

**“A STUDY OF FUNCTIONAL OUTCOME OF PROXIMAL TIBIA
FRACTURES TREATED WITH MINIMALLY INVASIVE
PERCUTANEOUS PLATE OSTEOSYNTHESIS TECHNIQUE – A
PROSPECTIVE STUDY”**

BY

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**DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER
EDUCATION AND RESEARCH, KOLAR, KARNATAKA**

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

ORTHOPAEDICS

Under the Guidance of

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ACKNOWLEDGEMENT

*First and foremost, I express my profound gratitude to **ALMIGHTY** and my beloved parents **H.M ASHWATH NARAYANA REDDY** and **RUKMINI A N REDDY**, my sisters **GOWTHAMI A** and **MONICA A.N REDDY** and my brother-in-laws **RAVINDRA P** and **SHARATH S** and my friends **NITESH S, DR SUPREETH , Dr MANASA REDDY, Dr SANJANA GK, Dr KOTLO RUKMINI** for giving me continuous encouragement, unfailing support and unconditional love throughout my journey of completing my postgraduate dissertation and my life. Their encouragement and belief in me motivated me to strive for excellence. I am grateful for their understanding when I was consumed with my work and for always being there for me emotionally and practically. I would like to thank my parents for providing me with all the resources I needed and for always being my role models.*

I would like to acknowledge all those who have supported me, not only to complete my dissertation, but throughout my post-graduation course.

*I wish to express my heartfelt indebtedness and owe a deep sense of gratitude to my mentor and guide **Dr. NAGAKUMAR JS** Professor and head of the Department, Department of Orthopaedics for being very helpful throughout the study and offered their invaluable guidance and support to fully understand and complete this study. Through their vast professional knowledge and expertise, he ensured that I understood everything before I apply the information in my study. Without their constant supervision and advice completion of this dissertation would have been impossible. Their stature, sense of punctuality, strict adherence to academic schedule, humility and knowledge have been highly inspirational for the whole of my post graduation period.*

*I am extremely thankful to **Dr. ARUN H.S**, Professor and Head of the Unit, Department of Orthopedics, for encouraging me to the highest peak, paying close and continuous attention towards me to finish all tasks and providing his kind support, valuable suggestions, immense patience and great care. His sense of punctuality, strict adherence to academic schedule, humility and knowledge have been highly inspirational for the whole of my postgraduation period.*

*It gives me immense pleasure to extend my sincere thanks to Professor **Dr. PRABHU E**, Professor and Head of the Unit, Department of Orthopaedics. Who is a pioneer in academics and teaching activities, taking it to high standards for a post graduate student and keep encouraging, guiding in correct path to be knowledgeable and successful in the field of Orthopaedics.*

*I wish to express my heartfelt sense of gratitude to **Dr. HARIPRASAD.S** Professor, Head of the unit, Department of Orthopedics for being helpful throughout the study. He had offered his invaluable guidance and moral support during my entire post-graduate course, which enabled me to complete my work.*

*It gives me immense pleasure to extend my sincere thanks to Professor **Dr. SAGAR V** for his guidance, motivation and moral support during my entire postgraduate course which enabled to complete my work.*

*I am extremely thankful to **Dr. MANOJ KUMAR, Dr. ANIL KUMAR, Dr. KARTHIK SJ, Dr. ARUN KUMAAR, Dr. VINOD KUMAR K, Dr. NULAKA HARISH, Dr. PUNITH, Dr. SRINATH REDDY KB, Dr. ATHEETH** for their constant help and guidance throughout the course. They were the source of encouragement, support and for patient perusal, to which I am deeply obliged.*

*I am extremely thankful to **Dr PRADEEP KUMAR** for his constant help and guidance throughout the course. He was the source of encouragement, support and for patient perusal, to which I am deeply obliged.*

*My heartfelt thanks to my seniors **Dr. B.V HRUSHIKESH, Dr.VISHNUVARDHAN, Dr. SIYAD M NAZAR, Dr. KIRAN, Dr. JAGADISH, Dr. VYSHNAV, Dr. TARUN** for their support and help in carrying this study and throughout the graduation course.*

*I express my sincere thanks to my colleagues and dear friends **Dr. AKSHAY, Dr. GILS, Dr.NAVIN, Dr. ARYADEV, Dr. GOWTHAM, Dr. ROHITH, Dr. AYUSH** for their constant support.*

*I thank my JUNIORS **Dr. SHOBHET, Dr. MUTHUKUMAR, Dr. RAHUL THAPA Dr.ASHWIN, Dr.RICHIK SARKAR ,Dr.SIVA, Dr. NIDHIL, Dr.KAMAL, Dr. ANJANI, Dr.KASHYAP, Dr. AJAY, Dr. JAYAVARDHAN, Dr. RAGHU, Dr. JHANAVI, Dr. AMIT, Dr. ANKIT** for providing support throughout the study.*

*I am also thankful to all the **INTERNS, OT, OPD and PARAMEDICAL STAFF** for their valuable help while performing this study.*

*I express my special thanks to all my **PATIENTS** and their families, who in the final conclusion are the best teachers and without whom this study would have been impossible.*

DR. BASANTH REDDY A



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PERCUTANEOUS PLATE OSTEOSYNTHESIS TECHNIQUE – A
PROSPECTIVE STUDY**



ABSTRACT

Background

Proximal tibia fractures, often resulting from high-velocity injuries or fall from great heights, pose significant challenges due to their complexity ,intraarticular extension and post operative complications. This study aims to evaluate Minimally invasive percutaneous plate osteosynthesis technique in treating these fractures, focusing on functional outcome.

Aim and Objective

Aim:

- To assess the functional outcome of Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using modified Rasmussen score at the end of 1, 3 and 6 months.

Objectives:

- To evaluate the pain after Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using Visual analogue score.
- To assess the functional outcome of Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using modified Rasmussen score at the end of 1, 3 and 6 months.

Methodology

This prospective observational study included 35 patients aged 18 years and above with proximal tibia fractures treated at R.L. Jalappa Hospital and Research Centre. Data on demographics, comorbidities, fracture type, and outcomes were collected. After considering inclusion and exclusion criteria, Patients underwent Minimally invasive percutaneous plate osteosynthesis technique for proximal tibia fractures and were followed up at 1 month, 3 months, and 6 months postoperatively.

Results

Patients with proximal tibia fractures had an average age of 43.91 years; 74.29% of the individuals were of the male gender, and the remaining 25.71% were of the female gender. 40% of patients had left side injuries, and 60% of patients had right side injuries. 31.43% of patients had schatzker type IV. There were significant improvements in functional outcomes as measured by Modified Rasmussen score, with most patients showing substantial increases by 6 months post-op. In an average of twenty weeks, most fractures were satisfactorily united. And there was a significant decrease in pain score during the follow-up. Complications were minimal and included surgical site infection in one case.

Conclusion

From the study findings it can be concluded that proximal tibia fractures treated with Minimally invasive percutaneous plate osteosynthesis technique had significant functional improvement. Modified Rasmussen score significantly improved from the first month to the third and sixth months. At one, three and six months, the VAS score showed a substantial reduction in pain. In this study, a lower rate of complications was seen.

MIPPO favor biological environment for further healing(biological fixation) as it preserves vascularity and fracture hematoma. Fracture healing is noted with better outcome as compared to other methods.

Keywords: Minimally invasive percutaneous plate osteosynthesis MIPPO), Visual analog score(VAS), Modified Rasmussen score.

