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Canadian Association of Radiologists Journal xx (2018) 1−10

CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL

www.carjonline.org

Musculoskeletal Radiology / Radiologies musculo-squelettique

Imaging of Benign Fibular Tumours and Their Mimics

Barry Glenn Hansford, MD[a,*], Zachary C. Smith, MD[b], Gregory Scott Stacy, MD[c]

[a]*Department of Diagnostic Radiology, Oregon Health and Sciences University, Portland, Oregon, USA*
[b]*Department of Radiology, University Medical Center, University of Utah, Salt Lake City, Utah, USA*
[c]*Department of Radiology, University of Chicago Medicine, Chicago, Illinois, USA*

Key Words: Benign bone tumour; Bone biopsy; Gracile bone; Bone tumour mimic

The fibula is a non−weight bearing, gracile bone that contributes to stability of the ankle and knee by acting as a site for tendon and ligament attachments. The fibula accounts for 2.5% of primary bone tumours [1]. Benign tumours may have an atypical, aggressive appearance in the fibula. A brief discussion of the workup and management of fibular lesions is provided, followed by a discussion of individual primary benign fibular tumours and their mimics, both benign and malignant.

Work-up and Management of Fibular Lesions

Patient history, physical examination, and laboratory and imaging studies are adequate for diagnosing many fibular lesions. Radiographs are appropriate for initial evaluation, as they are inexpensive and often capable of adequately characterising many tumours and tumour-like conditions. However, the non−weight-bearing nature of the fibula results in a gracile morphology that is more susceptible to expansile remodelling than thicker bones, allowing for benign lesions to appear aggressive, and a thin cortex which allows for early cortical breakthrough of aggressive tumours, with direct muscle or tendon invasion frequent at initial presentation. For such cases, magnetic resonance imaging (MRI) is necessary for preoperative planning.

To avoid compromising limb salvage surgery, image-guided biopsy of fibular lesions must be planned with the referring orthopaedic oncologist. The biopsy tract should be the shortest route, without violating more than 1 compartment, and should be as far as possible from the main neurovascular bundle. A proximal to mid-fibular lesion should be targeted with an approach traversing the peroneal musculature. To avoid ankle joint contamination, a distal fibular lesion is targeted with a direct lateral approach [2].

Two basic types of proximal fibular resections exist. Type I resection is intended for benign aggressive and low-grade malignant neoplasms, consisting of intra-articular resection of the proximal fibula as well as 2−3 cm of normal diaphysis and thin cuff of surrounding musculature. The peroneal nerve and its motor branches are usually spared and the anterior tibial artery is occasionally sacrificed [3]. High-grade proximal fibular malignancies usually invade the tibiofibular joint and posterior joint capsule requiring an en bloc type II resection [4], consisting of an extra-articular resection of the proximal fibula with 6 cm of normal diaphysis, the anterior tibial artery, anterior and lateral muscle compartments, and sometimes the peroneal artery and nerve. Historically, below-the-knee amputation has been the primary surgical approach for distal fibular malignant neoplasms, with advances in chemotherapy and surgical techniques resulting in development of various limb salvaging techniques, each with specific pros and cons based on surgeon expertise and preference.

Benign Fibular Tumours and Their Mimics

Lesions Arising From the Fibular Surface

Osteochondroma is the most common benign fibular neoplasm (38%−50% of benign fibular tumours) (Table 1).

* Address for correspondence: Barry Glenn Hansford, MD, Oregon Health and Sciences University, 3181 SW Sam Jackson Park Road, Portland, Oregon 97239, USA.
E-mail address: hansford@ohsu.edu (B. G. Hansford).

https://doi.org/10.1016/j.carj.2018.03.007

Table 1
Frequency of benign fibular lesions managed surgically in the largest published case series

Diagnosis	Total number of tumours (N = 110)
Osteochondroma	46 (38)
Giant cell tumour	23 (19)
Enchondroma	11 (9)
Aneurysmal bone cyst	10 (8)
Simple bone cyst	7 (6)
Fibrous dysplasia	6 (5)
Intraosseous ganglion	2 (2)
Eosinophilic granuloma	1 (1)
Nonossifying fibroma	1 (1)
Chondroblastoma	1 (1)

Adapted from Abdel et al [3] with permission from Wolters Kluwer Health, Inc. Values are n (%).

