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Original Research Article

Study of incidence of periprosthetic fractures after total knee replacement

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Abstract: The incidence of periprosthetic fractures after total knee arthroplasty is continuously rising because of an increasing number of knee joint replacements and an enhanced survivorship of the elderly population after knee arthroplasty. The purpose of this study was to analyze the incidence of periprosthetic fractures. The Materials and methods We reviewed the clinical and radiographic records of 2300 patients. Out of these, 1205 were women and 1095 were men. The average age of the patients was 68.6 years. In Results Total 158 patients (6.86%) were found to have periprosthetic fractures after total knee arthroplasty between periods of 5 years were taken for the consideration. Out of these, 144 (91.13%) patients showed a periprosthetic fracture of the distal femur, and fourteen (8.87%) patients had a periprosthetic proximal tibial fracture. In concusion the incidence of the periprosthetic fractures were increasing as the total knee replacement surgeries were increasing. Special care must be taken to reduce the incidence of the periprosthetic fractures.
Keywords: Periprosthetic fractures, Total knee replacement, arthroplasty

INTRODUCTION:

Total knee arthroplasty is one of the most common orthopaedic procedures performed in recent years [1]. Previous reports suggest that total knee arthroplasty improve functional status, relieve pain, and result in relatively low perioperative morbidity. However, based on the results of previous studies, there is considerable disagreement about the indications for the procedure; that is, which patients are most likely to benefit from total knee arthroplasty and, conversely, in which patients is total knee arthroplasty contraindicated or of low value

Total knee arthroplasty is a commonly performed surgical procedure designed to alleviate knee pain and improve function in individuals with knee osteoarthritis or rheumatoid arthritis. More than 450000 total knee arthroplasty are performed each year in the United States and this number is expected to nearly double by 2020. Despite the high incidence of knee replacement and the availability of postoperative rehabilitative approaches, the resultant muscle impairments are not well defined and are an understudied area of postoperative care. Of particular interest to rehabilitation professionals is the acute profound postoperative deficit in quadriceps muscle strength [3, 4, 5].

Despite the ubiquitous muscle impairments following total knee arthroplasty, long-term functional outcomes are depicted by both favorable and non-favorable results. In general, self-report functional questionnaires like the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Medical Outcome Study 36-Item Short Form Health Survey (SF-36), show large improvements following total knee arthroplasty [3].

Periprosthetic fracture of the distal femur is an infrequent but devastating complication after total knee arthroplasty. Nonoperative treatment of displaced fractures is associated with a high complication rate, but there is no consensus on the best surgical treatment for this fracture [6, 7].

Incidence of periprosthetic fracture following total knee arthroplasty is gradually increasing, and management of these fractures can be challenging for orthopaedic surgeons [8].

MATERIALS AND METHODS:

This study was done on patient's undergone surgery of the total knee arthroplasty. The study reviewed the clinical and radiographic records of 2300

patients. Out of these, 1205 were women and 1095 were men. The average age of the patients was 68.6 years. Approval of the local ethical committee was taken before start of the study and informed consent was obtained from each of the study participants.

Inclusive criteria:

Patient's undergone surgery of total knee arthroplasty.

Exclusion criteria:

Patients not willing to participate in the study.

RESULTS:

Total 158 patients (6.86%) were found to have periprosthetic fractures after total knee arthroplasty between periods of 5 years were taken for the consideration. Out of these, 144 (91.13%) patients showed a periprosthetic fracture of the distal femur, and fourteen (8.87%) patients had a periprosthetic proximal tibial fracture.

DISCUSSION:

Total knee arthroplasty surgery is performed in ever increasing numbers. One potential complication is of periprosthetic fractures during primary and revision surgery or a result of trauma [9, 10].

The incidence of periprosthetic fractures after total knee arthroplasty is continuously rising because of an increasing number of knee joint replacements and an enhanced survivorship of the elderly population after knee arthroplasty [11].

Prevalence and pathogenesis:

The prevalence of supracondylar femoral fracture in patients with total knee replacement ranges from 0.3 to 4.2%. Most of the patients who sustain fractures about a total knee arthroplasty are women, usually in their seventh decade of life. As with other supracondylar fractures in the elderly, periprosthetic fractures usually occurs after low energy trauma. Osteoporosis is often present as well, due to a number of factors including stress shielding because of a rigid implant, pharmacologic causes, hormonal influences and senility. An association with rheumatoid arthritis, especially when the patient is receiving oral corticosteroid treatment, has been noted. Neurologic disorders have also been involved in the occurrence of these fractures, due to either medication induced osteoporosis or gait disturbance. In addition, revision arthroplasty has been associated with an increased incidence of periprosthetic fractures, more commonly when constrained implants are used, as they transfer applied torque more directly to bone that is potentially already deficient. Notching of the anterior femoral cortex during total knee arthroplasty has been indicated as one factor contributing to these periprosthetic femoral fractures. The prevalence of inadvertent cortical notching of the femur during total knee arthroplasty has been reported to be as high as 27% and there are several studies performed to quantify the reduction in bending and torsion strength resulting from femoral notching in attempt to provide the clinician with useful information related to the postoperative management [4, 12, 13].

Epidemiology and pathogenesis Incidence of distal femoral metaphyseal periprosthetic fractures associated with total knee replacement has been reported to range between 0.3% and 2.5%. Majority of these fractures occur following minor trauma after a simple fall. Other causes include road-traffic accidents, seizures and forced manipulation of a stiff knee. There are many risk factors which can predispose to these fractures. 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%. Ritter *et al.;* however, in a clinical study, did not find any relation between anterior notching of the distal femur and occurrence of periprosthetic fractures. They reviewed 1,089 cases at an average follow-up of 5 years and noted anterior notching in 29.8% of cases. During this period there were only two cases of periprosthetic fractures in this group, and both were in femora treated without notching. Unlike periprosthetic fractures of the tibia, malalignment has not been shown to be a causative factor for periprosthetic fracture of the femur [8, 14, 15].

