Evaluation of Pain in Patients With Apparently Solidly Fixed Total Hip Arthroplasty Components

Graham M. Robbins, MB, BS, FRCSOrth, Bassam A. Masri, MD, FRCSC, Donald S. Garbuz, MD, FRCSC, and Clive P. Duncan, MB, MSc, FRCSC

Abstract

The cause of pain in a patient with an apparently solidly fixed total hip arthroplasty can be difficult to elucidate. A detailed history, careful examination, and plain radiographs provide the most useful information, especially in excluding causes not primarily related to the hip. Determining whether the pain is related to the implant, to soft tissue, or to bone can require laboratory tests, radiographic and fluoroscopic imaging, and contrast arthrography and local anesthetic injections. Particularly when pain is caused by occult infection, erythrocyte sedimentation rate, C-reactive protein level, hip aspiration, advanced radiologic imaging, and nuclear medicine scans can help determine the diagnosis.


Total hip arthroplasty (THA) is a very successful procedure, achieving excellent pain relief, improvement in activity level, and patient satisfaction in 90% of cases. However, in some patients, discomfort persists or develops. Although the main cause of failure of THA is aseptic loosening, hip pain of other origin should not be attributed to presumed loosening. The diagnostic dilemma of the painful hip after a seemingly well-fixed THA is becoming more common as more arthroplasties are performed. Therefore, practitioners who treat patients who have undergone THA should appreciate the range of causes of hip pain and develop a rational approach for investigation.

The level of postoperative patient satisfaction depends partially on the patient’s expectations for the surgery. It is necessary to ensure that an unmet expectation is not at the root of the patient’s dissatisfaction (eg, a persistent limp when a leg-length inequality has not been fully corrected). Mancuso et al found that 60% of patients expected pain relief and only 7% expected an increase in nonessential activities. Those who expected psychological improvement—for example, to “feel normal again” and lose the “stigma” of disability—were the most satisfied (96%); those who wanted to return to nonessential activities were least satisfied (75%). Burton et al reported that only 55% of patients had their expectations fully met by THA. In addition, the extent of disease and any comorbidities also can have a marked effect on functional result and overall satisfaction—for example, whether the primary condition affects only the treated hip or both hips and whether other systemic disabilities exist.

The assessment of pain after THA is made more difficult because, although it is the primary reason for a THA, pain is often underweighted by hip scores. Although the Harris hip score weighs pain more heavily than does the Charnley score, one third of patients who fail on the pain rating do not fail on overall Harris or Charnley scores. It has been suggested that a simple visual analog pain score may be more accurate in assessing outcome because it correlates highly with the Harris hip score. Also, in patients with multiple joint dysfunction, reference thus can be made specifically to the joint of interest. A THA Outcome Evaluation Form prepared jointly by the Hip Society, the American Academy of Orthopaedic Surgeons, and the Société Internationale de Chirurgie Orthopédique et de Traumatologie attempts to address the deficiencies of previous scores by incorporating patient satisfaction. It also contains all the data necessary for calculating the other standard hip scores.
Pain after THA in which the components appear to be solidly fixed can have many causes. A number of investigative steps may be required to elicit the underlying cause (Fig. 1).

**History**

A precise, in-depth history and physical examination of the patient are the most important steps in assessing the painful THA. Even most cases of deep sepsis may be correctly diagnosed from the history and physical examination alone. The time of onset of pain is of key importance. If the patient has had no pain-free interval after surgery and if the nature of the pain is different from that experienced preoperatively, a cause related directly to the surgery is implied, such as an acute infection, a large hematoma, poor implant fixation, impingement, instability, or fracture. Persistence of the preoperative pain suggests that the original diagnosis for which the THA was done should be questioned because another source is likely.

