

Review Paper

Multidisciplinary Approach for Management of Bone and Soft Tissue Tumors in the Iranian Population



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ABSTRACT

Background: Primary musculoskeletal tumors are rare but impose a significant health burden, mainly affecting young, active people, and posing risks of disability and death. Managing these tumors requires careful, staged, multidisciplinary approaches. In Iran, despite advances, issues, such as delayed diagnosis, unplanned initial surgeries, and poor referral pathways, remain.

Objective: This study aimed to present a clinical algorithm based on the current evidence and specifics of Iran's health system.

Methods: We conducted a narrative review of authoritative scientific literature, international guidelines (National Comprehensive Cancer Network, European Society for Medical Oncology), and local epidemiologic studies in Iran. The focus was on integrating clinical, radiologic, and pathologic findings to achieve accurate diagnosis and to formulate appropriate treatment plans.

Results: Accurate differential diagnosis relies on identifying specific radiologic patterns and avoiding unnecessary biopsies of lesions exhibiting pathognomonic benign features, commonly referred to as "leave-me-alone lesions." Osteosarcoma is the most prevalent malignant bone tumor in Iran and exhibits a bimodal age distribution. Biopsy should be the final step in diagnosis, ideally performed by the surgeon responsible for definitive treatment. Uninformed interventions on soft tissue masses without appropriate imaging may contaminate tissue planes and reduce the likelihood of limb-salvage surgery.

Conclusion: Establishing multidisciplinary teams at referral centers, educating general practitioners on red flag signs, and reforming the patient referral pathway are pivotal strategies for improving patient outcomes in Iran.

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Introduction

Bone and soft tissue tumors constitute a heterogeneous group of mesenchymal neoplasms arising from tissues, such as bone, cartilage, muscle, fat, and blood vessels. Although primary bone sarcomas account for less than 0.2 % of all malignancies, their clinical significance extends beyond this statistic [1, 2]. These tumors often present in the first and second decades of life and are a major cause of cancer-related mortality among children and adolescents. Soft tissue sarcomas (STS), which are more common, typically present without pain, leading to delayed diagnosis [2-4].

In recent decades, the therapeutic paradigm for sarcomas has shifted from purely surgical approaches, often resulting in amputation, toward combined modalities, including neoadjuvant chemotherapy, advanced radiotherapy, and complex limb-salvage procedures [5]. Implementing these standards requires close coordination among multiple medical disciplines. In developing countries, such as Iran, applying these standards poses unique challenges: the historical absence of a centralized, accurate cancer registry, limited access to novel drugs and advanced reconstructive technologies, and cultural factors that affect healthcare-seeking behavior [6-8].

The relevance of this article to the Iranian health system lies in its highlighting critical points along the diagnostic and treatment pathways. Evidence indicates that many patients with sarcoma in Iran undergo inappropriate treatments or incomplete surgeries before reaching specialized centers, profoundly affecting their prognosis [9]. By integrating global knowledge with local experience, this review aims to provide a comprehensive guide for physicians at all levels to close the gap between current practice and optimal standards.

Epidemiology and Distribution Pattern in Iran

Understanding the epidemiologic pattern of tumors is the foundation of differential diagnosis. Patient age, sex, and tumor location are the three main pillars for narrowing down the list of potential diagnoses.

Epidemiologic Profile of Bone Tumors

Studies from major referral centers in Iran, such as the Imam Khomeini Hospital Complex in Tehran

Province, Iran, and population-based studies in provinces, such as Golestan, have delineated a distinct pattern of these diseases. Osteosarcoma is recognized as the most common primary malignant bone tumor in Iran, accounting for 32.6–50.6% of all malignant bone neoplasms [10] (Table 1). Chondrosarcoma and Ewing sarcoma followed in prevalence. Notably, data from Iran show an increasing trend in the incidence of malignant tumors in recent years. A five-year study (2017–2022) demonstrated a decline in benign tumors alongside a rise in malignant tumors [11]. Improved diagnostic methods and better registration may partly explain this increase; however, environmental and demographic factors are likely to be contributory.

