"ROLE OF DYNAMIZATION IN FRACTURE HEALING OF FEMUR AND TIBIA AFTER INTRAMEDULLARY INTERLOCKING NAIL – A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

BY

REGISTRATION NO. BL0119008

Dissertation

Submitted to the

KLE Academy of Higher Education & Research

(Deemed-to-be-University)

Belagavi, Karnataka

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

ORTHOPAEDICS

DEPARTMENT OF ORTHOPAEDICS

J. N. MEDICAL COLLEGE

BELAGAVI- 590010. KARNATAKA

APRIL 2022

KLE Academy of Higher Education & Research
(Deemed-to-be-University)
Belagavi, Karnataka

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Ref No: MDC/PG/ Date: 16-11-2021

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ABSTRACT

Introduction: Intramedullary interlocked nailing has been the most widely accepted and practiced strategy of the management of diaphyseal fractures of tibia and femur, however, associated with delayed and/or non-union in many cases. Dynamization forms one of the various methods proposed to overcome the problem of delayed union and non-union. This study aims at assessing the need and effectiveness of dynamization in tibial and femoral diaphyseal fractures.

Materials and Methods: A total of 30 cases selected, out of which 11 cases of femur fracture and 19 cases of tibia fractures were selected for the prospective study in the time frame of 01-01-2020 to 31-12-2020. All patients underwent closed or open interlocking nailing, and clinical and radiological follow-up was done for 1 year with the results being obtained on radiological assessment.

Results: In case of femur dynamization, out of 11 cases, 7 cases achieved union. For tibial dynamization, out of 19 cases, 14 achieved union.

Conclusion: Delayed and non-union continue to be a major problem associated with intramedullary interlocking nailing of diaphyseal fractures of tibia and femur, for which dynamization has been advised. In our study, we did dynamization in all 30 cases which were showing signs of delayed union, 8 weeks after nailing and it was observed that dynamization had a definite role in enhancing tibial diaphyseal fracture union while having an equivocal effect on femoral diaphyseal fractures.

Keyword: dynamization, intramedullary nailing, femur, tibia

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INTRODUCTION

Since diaphyseal fractures of long bones had been recognised since Hippocrates' time (300 BC), mediaeval specialists from Europe and North America were fast to approach with the prospect of internal splintage of diaphyseal fractures of the femur and tibia in the mid-16th century (1).

With the restricted assets of the time , they utilized wooden sticks or ivory created nails in medullary cavities of long bones for internal fixation. The earliest depiction of metallic nails utilized for intramedullary fixation has been given during World War 1 (2).

As science progressed , the innovation additionally developed. The biomechanics of human step and weight bearing examples were better perceived and thus, more up to date embeds more helpful for the human life systems were created. Alongside this, the materials utilized for assembling of such implants were additionally put under the magnifying instrument for detail assessment and fresher metals and their combinations approached , having a consistently expanding level of solidarity ,flexibility alongside physical and physiological similarity. Prior nails were strong or empty tube shaped sections of wood, ivory or metal that were basically brought into the medullary cavity, accordingly giving the most rudimentary type of internal splintage(3). These inserts anyway were exceptionally responsive and went with the helpless arrangement and execution of sterilization procedure, prompted an extremely high pace of disease and non-union. To resolve these issues, metallic inserts as strong metallic poles were created. After much examination, compounds that were negligibly responsive to the human body and had more noteworthy strength and elasticity were created and utilized for make for inserts. Improvement in sterilization technique also leads to decrease in rate of infection.

Anyway unsuitable fracture stability prompting a high pace of non-union of fracture actually represented a significant challenge to orthopedician world over.

By presenting basic changes in the design and state of the nail, delivering it empty and altering the cross segment from round to a clover-leaf shape , apparent upgrades in fixation steadiness were seen.

Many methods for further developing the fixation were supported. With the introduction of the Kuntscher nail (4) , the idea of 3 point fixation of a nail was brought into light that got quick and far reaching acknowledgment across the orthopaedic community. However the K-nail provide axial stability as well as 3-point fixation consequently, further developed soundness of the fracture yet it couldn't give rotatory stability besides in transverse or short oblique fracture in the isthmic part of femur(5) .

To further develop rotatory stability specialists concocted putting screws simply foremost or back to the nail to obliterate the space and later to place screws into the opening of the nail to confine the rotatory mobility at the break .

These techniques for rotatory strength arrangement were firmly followed up and it was seen that they were related with an exceptionally high pace of non-union.

To defeat this issue, the idea of interlocking nails came where the screw was passed from the cortex of the bone into the opening of the nail and into the contrary cortex at the two closures of the nail (5).

In any case, again a high pace of non-union was seen and thus specialists suggested dynamization in every single instance of interlocking following 6 to 12 weeks of operative procedure.

Dynamization could be accomplished by arrangement of elongated spaces in the intramedullary nails (6) called as dynamic holes, alongside the roundabout spaces. From there on the course of dynamization was done that remembered expulsion of the screw for the round opening (static opening) following 6-12 weeks of operative procedure when the soft callus had formed , that permitted the interlocking screw in the dynamic hole to move about the pivotal way subsequently presenting a unique pressure at the break site during weight bearing.

There are anyway benefits and burdens of the two strategies for fixation. Static nailing gives rigid fixation in this way helps in keeping up with length and alignment specially in comminuted and segmental fracture where dynamic nailing from the start might prompt loss of reduction and shortening in comminuted fracture.

Today the discussion for nailing in static mode and dynamization later on or nailing in a dynamic mode since starting is continuing. This review has been attempted to concentrate on the role and timing of dynamization in the wake of interlocking nailing in diaphyseal fracture of femur and tibia.

AIMS AND OBJECTIVES

1. Assessment of results after dynamization of interlocking nail in diaphyseal fracture of femur and tibia.

2. Timing of dynamization.

REVIEW OF LITERATURE

The earliest evidence of intramedullary fixation of diaphyseal fractures of long bones date from the sixteenth century in Mexico, when Aztec experts attempted to treat non-union fractures by inserting wooden sticks into the medullary chamber of long bones (Farill .J , 1952 Orthopaedics in Mexico (1).

A substantial chunk of the work in intramedullary nailing of non-union seems to revolve around the use of ivory stakes from the mid 1800s through the first decade of the 1900s. Metallic inserts, on the other hand, became fibrous and enclosed, whereas ivory stakes reabsorbed in the human body.

The majority of this work was accounted for in German literature at the time.

This prospective randomised comparative research, conducted by M.N.Basumallick and A Bandopadhyay(7) in 2002, assessed the role of dynamization of interlocking nails following open reduction and internal fixation of femoral shaft fractures. Fifty femoral shaft fractures were treated and statically secured using open interlocking nailing. Twenty-six of the 50 patients were chosen at random for dynamization, whereas the other 24 were not. For at least two years, the patients were followed up on. The 26 dynamized cases united between 13 and 28 weeks (average 19.2 weeks), with two unsatisfactory outcomes, including one non-union. The non-dynamized instances took 16 to 30 weeks (on average 23.5 weeks) to union, with two bad outcomes, including one nail fracture. Though the end outcomes are equivalent, the study implies that dynamization following open interlocking nailing reduces the mean time to union while having no effect on the femoral shaft fracture union rate.

Vidya Bhushan singh, Amit and Lakhtakia (8) did study in 2017 on 18 fracture shaft femur patient treated with intramedullary nail and did dynamization after 4 months.

They concluded that not all cases achieve union after dynamization and it should be reserved for delayed healing axially stable fracture without significant angular deformity.

Josh Vaughn (9) in 2016 did retrospective study on 35 cases treated with dynamization and published that dynamization is able to create union in 54% of cases.

He stated that dynamization is effective tool to prevent delayed union and non-union.

Gluck, Birch, and Konig (10,11), openly reported the main depictions of interlocking intramedullary devices in the 1880s. An ivory intramedullary nail with apertures at the end through which ivory interlocking pins may be fed made up the device.

In 1897, Nicolaysen (12) was the first to demonstrate the biomechanical parameters for intramedullary implants. He proposed that intramedullary implants be made longer to offer the most biomechanical effect.

Hoglund (13) of the United States revealed the use of autogenous bone as an intramedullary insert in 1917, but ivory looked to be the preferred material in German writing. He advocated cutting a part of the cortex and sending it through the medullary cavity's fracture site. (13)

Hey Groves of England (14,15,16,17) announced the use of metallic implants for the treatment of gunshot wounds during World War I. Through an entrance hole constructed over the break site, these implants were inserted into the medullary depression. This approach has a high rate of contamination and was not widely accepted.

