

A Case Report of Humeral Nail Breakage after 11 Years Secondary to Shaft Nonunion: Treatment with Autogenous Iliac Crest Bone Graft and Compression Plate

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Learning Point of the Article:

The very rare case of nail breakage after humerus fracture treatment can be addressed with a one stage procedure, even after a long standing non-union of the fracture.

Abstract

Introduction: The rate of nonunion of operatively treated fractures of humeral shaft is low. Increased incidence of nonunion is associated with different conditions such as open fractures, bone loss, or fracture gapping. Nonunions after prior intramedullary nailing can be difficult to address, even more with hardware failure. We present the case of a humeral nail breakage 11 years after implantation, secondary to nonunion.

Case Report: A 33-year-old man referred to our hospital with oligotrophic nonunion of the middle humeral diaphysis and nail breakage after 11 years from the first fracture. We decided then to schedule a one-stage surgical procedure of nail removal and new osteosynthesis with autogenous iliac crest bone graft.

Conclusions: The patient presented good clinical evolution, without functional limitation or pain. Bone graft union was radiologically confirmed at final follow-up. To the best of our knowledge, this is the first case of non-traumatic nail breakage in a humeral shaft nonunion after such a long period of time. In this case, we found that a one-stage surgical procedure with nail removal and locking compression plate fixation associated with tricortical autogenous iliac crest bone grafting after long-standing humeral shaft nonunion is favorable.

Keywords: Humerus, nail, breakage, nonunion, treatment.

Introduction

Fractures of the humeral shaft account for 3–5% of all fractures and approximately 30% of those of the humerus [1,2]. While there may be some consensus on the nature of operative treatment, in general, the choice of the fixation device (plate vs. nail) is still debated [3]. The rate of nonunion is reported to range from 3% to 5% of all operatively treated fractures while after non-operative treatment is higher and described as up to 23% in literature [4, 5, 6, 7, 8].

Increased incidence of nonunion is associated with open fractures, high-impact injuries, bone loss or fracture gapping, soft tissue interposition, unstable fracture patterns, segmental fractures, impaired blood supply, infection, and initial treatment

with traction or a hanging cast [2]. The patient factors such as obesity, osteoporosis, alcoholism, malnutrition, and non-compliance also are influential [2,9,10].

Humeral nonunions after prior intramedullary (IM) nailing can be difficult to address due to possible bone loss around a loose nail, which complicates the reconstructive procedure and lead to poorer operative results compared to prior non-operative treatment or plate fixation [11].

Different treatment techniques have been described for the specific reconstructive problems including open reduction and plating with the removal of the nail, exchange IM nailing, Ilizarov external fixation, and the application of a wave plate [5,11, 12, 13, 14, 15].

Author's Photo Gallery



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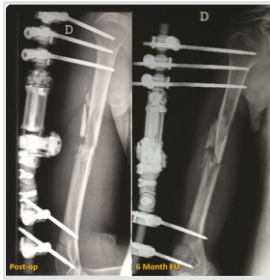


Figure 1: Post-operative and 6 months follow-up radiography of initial treatment.

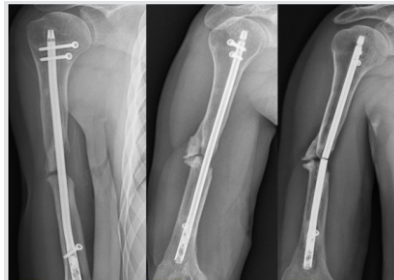


Figure 2: Oligotrophic nonunion and nail breakage after 11 years.

Herein, we present the case of a 33-year-old male with nail breakage 11 years after implantation, secondary to nonunion of the humeral shaft. To the best of our knowledge, it is the first case reported in literature.

Case Report

A 33-year-old man referred to our hospital with oligotrophic nonunion of the middle humeral diaphysis and nail breakage. He had a history of Gustilo type I open fracture 12 years before (May 2006), secondary to a motorcycle accident, with a multifragmentary pattern (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopedic Trauma Association type 12B3). He had been initially treated with debridement, wound closure, and positioning of a uniplanar external fixator. After 6 months of clinical and radiological follow-up, there were no signs of healing and persistent pain at fracture site (Fig. 1). It was then decided to convert the external fixator into a roamed retrograde IM nail. The patient was followed up clinically and radiologically until 2017 and had returned to his normal life without complaining of any pain during everyday life and working activity. Unfortunately, unlike the good clinical outcome, the follow-up X-rays showed an oligotrophic nonunion of the midshaft of the humerus with, at least, 1 cm of bone loss. A year later (May 2018), the patient came to our attention because, after a mere twisting movement, he heard a snap and, subsequently, pain and loss of function to the right arm. With plain radiographs, a nail breakage was assessed (Fig. 2). He complained of moderate pain and functional disability of the involved limb and was then admitted to our hospital. Full blood count, sedimentation rate, and C-reactive protein level were preoperatively investigated for infection and were

