

## CHEAP, SAFE YET EFFECTIVE MANAGEMENT OF DELAYED UNION OF TIBIA IN A LIMITED RESOURCE SET UP

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### ABSTRACT

#### BACKGROUND

Traumatic bone injuries are ever on the increase following a steep rise in road traffic accidents and other high velocity injuries. The number of primary surgeries and repeat surgeries as well are also hence on a steady increase. The limited infrastructure facilities, patient overload, and economic constraints of the patients' as well as the institutes', are problems that are encountered.

#### MATERIALS AND METHODS

The study was conducted in Government Medical College, Kottayam, Kerala. Study group included both males and females, mainly males. The age group of patients varied from 20 years to 64 years. The period of study was from June 2013 to January 2018. There were 48 patients: 40 were males and 8 were females. The cases included closed fractures in 30 and open fractures in 18. The fracture pattern included simple as well as mildly comminuted with two patients having butterfly fragment.

#### RESULTS

Of the 48 patients in this study group during June 2013 to January 2018 study period, all ended up in solid union at the end of the treatment period. Two patients with butterfly fragment along with comminution were given bone marrow injection at the site of butterfly fragment gap at the first follow up to enhance union and finally united at the end of third follow up i.e., at the end of 4 ½ months after the intervention. The time period for symptom free union from the onset of this interventional treatment varied from 6 weeks to 4½ months.

#### CONCLUSION

Delayed union occurring in fracture tibia which has been treated initially by ILN can be managed by a minimally invasive way in a group of patients by a relatively minor surgery as well as combining the advantages of functional cast bracing to permit early return to pre-morbid activities.

#### KEYWORDS

Delayed Union, Nonunion, Dynamization, Interlocking, Nailing, PTB Brace, Fibular Osteotomy, Exchange Nailing, Bone Grafting.

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#### BACKGROUND

Traumatic bone injuries are ever on the increase following a steep rise in road traffic accidents and other high velocity injuries. The number of primary surgeries and repeat surgeries as well are also hence on a steady increase. The limited infrastructure facilities, patient overload, and economic constraints of the patients' as well as the institutes' are problems that are encountered.

Delayed union of tibia<sup>1</sup> going into a stage of nonunion is a regular observation due to inadequate attention and delay in warranted repeated surgery, along with several other factors leading to prolonged morbidity. Patients suffer, the morbidity adding to the loss of work, delay in returning to work affecting the family and dependants in various ways apart from the main economic loss. Loss of quality of life

need not be mentioned separately. So, an effective, safe, cheaper treatment alternative for managing at least a portion of these patients will be a boon to these hapless patients. Not only that, a portion of patients are benefitted but also the administration also gets relaxation since a portion of patient crowd is effectively managed this way. It is in this background that a modifying cheap, safe but effective treatment method for the management of delayed union<sup>1</sup> including those going into a stage of nonunion was attempted. Results were excellent. Therefore, I am sharing this experience to help a group of patients in the limited resource, secondary or tertiary government hospital set up. This modality of treatment helps in reducing morbidity, reducing economic burden, re-establishing social/family realignment, early return to studies/recreation even while taking treatment. This treatment protocol eliminates a major repeat surgery, partly eliminates procedures like bone grafting, blood transfusion, and requirement of general/spinal anaesthesia, major operation theatre set up and prolonged hospital stay. This also partly reduces the chance of spread of hepatitis B virus hepatitis C virus and HIV infections. Above all, this facilitates early return to study, occupation/recreation even before the complete period of treatment.

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In a portion of orthopaedic trauma patients, the prime injury is an open or closed fracture of tibia with or without fracture of fibula. Primary interlocking nailing with or without debridement depending on open or closed nature of the fracture is a standard treatment which has stood the test of time and continues to be so even now.<sup>2</sup> This present treatment of interlocking nailing does not give complete answer to the problem due to some inherent defects in patient management system. A section of these patients discharged from government and occasionally private tertiary level hospitals have one of the following events on follow up:

1. They can go in for uneventful union in a time period varying from 2 months to 18 months. There were occasions when repeat surgery including exchange nailing and bone grafting were done in patients as late as 2 years after the first surgery, where neither nail dynamization<sup>1,3</sup> nor fibular osteotomy were done after the initial surgery and a well demarcated gap persisted at the original fracture site.
2. Some people are lost to follow up in the initial post discharge period due to lack of awareness, lack of symptoms, monetary matters and a multitude of other reasons. So, a supervised quality followup does not occur in these groups.
3. Certain others do come up for follow up initially, but due to lack of experience of the treating surgeon, do not get timely intervention like dynamization,<sup>4,5</sup> osteotomy of the intact fibula, osteotomy of the fibula which has united earlier than fractured tibia, erroneous assessment of the status of the fracture as well as difficult judgment regarding when or whether to interfere and also the decision as to the requirement of any of the bone grafting procedures.

