Peri prosthetic fractures after total knee arthroplasty

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Abstract

Background: The risk of periprosthetic fracture following TKA is particularly high because most of the TKA patients are elderly and also have osteoporosis. The management remains challenging as a result of poor bone stock, pre-existing implant and bone cement that may impede fracture reduction and fixation, predisposing to non-union or malunion . This article is a comprehensive review of Periprosthetic fractures following total knee replacement surgery along with their management algorithms.
Keywords: Total knee arthroplasty, Preprosthetic fracture, Review.

Introduction

As quality of life and life expectancy increases, there has been sharp rise in the incidence of total knee arthroplasty (TKA) and hence the chance of postoperative complications. Periprosthetic fractures account for approximately 6% of revision cases and are third most important cause of revision arthroplasty, after aseptic loosening and infection.

The most common periprosthetic fractures after TKA are supracondylar femoral fractures (0.3– 2.5%), followed by patellar fractures (0.15–12%) and tibial fractures (0.4–1.7%).

The risk of periprosthetic fracture following TKA is particularly high because most of the TKA patients are in advanced age with osteoporosis. The management remains challenging as a result of poor bone stock, pre-existing implant and bone cement that may impede fracture reduction and fixation, predisposing to non-union or malunion . In a systematic review of 415 cases, Herrera et al. reported a non-union rate of 9%, fixation failure in 4%, an infection rate of 3% and revision surgery rate of 13% – .

This article is a comprehensive review of Periprosthetic fractures following total knee replacement surgery along with their management algorithms.

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Predisposing Factors

Predisposing factors include osteoporosis, anterior femoral notching, rheumatoid arthritis , steroid therapy, neurological diseases, previous revision arthroplasty, local osteolysis and infection. As evidenced from Swedish National Registry, most of these fractures are due to low energy trauma, commonly occurring as a result of fall from sitting or standing height . Other causes include road-traffic accidents, seizures and forced manipulation of a stiff knee .

A biomechanical study has shown that notching of the anterior cortex significantly lessens the load to failure by decreasing the bending strength by 18% and torsional strength by about 40% .

Diagnosis

Diagnosis is made when a patient previously operated with TKR presents with history of fall followed by swelling and tenderness depending on the location of fracture. At this juncture it is imperative for the attending clinician to ask about the function of the joint before the injury. A history of pain or dysfunction before the trauma is a tell-a-tale feature of prosthetic loosening or infection. Thus other signs of infection also need to be looked for .

Plain radiographs are the initial investigations that must be advised. High quality and high resolution radiographs prove vital in detecting the fractures especially if it is undisplaced. Also detecting implant loosening is possible fairly accurately by looking for radiolucent lines around the prosthesis or cement. Serial radiographs are compared for better judgement of the loosening of implant.

Computed Tomography can be done to detect exact fracture geometry, further visualise fracture lines and detect prosthesis loosening by visualising radiolucent lines around the prosthesis or cement mantle or osteolysis.

Whenever loosening is detected, blood parameters such as total and differential leukocyte count, Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) is advised to rule out joint infection. In cases where infection is

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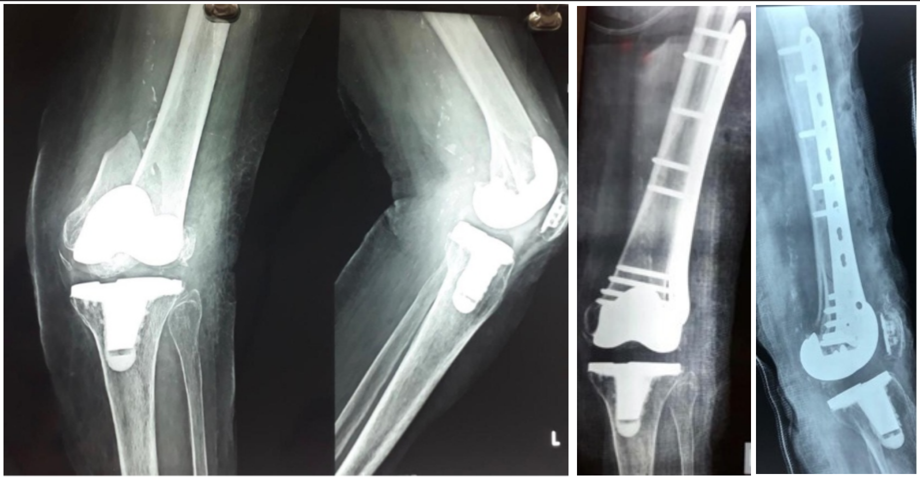


Figure 1: a-Pre-op Xray-Rorabeck&Taylor Type 2 Supracondylar femur fracture, b-Post-op Xray-Rorabeck&Taylor Type 2 Supracondylar femur fracture, c-Post-op Xray-Rorabeck&Taylor Type 2 Supracondylar femur fracture.

highly suspected, joint aspiration should be done and the fluid should be sent for total and differential count as well as culture sensitivity .