The usage of metallic intramedullary inserts began to increase rapidly after Smith-Petersen's (18) 1931, publication on the efficient treatment of femoral neck fractures with stainless steel nails.

Metallic Steinman pins inserted in the medullary canal were used to repair proximal ulna and proximal femur fractures, according to Rush and Rush (19) (1939) in the United States. While these procedures lay the framework for treating intramedullary fixation fractures, there would be an explosion of ideas and treatments in the decades ahead.

With the invention of the Kuntscher nail in 1940, Gerhard Kuntscher (20) revolutionised intramedullary nailing concepts.

He established a set of guidelines for his work:

1. A operation that has been completed.

2. Fracture fixation that is stable

3. There is no external support.

4. Weight-bearing and rehabilitation at a young age The first intramedullary nail he received was a V-shaped stainless steel nail that was implanted antegrade.

In 1940, Küntscher described the V-shaped nail for the first time, hypothesising that it acted as an internal splint, forming an elastic union with the inner medullary cavity. He appears to have fought for the placement of the nail in the bone away from the fracture site early on in the development of his therapy, avoiding any disruption of the injury zone.

Intraoperative reductions were accomplished with several slings, and bone imaging was done using head-worn fluoroscopy. The proper insertion of Küntscher's nail, he believed, would enable for the patient's functional movement to be restored quickly.

These intramedullary devices could keep the pieces in place and maintain axial alignment, but they didn't always give rotatory stability, especially in comminuted fractures or if the marrow was loose and intramedullary fixation was necessary. External splints, plaster immobilisation, or plates are some of the options.

To circumvent this limitation, surgeons devised the concept of interlocking nails, which not only maintain axial alignment but also give rotatory stability to the fracture, aiding healing and allowing early mobility of neighbouring joints.

Fischer, identified the use of intramedullary reamers to extend the contact zone between the nail and the host bone in order to improve the hardness of the fracture in German literature. Despite this, Küntscher's demonstration of flexible reamers took another decade to gain popularity. Fischer also agreed that reaming in conjunction with a larger-width nail would increase the contact area and so improve the crack's security. Despite the fact that the intramedullary vascular supply was cut off during the procedure, he was confident that the periosteum and surrounding tissues would proceed to a sufficient bone arrangement for healing.

Both Westborn and Seour published papers on the use of V-nails in the treatment of long bone diaphyseal fractures in 1944 and 1946 [21,22).

In 1947, Hansen (23), invented the "Hansen road nail." This was a strong diamond-shaped nail that had a compressive fit into the cancellous bone to keep the fracture from rotating. These nails were originally implanted using a closed technique to prevent the substantial contamination rate demonstrated by Hey Groves. Despite this, to reduce fluoroscopy side effects, Street switched to open retrograde nailing with penicillin.

Modny and Bambara (24) approached with their own idea of interlocking nails in 1953. This nail was cruciate-shaped, with numerous apertures along its length to accommodate the placement of screws at 90 degrees to one another. Unreamed nailing became the standard for open fractures as the use of reamed nailing became more common. There was also a substantial growth in the use of reamed nails for treating tibial shaft fractures during this time. The open cloverleaf shaped interlocking nail, such as the AO and Grosse-Kempf nails, was the most common implant design during this time period.

As operative procedures kept on increasing during this time, there was a surge in clinical information with respect to the utilization of reamed interlocking nails of both the femur and tibia. This was finished by a three-section investigation of reamed interlocked femoral nails by Brumback (25) and associates. In 87 femur fractures, statically locked, reamed intramedullary nails showed a 98 percent (85/87) initial healing rate.

Union was accounted for in the other two fractures after dynamization. While there was sure advancement, taking everything into account during the 1990s, the significant progressions accompanied the expansion of indication for undreamed and reamed intramedullary nailing. Open tibial shaft breaks were currently being treated with intramedullary fixation with great outcomes. Moreover, open femur fractures that previously fixed with unreamed nails, were presently being treated with reamed nails. Likewise, opened cloverleaf cross-sectional design were being supplanted by unslotted design that gave more prominent torsional unbending nature.

Brumback and colleagues (26,27) published a two-part research in 1999 that looked at early weightbearing in patients treated with intramedullary nailing for comminuted femoral shaft fractures. These researchers concluded that rapid weightbearing is acceptable in patients whose femur fractures were repaired with large diameter nails with high fatigue strength, since this allows for early mobility of the wounded patient with multiple limb wounds.

Siddharth Sharma and Hitesh Gopalan (28), 2011 , aggregated the whole history of principles of interlocking intramedullary nailing and ordered different designs into moderate ages as follows :-

1st Generation ; having a trademark longitudinal space along the whole length of nail with arrangement of openings for proximal locking screws as it were. Eg. K-nails

2nd Generation ; cylindrical nails without opening however arrangement of both proximal and distal interlocking openings. Eg. Russel Taylor nail , Delta nail

3rd Generation ; made of titanium composite, might be solid or cylindrical. Eg. Trigen nail , Universal Synthes femoral nail.

The achievement of interlocking nailing for treating diaphyseal fracture of tibia and femur is well known.

It has prompted a sensational improvement in the useful result and has turned into the treatment of choice the world over.

Strangely, all through the early history of intramedullary nailing, the advances in strategy, guideline, and configuration seem to resemble progresses in anaesthetic and aseptic methods, taking into account routine usable consideration of fracture to emerge. Fracture union following intramedullary fixation is an intricate cycle which proceeds for quite a long time after clinical and radiological association until the bone holds its unique construction and capacity.

Delayed union and non-union are two of the normal issues that any surgeon might confront managing fracture healing.

Delayed union might be brought about by a few factors such among which too rigid fixation and a gap at the fracture site are significant causes. Several strategies have been formulated to beat this issue incorporating dynamization with/without bone graft, which is our subject of interest in the review.

Dynamization as an idea came up during the 1940s when Kuntscher proposed the role of micromovements at the fracture site in speeding up the healing process.

Winquist, 1984 (29) , studied on 500 patients (313 guys and 187 females) of femoral shaft fracture including 261 comminuted and 86 open fractures. Altogether 520 intramedullary nailing methodology were done, 497 were done closed and other 23 were done with open reduction.

He accomplished 99.1% association rate having performed dynamization in 171 of his cases and in this manner showed up at results leaning toward dynamization.

Hao Ming (30), 1997 , directed a review study on 28 static femoral nails which were all dynamized at around a half year time. 24 of these accomplished strong union , more than 2 cm femoral shortening present in 4 of the cases and advanced on to non-union which later required cancellous bone grafting.

Charles and Hansen, 2009 (31) , studied on 280 patients who went through femur interlock nailing procedure of which 35 cases presented non-union. 17 of them were treated by dynamization of which 13 united and 4 presented with shortening which required reoperation, 5 were treated by bone grafting , 3 were treated by revision nailing and 10 cases were lost to follow up. Subsequently a generally valuable role of dynamization was reported by them.

LiMin and Han Duan (32), 2013 , studied on the impacts of dynamization of interlocking nails for non-union following proximal intercalary reconstruction and showed up at positive outcomes.

Carlton , Hick and Trevors (33), 2005 , studied 179 cases of closed femoral shaft fracture of which 75 were dynamized and rest left static. They saw that union was quicker in the static group (103 days) when compared with the dynamized group (126 days).

Siddharth Sharma and Hitesh Gopalan (28), 2011 , studied on the role of dynamization in fracture with interruption and revealed results showing achievement rate differing from 54% to 92.3%.

S.Salooki and SAR Misbah (34), 2011 , studied on 173 patients of tibial and femoral fracture including 112 instances of tibial and 61 instances of femoral fracture , of which no cases were dynamized. All instances of tibial fracture accomplished good union with 4 patients showing delayed union while all cases of femoral fracture accomplished total union except one, without any significant complication. Along these lines they reasoned that normal dynamization isn't valuable in long bone diaphyseal fracture.

It very well might be qualified to take note of that every underlying idea and works (Majowski, Baker, 1991; Rockwood, Green, Buckolz, (34)1991; Thoreson, Alho, Ekeland (35), 1993 , on dynamization upheld expulsion of the static screws from the long segment at 10-24 weeks post-operation, regularly in all patients of long bone diaphyseal fracture. The requirement for routine dynamization anyway has been disputable.