Geographic Distribution and Risk Factors

Epidemiological studies have indicated that the geographic distribution of sarcomas in Iran is non-uniform. According to national cancer registry data, northern and eastern provinces, such as South Khorasan and Qazvin Provinces, Iran, have reported higher sarcoma incidence. For example, in Golestan Province, the incidence rate among men (1.51 per 100,000) exceeds that among women (1.15 per 100,000), mirroring the global pattern [12]. These geographic differences may arise from unknown environmental factors or variations in data quality; nonetheless, they underscore the need for targeted screening and education in these regions. Disease patterns differ in Iran's elderly population. Among individuals aged ≥ 65 years, STS are far more common than bone tumors (94.4% versus 5.6%) [13]. This finding implies that clinicians should maintain a high index of suspicion for malignancy when evaluating soft-tissue masses in elderly Iranian patients.

Clinical approach: From patient complaint to diagnostic suspicion

Early diagnosis of sarcomas remains the greatest clinical challenge. Many patients present with nonspecific complaints that are easily mistaken for common conditions.

History and Red Flags

Pain is the most common symptom of bone tumors. Unlike mechanical or osteoarthritic pain, which worsens with activity and improves with rest, tumor-related pain usually worsens over time, becomes more severe at night, and does not improve with rest or standard painkillers (night pain) [2]. In children, this pain is sometimes mistaken for “growing pains,” leading to delayed

Table 1. Age and sex distribution of common bone tumors in Iranian studies [1]

Tumor Type	Approximate Percentage of Total Malignancies	Common Age Peak (Decade)	Sex Ratio (Male: Female)	Common Anatomic Sites
Osteosarcoma	50.6% – 32.6%	2 nd and 3 rd decades (10–25 years)	1.3 – 1.5: 1	Distal femur, proximal tibia
Chondrosarcoma	20.8% – 8%	4 th decade and beyond (>40 years)	1.2: 1	Pelvis, proximal femur, shoulder girdle
Ewing sarcoma	16.7– 15.9	1 st and 2 nd decades (<20 years)	1.5 – 6: 1	Shaft of long bones, pelvis
Giant cell tumor (benign but locally aggressive)	–	3 rd and 4 th decades (20–40 years)	1: 1.2 (female > male)	Epiphyses of long bones (around the knee)

Journal of Research in
Orthopedic Science

diagnosis. Any skeletal pain in a child or adolescent that persists for more than two weeks and is unrelated to activity warrants imaging.

For soft tissue masses, the “golf-ball rule” is a simple yet crucial screening tool. Any mass with the following features should be considered a sarcoma until proven otherwise [14]:

Size greater than 5 cm (approximately the size of a golf ball);

Location deep in the fascia;

Progressive, rapid growth;

Firmness and adherence to surrounding tissues.

Challenges of Delayed Diagnosis in the Cultural Context of Iran

Multiple factors beyond biology influence diagnostic delays in Iran. Qualitative studies have shown that “cancer phobia” and the associated social stigma are major obstacles to early presentation [15]. Many patients postpone seeking care after palpating a mass due to fear of a cancer diagnosis. Furthermore, the widespread use of traditional medicine and alternative remedies for musculoskeletal pain in Iranian culture can waste critical therapeutic time. The use of herbal plasters, such as turmeric, eggs, and local medicinal plants, to relieve pain or swelling not only delays treatment but, in some cases, also induces localized inflammation and hyperemia that complicate the interpretation of subsequent radiologic images [16, 17]. Clinicians should specifically inquire about the use of such remedies when taking a history. An inefficient referral system also plays a substantial role. Patients are frequently referred between specialists, including rheumatologists, physiotherapists, and internists, and receive symptomatic treatments [11]. Educating general practitioners and frontline specialists to

recognize red-flag signs and refer directly to orthopedic oncology centers is key to shortening these delays.

Imaging Algorithms and Radiologic Diagnosis

Imaging is the diagnostic compass in musculoskeletal tumors. Correct interpretation of images can often preclude unnecessary and potentially hazardous biopsies.

