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Bone tumours around the elbow: a rare entity

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■ Bone tumours around the elbow are rare. Even nowadays diagnostic dilemmas and delays are common. During recent decades the management and prognosis of patients with elbow bone tumours has improved significantly.

■ Benign tumours can be treated using minimally invasive procedures, whereas malignant ones require a multidisciplinary team approach based on an adjuvant therapeutic regimen of chemotherapy, radiotherapy and limb salvage procedures.

■ This article reviews the most commonly encountered elbow bone tumours and their management.

Keywords: benign; bone tumour; elbow; malignant

Introduction

Bone tumours around the elbow are rare and their incidence is approximately 1%.[1] The literature regarding primary bone tumours of the elbow is sparse, with only two case series consisting of 75 patients and 25 patients respectively.[2,3] During recent decades advances in the diagnosis, management and prognosis of patients with bone tumours around the elbow have been made. Early diagnosis and preoperative planning is essential and can dramatically change the treatment and prognosis of these patients.

Elbow tumours pose a diagnostic challenge for orthopaedic surgeons. Physical examination and a thorough history are the cornerstones of diagnosis. Patients usually present with persistent, unexplained, non-mechanical rest pain, soft tissue swelling, change in size of the mass, fever, night sweats and chills, which would warrant a higher level of suspicion for malignancy.[4] Diagnostic imaging is an important component of the workup of a patient with a musculoskeletal tumour and should proceed in an organized fashion.

Patients with presence of bone lysis, cortical erosion, new bone formation, mineralization or periosteal reaction in plain radiographs of the elbow should have additional workup.[5] Magnetic resonance imaging (MRI) is crucial in providing information regarding the location, size, tissue characteristics of the lesion and involvement of peripheral neurovascular structures. Other diagnostic modalities such as computerized tomography (CT) and bone scans are only performed in cases of lesions with particularly aggressive features. For bone lesions with such worrisome and aggressive imaging features, a histologic specimen should be obtained for diagnosis. A biopsy with a fine needle aspiration (FNA) or core needle biopsy, may be performed under CT or ultrasound guidance to confirm the diagnosis. However, these techniques may not yield sufficient tissue, thus an open biopsy with immunohistochemical stains and/or molecular studies may be required. An inappropriate or inaccurate biopsy may lead to poor outcome regarding limb salvage and even survivorship of the patient.[6] Even nowadays delay in diagnosis is common, usually because of the rarity of these lesions, the atypical clinical presentation and the low index of suspicion, with misdiagnosis incidence up to 13%.[2] Although these entities are rare, the treating physician must be aware of the possibility of a bone tumour in the elbow area. An algorithm for appropriate assessment of patients with a bone lesion is presented (Fig. 1).[7]

A multidisciplinary team approach should include an orthopaedic oncologist, an interventional radiologist, a pathologist, an oncologist, a vascular surgeon, and a plastic surgeon. Nowadays, benign tumours around the elbow such as juxta-articular osteoid osteoma (OO) can be treated with minimally invasive techniques such as CT-guided percutaneous radiofrequency thermal ablation (RFA) or arthroscopic excision.[8] Moreover, the
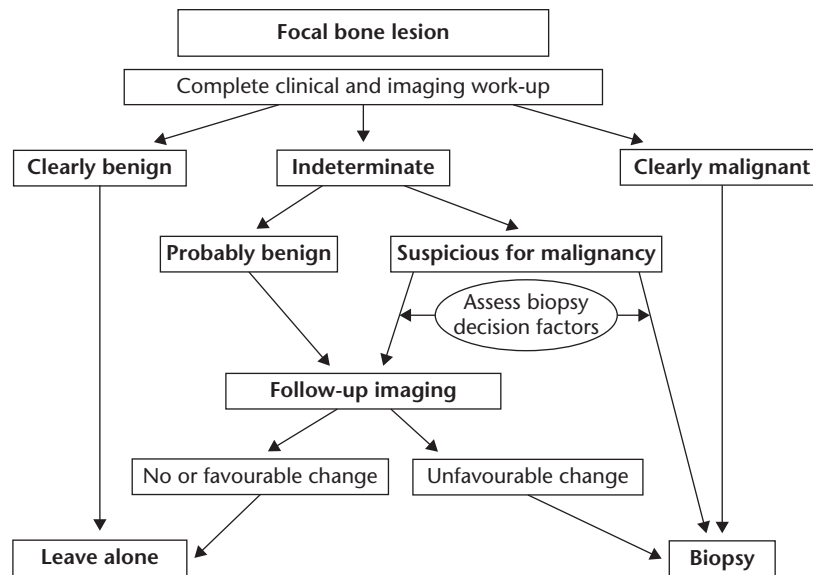
Fig. 1 Algorithm for patients presenting with a bony lesion around the elbow.