The site of the pain may give some insight into its source. Groin and buttock pain are usually indicative of acetabular cup or capsular abnormalities, while thigh pain or referred knee pain are often related to the femoral component. Localized pain over the greater trochanter is suggestive of bursitis, and pain radiating below the knee is usually of radicular or peripheral nerve origin. So-called start-up pain may represent early loosening of one or both components. Pain associated solely with activity may be related to an inflammatory condition, such as iliopsoas tendinitis or iliopsoptelial bursitis. End-of-stem pain may be caused by a modulus mismatch between the implant stem and the bone. Pain at night or at rest suggests infection or tumor but may also occur with aseptic loosening.

In addition to the timing of the onset and location of pain, a careful history should be taken to identify any precipitating events, such as trauma, systemic illness, or infection elsewhere. There is an increased risk of deep prosthetic infection as a result of delayed wound healing or large hematoma formation. Therefore, specific inquiry should be made about wound drainage, persistent fever, prolonged antibiotic

---

**Figure 1** Algorithm for the investigation of painful total hip arthroplasty. THA = total hip arthroplasty; ESR = erythrocyte sedimentation rate; CRP = C-reactive protein level; $^{99}$Tc MDP = technetium 99 methylene diphosphonate.  

---
administration, or delayed hospital discharge. General factors that increase the risk of infection include previous hip surgery or infection, ongoing infection (eg, venous stasis ulcers), immunosuppression, or neoplastic disease. Moeckel et al did not find increased incidence of deep sepsis of hip arthroplasty in patients with diabetes mellitus, a finding contrary to popular belief. In female patients, a gynecologic history also should be obtained, particularly to elicit any relationship between the pain and menses, which can occur with endometriosis and other conditions.

Physical Examination

Although the patient may complain primarily of pain in the hip, referred pain from conditions unrelated to the arthroplasty must be ruled out. The skin should be examined for inflammation, a sinus (healed or open), wound drainage, and any sources of remote infection that may spread to the hip. Areas of altered sensation and localized tenderness in a scar suggest a neuroma. Palpation may accurately localize an area of tenderness or discomfort, such as that from trochanteric bursitis or a stress fracture of the pubic ramus or midfemur. The groin and the iliac fossa should be carefully examined for any fullness or masses, especially to eliminate the possibility of an inguinal hernia.

The range of movement of the hip should be carefully assessed and documented. Pain at the extremes of motion is indicative of loosening, whereas pain present throughout the range suggests inflammation or infection. Pain on resisted abduction may be seen with trochanteric bursitis, gluteal calcific tendinitis, or the early stages of heterotopic ossification. Pain with resisted hip flexion or passive hip extension may be associated with iliopsoas tendinitis.

Instability or impingement may be a more subtle cause of intermittent pain in the hip; they may be elicited by a particular position or motion of the lower extremity corresponding to the position or activity during which the patient has experienced pain. A complete examination of the ipsilateral knee and the spine should include range of motion and assessment of nerves and tendons. When predicated, an abdominal, pelvic, neurologic, or vascular assessment can be done to rule out causes of referred pain from an abdominal or pelvic mass, peripheral vascular disease, or spinal stenosis.

Differential Diagnosis of the Painful THA

Referred Pain

When surgery does not provide relief of symptoms, hip pathology may not have been the cause of the symptoms for which the THA was done. Other conditions can mimic degenerative arthritis of the hip by producing hip and leg pain. Spinal stenosis may produce buttock, hip, thigh, or even groin pain; however, the pain should not be exacerbated by passive range of motion of the hip, and some neurologic findings should be discovered on physical examination. Sometimes the symptoms of spinal stenosis develop only after surgery because of the patient’s increased level of activity; however, the patient should be able to distinguish this as a new pain, different from preoperative pain. Degenerative and inflammatory disorders of the lumbar spine and sacroiliac joints also may produce symptoms in the hip region. These conditions are usually apparent on taking a detailed history and examination and can be confirmed with radiographs, computer tomography, or magnetic resonance imaging. Nevertheless, a subset of patients has symptoms of hip disease that cannot be easily distinguished from spinal disease. Such symptoms can be particularly perplexing after hip replacement. In such cases, a diagnostic block of the hip joint with local anesthetic may help delineate the source of the pain. In some cases, local irritation of the sciatic nerve may cause thigh pain without spinal disease.

