Case 26: Plating After Lengthening

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Contents

Abstract

Prolonged time in an external fixator during limb reconstruction increases the risk of pin site infection, hardware breakage, and soft tissue contractures. This can cause patient dissatisfaction. Plating after lengthening is a method to reduce the time in external fixation. It is a practical technique in large bone defect reconstruction or delayed callus consolidation – especially in the metaphyseal area. The principles of this surgical technique are presented in a patient who sustained a motorcycle accident, which resulted in a septic pseudarthrosis.

1 Brief Clinical History

A 48 year old male sustained a distal tibia and fibula fracture from a motorcycle accident in 2000. He was treated initially abroad with simple tibial screw fixation. In 2007 the patient presented in our outpatient deformity clinic with chronic osteomyelitis and a draining sinus at the distal tibia.

2 Preoperative Clinical Photos and Radiographs

See Figs. 1 and 2.

3 Preoperative Problem List

1. Septic pseudarthrosis of the tibia
2. Soft tissue and bone defect

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Fig. 1 Distal tibial septic nonunion with screw fixation between the fibula and tibia proximally and distally of the nonunion site

4 Treatment Strategy

Initial surgery:

1. Screw removal.
2. VAC system after debridement of the soft tissue. The sclerotic dead bone was positioned on the distal tibia.
3. A bifocal ring fixator was mounted. Hereby gradual shortening was performed distally at the nonunion site and distraction at the proximal tibial osteotomy.
4. Antibiotic beads were placed into the bone defect distally to decrease the dead space.

Further surgery:

5. Soft tissue was covered temporarily with synthetic skin (Epigard®).
6. Secondary plating after osteodistraction at the metaphyseal area was performed because of the delayed maturation of the callus with additional bone grafting and bone biologics (BMP).

5 Basic Principles

1. Distraction osteogenesis utilizing external ring fixation is an excellent option for limb lengthening and deformity correction. It is also feasible in cases of septic pseudarthrosis. The hematoma at the osteotomy gap has osteogenetic potency for new bone formation. By distracting two osteotomized fragments (called callus distraction) or by shifting a bony fragment (**segment transport**), callus formation is induced. Segment transport is performed over an external ring fixator by daily transporting the bony segment into the bone defect.
2. During distraction osteogenesis, prolonged external fixation can lead to pin site infection, hardware failure, and patient's dissatisfaction. Furthermore fractures and bending of the new bone after frame removal may occur. Therefore, in some cases several hybrid techniques are useful to avoid these complications. Approaches in these hybrid techniques are nailing after lengthening, lengthening over nail, or **plating after lengthening**. The indication for secondary internal fixation can be determined either before or during the distraction phase.
3. A common technique in bone graft harvesting is the **reamer-irrigator-aspirator system** (**RIA**, DePuy Synthes®). Initially this technique was developed to prevent intramedullary pressure rise resulting in fat embolization during reaming. It has been described as a sufficient and safe procedure of significant amount of bone harvest especially in the treatment of long bone nonunions. Hereby the reaming debris is rich in growth factors.

6 Images During Treatment

See Figs. 3, 4, 5, 6, 7, and 8.

7 Technical Pearls

(a) When using the **RIA system** for bone harvesting, certain technical facts have to be considered: The cortical diameter at harvest site has to be assessed initially, intra-operative reaming has to be monitored with fluoroscopy, bone harvesting in osteoporotic patients has to be avoided, and the technique requires clinical experience with intramedullary reaming. The advantage of this technique is that sufficient amount of bone graft can be harvested from the intramedullary canal. This bone graft is biologically active with osteogenic,

