ILIZAROV COMPRESSION ARTHRODESIS OF KNEE
Kollam Chandrasekhar1, Valya B2, Surender Rao Y3

1Associate Professor, Department of Orthopaedics, Gandhi Medical College, Secunderabad.
2Professor & HOD, Department of Orthopaedics, Gandhi Medical College, Secunderabad.
3Retd. Professor, Department of Orthopaedics, Gandhi Medical College, Secunderabad.

BACKGROUND
We report the results of knee fusion with an Ilizarov circular fixator for failed previous treatment for deformed and/or infected knee.

MATERIALS AND METHODS
The series included 11 patients with a mean age of 51.7 years who were treated by knee fusion between 1999 and 2015 with Ilizarov frame consisting of three rings and one femoral arch in 9 patients and two rings with two extra transfixation wires. Full weight-bearing was allowed within a week when three rings and femoral arch is used. Full weight-bearing was delayed till 4 to 6 weeks when two rings are used.

RESULTS
Sound fusion was achieved in 10 out of 11 patients following Ilizarov at in a mean time of 5.6 months. Mean followup was 43.6 months. One patient got the fixator removed early at second month due to intolerance and had non-union. Another patient had sound fusion but had persistent chronic osteomyelitis with discharging sinuses.

CONCLUSIONS
The Ilizarov circular frame is a very reliable fixation system as we have control to correct deformity and further compression across the fusion site after application of frame in the followup period due to the versatility, stability on axial loading and low risk of infection.

KEYWORDS
Arthrodesis Knee, Ilizarov External Fixator.


INTRODUCTION: Arthrodesis of knee is the most effective surgical solution to establish a stable joint as a salvage procedure done for severe joint pathologies like inflammatory, degenerative, infective post-traumatic, post-infective following failed total knee arthroplasty.(1,2) Solid bony fusion is achieved even in chronic infection or in extensive peri-articular bone loss. Arthrodesis of an infected knee may be required when there is much loss of bone, with the soft tissues around the knee compromised, when the extensor function of the knee is deficient, and with very little or no movement of the joint is possible. Many procedures are described like intramedullary nailing with long nail,(3), plating which require lot of soft tissue exposure and can’t be contemplated when there is infection.(2) Uniplanar fixator with or without cross cancellous screws, bi-planar fixator,(4) like Charnley’s compression clamps with Denham pins, multiplanar fixators like Ilizarov which has steering handle in surgeons hands to correct postoperatively without any further anaesthesia and exposures.

We used Ilizarov fixator to achieve arthrodesis, thereby salvaging the limb and avoiding amputation.

The Ring Fixator has Several Technical Advantages:
1. It is a stable frame yet versatile to control compression and correct the position of bones even in postoperative period.
2. Continuous axial compression helps in stimulating bone healing as well as resolution of bone and soft tissue infection.
3. Can be applied in the presence of active infection.
4. No requirement for bone grafting.
5. Early ambulation is possible with Ilizarov frame, which helps in micromotion at axial loading, hence early fusion.(5,6,7)

MATERIALS AND METHODS: Between 1999 and 2015 we have done knee fusions by using Ilizarov method and we are presenting here 11 of the cases available for followup. All of them were male and were done as a secondary procedure following failed primary treatment. The patients had painful fibrous union following trauma or following post-infective post-traumatic deformity or chronic osteomyelitis with draining sinuses or soft tissue loss or bone loss joint deformity with no possible range at knee.
In one patient who had fixed flexion deformity of 70° with discharging sinuses over distal thigh and proximal leg with no possible range beyond this deformity, which he had been suffering since 13 years following RTA for which he was treated elsewhere. He was managing with this FFD since then and again he sustained RTA and cut wound was through knee up to posterior neurovascular structures damaging all ligaments around knee (Fig 5).

**PROCEDURE:** Surgical approach depended on previous scars and underlying pathology. Osseous bed was prepared by removing residual cartilage from bone ends to expose vascular bone for better apposition. While preserving the bone stock the deformity was corrected, keeping valgus 5°, flexion 5° and the bone ends are placed in stable apposition. As most fixators are weak in sagittal plane that is AP bending, an additional Schanz pin is placed on the ventral side of the frame, routinely after the bone preparation, 3-ring Ilizarov fixator is fixed with transfixation wire tensioned with dynamic tensionometer with a femoral arch is fixed with Schanz pins. Threaded rods are connected to rings for compression across the fusion site. Compression is done at a rate of 1 mm per week. In two of our patients, we used only two rings with one or two additional transfixation wires attached to rings with extension on either side of fusion area. And we mobilised them early as with two rings it was stable at fusion site. No bone grafting was required in our cases. One of our cases had 5 cm shortening due to post-traumatic bone loss; he managed with a shoe rise.

**RESULTS:** We operated for knee arthrodesis in few patients since 1999 to 2015 and we are presenting 11 cases here, which were available for followup during this period. In our study group, all were males presented to us following previous treatment here or elsewhere. Average followup time was 43.6 months. All patients had good soft tissue recovery with good granulations and discharging sinuses healed well except in one where there were acute flares on chronic osteomyelitis at initial presentation before Ilizarov had discharging sinuses. 10 cases had solid fusion at an average followup of 5.6 months (5 month to 8 months). In one patient though fusion was successful, the discharging sinuses persisted in view of pre-existing longstanding osteomyelitis. One patient got his fixator removed prematurely at 2 months and used posterior support for another month and later ended up in non-union.