Pain also may be related to a metabolic condition, such as Paget’s disease. This disease can be unilateral and affect the pelvis, lumbar spine, or femur. It may coexist with osteoarthritis of the hip but should be apparent from plain radiographs and laboratory studies. Paget’s disease can produce pain in the postoperative period but should respond well to medical management.

Primary bone tumors and metastases in either the pelvis (Fig. 2), lumbar spine, or femur can give rise to symptoms suggestive of a painful THA. Likewise, supra-acetabular, femoral head, and femoral neck metastases can give rise to pain similar in nature to degenerative arthritis of the hip. These metastases may not be evident on plain radiographs, however, because they may be hidden by bone changes of arthritis. A detailed history of a previous malignancy and risk factors may explain new symptoms or signs as well as radiographic features of bone destruction. Night or rest pain is a particular feature of this diagnosis. If a diagnosis of neoplastic disease is considered, then further investigation includes tests for erythrocyte sedimentation rate, prostate-specific antigen, serum protein electrophoresis, and urinary protein electrophoresis, as well as chest radiograph, bone scan, mammography, and, potentially, computed tomography.

Local Pain

When referred causes of pain have been excluded, the pain is likely related to the hip itself.
Implant-Related Pain

Aseptic loosening is the main cause of pain after THA and must be considered even when the components appear to be firmly fixed. Although loosening is usually clear from the typical features on plain radiographs (ie, progressively increasing lucent lines, cement fracture, or component migration), loosening sometimes becomes apparent only during further investigation.

Thigh pain, a major concern with earlier uncemented arthroplasties, has become much less of a clinical problem. Callaghan et al reported an incidence of thigh pain of 18% at 1 year, which remained unchanged when the patients were rereviewed at longer follow-up. Engh and Massin found an incidence of thigh pain of 8% in patients with bone ingrowth and of 35% with fibrous ingrowth. They described two different types of thigh pain, one caused by a loosely fitting undersized distal stem with some relative movement, the other by good end fill causing localized stresses and bony hypertrophy. Pain from end fill is usually less than that from loosely fitting distal stems and is of later onset. Whiteside, using a proximally porous-coated implant, found that pain occurred in 3% of patients with a tight distal fit and in 53% of those with loose fit. Pain also can be produced by a large uncemented stem due to a modulus of elasticity mismatch with the surrounding bone.

Joint instability can cause pain. Dislocation of the arthroplasty is a discrete event with an obvious history and can be clearly seen on examination as well as on diagnostic radiographs. Subluxation is less obvious; the patient may have discomfort only from soft-tissue stretching, which can be associated with a mechanical clunk. Subluxation is often provoked by a particular movement or posture and is more likely to occur in patients with detachment of the abductor mechanism or as a result of poor patient compliance. Repeated episodes of subluxation may give rise to a more constant pain. Incorrect cup position and advanced polyethylene wear also may precipitate subluxation.

Insufficient anteversion of large uncemented acetabular components that produces a prominent anterior lip can cause iliopsoas impingement. The impingement may respond to injection of corticosteroid or to arthroscopic tenotomy, but it may require cup revision and iliopsoas débridement. Similarly, large marginal osteophytes or extruded cement can cause impingement pain.

Deep sepsis remains a serious complication after THA. The types of wound sepsis have been classified into three stages by Fitzgerald et al. Stage I represents an obvious florid postoperative infection, which may be difficult to distinguish from a more superficial infection. Stage II is an indolent infection occurring 6 to 24 months after surgery, and stage III is the initial occurrence of infection more than 2 years after surgery. Although the implant may remain solidly fixed for a considerable period, progressive loosening inevitably occurs in the presence of infection.

