Knee Lesion in a 62-year-old Woman

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History and Physical Examination

A 62-year-old woman presented for evaluation of a knee contusion sustained approximately 2 weeks previously. Her pain had decreased considerably since the injury, and at the time of presentation, she had neither pain nor swelling. Several years earlier, she had sustained a traumatic fracture of the right pubic and ischial rami, which resulted in intermittent radicular pain to her right leg. She denied any constitutional symptoms and her medical history was noncontributory.

The general physical examination was unremarkable. Point tenderness with no discrete palpable mass was noticed on the posterior aspect of her knee, adjacent to the

medial femoral epicondyle. Neither warmth nor erythema was detected, and there was no palpable inguinal or popliteal lymphadenopathy. Examination of the knee showed no effusion. There was full painless range of motion with no ligamentous instability or joint line tenderness. The rest of her musculoskeletal examination was normal. The laboratory workup was unremarkable.

Because of the concerning radiographic features (Fig. 1), computed tomography (CT) scans (Fig. 2) and magnetic resonance (MR) images (Figs. 3, 4) were obtained.

Based on clinical history, physical examination, laboratory tests, and imaging studies, what is the differential diagnosis?

Imaging Interpretation

Anteroposterior (Fig. 1A) and lateral (Fig. 1B) radiographs showed an area of cortical irregularity at the posterior aspect of the medial femoral condyle, associated with a partially mineralized soft tissue mass. On CT (Fig. 2), the soft tissue mass measured $3.0 \times 3.0 \times 2.5$ cm and was contiguous with the posteromedial cortex at the origin of the medial gastrocnemius head. It had an attenuation similar to that of adjacent skeletal muscle, with scattered areas of mineralization. On MRI, the lesion had hyperintense signal on gradient echo (Fig. 3A) and intermediate signal on proton density-weighted (Fig. 3B) sagittal images. On axial images, the somewhat lobular mass was directly contiguous with the femur but did not invade it, with normal underlying marrow signal (Fig. 3C). The mass demonstrated heterogeneous enhancement on postgadolinium images (Fig. 4). Degenerative changes in the medial meniscus, a popliteal cyst, and a joint effusion were also noted.

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Each author certifies that his institution has approved the reporting of this case report, that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

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Fig. 1A–B (A) Anteroposterior and (B) lateral radiographs show an area of cortical irregularity at the posterior aspect of medial femoral condyle, associated with a partially mineralized soft tissue mass (arrows).

Fig. 2 A CT scan shows a 3.0- × 3.0- × 2.5-cm soft tissue mass (arrow) that is contiguous with the posteromedial cortex at the origin of the medial head of the gastrocnemius. The attenuation coefficient of the lesion is similar to adjacent skeletal muscle, with scattered areas of mineralization and no organization (zonation).

Differential Diagnosis

- Parosteal/periosteal (surface) osteosarcoma
- Other surface tumors, including juxtacortical chondrosarcoma, osteochondroma, and periosteal chondroma
- Soft tissue sarcoma
- Myositis ossificans
- Distal femoral cortical irregularity
- Florid reactive periostitis and bizarre parosteal osteochondromatous proliferation (Nora's lesion)

The patient underwent a CT-guided needle biopsy, which showed a cytologically bland fibrous proliferation.

To mitigate potential sampling error, an open biopsy was performed and the histology of the lesion was studied (Fig. 5).

Based on the clinical history, physical examination, laboratory studies, radiographic images, and histologic picture, what is the diagnosis and how should this lesion be treated?

Histology Interpretation

The material consisted of multiple, tan-grey, soft tissue fragments measuring 8.0 × 6.0 × 3.0 mm in aggregate. Microscopically, there was a hypocellular, fibroblastic proliferation associated with fragments of tendon, fibrocartilage, and focal myxoid areas of dissecting collagen fibers. There was no cellular atypia or mitoses (Fig. 5).

Diagnosis

Distal femoral cortical irregularity.

Discussion and Treatment

The diagnosis of distal femoral cortical irregularity was based on its location (distal medial femur) and supporting histologic features, despite the worrisome atypical radiographic features. The diagnosis was further supported by the lack of additional progression after 7 years' followup.

