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ROLE OF LIMB RECONSTRUCTION SYSTEM IN INFECTIVE NON-UNION OF FEMUR AND TIBIA

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ABSTRACT

Background: Traditional treatments for infected non-union of the tibia and femur—such as external fixation, drainage, sequestrectomies, and large bone grafts—often fail due to issues like limited graft availability, poor vascularity, persistent infection, and significant bone defects. This study explores the effectiveness of the Limb Reconstruction System (LRS), a single-bar device with telescoping capabilities for dynamic fixation, in managing these challenging cases. **Materials And Methods:** In this study, 20 cases of infective non-union of the femur and tibia were treated with the Limb Reconstruction System (LRS) external fixator. The management involved compression, distraction osteogenesis, fibulectomy, sequestrectomy, and removal of existing implants. Corticotomy was also performed. The fixator was used until radiological evidence of solid union was achieved. **Results:** By the end of the present study and after follow-up of average 5.6 months, we obtained excellent results in 70% of patients, good results in 20% and poor results in 10% of patients. **Conclusion:** The LRS external fixator creates optimal biomechanical conditions throughout the healing process, effectively managing infective non-union with bone defects up to 8 cm. Its uniplanar design also facilitates access for secondary plastic procedures.

INTRODUCTION

Sir Girdlestone's observation highlights a key issue in modern fracture management. While the emphasis has shifted towards precise surgical techniques and internal fixation to achieve optimal bone alignment, this has sometimes come at the expense of adequate soft tissue care. This shift, alongside the increase in road traffic accidents—resulting in complex compound fractures—has led to a rise in non-union cases where fractures fail to heal properly. Complicated scenarios such as bone loss, deformities, infections, and limb length discrepancies further exacerbate treatment challenges.[1]

Traditional methods for managing such complex fractures, particularly those involving infection and non-union, have included external fixation, drainage, sequestrectomies, and extensive bone grafting. These approaches often face limitations like insufficient graft material, poor vascularity, and persistent infections, which frequently lead to unsatisfactory outcomes and potential amputation.

A significant advancement came in 1979 with De Bastiani et al.'s introduction of a new external fixation system—the Limb Reconstruction System (LRS). This system, reported in 1984, features a single-bar design with telescoping capabilities that allow for both rigid and dynamic fixation.[2] This dynamic fixation facilitates increased axial movement at the fracture site, promoting callus formation and potentially improving healing outcomes. The LRS is simpler to apply than traditional ring fixators and is generally better tolerated by patients.[3]

The LRS enables effective treatment of non-union and deformities by providing adjustable stability and supporting significant limb lengthening (up to 15 cm) without requiring device replacement. It is also valuable in correcting deformities, managing comminuted fractures with bone loss, and addressing infected non-unions. The system's design allows for flexible clamp positioning and precise adjustment, addressing the complexities of fracture management more effectively than conventional methods.[4]

Objectives

- To evaluate clinical outcome in terms of pain, union and eradication of infection.
- To evaluate radiologically in terms of union.
- To evaluate complications in terms of difficulty in placing pins, secondary infection and implant failure.

MATERIALS AND METHODS

The study titled "Role of Limb Reconstruction System in Management of Infective Non-Union of Femur and Tibia" was conducted at Silchar Medical College & Hospital, Assam, from June 1, 2011, to May 31, 2012. It involved 20 patients diagnosed with infective non-union of the femur and tibia, managed using the LRS external fixator and primarily employing compression and distraction osteogenesis methods.

Inclusion Criteria:

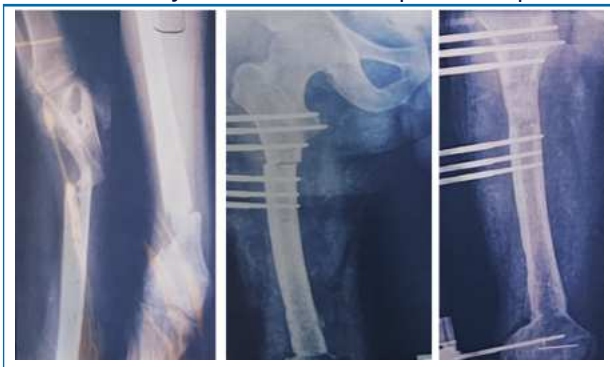
- Diagnosis of infective non-union of femur or tibia.
- Adequate neurological and vascular limb status.
- Functional contralateral limb.
- Ability to meet medical standards for surgery.
- Patient consent for surgery.

Exclusion Criteria:

- Lack of patient consent.
- Medical contraindications for surgery.
- Inability to participate in post-operative rehabilitation.