management and prognosis of patients with malignant tumours, such as Ewing sarcoma and osteosarcoma, have improved thanks to the adjuvant chemotherapeutic protocols and improved radiation therapy techniques combined with 'en bloc' resection of the tumour and various limb salvage procedures and reconstructions with total elbow arthroplasties, megaprostheses, allografts, vascularized autografts, or allograft-prosthetic composite reconstructions.[9] However, reconstruction of the elbow poses a unique challenge with limited options described in the literature. The elbow joint is a complex interplay between multiple joints which need to be stabilized for the optimal wrist and hand functional outcome and sometimes it is challenging to achieve 'safe' oncological margins.

Benign lesions are more common than malignant ones. They usually affect the proximal ulna and radius.[2] The commonest benign tumours around the elbow joint are the osteoid osteoma, the giant cell tumour, the aneurysmal bone cyst and the fibrous dysplasia. Ewing sarcoma, osteosarcoma and chondrosarcoma of the elbow are the most common malignant tumours, and occur more frequently in older patients with the distal humerus more often affected.[3] In a recent case series, these rare tumours continue to have significant morbidity and mortality, with recurrences which resulted in further surgery in over a quarter of the patients with a benign lesion, while the five-year mortality for the high grade malignancies was 68%.[2] This article summarizes the current diagnosis and treatment of these tumours around the elbow and discusses some of the features that are unique to this anatomic area.

Benign bone tumours

Osteoid osteoma

Osteoid osteoma is not so sporadic in the elbow; however, its intra-articular location is rare.[10–12] The typical age of presentation is between 7 and 30 years, but it may also be diagnosed in middle-aged and elderly patients. Symptoms at the elbow can last from weeks to years prior to diagnosis and meanwhile patients may usually be treated for other conditions. The average delay of diagnosis may be up to 2 years.[13] Patients present with the characteristic clinical feature of pain mainly at night that usually subsides after administration of non-steroidal anti-inflammatory drugs (NSAIDs) or aspirin, along with swelling and tenderness. Some patients, though, may also present with non-specific clinical symptoms of joint effusion and synovitis and some degree of flexion contracture, instead of the characteristic nocturnal pain responsive to salicylates.[14,15] In radiographic examination, osteoid osteoma presents as an intracortical radiolucent nidus surrounded by a rim of dense reactive bone. Thin-section (0.5 to 2.0 mm) CT with multiplanar reconstructions is the diagnostic gold standard to confirm the benign nature of the reactive bone and to identify the nidus of the lesion.[16] Osteoid osteoma is usually smaller than 1.5–2.0 cm.[10–12] Bone scintigraphy may show intense isotope uptake in these lesions. The role of MRI in the evaluation of osteoid osteoma is controversial. A constant finding on MRI scan is a marked bone marrow oedema corresponding to the highly vascularized mesenchymal tissue which is reported to be observed in all patients.[16–18]

