TECHNICAL NOTE

Autologous platelet concentrate infiltration in Management of Delayed / Non-Union of Fractures- Technical Note and Tips

J.N.Sridhara Murthy[1], Bharath Raju G[1], Manoj Kumar P[1]

INTRODUCTION

Most diaphyseal fractures heal without secondary surgical intervention. The two most common methods for fixation of long bone fractures are plate osteosynthesis and intramedullary nail fixation[1]. When delayed/nonunion does occur, it is likely to be related to open fractures, infected fractures, segmental fractures, with impaired blood supply, usually to the middle fragment, comminuted by severe trauma, insecurely fixed, immobilized for an insufficient time, treated by ill-advised open reduction, distracted either by traction or by a plate and screws and irradiated bone[2]. Despite continued advances in the treatment of long bone fractures, disturbances of healing process remain a difficult challenge[3]. Nonunions are estimated to occur in 2% to 15% of all tibial fractures. For femur the nonunion rates have reduced since the use of modern interlocking femoral nails and union rates of around 99% are reported. Nonunions occur in approximately 10% of patients with humeral shaft fractures regardless of the type of treatment used because motion can be difficult to control. Nonunions of both bones of forearm are reported to be approximately 5% after stable fixation[4]. The treatment of nonunion has advanced with improvements in electrical and electromagnetic stimulation, ultrasound, and bone grafting. The Ilizarov external fixator continues to be an effective and versatile method for treatment of difficult nonunions complicated by complex deformity, infection, and bone loss. Improvements in internal fixation systems have provided sufficiently stable fixation to allow active and passive range of motion of adjacent joints, promoting complete functional recovery in addition to bony union. Research also continues in the use of bone grafts, bone graft substitutes, bone morphogenetic protein (BMP) [4], supplementing fixation with bone grafting helps in union. Autologous cancellous bone harvested from the iliac crest is commonly used for bone grafting[5]. Autologous Platelet concentrate, rich in the growth factors is a novel osteoinductive therapy that could achieve this goal in the treatment of disturbances of bone healing process[6].

[1]Department of orthopaedics, KIMS, Bangalore.

Address of correspondence: Dr Bharath Raju G
Department of orthopaedics, KIMS, Bangalore.India.

TECHNIQUE:

Preparation of autologous platelet concentrate:

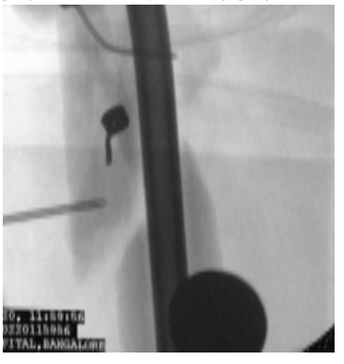
One unit of Autologous blood is collected from the patient in a blood donation bag. The platelets are separated by triple centrifugation technique. This separates whole blood into packed cells (sediment), plasma and platelet concentrate (supernatant). The platelet concentrate is kept in the agitator, to avoid clumping, till it is used. Packed cells are transfused back to the patient. About 25-50 ml of platelet concentrate is separated per unit of whole blood. The procedure of preparation of platelet concentrate is done in the blood bank. The platelet concentrate thus obtained, should be used within 72 hours after the collection.

Infiltration method:

All infiltrations are done either under sedation or short anesthesia in the operating room under strict aseptic conditions. The platelet concentrate is transferred to a 50 cc syringe. 18 G or 20 G long stainless steel needles are used for the infiltration (fig 1). Needle is inserted to the nonunion/delayed union site under C-arm guidance (fig 2), micro trauma is incited at the site by multiple pricks. The platelet concentrate is infiltrated into the nonunion site & its immediate vicinity.

