Loosening of total knee replacement prosthesis - imaging features

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Learning objectives

Imaging evaluation of aseptic and infective loosening usually involves conventional radiographs and nuclear imaging. To be able to identify patterns of uptake on Tc99m MDP scan and In111 white cell scan in infective and aseptic loosening.
Background

Total knee replacements have a 10- to 15-year survival rate greater than 90%. Despite the long term success of knee replacements, failure does occur.

Common causes of failure include aseptic loosening, instability, infection, polyethylene wear with or without particle disease (osteolysis) and extensor mechanism failure.

The most common cause of early failure (< 2 years after initial surgery) are infection and instability. More than 2 years after primary implantation, the most common causes of failure are polyethylene wear and aseptic loosening.
Imaging findings OR Procedure Details

The most common cause of early failure (< 2 years after initial surgery) are infection and instability. More than 2 years after primary implantation, the most common causes of failure are polyethylene wear and aseptic loosening.

Periprosthetic infection

The prevalence of deep infection after TKA is approximately 0.4-2% but it is higher (up to 10%) in revision arthroplasty. The cause is usually haematogenous seeding associated with a distant infection. The diagnostic work-up for infection includes ESR and CRP and joint aspiration for suspected infection.

Radiographic findings of infection may vary from normal to bone destruction mimicking loosening. Soft tissue gas, secondary to gas-forming organisms is pathognomonic but rare. Differentiating aseptic from infective loosening often cannot be made on plain radiographs.

Tc99m triple phase bone scan findings of infected TKR are increased uptake in all the three phases. The lack of increased uptake on the first two phases mitigates against the diagnosis of infection. Increased uptake on the first and second phases signifies hyperemia and increased blood pool uptake and are nonspecific.

In111 leukocyte scanning has a high sensitivity and negative predictive value approaching 95% and 100% respectively. Indium labeled leukocytes accumulate in areas of inflammation or infection. In addition, the marrow surrounding the implanted joint prosthesis has been shown to have hyperplastic elements that often result in physiologic increased periprosthetic Indium uptake in the normal postoperative state. It is therefore important to compare positive indium scans with a Tc-Sulphur Colloid marrow scan to improve accuracy and specificity of the study.

If the indium and marrow scans match, they are considered congruent and carry a low likelihood of infection. If there is a mismatch, where the areas of increased uptake on the indium scan are normal on the marrow scan, the findings are considered incongruent and correlate with a high likelihood (>90%) of infection.

The treatment includes removal of the implant and cement and insertion of an articulating cement antibiotic spacer along with 6 weeks of antibiotics followed by delayed reimplantation.

Aseptic loosening
It is the most common cause of delayed TKR failure. Radiographic criteria include wide (greater than 2mm) or progressive periprosthetic radiolucency at the interface on follow-up radiographs. Tibial component loosening is more frequent than femoral component loosening. Tc99m triple phase bone scan findings of aseptic loosening of TKR are increased uptake only in the third/delayed phase and not in the initial two phases.
**Fig. 1:** Case 1: There is increased periprosthetic tracer accumulation at the right knee on the dynamic images of the Tc99m MDP bone scan.

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Fig. 2: Case 1: There is increased periprosthetic tracer accumulation at the right knee on the blood pool images of the Tc99m MDP bone scan. There is increased tracer accumulation on the 4hr In111 wbc scan, also present on the 28 hr images. On the delayed static images of the Tc99m MDP scan, there is increased periprosthetic uptake at the right knee. Infective loosening

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**Fig. 4:** Case 2: Increased periprosthetic tracer accumulation at the lateral aspect of the right femoral condyle on the 4 hour image, better appreciated on the 28 hour image of the In 111 wbc. Increased blood pool and delayed phase periprosthetic tracer uptake at the lateral aspect of the right femoral condyle on the Tc99m MDP scan. Infection.

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**Fig. 3:** Case 2: No definite features to suggest loosening or infection on plain radiograph of the right knee prosthesis.

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**Fig. 5:** Case 3: Joint effusion, no specific periprosthetic features of loosening or infection.

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**Fig. 6:** Case 3: Increased synovitic pattern tracer accumulation on the blood pool images and increased periprosthetic delayed phase uptake at the right knee on Tc99m MDP scan.

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Fig. 7: Case 3: Increased synovitic pattern tracer accumulation on blood pool images and increased periprosthetic tracer uptake on delayed phase Tc99m MDP scan but no increased tracer uptake on In 111 wbc scan. Non-infective loosening

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Conclusion

Imaging is an important aspect of the identification and management of loosening of total knee replacement prosthesis.

Plain radiographic findings may be nonspecific. Triple phase Tc99m bone scan and Indium leukocyte scanning have important role in differentiating between infected and aseptic loosening.
References


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