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Case report

Primary total knee arthroplasty in a patient with a chronic extensor mechanism deficiency

Daniel L. Levy, BS, J. Ryan Martin, MD, Tyler S. Watters, MD *, Jason M. Jennings, MD, DPT, Todd M. Miner, MD

Colorado Joint Replacement, Department of Orthopaedic Surgery, Porter Adventist Hospital, Denver, CO, USA

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ABSTRACT

A 44-year-old female presented with a chief complaint of left knee pain and dysfunction. The patient had a complex surgical history including patellar fracture repair, subsequent patellar ligament repair, and ultimately allograft reconstruction which was complicated by septic arthritis requiring graft resection. On presentation to our clinic, she was noted to have significant degenerative disease in addition to chronic extensor mechanism deficiency. She underwent primary total knee arthroplasty with concomitant tibial tubercle osteotomy and advancement. The patient has had an excellent result postoperatively including return of full range of motion without residual extensor lag.

Introduction

Total knee arthroplasty (TKA) has been shown to be an effective, reliable treatment with reproducible functional outcomes [1]. Despite the efficacy of primary TKA, there is a subset of patients that undergo primary TKA present with unique pathologies which pose the challenge of more complex procedures that have been associated with worse outcomes [2-4]. We present a unique case of a patient that required a tibial tubercle osteotomy during a TKA secondary to chronic extensor mechanism deficiency in the setting of prior patella fracture and extensor mechanism deficiency that was secondarily infected.

Case history

Institutional review board approval and patient consent were obtained for the following case report. A 44-year-old female presented with a chief complaint of left knee pain and dysfunction. She initially sustained a patella fracture 12 years prior as the result of a fall from stairs and underwent operative repair. Two months later, she slipped on ice and ruptured her patellar tendon. Primary repair of the tendon was performed at that time, although this ultimately failed, resulting in chronic extensor lag. Several years later, she underwent allograft reconstruction/augmentation of the patella tendon. Unfortunately, she developed an acute postoperative staphylococcal wound infection requiring multiple debridements and prolonged antibiotic therapy.

On initial presentation to our clinic, nearly 2 years from her last surgery, the patient demonstrated a severe antalgic gait pattern and required a walker. Her left knee revealed multiple well-healed surgical incisions, including an anterior midline incision. There was a trace effusion without signs of infection. Straight leg raise revealed a 30° extensor lag. Passive range of motion of her knee was 4°-130° of flexion. Patella alta was noted along with retropatellar crepitus and a positive patellofemoral inhibition sign. Tenderness to palpation was present over her medial and lateral joint line. The remainder of her ligamentous and neurovascular examination was normal. Radiographs revealed an anatomic valgus alignment of 7° and patella alta secondary to her chronic extensor mechanism insufficiency (Fig. 1a, b, and c). Magnetic resonance imaging was not obtained preoperatively. The patient's preoperative knee society score was 56.

Serum laboratory markers were obtained, and knee aspiration was performed to rule out any indolent infection. Inflammatory markers were within the reference range, and aspiration cell count yielded 129 nucleated cells with no growth on cultures. The patient

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* Corresponding author. Colorado Joint Replacement, Porter Medical Plaza, 2535 S. Downing Street, Suite 100, Denver, CO 80210, USA. Tel.: 720-524-1367.
E-mail address: TylerWatters@Centura.org

