What is the role of imaging in before, during, and after total hip arthroplasty (THA)?

Radiographs are the first level of imaging in the pre- and postoperative study of THA. Imaging is fundamental to identifying the correct indications for THA. It is also important in judging the morphology of the femur in terms of flare and the cortical index and of anteversion. These features are the main factors in the choice of femoral stem geometry. In the postoperative phase, imaging is fundamental for the serial evaluation of fixation. In my experience, some concerns exist about the use of imaging during surgery. I only use it in difficult cases during surgery, especially in revision surgery where the bone loss could influence improper stem position. In primary cases, its use should be limited; for example, I consider its use in the first phase of learning to perform a new approach and using a new implant.

What criteria do you use to determine when to perform THA?

The most common indication for THA is pain in severe osteoarthritis of the hip. Other conditions for which the procedure may be indicated are developmental dysplasia of the hip, Paget’s disease, trauma, and osteonecrosis of the femoral head. All of these conditions are characterized by severe pain and limitations in performing activities of daily living. Patients and their comorbidities and a nonresponse of pain to conservative treatment measures, such as oral nonsteroidal anti-inflammatory drugs, weight reduction, activity restriction, and the use of supports, such as a cane, should be considered.

Do you use any navigation or templating systems during THA?

I use a templating system that consists of digital acquisition of preoperative radiographs. Once the image of the pelvis is acquired, I try to reconstruct a new hip by restoring the correct position of the rotation center, offset, and leg length. Another possibility, depending on the system, is to choose the size of the implant based on the measurements taken during templating. However, some problems with using a templating system like this are the quality of the radiographs and ensuring the proper position of the metallic marker to calibrate the system. Any modifications of this position could lead to an under- or oversizing of the chosen implant.

What approach do you use to perform THA?

I usually use a posterolateral approach to fix the external rotators and the capsule to minimize soft tissue damage and the risk of dislocation. I also have experience using a direct anterior approach with or without a traction table. I think that the difference between these approaches is only seen immediately postoperatively.1

The direct anterior approach is considered an internervous plane approach between the zones of innervation of the superior

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and inferior gluteal nerves laterally and the femoral nerve medially. In this approach, the origin of the tensor fascia latae, sartorius, and rectus femoris is not sectioned, and insertions of the gluteus medius and minimus muscle are not detached by blunt exposure techniques. Therefore, the direct anterior approach could be considered a muscle-preserving procedure followed by rapid functional recovery. However, the gluteus maximus is incised in the posteriorlateral approach. The short external rotators, which play many important roles in hip function and dynamic hip stabilization, are also disturbed in the posterolateral approach.

We consider that rapid functional recovery in the direct anterior approach is caused by the difference in invasion to the gluteus maximus, a deltoid of the hip, hip abductors, and short external rotators between the direct anterior and posterolateral approaches.

**How does bone fragility affect THA?**

Bone fragility is a key point as the increasing life expectancy of patients leads surgeons to perform more primary surgeries in the elderly. The classic anatomic feature of these patients is the presence of a large femoral cavity with a thin cortex. The decision on whether to use cement or acrylic for the stem is paramount, and both techniques have advantages and disadvantages. Using an uncedmented stem, the biggest risk is the need to obtain a rigid construct related to a complete filling of the cavity. Conversely, the use of acrylic cement could cause some medical complications in patients with comorbidities. Bone cement implantation syndrome is a rare but potentially fatal intraoperative complication that occurs in patients undergoing cemented orthopedic surgeries. Older patients may have coexisting pathologies that can increase the likelihood of developing bone cement implantation syndrome. Making the correct decision influences the duration of the fixation. Usually age, imaging, and intraoperative findings are the factors that influence a decision. This choice is also influenced by demographic data; for example, in northern Europe, the cemented implants are preferred for use with patients of all ages. I prefer to use biologic fixation; this choice is related to the higher primary stability obtained with new materials with a 3-dimensional structure.