Whereas some cases are self-limiting, surgical treatment options include intralesional curettage or radiofrequency ablation. The 'en bloc' resection and curettage of the lesion is the recommended treatment for juxta- or intra-articular osteoid osteoma of the elbow.[15,19] Nowadays, complete excision of juxta-articular osteoid osteoma of the elbow may also be performed arthroscopically.[20] Recently, Kamrani et al treated osteoid osteoma of the elbow through arthroscopic ablation in 10 patients.[21] Arthroscopic excision of the lesion was performed at a mean of 23 months (range, 12–36 months) after initial symptoms. Postoperative elbow flexion–extension range of motion (ROM) (129° ± 5°) was statistically significantly higher than the preoperative (80° ± 12°). Moreover, the Mayo Elbow Performance Score and the visual analogue scale for the elbow and wrist were significantly higher compared with these before surgery ($P < .001$). The authors stated that arthroscopic ablation is a safe and efficient method of treatment for osteoid osteoma of the elbow, without the need for capsulectomy or intraoperative manipulation to treat the limitation of elbow ROM, and it has a relatively shorter rehabilitation time.[21] Currently, percutaneous ablation under CT guidance, for lesion localization, with radiofrequency thermal ablation (RFA) is the most effective treatment option with a success rate of 87% to 100%.[22] Radiofrequency thermal ablation has gained popularity as a cost-effective, minimally invasive method with lower morbidity and fewer complications compared to an open technique.[23] However, this technique presents a high risk for bone necrosis and soft tissue damage, especially in tumours localized at the anterior aspect of the elbow joint and near (within approximately 1.5 cm) neurovascular structures.[15,22,24] Moreover, local destruction without preserving the pathologic tissue for histological examination limits its indication in patients with unusual clinical presentation.[25] Albisinni et al treated 27 patients (13 cases located in the humerus, 13 in the ulna and one in the radius) with intracapsular osteoid osteoma of the elbow by CT-guided percutaneous RFA.[26] All patients were assessed in terms of function, successful eradication and complication rate. Twenty-five out of 27 patients (92.5%) presented with excellent functional results as their Mayo Elbow Performance Scores ranged from 90 to 100 points at final follow-up. Osteoid osteoma recurred in only one patient (3.7%) five months after the initial procedure and was successfully retreated using RFA. No major complications were observed and all patients were disease free at the final follow-up. However, the authors stated that this invasive treatment requires meticulous planning and technique application to minimize potential risks for the patient.[26]

Giant cell tumour

Another benign tumour but with aggressive behaviour encountered in the region of the elbow is the giant cell tumour (GCT). This tumour occurs mainly after skeletal maturity and has its peak incidence in the third and fourth decades of life.[27] Most giant cell tumours are located within the epiphyses of long bones, they often extend to the articular subchondral bone or the cartilage, but they rarely invade the adjacent joint or its capsule. In skeletally immature patients they are often located into the metaphysis.[28]

Pain in the elbow is the most common symptom, while swelling and deformity are associated with large lesions. Histologically GCT is characterized by the presence of multinucleated giant cells (osteoclast-like cells), neoplastic stromal cells which are the predominant proliferating cell population and secondarily recruited mononuclear histiocytic cells.[29] Giant cell tumours were initially classified by Enneking and later by Campanacci, based on radiographic appearance.[30,31] Three stages were described – Stage I (latent), Stage II (active), Stage III (aggressive) – which correlate with tumour aggressiveness and risk of local recurrence. Radiographically, they usually appear as an eccentric epiphyseal or metaphyseal lytic lesion with cortical thinning and a 'soap bubble' appearance.[32]

Surgery with complete ablation to prevent recurrence and preserve the joint articulation remains the mainstay of treatment.[33] Local recurrence has been found to be a risk factor for pulmonary metastasis, which occurs in approximately 2% to 9% of patients.[34] The key in order to ensure an adequate curettage and complete excision of the tumour is to obtain sufficient exposure of the lesion with a large cortical 'window'.[35] Curettage of the bone cavity with high-speed burr or drill and the use of adjuvant cryosurgery (liquid nitrogen or a closed system of argon and helium) is recommended. The void is filled with bone graft or polymethyl-methacrylate (PMMA) bone cement. The use of internal fixation devices is controversial. Although early mobilization is facilitated with internal fixation, postoperative follow-up for tumour recurrence is more difficult.[36–38] Giant cell tumour recurrence rates vary significantly between different centres, different methods (wide resection, curettage +/- burr +/- phenol, +/- PMMA) and the local presentation of the tumour, ranging from 0% to 65%, therefore close follow-up with serial imaging is mandatory with these benign aggressive tumours.[39–41] In patients with highly aggressive lesions or local recurrence, where the tumour may invade through the cortex of the distal humerus to the surrounding soft tissue structures, curettage is unlikely to be effective and thus preserving the joint congruity of the elbow may not be possible. Nowadays, where it is not possible for the joint to be preserved, wide resection and total elbow arthroplasty using a custom-made prosthesis with good soft tissue coverage is a viable option, as it provides good pain relief and functional improvement with lower complication rates.[42–44] In addition to skeletal

reconstruction, of equal importance is to achieve good soft tissue coverage for both the implant and the elbow, as well as to preserve elbow function. Following tumour excision, hemi-articular and total elbow allografts have been used for reconstruction of these defects, but high complication rates were reported and thus these techniques are reserved as salvage procedures following failed total elbow arthroplasty.[45]

