MENTORS IN ORTHOPEDICS

BASIC MOST IMPORTANT TIPS AND TRICKS FOR TREATMENT OF THE NON-INFECTED UNHAPPY TOTAL KNEE ARTHROPLASTY - WHAT TO DO?

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SUMMARY

Background: Approximately 10% to 30% of patients experience persistent pain or dissatisfaction following primary total knee arthroplasty (TKA), with global registries reporting revision rates between 3% and 12%. Common failure modes include aseptic loosening, infection, instability, and malalignment. Addressing these complications requires a systematic approach to differentiate between intra-articular and extra-articular etiologies.

Objective: This article delineates a standardized diagnostic algorithm and therapeutic framework for the management of the painful or failing TKA, emphasizing the "puzzle concept" to correlate clinical symptoms with objective pathological findings.

Key Points: A comprehensive diagnostic work-up is essential, incorporating detailed medical history to identify specific pain patterns, such as instability-related lancinating pain or patellofemoral-related pain during stair descent. Radiographic evaluation must include weight-bearing, patellar skyline, and whole-leg views to assess component positioning and mechanical axes. Advanced imaging, specifically combined SPECT/CT, provides integrated mechanical, structural, and biological data for precise component measurement in three planes. Differential diagnoses should consider periprosthetic joint infection, metal hypersensitivity, and nerve entrapment, such as the infrapatellar branch of the saphenous nerve. Surgical intervention is reserved for cases with a confirmed mechanical or biological cause. Revision strategies utilize zonal fixation across the joint, metaphyseal, and diaphyseal regions, often requiring increased prosthetic constraint ranging from posterior-stabilized to hinged designs.

Conclusion: Successful revision TKA depends on the precise identification of failure modes through a standardized multidisciplinary algorithm. Surgical intervention should only be pursued when objective diagnostic findings align with patient symptoms and expectations.

KEYWORDS

Arthroplasty, Replacement, Knee; Reoperation; Joint Instability; Knee Prosthesis; Single Photon Emission Computed Tomography Computed Tomography

About 10-30 % of the patients after total knee arthroplasty (TKA) report ongoing or recurrent pain or are not satisfied after TKA and some require subsequent revision surgery. The number of revision TKAs is rising in many countries all over the world. National registries report revision rates between 3 and 12 %, depending on the length of the observed period and included interventions (1,2). Previous studies have analysed failure modes after primary TKA. According to those results, five most common failure modes could be identified (1,2) (Table 1)

Infection
Loosening
Instability
Arthrofibrosis
Osteolysis.

Table 1: most frequent failure modes

Most data on the causes of TKA failure and further revision surgery are obtained from national joint registries, health care providers and multicentre studies (1,2). This article aims to emphasize on basic tips and tricks for revision total knee arthroplasty (TKA) and represents the perspective of a specialized revision center.

DIAGNOSTIC ALGORITHM

Standardised diagnostic algorithm should be run in specialized centers for knee arthroplasty including revisions! Such a diagnostic algorithm (Fig.1) helps to standardize diagnostics and subsequent treatment of patients with problems after TKA. This algorithm needs to be adapted to local hospital conditions.

