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Original article

The painful knee after total knee arthroplasty: evaluation and management

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Summary. Total knee arthroplasty (TKA) is the treatment of choice for end-stage osteoarthritis of the knee. The aging of population and the need to maintain high quality of life have increased the demand for TKA. Although considered a successful procedure, 15-30% of patients presenting persistent pain. The management of these patients requires a clinical, laboratory and radiological assessment in order to address the underlying aetiology. There are several causes of pain, divided in joint and non-joint related, which should be diagnosed and treated promptly. Patients with unexplained pain should be treated conservatively since a plausible reason has been identified. (www.actabiomedica.it)

Key words: knee, arthroplasty, painful , evaluation, management

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.

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 posterostabilized 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 pes anserinus 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.

Figure 1. Under load x-rays show TKA with overhang of the tibial component

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).

Radiological evaluation

Under load full leg antero-posterior, lateral and axial patella view x-rays are necessary to evaluate a painful TKA. Possible findings are the presence of radiolucency, varus-valgus malalignment, malrotation, periosteal reaction, gas in soft tissues, signs of loosening, joint space asymmetry, component sizes, polyethylene abrasion, stress fracture and heterotopic ossification. Lateral view shows tibial slope, patellar height related to joint line and sagittal alignment of femoral and tibial components. Also examination of preoperative x-rays is important for determinate previous joint line, posterior femoral offset and patellar position.

In case of evidence of loosening or overload at prostheses-bone interface a Technetium-99m scintigraphy is indicated (2). This is not a screening tool and present high sensitivity but low specificity. Because of the physiological bone remodelling before one year after surgery, is not suggested in this period. Evaluation of serial examination and amount of uptake, diffuse and disproportional, should be indicating TKA loosening (Figure 2). Even after these results, with this exam is impossible to differentiate between septic o aseptic loosening. Association with leukocytes labelled with Indium-111 scintigraphy improve sensitivity and specificity to 85% (15)

Ultrasonography (US) is conducted if abnormalities in superficial soft tissue are suspected, particular collateral ligament lesions and tendon injuries.

Computer tomography (CT) pays a fundamental role in description of osteolysis areas (16) and in case of suspected fracture. Moreover should be used for diagnosis of malrotation of femoral or tibial components.