In light of current molecular biological understanding regarding the implication of the RANKL molecular pathway in the pathogenesis of GCT of bone, systemic targeted therapy has been advocated. In cases of locally advanced, unresectable, recurrent and/or metastatic CGT, the use of denosumab as a RANKL inhibitor has been introduced in order to facilitate surgery at a later stage, by making the tumour resectable or even appropriate for curettage.[46] Many recent studies have shown significant clinical benefits regarding the use of denosumab in the treatment of GCT, leading to a surgical down-staging and demonstrating an objective response range from 86% to 100% of cases.[47–50]

Aneurysmal bone cyst

Another benign lesion of the elbow causing pain and swelling is the aneurysmal bone cyst (ABC). This tumour occurs mainly in patients under 20 years of age and may present either as a primary bone lesion (70% of cases), when no precursor bone lesion is identified or as a secondary bone lesion (30% of cases) when a pre-existing osseous lesion can be identified.[51] In the Mayo Clinic's experience, only eight examples of aneurysmal bone cysts were found in the elbow region.[37] It is an osteolytic bone neoplasm characterized by several sponge-like blood or serum-filled, generally non-endothelialized spaces of various diameters.[37] Regarding its aetiology, theories range from a post-traumatic reactive vascular malformation to a genetic predisposed bone tumour.[52,53] The formation of an arteriovenous fistula within bone, caused by increased venous pressure and resultant dilation and rupture of the local vascular network has been the most common theory over the long term.[54,55] However, studies have also demonstrated the clonal neoplastic nature of the cyst.[56]

Patients usually present with pain, swelling, enlarging mass and even a pathologic fracture in the elbow area. The symptoms are usually presented for several weeks to months before the diagnosis. Neurologic symptoms may also develop secondary to pressure or tenting of the nerve structures in the elbow area. Radiographically, ABC usually presents as a metaphyseal eccentric lesion, that may elevate the periosteum and progressively cause erosion of the cortex. These tumours may be confused with malignancy, as imaging studies, even CT scan and MRI, do not always provide clear diagnostic criteria for the diagnosis. Nevertheless, the zone of rarefaction is usually well circumscribed, eccentric, and is associated with an obvious soft tissue extension (Fig. 2a–h).[57] Differential diagnosis of ABC includes unicameral bone cyst, eosinophilic granuloma and giant cell tumour.[58]

Curettage of the cyst remains the gold standard for treatment and it is usually curative. Local recurrence rates after curettage and polymethyl-methacrylate (PMMA) bone cement and curettage and bone grafting are reported at 17% and 37% respectively.[54] Although wide resection of the lesion can lessen recurrence rates, these treatments require complicated reconstructive procedures and are not generally indicated in long bones.[51,55] A plethora of new therapies has been proposed for the treatment of ABC which still remains controversial. New methods include embolization with sclerotherapy regiments based on an alcoholic solution of zein and intralesional implantation of demineralized bone particles with promising results; however, because of the serious side effects, they are mainly used in cases where the extent of the cyst makes the operative intervention hazardous.[59,60] Modern sclerotherapy treatment utilizes polidocanol, which is regarded as a safe regiment with no serious side effects. Rastogi et al reported a healing rate of 97% in a case series of 72 patients treated with percutaneous intralesional injections of polidocanol, whereas Varshney et al reported that while sclerotherapy was equally effective to intralesional excision, it was accompanied by less morbidity.[61,62] Therefore, due to the promising results, sclerotherapy is advocated in many centres as the treatment of choice. Reddy et al described the curopsy, a percutaneous limited curettage during biopsy, as another minimally invasive technique. The authors removed the lining membrane from various areas of the lesion and reported a healing rate of 81%. Although having an inferior success rate compared to curettage, the technique has a considerably faster recovery time, is safe, efficient and has good functional outcomes.[63]

