Ultrasonography Applications in Diagnosis and Management of Early Rheumatoid Arthritis

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KEYWORDS
- Early-onset rheumatoid arthritis
- Synovitis
- Power Doppler
- Ultrasonography
- Ultrasound

Key Points
- High-frequency ultrasonography allows detailed assessment of superficial structures including tendons, tendon sheaths, joint capsule, cartilage, and cortical surface of bone.
- Gray-scale ultrasonography can visualize proliferative synovial tissue, fluid collections in tendon sheaths or joints, and bony erosions.
- Doppler ultrasonography can visualize synovial hyperemia, the strongest predictor of future joint damage in rheumatoid arthritis.
- Change in synovial thickening and hyperemia in response to treatment can be documented with serial ultrasonography.

As arthritis is so common, new imaging modalities have often been used for its assessment shortly after they have become available. Only a few months after Konrad Roentgen began lecturing on his “X-rays,” the first articles on imaging features of arthritis were published in 1896. The first articles on the use of ultrasonography in rheumatoid arthritis (RA) came from the University of California at Los Angeles, and were published in 1975. It was not until the 1980s and 1990s that the potential of ultrasonography to assess typical changes of RA became apparent. At that time, ultrasound equipment with higher frequencies became more readily available. Higher ultrasound...
frequencies allow better resolution of structures at shallow locations. These probes were initially developed for the assessment of thyroid glands, but were soon used by providers in musculoskeletal medicine. Since then, annual numbers of publications on musculoskeletal ultrasonography have increased almost exponentially (Fig. 1).

Ultrasonography can now be a point-of-care modality: The provider performs the examination in the office, with no referral needed. Findings can be addressed immediately, and necessary adjustments of treatment can be made at the same visit. If a fluid collection is detected and an aspiration is indicated, ultrasound guidance can help improve the accuracy of the aspiration and injection.3

RATIONALE FOR USING ULTRASONOGRAPHY IN THE ASSESSMENT OF EARLY RHEUMATOID ARTHRITIS

Without imaging of soft tissues, providers in rheumatology have to rely on surrogate markers of joint inflammation. It is assumed that tenderness and swelling over joints are due to synovitis. If serologic markers of inflammation are abnormal, this is taken as an additional indicator of joint inflammation. However, fullness and pain on examination may have causes other than synovitis, and elevated sedimentation rates or levels of C-reactive protein may not always be due to RA. Even fibromyalgia patients may complain about morning stiffness and swollen hands.

Assessment of Early Rheumatoid Arthritis: Ultrasonography Versus Clinical Scores

Clinical scores remain the mainstay of assessment of disease activity. These scores, alone or in combination with measurement of acute-phase reactants, give no actual information about presence or absence of features of RA such as synovitis,
tenosynovitis, or erosive disease, but serve as surrogate markers to help guide treatment recommendations. With ultrasonography or magnetic resonance imaging (MRI), synovial inflammation can often be detected in patients assumed to be in remission based on clinical scores alone.\textsuperscript{4,5} There thus appears to be a disconnect between Disease Activity Score (DAS) remission and imaging remission.\textsuperscript{6}

Interobserver and intraobserver reliability of ultrasonography and clinical scores have been compared in several studies. Ultrasonography was found to be at least as good, or better, for repeatability (intraobserver) and reproducibility (interobserver) of findings than was assessment of disease activity with surrogate clinical scores.\textsuperscript{7,8} When ultrasonography assessment is added to clinical scores, such a composite index (US-DAS) may be a better predictor of future joint damage than a standard DAS28 alone.\textsuperscript{9}

**Assessment of Early Rheumatoid Arthritis: Ultrasonography Versus Conventional Radiography**

In a world where conventional radiography is the only readily available imaging modality, the features of RA that can be assessed with this modality assume great importance. Erosions, joint-space narrowing, and periarticular osteopenia are the classic features. However, even though conventional radiography is the historical gold standard of erosion assessment, it is insensitive when compared with ultrasonography.\textsuperscript{10}

When ultrasonography was compared with conventional radiography in a study of patients with RA, sonography detected 6.5-fold more erosions in early disease, in 7.5-fold the number of patients (Fig. 2). Two independent operators performed scans of metacarpophalangeal (MCP) joints sequentially for this study, and reached good interobserver reliability (Cohen $\kappa = 0.75$).\textsuperscript{11}

