Systematic Evaluation of Painful Total Knee Arthroplasty

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Contents

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56.1 Introduction

Total knee arthroplasty (TKA) has been shown to be effective, reliable, and durable in relieving pain and improving function in patients with end-stage arthritis of the knee joint (Hopley and Dalury 2014). However, as the number of performed TKAs increases, there will be an expected corresponding increase in the number of failures and revisions (Bozic et al. 2010).

The reasons knees fail can be variable and sometimes multifactorial (Sharkey et al. 2014). While pain is nearly a universal complaint of patients with failing knee replacements, identifying and understanding the mechanism of failure and pain are critical for successful revision surgery.

> Mont et al. reported 59% poor results following exploration in patients with radiographically normal knees with unexplained pain (Mont et al. 1996).

Therefore, revision surgery should not be undertaken unless a definite and correctable cause can be identified preoperatively.

The evaluation of a painful TKA requires a systematic approach. Only the combination of the clinical history, physical examination, and radiographic and laboratory evaluations can provide the complete clinical picture that is critical to the understanding of why a particular knee has failed. This chapter will discuss the workup of the painful knee replacement.

56.2 Clinical History

A detailed clinical history is the starting point for the treatment of a painful TKA. Useful information includes the circumstances surrounding the initial arthroplasty including diagnosis, prior surgeries, and complications including wound healing complications and infection. Additionally, a review of preoperative radiographs prior to the initial TKA can provide important information with regard to the indications of surgery as well as information on whether the initial TKA relieved the preoperative knee pain.

Polkowski et al. showed that early-grade arthritis at the time of TKA was significantly associated with pain and dissatisfaction following TKA (Polkowski et al. 2013).

The type, characteristic, and duration of pain can also hint at the mechanism of failure. In general, symptoms such as pain with activities that is relieved at rest are associated with mechanical and aseptic failures, while rest pain and particularly pain at night should be suspicious for infection. Start-up pain, defined by initial worsening pain following rest (i.e., first few steps of the day or following periods of sitting), can be indicative of aseptic loosening. In addition, knee weakness, falls, and difficulty walking on uneven terrain is often associated with an unstable knee. Finally, recurrent hemarthrosis or sterile effusions with stair descent activities are characteristically seen in patients with flexion instability (Stambough et al. 2019).

56.3 Physical Examination

The clinical examination begins at the moment the patient walks through the exam room doors. Observing the patient's gait can provide significant information about the causes of dysfunction even before one lays hands on the knee joint. The presence of an abductor lurch (i.e., Trendelenburg gait) or ataxia points to the coexistence of hip or neural pathologies, respectively. The excursion of the knee joint through the gait cycle can demonstrate the presence of either fixed flexion contractures, knee recurvatum, or ligament instability (i.e., varus or valgus thrusts).

The systematic examination then progresses to the soft tissue envelope of the knee, where the incision and soft tissues are evaluated. The presence or absence of joint effusion or synovitis is noted. Draining wounds or nonhealing sinuses are seen in cases of infection while soft tissue defects with associated muscle dysfunction are present in cases with extensor mechanism disruptions. Both active and passive range of motion of the knee should be recorded, and the presence of any flexion contractures or extensor lags should be noted. The alignment of the knee joint is assessed in both the standing (weight-bearing) and supine (non-weight-bearing) positions. The presence of extra-articular deformities including excessive planovalgus foot deformity can significantly affect overall limb alignment (Meding et al. 2005). Patellar tracking is assessed throughout the entire arc of knee motion. The stability of the knee joint is then assessed in full extension, 30°, 60°, and 90° of knee flexion. Excessive differences in medial-lateral gapping represents medial-lateral gap imbalance, while excessive anterior-posterior translation and superior-inferior pistoning of the knee at 90° of flexion is seen in cases of flexion instability (Fig. 56.1).

> It is important to note that since instability is poorly defined, a comparison to the contralateral knee and asking whether the patient is painful or uncomfortable during any of these maneuvers can distinguish physiologic vs. pathologic laxity.

Fig. 56.1 Diagnosis of flexion instability. The patient is asked to sit at the edge of the exam table, and the examiner anchors the foot; this allows the patient to relax and allows the examiner to translate the knee anterior-posteriorly or "piston" the knee superior-inferiorly

Finally, an evaluation of the hip joint, spine, and a complete neurovascular exam is performed in order not to overlook coexisting pathologies and other potential sources of pain.

56.4 Radiographic Evaluation

A standard radiographic review includes standing anterior-posterior (AP), lateral, and Merchant or sunrise views of the knee. A long-standing hip-to-ankle radiograph can aid in the assessment of overall limb alignment, particularly in the setting of extra-articular deformities. Oblique radiographs have been shown to be more sensitive in the evaluation of osteolytic lesions (Nadaud et al. 2004). A critical evaluation of component fixation and position includes coronal and sagittal alignments, joint line position, posterior condylar offset, tibial slope, and the presence of radiolucent lines.

