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Indian Journal of Orthopaedics Surgery

Journal homepage: www.innovativepublication.com

Short Communication

Malunited proximal third tibia fracture treated with open reduction and internal fixation surgery with a raft plate using the early stage callus as a potential autograft

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ARTICLE INFO

Article history:
Received 08-05-2020
Accepted 19-05-2020
Available online 07-07-2020

Keywords:
Proximal tibia
Malunion
Varus
Rotational deformity
Raft plate
Callus
Autograft

ABSTRACT

The incidence of proximal tibia fractures occur only in 5%-11% of all tibia shaft fractures and often result from high impetus trauma commonly seen in motor vehicle accidents.Repairing a bone defect, healing of a nonunion, or surgery for the malunited fracture often requires bone grafting. There is a notable interest among orthopaedic surgeons to learn whether the bone callus can be used as an autograft material.

1. Introduction

The incidence of proximal tibia fractures occur only in 5%-11% of all tibia shaft fractures and often result from high impetus trauma.[1] Conservative management of such fractures by cast application leads to extended immobilization of knee and ankle has often resulted in malunion, nonunion, procurvatum, rotational deformity or stiffness of adjacent joints hampering the quality of mobility of the patients. Bone callus is often removed and discarded, especially in second stage surgery in the cases of malunion.[2] Repairing a bone defect, healing of a nonunion, or surgery for the malunited fractures often requires a bone graft using autologous bone harvested from the iliac crest.[3] Nevertheless, performing such grafts is complicated by the subsidiary surgery required to obtain the bone graft associated with infection, related donor site pain and unsightly scars.[4–6] Bone callus forms along with fracture healing, which is a process involving a complex interplay of cells, growth factors, and extracellular matrix.[7,8] At the cellular level, chondroblasts and osteoblasts are involved in callus formation.[8–10] Also, bone callus tissue is non-immunogenic and histocompatible, reducing the perils of transmitting diseases when used as grafting material.[9–16]

2. The Presentation

This article presents a study of 26 year old male with 3 months old malunited proximal third tibia fracture following a motor vehicle accident which was treated conservatively by a quack outside at that time and presented to us for definitive management of a fracture malunion with bridging callus associated with 11° of varus deformity. Post surgery, the patient was followed for 9 months and evaluated based on radiological outcomes through xrays and functionally by Knee Society Scoring(KSS).

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https://doi.org/10.18231/j.ijos.2020.028

2.1. Biomechanical Assessment prior to the surgery

Knee joint examination and rom - painful flexion not more than 40°.

Inability to bear weight,

Gait Disturbance,

Shortening > 2 cms,

Fracture Geometry and Overlapping (Then and now),

Varus Deformity : 11°,

Presence of external rotation deformity and

Malalignment of hip-knee-ankle angle (Mechanical axis).

After functional and radiological assessment, considering the patient's age and functional demand, we decided to perform open reduction and internal fixation of proximal third tibia and deformity correction surgery with a raft plate using the early stage callus as a potential autograft.

Before the surgical intervention, patient underwent routine investigations, obtained anaesthetic, informed consent clearance, medical fitness and adequate antibiotic dosage.

Fracture site was exposed through standard antero-lateral curvilinear incision, previously formed callus extracted through a bone nibbler, freshening up of the fracture ends done followed by appropriate reduction through axial traction, valgus force and reduction clamp under c-arm image intensifier followed by internal fixation with a proximal tibial raft plate along with screws according to the fracture geometry and stability. The extracted callus was then made into small chunks and re-inserted through artery forceps in the bone void(Figure 4). Closure was done in layers.

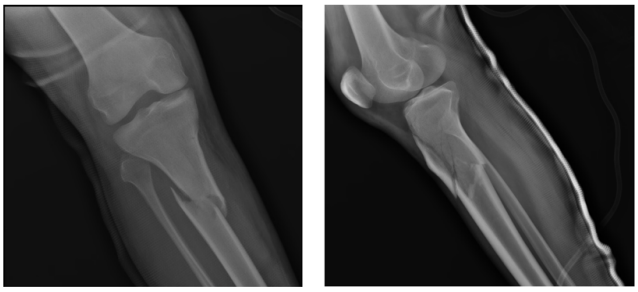

Fig. 1: AP and lateral radiographs just after the road traffic accident illustrating displaced spiral proximal third tibia fracture for which surgery was advised but patient refused for the same

3. Result

Radiography series from immediate post operative till 9 months post surgery illustrating excellent union, adequate alignment(deformity correction considering previous varus, external rotation and unaligned mechanical axis) and functional assessment was done using Knee Society Score (KSS) which was 82/100 depicting good to excellent overall

Fig. 2: AP and lateral radiographs at 3 months following the injury illustrating a proximal third fracture malunion with 11° of varus deformity