Is there such a thing as “operator dependence” when obtaining conventional radiographs? As radiography projects 3-dimensional structures on 2-dimensional planes, breaks in the bony cortex need to be seen in profile to be characterized as erosions (lesions that are not seen in profile may be either cysts or erosions). To help detect erosions of the cortex in RA, extremities are assessed in different views, for example,

![Fig. 2. Radiography and ultrasonography: comparison of number of detected bony erosions in early rheumatoid arthritis by joint. (Data from Wakefield RJ, Gibbon WW, Conaghan PG, et al. The value of sonography in the detection of bone erosions in patients with rheumatoid arthritis: a comparison with conventional radiography. Arthritis Rheum 2000;43(12):2762–70.)](image-url)
anterior-posterior, lateral and oblique, or “ball-catcher’s” views of the hands. Detection of cortical breaks will vary with positioning of the extremity. The radiology technician, and the patient, will make an effort to standardize the position of the extremity as much as possible. Nevertheless, a few degrees in difference of rotation can render an erosion impossible to detect. Furthermore, for an assessment at a different time point, for example, to evaluate progression of erosions, the exact same position would need to be assumed, which is problematic in a free-hand approach (Fig. 3). Once radiographs are obtained, will different readers come to the same conclusions? John T. Sharp found that “the variability in scoring radiographic abnormalities is considerable among this group of 11 expert readers” in a study with standard data sets of patients with RA.\textsuperscript{12}

Synovitis or tenosynovitis, both very early findings in RA, cannot be assessed radiographically.

Assessment of Early Rheumatoid Arthritis: Ultrasonography Versus MRI

For the image assessment of RA, ultrasonography is often compared with MR imaging. Both are cross-sectional modalities that evaluate similar features of RA. It is therefore of considerable interest to identify the modality that is more sensitive, specific, reproducible, and repeatable. Both modalities can assess bony erosions, synovial tissue proliferation, synovial fluid collections, tenosynovitis, enthesitis, and synovial hyperemia. MRI can identify bone marrow edema, which ultrasonography cannot. Ultrasonography can be a dynamic, real-time examination, which MRI is not (dynamic cardiac MRI would be the exception). Displaceability of synovial fluid and compressibility of synovial tissue can only be assessed sonographically. Synovial hyperemia can be seen in real time with ultrasonography. The greatest extent of hyperemia during systole can safely be appreciated and used for scoring of disease. It has not been studied well if MRI assessment of hyperemia is subject to variation during systole and diastole, and if an MR image taken during diastole could lead to inaccurate assessment of synovial hyperemia. It is frequently mentioned that operator dependence could be a discriminating factor between MRI and ultrasonography. The operator dependence of MRI assessment of rheumatic disease has not been systematically studied. For such a study, 2 or more operators (radiology technicians or physician providers) would need to separately perform MRI studies of the same patients to assess predefined features of RA, using 2 or more different MRI coils.

Fig. 3. (A, B) Lateral radiographs of hands and wrists of the same patient at 2 different time points. The slight variation as 2 different poses are assumed makes comparison of specific details more difficult.
The resulting images would need to be read by 2 or more radiologists. If the agreement were 100% at all times, MRI could be called operator independent—an unlikely scenario at best. Unsurprisingly, the diagnostic accuracy of MRI interpretations varies between readers and depends on the experience of the provider. In a study of 21,482 consecutive computed tomography (CT), MRI, and ultrasonography studies, MRI and CT interpretations had significantly higher rates of discrepancy among readers than ultrasonography.

**MRI and ultrasonography: erosions**
A recent systematic literature review found no statistical difference in the efficacy of MRI and ultrasonography in detecting erosions in RA. In early RA, ultrasonography tended to detect more erosions than MRI, whereas MRI tended to detect more erosions in late disease. Good reproducibility of ultrasonography findings for erosion detection was found. Ultrasonography assessment of erosions may therefore be regarded more cost effective than MRI for this indication.

**MRI and ultrasonography: synovitis and tenosynovitis**
For a reliable assessment of RA, an imaging modality must depict the anatomic reality as faithfully as possible. Ultrasonography findings of synovial hyperplasia and hyperemia correlate well with histopathological findings after surgery. In a recent study, findings of power Doppler ultrasonography were closely associated with all “pathologic compartments” of synovitis, including inflammatory cell infiltrates, synovial lining layer thickness, and vascularity. Ultrasonography findings more faithfully illustrated active synovitis than those of MRI.

Small fluid collections and tenosynovitis in patients with RA are more readily detected by ultrasonography when compared with MRI.

