Role of Ilizarov Fixator in Non-Union Humeral Shaft Fractures.

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ABSTRACT

Objective: To determine the radiological and functional outcome of nonunion humeral shaft fractures treated with Ilizarov fixator without bone grafting.

Methods: This descriptive study was conducted in department of Orthopaedic Surgery Nishtar Hospital Multan from 2nd January 2019 to 25th December 2021. All patients with humeral shaft non unions fulfilling the inclusion criteria were treated with half pin Ilizarov fixator without bone grafting. Post operative bone results and functional results were assessed with Association for the Study and Application of Methods of Ilizarov (ASAMI) Scoring System and graded as excellent, good, fair, poor and failure.

Results: In this study 30 patients were included. The mean age was 39.47±9.72 years. Male patients were 22(73.33%) and females were 8(26.66%). Right sided humeral nonunion was present in 17(56.66%) and left in 13(43.33%).All fractures achieved union. Excellent bone results were achieved in 19 (63.33%) patients, good in 7 (23.33%), fair in 3(10%) and poor in 1 (3.33%) patient while functional results were excellent in 20(66.66%) patients, good in 9(30%) and fair in 1(3.33%) patient as per ASAMI scoring system.

Conclusion: The application of Ilizarov ring fixator without bone grafting is an effective way of treating nonunion of humeral shaft fractures as shown by the excellent and good radiological and functional outcome in majority of our patients in this study.

Keywords: ASAMI, Half pin, Humerus, Ilizarov, Non-union

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INTRODUCTION

Humerus fractures account for approximately 3% of all fractures.[1] Non-union humeral shaft fractures occurs in 6% to 12% patients treated conservatively or operatively.[2] Rosen has defined non union humerus as failure of fracture to heal in 6 to 8 months.[3] Non union humerus is a challenge and treatment is often difficult as there is associated stiffness of the elbow and shoulder and scarring and fibrosis due to previously done multiple surgical intervention in most cases.[4] The common modalities of treatment for aseptic nonunion are plating and cancellous bone grafting, intramedullary nailing and bone grafting and Ilizarov ring fixator[5]. In infected nonunion humerus the usual treatment is removal of hardware, if any, debridement and some form of external fixation followed by bone grafting once the infection subsides.[6-8] The Ilizarov ring fixator has shown satisfactory results not only in periarticular comminuted fractures of the long bones but also in non-unions of different long bones.[9] The Ilizarov ring fixator can be applied even in the presence of infection, bone loss can be covered and deformity can be corrected simultaneously and union is achieved without bone grafting in many cases. [10-12] Ilizarov technique is more popular and has favorable results than vascularized bone grafts for humeral

shaft non-unions [2,13-16] The objective of our study was to determine the radiological and functional outcome of non union humeral shaft fractures treated with Ilizarov fixator without bone grafting.

METHODS

We conducted this descriptive study was in department of Orthopaedic Surgery Nishtar Hospital Multan from 2nd January 2019 to 25th December 2021. The study was approved by the Institutional Review Board of our hospital. All adults patients of both gender with infected and non-infected non-union humerus shaft of 6 months duration or more were included in the study. Obese (BMI >30) patients, diabetics, associated vascular and brachial plexus injuries, pathological fractures, gap non unions and segmental fractures were excluded. All patients were admitted from outpatient department. Informed written consent was taken from each patient. Detailed history and clinical examination was documented for each patient. All relevant investigations(radiographs and serum markers of infection) were obtained prior to surgery and surgeries were planned accordingly.

Surgical Technique

All surgeries were performed under general anaesthesia and by the same surgical team with primary surgeon being one senior consultant orthopedic Ilizarov surgeon. Position of the patients was supine. In infected cases previous hard ware or sequestrum (if any) was removed and debridement was done. Deep infected tissues and pus was obtained for culture and sensitivity. After thorough wash Ilizarov was applied. Non-infected non unions(without any hard wares in situ) were fixed with Ilizarov without opening the non-union. Non infected non unions with hard wares in situ were opened for hardware removal followed by Ilizarov ring fixator.

We used three rings in our Ilizarov construct with one complete ring with one and half anterolateral ring in the larger fragment and half anterolateral ring in the smaller fragment. For half pins in humerus five to six, 4 or 5mm Schanz pins were used depending upon the bone diameter taking care of safe zones. Fracture alignment was checked per-operatively with image intensifier.

On 1st Post operative day distal neurovascular status was checked and dressing was changed. Elbow and shoulder physiotherapy was started under the supervision of physiotherapist. Radiographs were taken to document the bone alignment. Pin care was explained to the patient. On 5th post operative day drain was removed and antibiotics stopped for non-infected non-unions and changed (according to culture and sensitivity report) for infected non-unions and continued for 3 weeks. At 2nd week postoperatively stitches were removed and full range of motion exercises were started. Follow up visits were scheduled every four weekly. At 6th week about cyclic loading was started in cases where progress of union was not satisfactory. Cyclic loading was done for 6 weeks with 4 days compression (0.25mm twice a day) alternating with 6 days of compression (0.25mm twice a day). The Ilizarov was removed once radiological union was achieved and consolidation confirmed clinically. Removal of frame was done step wise. Few pins were removed initially followed by removal of few rods and then finally whole apparatus. Final radiological and functional assessment was done after frame removal with the help of Association for the Study and Application of Methods of Ilizarov (ASAMI) Scoring System[17] and bone results and functional results were graded as excellent, good, fair, poor and failure.

All the data was analyzed using SPSS version 25. Descriptive statistics were used to calculate mean and standard deviation for quantitative variables like age and bone healing time. Frequencies and percentages were calculated for qualitative variables like gender.. Cofounders and Effect Modifiers like age and gender were controlled by stratification of data. Post stratification, Chi-square test, t-test and Anova test was applied and P value was calculated. P value <0.05 was considered significant. Data was presented in table where necessary.