**What are some complications of THA?**

The most important complication of a THA is dislocation. It depends on several well-known factors. The experience of the surgeon is the most important of these; in fact, it seems that the number of dislocations is inversely correlated with the number of implants performed. As a consequence of these data, joint replacement must be performed in experienced centers and not in smaller centers with fewer numbers of THAs performed per year. Surgeons’ experience also relates to the choice of the correct approach, which is important because it influences the position of the components. The optimal position of the components is a key point in joint stability.

One of the most serious complications related to THA is infection. Most studies report an infection rate of 1% or less in primary THA. In revision THAs, this rate is reported to be 3% or higher. This relatively low infection rate is due in part to the routine use of prophylactic antibiotics in the perioperative period. The additional use of ultra-clean air enclosures may reduce infection rates to lower than 1%. Deep infection in THA that presents more than 1 year after the procedure may occur as the result of hematogenous seeding of the implant by organisms originating from a distant site. Infections of the skin, urinary tract, gastrointestinal tract, and mouth are most frequently implicated as sources.

One of the most debilitating complications is nerve injury. Transient or permanent nerve injuries may occur with THA and are related to the approach used. The most common nerve injured during a posterior approach is the sciatic nerve, with a reported incidence of 0.7%. This is usually caused by intraoperative trauma or by excessive lengthening of the leg in hip dysplasia. Using an anterior approach, an injury to the lateral femoral cutaneous nerve, a large skin nerve just adjacent to the incision of the anterior approach THA, is possible. Injury to this nerve can lead to chronic pain and abnormal sensations along the front and side of the thigh.

Another complication is heterotopic ossification. They may occur in as many as 50% of patients undergoing THA. The incidence of this complication in its more severe and limiting form is approximately 4%. When severe, heterotopic ossification usually compromises range of motion rather than producing pain.

Risk factors for complications are male sex, history of previous heterotropic bone formation, idiopathic skeletal hyperostosis, ankylosing spondylitis, and hypertrophic osteoarthritis. Prophylaxis with certain nonsteroidal anti-inflammatory drugs or with postoperative low-dose radiation therapy is effective for patients at risk. In the event that substantial ossification develops, surgical excision may be helpful, but it is usually delayed for 1 year to allow the ectopic bone to mature fully.

**What is the rehabilitation protocol for patients who have undergone THA?**

Postoperative rehabilitation is of the utmost importance following THA to ensure pain-free function of the joint and improve the patient’s quality of life. The main factors defining therapy management are the surgical approach and the general state of the patient. The posterior approach implies that precautions should be taken against dislocation when exercises combine flexion, internal rotation, and adduction. For the anterior approach, the combination of extension, external rotation, and abduction should be monitored for possible dislocation, although the probability of dislocation is less likely in the anterior vs posterior approach.

Rehabilitation after a THA should start as soon as possible according to the patient’s tolerance and medical recommendations. The proper use of pain medication after THA is an important as-
pect of recovery. When postoperative pain is controlled, pain and stress are minimized, and patients will be able to perform physical therapy and home exercises with minimal discomfort.

Early exercises, including full weight-bearing exercises, have had different positive effects on the recovery of patients after THA, including faster recovery and gain in walking ability. Physical activity is also good for the quality of bone tissue. It improves the fixation of the prosthesis and decreases the incidence of early loosening.

What does the future hold for THA?

The main objective is to obtain a long-lasting implant, even in younger individuals. Thus, the focus among orthopedic surgeons has largely shifted to THA bearing surfaces, including which head and cup combinations are the safest and most durable to use in different patients and whether any solutions are on the horizon that may further improve hip tribology.

Despite the growing interest in metal-on-metal coupling, some concerns arise because of the release of metallic ions and their toxic effects, both local and systemic. Ceramic-on-ceramic bearing surfaces still remain relatively popular in the younger patient population. Ceramic surfaces are hard and have decreased wear rates, but ceramic is brittle, so a risk of shattering the bearing surface during a fall exists. The most common bearing surface remains polyethylene for the acetabular side and metal for the femoral head. Polyethylene material has become available with more bonding, or cross-linking, at the molecular level. This means that cross-linked polyethylene, as a bearing surface, may be more resistant to mechanical stress than a standard one. Furthermore, research into minimizing bone tissue damage has addressed some variations in stem geometry. New short stems are available and are commonly used with any approach.

REFERENCES