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Management of Tibial stress fracture in Osteoarthritic deformed Knee with Total Knee Arthroplasty

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Abstract:*Stress fractures of the tibia which occurs due to the osteoarthritic deformities are rare and pose a great challenge in management. We managed three such patients with stress fractures of proximal tibia with deformed osteoarthritic knee. All patients had established osteoarthritis of the knee; one patient with genu valgus deformity and the other two with genu varus deformity. All of them underwent a total knee replacement with a long tibial stem extension, and subsequently, their fractures united on followup. All three patients recovered uneventfully with good functional range of movements restored. Correction of extra –articular deformities with the restoration of normal knee mechanics and joint lines along with reduction of tension stresses on the bone and stabilisation of the associated stress fractures and replacement of the arthritic joints can all be done effectively with long stemmed modular total knee arthroplasty implants.*
Key words: *Stress fracture, Deformity, Osteoarthritis Knee, Total Knee Arthroplasty*

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I. Introduction

Stress fractures of the tibia are commonly observed in the young and the causes can be varied. Most often, 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 stressesthat 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. [(1-6)]

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. [(6,14,16)] 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.

Stress fractures can occur atmany different sites in the body, but the tibia accounts for almost 50% of such fracture incidences. [(7)] 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. [(8)]

II. Case Report

We describe three cases of tibial stress fractures secondary to deformed arthritic knees. All patients we of the elder age group with the age at the range of 56-63 years. All of them presented with minimum of four weeks of knee pain with a history of increasing deformity in the knee. Examination revealed genu valgus deformity in one and the other two patients with genu varus deformity.

Radiographic evaluation revealed a grossly osteoarthritic knee joint in all three patients with stress fracture in the proximal third of the tibia. Two of them underwent a modular total knee prosthesis with a long tibial stem extension while the other one was initially treated conservatively but the fracture failed to unite so she was subsequently treated surgically with total knee arthroplasty with long tibial stem component. All oftheir fractures united at an average of 18 weeks and one-yearfollow-up examination revealed that the knees were free of any pain and range of motion of 0-100 degrees possible in all of them. The period of follow-up of these cases ranged from 13 months to 24 months.

III. Discussion

Stress fractures result from repetitive abnormalmechanical loading on normal bone, or normalmechanical loading on abnormal bone. The causes ofthese fractures are varied, and insults on the bone areusually chronic and of low intensity, thus resulting ina fracture which is often not acute. Stress fractures ofthe tibia in the elderly are well described, althoughuncommonly. The associations of stress fracturesinclude RA, OA, osteoporosis and Paget's disease.Pyrophosphate arthropathy and renal osteodystrophyare other more uncommon causes. [(16)] These fracturesare rare, possibly because a TKA would have beenperformed for the patient who has a very symptomaticpainful knee before gross deformity and subsequentfracture have time to occur. [(17)] Advances in osteoporotictreatment with new drugs could also be a contributingfactor, as such treatments help to increase the strengthof the bone.

IV. Mechanism Of Stress Fracture

Severe extra -articular tibial deformity secondary toOA, as observed in our patients, results in the shiftingof the mechanical axis of the lower limb. This causesabnormal forces and load to be placed onto the tibia.Eccentric forces result in tension stresses on the convexside of the bone, and compression places stress on theconcave side. Large valgus or varus malalignment wouldthus severely affect the bone, leading to its gradualweakening and hence, a stress fracture ascends into the picture. [(18)]Callus and new bone formation would generally beinitiated, and fracture repair carried out. However,this would not lead to fracture union, as the abnormalmechanical axis from the severe tibial extra –articulardeformities are still present.

V. Clincal Features

The physical signs of a stress fracture would belocalised tenderness over the fracture site. Sometimes,there might be a bony callus that is palpable as thefracture begins to heal. Severe deformity is rarelyobserved, and unless a complete fracture occurs, itis not usually visible. [(9)]

Radiographs may reveal thestress fracture or malunion/non-union at the site ofthe fracture. If a stress fracture is not visible, a repeatradiograph may be conducted at a suitable interval,which might show up the fracture site; alternatively, atechnetium -99 m bone imaging can be performed.[(10)]The fracture site would then be illuminated on imaging,and subsequently identified.

