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Dr. Sameer Mohammad Zargar
PG Scholar Orthopaedics, GMC Srinagar, Jammu & Kashmir, India

Dr. Rajkumar Prasad
Assistant Professor, Department of Orthopaedics, JNUIMSRC, Jaipur, Rajasthan, India

Dr. Uroosa Fayaz Mir
PG Scholar, Department of Anatomy, JNUIMSRC, Jaipur, Rajasthan, India

Corresponding Author:
Dr. Sameer Mohammad Zargar
PG Scholar Orthopaedics, GMC Srinagar, Jammu & Kashmir, India

Complications of ilizarov external fixator

Dr. Sameer Mohammad Zargar, Dr. Rajkumar Prasad and Dr. Uroosa Fayaz Mir

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Abstract
Introduction: Ilizarov external fixator is a versatile system, applicable in vast number of Orthopaedics cases which has its own advantages as well as associated complications. Present study was done with an aim to analyze and evaluate the complications in patients managed with ilizarov method.
Materials and Methods: A total of 112 patients were enrolled in this study who were managed with Ilizarov technique for different indications. The complications were classified into two categories I (minor) and category II (major). Results were graded as excellent, good, fair and poor as per modified ASAMI (Association for the Study and Application of Methods of Ilizarov) classification based on radiological and clinical criteria.
Results: In this study the complications encountered were pin tract infection in 41 (36.61%) patients, muscle contracture in 3 (2.68%) patients, joint stiffness in 17 (15.18%) patients, mal-union in 7 (6.25%) patients, non-union in 5 (4.46%) patients, 3 (2.68%) patients had RSD (reflex sympathetic dystrophy) which were treated with physiotherapy and 2 (1.79%) patients had bleeding from pin site which was managed conservatively.
Conclusion: Complications of Ilizarov can be minimized by following standard Ilizarov principles. Pin tracts care must be done, motion exercises must be followed to reduce stiffness of joints.

Keywords: Fractures, ilizarov frame, complications

Introduction
In the past, patients with fractures which failed to heal (non-union), or healed incorrectly (malunion) had little treatment available to them, and patients who required surgical removal of infected bone (osteomyelitis) or cancerous bone often had no choice but to have an amputation of the affected limb. The treatment of such orthopaedic conditions was revolutionized by Dr Gavril Ilizarov. In the mid1960, Dr. Gavril Ilizarov revolutionized Orthopaedic management of difficult fractures, with his invention of ring external fixator, by treating his first patient with this technique in 1950s. Many have adapted and modified this fixator, but the principles remain the same.
Ilizarov external fixator is a versatile system, applicable in vast number of Orthopaedics cases. Fixator has edge over various internal fixation system as it preserves soft tissue and periosteum, does not disrupt fracture hematoma, can be applied in open fractures and weight bearing can be started early on. This device has a wide range of applications in current orthopaedic practice like non-union, skeletal defects, chronic refractory osteomyelitis, filling septic cavities, limb lengthening, joint contractures, angular and other limb deformity correction e.g. Genu varum.
Ilizarov method too has its own advantages as well as associated complications just like any other surgical technique in the history of orthopaedics. These can occur in intra operative, immediate post-operative or late post-operative period. Ilizarov external fixator is associated with high morbidity, when applied for prolonged durations [1]. Pin track infections are at the top of list of complications of Ilizarov. Different studies have shown different incidence of this occurrence, ranging from 1-100% [2, 3]. Neurovascular and muscle/tendon impingement is another issue. Surgeon must be vigilant about established safe zones before inserting a wire or half pin. Too much a rigid frame can cause a nonunion or a delayed union. Fracture or re-fracture of the bone may occur with this fixator. A rigid fixation may result in a union which is entirely endosteal. Frame removal will make this weak bone, prone to re- fracture.

During deformity correction bones might get fractured or joint may be subluxed [4, 5, 6]. Compartment syndrome, poor regeneration of bone during distraction osteogenesis ankle stiffness can be result after Ilizarov fixation that can be avoided by placement of wires in safe zones and optimal timing of distraction respectively.

It is remaining a major concern to these complications which could affect the clinical outcomes. Therefore, the purpose of our study was to retrospectively analyze and evaluate the complications in patients managed with ilizarov method.

Materials and Methods

This study was carried out from 2016 to 2023. A total of 112 patients, who were managed with Ilizarov technique for different indications, were enrolled in this study. All surgeries were done under general anesthesia. An Ilizarov fixator was pre-assembled and applied to the patients.

Intraoperative and postoperative antibiotic regimen and postoperative control radiographs were performed routinely. Range of motion exercises and quantitative weight bearing was advised. Follow-ups were done at the interval of two weeks and all patients were followed up for at least 12 months. All fixators were removed in operation theaters which incorporated pin tract curettage and immobilization with plaster of Paris for one to one and a half month.

The complications were classified into two categories I (minor) and category II (major). Results were graded as excellent, good, fair and poor as per modified ASAMI (Association for the Study and Application of Methods of Ilizarov) classification based on radiological and clinical criteria [7].

