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Surveillance of painful knee after total knee arthroplasty: Our experience at a tertiary care teaching hospital

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Abstract
Background: Persistent pain after total knee arthroplasty (TKA) is dissatisfying to the patient and frustrating to the surgeon. The purpose of this study is to evaluate the aseptic causes and clinical course of intractable pain following TKA.
Methods: Of the total 2,534 cases of primary TKA reviewed, 178 cases were classified as having aseptic persistent pain that was not resolved within 1 year after surgery. Except for the cases with periprosthetic fracture (56 knees), 122 cases of aseptic painful TKA were divided into two groups: intra-articular group (83 knees) and extra-articular group (39 knees).
Results: In the intra-articular group, the main reasons for pain were aseptic loosening (n = 40), polyethylene wear (n = 16), instability (n = 10), recurrent hemarthrosis (n = 5), patellar maltracking (n = 4), tendon ruptures (n = 4), and stiffness (n = 2). In the extraarticular group, 10 knees (25.6%) were found to have nerve entrapment in the spine, 6 knees (15.4%) were found to have hip osteoarthritis or femoral head avascular necrosis. The reasons for persistent knee pain in the remaining 23 knees (59.0%) still remain elusive.
Conclusions: Persistent pain after TKA originated from pathology of extra-articular origin in a considerable number of cases in this study. Therefore, it is important to perform thorough preoperative evaluations to reduce pain resulting from extra-articular causes. Furthermore, meticulous surgical procedures and optimal alignment are required to reduce pain of intra-articular origin related to implant wear, instability, and patellar maltracking.

Keywords: Non-infective, chronic pain, causes, total knee arthroplasty

Introduction
Total knee arthroplasty (TKA) is a very successful treatment for knee osteoarthritis (OA), a progressive musculoskeletal disorder that affects an ever-growing proportion of the population. The demand for prosthetic surgery increasing not only due to the aging of the population, but also for obtains quality of life preservation [1]. The indications of TKA are expanding also to younger patients such as implants and surgical techniques continue to improve. Usually this surgery leads to a significative improvement of symptoms; registries and meta-analysis report a satisfaction rate of 80 to 85% [2]. Nevertheless many patients suffer for different symptoms after this procedure [3] and several studies indicate a dissatisfaction rate of 15-30% after 3 months, in particular due to lack of functional improvement and persistent pain [4, 5]. Analysing these patients, most have no identifiable causes of pain and the symptoms getting worse with time despite treatments [6, 7]. A painful articulation could have a good objective evaluation, range of motion and correct implant positioning on x-rays.
The evaluation of painful TKA needs consensus regarding the definition of pain; in literature recent studies conducted utilizing the minimal clinical important difference (MCID) and the patient acceptable symptoms state (PASS) shows concordance and reliability in post TKA outcome evaluation [8]. Unfortunately the majority of studies are based on heterogenic values and subjects leading to difficult comparison. Another focus is the time of pain evaluation and in these terms lack of standardization doesn't allow to statistical analysis and strong evidences. Although these critical issues, the correct evaluation of painful TKA includes: clinical evaluation, serological investigation, diagnostic imaging and microbiological analysis in order to recognize the underlying cause.

Materials and Methods

Clinical evaluation

The history of symptoms pays a central role in the investigation: if the pain is the same before and after surgery, the cause could be not related to knee OA and the implant doesn't improve the condition, such as in case of avascular necrosis of the femoral head, hip arthritis, arterial insufficiency, aneurysm, thrombosis and diabetes neuropathy. Pain onset in first days after surgery should be investigated for acute infection, prostheses instability o misalignment. Inflammatory pain is usually continuous while when it appears with movement suggests a mechanic cause. Second onset pain could be related to loosing of the components, late posterior instability in poster stabilized TKA or late infections (that could be without typical signs like heat, redness and swelling). In case of persistent pain, also without increase of joint volume, chronic infections caused by anaerobic germs should be suspected [9]. Scar neuromas, tendinitis and bursitis of pesanserinus and femoral biceps are identified by palpation around the joint. In such cases local anesthetic injection improves rapidly symptoms and pain. Palpation is painful also in case of overhang, in particular due to protrusion of tibial component in the medial region (Figure 1). Evaluation of the vascular and neurological status is mandatory in order to find out neuritis, radicular compression or vascular insufficiency. In case of abnormal pain, complex regional pain syndrome (CRPS) should be considered. The prevalence is 21% at one, 13% a three and 12,7% at six months after TKA [10]. Common risk factors are pre-operative pain, anxiety and depression. Trophic changes, motor disturbance, oedema and joint stiffness characterizing this condition, usually pain is diffuse, with burning sensation that worsen with movement and cold.