Fibrous dysplasia

Fibrous dysplasia (FD) is a rare disease which typically occurs in spine, ribs, scull and diaphysis of long bones and accounts approximately for 5% to 7% of all benign bone tumours. However, in a large series of 75 patients FD was the most common (20% of cases) benign tumour encountered in the elbow.[2] It commonly presents in adolescents and young adults, and may be either monostotic (70% to 80% of cases) or polyostotic.[64,65] Most monostotic lesions are asymptomatic and are discovered when plain radiographs of the involved region are made for other reasons or because a pathological fracture has developed.[66] At first presentation about 67% of patients may have pain at the site of the lesion and up to 20% of patients may have a pathological fracture at presentation.[67] It may occasionally affect the structural integrity of the affected area and
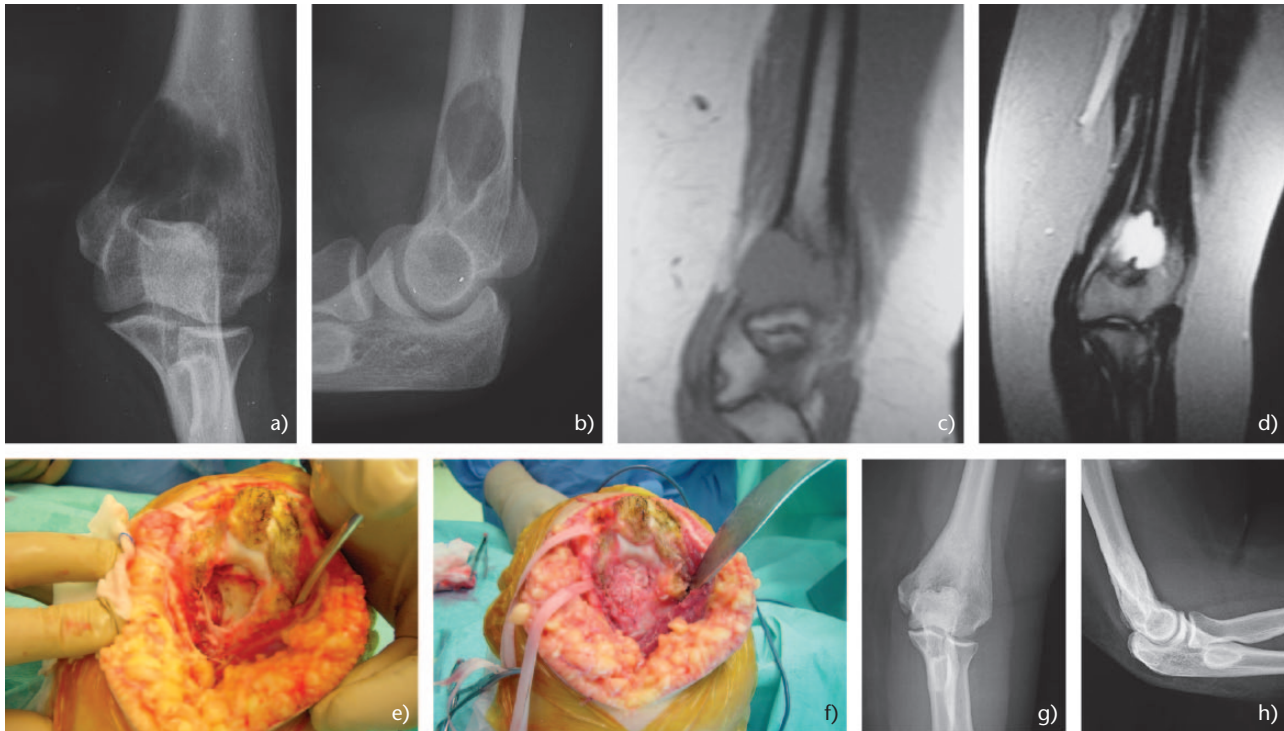
Fig. 2 (a) Anteroposterior and (b) lateral radiographs of the elbow showing an aneurysmal bone cyst of the distal humerus in 17-year-old female. (c) T1 and (d) T2 magnetic resonance images of the elbow. (e) Intraoperative images showing the gross destruction of the distal humerus. (f) The lesion was treated with curettage and bone grafting. (g) Anteroposterior and (h) lateral radiographs of the elbow 11 years postoperative showing a good incorporation of the graft and no sign of recurrence.

thus result in a bowing deformity.[65] Histologically, FD is considered to be the result of excessive proliferation of fibrous tissue within the bone marrow, due to poorly differentiated mutated osteoblasts. The osteoblasts then produce a high amount of interleukin 6, resulting in significant osteoclastic activity, which consequently leads to the formation of lytic lesions within the fibrous tissue and surrounding normal bone.[68] In radiographic examination FD usually has a characteristic radiolucent 'ground-glass' appearance with well-defined thick sclerotic borders. At times, calcified cartilaginous foci may also be evident within the lesion.[65]

