

# High Resolution Ultrasonography in Detection of Bone Erosions in Patients with Hand Osteoarthritis

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**ABSTRACT. Objective.** To evaluate the ability of high resolution ultrasonography (US) in the diagnosis of erosive osteoarthritis (OA).

**Methods.** We enrolled 110 patients with signs and symptoms of inflammatory OA. Radiographs of both hands were performed in all patients; 22 were diagnosed as having erosive OA and 88 classical OA on the basis of typical erosive/non-erosive patterns. Distal and proximal interphalangeal joints of all patients were evaluated by US by 2 independent operators blinded to patient data. The examination was performed with a multiplanar scan technique, with joints in both maximal extension and flexion, using either a 14 MHz or 8–16 MHz broadband linear probe. The presence of articular bone surface irregularities defined as either marginal osteophytes or central erosions was recorded. Sensitivity, specificity, and likelihood ratios on the presence of erosions were calculated.

**Results.** Central erosions were detected by US in 16 of 22 (72.7%) patients with erosive OA and in none of 88 patients with classical hand OA. Sensitivity and specificity for the detection of central erosions by US were 73% and 100%, respectively. The positive and negative likelihood ratios were 100% and 94%.

**Conclusion.** This is the first study to evaluate the presence of erosions in patients with erosive OA by US. Our results showed good concordance between US and radiography in detecting central joint erosions. We believe US may be considered a useful technique for the differential diagnosis between erosive OA and classical hand OA. (J Rheumatol 2005;32:2381–3)

## Key Indexing Terms:

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BONE EROSIONS

HAND OSTEOARTHRITIS

Recently, ultrasonography (US) has gained reliability in detecting bone erosions in patients with arthritis<sup>1–3</sup>. Erosive osteoarthritis (OA) is considered an aggressive subset of hand OA, characterized by an acute course and appearance of symmetrical erosions, mainly in distal (DIP) and proximal interphalangeal (PIP) joints. Clinically, erosive OA may pose problems of differential diagnosis with inflammatory arthropathies. Diagnosis is based upon radiographs that, in combination with the classical hallmarks of OA, show typical central erosions, collapse of the subchondral bone, and interosseus bone fusion<sup>4,5</sup>.

We investigated the utility of US in the detection of bone erosions in patients with erosive OA.

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## MATERIALS AND METHODS

From 1998 to 2003, we enrolled 110 consecutive female patients who attended the authors' 2 rheumatology units, and who had swelling, pain, and tenderness of DIP and PIP joints, with Heberden's and Bouchard's nodes.

Posteroanterior radiographs of both hands were performed in all patients. Erosive OA was diagnosed on the presence of typical central erosions, subchondral plate collapse, and bone ankylosis in combination with classical OA changes such as joint space narrowing, subchondral sclerosis, osteophytes, and subchondral cysts. Classical hand OA was diagnosed in the absence of joint erosions and presence of the other alterations. Cases with radiographic signs of rheumatoid arthritis, psoriatic arthritis, chondrocalcinosis, and gout and elevation of erythrocyte sedimentation rate (> 20 mm/h) and C-reactive protein (> 0.5 mg/dl) and/or with positive rheumatoid factor and antinuclear antibodies were excluded.

Erosive OA was diagnosed in 22 patients, mean age 57 years (SD ± 6.8, range 47–70) and mean disease duration from first appearance of symptoms 3.9 years (SD ± 2.8, range 7 months to 12 years).

Classical hand OA was diagnosed in 88 cases, mean age 67 years (SD ± 10.5, range 44–88).

**Sonographic evaluation.** US examinations were performed by 2 independent rheumatologists, experienced in musculoskeletal US and blinded to patient clinical and radiographic data.

In the 10 patients studied in the Rheumatology Unit of Ancona University, a Diasus unit (Dynamic Imaging, Livingston, UK) equipped with an 8–16 MHz broadband linear transducer was used. In the 100 patients enrolled in the Rheumatology Unit of La Sapienza University of Rome, an Image Point HX–Agilent machine (Philips, Bothell, WA, USA) equipped with a 14 MHz linear transducer was used. DIP and PIP joints of both hands were scanned using a multiplanar technique. Longitudinal and transverse scans were performed on both volar and dorsal sides, sequen-

tially with the finger extended and in maximal flexion, to visualize the maximal possible joint surface. A definite erosion was defined as a cortical break seen in both longitudinal and transverse scans<sup>1,6,7</sup>.