Plain radiography: The lost art

Despite technological advances, plain radiography (X-ray) remains the first and most important diagnostic modality for osseous lesions [18, 19]. Information gleaned from a good-quality radiograph includes the following, each of which has high diagnostic value:

Location: Tumors, such as giant cell tumors and chondroblastoma, tend to involve the epiphysis, whereas osteosarcoma and bone cysts primarily affect the metaphysis. Ewing sarcoma and fibrous dysplasia are often observed in the diaphysis [18].

Zone of transition: Benign lesions usually have well-defined margins and a narrow zone of transition (geographic pattern). In contrast, malignancies grow rapidly, allowing little time for the host bone to react, resulting in ill-defined margins with a broad zone of transition (moth-eaten or permeative pattern) [18].

Periosteal reaction: The type of periosteal reaction reflects the growth rate of the lesion. Solid, thick reactions indicate benign, chronic processes. Complex patterns, such as the “onion skin” observed in Ewing sarcoma, the “sunburst,” and Codman’s triangle in osteosarcoma indicate rapid growth and tumor invasion into adjacent soft tissues, lifting the periosteum [13].

Tumor matrix: Identifying the type of matrix produced by the tumor is key. A cloud-like or fluffy matrix suggests bone (osteoid) production and raises suspicion for osteosarcoma. Rings and arcs or popcorn-like calcifications are characteristic of cartilaginous lesions, such as chondrosarcoma or enchondroma [18].

Leave-me-alone lesions

Recognition of lesions that require no diagnostic or therapeutic intervention is one of the most crucial skills for a physician. These lesions, also known as “do-not-touch lesions,” have a completely pathognomonic radiologic appearance; biopsy is not only unnecessary but may also be misleading or harmful [20]. Some of the most common such lesions in the Iranian population include:

Non-ossifying fibroma: The most common bone lesion in children, presenting as a lytic lesion with sclerotic, lobulated margins in the metaphyseal cortex. It develops spontaneously with skeletal maturity and requires no treatment unless it is extremely large and fracture-prone [21].

Bone island (enostosis): Dense round or oval foci within cancellous bone that are homogeneous and have margins that gradually blend into the surrounding trabeculae (thorny margins). These are incidental findings and should not be confused with sclerotic metastases [22].

Myositis ossificans: A bone-forming mass in muscle, usually following trauma. The key radiologic diagnostic feature is “zonation,” meaning bone formation progresses from the periphery inward (the periphery is more mature than the center). In the early stages, biopsy may show highly active pathology that can be misdiagnosed as sarcoma; therefore, diagnosis should be based solely on imaging [23].

Bone-reporting and data system (RADS) and advanced imaging

To standardize reporting of incidental osseous lesions, the Bone-RADS has been proposed, following an algorithm analogous to the breast imaging RADS. This system categorizes lesions based on computed tomography (CT) and magnetic resonance imaging (MRI) appearance as benign (Bone-RADS 1), requiring follow-up (Bone-RADS 3), or suspicious for malignancy (Bone-RADS 4) [24]. Implementing Bone-RADS in Iranian radiology centers could foster a common language between radiologists and orthopedists.

MRI: MRI is the definitive and standard modality for local staging. MRI should cover the entire affected bone to detect possible skip lesions within the medullary canal. These skip lesions can alter the level of amputation or the extent of surgical resection [25].

Chest CT: Because the lungs are the most common sites of metastasis for bone and STS, chest CT is mandatory for all suspected cases [25].

Positron emission tomography (PET)/CT: In recent years, PET/CT has gained a special role, particularly in distinguishing scar or therapy-induced necrosis from tumor recurrence and in detecting distant non-pulmonary metastases [26].

Principles of Biopsy: The Fine Line Between Diagnosis and Disaster

Biopsy is the final diagnostic step and should not be the initial approach. The golden rule in orthopedic oncology is: “The biopsy should be performed by the surgeon who will undertake the definitive surgery.” Violation of biopsy principles can disseminate tumor cells into normal tissues and convert a potentially limb-salvageable tumor into one requiring amputation [27].