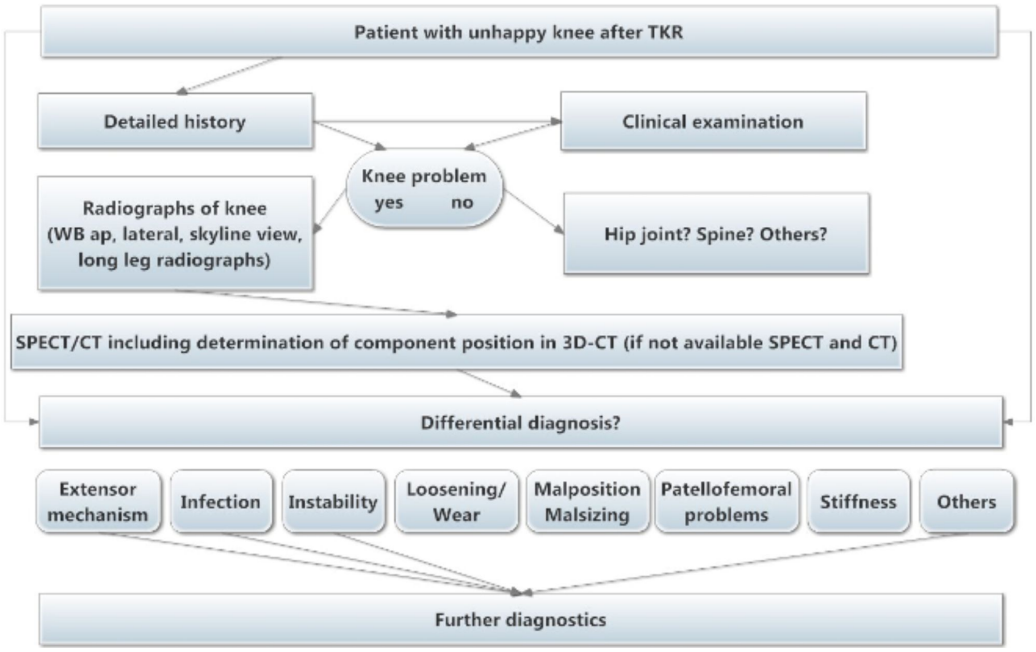

Figure 1 : Algorithme standardisé pour les patients malheureux après une arthroplastie totale du genou (ATG).

A variety of different causes for pain after TKR have been identified during the last decades which could be responsible for problems after TKA (1,2). One should differentiate between intra- and extra-articular causes for problems after TKA. An optimal diagnostic algorithm should be able to identify all causes and not only the most common ones. Our detailed diagnostic algorithm is based on the four columns (table 2).

Detailed medical history
Thorough clinical examination
Microbiological and allergological work-up
Radiological and nuclear medicine imaging and imaging analysis

Table 2: Four columns of diagnostic algorithm

Every patient presenting with pain or problems after TKA should undergo a standardized diagnostic work-up including a detailed medical history, laboratory work-up and thorough clinical and radiological examination. Its role in the establishment of the optimal diagnosis and subsequent treatment cannot be overestimated. The first key questions to be answered are: Is it a knee problem? Do we encounter an articular or an extra-articular problem?

HISTORY AND CLINICAL EXAMINATION

The medical history should consist of a set of standardized questions such as: When did the pain start? Is the pain different than before TKA? Where is the pain located? Does the pain radiate? Do you feel stable when asecending or descending stairs? What are the factors to alleviate or worsen the pain? Are there any provoking factors? Additional questions should aim to better understand if the pain character (e.g. sharp, dull, burning), the intensity, the chronicity as well as the location of the pain experienced.

There are typical pain patterns related to different pathologies. However, the knowledge among knee surgeons about this issue is scarce. In a landmark study of a local registry using prospectively collected data of 97 painful primary TKA patients Mathis et al. identified specific pain patterns and linked these to underlying pathologies (3). All patients followed a standardized diagnostic algorithm, which led to a diagnosis that set the indication for revision surgery (3). Character, location, dynamics, and radiation of pain were systematically assessed and correlated with the underlying pathologies. Most frequent pain characters were pricking/lancinating (45.7%), pinching/crushing, and dull/heavy (38.6%); 89.5% of all patients localized their knee pain anteriorly; 48.1% reported pain aggravations by descending stairs (3). Radiating pain was reported in 14% of the patients. Patella-related problems (56.7%) and instability (52.6%) were the most frequent pathologies. Based on correlations between the characteristics six specific pain patterns were identified. The most outstanding ones include the following: pattern 1, instability is associated with jumping/shooting, pricking/lancinating and tugging/wrenching pain, and aggravated by chair raising and starting; pattern 6, pain aggravation by descending stairs is associated with anterior and lateral jumping/shooting, tingling/stinging and sharp/lacerating pain character, and TKA positioning and patella baja (3).

The detailed patient`s history already finger points towards the four major subjects of complaint (Table 3).

