

Case report



INTRAMEDULLARY NON-VASCULARIZED AUTOFIBULA IN INFECTED NONADHESIONS OF THE HUMERUS

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ABSTRACT:

This communication aims to present a modified technique in applying an intramedullary non-vascularized auto fibula and plate fixation in a patient with atonic diaphyseal non-union and pseudoarthrosis with failed osteosynthesis due to infection.

Case description: A patient with failed metal osteosynthesis due to infection is presented. After infection remediation and radical resection, a 7 cm non-vascularized autofibula (NAF) was inserted and reinforced with a *locking compression plate (LCP-plate)* and bone substitutes.

Result: Clinical and radiological bone healing of the pseudoarthrosis was achieved after 4 1/2 months, with a good functional and cosmetic outcome.

Conclusion: Using NAF in selected patients at fitting recipient beds is an easy operative technique and is still applicable in reconstructing bone defects.

Keywords: atonic non-union, intramedullary autofibula, non-vascularized autofibula, intramedullary nailing, external fixator, vascularized autofibula,

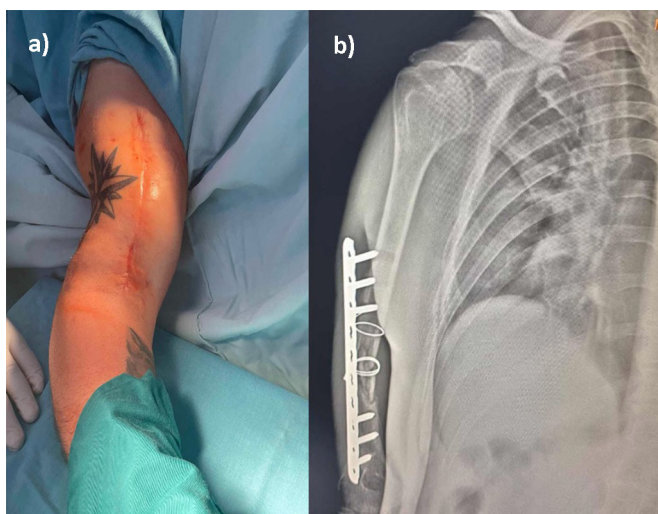
BACKGROUND:

Atonic non-union (ANU) and pseudoarthrosis of the humerus are difficult reconstructive problems due to bone loss, osteopenia, and osteoporosis in the setting of infection [1]. Many operative techniques have been proposed: plate fixation, bone grafting, intramedullary nails, two-plate fusion, and external fixator (EF), but there is no universally adopted standard, which makes the problem even more difficult. In the setting of infection with bone loss and osteoporosis, the screw support of the plate is less efficient and leads to an increased risk of failed fixation. Wright's method, in which NAF serves as an additional internal support in four-screw cortical fixation plus bone grafting, yields 90% fusion [2]. In intramedullary nailing (IMN) cases, replacement with a larger nail (1 mm) is recommended, but this is often accompanied by fracture distraction and distal fragment fracture [3]. Many complications, a risk of infection, and a longer healing period accompany EF. Allografts are associated with a high infection rate and immunological reaction (rejection). A bone graft should be preserved inductive, conductive and osteogenic function [4]. The iliac graft meets these requirements, but unfortunately, it lacks mechanical stability and is inapplicable in cases with large defects. A graft that meets these requirements is the autologous autofibula [5], generally accepted as a conventional graft, size 6-7 cm. For larger defects and in cases of poor recipient beds, biological materials, vascularized autofibula (VAF), and endoprostheses are used [6]. Usually, up to 92% fusion of problematic defects is achieved by this methodology. VAF and NAF are the methods of choice for these infected diaphyseal defects. NAF provides biological reconstruction, creating mechanical and biological support in the presence of additional fixation with a plate [7].