Soft-Tissue-Related Pain

Trochanteric bursitis usually presents as localized tenderness over the greater trochanter and is reported to occur in 17% of arthroplasties performed with a trochanteric osteotomy and in 3% without. Trochanteric bursitis can be produced by prominent or broken wires from the reattachment of the osteotomy; however, the benefit of wire removal in such cases is variable. A local anesthetic injection, with or without corticosteroid, may be tried initially to predict the probable benefit of surgery. Similarly, symptoms can be produced by prominent sutures used in the repair after other surgical approaches.

Tendinitis may occur, and it usually affects the abductor, adductor, or iliopsoas muscles. There also might

Figure 2 A, Normal anteroposterior radiograph of the pelvis 5 years after a right total hip arthroplasty. B, Two years later, the patient reported right groin pain and had a metastatic lesion to the pubic ramus from carcinoma of the lung.
be pain from tight tissue tension, which is evident by restricted range of movement or by a fixed deformity. Although detachment of the abductors is associated with abnormal gait mechanics and weakness, detachment itself is not uniformly agreed to be a cause of hip pain. Nerve injuries occur in fewer than 1% of hip arthroplasties, most commonly in women. The injury may be direct (eg, caused by an instrument, cement, hemotoma, or scar entrapment) or indirect, caused by tension on a nerve when leg length is markedly increased during arthroplasty. The sciatic, femoral, obturator, or lateral cutaneous nerves of the thigh may be affected. Meralgia paresthetica, a condition affecting the lateral femoral cutaneous nerve of the thigh, typically is marked by a sensory deficit and a trigger point, either medial to the anterosuperior iliac spine or anywhere within an adjacent scar. The site can be localized with regional anesthetic injection studies. Causalgic pain occurs in approximately one fourth of nerve injuries, and while it usually affects the foot, it may be felt more proximally. Postoperative hip and thigh pain caused by vascular complications is less frequent. Hematoma formation or injury to the femoral artery resulting in an aneurysm can cause vascular claudication.

Herniation of the vastus lateralis muscle through a distal defect in the fascia lata closure has been reported in 6 of 780 patients in the first 5 months after surgery. All patients presented with lateral thigh pain on activity or standing; the pain was relieved by a thigh support stocking and, ultimately, by surgical closure of the defect. The diagnosis is indicated by the local tenderness and palpable defect in the lower end of the wound. Therefore, care should be taken in closing the distal fascia lata, particularly where it extends beyond the skin incision.

**Bone Pain**

Intraoperative fractures of the greater trochanter or shaft are usually apparent at the time of surgery. Femoral stress fractures can occur in the late postoperative period, usually at the stem tip, particularly when stems implanted in varus with the stem tip are in contact with the lateral cortex. In patients undergoing revision surgery, a stress fracture may develop at the site of shaft windows and perforations. Therefore, round or oval anterior windows are preferable to lateral ones with corners. Eschenroeder and Krackow describe the late onset of a stress fracture of the femoral shaft at the site of extruded cement and recommend bone grafting of these defects if they become symptomatic. Stress fractures of the pubis usually occur because of increased patient activity after the arthroplasty, but this may be complicated by development of disuse osteoporosis before surgery. These insufficiency fractures may not become apparent on radiographs for several weeks after the onset of pain, when the healing response first can be seen radiographically.

Whether nonunion of a trochanteric osteotomy causes pain remains controversial. Although fixation of markedly displaced nonunions has been reported to relieve pain, most authors have demonstrated no distinct correlation between pain and the nonunion itself. Finally, while heterotopic bone has been reported to cause discomfort in the early stages of its development, it is debatable whether it causes any pain once it has matured.

**Laboratory and Radiographic Evaluation**

If the cause of persistent pain after a hip replacement is not obvious after a thorough history, physical examination, and plain radiographic evaluation have been done, further investigation is required. Useful modalities include serologic tests, sophisticated radiologic investigations, and nuclear medicine scans, as well as microbiologic investigations to rule out occult infection.

