

Management of Limb Length Discrepancy after Total Hip Arthroplasty

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Limb-length discrepancy after total hip arthroplasty remains a vexing problem to both patient and surgeon. Patients can present with various symptoms, including gait disturbance, neurologic disturbances, instability, and pain. There are various etiologies to this problem that can be either correctable or noncorrectable. The source of the discrepancy must be first identified and explained to the patient, followed by a stepwise system of addressing the correctable causes and managing them. Treatment most often is conducted in a nonoperative manner, however, when these modalities fail, surgical correction is usually possible and successful. By addressing femoral and acetabular component position with respect to anatomic and radiographic landmarks, as well as maintaining appropriate soft-tissue tension, the correctable causes of limb-length discrepancy that fail to respond to nonsurgical means are usually amenable to operative intervention.

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Limb length discrepancy (LLD) after total hip arthroplasty (THA) poses a potentially persistent and sometimes deleterious effect on what would otherwise be an outstanding result.¹⁻⁵ A usually successful procedure with a typical patient satisfaction rate as high as 98 to 99% can be diminished by the patient's perception that the leg lengths are not equal. Not surprisingly, postoperative LLD has been found to be the most common cause for litigation against orthopaedists.^{6,7}

The prevalence of LLD after THA has not been well established. Reports in the literature range from as little as 16% to as high as 96% in some series.^{4,8} This may, in part, be due to poor standardization of measuring techniques. The lack of an accepted standard minimum side-to-side difference to be defined as an LLD has also played a role in this ambiguity.

The perception of limb length inequality is common after THA. In the vast majority of instances, this resolves with time and physical therapy. In some instances, the perception, or true LLD persists. Management of this problem should most often be performed conservatively. Orthotics and shoe/heel lifts can usually compensate for the inequality. More importantly, the patient must be educated preoperatively regarding the possibility of LLD even under the best of surgical circumstances. The rela-

tively small subset of patients who require revision THA for their LLD include those with persistent instability, functional impairment, and failure of conservative, nonoperative measures.

Clinical Signs and Symptoms of LLD

Patients with symptomatic LLD present with an array of symptoms, which can be grouped into one of three types. Most commonly, patients present with pain from the resultant imbalance in muscle force recruitment both around the hip and the knee, as well as around the spine. Balance problems and general gait disturbances are also included in this group.⁹ Patients often describe symptoms of pain and fatigue from the longer leg's quadriceps and hamstring muscles. This is attributable to a "flexed knee syndrome" in which the patient walks with the longer leg constantly flexed at the knee to maintain a level pelvis.

Complaints of instability or a history of dislocation are often associated with LLD as a result of component orientation. The instability is often accompanied by pain about the hip as periarticular muscles fatigue from preventing subluxations. These symptoms may or may not improve with physical therapy, depending on the component position.

Other symptoms include those that are caused by stretching the nerves that cross the hip joint, most notably the sci-

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Table 1 Etiology

Classification of LLD	
Noncorrectable	Spinal deformity Contralateral hip OA Preexisting short tibia, femur Preexisting long leg from prior THA
Correctable	Apparent LLD postoperatively Component position Soft-tissue tension

atic. Patients can present with dyesthesias and/or paresis in the distribution of the tethered nerve.¹⁰⁻¹⁵ In this case, it is important to evaluate the patient for spinal pathology that could be causing such symptoms.

Correctable versus Noncorrectable LLD

The workup of a patient with an apparent LLD after THA should determine whether the inequality is from a correctable or a noncorrectable cause (Table 1). The noncorrectable causes include spine deformity, contralateral hip arthritis, preexisting shortening of the femur or tibia, or a preexisting LLD with the operative side longer before THA. These causes can be excluded based on a thorough physical examination, as well as plain radiographs of the spine, pelvis, and possibly a weightbearing scanogram of the lower extremities.¹⁶

Another useful tool in the evaluation of a patient with an apparent LLD is a set of variable thickness standardized measuring blocks that are placed under the foot of the shorter leg. These are available in 1/8-inch increments and allow the patient to describe at what compensatory thickness the leg lengths feel equal. These are particularly useful not only in their diagnostic use, but also in that they offer the appropriate measurement for a shoe/heel lift.

The correctable causes of LLD can be broken down into three types: (1) initial postoperative apparent LLD, (2) component problems, and (3) soft tissue tension problems. The initial postoperative LLD is an important finding and bears mentioning as described by Ranawat and Rodriguez.³ Periarthicular muscle spasm, lumbosacral scoliosis, and pelvic obliquity can each produce this early postoperative LLD. The physical result is a tilted pelvis relative to the floor, with the surgical hemipelvis pushed inferiorly and the contralateral hemipelvis pulled superiorly, giving an apparent LLD despite equal lengths from the anterior superior iliac spines to medial malleoli (Fig. 1) Postoperative pelvic obliquity after THA is fairly common. It has been found transiently in approximately 14% of THAs, with 0.5% persisting long term. The mainstay of treatment for this problem is patient education, reassurance, physical therapy, and possibly a temporary shoe lift. The patient should be reassured that most cases resolve within 6 months from surgery.

Surgical Treatment of Correctable LLD

The correctable causes of LLD after THA can be either direct or indirect. The direct causes include inferior positioning of the acetabular component and proximal positioning of the femoral component. The indirect causes can be defined as those in which the position or orientation of a component leads to hip instability intraoperatively, necessitating increased neck length, offset, or both to stabilize the hip with resultant overlengthening of the extremity.

The Femoral Component

The direct cause of LLD related to femoral component position is a change in the distance between the center of the femoral head and the greater trochanter. The vertical distance between parallel horizontal lines drawn through the two landmarks should be roughly matched at THA to maintain leg lengths. Likewise, the horizontal distance between parallel vertical lines drawn through the head and greater trochanter (femoral offset) should be approximately matched so as to maintain appropriate soft tissue tension. This is a possible indirect cause of LLD, such as the case of a patient whose intraoperative THA trial is unstable secondary to insufficient offset, and a longer neck option is chosen to tighten the soft tissues and to stabilize the hip (Fig. 2A). Such a decision effectively lengthens the leg. Revision of the femoral component must therefore address these two very important parameters (Fig. 2B). Newer modular revision systems offer more options with varying body/neck lengths as well as offsets. By adjusting these variables independently, one can correct either for a vertically malpositioned stem, a stem with inadequate offset, or both. Another method to address inadequate offset is through lateralized acetabular lines. These can be particularly useful when faced with a well-fixed, cementless stem that is otherwise well positioned.



Figure 1 Pelvic Obliquity. Postoperative radiograph after left THA showing inferiorly tilted left hemipelvis with apparent “lengthening” of operative extremity despite equal leg lengths intraoperatively.

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