Osteochondroma presents as a metadiaphyseal bone projection with corticomedullary continuity with the parent bone (Figure 1) [5]. The proximal fibula is reported as the most frequent location for osteochondroma resection due to peroneal neuropathy [5]. Surgical excision of proximal fibula osteochondroma has been advocated in children to prevent knee deformities. In skeletally mature patients, a cartilage cap >1.5 cm or recent growth should raise suspicion for malignant degeneration to chondrosarcoma. A mechanical tug lesion at the soleus origin may mimic a fibular osteochondroma (Figure 2).

Bizarre parosteal osteochondromatous proliferation (BPOP) is a rare entity of disordered proliferation of bone, cartilage, and fibrous tissue usually occurring in small tubular bones of the hands and feet, although approximately 25% involve the long bones including the fibula. In a series of 65 cases reported by Meneses et al [6], 2 involved the fibula. BPOP appears as a pedunculated or sessile heavily mineralized surface lesion lacking medullary continuity with parent bone, unlike osteochondroma (Figure 3). Post-traumatic heterotopic ossification (HO) of the distal tibiofibular syndesmosis can mimic BPOP; however, the distinction is made by history of trauma and ossification arising from the inner aspects of both the distal tibia and fibula (Figure 4). A more sinister mimic is parosteal osteosarcoma (PO), a rare surface variant osteosarcoma that is less common and presents later than conventional fibular osteosarcoma [7]. PO may radiographically appear similar to BPOP; however, PO is rarely as homogeneously dense as BPOP and often demonstrates internal regions of increased radiolucency. PO may invade the underlying fibular medullary cavity; this can be confirmed with MRI (Figure 5).

Lesions Arising Within the End of the Fibula

Giant cell tumour (GCT) is the second most common benign fibular tumour (20% of benign fibular lesions) [1,3]. Although typically benign, GCT is locally aggressive. GCT presents with pain and swelling, with a peak incidence between 20-45 years of age. GCT occurs at the end of long bones, presenting radiographically as an expansile, lucent lesion with a narrow zone of transition extending to subchondral bone. GCT may appear aggressive with soft tissue extension, which, like other potentially expansile lesions, may be a more frequent presentation in the fibula given its slender morphology (Figure 6) [8]. Low signal intensity is frequently encountered on T2-weighted magnetic resonance images due to hemosiderin and fibrous components. A lesion that can mimic GCT is intraosseous ganglion (IOG), which also occurs at the end of a long bone, particularly about the knee, in young-to-middle-aged adults, resulting in a juxta-articular lucent lesion that may demonstrate expansile remodelling and even cortical breakthrough with a soft tissue component. Unlike GCT,

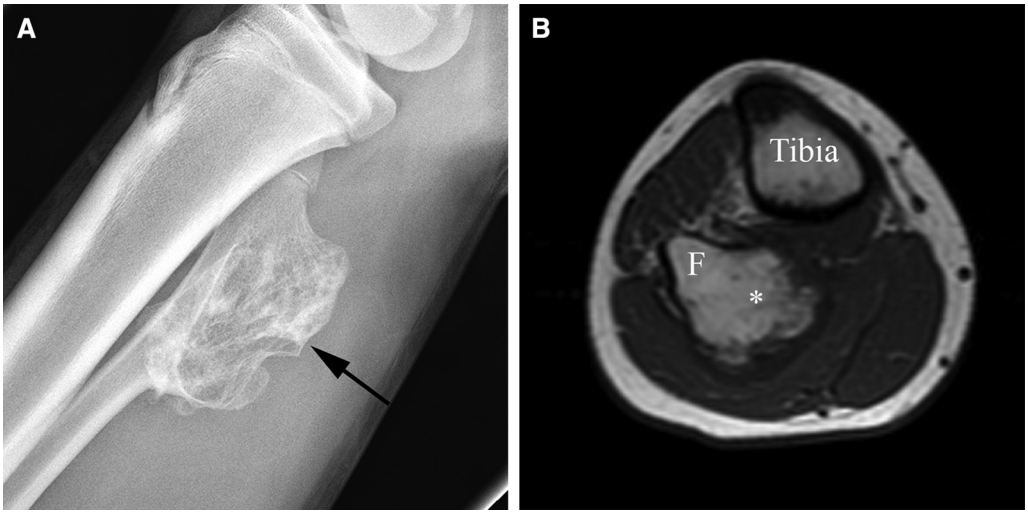

Figure 1. A 25-year-old man with osteochondroma of proximal fibula. (A) Lateral leg radiograph shows broad-based bony projection (arrow) from the proximal fibula. (B) Transverse T1-weighted magnetic resonance image shows corticomedullary continuity of lesion (asterisk) with fibula (F).