Brumback, Reilly, Poka and Lakatos (36), 1988 , studied on 122 patients of tibial shaft fracture out of which 119 accomplished agreeable union with next to no requirement for dynamization.

Brumback, Uwagi, Lakatos, Bathon and Burges (37), 1988 , studied on 98 patients of tibial and femoral diaphyseal fracture and noticed acceptable union in 96 cases with 2 cases creating post operation contamination.

Accordingly they likewise viewed as normal dynamization pointless. Besides a subsequent activity is likewise needed for dynamization. Alongside this , the suitable planning of dynamization has likewise been a subject of much conversation and discussion.

R.G.Kar, Suremath, Basumallick, 1988 , Requrmot and Rodriguez, 1992 , advovated an early dynamization between 10-24 weeks.

Subramaniam, 1988 , leaned toward deferred dynamization following 24 weeks.

Surgeons the world over , remembering every one of the entanglements of dynamization, thought of the idea of specific dynamization just in situations where advised.

[Thoreson BO, Alho, Ekeland A, Stromse, 1985(35) and Wiss, Brien, Stenson, 1990, Klemm and Schelmann(38), 1992 , studied on the role of dynamization and proposed radiological assessment of fracture recuperating on 3 successive X-rays utilizing same boundaries at about a month and a half stretch and supported dynamization if the healing was advancing sufficiently. This proposal, from that point forward has remained to be the most broadly acknowledged among most surgeons all throughout the planet

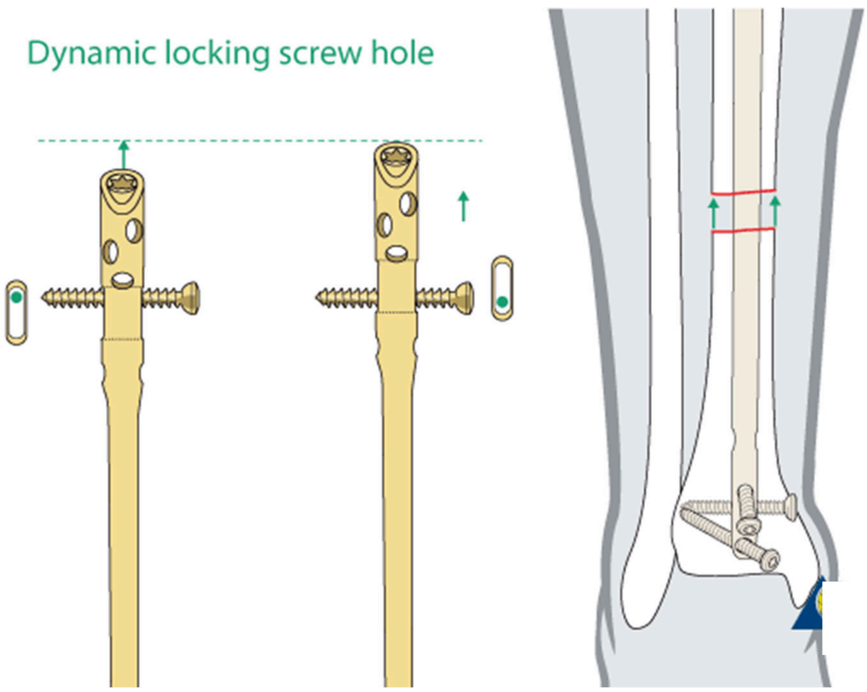


Fig-1- Dynamic locking screw

MATERIALS AND METHODS

Study – One year hospital based prospective study

Sample size- Number of dynamization done in a year - 30

Operated cases of femur and tibia shaft fracture attending the outpatient department of Jawaharlal Nehru Medical college, Belgaum were selected for the study in the time frame of 01-01-2020 to 31-12-2020.

Patients were examined and x-ray advised , anteroposterior and lateral view.

X-ray was evaluated for the sign of union and delayed-union after 8 weeks post nailing.

Clinical evaluation was also done.

Local tenderness and pain at fracture site is the sign of delayed union.

Relevant data was recorded in pre-prepared proforma.

Patients were evaluated clinically for anaesthesia fitness and surgery. Relevant investigations were done.

INCLUSION CRITERIA :

1- Operated case of fracture shaft femur treated with intramedullary interlocking nail

2- Operated case of fracture shaft tibia treated with intramedullary interlocking nail

3- Grade 1,2 Gustilo Anderson open fracture

EXCLUSION CRITERIA :

1-Gustilo Anderson type 3

2-Ipsilateral hip, knee and ankle fracture

3-Pathological fracture

4-Below 18 years age

5-Infected cases

FEMUR INTERLOCKING PROCEDURE

For femur interlocking, the patient was placed on an orthopaedic fracture table, whereas for tibia interlocking, the leg was hung by the side of the table.

1. Starting at the level of the greater trochanter's tip and continuing 4-5 cm proximally, an incision was made over the lateral part of the thigh.

2. The iliotibial tract was cut parallel to the skin incision and retracted.

3. The fascia that covers the vastus lateralis muscle was incised as well.

4. Vastus lateralis fibres were divided and horizontally retracted.

5. The hip abductors inserting into to the greater trochanter were meticulously examined and divided to reveal the pyriform fossa area.

6. Entry point was made with the help of curved awl until it reaches medullary cavity.

7. The awl was removed and a ball-tipped guide wire was inserted into the wound.

8. Traction and manipulation were used to reduce the fracture, and a guide wire was passed across the fracture, confirming its location under fluoroscopy.

9. Depending on the diameter of the medullary cavity, reamers of increasing diameters were used, ranging from 8mm to a maximum of 12mm.

10. After inserting an exchange sleeve, a ball tipped guide wire was replaced with a basic wire.

11. The size of the nail was established by measuring the length of the guide wire put into the medullary cavity and choosing a diameter that was 1mm smaller than the widest reamer used.

12. A proximal jig was used to implant the nail, which was then passed into the distal fragment while maintaining reduction.

13. Distal locking was performed freehand under fluoroscopic supervision using a 4.00 mm drill bit.

14. Cortical screws of proper diameters, 4.9mm, were used to lock the nail.

16. After predrilling with a 4.00mm drill bit and utilising 4.9mm cortical screws of appropriate sizes, proximal locking was performed using the proximal jig.

17. Jig was removed, and all wounds were carefully closed in layers.

18. Patients were transferred to the post-operative room with compression dressing.

19. All patients received post-operative treatment, which included continued antibiotic prophylaxis, post-op check dressings, and vigorous quadriceps exercises (if possible, given the concomitant fractures).

PROCEDURE FOR TIBIA INTERLOCKING

1. A midline incision was made along the anterior part of the proximal tibia, beginning at the lower pole of the patella and extending 3-4 cm distally.

2. The patellar tendon was exposed by dissecting subcutaneous tissue in accordance with the skin incision.

3. To expose the tibial plateau area, the patellar tendon was either bluntly divided in the middle or retracted laterally.

4. Curved bone awl was inserted at a position just distal to the anterior tibial plateau and just medial to the lateral tibial spine.

5. A guide wire was inserted once the medullary cavity was reached.

6. Traction and manipulation were used to accomplish reduction, and a guide wire was inserted into the distal fragment, confirming its location under fluoroscopic supervision.

7. Reaming was carried out with reamers of increasing diameters, ranging from 8 to 12 mm.

8. A second, identical-length guide wire was used to determine the length of the wire pushed into the bone, and hence the length of the nail to be used.

9. The nail was chosen to be 1 mm smaller in diameter than the thickest reamer that was successfully employed.

10. Nail thus chosen was inserted using a jig and passed across the fracture site into the distal fragment while maintaining

reduction.

11. Distal locking was done using the free hand technique under fluoroscopic guidance.

12. 4.00 mm drill bit was initially used to drill a pilot hole through the bone and locking was done using 4.9 mm cortical screws of appropriate lengths.

13. Reverse impaction was done if indicated by fluoroscopic to impact fracture site if reduction was not proper.

14. Proximal locking was done using the proximal jig after predrilling with 4.00mm drill bit and using 4.9mm cortical screws of appropriate sizes.

15. The jig was removed, and all wounds were carefully closed in layers.

16. Occlusive dressings were applied, and patients were transferred to the post-operative room.

17. All patients, even those who had surgery, received post-operative antibiotic prophylaxis, post-operative check dressings, and active treatment.

