

Early Outcomes of Humeral Non-Union Treatment with Intramedullary Strut Grafting and Long LCP Plating: Case Reports after Failed Ilizarov (Ring) Fixation

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Abstract

Humeral diaphysis non-union is extremely difficult complication for the patients and orthopedic surgeons as well. Number of methods of managing atrophic humeral nonunion have been suggested, and each has its drawbacks. In current literature, there are no articles regarding treatment of humeral non-union after failed Ilizarov (ring) fixation surgery. This article presents early results of two cases of surgically treated fibular (intramedullary) strut graft and long LCP (PHILOS) plate. It is shown that fibular strut auto-graft bridging non-union site in conjunction with locked plating could be high potency healing material in osteoporotic atrophic humeral non-union. This technique need future and long term follow up analysis with potential use in different long bone non-union sites.

Keywords: Atrophic humeral nonunion; LCP; Iliac crest

Introduction

Humeral diaphysis non-union is somehow rare, but extremely difficult complication, for the patients and orthopedic surgeons as well [1,2]. Non-union is likely to be related to the severity of initial injury, transverse pattern of fracture, or soft-tissue interposition. Failure to unite after surgical treatment may be due to poor contact between the bone ends, inadequate stabilization, devitalization of bone, osteopenia, and bone defects. Different methods in managing atrophic fracture non-union have been suggested, and each has its drawbacks [3-5]. Most surgeons favour the use of an interlocking nail, Ilizarov (ring) external fixator, or LCP for stabilisation and vascularised fibular graft or cancellous iliac crest bone graft for enhancement of fracture union [5] and all techniques seems to be the right choice after pseudoarthrosis union. But, real questions for the patient and orthopaedic surgeon are failed non-union treatment [6] and bone transport. Distraction histogenesis with Ilizarov external fixation in the treatment of complex posttraumatic problems has advantages, but it is rather complex and technically demanding: excessive treatment, pin track infection, pain, loss of stability [7,8]. There are no articles in current literature of humeral non-union treated after failed Ilizarov external fixation surgery combined with fibular non-vascular strut graft [9]. The purpose of this case study is to present LCP philosophy and autografting in favor of long bone pseudoarthrosis treatment.

Case Report 1

54 years old male patient with humeral shaft non-union after treatment with Ilizarov ring fixator. The initial humeral shaft fracture was treated with DCP and screws fixation and resulted in infected non-union (Figure 1). After plate removal, distraction hystiogenesis with Ilizarov fixation was the choice of treatment (Figure 2) for almost 2 years. Atrophic pseudoarthrosis with bone defect, humeral shaft shortening and deformity was end result (Figure 3) with debilitated and compromised everyday life. We favoured mechanical properties of long LCP plate and fibular intramedullary strut autograft biology as revision surgical option (Figures 4a and 4b). Four months later patient presented improved arm function, and X-rays showed stable positioned graft and signs of solid incorporation (Figures 5a-5c).

Case Report 2

65 years old female patient was initially treated nonoperatively after humeral shaft fracture (Figure 6). After two months of cast immobilisation and conservative treatment, Ilizarov ring fixator was used due to non-union (Figure 7). Six months later, fixator was replaces with new Ilizarov ring construction with better fragment apposition and healing stimulation (Figure 8). After more than 9 months, treatment



Figure 1: Treatment with open reduction and DCP fixation resulted in humeral diaphysis non-union and infection.

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finished with atrophic non-union and large humeral shaft bone defect (Figure 9). We used fibular strut autograft with long LCP (Philos) fixation, providing opportunity for good reduction, defect substitution and potential for healing and functional recovery (Figures 10a and 10b), (Figure 11). After 4 months, there were no fragment movements or pain on palpation, with compromised elbow function and initial flexion and elevation of 90 degrees.

Discussion

The incidence of non-union of humeral shaft fractures is reported to be around 15% when managed by open reduction and internal fixation and 2-10% when managed conservatively [2,5]. Humeral non-union provides insufficient mechanical stability and interferes with personal hygiene, dressing, and simple activities of daily living. Only few studies have focused specifically on non-union after failure of one or more surgical interventions [9,10]. Tomić et al. [10] reported



Figure 2: Ilizarov ring fixation with appropriate axis and fragments coaptation.



Figure 3: Atrophic humeral diaphysis non-union despite more than two years of treatment with Ilizarov ring fixator.



Figure 4a and 4b: Solid graft incorporation, 4 months after long LCP (Philos) osteosynthesis and using fibular strut autograft.

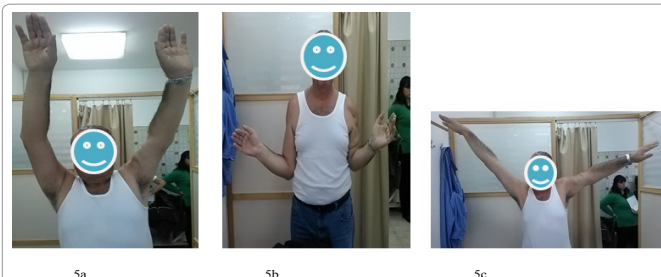


Figure 5: Patient arm function after 4 months.



Figure 6: Humeral shaft fracture initially treated non-operatively.