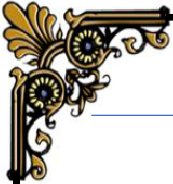


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ABBREVIATIONS

S. No	Abbreviation	Explanation
1	MIPPO	Minimally Invasive Percutaneous Plate Osteosynthesis
2	AO	Arbeitsgemeinschaft Fur Osteosynthesefragen
3	CRIF	Closed reduction and internal fixation
4	ORIF	Open Reduction and Internal Fixation
5	ARIF	Arthroscopic reduction and internal fixation
6	RTA	Road Traffic Accident
7	VAS	Visual Analog Score
8	ROM	Range Of Motion
9	ECG	Electrocardiography
10	LCP	Locking compression plate

INTRODUCTION

INTRODUCTION

Five to eleven percent of all tibia fractures are proximal tibia fractures.¹ Most proximal tibia fractures happen because of high velocity injury or fall from heights.²

If not properly treated, proximal tibia intraarticular fractures might cause functional disability. The lateral condyle is affected in proximal tibia intraarticular fractures in 55-70% of cases. Bicondylar fractures are observed in 10-30% of proximal tibia fracture cases, whereas 10–23% of instances include isolated injuries to the medial condyle.³

High-energy trauma-related intra-articular fractures are typically accompanied by damage to the capsule, ligaments, and other soft tissues around the joint.³ Low energy trauma is characterized by wedge failure, wedge depression, and pure depression types.⁴

Undisplaced proximal tibia fractures can be managed conservatively with closed reduction and cast application but can lead to complications like knee stiffness, malunion. Various options for operative managements such as, Interlocked nailing will have disadvantage of biomechanically not suitable. Fixation with

screws can lead to complications like inadequate fixation and residual deformities.

Complications like wound infections, skin necrosis, and extensive dissection of soft tissues might arise from open traditional plating. Complications such as pin site infections, septic arthritis of the knee joint, and arthritis can arise from external stabilization using pins and rods.^{3,4}

A positive functional outcome can be further achieved by fixing the condyles and requiring less manipulation of the soft tissue with the use of Minimally invasive percutaneous plate osteosynthesis (MIPPO) technique.⁵

AIMS & OBJECTIVES

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AIM & OBJECTIVES

AIM:

- To assess the functional outcome of Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using Modified Rasmussen score at the end of 1, 3 and 6 months.

OBJECTIVES:

- To evaluate the pain after Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using Visual analog score(VAS score).
 - To assess the functional outcome of Minimally invasive percutaneous plate osteosynthesis technique in proximal tibia fractures using modified Rasmussen score at the end of 1, 3 and 6 months.
-

REVIEW OF LITERATURE

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REVIEW OF LITERATURE

Anatomy of Tibia:

The tibia is one of the two bones that make up the leg.⁸ It is the weight-bearing bone, larger and stronger than the fibula. The tibia forms the ankle joint distally with the talus and fibula, and the knee joint proximally with the femur. The interosseous membrane connects the tibia and fibula as it extends medially from just below the knee joint to the ankle joint.⁹

The medial and lateral condyles of tibia make up the inferior portion of the knee joint. The anterior collateral ligament, posterior collateral ligament, and menisci attach to the intercondylar region, which is located between the two condyles.

There are three surfaces and three boundaries on the triangular-shaped shaft of the tibia.¹⁰ The lateral, medial (anterior), and posterior are the three surfaces, and the three borders are the anterior, medial, and interosseous. The posterior surface abuts the posterior compartment of the leg, the lateral surface abuts the anterior compartment, and the medial surface is primarily subcutaneous.

The medial malleolus is a distal medial protuberance that forms the distal portion of the tibia, which has a box-like structure.¹¹ The distal tibia consists of five surfaces. The talus and inferior surface of tibia articulate smoothly.

The anterior surface is covered by extensor tendons and provides an area for ankle joint capsule attachment. A groove for the tibialis posterior muscle is present on the posterior surface. On the lateral surface there is a fibular notch where the interosseous membrane is attached. The medial surface consists of a broad bony prominence called the medial malleolus.

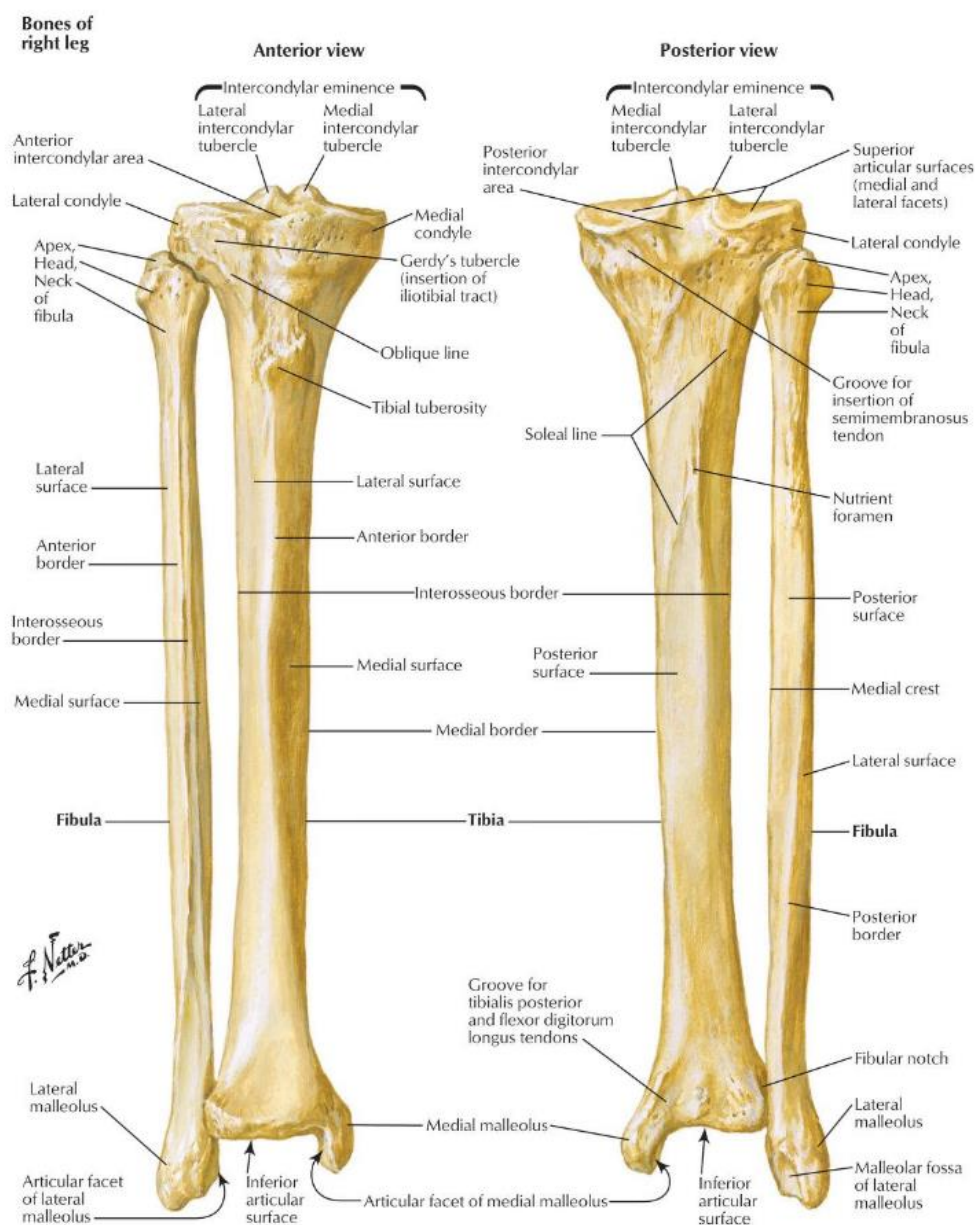


Figure 1:Osteology of Tibia⁵⁵

Structure and Function

Being the body's second-largest bone, The medial portion of the tibia function is to bear the majority of the weight load.¹² Additionally, it is the origin or insertion point of eleven muscles that enable extension and flexion at the knee joint, dorsiflexion and plantarflexion at the ankle joint.

