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CASE REPORT

Total knee arthroplasty with "Collar Tightening Technique" for advanced knee osteoarthritis with concurrent chronic posterolateral knee dislocation and lateral patellar dislocation: A case report

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ABSTRACT

Chronic posterolateral knee dislocation with concurrent lateral patellar dislocation is a rare and challenging pathology. Without appropriate treatment, it invariably leads to advanced osteoarthritis, frequently necessitating total knee arthroplasty. However, achieving optimal patellofemoral tracking remains a primary challenge, and no consensus on a definitive surgical technique exists. In this article, we introduce a novel "Collar Tightening Technique" to address this complex clinical scenario. A 66-year-old male with a complex medical history, including prior right knee medial collateral ligament/posterior cruciate ligament reconstruction, presented with chronic right knee pain with difficulty in ambulation. Imaging revealed advanced osteoarthritis, posterolateral knee dislocation, and lateral patellar dislocation with a fixed 20-degree tibial external rotation deformity. The patient underwent total knee arthroplasty, during which the collar tightening technique was employed to restore patellofemoral stability. This technique consisted of three key components: *(i)* an extensive lateral release, *(ii)* distal and lateral advancement of the quadriceps tendon, and *(iii)* medialization of the patellar component. A hinged prosthesis was utilized to address the underlying global instability. Postoperatively, the patient could walk smoothly with single cane assistance. In conclusion, restoring stable patellofemoral tracking is of paramount importance in complex total knee arthroplasty. The collar tightening technique provides an effective solution by combining dynamic stabilization from muscle advancement with static stabilization from component positioning. This comprehensive approach warrants consideration when a simple lateral retinacular release is insufficient to achieve proper patellofemoral alignment.

Keywords: Lateral patella dislocation, patellofemoral tracking, posterolateral knee dislocation, surgical technique, total knee arthroplasty.

Acute knee dislocations account for only 0.2% of orthopedic injuries, yet they progress to a chronic, unreduced state creating a complex clinical situation characterized by soft tissue contractures, distorted anatomy, and significant articular degeneration.[1] An even rarer and more challenging subset is the concurrent chronic posterolateral knee dislocation and lateral patellar dislocation, a condition with limited guidance in the existing literature.[2] In general, if articular degeneration does not develop, reduction followed by ligament reconstruction may suffice. On the contrary, total knee arthroplasty (TKA) is indicated, if there is advanced osteoarthritis (OA).[3,4] However, achieving stable patellofemoral tracking is difficult in this scenario. Due to the severe deformity and longstanding malalignment, conventional techniques such as simple lateral retinacular release are often insufficient.

To address this therapeutic gap, we developed the "Collar Tightening Technique." In this article, we

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report a case of patellofemoral maltracking during complex TKA in which this novel technique was successfully applied in the light of literature data.

CASE REPORT

A 66-year-old male patient presented with a history of progressive right knee pain and deformity causing difficulty walking for many years, superimposed on a complex medical and surgical background. The patient's systemic comorbidities presented a high-risk surgical profile, including severe cardiovascular disease (hypertension, congestive heart failure, and coronary artery disease status post-intervention), type 2 diabetes mellitus, and Stage 3 chronic kidney disease. His orthopedic history was remarkable for right knee

FIGURE 1. Preoperative **(a)** passive range of motion and **(b)** passive knee range of motion was 15-95 degrees.

FIGURE 2. Preoperative **(a)** radiographs of the right knee and **(b)** anteroposterior view and lateral view showing right knee severe osteoarthritis with previous surgical implant retention and tibia lateral dislocation **(c)** merchant view showing patella lateral dislocation.

medial collateral ligament (MCL) and posterior cruciate ligament (PCL) reconstruction performed over 10 years ago, which failed to provide long term stability. In addition, right ankle fusion was also conducted three years prior due to ankle and subtalar arthritis. The patient reported no recent trauma precipitating his current presentation. Upon physical examination, the patient demonstrated a varus deformity of the right knee with associated tenderness and painful limitation of range of motion (ROM). The ROM was measured from 15 to 95 degrees (Figure 1), while the distal neurovascular status of the right leg remained intact.