negative. We decided then to schedule a one-stage surgical procedure of nail removal and new osteosynthesis with autogenous iliac crest bone graft. After regional nerve block and general anesthesia, the patient is seated in a lazy beach chair position, with the head of the bed elevated approximately 30°. This position allows good surgical exposure of the humerus and eases access to the iliac crest. In addition, a padded bump is placed under the ipsilateral hip to ease in the access of the iliac crest by increasing the crests' prominence. The humeral nonunion was exposed through an extended anterolateral approach. A straight incision at the lateral border of the biceps muscle was made, and, after cutting the fascia, the biceps muscle was retracted medially, bringing the brachialis muscle into view. The brachialis muscle was split longitudinally throughout its lateral third and transected down to the bone. Through deltopectoral surgical exposure, the two proximal screws were removed. Distally, the radial nerve was identified, surrounded with a vessel loop and the distal screw was then removed. The nonunion zone was debrided by removing all fibrous tissue, interposed muscle, and necrotic bone followed by decortication, until bleeding bone was observed to provide a viable bed for the bone graft and to stimulate callus formation. The debridement left almost 2 cm bone gap and exposed the broken nail which was removed. A tricortical bone graft is obtained from the iliac crest according to previously described technique [16]. The iliac crest graft was trimmed to enable it to snugly telescope into the fracture fragments (the harvested bone graft was then packed into the defect) and then, a 4.5mm limited contact dynamic compression plate was placed on the anterior face of the humerus (Fig. 3). Dynamic examination of the synthesis under fluoroscopy has been used as an intraoperative method to assess the stability of the construct. Wound closure was provided. Three sets of intraoperative cultures were done with negative results. Post-operative X-rays showed good alignment of the nonunion and refilling of the bone defect. The patient was allowed early rehabilitation with free shoulder and elbow motion to avoid joint stiffness. He was followed up radiologically at regular time intervals of 4 weeks and clinically with Constant shoulder score (CS), subjective shoulder value (SSV), and visual analog scale (VAS). Visits were scheduled until bone graft union was radiologically



Figure 3: Illustrations demonstrating nonunion and plate fixation with autograft.



Figure 4: Illustrations showing 1 month and 6 months follow-up X-rays.

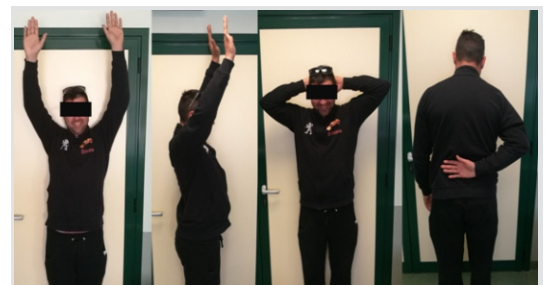


Figure 5: Clinical follow-up at 6 months.

confirmed at final follow-up (Fig. 4). At this point, good clinical function was achieved with SSV of 80%, VAS 0, and CS of 76 (Fig. 5).

Discussion

To the best of our knowledge, this is the first case of nail breakage in a humeral shaft nonunion after a long period of time. A shaft nonunion in long bone fractures after IM nailing is usually a rare complication, especially since the introduction of locking nails. However, it has been indicated that the treatment of diaphyseal nonunions after failed locked nailing of the humerus is not analogous to similar problems observed in the tibia or femur [17]. While in the lower limb, body weight and smaller torsional forces contribute to dynamic loading, the humerus is subject to more rotatory forces and minor axial loading [18]. Still, rotational instability combined with gap distraction at the fracture site contributes to the majority of humeral shaft nonunions after IM nailing [19].

In our opinion, this rotational force to which the arm has been subjected for such a long period of time (11 years) in association with nonunion of the fracture could have led to hardware breakage in this patient. Any nail, in fact, can resist a specific number of cycles and the lack of healing at a certain time might cause an implant failure. This complication is rare and reported in literature for implants in proximal femoral fractures [20]. Most of the fractures that presented this complication were initially classified as unstable and were presented as nonunion at the fracture site at the last follow-up previous to the implant breakage [21].

Humeral nonunions after prior IM nailing can be difficult to address, even more with nail breakage. Conventionally, removal of the IM device followed by open compression plating has been advocated and has shown high healing rates [11]. Lin et al. presented a large study of 86 patients with humeral shaft nonunions managed by the removal of previous implants, open reduction, and internal fixation with dynamic compression plating, supplemented with cancellous bone grafts. Of these patients, 38 were primarily treated with IM nailing. All nonunions healed within an average of 18 weeks [22]. McKee et al. [11] reported the treatment results of nail removal and

plating (9 patients) and exchange nailing (10 patients). Union was achieved in all patients with plating and bone grafting but in only 4 of 10 patients with exchange nailing. Exchange nailing alone appears to be ineffective, as Flinkkila et al. [17] found a similar low healing rate of nonunions in 6 of 13 patients. Better results have been reported when exchange nailing is combined with decortication, fibrous tissue removal, and bone grafting. Lin et al. [23] reported on 23 patients treated by open exchange locked nailing with bone grafting, with additional compression wiring in 19 of those patients. All but one nonunion healed.

Conclusion

In this case, we found that the outcomes after locking compression plate (LCP) fixation associated with tricortical autogenous iliac crest bone grafting for long-standing humeral shaft nonunion are favorable. LCP fixation can achieve a high degree of cortex-to-cortex stability with compression of the bone segments and correction of the malalignment. In addition, an autogenous graft with intimate contact with both fragments may facilitate neovascularization and migration of osteogenic cells, which can foster an environment conducive to bone healing. The range of motion of the patient's shoulder recovered to its pre-injury level. Therefore, we can suggest that this technique could be employed for treating humeral shaft nonunion associated with nail breakage even after such a long period of time.

Clinical Message

Non-traumatic breakage of the IM nail is an uncommon complication. The implant failure usually occurs when the fracture does not achieve the consolidation. It is usually observed after lower limb fracture treatment and never described so far for humerus nailing. The very rare case of nail breakage after humerus fracture treatment can be addressed with a one-stage procedure, even after a long-standing nonunion of the fracture (11 years in this patient).

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