Types of biopsy

Core needle biopsy (CNB): This is the preferred method for most musculoskeletal tumors. It is minimally invasive, poses a lower risk of contamination, and has a diagnostic accuracy of 85%–95% [27]. Performing the biopsy under image guidance (ultrasound or CT) enhances the likelihood of obtaining samples from viable tumor areas and avoiding necrotic zones [27].

Open (incisional) biopsy: Reserved for cases where core needle biopsy (CNB) cannot yield a definitive diagnosis or when more tissue is needed for molecular studies.

Fine-needle aspiration (FNA): Has a limited role in initial diagnosis because it cannot reveal tissue architecture, and differentiating sarcoma subtypes is difficult. It is primarily used to confirm metastasis or nodal recurrence [27].

Critical technical considerations in biopsy

Biopsy tract: The path of the needle or scalpel should be designed so that it is incorporated along the line of the definitive surgical incision. The tract is always considered contaminated and must be removed en bloc with the

Table 2. Comparison of the Enneking and AJCC/UICC staging systems

Characteristic	Enneking System (MSTS)	AJCC/UICC System
Primary users	Orthopedic surgeons	Medical oncologists, and pathologists
Main focus	Surgical anatomy and compartments	Prognosis and survival
Key factors	Grade (G), site (T1 / T2), metastasis (M)	Tumor size (T; e.g. 8 cm for bone), nodal involvement (N), metastasis (M), grade (G)
Definition of T	T1: within a compartment; T2: beyond the compartment	Based on size (e.g. 8 cm threshold for bone tumors) and discontinuity
Clinical application	Planning for limb-salvage surgery	Decision-making for chemotherapy, and survival prediction

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Abbreviations: MSTS: Musculoskeletal Tumor Society; AJCC: American Joint Committee on Cancer; UICC: Union for International Cancer Control.

tumor during the definitive procedure. Deviation from this principle increases the risk of local recurrence [28].

Respecting compartments: The biopsy needle should not traverse a healthy compartment to reach the tumor. Breaching compartments may spread the tumor and preclude limb-salvage surgery.

Meticulous hemostasis: Preventing hematoma formation is essential in open biopsies. A hematoma can disseminate tumor cells through muscle planes and beneath the fascia over long distances.

The “unplanned excision” phenomenon

One of the major problems in Iran and worldwide is the removal of sarcomas under the assumption of benignity, such as lipomas or cysts, by non-specialist surgeons. This phenomenon, known as “whoops surgery,” often results in a microscopic residual tumor at the surgical bed (positive margins) [29]. Studies have shown that patients who undergo such incomplete surgeries require wider re-excision, higher doses of radiotherapy, and sometimes amputation; their functional outcome and survival are jeopardized [9]. Educating general surgeons to refer suspicious masses, in accordance with the golf-ball rule, prior to any surgical intervention, is the sole method to prevent such adverse outcomes.

Staging Systems

Accurate staging is essential for prognostication and treatment selection. Two main staging systems exist, each with particular utilities (Table 2).

In the Enneking system, emphasis is placed on whether the tumor is confined by natural anatomic barriers (compartments). In contrast, the AJCC 8th edition places greater emphasis on tumor size because studies have

shown a direct correlation between tumor size, response to therapy, and patient survival [30].

Principles of Treatment and Multidisciplinary Management (MDT)

The management of sarcomas epitomizes the need for multidisciplinary medicine. Robust evidence demonstrates that patients treated at centers with a MDT enjoy better survival and higher limb-salvage rates [31].

Limb-salvage surgery

In the past, amputation was the standard treatment for bone sarcomas. Today, with advances in therapy, >90% of patients are candidates for limb-salvage surgery [32]. The goal is to excise the tumor completely with a wide margin while preserving limb function [33, 34]. Various options exist to reconstruct the resultant bone defect:

Megaprotheses (endoprotheses): Large modular joint prostheses that replace the resected bone and joint. They allow early mobility but carry the risk of loosening and long-term infection [35, 36].

Allografts or osteoarticular allograft: Use of large donor bone segments [37].

