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Original Research Article

Efficacy of Monolateral External Fixator in the Complicated Traumatic Lower Extremity through Limb Reconstruction System with Evaluating The Result in Respect to Time for Union, Knee Range of Motion and Shortening

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Abstract:

Background: High-impact accident, often resulting from such as car crashes, motorcycle, and falls from heights, is a significant cause of fatalities among the younger population worldwide. The implications of losing a young and active member of the population due to such traumatic incidents are indeed profound and multifaceted, affecting individuals, families, communities, and the nation as a whole. The LRS (limb reconstruction system) consists of an assembly of clamps usually two or three which can slide on a rigid rail & can be connected by compression distraction units. The LRS may be used to achieve 15 cm or more of lengthening without the need to change the device for a longer one. The goal of these treatments is to promote optimal healing, restore function, and minimize the risk of complications such as decrease range of motion, malunion, nonunion and shortening.

Aim: Evaluating the efficacy of Monolateral external fixator for the management of lower extremity with respect to time for union, Knee range of motion and shortening.

Methods: Prospective study of 26 cases of lower extremity trauma managed by LRS over a period of 6 months. Mean age group of the patient is 37 years i.e. 26.92%. Dominancy of Male and common mode of injury is Road Traffic Accidents. Patients had already received surgical interventions for their lower extremity trauma but required further treatment using the LRS due to the complexity of their injuries. All the patient got treatment in the hospital and the surgery were done in the period of June 2005-June 2007. The combination of pulsed lavage, debridement, and fracture fixation helps create a suitable environment for subsequent interventions, like using the LRS for limb reconstruction in cases where multiple surgeries were necessary due to the complexity of the injuries. Combination of radiography, clinical evaluations, and standardized scoring systems like the ASAMI score provides a comprehensive picture of the treatment outcomes.

Results: Union was achieved in n=9(73%) patient, out of 26 patient and n=22(68%) patients have good range of motion with no limb length discrepancy, has been found associated with difference of Postoperative 1-4cm after Preoperative 3-15 cm shortening. Average time for frame removal 28 weeks then patient nailing done. It reduced the financial burden 40% compared to multi staged surgery make the patient stay average 7 days in the hospital.

Conclusion: LRS External fixator is simple, rigid and safe device in trauma management with excellent result respect to time for Union, Knee Range of Motion and Shortening. Research findings, which indicate that the LRS can be an effective tool for treating lower extremity trauma, promoting bone healing, maintaining joint function, and achieving positive patient outcomes.

Keywords: LRS, ROM, ASAMI Score, Union, Trauma, Nailing.

Introduction

Efforts to reduce fatalities among younger individuals due to high-velocity trauma. Advances in trauma surgery techniques, wound management, and the use of external fixators like the Limb Reconstruction System (LRS) can contribute to improved outcomes for patients with open fractures of the leg. Techniques like the Limb Reconstruction System (LRS) and advancements in

wound care have the potential to mitigate these challenges and improve outcomes for patients with tibial injuries. Standardizing the use of external fixation for severe open fractures was a significant advancement in trauma surgery during the 1980s. This approach has proven effective in managing these challenging cases and has contributed to improved outcomes for patients by reducing the risk of infection, improving soft tissue healing, and allowing for better overall fracture management. While external fixation remains a valuable option, advancements in surgical techniques and technologies have continued to evolve, providing surgeons with a range of tools to address complex open fractures and severe soft tissue injuries. The LRS consist of an assembly of clamps connected by compression and distraction units [1,2,3,4,5,6,7].

LRS may be used to achieve 15 cm or lengthening without the need to change the device for a longer one [1,8-9]. The versatility of the LRS system, particularly its ability to adjust the position of clamps and screws along the length of the bone, makes it a valuable tool in achieving maximum stability and promoting successful outcomes in challenging situations.

Aims and Objectives: Efficacy of monolateral fixator in complicated traumatic lower limb injury through LRS support while evaluating the objective are as follows:

1. To analyze the results with respect to time for union.
2. To get the measure of the Knee range of motion.
3. To evaluate the Shortening.

Material and Methods: With Limb Reconstructive surgery, 26 patients were treated. Multiple types of cases were included in the study are Non-union femur and tibia, septic arthritis knee, Fresh trauma of both femur and tibia with severe soft tissue injuries and aseptic Non-union fractures of femur and tibia with some cases were of gap Non-union and shortening. Patient was lying in the age group of 13-67 years within the predominancy of male injured from road accidents. Before the LRS application, many Patients were exposed to number of surgeries. All the patient were treated in the hospital and the surgeries were done in the period of two years from June 2005- 2007.All the cases were properly documented pre and post operatively and at fixed regular interval. The fracture was classified according to the grades Gustilo Anderson classification and comminution as per Winquist-Hansen Classification. Preoperatively, emergency stabilization without bone fragments were covered sterile dressing. The patient was taken to the Pulse lavage and debridement of the wound. Flap cover required in some cases. Unilateral uniaxial frame used as a configuration of the external fixator. Anterior-Posterior and lateral radiographs were taken of femur. Comparative X ray incorporated with Radio opaque scale enables selection of correct lengthening rail and allows for planning of screw positions. For the deformity an X ray has been taken. According to the preference and requirement of the cases, on the decision of Anesthesiologist, anesthesia given to the patient. Third generation cephalosporin was given I.V