Exercises for the quadriceps.

Most patients were discharged on the advice of non-weight bearing, continued physiotherapy, and oral antibiotic prophylaxis, with a follow-up appointment for stitch removal on the 14th post-operative day, if the stitch line was healthy and satisfactory mobilisation of surrounding joints had begun on the 2nd post-operative day.

Wound was checked on the 14th post-operative day and if they were healthy, stitches were removed.

Patients were then instructed to return after one month (4 weeks post-surgery).

The following evaluations were performed at the next visit:

1. Suture line condition.

2. Fracture alignment.

3. Pain.

4.Tenderness at fracture site.

5. Knee, hip, and ankle mobility.

6. Evidence of callus on x-ray.

7. Evidence of deep vein thrombosis if any.

This was the first time the state of the healing at the fracture could be examined clinically as well as radiologically.

At this visit, full weight bearing was recommended, and the patient was told to return in 4 weeks for another check-up (total of 2 months post-op)

The following measures were performed at the 2-month post-op visit:

1. Pain at the fracture site.
2. Tenderness at the fracture site.
3. Hip, knee, and ankle mobility.
4. Callus at fracture site on x-ray.
5. Any proof of delayed union.
6. Weight-bearing status / functional status

Based on these findings, the patients were either advised to continue full weight bearing or were recommended to have dynamization, with or without bone marrow injections, if there were no signs of union.

PROCEDURE FOR DYNAMIZATION

Dynamization was carried out in a few situations based on the aforementioned parameters.

Under local anaesthetic, the static screw from the proximal portion of the nail is removed. A bone marrow injection at the fracture site may or may not be performed in conjunction with this surgery.

Only the proximal end of the tibial and femoral interlocking nails had dynamic holes at our facility. As a result, the proximal static interlocking screw was removed for all dynamization treatments.

The steps are as follows:-

1. A sandbag was put beneath the gluteal area on the side to be operated in a supine posture.

2. A portion of the femur/tibia was cleansed, painted and draped.

3. Using fluoroscopic guidance, the exact position of the static screw was identified, and a stab incision was made immediately above it.

4. The static screw was removed with the proper screwdriver after the subcutaneous tissue and muscles were carefully divided and retracted.

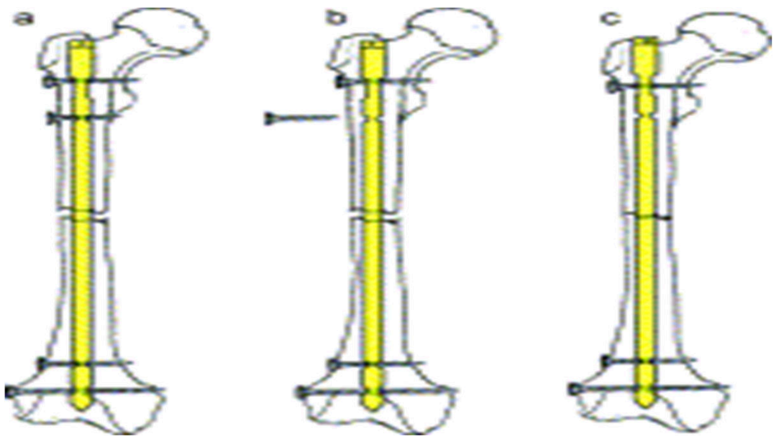
5. If a bone marrow injection was needed, a 2.7 mm drill hole was drilled in the proximal tibial (cancellous) area of the contralateral side, followed by bone marrow aspiration with an 18G needle.

6. Under fluoroscopic supervision, the aspirated marrow fluid was injected directly into the fracture site.

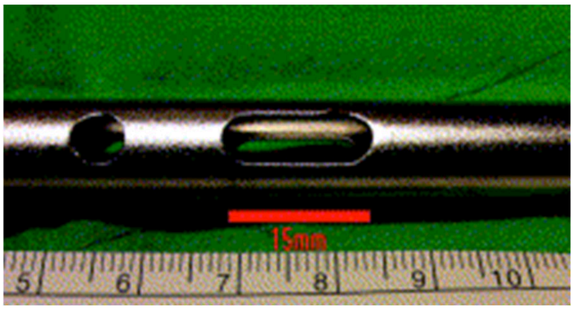
7. The wound was carefully cleaned, and suturing was done in layers.

8. Occlusive dressings were placed, and i/v antibiotic prophylaxis was given post-operatively.

Patients were discharged with oral antibiotics, full weight bearing, and rehabilitation instructions, as well as directions to return for suture removal in 14 days.



Procedure of Dynamization



Dynamic Hole

Fig -2- Procedure of dynamization and dynamic hole

RESULTS

GENDER	FEMUR	TIBIA	TOTAL
FEMALE	3	8	11
MALE	8	11	19
TOTAL	11	19	30

Table-1- Gender wise distribution of fracture

Out of 30, total 11 cases of femur and tibia fracture seen in female and 19 cases in male

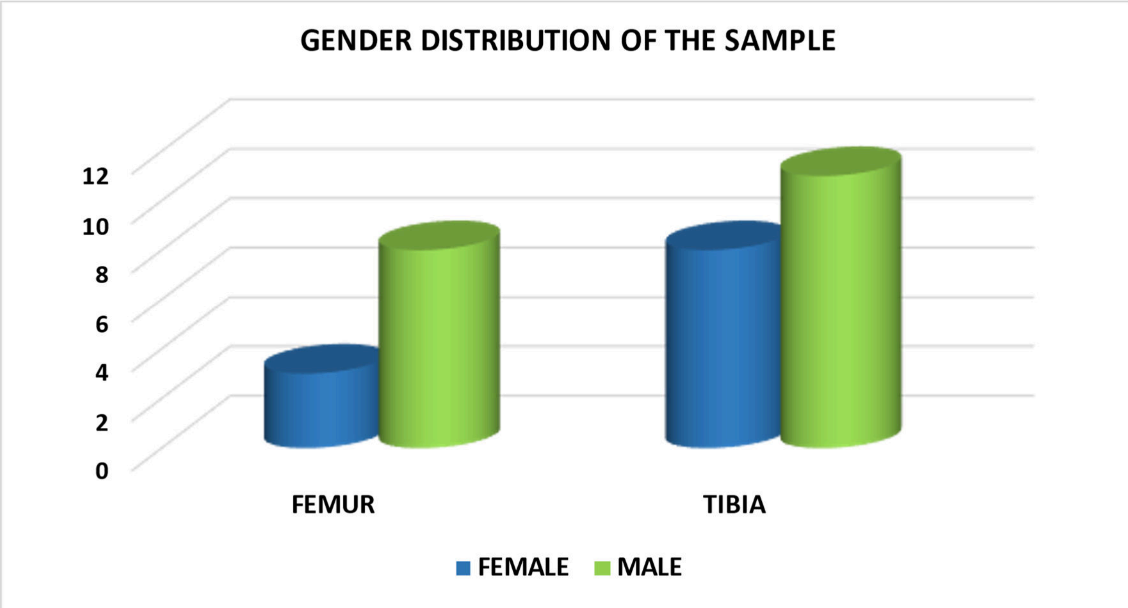


Fig-3- Graphical representation of femur and tibia fracture in male and female.

Out of 30, total 11 cases of femur and tibia fracture seen in female and 19 cases in male.

AGE	FEMUR	TIBIA	TOTAL
20- 29	4	3	7
30 – 39	4	5	9
40 – 49	2	5	7
50 – 59	1	6	7
TOTAL	11	19	30

Table- 2- Age wise distribution of femur and tibia fracture.

Most of femur and tibia fracture seen in the age group of 30-39 years.

