—key issues in upper-limb and head-and-neck swellings, which were common sites in this study. The predominance of upper-limb lesions (30.0%) is clinically relevant because ganglia and other peritendinous/periarticular cysts frequently mimic solid nodules on palpation, especially when tense or multiloculated. Many ganglia appear complex rather than purely anechoic on imaging.[10] These features can still be recognized as "cystic" with careful technique and that help guide aspiration versus excision decisions. Earlier clinical experience reported by Spence *et al*. also emphasized that ultrasound can resolve diagnostic doubt in suspected ganglion cysts when clinical assessment is uncertain.[11] This illustrates why ultrasound is particularly valuable in the hand and wrist region where small lesions, atypical locations or adjacent tenosynovitis can confound examination.

Modern sonographic literature suggests that diagnostic performance improves when specific morphological signs are actively sought rather than relying on generic "hypoechoic with posterior enhancement" descriptions. Lee *et al*. developed and validated a feature-based diagnostic model for epidermal cysts and concluded that incorporating dermal involvement and the "submarine sign," has high sensitivity and clinically useful specificity.[12] In dermatology practice, this is particularly relevant because inflamed or ruptured cysts can masquerade as abscesses and lead to inappropriate incision and drainage or incomplete excision if the capsule is not appreciated. Likewise, Ruiz Santiago demonstrated that adding diagnostic ultrasonography improves the reliability of preoperative diagnosis for subcutaneous lesions. The study concluded that imaging outperforms clinical diagnosis in terms of accuracy and should be mandatory before any interventional procedure.[13] High proportion of epidermoid cysts, together with strong benign

triage performance, supports incorporating structured reporting of key signs (tract/dermal connection, internal echoes, capsular definition, and Doppler behavior) to reduce ambiguity between cystic, inflammatory, and solid entities.

The most clinically consequential observation in this study was the absence of false negatives for malignancy: both malignant lesions (DFSP and liposarcoma) were classified as malignant/suspicious on ultrasound. While the malignant sample is small, the pattern is consistent with the prevailing philosophy in superficial mass imaging that triage should prioritize sensitivity (do not miss malignancy), even at the cost of occasional cautious overcalls. Aparisi Gómez *et al*.,[14] conducted a review study to analyze the role of ultrasound in diagnosing soft tissue tumors. The study found that most soft tissue masses were benign and ultrasound effectively identified common benign lesions, though atypical or deep lesions required MRI or biopsy.[15]

The limitation of this study was that it was retrospective and record-based, so scanning technique, reporting style, and clinical work-up could not be fully standardized. The sample size was modest (n=60) with very few malignant lesions (n=2), so estimates for malignancy-related metrics (especially PPV and sensitivity) have wide uncertainty and limited generalizability. This represents the single most important limitation of the present study, and readers should interpret the reported sensitivity and PPV with appropriate caution given the small malignant sample size. Moreover, ultrasonography is operator- and experience-dependent, and inter-observer variability was not assessed, which is a significant methodological limitation that affects the reproducibility and external validity of these findings. Advanced imaging modalities (MRI correlation, elastography, contrast-enhanced ultrasound) were not evaluated for indeterminate cases. Being a single-center study, external validity across different equipment and populations may be limited.

Despite the abovementioned limitations, it can be concluded that high-resolution ultrasonography is a highly effective first-line modality for evaluating superficial soft tissue swellings in dermatology OPD practice. In this cohort, USG demonstrated good performance for malignancy triage. The sensitivity and negative predictive value of ultrasound for detection of malignant lesion was high, making it particularly useful for confidently ruling out malignancy and guiding timely reassurance, though this finding requires validation in larger cohorts with more malignant cases. The modest positive predictive value for "suspicious" lesions reflects the low prevalence of malignancy. Therefore, USG should be integrated early into routine clinical pathways while indeterminate or suspicious lesions should be escalated appropriately for histopathology and further imaging when required.