*Statistical analysis.* Bayesian analysis (prevalence, sensitivity, specificity, positive and negative likelihood ratios on the presence of erosions) was performed using an online calculator by the Division of General Internal Medicine, Medical College of Wisconsin, Milwaukee, WI, USA.

## RESULTS

Central erosions were detected in 16 out of 22 (72.7%) patients with erosive OA and in none of the 88 patients with classical OA. Interobserver variation was 5% (nonsignificant). Prevalence, sensitivity, and specificity for the detection of central erosions were 0.2, 0.7273, and 1.0, respectively. The positive and negative predictive values were 1.0 and 0.9362 and the positive and negative likelihood ratios were infinity and 0.2727. Figures 1 and 2 show sonographic images of classical OA and erosive OA at DIP joints.

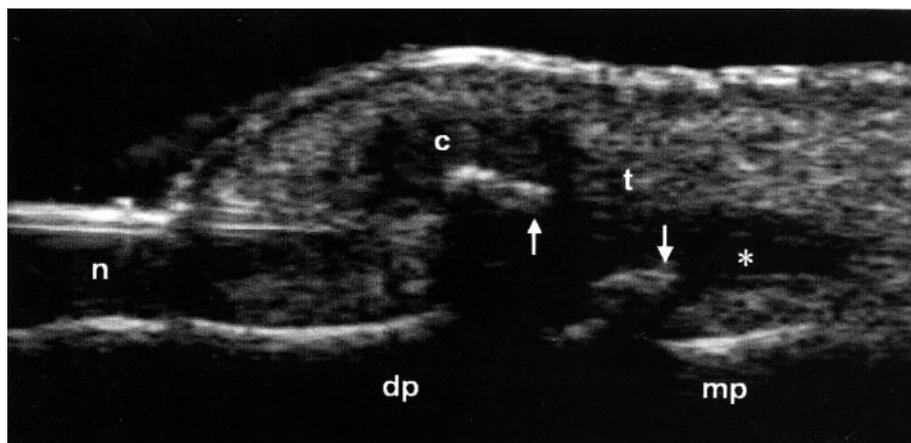
## DISCUSSION

To our knowledge, this is the first study that evaluates ero-

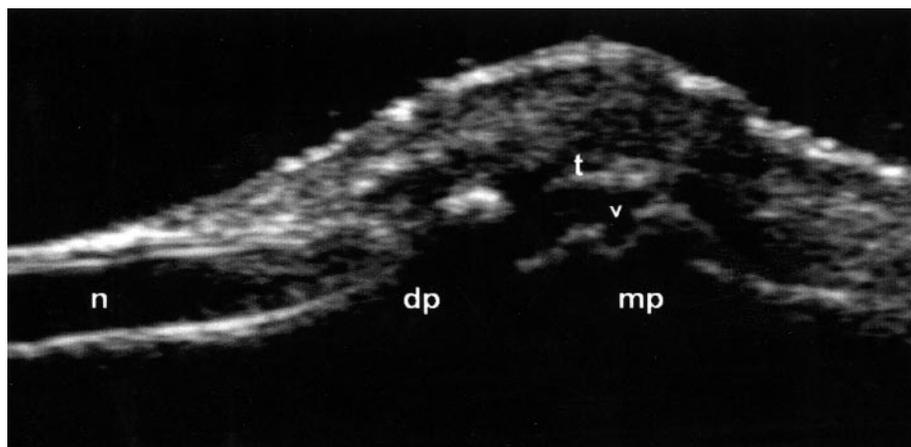
sions by US in erosive OA. Central erosions were detected in 72.7% of patients with erosive OA and in no patient with classical hand OA.

Radiography has been considered the diagnostic standard of reference for erosive OA. The concept of "central erosion" has been reported as a specific feature of erosive OA, characterized by sharply margined erosions located in the peripheral subchondral region of the distal side of the joint and in the central subchondral region of the proximal side, and visualized as the typical "gull wing" deformity on radiography<sup>8</sup>.

In recent years, US has gained widespread acceptance in the evaluation of musculoskeletal pathology, mostly because of refinements in the scanning technique and the introduction of high frequency transducers able to provide a level of anatomic detail not previously seen<sup>9-11</sup>. Several reports claim a greater sensitivity of US in the detection of erosions compared to conventional radiography<sup>6,7</sup>, probably because radiography is only able to show erosions contacted tangentially by the beam, while the dynamic multiplanar US technique might visualize hidden areas.