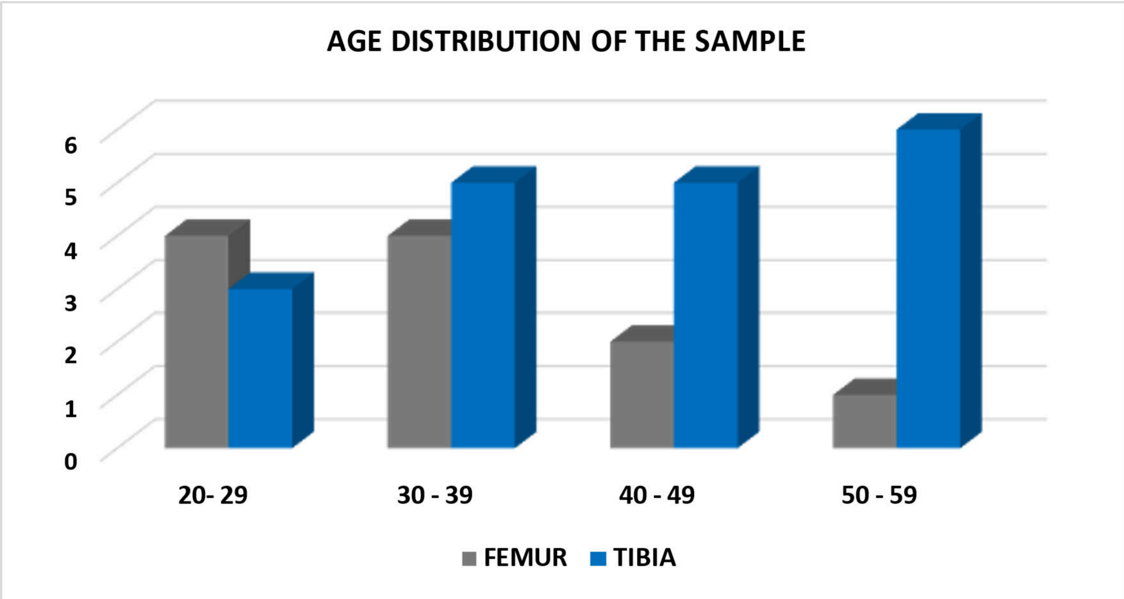


Fig-4- Age wise graphical representation of femur and tibia fracture.

Most of femur and tibia fracture seen in the age group of 30-39 years.

MODE OF INJURY	FEMUR	TIBIA	TOTAL	p VALUE
RTA	10	13	23	0.3303
SELF FALL	1	4	5	
TRIVIAL TRAUMA	0	2	2	
TOTAL	11	19	30	

Table-3- Mode of injury

RTA is most common cause of femur and tibia fracture

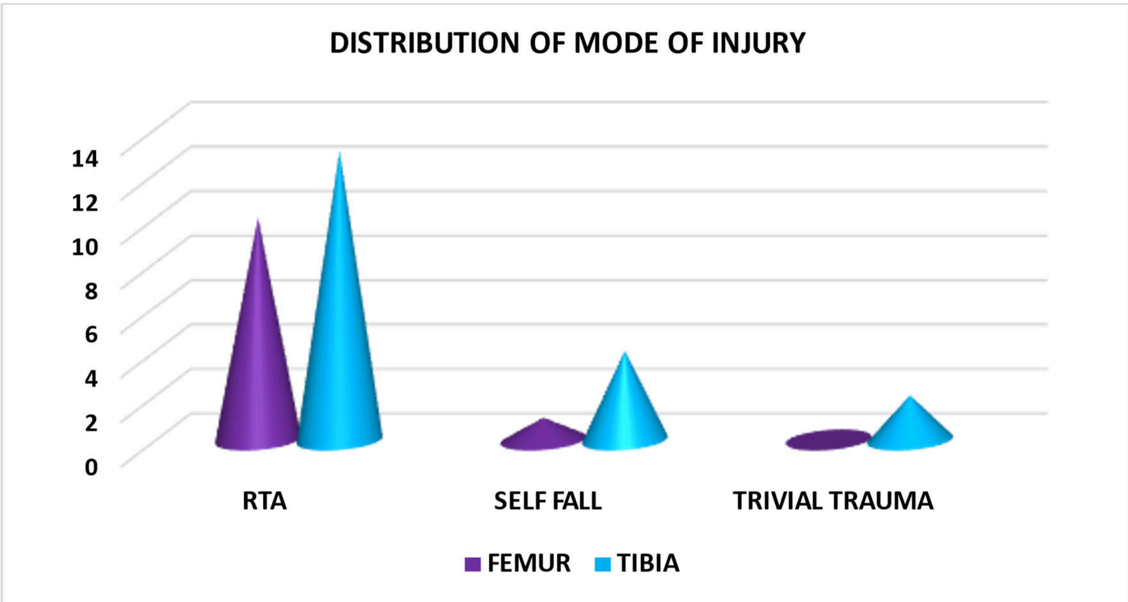


Fig 5-Graphical representation of mode of injury.

Most common cause of injury is road traffic accident.

TYPE OF FRACTURE	FEMUR	TIBIA	TOTAL	p VALUE
COMMINUTED	2	1	3	0.6365
OBLIQUE	2	4	6	
SPIRAL	4	10	14	
TRANSVERSE	3	4	7	
TOTAL	11	19	30	

Table 4- Fracture pattern in Femur and Tibia fracture.

Most common is spiral and transverse fracture.

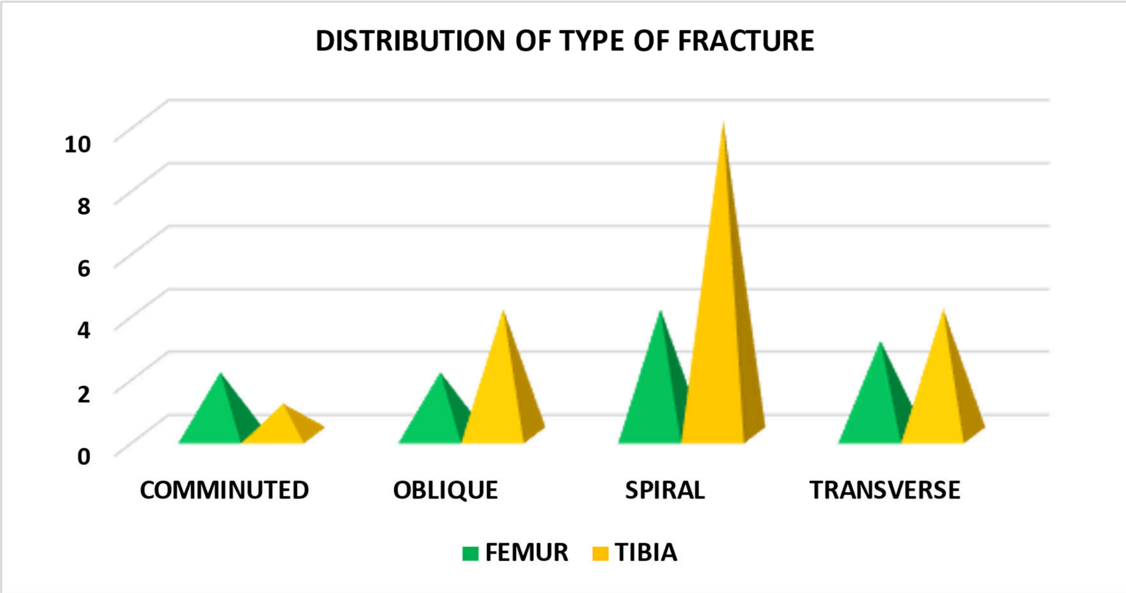


FIG-6- Graphical representation of fracture pattern in femur and tibia fracture.

Most common is spiral fracture.

NUMBER OF CORTICAL UNION AT 8 WEEKS	**FEMUR**	**TIBIA**	**TOTAL**	**p VALUE**
0	3	4	7	0.8500
1	3	7	10	
2	5	8	13	
TOTAL	11	19	30	

Table 5- In 7 cases, no cortex united at 8 weeks, in 10 cases, 1 cortical union at 8 weeks, In 13 cases, 2 cortical union at 8 weeks on AP and Lateral x-ray**.**

