Total hip replacement (THR) is a very common procedure undertaken for 285,000 Americans each year. Patient satisfaction with THR is very high including reported improvements in general health, quality of life, and function whilst being very cost effective. A minority of 27% experience some discomfort, and up to 6% experience severe chronic pain. Although it can be difficult to diagnose the cause of the pain in these patients, careful analysis can often result in a specific diagnosis being reached.

Sources of pain
To assist further in the diagnosis, the source of the pain can be considered as extrinsic or intrinsic to the hip joint. Extrinsic causes of hip pain are common, especially the spinal pathology presenting with hip pain. Although THR can have a positive impact on low back pain, hip symptoms can be experienced by patients with spinal stenosis, disc herniation, or spondylosis or spondylolisthesis. Peripheral nerves, including the femoral, sciatic or lateral femoral cutaneous nerve, can also be a source of pain. Other structures around the hip can cause pain, such as the genito-urinary tract, inguinal hernia, or muscle hernias. Abductor tendinopathy or tears are also a known cause of hip pain, and may occur more commonly than diagnosed. Although rare, metabolic bone disease or malignancy always needs to be considered. Of all forms of malignant tumour, malignant fibrous histiocytomas is the most common, and metastasis should also be kept in mind. Vascular disease is another rare but important cause of hip pain and sometimes can be treated by angioplasty. Diabetes is a risk factor for neuropathy, which can cause significant hip or thigh pain. Complex regional pain syndrome post THR may also compromise patient satisfaction.

Intrinsic causes can be divided into being either extracapsular or intracapsular. The extra-capsular causes of pain include iliopsoas tendonitis, heterotopic ossification, or trochanteric bursitis. Intrinsic or implant related causes include aseptic loosening, infection, prosthetic failure, osteolysis, stem tip pain, pending stress fracture, instability, periprosthetic fracture, non-union, or impingement. Finally, insufficiency fractures of the pubic rami may also be an extrinsic source of pain after a hip replacement.

Patient history
When considering a possible diagnosis, a detailed and focused history is critical. The patient’s past medical history such as diabetes, obesity or the higher bacteremic load in patients with poor dental hygiene may be contributory factors. Pre-operative predictive factors such as depression and number of pain loci present before surgery have been shown to be independent predictive variables in the risk of developing chronic pain. An individual’s emotional state of mind is also important: spending time to allow the patient to describe their symptoms develops a caring relationship of trust as well as directing appropriate investigations. The patient’s perception of their own
health prior to surgery has been directly correlated to the post-operative perception of health and bodily function.\textsuperscript{21,22} The patient’s pre-operative diagnosis, symptoms and expectations have an impact on satisfaction post THR and should be considered alongside any imaging or diagnostics available.

Location, character and radiation of pain are all important in the patient’s experience. Management of symptoms, including exacerbating and relieving factors should be determined. Onset of symptoms is important, as the potential diagnosis for a patient that had a pain free interval is quite different than a patient whose symptoms have been unremitting since THR. If the symptoms had a specific onset, events surrounding that time should be assessed. Recent dental or surgical procedures, distant infections, falls, change in health status may provide information.\textsuperscript{20} For example potential diagnosis can include activity-related pain, aseptic loosening, stress fracture or claudication. However, if the patient describes constant pain, pain at rest, or nocturnal pain, sepsis or malignancy are all considerations.

Precise location of the pain may be important as part of the history. Groin or deep buttock pain may indicate acetabular loosening, osteolysis or iliopsoas tendinitis. Hernia, psoas abscess or genito-urinary diagnoses are possible, though rare. Buttock and leg pain is not uncommonly secondary to spinal pathology such as spinal stenosis or nerve impingement secondary to disc herniation. Systemic complaints are also important, as patients may present with signs or symptoms of systemic toxicity due to metal ion exposure. If the patient complains of fullness, presence of mass or progressive weakness, the presence of an inflammatory or aseptic lymphocyte-dominated vasculitis associated lesion must be considered.

Operative notes can give insight into the type of hip pathology, potential of inflammatory changes, chronic infection or tumour. The type, characteristics and history of the implant used should be sought. A history of wound drainage, presence of fevers, remote or systemic infections, and requirements for urinary or intravenous catheterisation should also be noted.

**Examination**

Although a detailed history can often facilitate a tentative diagnosis, a thorough physical examination is important. Observation of gait can reveal leg-length discrepancy, hip weakness, neurological changes, dysfunctional balance, or co-ordination issues. Inspection of the skin for prior incisions, swellings, erythema, sinus tracts, and observations of any fluctuant swelling or muscle wasting should be conducted including an inspection of the soles of the feet to exclude ulceration. Hernias, lymphadenopathy and trochanteric bursitis can be explored through palpation. Particular attention should be paid to assessment of the hip abductors during gait as well as an assessment of strength. A thorough examination the spine should include a reverse straight leg raising test. Neurological examination should include assessments of strength and sensation related to specific nerve roots as well as peripheral nerves and can be correlated to any perceived pre-operative change. Assessment of the contralateral hip and ipsilateral knee may reveal joint pathology resulting in abnormal mechanics and increased forces with potentially increased symptoms in the affected hip.\textsuperscript{23} Leg lengths should be assessed for real and apparent shortening. This should be reviewed in the light of pelvic obliquity, spinal pathology and deformity, hip and knee flexion contractures and the potential for any limb length discrepancy distal to the hip. Direct measurement of limb length as well as measurement using blocks under the foot of the shorter limb should be carried out. Any change in leg length secondary to the initial THR surgery should be noted, and a progressive change in length may indicate a failure of implant fixation or a potential peri-prosthetic fracture.