Each patient underwent a comprehensive assessment, including clinical, systemic, and local examinations, with a focus on infection types. Routine tests and bacteriological studies were conducted, and appropriate antibiotics were administered. Pre-operative radiographs and orthoscanograms were used to evaluate the extent of non-union, infection, and bone quality.

Pre-operative planning included fixation techniques, pin placement, and deformity correction. The study incorporated various procedures such as fibulectomy, sequestrectomy, implant removal, and corticotomy. Bone defects were addressed with bone transport for defects greater than 3 cm in tibia and 5 cm in femur. Post-operatively, intravenous antibiotics were administered, and wound coverage was provided via flaps or skin grafts. Functional cast bracing and physiotherapy were implemented until radiological union was achieved.



Case-1 : A: Pre op x-ray of Infected non- union distal femur. B: Debridement with LRS application with acute docking. C: Union achieved after 12 months.

Case- 2: A: Pre op x-ray of Infected Non-union Distal Femur. B: Debridement with LRS application. C: Distraction with callus formation D: Union achieved at the end of 8 months.

Clinical photos of post- op patients with LRS application

RESULTS AND OBSERVATIONS

During the study from June 1, 2011, to May 31, 2012, 20 cases of femur and tibia non-unions were treated using the Limb Reconstruction System (LRS) external fixator. Key findings are summarized below:

1. **Age Distribution:** Patients ranged from 7 to 70 years, with an average age of 30.1 years. Non-unions were most common in the second (25%), third (15%), and fourth (30%) decades of life, likely due to higher rates of high-velocity trauma, such as road traffic accidents, in these age groups.
2. **Gender Distribution:** There was a predominance of males, attributed to their higher exposure to outdoor activities and accidents.
3. **Bone Involvement:** The femur was more frequently affected (60%) compared to the tibia (40%).
4. **Type of Infected Non-Union:** Quiescent (45%) and draining (45%) types were the most common, with the active type being less frequent (10%).
5. **Bone Defect:** Defects ranged from 3 cm to 8 cm, with an average defect of 5.8 cm.
6. **Mode of LRS Application:** For defects smaller than 5 cm in the femur and 3 cm in the tibia, acute docking followed by bone lengthening was used. For larger defects, bone transport was employed. Bone transport was used in 60% of cases, while 40% received acute docking followed by bone lengthening.
7. **Duration of Treatment:** The treatment consisted of a transport phase (2 to 3 months, average 2.43 months) and a consolidation phase (5.5 to 9 months, average 7.8 months). Total treatment duration ranged from 8 to 12 months, with an average of 10.23 months. The transport phase was approximately 1:3.2 times shorter than the consolidation phase.
8. **Follow-Up:** Follow-up ranged from 2 to 7 months, with an average of 4.45 months.
9. **Complications:** Common complications included joint stiffness (65%), pin tract infections (60%), limb swelling (15%), angulation/displacement (20%), discharging sinus (10%), and non-union at the docking site (5%).
10. **Results:** At the end of the study, with an average follow-up of 5.6 months, 70% of patients achieved excellent results, 20% good results, and 10% poor results.

DISCUSSION

In a study of 20 cases of infective non-union of the femur and tibia managed with a Limb Reconstruction System (LRS) external fixator, researchers evaluated its efficacy in promoting union and reducing treatment duration. Over 12 months, with an average follow-up of 4.45 months, the study aimed to assess the LRS fixator compared to other methods, including the Ilizarov fixator, which is more cumbersome and prone to complications.

The LRS fixator, a simpler, unilateral device, effectively managed non-union in 80% of cases, with the remaining 20% facing challenges due to persistent infection or non-union.[5] The average fixator application lasted 10.23 months, including transport and consolidation phases. Infection control was achieved in 90% of cases, and limb length discrepancy was corrected in 90% of patients. Angular deviations were corrected in all but two cases. Common complications included pin tract infections (60%) and joint stiffness (65%), with the latter improving with physiotherapy.[6] Overall, the results showed 70% excellent, 20% good, and 10% poor outcomes. The study highlights the LRS fixator's advantages in simplicity and patient comfort while managing infective non-union effectively.

CONCLUSION

Meticulous pre-operative planning is the back bone of management of Infective non-union. Limb reconstruction system being the simplest and best available dynamized external fixator, which is an answer to most of the complications associated with infective non-union.[7]

LRS external fixator by its principle helps create the most favourable biomechanical conditions at every stage of the healing cycle, using minimally invasive techniques, which acknowledge and respect the already damaged soft tissues.[9]

It can be used in the management of Infective non-union with a bone defect up to 8 cm. Being a uniplanar external fixator, it allows easy accessibility for secondary plastic procedures.[11]

LRS external fixator is more patient friendly and simple in giving compression distraction across the fracture site, than a complicated Ilizarov external fixator.

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