Laboratory evaluation

Laboratory tests are mandatory when infection is suspected, in particular inflammatory activity while hemograms and leukograms are not specific especially in implants with chronic infections.

Assay of erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and procalcitonin (PCT) are commonly used to prove the suspicion of infection; nevertheless they present high sensitivity but low specificity, with high rate of false positives. The ESR peak is 5-7 days after surgery, while CRP peak is 2-3 days after surgery. Baseline values are reached respectively after three months and three weeks. High levels of ESR and CRP are related to infection with a sensitivity of 0.95, specificity of 0.93 and a negative predictive value of 0.97 [11]. In early postoperative days pay an important role serum level of interleukin 6 (IL-6) cause its rapid peak that comes baseline after 48 to 72 hours. Test of joint puncture is mandatory for suspected infection [12] with leukocytes count and cultures of aerobic and anaerobic bacteria. Results higher than 2500 leukocytes per high magnification field and about 60% of polymorphonulear leukocytes (PMN) are indicative of infection with a sensitivity and specificity of 98% [9]. Positive culture should be compared to the symptoms and blood samples, if contamination is suspected repetition of puncture is suggested. Parvizi *et al.* [13] published a diagnostic algorithm for TKA infection based on at least three aspiration, characterized by major and minor criteria. Recently several studies have purposed the assessment of α-defensin in the articular samples with encouraging result, but large-scale evidences are needed for state its significance for the diagnosis of periprosthetic joint infections [14].

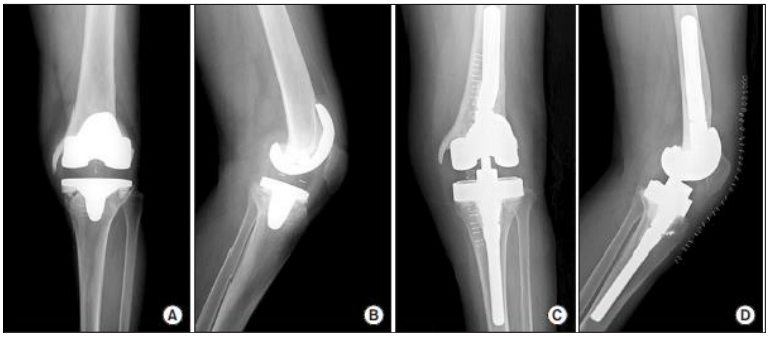

Fig 1: Postoperative 5-year anteroposterior X-ray (A) and lateral X-ray (B) showing subsidence of the femoral component with osteolysis greater than 2 mm in width around the prosthesis in a 66-year-old female. Anteroposterior X-ray (C) and lateral X-ray (D) taken after revision total knee arthroplasty.

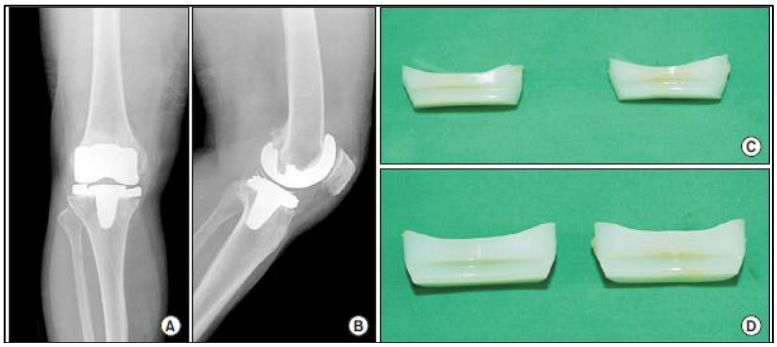

Fig 2: Postoperative 2-year anteroposterior X-ray (A) and lateral X-ray (B) showing a decrease in the femorotibial distance defined as the shortest perpendicular distance from the femoral condyle to the tibial baseplate. Intraoperative photographs of the thin worn polyethylene inserts (C) and the thick revised polyethylene inserts (D).

Results

The 122 painful aseptic TKA knees were largely divided into two groups according to the cause except for infection and periprosthetic fracture: intra-articular group (83 knees, 68.0%) and extra-articular group (39 knees, 32.0%). The mean age at the time of primary surgery was 69.5 years (range, 53 to 85 years) in the intra-articular group and 69.6 years (range, 57 to 91 years) in the extra-articular group. There were 51 males (36 in the intra-articular group and 15 in the extra-articular group) and 71 females (47 in the intra-articular group and 24 in the extra-articular group). There was no statistically significant intergroup difference in age, gender ratio, BMI, cause of primary surgery, implant type, and additional procedure ($p > 0.05$) (Table 1).