*Figure 1.* Typical sonographic image of a Heberden's node on longitudinal dorsal scan. Note the mucous cyst (c) on the dorsal aspect of the distal phalanx and the osteophytes (arrows). Synovitis is revealed by an increased amount of synovial fluid (\*). n: nail, dp: distal phalanx, mp: middle phalanx, t: extensor tendon.



*Figure 2.* Erosive OA. Longitudinal dorsal scan of the central aspect of a DIP joint showing an evident bone erosion (v) of the middle phalanx head. n: nail, dp: distal phalanx, mp: middle phalanx, t: extensor tendon.

We found no erosions in 27.3% of patients with erosive OA, probably due to the interposition of osteophytes, which may limit the width of the acoustic window and make it impossible to detect underlying erosions, thus decreasing the sensitivity of US to some extent.

Given these limitations, our results suggest a useful role for US in the diagnosis of erosive OA. Rheumatologists may perform US during the first encounter with the patient to complement the clinical examination. We do this in our daily rheumatology clinical practice. In patients in whom erosive OA is clinically suspected and the diagnosis is confirmed by US, it might not be necessary to perform a radiographic examination, with savings in money, time, and radiation exposure. In our experience, it takes about 20 minutes to fully scan DIP and PIP joints of both hands. Further, the rheumatologist may decide to scan only clinically involved joints, saving extra time. Dependency on the US operator remains the major limitation. Greater expertise in the field is warranted. New high quality equipment, widespread musculoskeletal US courses, and easy access to affordable, portable and battery-operated ultrasound systems are helping to reduce inter-operator variability. US may become a "bedside" rheumatologic procedure<sup>12,13</sup>, even though its future effect on general clinical practice is still to be determined. US probably will never replace conventional radiography in the investigation of hand arthropathy, but it may become a useful complementary tool to define concomitant soft tissue pathology<sup>2</sup> and early erosions<sup>1</sup>. Standardization of normal and pathological findings is an open issue and investigations are under way to define general points of reference<sup>14</sup>.

Our results show good concordance between US and radiography in detecting central joint erosions, suggesting a useful role for US in the differential diagnosis of patients with erosive OA and classical hand OA.

## REFERENCES

1. Grassi W, Filippucci E, Farina A, Salaffi F, Cervini C. Ultrasonography in the evaluation of bone erosions. *Ann Rheum Dis* 2001;60:98-103.
2. Lund PJ, Heikal A, Maricic MJ, Krupinski EA, Williams CS. Ultrasonographic imaging of the hand and wrist in rheumatoid arthritis. *Skeletal Radiol* 1995;24:591-6.
3. Filippucci E, Farina A, Salaffi F, Grassi W. Hidden bone erosions [Italian]. *Reumatismo* 2003;55:52-5.
4. Ehrlich GE. Inflammatory osteoarthritis. I: the clinical syndrome. *J Chron Dis* 1972;25:317-28.
5. Utsinger PD, Resnick D, Shapiro RF, Wiesner KB. Roentgenologic, immunologic, and therapeutic study of erosive (inflammatory) osteoarthritis. *Arch Intern Med* 1978;138:693-7.
6. 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;43:2762-70.
7. Backhaus M, Kamradt T, Sandrock D, et al. Arthritis of the finger joints: a comprehensive approach comparing conventional radiography, scintigraphy, ultrasound, and contrast-enhanced magnetic resonance imaging. *Arthritis Rheum* 1999;42:1232-45.
8. Martel W, Stuck KJ, Dworin AM, Hylland RG. Erosive osteoarthritis and psoriatic arthritis: a radiologic comparison in the hand, wrist, and foot. *AJR Am J Roentgenol* 1980;134:125-35.
9. Erickson SJ. High-resolution imaging of the musculoskeletal system. *Radiology* 1997;205:593-618.
10. Grassi W, Filippucci E, Farina A, Cervini C. Sonographic imaging of the distal phalanx. *Semin Arthritis Rheum* 2000;29:379-84.
11. Schmidt WA. Value of sonography in diagnosis of rheumatoid arthritis. *Lancet* 2001;357:1056-7.
12. Manger B, Kalden JR. Joint and connective tissue ultrasonography — a rheumatologic bedside procedure? A German experience. *Arthritis Rheum* 1995;38:736-42.
13. Backhaus M, Burmester GR, Sandrock D, et al. Prospective two year follow up study comparing novel and conventional imaging procedures in patients with arthritic finger joints. *Ann Rheum Dis* 2002;61:895-904.
14. Schmidt WA, Schmidt H, Schicke B, Gromnica-Ihle E. Standard reference values for musculoskeletal ultrasonography. *Ann Rheum Dis* 2004;63:988-94.