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Research Article

Primary osteosynthesis augmented with autologous bone graft with total knee arthroplasty in patients with stress fractures of medial femoral condyle with knee osteoarthritis: a cost effective approach

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ABSTRACT

Background: We report six cases of an arthritic knee with stress fractures of medial femoral condyle causes substantial pain in the medial compartment severe enough to hamper their routine activities. Suggestive findings were appreciated on Skiagram in only one case, in rest was diagnosed by magnetic resonance imaging (MRI). These are likely underdiagnosed and frequently mistaken for primary osteonecrosis. The present report showed that the early detection and treatment of stress injuries in an arthritic knee is imperative to ensure best possible outcome.
Methods: Six patients with a mean age of 73.1±5.7 years were registered with an arthritic knee with stress fracture of medial femoral condyle. Primary osteosynthesis augmented with autologous bone-graft with total knee arthroplasty (TKA) done in all patients. All patients were followed up until they became asymptomatic, displayed radiographic healing, and had recovered full range of motion with no pain. Pre and post-operative western ontario and mc-master universities osteoarthritis index (WOMAC) score were recorded and compared. The level of significance was set at 0.05 levels.
Results: Mean follow-up was 7.0 years. All patients showed statistically significant improvement in their WOMAC total scores ($p < 0.05$). Stress fractures united with good knee alignment. All patients had recovered full range of motion with no pain at the time of final follow-up. No adverse events were noted in any of the patient treated.
Conclusions: The present approach is a successful procedure for the elderly population with an arthritic knee with stress fracture of medial femoral condyle. Return to pre-morbid level of functional activity occurs very swiftly.

Keywords: Stress fracture medial condyle femur, Total knee arthroplasty, WOMAC score

INTRODUCTION

Stress fractures result from repetitive submaximal stress, were first reported in the metatarsals of Prussian soldiers in the year 1855.[2] These stress injuries are usually associated with military or athletic activities in young adults.[3] In elderly although less common is thought to be due to a combination of stress and insufficiency fractures related to abnormal mechanical loading on abnormal bone (rheumatoid arthritis, osteoarthritis, deformities) or normal mechanical loading on abnormal bone (paget's disease, pyrophosphate arthropathy, osteoporosis).[4-8] High-risk sites for stress fractures/injuries include the femoral neck, patella, anterior tibial diaphysis, and the medial malleolus.[9] The stress fractures are unusual at medial femoral condyle and other epiphyses, unlike osteonecrosis or posttraumatic intra-osseous fractures.[10] There is paucity of data regarding arthritic knee with stress fractures of medial femoral condyle as there are only few case reports/series published in the medical

literature.[11-14] Stress fracture of medial femoral condyle secondary to deformities from osteoarthritis is uncommon, and may be difficult to manage. Stress fracture are often treated conservatively viz splint/or casting and rest.[15,16] Surgery is indicated in complicated fractures.[17,18] Conservative treatment of fracture in this age group is fraught with all the complications of prolonged recumbency viz. chest infections, bed sores, disuses osteoporosis, muscle dystrophy besides malunion/delayed or non-union of fracture and mal-alignment and deformity of the limb. Also, prolonged immobilization/bracing/casting causes contractures of the capsule and peri-capsular soft tissues, will eventually lead to increased knee stiffness. In view of these critical concerns the authors have advocated single stage surgical intervention for stress fracture and osteoarthritis. The primary objective of the present approach is early mobilization, in an effort to prevent the complications associated with prolonged recumbency in old age and to return to a functional activity by achieving a painless and stable knee without significant residual malalignment and/or deformity. The present study documents the long-term follow up of patients with an arthritic knee with stress fracture of medial femoral condyle, all referred to a our centre, in an attempt to contribute to a better understanding of the biomechanics of the condition and, hence its further management.

METHODS

Six cases of stress fracture medial condyle femur with osteoarthritis were identified. All six patients were women and were older than 70 years. Mean age was 73.1±5.7 (range, 70-80) years. Patients present with knee pain and impeded walking. There was no history of trauma or of any identifiable precipitating factor. All patients had history of sudden deterioration of activities. It became worst on weight bearing and/or activity. Past medical history revealed that they have visited to family physician few months earlier; the radiographs of knee showed osteoarthritic changes, the laboratory tests were normal, and prescribed conservative treatment viz. non steroid anti-inflammatory drugs (NSAIDS) and physical therapy. Patients do not experienced significant relief from the therapy. Instead they have persistent pain and gradually worsened over the next few months; were eventually confined to wheelchair. All patients were promptly referred to Shalby hospital for further management.