**Blood Tests**

The white blood cell (WBC) count is usually not helpful and is rarely elevated, even in obviously infected hips. Canner et al found an abnormal WBC count in only 15% of infected hips, and Spangehl et al found an elevated WBC count in only 20% of patients with hip infection.

Because the erythrocyte sedimentation rate (ESR) is a nonspecific inflammatory marker, it is difficult to interpret. A substantial number of patients also have connective tissue disorders and other conditions that can raise the ESR. After an uncomplicated THA, the ESR usually returns to normal by 6 months, but can remain elevated for longer than 1 year. Lachiewicz et al found the ESR markedly elevated (mean, >80 mm/h) in 17 of 19 patients with infected THAs but also slightly increased (mean, 32 mm/h) in 58 of 116 of the uninfected patients. Sanzén and Carlsson found no cases of aseptic loosening with an ESR >30 mm/h, and other authors have shown that a cutoff of 30 mm/h has a diagnostic sensitivity of 60% to 94% and specificity of 65% to 85% for identifying infection (Table 1).

The C-reactive protein (CRP) is an acute-phase protein that rises within hours of surgery. In uncomplicated cases, the CRP level returns to normal by 3 months postoperatively. Sanzén and Carlsson found that no cases of aseptic loosening had a CRP level >20 mg/L without another probable cause for the elevation.

Improved diagnostic accuracy can be obtained by using both the ESR and the CRP values. Of the infected hips in the study by Sanzén...
and Carlsson, 18 of 25 had a CRP level >20 mg/L and 14 of 23 had an ESR >30 mm/h. Only 1 of 23 infected hips, but all 33 uninfected hips, had a CRP level <20 mg/L and an ESR <30 mm/h. Similarly, Spangehl et al.5 found that an upper-limit CRP level of 10 mg/L gave a sensitivity of 96% and a specificity of 92% and that all infected hips had at least either a CRP level >10 mg/L or an ESR >30 mm/h. They suggest that normal measurements of ESR and CRP level exclude infection and that an elevation of both the ESR and CRP level indicates an 84% probability of sepsis.

Plain Radiography
The careful analysis of plain radiographs, including an anteroposterior view of the pelvis to show the proximal femur, a lateral view of the hip, and anteroposterior and lateral views of the femur, often reveals helpful features in diagnosing pain after total hip arthroplasty. Rapidly progressive osteolysis may be seen secondary to wear particles. Assessment of the component position might suggest instability, whereas prominence of an area of cement or an osteophyte can imply impingement. Although osteolysis secondary to polyethylene wear is often silent, with severe bone loss, pain may result from an impending pathologic fracture around the acetabular component, in the greater trochanter, or even in the femoral shaft (Fig. 3). Radiographs should be carefully scrutinized for evidence of asymmetrical wear and osteolysis. The typical features of loosening, such as progressively increasing lucent lines, cement fracture, and component migration, are best appreciated on serial radiographs. Endosteal scalloping and multilamellar periosteal new bone formation in the femur are highly suggestive of infection.

Fluoroscopy
When subluxation is suspected, imaging the hip under fluoroscopy may not only identify the presence of the instability but also help the surgeon determine the potential cause. Fluoroscopy also can indicate the positions a patient should avoid to prevent impingement.

