The role of the Ilizarov method in treatment of lower limb fractures versus other techniques

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Abstract

Deformities of the lower limbs can be congenital or acquired. Various surgical treatments have been employed for such disorders including osteotomy followed by either external fixation, internal fixation.

The goal of this study was to comparing the impact of the Ilizarov method with other methods for the treatment of lower limb trauma.

Materials and methods presented the results of 8 8 male patients who have various injuries in lower limb were treated with Ilizarov external fixation after failed treated them by other fixations. The quality of life evaluation was done using the SF-36 Scoring system, and bone union with serial radiographs .

Results after application of the Ilizarov frame, the bone union successfully in most patients, and improve the quality of life for them .

Conclude that the Ilizarov circular external fixators are an efficient treatment option for patients who were suffering from complex lower limb trauma.

Key words: Ilizarov , unilateral external, bilateral external, internal fixation, SF-score, radiographic

.1Introduction

External fixation for the objective of bony realignment has been in practice since the early 1900s and is widely utilized today. External fixators are used mainly for trauma but may also be used for deformity correction and arthrodesis, among other applications. The advantages of external fixation over open reduction and internal fixation and intramedullary nailing include simplicity of application, adjustability of the construct, increased access for wound care, and wound monitoring after fixation is achieved (Moss, 2007.(

External fixation has evolved from being utilized mostly as a last resort fixation method to becoming a main stream technique applied for treat a myriad of bone and soft tissue pathologies (Fragomen et al, 2007.(

The Ilizarov Ring Fixator (IRF) is thought to have several advantages over other surgical options in the treatment of axial deformity (Sluga et al, 2003; Fadel et al,

2005; Manner et al, 2007; Matsubara et al, 2007; Tellisi et al, 2008; Küçükkaya et al, 2009; Thiryayi et al, 2010; Ganger et al, 2010; Floerkemeier et al, 2010; Reitenbach et al, 2016). For the use in deformity correction, the surgeon uses hinges and translation mechanisms to build a custom made frame system for each distinct deformity (Fadel et al, 2005; Manner et al, 2007; Küçükkaya et al, 2009;Reitenbach et al, 2016.(

During the treatment, correction of complex deformities may require changes of the frame construct, which may be very time consuming or even impossible (Manner et al, 2007; Küçükkaya et al, 2009; Floerkemeier et al, 2010). In this case, a ring fixator may need modification occasionally throughout the correction of complex deformities (Sluga et al, 2003; Fadel et al, 2005; Manner et al, 2007; Matsubara et al, 2007; Tellisi et al, 2008; Küçükkaya et al, 2009; Thiryayi et al, 2010; Ganger et al, 2010; Floerkemeier et al, 2010.(

Two phases characterize the treatment of war and open injuries of extremities. The initial phase comprises primary surgical assistance, whose main aim is the preventing of early complications like blood loss, shock, infection, ischemia of extremities, and stabilization of fractured bone by external fixator. This phase is short and lasts to about seven days. necessary to particularly emphasize that the adequate primary surgical treatment depends entirely on more treatment. In a second or so known “reparative phase the complications had treated, such as bone infection, pseudarthrosis, wrong growth fractures, short limbs, joint contractures, and functional outbursts (Grubor et al, 2012.(

The selection of treatment techniques for an infected non-unions depends on various factors, such as the non-union (usually atrophic), the extent of the infection, and trophic skin changes (Reddy et al, 2018.(

The 36-item Short-Form Health Survey (SF-36) is one of the generic quality of life (QoL) instruments which can be used in clinical practice and research, to evaluate, follow and supervise population health status. It is a multipurpose, short-form health survey with only 36 questions it yields an 8-scale profile of functional health and well-being scores (BRAZIER et al, 1992). The score ranging from 0 to 100, with a higher score indicated to a higher level of function and/or better health and a lower score indicating a lower level of function and/or bad health.

Radiographic images may serve a useful role in the qualitative evaluation of union or nonunion of the bone during treatment; therefore it was used to estimate

the difference between Ilizarov device and other techniques (Blane et al, 1991). This work aims to study an effectiveness of Ilizarov external fixation on correction or union of the bone compared with other fixations utilizing radiograph and SF-36 score.

.2Patients and method

The research group consists of 8 male patients with a mean age of 32.25 (24 to 50) years undergone treatment employing the Ilizarov technique. They had different injuries in the lower limb due to accident war between 2016-2018. All the patients had subject surgeries with other techniques before Ilizarov's operation, as shown in a table.1 and figure.1, but without improvement. Therefore the Ilizarov method was used for treating them.