**ULTRASONOGRAPHIC FEATURES OF RHEUMATOID ARTHRITIS**

**Tenosynovitis**

There is some evidence that tenosynovitis is a very early feature of RA. It may precede synovial proliferation within the joints. Tenosynovitis can, by definition, only occur at sites where tendon sheaths encase the tendons. Tendon sheaths around the wrists particularly are affected early on but also later in the disease process. Tendon sheaths of the extensor carpi ulnaris tendon (extensor compartment 6) and extensor digitorum together with extensor indicis tendon (extensor compartment 4) are typical tendon sheaths affected by tenosynovitis in RA.

**Sonoanatomy of tendon and sheath**

Tendons with their sheaths share anatomic characteristics with joints. The tendon fibers are encased by a layer of synovial tissue, the inner lining or visceral layer. The fibrous tendon sheath connects to the adjacent periosteum and is lined by the outer or parietal synovial layer. The 2 synovial layers connect through a duplication along the mesotendineum, or mesotenon, a vascularized suspensory ligament that connects the tendon with its environment. In RA, synovial tissue can proliferate from both layers, as well as from the lining of the mesotendineum, the “third layer” (Fig. 4).

**Tenosynovial effusions**

Fluid collections, or tenosynovial effusions, will distend the layers. Synovial fluid is usually anechoic. It will provide contrast to better appreciate the anatomic structures. In RA, effusions of the tendon sheath are often associated with synovial proliferation. By contrast, effusions caused by mechanically induced tenosynovitis will have only little coexisting synovial thickening.
Synovial proliferation

The delicate synovial lining of tendon and sheath can usually not be seen sonographically in healthy individuals. Detection of synovial tissue is an abnormal finding. Synovial tissue will appear as hypoechoic, gray-appearing tissue interposed between the fibrous and bright, or hyperechoic-appearing tendon sheath and the bright, hyperechoic tendon fibers. If synovial fluid is present, it will usually appear as dark or anechoic, and will accentuate the anatomy of tendon, sheath, and synovial tissue. With transducer pressure, fluid will be displaceable: it will flow away from the pressure of the transducer. By contrast, synovial tissue is not displaceable and will stay in place. A minimal compressibility of synovial tissue may be seen, due to its often villous structure with sponge-like qualities.

Synovial hyperemia

No significant blood flow is usually detectable sonographically in tendon and sheath of healthy adults. If synovial proliferation is detected or suspected on gray-scale ultrasonography, this tissue must be examined for hyperemia using Doppler ultrasonography.
Paratenonitis

Another concept is the idea of paratenonitis. Inflamed tissue adjacent to tendons without sheath can occasionally be seen by ultrasonography in inflammatory arthritis, including RA. This feature has found its way into the US7 ultrasonography scoring system for RA. It is unclear what precise tissues become edematous and hyperemic adjacent to sheathless tendons, and paratenonitis has not been described elsewhere as a typical feature of RA. It is possible that synovial pannus breaks through the joint capsule and allows for synovitis to distribute along the tendon (Fig. 5).

Synovitis

Based on clinical examination alone, it may be difficult to tell if palpable fullness or warmth over a joint, or tenderness on palpation, is due to subcutaneous edema, tenosynovitis, paratenonitis, a joint effusion, or synovial proliferation within the joint. Ultrasonography can help with a more precise assessment.

Joint effusion

Ultrasonography appears to be more sensitive than clinical examination or MRI for the detection of small, supraphysiologic fluid collections in early RA. Synovial fluid has an anechoic, or “black” sonographic appearance. It will distend the more hyperechoic fibrous joint capsule. Early on, synovial fluid will collect in the proximal recesses of the joint capsules of small joints of hands and feet (Fig. 6). Later in the disease process, excess synovial fluid can displace the fibroadipose pad that reinforces the dorsal joint capsule in these joints, and eventually lead to a convex elevation of the joint capsule over proximal and distal bony endings. The fibrous volar and plantar plates that prevent overextension of finger and toe joints may be displaced by synovial fluid. In contrast to tissue, synovial fluid moves freely within the joint. Ultrasonography is a dynamic, real-time imaging modality. Transducer pressure on the joints can displace fluid away from the transducer. By contrast, synovial tissue will be just slightly compressible (sponge-like) as in tendon sheaths, but will not be displaced by transducer pressure.