Contrast Arthrography and Diagnostic Local Anesthetic Injections
Although the main use of contrast arthrography is to confirm needle position during aspiration of the hip joint to rule out occult infection, it also can be used to examine the extensions of the smooth-walled, small pseudocapsule that will have formed around the hip joint by 4 to 5 months after surgery. Contrast arthrography also is used to look for abnormal bursae and occult implant loosening not readily visible on the plain radiographs. Abscess cavities are usually irregular, with synovial hypertrophy and a narrow communication with the joint, while sterile bursal cavities are typically larger

<table>
<thead>
<tr>
<th>Study</th>
<th>No. Prostheses</th>
<th>No. Infected</th>
<th>Diagnostic Sensitivity (%)</th>
<th>Diagnostic Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forster and Crawford18</td>
<td>100</td>
<td>33</td>
<td>94</td>
<td>73</td>
</tr>
<tr>
<td>Levitsky et al21</td>
<td>72</td>
<td>—</td>
<td>60-67</td>
<td>65</td>
</tr>
<tr>
<td>Magnuson et al22</td>
<td>98</td>
<td>50</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td>Spangehl et al5</td>
<td>202</td>
<td>34</td>
<td>82</td>
<td>85</td>
</tr>
</tbody>
</table>
smooth-walled extensions of the pseudocapsule. Bursae were identified in 43% of patients with a painful hip arthroplasty; approximately one half of these bursae were greater trochanteric, one quarter were supraacetabular, and one quarter were located around the iliopsoas tendon. Of those with no radiologic findings to suggest infection or loosening, 12 of 27 (44%) responded to a local anesthetic injection, supporting a diagnosis of bursitis. To reduce the rate of false negatives in tests for loosening, it is essential to inject sufficient contrast to fill the pseudocapsule and obtain postambulatory radiographs.

Arthrogram can help rule out occult loosening in a particularly perplexing case, although this use of arthrography is rare. Arthrography appears to be no more accurate than plain radiography for excluding loosening of the femoral component, but it is more sensitive than radiography (89% versus 37%, respectively) and is more specific (80% versus 63%, respectively) for excluding loosening of the acetabular component. Murray and Rodriguez did arthrograms on 53 asymptomatic hips; 23% appeared to be loose. Furthermore, 7 of 12 hips with positive arthograms were later found not to be loose. In general, arthrography overestimates acetabular loosening and underestimates femoral loosening. Digital subtraction arthrography may provide a slight benefit over plain arthrography. Nevertheless, arthrography is rarely used alone to investigate a hip replacement for loosening, except in the context of aspiration biopsy.

Aspiration of the Hip Joint

When the clinical suspicion of infection is high, with elevation of either the ESR or the CRP level, or both, a hip joint aspiration is indicated. Hip aspiration has a reported sensitivity in identifying infection of between 67% and 92% and a specificity of between 94% and 97%, Levitsky et al found aspiration to be the single most useful test in identifying deep sepsis. As mentioned, Spanghel et al demonstrated that if the ESR and the CRP level are raised, the probability of sepsis is 84%; this rate rises to 89% with a positive hip aspirate culture.

Local Anesthetic Diagnostic Blocks

Local anesthetic injection studies may be performed to try to localize the site of origin of the pain. If trochanteric bursitis is thought to contribute to the pain, the bursa may be injected with either lidocaine alone, as a diagnostic test, or in combination with a corticosteroid, as a therapeutic modality. Injection of the hip joint with local anesthetic may help distinguish between pain of articular origin and pain that may be referred to the hip joint. Braunstein et al found that 10 of 11 painful THAs (91%) with an identifiable intracapsular cause obtained relief of pain within 20 minutes of an intra-articular bupivacaine injection. If there is no pain relief with the injection of local anesthetic into the joint, then extra-articular causes of the pain should be sought.

Bone Scintigraphy

Technetium 99 methylene diphosphonate (99Tc MDP) bone scintigraphy identifies areas of increased bone activity through the preferential uptake of the diphosphonate by metabolically active bone (Fig. 4). 99Tc MDP scintigraphy requires the bone to have a good blood supply; otherwise, false-negative results can occur. In addition to loosening or infection, increased uptake may be seen with heterotopic bone formation, Paget’s disease, stress fractures, modulus mismatch of a large uncremented stem, tumors, reflex sympathetic dystrophy, and other metabolic conditions. In the uncomplicated THA, uptake around the lesser trochanter and shaft is usually insignificant by 6 months, but in 10% of cases, uptake may persist at the greater trochanter, prosthesis tip, and acetabulum for more than 2 years. The pattern of uptake has not been found to consistently reflect the presence or absence of infection and, despite initial enthusiasm, more recent studies have shown no substantial benefit with 99Tc MDP over serial radiographs in the diagnosis of infection or loosening.

