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Comparison of Union Rate of Tibial Diaphyseal Fractures Treated with Intramedullary Interlocking (IIL) Nails Versus Dynamic Compression Plate (DCP)

Subhan Shahid[1], Saqib Saleem[2], Suhail Niaz Khan Niazi[3], Mumraiz Salik Naqshband[4], Khair Ul Inam[5], Faisal Masood[6]

1 *Associate Professor, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Data collection, Manuscript writing

2 *Post Graduate Resident, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Data collection

3 *Assistant Professor, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Data interpretation

4 *Associate Professor, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Data analysis

5 *Post Graduate Resident, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Data collection

6 *Professor, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan*
Supervised the study

CORRESPONDING AUTHOR
Dr. Subhan Shahid
Associate Professor, Department of Orthopedic Surgery, Mayo Hospital, Lahore Pakistan
Email: drsubhan1973@gmail.com

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ABSTRACT

Background: In modern era high speed vehicular traffic accident fractures of the tibial shaft are common injuries among the long bones and mainly affect young adults, individuals at their peak of physical and work capacity. This study compares the effectiveness of interlock intramedullary nailing and Dynamic Compression Plating (DCP) for treating tibial diaphyseal fractures. **Objective:** The purpose of this study was to compare the union rate of DCP and intramedullary interlocking nail in diaphyseal fractures of the tibia. **Study Design:** Randomized Controlled Trial. **Settings:** Department of Orthopaedic surgery Mayo Hospital, King Edward Medical University, Lahore Pakistan. **Duration:** Nine months from April 2023 to December 2023. **Methods:** The study includes a sample size of 54 patients (27 patients in each group). Patients were randomly divided into nail and plate groups. All patients were operated by same team of surgeons and results regarding union rate were compared for the two procedures by randomized controlled trial up to nine months. **Results:** A total of 54 patients were enrolled in the study (27 in each group). Out of 27 patients in the nail group, 21(77.78%) had radiological union at last follow up whereas 25 out of 27(92.59%) had union in plate group at same follow up period. **Conclusion:** We concluded that union rate of Dynamic Compression Plate (DCP) is better than interlocking nail. Although, implementation of interlocking nail is ideal in diaphyseal fractures. Furthermore, nail allows early mobilization and weight bearing but union rate is lower than Dynamic Compression Plates.

Keywords: *Tibia, Diaphyseal fractures, DCP, Interlocking nail, Union rate, Fracture.*

INTRODUCTION

In today's world, where industries and machines are widespread, fast traffic accidents often lead to fractures in the shinbone (tibia).[1] These injuries are common among young adults, who are usually at their strongest physically and at their peak working capacity.[2] Tibial shaft fractures can cause temporary or permanent disability because of how often they happen, where they occur, the way the injury happens, and sometimes the type of treatment needed.[3] Despite advancements in medical care, tibia fractures still challenge orthopedic surgeons because complications like non- healing and infections are quite common.[4] The primary complications associated with fractures in the tibial diaphysis involve infection, delayed union, malunion, and nonunion. Consequently, the effective management of these fractures necessitates the application of advanced techniques and specialized care.[5]

Tibial diaphyseal fractures present a common Orthopedic challenge, and the choice of treatment significantly impacts patients' outcomes.[6] A tibial diaphyseal fracture stands out as the most frequently occurring fracture among long bones.[7] Positioned prominently and with approximately one-third of its surface beneath the skin, the tibia is susceptible to frequent injuries.[8] Complicating

matters, the knee and ankle joints function as hinges, making it challenging to compensate for rotational deformities associated with tibial fractures.[9]

Interlocking nails are thin rods that surgeons use to stabilize broken bones, especially in the shinbone (tibia). These nails have a unique design, fitting inside the bone to provide strong support.[10] During surgery, the interlocking nail is carefully placed and secured, allowing the bone to heal properly. This method is efficient and helps patients get back on their feet faster.[11]

Dynamic Compression Plates (DCP) are like sturdy metal plates used to fix fractured bones. Surgeons carefully position the plate on the surface of the bone and secure it with screws.[12] The plate helps the bone stay in place and supports the healing process. DCP is a reliable method, offering compression and stability to the fractured bone and aiding in a quicker recovery of patients.[13]

The reason for conducting this study lies in the fact that using an Intramedullary Interlocking nail demands an image intensifier, exposing individuals to radiation and requiring technical expertise. On the contrary, Dynamic Compression Plating (DCP) can be done without an image intensifier and is simpler to perform.

Thus, the aim was to compare these two techniques and determine their respective rates of union in tibia shaft fractures.

METHODS

In this study, a rigorous research design has been employed, adopting a Randomized Controlled Trial (RCT) methodology. Ethical approval taken from the hospital ethical board (no#413/RC/KEMU).

The sample size was meticulously determined, targeting a cohort of 54 patients, with 27 individuals allocated to each treatment group. The estimation of this sample size was conducted using a 5% level of significance and ensuring a robust 95% power of the test. To enhance the randomness and generalizability of the study, a probability simple random sampling technique was employed as the sampling strategy. This method ensures that every suitable patient has the same opportunity to be chosen for either the intramedullary interlocking nail or dynamic compression plate group. This contributes to making the study results more dependable and trustworthy.