With written informed approval from the patients before each operation, the following parameters were assessed: sex, age at surgery, influenced side, traumatic cause, surgical procedure, pre-operative and post-operative deformity parameters (motion improvement and healing of fracture) in radiographs (Figures 2,3, and 4). The pre-and post-operative pain, function and other complaints via clinical scores, including Health-related Quality of Life through Short- Form 36 (SF-36) scores were collected from the patients (Jirarattanaphochai et al, 2005; Angthong et al, 2011(

.3 Statistics analysis

Statistical analysis was implemented using the IBM SPSS (Statistical Packages for Social Sciences) software version 21.0. After with the normality distribution was checked by using Shapiro-Wilk, and found the data of most SF-36 domains not normally distributed whether in the data that measured before Ilizarov application " Other interventions (OI) " or the data of post Ilizarov application "Ilizarov reconstruction (IR)". Therefore, the Wilcoxon signed-rank Non-parametric test was used to analyze the statistical significance of differences between median values of the SF-36 domains. Each analysis was carried out at the level of importance set at a p-value <0.05 was considered as significant discrimination point.

.4Results

In this study, the patients had a follow up average 22 months. Where the patients were examined clinically and radiographs at monthly intervals until bone union was observed. Union was clinically determined when the patient was carrying a full

weight without any pain at the site of the fracture, and radiographically when the callus was attached to at least three cortices .

Through follow-up the patients by radiograph found there were differences between Ilizarov reconstruction (IR) and other interventions (OI) in bone healing or its correct union . The patients (P1, P2, P4, P5 and P8) used unilateral external fixation and treatment time with a mean of 7.8 months, the bones mal-union or non-union and refracture in P4, after removal external fixation and used Ilizarov method with a mean of 6.6 months, the results were good. The patients (P3 and P7) were used bilateral external fixation with a mean of 5.5 months; also union signs not showed; therefore, the patients used IRF for treatment with a mean of 8 months, and the results were somewhat reasonable. Also, the patient (P6) used internal fixation for interval one year, but noted displacement is still and non-union after internal removal fixation, while the results were much better after used Ilizarov for period six months.

Knowing that a patient P3 and P4 had used a cast for 1 month after removal (bilateral and unilateral) external fixation.

The p values obtained after comparing the median values of SF-36 domains between the Ilizarov external fixation (IR) and other techniques (OI) that used by eight patients (table.2) had different injuries in bones (table.1). There are statistically significant between medians of scores SF-36, where the PF (p= 0.008); RP and RE (p=0.01); VT, MH, SF, BP and GH (p=0.007); and health change (p=0.006 .(

.5Discussion

The more important goal in the treatment of fractures is to restore the full function of the injured extremity in the shortest possible time frame. External fixation and intramedullary nailing are well accepted techniques for the treatment of open tibial fractures. Both techniques offer the advantages of minimum operative trauma and high union rates in the treatment of open tibial fractures. However, there is still no universal acceptance of either external fixation or intramedullary nailing (Inan et al, 2007). The Ilizarov method for bone transport in bone defects due to trauma, non-union or osteomyelitis has found extensive use in orthopaedics (Fabry et al, 2006;

Dhar et al, 2007). The Ilizarov frame provided a judicious alternate to the permanence of the external fixators where able to remove Schanz pins with clinical signs of infection and replace with the thinner Ilizarov wires to preserve and increase the biomechanical advantages of the fixation. Also, this method diminishes the load on the elongate image intensifier facilities (Dhar et al, 2008.(

In this study, the differences were found regarding the mean time between Ilizarov external and bilateral external, but these differences in the mean time were slightly between Ilizarov and unilateral external fixations. At the same time, the union of bone for the Ilizarov method was better than two other methods (unilateral and bilateral fixations). and Hosney et al. (2003) and Wani et al.(2011) found similar mean time for union of fractures that were 5.6 and 6months respectively, when they used Ilizarov for treatment of tibial open and were near to that found in our study. Paley. D et al. (1989) and Sen et al.(2004) found a longer duration of time for union of fractures (13.6 and 7.5 months) with Ilizarov and were higher than that we found in this study. The average length of the treatment period with the Ilizarov fixator was 9.7 weeks (range, 8 to 12 weeks) when using the management of intra-articular calcaneal fractures with an external fixator (Ali et al,2009), and the same was that we found in this study.

Also, using the period of Ilizarov for treatment the shank bone fracture was half period of using internal fixation in this treatise. At the management of ankle arthritis, the mean interval of the treatment with the Ilizarov fixator was 13.0 weeks and with internal plate fixation 17.5 weeks (Li et al,2017 .(

Schep.N et al. reported that the quality of life and functional result returning to normal after post-traumatic distraction osteogenesis of the lower extremity (Schep et al,2009). The Ilizarov-type reconstruction of deformity of the lower limb not only restores bony configuration but also produces a considerable improvement in the general health status of patients (McKee et al,1998). The evaluation post-removal Ilizarov showed which there significant findings for SF-36 domains when compared with other external modes that were used before the Ilizarov operation.

٦. Conclusion

The results of our study demonstrated that an efficacies of treatment with Ilizarov were high when all the other methods unsuccessful in the union of bone. Also, the Ilizarov way provided significantly best assessment clinical SF-36 scores .