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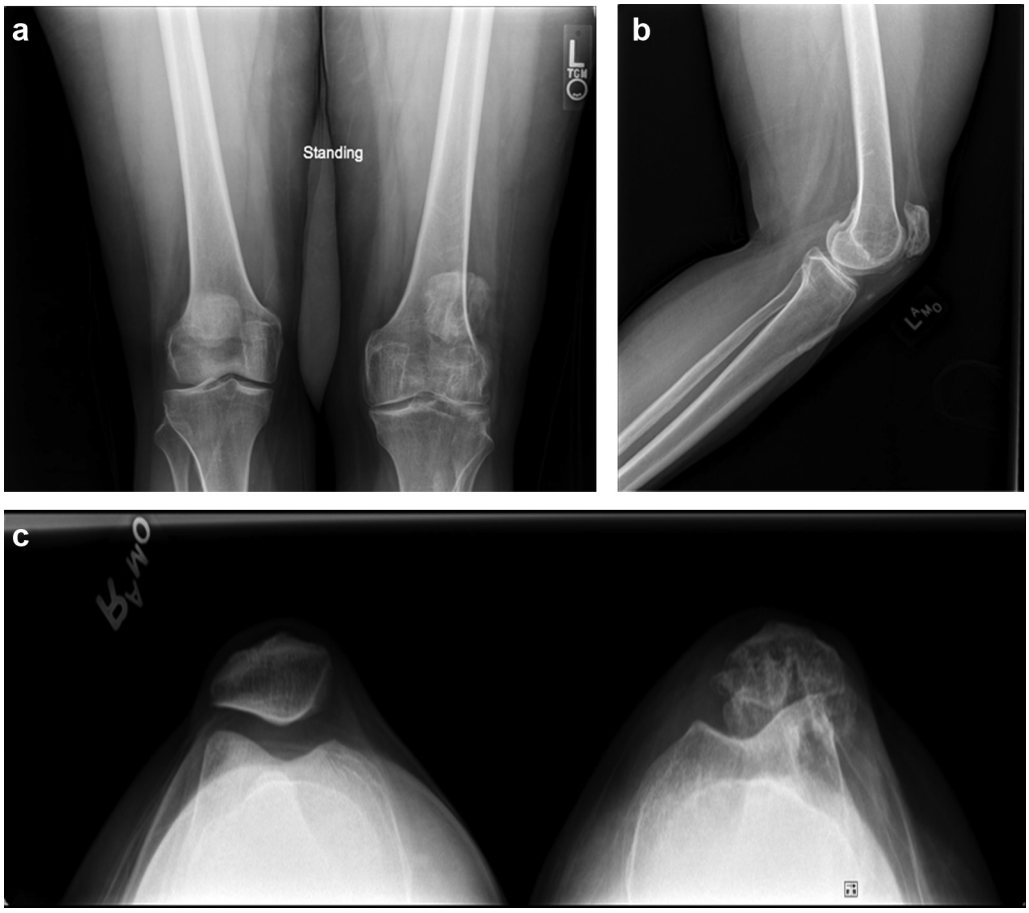

Figure 1. (a) Preoperative weight-bearing anteroposterior radiograph of the bilateral knees. The left knee is noted to have significant degenerative changes. (b) Preoperative lateral radiograph demonstrates patella alta. (c) Preoperative Merchant views show significant posttraumatic deformity of the left patella.

was offered reconstruction including primary TKA with concomitant extensor mechanism reconstruction, most likely to include a whole extensor mechanism allograft (EMA).

The procedure was performed with a tourniquet and used the former anterior incision and ellipsing hypertrophic scar. Sharp dissection was carried down to the extensor mechanism which was inspected. There was patellar tendon tissue present and viable; however, the patellar tendon itself was quite elongated. With the knee was in full extension, the extensor mechanism was redundant but in continuity. Surrounding scar tissue was removed to confirm the continuity of the patellar tendon from the patella to the tibial tubercle. The quadriceps tendon and musculature were intact. A median parapatellar arthrotomy was used, and TKA was performed using a gap balancing technique with a primary, posterior-stabilized, fixed-bearing implant. The chondral surface of the patella was fairly intact and was not resurfaced because of the severe alta position and to avoid potential patellofemoral instability. Facetectomy was performed to contour the patella and avoid impingement of osteophytes.

The extensor mechanism reconstruction was then addressed. Given the continuity of the patellar tendon with tissue redundancy, a tibial tubercle osteotomy with advancement was performed. The osteotomy was made in the standard fashion. The outline of the tubercle was marked, and an osteotomy of approximately 7 cm in length was made. The fascial attachments along the medial and lateral patellar ligaments were freed to allow advancement of the extensor mechanism. With the knee in full extension, the tubercle was advanced to achieve acceptable tension on the extensor mechanism. Distally, overlapping cortical bone was removed. The tubercle fragment was then fixed in its newly tensioned position with 4.0-mm fully-threaded cortical screws with washers. Autogolous bone from the distal end of the tubercle osteotomy was used as a local bone graft along the osteotomy site. Fluoroscopy was used to assess the osteotomy site and confirm the acceptable patellar

Figure 2. Intraoperative fluoroscopic image demonstrating advancement of the tibial tubercle with screw fixation.

position (Fig. 2), and tracking was central without subluxation or excessive tilt. After closure, the patient was then placed in a cylinder cast maintaining the knee in full extension.

The patient had an uneventful hospital course and was discharged to her home on postoperative day 3. Touchdown weight bearing was maintained for 4 weeks. After wound check at 2 weeks, she was placed back into a cylinder cast for an additional 8 weeks, at which time the cast was removed and she was permitted progressive flexion of the knee in a hinged knee brace.

Approximately 11 months postoperatively, the patient noted mild discomfort over the screw fixation of her tibial tubercle and underwent outpatient hardware removal without complication. At 18-month follow-up, she was ambulatory with no assistive devices and reported an excellent outcome. Range of motion was 0-120° and she did not demonstrate an extensor lag. Her Knee Society Score was 100. Radiographs revealed excellent coronal plane alignment, healed tibial tubercle osteotomy, and central patellar tracking (Fig. 3a, b, and c). The Insall-Salvati ratio was found to be 2.12. She was not given any lifelong activity restrictions other than that which is given to our typical TKA patients which includes the recommendation to avoid jumping sports or high-impact activities.