Periprosthetic supracondylar femoral fractures

Classification

Multiple classifications of supracondylar femoral fractures after total knee arthroplasty are described. However, Rorabeck and Taylor classification is the most commonly followed . This classification is based on the fracture displacement and prosthesis condition (well fixed or loose).

Type	Fracture displacement	Component fixation
I	Undisplaced	Well fixed
II	Displaced	Well fixed
III	Undisplaced / Displaced	Loose

Treatment:

The ultimate goal of treatment in periprosthetic distal femur fractures is to obtain a well aligned, stable, painless and mobile lower extremity ensuring the patient a quick return to their preinjury status. Factors such as the design and stability of the previous implants, presence of associated comorbid conditions, bone stock available and ambulatory status of the patient have a significant impact on the choice of treatment.

Non operative treatment

Conservative treatment can be considered in patients who are not suitable candidates for surgery (non-ambulatory or paraplegics, severe cardiopulmonary compromise, ASA grade >3) and in patients with nondisplaced fractures. Complications such as decubitus ulcers, DVT, urinary sepsis, prolonged immobilisations are known with nonoperative treatment and hence the role of conservative treatment is limited.

Operative treatment

Several surgical options are available for the treatment of periprosthetic fractures around the knee. Stability of the prosthesis and adequate available bone stock are necessary prerequisites for osteosynthesis. Open reduction and Internal fixation (ORIF) using either conventional plates of locking plates aim at anatomical reduction and early rehabilitation of the patient. Use of traditional non-locking plates are associated with high rates of non-union, varus malalignment, delayed union, and high need of supplemental bone grafting.

Use of locking plates have revolutionised the treatment of periprosthetic fractures. A well fixed prosthesis with an adequate distal fragment for screw fixation is an essential prerequisite for good clinical outcomes. Adequate preoperative planning is needed to determine the length of the plate and placement of screws. Use of longer plate and adequately spaced cortical screws limits implant