In general, the joint line should be positioned approximately 25–30 mm from the medial epicondyle of the femur, while the posterior condylar offset should measure approximately 25–30 mm from the posterior femoral cortex (Voleti et al. 2015). Failure to restore posterior condylar offset can result in flexion instability and loss of knee flexion. Comparing the prosthetic offset to the contralateral knee can also be helpful. In terms of tibial slope, depending on the type of prosthesis being used (PS vs. CR), it should be approximately 0–5°: 0–3° in PS knee implants and 3–5° in CR implants. Excessive posterior slope is associated with flexion instability, while anterior slope is associated with poor flexion (Song et al. 2019).

Fixation of the TKA components is determined by the presence or absence of signs of prosthetic loosening. A prosthesis is loose if there is

- Circumferential radiolucent lines around the entire implant greater than 2 mm
- Progressive radiolucent lines on serial radiographs
- Evidence of component migration on serial radiographs (Fig. 56.2)

In stemmed implants, a shift in stem position, subsidence, or pedestal formation are also signs of loosening (Fig. 56.3). While bone scans can show increased activity in loose TKA implants, their utility in the workup of a painful TKA has diminished over the past decade. Finally, it is also important to recognize that a positive bone scan up to 18 months following surgery can be normal and not indicative of component loosening (Niccoli et al. 2017).

Femoral and/or tibial component malrotation has been associated with extensor mechanism problems and persistent pain following TKA (Panni et al. 2018). While the sunrise or Merchant views can roughly assess femoral component rotation, in general, rotation is generally assessed using computed tomography (CT). On the femoral side, the femoral component should be parallel to the transepicondylar axis of the femur, while on the tibial side, the tibial component should not be internally rotated to the medial border of the tibial tubercle (Lee et al. 2004) (Fig. 56.4). While these rotational guidelines have been used over the past 30 years, recent studies in kinematically aligned knees have shown that small deviations from these landmarks can still be compatible with well-functioning TKAs (Nedopil et al. 2016).

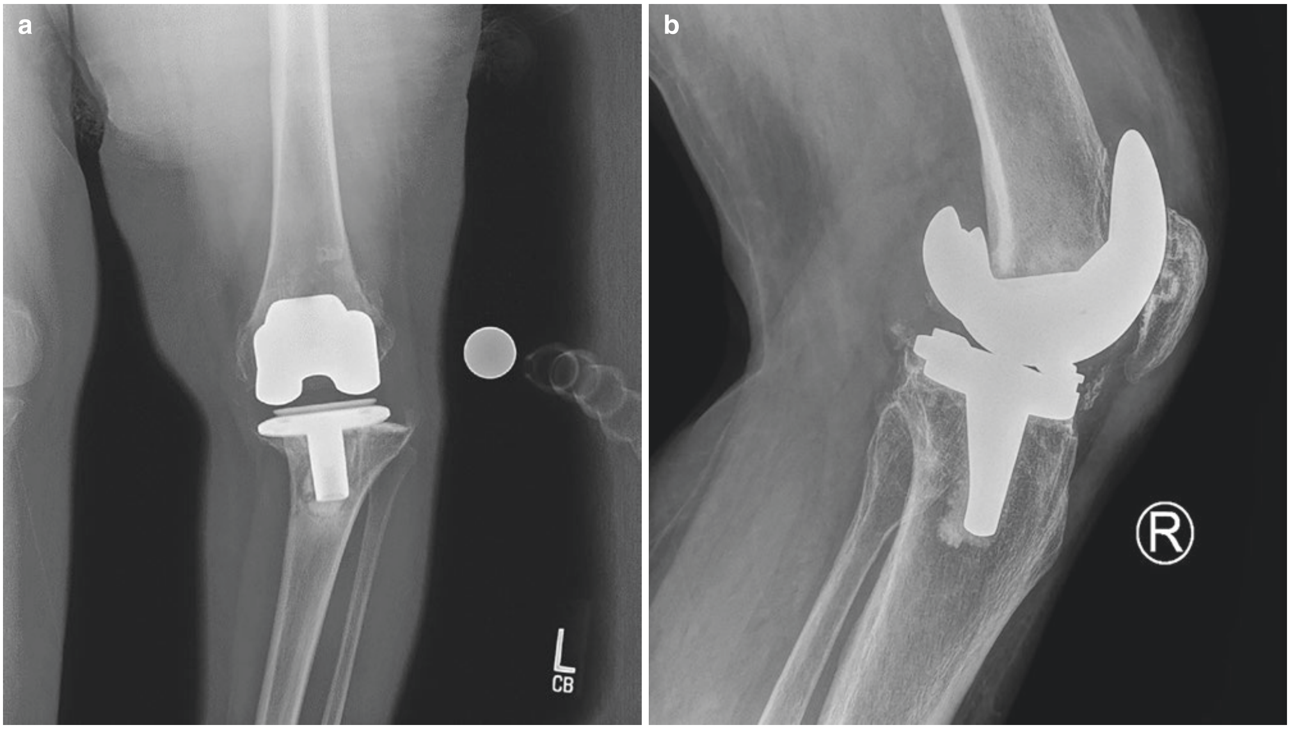

Fig. 56.2 **a** AP radiograph of the knee demonstrating a loose tibial component. Note the circumferential radiolucent lines and the collapse and migration of the prosthesis into varus. **b** Lateral radiograph of a loose femoral component. Radiolucencies are present around the entire implant, and the component has migrated proximally and into flexion