Synovial hypertrophy

Proliferation of synovial-lining tissue will be one of the earliest features of RA that can be detected sonographically. As physiologic synovial lining tissue is only 1 to 3 cell layers strong, any sonographically detectable synovial thickening raises the suspicion of inflammatory arthritis. Sonographically, synovial tissue will appear hypoechoic or gray, in contrast to adjacent hyperechoic, fibrous capsule tissue; anechoic, or black-appearing synovial fluid; anechoic hyaline cartilage; and hyperechoic bony contour.

Synovial hyperemia

Once synovial tissue is detected using gray-scale, or B-mode, ultrasonography, color Doppler or power Doppler can help assess the degree of hyperemia of this tissue (Fig. 7). Doppler signals will represent blood flow rather than artifact if they are seen over an area that was identified as abnormal in the preceding gray-scale assessment, have a pulsatile quality synchronous to the pulse, and are seen persistently in the same area during a real-time examination.

Bony Erosions

Bony erosions can be detected sonographically relatively early in the disease process (Fig. 8). Ultrasonography of erosions performs better in joints that are readily
Fig. 5. (A) Erythema and swelling of second proximal interphalangeal (PIP) joint of the right hand. (B) Dorsal long-axis view of second PIP joint of the right hand. A hypoechoic to anechoic area is seen overlying the extensor tendon (arrows). (C) Hyperemia is seen over the area of interest. (D) Dorsal short-axis view of second PIP joint of the right hand. Breaks in the dorsal joint capsule (between arrows) allow synovial pannus tissue to escape the confines of the joint and distribute along the extensor tendon.
accessible to sonographic evaluation, including small joints of hands and feet. It is less strong in deeper-seated bony structures and in bones that will not allow circumferential assessment, such as the carpal bones in wrists or the tarsal bones in feet. Bony erosions are defined as breaks in the bony cortex, seen in 2 perpendicular planes. It is helpful to gain experience with the sonographic appearance of the anatomic neck of the distal metacarpal and metatarsal bones, as it is located near typical sites of erosion in RA.

As the precursors of erosions including synovial pannus formation and synovial hyperemia can be seen sonographically, and these are sensitive to therapeutic intervention, the detection of erosions loses some of its prior importance.

DESCRIBING AND QUANTIFYING ULTRASONOGRAPHIC FINDINGS OF RHEUMATOID ARTHRITIS

Erosions, synovial effusions, and proliferation of synovial tissue seen on gray-scale ultrasonography can be described as present or absent. Similarly, synovial hyperemia seen on Doppler ultrasonography can be described as present or absent. As the mere presence of synovitis and hyperemia indicates the absence of remission, such a dichotomous description can be useful in clinical practice. To create a score that helps describe worsening or improvement of disease in clinical trials, semiquantitative scoring systems are used. The most commonly used systems describe findings on

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**Fig. 6. Inflammatory arthritis.** (Middle) Dorsal long-axis view of first metatarsophalangeal joint. Distension of hyperechoic joint capsule is seen. Hypoechoic synovial tissue and anechoic synovial fluid are shown (arrows). (Bottom) Healthy control. (Histologic image courtesy of American College of Rheumatology © 2012 American College of Rheumatology. Used with permission.)
a scale from 0 to 3, with 0 representing absence of findings (Table 1). Efforts have been undertaken to identify condensed scoring systems that examine a small number of joint areas thought to be representative of the disease on the patient level. The US7 system assesses 7 joints for erosions, synovitis, and tendon involvement.

Fig. 7. Dorsal long-axis views of MCP joint. (Top) Healthy control. (Middle) Displacement of fibrous capsular triangle is seen. The distal recess of the joint is distended by synovitis (arrow). (Bottom) Hyperemia seen over the area of interest.

Fig. 8. Dorsal long-axis view over MCP 2. (Top left and right) Unremarkable radiographs. (Bottom) Ultrasonogram of the same patient, taken on the same day as the radiographs. A large bony erosion with invasion of synovial pannus tissue is seen over the metacarpal head.
A high-yield examination can be obtained if MCP joints 2 to 4 are evaluated for synovitis from the dorsal aspect, proximal interphalangeal joints 2 to 4 are evaluated from the volar aspect, and the wrist is evaluated from the dorsal aspect in the midline for tenosynovitis of extensor tendons and synovitis in the radiocarpal and midcarpal joints, and for tenosynovitis of the extensor carpi ulnaris tendon from the ulnar aspect.

