

# Considering Cartilage Lesions in the Evaluation of the Adult with Joint Pain

Russell Stitzlein, MD<sup>1</sup>  
 Kristy Weber, MD<sup>1</sup>

<sup>1</sup>Department of Orthopaedic Surgery  
 School of Medicine  
 University of Pennsylvania  
 Philadelphia, Pennsylvania, USA

## Introduction

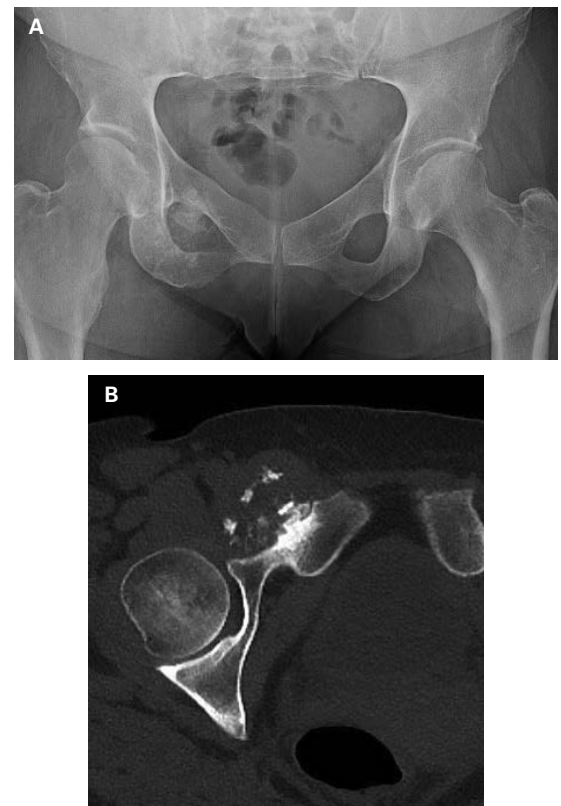
Patients commonly present to orthopaedic surgeons for evaluation of “joint” pain. The etiology of the pain is generally articular or peri-articular; however, occasionally the pain may be referred from a regional or distant location. A thorough history and physical examination in conjunction with appropriate radiographic imaging usually leads to an accurate diagnosis. Common causes of large joint (shoulder, hip and knee) pain with which orthopaedic surgeons are familiar and can consistently diagnose accurately include osteoarthritis, infection, avascular necrosis, rotator cuff injury of the shoulder, and meniscus tears of the knee. Several additional entities more specific to the individual joints exist for which the familiarity and level of diagnostic expertise varies based on pathology prevalence and level of surgeon experience and sub-specialization. Occasionally, a bone lesion will be identified in the workup of joint pain. Determining whether the bone lesion is the source of the patient’s symptoms is crucial to ensuring the patient receives appropriate management. Misdiagnosed and/or inappropriate management of malignant bone lesions leads to poor outcomes.<sup>1-4</sup> Alternatively, attributing a patient’s symptoms to a benign cartilage lesion should occur only after ruling out other, more common, causes of joint pain in the adult patient. This article will focus on common cartilage lesions that may be encountered in the evaluation of the adult with joint pain.

## Benign Cartilage Lesions

**Osteochondroma** is the most common benign bone lesion and it is not uncommon for a person with an osteochondroma to have multiple lesions.<sup>5</sup> Osteochondromas have a stalk that is confluent with the normal medullary canal attached to a cartilage cap. Typically, they arise from the metaphysis of long bones, may be associated with metaphyseal broadening and are directed away from joints (Figure 1a). Osteochondromas usually present and grow in childhood or adolescence; growth or the development of pain in adulthood warrant further evaluation, as malignant degeneration is known to occur at a rate of < 1% for solitary lesions and in 1%-10% of patients with multiple osteochondromas (Figure 1b).<sup>6,7</sup> Pain does

not necessarily mean a lesion is malignant; osteochondromas can cause pain due to tendon or soft tissue irritation (bursitis), irritation of an adjacent nerve or if the stalk fractures. Advanced imaging (CT +/- MRI) can be helpful to evaluate a painful osteochondroma. A cartilage cap > 2cm in adulthood has been shown to be suggestive of secondary chondrosarcoma, as the cartilage cap should decrease with the termination of skeletal growth as growth factors disappear.<sup>7,8</sup>

**Enchondromas** are benign tumors of hyaline cartilage that typically occur in the medullary canal in the metaphysis of long bones (particularly proximal humerus and distal femur) or in the distal appendages. Almost always,



**Figure 1.** (A) An AP pelvis radiograph demonstrating a sessile osteochondroma of the proximal right femur as well as a secondary chondrosarcoma arising from an osteochondroma of the right superior pubic ramus in a 61-year-old female with Multiple Hereditary Exostoses (MHE). The patient presented with a slowly progressive painful mass in her right anterior pelvis. (B) Axial CT image of the right hip reveals the superior pubic ramus secondary chondrosarcoma. Note the stippled calcifications and loss of “regular” osteochondroma architecture. Surgical pathology confirmed the presence of a Grade 1 chondrosarcoma.