Pain
Stiffness
Instability
Swelling

Table 3: four major subjects of complaint

Frequently a combination of these problems is present. Stiffness is either objective and reflected by decreased range of motion (flexion and/or extension) or more a subjective feeling and represents just the feeling of a band-like tourniquet around the knee joint. Instability is the feeling of the knee giving way and not having full control. Instability can be felt in extension or flexion or even combined. Swelling is a typical symptom for infected knees after TKA, but can also be due to instability, rheumatoid disease or less frequently metal hypersensitivity.

IMAGING STUDIES

Assessment of preoperative radiographs is important as the degree of preoperative osteoarthritis is known to be an important predictor of outcome after TKA and these give insight into the change of alignment (4,5). If a knee problem is suspected standard radiographs (anterior-posterior and lateral weight bearing, patellar skyline view) should be performed. A frank component malposition, polyethylene wear, component over- or undersizing, component overhang, notching, periprosthetic fractures, overstuffing or extensive loosening can be detected. Whole leg radiographs are necessary for the assessment of the mechanical and anatomical knee axes. A patella baja or alta can be evaluated on lateral radiographs with the knee in 30° flexion. Stress radiographs in comparison to the contralateral side or fluoroscopy are performed in suspicion of instability or impingement (Fig 2) (6).

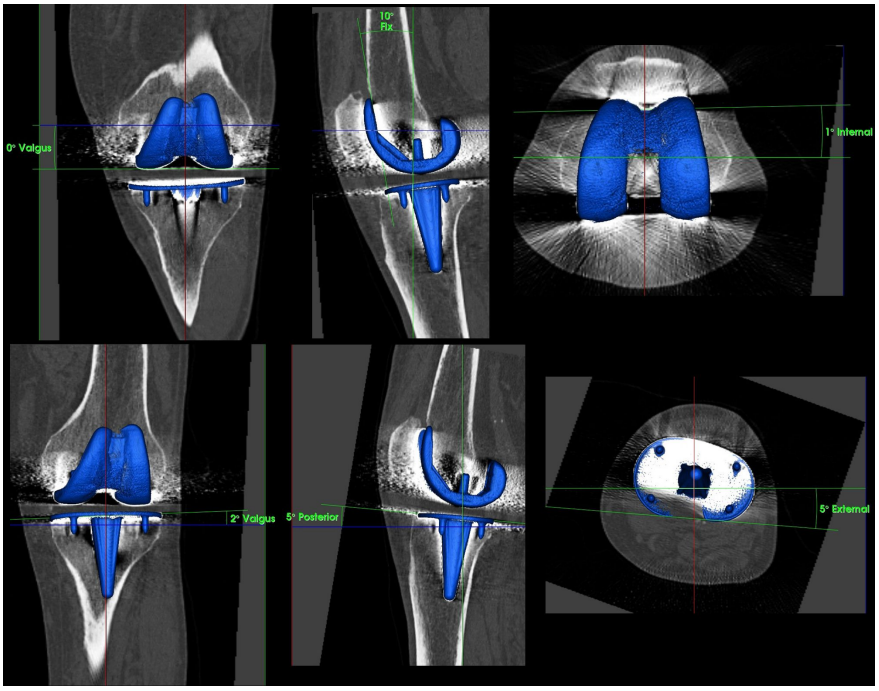

Figure 2 : Stress radiographs as part of the diagnostic algorithm

Stress radiographs should be performed in full extension and 15-20° flexion for varus-valgus stress and in 30° and 90° flexion for anterior-posterior stress (6). A Kanekasu view x-ray is helpful to detect asymmetric medial or lateral flexion instabilities. In all cases preoperative radiographs should be assessed for the degree of OA. It is also increasingly important to analyse the preoperative individual knee phenotype as we have understood that postoperative alignment and laxity can only be interpreted when you know the preoperative situation (4,7).

One decisive part of our routine diagnostic work-up is combined single photon emission computerized tomography (SPECT) and computerized tomography (CT), which is called SPECT/CT. Our SPECT/CT imaging protocol includes accurate determination of TKR component position on 3D-CT. SPECT/CT is increasingly recognized in orthopaedics and particularly for the evaluation of unhappy patients after TKA (8-10). It is our opinion that there is no place for conventional bone scans or SPECT alone. If SPECT/CT is not available one can perform a bone scan and CT separately. However, then the additional benefits of hybrid bone imaging such as combined mechanical (anatomical and mechanical alignment, TKA component position), structural (CT) and biological (SPECT) information cannot be used (8-10).