Platelet concentrate infiltration (fig 1)

C-arm picture (fig 2)



Case Illustration

29 years old male with noonion tibile

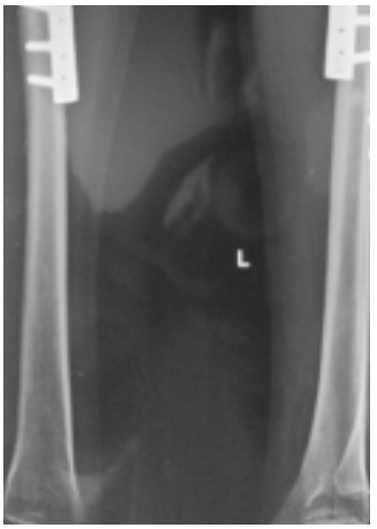
Site of fracture : fracture both bones left forearm- middle 1/3.

Duration of injury : 8 months.

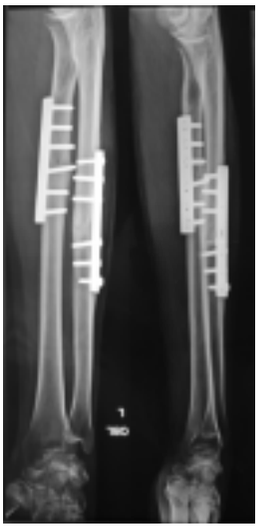
Type of fixation : ORIF with DCP done elsewhere.

Non – union gap on x-ray : radius – 2 mm
ulna – 2 mm

Pre infiltration x-ray (fig 4)



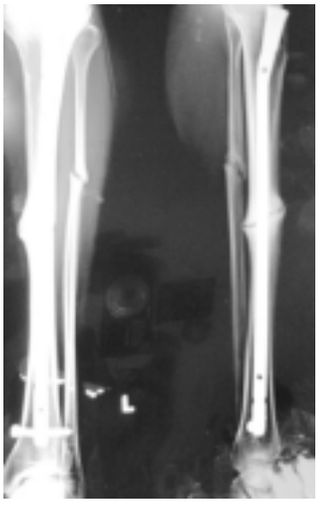
Post infiltrate 3rd follow up (fig 5)



Case Illustration

30 years old male
Site of fracture : fracture both bones of left leg at middle 1/3
Duration of injury :1 1/2 yrs.
Type of fixation : CRIF with IMIL
Non – union gap on x-ray :
AP – 2 mm
LATERAL – 1 mm

Pre infiltration x-ray(fig 5)



Post infiltrate 3rd follow up(fig 6)

DISCUSSION

The use of growth factors in combination with tissue engineering seems to be the most promising method in the future for the treatment of the bone and cartilage defect[7]. Growth factors are cytokines with regulatory functions for healing in musculoskeletal system. These small peptides are synthesized by the resident cells at the site of injury, such as mesenchymal stem cells and chondrocytes or by the infiltrating inflammatory process. During clotting, platelets aggregate and release numerous regulatory molecules to the fracture site such as PDGF, TGF-3, VEGF, IGF, and EGF. They play an important role in the initial phase of the healing process[8]. It is generally accepted that once the cells enter the fracture site, their proliferation & differentiation are most likely to be determined by the type and the level of growth factors present at the fracture site. Autologous bone graft potentially contributes three vital local components: osteoconduction, osteoinduction and osteogenic cells. However, the surgical procedure requiring harvesting of the iliac bone graft, introduces a variety of potential risks to the patient, including increased surgical time & stay in the hospital, increased blood loss, & post operative pain, infection, scar etc[3]. Connolly & Haley et al. have demonstrated that percutaneous injections of the autologous bone marrow can successfully treat between 78 % and 95 % of nonunion[9]. The use of platelet rich concentrate to enhance bone regeneration and soft tissue maturation has increased in the fields of maxillofacial surgery over the last decade. Lowery et al. used platelet rich gel with allogenic grafts in the lumbar spinal fusion with good results[10]. Kitoh reviewed clinical results of distraction osteogenisis with transplantation of marrow derived mesenchymal stem cells (MSCs) and platelet rich gel. Platelet concentrate dominates only osteoinductive properties, it is sufficient to obtain union , which is a less invasive procedure than the bone marrow injection[11] .

Percutaneous autologous platelet concentrate could be effective & safe method for the treatment of delayed/nonunion of fractures.

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Source of Support: Nil, Conflict of Interest: none