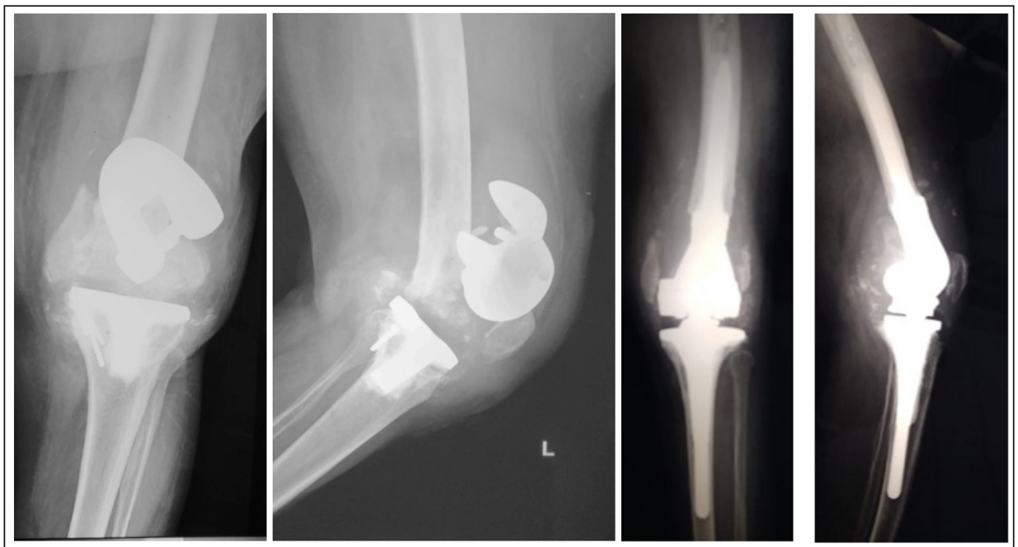
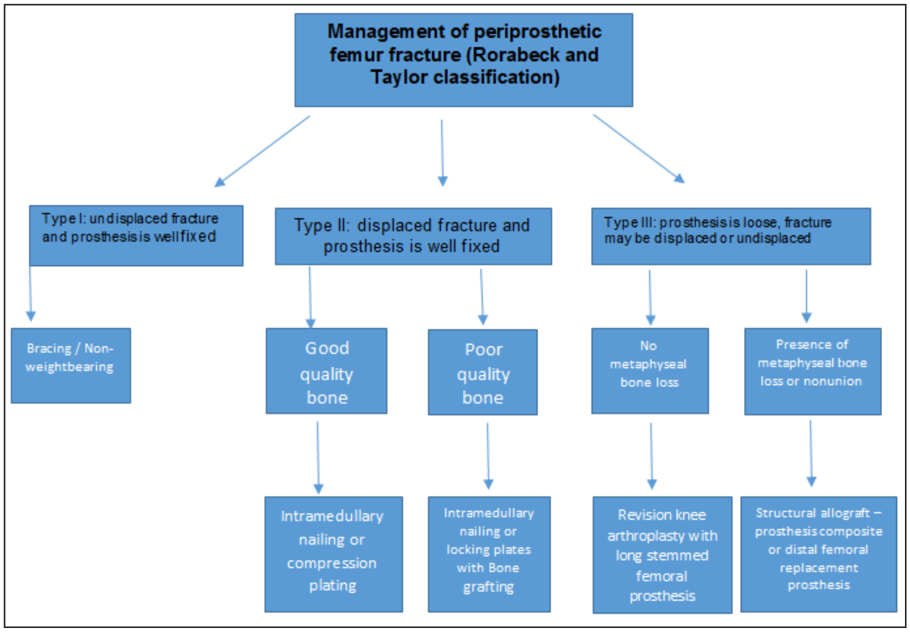


Figure 2: a-Pre-op AP Xray-Rorabeck&Taylor Type 3 Supracondylar femur fracture, b-Pre-op Lateral Xray-Rorabeck&Taylor Type 3 Supracondylar femur fracture, c-Post-op Xray-Rorabeck&Taylor Type 3 Supracondylar femur fracture



Class	Subclass	Treatment
1	A	conservative
	B	Revision Arthroplasty
2	A	conservative
	B	osteosynthesis
3	A	osteosynthesis
	B	osteosynthesis

stiffness and promotes secondary bone healing. Pointed reduction forceps, 'King Tong' clamps, Universal (femoral) distractors can provide necessary intraoperative help.

Use of Less Invasive Stabilisation Systems (LISS) have further helped in the management of these cases by preservation of biology and promoting high union rates and early range of motion.

Intramedullary Retrograde nailing have also shown high success rates for periprosthetic distal femur fracture. This technique uses same prior incision, no periosteal stripping and soft tissue dissection promoting high union rates. A major limitation to the use of intramedullary nail is the intercondylar box of the femoral component. Also, intramedullary nail is contraindicated in the presence of ipsilateral hip replacement done to avoid stress riser effect.

Revision TKA is typically reserved for patients with loose or unstable prosthesis, severe comminution and extremely distal fractures where osteosynthesis cannot be achieved. Either long stemmed prosthesis or distal femur replacement prosthesis are used. Traditional long-stemmed prosthesis may be used if there is sufficient metaphyseal bone stock. Diaphyseal fitting stems provide stability across the fracture site allowing early rehabilitation. In cases with notably large bone defects, use of sleeves or cones can help achieve restoration of joint line.

Summary of management

Periprosthetic Tibial fractures

Periprosthetic tibial fractures are relatively rare (<1%) and hence less investigated than femoral fractures (4). However due to the large number of TKR performed, the absolute number becomes significant (10). Some of the specific risk factors are prior tibial tubercle osteotomy, component loosening, component malposition, insertion of long-stemmed tibial components.

Classification

Of the many available classification systems Mayo Classification described by Felix et al is the most commonly used for periprosthetic tibial fractures after Total Knee Arthroplasty (11). The classification can be summarised as follows:

Type I fractures consist of a depression or split of the tibial plateau and extend to the interface of the implant, type II fractures occur adjacent to the stem, type III fractures are diaphyseal fractures occurring distal to the prosthesis and type IV fractures are avulsion injuries of the tibial tubercle. Types I–III are further subtyped A, B or C depending on whether the prosthesis is well fixed, loose or whether the fracture occurred intra-operatively respectively.