Initial radiographic evaluation revealed advanced OA of the right knee, with well-seated implants from previous PCL and MCL reconstructions. Of greater concern was the presence of a posterolateral knee dislocation accompanied by lateral patellar dislocation (Figure 2). To better understand the extent of the deformity, computed tomography (CT) was performed. The imaging revealed that the lateral tibia plateau was posteriorly dislocated relative to the lateral femoral condyle, with marked depression and destruction of its anterior portion. The tibia demonstrated a fixed 20-degree external rotation deformity relative to the femur. The patella was found to be laterally dislocated and firmly positioned extra-articularly over the lateral surface of the lateral femoral condyle (Figure 3).

Total knee arthroplasty was indicated for addressing both the dislocation and advanced

FIGURE 3. Preoperative computed tomography (CT) of the right knee **(a)** and **(b)** prominent osteophytes formation and posterior sagging of the tibia **(c)** and **(d)** patella lateral dislocation with tibia external rotation about 20 degrees suggesting knee post.

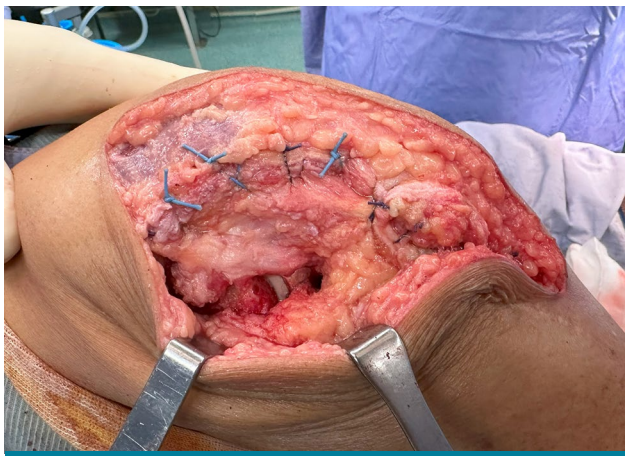

FIGURE 4. Intraoperative photography "Collar Tightening Technique" was utilized with medial portion quadriceps being advanced distally and laterally. Medial portion quadriceps tendon is sutured to lateral retinaculum after patella component medialization.

OA. The procedure commenced through a medial parapatellar arthrotomy and the removal of extensive, encircling osteophytes was performed to clearly evaluate the stability and potential bony defects. Additionally, interference screws from the prior reconstruction were removed to prepare the intramedullary canals and bone surfaces. Ligamentous insufficiency with both coronal and sagittal plane instability was confirmed and hinged prosthesis was deemed necessary. Femoral component was positioned at 3 degrees external rotation and tibia component was aligned with the tibia tuberosity.

The dislocated patella was, then, addressed through sequential steps. Patella component was positioned 2.5 mm medial to the patella center to further decrease lateral compression force. An extensive lateral release was further performed. The lateral release incision was extended proximally, lateral to the vastus lateralis muscle for the purpose of preserving the integrity of the muscle and the overall muscle power. However, difficulty was encountered despite the release, an advanced soft tissue realignment technique was implemented. The medial portion of the incised quadriceps tendon was advanced laterally and distally to completely cover the patella. The leading edge of this tendon flap was, then, securely sutured to the medial edge of the

FIGURE 5 Postoperative radiograph of right knee **(a)** anteroposterior view **(b)** lateral view **(c)** merchant view showing well seated implant and adequate patellofemoral tracking after total knee arthroplasty.

FIGURE 6. (a) Postoperative active knee range of motion and **(b)** postoperative active knee range of motion was 5 to 95 degrees.