RESULTS

We treated 30 non union humeral shaft fractures with Ilizarov ring fixator. The mean age was 39.47±9.72 years. Male patients were 22(73.33%) and females were 8(26.66%).Right sided humeral non union was present in 17(56.66%) and left in 13(43.33%). History revealed that initial fractures were closed in 23(76.66%) patients and open in 07(23.33%) patients. The initial mode of treatment in majority(86.66%,n=26) of humerus shaft fractures were surgical while only 04(13.33%) cases were managed conservatively. Majority(73.33%,n=22) of our fractures were non infected non unions while infected non unions were present in 08(26.66%) patients.Union was achieved in all cases. Excellent bone results were achieved in 19 (63.33%) patients, good in 7 (23.33%), fair in 3(10%) and poor in 1 (3.33%) patient while functional results were excellent in 20(66.66%) patients ,good in 9(30%)

and fair in 1(3.33%) patient as per ASAMI scoring system. No poor results and failure was noted in our series. The mean union time was 7±1.82 months (range 4 to 10 months). Data stratification(Table I) revealed no statistically significant association between ASAMI score and gender, initial treatment type of non union and time since injury(p>0.05). Superficial surgical site infection was noted in 02(6.66%) patients but resolved with dressing and antibiotics. No neurological deficit was noted. Union was achieved in all cases without any additional surgery.

Table I: ASAMI scoring as per data stratification.

Demographic/clinical Parameters		Number	ASAMI bone result				*P* value	ASAMI functional results					*P* value	Post op Infection			*P* Value
			Excellent	Good	Fair	Poor		Excellent	Good	Fair	Poor	Failure		None	Superficial	Deep	
Gender	Male	22	12	06	03	01	0.39	16	06	00	00	00	0.21	20	02	NONE	0.377
	Female	08	07	01	00	00		04	03	01	00	00		00	00		
Initial fracture	Close	23	17	03	02	01	0.08	18	04	01	00	00	0.13	21	02		0.419
	Open	07	02	04	01	00		04	03	01	00	00		07	00		
Initial treatment	Conservative	04	02	01	01	00	0.55	02	01	01	00	00	0.33	04	00		0.444
	DCP	20	14	04	01	01		15	04	01	00	00		19	01		
	ILN	02	00	01	01	00		01	00	01	00	00		02	00		
	AO Ex Fix	04	03	01	00	00		01	02	01	00	00		03	01		
Number of previous surgeries	None	04	02	01	01	00	0.88	04	00	00	00	00	0.56	04	00		0.485
	One	14	10	02	01	01		10	04	00	00	00		12	02		
	Two	08	04	03	01	00		06	01	01	00	00		08	00		
	More than two	04	03	01	00	00		02	01	01	00	00		04	00		
Time since Injury	6 months	09	07	00	02	00	0.07	06	03	00	00	00	0.09	08	01		0.723
	9 months	16	07	07	01	01		10	05	01	00	00		15	01		
	12 months	05	05	00	00	00		03	02	00	00	00		05	01		
Type of non-union	Non infected	22	15	05	01	01	0.37	16	05	01	00	00	0.45	20	02		0.377
	Infected	08	04	02	02	00		03	04	01	00	00		08	00		

DISCUSSION

In this study we treated 30 nonunion humerus shaft fractures. The outcome was assessed with ASAMI scoring system and documented excellent bone results in 19 (63.33%) patients, good in 7 (23.33%), fair in 3(10%) and poor in 1 (3.33%) patient while functional results were excellent in 20(66.66%) patients ,good in 9(30%) and fair in 1(3.33%) patient.Meselhy[18] treated 20 non union humeral fractures with Ilizarov and documented excellent ASAMI bone results in 13(65%),good in 4(20%) and fair in 3(15%) patients while ASAMI functional results were excellent in 12(60%) patients,good in 4(20%),fair in 2(10%) and poor in 2(10%) patients. This study also reported a statistically significant improvement in post operative DASH score and VAS.Kiran[19] treated 19 non union humerus and reported excellent bone healing results in 18(94.73%) and good in 1(5.26%) patient. The functional results were excellent in 14(73.68%),good in 4(21.05%) and fair in 1(5.26%). Kiran concluded that Ilizarov ring fixator is a technique of choice for aseptic and septic non union shaft of humerus fracture. This technique simultaneously treated all the issues of non union like joint stiffness, deformity and infection.

Das[20] treated 11 non union humerus and noted excellent bone results in 10(90.9%) patients and good in 1(9.09%) patient.The functional outcome was excellent in 7(63.63%) cases and fair in 1(9.09%) patient. Patel[12] treated 16 non union humerus with Ilizarov and achieved excellent bone results in 92% patients,good in 4% and fair in 4% patients.The functional outcome was excellent in 15%,good in 45%,fair in 15% and poor in 20% patients. Tomic[21] and colleague treated 28 atrophic non union of humeral shaft fractures with Ilizarov ring fixator and achieved union in all cases.Excellent functional outcome was achieved in all patients as measured by Lammens scoring scale. Brinker[22] treated 6 infected non union distal humerus fractures with Ilizarov and achieved union in all cases.Significant improvement in functional outcome was noted and measured as per DASH score and SF-12 Physical Component Scale(PCS) in his cases.

Our study had few limitations. The design of our study was descriptive. The sample size was small and follow up was short. Further studies are therefore recommended to verify our results.

CONCLUSION

The application of Ilizarov ring fixator without bone grafting is an effective way of treating non union of humeral shaft fractures as shown by the excellent and good radiological and functional outcome in majority of our patients in this study.

Conflict of Interest: None

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