So, the number of repeat major surgeries like exchange nailing,<sup>1,9</sup> exchange nailing with bone grafting, repeat surgery with nail removal and plating, nail removal and plating with bone grafting are ever on the increase, proportionate to the increasing number of traumas.

It is in this situation that fracture tibia with delayed union as well as delayed union going to a stage of nonunion are managed by a less invasive, less expensive, cheap and safe but effective treatment method is discussed.

The group of patients included tibial fracture patients with or without fibular fracture, which were primarily treated by closed or open interlocking nailing and were erratically followed up. They went in for delayed union and to a stage of nonunion in certain cases due to static mode of locking preventing approximation of fragments.<sup>6</sup> These patients underwent dynamization which happened to be late due to late presentation to the surgeon who conducted the study.<sup>4</sup> Along with dynamization, fibular osteotomy was also done. After the above procedures of dynamization,<sup>4</sup> and fibular osteotomy early post-operative mobilization with PTB brace<sup>3</sup> was enforced once the sutures are removed. Intensive phase of compulsive walking with the brace applied to the fractured leg was programmed. Patients were insisted to

follow up once in six weeks or earlier SOS with radiographic assessment during follow up. Further follow up was suggested depending on the findings on the first follow up.

## MATERIALS AND METHODS

The study was conducted in Government Medical College, Kottayam, Kerala. Study group included both males and females, mainly males. The age group of patients varied from 20 years to 64 years. The period of study was from June 2013 to January 2018. There were 48 patients: 40 were males and 8 were females. The cases included closed fractures in 30 and open fractures in 18. The fracture pattern included simple as well as mildly comminuted with two patients having butterfly fragment. Patients were discharged from hospital wards in some cases after 5 days where they preferred immediate follow up in their nearby hometown hospital. In others where it was decided to retain until suture removal discharge was done after 10 days. Since the unit wise division pattern of functioning of the orthopaedic and other specialty departments existed in the institution, the advice at discharge was either dictated by the doctor in charge of the unit or by resident doctors entrusted by him. So, the study investigating and conducting surgeon had limitations at this point of time regarding discharge advice to ensure proper scientific follow up. There often existed lack of similarity in the follow up advice like when to follow up, frequency of follow up, and what modification in the treatment to be made during follow up etc. Since this pattern of functioning existed, the follow up of patients was random, in the sense that the patients were seen by different doctors including residents at each follow up lacking uniformity in the observation or follow up advice. Moreover, interpretation, follow up protocol and frequency of advised follow up varied from consultant to consultant based on their personal experience and opinion. There is even lack of consensus regarding when to dynamize or whether to dynamize the ILN fixation that has been done. The hefty workload in the wards and OPD made situations still worse and obscure. The end result was the lack of uniformity in the treatment protocol so that some patients ended up with delayed union or even a transition phase to nonunion, period-wise, radiologically and clinically. Some of those patients, who expressed more faith in the study conducted surgeon, approached him at periods ranging from four months to eight months or over for further follow up where some showed very scanty callus or no callus at all with radiological gap and dynamization of ILN not done so far. A portion of these patients had intact fibula while another group had the fibula united ahead of tibia making tibial approximation difficult. All the available treatment records of the patients were sequentially verified and studied along with the assessment of radiographs. The radiological gap persists even upto 1.5 cm, and the situation was discussed with the patients and relatives. They were informed of the presenting situation, the delay that occurred in the intervention, the procedure that could have been considered if the follow up was methodical and structured and any one particular surgeon oriented. The plan for fibular osteotomy

