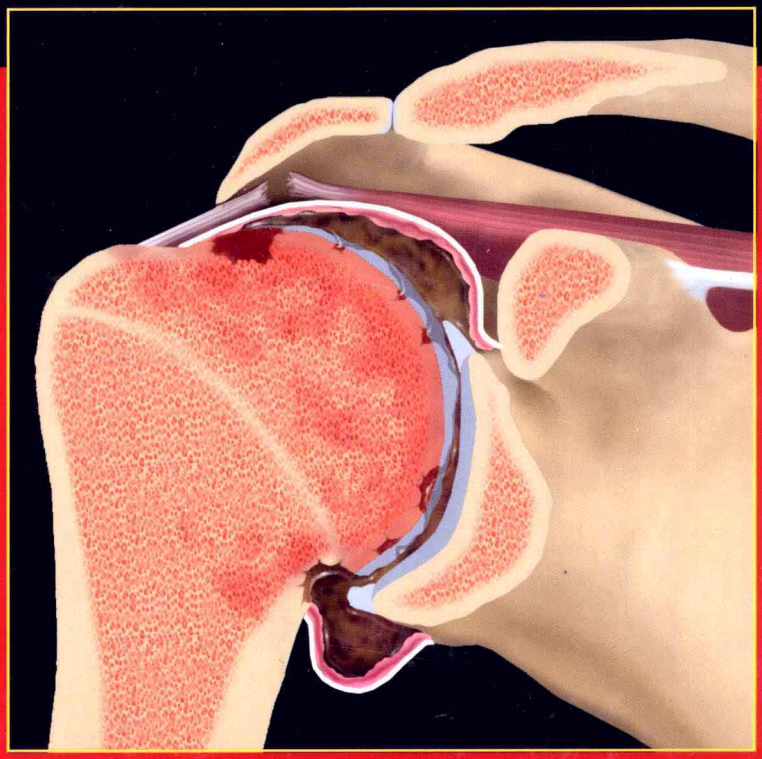
DIAGNOSTIC IMAGING

MUSCULOSKELETAL:
NON-TRAUMATIC DISEASE



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DIAGNOSTIC IMAGING

MUSCULOSKELETAL: NON-TRAUMATIC DISEASE

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SECTION 1
Arthritis

Introduction and Overview

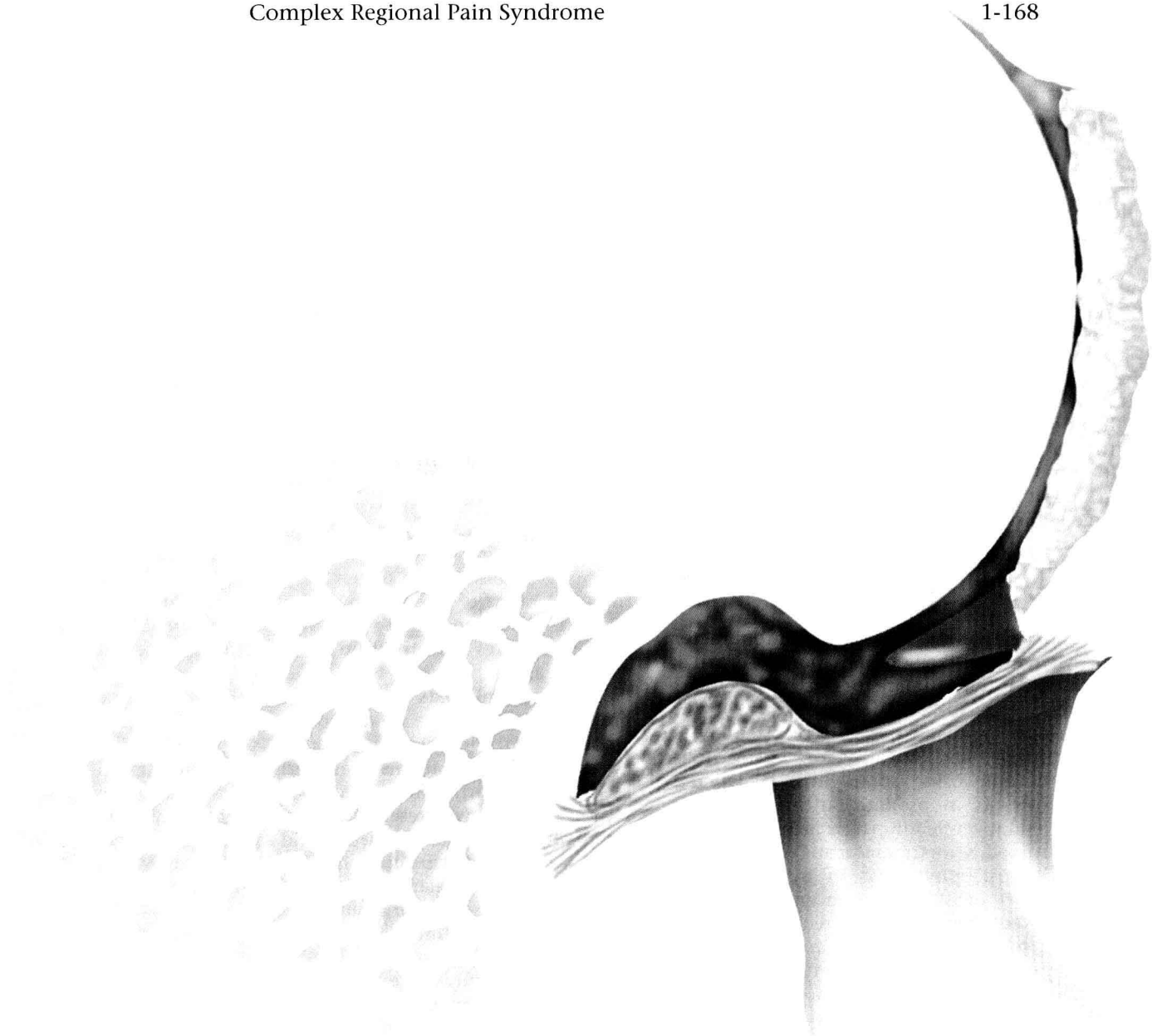
Erosive

Productive

Mixed Erosive and Productive

Due to Biochemical Disorders or Depositional Disease

Miscellaneous Joint Disorders



Classic Appearance of Arthritic Processes

When an arthritic process is well established in a particular patient, it will usually achieve a typical appearance, which allows diagnosis by means of imaging. At such a moderately early or midstage of disease, radiographs are usually sufficient to make the correct diagnosis. *The diagnosis usually depends on the location of the joint abnormalities and a host of other radiographic characteristics.*

Location of involved joints can often eliminate some diagnoses and raise the probability of others. For example, distal interphalangeal joint disease is commonly seen in psoriatic arthritis, osteoarthritis, and erosive osteoarthritis. However, it is not seen in rheumatoid arthritis; thus this diagnosis should not be considered. Similarly, a disease involving the sacroiliac joints would raise the possibility of ankylosing spondylitis, inflammatory bowel disease arthritis, psoriatic spondyloarthropathy, chronic reactive arthritis, osteoarthritis, and DISH. Common locations of joint involvement are illustrated in diagrammatic fashion in this section. Note the joints that are involved earliest and most commonly are distinguished from those involved less frequently or in end-stage disease.

While the location of the joints involved certainly contributes to establishing a list of reasonable diagnoses, the lists can be relatively long, as in the examples above. There are several other parameters that are useful in honing that list to a single diagnosis that are outlined in the tables that follow. Further explanation regarding some of these parameters may be helpful, as follows.

Age and gender may be the easiest parameters to apply. There are a minimal number of arthritic processes that affect children (juvenile inflammatory arthritis, hemophilic arthropathy, inflammatory bowel disease arthropathy, and septic joint) and teenagers (in addition to those affecting children, early onset adult rheumatoid arthritis and ankylosing spondylitis). Some diseases are gender specific (hemophilic arthropathy and hemochromatosis), while others are found in one gender far more frequently (gout, ankylosing spondylitis, chronic reactive arthritis in males, and rheumatoid arthritis in females).