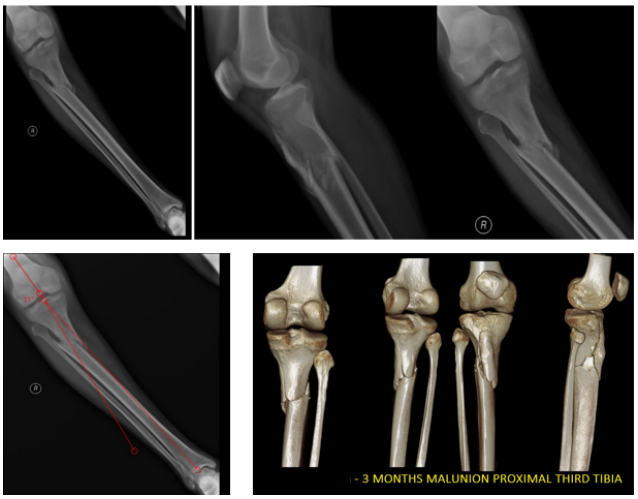

Fig. 3: AP and lateral radiographs at 3 months following the injury illustratinga proximal third fracture malunion with 11° of varus deformity

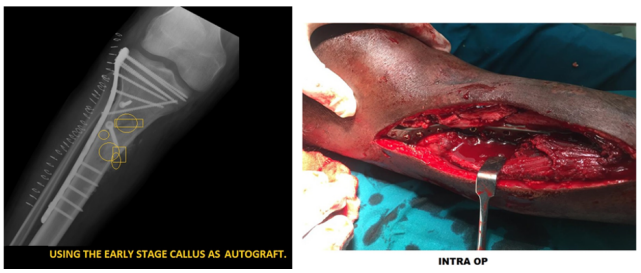

Fig. 4: Intra operative images

outcome (Figures 5, 6, 7, 8, 9, 10 and 11).

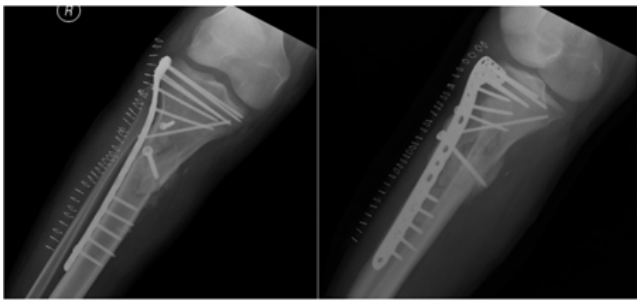

Fig. 5: POD O (Immediate Post Op X-ray

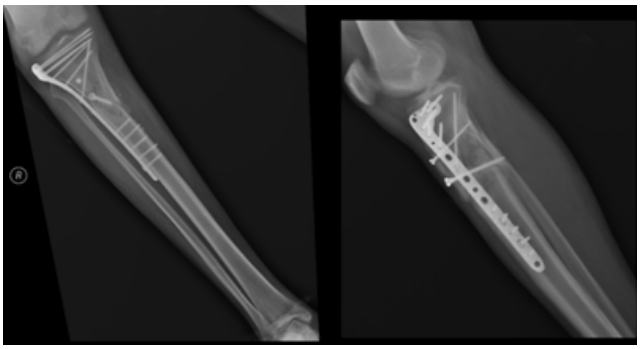

Fig. 6: 4 weeks Post Op

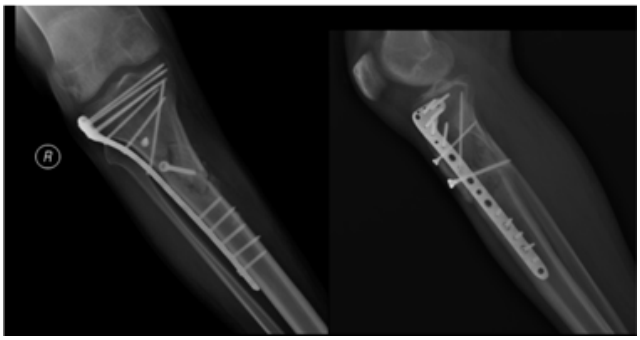

Fig. 7: 8 weeks Post Op

4. Discussion

A standard post operative protocol was followed considering adequate antibiotics, analgesics and physiotherapy rehabilitation. As the construct was considered to be stable, partial weight bearing walking with a walker was allowed from the second post operative day. Full weight bearing was allowed only after complete clinical and radiological union which occurred at 12th week post surgery with Knee Society Score of 82. The patient was followed till 9 months post surgery. X-ray series were compared to evaluate the