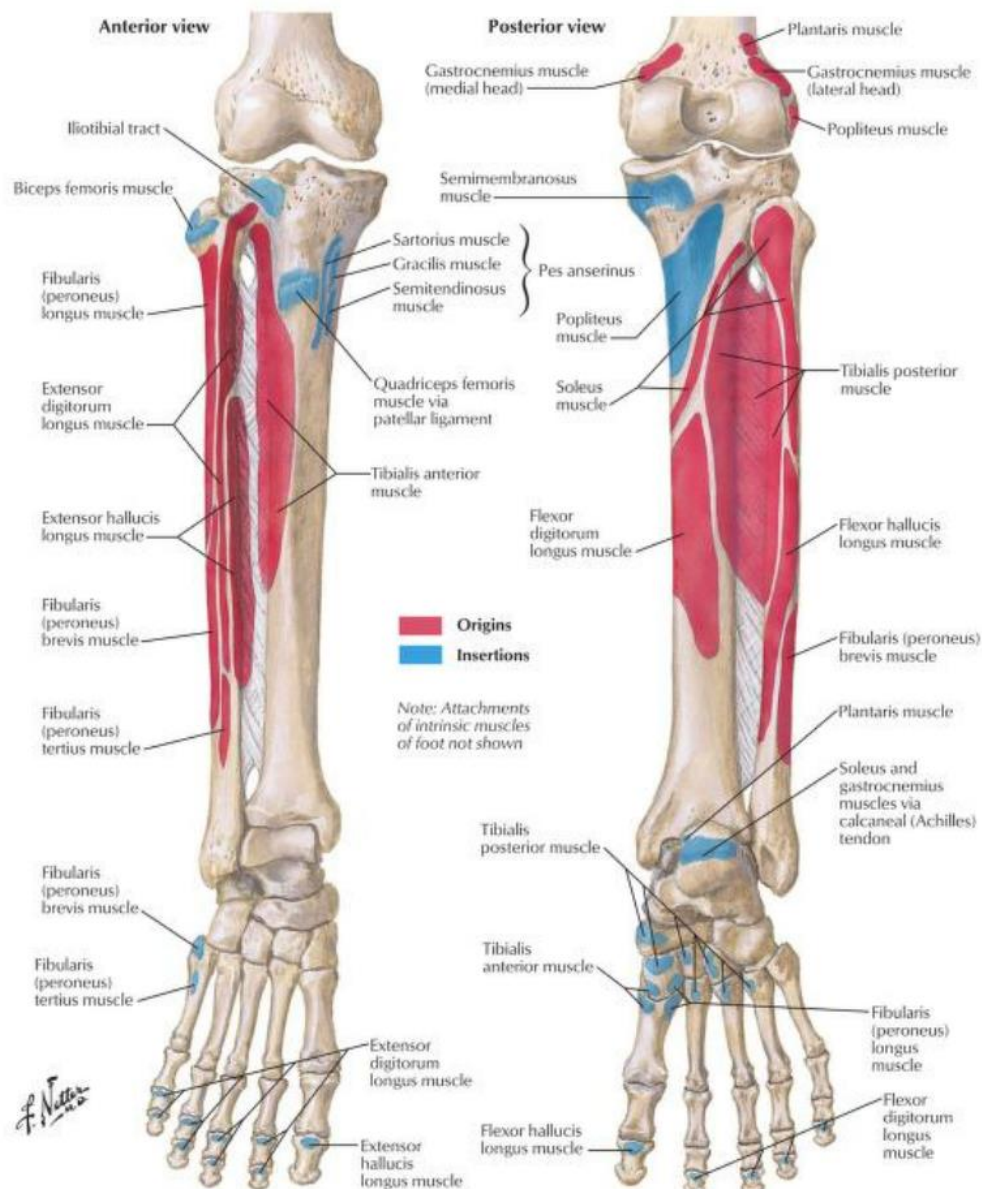


Figure 2: Muscle attachment of leg⁵⁵

Tibial Osteology

The Proximal Tibia:

- Lateral condyle : the tibia's lateral proximal portion where it articulates with the femur
- Medial condyle - The tibia's medial proximal portion articulates with the femur.
- Lateral tibial plateau - the superior articular surface of the lateral condyle
- Medial tibial plateau - the superior articular surface of the medial condyle
- Intercondylar area
- Anterior area: situated between the lateral and medial condyles anteriorly. the anterior cruciate ligament's attachment site.
- Posterior area: situated between the lateral and medial condyles posteriorly. the posterior cruciate ligament attachment site.
- Intercondyloid eminence (tibial spine): consisting of a medial and lateral tubercle situated between the articular facets. Menisci and cruciate ligament attachment points are located in the depression posterior to the intercondylar eminence.

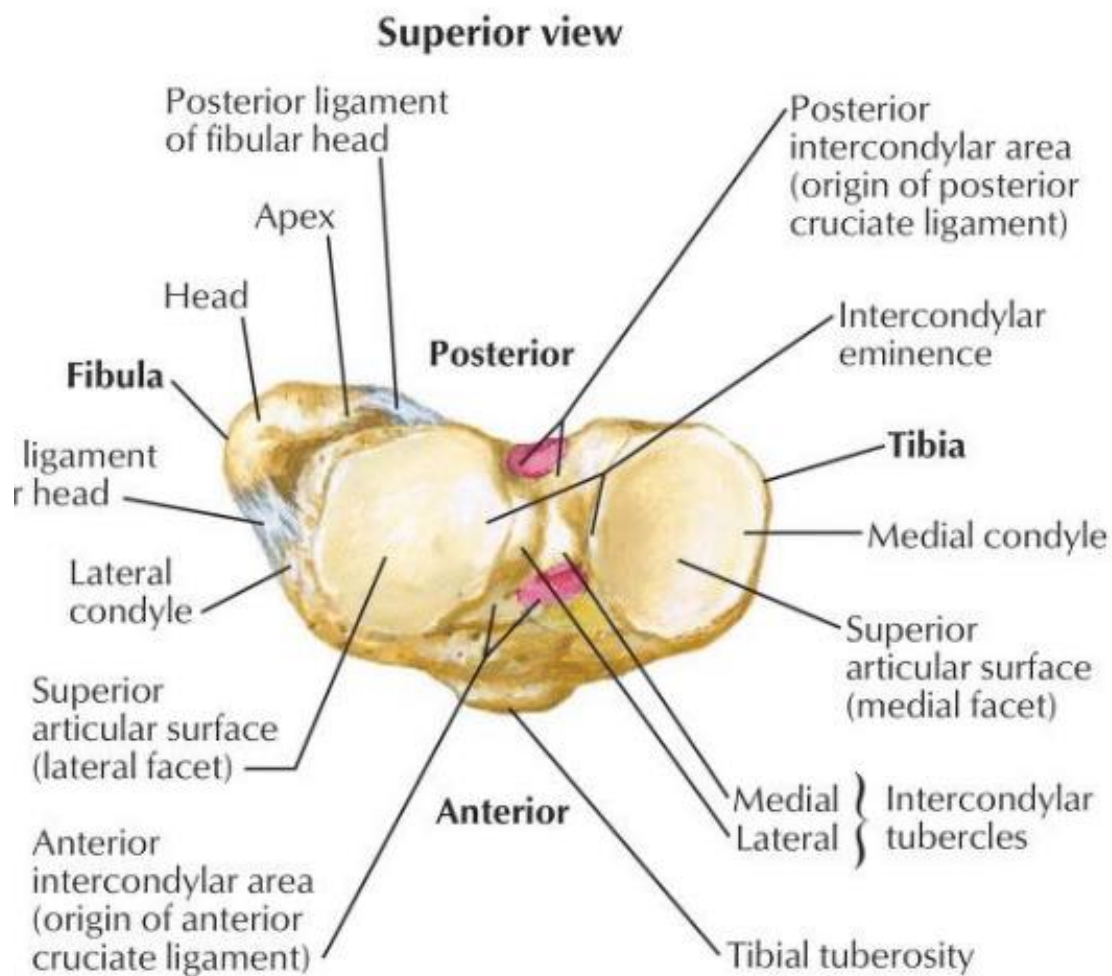


Figure 3: Anatomy of Tibial condyles⁵⁵

The Tibial Shaft:

- The tibia shaft is shaped like a prism with three borders (anterior, medial, and interosseous) and three surfaces (lateral, medial/anterior, and posterior).
- The lateral and medial surfaces are separated by the anterior border. The medial border separates the posterior surface from the medial surface. The posterior surface from the lateral surface is separated by interosseous border. The medial/anterior surface, sometimes known as the shin, is perceptible down the lower leg. It has the tibial tuberosity in it, the bony projection where the patellar ligament attaches to the anterior tibia
- Lateral surface: acts as the tibia and fibula's interosseous membrane's boundary and point of attachment.
- Posterior surface: comprises the soleal line. The soleal line, an oblique line on the posterior tibia, is the point of origin for the flexor digitorum longus, tibialis posterior, and soleus muscles.
- The tibial shaft serves as the place of origin or insertion for a number of muscles, including the quadriceps femoris, extensor digitorum longus, sartorius, gracilis, soleus, flexor digitorum longus, popliteus and tibialis posterior.¹⁰

The Distal Tibia:

- The distal part of the tibia has a box-like appearance. ¹¹ Distal tibia is composed of five surfaces.
- The location for ankle joint capsule attachment is located on the anterior surface, which is covered by extensor tendons.
- The talus and inferior surface articulate smoothly.
- A groove for the tibialis posterior muscle is present on the posterior surface.
- The interosseous membrane attaches to the lateral surface by a fibular notch.
- The medial surface, which comprises the medial malleolus, is a large bony protrusion. The distal projection of the tibia that articulates with the talus is called the medial malleolus. On the posterior portion of medial malleolus lies the groove where tendon of tibialis posterior is situated.
- The tibiofibular joint is located near the fibular notch.

