

How to Avoid Instability after Total Hip Arthroplasty, Narrative Review

Abstract

Total hip Arthroplasty (THA) is an advanced surgical modality, which reduces hip pain resulting from destruction or degenerative change. THA may be associated with complications, such as instability. Instability is the second common reason for revision surgery. The etiology of instability can be factors like prosthetic malposition, impingement, and low soft tissue tension around the hip and also polyethylene wear. In this paper, we will review the common causes of instability following THA in various phases, and suggest the strategies to prevent instability following THA.

Keywords Total Hip Arthroplasty, Joint Instability, Prostheses and Implants, Bone Malalignment, Hip Joint

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Introduction

The Total hip Arthroplasty (THA) is an advanced surgery that reduces the pain and improves the function of the hip^(1, 2) and is accompanied by a low rate of complications⁽³⁾. Hip instability is a complication following THA, which is the most common early complication after THA and the second reason for revision THA⁽⁴⁾. Australian national registry in 2008 reported that the incidence of instability following primary and Revision THA was 5-10 % and 5-28 %, respectively⁽⁵⁾. The instability means loss of partial or complete articulation, when head moves out of liner for any reason. In this paper, we reviewed the risk factors of instability following THA and also steps in prevention and solutions to manage instability.

Clinical Patient evaluation

Some patients are at risk of postoperative complications such as instability. THA instability is the second common cause of revision surgery and has some risk factors such as age, sex, neurologic disorders, surgical approach, hyperlaxity, tension, and prosthesis design.

Previous studies have reported some risk factors for dislocation and instability following THA, including female gender, obesity, diagnosis of a femoral neck fracture, neuromuscular and cognitive diseases, hyperlaxity or connective tissue disorders, posterior approach, and alcoholism⁽⁶⁻⁸⁾.

Some studies have revealed that the surgical approach of THA are effective in postoperative hip instability. The dislocation rate increases with the posterior approach compared with other approaches like direct anterior, direct lateral, and superior approach¹. Some studies blame muscle splitting, hip external rotator muscle detachment, and posterior capsule incision for this higher level⁽⁹⁻¹¹⁾. However, limited studies demonstrated a similar dislocation rate between three popular approaches (anterior, posterior, and lateral)^(12, 13).

1 The direct superior (DS) approach for total hip arthroplasty (THA) is a minimally invasive posterior approach that enables preservation of the iliotibial band, short external rotators (specifically the quadratus femoris and obturator externus muscles), and hip abductors

Preoperative Templating

Preoperative Templating helps us to choose the best prosthesis sizing and more postoperative stability. For Templating, we need a standard scaled pelvic AP and lateral radiography. Some landmarks help us with Templating, such as teardrop, ileoischial line, and suprolateral acetabulum. The teardrop is the most important landmark, which allows proper cup positioning. The inferior border of the acetabular component is positioned at the same level as the teardrop. It is crucial to restoring the typical and anatomic center of rotation (COR) of the hip for achieving the most stability following THA.

Finally, we could size the femoral and acetabular component with preoperative planning and the horizontal and vertical offset of the femur. We matched the hip's standard offset with the stem's offset and achieved more stability following THA with low pelvic obliquity based on our unpublished data. Templating helps us to be prepared during surgery to prevent malposition of the cup and stem and avoiding instability following THA which caused by the surgeon.

Management of Instability; causes and discussion

Implant Malposition

The positioning of implants plays a significant role in obtaining a stable THA. It is essential to prevent implant malpositioning to restore the joint biomechanics. Lewinnek et al. proposed a "safe zone" of cup inclination- (40 ± 10)- and anteversion- (15 ± 10)- to minimize dislocation and instability following THA⁽¹⁴⁾. The study revealed that 15% of dislocations occur despite normal Lewinnek components position⁽¹⁴⁾.

The acetabular cup inclination could be measured in pelvis AP radiography. The inclination is the angle between the cup

and reference line (inter teardrop line) (Fig 1). The cup anteversion is measured with an Axial CT scan between the cup and the anteroposterior line (Fig 2).

