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RESEARCH ARTICLE

EXTRA-ARTICULAR DUAL PLATING FOR INFECTIVE GAP NON-UNION IN DISTAL HUMERUS FRACTURE - A CASE REPORT

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Abstract

Introduction: Distal humerus fractures, especially those associated with complex soft tissue injuries, can present significant challenges in orthopaedic management. The Masquelet technique, a two-stage surgical approach utilizing induced membrane and bone grafting, has gained popularity for managing infected nonunion. However, stability after fixation remains a concern, particularly in cases with compromised bone stock. Extra-articular plating with bone grafting with an additional plate as a pillar is an emerging strategy for enhancing fixation in these challenging cases, offering biomechanical advantages in providing stability during the healing phase.

Case Report: A 30yr old male came with complaints of discharging wound from the right arm following two previous surgeries done more than a year ago. He had abnormal mobility at the fracture site with signs of radial and musculocutaneous nerve injury. On X-ray there was non-union of the distal 1/3 of shaft of humerus with implant failure. In the primary surgery Masquelet technique was used after extensive debridement. After 6 weeks when counts were normal, CRP was normal and sinus completely healed, definitive fixation with dual plate and bone grafting was done. His radial nerve injury showed signs of recovery immediate post op. Although musculocutaneous nerve injury has not shown significant recovery immediately and is now showing signs of recovery. He is able to carry out his daily activities.

Result: Open Distal humerus fractures in a 30yr old male patient treated with Masquelet technique followed by open reduction and internal fixation with dual plate with bone grafting has shown good functional outcome in terms of union and early mobilisation with good range of motion.

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Introduction:-

The induced membrane technique (IMT) firstly described by Masquelet et al. is a two- step procedure to treat bone defects and non-unions [1]. Masquelet describes an initial debridement of soft tissues and necrotic bone to bleeding

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healthy tissue (“paprika sign”), and the use of a polymethyl methacrylate (PMMA) cement spacer placed in the bony defect, which is stabilised with a temporary external fixator [2,3]. During the initial stage, soft tissue reconstruction is required if coverage is inadequate [1–8]. The role of the spacer is two-fold; it prevents fibrous tissue invasion of the defect area, whilst inducing the development of a surrounding pseudo-synovial membrane, as a result of a foreign body reaction [9]. After 6–8 weeks, the second step is undertaken. The induced membrane is carefully incised and the spacer removed. Morcellized cancellous bone from the iliac crest is implanted and the membrane closed with definitive fixation [1].

The membrane is key to provide a vascular source to the bone graft [10] and also secretes growth factors (such as BMP-2, VEGF and TGF-beta1) [9]. The autologous bone graft is then able to allow osteoconduction (acting as a scaffold), osteoinduction and osteogenesis (containing further growth factors and osteoprogenitor cells) [11]. Several small case series reports have demonstrated the efficiency of IMT, particularly in post-traumatic defects, septic and aseptic non-unions, tumor resections, and irradiated bones.

Case Report:-

A 30-year-old male presented with a discharging wound from the right arm, following two previous unsuccessful surgeries done a year ago. Clinical examination revealed abnormal mobility at the fracture site with signs of radial and musculocutaneous nerve injury. Radiographs confirmed non-union of the distal third of the humeral shaft with implant failure.

Due to neurological injury he was unable to extend his right wrist and also was unable to flex his right elbow.



Image 1:-



Image 2:-

Image 1 and 2:- Radiograph showing AP and LATERAL views of Right humerus with implant failure.

A staged surgical plan was adopted:

- Stage 1: Extensive debridement was performed, and an antibiotic-loaded cement spacer was placed as per the Masquelet technique.

**Image 3:-****Image 4:-**

Image 3 and 4:- Radiograph showing AP and Lateral views of right humerus post implant removal with antibiotic cement spacer and TENS in situ.

Stage 2: After 6 weeks, once CRP levels normalized and the sinus healed, definitive fixation was carried out using dual extra-articular plates along with autologous bone grafting.

