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Case Report

Bone grafting of the regenerate: a previously undescribed case and surgical technique

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ABSTRACT

Distraction osteogenesis can occasionally be complicated with poor-quality regenerated bone. Several factors have been identified in the literature in order to reinforce the maturation of the regenerate. We would like to present a case in a 40 years old patient who presented with shortening and uniplanar varus angulation at his proximal tibia. The patient was treated with distraction osteogenesis using a circular frame. He had significant delay in the maturation of the 4-5 cm gap, and it was decided to use a non-vascularized fibular graft that was introduced using the tibial intramedullary nailing instrumentation. The graft led to an impressive acceleration of the maturation of the regenerate, mostly posteriorly and laterally with poor progression at the anterior part of the tibia. As this is the first such case presented in the international literature it is difficult to speculate why the regenerate was stimulated only in specific areas. Further reporting is necessary to reach safe conclusions.

Keywords: Distraction osteogenesis, Grafting poor regenerate, Non-vascularized fibular graft, Circular external fixator, Compression and distraction

INTRODUCTION

Poor bone formation is a well-known complication of distraction osteogenesis. A variety of attributing factors have been proposed that predispose to this. Patient related factors include the use of non-steroidal-anti-inflammatory drugs, smoking, congenital predisposition and systemic disease such as diabetes. Regional factors include soft tissue scarring, infection, radiation as well as disease specific such as congenital pseudarthrosis of the tibia. Other factors include a compromised soft tissue envelope, poor selection of the corticotomy site, suboptimal corticotomy technique, unstable frame configuration, short latency period or rapid distraction rate.[1]

We would like to present a previously not described case of grafting a poor regenerate with a non-vascularized fibular strut graft.

CASE REPORT

A 40 years old patient was referred to our hospital due to left lower limb shortening and abnormal gait. He claimed he had sustained a comminuted proximal tibial fracture due to a gun-shot injury 20 years before, that required several debridment's under general anaesthesia, internal fixation of his fracture, followed by a circular external fixator and finally with re-plating of his fracture. Five years following his initial injury, his left lower limb was further compromised by another gun-shot at his ipsilateral femur that was dealt with an intramedullary nail.

On presentation there was obvious limb discrepancy and muscle wasting in the whole of his left lower limb. On inspection, he had multiple scars in the femur and proximal tibia and clinical varus angulation at his tibia. He had a full

range of movement at his left knee, hip and ankle and was neurovascularly intact.

Radiologically he had a proximal tibial malunion with 14° of uniplanar varus angulation and 5 cm shortening at his left tibia as shown on full length computer tomography scan.

Figure 1: Tomography scan of both lower limbs showing shortening of the left tibia 5 cm and varus angulation.

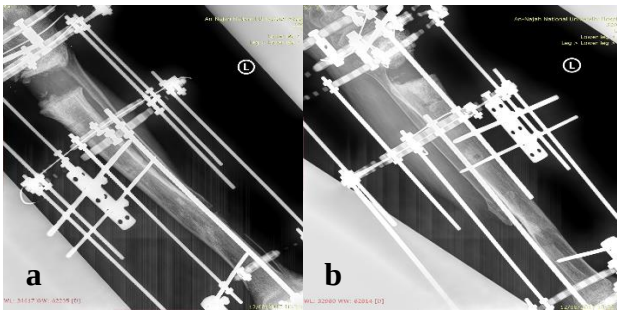

Figure 2: (a) AP view of tibia showing poor regenerate after 6 months of distraction and (b) lateral view of tibia showing poor regenerate after 6 months of distraction.

The center of rotation of his angulation (CORA) was at the level of the nonunion at the proximal tibia. Due to the damaged soft tissue envelope, the multiple soft tissue scars and the quality of the bone at the level of the malunion, it was decided to proceed with monofocal distraction osteogenesis near the level of the CORA with concomitant correction of the angulatory deformity with the assistance of a circular frame. Two rings were used per segment with wires and half pins fixation, and initially the segments were connected with hinges and motor in order to address first the angulatory deformity.