One of the most important parameters is the **character of the process**. Some arthritides are **purely erosive**; rheumatoid arthritis is the hallmark for this group. Others are **purely bone-forming** (also termed "productive"). This bone formation may appear in the form of osteophytes (as in osteoarthritis), enthesopathy or ligamentous ossification (as in ankylosing spondylitis, DISH, and OPLL), or periositis (as in psoriatic arthritis, chronic reactive arthritis, and juvenile idiopathic arthritis). Other processes may be **mixed**, sometimes starting with erosions but progressing to osteophytes (as in pyrophosphate arthropathy or gout) or starting with periostitis and progressing to mixed erosions and osteophytes (as in psoriatic arthritis or chronic reactive arthritis). These processes tend to be distinctive for each type of arthritis by the time they are well established; between evaluating the character of the process and its primary location in an individual, the diagnosis can usually be secured.

Bilateral symmetry of an arthritic process can be a useful characteristic. Rheumatoid arthritis is especially well known for appearing bilaterally symmetric. Note that rheumatologists do not require specific joints of specific digits to qualify the arthritis as symmetric. For example, 5th PIP left hand and 3rd PIP right hand would be considered symmetric disease simply because of PIP involvement of each hand. Note also that bilateral symmetry may not be present in early stages of arthritic disease, even in rheumatoid arthritis. Similarly, while we usually think of the sacroiliitis of ankylosing spondylitis as being bilaterally symmetric, in its early stages the symmetry is often strikingly absent. Therefore, useful generalizations regarding bilateral symmetry are most often made in the mature stages of the disease process. However, rigid application of "rules" of symmetry should be avoided when evaluating early arthritis.

Soft tissue swelling can be the key to finding the earliest changes of arthritis on a radiograph. The sausage digit may lead to the discovery of subtle periostitis, even in the absence of joint space narrowing or erosions. Swelling around a metacarpophalangeal joint may lead to closer examination of a metacarpal head showing cortical indistinctness or the dot-dash pattern of early inflammatory disease. Be sure to window every image to evaluate the soft tissues, as these abnormalities can lead to closer examination of adjacent joints.

Soft tissue masses are not frequently seen in conjunction with arthritic processes. However, they may lead to specificity in diagnosis. Gouty tophi, seen as a mass containing a variable degree of dense tissue, can be diagnostic. As another example, soft tissue nodules, combined with acroosteolysis and interphalangeal joint erosions, leads to the rare diagnosis of multicentric reticulohistiocytosis.

In differentiating between the ligamentous ossification of DISH/OPLL, osteophytes of spondylosis deformans, syndesmophytes of ankylosing spondylitis, and paravertebral ossification of psoriatic arthritis and chronic reactive arthritis, the **character of paravertebral ossification** can often suggest the correct diagnosis. However, as with other parameters, it is important to note that mature paravertebral ossification in each of these entities may all have a similar appearance. True osteophytes may bridge across the disc space and give the appearance of the flowing ligamentous ossification of DISH. Mature ankylosing spondylitis has much bulkier syndesmophytes than the thin vertical ones depicted in early disease.

Subchondral cysts are seen in virtually all arthritic processes and therefore are rarely useful in differentiating among them. However, occasionally the subchondral cysts are so large that this characteristic becomes useful in diagnosis. Particularly large subchondral cysts in a setting that otherwise resembles rheumatoid arthritis lead to the diagnosis of robust rheumatoid arthritis. Very large cysts are also noted in pyrophosphate arthropathy and pigmented villonodular synovitis. Osteoarthritis and gout may also produce very large subchondral cysts.

Bone density must always be interpreted within the context of patient age and gender. An elderly female will usually have diffuse osteoporosis, with or without superimposed rheumatoid arthritis (classically described as causing juxtaarticular, followed by diffuse osteoporosis). Thus, though we state that normal bone density is a characteristic of osteoarthritis and gout, in an older patient those arthritic processes may be seen in the presence of diffuse osteoporosis. Another

example that may cause confusion is the young adult with end-stage renal disease and a renal transplant. Erosive disease in these patients is likely to be gout or amyloid. However, the bone density will be decreased due to both their renal osteodystrophy and likely use of steroids for their transplant. In this case, gout should be suggested to explain erosive disease, despite the bone appearing osteoporotic. Focal osteoporosis can also be helpful in identifying joints with active inflammation, as the hyperemia from the inflammatory process leaches the calcium from the bone.

The **pattern and timing of cartilage destruction** may be another useful parameter. Some arthritides, such as gout, classically cause prominent erosions before significant cartilage destruction, while most inflammatory arthritides, such as rheumatoid arthritis, result in early marginal erosions but also relatively early cartilage destruction. The pattern of cartilage destruction also distinguishes the inflammatory arthropathies, where it is uniform throughout the joint as opposed to the more focal cartilage destruction seen in the weight-bearing portions of the joint in osteoarthritis.