Discussion

TKA is a reproducible procedure that has been shown to effectively treat end-stage osteoarthritis and produce good long-term outcomes [5,6]. There are subsets of patients with more complex pathologies that represent more challenging surgical considerations and, thus, have less predictable functional outcomes. The patient presented was noted to have 4 factors that are commonly associated with lower outcomes after TKA: (1) prior patella fracture, (2) history of septic arthritis, (3) a history of an extensor mechanism injury, and (4) requirement for TTO at the time of primary TKA. LeBrun et al. [7] showed that operatively treated patellar fractures can lead to continued symptoms and functional deficiencies that tend to persist. In addition, patients who present with a history of septic arthritis are often subject to reinfection and

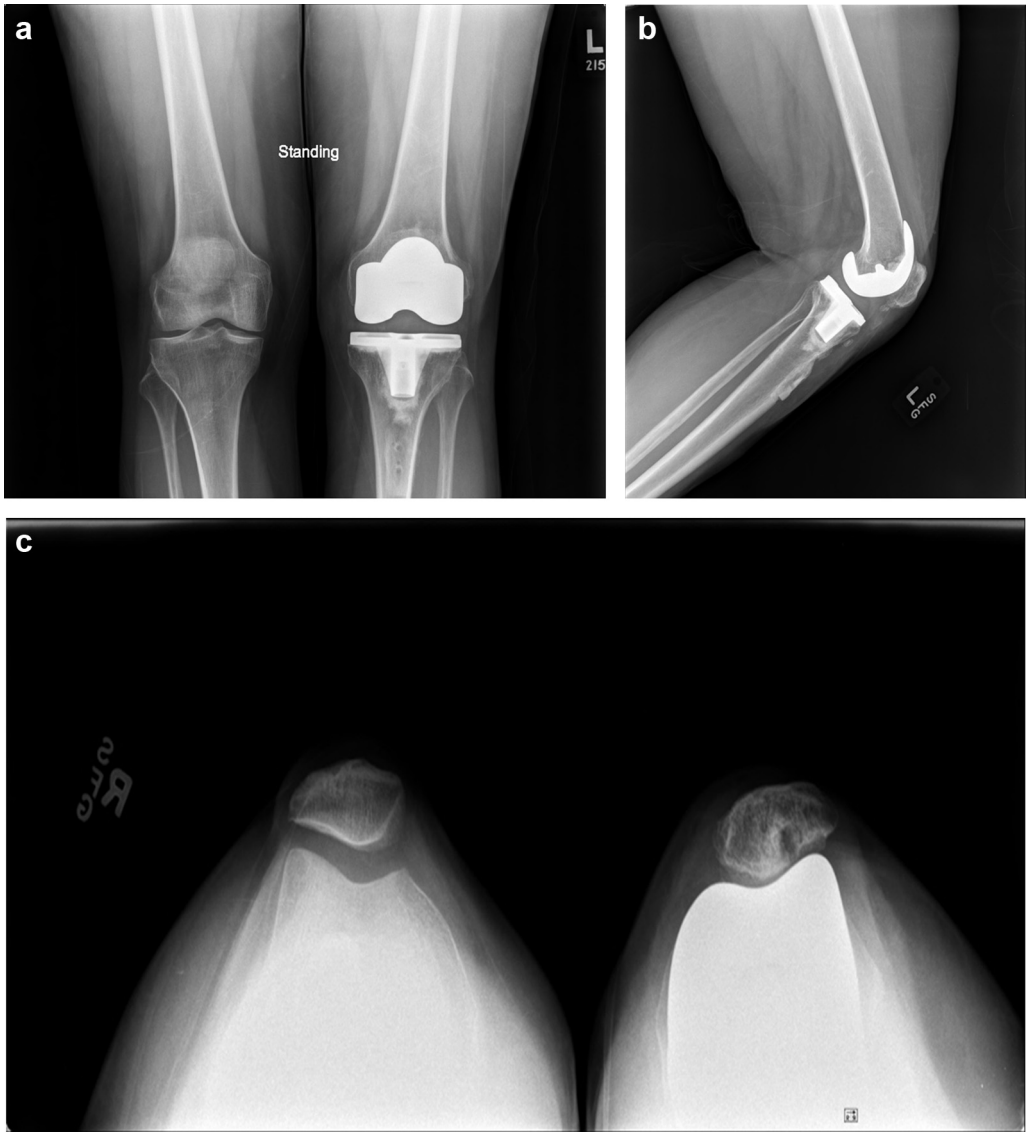

Figure 3. (a) Final postoperative radiographs demonstrate excellent coronal alignment with no evidence of osteolysis or loosening. (b) Final follow-up postoperative radiograph demonstrating no evidence of loosening and complete healing of the tibial tubercle osteotomy. (c) Final follow-up Merchant views show excellent tracking of the native patella in the trochlear groove of the femoral component.

