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PERIPROSTHETIC FEMORAL FRACTURES AROUND KNEE

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Abstract:

Purpose: *Owing to the aging population, posttotal knee arthroplasty fractures are becoming increasingly frequent. The treatment of these fractures is still very challenging for the surgeons. The present research work assesses the prevalence of femoral periprosthetic fractures along with its treatment options, classification and risk factors.****Method:*** *The present study was conducted fromMay 2012 to September 2019 at Orthopedics department first affiliated hospitalXinjiang Medical University. The present study included 21 patients, suffering from periprosthetic kneefractures. There were 10 males and 11 females with mean age of 70.76±8.31years (range, 44 to 80 years). All the patients were treated by revision surgery.* ***Results:*** *The classification was based on Rorabeck system, according to which, 2 cases were Rorabeck 1, 14 cases were Rorabeck 2 and 4 cases were Rorabeck type 3.One patient was classified as Felix type 2.****Conclusion****:Knee joint revision can achieve good surgical results in the treatment of distal femoral periprosthetic fracture after TKA. Reasonable and correct surgical operation is the key to successful operation. Postoperative follow-up results were good.*

Keywords: Total knee arthroplasty,Periprosthetic fractures, Revision

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INTRODUCTION:

With the rise in population's age, demand for joint arthroplasty for treatment of osteoarthritis in distal femur has increased tremendously. According to an estimate, 450,000 arthroplasties is the average for any country per year (1). Consequently, the incidence of revision surgery is also growing. Around 10,000 revision arthroplasties are conducted each year with an approximate increase of 10% annually. In the year 2012, in only USA 700,100 TKA were performed. This was labelled as the most frequent procedure performed in this year (2). The knee arthroplasty was regarded as the second leading procedure with high variability in occurrence from 2003 to 2012. During this time period, TKA grew by more than 50% with an annual change rate of 4.9% (3).

On the basis of age groups, majority (94.7%) of the procedures are performed on elderly individuals with age range of 65 to 84 years (4). With regard to gender, women makes 60% of the patients requiring this procedure, whereas, men make 40%. It is expected that incidence of periprosthetic fractures of knee will rise in accordance with these statistics in future (5).

It has been estimated that periprosthetic fractures exist with a range of 2.5% to 3.8%, after revision surgery (6). The tibial periprosthetic fractures may mount up to 4%. According to a previous study, 19% of the periprosthetic fractures results during implantation of the prosthesis. A recent study has indicated complication rate of 41% and revision rate of 29% for periprosthetic fractures after primary total knee arthroplasty (7).

The post-operative complications may arise due to various reasons such as delayed healing due to ageing, poor bone quality due to already existing osteoporosis, prosthesis loosening, intramedullary implant making fixation instable (8). The complications that may arise after internal fixation of periprosthetic fractures includeinfection, implant failure, non-union, loss of fixation, prosthesis loosening, mal-union, and malrotation (9).

The most common risk factor for periprosthetic fractures is the advanced age (10). Many previous research works have emphasized on this risk factor (11). The advancing age can enhance osteoporosis and recurrent falls, which are also important risk factors for periprosthetic fractures. The work of Meek et al (12), showed that females with more than 70 years age have high risk of periprosthetic fractures. On the other hand, the work of Singh et al (13), showed that age less than 60 years is highly associated with post-operative periprosthetic fractures, after primary TKR.

Other important risk factors associated with periprosthetic fractures include steroid therapy, neurological diseases and inflammatory arthropathies (14). The co-morbidity of diabetes mellitus (DM) can also increase risk of periprosthetic fractures. It can influence the stability of patient and increase chances of recurrent falls. Through neural and microvascular damage, diabetes can delay the healing process (15).