When the diagnosis is confirmed by a biopsy, most lesions around the elbow can be treated non-operatively with immobilization in a cast. Non-steroidal anti-inflammatory drugs, opioids and bisphosphonates have been used to treat patients reporting bone pain, with the most favourable outcomes detected in individuals treated with bisphosphonates, mainly pamidronate.[69,70] Although most lesions respond well to non-operative treatment, there are a few indications for surgery, including non-union after a pathologic fracture, persistent pain and severely progressive deformity. Intralesional curettage and bone allograft or vascularized bone graft, with or without internal fixation, have been used, whereas in

cases with severe bone deformity corrective osteotomies and rigid internal fixation have satisfactory results and no major complications.[67,71,72] Fibrous dysplasia has a good prognosis; however, malignant transformation can occur in up to 4% of patients.[73]

Malignant bone tumours

Ewing sarcoma

Management of Ewing sarcoma has improved remarkably within recent decades. Many theories have evolved regarding how Ewing sarcomas arise. While the origin of these tumours is still not definitively known, most cases of Ewing sarcoma (85%) are the result of a translocation between chromosomes 11 and 22, which fuses the EWS gene on chromosome 22 to the FLI1 gene on chromosome 11. Other translocations are at t(21;22) and t(7;22).[74] Because a large percentage of Ewing sarcomas and primitive neuroectodermal tumours (PNET) have identical translocation, these two tumours have been grouped into a class of cancers entitled Ewing Sarcoma Family of Tumours (ESFT).[43] Nowadays, immunohistochemical stains and molecular genetic testing are required for a definitive diagnosis.[75] Patients usually experience extreme bone pain, intermittent fevers,

137

anaemia, and other symptoms of inflammatory systemic illness. Ewing sarcoma may arise in any bone, including those in the region of the elbow. It is more frequent in children than adults. Radiographically Ewing sarcoma is a highly destructive moth-eaten radiolucent lesion without evidence of bone formation associated with periosteal elevation.[74]

The prognosis of patients with Ewing sarcoma has improved dramatically. Although 20% to 25% of patients with Ewing sarcoma are metastatic at presentation, overall survival in patients with lesions of the extremities now ranges between 40% and 75%.[34]

Osteosarcoma

Osteosarcoma is another malignant tumour occurring in the elbow joint, although it is not so frequent as in the distal femur, proximal tibia and proximal humerus.[78] The prognosis for patients with non-metastatic osteosarcoma nowadays is significantly improved and 70% to 90% of these patients may be long-term survivors.[44,79] Symptoms around the elbow joint may be present for weeks, months, or longer before osteosarcoma is diagnosed. The most common presenting symptom is pain, which is exaggerated with activity, and swelling. Patients may complain of a sprain or 'growing' pain. The patient often has a history of trauma. Systemic symptoms, such as fever and night sweats, are rare.[1] Radiographically, osteosarcomas usually appear to be aggressive, with evidence of cortical erosion and reactive periosteal new bone formation. In the distal humerus, the classic 'sunburst' appearance may be evident.[80] Nevertheless, the precise extent of the lesion may not be apparent on plain radiographs. Histologically, the majority of osteosarcomas are high-grade tumours. Approximately 8–15% of patients originally diagnosed with osteosarcoma have metastatic disease.[81]

Chondrosarcoma

Chondrosarcoma is the third most common primary malignant tumour of bone, though is remarkably rare in the elbow.[2] It is a malignant bone tumour that develops from cartilaginous tissue but can also arise de novo in extra-skeletal tissue. There are a few case reports of chondrosarcoma arising from synovial chondromatosis of the elbow.[82] Late diagnosis because of slow progression of the tumour and inadequate first treatment occurred frequently.[82,83] Chondrosarcoma of the elbow has a poor prognosis and lung metastases occurred frequently at the time of diagnosis.[83]

Treatment of malignant bone tumours

Treatment of malignant bone tumours in the region of the elbow is more challenging than in other anatomic areas because of limited soft tissue envelope and neurovascular structures in close proximity to the tumour. For these anatomic considerations, in the past amputation was the treatment of choice. Nowadays, the majority of patients with Ewing sarcoma and osteosarcoma of the elbow can be treated with adjuvant chemotherapy, wide excision of the tumour and limb salvage procedures.[34] The choice between amputation and limb-sparing resection must be made by an orthopaedic oncologist taking into account tumour location, size, extramedullary extension, distant metastatic disease and patient factors. Reconstructive options are limited and technically challenging and include endoprosthetic replacements, resection arthroplasty, interposition arthroplasty, arthrodesis, elbow osteoarticular allograft reconstruction, or allograft-prosthesis composite arthroplasty and vascularized fibular grafts.[43,76,84] There is limited literature supporting the ability to achieve en bloc extra-articular excision of the tumour in the elbow area, with most case series describing trans-articular hemi-resection through the elbow joint.[43,85–88]