INTRA ARTICULAR STRUCTURES:

These include the menisci and cruciate ligaments.

The two ligaments are

1) Anterior Cruciate Ligament

2) Posterior Cruciate Ligament

- In the sagittal plane, they provide stability. All of them are intracapsular.

With ACL being intrasynovial and PCL being extrasynovial.

MENISCUS:

1) Medial meniscus

2) Lateral meniscus

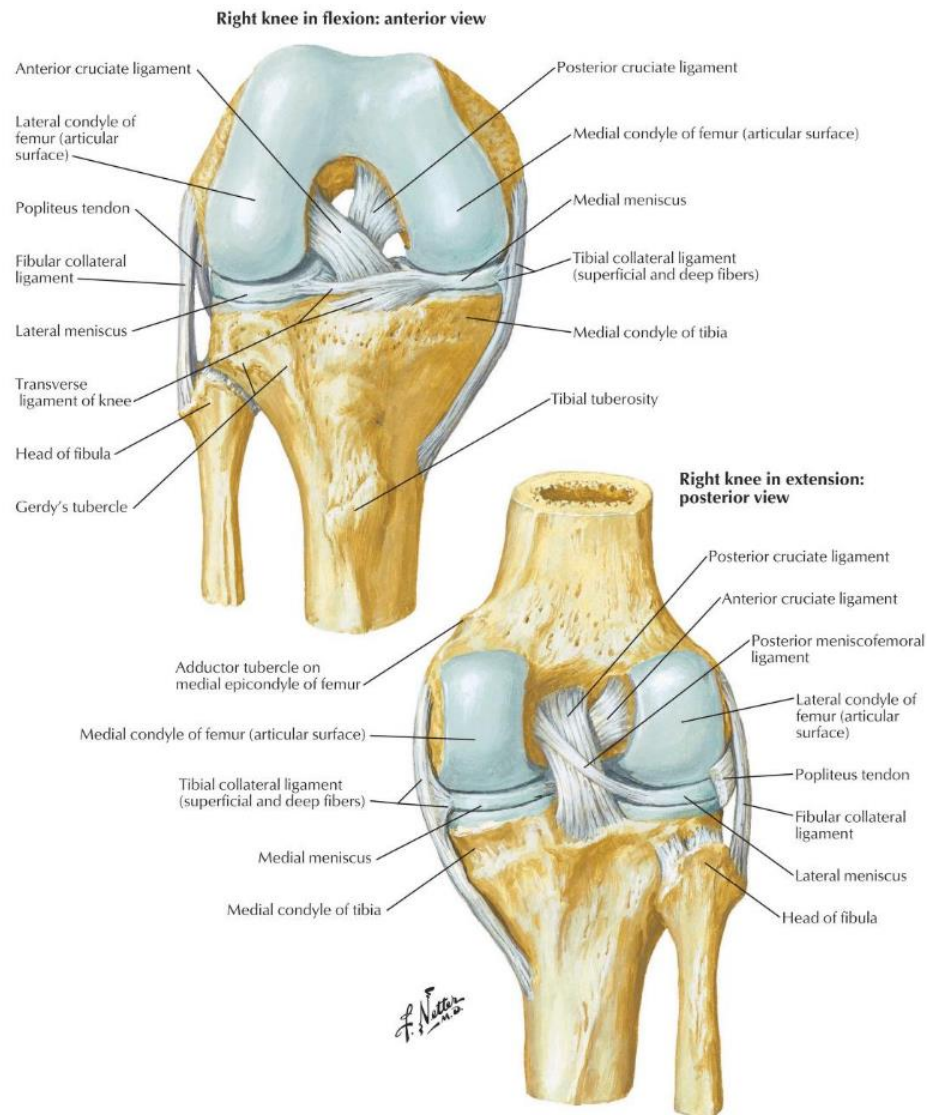


Figure 4:Anatomy of Knee joint⁵⁵

EMBRYOLOGY

There are three ossification centres on the tibia: one for each epiphysis and diaphysis. It starts in the shaft approximately the 7th week of pregnancy. For females, the proximal ossification centre closes at age 16, whereas for men, it closes at age 18.^{12,13} For females, the distal ossification centre closes at age 15, and for males, it closes at age 17.

NERVE SUPPLY

The major nerves supply the surrounding compartments are the main source of all the nerves that supply the tibia.¹⁵ In the leg's posterior compartment, posterior aspect of the tibia is supplied by tibial nerve, whereas anterior aspect of the tibia in the anterior compartment is supplied by deep fibular nerve.

VASCULAR SUPPLY

Blood is supplied to the tibia by the nutrient artery and the periosteal vessels. The nutrient artery emerges from the posterior tibial artery and enters the bone posteriorly and distal to the soleal line. The periosteal vessels originate from the anterior tibial artery.¹⁴