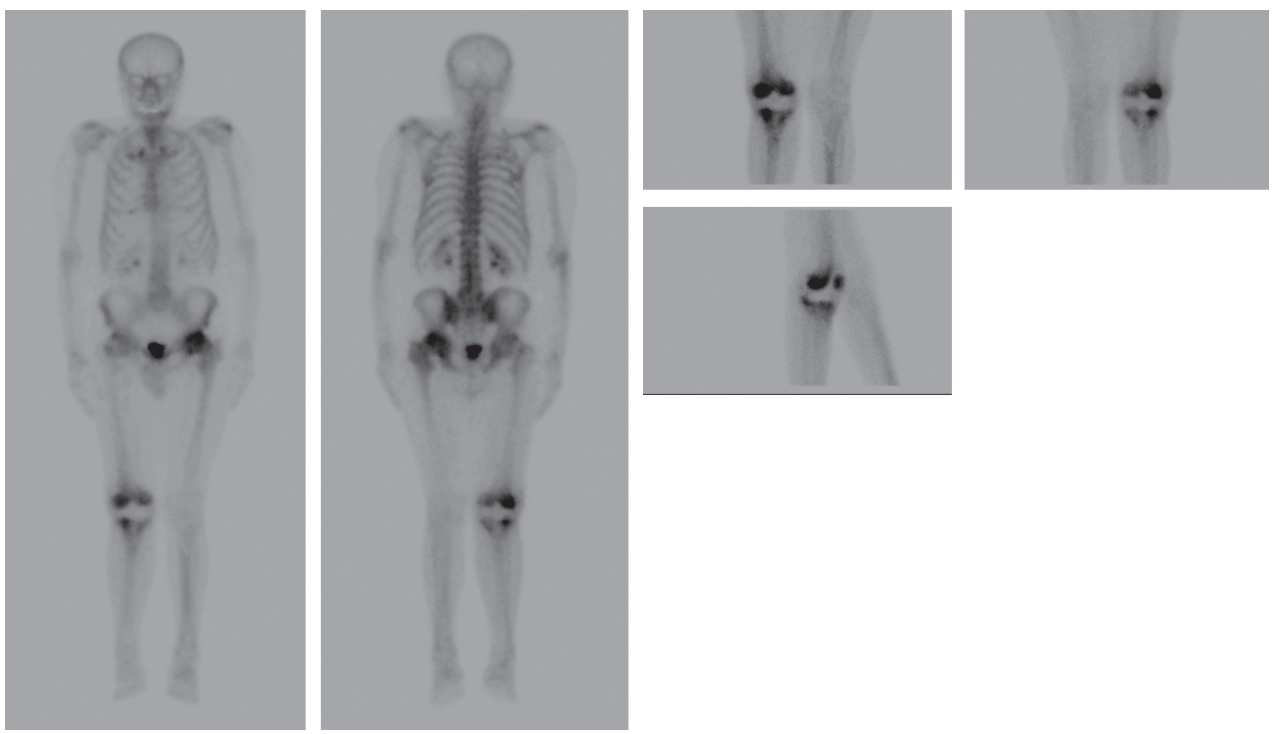

Figure 2. Bone scintigraphy shows high uptake at the rigth knee TKA

Management of pain

According to the literature, pain after TKA is due to in to joint related, non-joint related and unexplained causes.

Joint related causes:

Infections, instability, loosening of implant, fractures, femoropatellar problems, other causes (component overhang, irritation of lateral facet of the patella, patellar clunck syndrome, popliteal tendon dysfunction).

• Regarding **infections** decision-making process depend on time of onset, organism, conditions of tissues, host situation and whether the infection is superficial or deep.

Treatment with antibiotic therapy by vein, arthroscopic or open debridement are conducted in case of acute infection, while in chronic infections one or two stage revision is required (Figures 3, 4) (17-19).

Figure 3. Under load x-rays show TKA with chronic infection and signs of loosening (antero-posterior view)

Figure 4. Under load x-rays show TKA with chronic infection and signs of loosening (lateral view)

• **Instability** is often in association with pain because of abnormal stresses discharge on the knee. Acute onset can depends on traumatic events regarding ligaments, but more frequently the focus is problems in balancing of soft tissues during the surgery (20). Flexion instability is due to incorrect balancing of flexion and extension gaps, in frontal plane pay a crucial role stability of medial and lateral collateral ligaments.

Late instability is secondary to malalignment (Figures 5A, 5B), wear of the polyethylene and loosening of the components.

The treatment of TKA instability is demanding, start with lose weight in obese patients, rehabilitation in patients with muscular weakness but often revision surgery is mandatory in order to restore soft tissues tension and flexion/extension balancing. Ligaments procedure or reconstructions are indicating only in association with constrained device (21).

• Component **loosening** and osteolisys due to polyethylene wear are common causes of painful TKA.

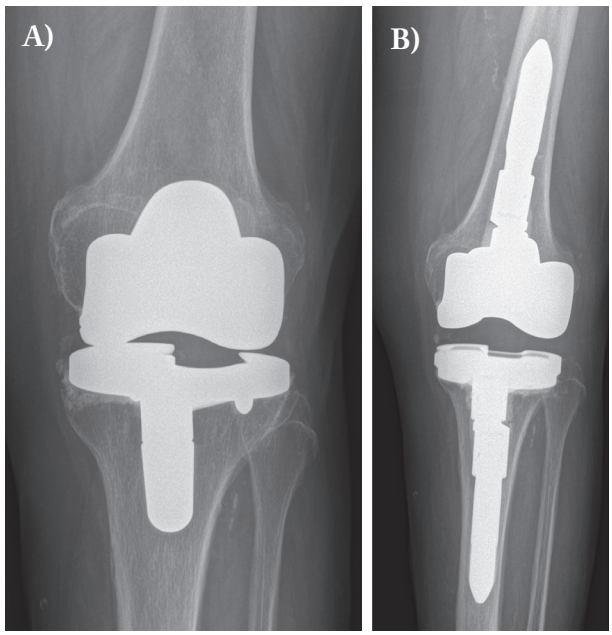

Figure 5. A) X-rays show TKA with tibial component malalignment; B) X-rays after revision implant