Operative Technique: On the opposite side of the patient to the surgeon, a radiolucent table is used and the Image Intensifier placed at right angles to the table on the opposite side. For making the external rotated position to neutral, a sandbag is placed under the lower-back and buttock. Handling the limb with care for unstable segment. From toes to abdomen, whole skin prepared. To isolate the perineum disposable U drape used. The leg moves freely, as the U drape applied. Important landmarks are identified by image intensifier. Each mark is made perpendicular to the axis of the bone so that a line drawn at right angles defines the axis of the bone and will be parallel to the final position of the fixator. Other landmarks to be avoided, as the position of the defect should also be marked together. Cortical screws should be used in the diaphysis and cancellous screws only in wide metaphyseal or epiphyseal sites [14]. This screw should be inserted with the aid of the template to ensure that the rail will be parallel to the long axis ofthe bone.

The appropriate length screw guide is now selected and inserted into the incision using the trocar to locate the mid-point of the bone. It is then locked into the fourth seat of the proximal clamp (counting from the site of the proposed osteotomy), with the locking screws of the Template clamps loosened so that they can all move freely on the rail. With an assistant holding the rail in the correct position, parallel to the long axis of the bone, the surgeon ensures that the screw guide is in a plane 15° anterior to the coronal plane. Since the natural position of the leg in bed is in slight external rotation, positioning of the screws antero-laterally will avoid undue pressure being exerted upon them. At this point the proximal clamp template is locked to therail. The proximal clamp cover is now tightened. Using gentle pressure to keep the screw guide in contact with the cortex, the trocar is withdrawn, and the screw guide tapped lightly with a hammer to engage its teeth in the cortex. The correct length 4.8 mm drill guide is now inserted into the screw guide and, using a 4.8 mm drill bit, the first and second cortices are drille danda cortical screw of appropriate dimensions inserted usinga T-wrench. A slight increase in resistance is normally felt asthescrew penetrates the second

cortex. At this point, a further 5 or 6 half turns are required to ensure that about 2mm of the screw thread will project beyond these cortex. This should be verified using the Image Intensifier. The next screw to be placed will be the most distal one. The position of this distal screw is critical since, if it is incorrectly sited, the screws in the middle clamp (which will be used to transport the bone segment) may miss the bone [14].The surgeon now chooses a position for the middle clamp. It is important to ensure that the middle clamp is not placed so close to the advancing end of the middle segment that it would against the distal clamp before the bone ends have docked.

Skin incisions are made and a second trocar and a screw guide used to check that screws sited in the outer seats of the middle clamp will penetrate the center of the bone. If the middle clamp is too low or too high on this test, its position can normally be corrected by asking the assistant to move the distal end of the rail either anteriorly or posteriorly until a more satisfactory position is identified. LRS applied, the assistant steadies the leg while the clamp template screws are loosened, so that the rail and clamp templates can be removed together with the screw guides. The clamp templates are exchanged three straight clamps. The assembly is new reapplied with the locking screws and the clamp cover screws loosened. When applying it, adequate distance should be left between the skin and the rail [16]. The site of the osteotomy is approximately 1.5 cm below the distal screw of the proximal clamp.

The bone is exposed via an anterior incision dividing the deep fascia. The periosteum must be incised longitudinally and carefully detached from the cortex. Bone levers are placed on either side of the bone to hold the muscle and periosteum away from the bone surface. Using a 2mm and its corresponding drill, holes are drilled from the anterior face of the bone and from medial and lateral surfaces as far as possible penetrating the far cortex each time. The drill stop used to prevent travel into the soft tissue beyond the second cortex.

The holes are now connected with an osteotome, taking particular care to divide the Postero-medial and Postero-lateral columns. When enough of the cortex has been divided in this way, the osteotomy will glide apart under the tension previously applied. Completeness of the osteotomy should be confirmed by the demonstration of a gap using the Image Intensifier and the obvious lack of resistance when the segments are distracted by turning the compression-distraction unit screw counter clockwise. If the osteotomy does not open as expected, this indicates that a bony bridge still exists, most probably in the posterior cortex. In these circumstances the osteotome or drill should be used to complete the osteotomy. The two segments are now brought together again under slight compression and the middle clamp is now locked. The periosteum is laid back, sutured if possible, and the incision closed with single suction drain. The osteotomy completed, the hip is flexed to 70° and the knee to 90° to check for skin and/or soft tissue tethering around the screws, which will need to be released [14, 16]. Special attention should be paid to the fascia lata which should be divided longitudinally in association with each of the screws in the middle and distal clamps. Assuming good pre-operative function, the knee should flex passively to 90° without tethering at the conclusion of this procedure. Bulky dressings are now placed around each screw to prevent shuttling of the soft tissues around the screws. The suction drain is left clamped and removed at 48 hours. It should only be released within this period if hematoma develops.

