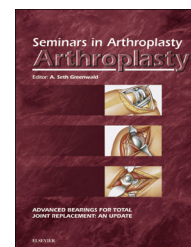


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The painful total knee arthroplasty: Keys to diagnosis

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ARTICLE INFO

Keywords:

Knee pain
Total knee arthroplasty
Painful total knee
Painful knee arthroplasty

ABSTRACT

As the prevalence of patients living with total knee replacements continues to rise we continue to see a significant portion of patients living with pain following their primary total knee arthroplasty. For some patients, the etiology of their pain following knee replacement is obvious, yet in many cases the cause of pain remains elusive and thus creates a significant burden for the patient and treating physician. In this review article we focus on common sources of pain following knee replacement and discuss keys to diagnosis. We also propose a unique clinical pathway algorithm to guide diagnostic work up and treatment options.

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1. Introduction

Total knee arthroplasty (TKA) is one of the most commonly performed operations in the United States. Over 7.2 million Americans are currently living with a hip or knee arthroplasty implant and two-thirds of these patients have a total knee replacement [1]. Despite technological and methodological advancements, studies have shown up to 20% of patients that undergo a primary total knee arthroplasty are not satisfied with the outcome [2]. Multiple factors contribute to dissatisfaction including unmet expectations, functional limitations, and post-operative complications including pain are the most common cause of dissatisfaction in these patients [3]. Pain following TKA is a complex multi-factorial process that presents a diagnostic challenge requiring a broad differential and systematic investigation. Identifying the source of pain is paramount to determining appropriate treatment and ensuring successful outcome in management and resolution of pain. In this review, we will describe common etiologies of pain after total knee arthroplasty. We will review the history, clinical exam, and laboratory findings in these conditions and briefly describe the management of these problems.

2. History

An accurate and detailed history of pain symptoms may help to differentiate the type of pain a patient is having as well as the source of the pain. Pain following total knee arthroplasty can be broadly classified into two categories: nociceptive pain or neuropathic pain. Each type of pain will have a unique presentation and require a unique treatment strategy. Since these two categories are not mutually exclusive a multimodal pain management strategy is often necessary.

The international pain study group has defined neuropathic pain as "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system", which includes direct damage to nerve endings, the peripheral or central nervous system [4]. Neuropathic pain has been estimated to have a prevalence from 6% up to 13% following TKA [5,6]. Diabetic neuropathy, fibromyalgia, complex regional pain syndrome (CRPS) and infra-patellar saphenous neuralgia are potential sources of neuropathic pain following TKA. Neuropathic pain may be described as dull and burning in nature. The patient may describe a history of pain being out of proportion to touch and commonly associated with

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some numbness. Unlike nociceptive pain, neuropathic pain is rarely relieved by NSAIDs and can be resistant to opioids, but it may respond well to anti-depressants or anti-convulsants that target the nervous system [7]. Strategies that use medications or procedural interventions that target the affected nervous system have proven to be useful in neuropathic pain following TKA for neuropathic symptoms such as CRPS, fibromyalgia and neuropathy. Buvanendran et al. [8] published a double-blinded, randomized, prospective clinical study that showed TKA patients who received oral pregabalin pre-operatively and for 14 days post-operatively had reduced rates of neuropathic pain (p -value = 0.001).

Nociceptive pain refers to noxious stimuli detected by sensory neurons and is caused by real or potential tissue damage [9]. Soft tissue or bony impingement, component loosening, fracture, ligamentous laxity, mal-tracking, patellar clunk, tendon snapping and bony erosion are all types of mechanical nociceptive pain generators. Opioids and non-steroidal anti-inflammatory medications target nociceptive pain generated in bone, tendon, ligament, synovium or peri-articular soft tissues. Nociceptive causes of pain are more often related to intra-articular or peri-articular pathology evoked by noxious mechanical stimuli that may be more readily identified on physical exam or imaging modalities when compared to neuropathic pain sources. However, long-term opioid use prior to TKA may lead to a paradoxical pain response, in which minimal noxious stimuli produces a hyper intense pain response due to nociceptive sensitization for chronic opioid use [10]. Obtaining a thorough history from the patient will help identify the type of pain they are experiencing and guide the appropriate treatment modality.