Obesity is another important risk factor for periprosthetic fractures. Previous research works have reported that obesity can impair functionality and mechanical outcomes after TKA. Some researchers have regarded revision TKA as a major risk factor for periprosthetic fractures (16). A previous study reported risk of fracture after TKA to be 0.6%, whereas, it was 1.7% after revision TKA. Another study noted that prevalence of periprosthetic fractures was 1.1% after primary TKR, whereas, it was 2.5% after revision TKR (17). It has been suggested that in individuals with revision TKR, factors such as infection, non-union and components removal were important predictors of periprosthetic fractures (18). The individuals with wear, loosening, osteolysis are found to be 5 times more prone towards postoperative periprosthetic fractures (19).

The periprosthetic fractures around the knee may exist within a range of 0.3% to 2.5%. However, its management is very challenging (20). Furthermore, the increased activity after TKA of ageing population may additionally intensify the incidence of periprostheitc fractures. Most oftenly the TKA failure results in bone loss, which further increases the risk of post and intra operative periprosthetic fractures (21).

The periprosthetic fractures can occur in patella, tibia or femur. The prevention of periprosthetic fractures depends on various factors such as identification of risk factors, management of risk factors, appropriate preoperative planning, availability of adequate surgical expertise, selection of proper prosthesis and availability of appropriate resources. The knowledge of complications is also very important in order to deal with them (22).

The treatment of complications of periprosthetic fractures is a tiresome work but important at the same time. The economic burden laid by revision TKA is $2.7 billion only in USA, which is expected to rise tremendously with increase in procedure rate, in upcoming years (23). Previous research works have indicated failure rate and mortality rate in association with periprosthetic fractures of femur

(24). The periprosthetic femur fractures are observed to have higher failure and mortality risks and rates as compared to knee arthroplasties, hip arthroplasties and operative fixation of native distal femur fractures (16).

The treatment of periprosthetic knee fractures is oriented towards prosthetic stability and fracture union. The aim of treating periprosthetic fractures is to achieve fracture union within 6 months with a range of motion of more than 0 to 90º (25). Previous research works have recommended revision arthroplasty or open reduction and internal fixation (ORIF) as the treatment option for periprosthetic fractures (26). However, non-operative treatment option to reduce fracture in stable manner has also been suggested and elaborated by previous research works. The management of fractures by use of skeletal traction has also been suggested. Some research works have advocated conservative measures to address this issue (27). However, literature has also shown high failure rate of non-operative treatment with high risks of prolonged bed rest, joint stiffness, non-union, mal-union and loss of knee motion. Operative treatment is preferred due to improve in range of knee motion, early mobilization and absence of malunion or non-union (28).

According to literature, the complication rate after treatment of periprosthetic fractures range from 1.5% to 2.5% (29). The present research work assesses the prevalence of femoral periprosthetic fractures along with its treatment options, classification and risk factors. The article has focused only on femoral fractures, owing to their high prevalence.

METHODOLOGY:

The present study was conducted from May 2012 to September 2019 at Orthopedics department Xinjiang Medical University. The data of patients with the age range of 44 to 80 years was included, who were suffering from periprosthetic femoral fractures. Informed consents were collected from each patient and they were explained with the purpose of the study.

For radiological investigation, standard lateral and anteroposterior radiographs of the knee were reviewed to take views of complete length of affected bone with fracture. The fractures were classified on the basis of Lewis & Rorabeck classification. The radiographs were assessed for any indication of implant loosening like radiolucency and migration. The patients were also asked for previous radiographs to make comparison of progression. In case of experiencing pain with the affected joint before the fracture indicates already existing implant loosening. The bone stock availability was noted for fixation with regard to comminution and osteolysis. Computerized tomography (CT) scan were also performed for assessing bone stock and association with implant. In case of suspicion of infection, preoperative aspiration was performed with polymorphonuclear (PMN) cell proportion, synovial white cell count (WCC), and microbiological analysis. The thresholds described by the International Consensus on Periprosthetic Joint Infection were used for defining infection. The stability of prosthesis was also evaluated in regard to history of the patient before trauma and X-ray. The signs such as displacement of the shield or cement separation were detected.