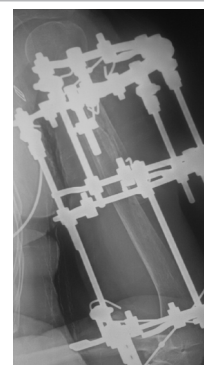


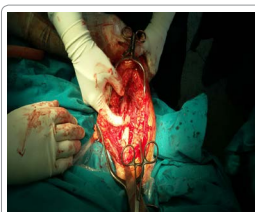
Figure 7: Ilizarov ring fixator was used after two months of failed conservative treatment.



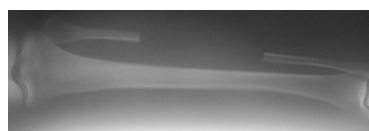
Figure 8: After six months, previous fixator was replaced with new Ilizarov ring construction for better fragment apposition and union stimulation.



Figure 9: Ilizarov treatment method for humeral shaft fracture in this case resulted as non-union with bone defect.



10a



10b

Figure 10: Fibular strut autograft use for atrophic non-union treatment.

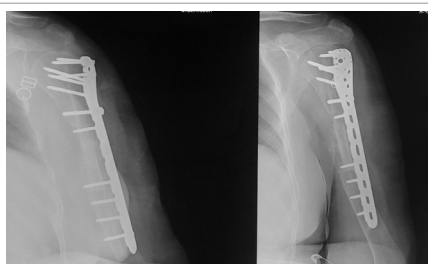


Figure 11: Long Philos LCP osteosynthesis with fibular strut autograft four months after surgery.

the results of using Ilizarov fixator for the treatment of atrophic non-union with very good results and recommended procedure for primary fractures. Kumar et al. [11] showed how locking compression plating and cancellous bone grafting is a reliable option for achieving union in humeral diaphyseal non-union with failed previous internal fixation.

Our “osteoscopy” is familiar to LCP approach and biomechanics after failed Ilizarov technique for humeral shaft non unions we decided to treat, and which we didn’t find in literature. Fibula is probably the most suitable donor bone for reconstruction of defects in a long bone because of its length, geometrical shape, and mechanical strength [12,13]. It is necessary to include humeral head and neck in locking

composition and stable fixation and stress shielding to plate with no screw loosening and break out in osteoporotic bone. Even more, including cortical screw fixation through the bone and cortical fibular graft itself, give high potential for stability and union.

Conclusion

The fibula acts as “intramedullary nail” to the non-union site, aiding stability of osteosynthesis and also increasing the number of cortices adding mechanical stability of the plate (vs. dynamic plate), thus increasing the pull-out strength of the screws. Advantage of long LCP (PHILOS) plate and achieving fixation in humeral head and neck could be the key of this approach. Intramedullary fibular graft positioning in addition to load sharing, also helps bone ongrowth and osseointegration. Long fibula placed at both ends and leaving full thickness at the non-union site improve limb length in addition to mechanical stability. This technique need future and long term follow up analysis with potential use in different long bone nonunion sites.

References

1. Epps CH Jr, Grant RE (1991) Fractures of the shaft of the humerus. In: Rockwood CA Jr, Green DP, Bucholz RW (eds.) *Rockwood and Green's fractures in adults* (3rd edn) J.B. Lippincott Co., Philadelphia, 843-869.
2. Taylor JC (1992) Delayed union and nonunion of fractures. In: Crenshaw AH (ed.) *Campbell's operative orthopaedics* (8th edn). Mosby Year Book, St Louis, 1329-1332.
3. Ilizarov GA (1992) Transosseous osteosynthesis: theoretical and clinical aspects of the regeneration and growth of tissue. Springer, Berlin, Germany.
4. Rosen H (1990) The treatment of nonunions and pseudarthroses of the humeral shaft. *Orthop Clin North Am* 21: 725-742.
5. Pugh DM, McKee MD (2003) Advances in the management of humeral nonunion. *J Am Acad Orthop Surg* 11: 48-59.
6. Borus TA, Yian EH, Karunakar MA (2005) A case series and review of salvage surgery for refractory humeral shaft nonunion following two or more prior surgical procedures. *Iowa Orthop J* 25: 194-199.
7. Kocaoglu M, Eralp L, Tomak Y (2001) Treatment of humerus shaft non-unions by the Ilizarov method. *Int Orthop* 25: 396-400.
8. Paley D (1990) Problems, obstacles and complications of limb lengthening by the Ilizarov technique. *Clin Orthop* 250: 81-104.
9. Patel VR, Menon DK, Pool RD, Simonis RB (2000) Nonunion of the humerus after failure of surgical treatment. Management using the Ilizarov circular fixator. *J Bone Joint Surg Br* 82: 977-983.
10. Tomić S, Bumbasirević M, Lesić A, Mitković M, Atkinson HD (2007) Ilizarov frame fixation without bone graft for atrophic humeral shaft nonunion: 28 patients with a minimum 2-year follow-up. *J Orthop Trauma* 21: 549-556.
11. Kumar MN, Ravindranath VP, Ravishankar M (2013) Outcome of locking compression plates in humeral shaft nonunions. *Indian J Orthop* 47: 150-155.
12. Vidyadhara S, Vamsi K, Rao SK, Gnanadoss JJ, Pandian S (2009) Use of intramedullary fibular strut graft: a novel adjunct to plating in the treatment of osteoporotic humeral shaft nonunion. *Int Orthop* 33: 1009-1014.
13. Tan E, Lie D, Wong MK (2014) Early Outcomes of Proximal Humerus Fracture Fixation With Locking Plate and Intramedullary Fibular Strut Graft. 37: e822-e827.