Physical examination revealed significant varus deformity. There was severe tenderness in the medial compartment of knee with painful restriction of movements. No fixed flexion deformity/contractures existed. Vital signs were with-in normal limit. All patients were evaluated using the WOMAC score. The extent of varus deformity (range 15-20 degree, mean 16.60±2.92) was measured using standing weight-bearing full-length radiographs. Radiograph demonstrated marked diminution of medial joint space, opening of lateral space, osteophytes with sclerosis. The past medical history and clinical examination are indicative of stress fracture. As radiographs have a low sensitivity and are of limited utility, MRI was advised to confirm the diagnosis. Suggestive changes were seen on x-ray of one patient (Figure 1) in rest the diagnosis was established only by MRI.[19] Imaging revealed a stress fracture of the medial femoral condyle. Patients were explained about the diagnosis and the potential benefits and harms of treatment options. Single staged primary osteosynthesis with total knee arthroplasty was planned through the standard midline skin incision with medial para-patellar approach. Once exposed the fracture edges were cleaned and fragments were held in reduced position with the help of a tenaculum (Figure 2).

These in effect allowed femoral preparation in a standard fashion by keeping the medullary canal open for insertion of femoral intramedullary jig. Rest of the procedure was as for a standard total knee replacement. After the trial the fragment was fixed with two 6.5 mm cancellous screws and fracture site was bone grafted. TKA using Pfc sigma (Depuy) done. Care was taken to avoid extrusion of cement into the fracture site.

Figure 1: Radiograph showing stress fracture of medial femoral condyle with degenerative changes in the knee.

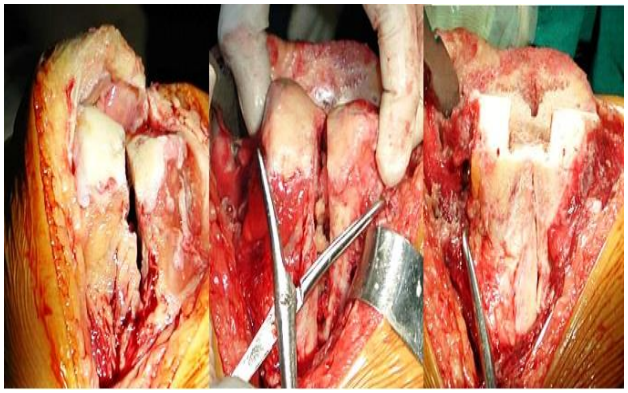

Figure 2: Intraoperative photograph showing the fracture fragment held with tenaculum before and after the femoral preparation.

Post-operative protocol

In-bed active flexion was allowed from the day following the surgery. Patient was kept non-weight bearing for first three weeks and partial weight bearing for further three weeks. Throughout the six weeks long knee brace was used while walking. From 6-12 week hinged knee brace was advised. Patients were followed up at week 4, month 3, 8, and 12, and yearly thereafter. Once the serial x-rays revealed fracture consolidation braces and supporting aid were discontinued.

RESULTS

The mean follow up period was 7.0 (range, 2.5-14 years; SD: 4.34) years. The patients stayed in the hospital for 4.16 days (SD±0.03) on average. The deformity fully corrected. The mean WOMAC total scores improved from 44.68±7.1 to 17.45±9.6, signifying an overall improvement in symptoms ($p < 0.05$). At the final follow-up, all the patients made an uneventful recovery. The fracture progressed to union with significant improvement in symptoms. All patients had recovered full motion with no pain at the time of final follow-up.