present a higher risk than the conventional, aseptic patients [8]. Patients who must undergo tibial tubercle osteotomies in TKAs have been shown to be at higher risk for tibial tubercle fracture and skin necrosis [9]. We noted multiple studies on patients that sustained an extensor mechanism disruption after TKA but were unable to find a patient that had this unique combination of preoperative risk factors [10-12]. To our knowledge this patient represents the first report encompassing all 4 of these pathologies in a complex primary TKA. This unique case report demonstrates that it is possible to achieve excellent outcomes in a technically challenging patient. That being said, we note that this is a single case and is not generalizable, and significant preoperative planning is necessary in such cases.

In this complex patient, it is important to systematically address all of the technical considerations before embarking on surgical intervention. We were prepared to perform a complete EMA at the time of arthroplasty, if necessary. However, intraoperative assessment proved the patient's extensor mechanism to be intact, albeit elongated. We hypothesized that we could address the extensor lag by advancing the tibial tubercle to the correct length and achieve full extension while maintaining adequate flexion. Especially in light of the patient's age, we felt that maintaining her native extensor mechanism was more prudent than performing a complete EMA. If full flexion had unobtainable with tubercle advancement, this would not have been possible, and EMA would have been the next step. It is important to note, however, that EMA either after or concurrently in the setting of TKA has variable success with a high risk of complications. Brown et al [12] reported on 50 consecutive EMA reconstructions in 47 patients with extensor mechanism failure after TKA. The mean age of patients in their study was 68, and at mean follow-up of 57.6 months, the failure rate was 38%. From an infection standpoint, we obtained preoperative erythrocyte sedimentation rate and C-reactive protein as well as a knee aspiration which were noted to be within the acceptable reference ranges. Intraoperatively, the patient had no signs of continued infection. Had the patient presented signs of persistent septic arthritis, a secondary plan of performing a 2-stage procedure incorporating the TTO into the second stage of reconstruction would have been used. An additional consideration was the management of the TTO. The knee was casted in full extension to ensure adequate healing of the osteotomy while avoiding a flexion contracture. We conceded that the patient may have a minor loss of flexion with the length of time she was immobilized but from a functional standpoint wanted to assure she was able to do a straight leg raise without an extensor lag. Furthermore, regarding the fixation of the TTO, we were able to fix the tubercle after advancement distally with anterior to posterior screws, similar to standard fixation methods for tubercle osteotomies for patellofemoral instability and realignment procedures (eg, Fulkerson, Elmslie-Trillat). This technique has the inherent risk of creating a stress riser between the end of the keel of the primary tibial baseplate and the osteotomy site and may be susceptible to late fracture. Klein et al. [13] described 3 such cases of proximal tibial fractures in the setting of short tibial components after EMA reconstruction for extensor mechanism failure after TKA and recommended the use of long-stemmed tibial components that bypass the osteotomy. However, these cases included EMA reconstruction in which a large trough was required in the tibia to accommodate the allograft bone block, not advancement of the native tubercle as in our case. Because we planned to cast the patient and restrict weight bearing postoperatively in the setting of a native tubercle advancement, a long-stemmed tibial prosthesis was not necessary. Finally, the patient had a prior patella fracture that had completely healed. Typically, in the setting of posttraumatic patellar deformity, the patella would be resurfaced. However, in our patient's case, the patellar cartilage was noted to be intact. In addition, it was perceived that owing to her excessive patella alta, her anatomic patellar geometry would track better than a patellar button would. Therefore, we elected to not resurface her patella to attempt to minimize the potential of creating patellar instability. We noted intraoperatively and at final follow-up radiographs that her patella tracked centrally in the trochlear groove with no evidence of patellar tilt or subluxation.

Summary

The case presented represents a unique and extremely complex presentation of a patient with knee arthritis in the setting of prior patellar fracture, extensor mechanism compromise with failed reconstruction, and history of joint sepsis that underwent successful TKA with concomitant tibial tubercle osteotomy and advancement. Although excellent results were achieved, meticulous surgical planning was required to prepare for a number of possible intraoperative variables that could have called for a different reconstructive approach. In the setting of primary arthroplasty in patients with complex surgical factors, informed consent is vital to ensure that patients understand that results of TKA may not be as predictable.

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