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# STUDY OF APPLICATION OF METHODS OF ILIZAROV IN DIFFICULT ORTHOPEDIC CONDITIONS

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## ABSTRACT

***Background***: The Ilizarov external fixator has revolutionized orthopaedic surgery so significantly, that it provides easy correction of those previously non-rectifiable difficult orthopaedic conditions while at the same time maintained mobility and weight bearing and function of the limb.

***Methods***: In present study application of Ilizarov external fixator in difficult orthopaedic conditions was assessed. Aims and objectives have been established. History has been reviewed. Detailed case history and findings were illustrated, along with clinical and radiological materials. Ilizarov technique is a versatile procedure which can be applied to treat various difficult orthopaedic conditions which may not be amenable to other methods of treatment.

In the present study the Ilizarov external fixator has been used successfully for the treatment of difficult orthopaedic conditions like non-union associated with deformity, infection and bone loss, congenital and acquired deformities which made treatment by conventional methods inapplicable.

***Results***: The conditions treated in the study were 20 cases of infected non-union tibia, 5 cases of infected non-union femur, 4 cases of congenital pseudarthrosis, 1 case of non-union of humerus, 1 malunited supra-condylar fracture of femurs, 1 CTEV, 1 equinus deformity, 3 comminuted fractures of tibia, 1. Tibial condyle fracture, 8 fixed flexion deformities of knee, 1 Non-union of ulna, 1 Pilon fracture and 1 segmental fracture of humerus.

***Conclusion***: Though this procedure is technically demanding, hybridization with AO external fixator or intramedullary nail will further increase its applicability. It also increased efficacy by reducing the number of rings to be applied and increasing the comfort when applied near to shoulder and hip. Despite of minor-complications, this technique was found to be effective with better success rate and reduced morbidity.

## INTRODUCTION

The field of orthopaedics is full of turning points, Ilizarov external fixator has started a new chapter in the principles of management of compound fractures, infected non-union, limb length discrepancy, flexion deformities and osteomyelitis, which have relieved the suffering of many orthopaedic patients.[1] "This dynamic apparatus could solve most of the orthopaedic conditions if not all", as described by Ilizarov, its future will depend greatly on the care and consideration given to it by its users.[2]

FromKuntscher's intramedullary nailing to AO group principles ofbiomechanical aspects of fracture healing, new principles haveachieved miracles.Invented as early as in 1951 by Prof. G.A.Ilizarov, a Russianscientist, this ring fixator system named after him has donemiracles in the management of various orthopaedic problems.[3]

With its success rate far exceeding the imagination and itsversatile allocation in themanagement of orthopaedic problems,this system can be called "The orthopaedic invention of 20th century".[4] Considering high success rate among already failed andcomplicated cases, we feel this Ilizarov ring fixator system will bean answer in the future for the management of infectednon-union, limb lengthening, deformity correction, fracturemanagement and congenital pseudoarthrosis.[5]This study was conducted to study the principles of Ilizarov external fixator, to evaluate the problems, obstacles, and complications of the Ilizarov external fixators also to analyse results and draw conclusions.

## MATERIAL AND METHODS

This clinical trial was performed in Maharajah's Institute Of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh. In our series, the Ilizarov external fixator was applied to 50 patients as young as 6 years to older patient of 60 years of age. Out of the 50 patientstreated, 38 were men and 12 were women, 27 were on the right side and 23 on the left side. This may be a small series to have a clear idea of sex incidence. Preoperatively relevant radiographs were studied toplan the assembly. Preoperative antibiotics were given to all the patients.All the necessary instruments and components were kept ready forsurgery. In all patients frame was assembled intra-operatively stage bystage. Ilizarov external fixator was applied according to the basic operativeprinciples under anaesthesia. Sterile dressings were applied around thepin site.

Postoperatively patients were made to walk as soon as he/sherecovered from anaesthesia. Wire tension and frame integrity was checkedroutinely. Analgesics in the form of injections and tablets were given forpain. X-rays were taken; pin track infections were managed withapropriate antibiotics according to the culture sensitivity reports. All thepatients were encouraged to move around in hospital surroundings to create an atmosphere of wellbeing. Neighbouring joints were mobilized toprevent joint stiffness. Compression-distractions were done at regularintervals when required and for some patients the technique was eventaught. All the patients were followed at regular intervals. Fixator was dynamised 2 days before removal. After removal ofthe fixator, plaster casts were applied for a short period of time dependingon the case. Duration of followup ranged from 6 to 18 months.