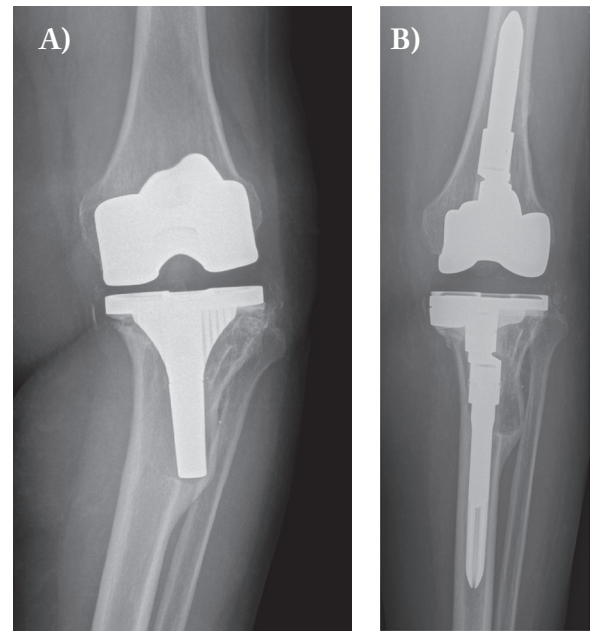

Figure 6. A) X-rays show TKA with aseptic loosening; B) X-rays after revision implant

Improvement of tibial component locking mechanism, design and procedure of sterilization reduced the incidence of these conditions, that remain 10% of TKA revision according to Schrorer et al (22). The diagnosis of polyethylene wear is based on signs of loss of liner height, bone reabsorption and subsidence. Moreover inadequate initial fixation because of poor cementing technique or tibial component design could lead to loss of fixation and pain. The treatment is usually based on revision of the implant (Figures 6A-6B).

• **Periprosthetic frature** (PPF) after TKA is a reported cause of painful knee and age over 70, high activity level, female gender, steroid therapy, rheumatoid arthritis and osteoporosis are related risk factors (23). The majority of fractures are localized in the supracondylar area above the prostheses (0,3-2,5% of TKAs) often due to low energy torsional or axial traumas (24). In literature biomechanical studies reported that anterior femoral notching increase the risk of fracture (25,26), but other authors in clinical series don't confirm an independent role in fracture inducing (27,28). PPF of the patella and tibial bone are less common, related to osteolisys with subsidence and malalignment but also due to intraoperative manoeuvre (29). All these fractures are diagnosed with x-rays and the treatment depends of location, fracture displacement, prostheses stability and patient factors.

• **Anterior knee pain** (AKP) is common problem that affect patients after TKA with a prevalence of 5-10% (30). In literature several studies are conducted about the associations between AKP and patellar resurfacing, but is still debating the indication of patellar replacement in TKA and if this procedure resolve the problem of AKP (30,31). Also the design and the congruency of femoral and patellar component are potential source of pain and patellar maltracking. Moreover internal rotation of the femoral and tibial elements can cause femoropatellar instability and pain (32) and when suspected a CT scan is mandatory. However also soft tissue structures should be considered in diagnosis and treatment of AKP; if the pain is related to malrotation of the component revision surgery is required (Figure 7).