Femoral and tibial TKR component position should be determined in the coronal (varus-valgus), sagittal (flexion-extension) and axial plane (internal rotation-external rotation). The measurements are performed on 3D-CT using a customized software solution (Fig. 3).

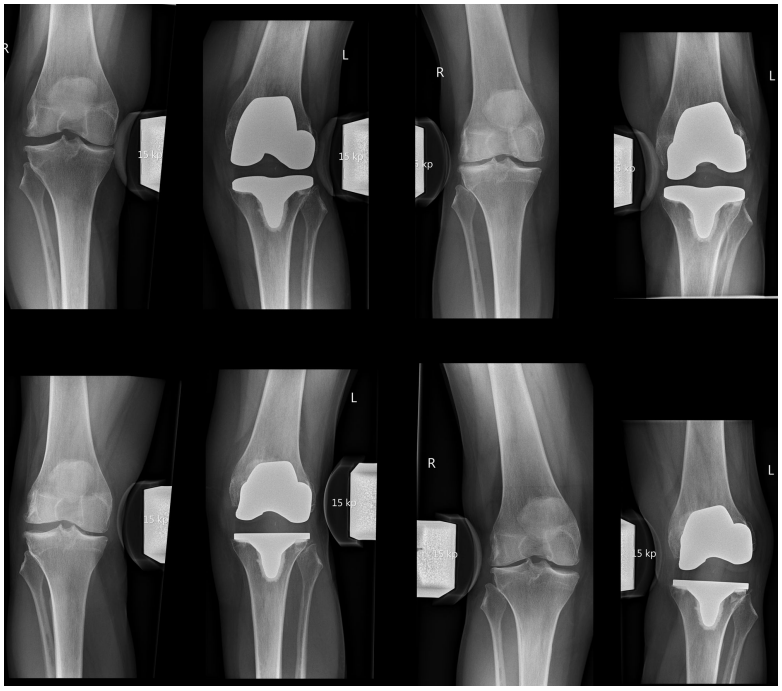

Figure 3: Measurement of femoral and tibial TKR component position using a customized software solution.

ADDITIONAL TESTS

Finally, all information obtained is analysed and weighted by the orthopaedic surgeon and one or several differential diagnoses are established. In case of suspected infection, instability and metal allergy additional diagnostic tests, lab work and imaging is indicated. Diagnostic infiltrations might add in cases of chronic insertion tendinopathy or suspected nerve entrapment syndromes to better understand the causal relationship. A frequent problem after TKA is an entrapment or the lesion of the infrapatellar branch of the saphenous nerve crossing the incision site (Fig 4) (11).

