Management of knee osteoarthritis presenting with tibial stress fractures

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ABSTRACT

Stress fractures of the tibia secondary to tibial deformities from osteoarthritis are rare, and may be difficult to manage. We treated two patients with stress fractures of the proximal tibial diaphyses over a period of two years. Both patients had osteoarthritis of the knee; one with genu valgus deformity and the other, genu varus deformity. The former patient also had a distal tibial fracture and had previously undergone open reduction and internal fixation. The stress fractures of both the patients had been treated conservatively by nonoperative means, but their fractures failed to unite. They then underwent a modular total knee prosthesis with a long tibial stem extension, and subsequently, their fractures united. Both patients recovered uneventfully.

Keywords: deformity, osteoarthritis, tibial stress fractures, total knee arthroplasty

Singapore Med J 2010; 51(9): e149-e152

Fig. 1 Anteroposterior and lateral knee radiographs show osteoarthritis of the knee with severe genu varus deformity and a malunited proximal tibial fracture.

Fig. 2 Anteroposterior and lateral tib-fib radiographs show osteoarthritis of the knee with severe genu varus deformity, a malunited proximal tibia fracture, and an old open reduction and internal fixation of the distal tibia.

INTRODUCTION

Stress fractures of the tibia are commonly observed, and the causes can be varied. Most often, they are observed in the young, where abnormal repetitive stresses are placed on normal bone (fatigue fracture), and are usually associated with military or athletic activities. Although less common, stress fractures are also observed in elderly patients, where normal stresses that are placed on abnormal bone result in fracture. The associations of stress fractures include rheumatoid arthritis (RA), osteoarthritis (OA), osteoporosis and Paget's disease. Pyrophosphate arthropathy and renal osteodystrophy are other rarer causes. Such fractures arise from repeated, cyclical, low magnitude forces exerting upon a weakened bone over a considerable period of time.[1-16]

Stress fractures are often managed conservatively without surgery; in such cases, adequate rest, analgesia and reduced activity often allow the patient to return to a fully functional state after a period of time. Occasionally, casting is done to further protect the fracture site.[6,14,15] However, if the fractures have resulted in a malunion or non-union, it would present as a more complicated clinical problem, and surgery may be indicated.[17] Stress fractures can occur at many different sites in the body, but the tibia accounts for almost 50% of such fracture incidences. Within the tibia, the majority of the fractures occur at the junction of the middle and the distal third, where the curvature of the bone, and hence the greatest stress, occurs.

We describe two cases of tibial stress fractures

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Fig. 3 Anteroposterior and lateral tib-fib radiographs show correction of the deformity, osteoarthritis of the knee with a high tibial osteotomy, and a total knee arthroplasty with a long tibial stem to bridge the fracture site.

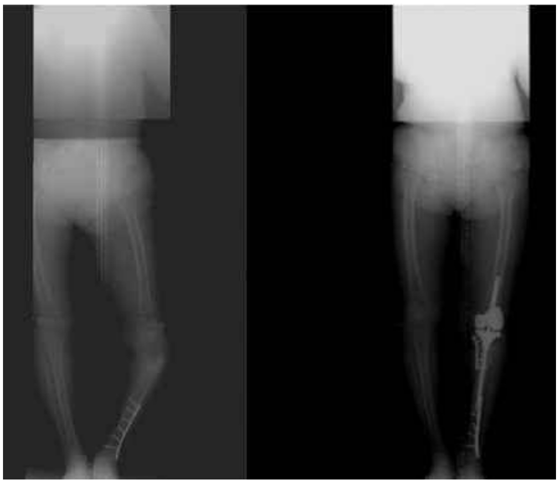

Fig. 4 Weight-bearing anteroposterior tib-fib radiographs show osteoarthritis of the knee with severe genu varus deformity, a malunited proximal tibial fracture, and an old open reduction and internal fixation of the distal tibia. Postoperative radiograph shows a high tibial osteotomy with a total knee arthroplasty with modular femoral and tibial stems. Restoration of the mechanical axis is seen.

secondary to deformed arthritic knees. The first patient presented with a genu varus deformity, and the other, a genu valgus deformity.

CASE 1

A 61-year-old Chinese woman with a ten-year history of bilateral knee OA presented to the clinic with complaints of mechanical left knee pain. She had a left distal tibial fracture previously and had undergone an open reduction and internal fixation (ORIF) around 20 years ago. Pre-morbidly, she was ambulant with a walking frame. Clinical examination revealed a combined varus deformity of 40°, with a fixed flexion deformity (FFD) of 30° and range of motion (ROM) of 30° to 80°. Radiographs of the left lower limb revealed a previous distal tibial fracture with ORIF done (Figs. 1 & 2) and showed a malunited proximal tibial fracture with severe osteoarthritic knee and genu varus.