Following 15 days resting period, the angulation was gradually corrected and lengthening was initiated after changing the hinges to straight lengthening rods. Due to the patient's pain, the scarring of the area and the bad quality of bone, distraction was achieved by 0-75 mm per day, in 8 hourly intervals. The patient opted to stop lengthening once he reached 4.5 cm. Due to his poor quality of the regenerate, three cycles of compression and distraction of the regenerate were performed as well as oral administration of bisphosphonates, but without success. After six months of waiting (Figure 2 a and b) for the regenerate to mature, and after consideration of other options, it was decided to bone graft the regenerate.

Under general anaesthesia, an 11 cm non-vascularized fibular strut graft was obtained from his contralateral calf. A midline incision over the patellar tendon was performed at the injured limb, and through a trans patellar approach and utilizing the instrumentation for the insertion of tibial nailing, the graft was inserted within the circumference of the regenerate (Figure 3a and b).

Figure 3: (a) AP view of upper tibia showing fibular graft and (b) lateral view of upper tibia showing fibular graft.

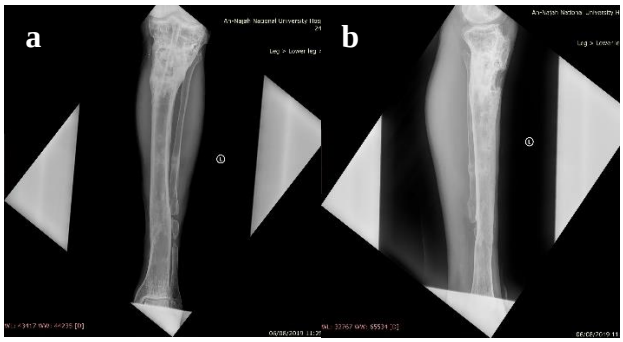

Figure 4: (a) AP view of tibia showing final outcome and (b) lateral view of tibia showing final outcome.

The graft led to an impressive acceleration of the maturation of the regenerate, mostly posteriorly and laterally with poor progression at the anterior part.

Training of the regenerate started 5 months following the grafting and a month later the frame was removed. Eighteen months following the removal, the patient was reviewed. He was happy with the outcome, able to walk near normally despite his persistent muscle wasting. Radiologically, there was consolidation of the regenerate.

The graft was still visible. The anterior part of the regenerate did not recover (Figure 4 a and b).

DISCUSSION

A variety of techniques have been suggested in the literature to address the poor regenerate formation such as compaction of the regenerate with or without additional osteotomy, the accordion maneuver with cycles of compression/distraction of the regenerate, as well as low intensity pulse ultrasound, bisphosphonates, bone morphogenic proteins, injections of bone marrow and/or platelet rich plasma.[2-7] Cancellous bone grafting has been widely used for late complications of the regenerate such as fracture following frame removal.

In our case the regenerate was very poor probably due to a variety of reasons. Certainly, the extensive scarring of the area contributed, and, on retrospect, the choice of the corticotomy area was suboptimal. The use of bisphosphonates and cycles of compression/distraction did not help the improve the maturation of the regenerate. Intramedullary nailing was suggested, but the in-house nailing system did not allow two proximal locking screws to provide sufficient stabilization of the proximal segment.

To the best of our knowledge there is no other report of grafting the regenerate with a strut fibular graft in the literature. This was possible as the regenerate was in the proximal tibia, and access to the center of the circumference of the regenerate was easily achieved through the mid patellar-tendon approach which is commonly used for the insertion of the tibial intramedullary nail. In fact, the only tool that was required was the initial owl of the tibial nailing system to provide access to the medullary cavity.

There is no doubt that the fibular grafting stimulated the poor regenerate, which soon after started maturing and consolidating. The anterior part of the tibia did not interact with the fibular graft, and possibly inhibited the maturation process at the area. It is difficult to speculate why this happened, but could be attributed to the poor vascularity in the area that has no muscle attachments over the bone. Obviously no safe conclusion can be reached by reporting a single case apart from the fact that it is technically easy and, in our case, had a favorable result.

CONCLUSION

To conclude, fibular grafting of the poor regenerate is technically easy and, in our case, provided acceleration of the maturation of the regenerate. Further evidence is required to reach safe conclusion regarding this previously undescribed technique.

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