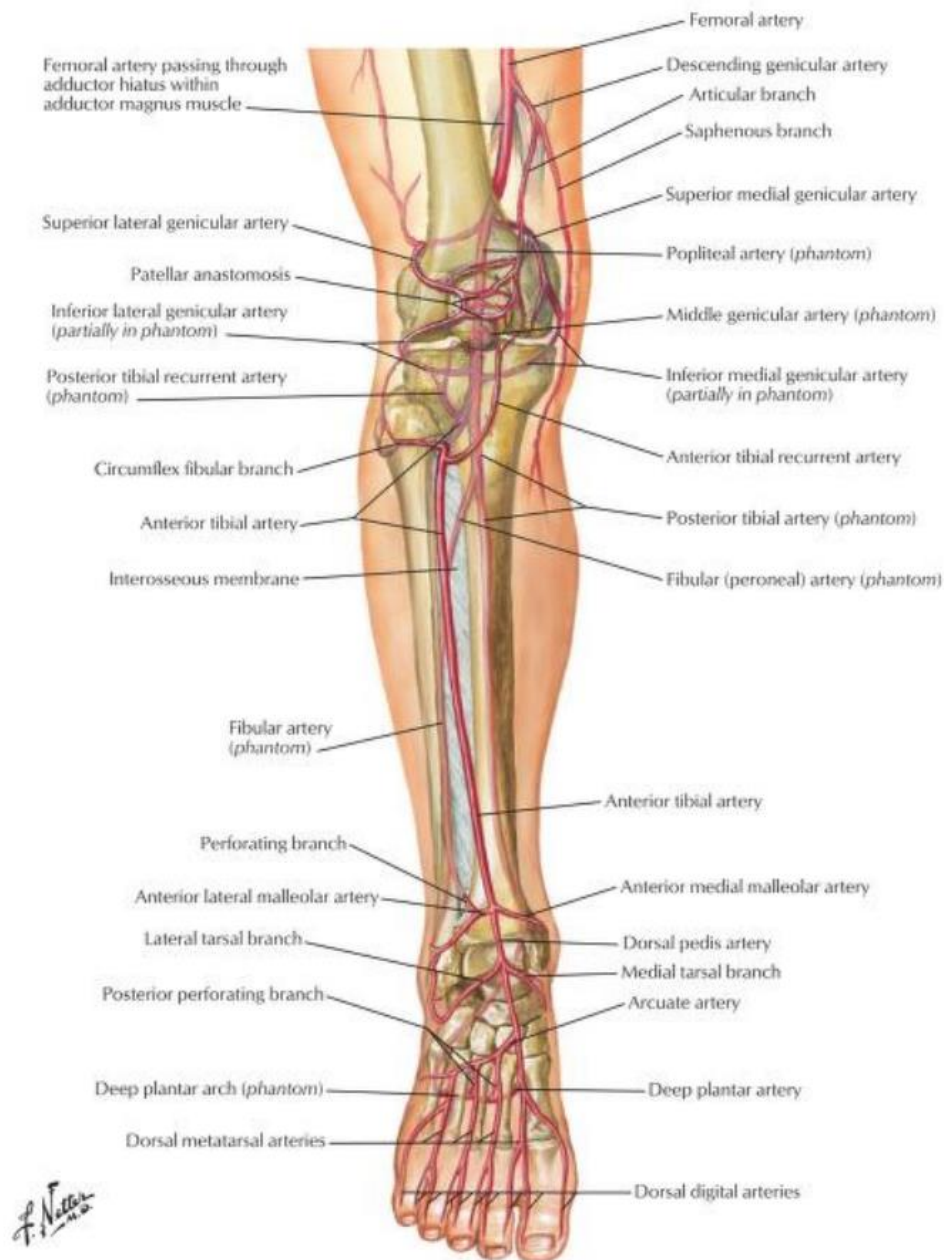


Figure 5: Blood supply of Leg⁵⁵

PROXIMAL TIBIA FRACTURES:

Classification:

To minimize complications and increase success, the treating physician must properly match treatment approaches with the kind of fracture and soft tissue injury patterns. To accomplish this, the injury needs to be classified in some way. Its classification should indicate the likelihood of complications during treatment, allowing for the selection of management techniques that will reduce such risks and maximize results. Surgeons with experience make these selections based on a range of information that gives them an idea of the "personality" of the fractures.¹⁶ Surgeons have been formally classifying proximal tibia fracture forms for a long time. Researchers have tried to categorize the soft tissue damage more recently. Unfortunately, research has demonstrated that the fracture classifications now in use have rather low observer reliability and reproducibility.¹⁷ This issue has significantly hindered the systems capacity to precisely estimate the risk of problems, define prognosis, and compare the outcomes of various treatment modalities.

AO CLASSIFICATION:¹⁸

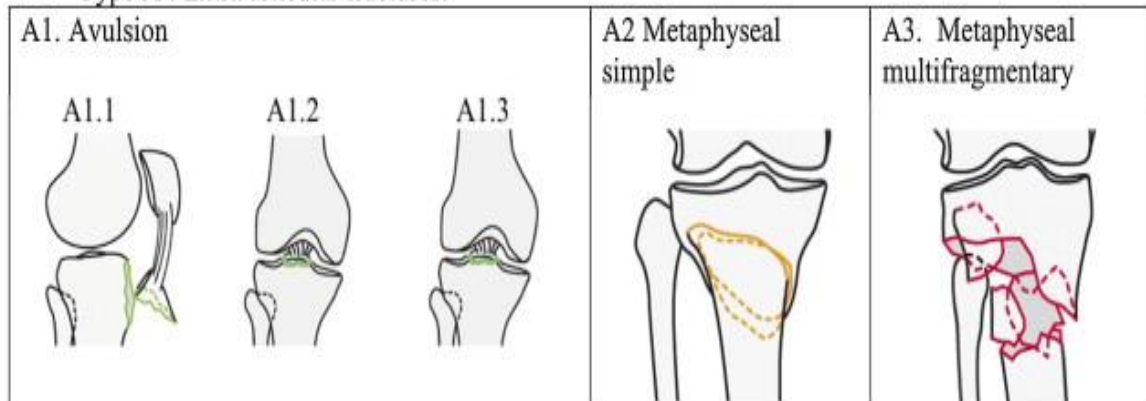
For proximal tibial fractures, the AO/OTA classification system offers thorough explanation.

Table 1: Showing the AO classification of proximal tibial fractures.

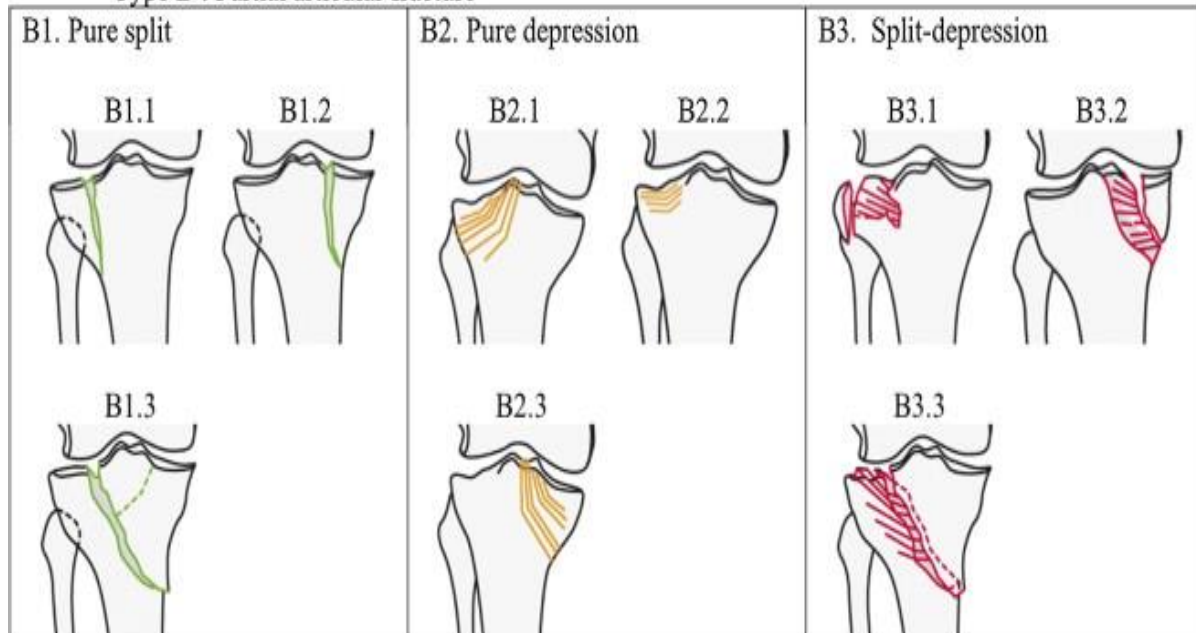
Type	Sub type	Description
Extra Articular	A1	Avulsion
	A2	Metaphyseal simple
	A3	Metaphyseal multifragmentary
Partial articular	B1	Pure split
	B2	Pure Depression
	B3	Slit Depression
Complete articular	C1	Simple, Metaphyseal simple
	C2	Simple metaphyseal, multi fragmentary
	C3	Multi fragmentary

Section 41 : proximal tibia/fibula fractures

Type A : Extra articular fractures.



Type B : Partial articular fracture



Type C : Complete articular fracture

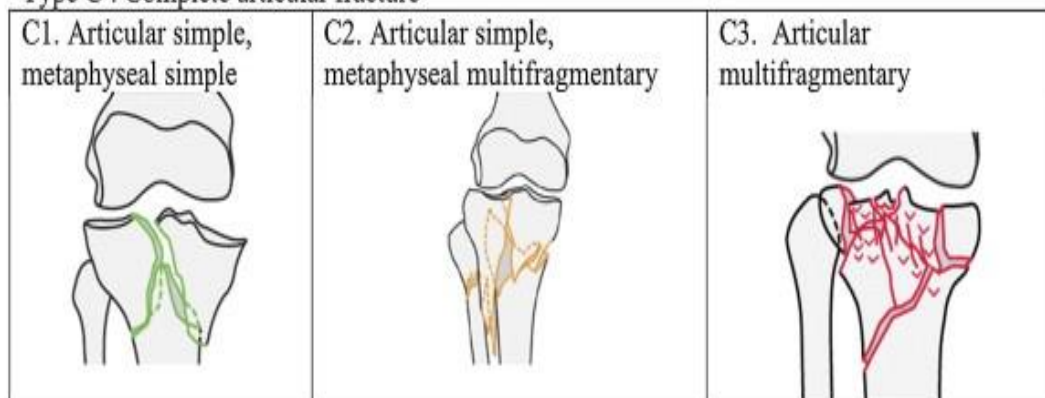


Figure 6: Showing the AO classification of fractures of proximal tibia

SCHATZKER CLASSIFICATION:¹⁹

The Schatzker classification divides tibial plateau fractures into six types: Type I is lateral plateau fracture without depression; type II is lateral plateau fracture with depression; Compression fracture of the lateral (type IIIA) or central (type IIIB) plateau; type IV is medial plateau fracture; type V is bicondylar plateau fracture; type VI is plateau fracture with diaphyseal discontinuity.