Usually, distal femoral cortical irregularity differs from malignant tumors by the absence of a soft tissue mass, the preservation of soft tissue planes, the absence of periosteal reaction, and the lack of associated warmth or local tenderness on physical examination [21]. Histologically, the absence of mitotic activity and pleomorphism will help distinguish it from sarcomas. Sarcomas of bone exhibit greater cellularity with plump hyperchromatic nuclei, nuclear and cellular pleomorphism, and increased mitotic activity. These differences, together with knowledge of radiographic variation, should make the diagnosis apparent. Serial radiographs can be very beneficial. Fibrous cortical defect is characteristically present near the metaphysis of long bones. It is eccentric in bone, has a geographic "soap bubble" appearance, and erodes the cortex from within, whereas the avulsive cortical irregularity erodes the external surface of the bone. A fibrous cortical defect is generally an isolated osseous lesion without a soft tissue component. It tends to migrate more proximally with growth [25]. Histologically, the two entities are distinct, as the fibrous cortical defect has a whirling spindled pattern of growth with giant cells and hemosiderin-rich macrophages. Osteochondroma has a typical

Fig. 3A–C MRI shows the lesion (arrows) having (A) hyperintense signal on gradient echo (TR 800, TE 15) and (B) intermediate signal on proton density-weighted (TR 2442, TE 15) sagittal images. (C) An axial image (TR 5000, TE 21.7) shows the mass has a lobular

morphology and is contiguous with the femur but does not appear to invade it, with normal underlying marrow signal. A blooming artifact (predominant low signal) can be seen on (A) and (B) (arrowheads) in an area corresponding to an area of mineralization on radiographs and CT.

Fig. 4 A postgadolinium contrast axial MR image (TR 550, TE 9) shows heterogeneous enhancement of the mass (arrow), with no enhancement of adjoining bone or soft tissue.

cartilage cap with enchondral ossification. The lack of cortical and medullary continuity between the mass and the adjacent bone excludes the diagnosis of osteochondroma. Florid reactive periostitis commonly affects the digits of the hands and feet of adolescents and young adults. Clinically, there is a history of gradually progressive swelling,

erythema, and pain or a painful mass in the affected part and approximately 50% of patients have a history of trauma. There is mature and immature osteoid and woven bone, cartilage, or a mix of chondroid, osteoid, and myxoid elements with frequent multinucleated giant cells. They show intense uptake on bone scan and may also show zonal maturation of the tissues similar to that observed in myositis ossificans. It is thought to progress to bizarre parosteal osteochondromatous proliferation, an entity also common in hands and feet. Bizarre parosteal osteochondromatous proliferation has a cartilaginous cap covering a bone stalk with areas of ossification attached to the cortex by a broad base; cortical erosion or corticomedullary continuity is not present. Periosteal chondromas typically show external cortical saucerization and a thick periosteal reaction (but-tressing) with or without mineralized chondroid matrix.

Since its first description by Kimmelstiel and Rapp [13] in 1951 as “periosteal desmoid,” this lesion has also been called cortical desmoid, avulsive cortical irregularity, subperiosteal dermoid, subperiosteal abrasion, cortical abrasion, subperiosteal cortical defect, parosteal or juxta-cortical desmoid, medial distal metaphyseal femoral irregularity, or fibrous metaphyseal defect [1–4, 8, 9, 11–15, 20–27]. This is a benign entity that may have an atypical and aggressive appearance or a focal geographic

Fig. 5A–B Photomicrographs show (A) hypocellular fibroblastic proliferation with no cellular atypia or mitosis and (B) focal myxoid areas of dissecting collagen fibers (Stain, hematoxylin and eosin; original magnification, $\times 200$).

radiolucency within the posterior cortex of medial femoral condyle. It typically occurs between the ages of 3 to 17 years, with a peak incidence at 10 to 15 years, and has been reported in 11.5% of boys and 3.6% of girls [21]. At epiphyseal closure, the irregularity decreases in size and often disappears, although it may persist into adulthood [7, 9, 13, 20, 27], as documented in one report in a 57-year-old man [17]. Suh et al. [23] also found distal femoral cortical irregularities in 44 of 100 knee MRIs (mostly adults) and divided them into concave (four cases with cortical concavity), convex (36 cases with cortical convexities), and divergent (four cases with wide and split cortex). The lesion is often asymptomatic, producing no palpable mass, pain, or swelling and has a benign course [8, 9, 16, 19]. Consequently, they are frequently an incidental finding when radiographs are reviewed for unrelated conditions or knee trauma as in our patient [7, 9].