Postoperatively systemically antibiotic given for 5 days and dressing done regularly. During this period treated with elevated limb, analgesics, Inj. Cefuroxime 1BD, with injection Gentamycin 80 mg iv Bd with Inj. Metronidazole 100cc iv. TDS for 14 days. Physiotherapy has been started for avoiding the complications i.e. joint contracture and muscle atrophy. Patient follows up at regular interval up to 6 months. In patient whose bone are exposed, with the improving wound planned for the flap rotation. Distraction of the osteotomy was started after a week of the osteotomy at the rate of one fourth turn 4 times a day resulting in a total bone transport of 1 mm/day or 7 mm/week. This bone transport was continued till the fracture end approximated. And when the bone ends approximated, the distraction was stopped and dynamization of the LRS system done, followed by weight bearing mobilization by the patient as his/her tolerance.

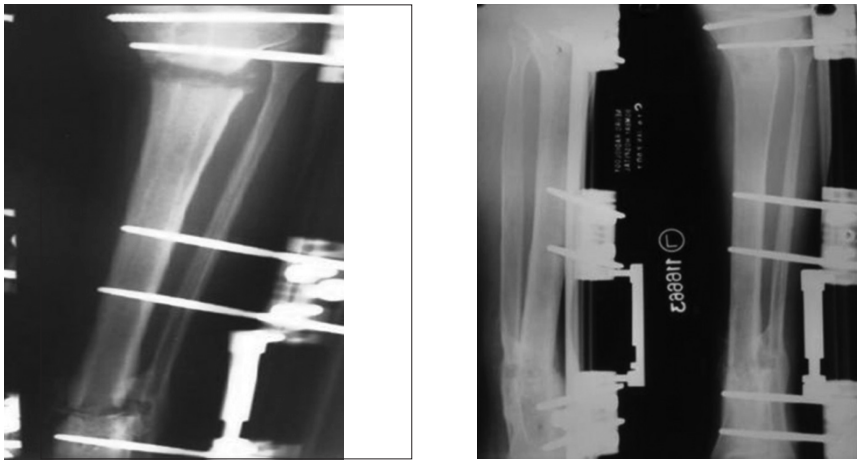

Figure 1: Immediate Post of X ray 8 month follow up

The dynamized LRS system was left in situ for further 15–20 weeks for consolidation of the regenerate and fracture union to occur. In some patients, rate of distraction were altered during the distraction phase depending on the patient compliance and the type of regenerate. Patients were encouraged to attain knee and ankle ROM after the application of LRS, depending on the patient pain tolerance. Assessment of quality of regenerate was done by plain radiography at monthly intervals. Since the LRS remained clamps (usually two or three) which can slide on a rigid rail and can be connected by compression-distraction units to achieve bone transport.

Observation and Results:

26 patients of lower extremity complicated trauma were managed by LRS in closed and open fracture. Mean age group of the patient is 37 years. Mostly are male have a predominancy of Road traffic accident is 61.53%.

Range of motion tested at the time of union gave 68% have good range of motion. Only for 2 patient nailing done after removal of frame. Average time frame is 28 weeks. Among 17 out of 26 patients preoperative shortening was ranging from 3-15 am and postoperatively from 1-4 cm. Limb length discrepancy was nearly equalized in most of the cases.in one patient with 4 cm shortening distraction is still continuing and 1 patient recently frame removed with 15 cm short.

Discussion:

Associated injuries were observed in 57.69% of our patients. This reflect the high velocity nature of trauma. In our study bone was assessed for union, infection, limb length discrepancy and mechanical insufficiencies at the docking site. The result considered excellent when there is union, no infection, deformity of less than 7 degree and limb discrepancy of less than 2.5 cm in femur, tibia and fibula. The result was considered good when there was union and one of the other criteria. Poor there was non-union or refracture or none of the other criteria. Limb reconstruction system fixator gave us excellent result or good result in 92 cases. Average time for frame removal is 28 weeks. A single case had a poor result due to persistent deep infection, 10 cases had pin site infection severe to require antibiotic treatment. One patient had infection severe enough to require pin removal.

Amongst 26 cases 4 knee arthrodesis done with various indications, single case done for infected TKR [11,12,13,14]. All patients had shortening of the affected limb following limb arthrodesis. The LLD has ranged from 2.56-4 cm. 22 cases from 26 were assessed for knee range of motion.68% having good range of motion with greater than 110.Mohr et al reported 80% full rom. Average flexion is 130 degree. Fazal Ali and M. Saleh reported 80degree average ROM [15,16,17].

Conclusion:

The speed with which an LRS fixator can be applied under the circumstances has a major impact rates in polytrauma. LRS proved effective in lower extremity fracture with bone loss or complicated trauma or in the case of modality of treatment for achieving union, Knee range of motion and avoid LLD. Its saves time and Cost effective.

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