Classification [8]:

Numerous classifications of supracondylar femoral fractures after total knee arthroplasty have been described. The most commonly used classification was developed by Rorabeck and Taylor. This classification takes into account fracture displacement and prosthesis condition (well fixed or loose).

Type I: undisplaced fracture and prosthesis is well fixed
Type II: displaced fracture and prosthesis is well fixed
Type III: prosthesis is loose; fracture may be displaced or undisplaced.

Based on Wolff's law, distal part of the femur would strengthen after the operation as result of remodeling, thus reduction in femoral bone strength should primarily be expected in the immediate postoperative period. Therefore a clear recommendation should be given to the patients who sustain inadvertent notching that they should have additional protection in the early postoperative period, and to consider the use a femoral component with stem as a means to bypass the stress riser of the anterior cortical notch. Most important, authors believe that an anterior cortical notch should be considered as a contraindication for

manipulation of the knee prosthesis in the early postoperative period [12, 16].

Risk factors / etiology:

Literature data show that patients with osteopenia are at greater risk to acquire supracondylar femoral fracture after total knee arthroplasty, followed by rheumatoid arthritis, corticosteroid treatment, female gender and older age. Additional risk factors are: neurological disorders, a revision total knee replacement and rotationally constrained implants that create increased torsion load transfer to bone [12, 17, 18].

Furthermore, there is a general feeling that the most significant risk factor causing supracondylar fracture is the increase in activity that elderly patients achieve after knee replacement, exposing them to a greater risk of slipping and falling [12].

Varied risk factors for periprosthetic femoral fractures above total knee arthroplasty have been reported in the literature, such as female gender, advancing age, osteoporosis, rheumatoid arthritis, chronic steroid use and other conditions that result in osteopenia, and anterior notching of the femoral cortex. These fractures are usually the result of low energy trauma in combination with an axial and torsional force. Most of periprosthetic fractures in our study (78%) resulted after low-velocity falls from standing and were related to the presence of radiographic osteopenia. The role of notching of the anterior femoral cortex remains controversial. Two biomechanical studies found that notching of the anterior cortex was a risk factor for periprosthetic fracture above total knee arthroplasty because it decreased the bending and torsional strengths in the distal third of the femur, which was supported by some clinical studies. However, in another study of 1089 total knee arthroplasty, 30% of this series had nothing but did not appear to pre-dispose to periprosthetic fracture [7, 19].

Management:

The aim of treatment in fractures of the distal femur proximal to total knee arthroplasty is to achieve a painless and stable knee without significant residual malalignment. Choice of treatment depends on condition of the knee prosthesis (loose or well fixed), the fracture pattern, quality of bone stock, presence of any other implant in the proximal femur and general physical condition of the patient [8, 20].

Nonoperative treatment:

Nonoperative treatment involves application of a cast brace with or without a period in skeletal traction. Some studies have reported good results after nonoperative treatment. Sisto et al. recommended closed reduction and skeletal traction as primary treatment of these fracture and to consider surgical option only if satisfactory alignment could not be maintained. However, this may be associated with difficulty in maintaining reduction, prolonged period of immobilization, reduced knee functions, malunion and nonunion [8, 21, 22].

Operative treatment:

There are several surgical options to treat periprosthetic fractures of the distal femur. If the implant is stable, then osteosynthesis by any appropriate means with or without bone graft would be recommended. However, if the prosthesis is loose, then a major reconstruction with revision to a stemmed component is required.[8]

Open reduction and internal fixation using conventional plates:

Open reduction and internal fixation allows anatomical reconstruction and early rehabilitation of the patient. Several authors have reported good results after open reduction and internal fixation of these fractures [8].

Various fixation methods are available, such as blade plate, dynamic condylar screw, locking condylar plate or retrograde intramedullary nail, but none has yielded consistently acceptable results. The goals of the surgical treatment for these displaced fractures are to provide stable fixation for fracture healing in proper alignment, allowing early mobilization of the knee, preserving a painless range of knee motion, and return to pre-injury level of ambulation. Most studies on the treatment of these fractures have been small retrospective series with a follow-up relatively short (less than 2.5 years on mean). To our knowledge, only one previous study has been reported on a prospective series of periprosthetic fractures after total knee arthroplasty, and this had a mean follow-up of 15 months. In addition, these studies focus on diverse fracture fixation techniques and in relation to the fracture healing and the surgical and mechanical results, but postoperative knee outcomes have not usually been well documented. Periprosthetic fracture is a serious injury to the knee that may influence the clinical outcome of the arthroplasty but, to our knowledge, there has not been a study specifically evaluating the functional outcomes of the total knee arthroplasty after periprosthetic fracture at the medium or long term [7].

Locking plates:

New locking plates offer advantages over conventional plates for the treatment of periprosthetic fracture associated with total knee arthroplasty. These devices provide stable fixation in osteopenic bone, are adaptable to different types of fracture and prosthesis and can be inserted using a minimally invasive approach [8].

Intramedullary fixation:

Flexible intramedullary rods have been used to treat periprosthetic fractures around the knee. Ritter *et al.;* reported their results in 22 patients, achieving union in all cases without any major complications [8]. Periprosthetic fractures associated with total knee arthroplasty are rare but present a challenging problem particularly when associated with revision arthroplasty. Fractures around tibial stems are particularly difficult with no accepted technique in their management [10].

CONCLUSION:

The incidence of the periprosthetic fractures were increasing as the total knee replacement surgeries were increasing. Special care must be taken to reduce the incidence of the periprosthetic fractures.

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