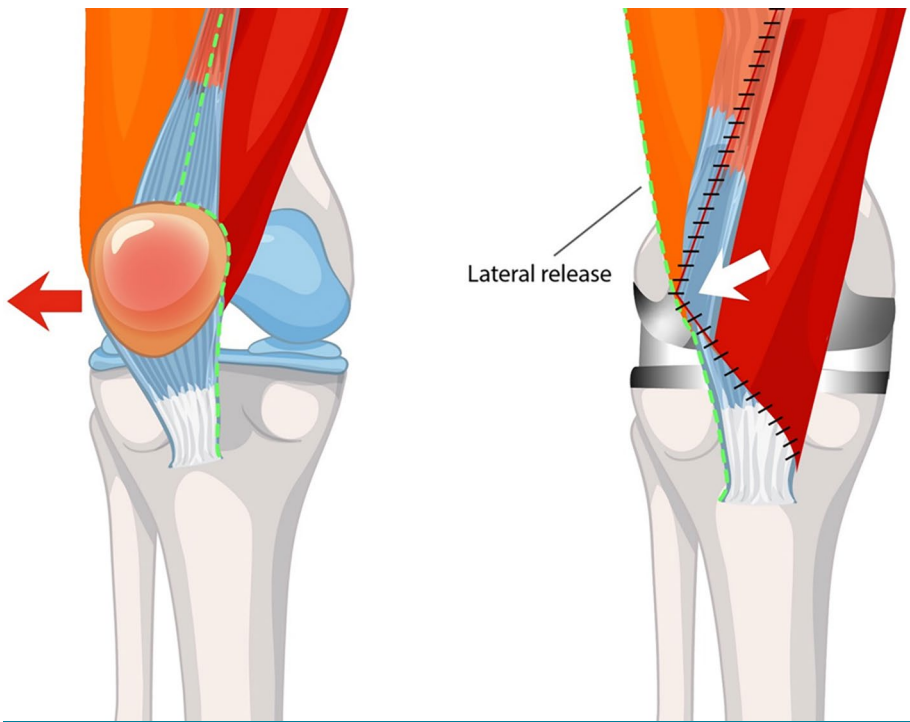

FIGURE 7. Illustration of the "Collar Tightening Technique" for patellar realignment in total knee arthroplasty. The medialized patella covered by laterally and distally advanced quadriceps tendon can be imagined as daily task of tightening the collar.

previously released lateral retinaculum. The repair was performed using No. 5 non-absorbable Ethibond Excel™ polyester suture (Johnson & Johnson Medtech, IN, USA) to ensure robust fixation of the dense tissues. This technique effectively neutralized the lateral vector forces acting on the patella (Figure 4). Through the combined approach of modified component positioning, extensive lateral release, and soft tissue advancement, we successfully reconstructed the patella with proper patellofemoral tracking. The postoperative radiograph showed appropriately positioned implant and patellofemoral tracking (Figure 5).

At one-year postoperative follow-up, the patient demonstrated a knee ROM from 5° to 95° (Figure 6). He was ambulatory with the assistance of a single cane. Patellar tracking was stable throughout the

available ROM. The patient reported intermittent tightness and mild pain, corresponding to a Visual Analog Scale (VAS) score of 1/10, primarily at terminal flexion. Overall, the patient was satisfied with the surgical outcome. A written informed consent was obtained from the patient.

DISCUSSION

Chronic, unreduced knee dislocations, particularly the posterolateral subtype combined with lateral patellar dislocation, pose a significant reconstructive challenge. Chronicity fundamentally alters the local anatomy, leading to contracted medial soft tissues and retinaculum. As reported in the literature, the medial femoral condyle may buttonhole through the capsule, creating substantial barriers to reduction.[5-7] Gao et al.[8] proposed that dislocation of patella was a dislocation of extensor mechanism, leading to vastus lateralis and iliotibial tract contracture, and the shortened quadriceps tendon exerted a lateral pull on the tibia, resulting in a valgus and external rotation deformity of the tibia. If left unreduced or only partially reduced without adequate stability, the knee would eventually progress to advanced OA.