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Figures of this paper

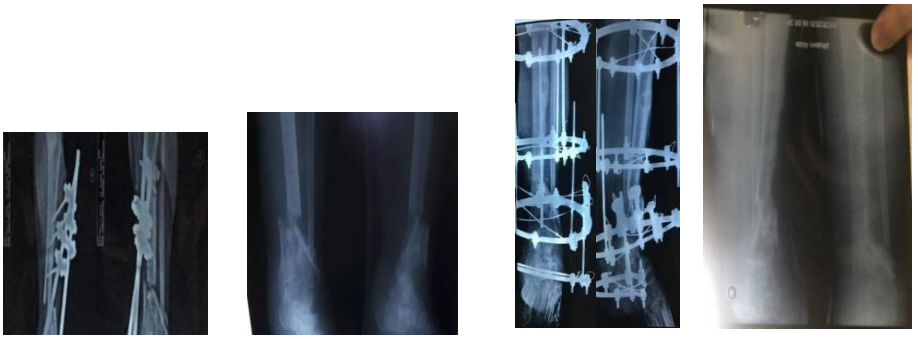
(a)

(b)

Figure1: (a) with bilateral external fixation; (b) with Ilizarov fixation.

(a) (b) (c) (d)

Figure2 A mid-diaphyseal tibial fracture fixed with a unilateral external fixator followed by consecutive conversion osteosynthesis to an Ilizarov frame, and the final result in figure (d).

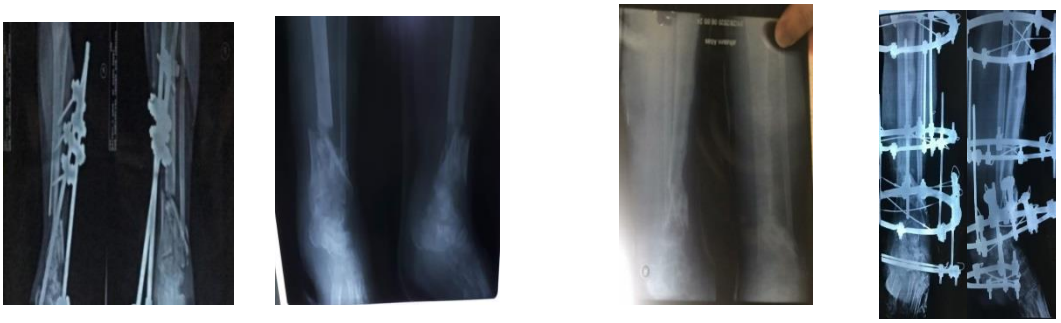


(a) (b) (c) (d)

Figure3 A fracture of the distal tibia stabilized with a bilateral external fixator followed by consecutive conversion osteosynthesis to the Ilizarov fram, and final result in figure (d).

(a) (b) (c) (d)

Figure4 A fracture in shinbone and fibula stabilized with plate internal fixator followed by consecutive conversion osteosynthesis to the Ilizarov frame, and final result in figure (d).



(a) (b) (c) (d)

Figure3 A fracture of the distal tibia stabilized with a bilateral external fixator followed by consecutive conversion osteosynthesis to the Ilizarov fram, and final result in figure (d).

(a) (b) (c) (d)

Figure4 A fracture in shinbone and fibula stabilized with plate internal fixator followed by consecutive conversion osteosynthesis to the Ilizarov frame, and final result in figure (d).

Tables

Table.1 Characteristic of patient participation and type technique using before Ilizarov surgery

patients	Abnormal site		Type of injury (Etiology)	Type of technique before Ilizarov surgery
	Right	Left		
P1		✓	6-cm long bone loss in the mid-diaphyseal (tibial bone loss)/ Post-traumatic	unilateral external fixation
***P2**	✓	✓	Right: fracture of the bottom of the leg bone resulting in severe pain and limited	unilateral external fixation

			ankle movement. Left: deformation above ankle.	
P3	✓		multiple fractures (above ankle and in femur bone)	bilateral external fixation
P4		✓	mid-diaphyseal of tibia fracture	unilateral external fixation
P5	✓		fracture in shin bone	unilateral external fixation
P6	✓		fracture in shin bone and fibula	Plate internal fixation
P7		✓	Articular calcaneal fracture	bilateral external fixation
P8	✓		Drop foot	unilateral external fixation

***P2** has an injury on two (right and left) limbs, i.e. he performed Ilizarov surgery for two times.

Table.2 Statistical analysis of differences between medians of scores of different SF-36 QOL domains of Ilizarov reconstruction and Other interventions

domains	**Ilizarov reconstruction (IR)**		**Other interventions (OI)**		***P value**
	Median	**IQR**	**Median**	**IQR**	
PF	55	32.5	5	27.5	0.008
RP	50	25	0	0	0.01
RE	100	16.65	66.7	66.7	0.01
VT	55	10	25	20	0.007
MH	60	10	40	10	0.007
SF	75	18.75	25	25	0.007
BP	77.5	22.5	22.5	33.75	0.007
GH	50	10	25	2.5	0.007
Health change	75	0	25	50	0.006

*** according to Wilcoxon Signed Ranks Test**

Highlights

There have some limitations to the study. The numbers of the patient were quite limited as 8 patients; therefore, this needs further study, larger number of patients, and a longer period of follow-up to confirm the proposed affair of the current study. However, the current study might be a potential report that proposed the basic information for further researches.