VI. Management

Stress fractures can be treated conservativelyor surgically. In most cases of stress fractures, rest,reduction of weight -bearing activity level and analgesiaresult in bone healing, and also allow a patient to returnto full function after some time. However, if a patientpresents with stress fractures secondary to severedeformity with concomitant OA, as in our case studies,surgery is often indicated.[(17)] Surgery can be usedto treat the fracture and OA with genu varus or valgusdeformity at a single shot. The mechanical axis can also be re –alignedand the abnormal stresses on the tibia removed.

In all our patientswe managed to correct the deformity with the tibial cuts without any augments in the form of blocks or grafts.A modular TKA was used to replace the arthritic jointand to restore a good range of movement and betterkinematics for the patient's knee. This helped to realignthe mechanical axis, and converted the tension stressesacross the proximal tibia into compression forces.

Correction of the alignment both at theknee joint and at the fracture site is necessary torestore the mechanical axis of the limb to normaland facilitate fracture healing. Osteoporosis resultingin lower fatigue strength of the bone and stiffnessof the adjacent joint due to arthritis areundoubtedly important etiologic factors.[(11-13)]

Non-operative measures may achieve union inpatients with minimal limb malalignment, butthere is a high rate of failure in mal-aligned limbsand symptoms derived from the arthritic kneewill persist.[(14)]Operative realignment and grafting of the fracturewith or without fixation will usually result inunion of the fracture, but the arthritic joint remainsmalaligned and may be painful. Further stress fracturesmay occur moredistal to the fixation device. [(15)]

Knee joint arthroplasty with a stemmed tibialimplant, although not without possible complications,has the advantages of restoring fracture andjoint alignment and treating the arthritic joint inone procedure, thus allowing the fracture to unitein a biomechanically favourable situation.[(16)] It alsoallows immediate mobilization of the patient withoutthe need for cumbersome casts or splintage.The procedure can be technically demanding and open reduction of the fracture site may be necessary.

It is important to use a long enough tibial stemto bypass the fracture site and provide stable fixationof the fracture in the correct alignment. The use of a modular prosthesis allowed the extensionof the tibial stem to bridge both the fracture andosteotomy sites, acting as an intramedullary splint, andto provide greater stability to the construct.[(17)] To avoidany potential stress risers, the tibial stem was extendedbeyond the distal tibial plate,

which provided additionalstability and support to the entire tibia, while reducingthe potential for any future fractures.[18]

Similarly, the useof a modular stemmed prosthesis in our second patientallowed us to correct the extra - articular tibial deformity,restore the joint line and replace the arthritic knee. Theintramedullary fixation thus provided gives moreideal conditions for fracture healing.