SCHATZKER CLASSIFICATION

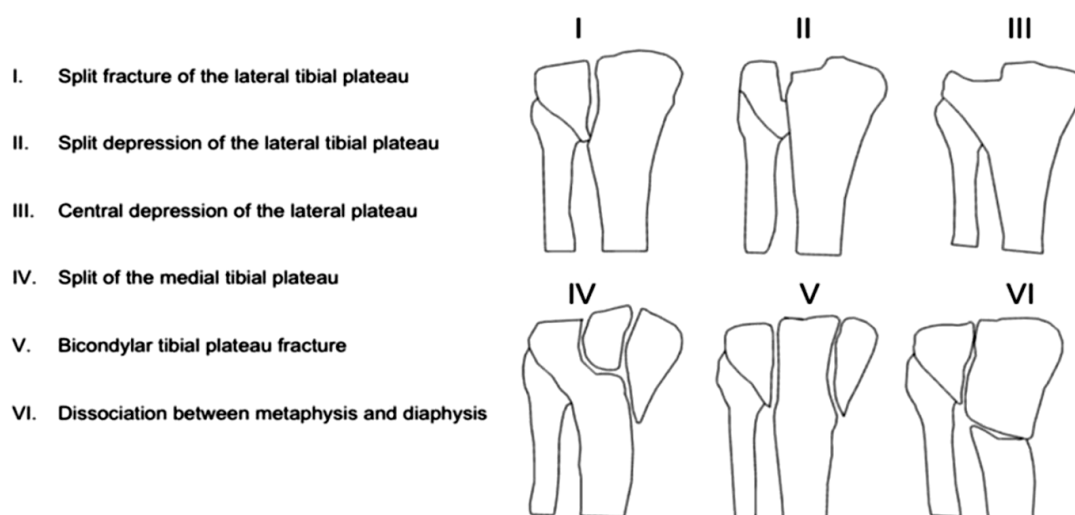


Figure 7: Schatzker classification of proximal tibia fracture

MANAGEMENT:

When treating proximal tibial fractures, there are three objectives:

1) Reconstruction of the joint surface:

It's critical to accurately rebuild the tibial articular surface because if the uneven levels persist, Secondary osteoarthritis may arise as a result of amplified impact force and fast erosion, especially in the area of maximal weight bearing where there is no meniscal protection.

2) Reconstruction of knee axis and a “height stable” tibial plateau:

It can occasionally be challenging to attain perfect articular congruency, particularly in cases of severely comminuted fractures. Furthermore, opinions differ about the acceptable step-off in the articular surface. When compared to other joints, articular incongruities alone seem to be more easily tolerated in the tibial plateau. Meniscus retention needs to be given specific attention in addition to joint stability and coronal alignment.²⁰ Joint instability, or "pseudolaxity," which results from a lower tibial head height rather than a ligamentous damage, is significantly linked to a poor outcome.²¹

3) Early mobilization:

The already compromised nourishment of the cartilage will deteriorate with prolonged immobilization of the joint. A further consequence of extended immobility is arthrofibrosis.

CONSERVATIVE TREATMENT

For isolated, non-displaced fractures, conservative treatment modalities are effective.

The permissible range of articular step-off and articular gap has not been determined, as previously indicated. Generally , gaps under 5 mm or incongruencies under 2 mm are deemed acceptable. Conservative therapy is indicated if there are no or very slightly displaced tibial edge pieces (posteromedial or anterolateral edge fragment, Second fracture).

However, ligament disorders are frequently present with these fractures and should be evaluated because they may go undiagnosed. Pain and dislocation risk are the only clinical examinations conducted during the initial diagnostic work-up, which necessitates a more thorough diagnostic process, including MRI imaging. Reconstruction of collateral lesions, including cruciate or collateral ligament abnormalities, should occur first or second, based on the specific indication and collateral damage.

ARTHROSCOPIC REDUCTION AND INTERNAL FIXATION (ARIF)

Avulsion fractures of the intercondylar eminence, depression in the mid or posterior joint region (e.g., AO A1, B1 to 3, Schatzker I, II, III), and non-to-slightly dislocated split fractures are indications for arthroscopically assisted surgical operations.

For the following reasons, arthroscopically assisted osteosynthesis is generally regarded as preferable to open procedures^{22,24} because of specific reasons: Minimal soft tissue collateral damage is possible when using small joint incisions during arthroscopy, allowing for internal fixation and reduction with fewer soft tissue problems.²⁵ Early postoperative rehabilitation and mobilization are made possible by lower morbidity. When compared to open operations, It is possible to lower hospital stays and the prevalence of postoperative arthrofibrosis.

In contrast for 2D fluoroscopy, which is limited to detecting steps of 5 mm and above, arthroscopic vision enables accurate assessment and precise staging of joint surfaces.²⁶ Refixation of the meniscus is one example of treating concurrent extra- and intraarticular abnormalities (cruciate ligaments, menisci) at the same session.

Regarding these benefits, the literature currently in publication is debatable. Studies involving Schatzker I–III fractures discovered that ARIF outperformed ORIF in terms of the previously listed benefits, such as complications, a shorter hospital stay, a lower infection rate, and radiological outcome (measured by Rasmussen's radiological score).^{27,28,29,31} In research including Schatzker I–IV fractures, ARIF outperformed ORIF in terms of radiological result (Rasmussen's radiological score).³¹

Treating intraarticular soft tissue injuries is another benefit of arthroscopy. Patients with tibial plateau fractures (>70%) frequently have a range of soft tissue injuries, such as meniscus and ligament tears, which an arthroscopy can detect and treat.

CLOSED REDUCTION AND INTERNAL FIXATION (CRIF)

Fixation with Percutaneous cannulated screw can be used to produce osteosynthesis of small fractures (i.e., split/depression fractures AO 41 B1 to B3) in cases when there is no greater bone defect. If the soft tissue conditions around the joint surfaces could withstand it, simultaneous arthroscopic control of the joint surfaces would be ideal.

EXTERNAL FIXATION AS A DEFINITIVE TREATMENT

For definitive treatment, external fixation with an Ilizarov ring fixator or hybrid fixator is appropriate, either with or without further osteosynthesis. Although monolateral bridging external fixation is frequently used as a temporary aid in a phased therapy of unstable fracture types.^{32,33,34} To bridge the knee in cases of severely unstable fractures (AO 41 C1 to 3, Moore V, Schatzker V, and VI, for example), two more distal femur rings with hinged rods are required. This method allows for full weight bearing while combining the benefits of high stability and soft tissue protection.³⁵

OPEN REDUCTION AND INTERNAL FIXATION (ORIF)

The two factors affecting the risk of developing osteoarthritis over the long term and knee function are:

- (1) Ligamentous and osseous stability with correct mechanical axis,
- (2) Reconstruction of joint surfaces.

When achieving these primary therapeutic objectives is not feasible with the less invasive options listed above, ORIF should be used.

Managing proximal tibia fractures can be quite difficult. They frequently have wound infections and are infamously difficult to minimize, align, and stabilize. There are numerous established methods for managing these fractures. The following issues are frequently linked to conventional proximal tibial fracture treatment methods:

- Knee stiffness, prolonged therapy, and malunion are examples of conservative treatments, along with closed reduction and cast application
- Interlocked nailing is not a biomechanically sound method.
- Fixation with screws might cause inadequate fixation and residual deformities.
- Open conventional plating: large-scale dissection of soft tissues, infections and skin necrosis.
- Pin site infections, septic arthritis of the knee joint, and arthritis can result with external stabilization with pins and rods.^{3,4}

MINIMALLY INVASIVE PERCUTANEOUS PLATE OSTEOSYNTHESIS (MIPPO)

The outcome of treating these fractures has improved recently due to advancements made using MIPPO procedure.

These include:

- Use of indirect reduction method.
- Preservation of the bone's vascularity and soft tissue
- Maintaining the osteogenic hematoma
- Enhancement of the fixing quality using angular stable plates.