DISCUSSION

Osteoarthritis of knee joint complicated by stress fracture femoral medial condyle is rare occurrence. The abnormal stress on peri-articular bone secondary to deformities in an arthritic knee may lead to stress fracture. The surgical management of an arthritic knee with stress fracture of medial condyle is complex and fraught with potential complications and challenges, so no single/standard approach can be recommended for all cases. The challenge faced includes difficulty to obtain stable fracture fixation and restoration of mechanical axis, osteoporotic bone, a diminished healing capacity in old age. Despite these challenges the authors recommended that surgery can lessen the complications associated with prolonged recumbency and of fracture. There are several options for osteosynthesis, treatment of osteoarthritis and correction of varus deformity. The first and foremost option is a single stage total knee arthroplasty with long stem extension of the femoral component to bypass the fracture site.[14] This would have been feasible in our series if the fracture had occurred in the metaphyseo-diaphyseal region. In the present series the stress fracture is intra-articular extending from intercondylar notch to medial cortex of femur. The author reasserted that lack of adequate compression among the fragment would lead to non union or delayed union. Also stem failure to bypass the fracture site could be a major factor in fracture healing and construct strength.[20] Furthermore, inadequate compression causes extrusion or ingression of bone cement into the fracture site that may impair fracture healing.[21] The second option is a two-stage procedure. In stage one internal fixation of the fracture done. In stage two, following the consolidation of the fracture, total knee replacement with the removal of the hardware. Although this is less technically demanding but it requires two separate incisions and separate surgical procedure. Also, the persistence of varus deformity and abnormal mechanical axis after the stage one will causes abnormal stress over the hardware and lead to failure.[22] The two stage option also increases the cost as well as the hospital stay and morbidity. The third option is single stage total knee replacement with correction of deformity and internal fixation of fracture. This option has an edge over the other options as it requires single incisions, single procedure and one session anesthetic risk. The authors decided that the last option as the safest and most feasible for our group of patients. Although the locking plate provides rigid fixation the authors were not in favor of same as it requires extensive soft tissue dissection, which may lead to wound dehiscence and infection. The plate provides stress rises and creates the risk of fracture in future necessitating its removal. Residual empty holes (stress risers) after hardware removal weaken the bone and will lead to re-fracture.[23] As a result the authors decided to use two 6.5 mm cancellous screws. These provide adequate compression at the fracture site, reducing surgical time and require only minimal dissection. The fixation was augmented with autologous bone graft obtained from cuts of distal femur and tibia. Bone graft has biological advantage and enhances implant fixation and fracture healing. Total knee arthroplasty for osteoarthritis with correction of deformity and axis with minimal fixation of stress fracture of medial femoral condyle augmented with bone graft restores limb alignment and facilitates fracture healing with excellent functional outcome. All fractures had united at the latest follow-up (Figure 3). All patients show significant improvement in their WOMAC scores ($P < 0.05$). There were no complications of infection, non-union or delayed union, joint instability, and mal-alignment/deformity or patellar problems.

Figure 3: Postoperative anteroposterior and lateral radiographs complete union at fracture site (follow up to 14 years (date of surgery to latest follow up)).

The long-term follow-up 7.0 (range, 2.5-14 years; SD: 4.34) years of these patients led the authors to the conclusion that when a patient with osteoarthritis of the knee presents with sudden deterioration and marked tenderness over the medial femoral joint line, the possibility of a medial femoral condyle stress fracture

should be considered. These group of patients need to be thoroughly evaluated both clinically and radiographically. MRI provides most comprehensive imaging modality with highest sensitivity (86-100%) and specificity (100%), making it the imaging of choice for diagnosing these stress fractures.[24,25] Surgeons are often confronted with the challenge of treating both conditions simultaneously. To our knowledge the studies discussing the outcome of single stage TKR and internal fixation of medial femoral stress fracture are sparse in the literature.[14] In spite of the existing controversy regarding the safety of one-stage TKR and internal fixation of stress fracture, we prefer this approach in these patients due to its significant cost advantages and other benefits viz. speedy recovery, early rehabilitation, shorter hospital stay, single-session anaesthetic risk and avoids multiple surgeries. Although limited by small sample size, the present approach had a number of strengths; primarily the long term follow up of the study, the use of minimal hardware, low post-operative morbidity, early and speedy recovery and cost-effectiveness.

CONCLUSION

The authors reasserted the significance of obtaining a detailed history, patient clinical evaluation and the importance of having a high index of suspicion of a stress fracture of medial femoral condyle with persistent knee pain and marked tenderness despite conventional therapy in patients with osteoarthritis. Return to pre-morbid level of functional activity occurs very swiftly, avoiding/minimizing the complications of prolonged recumbency. The present approach is recommendable for elderly, with simple easily reducible intra-articular stress fracture associated with an arthritic knee; it has some significant advantages over other options, such as shorter learning curve, minimal trauma to soft tissues, reduced blood loss, low post-operative morbidity, early and speedy recovery, short hospital stay, and cost effectiveness.

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