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Periprosthetic fractures above a total knee arthroplasty—A review of best practice

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Summary
Periprosthetic fractures around knee replacements remain one of the most challenging problems that face the modern day orthopaedic surgeon. The incidence is on the rise with both an increasing elderly population and the increased use of prosthetic implants. This review looks at the options available to treat these fractures and, based on published results, presents an algorithm as a guide for the management of periprosthetic fractures of the femur above total knee arthroplasties.

Introduction

Periprosthetic fractures around knee replacements remain one of the most challenging problems that face the modern day orthopaedic surgeon. The incidence is on the rise with both an increasing elderly population and the increased use of prosthetic implants. Currently myriad methods are available to treat these fractures aiming to restore both the biological and mechanical environment to allow optimal fracture healing. This review looks at the available literature and offers an algorithm suggesting the current best treatment for periprosthetic fractures of the femur above total knee arthroplasties (TKAs).

Incidence and aetiology

The elderly population is increasing. It has been estimated that within the next 50 years the population of those over the age of 65 years will increase five-fold.[1,2] In tandem with this the indications for joint replacements are also broadening, inevitably leading to an increased number of patients with joint arthroplasties[3–5] and periprosthetic fractures.

The incidence of periprosthetic femoral fractures above TKAs has a reported incidence between 0.3% and 2.5%.[6–10] One of the biggest published series to date following patients after primary TKAs was by Merkel and Johnson[11] looking at 4539 patients. They showed a 0.6% incidence of periprosthetic fractures following primary total knee

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Table 1 Risk factors for periprosthetic fractures.

Patient factors	Local factors
Rheumatoid arthritis	Osteolysis
Osteoporosis	Anterior femoral notching
Steroid use	Stress risers
Neurological disorders	Loosening
Smoking	
Immunosuppression	
Female sex	
Frequent falls	

arthroplasty. Within the same review 637 patients underwent revision surgery and an increased fracture incidence of 1.6%, nearly three times as much, was noted.

Most periprosthetic fractures that occur in the femur do so as a result of only low energy trauma, be it a fall or spontaneously. In most series considered when compiling this review, most fractures occurred as a result of minor trauma, such as a fall.

The risk factors for these fractures can be divided into two broad groups: those related to the patient and those related to the prosthesis (Table 1). Patient factors include disorders leading to osteopenic bone, such as rheumatoid arthritis,[10,12,13] steroid use[10] and osteoporosis.[5,6,8–10,12] Other patient factors include neurological disorders, immunosuppression, smoking, female sex, frequent falls in the elderly[6,8,10,12] and previous fracture.[14]

Factors local to the prosthesis include osteolysis associated with particulate debris from bearing surfaces or loosening,[15] and stress risers from previous surgery.[16] Historically, the most commonly reported local factor responsible for an increased risk of a periprosthetic fracture above a TKA is anterior femoral notching. The risk of fracture was initially thought to be due to a decrease in bending and torsional strength associated with notching.[17,18] These results however, were based on mathematical and biomechanical studies but in clinical practice little evidence is available to support this theory. Ritter et al.[19] reviewed a total of 670 TKAs, 180 of these having had some degree of femoral notching. They reported that only two of these developed a periprosthetic fracture. They concluded that anterior femoral notching was of minimal concern in fracture risk beyond the first 6 months postoperatively.

Classification

In order for a fracture classification to be useful it must suggest treatment, estimate prognosis, give an indication of likely outcome[12] and also allow comparison of results by different centres.[20] For fractures around TKAs a number of systems have been described,[6–9,11] However only that proposed by Lewis and Rorabeck[21] appears to have achieved universal acceptance (Table 2).

The Rorabeck classification (Fig. 1), as it is known, offers a good basis for treatment. Type I fractures are undisplaced fractures with an intact prosthesis, Type II are displaced fractures around an intact prosthesis and Type III are those associated with a loose or failing prosthesis (Fig. 2). One drawback of this classification system is that it does not differentiate between infected or aseptic loosening, which is of paramount importance in the management of these fractures.

Table 2 Rorabeck classification of periprosthetic fractures.

Type	Description
I	Undisplaced fracture with an intact prosthesis
II	Displaced fracture with an intact prosthesis (Fig. 1)
III	Fractures associated with a loose or failing prosthesis (Fig. 2)

Figure 1 Type II Fracture associated with a stable prosthesis.

Treatment of fractures above TKAs

The ideal outcome after fixation of these fractures, as with most fractures, would be union, ability to weight bear and restoration of the range of movement around the joint. Historically a good outcome for the patient is one which results in a minimum of 90° of knee flexion or restoration of preoperative motion, shortening of less than 2 cm, a varus/valgus mal-alignment of less than 5° and flexion/extension mal-alignment of less than 10°.[21,22] For the purpose of this review results reported in the literature will be compared to these 'standards' and if they are achieved the outcome will be seen as a success.

Fundamental to achieving a successful outcome is good preoperative planning. This must take into account the type