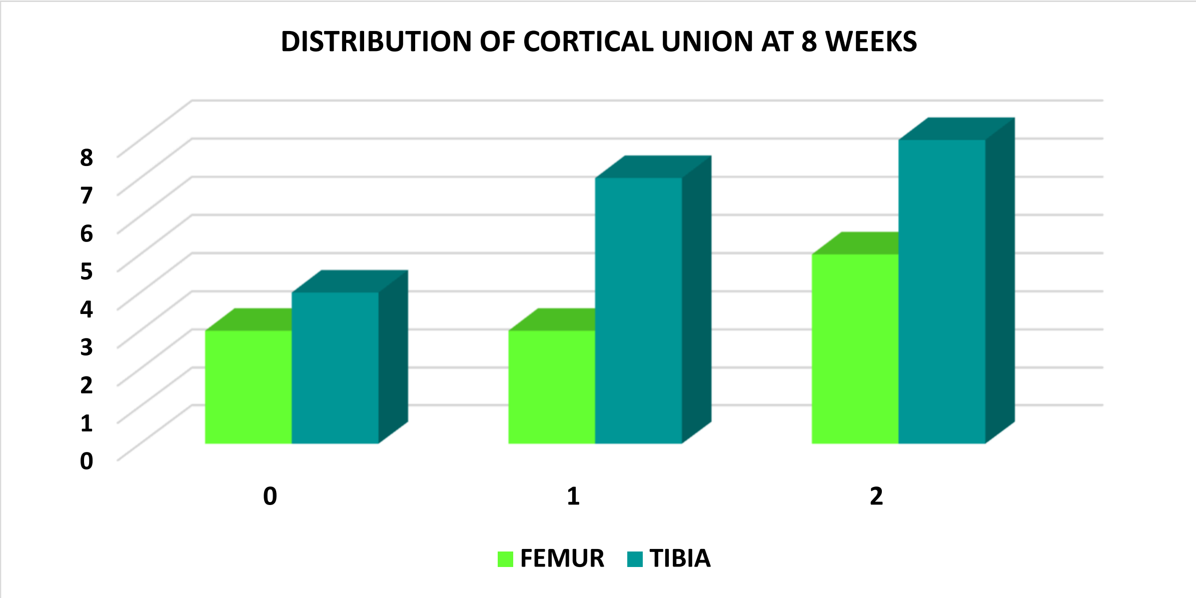


Fig-7-In 10 cases, only one cortex was united at the time of dynamization (8 weeks), 2 cortex in 13 cases, and zero cortex in 7 cases.

RESULT	FEMUR	TIBIA	TOTAL	p VALUE
NON-UNION	2	1	3	0.5242
DELAYED	2	4	6	
UNITED	7	14	21	
TOTAL	11	19	30	

Table 6 - 21 cases achieved union at 3 months post dynamization, 6 cases of delayed union and 3 of non-union.

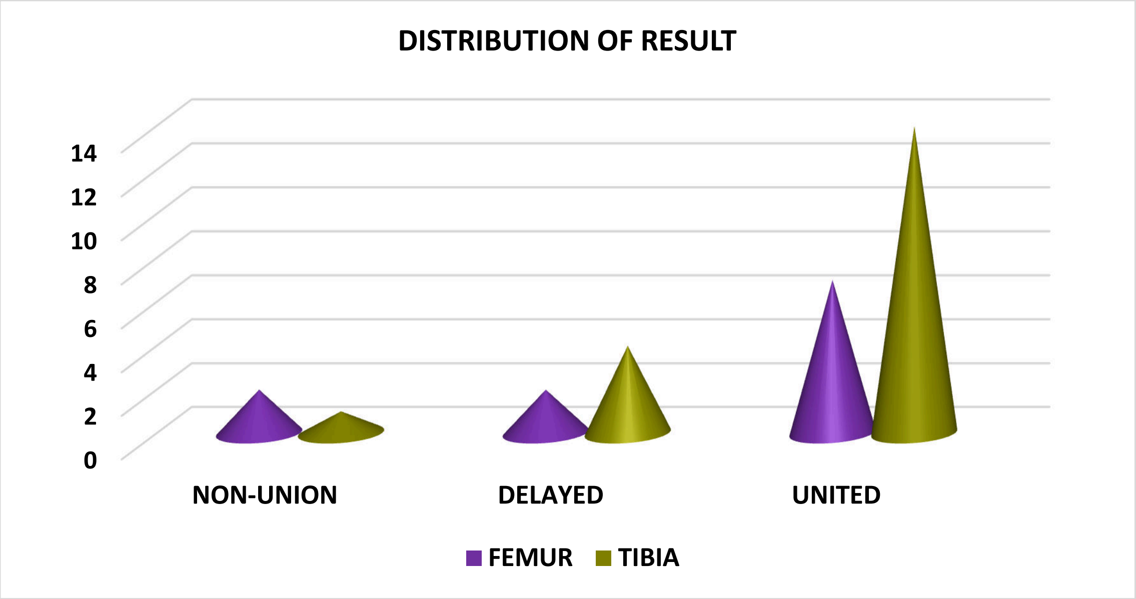


Fig-8- In all 30 cases of delayed union and non-union, dynamization was done at 8 weeks.21 cases achieved union at 3 months follow up

DISCUSSION

The high frequency of tibial and femoral fracture has consistently been a wellspring of extraordinary physical and financial burden just as mortality across all age bunches across the range of reported clinical history.

Researchers and surgeons the world over have thought of various methodologies and strategies for fixation of such fracture and the management of comorbidities. Among them ,intramedullary nailing has endured for an extremely long period to arise as the most dependable technique for fixation of diaphyseal fracture of tibia and femur.

Intramedullary nailing has seen many phases of advancement to arrive at its current structure that we see today in day to day practice. Among the different amendment of standards, has been the idea of dynamization, that focuses on further developing the fracture union by allowing micromovements (Kuntscher ,1940) (20) at the fracture site. Anyway there has been banter over its real need , its proper planning and the general adequacy. Our study has been done to assess this large number of inquiries.

Our review incorporated a sum of 30 patients of femoral and tibial shaft fracture that were studied at our hospital during the time-frame of 12 months (January 1st,2020 to December 31st 2020).

Cases were included for the review as per their inclusion and exclusion criteria.

Similar studies were done by Brumback, Uwagi, Lakatos, Bathon (25,26,27) furthermore, Burges in 1988 who studied on 98 patients of femoral and tibial diaphyseal fracture to arrive at their outcomes.

One more review with a bigger study on group was from Salooki and Misbah (35) in 2011 who examined 173 patients with 112 tibial and 61 femoral diaphyseal fracture. Every one of these study show the more prominent commonness of tibial fracture inferable from the lesser measure of power needed to create a fracture when compared with the femur.

The age appropriation of our patients inclined towards the more younger age group with 36.33% of femur and 26.31% tibial fracture from the age group of 30-39 which shows the more prominent inclusion of more young people in outdoor activities and road traffic accident. Comparative evidences was found in the study by Brumback, Uwagi, Lakatos, Bathon furthermore, Burges in 1988 who experienced 47% cases from the age gathering of 20-30.

In our review ,the mean time from injury to surgical procedure was 2-4 days (2.6 days for fracture tibia and 3.4 days for fracture femur)

The associated injuries which the patient had in our study were generally head injury

CONCLUSION

In our prospective study conducted on the total 30 cases, 19 tibia and 11 femur fracture cases treated with static intramedullary interlocking nail.

After dynamization patient were evaluated radiographically and clinically after 4 weeks, 8 weeks and 12 weeks and the result showed that in 21 cases union was achieved after dynamization , which is 70% union rate.

In the instance of delayed union, we found that dynamization done early at 8 weeks after nailing, increases the chances of union by 70%.

Further studies are required in a large sample size to know the factors causing delayed union and non-union after intramedullary interlocking nail and beneficial role of dynamization in Gustilo Anderson type 3 open fractures.

SUMMARY

Femur and tibia fracture is very common fracture in all age group. Most of the cases of femur and tibia shaft fractures are treated with intramedullary nailing now a days.

We conducted our study on a sample size of 30 patients. 19 male patients and 11 female patients of femur and tibia fracture.

Road traffic accident is most common mode of injury in all age groups followed by self fall and trivial trauma.

Maximum cases in our sample size belongs to the age group of 30-39 years.

In all the above cases we did intramedullary interlocking nailing for femur and tibia fracture and advised for toe -touch weight bearing for first 14 days later full weight bearing.

All the patients were called for follow up on 2 weeks , 4 weeks and 8 weeks and evaluated clinically and radiographically for the signs of delayed union.

On x-ray evaluation if callus was formed at 2 or less than 2 cortex in AP and lateral radiograph followed by tenderness at fracture site on clinical evaluation then dynamization was advised to all those patients.

All the patients undergone dynamization at 8 weeks and called for follow up 4 weeks , 8 weeks and 12 weeks and evaluated clinically and radiographically.

Out of 30 patients of femur and tibia shaft fracture, 21 cases achieved union 3 months after dynamization.

In cases of delayed union, 4 out of 6 cases, bone marrow injection at the fracture site lead to union and in 2 cases bone marrow injection along with bone grafting lead to union.

