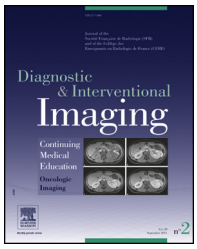
Diagnostic and Interventional Imaging (2016) **97**, 809—821



CONTINUING EDUCATION PROGRAM: FOCUS...

Imaging of knee implants and related complications

C. Cyteval

Service d'imagerie médicale, hôpital Lapeyronie, 371, avenue du Doyen-Gaston-Giraud, 34295 Montpellier cedex 5, France

KEYWORDS
Implant;
Knee;
Complication;
Imaging

Abstract Various types of knee arthroplasty implants are available depending on the number of knee compartments to be replaced and ligament stability. Unlike unicompartmental arthroplasty, the aim of total knee replacement is to maintain normal knee alignment. EOS X-ray imaging in the coronal and sagittal planes is the best modality for measuring the reference axes of the knee, but may by complemented by CT scans in the transverse plane. In addition to implant-related complications such as loosening and polyethylene wear, complications of the knee extensor mechanism are sometimes observed. Conventional radiography remains the first-line diagnostic modality in the event of post-knee replacement pain or instability. Ultrasound and CT imaging may also be helpful to make diagnosis.

The aim of knee replacement surgery, whether partial or total, is to provide a new long-lasting knee joint that is stable, aligned and painless, and ensures optimal use for the patient. The purpose of this article is to help radiologists:
- determine what kind of implant they are dealing with;
- recognize the signs of inappropriate placement;
- detect mechanical complications and contributing factors;
- detect or suspect infection.

E-mail address: c-cyteval@chu-montpellier.fr

http://dx.doi.org/10.1016/j.diii.2016.02.015

Types of knee replacement implants

The key feature distinguishing between the different types of implants is the presence of not of a physical link between the femoral and tibial components. There are hence two main groups of implants: constrained or ''hinged'' implants, and non-constrained implants [1].

Constrained implants

These hinged implants are used for patients with severely damaged knee ligaments. The femur and the tibia are linked together via a hinge mechanism in the horizontal plane that allows flexion-extension movements (Fig. 1). More recent hinged implants (second and third generations) also allow some rotation around a vertical post in the tibial baseplate.

Non-constrained implants

Non-constrained or semi-constrained (sliding) implants are designed to imitate normal physiological knee movement (flexion-extension, varus-valgus, rotation) (Fig. 2). They rely on the patient's collateral ligaments for stability. Depending on the number of compartments replaced, non-constrained knee implants can be further classified into unicompartmental implants, bicompartmental implants, and tricompartmental or total knee implants.

Unicompartmental implants

Unicompartmental implants are used when only one bone compartment is replaced. The anterior cruciate ligament (ACL) must be intact, and preoperative MR imaging can sometimes be justified to ensure this is the case. The two following types of implant are used depending on which compartment is replaced.

Tibial-femoral unicompartmental implants

The implant consists of femoral and tibial components that replace either the medial or lateral compartment (Fig. 3).

A unilateral metal femoral component replaces the inferior and posterior surfaces of the native condyle, and a unilateral metal tibial baseplate is inserted into the tibia.

The metal components are separated by a polyethylene insert that is either attached (fixed-bearing prosthesis) or not (mobile-bearing prosthesis, only for medial compartment replacement) to the tibial baseplate.

Patellofemoral implants

The native trochlea is replaced by a metal trochlear component that faces a polyethylene patellar component.

Bicompartimental implants

Both the medial and lateral tibial and femoral compartments are replaced at the same time. The native patella is retained. The criteria for implantation and the surgical technique are identical to those for total knee replacement and, therefore, will not be further described here.

Tricompartmental implants

Tricompartmental implants are used in total knee arthroplasty (TKA) (Fig. 4). All tibial-femoral and patellofemoral compartments are replaced by the following four components:

- a metal femoral component consisting of two condyles and a trochlea;
- a metal tibial baseplate;

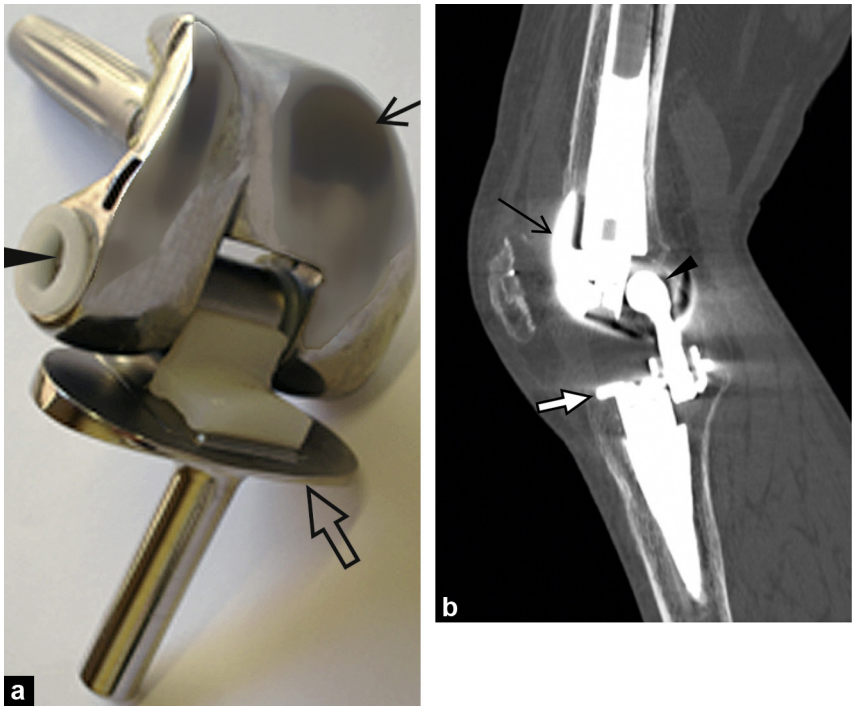


Figure 1. a: hinged implant; b: CT image in the sagittal plane. Femoral condyle (arrow); tibial plateau (hollow arrow); flexion axis (arrowhead).