Type I fractures are the most common and involve the medial plateau in a large number of cases.

Depending upon the Mayo class of the fracture the treatment recommended can be summarised as follows(12) :

All type C fractures (intraoperative) should be treated with osteosynthesis with or without revision stem implantation.

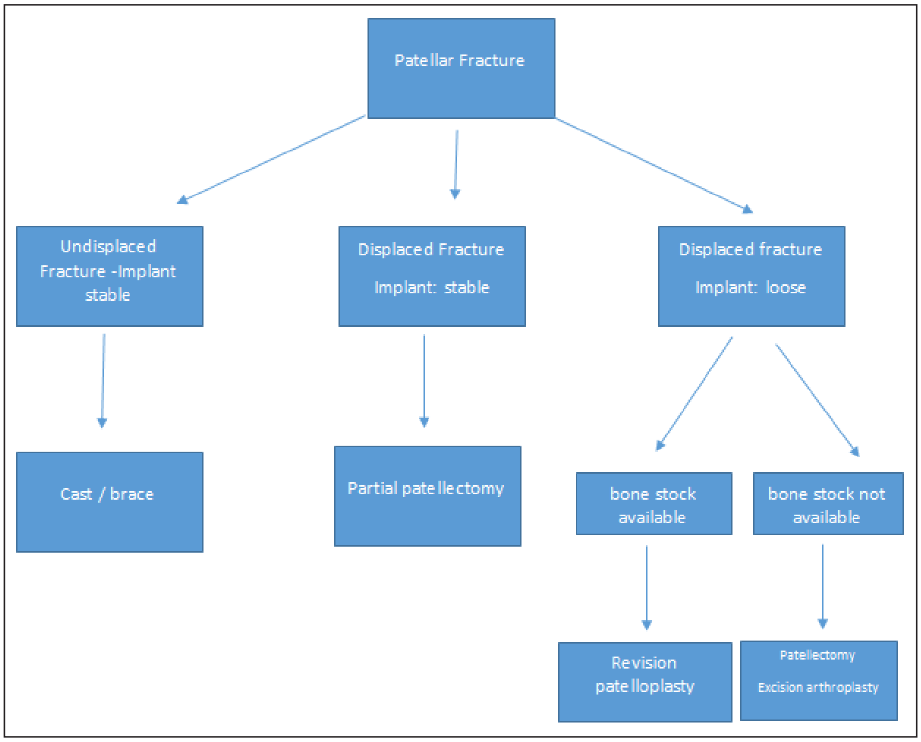
Periprosthetic patellar fractures

The most common risk factor for periprosthetic patellar fractures after TKA is excessive patellar resection, followed by malalignment. Compromise of patellar blood supply, caused by a short patellar tendon, obesity, excessive flexion of knee, and excessive lateral release can lead to fractures (4).

The most widely used system to classify patellar fractures is of Ortiguera and Berry (13) in which the defining parameters consist of integrity of the extensor mechanism, fixation status of the patellar component and quality of residual bone stock. There are four types:

The algorithm for management of

TYPE	Description
1	Well fixed prosthesis with intact extensor mechanism
2	Well fixed prosthesis with disrupted extensor mechanism
3a	Loose prosthesis with reasonable bone stock
3b	Loose prosthesis with poor bone stock (<10mm thick or marked comminution)



healing especially in the elderly make it more difficult to treat. Conservative management is usually reserved for undisplaced fractures with stable prostheses and high risk patients with multiple co-morbidities who will not be able to tolerate surgery. However surgery lessens the complications associated with prolonged immobilisation and hence treatment should be offered by the surgeon as per the evidence presented in this article after taking into consideration the individual needs and condition of the patient. Osteoporosis is considered as an independent risk factor for development of periprosthetic fractures. Hence an adequate treatment of osteoporosis is a useful corollary in the management of these fractures.

patellar periprosthetic fractures can be summarised as per the recommendations of a review article by Sarmah et al (14) is as follows:

Conclusion

Periprosthetic fractures following TKR is a complex problem to be dealt with utmost care. The poor bone stock together with a diminished capacity of

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