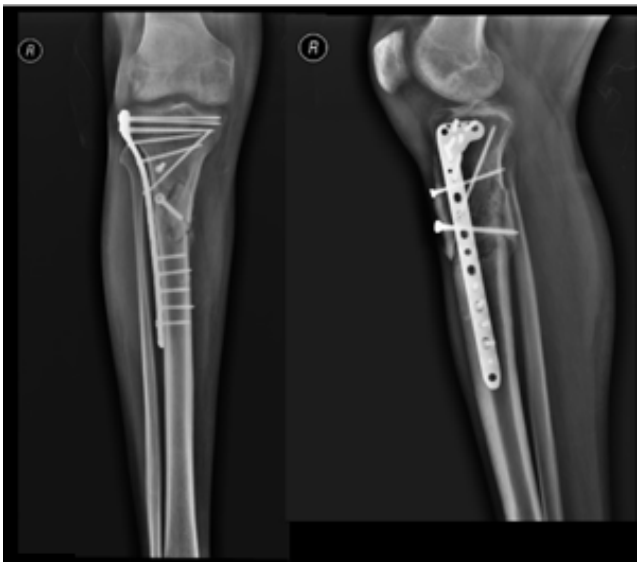

Fig. 8: 3 months Post Op

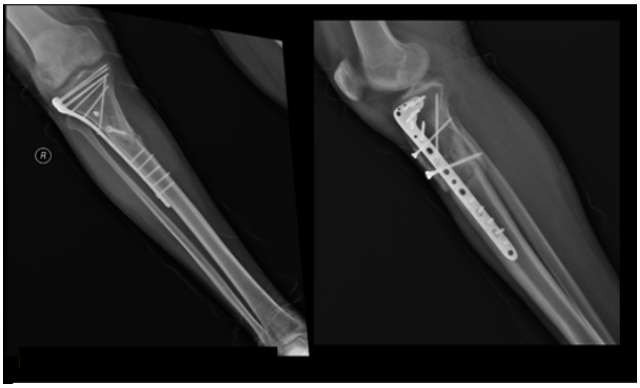

Fig. 9: 4 months Post Op

Fig. 10: 6 months Post Op

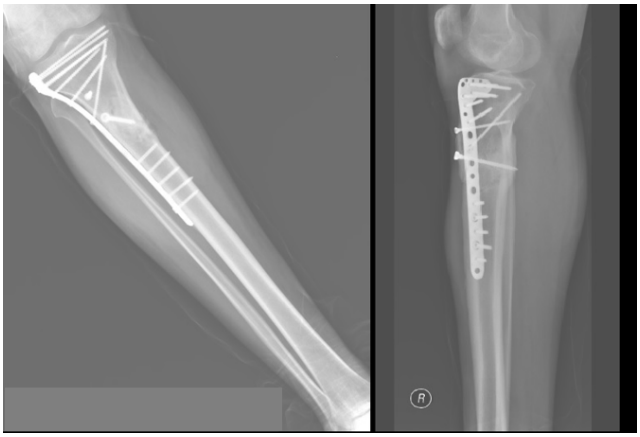

Fig. 11: 9 months Post Op

accuracy of reduction, resultant union and mechanical axis alignment. Measurements were performed for varus and pro/recurvatum plane deformities using the technique described by Freedman et al.[17] Range of motion, shortening and rotational alignment were evaluated clinically.[18] Extra-articular proximal tibia fractures has been a challenging situation to most of the surgeons today and often requires surgical treatment as definitive management. The deforming muscular forces produced by gastrocnemius, tibialis anterior and patellar ligament and the displacement pattern commonly valgus and extension malalignment of the proximal fragment regarding the fracture geometry must be understood to obtain and maintain anatomical reduction. The primary surgical goal for such fractures should be anatomic restoration of length, articular margin, rotational alignment and early knee motion while avoiding soft tissue complications. Callus filling at fracture site for malunion after proximal tibial is a rare technique, but it achieved a favorable postoperative outcome. The bone callus, which is generated during fracture healing, is commonly discarded during surgical procedures. The aim was to investigate the osteogenic potential of bone callus and its possible use as autograft material for patients needing bone grafts. Han et al.[19]has studied that early-stage callus (within 3 months after fracture) resulted significantly improved osteogenic properties compared to medium(between3-9 months) and late stage (more than 9 months) callus. Since favorable bone fusion was achieved with callus, this treatment method may overcome the disadvantages of autogenous bone graft, such as pain at the donor region. Danoff et al. demonstrated that callus has osteoconductivity and osteoinductivity in an animal experiment[20] and Han et al[19] reported that callus is a useful bone graft material with superior histocompatibility causing no immune reaction, and histologically, osteoblasts are distributed in a trabecular pattern in the margin of single-layer porous bone tissue and promote bone fusion by expressing osteoinductive factors such as bone morphogenetic protein.

5. Conclusion

We present a study in which the bone defect was filled with early stage callus and favorable bone fusion was achieved with callus, suggesting that this treatment method overcomes the disadvantages of autogenous bone graft, such as pain at the donor region, in patients in whom a sufficient amount of callus can be collected. In such cases, early stage callus should be considered as a potential bone graft subsitute as it promotes union by expressing osteoinductive factors. Although, the technique is useful in limited cases with prerequisite such as small bone defect sizes and sufficient callus formation. Further studies are needed with a large database of cases.

6. Source of Funding

Nil.

7. Conflict of Interest

Nil.

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Cite this article: Kakkar RS, Kore P, Deshpande A. Malunited proximal third tibia fracture treated with open reduction and internal fixation surgery with a raft plate using the early stage callus as a potential autograft. *Indian J Orthop Surg* 2020;6(2):147-151.