Fixation of condyles is possible with the use of MIPPO technique , and minimum soft tissue manipulation contributes to a satisfactory functional outcome.⁵

SURGICAL APPROACHES:

For the purpose of reducing and internally fixing tibial plateau fractures, two common surgical techniques are performed.

- 1) Antero-lateral approach
- 2) Postero-medial approach.

They are applied separately to fractures on the medial and lateral tibial plateaus, respectively. Other approaches are now uncommon or only used in specific situations.

- 1) Antero-lateral approach

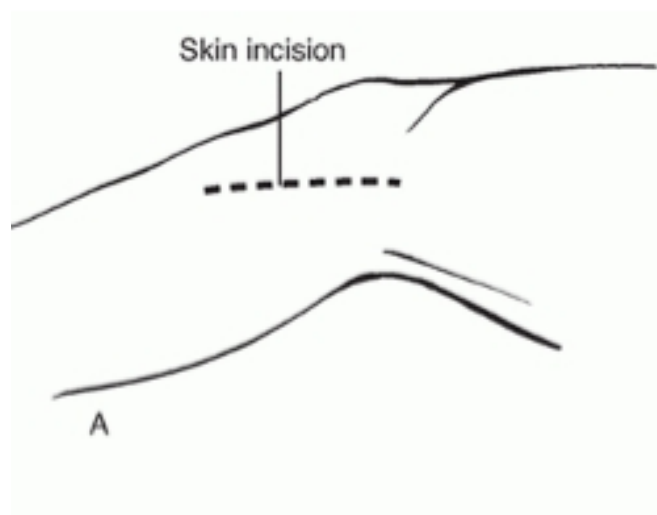


Figure 8: Antero-lateral Approach for proximal tibia

The antero-lateral approach is the most often used method for reducing and internally fixing tibial plateau fractures. This approach is used to reduce split depression type of the lateral tibial condyle fractures. The incision extends distally over the anterior compartment and is made over Gerdy's tubercle. The anterior compartment muscles origin is cut in an L-shape, granting access to the tibia's anterolateral surface. Because the anterior tibial artery travels through the interosseous membrane from back to front, caution should be used while making incisions over the posterolateral border of the tibia. The surgeon's preference will determine the anterolateral approach used when accessing the proximal region of the tibia.

2) Postero-medial approach

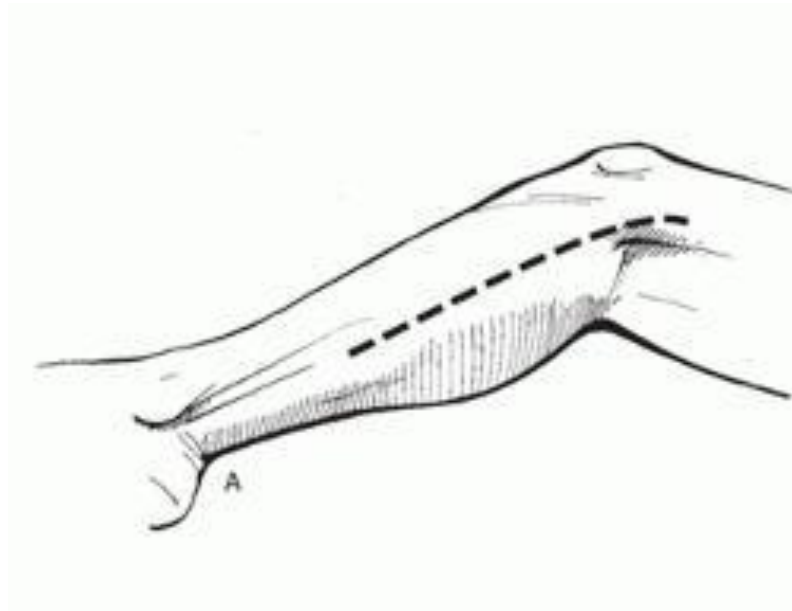


Figure 9:Postero-medial Approach for proximal tibia

The medial side of the proximal tibia fracture is treated with the posteromedial technique, which primarily fixes the posteromedial fragment. It has the benefit of having a comparatively excellent soft tissue cover and being far apart from the antero-lateral approach, which permits the combination of these two techniques as needed. Reducing fragments of extra-articular fractures is easy. To hold the huge posteromedial fragment in place and to withstand deforming stresses, posteromedial plating is highly helpful. Over the region of maximum displacement near the fracture's apex, an anti-glide plate is positioned. Most frequently, When applying a distracter or gaining access to the front of the knee for a second anterolateral approach, the supine posture is utilized.⁴⁵ Easy access is made possible by the leg's external rotation. Alternatively, the patient may be positioned prone, which aids fracture reduction by knee extension and makes it easier to implant the posterior to anterior hardware.

During the subcutaneous dissection, the saphenous nerve and vein must be avoided, and the incision must be posterior enough to permit the placement of a plate on the tibia without the skin flap getting in the way of the screw pathways over the posterior aspect. The gastrocnemius muscles medial head and the posterior border of the pes anserine form the deep interval. A retractor positioned behind the medial head shields the structures of the popliteal fossa. Dividing the gastrocnemius medial head increases exposure. The origin of the popliteus muscle is raised and retracts laterally, aiding in direct fracture visualization.

SURGICAL PROCEDURE

The patient was put in a supine position and given either general anesthesia or spinal anesthesia. The affected limb is draped and painted, The limb must be free to perform reduction procedures during the process. With C-arm guidance, closed techniques utilizing ligamentotaxis were used to reduce the fracture. Depending on the reduction, combined traction with valgus or varus strain was applied in either flexion or extension of the knee, depending on the needs of the particular patient. Where necessary, a compression bone clamp was employed to join the fracture fragments together. A locking plate was used for fixing the fracture after the reduction was confirmed under C-arm guidance.

Relevant Articles describing related to functional outcome of MIPPO in proximal tibia:

- A study was done by **Kayastha H et al.** assessing the functional result of proximal tibial fractures treated with LCP. This retrospective research includes 30 individuals with proximal tibia fractures treated with LCP. (20 patients underwent the MIPPO and 10 underwent the ORIF). All patients were monitored until their fractures were completely united and they achieved a desired functional outcome. The time it took for the fractures to unite was sixteen weeks on average (range: 12-24 weeks). Eighty percent of patients achieved an overall satisfactory functional outcome. Compared to patients treated with ORIF, those treated with the MIPPO method healed faster and more often with excellent outcomes. Even in challenging fracture scenarios, a locking compression plate system provides an effective biological fixation for proximal tibia fractures. The MIPPO approach provides a shorter procedure time, less blood loss, less damage to soft tissues, improved with faster wound healing, and a better clinical result than ORIF.³⁶
- A study was done by **Vora J et al.** to evaluate the proximal tibia's functional response to MIPPO. Schatzker type I fractures accounted for sixteen cases, whereas 5 cases of type II, 4 cases of type III, 2 cases of type IV, 1 case of type V, and 2 cases of type VI fractures. The healing

process was determined both functionally and radiologically. With 50% of fractures uniting in fourteen –sixteen weeks, the mean time to union was 17.6 weeks. Two (10%) of the cases had infection, two had fracture collapse, and two had malunion. Sanders's score was used to analyze each case's functional outcome. Sixty-three percent of patients performed exceptionally well; twenty percent had a good result, thirteen percent had a fair outcome, and one patient had a poor outcome. MIPPO is a useful method for stabilizing fractures of the proximal tibia condyle, particularly when combined with careful soft tissue management during surgery.³⁷

- A study was done by **Sahu SK et al.** to investigate the treatment of tibial plateau fractures using MIPPO. Soon after admission procedure, the patients' information was documented following a clinical examination and history documentation. The fracture patterns were categorized radiologically in accordance with Schatzker classification. Anterolateral and anteromedial approaches were used with every subject. The follow-up was carried out every six to eight weeks. 38 patients in the age range of twenty to seventy five years were involved in the study between March 2018 and March 2020. The age range of twenty to fifty years old accounted for the largest percentage of 38 patients (68%). The highest number of fracture forms, according to the classification associated with high velocity injuries, were Schatzker's types IV and V. Two patients had

a varus deformity, One patient experienced joint stiffness, and two individuals suffered wound infections. 26 cases had excellent outcome; six patients had good results; three patients each had fair or poor outcome. Because the MIPPO technique preserves the fracture site biologically and causes minimal tissue injury, it has been shown to have excellent healing results for proximal tibia fractures and to promote robust bone union.³⁸