Once advanced OA develops, TKA becomes the definitive treatment. However, the procedure in this context is far from standard, presenting two primary intraoperative challenges: *(i)* possible global instability and *(ii)* patellofemoral maltracking. The surgeon must cope with potential bone loss and unpredictable integrity of the medial and lateral collateral ligament and posterolateral corner complex, which dictates the necessary level of implant constraint. In general, if the end point could be confirmed during a varus/valgus stress test, unconstrained prosthesis may be selected. On the contrary, a condylar constrained prosthesis or hinged knee prosthesis should be considered in patients with higher levels of instability, as demonstrated in this case.

Considering the patellofemoral relationship, there are more uncertainties in surgical techniques. The existing literature, though sparse, reflects a spectrum of solutions for patellar maltracking, usually falling into three main categories. The foundational step, employed by most authors, is lateral retinacular release.[9-11] Once this proves insufficient, some have added proximal realignment procedures, such as medial patellofemoral ligament reconstruction, quadricepsplasty, and Insall's proximal tube realignment techniques.[9,12-14] For the most recalcitrant cases, distal realignment via a tibial tubercle osteotomy offers a powerful, but more invasive correction with the risk of bone nonunion.[15] This variety underscores that no single technique is universally applicable due to patient-specific deformities. While these approaches address static (ligament) or dynamic (muscle) factors, a comprehensive technique which synergistically combines multiple corrective forces may offer a more robust solution.

In our case, we encountered difficulties in achieving proper patellofemoral tracking despite employing simple lateral retinacular and capsular release as described in the literature.[16] Our modified technique, namely the collar tightening technique, with sequential steps including *(i)* medialization of the patella component, *(ii)* extensive lateral release, and *(iii)* lateral and distal advancement of quadriceps tendon, provided an effective solution for this difficult case (Figure 7). The extensive lateral release in our technique is slightly different from Insall's proximal realignment technique. Our lateral release incision was lateral to vastus lateralis for the purpose of preserving the muscle integrity and overall muscle power. The proximal extension of the lateral release should be far enough to separate the intermuscular septum completely, which increases the mobility of the following quadriceps advancement. By redirecting part of the extensor mechanism, we created a dynamic stabilizing force which counteracted the pathological lateral vector affecting the patella. Although this approach differs from standard protocols, it builds upon established principles of soft tissue balancing in patellofemoral disorders.

The additional step of positioning the patella component 2.5 mm medially to the anatomic center represents a refinement aimed at reducing lateral compressive forces. Anglin et al.[17] showed in their biomechanical study that medialization of patella component had the advantages of reducing tension in lateral retinaculum, as well as providing better patella tracking. Kawano et al.[18] also published their study on the factors affecting patellofemoral tracking after TKA and they found that medialized patella component was effective for obtaining proper patellofemoral tracking.

The modest medialization in our case, when combined with soft tissue realignment, appeared to enhance patellofemoral tracking without creating excessive medial tension or constraint. The key advantage of the collar tightening technique was

its ability to address both static and dynamic components of patellar dislocation using the patient's own tissue. By utilizing existing structures rather than introducing artificial materials or performing more invasive osteotomy, we potentially reduce complication risks while achieving the necessary biomechanical correction.

While this technique proved successful in our case, there are several limitations. The optimal degree of advancement may vary between patients and is a subjective decision of the surgeon, which poses challenges to its reproducibility. The tension of the suture fixation, a related factor, is also subject to intraoperative test of patella tracking and ROM. Moreover, the current analysis is constrained by a lack of long-term follow-up data, which is essential for assessing the durability of the reconstruction and monitoring for late-term complications. To address these issues, further cadaveric biomechanical studies are planned to investigate the force-displacement characteristics of the construct, which may help establish a more standardized and evidence-based approach to the advancement procedure.

In conclusion, for complex TKA with recalcitrant patellar dislocation, the novel collar tightening technique, performed in sequence with patellar component medialization, extensive lateral release, and medial quadriceps advancement, is a valuable surgical option to be considered.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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