in intact and early united fibula along with dynamization.<sup>4</sup> of the ILN was explained to the patient with limitations in expectation for complete success of the procedure. Those who desired to go in directly for an open repeat procedure were given the option to discuss the same with the surgeon in charge of the inpatient care. Those who were willing to undergo the procedure under local anaesthesia with or without IV sedation were selected. They were further informed of the use of a PTB brace.<sup>3</sup> to be used along after the suture removal, to facilitate early weight bearing after surgery. They were educated about the scientific advantage of a "functional cast bracing."<sup>3</sup> like situation apart from the added advantage of early return to occupation/recreation or academic activity based on the patient's status in this respect. All the pre-operative standard protocols for a surgical procedure were performed as in a routine practice. Patient was in supine position with Bolsters' pillow under the knee. The local preparation of the limb was done as in any orthopaedic surgery. Local anaesthetic with adrenaline was infiltrated in the skin and subcutaneous tissue, and the underlying soft tissue up to the bone around the junction of middle third and distal third of fibula where it is more accessible. The local anaesthetic was infiltrated well upto the periosteum. Wherever fibula was intact and where fibula had united before tibia osteotomy was done with resection of 1.5 to 2 cm length of fibula. Hand drill with 2.5 mm drill-bit, bone cutter, nibbler and other minor orthopaedic surgical instruments alone were used. The dynamization.<sup>4</sup> wherever possible distally, and if decided to be proximally based on fracture pattern, as indicated was done. Apart from the pre-operative bolus dose of antibiotic cefotaxime and amikacin, second dose was given after surgery at a time interval of 12 hours. The patients were retained in observation room for about 12 hrs and subsequently discharged with oral antibiotics prescribed along with analgesics for five more days. Patients were advised to review in OPD between 10-14 days for suture removal. The PTB brace measure and mould which was taken prior to surgery was made available by the 14<sup>th</sup> day when the patient turns up for review.<sup>3</sup> Patients were encouraged to start weight bearing from 14<sup>th</sup> day during review using the PTB brace.<sup>3</sup> They were informed about the possibility of some pain at the fracture site as well as possible variable extent swelling of the foot and leg towards the evening hours on the commencement of ambulation. A combination of paracetamol 350 mg and tramadol hydrochloride 50 mg was prescribed to be taken on SOS basis for pain with half tablet in the morning and one tablet in the evening. Those who required returning to work or study were permitted to do so. The PTB brace.<sup>3</sup> was retained as a loose application at night. When patient requested night time removal, elastic bandage of 10 cm breadth was applied from foot starting from the base of the toes, in a firm manner in foot and relatively less firm manner in leg., Patients were advised to keep the leg over to pillows at night to prevent oedema. Patients were asked to ambulate to the maximum possible extent when they remained indoors. Patients were reviewed at the end of six weeks after PTB ambulation and were assessed clinically and

radiologically. Bearable/unbearable nature of pain at the fracture site was enquired into. Majority of the patients experienced some pain and discomfort at fracture site especially towards evening hours, but were very effectively managed by the small dose of analgesics prescribed. None of the patients had discomfort to such an extent as to stop weight bearing and ambulation. Even the first follow up at six weeks showed some swelling/fullness at the fracture site clinically with some warmth also over the area. The radiographs showed soft tissue haziness in the previous clear area, apart from the diminution in the fracture gap. All the patients were showing good clinical as well as radiological features of progressive union of fracture at the end of 12 weeks after the procedure. Four patients who were lost to follow up after the first review, returned later with apologies that they had to go back to work at the other corner of the country and also informed that they were symptom free. But they all continued to wear PTB brace.<sup>3</sup> for periods ranging from 6-9 months as they had fear of nonunion, especially because they were not in a position for follow up. In fact, they decided to come for follow up later only to consider removal of the ILN. The callus which was observed was exuberant and above the bone fracture dimension.

## RESULTS

Of the 48 patients in this study group during June 2013 to January 2018 study period, all ended up in solid union at the end of the treatment period. Two patients with butterfly fragment along with comminution was given bone marrow injection at the site of butterfly fragment gap at the first follow up to enhance union and finally united at the end of third follow up i.e., at the end of 4½ months after the intervention. The time period for symptom free union from the onset of this interventional treatment varied from 6 weeks to 4½ months. Generally, the time for union depends on the patient's age, location of fracture, nutritional status, habits like smoking, and other co-morbidities like diabetes mellitus like vascular insufficiency in the regular healing process of fracture. Since the final outcome of the treatment was successful, complete in all these patients, other factors considering the union do not merit mention in this study. The attempt at this mode of therapeutic intervention was stimulated by the observation of huge number of patients with similar fracture who had to undergo repeat redo procedures with or without modification in the initial surgery type at the end of periods ranging from five months to two years and more.

