

Bone transport using semicircular Ilizarov ring fixator in the treatment of the infected nonunion of the humerus: A case report

Kamarul Izham bin Kamarudin, Jun Wei Then, Ching Wooi Yeoh, Ying Jing Ooi, Chopra S

Abstract

Bone transport using the Ilizarov technique has been one of the most popular techniques in treating fracture with significant bone defect. However, pain and joint stiffness following Ilizarov fixation are few of the well-known complications. We report a case of a 23-year-old gentleman with a closed left humeral diaphyseal fracture following a traffic accident who underwent plating of the left humerus which was later complicated with infected nonunion. He was then treated with corticotomy and bone lengthening using the semicircular Ilizarov ring fixator. Good clinical and functional outcomes were observed during transportation period (elbow flexion 10° to 90°) with minimal complications.

IeJSME 2018 12(2): 34-36

Keywords: Semi-circular Ilizarov rings, infected nonunion, bone transport

Introduction

Septic non-union is a relatively common complication encountered in our day-to-day practice as an orthopaedic surgeon. Achieving union in septic nonunion with multiple previous surgeries remained a major challenge. Bone transport using the Ilizarov technique is a well-established and widely accepted method in treating fractures with significant bone defects.¹⁻⁴ This technique is preferred and thought to be more superior over others owing to its peculiar entities, especially the use of percutaneous transosseous wiring which significantly reduces the intraoperative and postoperative complications, predominantly the risk of soft tissue and neurovascular injury as well as pin site infection. However, the use of the traditional full ring Ilizarov system due to its increased stability has been associated with multiple debilitating complications including bulky and heavy apparatus, pain and discomfort, as well as joint stiffness⁵ that further limits its wide application especially in the case of upper limbs.

Case Report

A 23-year-old gentleman was presented to us following a traffic accident complaining of pain and swelling over the left arm. He was diagnosed with closed fracture of left mid shaft humerus and initially underwent open reduction and internal fixation with plating, complicated with infection and subsequently developed nonunion. He presented to us 9 months post internal fixation with nonunion of the left humerus. Laboratory and radiological investigations revealed active infection with signs of chronic osteomyelitis. Removal of implant, sequestrectomy and external fixation of the left humerus was done subsequently, with implant loosening, presence of biofilm, slough tissues and seropurulent discharge noted intraoperatively. Four cm of infected devitalized bones resected. Multiple courses of parenteral and oral antibiotics were given until the infection settled completely, evidenced clinically as well as biochemically.

The nonunion of the left humerus was ultimately treated with bone transport by using semicircular Ilizarov ring fixator. The fibrous scar tissues were removed and both proximal and distal rounded bone ends were refreshed until healthy bleeding bones exposed. Medullary canals over both ends were opened. Three Shanz pins were inserted into the proximal fragment, 2 Shanz pins were inserted into the transport fragment while 1 Shanz pin and a 1.5mm K-wire were inserted into the distal fragment. Four semicircular rings were attached. A total of 30mm bone gap was left for transport. Corticotomy was done over the distal metaphyseal-diaphyseal junction of the left humerus. Bone transport was started on day 14 post fixation at the rate of 1mm/day (0.25mm QID) for a total of 50 days until docking of the fracture ends achieved. Active range of motion exercise was started on the immediate postoperative day and was maintained throughout the transportation period.

Distraction osteogenesis of 30 mm was successfully achieved within a period of 50 days. Good callus consolidation over the callotaxis portion of the bone

Department of Orthopaedic, Hospital Sultanah Bahiyah, 05460 Alor Setar, Kedah, MALAYSIA

Address for Correspondence:

Dr Kamarul Izham bin Kamarudin, Hospital Sultanah Bahiyah, Km 6, Jalan Langgar, 05460 Alor Setar, Kedah, MALAYSIA

E-mail: drizham75@gmail.com

was observed over the follow up period of 6 months. Throughout the transportation period no calcium, vitamin D supplements or other bone forming agents was given. Mild superficial pin tract infection was noted over 2 pins but not complicated with pin/wire loosening and resolved following a combination of antibiotics (Tab cefuroxime 250mg BD for 1 week) and dressings. Satisfactory range of motion of the elbow was observed (10 - 90 degrees of flexion) during every subsequent follow up. No other complications such as radial nerve palsy or callus fracture occurred.