Biologic reconstruction: Use of the patient’s vascularized fibula, which has the potential to unite and remodel; this option is preferable in growing children [32].

Three-dimensional (3D) printed prostheses: The use of custom-made, 3D printed prostheses has gained increasing acceptance in recent years, particularly for pelvic reconstruction following wide tumor resection, and has emerged as a prevalent approach in the surgical management of these patients [38].

Chemotherapy and radiotherapy

Osteosarcoma: Neoadjuvant (pre-operative) chemotherapy is the standard of care. It reduces tumor size, facilitates surgery, and eradicates micrometastases. The degree of tumor necrosis after chemotherapy, as assessed by pathology in the surgical specimen, is the most important prognostic factor [35]. Radiotherapy has a limited role because osteosarcoma is radioresistant.

Ewing sarcoma: Highly sensitive to both chemotherapy and radiotherapy. Treatment typically combines all three modalities [39].

Chondrosarcoma: Generally resistant to chemotherapy and radiotherapy; wide surgical excision remains the mainstay [40].

STS: Radiotherapy (pre- or post-operative) plays a vital role in reducing local recurrence, particularly in large, high-grade tumors [41, 42].

Health System Challenges and Proposed Solutions

Improving sarcoma care in Iran requires attention to structural and cultural challenges.

Reforming the referral system

Decentralized sarcoma management can be dangerous. Establishing a network of level 3 referral centers in geographic hubs (e.g. Tehran, Shiraz, Mashhad, Tabriz), equipped with specialized pathology services, advanced radiotherapy, and trained surgeons, is essential. The electronic referral system should be configured to enable family physicians to refer patients directly to these centers when they encounter warning signs [43].

Education and awareness

Continuing education programs for general practitioners, non-specialist radiologists, and orthopedists should emphasize differential diagnosis of masses and the “don’t-touch” principle before referral. Public awareness campaigns may dispel misconceptions about cancer and reduce fear of seeking medical care.

Final Conclusions and Key Messages for Specialists

Management of bone and soft-tissue tumors is a complex, high-stakes process requiring scientific rigor and

teamwork. For Iranian physicians and specialists, adhering to the following points can markedly influence patient outcomes:

High clinical suspicion: Take seriously any persistent, non-mechanical bone pain and any soft tissue mass larger than 5 cm or located deep to the fascia.

Imaging before intervention: Never remove or biopsy a mass before complete imaging, including at a minimum, an X-ray and MRI.

Avoid uninformed actions: If a tumor is suspicious for sarcoma, the best course for a general or orthopedic surgeon is to refer rather than perform a biopsy or surgery.

Respect anatomy: If a biopsy is necessary, adhere meticulously to technical principles to preserve the possibility of limb salvage.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

Conceptualization, methodology, validation: Mohammadreza Dolikhani and Ghazaleh Shakibamaram; Khalil Kargar Shooroki; Data collection: Mohammadreza Dolikhani, Ghazaleh Shakibamaram, Babak Toloue Ghamari and Behnam Sour; Data curation: Mohammadreza Dolikhani and Ghazaleh Shakibamaram; Mohammadreza Dolikhani and Ghazaleh Shakibamaram; Supervision and resources: Khalil Kargar Shooroki; Formal analysis, investigation, visualization, and writing the original draft: Mohammadreza Dolikhani and Ghazaleh Shakibamaram; Review and editing: Khalil Kargar Shooroki; Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