References

1. Kapustianskyi D, Ivanytskyi I, Ivanytska T, Zhamardiy V, Donchenko V. Differential diagnosis of soft tissue tumors. Wiad Lek. 2022;75(6):1596–9. doi:10.36740/WLek202206131.
2. Jartarkar SR, Patil A, Wollina U, Gold MH, Stege H, Grabbe S, et al. New diagnostic and imaging technologies in dermatology. J Cosmet Dermatol. 2021;20(12):3782–7. doi:10.1111/jocd.14499.
3. Hibler BP, Qi Q, Rossi AM. Current state of imaging in dermatology. Semin Cutan Med Surg. 2016;35(1):2–8. doi:10.12788/j.sder.2016.001.
4. Pluetrattanabha N, Direksunthorn T. Recent advances in ultrasound of soft tissue lesions. Int J Gen Med. 2023;16:1163–1170. doi:10.2147/IJGM.S404682.
5. Catalano O, Varelli C, Sbordone C, Corvino A, De Rosa D, Vallone G, et al. A bump: what to do next? Ultrasound imaging of superficial soft-tissue palpable lesions. J Ultrasound. 2020;23(3):287–300. doi:10.1007/s40477-019-00415-z.
6. Hung EHY, Griffith JF, Yip SWY, Ivory M, Lee JCH, Ng AWH, et al. Accuracy of ultrasound in the characterization of superficial soft tissue tumors: a prospective study. Skeletal Radiol. 2020;49(6):883–92. doi:10.1007/s00256-019-03365-z.
7. Griffith JF. Practical approach to ultrasound of soft tissue tumors and the added value of MRI: how I do it. J Ultrason. 2023;23(95):e299–e312. doi:10.15557/JoU.2023.0036.

8. Rahmani G, McCarthy P, Bergin D. The diagnostic accuracy of ultrasonography for soft tissue lipomas: a systematic review. Acta Radiol Open. 2017;6(6):2058460117716704. doi:10.1177/2058460117716704.
9. Kim GH, Lee JH. The diagnostic accuracy of depth prediction for lipomas by preoperative imaging with distribution according to anatomical site in Korea: a retrospective analysis. Arch Craniofac Surg. 2025;26(1):13–8. doi:10.7181/acfs.2024.00535.
10. Musiol J, Hansen J, Wood J. Ganglion of the sternoclavicular joint: a rare location of an uncommon pediatric mass. Case Rep Radiol. 2020;2020:2035756. doi:10.1155/2020/2035756.
11. Zoller SD, Benner NR, Iannuzzi NP. Ganglions in the hand and wrist: advances in 2 decades. J Am Acad Orthop Surg. 2023;31(2):e58–e67. doi:10.5435/JAAOS-D-22-00105.
12. Lee DH, Yoon CS, Lim BJ, Lee HS, Kim S, Choi AL, Kim S. Ultrasound feature-based diagnostic model focusing on the "submarine sign" for epidermal cysts among superficial soft tissue lesions. Korean J Radiol. 2019;20(10):1409–1421. doi:10.3348/kjr.2019.0241.
13. Ruiz Santiago F, Orellana González C, Moraleda Cabrera B, Láinez Ramos-Bossini AJ. Accuracy of clinical diagnosis, imaging methods, and biopsy in tumours and pseudo-tumours of the hand. Quant Imaging Med Surg. 2024;14(11):7803–816. doi:10.21037/qims-24-347.
14. Aparisi Gómez MP, Errani C, Lalam R, Vasilevska Nikodinovska V, Fanti S, Tagliafico AS, et al. The role of ultrasound in the diagnosis of soft tissue tumors. Semin Musculoskelet Radiol. 2020;24(2):135–55. doi:10.1055/s-0039-3402060.
15. Jacobson JA, Middleton WD, Allison SJ, Dahiya N, Lee KS, Levine BD, et al. Ultrasonography of superficial soft-tissue masses: Society of Radiologists in Ultrasound Consensus Conference Statement. Radiology. 2022;304(1):18–30. doi:10.1148/radiol.211101.