CASE DESCRIPTION:

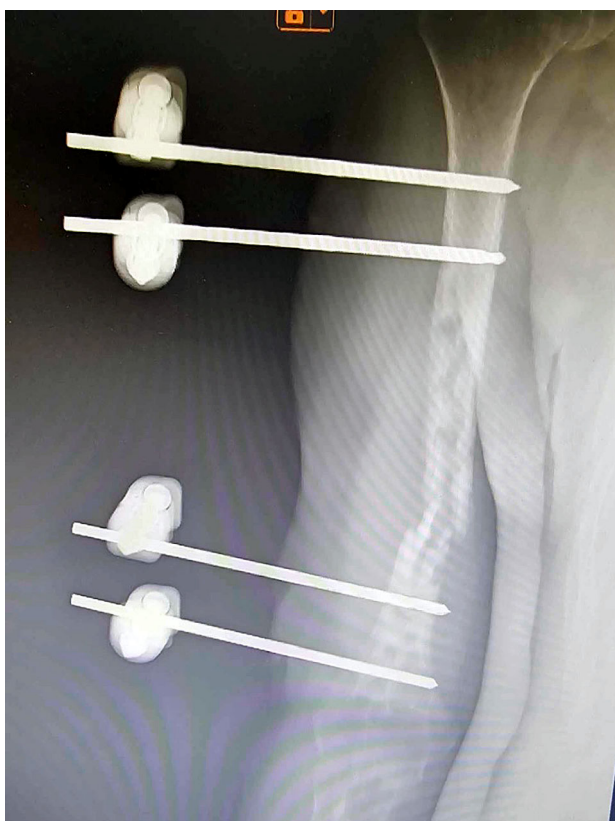
We present a patient with ANU, pseudoarthrosis, and failed metal osteosynthesis, who had been operated on eight months before he was admitted to the Clinic of Orthopaedics and Traumatology of G. Stranski University Hospital – Pleven. The patient presented with pathological mobility and pain, radiology revealed non-union (cortical thinning, osteoporosis, and an enlarged medullary canal- Fig.1a, 1b).

Fig.1. a) Deformity and pathological movement of the hand due to pseudoarthrosis. **b)** Radiology revealed non-union and failed metal osteosynthesis.



Revision revealed the presence of failed osteosynthesis in the setting of suppurative infection and sequestrum formation. Removal of the osteosynthesis and resection to visibly vital bone tissue was required, shortening it by about 4-5 cm. EF, permanent flush drainage (W-Rott) was administered for ten days (Figure 2). *S. aureus* and *S. epidermidis* were isolated from the wound, which necessitated antibiotic therapy with Vancomycin and Òeicoplanin. The treatment with EF took four months, after which reconstruction was performed.

Fig. 2. External fixator as part of the treatment.



Extended lateral approach was used, followed by isolation of the n. radialis on a holder, sequestrectomy, and resection of 3 cm of each segment to visibly bleeding bone. The medullary canal was then carefully reamed with a 7-mm reamer to preserve the endosteum followed: careful reaming at 7 mm rhymer to preserve the endosteum. NAF was placed in the proximal part and then in the distal part (Fig. 3). Half of the autofibula diameter was cut. The endosteum of the fibula was rotated to the endosteum of the humerus, and the remainder of the diameter was reconstructed with bone slices in the same manner from lateral. With gentle distraction, the distal portion was gently deployed, and the defect created was compressed with gentle taps cubitally (Fig. 4). An LCP plate with seven screws and bone substitutes - TriOSS® was applied circumferentially (Fig. 5). The patient was immobilized for four weeks. Then, early mobilization of the shoulder and elbow was administered.

Fig. 3. a) Autofibula. **b)** Reaming the medullary canal.