The patient underwent computer-navigated surgery. Trackers were inserted, a subsequent opening wedge osteotomy was performed and a locking five-hole contoured Recon plate was used to secure the osteotomy. Constrained femur and tibia stemmed total knee arthroplasty (TKA) implants were used to reconstruct the knee joint (Figs. 3 & 4). Cement augmentation was also done to fill up the posteromedial tibial defect found intraoperatively. Optimal soft tissue tensioning was performed. Postoperative ROM was 0° to 100°. The patient made an uneventful recovery and the fracture osteotomy sites healed in four months. She was clinically well on her last follow-up at 13 months, and could walk without any aid.

CASE 2

A 79-year-old Malay woman presented with an extremely painful, stiff and deformed osteoarthritic left knee. She had been symptomatic for several years and wheelchair-bound in the preceeding few months due to the severe pain. Clinical examination revealed a severe genu valgus deformity at 30° to the mechanical axis. The patient had an FFD of 20° and a ROM of 20° to 100°. Radiographs revealed an osteoarthritic knee with severe genu valgus, with a joint line valgus of 10°. A proximal tibial stress fracture was also noted (Fig. 5).

The patient had a constrained stemmed femoral and tibial TKA implanted (Fig. 6). Optimal soft tissue tensioning was performed along with excision of the posterior cruciate ligament, and lateral soft-tissue pie-crusting was performed. Postoperative ROM was 0° to 130°. The patient's fracture healed in three months. She recovered uneventfully, and was able to walk without any aids, as observed during the last follow-up at 15 months.

DISCUSSION

Stress fractures result from repetitive abnormal mechanical loading on normal bone, or normal mechanical loading on abnormal bone. The causes of these fractures are varied, and insults on the bone are usually chronic and of low intensity, thus resulting in a fracture which is often not acute. Stress fractures of the tibia in the elderly are well described, although uncommonly. The associations of stress fractures include RA, OA, osteoporosis and Paget's disease. Pyrophosphate arthropathy and renal osteodystrophy are other more uncommon causes.[16] These fractures are rare, possibly because a TKA would have been

Fig. 5 Anteroposterior and lateral knee radiographs show osteoarthritis of the knee with severe genu valgus deformity and a proximal tibia stress fracture.

Fig. 6 Anteroposterior and lateral knee radiographs show correction of the deformity, osteoarthritis of the knee, and a total knee arthroplasty with a long tibial stem to bridge the fracture site.

performed for the patient who has a very symptomatic painful knee before gross deformity and subsequent fracture have time to occur. Advances in osteoporotic treatment with new drugs could also be a contributing factor, as such treatments help to increase the strength of the bone.

Severe extra-articular tibial deformity secondary to OA, as observed in our patients, results in the shifting of the mechanical axis of the lower limb. This causes abnormal forces and load to be placed onto the tibia. Eccentric forces result in tension stresses on the convex side of the bone, and compression places stress on the concave side. Large valgus or varus malalignment would thus severely affect the bone, leading to its gradual weakening and hence, a stress fracture formation.[18,19] Callus and new bone formation would generally be initiated, and fracture repair carried out. However, this would not lead to fracture union, as the abnormal mechanical axis from the severe tibial extra-articular deformities is still present.

The physical signs of a stress fracture would be localised tenderness over the fracture site. Sometimes, there might be a bony callus that is palpable as the fracture begins to heal. Severe deformity is rarely observed, and unless a complete fracture occurs, it is not usually visible. Radiographs may reveal the stress fracture or malunion/non-union at the site of the fracture. If a stress fracture is not visible, a repeat radiograph may be conducted at a suitable interval, which might show up the fracture site; alternatively, a technetium-99 m bone imaging can be performed.[1,15] The fracture site would then be illuminated on imaging, and subsequently identified.

Stress fractures can be treated conservatively or surgically. In most cases of stress fractures, rest, reduction of weight-bearing activity level and analgesia result in bone healing, and also allow a patient to return to full function after some time. However, if a patient presents with stress fractures secondary to severe deformity with concomitant OA, as in our case studies, surgery is often indicated.[6,14,15] Surgery can be used to treat the fracture and OA with genu varus or valgus deformity. The mechanical axis can also be re-aligned and the abnormal stresses on the tibia removed.