## RESULTS

The observations and detailed analysis of the findings are listed here.In the current study the usefulness of the Ilizarov external fixator intreating various limb abnormalities, posing difficulty to the orthopaedic surgeon, was assessed, the results of the treatment recorded and analysedprecisely.

This may be asmall series to have a clear idea of sex incidence. In most series the malefemale ratio was found to be higher to the male side.35 were of traumatic aetiology, 1 wasinfective (Polio), 1 followed snake bite, 6 were congenital, 4 rheumatoidarthritis and 3 due to

haemophilic arthritis.Out of 35 cases of traumatic aetiology, 26 involved thetibia, 5 involved the Femur and only 4 involved the upper limb out of which3 were of the humerus and 1 of the forearm(ulna).All the 8 fixed flexiondeformities involved the knee, of the 6 congenital deformities 5 were of thetibia, 1 of the foot. One patient developed equinus deformity followingsloughing of the lateral comportment of the leg due to snake bite.

Except for 1case of non-union of the humerus and 1 case of non-union of the ulna, all the other non-unions were infected.Except for 1 patient, all the other non-unions had history of previoussurgery with an implant/Ex-fix.No. of plates – 15, No. of nails– 6, Ex-fix - 6

All the patients who presented with implant were treated byimplant removal, debridement of the wound and freshening of the fractureends.4 of the non-union patients had corticotomy done for filling the gap.All the 4 congenital pseudarthrotic patients had corticotomy done forfilling the gap created surgically at the pseudoarthrotic site.One patient with cubitus valgus had lower humeral obliquecorticotomy done for correction ofdeformity.We performed closed corticotomy in all the cases.

In the present series the commonest complications observed were, Pin track infections Neuropraxia, oedema and intolerability even to the extent of suicidal tendency in one patient with infected non-union of femur. Other complications observed during the course were delayed consolidation, translational angular, axial deviations and joint contractures which were identified early and corrected. During this course of the study no intra operative complications like neurologic or vascular injuries were observed. Limb length equality is achieved in all patients who came for follow up.

The results were then graded as excellent, good, fair or poor

- 2 of the 20 infected non unions of tibia had excellent results, 12 had good results, 4 were fair and 2 were poor.
- 1 of the 5 infected non unions of femur had good result, 2 had fair result and 2 had poor result.
- All of the 4 congenital pseudarthrosis patients had excellent result.
- 1 of the 1 non-union humerus treated had excellent result.
- 1 of the 1 mal-united supra condylar fracture of the humerus treated had good correction
- 1 of 1 CTEV patient had fair correction of the deformities
- 1 of 1 Equinus foot deformity patient had good correction
- Of 3 patients with comminuted fracture Tibia had good 2 had fair and 1 had a poor outcome.
- 1 of 2 Tibial condyle fractures had well and other had a fair result.
- 8 of 8 fixed flexion deformities of the knee had good correction done.
- 1 of 1 non-union of ulna had an excellent union with preservation of good elbow and wrist movements.
- 1 of 1 patient with limb length discrepancy had an excellent outcome.
- 1 of 1 patient with Pilon fracture of tibia had a good outcome.
- 1 of 1 segmental fracture humerus had a good outcome.

- We had poor result because of noncompliance of the patient who discontinued treatment within a month.

***Technical*:**

- In correcting flexion deformities, though distraction wasgradual and slow, resulted in some amount of paraesthesia, whichwas transient. It was managed by reducing the rate or minimizingdistractions.
- Oedema or swelling – was managed by elevation of the limb.
- Joint contracture – in limb lengthening joint contracture was overcome by maintaining the joints in neutral position by slantingand vigorous joint mobilization exercise.
- Premature consolidation of regenerate – was not observed.
- Delayed consolidation – was overcome by stopping the distraction for 1 week as and when observed.
- Angular and axial deviation – were corrected by appropriate hinged, rotation and translation device.