Placing the acetabular component in the 'safe zone' could decrease the rate of instability and dislocation following THA. Acetabular orientation is important for placing the cup in the safe zone, which had dynamic parameters such as pelvic tilt (PT), Sacral slope (SS), and pelvic incidence (PI). The current concept about the relationship between the pelvic and hip showed that it is important to consider the spinal deformity and pelvic motion preoperatively^(15, 16). It is important to consider the spinal deformity and stiffness before the surgery. It is best to take a set of standing lumbopelvic radiographs preoperatively, and measure all the spinopelvic parameters such as PT, SS, PI, pelvic femoral angle (PFA), sacral acetabular angle (SAA), and acetabular ante-inclination (AI) preoperatively. By the angles and comparison of sitting and standing x-rays, one could demonstrate whether the spinopelvic junction is fused or has mobility. Such evaluation can affect the THA outcome and implant positioning (Fig 3).

Impingement

The impingement following THA is a cause of instability and dislocation of the prosthesis. Bartz et al. revealed the instability and dislocation mechanisms following THA, including prosthesis impingement, bony impingement, and spontaneous dislocation⁽¹⁷⁾. There are various factors causing impingement and complicate THA, such as anterior iliopsoas impingement causing groin pain⁽¹⁸⁾. Femoral neck-socket impingement is a leading cause of THA instability. This condition can occur in conditions such as small head, skirted head, ceramic head,

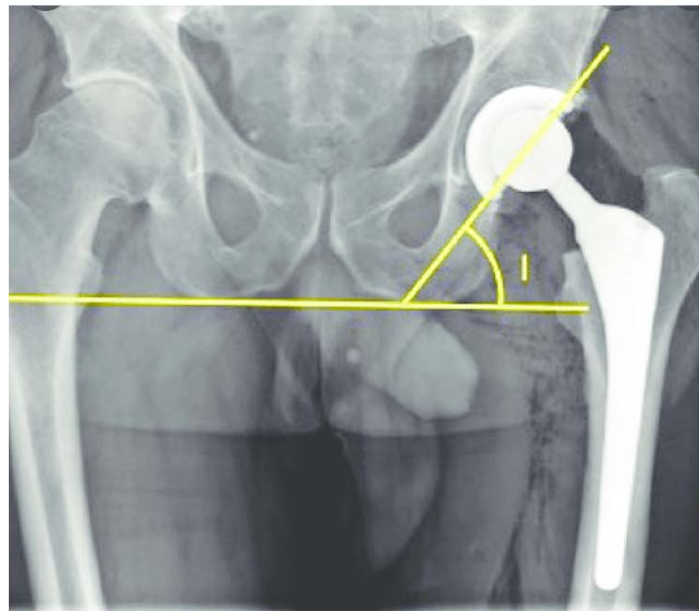


Figure 1 The acetabular cup inclination measuring, the angle between the cup and reference line (40 ± 10)

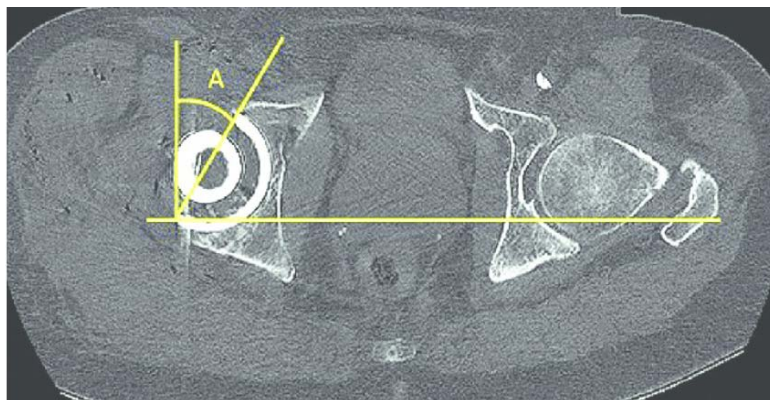


Figure 2 CT scan :The cup anteversion, the angle between the cup and anteroposterior line

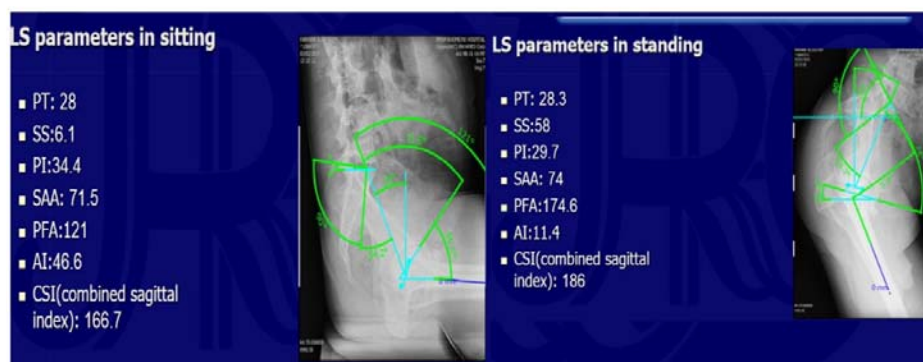


Figure 3 The Spinopelvic parameters, comparison between setting and standing parameters preoperatively