The etiology is uncertain and controversial. Some [21] consider it a developmental anomaly while others consider

it an earlier phase of the more common fibrocortical defect [4, 7]. Most lesions can be related to chronic traction or avulsive injury at the insertion of the extensor aspect of the adductor magus [2, 5, 9, 14, 20] or to the origin of the medial head of the gastrocnemius [7, 17, 20, 23, 26] and plantaris muscles [7]. Some authors, however, have not found tendinous attachments at this location [4, 21, 27]. In addition to the strong muscle pull exerted in this area, intense bone remodeling occurs simultaneously during periods of rapid skeletal growth. The cortex of the bone is consequently weakened, and the excessive mechanical stress that occurs at this site is believed to produce microavulsions of the cortical bone that elicit a hypervascular and fibroblastic response, which in turn stimulates osteoclastic activity and bone resorption [5]. It is postulated this lesion is a fibroblastic periosteal response resulting in periosteal new bone formation on the surface and concomitant cortical osteoclastic bone resorption. If bone formation prevails, soft tissue mineralization is evident radiographically. If the fibroblastic reaction is predominant, a cortical defect is seen. In contrast, Young et al. [27] found the lesion indistinguishable from an osteochondroma, with a layer of cartilage and an underlying fibroblastic layer. Resnick and Greenway [20] classified them as excavations or proliferative cortical irregularities and found thickened periosteum with fibrous connective tissue in the proliferative cortical irregularity. Marek [16] has described the lesion as a “cork in the bottle,” with part of the mass within the bone and part outside bone. The morphologic features are reminiscent of a reactive process rather than a neoplastic one. The wide variation in the nomenclature of these lesions reflects differences in histopathologic interpretation [8].

Although most common at the posteromedial aspect of the medial femoral condyle, similar lesions have been documented in the humerus, tibia, fibula, radius, metatarsal, metacarpal, and even distal phalanx [5, 24], all sites of strong tendon insertions. A proximal humeral lesion at the insertion of the pectoralis major has been described as a “ringman’s shoulder,” occurring primarily in gymnasts [10]. The femoral lesion is best demonstrated radiographically with the knee in 20° to 45° of external rotation [9]. The involved area is typically 1 to 2 cm in length, occasionally with reactive bone formation extending into the soft tissue [9]. Examination of both knees is recommended since the lesion is frequently bilateral (up to 35%) [21, 26]. Additional imaging is sometimes required to differentiate this benign process from malignant bone and soft tissue tumors and, thus, CT and MRI are important imaging tools to ascertain anatomic relationship, bone destruction, and soft tissue involvement [22, 23, 26]. Technetium bone scintigraphy generally reveals no uptake in the area of irregularity, although this negative finding may be masked

by the proximity of a growing epiphysis in children, a degenerative joint in the elderly [6, 24], or concomitant pathologic conditions such as osteomyelitis and lymphoma [6]. There is also a report of a stress fracture that simulated a distal femoral cortical irregularity radiographically and was differentiated by a bone scan, MRI, and histopathologic findings [18]. Single-photon emission CT imaging of the knee will show increased uptake [12].

The distal femur is a common site of developmental anomalies and primary bone tumors [21]. Whether or not a particular radiograph is interpreted as a normal variant depends on the clinical situation (patient age and location), the degree of cortical irregularity, the radiographic projection, and the experience of the radiologist and the orthopaedist interpreting the data [9]. Thus, as one gains familiarity with this variant, there is less likelihood of performing an unnecessary biopsy [9]. Six of seven cases (85.7%) in the study of Craigen et al. [8] were diagnosed primarily as malignant tumors and five (71.4%) underwent a biopsy. A biopsy may even result in a false-positive diagnosis of malignancy [24]. Therefore, recognition of this benign lesion is important, as it could easily be mistaken for a malignant change and unnecessary surgery may be performed. Amputation has been reported because of confusion with a malignant process [13].

Although a biopsy is not recommended for this lesion, the patient described herein underwent biopsy twice. Advanced age, the location at the posteromedial distal femur, point tenderness, and an associated soft tissue mass with mineralization, along with cortical irregularity and mild periosteal reactive changes, were worrisome for malignancy. Because of the atypical clinical and radiographic features, concerns were expressed about the adequacy of the CT-guided biopsy material. This diagnostic uncertainty and concern over sampling error led to an open biopsy. This biopsy confirmed the diagnosis of a distal femoral cortical irregularity, and observation was recommended, along with the judicious use of antiinflammatory medications. The patient remains asymptomatic at 7 years' followup, with no evidence of disease progression.

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