***Mechanical***:

- Bending of the connecting 6 mm rods when weight bearing isallowed, and also during arthrodiastasis of joints.
- K-wires and Olive wires become blunt while drilling especially at thediaphysis for long bones.

***Patient tolerance:***

- Some patients showed increased resistance to maintain theframe for more than 3 months. Pain related to the pins becomeintolerable in some patients. Children tolerate the frame well evenfor long duration.

## DISCUSSION

A survey conducted with twenty five orthopaedicsurgeons andseven pediatric orthopaedicsurgeons on the panel by "The Journal ofthe American Medical Association" in 1992.[6] Revealed andestablished the effectiveness of the Ilizarov procedure in correcting the conditions like Limb length discrepancy without deformity, limb length discrepancywith an associated deformity, bone defect without deformity, bonedefect with an associated deformity, and angular/rotationaldeformity of the long bones.

This present study also revealed the same.Ebrahein NA in the year 1995 treated 9 patients with non-union of the tibia associated with angular deformity, out of which 8 patientshad correction of deformity.[7] He concluded that Ilizarov externalfixator is an alternative in the treatment of non-union of tibiacombined with angular deformities.Present study included 5 non-union of tibia with angulardeformity which were corrected and good union achieved.

In 1994 Herzenberg reviewed 14 knees corrected by gradualdistraction using Ilizarov external fixator and orthfix external fixatorand came to a conclusion that though there is residual stiffness thecontracture gets corrected and overall function of the limb will beimproved by this procedure.[8]

The current study included a case of post-polioresidualparalysis with fixed flexion deformity 3 case of haemophilic arthritisand 4 cases of rheumatoid arthritis. All the patients had wellcorrection done and total arc of motion and gait was improved.

Mc Donald MG, et al in the year 1996[9] reviewed 13 Pilon fractureswhich were treated by diaphyseo-epiphyseal techniques of Ilizarovexternal fixation. 84% of fractures healed within 16 weeks aftersurgery. Most patients experienced mild or no pain. There were nodeep infections. He concluded that this technique is an effectivetreatment option for TibialPilon fractures.Present study of 1 case of Pilon fracture showed good union, by12 weeks and had painless full range of motion of ankle joint wasattained.

P. L. Kristiansenetal[10] described the treatment of "Schatzker type VITibial plateau fractures and the Ilizarov circular external fixator" andfound it to be useful in treating such cases.Present study included 1 case of Tibial metaphyseal fracturetreated by Ilizarov external fixator with good union. Use of application of Ilizarov technique has not been describedin the literature in the treatment of malunited supracondylarfractures.Present series included 1 case of malunited supracondylarfracture with cubitus valgus deformity corrected with Ilizarovexternal fixator.

S.A.Green, in 1994[11] compared 2 different methods of managingsegmental skeletal defects, 15 patients treated with the open bonegraft (Papineau) technique were compared with 17 patients who hadintercalary bone transport (Ilizarov) management and found thetreatment time to be identical for both the groups, and both the groupshad its own unique problems. The problems for the bone graftedgroups are limited graft availability, donor site morbidity and graftfracture. For the bone transport group, the main problems werefailure of the docking site to unite without a supplementary graft andjoint contractures.The present series included 9 conditionswhich required corticotomyout of which 8 were transports. None of the patients had bonegrafting done.

The possible complications were prevented by joint stiffness, early mobilization, delayed consolidation early weight bearing, premature consolidation increasing the rate of distraction, docking site non-union proper resection, resurfacing of the fracture ends, deformity early recognition, and corrective splinting.

Paley Dror et al in the year 1992[12] in his article "The correctionof complex foot deformities using Ilizarov's distraction osteotomies," described correction of complex foot deformities by differentdistraction osteotomies'.Present series included 1 case of equinus deformity of the footfollowing doughing of lateral compartment of the leg following snakebite and 1 case of congenital talipes equinus varus deformity. In boththe conditions no osteotomy wasperformed and good correction ofdeformity was achieved.