References

- [1] Patrichi AI, Gurzu S. Pathogenetic and molecular classifications of soft tissue and bone tumors: A 2024 update. *Pathol Res Pract*. 2024; 260:155406. [DOI:10.1016/j.prp.2024.155406] [PMID]
- [2] Strauss SJ, Frezza AM, Abecassis N, Bajpai J, Bauer S, Biagini R, et al. Bone sarcomas: ESMO-EURACAN-GENTURIS-ERN PaedCan Clinical Practice Guideline for diagnosis, treatment and follow-up. *Ann Oncol*. 2021; 32(12):1520-36. [DOI:10.1016/j.annonc.2021.08.1995] [PMID]
- [3] Bosma SE, Ayu O, Fiocco M, Gelderblom H, Dijkstra PDS. Prognostic factors for survival in Ewing sarcoma: A systematic review. *Surg Oncol*. 2018; 27(4):603-10. [DOI:10.1016/j.suronc.2018.07.016] [PMID]
- [4] Sinha S, Peach AH. Diagnosis and management of soft tissue sarcoma. *Bmj*. 2010; 341:c7170. [DOI:10.1136/bmj.c7170] [PMID]
- [5] Evans DR, Lazarides AL, Visgauss JD, Somarelli JA, Blazer DG, Brigman BE, et al. Limb salvage versus amputation in patients with osteosarcoma of the extremities: an update in the modern era using the national cancer database. *BMC Cancer*. 2020; 20(1):995. [DOI:10.1186/s12885-020-07502-z] [PMID]
- [6] Jamshidi K, Mostafavi K, Kargar Shooroki K, Latifi M, Sharifi Dalooei SMA, Mohammadi M. Cross-cultural adaptation, validation, and reliability of the Persian version of the Toronto extremity salvage score (TESS) for lower extremity. *Arch Bone Jt Surg*. 2025; 13(8):509-16. [DOI:10.22038/abjs.2025.80920.3691]
- [7] Nahvijou A, Zendehelel K. The evolution of population-based cancer registries in Iran: A 70-Year Journey. *Basic Clin Cancer Res*. 2024; 16(4):230-40. [Link]
- [8] Mohammadi G, Akbari ME, Mehrabi Y, Motlagh AG. Quality assessment of the national cancer registry in Iran: Completeness and validity. *Iran J Cancer Prev*. 2016; 9(6):e8479. [DOI:10.17795/ijcp-8479]
- [9] Umer HM, Umer M, Qadir I, Abbasi N, Masood N. Impact of unplanned excision on prognosis of patients with extremity soft tissue sarcoma. *Sarcoma*. 2013; 2013(1):498604. [DOI:10.1155/2013/498604] [PMID]
- [10] Solooki S, Vosoughi AR, Masoomi V. Epidemiology of musculoskeletal tumors in Shiraz, south of Iran. *Indian J Med Paediatr Oncol*. 2011; 32(04):187-91. [DOI:10.4103/0971-5851.95138] [PMID]
- [11] Salarvand S, Abdollahi A, Ardekani SS, Mortazavi SMJ, Nazar E. The epidemiological trends of primary benign and malignant bone tumors in Iran. *Asian Pacific J Cancer Biol*. 2024; 9(4):487-93. [DOI:10.31557/apjcb.2024.9.4.487-493]
- [12] Soghi A, Aarabi M, Sedaghat SM, Salamat F, Ghasemi-Kebria F, Roshandel G, et al. Incidence and temporal variations of bone and soft tissue cancers in the Golestan province, northern Iran, 2004-2016. *Arch Iran Med*. 2023; 26(2):62-8. [DOI:10.34172/aim.2023.11] [PMID]
- [13] Akbari ME, Fararouei M, Kabiri LA, Karami M, Gheibi Z, Nikeghbalian Z, et al. Bone and soft tissue sarcoma epidemiology in iranian elderly population; an analysis of the iranian national registry for cancer (2009-2014 Years). *Iran J Public Health*. 2024; 53(7):1670-80. [DOI:10.18502/ijph.v53i7.16061] [PMID]