Adjacent calcific or ossific densities may be particularly helpful in diagnosis. Chondrocalcinosis is not unique to pyrophosphate arthropathy but is most frequently seen in that disease. The presence of chondrocalcinosis should also raise the question of traumatic osteoarthritis and hemochromatosis. Calcifications in gouty tophi are usually unique in their appearance. Calcific or ossific bodies in synovial chondromatosis are different from the osseous debris seen with a Charcot joint. Therefore, the character of adjacent calcific or osseous densities may be useful in the diagnostic process.

Ankylosis of the peripheral joints is most commonly seen in psoriatic arthritis and juvenile idiopathic arthritis. It is commonly found in the spine of patients suffering from spondyloarthropathies (most frequently ankylosing spondylitis), DISH, and juvenile idiopathic arthritis. Other more rare arthritic processes may show ankylosis as well. On the other hand, ankylosis in cases of rheumatoid arthritis is exceedingly rare. Do not be fooled by a surgical arthrodesis in a patient with severe rheumatoid arthritis. Arthrodesis is often attempted to stabilize the digits in this disease, and may mimic ankylosis.

Early Appearance of Arthritic Processes

We are now diagnosing arthritic processes at an earlier stage, prior to any radiographic change. This ability is essential, since early application of disease-modifying drug therapy may halt joint destruction. The benefit of early diagnosis is obvious, yielding longer patient productivity and decreasing the need for arthroplasty. However, the diagnosis may be difficult with subtle or absent radiographic findings and relies on MR or ultrasound. Early tenosynovitis and joint effusions may be identified on ultrasound, and MR may demonstrate tenosynovitis, effusion, and bone marrow edema long before actual erosions are seen in rheumatoid arthritis. Inflammatory change at vertebral body corners may be identified on MR, indicating early spondyloarthropathy. Even more subtle may be the enthesitis and adjacent marrow edema found in early ankylosing spondylitis, which are often found at the "corners" of the image (interspinous ligaments, iliac spine, greater trochanter) and are easily overlooked. Close attention should be paid to these locations, even when evaluating a "routine lower back pain" spine MR exam.

Late Appearance of Arthritic Processes

End-stage arthritic processes may have a classic appearance. Classic changes are often seen in the deformities and erosive change in rheumatoid patients or in the postural changes with vertebral column fusion in ankylosing spondylitis patients. However, at times an arthritic process, particularly when ineffectively treated, may attain a potentially confusing nonstandard appearance. An example of this is the rheumatoid patient who has failed drug therapy, resulting in an arthritis mutilans appearance of the hands (remember that pencil-in-cup and arthritis mutilans are not exclusively seen in psoriatic arthritis). Another example is the Native American ankylosing spondylitis patient who is treated without the use of Western medications and may present not only with the spondyloarthropathy expected in ankylosing spondylitis, but also with erosive disease involving all the peripheral joints, including hands and feet. Finally, the classic disease process that may be confusing is end-stage gout, which, if misdiagnosed or undertreated, may result in spectacular erosive disease at unexpected locations. It is important to remember that gout can look like anything and can be located at any joint!

Coexistence of Arthritic Processes

It is not unusual for two of the more common arthritic processes to coexist, particularly in the elderly patient. This may be confusing initially but can be worked out through understanding the prevalence of the diseases in the patient population, as well as by paying attention to the appearance and location of the abnormalities present. The most common combination is a new onset of rheumatoid arthritis superimposed on osteoarthritis. In this case, the osteoarthritis is usually well-established, involving the 1st carpometacarpal and interphalangeal joints in classic fashion, but there is new inflammatory change seen in the metacarpophalangeal joints. The elderly patient may also develop pyrophosphate arthropathy, superimposed over osteoarthritis or rheumatoid arthritis. The patient with a diabetic Charcot joint may develop superimposed septic arthritis. Keeping these possibilities in mind is useful to the interpreter, as the pattern of disease may not be classic.

Conclusion

There are many subtleties involved at specific joint locations in specific diseases, which cannot be discussed in such a broad introduction. These will be covered in proper detail in the individual sections that follow.