M. Raschike, et al in 1998[13] described 1 case of Non-union of thehumerus followingintramedullary nailing treated by Ilizarov hybridfixation, and came out with an excellent result.Present study included 1 case of mid diaphyseal fracturenon-union of the humerus with K nailin situ. Ilizarov external fixatorwas applied with K nail in situ and good fracture union was achieved.Retaining the nail reduced the number of rings to be used from 4 to 2

- ***Infective status of the wound:*** "Infection burns in the fire ofregenerate"(Ilizarov). Observation in the present study is in accordance with thisstatement. Where, infection was controlled in all the cases which visited for follow-up.
- ***Corticotomy***:In this study only closed corticotomy were performed andfound it to be satisfactory. By performing closed corticotomydeformities were corrected, Bone defects were filled and limb lengthequality was achieved.
- ***Regional variations:***During the course of the present study it was observed thatapplication of this method is relatively more difficult while treatingconditions involving the femur and humerus. This is in accordance with the previous observations hence hybridization techniques wereused during the due course to improve the patient comfort.
- ***Patient Tolerance:*** Young patients and patients with Tibial ailments tolerated the fixator better intolerance was more especially when upper femoral arch was used. This was improved by hybridization
- ***Number of rings and Hybridization:***The number of rings required in treating mid-diaphysealnon-union were reduce from 4 to 2 by using hybrid technique viz.,Intra medullary nail.

In the present series the commonest complications observed were, Pin track infections Neuropraxia, oedema and intolerability at the extent of suicidal tendency in one patient with infected non-union of femur. Other complications observed during the course were delayed consolidation, translational angular, axial deviations and joint contractures which were identified early and corrected. During this course of the study no intra operative complications like neurologic or vascular injuries were observed. Limb length equality is achieved in all patients who came for follow up.

## CONCLUSIONS

This technique manipulates the ability of bones, muscles, nerves andtendons to regenerate.

Ilizarov technique provides a simple and effective surgical procedureto treat the difficult conditions like, Non-union with deformity, infection,bone loss and correction of congenital and acquired deformities.It has eliminated the necessity for bone grafting and soft tissue

covering procedures. It is technically demanding.It not only requires patient's compliance but also requires the patience of the treating surgeon to wait longer for better results, it has less complication rate. Some patients show increased resistance to maintain the frame for longer periods.Children tolerate the fixator better.Ilizarov external fixator achieves union, corrects deformity, eradicates infection, re-establishes limb length and eliminates bone defects; while at the same time maintaining articular function and weight bearing.

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## TABLES

**Table 1: Complications**

| **Complication** | **Minor -1** | **Serious-11** | **Severe-111** |
|---|---|---|---|
| Pin site problems | Minor infection | Ring sequestrum | |
| Infection | Superficial wound | Deep wound | Osteomyelitis |
| Vascular | | | Vascular laceration or occlusion require repair |
| Neurologic medical | Hyperesthesia | Neuropraxia e.g. DVT, pneumonia | Permanent palsy e.g. cardiac arrest |
| Psychological | | | Requires change in treatment |
| Premature consolidation | | Requires repeat corticotomy | |
| Delayed union/non union | | LI>2/per adult or >1.5/child | Bone graft or retreatment |
| Fracture | | Repeat fixation | Osteotomy |
| Axis deviation >5° | | 6°-10° | >10° |
| Subluxation | | Temporary | Permanent |
| Contracture | <10° | 11°-20° | >20° and/or gait disturbance |
| Did not equalize | <2.5cm | 2.5-5.0cm | >5.cm |

**Table 2: summary of observations**

| Case | No | Result | | | | M | F | R | L |
|---|---|---|---|---|---|---|---|---|---|
| | | E | G | F | P | | | | |
| INUT | 20 | 2 | 12 | 4 | 2 | 18 | 2 | 13 | 7 |
| INUF | 5 | 0 | 1 | 2 | 2 | 5 | 0 | 1 | 4 |
| CPAT | 4 | 4 | 0 | 0 | 0 | 1 | 3 | 0 | 4 |
| NUH | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| MUSFH | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| CTEV | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| EQ | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| CFT | 3 | 0 | 0 | 2 | 1 | 3 | 0 | 1 | 2 |
| TCF | 2 | 0 | 1 | 1 | 0 | 2 | 0 | 2 | 0 |
| FFDK | 8 | 0 | 8 | 0 | 0 | 2 | 6 | 5 | 3 |
| NUU | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| LLD | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| PF | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| SFH | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |

**ATLAS**