Table 1: Demographic characters of patients and indications for which ilizarov frames were applied

Demographic characters		No. of patients	Percentage
Gender	Male	69	61.61
	Female	43	38.89
Age group	<30 Years	37	33.03
	30-50 Years	62	55.36
	>50 Years	13	11.61
Limb	Upper limb	11	9.82
	Lower limb	101	90.18
Indications			
Infected non-union tibia		19	16.96
Tibia			
Closed fractures of distal tibia		6	5.36
Closed fractures of proximal tibia		11	9.82
Open fractures of tibia		18	16.07
Open fractures of femur		9	8.04
Genu Varun / Valgus		6	5.36
Limb lengthening		4	3.57
Ankle arthrodesis		3	2.68
CTEV correction		5	4.46
Congenital pseudoarthrosis		2	1.79
Unicompartmental osteoarthritis		4	3.57
Neglected monteggia dislocations		5	4.46
Joint contractures		4	3.57
Chronic osteomyelitis		10	8.93
Procurvatum / Recurvatum		6	5.36

Results

A total of 112 patients, who were managed with Ilizarov technique for different indications, were enrolled in this study. The average age of the study population was 43.70±9.20 (range 17-62) years. There were 69 (61.61%) males and 43 (38.39%) females. 11 (9.82%) patients had upper limb and 101 (90.18%) patients had lower limb involved (Table 1). The different indications for which patients were treated with Ilizarov are summarized in table 1.

In this study outcomes were assessed by the ASAMI criteria, as excellent in 70 (62.50%) patients, good in 31 (27.68%) patients, fair in 6 (5.35%) patients and poor in 5 (4.46%) patients.

In this study the complications encountered were pin tract infection in 41 (36.61%) patients, muscle contracture in 3 (2.68%) patients, joint stiffness in 17 (15.18%) patients, mal-union in 7 (6.25%) patients, non-union in 5 (4.46%) patients, 3 (2.68%) patients had RSD (reflex sympathetic dystrophy) which were treated with physiotherapy and 2 (1.79%) patients had bleeding from pin site which was managed conservatively (Table 2).

Table 2: Complications

Complication		No. of patients	Percentage
Pin tract infection (N=41)	Skin inflammation (Grade 1)	31	27.68
	Infection of adjacent soft tissue (Grade 2)	8	7.14
	Infection of bone (Grade 3)	2	1.79
Muscle contracture		3	2.68
Joint stiffness		17	15.18
Mal-union		7	6.25
Non-union		5	4.46
RSD (reflex sympathetic dystrophy)		3	2.68
Bleeding from pin site		2	1.79

Fig 1: A (Pin site infection, B (Pathological fracture humerus shaf), C (Compound fracture distal femur with IRF), D (CTEV correction with IRF), E (Ankle arthrodesis with IRF) F (Flexion deformity correction with IRF) and G (Tibial non-union with IRF).

Discussion

After the preservation of life, for patients who suffer from multiple fractures or poly-trauma conditions, the preservation of normal limb function with minimal complications is the top priority. The goal is that the patient has stable limbs of equal length, without deformation, well-functioning muscles, a good range of movement though the joint, and is free of pain. Also important is that the time of disability is minimal and as few surgical procedures as possible are performed. By and large, the Ilizarov external fixation technique enables the achievement of these goals.

The Ilizarov external fixator is particularly advantageous in situations when there is poor soft tissue coverage, or in the case of wound contamination. The circular ring fixator is also much more stable than a monolateral fixator so is used successfully for multiple level of stabilization in the case of segmental fractures and allows early weight bearing. The circular fixator can also be used when intramedullary nailing of the bone is impossible or unsuitable, for example in the elderly due to osteoporotic bone and deficient soft tissues.

The Ilizarov method is a versatile technique, useful in different complex orthopaedic conditions. Several potential advantages are as follows: fracture reduction and fragment fixation can be achieved with almost no soft-tissue exposure or blood loss; the adjustment of the alignment with compression or distraction of the fracture fragments can be performed both during and after the primary surgical intervention; the fixator is stable enough to allow early weight bearing irrespective of the type of fracture; finally, no implants are left in situ when the fracture is healed [8]. Nevertheless, it is very labour-intensive for both patient and surgeon, requiring patient education, compliance, demanding learning curve, and specialised staff [9].

Many authors have used this method for management of segmental skeletal defects and reported variable results. Some reported good results [10-12], whereas others reported high complication rate with this method [13]. We conducted this study to show the intra-operative and post-operative complications encountered in patients who were managed with ilizarov technique for different indications.

In this study, the common complication was pin tract infection that is known to occur universally. 41 (36.61%) patients in this study had pin tract infection, of which skin infection (Grade 1) was noted in 31 (27.68%), infection of adjacent soft tissue (Grade 2) in 8 (7.14%) and infection of bone (Grade 3) was noted in 2 (1.79%). Superficial infections were treated with local wound care and oral antibiotic while deep infections needed pin removal and curettage. In this study infections rate was near about equivalent to Pasha IF [14] who noted 40% infections in his study and Sahibzaba AS [15] who also noted 40% infection rate.

In our study joint stiffness was noted as the second common complication in 17 (15.18%) patients, the reported incidence is 20%. Near about all of the patients recovered with range of motion exercises and physiotherapy. Other complications arise during course of treatment was poor new bone formation resulted into delayed union or nonunion. No neurovascular complications were noted in this study

Conclusion

Complications of Ilizarov can be minimized by following standard Ilizarov principles. Pin tracts care must be done, motion exercises must be followed to reduce stiffness of joints.

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