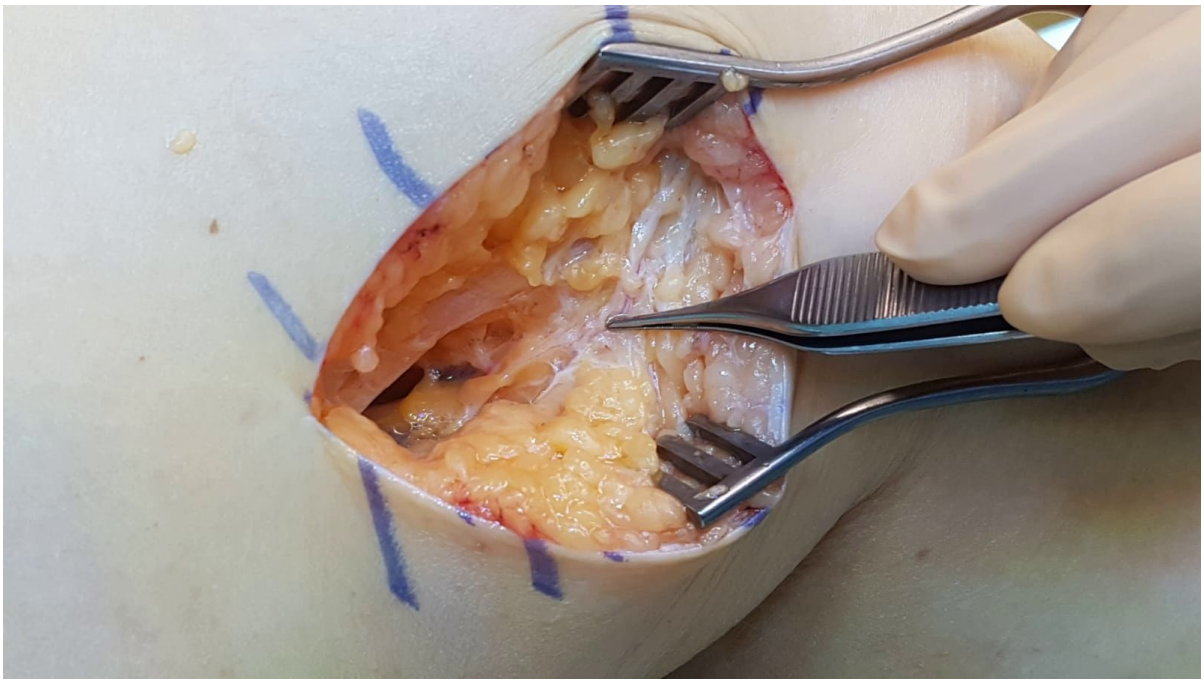

Figure 4: Entrapment of the infrapatellar branch of the saphenous nerve

MRI is beneficial for the assessment of extensor apparatus problems and muscle wasting, as well as ligamentous instabilities. The diagnostic algorithm (Fig.1) helps to standardize the different diagnostics steps. Establishment of the correct diagnosis is like a puzzle where each diagnostic component adds to the picture ("puzzle concept").

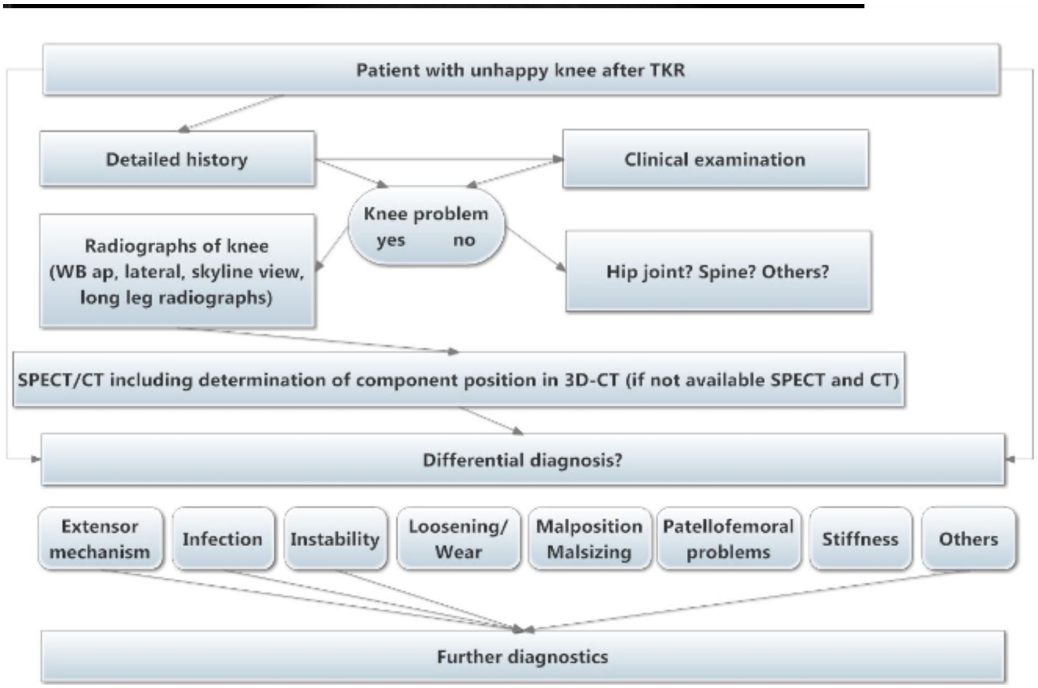

Figure 1 : Algorithme standardisé pour les patients malheureux après une arthroplastie totale du genou (ATG).