Gallium citrate (67Ga) is taken up by leukocytes and is therefore a better indicator of infection or inflammation. It has been used in conjunction with 99Tc MDP scintigraphy to investigate musculoskeletal infection. Sequential 99Tc MDP and 67Ga scanning is a specific test (89%) for differentiating between infection and aseptic loosening of orthopaedic prostheses but it has a poor rate of sensitivity (57%) and accuracy of only 75%.

Indium 111-labeled (111In) leukocyte scans are better than sequential 99Tc MDP and 67Ga scans for excluding infection. Merkel et al found
the sensitivity of $^{111}$In leukocyte scans to be 86% (compared with 57% for sequential $^{99}$Tc MDP and $^{67}$Ga scans) and the specificity to be 100% (compared with 89%). The accuracy of $^{111}$In leukocyte scans was 94%, compared with 75% for sequential $^{99}$Tc MDP–$^{67}$Ga, with no false-negatives. Other studies have demonstrated a high sensitivity (range, 88% to 92%) and specificity (range, 73% to 100%) with $^{111}$In leukocyte scans. The use of an $^{111}$In leukocyte scan is therefore preferable to the use of a $^{67}$Ga scan in the patient with a painful THA.

Oswald et al. described the normal findings in $^{99}$Tc MDP and $^{111}$In leukocyte scanning of the uncemented hip. At 24 months, the porous-coated acetabulum still showed increased activity in 76% of $^{99}$Tc MDP and 37% of $^{111}$In leukocyte scans, but all were decreasing with time. At 24 months, the proximally porous-coated femoral components continued to show uptake (primarily at the tip) in 72% of $^{99}$Tc MDP and 48% of $^{111}$In leukocyte scans.

To differentiate infection from loosening more accurately, $^{111}$In leukocyte scans have been combined with complementary $^{99}$Tc sulfur colloid imaging. Osteomyelitis stimulates leukocyte accumulation but inhibits sulfur colloid. The $^{99}$Tc sulfur colloid has similar uptake to $^{111}$In-labeled leukocytes in normal bone, but its uptake is inhibited by infection. Palestro et al. found that while the $^{111}$In leukocyte scan was positive in 100% of infected hips in their study, it also was positive in 77% of aseptic loosening hips. Complementary sulfur colloid scanning improved the diagnostic accuracy to 98% (sensitivity, 100% and specificity, 97%).

Because $^{99}$Tc MDP bone scintigraphy alone is of little benefit in the investigation of the painful hip after THA, its routine use is not recommended. In contrast, serial $^{99}$Tc MDP–$^{111}$In scanning may be of help when infection is suspected and other tests are nondiagnostic. A finding that the amount of uptake on the $^{111}$In-labeled scan is not as high as that on the $^{99}$Tc MDP scan can justify investigating causes of pain other than occult infection.

Although in some instances exploration of a painful THA without a definite diagnosis has been of benefit to the patient, if, after careful assessment and consideration of the causes there is still no working diagnosis, then exploratory surgery is unwise.

**Summary**

The investigation of pain in a patient with a THA that is not obviously loose presents a diagnostic challenge. A precise history and careful examination provide the most helpful information, especially in excluding causes unrelated to the hip surgery. Pain related to the surgery itself can be associated with the implant, soft-tissue or nerve injuries, herniation, or bone. All potential causes of the pain should be investigated systematically, including laboratory and radiographic evaluations. Exploratory surgery without a definite diagnosis should not be done.

### References

Pain After Total Hip Arthroplasty