Fig. 56.3 AP radiograph of a loose stemmed tibial and femoral component. Notice again the lucent lines around the stem of the implant and migration of the stem into varus. In addition, notice the bony pedestal at the tip of the stem

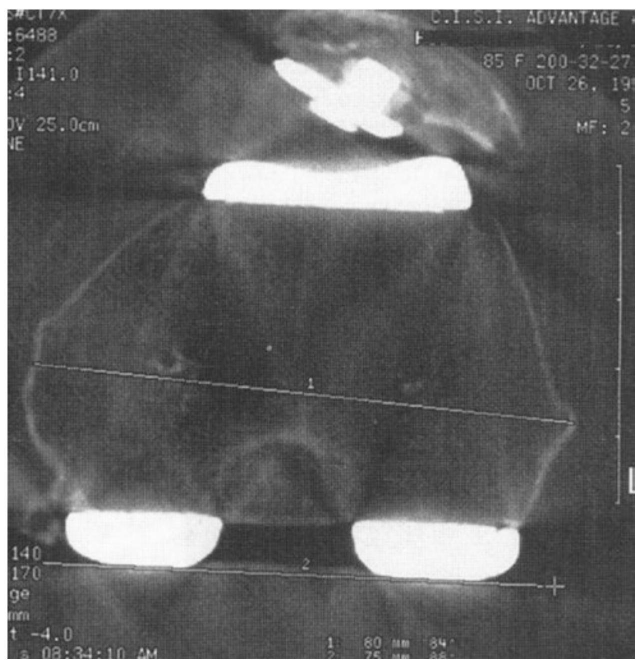

Fig. 56.4 CT scan of a knee with patellofemoral maltracking. The femoral component is internally rotated in relation to the transepicondylar axis of the knee (*line*)

> Consequently, one must consider the overall clinical picture and recommend revision only when the radiographic abnormality coincides with the patient's symptoms.

56.5 Laboratory Studies

There are three questions that need to be answered when evaluating a painful TKA:

1. Is the bone broken?
2. Is the implant well fixed, loose, or unstable?
3. Is the knee infected?

> Infection is the leading cause for early revision in some series following TKA today (Sharkey et al. 2014). Therefore, it is imperative that the workup of a painful knee replacement includes an evaluation for prosthetic joint infection (PJI).

The American Academy of Orthopaedic Surgery has published clinical practice guidelines for the diagnosis of prosthetic joint infections (Parvizi and Della Valle 2010). The first step in this algorithm is obtaining a serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) in all painful joint replacements. These markers are nonspecific inflammatory markers that have been shown to be highly sensitive when both are elevated to correlate with the presence of infection (Bingham et al. 2019). In rare instances, seronegative (negative ESR/CRP) prosthetic joint infections have also been reported (McArthur et al. 2015). The utility of other biomarkers including D-dimer and interleukin-6 remains undefined (Lee et al. 2017).

If the index of clinical suspicion for infection is high, joint aspiration of antibiotics is the most sensitive and specific way to diagnose prosthetic joint infections today. Synovial white blood cell count and differential have been shown to be correlated with infection. The thresholds can be variable, but the Musculoskeletal Infection Society (MSIS) currently recommends a synovial WBC threshold of 3000 cells and a PMN differential of 65% for chronic infections. For infections occurring within the first 6 weeks, a synovial WBC threshold of 10,000 cells and PMN differential greater than 90% is used (Aalirezaie et al. 2019). Leukocyte esterase and α-defensin have also been shown to be both sensitive and specific in the detection of PJI (Lee et al. 2017).

56.6 Preoperative Counseling

Finally, for the patient facing re-operation, a failed TKA can be the source of disappointment and anger. Questions such as why and how this condition did happen or whether anything done at the time of the initial operation prompted the current state of affairs can be uncomfortable. The surgeon should educate the patient and establish clear and realistic expectations in terms of the procedure, recovery, and likely successful outcome (i.e., motion, residual pain, stiffness, and activity levels) in order to assist the patient in the decision-making process.

> The physician's definition of successful revision must be aligned with the patient's definition of success in order to minimize patient dissatisfaction.

Conclusion

There are many reasons why a patient can present with a painful TKA. Accurate identification and understanding of the mode of failure (if any) is critical to successful management. A systematic approach including a detailed history, physical examination, and laboratory and radiographic studies is required to maximize success and minimize complications.

Take-Home Messages

- To successfully manage pain in TKA, accuracy in the identification and understanding of the mode of failure is key.
- A systematic approach including a detailed history, physical examination, and laboratory and radiographic studies is required to maximize success and minimize complications.
- All evaluations must include a workup for prosthetic joint infection. The presence or absence of infection must be established prior to revision.
- All causes of pain must be considered including referred sources such as the hip or spine and neurogenic pain.
- Setting realistic patient expectations prior to revision surgery in terms of recovery and ultimate function will assist the patient in the decision-making process of whether re-operation is necessary.

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