The patients between the ages of 18 to 70 years, of either gender, who were presented within 24 hours of injury. The patients who face tibia diaphyseal fracture are categorized as AO types 42A, 42B, and 42C were considered eligible for participation.

We didn't include patients with conditions like diabetes, chronic liver disease, or chronic kidney disease. Also, we left out those with more than one fracture, nerve or blood vessel issues, past injuries to the same leg, leg deformities, open fractures from farms, weak bones, or fractures caused by diseases. We made these decisions after carefully looking at their medical history, doing clinical assessments, and checking X-rays.

After obtaining approval from the Institutional Review Board (IRB), we selected patients who met the inclusion criteria through the Orthopedic Emergency department at Mayo Hospital Lahore. Each patient or their attendants provided informed written consent. Using a lottery method, patients were randomly assigned to either group A or group B. Group A patients underwent treatment with a reamed Intramedullary Interlocking nail, while Group B patients were treated with a Dynamic Compression Plate (DCP). Both groups were allowed knee and ankle movements, and patients started using crutches one day after the operation. Our main focus was on observing radiological union as the primary outcome. Patients had follow-up appointments in the outpatient department at the 2nd, 6th, 12th, 18th, 24th, and 36th week postoperatively. Bone union based on Modified RUST (Radiological Union Scoring for Tibia) criteria was assessed. Partial weight bearing was permitted at the 6th week and gradually increased.

SURGICAL TECHNIQUE:

Intermedullary Interlocking Nailing: In group A, every patient underwent treatment with reamed intramedullary interlocking nail. Patients were prepared and placed on a radiolucent table in a lying-down position after obtaining informed consent from them or their attendants. The approach was made through the knee, followed by the insertion of a guide wire, fracture reduction, reaming, and finally securing the nail with interlocking screws.

Fixation with DCP: Patient in Group B underwent treatment with Dynamic Compression Plating. After preparation, informed consent was obtained from patients or their attendants. An incision was given along the subcutaneous border of the tibia, subcutaneous tissues dissected, and the fracture was exposed and reduced. Following this, Dynamic Compression Plating, either with or without a lag screw, was applied, and a minimum of four screws were inserted on both sides of the fracture.

The data was arranged, entered and examined through SPSS version 26.0. Age, considered a quantitative variable, were expressed as mean ± standard deviation. Gender and the limb's side, which are qualitative variables, were presented as frequencies and percentages.

An Independent T-test was applied to assess the relationship between gender and patient union, considering a significance level of p- value less than 0.05.

RESULTS

The outcomes of this Randomized Controlled Trial (RCT) revealed intriguing insights into the union rates of tibial diaphyseal fractures when treated with either intramedullary interlocking nail or dynamic compression plate. Over the nine-month study period, a meticulously selected cohort of 54 patients, evenly distributed between the two treatment groups, underwent thorough assessment and analysis.

The results of this randomized controlled trial, comprising a sample size of 54 patients (27 in each group), revealed noteworthy differences in the union rates between tibial diaphyseal fractures treated with Intramedullary Interlocking Nail (IIN) and Dynamic Compression Plate (DCP). Among the patients treated with IIN, 21 out of 27 exhibited radiographic evidence of union within the study period, yielding an 77.78% union rate. Contrastingly, the group treated with DCP demonstrated a higher union rate, with 25 out of 27 patients achieving radiographic.

union, resulting in an 92.59% success rate (p value = 0.03). These numerical outcomes suggest a notable advantage in favor of DCP in promoting the union of tibial diaphyseal fractures within the specified study duration. The statistical significance of these findings will be further analyzed to ascertain the robustness and generalizability of the observed differences.

DISCUSSION

The observed differences in union rates between the Intramedullary Interlocking Nail (IIN) and Dynamic Compression Plate (DCP) groups, as evidenced by the study's sample size of 54 patients (27 in each group), carry significant implications. The results indicate a 77.78% union rate for tibial diaphyseal fractures treated with IIN, while fractures managed with DCP exhibited a higher union rate of 92.59%. This numerical contrast suggests a considerable advantage in favour of DCP in promoting successful fracture union within the specified nine-month study duration. The 14.81% absolute difference between the two groups highlights a potentially clinically relevant discrepancy. The superior performance of DCP may be attributed to its capacity for rigid stabilization, precise alignment control, and adaptability to various fracture patterns. Nevertheless, it is crucial to conduct additional research to examine potential variables that might impact the results and ascertain the applicability of these findings to a wider population. Furthermore, the practical importance of the observed percentage difference should be evaluated within the framework of individual patient factors and their long-term outcomes.

CONCLUSION

Our study concluded that as compared to intramedullary interlocking nail, Dynamic Compression Plating of tibial diaphyseal fractures have superior results in terms of union. This may be due to primary compression preventing micro movements at fracture site, anatomical reduction and rigid fixation. However, patient is unable to bear weight on affected leg as compared to intramedullary nailing where early mobilization is the main advantage

LIMITATIONS

Limitations of our study are small sample size and lesser duration of follow up.

SUGGESTIONS / RECOMMENDATIONS

We recommend further trials to generalize these results.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare that there was no conflict of interest.

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