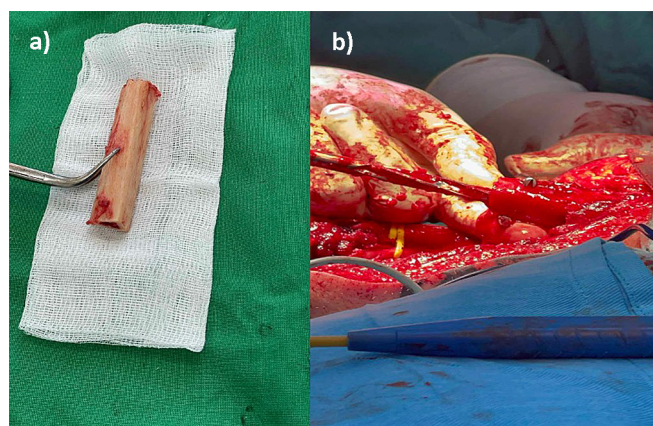
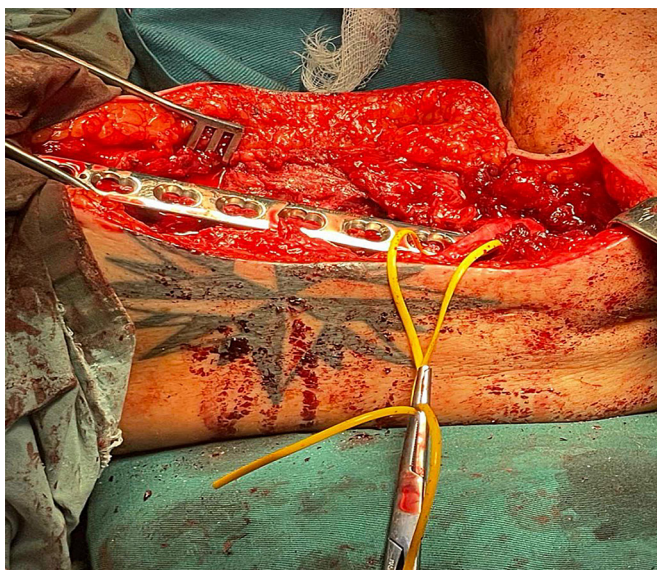


Fig. 4. Implantation of the autofibula.



Fig. 5. Definitive synthesis



RESULT:

The clinical and radiologically proven fusion occurred between the 4th and 5th months. The patient was followed up for 20 months. (Fig. 6a, 6b) There were no complications such as supracondylar plate fracture comorbidity from the donor site - paresis of the fibular nerve and ankle instability or paresis of the radial nerve.

Fig. 6. a) Restored functionality of the humerus. **b)** Radiographic sign for bone union.



DISCUSSION:

Many techniques have been proposed for treating diaphyseal ANU and pseudoarthroses. Impaired bone quality is a predisposition for a new failure. Many attempts to increase screw fixation by four cortical fixation and bone cement have been reported [8, 9]. Bone cement causes an exothermic reaction and inhibits biological regeneration. Furthermore, it is an intraosseous foreign body (especially in infection). Furthermore, VAF also has negative aspects: early thrombosis of the anastomosis, stress fractures between the 3rd and 6th months, and insufficient mechanical fixation due to the impaired periosteal blood supply with the use of metal osteosynthesis, as well as long operative time and increased comorbidity [10].

The disadvantages of NAF include early graft resorption, graft fracture, impaired biological activity, and muscle atrophy [11]. Defects up to 6 cm are common, but with good recipient beds and good biomechanics, defects between 6 and 8 cm can be bridged in cases of proper compression and be treated with NAF, and defects over 6 cm-10 cm in tumor resections – with VAF [12, 13]. The surgeon should always be aware of the risk factors: general (impaired bone metabolism, diabetes, smoking, etc.), as well as local ones (infection, impaired vascularization, impaired biomechanical instability, poor contact, fragmented and segmental fractures, interponium, short-length fractures and iatrogenic factors (hyperdistraction resulting in no bone contact or bone defect greater than 5 mm., insufficient stabilization, and unnecessary deperiostination. Given the risk factors, it is always appropriate to consider infection, especially if the fracture has been opened or treated with EF.

CONCLUSION:

The proposed modified technique for applying NAF in ANU and pseudoarthrosis in combination with LCP- plate and bone graft (bone substitutes) is easy to apply with reduced operative time and good functional and cosmetic effects.

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