ULTRASONOGRAPHY IN THE DIFFERENTIAL DIAGNOSIS OF EARLY RHEUMATOID ARTHRITIS

Particularly early in the disease, the diagnosis of RA may not yet be firmly established. Ultrasonography can help distinguish typical features of RA from other inflammatory arthritides, and from noninflammatory musculoskeletal conditions.

Rheumatoid Arthritis Versus Crystal-Associated Arthritis

Both synovial pannus tissue and tophaceous material can distend the joint capsule and lead to a clinical picture of swollen and tender joints. Sonographically, synovial pannus tissue is more hypoechoic than crystal deposition because of its higher water content.26,27 If conventional radiographs are available, synovial tissue as well as monosodium urate (MSU) crystals will be radiolucent (ie, escape radiographic detection). Calcium-containing crystals will be detected radiographically. Sonographically they may produce a posterior acoustic shadow, that is, they will not permit through-transmission of sound waves once they reach a critical size.

Synovial tissue proliferates from the inner lining of the hyperechoic joint capsule: it is attached to the capsule. By contrast, tophaceous material is generally not attached to the joint capsule (with the exception of microtophi). A hypoechoic or anechoic margin separates more hyperechoic tophi from the joint capsule and synovial lining.

Rheumatoid nodules appear sonographically as more hypoechoic, or darker than hyperechoic crystalline tophi.

Rheumatoid Arthritis Versus Spondyloarthritis

Few sonographic features truly discriminate between RA and the spondyloarthropathies. Inflammatory changes at the interface of tendons or ligaments and bone are characteristic of spondyloarthritis, but enthesitis can also be seen in RA. Sonographic features of the enthesal involvement in spondyloarthritis include edematous thickening of the tendon or ligament near and at origin or insertion with a loss of the pattern of densely packed, hyperechoic parallel fibers; blood flow at the interface with bone; synovial proliferation in adjacent bursae; erosion formation outside of synovial joints; and new bone formation.28,29 The combination of these findings would not be a typical sonographic feature of RA. Dactylitis, or “sausage digits” of spondyloarthritis, may be due to enthesitis of ligaments or involvement of tendons rather than joint involvement alone, and ultrasonography can help shed light on this.30,31

<table>
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<tr>
<td>0</td>
<td>No gray-scale change</td>
</tr>
<tr>
<td>1</td>
<td>Mild synovitis</td>
</tr>
<tr>
<td>2</td>
<td>Moderate synovitis</td>
</tr>
<tr>
<td>3</td>
<td>Severe synovitis</td>
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| Table 1: Grades of ultrasonography findings |

Ultrasonography in Early RA Diagnosis
The extensor tendons over fingers are devoid of a tendon sheath, so that the term tenosynovitis is not applicable here. The term paratenonitis is used to describe extra-articular hyperemia or anechoic fluid collections along the extensor tendons of the fingers. This term has found entrance into one sonographic scoring system of RA, the US7. One study found paratenonitis in patients with spondyloarthritis but not RA, and the investigators have proposed this as a discriminating sonographic feature.

Rheumatoid Arthritis Versus Erosive Osteoarthritis

Distinction of erosive osteoarthritis from RA is generally not a problem, because of the different patterns of distribution of the erosions. Typical central erosions of distal and proximal interphalangeal joints in erosive osteoarthritis associated with new bone formation can be readily distinguished on conventional radiographs from more marginal erosions in proximal interphalangeal and metacarpophalangeal joints without new bone formation in RA. The operational term “inflammatory osteoarthritis” has been coined to describe patients with periarticular redness, swelling, or even warmth. However, true synovitis defined as an increased intra-articular fluid collection, synovial proliferation, or synovial hyperemia is rare in osteoarthritis. Minimal fluid collections can be seen sonographically around prominent intra-articular bone spurs. This appearance has been described as a “tent-pole” phenomenon, with the bony spur mechanically expanding the fibrous joint capsule, and adding room for fluid collections (G. Kunkel, personal communication, 2011).

As osteoarthritis is often accompanied by shedding of calcium-containing crystals, a response to these crystals has been postulated as the mechanism for synovitis in osteoarthritis. Small calcific concrements can often be seen both radiographically and sonographically in osteoarthritis.

Synovial pannus tissue invading the subchondral bone seen on ultrasonography is consistent with RA, but clearly not with osteoarthritis. Two very distinct disease mechanisms are at work forming the erosions.