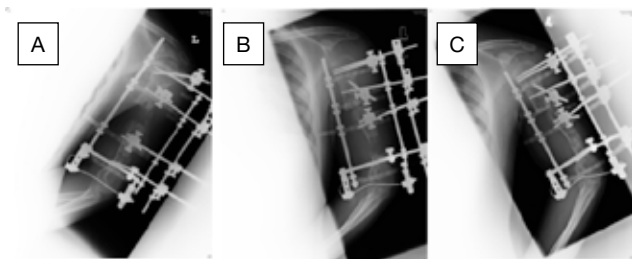


Figure 1: plain radiographs of left humerus at (A) 0 month, (B) 3 months and (C) 6 months follow up; showing radiological evidence of good callus formation and consolidation over callotaxis site

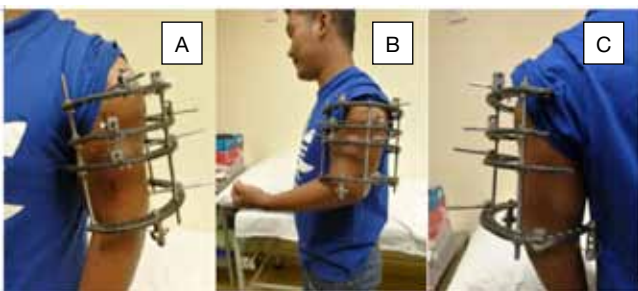


Figure 2: (A) anterior view, (B) lateral view, (C) posterior view of patient with semicircular Ilizarov ring fixator in situ with elbow flexed to 90 degrees

Discussion

Ilizarov has been a very successful and widely accepted technique in treating nonunion of humerus. It offers stable construction via minimally invasive procedures with minor discomfort without compromising the blood supply and osteogenic tissues, apart from being relatively safe with no major complications.⁶ The application of Ilizarov provides numerous advantages including its feasibility in infective cases, allows postoperative 3-dimensional correction of deformities and early mobilization of fractured limbs.⁷ Multiple studies have shown its success in humeral lengthening from 8-16 cm without significant complications.⁷⁻⁹ However its benefits and usage are limited by various complications mainly due to the bulkiness of the fixator, persistent pain and discomfort, pin tracts infection and prolonged joint immobilization.

Various literatures have demonstrated excellent results with the introduction of the semicircular ring fixators as the substitution of full ring fixators in other regions of the body especially in femur and tibia.^{10,14,15} However little has been mentioned regarding its efficacy in treating upper limb fractures. The implementation of the semicircular ring fixation in our case has shown to yield comparable results while being able to minimize the potential complications seen with conventional full ring Ilizarov fixation. The choice of semicircular ring fixation did not demonstrate any compromise or inferiority in terms of stability of the construct as compared to the full ring fixation. In turn it appeared to be more user friendly and easily assembled and therefore warranted a shorter operation time. Patient's self satisfaction level and compliance to the fixator also markedly improved owing to the less bulky apparatus and potentially the absence of impingement of the frame against the lateral chest wall unlike those invariably seen in full ring fixator, hence less pain and discomfort.

Multiple previous studies had revealed that the commonest complications - pin tract infection and joint stiffness were invariably present following the

application of ring fixators with the incidence of approximately 10%, respectively.^{7,10-13} Pin tract infection as an inevitable complication has also been observed in our patient during the transportation period but it was easily manageable with little intervention and no residual complication. The range of motion of the affected elbow was also able to be maintained at an acceptable and satisfactory range. On the other hand, other complications such as recurrence/persistence infection, failure of distraction osteogenesis, premature callus consolidation and neurovascular injury were not encountered.