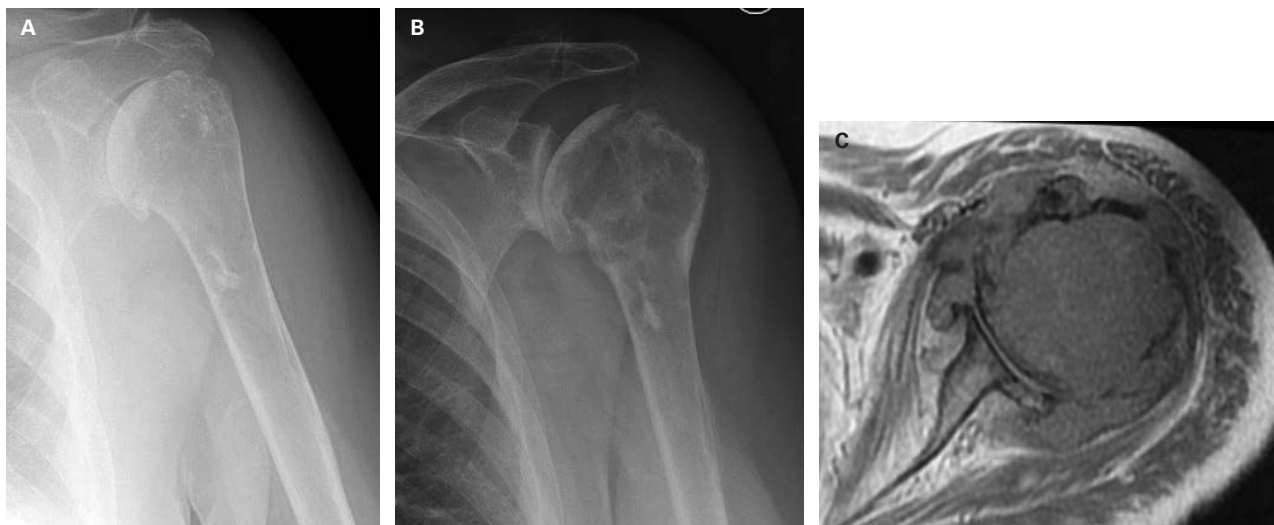
enchondromas are asymptomatic and found incidentally.<sup>5</sup> Radiographically (Figure 2a), they are well-marginated and have a central area with a variable amount of mineralization (*i.e.* “popcorn calcification”). Imaging findings concerning for a more aggressive lesion include an eccentric location, irregular calcification, endosteal scalloping, cortical thickening, soft tissue extension, bone expansion, and/or intralesional lucencies (Figure 2b and c). If present, these findings may warrant further advanced imaging (CT and/or MRI). Treatment of enchondromas is observation. If a pathologic fracture occurs through an enchondroma, nonoperative management is often possible due to the high healing rate.

**Chondroblastoma** is a rare benign cartilage tumor that almost exclusively occurs in the pediatric population and is usually epiphyseal in location. They tend to be painful and can lead to joint effusion and stiffness, particularly when there is cortical breakthrough. On plain radiographs, chondroblastomas are radiolucent with a sharply demarcated border (Figure 3a and b). Chondroblastomas are benign but can extremely rarely metastasize to the lungs. Management is surgical curettage and bone grafting.

**Synovial Chondromatosis** is a metaplastic process whereby synovial cells produce intra-articular loose bodies comprised of hyaline cartilage.<sup>8</sup> The nodules are typically small and numerous; however, they can become confluent. They may also become lodged in the synovial lining and no longer appear as “loose” bodies. There is a clear predilection for large joints, with the knee being most commonly affected. Synovial chondromatosis can be painful and present similar to osteoarthritis. Pain is mediated through mechanical damage and inflammatory molecules. Plain radiographs usually demonstrate small intra-articular calcified nodules but may be negative if the nodules have not calcified. Treatment of synovial chondromatosis is removal of loose bodies and synovectomy. Rarely, malignant progression can occur.<sup>9</sup>