All the cases of non-union that did not unite with dynamization required exchange nailing with bone grafting at fracture site.

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ANNEXURE I -ETHICAL CLEARANCE

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
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Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 246 **Date: 24/12/2019**

To,
BL0119008
PG student in Orthopaedics,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"ROLE OF DYNAMIZATION IN FRACTURE HEALING OF FEMUR AND TIBIA AFTER STATIC INTRAMEDULLARY INTERLOCKING NAIL-PROSPECTIVE STUDY ",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

ANNEXURE II-PROFORMA

"ROLE OF DYNAMIZATION IN FRACTURE HEALING OF FEMUR AND TIBIA AFTER INTRAMEDULLARY INTERLOCKING NAIL-A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

Patient NO : IP NO:

Name:

Age: Sex:

Address:

Occupation:

Date of addmission:

Date of Dynamization:

Date of discharge:

Date of static Intramedullary Interlocking nailing done in the Past:

Duration Since Nailing:

Type of fracture:

local Examination:

Inspection:

Lower Limb Involved RIGHT LEFT

Pain

Attitude

PALPATION:

Tenderness

Abnormal mobility

Loss of transmitted movements and continuity of bone

Peripheral Pulses: Dorsalis pedis / Posterior Tibial

Neurovascular Deficits: (Tingling numbness, Power)

Yes

No

Relevant Investigations:

1. X-ray of femur / tibia
2. Routine investigations:

Blood: Hb%, TLC, DLC, ESR, Platelet Count, Blood Grouping, CRP, RBS, Coagulation profile

3. HIV, HbsAg , HCV
4. URINE: albumin, sugar, microscopy.

DIAGNOSIS:

1. X-ray of femur
2. X-ray of tibia

Pre-op x-ray before dynamization:

NO. of cortex united/ callus formed AP Lateral

After 3 months follow up x-ray

NO. of cortex united/callus formed AP LATERAL

Final Result after 3 months follow up:

ANNEXURE III - INFORMED CONSENT

TITLE OF THE STUDY ” ROLE OF DYNAMIZATION IN FRACTURE HEALING OF FEMUR AND TIBIA AFTER STATIC INTRAMEDULLARY INTERLOCKING NAIL-A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

PRINCIPAL INVESTIGATOR:

GUIDE:

INTRODUCTION AND PURPOSE:

Femur and Tibia shaft fractures are one of the commonest injuries sustained by the elderly population. The incidence is growing rapidly due to increase number of road traffic accidents .It is commonly associated trivial trauma in any age group patients. Non operative approach includes reduction via traction and immobilization. However it usually resulted in malunion, varus and external rotation deformities resulting in short limb gait. Due to prolonged immobilization complications like bedsores, deep vein thrombosis, respiratory infections can happen. Static intramedullary interlocking nail is done in shaft Femur and Tibia fractures. But cases reported in which after static intramedullary interlocking nail, fracture goes into Delayed union or non-union.

To overcome the problem of delayed union or non-union , we remove the static screw from the intramedullary interlocking nail and make it dynamic. Dynamization causes micro-movement between the proximal and distal fracture fragments leading to osteogenesis and callus formation between the proximal and distal fragments resulting into union.

The advantages of Dynamizations are:

1. Decreases time for fracture union

2. Decreases non-union cases

The purpose of this study is to determine the best Clinical outcome for “ROLE OF DYNAMIZATION IN FRACTURE HEALING OF FEMUR AND TIBIA AFTER STATIC INTRAMEDULLARY INTERLOCKING NAIL-A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY" in Orthopaedic department of KLE’S Dr. Prabhakar Kore Hospital and Medical Research Centre and Charitable Hospital, Belagavi from 1st January 2020 to 31st December 2020.

PROCEDURE:

Spinal or Regional anaesthesia given to the patient.

Patient positioning, painting and draping done.

Under C-arm, both static and dynamic screws are marked. Lateral incision is made above the static screw.

Soft tissue present around and above the static screw is incised and elevated with the help of periosteal elevator.

Static screw is removed with help of screw driver.

Layer by layer suturing done.

Incision is closed.

VOLUNTARY PARTICIPATION/ WITHDRAWL:

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The investigator or the sponsor may stop my participation in this study. I will tell of any important new findings that may change my willingness to continue to take part. If I choose not to take part in the study, I will receive the standard treatment for patients with my condition.

COMPENSATION:

As the subject voluntarily consents to be a part of the study, no compensation will be given.

CONFIDENTIALITY:

All information collected about the subject during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify the subject in this research record. Information from this study may be presented but the subjects identity will be confidential in any publication.

If any enquiries in the future or in case of study related injury or illness, you may contact following person:

PRINCIPAL INVESTIGATOR:

PG. RESIDENT,

DEPARTMENT OF ORTHOPAEDICS,

KAHER,

JAWAHARLAL NEHRU MEDICAL COLLEGE,

NEHRU NAGAR,

BELAGAVI – 590010

GUIDE:

ASSOCIATE PROFESSOR,

DEPT. OF ORTHOPAEDICS,

KAHER J. N. MEDICAL COLLEGE,

BELAGAVI –590010.

If you still have any queries please contact:

Chairperson,

Institutional Ethics Committee for

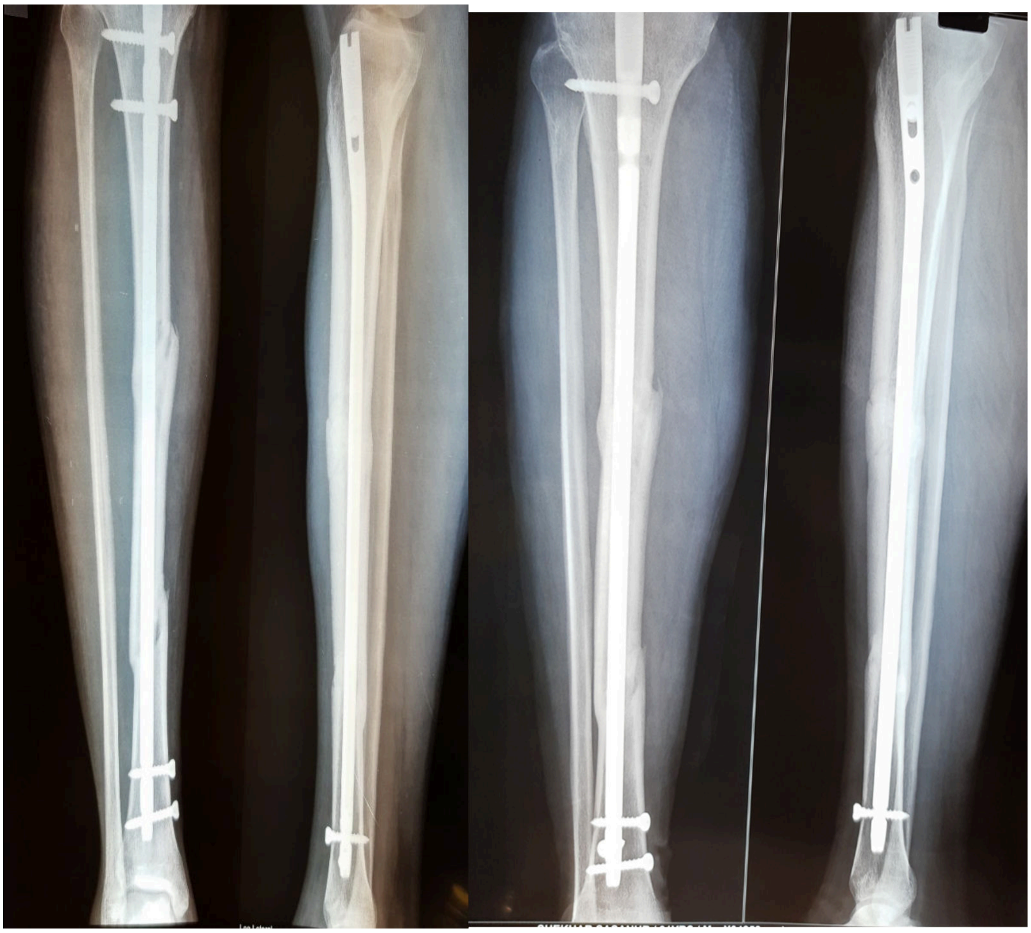
Human Subjects Research,

Jawaharlal Nehru Medical College,

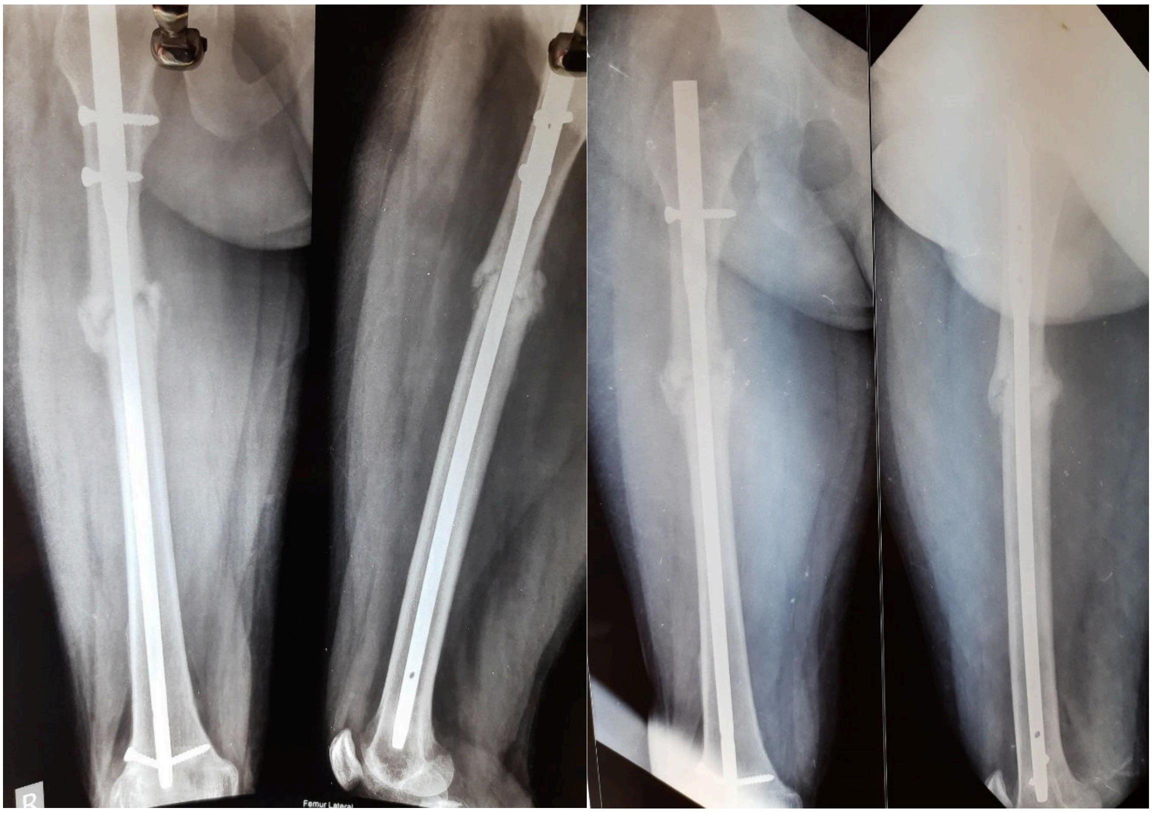
Belgaum -590010

Ph No. 0831-2473777

ANNEXURE IV- PHOTOGRAPHY



Case 3 – Tibia dynamization X-ray



Case 7- Femur dynamization X-ray

ANNEXURE 5- MASTERCHART

AGE/SEX	BONE INVOLVED	MODE OF INJURY	TYPE OF FRACTURE		DATE OF NAILING	CORTEX FUSED	DATE OF DYNAMIZATION	1 MONTH FOLLOW UP	2 MONTH FOLLOW UP	3 MONTH FOLLOW UP	RESULT
20/M	FEMUR	RTA	OBLIQUE	CLOSED	10/22/2019	0	1/14/2020	TWO	THREE	THREE	UNITED
44/M	FEMUR	RTA	SPIRAL	CLOSED	10/28/2019	2	1/14/2020	THREE	THREE	FOUR	UNITED
28/M	TIBIA	RTA	SPIRAL	CLOSED	11/10/2019	1	1/23/2020	TWO	TWO	THREE	UNITED
35/M	TIBIA	RTA	TRANSVERSE	CLOSED	11/16/2019	0	1/25/2020	ZERO	TWO	TWO	NON-UNION
48/F	TIBIA	SELF FALL	OBLIQUE	CLOSED	11/24/2019	2	1/30/2020	TWO	THREE	FOUR	UNITED
53/M	FEMUR	RTA	TRANSVERSE	CLOSED	12/15/2019	0	2/21/2020	ONE	ONE	ONE	NON-UNION
53/M	TIBIA	RTA	SPIRAL	CLOSED	12/15/2019	1	2/21/2020	ONE	THREE	THREE	UNITED
28/M	FEMUR	RTA	SPIRAL	CLOSED	12/24/2019	2	2/25/2020	ONE	TWO	FOUR	UNITED
26/M	FEMUR	RTA	TRANSVERSE	OPEN TYPE 2	12/28/2019	0	2/28/2020	ZERO	ONE	ONE	NON UNION
40/F	TIBIA	RTA	SPIRAL	CLOSED	1/10/2020	2	3/14/2020	THREE	FOUR	FOUR	UNITED
47/M	TIBIA	RTA	SPIRAL	CLOSED	1/20/2020	1	3/24/2020	TWO	TWO	THREE	UNITED
39/M	TIBIA	SELF FALL	OBLIQUE	CLOSED	2/2/2020	2	4/10/2020	TWO	THREE	FOUR	UNITED
44/F	TIBIA	SELF FALL	SPIRAL	CLOSED	2/20/2020	2	4/28/2020	TWO	THREE	FOUR	UNITED
37/F	FEMUR	RTA	COMMINUTED	OPEN TYPE 1	3/3/2020	1	5/14/2020	ONE	ONE	TWO	DELAYED
35/M	FEMUR	RTA	SPIRAL	CLOSED	3/15/2020	2	5/20/2020	TWO	THREE	FOUR	UNITED
25/F	TIBIA	RTA	TRANSVERSE	CLOSED	3/30/2020	0	5/30/2020	ZERO	ONE	ONE	NON-UNION
58/M	TIBIA	TRIVIAL TRAUMA	TRANSVERSE	CLOSED	4/18/2020	0	6/14/2020	ZERO	ZERO	ZERO	NON-UNION
39/F	TIBIA	RTA	SPIRAL	CLOSED	6/14/2020	2	8/18/2020	TWO	TWO	FOUR	UNITED
34/M	TIBIA	RTA	OBLIQUE	OPEN TYPE 2	7/1/2020	1	9/4/2020	ONE	TWO	THREE	UNITED
30/M	FEMUR	RTA	COMMINUTED	CLOSED	8/24/2020	1	10/24/2020	ZERO	ZERO	TWO	DELAYED
56/F	TIBIA	RTA	TRANSVERSE	OPEN TYPE 2	9/16/2020	0	11/10/2020	ZERO	ZERO	ONE	NON-UNION
52/F	TIBIA	RTA	OBLIQUE	CLOSED	9/24/2020	1	11/30/2020	TWO	TWO	THREE	UNITED
43/M	TIBIA	SELF FALL	SPIRAL	CLOSED	10/14/2020	2	12/25/2020	TWO	TWO	FOUR	UNITED
31/F	TIBIA	RTA	SPIRAL	CLOSED	11/1/2020	2	1/10/2021	TWO	TWO	FOUR	UNITED
37/F	FEMUR	RTA	TRANSVERSE	CLOSED	11/8/2020	2	1/20/2021	TWO	THREE	FOUR	UNITED
26/M	FEMUR	RTA	SPIRAL	CLOSED	11/12/2020	1	1/24/2021	TWO	THREE	THREE	UNITED
59/M	TIBIA	RTA	COMMINUTED	OPEN TYPE 1	11/20/2020	1	1/28/2021	ONE	ONE	TWO	DELAYED
50/M	TIBIA	TRIVIAL TRAUMA	SPIRAL	CLOSED	11/28/2021	2	2/10/2021	TWO	THREE	THREE	UNITED
48/F	FEMUR	SELF FALL	OBLIQUE	CLOSED	12/14/2020	2	2/20/2021	THREE	FOUR	FOUR	UNITED
29/M	TIBIA		SPIRAL	CLOSED	12/24/2020	1	3/10/2021	TWO	THREE	FOUR	UNITED