- [14] Nandra R, Forsberg J, Grimer R. If your lump is bigger than a golf ball and growing, think Sarcoma. *Eur J Surg Oncol*. 2015; 41(10):1400-5. [DOI:10.1016/j.ejso.2015.05.017] [PMID]
- [15] Yeo S, Lee J, Kim K, Kim HJ, Chung S. Depression, rather than cancer-related fatigue or insomnia, decreased the quality of life of cancer patients. *Cancer Res Treat*. 2021; 53(3):641-9. [DOI:10.4143/crt.2020.1212] [PMID]
- [16] No Author. Turmeric. *Reactions weekly*. 2017; 1636(1):305. [DOI:10.1007/s40278-017-25865-5]
- [17] Saran JSRG, Anand D, Vijayanand S. A rare case of Cassia-induced allergic contact dermatitis following traditional South Indian bone setting: Diagnostic and surgical management considerations. *Med J Arm Force India*. 2025. [DOI:10.1016/j.mjafi.2025.09.013]
- [18] Umer M, Hasan OHA, Khan D, Uddin N, Noordin S. Systematic approach to musculoskeletal benign tumors. *Int J Surg Oncol (N Y)*. 2017; 2(11):e46. [DOI:10.1097/IJ9.0000000000000046] [PMID]
- [19] Ahlawat S, Lenchik L, Baker JC, Allen H, Banks J, Florou V, et al. ACR appropriateness criteria® suspected primary bone tumors: 2024 update. *J Am College Radiol*. 2025; 22(5, Supplement):S440-S54. [DOI:10.1016/j.jacr.2025.02.020] [PMID]
- [20] Fonseca E, Castro A, Kubo RS, Miranda FC, Taneja AK, Santos D, et al. Musculoskeletal "don't touch" lesions: Pictorial essay. *Radiol Bras*. 2019; 52(1):48-53. [DOI:10.1590/0100-3984.2016.0225] [PMID]
- [21] Othman AA, Babcock HE, Ferreira CR. Osteoglyphonic Dysplasia. 2024 Apr 18. In: Adam MP, Bick S, Mirzaa GM, Pagon RA, Wallace SE, Amemiya A, editors. *GeneReviews®* [Internet]. Seattle (WA): University of Washington, Seattle; 1993–2026. [PMID]
- [22] Morton AM, Peipert LJ, Moore DC, Ladd AL, Weiss AC, Molino J, et al. Bone morphological changes of the trapezium and first metacarpal with early thumb osteoarthritis progression. *Clin Biomech (Bristol)*. 2022; 100:105791. [DOI:10.1016/j.clinbiomech.2022.105791] [PMID]
- [23] Gould CF, Ly JQ, Lattin GE, Beall DP, Sutcliffe JB. Bone tumor mimics: Avoiding misdiagnosis. *Curr Probl Diagn Radiol*. 2007; 36(3):124-41. [DOI:10.1067/j.cpradiol.2007.01.001] [PMID]
- [24] Ghasemi A, Ahlawat S. Bone Reporting and data system (bone-RADS) and other proposed practice guidelines for reporting bone tumors. *Rofo*. 2024; 196(11):1134-42. [DOI:10.1055/a-2262-8411] [PMID]
- [25] Stacy GS, Mahal RS, Peabody TD. Staging of bone tumors: a review with illustrative examples. *AJR Am J Roentgenol*. 2006; 186(4):967-76. [DOI:10.2214/AJR.05.0654] [PMID]
- [26] Rutland CS. Advances in Soft Tissue and Bone Sarcoma. *Cancers (Basel)*. 2024; 16(16). [DOI:10.3390/cancers16162875] [PMID]
- [27] Mavrogenis AF, Altsitzioglou P, Tsukamoto S, Errani C. Biopsy techniques for musculoskeletal tumors: Basic principles and specialized techniques. *Curr Oncol*. 2024; 31(2):900-17. [DOI:10.3390/curroncol31020067] [PMID]