## Malignant Cartilage Lesions

**Chondrosarcoma** is the malignant form of a cartilage lesion and may arise primarily or be secondary to a benign cartilage lesion. The pelvis and proximal appendicular skeleton are the most common sites and it is very rare in the hands and feet. Chondrosarcoma in the long bones infrequently is associated with a soft tissue mass and differs from most sarcomas in that they are usually slower in progression and low to intermediate-grade. Thus, the typical presentation for chondrosarcoma is long-standing history of pain with mild swelling and progressive limitation in daily activities and sports—strikingly similar to the presentation of a number of common arthropathies, such as osteoarthritis.<sup>10</sup> Dedifferentiation of chondrosarcoma is possible, which may present with a rapid conversion from indolent to fulminant disease (and symptomology). Chondrosarcomas are designated as low- (Grade 1), intermediate- (Grade 2), or high- (Grade 3) grade. Sixty-percent are low-grade and can be difficult to distinguish from enchondromas radiographically and histologically; interobserver agreement by pathologists between enchondroma and low-grade chondrosarcoma is only moderate.<sup>11</sup> Because of this, history, physical examination and critical review of imaging is critical to making the diagnosis of chondrosarcoma. Subtle scalloping may be the only radiographic finding suggestive of a malignant lesion. A change in appearance of a previously stable lesion is suggestive of possible malignant transformation. Anatomical location also matters. Two pathology specimens from the hand and pelvis may be identical; however the specimen from the hand will likely be an enchondroma whereas the pelvic specimen is more likely a low-grade chondrosarcoma. Grade 2 chondrosarcomas usually have a more aggressive radiographic appearance with cortical breakthrough and bony destruction evident. Grade 3 chondrosarcomas appear similar to other high-grade lesions with significant bony destruction, cortical breakthrough, associated soft-tissue mass, and periosteal changes. High-grade



**Figure 2.** (A) AP radiograph demonstrating left proximal humerus enchondroma in a 79-year-old female being evaluated for left shoulder pain deemed to be due to cuff tear arthropathy. Note the medullary-based lesion with “popcorn” calcification pattern. (B) AP radiograph demonstrating malignant degeneration of the proximal humerus enchondroma into a chondrosarcoma. Note the expansile and destructive nature of the lesion as well as multiple focal lucencies within the lesion. (C) Axial T1-weighted MRI showing associated soft tissue mass. The patient, now 85-year-old, presented with increased shoulder pain and dysfunction. The patient ultimately underwent surgical resection and endoprosthesis reconstruction. Pathology revealed a Grade 2 chondrosarcoma.



**Figure 3.** (A) AP and (B) Lateral radiographs of the left knee in a 17-year-old male demonstrate a chondroblastoma of the distal posterior medial femoral condyle. Note the characteristic epiphyseal location and the classic findings of radiolucency with a sharply demarcated border. The patient presented with knee pain, swelling and painful range of motion.

primary chondrosarcomas have minimal calcification unless they are dedifferentiated from low-grade lesions. Treatment of chondrosarcomas is focused on wide surgical resection, as these tumors are notoriously resistant to chemotherapy and radiation therapy.

## Discussion

Bone lesions frequently generate stressful situations for both patients and physicians; arriving at an accurate diagnosis for the bone lesion as well as the patient's presenting symptoms is critical to assuaging anxiety and helping ensure proper management is implemented. A diligent history, physical examination, and critical review of imaging studies can frequently help determine whether a patient has an incidental benign bone lesion associated with real joint pathology that fits the patient's symptomology or whether there is concern that the bone lesion might be the source of the patient's symptoms and might warrant further workup and/or referral to an orthopaedic oncologist.

One common scenario encountered by orthopaedic surgeons is a middle-aged patient presenting with shoulder pain. The vast majority of such patients will have rotator cuff +/- biceps tendon pathology or pain referable to degenerative changes of the glenohumeral or acromioclavicular joints. Onset, location, character, intensity, duration and aggravating/alleviating factors of pain are important. Reproducible pain with specific provocative maneuvers is unlikely to be from a cartilage lesion. Plain film radiographs may show characteristics of enchondroma; however, if the exam and other advanced imaging (MRI is often the imaging modality of choice to evaluate various shoulder pathology) are consistent with a benign enchondroma and a separate shoulder pathology, the patient should be treated independently of the lesion. If there is concern, a diagnostic

intra-articular or subacromial injection may be performed; pain from an intraosseous cartilage lesion will not be alleviated, whereas pain from rotator cuff pathology or osteoarthritis should be significantly decreased after therapeutic injection. If there is a change in symptoms, the patient should be reassessed and new imaging should be obtained. It is possible that the patient has developed worsening or new shoulder pathology, but it is possible that the previously identified benign cartilage lesion is now symptomatic due to malignant transformation (Figure 2b and c).

Another common scenario involves patients being evaluated and treated for degenerative joint disease of the hip or knee. The overwhelming majority of older adults presenting with hip or knee pain will have osteoarthritis and it is tempting to focus solely on the classic radiographic findings of degenerative joint disease (joint space narrowing, subchondral sclerosis, osteophyte formation and subchondral cyst formation). Careful attention must be paid, however, to radiographs, particularly around the hip, as chondrosarcomas involving the acetabulum may present quite similarly to hip osteoarthritis and can be subtle due to overlapping tissues in the pelvis. Chondrosarcoma diagnosed at the time of reconstructive hip surgery may compromise an opportunity for a limb salvage procedure and ultimately lead to a poorer prognosis.<sup>3</sup> If the degree of radiographic degenerative joint disease does not match the level of symptoms, one must be confident that there are no other potential etiologies. Articular based lesions of the hip in adults that do not fit classic descriptions of common pathology (eg. avascular necrosis) often warrant further workup or referral to an orthopaedic oncologist as there is a greater chance for primary or metastatic malignancy in this location.

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