Immediate Post Op Radiograph**Image 5:-****Image 6:-**

Image 5 and 6 : Radiograph showing immediate post operative xray of right humerus AP and Lateral views .
6 month follow up radiograph

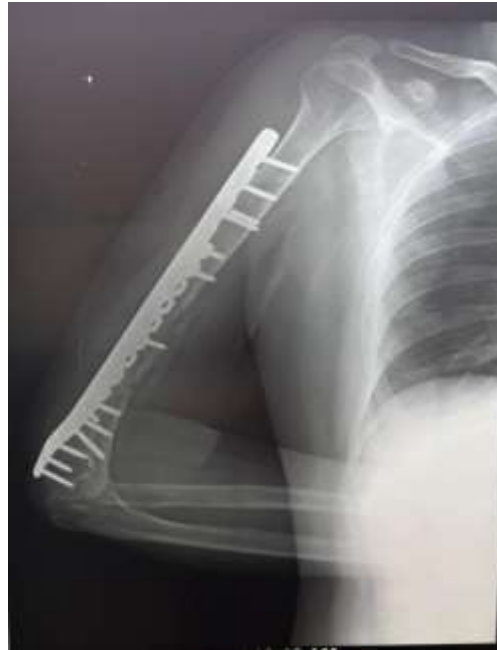
**Image 7:-****Image 8:-**

Image 7 and 8:- Radiograph showing post operative 6 months follow up AP and Lateral views of right humerus .

Operative Procedure.

Patient was explained about the diagnosis and treatment plan and also the prognosis. Written and informed consent was taken. Patient was made to lie in left lateral position on the operating table with right hand on a side post and patient under brachial block and spinal anaesthesia. The right arm and the ipsilateral iliac area was cleansed with 10% betadine scrub and was draped in a sterile manner. Posterior approach was used, a linear incision taken, soft tissue dissected and the bone was visualized. The induced membrane was identified, a clean incision taken on the membrane and the bone cement was removed carefully without disturbing the induced membrane and a good amount of autologous iliac bone graft was filled to fill the defect. The bony construct was stabilized with two plates-one extra-articular distal humerus plate posteriorly and a 4.5mm recon plate laterally. Hemostasis was achieved, wound was closed in a standard manner over a drain.

Post Operative Rehabilitation.

Post operatively a crepe bandage was applied and placed in an arm pouch to support the limb, however the elbow range of movements were started on post operative day 1, along with regular antibiotics.

Post-operatively, the patient showed signs of radial nerve recovery with extension of the wrist and thumb, though musculocutaneous nerve did not show any signs of recovery. Subsequently musculocutaneous nerve is showing signs of recovery and the patient is able to flex his elbow upto 90-100 degrees.

The patient regained sufficient function to carry out daily activities, and radiological union was observed.



9



10



11



12



13



14

Image 9,10,11,12,13,14:- Clinical images showing Range of movements and recovery of neurological injury.

Results:-

This case of infected distal humerus non-union in a 30-year-old male treated with the Masquelet technique followed by dual plate fixation and bone grafting achieved radiological union, restoration of good range of motion, and showed signs of nerve recovery. With early mobilization there was satisfactory functional outcome and there were no signs of infection till the last follow up.

Discussion:-

The combination of induced membrane technique and dual extra-articular plating with bone grafting addresses both biological and mechanical challenges in infected humeral non-union. The Masquelet technique provides a biologically favorable environment for bone healing, while dual plating ensures the mechanical stability necessary for union, especially in cases with compromised bone stock.

The application of bone autografts offers an additional guarantee to "revitalize" non-union locus.[12]

Considering that our patient came from a lower-income population without reliable insurance, a less expensive reconstruction method was favourable. With lower risk of infection in the Masquelet technique, it seemed to be a favourable option in managing this particular case.

In the second stage, 6 to 8 weeks later, an incision is made on the membrane, the spacer is removed, and the bone defect is filled with an autogenous morcellated iliac crest graft. Finally, stability is delivered to the construct with an endomedullary nail or plate. This technique has a variable success rate of approximately 80%, most of them on the femur and tibia and few on the upper limb[13]

This technique makes it possible to address severe humerus bone defects, with few therapeutic alternatives that could be managed even with limb amputation. Although it is a highly demanding surgery, it has clear advantages over distractive osteogenesis, which requires long treatments, and is poorly tolerated in the upper limb, offering recovery of only acceptable functionality. The scope of this technique should not be limited to the management of posttraumatic bone defects (eg, exposed fractures, nonunion, and secondary osteomyelitis) but also as a reconstruction technique after resection in bone tumor lesions.[13]

The main drawback is the 2-stage procedure. However, we consider this mandatory in case of history of infection, and ideal in case of bone defect but also in the absence of defect: the membrane forms a sleeve providing contention and trophic protection for the graft. With or without defect, cementing should include surrounding the non-union site with tiles overlapping its edges, so that the membrane develops as a sheath. The cancellous graft can then be placed inside the induced-membrane sheath [14].

Conclusion:-

Extra-articular dual plating, when combined with the Masquelet technique, is an effective strategy for managing infective gap non-unions of the distal humerus. A staged approach with thorough infection control and stable reconstruction leads to improved functional outcomes and limb salvage.

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