Instability in Primary Total Knee Arthroplasty

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Abstract

Instability is one of the most common causes of failure of total knee arthroplasty (TKA). The presentation can vary from pain to frank dislocation with the etiologies just as varied. Instability after TKA can be classified by where the instability occurs in the knee’s arc of motion as well as the chronicity of the problem. Acute instability is related to intraoperative injuries or excessive release of important coronal stabilizers such as the medial collateral ligament in extension or the posterolateral corner in flexion. Chronic instability in extension is often related to varus/valgus malalignment. Chronic instability in flexion can be related to an undersized femoral component, excessive tibial slope, or excessive elevation of the joint line affecting the isometry of the collateral ligaments in midflexion. Recurvatum instability is a rare complication that often coincides with extensor mechanism dysfunction or neuromuscular disorders. When addressing instability after TKA, it is critical to determine the root cause of the problem as well as evaluate for other causes of pain such as infection or aseptic loosening. When revision surgery is warranted, it should follow the basic principles of restoring a neutral mechanical alignment, setting the appropriate component rotation, balancing the flexion and extension spaces, and restoring the height of the native joint line.

Figure: In addition to the obvious coronal instability, this patient had a malrotated femoral component diagnosed by CT scan and instability of the patellofemoral articulation.
Instability is one of the most common causes of failure following total knee arthroplasty (TKA). There are multiple known etiologies and the presentation can vary greatly from subtle intermittent pain to frank dislocation. When addressing instability after TKA, it is critical to determine the root cause of the problem. This article will focus on issues arising at the tibiofemoral articulation. It is also important to assess for other possible causes of pain and feelings of instability such as problems with the patellofemoral articulation, muscular weakness, component loosening, and infection (Figure 1).

All patients with a painful or unstable TKA surgery require a thorough history. If the index surgery was performed by another surgeon, records including the operative report and pre- and postoperative radiographs should be obtained. Laboratory studies including an erythrocyte sedimentation rate and c-reactive protein should be obtained in all patients presenting with pain or failure following TKA as a screen for periprosthetic joint infection. Physical examination of the knee should assess for laxity in the coronal and sagittal planes in full extension, 30° and 90° of flexion. Examination for anteroposterior instability at 90° of flexion is best performed with the patient in a seated position and the foot gently resting on the floor or a stool.

Acute instability in extension can be caused by intraoperative injury of the meniscal collateral ligament (MCL). This is a known complication of primary TKA with reported rates as high as 8% in high risk patients such as the morbidly obese. We had previously reported successful results (primarily in cruciate retaining implants) with end-to-end repair of midsubstance lacerations and suture anchor (or screw/washer) reattachment of MCL avulsions. No patients required components with varus/valgus constraint. These results differ from those reported by Lee and Lotke, who reviewed the results of 37 intraoperative MCL injuries in TKAs with a posterior stabilized design. The authors noted lower Knee Society Scores and a high rate of revision for instability when components with varus/valgus constraint were not used.

Chronic instability in extension is due to imbalance in the medial and lateral ligamentous soft tissues. This is likely to occur when there is inadequate release of the contacted side of either a severe varus or valgus preoperative deformity (Figure 2). The problem is compounded when there is failure to restore a neutral mechanical alignment. For example, if a TKA performed in the setting of preoperative valgus deformity is left in residual valgus, the already attenuated medial ligamentous structures will experience increased strain. While these patients may have acceptable function initially, the increased strain can ultimately stretch the medial tissues leading to progressive deformity and instability. Revision surgery is usually required in this situation to create a neutral mechanical alignment and balance the medial and lateral ligamentous tissues. If severe collateral ligament attenuation has occurred, revision to a varus/valgus constrained implant may be necessary.

Acute instability in flexion often results from intraoperative injury to one or more lateral ligamentous structures. This problem is more common in posterior stabilized than cruciate retaining TKA designs. Some of the first reports of TKA dislocation were related to aggressive lateral releases performed to correct a valgus deformity. This led authors to adopt the more graduated pie crusting technique which has demonstrated a much lower rate of lateral instability. Patients with acute flexion instability will report laxity or even suffer a dislocation when the knee is subjected to varus force while in flexion (donning a shoe while resting the foot on the contralateral knee). Dislocations of a TKA should be reduced under general anesthesia. A single dislocation can be successfully treated with a period of bracing followed by avoidance of the offending maneuver. Recurrence of dislocation warrants revision surgery, usually of both the femoral and tibial components as modular polyethylene liner exchange will fail to differentially address the increased flexion space without over tightening the extension space; further component revision allows for the use of an articulation with increased inherent constraint if required.

Chronic instability in flexion has gained increased attention as this problem has been historically underdiagnosed. Patients often present with complaints other than instability, such as recurrent effusions, pain, and difficulty with ascending and descending stairs. The knee should be examined for anteroposterior laxity with the patient sitting, the foot...
Midflexion instability is another relatively newly described problem. Although there appears to be multiple etiologies to midflexion instability, it arises most commonly in primary TKA when a large distal femoral cut is made to address a preoperative flexion contracture.1 The larger cut allows the knee to come to full extension, bypassing the restraint from contracted posterior capsular tissues. With the knee in full extension the posterior capsule will provide varus/valgus stability. With the knee past 30° of flexion the posterior capsule is no longer taut, the collateral ligaments will be loose due to elevation of the joint line, and the knee will exhibit instability in the coronal plane.2 Midflexion instability is best prevented by addressing preoperative flexion contracture with posterior capsular release and osteophyte removal while minimizing excessive distal femoral resection. Revision for midflexion instability involves restoration of the joint line while maintaining balanced flexion and extension spaces. In difficult cases where posterior capsular release and osteophyte removal is insufficient to open the extension space, an elevated joint line may need to be accepted and components with additional constraint used.

Recurvatum after TKA is a rare condition that often involves dysfunction of the extensor mechanism. This is classically described in neuromuscular conditions such as polio.3,13,14 Patients with significantly weak quadriceps will attempt to force the knee into hyperextension during the stance phase of gait for stability. This ultimately leads to worsening deformity and instability. In these situations, patients can be offered bracing, revision to a hinged device with an extension stop, or an arthrodesis. Although some authors have had success with advancing the collateral ligaments,15 we have in general gone to distalizing the joint line as much as reasonably possible along with the placement of a rotating hinged implant with a hyperextension stop.3

**SUMMARY**

Although instability is a common cause of failure of primary TKA, many of the root causes are due to technical errors that can be avoided. Before performing a revision, it is important to establish the underlying etiology of the instability as well as evaluate for concomitant pathology. Revision surgery for instability after TKA follows the general principals of creating neutral mechanical alignment, balanced medial/lateral soft tissues, balanced flexion/extension spaces, and restoring the native joint line.

**REFERENCES**