- [28] Gharehdaghi M. Biopsy in musculoskeletal tumors. *Arch Bone Jt Surg*. 2014; 2(3):128-9. [PMID]
- [29] Belzarena AC, Binitie O, Letson GD, Joyce DM. Unplanned sarcoma excisions: Understanding how they happen. *J Am Acad Orthop Surg Glob Res Rev*. 2024; 8(1). [DOI:10.5435/JAOSGlobal-D-23-00176] [PMID]
- [30] Jawad MU, Scully SP. In brief: Classifications in brief: Enneking classification: Benign and malignant tumors of the musculoskeletal system. *Clin Orthop Relat Res*. 2010; 468(7):2000-2. [DOI:10.1007/s11999-010-1315-7] [PMID]
- [31] Siegel GW, Biermann JS, Chugh R, Jacobson JA, Lucas D, Feng M, et al. The multidisciplinary management of bone and soft tissue sarcoma: An essential organizational framework. *J Multidiscip Healthc*. 2015; 8:109-15. [DOI:10.2147/JMDH.S49805] [PMID]
- [32] Leit ME, Tomaino MM. Principles of limb salvage surgery of the upper extremity. *Hand Clin*. 2004; 20(2):167-79. [DOI:10.1016/j.hcl.2004.03.001] [PMID]
- [33] Sakdejayont S, Chobpenthai T, Suksirivecharuk P, Ninatkiattikul IF, Poosiripinyo T. A review on bone tumor management: cutting-edge strategies in bone grafting, bone graft substitute, and growth factors for defect reconstruction. *Orthop Res Rev*. 2025; 17:175-88. [DOI:10.2147/ORR.S521832] [PMID]
- [34] Hajjaliloo Sami S, Kargar Shooroki K, Ammar W, Nahvizadeh S, Mohammadi M, Dehghani R, et al. Outcomes of osteoarticular ulna allograft for the reconstruction of proximal ulna tumour. *Bone Jt Open*. 2024; 5(9):749-57. [DOI:10.1302/2633-1462.59.BJO-2024-0088.R1] [PMID]
- [35] Ferguson JL, Turner SP. Bone cancer: Diagnosis and treatment principles. *Am Fam Physician*. 2018;9 8(4):205-13. [PMID]
- [36] Jamshidi K, Ammar W, Kargar Shooroki K, Mirzaei A. Outcomes of megaprosthesis reconstruction for the salvage of failed osteoarticular allograft around the knee implanted before skeletal maturity in primary bone sarcoma: A case-series. *Arch Bone Jt Surg*. 2024; 12(3):211-8. [PMID]
- [37] Hajjaliloo Sami S, Toloue Ghamari B, Kargar Shooroki K, Mohammadi Aniloo F, Ammar W, Rikhtehgar M, et al. Metatarsal aneurysmal bone cysts treated with en bloc resection and reconstruction with fibular allograft. *Foot Ankle Int*. 2025; 46(1):9-16. [DOI:10.1177/10711007241287714] [PMID]
- [38] Saberi S, Naghizadeh H, Kargar Shooroki K, Khabiri SS. Surgical site infections following pelvic sarcoma reconstruction with 3D-Printed implants: Current concepts and future directions. *Surg Infect (Larchmt)*. 2025; 26(7):541-7. [DOI:10.1089/sur.2024.319] [PMID]
- [39] Barzegari J, Shahreza FA. Challenges of the referral system in family medicine program in Iran: A Scoping Review. *Iran J Public Health*. 2025; 54(9):1831-41. [DOI:10.18502/ijph.v54i9.19852]
- [40] Chow WA. Chondrosarcoma: Biology, genetics, and epigenetics. *F1000Res*. 2018; 7. [DOI:10.12688/f1000research.15953.1] [PMID]
- [41] Gronchi A, Miah AB, Dei Tos AP, Abecassis N, Bajpai J, Bauer S, et al. Soft tissue and visceral sarcomas: ESMO-EURACAN-GENTURIS clinical practice guidelines for diagnosis, treatment and follow-up(□). *Ann Oncol*. 2021; 32(11):1348-65. [DOI:10.1016/j.annonc.2021.07.006] [PMID]
- [42] Khabiri SS, Shooroki KK, Saberi S, Naghizadeh H. Osseous invasion in extremity soft-tissue sarcomas: Prevalence, diagnosis, and surgical management- A narrative review. *J Bone Oncol*. 2025; 54:100712. [DOI:10.1016/j.jbo.2025.100712] [PMID]
- [43] Aminaie N, Mirlashari J, Lehto RH, Lashkari M, Negerandeh R. Iranian cancer patients perceptions of barriers to participation in decision-making: potential impact on patient-centered care. *Asia Pac J Oncol Nurs*. 2019; 6(4):372-80. [DOI:10.4103/apjon.apjon_11_19] [PMID]