Rheumatoid Arthritis Versus Fibromyalgia

Patients with fibromyalgia share several symptoms and complaints with patients affected by RA. Patient and caregiver may be concerned that an actual inflammatory arthritis is present. Patients with fibromyalgia may complain about symmetric joint pain and swelling affecting small joints of hands and wrists. Perceived morning stiffness may last for more than 1 hour, and patients may point out a family history of arthritis; they may have difficulty taking off the rings from their fingers. In this situation, an ultrasonographic assessment of the small finger joints and wrist joints can be extremely helpful to safely rule out any effusion or synovitis. Joint effusions and synovial hyperemia are not sonographic features seen in painful hands in the fibromyalgia syndrome.

TECHNICAL ASPECTS OF ULTRASONOGRAPHIC ASSESSMENT OF RHEUMATOID ARTHRITIS

Higher ultrasound frequencies provide better resolution of superficial structures, but will not penetrate tissues as deep as will lower frequencies. For the assessment of soft-tissue structures in small joints, ultrasound transducers with frequencies of 12 to 18 MHz are typically used. Lower frequencies may be needed for the deeper-seated hip joint. Details of synovial proliferation and synovial hyperemia can therefore be less well seen in the hip joint, but effusions can be seen as a distension of the joint capsule at the femoral neck. Linear transducers with a straight end are appropriate for most joints. Some examiners may prefer a probe with a small footprint (which can have a “hockey-stick” appearance) to maneuver around metacarpal or metatarsal heads for
the assessment of erosions. The following can be helpful for ultrasonographic assessment of early RA:

- Start with a gray-scale assessment and identify structures of interest
- Adjust the frequency to the depth of the examined structure (higher frequencies for more superficial structures)
- Adjust the gray-scale gain so that hyperechoic bony cortex, hyperechoic fibrous joint capsule, as well as hypoechoic synovial tissue and anechoic synovial fluid, if present, can be distinguished
- Place focal point or focal points at the level or slightly deep to the level of the structure of interest
- Adjust the overall depth of the image on the screen so that not more than one-third of the image on the screen is located deep to the bony cortex
- If synovitis is identified with gray-scale ultrasonography, assess this tissue with Doppler ultrasonography
- Decrease Doppler gain until artifacts, particularly signals deep to the bony cortex, just disappear
- Label and save images
- Communicate findings and create a report.

Gauging the Doppler Function for RA Assessment

Sensitivity and specificity of the Doppler signal is variable among different ultrasound machines. Color or power Doppler should be able to detect blood flow in a vessel, and depict this flow within the confines of the vessel. A sensitive Doppler function will detect flow in vessels down to the size of capillaries if they are superficially located, as in small joints of hands and feet. The specificity for intraluminal flow is decreased if the Doppler signal is amplified so that color signals extend beyond the vascular wall. Such “bleeding” of the Doppler signal may potentially lead to an overestimation of hyperemia or vascularization of a given tissue.

Doppler assessment of blood flow in the volar aspect of the fingertip, the pulp, can help to calibrate and assess the quality of the Doppler function. Blood flow should be seen at least in the digital artery that overlies the bone of the distal phalanx. Smaller branches will extend medially and laterally from this artery and turn superficially toward the skin. The caliber of these terminal branches resembles the neovascularization of synovial pannus tissue in RA. Assessment of blood flow in the finger tip of healthy controls can help determine the suitability of the Doppler function for the assessment of synovial blood flow.

ULTRASONOGRAPHIC ASSESSMENT OF TREATMENT RESPONSE

Ultrasonography is safe and inexpensive, and can be repeated at consecutive office visits. Once abnormalities of RA are identified at baseline, they can be followed with serial ultrasonography over time, and a treatment response can be documented (Fig. 9). Enlargement or healing of bony erosions can be documented. Changes in synovial thickening can be measured using sonographic calipers. Changes in the degree of synovial hyperemia can be visualized and scored using typical scoring systems. Ultrasonographic findings of RA are sensitive to change.

ULTRASONOGRAPHY OF RHEUMATOID ARTHRITIS IN PERSPECTIVE

Because of initial concerns that the usefulness of ultrasonography to assess RA could be hampered by operator dependence, studies using ultrasonography routinely include assessments of interobserver and intraobserver variability. Ultrasonography
has proved to be a remarkably robust tool for reliable assessment of changes in RA. No evidence can be gleaned from the literature showing that problems with operator dependence would be greater than with other imaging modalities or physical examination, if performed by trained providers.

Ultrasonography is an elegant tool for the detection of tenosynovitis, synovitis, and erosions very early in RA, and the presence of a power Doppler signal is one of the best predictors of joint damage.

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REFERENCES