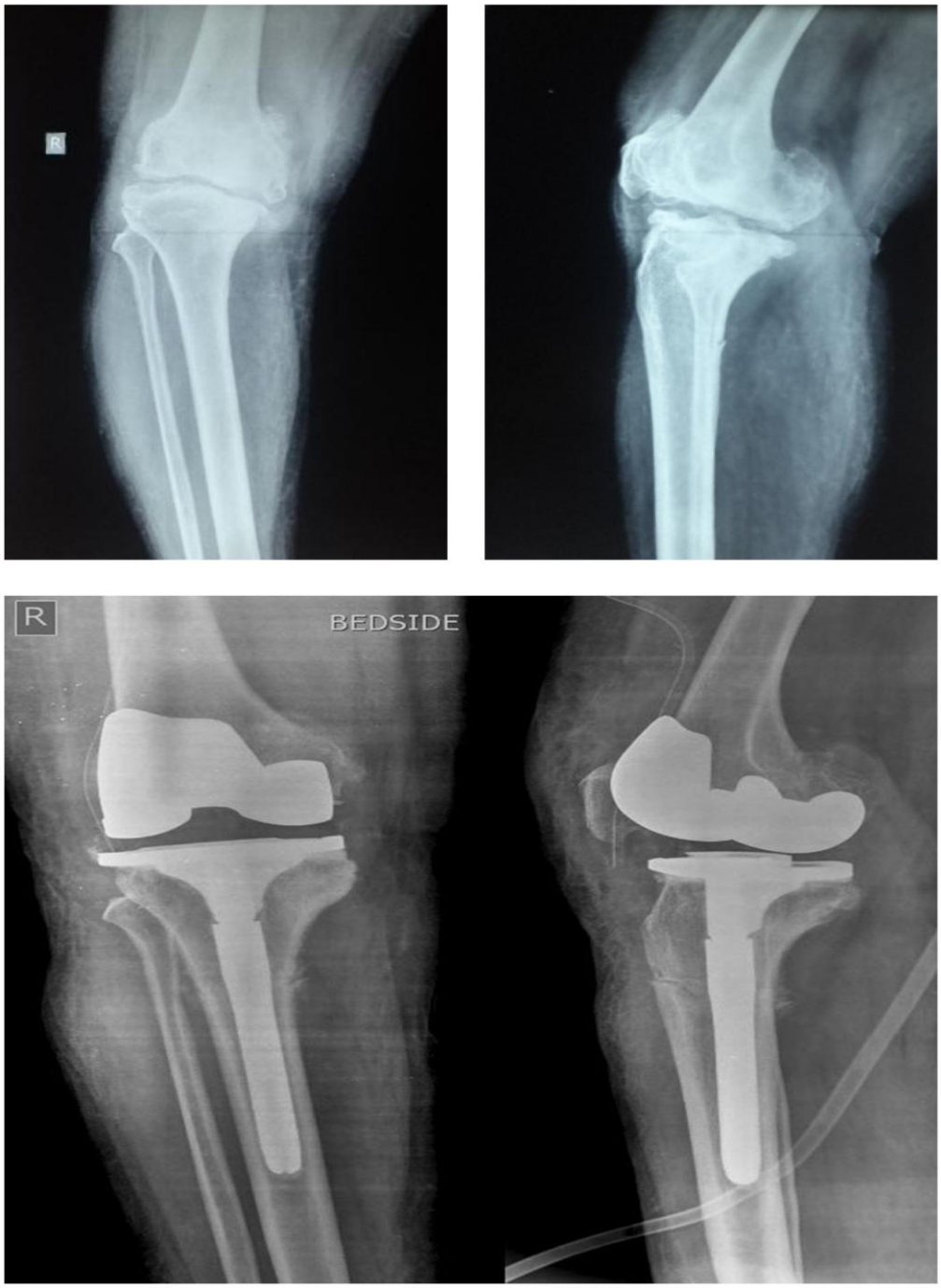

Figure shows the Pre Op X ray with proximal tibial stress fracture in a varus deformed osteoarthritic knee which was managed with total knee arthroplasty with long stem tibial component addressing both fracture and deformity in single surgery.

VII. Conclusion

Although our series of three cases is too small toallow recommendation of this technique as standardtreatment for stress fractures below arthritic kneejoints, our experience suggests that there is a placefor this technique, particularly when angular deformityat the joint or at the fracture site makes unionunlikely and when delayed or non-union hasoccurred after unsuccessful nonoperative treatment. Range of movement and knee mechanics of the patient greatly improved. All three patients went on to do well and recovered uneventfully, and are presently able to walkunaided with minimal symptoms.These cases serve to highlight the variousoptions that are available to the surgeon in cases oftibial stress fractures.

Correction of extra –articulardeformities, restoration of normal knee mechanics andjoint lines, reduction of tension stresses on the bone,stabilisation of the fractures and replacement of thearthritic joints can all be done effectively with stemmedmodular TKA implants.

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