Our first patient underwent an osteotomy to correct the severe genu varus deformity and tibial malunion. A modular TKA was used to replace the arthritic joint and to restore a good range of movement and better kinematics for the patient's knee. This helped to realign the mechanical axis, and converted the tension stresses across the proximal tibia into compression forces. Computer navigation enabled more precise bone cuts and soft tissue balancing, resulting in a more accurate selection and subsequent implantation of the prosthesis. The use of a modular prosthesis allowed the extension of the tibial stem to bridge both the fracture and osteotomy sites, acting as an intramedullary splint, and to provide greater stability to the construct. To avoid any potential stress risers, the tibial stem was extended beyond the distal tibial plate, which provided additional stability and support to the entire tibia, while reducing the potential for any future fractures. Similarly, the use of a modular stemmed prosthesis in our second patient allowed us to correct the extra-articular tibial deformity, restore the joint line and replace the arthritic knee. The range of movement and knee mechanics of the patient greatly improved. Both patients went on to do well and recovered uneventfully, and are presently able to walk unaided with minimal symptoms.

These two cases serve to highlight the various options that are available to the surgeon in cases of tibial stress fractures. Correction of extra-articular deformities, restoration of normal knee mechanics and joint lines, reduction of tension stresses on the bone, stabilisation of the fractures and replacement of the arthritic joints can all be done effectively with stemmed modular TKA implants.

REFERENCES

1. Devas M. Stress Fractures. Edinburgh, London and New York: Churchill Livingstone, 1975.
2. Giladi M, Ahronson Z, Stein M, Danon YL, Milgrom C. Unusual distribution and onset of stress fractures in soldiers. Clin Orthop Relat Res 1985; 192:142-6.
3. Milgrom C, Finestone A, Shlamkovitch N, et al. Youth is a risk factor for stress fracture. A study of 783 infantry recruits. J Bone Joint Surg Br 1994; 76:20-2.
4. Wheeldon FT. Spontaneous fractures of the shin in the presence of knee deformities. Proc R Soc Med 1961; 54:1108.
5. Young A, Kinsella P, Boland P. Stress fractures of the lower limb in patients with rheumatoid arthritis. J Bone Joint Surg Br 1981; 63-B:239-43.
6. Satku K, Kumar VP, Pho RW. Stress fractures of the tibia in osteoarthritis of the knee. J Bone Joint Surg Br 1987; 69:309-11.
7. Haspl M, Jelić M, Pećina M. Arthroplasty in treating knee osteoarthritis and proximal tibia stress fracture. Acta Chir Orthop Traumatol Cech 2003; 70:303-5.
8. Martin LM, Bourne RB, Rorabeck CH. Stress fractures associated with osteoarthritis of the knee. A report of three cases. J Bone Joint Surg Am 1988; 70:771-4.
9. Nabors ED, Kremchek TE, Burke DW. Stress fracture of the proximal tibia associated with severe osteoarthritis. Am J Knee Surg 1995; 8:141-3.
10. Sy MH, Diouf S, Ndoye A, Coumé M. [A new case of tibial stress fracture as a complication of knee osteoarthritis]. Rev Chir Orthop Reparatrice Appar Mot 1995; 81:445-8. French.
11. Kelly JM. Stress fractures in the tibia associated with knee deformities. J Ir Med Assoc 1974; 67:97-9.
12. Ross DJ, Dieppe PA, Watt I, Newman JH. Tibial stress fracture in pyrophosphate arthropathy. J Bone Joint Surg Br 1983; 65:474-7.
13. Grundy M. Fractures of the femur in Paget's disease of bone: their aetiology and treatment. J Bone Joint Surg Br 1970; 52:252-63.
14. Sawant MR, Bendall SP, Kavanagh TG, Citron ND. Nonunion of tibial stress fractures in patients with deformed arthritic knees. Treatment using modular total knee arthroplasty. J Bone Joint Surg Br 1999; 81:663-6.
15. Tey IK, Chong KW, Singh I. Stress fracture of the distal tibia secondary to severe knee osteoarthritis: a case report. J Orthop Surg (Hong Kong) 2006; 14:212-5.
16. Sourlas I, Papachristou G, Pilichou A, et al. Proximal tibial stress fractures associated with primary degenerative knee osteoarthritis. Am J Orthop (Belle Mead NJ) 2009; 38:120-4.
17. Tomlinson MP, Dingwall IM, Phillips H. Total knee arthroplasty in the management of proximal tibial stress fractures. J Arthroplasty 1995; 10:707-13.
18. Kobayashi T, Takaku Y, Nagaosa Y, Kikuchi S. Strength distribution in the tibia. Fukushima J Med Sci 1998; 44:107-12.
19. Alms M. Fracture mechanics. J Bone Joint Surg Br 1961; 43-B:162-6.