low head-neck ratio, and high liner offset⁽¹⁹⁾. Also, some anatomical points can abut

against each other and cause impingement, such as greater trochanteric

(GT) and ilium, lesser trochanteric (LT) and ischium, and also residual osteophytes, capsule, and scars that have not been released or resected at the time of original surgery⁽²⁰⁾.

The AP pelvic radiography, cross-table lateral view, and CT scan are necessary to diagnose the type of impingement and resolve it. It is crucial to know the size of the prosthesis, such as head and liner size. Usually, the impingement and instability can be resolved by changing the head size and offset or releasing the impingement by removal of remaining osteophytes.

Low soft Tissue Tension

Low soft tissue tension around the hip is a cause of THA instability. It is important to diagnose low soft tissue tension before the surgery to reduce the postoperative complications with preoperative planning. The femoral offset can affect the soft tissue tension around the prosthesis and use of an offset similar to the normal offset of the patient can reduce the instability⁽²¹⁾. There are two kinds of femoral offsets, namely medial and vertical offset. The medial offset is the distance between the center of the femoral head and GT, which could affect femoral abductor tension. The vertical offset is the distance between the femoral head and LT that could affect femoral adductor tension. Lack of muscle around the hip and hyperlaxity are other causes of low soft tissue tension, which must be considered preoperatively to decrease the chance of THA instability⁽²²⁾.

Preoperative planning and diagnosis of low soft tissue tension is an important issue in lowering the complications. The diagnosis of low soft tissue tension is notable preoperatively and postoperatively with hip fluoroscopy, offset measurement, abduction test, EMG, and medical history to resolving the instability with choosing the best surgical approach and technique⁽²³⁾.

In the patients with low soft tissue tension, several strategies reduce the instability, such as choosing the larger head and extended neck, using constrained liner and dual mobility cups.

High Tension dislocation

THA dislocation and instability could occur in patients with certain diseases such as Parkinson, CP, and epilepsy due to high soft tissue tension. Parkinson's disease has many complications following hip arthroplasty, and it is important to consider the disease preoperatively to reduce complications such as dislocation and periprosthetic fractures⁽²⁴⁾. The surgeons must consider the diseases with high-tension soft tissue preoperatively because of the risk of high-tension dislocation. Using high-grade acetabular cups or liner with lowering dislocation rates is suggested in these patients. Lazzenec et al. recommend using dual-mobility cups in patients with Parkinson disease to lower the rate of dislocation and similar complications⁽²⁵⁾.

Late Polyethylene (PE) wear

Polyethylene (PE) wear debris contribute to loosening and osteolysis in THA^(26, 27). Usually, the THA late instability has been associated with acetabular cup position and orientation^(28, 29). PE wear can induce THA instability and complications in late phases of hip arthroplasty^(30, 31). PE wear is an important issue that surgeons must consider in the THA cases with instability in late phases. Generally, dislocation in late stages following THA is uncommon to be from PE wear, but Orozco et al⁽³²⁾ reported 4 cases with recurrent dislocation in the late phases following THA, and attributed them to PE wear.

The diagnosis of the PE wears is based on AP pelvic radiography, CT scan, and patient's history. It is important to use a CT scan in cases where PE wear is suspected. (Fig 4). In these cases, we must

change the liner and head in revision surgery to achieve stability.

How to prevent instability?

In the Conclusion, Instability following THA is a significant problem among hip surgeons, causing several complications such as dislocation, fracture, and loosening. There are several reasons for THA instability in various phases following the surgery, and it is important to prevent instability to reduce the complications.

Some strategies can reduce the instability following the surgery, including accurate preoperative templating, using bony and soft tissue landmarks, using alignment guides, considering the patient's history, and choosing the best surgical approach. It is necessary to rule out infection as the first step in the approach to instability, before considering any other cause discussed in the above review.



Figure 4 THA instability in the late phases, as seen in right figure (CT scan) there is PE wear in acetabular component which cause THA instability

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