In the intra-articular group, the main reasons for pain were as follows: aseptic loosening (n = 40, 48.2%), polyethylene wear (n = 16, 19.3%), instability (n = 10, 12.0%), recurrent hemarthrosis (n = 5, 6.0%), stiffness (n = 5, 6.0%), patellar maltracking (n = 4, 4.8%), and tendon ruptures (n = 3, 3.6%; 1 quadriceps tendon rupture and 2 patellar tendon ruptures) (Table 2). Of the 40 patients with painful knees caused by aseptic loosening, 16 were relieved from persistent pain after revision surgery performed within 5 years and 24 patients underwent revision surgery after 5 years. Of the latter 24 patients, 2 complained of knee pain at the time of the last follow-up. In all 16 patients with polyethylene wear-related pain, diagnosis was made within a mean of 6.4 postoperative years and revision surgery was performed; however, 2 patients were not relieved from pain. Ten patients were diagnosed with unstable TKA and were subsequently revised (6 patients within 5 years and 4 patients after 5 years). All these patients did not complain of pain after revision surgery. In a majority of other knees where the causes of pain were recurrent hemarthrosis, patellar maltracking, tendon rupture, and stiffness, revision surgery was performed within 5 years. However, the condition became poor after 5 years in one of the patients with a ruptured tendon who showed only mild symptoms and active extension and walking ability at the time of onset. Pain was not resolved in 1 patient with stiffness. The pain in the extra-articular group (39 knees) could be due to hip or spine (Table 3). Thus, these patients were referred to other departments in our institute for evaluation of the hip, spine, or vascular problems. Ten knees (25.6%) had nerve entrapment in the spine, all of which were treated with conservative methods such as medication only, selective nerve root block, or epidural block. Pain in 8 of the 10 knees was resolved within 2 years with those treatment methods. Of the 39 knees in the extra-knee group, 6 (15.4%) were found to have hip osteoarthritis (n = 5) or femoral head avascular necrosis (n = 1).

Only one of them was treated with total hip arthroplasty. The rest of them were treated with conservative methods such as medication and hip joint injection. Of the six knees, pain was relieved in 2 (33.3%) including the patient with total hip arthroplasty. For the remaining 23 knees (59.0%), the reason for persistent knee pain still remains elusive. Seventeen (73.9%) out of the 23 knees had pain relief without any specific treatment other than the use of nonsteroidal anti-inflammatory drug for 2 years. The remaining 6 knees (15.4%) where the cause was not identified even after 2 years were reviewed at postoperative 4.2 • } 1.4 years. Overall, of the 39 knees in the extra-articular group, 27 (69.2%) did not experience significant pain after 2 years of follow-up.

Table 1. Demographic Data of Painful Aseptic Total Knee Arthroplasty*

Variable	Intra-articular group (n = 83)	Extra-articular group (n = 39)	*p*-value
Age (yr), mean (range)	69.5 (53–85)	69.6 (57–91)	0.560
Gender (male:female)	36:47	15:24	0.695
Body mass index (kg/m^2)	27.0 ± 3.4	27.4 ± 3.2	0.415
Rheumatoid arthritis	7 (8.4)	3 (7.7)	1.000
Cruciate retaining implant	43 (51.8)	17 (43.5)	0.441
Lateral release	10 (12.0)	4 (10.2)	1.000
Patellar resurfacing	1 (1.2)	0	1.000

Values are presented as mean ± standard deviation or number (%).
*Mann-Whitney *U*-test and chi-square test. The *p*-values shown are for intergroup comparisons. Significance was accepted for *p*-values of < 0.05.

Table 2. Cause of Pain in the Intra-articular Group

Variable	Intra-articular group (n = 83)	Early revisions (n = 58, ≤ 5 yr)	Late revisions (n = 81, > 5 yr)
Aseptic loosening	40 (48.2)	16	24
Polyethylene wear	16 (19.3)	0	16
Instability	10 (12.0)	6	4
Recurrent hemarthrosis	5 (6.0)	5	0
Stiffness	5 (6.0)	2	0
Patellar maltracking	4 (4.8)	4	0
Tendon rupture (patellar tendon, Q-tendon)	3 (3.6)	2	1

Values are presented as number (%).
Q-tendon: quadriceps tendon.