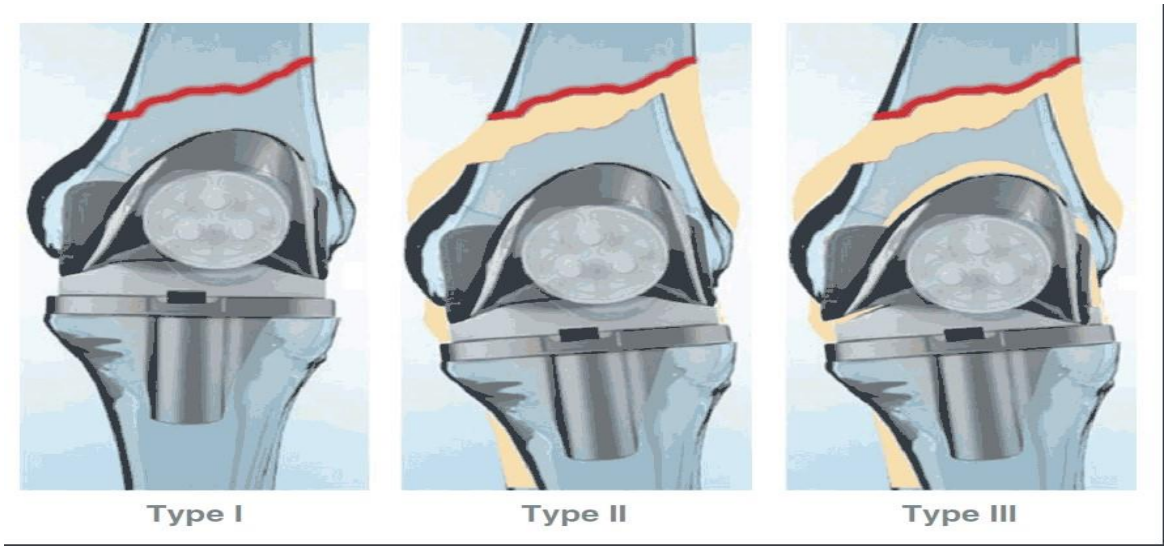

Figure 1: Lewis & Rorabeck classification for femoral periprosthetic fractures; Type I: undisplaced fracture and prosthesis is well fixed; Type II: displaced fracture and prosthesis is well fixed; Type III: prosthesis is loose, fracture may be displaced or undisplaced

RESULTS:

The present study included 21 patients, suffering from periprosthetic femoral fracutures. There were 10 males and 11 females with mean age of 70.76±8.31years (range, 44 to 80 years). The classification was based on Rorabeck system, according to which, 2 cases were Rorabeck type 1, 14 cases were Rorabeck type 2 and 4 cases were Rorabeck type 3.

All the cases underwent revision TKA, 2 patients took combination of LISS plate and revision TKA. And 2 patient had only LISS plate for the fracture fixation.

The risk factors for periprosthetic fractures were found to be diabetes, obesity, steroid therapy, inflammatory and neurological diseases. The most common risk factor was found to be osteoparotic, present in 8 patients.