In addition to categorizing the type of pain being generated, a good history should note the onset of symptoms, alleviating/aggravating factors, and any symptoms within the ipsilateral extremity or spine. Additionally, details of their original TKA and any perioperative complications should be noted. Determining whether TKA pain is aseptic or related to infectious etiology should be prioritized in the work-up and this determination can often be supported by history alone. Patients describing post-operative wound complications, night pain, recurrent effusions, recent illness or systemic symptoms including fever must be evaluated for infection as source of their pain. Feelings of instability, crepitus, and start-up pain with ambulation in the absence of the aforementioned infection symptoms are suggestive of component loosening. Frequent and recurrent effusions can be seen in both instability and infection, so an equivocal history and exam should be supplemented through laboratory testing of infectious indices and possible knee aspiration [11]. Additionally, that pain may be the only symptom seen in a post-operative TKA infection our institution routinely obtains infectious indices in the setting of a chronically painful TKA.

Several studies have proposed algorithms to approach pain in TKA based on intra-articular versus extra-articular etiologies [12–16]. Reviewing the patient's comorbid conditions, such as diabetes, peripheral vascular disease, renal disease, and lumbar stenosis, can give clues to possible extra-articular causes of pain. In every patient with pain in the knee after

TKA, the ipsilateral hip, ankle and lumbar spine should be thoroughly evaluated. Approximately 5% of patients with hip arthritis will present with predominantly knee pain [11].

Although imaging and laboratory studies may ultimately confirm a diagnosis it is a diligent history and physical exam that will guide the correct diagnostic pathway.

3. Physical examination

The physical examination is the next step in evaluation of a painful TKA. The skin examination should identify effusions, warmth, point tenderness, previous scars, draining sinuses, vascular congestion, and other abnormal physical exam findings. Pigmentation changes in the skin related to metal hypersensitivity rashes are rare but can occur [17]. Lack of full active or passive range of motion at the knee, along with patellar mal-tracking may be indicative of component malposition, soft tissue impingement or arthrofibrosis. A complete ligamentous exam in full extension, mid-flexion, and flexion at 90° should be performed. Ligamentous imbalance in the coronal or sagittal plane should be noted and recorded in both flexion and extension. Observation of the patients gait pattern may identify subtleties that correlate with instability and pain such as a varus or valgus thrust or audible component abutment.

Examining the patient's ipsilateral hip for irritability should always be performed. Palpation of the greater trochanter, the iliotibial band, and Gerdy's tubercle can differentiate extra-articular bursitis from other causes of pain.

Patellar apprehension or clunk can be palpated while ranging the knee from flexion into extension. A loose patellar component can be identified with a positive grind test while applying pressure over the patella during range of motion.

Following a comprehensive history and physical exam radiographs and laboratory test will be useful adjuncts in a diagnostic pathway. Fig. demonstrates a systematic approach with diagnostic pathway for work-up of the painful total knee arthroplasty.

4. Imaging

Radiographic analysis for painful TKA includes standing full leg length mechanical axis films, anterior-posterior (AP) view, lateral view, and merchant/sunrise views. These are useful in assessing component size, position, and fixation. If serial x-rays are available they should be used for pre-operative and post-operative comparisons. Additional imaging is often ordered for further information. Computed tomography (CT) is useful to assess rotation of the femoral and tibial components, and is more accurate than x-ray [22]. Magnetic resonance imaging (MRI) is often utilized to rule out extra-articular causes of knee pain such as, lumbar degenerative disc disease and spinal stenosis, but can also evaluate intra-articular causes such as synovitis and arthrofibrosis.

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