Fracture Pattern	No. of Patients
Patients without comminution	40
Patients with mild comminution	06
Patients with mild comminution and butterfly fragment	02
<b>Total</b>	<b>48</b>

**Table 1. Fracture Pattern**

Nature of Fracture	No. of Patients
Closed fracture	30
Type I and Type II open fracture	18
<b>Total</b>	<b>48</b>

**Table 2. Fracture Status**

Progress of Union	Period
Six weeks	12
Three months	16
Four months	20
<b>Total</b>	<b>48</b>

**Table 3. Progress of Union**

**Representative Case X-ray in Chronological Sequence**



**Radiograph 1. ILN at 6 Months, Not Dynamized and in a Stage of Delayed Union**



**Radiograph 2. Two Months after Dynamization and Fibular Osteotomy**



**Radiograph 3. Four Months after Dynamization and Fibular Osteotomy**



**Radiograph 4. Six Months after Dynamization and Fibular Osteotomy and Brace Assisted Walking**



**Radiograph 5. Eight Months after Dynamization and Fibular Osteotomy**

**Limitations of the Study**

There were limitations to this study; the reasons for the limitations are a few.

This mode of intervention could consider fractures without much comminution. Type 3 compound fractures which required plastic surgery procedures like local flap, crossed leg flap, or free flap could not be considered. Segmental fracture.<sup>7</sup> is also not very much suitable for this mode of treatment, especially if there is separation of fragments.

## DISCUSSION

Inter locking nailing is a time-tested standard treatment for the management of fractures of tibia which in fact is one of the most common high velocity fractures in orthopaedic practice. At the same time due to certain inadequacies of the hospital system prevailing in some sectors the number of repeat major surgeries are on the increase. This repeat major surgeries also get unduly prolonged due to patient overload, inadequate infrastructure and a lot of other factors. Managing at least a portion of these patients in a cheaper, safer but effective way is a big blessing to these patients at the same time partial relaxation to health care takers. Dynamization of inter locking nail even when presenting late, along with fibular osteotomy and inclusion of cast bracing was seen as a viable alternative in a group of patients with excellent results permitting them to return to their pre-injury activities. In our study the above intervention proved to be effective in patients even 8 months after initial surgery.

## CONCLUSION

Delayed union as well as delayed union going into a stage of nonunion was a regular observation in a good number of tibial fracture patients attending orthopaedics department of different tertiary care hospitals in Kerala. The reason for the occurrence as well as persistence of this situation discussed included non-dynamization, along with intact fibula, fibula uniting earlier than tibia and some inadequacies in the administrative set up. The modification of the treatment by way of dynamization of interlocking nail, eventhough delayed, fibular osteotomy of intact and earlier united fibula along with early ambulation with PTB brace support resulted in complete union. This avoided repeat major surgeries at the same time facilitated early return of patients to their free morbid activities. This is a viable, cheap alternative treatment that can be instituted for a group of patients with fracture tibia especially in a limited resource set up.

1. The patient underwent a repeat surgery in the form of exchange nailing. i.e. removal of the existing interlocking nail, further reaming the medullary cavity to a possible higher dimension, and introduction of a next higher size if available and feasible enduring all the difficulties in such a redo procedure due to the co-existing technical difficulties those are anticipated.
2. Along with the above procedure, a liberal bone grafting procedure was done with graft being harvested from iliac crest. Blood transfusion becomes almost always essential with its antecedent difficulties.

3. The interlocking nail was removed, bone ends freshened, and a locked compression plate fixation was done.
4. The above procedure is combined with a liberal bone grafting procedure with graft being harvested from iliac crest. As usual blood transfusion becomes almost always essential with its antecedent problems.
5. The patients were managed by Ilizarov ring fixator application which is a cumbersome implant and procedure, from the point of view of the patient as well as the average surgeon.

The economic loss to the patient as well as the hospital (in government sector) is one problem. Second is the difficulty in finding a gap for including this second surgery patient in the operation list when the hospital beds are already overcrowded with patients who are waiting for their first definitive surgery.

The patient who has already lost so many days of his occupation or academic activity, has to further start afresh his attempts to get a union in this situation; the relevance of this study, is in this background. These interventions which included dynamization of tibia eventhough delayed, fibular osteotomy of intact and earlier united fibula along with early ambulation, after wound healing, with support of PTB Brace. Since the end result was complete union in all the patients this is a viable, cheap alternative that can be instituted for a group of patients with fracture tibia especially in a limited resource set up.

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