Plain x-rays are the first line of investigation, and is the single most useful method available for the analysis of component position, leg lengths, offset, and any bony ingrowth. Component position can predispose the patient to specific modes of failure such as metallosis in metal-on-metal THR,\textsuperscript{24} or failure of engagement of ceramic liners within the metal acetabular components.\textsuperscript{25} If operative details are not available, the type of implant might be determined from radiograph images.

The radiographic criteria of loosening for the femur have been well established. For cemented femoral components, the Harris classification\textsuperscript{26} is useful. It indicates a loose component if there is migration on serial radiographs or fracture of the cement mantle. Stem loosening is probable if there is a continuous radiolucent line around the cement mantle and it encompasses 50\% to 100\% of the stem. For cementless femoral components, Engh, Massin and Suthers\textsuperscript{27} described radiographic signs of a loose stem, including migration, reactive lines, pedestal formation, calcar hypertrophy or atrophy, bead loss and the absence of clear areas of osseointegration (‘spot welds’). In addition to the images available, it is important to assess serial radiographs. This can allow a better sense of migration or progression of osteolysis. Chronic infections can also be seen with periosteal reactions, scalloping of the bone, or osteolysis. In a similar way, acetabular component loosening is definite if there is migration of the component, complete demarcation of the cement-bone interface, demarcation of the outer one-third and middle one-third, or demarcation of the outer one-third only.\textsuperscript{28}

Additional imaging can provide further information. An ultrasound can be helpful in the diagnosis of extrinsic causes of symptoms such as bursitis or abductor tears.\textsuperscript{29} Computed tomography (CT) scans can be used to assess undisplaced peri-prosthetic fractures or to quantify osteolysis, but special formatting may be required to compensate for scatter caused by a metal implant. Magnetic resonance imaging (MRI) can assess soft tissues around the hip, including inflammatory reactions to debris (pseudotumours). Nuclear Medicine scans include Technetium 99, Gallium,
Indium-111 labelled white blood cells (WBC), sulfur colloid bone marrow and scintigraphic arthrogaphy, and Indium labeled WBC scan has been used for the diagnosis of infection. However, the sensitivity and positive predictive values are low, but may be slightly improved with the inception of Technetium-99m scans. Currently the nuclear scan strategy most likely to diagnose infection may be a combined leukocyte and bone marrow imaging combination. Although positron emission tomography has a limited role in the diagnosis of infection in a stable implant, it may assist in differentiating loosening from a septic versus an non-infective situation. Time since surgery is important, as both the Technetium scans and Indium-111 may remain positive up to 24 months after THR using cementless stems. This differs from cemented stems, which reach a plateau at 12 months. Finally the use of an intra-articular injection of local anaesthesia may differentiate between intrinsic and extrinsic causes of symptoms.

Infection should be positively excluded in patients with implant related pain starting with the measurement of erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels. Where these blood parameters are abnormal, aspirates from the hip should be cultured in agar based and broth media as well as in aerobic and anaerobic environments. New technologies such as polymerase chain reaction may offer better specificity and sensitivity, but are not widely available. Leukocyte esterase testing has the attraction of being a cost-effective, rapid assessment that may be used intra-operatively, but as yet evidence is limited.

Also, blood or debris within the synovial fluid limits the ability to read the reagent strips as part of this test. Intra-operative frozen sections have inherent challenges as they are dependent on individual pathologist interpretation. Also, there is controversy with respect to the significance of numbers of cells per high-powered field.

A more recent potential source of symptoms in patients with a painful THR is metallosis. However the presence of an implant with a reputation for a high revision rate or the presence of elevated metal ion levels in the blood should not distract the clinician from doing the thorough work up described above. Indeed, it may be helpful initially to approach the patient as if the articulation were a metal-on-metal THR, and include the possibility of the metallosis only after working through other potential diagnosis. Although metallosis is most commonly recognised in metal on metal THR or hip resurfacings, other potential causes of metallosis include corrosion at the head–neck or modular neck–stem junctions irrespective of articular bearing. Most patients present with groin pain, but patients may be asymptomatic in spite of metallosis or the development of a pseudotumour.

Other presentations include a groin mass. Ion levels are recommended for monitoring of implant wear as elevated ions have been associated with early failures. However, ion levels need to be considered in light of the complete clinical scenario, and absolute values should not be considered in isolation. In extremely rare circumstances, significantly elevated cobalt levels can result in fatigue, cardiomyopathy, polycythaemia, neurologic symptoms, and hypothyroidism. Although rare, if these symptoms are encountered, the patient should be managed with urgency.

**Conclusion**

The source of pain in a patient with a symptomatic THR should be approached systematically and thoroughly. A detailed history and clinical examination can often provide the correct diagnosis and guide the appropriate selection of investigations, which then serve to confirm the clinical diagnosis. Surgical exploration without these steps is to be discouraged. Instead every effort should be made to make the diagnosis pre-operatively as surgical exploration without this has a very low chance of success. If the diagnosis cannot be made, a period of observation, discussion with colleagues, or referral for a second opinion could be the potential next step.

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**References**