Fig. 2 Clinical appearance of the soft tissue and bone defect

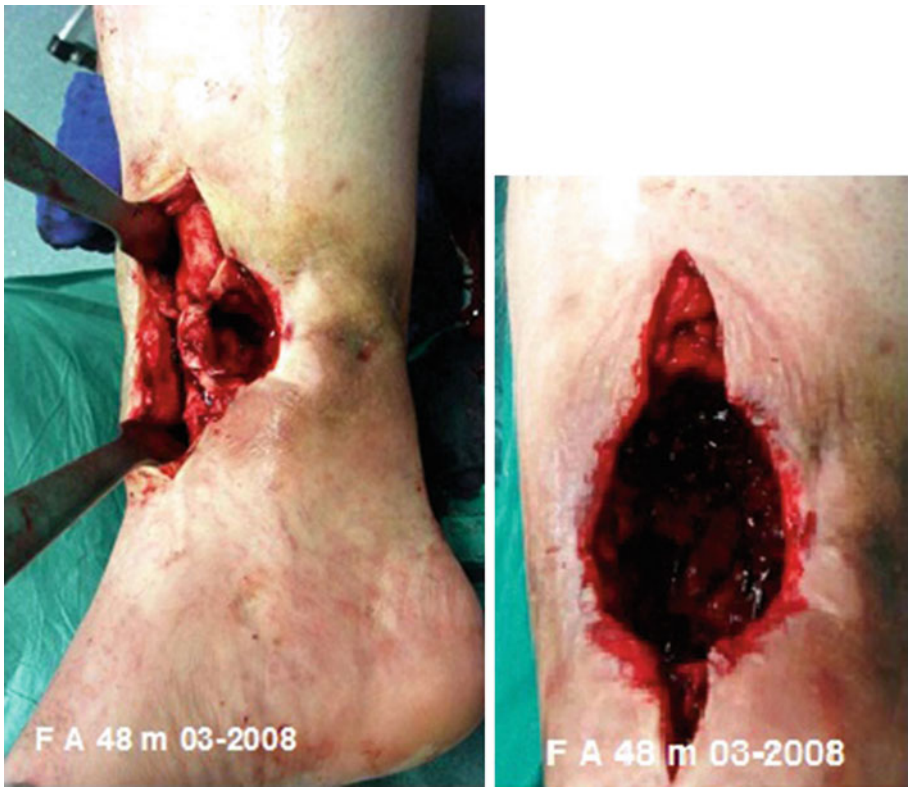

Fig. 3 Soft tissue and bone debridement of the nonunion site

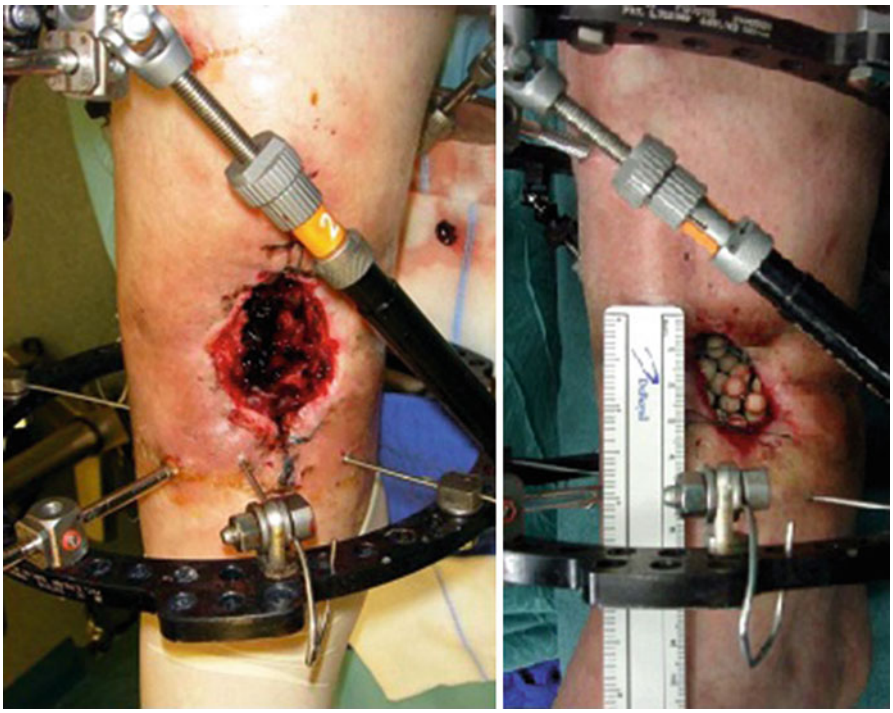

Fig. 4 Clinical aspect at revision surgery

Fig. 5 X-rays a.p. and lateral view during distraction osteogenesis (segment transport)