The better the diagnostic work-up the better the final diagnosis. A better and more accurate identification of the patient`s cause of the problems improves patients` outcomes after treatment if non-surgical or surgical.

"A LA CARTE" TREATMENT

The pertinent question is when and how to treat an unhappy patient after TKA. The mainstay of treatment is non-operatively including functional training and all kind of physical therapy, specialized pain therapy, infiltrations, bracing as well psychological support. All patients should undergo intensive non-surgical treatment first.

The surgical treatment depends on the causes identified using the diagnostic algorithm. There is no revision surgery for unclear pain. Only when the puzzle forms a nice picture and the diagnostic findings perfectly match with the patient's symptoms, a revision surgery should be considered (Fig 5, 6).

Figure 5: Patellar skyline view and stress radiographs indicating a patellofemoral maltracking and severe medial-lateral instability

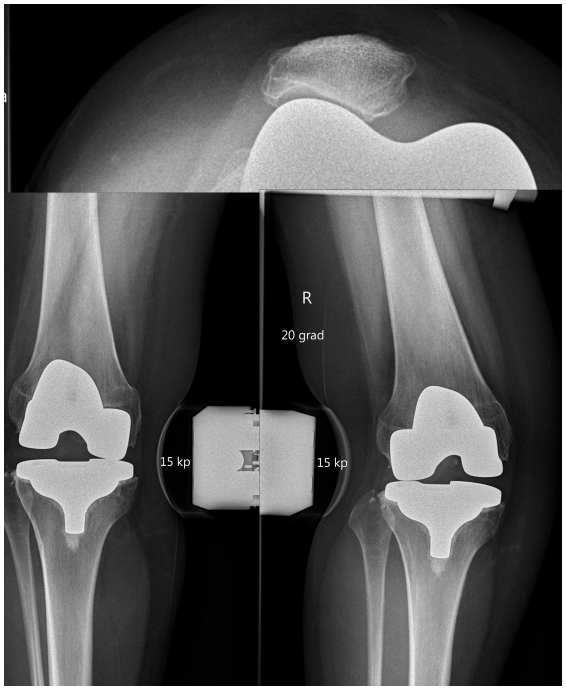

Figure 6: Recurrent Baker cyst problem after TKA

In such a case it is highly important to meticulously discuss the patient`s expectations. Possible treatment options are the change of polyethylene inlay to a thinner or thicker one, a partial exchange of the prosthesis or a complete exchange of the prosthesis.

An isolated exchange of the inlay is however rarely indicated (e.g. poly wear) as often the knee is not well aligned or balanced. A partial exchange is indicated when loosening of only one TKA component is seen. The most common TKA revision is the complete exchange of both components. Generally, at least one higher constraint is used for revision TKA. Meaning a previous CR TKA is revised to a PS TKA. A PS TKA is revised for a semi-constrained (LCCK- limited condylar constraint) TKA and a LCCK is revised to a rotating or pure hinge TKA (Fig 7) .

Figure 7: Typical revision total knee prostheses (left- hinge type, right- semi-constrained with a tibial metal sleeve for additional metaphyseal fixation)

For fixation and compensation of bone loss several different concepts exist. One has to understand the concept of zonal fixation (12). Based on this the revised TKA needs to be well fixed in at least two of the three fixation zones (joint, metaphyseal, diaphyseal). The fixation generally can be cemented and/or uncemented. For fixation in the metaphyseal zone sleeves and cones can be used. For fixation in the diaphyseal region either uncemented press-fit stems or cemented stems can be used. All these systems should be available in places in which revision TKA is performed. In summary, the diagnostics and treatment of an unhappy knee after TKA is a specialized one and requires a profound understanding and technical skill-set of a specialized knee revision surgeon (Fig 8). Only when the cause(s) of the problem are identified, revision surgery should be performed.

Figure 8: The challenge in revision TKA- which approach to choose? Always go for the most lateral one!

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