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Characteristics of Arthritic Processes

Arthritis Type	*Gender Predominance*	*# of Joints*	*Symmetry*	*Bone Density*	*Character of Process*	*Cartilage Destruction*
RA	M < F (1:3)	Polyarticular	Yes, by end stage	Density ↓	Erosive	Early, diffuse
Robust RA	M > F	Polyarticular	Yes, by end stage	End stage ↓	Erosive	Early, diffuse
JIA	M < F (1:4-5)	Pauci- or polyarticular	Generally no	End stage ↓	Erosive	Early, diffuse
Hemophilia	M only	Pauciarticular	No	Normal	Erosive	Early, diffuse
Adult Still disease	M = F	Polyarticular	Generally no	End stage ↓	Erosive	Early, diffuse
Multicentric reticulohistiocytosis	M < F	Polyarticular	Yes	Related to age	Erosive	Early, diffuse
Osteoarthritis	M < F	Polyarticular	Often	Normal	Produces bone	Early, focal
DISH/OPLL	M > F (2:1)	Nonarticular	Nonarticular	Normal	Produces bone	None
AS/IBD arthritis	AS: M > F (2.5-5:1); IBD: M = F	Polyarticular	Yes, by end stage	Mid- to end stage ↓	Mixed	Midstage, diffuse
PSA/CRA/HIV arthritis	PSA: M = F; CRA/HIV: M > F (5-6:1)	Polyarticular	Generally no	Normal	Mixed	Midstage, diffuse
Gout	M > F (9:1)	Polyarticular	No	Normal	Mixed	Late disease
Pyrophosphate arthropathy	M < F (1:2-7)	Polyarticular	Generally no	Related to age	Mixed	Midstage, diffuse
Hemochromatosis	M only	Polyarticular	Generally no	Normal	Produces bone	Late disease
Amyloid	M > F	Pauciarticular	No	Density ↓	Erosive	Early, focal
PVNS	M < F (1:2)	Monoarticular	No (single joint)	Normal	Erosive	Late, focal
PSC	M > F	Monoarticular	No (single joint)	Normal	Erosive	Late, focal
Charcot	M = F, relates to etiology	Mono- or pauciarticular	No	Not unless diabetic	Destructive	Early, diffuse
Septic arthritis	M = F	Monoarticular	No (single joint)	Normal	Erosive	Early, diffuse

Characteristics of Arthritic Processes

Arthritis Type	*Subchondral Cysts*	*Enthesopathy*	*Periostitis*	*Adjacent Density*	*Ankylosis*	*Soft Tissue Masses*
RA	Yes	No	No	No	No	Rheumatoid nodules
Robust RA	Yes, large	No	No	No	No	Rheumatoid nodules
JIA	Yes	No	Yes, early	No	Yes	No
Hemophilia	Yes	No	No	No	No	No
Adult Still disease	Yes	No	No	No	Yes	No
Multicentric reticulohistiocytosis	Yes	No	No	No	No	Nodules
Osteoarthritis	Yes	Yes	No	Rare chondrocalcinosis	No	Heberden nodes
DISH/OPLL	No	Yes, prominent	No	No	Yes	No
AS/IBD arthritis	Yes	Yes, prominent	No	No	Yes	No
PSA/CRA/HIV arthritis	Yes	Yes	Yes, prominent	No	Yes	No
Gout	Yes	No	No	Yes, tophus	No	Tophi
Pyrophosphate arthropathy	Yes, large	No	No	Chondrocalcinosis	No	No
Hemochromatosis	Yes	No	No	Chondrocalcinosis	No	No
Amyloid	Yes, large	No	No	No	No	Amyloid nodules
PVNS	Yes, large	No	No	No	No	No
PSC	Yes	No	No	Calcified bodies	no	Rare extraarticular
Charcot	Yes	No	Occasionally	Osseous debris	No	Large fluid collections
Septic arthritis	If chronic	No	Yes	No	Rare	No

Abbreviations: Rheumatoid arthritis (RA), juvenile idiopathic arthritis (JIA), diffuse idiopathic skeletal hyperostosis (DISH), ossification posterior longitudinal ligament (OPLL), ankylosing spondylitis (AS), inflammatory bowel disease (IBD), psoriatic arthritis (PSA), chronic reactive arthritis (CRA), pigmented villonodular synovitis (PVNS), & primary synovial chondromatosis (PSC).