Fig. 6 X-rays a.p. and lateral view during distraction osteogenesis showed delayed maturation of the callus

Fig. 7 RIA system – bone graft harvesting from the ipsilateral femur

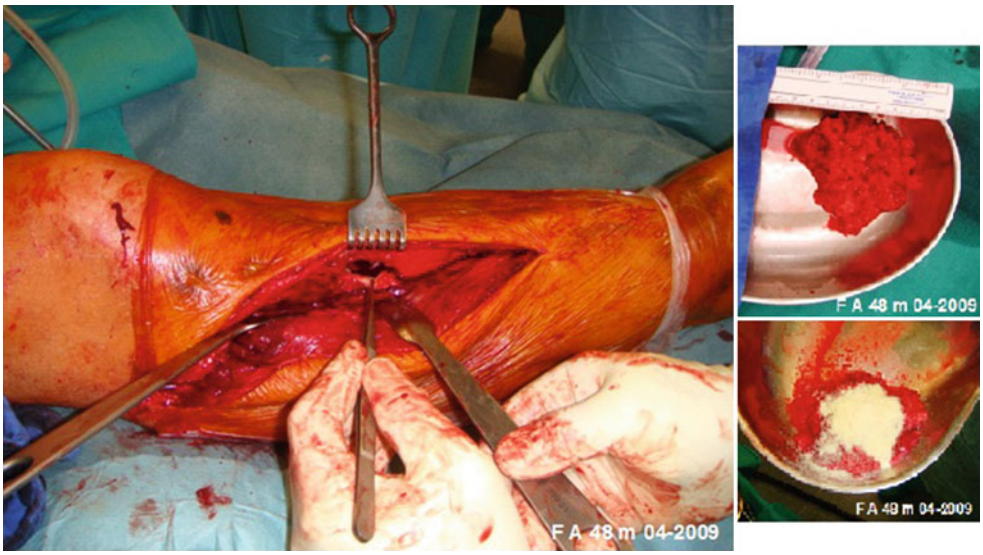

Fig. 8 Bone graft and bone biologics at distraction site

osteoconductive, and osteoinductive properties. The donor site morbidity appears to be less compared to iliac bone graft harvest. Combining BMPs with intramedullary graft is supposed to improve bone healing. This needs to be studied in the future.

(b) In cases of distraction osteogenesis close to the articular margin, nailing after lengthening or lengthening over a nail is not possible. **Plating after lengthening** is the alternative method. This technique can be performed either while the frame is still mounted or after frame removal. Plating after lengthening consists of removing the frame and plating in a one- or in a two-step surgical procedure, including temporary plaster fixation and wound healing in between the two surgical steps.

8 Outcome Clinical Photos and Radiographs

See Figs. 9, 10, 11, and 12.

Fig. 9 Standing long leg X-rays 4 years post-op

Fig. 10 Clinical outcome picture 2 years post-op

Fig. 11 Final a.p. tibial X-ray showing sound union at the plated proximal distraction area 30 months after surgery

9 Avoiding and Managing Problems

Plating after lengthening is a practical technique in cases of large bone defects or expected delayed consolidation of the bone regenerate especially in the metaphyseal area. Additionally, axis correction can be performed at the same time during plate fixation. The decision between plating and nailing after lengthening depends on the location of osteotomy or distraction as well as on the bone quality. Radiological follow-up in two planes is mandatory to monitor the development of callus tissue in the distraction gap and to evaluate the alignment. However, inadequate corticalization and premature removal of the external ring fixator can lead to bending, refracture, and loss of length. Various methods are available to analyze the stiffness of the callus tissue, maturation, and corticalization to determine the ideal time for fixator removal. Indirect quantitative methods such as pixel

Fig. 12 Final lateral X-ray corresponding to Fig. 11

value ratio (PVR), dual-energy X-ray absorptiometry (DEXA), ultrasonography, and quantitative computer tomography (QCT) have been described.

10 Cross-References

- Case 9: Limb Salvage After Massive Traumatic Femoral Bone Loss
- Case 16: Acute Shortening and Then Lengthening
- Case 38: Impaired Joint Motion During and After Callus Distraction

References and Suggested Reading

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