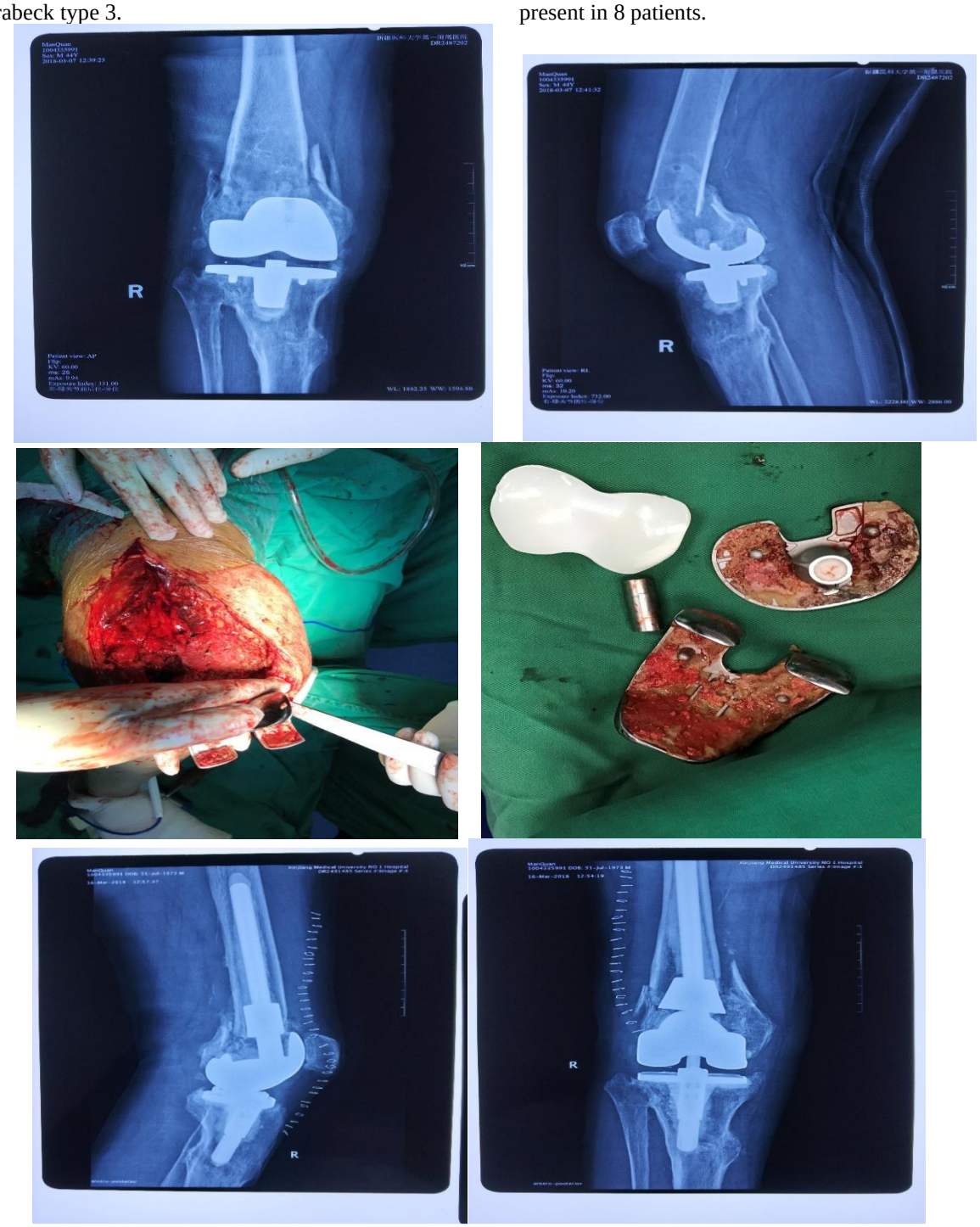

Figure 2: M 45yrs fig(a&b) periprosthetic fracture Rorabeck type 2 , fig(c&d) intraoperative removal of prosthesis, Fig (e&f) post revision xrays