• Protruding of femoral and tibial component (**overhang**) are quite common and lead to pain caused

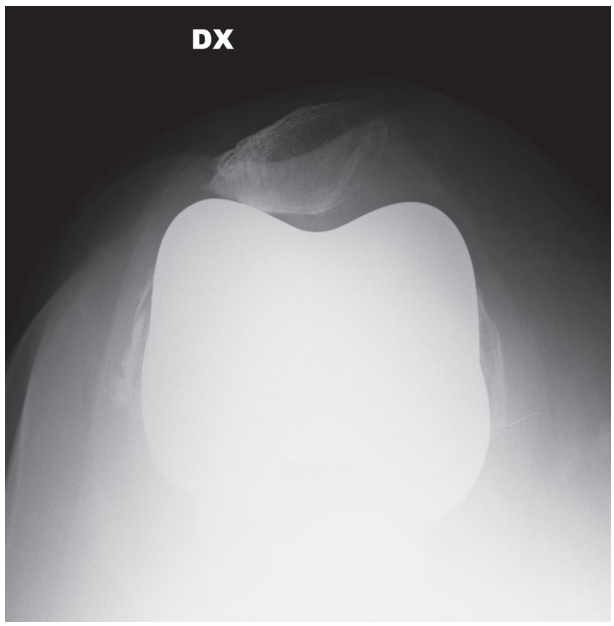

Figure 7. X-rays axial view shows TKA with patellar maltracking

by impingement and distension of collateral ligaments. Often medial tibial overhang acting as medial osteophyte lead to medial collateral ligament irritation. The only solution is surgical with component replacement (9,33).

Another pain situation is generating by incorrect resection of lateral patellar osteophyte or small/medially placed patellar component that lead to **irritation of lateral patellar facet**. The treatment is commonly changing the component or performing patellar replacement.

Patellar clunk syndrome and popliteal tendon dysfunction are reported causes of pain and the treatment is respectively with eventual resection of the fibrosis after observation and arthroscopic release or correction of the component size (34).

Non-joint causes:

Soft tissue irritation, neurological disease, hip disease, vascular disease and reflex sympathetic dystrophy.

• Potential causes of **soft tissue irritation** are impingement due to oversize components, overuse of muscles and tendons (i.e. patellar tedon, quadriceps tendon, iliotibial band and pes anserinus tendon) related to aggressive kinesioterapy.

Also hip necrosis and osteoarthritis, arterial insufficiency, aneurysm, thrombosis, spine disorders and peripheral neuropathies pay a role in painful TKA. A common condition reported in literature is the injury to the infrapatellar branch of saphenous nerve (35).

Neuropathic pain incidence is about 11% after primary implants, including dysaesthesia, allodynia and hyperalgesia. Potential treatment is based on topical application of capsaicin cream or 5% lignocaine plasters (36) in association with scar massages.

Complex regional pain syndrome (CRPS) is a less common cause of painful TKA, characterized by skin, joint and muscle pain in association with weakness, spasm and tremor. Causes and pathways aren't well known but recent studies pay attention in central sensory motor processing and integration with peripheral and sympathetic mechanisms (37). Fundamental steps are early diagnosis and early treatment with analgesics that allow patients to perform active rehabilitation programmes of desensitisation and strengthening. The prognosis of CRPS is variable and often patient sustain chronic symptoms; nevertheless long-term studies reported prognosis similar to uncomplicated TKA (38).

Finally younger age, female gender and intense preoperative pain are factors associated with high incidence of postoperative pain (39-42). As well as patients suffer for migraine, fibromyalgia and irritable bowel syndrome are prone to persistent pain after TKA. A recent meta-analysis report that poorer mental health status and greater preoperative pain are the stronger independent predictor factors of pain after TKA (42)

Studies in literature claim that after one in every 300 TKA suffer for pain without any know explanation (43). Brander et al report that one year after surgery 13,1% of the patients had unexplained pain (40). Other authors found that more than half of these patients show improvements without revision surgery (44). However in case of revision the result in these patients are at best unpredictable (45) and with a successful rate of only 17% (46).

Regarding unexplained pain more studies are necessary, probably superficial investigation on metal or bone cement allergies or sensitivity could play a role in this condition (47,48).

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 (49). 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 (46).

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