In the patient who had fixed flexion deformity with discharging sinuses over distal thigh and proximal leg with no possible range beyond this deformity of 70° which he had been suffering since 13 years following RTA for which he was treated elsewhere. We performed thorough debridement, prepared the bone ends and applied four-ring Ilizarov and skin grafting for the wound on leg. We mobilised him full weight-bearing after 4 weeks and we could achieve union in 28 weeks (Fig 6-10). All patients were on ambulation after frame application with walker on initial non-weight-bearing followed by full weight-bearing after 4 to 6 weeks.

All patients were given protective braces or plaster slab after removal of fixator. Results were evaluated based on activities of daily living, clinical and radiological union.

**Case No. 1:**

![Fig. 1: Pre-op](image1)

![Fig. 2: Post-op](image2)

![Fig. 3: Post-op Well United](image3)
Case No. 2:

Fig. 4: Post-Op Full Weight-Bearing

Fig. 5: Pre-op

Fig. 6: Peri-operative Picture with Ilizarov Fixator on

Fig. 7: Pre-operative X-ray Lateral View

Fig. 8: Pre-operative X-ray AP View

Fig. 9: Post-operative X-ray (Sound Fusion) before removal of Fixator AP and Lateral View
DISCUSSION: Arthrodesis of knee remains one of the last treatment choices for deformed knee, infected, tuberculosis where regaining movement is not possible. It is to provide stable pain-free weight-bearing joint. Many studies have shown that large joint arthrodesis functions well without much disability. The fusion is not easily achieved by previously described techniques. This described surgical procedures are intramedullary nailing, fixation with long plates and uniplanar/biplanar, or circular external fixators. Manzotti et al reported 6 patients treated between 1992 and 1998 average age 56.6 years and the mean number of previous surgical procedures was seven. Average followup was 34 months; all had obtained fusion after mean fixation time of 6.8 months.

The authors have recommended arthrodesis for patients with extensive bone loss, significant limb shortening or axial deformity or both. Xin Tang, Jin Zhu, reported knee arthrodesis in 26 patients with end-stage tuberculosis using uniplanar fixator with crossed cannulated screws. Mean time of radiographic bone union was 5.6 months. H. J. Oostenbroek, P. M. van Roermund From the University Medical Centre, The Netherlands presented their work on Arthrodesis of the knee after an infected arthroplasty using the Ilizarov method. They treated 15 patients by arthrodesis of the knee after removal of an infected total knee arthroplasty, using an Ilizarov ring fixator. Eight had a failed arthrodesis by another technique. The mean age of the patients was 75 years, the mean duration of retention of the frame was 28 weeks, the mean treatment time 51 weeks, and the mean followup 52 months. All but one knee fused at the first attempt, a rate of union of 93%. The incidence of complications related to treatment was 80%.

The length of treatment and rates of complication were attributed to advanced age and the adverse local clinical factors in these patients. The Ilizarov method is a promising technique for achieving arthrodesis under these circumstances. Cierney. Since the amount of available cancellous bone is important for the fusion, we classified the loss of bone as described by H. J. Oostenbroek, P. M. van Roermund, at the time of operation as follows:

1. Mild. Full bony contact is possible with congruous and almost continuous cancellous surfaces.
2. Moderate. There is incomplete bony contact with loss of cancellous bone after the removal of the tibial or femoral components, or a long-standing pseudoarthrosis following a failed arthrodesis.
3. Severe. There is minimal bony contact and two cone-shaped shells of cortical bone without cancellous contact.

In their experience, using the Ilizarov technique in 15 patients gave a rate of union of the knee arthrodesis of 93%. This is of particular significance since eight patients (53%) had undergone earlier attempts at arthrodesis in other hospitals; most had long-standing osteomyelitis, and were elderly. The rate of complications related to treatment was 80%. Other techniques showed rates of 25% to 75%. Although the rate of complications was high, the rate of union was also high. Many complications in their study were related to poor quality and quantity of available bone. In the patient with nonunion, abundant allografting had been performed in an attempt to achieve arthrodesis elsewhere. Allograft was not removed when the fixator applied. No graft was used in any other patient. The mean total duration of treatment with this technique was 51 weeks. M. Spina, G. Gualdrini. et al in their series of 58 septic knee prostheses treated between 1990 to 2007, 17 (29.3%) underwent femorotibial fusion with the Ilizarov circular external fixator.

The rate of complete healing was 76.5% at the first surgical attempt in a meantime of 9.3 months. Failure was in four patients (23.5% of the entire group); two of these patients had bad general health conditions; one patient died a few months after removal of the external fixator; another did not heal despite a second attempt at fusion with an Ilizarov external fixator. The other two patients were affected by an anxious-depressive syndrome that contributed to severe intolerance to the external fixator, so its early removal was inevitable. This event accounted for 50% of the failures, so they believed in the importance of carefully assessing the patient’s ability to cooperate before treatment.

We treated 11 patients by arthrodesis of the knee by using an Ilizarov ring fixator. Nine patients were post-traumatic and two were post infective. The mean age of the patients was 51.7 years, the mean duration of retention of the frame was 22 weeks, the mean treatment time 38 weeks, and the mean followup 43.6 months. All knees fused at the first attempt, a rate of union of 91% except one who got his fixator removed due to intolerance. Nine patients had no complications, one had limb shortening of 5 cm due to post-traumatic bone loss. Basing on Paley. D description, our complications were classified as problems, obstacles and complications. Problem is defined as difficulties that require no operative intervention to resolve, while obstacles are defined as difficulties that require an operative intervention. All difficulties that are not resolved before the end of treatment were considered as true complications.
CONCLUSION: The Ilizarov circular frame is a very reliable fixation system which helps in micromotion for achieving arthrodesis. And we have control to correct deformity and further compression across the fusion site after application of frame in the followup period due to the versatility, stability on axial loading and low risk of infection.

REFERENCES