We concluded that bone transport in humerus using the semicircular Ilizarov ring fixator is an equally effective method and is able to produce excellent results whilst eliminating the undesirable bulkiness and discomfort potentially caused by full ring fixator.

REFERENCES

1. Rigal S, Merloz P, Nen D L, Mathevon H, Masquelet A. Bone transport techniques in posttraumatic bone defects. *Orthop Trauma Surg Res*, 2012; 98: 103-8. doi:10.1016/j.otsr.2011.11.002
2. Paley D, Maar, D. Ilizarov Bone Transport Treatment for Tibial Defects. *J Orthop Trauma* 2000; 14: 76-85.
3. Yin P, Zhang Q, Mao Z, Li T, Zhang T, Tang P. The treatment of infected tibial nonunion by bone transport using the Ilizarov external fixator and a systematic review of infected tibial nonunion treated by Ilizarov methods. *Acta Orthop. Belg* 2014; 80, 426-35.
4. Bobroff GD, Gold S, Zinar D. Ten Year Experience with Use of Ilizarov Bone Transport for Tibial Defects. *Bull Hosp Jt Dis*. 2003; 61: 101-7.
5. Lakhani A, Singh D, Singh R. Outcome of rail fixator system in reconstructing bone gap. *Indian J Orthop* 2014; 48: 612-6. <http://doi.org/10.4103/0019-5413.144237>
6. Sioros VS, Lykissas MG, Pafilas D, Koulouvaris P, Mavrodontidis AN. Ilizarov treatment of humeral shaft nonunion in an antiepileptic drug patient with uncontrolled generalized tonic-clonic seizure activity. *J Orthop Surg Res* 2010; 5: 48. <http://doi.org/10.1186/1749-799X-5-48>
7. Kiran M, Jee R. Ilizarov's method for treatment of nonunion of diaphyseal fractures of the humerus. *Indian J Orthop* 2010; 44:444-7. <http://doi.org/10.4103/0019-5413.69319>
8. Cattaneo R, Catagni MA, Guerreschi F. Applications of the Ilizarov method in the humerus. Lengthenings and nonunions. *Hand Clin*. 1993; 9: 729-39.
9. Cattaneo R, Villa A, Catagni M, Tentori L, Cassi M. [Application of the Ilizarov technic in the lengthening of the humerus]. *Rev Chir Orthop Reparatrice Appar Mot*. 1986; 72: 203-9.
10. Lammens J, Bauduin G, Driesen R, Moens P, Stuyck J, De Smet L, et al. Treatment of non union of humerus using Ilizarov external fixator. *Clin Orthop Relat Res*. 1998; 353: 223-30.
11. Maini L, Chadha M, Vishwanath J, Kapoor S, Mehtani A, Dhaon BK. The Ilizarov method in infected non union of fractures. *Injury* 2000; 31: 509-17.
12. Patel VR, Menon DK, Pool RD, Simonis RB. Nonunion of humerus after failure of surgical treatment- management using Ilizarov external fixator. *J Bone Joint Surg Br*. 2000; 82: 977-83.
13. Iacobellis C, Berizzi A, Aldegheri R. Bone transport using the Ilizarov method: a review of complications in 100 consecutive cases, *Strateg Trauma Limb Recon* 2010; 5: 17-22, DOI: 10.1007/s11751-010-0085-9
14. Krishnan A, Pamecha C, Patwaet JJ. Modified Ilizarov technique for infected nonunion of the femur: the principle of distraction-compression osteogenesis. *J Orthop Surg* 2006; 13: 265-72.
15. Ashraf A. Khanfour, Mohamed M. El-Sayed. Efficacy of a compliant semicircular Ilizarov pin fixator module for treating infected nonunion of the femoral diaphysis. *Strat Traum Limb Recon* 2014; 9: 101-9. DOI 10.1007/s11751-014-0199-6