tenderness over the bone, and decreased range of motion in adjacent joints. The treatment of suspected acute osteomyelitis should begin immediately; do not wait for diagnostic imaging results.

In contrast to acute osteomyelitis, the diagnosis of chronic osteomyelitis can usually precede therapy. The diagnosis of chronic osteomyelitis also differs in that it is most common in adults and is usually associated with an open draining wound or sinus tract from the infected bone to the overlying skin. It is particularly difficult to diagnose in patients with diabetes because diabetes-related vascular changes and peripheral neuropathy may mask clinical signs and symptoms of infection. In addition, chronic osteomyelitis in patients with diabetes is usually polymicrobial.

Laboratory studies such as white blood cell count, erythrocyte sedimentation rates and C-reactive protein may be elevated in the patient with osteomyelitis, but these tests can be nonspecific in the presence of any type of inflammatory process. In addition, the characteristic radiologic changes that are suggestive of osteomyelitis may be obscured by osteoarthropathy in patients with diabetes.

Given these issues, bone biopsy is considered the gold standard for diagnosing chronic osteomyelitis. Despite its high accuracy level, the test warrants careful consideration because bone biopsy is an invasive procedure that is performed through uninvolved skin. In some cases, it requires taking the patient to the operating room to obtain the sample of bone.

A simple, commonly used bedside assessment, the probe-to-bone test, is often used to predict osteomyelitis before ordering expensive imaging studies. However, the reliability of this test recently came into question.

The palpation of bone with a metal probe to detect infection is based on the concept that if the probe can reach bone, so can bacteria. One of the first studies of the probe-to-bone test, published in 1995, followed 76 hospitalized diabetes patients with foot infections. The researchers found that 66% of the patients who turned out to have osteomyelitis had a positive probe-to-bone test result. This study has been scrutinized because of the high prevalence of osteomyelitis in the population under study.

A 2006 study in an outpatient diabetes clinic documented that 21 of 104 patients with diabetic foot ulcers had osteomyelitis. The probe-to-bone test was positive in 8 of the 21 patients with ulcers and in 7 of 83 patients who did not have osteomyelitis.

A study published this year compared the results of the probe-to-bone test with biopsy of affected bone in an outpatient setting and found that 247 (15%) of 1,666 patients developed foot wounds. The probe-to-bone test was positive in 26 of the 30 patients with osteomyelitis and 20 of the 217 without osteomyelitis.

Some providers have generalized the results of the 1995 study to all foot wounds (and even other wounds) in various clinical settings. But there is no interrater or intrarater reliability for the probe-to-bone test. More studies are needed to define the role of probe-to-bone testing as a clinical bedside tool for diagnosing osteomyelitis in patients with diabetic foot ulcers.

Several radiologic imaging techniques are used to diagnose osteomyelitis. Plain film x-rays are easy and relatively inexpensive to perform. However, the infection must extend greater than 1 cm into the bone and must be present for 10 to 21 days for it to be evident on x-rays. Because of this lag time, x-rays are also not helpful to monitor response to osteomyelitis treatment. Changes visible on x-ray may be described as lytic lesions, scalloping, osteopenia, periosteal thickening, or loss of trabecular architecture of cancellous bone.

### Table 2

**Characteristics of Acute vs. Chronic Osteomyelitis**

<table>
<thead>
<tr>
<th>ACUTE OSTEOMYELITIS</th>
<th>CHRONIC OSTEOMYELITIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infection has been present for less than 6 weeks.</strong></td>
<td><strong>Infection has been present for more than 6 weeks.</strong></td>
</tr>
<tr>
<td><strong>Symptoms may include fever or chills, malaise and, at the infection site, pain, limited range of motion, and redness, warmth or swelling.</strong></td>
<td><strong>Symptoms may include chronic, low-grade fever, chronic localized pain, and a draining sinus tract that has been present for months or even years.</strong></td>
</tr>
<tr>
<td><strong>This condition requires antibiotic treatment targeted to the specific infectious organism.</strong></td>
<td><strong>Patients with diabetes are at higher risk for chronic osteomyelitis compared with nondiabetics.</strong></td>
</tr>
<tr>
<td><strong>This condition requires surgical debridement of the infected bone plus antibiotics targeted to the specific infectious organism.</strong></td>
<td><strong>This condition requires surgical debridement of the infected bone plus antibiotics targeted to the specific infectious organism.</strong></td>
</tr>
</tbody>
</table>

### Table 3

**Classification of Osteomyelitis**

**Waldvogel Classification System**

*Based on pathogenesis of bone infection*

**Osteomyelitis types:**
- **Hematogenous** (transported by blood; more common in children, usually involves femur or tibia; often due to trauma)
- **Contiguous** (transported from adjacent site; more common in adults; usually involves the long bones; often due to open fractures, infected prostheses or chronic soft tissue infections)
- **Osteomyelitis due to vascular insufficiency** (more common in older adults and patients with diabetes; tends to be a polymicrobial infection)

**Cierny-Mader Classification System**

*Reflects the amount of bone involvement and the host’s clinical status*

**Bone Involvement**
- **Type 1:** medullary osteomyelitis
- **Type 2:** superficial osteomyelitis
- **Type 3:** localized osteomyelitis
- **Type 4:** diffuse osteomyelitis

**Host Status**
- **Class A hosts:** healthy patients (most likely to arrest the infection)
- **Class B hosts:** local (Bl), systemic (Bs) or immunocompromised (Bls)