Table 1: Patient characteristics

Gender (M/F)	Age (yrs)	Classification	Risk factors	Treatment
M	72	RORABECK 1	Diabetes	TKA revision
M	44	RORABECK 2	Obesity	TKA revision
F	68	RORABECK 3	Osteoporosis	TKA revision
F	64	RORABECK 2	Osteoporosis	TKA revision
M	74	RORABECK 2	Diabetes	TKA revision
F	71	RORABECK 2	Steroid therapy	TKA revision
F	74	RORABECK 2	Neurological disease	LISS plate
M	72	RORABECK 1	Neurological disease	TKA revision
F	71	RORABECK 2	Inflammatory disease	LISS plate
F	68	RORABECK 2	Inflammatory disease	TKA revision
M	59	RORABECK 3	Diabetes	TKA revision
M	45	RORABECK 2	Obesity +Steroid therapy	TKA revision
F	71	RORABECK 3	Diabetes + Steroid therapy	TKA revision + LISS plate
M	78	RORABECK 2	Obesity	TKA revision + LISS plate
M	80	RORABECK 3	Osteoporosis	TKA revision
F	76	RORABECK 2	Obesity	TKA revision
F	73	RORABECK 2	Obesity +Steroid therapy	TKA revision
M	68	RORABECK2	Osteoporosis	TKA revision
M	72	RORABECK2	Osteoporosis	TKA revision
F	76	RORABECK2	Osteoporosis	TKA revision
F	69	Felix 2	Osteoporosis	TKA revision

DISCUSSION:

Periprosthetic fractures are an emergent issue, despite all the efforts to overcome high associated morbidity and mortality rates. It is important to prevent occurrence of periprosthetic fractures through radiological survey in order to assess early signs of instability and implant loosening. Moreover, other risk factors that may increase its incidence needs to be treated adequately (30).

The study of Delanois et al (31) evaluated incidence of periprosthetic fractures and revision TKA, with the help of National Inpatient Sample (NIS). Women comprised 58% of the patients with infection and mechanical loosening being the common reasons of revision TKA. Among the reported reasons for revision TKA, a periprosthetic fracture is an important one (32). Another study (33) reported 181,738 TKA procedures in year 2015, which indicated a rise of 3.7% from year 2014. The aseptic loosening was found to be the reason for 33.3% cases, whereas, 27% cases resulted from infection. In the present study, women were more as compared to men patients. Moreover, the mean age was 69 years, which is again in accordance with the previous research works (34).

The femoral supracondylar periprosthetic fractures are most important and frequent with incidence rate of 0.3% to 2.5% after primary TKR. This can exceed upto 3.8% in individuals with revision surgeries. On the other hand, tibia fractures have incidence of 0.4% to 1.7% forprimary TKR. However, these estimations can fluctuate from the actual ones as fractures treated conservatively and by open reduction internal fixation (ORIF) are not reported (35).

Treatment algorithm is important to completely understand nature of fracture. Moreover, the treatment for periprosthetic fractures not only depends on stability, bone loss and location but also on the systemic factors including activity level, bone metabolism, patient age, and co-morbidities. The mechanical stability gained through advanced surgical methods in combination with pharmacological systemic treatment is mandatory to address the problem of periprosthetic fractures (36).

The less invasive surgical stabilization (LISS) plating is mostly performed for irreducible and displaced fractures with good bone stock quality (8). In the present study, 2 individuals underwent LISS plating. Both were having Rorabeck 2 fractures. The most common treatment taken by the patients was revision TKA. Only 2 patients took both treatments in combination. LISS plates have benefit of minimal soft tissue dissection and periosteal stripping. Recent published works have advocated the use of LISS plates due to better results as compared to other types of fixation.

The most common risk factor was found to be osteoparosis in present study. Previous research works have mostly indicated co-morbidities to be responsible risk factor for periprosthetic fractures. In the present study, diabetes, neurological and inflammatory diseases were also highly observable among the patients, which may act as important risk factors.

CONCLUSION:

It can be concluded that periprosthetic knee fractures have adverse outcomes for the individuals and can be challenging for the surgeon. These fractures are very common in old, weak individuals suffering from important co-morbidities. Their management and treatment are important and involves various techniques such as fixation with intramedullary device, fixation with locked plating system, distal femoral endoprosthesis and revision arthroplasty. The chosen treatment should be able to achieve good alignment with better mobility and low risks for the patient.

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