MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.12.317.322

OPEN ACCESS

Key Words
Dynamization, intramedullary nailing, femur, tibia

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Received: 10 October 2024
Accepted: 11 November 2024
Published: 26 November 2024

Citation: Imad Adil Khan, Ashutosh Singh and Umar Akhtar, 2024. Role of Dynamization in Fracture Healing of Femur and Tibia After Intramedullary Interlocking Nail: A One Year Hospital Based Prospective Study. Res. J. Med. Sci., 18: 317-322, doi: 10.36478/makrjms. 2024.12.317.322

Role of Dynamization in Fracture Healing of Femur and Tibia After Intramedullary Interlocking Nail: A One Year Hospital Based Prospective Study

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ABSTRACT
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 e effectiveness of dynamization in tibial and femoral diaphyseal fractures. A total of 30 fractures of femur (11) and tibia (19) were selected for the prospective study in the time frame of 01-01-2020-31-12-2020. 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. In case of femur dynamization, out of 11 cases, 7 cases achieved union. For tibial dynamization, out of 19 cases, 14 achieved union. 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, as compared to nondynamized cases.

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 soonest 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 elasticty 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 isthmi 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 6-12 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 extraordinarily 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.

MATERIALS AND METHODS

This hospital based prospective study was conducted among 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 01-01-2020-31-12-2020.

Sample Size:

- Number of dynamization done in a year-30.
- Patients were examined and x-ray advised, anteroposterior and lateral view.
- 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 clinical for anesthesia fitnesss and surgery. Relevant investigations were done.

Inclusion Criteria:

- Operated case of fracture shaft femur treated with intramedullary interlocking nail .
- Operated case of fracture shaft tibia treated with intramedullary interlocking nail.
- Grade 1,2 Gustillo Anderson open fracture.

Exclusion Criteria:

- Gustillo Anderson type 3.
- Ipsilateral hip, knee and ankle fracture.
- pathological fracture.
- 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.

- Starting at the level of the greater trochanter's tip and continuing 4-5cm proximally, an incision was made over the lateral part of the thigh.
- The iliotibial tract was cut parallel to the skin incision and retracted.
- The fascia that covers the vastus lateralis muscle was incised as well.
- Vastus lateralis fibers were divided and horizontally retracted.
- The hip abductors inserting into to the greater trochanter were meticulously examined and divided to reveal the pyriform fossa area.
- Entry point was made with the help of curved awl until it reaches medullary cavity.
- The awl was removed and a ball-tipped guide wire was inserted into the wound.
- Traction and manipulation were used to reduce the fracture, and a guide wire was passed across the fracture, confirming its location under fluoroscopy.
- Depending on the diameter of the medullary cavity, reamers of increasing diameters were used, ranging from 8mm to a maximum of 12mm.
- After inserting an exchange sleeve, a ball tipped guide wire was replaced with a basic wire.
- 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.
- A proximal jig was used to implant the nail, which was then passed into the distal fragment while maintaining reduction.
- Distal locking was performed freehand under fluoroscopic supervision using a 4.00 mm drill bit.
- Cortical screws of proper diameters, 4.9mm, were used to lock the nail.
- After predrilling with a 4.00mm drill bit and utilizing 4.9mm cortical screws of appropriate sizes, proximal locking was performed using the proximal jig.
- Jig was removed and all wounds were carefully closed in layers.
- Patients were transferred to the post-operative room with compression dressing.
- 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:

- A midline incision was made along the anterior part of the proximal tibia, beginning at the lower pole of the patella and extending 3-4cm distally.
- The patellar tendon was exposed by dissecting subcutaneous tissue in accordance with the skin incision.
- To expose the tibial plateau area, the patellar tendon was either bluntly divided in the middle or retracted laterally.
- Curved bone awl was inserted at a position just distal to the anterior tibial plateau and just medial to the lateral tibial spine.
- A guide wire was inserted once the medullary cavity was reached.
- Traction and manipulation were used to accomplish reduction and a guide wire was inserted into the distal fragment, confirming its location under fluoroscopic supervision.
- Reaming was carried out with reamers of increasing diameters, ranging from 8-12mm.
- 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.
- The nail was chosen to be 1mm smaller in diameter than the thickest reamer that was successfully employed.
- Nail thus chosen was inserted using a jig and passed across the fracture site into the distal fragment while maintaining reduction.
- Distal locking was done using the free hand technique under fluoroscopic guidance.
- 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.
- Reverse impaction was done if indicated by fluoroscopic to impact fracture site if reduction was not proper.
- Proximal locking was done using the proximal jig after predrilling with 4.00mm drill bit and using 4.9mm cortical screws of appropriate sizes.
- The jig was removed and all wounds were carefully closed in layers.
- Occlusive dressings were applied and patients were transferred to the post-operative room.