Discussion

TKA can provide a better quality of life by improving the range of motion and eliminating knee pain for patients who have chronic knee osteoarthritis. Therefore, postoperative pain is a major cause of dissatisfaction among patients after TKA. Studies have demonstrated that poor management of acute pain after TKA is strongly associated with development of chronic pain, emphasizing the importance of appropriate control of acute pain after TKA [15, 16]. Early diagnosis is very important for the treatment of intractable pain following TKA. A reoperation conducted without identification of a specific reason carries a high risk of failure [17, 18]. Therefore, this study was aimed at improving early diagnosis and facilitating appropriate treatment based on the identification of the underlying causes of pain after TKA. Some reports suggested that evaluating the character of pain thorough medical history or physical examination would be helpful in determining the cause of pain after TKA [7, 9, 10, 19]. Hofmann *et al*. [7] described several typical patterns of painful TKA and provided evidence for reasons of pain. Similarly, Dennis [9] classified such reasons according to the onset of pain. They suggested that component loosening or failure, ligamentous instability, or hematogenousbased infection would be the primary source of pain. For pain developing in months or years after TKA, prosthetic malalignment or no articular causes should be the first consideration. In this study, aseptic loosening, polyethylene wear, instability, recurrent hemarthrosis, patellar maltracking, extensor tendon rupture, and stiffness were categorized as intra-articular reasons of pain after TKA. Spine problems and hip diseases were categorized as extra-articular reasons. Al-Hadithy *et al*. [20] reported that pain after TKA had an unknown origin in most cases, and spine problems and hip osteoarthritis were the second most common causes of pain after TKA. In the present study, a considerable number of cases of aseptic painful TKA had an extra-articular origin, which could be managed with thorough preoperative evaluation on the nature of the pain and appropriate procedures such as epidural block in the perioperative period. There are numerous intra-articular causes of persistent pain after TKA. Sharkey *et al*. [6] suggested that polyethylene wear was the most common cause of early and late failures, and infection was most responsible (25.4%) for early failures. In another research, aseptic loosening (23.1%) was the most common cause of revision, whereas infection was the second common cause [21]. In this study, aseptic loosening, polyethylene wear, instability, and spine problems were all responsible for a high percentage of pain after TKA. We also demonstrated numerous intraarticular causes of painful TKA such as aseptic loosening, polyethylene wear, and instability. Meticulous surgical procedures and efforts to create optimal alignment and uniform tension throughout the range of motion are required to decrease the incidence of pain after TKA resulting from intra-articular causes. Despite the rigorous clinical and radiological evaluation, 23 knees (18.9%) were classified as having unknown causes in our study. Similarly, Dalury *et al*. [21] reported that pain after operation occurred in one in 8 patients despite the absence of clinical or radiological abnormalities. Therefore, a multidisciplinary approach involving a physiotherapist and a pain management team would be helpful in overall management of pain even if the exact etiology of painful TKA is unidentified [19]. This study was performed to evaluate the causes of persisting pain after TKA and reviewed over 2,500 patients. However, there are some limitations of the present study. First, our study was not standardized in terms of surgical method including the variable prosthesis and additional procedures such as lateral release and patellar resurfacing. Thus, studies using a standardized implant and procedure are required. Second, we did not evaluate the radiological outcomes such as the postoperative mechanical axis and prosthesis position although it is known that postoperative radiological malalignment is related to postoperative persistent pain. Lastly, we did not investigate correlations between pain after TKA and psychological problems, although many authors have reported that psychological distress had great effect on pain after knee or hip arthroplasty [22-24]. In conclusion, surgeons should carefully evaluate the preoperative nature of pain to decrease pain of extra-articular origin after TKA. Furthermore, meticulous surgical procedures and optimal alignment should be performed to reduce pain resulting from extra-articular causes such as implant wear, instability, and patellar maltracking.

Conclusions

Patients with painful TKA should be analysed systematically and causes should be identified and treated in the early stages to avoid the onset of chronic symptoms. Unfortunately the obvious reasons are not so common and often there are several "small mistakes" that lead to failure of the implant. Therefore a systematic approach is necessary and should repeated until reaching an adequate conclusion. The management requires a multi-disciplinary approach including surgeons, physiotherapists, pain specialists, infective disease specialists and patient's general practitioner. Only after a diagnosis revision surgery is allowed, otherwise the risk is to simply "repeat surgery" and fall in the same errors. For understand the complexity of these patients the literature report that although the cause is clear and correct with the surgery, good results are obtained only in 25% of the cases.

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