A total elbow arthroplasty in patients with large defects may result in instability with high rates of complications such as implant loosening and failure and postoperative infection. Endoprosthetic replacement using a constrained hinged megaprosthesis (Fig. 3a–h) cannot allow good function compared to that after a total elbow arthroplasty (TEA), in which the soft tissue 'envelope' is largely preserved.[86] Infection is one of the major concerns in this group of immunocompromised patients. There is emerging evidence in the literature to support the finding that silver-coated megaprostheses can reduce postoperative infection, as silver has antimicrobial properties.[89] Complex soft tissue reconstruction techniques such as pedicled myocutaneous latissimus dorsi rotation flap and reconstruction of the triceps may be necessary in these cases.[77] In skeletally immature adolescent patients with Ewing sarcoma, an expandable elbow endoprosthesis may be used. Ayoub et al treated eight patients with Ewing sarcoma of the humerus with limb salvage with extensible endoprosthesis, with 90% five-year survival.[90]

Allograft elbow reconstructions, total or hemi-articular, although they provide certain advantages, are rarely undertaken due to the unpredictable outcomes and high complications rates.[76,91,92] A vascularized fibular grafting including the fibular head can be used for reconstruction after excision of a malignant tumour in the proximal ulna. Kimura et al treated an eight-year-old girl with a Ewing sarcoma in of the proximal ulna using wide excision and reconstruction with a vascularized osteocutaneous fibular graft including the fibular head. Four years after surgery the patient was disease free with excellent elbow function and the upper extremity was growing without deformity.[93] Recently, Graci et al presented the case of a 12-year-old girl with parosteal osteosarcoma of the right distal humerus treated with en bloc resection, intraoperative extracorporeal irradiation and implantation. The authors

Fig. 3 (a) A rapidly enlarging mass in the right arm of a 69-year-old female. (b) Anteroposterior radiograph of the distal humerus showing a lytic lesion with permeation of lateral cortex. (c) High-grade sarcoma was diagnosed. Pathological fracture of the distal humerus. (d) T1-MRI image showing the tumour mass. (e) Intraoperative image of the right humerus after excision of the tumour with preservation of the neurovascular elements. (f) Elbow reconstruction using a custom-made cemented megaprosthesis (Link megaprostheses, Hamburg, Germany). (g) Anteroposterior and (h) lateral radiographs of the elbow 13 months postoperatively, showing the elbow endoprosthesis with no sign of local recurrence. Postoperatively, the patient had adjuvant chemotherapy. She died at 13 months due to lung metastatic disease.

inserted a non-vascularized fibular autograft through the middle of the irradiated graft to obtain a greater stability. Ten years after surgery the patient had no recurrence with an excellent functional result.[94]

In cases where complete excision of the tumour is impossible, amputation is recommended. Radiation therapy is mandatory in cases of Ewing sarcoma with marginal resection or with poor response to chemotherapy with dose of 4500 to 6000 cGy, delivered over six to eight weeks.[34,74]

Conclusion

Bone tumours around the elbow are rare and pose a diagnostic challenge for orthopaedic surgeons. Delay in diagnosis is common because of atypical clinical presentation and the low index of suspicion. Treatment, even that of the benign varieties, remains challenging because of the interference of the tumour with neurovascular structures and inadequate soft tissue coverage. Nowadays, benign tumours can be treated using minimally invasive techniques, and malignant ones with limb salvage procedures. Various reconstruction options include endoprosthetic replacements, resection arthroplasty, interposition arthroplasty, arthrodesis, elbow osteoarticular allograft reconstructions, allograft-prosthesis composite arthroplasty and vascularized fibular grafts including the fibular head. Surgical options for reconstruction of the elbow joint remain technically challenging. Management strategies with a multidisciplinary team approach are mandatory and should be individualized and address the characteristics of the bone tumour while respecting the patient's trajectory of illness.

139

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