- 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 mobilization 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:

- Suture line condition.
- Fracture alignment.
- Pain.
- Tenderness at fracture site.
- Knee, hip and ankle mobility.
- Evidence of callus on x-ray.
- 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 checkup (total of 2 months post-op). The following measures were performed at the 2-month post-op visit:

- Pain at the fracture site.
- Tenderness at the fracture site.
- Hip, knee and ankle mobility.
- Callus at fracture site on x-ray.
- Any proof of delayed union.
- 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:

- A sandbag was put beneath the gluteal area on the side to be operated in a supine posture.
- A portion of the femur/tibia was cleansed, painted and drapped.
- Using fluoroscopic guidance, the exact position of the static screw was identified and a stab incision was made immediately above it.
- The static screw was removed with the proper screwdriver after the subcutaneous tissue and muscles were carefully divided and retracted.
- If a bone marrow injection was needed, a 2.7mm drill hole was drilled in the proximal tibial (cancellous) area of the contra lateral side, followed by bone marrow aspiration with an 18G needle.
- Under fluoroscopic supervision, the aspirated marrow fluid was injected directly into the fracture site.
- The wound was carefully cleaned and suturing was done in layers.
- 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.

RESULTS AND DISCUSSIONS

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

Table 1: Gender Wise Distribution of Fracture

Gender	Femur	Tibia	Total
Female	3	8	11
Male	8	11	19
Total	11	19	30

Table 2: Age Wise Distribution of Femur and Tibia Fracture

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 3: RTA is Most Common Cause of Femur and Tibia Fracture

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 4: Fracture Pattern in Tibia and Femur Fracture. Most Common is Spiral and Transverse Fracture

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 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

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 6: 21 Cases Achieved Union, 3 Months Post Dynamization, 6 Delayed Union and 3 Non Union

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	

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 micro movements (Kuntscher ,1940)[7]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[8-10] 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[11] 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 inerrable 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[8-10] furthermore, Burges in 1988 who experienced 47% cases from the age gathering of 20-30. The side of involvement (counting both tibial and femoral breaks) in our review was right in 50% cases, left in 48% and both limb involvement in 2% cases, in this way showing the overall shortfall of preference for any side in road traffic accident. 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.

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. We come to conclusion that if sign of delayed union is there and dynamization is done at 8 weeks of nailing then the chances of union is around 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 how much dynamization is beneficial in gustilo Anderson type 3 open fractures.

REFERENCES

1. Farill, J., 1952. Orthopaedics in Mexico. J. Bone J. Surg. Am., 24: 506-512.
2. Bircher. H., 1887. Eine neue methode unmittelbarer retention bei fracturen derrohrenknochen. 0 Vol. 34.
3. Nicolaysen, J., 1897. Lidt om diagnosen og behandlingen af. colli femoris. , 30: 1-19.
4. Kuntscher, G., 1947. Die marknagelung. Berlin: Saenger.
5. Küntscher, G., 1940. Die Marknagelung von Knochenbrüchen. Langenbeck's Arch Klin Chir (Kongressbericht)., 200: 443-455.
6. Kellam, J.F., 1985. Early results of Sunnybrook experience with locked intramedullary nailing. Orthopaedics., 1985: 1387-1388.
7. Modny, M.T. and A.H. Lewart., 1986. Transfixion intramedullary nail. Orthop. Rev., 15: 83-88.
8. Brumback, R.J., J.P. Reilly, A. Poka, R.P. Lakatos, G.H. Bathon and A.R. Burgess, *et al.,* 1988. Intramedullary nailing of femoral shaft fractures. Part I: Decision-making errors with interlocking fixation. J Bone Joint Surg Am., 70: 1441-1452.

9. Brumback, R.J., S. Uwagie-Ero, R.P. Lakatos, A. Poka, Bathon GH and A.R. Burgess, *et al.,* 1988. Intramedullary nailing of femoral shaft fractures. Part II: Fracture-healing with static interlocking fixation. J Bone Joint Surg Am., Vol. 70.
10. Solooki, S. and S.A. Mesbahi., 2011. Orthopaedic surgery., Shiraz university of medical sciences Iran Red Crescent Med J., 13: 178-180.