- A study was done by **Verma PK et al.** to use the MIPPO approach to evaluate the functional outcome of proximal tibial fractures. Of the forty patients treated, 75% were male and in the 20–40 age range. Unilateral fractures, which fall under types 3 and 4 of Schatzker's classification and are linked to high-velocity RTAs, were more common than bilateral fractures. Three patients had one each of non-union, implant failure, and infection recorded; twelve fractures had good healing outcomes, while 23 fractures produced exceptional results. Just three patients got fair results, while two had subpar results. Because of the intrinsic advantages of minimal tissue injury and minimum disruption of fracture site biology, all of the fractures treated with the MIPPO approach were shown to be mending quickly through secondary fracture union, leading to significant bone fusion at the fracture site.³⁹

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- A study was done by **Gupta P et al.** on biological osteosynthesis using the MIPPO approach to treat these fractures while preserving the vascularity of the osseous and soft tissues. Among thirty patients (mean age 42.7 years; 22 males and 8 females) of closed tibia fractures, the authors performed a study on percutaneous plating with closed reduction and percutaneous plating. Of them, six had distal tibial fractures, and twenty-four had proximal tibial fractures. After the injury, the average recovery period was seven days. 72.6 minutes was the average operating time. The radiological union took an average of 17 weeks (range: 14–22 weeks). One superficial wound infection was treated with regular dressings and oral antibiotics for a week. A bone grafting was necessary for a patient who experienced non-union. This approach should be taken into consideration for periarticular fractures due to the good functional outcomes and lack of soft tissue problems. Complex fractures treated biologically result in stable, ideal internal fixation and full limb function recovery early on with little chance of complications.⁴⁰
 - A study was done by **Chintawar G et al.** to examine the clinical, radiological, and functional outcomes of proximal tibia fractures using MIPPO approach. MIPPO approach was used to treat 32 patients with proximal tibial fractures. There were three female and 29 male patients, with the majority of them being in the 31–40 age range. The AO

classification was used to categorize fractures. Eight patients (25%) had a C1 type fracture, while seven patients (21.9%) had an A2 type fracture. The ultimate analysis of the findings was conducted using Rasmussen's clinical and radiological scoring system. The average radiological score was 14.3, while average Rasmussens clinical score was 23.53. In the current study, 26 (81.4%) patients had good outcomes based on the Rasmussen clinical score, whereas just 1 (3.1%) patient had bad results. Based on Rasmussen's radiological assessment, 26 (81.3%) patients had satisfactory results, whereas just 1 (3.1%) patient had poor results. Only two patients (6.4%) experienced implant-related issues, including plate prominence and screw backout. Knee flexion ranged from 136.25 degrees on average, with seventeen patients (53.12%) achieving 131–140 degrees of flexion, though fourteen cases (43.75%) were able to extend up to -2 degrees. MIPPO is a superior approach that ought to be the first choice for treating proximal tibia fractures surgically. In terms of fracture union, early mobilization, and functional outcome, the clinical results of MIPPO approach are favorable and on par with global literature. Early fracture healing is made possible by the MIPPO procedure, which protects the soft tissues surrounding the fracture site. MIPPO may be a viable therapeutic option for grade I complex fractures for the same reason. The MIPPO technique is an efficient way to treat proximal tibia simple or grade I complex fractures.¹

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- A study done by **Shivanand et al.** on 20 patients in Karnataka in 2021, the MIPPO technique was found to facilitate soft tissue stripping through a small surgical incision and to provide rigid fracture reduction. It was also noted that 90% of the patients exhibited good to excellent performance.³
 - A study done by **Khaja et al** On 30 patients in Telangana, 2020, the ideal way to treat a proximal tibial fracture is to balance soft tissue treatment with fracture reduction and alignment. It was also noted that 67% of the patients had excellent performance. These patients were treated surgically with plate osteosynthesis.⁴¹
 - A study done by **Madiga et al** Using the MIPPO approach, 30 patients in Andhra Pradesh was treated for proximal tibial plateau fractures in 2019. The findings demonstrated rapid healing of the fractures through secondary fracture union, leading to strong bone union.⁴²
 - A study done by **Nageswara rao et al** Using the MIPPO approach, 30 patients in Telangana were treated for proximal tibial crest fractures in 2016. The results showed that all of the fractures were healing quickly by secondary fracture union, and 50% of the patients had excellent outcomes.⁴³

MATERIALS &

METHODS

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MATERIALS AND METHODS

STUDY DESIGN:

The study was a prospective observational hospital-based study.

STUDY AREA:

Patients with proximal tibia fractures who visited the Orthopaedic and Emergency departments of the R.L.Jalappa Hospital and Research Centre participated in the research study, which is attached to Sri Devaraj Urs Medical College and is associated with Sri Devaraj Urs Academy of Higher Education and Research (SDUAHER) in Kolar.

STUDY PERIOD & DURATION:

One year and four months was the time frame in which the research was carried out, beginning in September 2022 and ending in December 2023.

STUDY POPULATION:

All patients with a diagnosis of proximal tibia fractures who meets all the inclusion criteria was admitted to the Orthopaedics ward from the Emergency Medicine as well as Orthopedics Department of R.L.Jalappa Hospital and Research Centre, Kolar.

SAMPLE SIZE CALCULATION

A total of 35 cases were studied.

Shivanand S et al ³. had reported that 90% of the patients had good to excellent performance as per modified Rasmussen functional knee scoring system for tibial condyle fracture with MIPPO technique. Assuming alpha error of 5% (95% Confidence limit), Expected proportion (p) = 90%, Absolute precision (d) = 10%.

The minimum required sample size to determine the proportion with good to excellent functional outcomes was calculated to be 35 subjects. Z is the value for Confidence Interval d is the absolute precision, p is the expected proportion and $q=1-p$

The sample size was derived from the following formula:

Sample size (n) = $Z^2(P*Q) / d^2$, where; d^2 is the The sample size was calculated using OpenEpi software version 3.01 (Open Source Epidemiologic Statistics for Public Health). In the present setting, lost-to-follow up was found to be 10% and hence the final sample size was inflated to be 35 subjects who undergo MIPPO technique.

INCLUSION CRITERIA:

- Patient aged more than 18 years, both male and females
- Patients with closed displaced proximal tibia fractures less than 2 weeks old.

EXCLUSION CRITERIA:

- Previous or existing infection in the affected knee
- Uncontrolled comorbid conditions
- Compartment syndrome
- Patient with any other ipsilateral lower limb fracture
- Individuals who refuse to take part in the research

SAMPLING METHOD:

All consecutive patients who were diagnosed with proximal tibia fractures between September 2022 and December 2023 and who were admitted in Orthopaedics department of the R.L.Jalappa Hospital in Kolar

DETAILS OF THE STUDY:

Following a thorough history collection, a thorough clinical examination was performed. Every result was documented using a pre-tested, semi-structured proforma.

The following parameters were taken:

- a. Age.
- b. Gender
- c. Occupation
- d. Side affected
- e. Complete history of pain

Examination:

- 1. Systemic examination.
- 2. Local examination.
- 3. Radiological examination(X ray knee with proximal tibia):
 - a. Antero Posterior View
 - b. Lateral view

The following preoperative investigations were performed on each study participant:

- i. Complete blood picture.
- ii. Complete urine examination

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- iii. Fasting blood sugar and Post prandial
 - iv. Thyroid function tests
 - v. Serum electrolytes,
 - vi. Serum uric acid
 - vii. Fasting lipid profile
 - viii. Chest X ray
 - ix. ECG

STUDY TOOLS:

VAS - is a numerical pain rating scale that is subjective and ranges between 0 and 10, with 0 signifying no discomfort and 10 the most excruciating pain a person has ever experienced.

MODIFIED RASMUSSEN SCORE⁴¹

Figure 10: **MODIFIED RASMUSSEN SCORE⁴¹**:

Subjective	Points
A. Subjective complaints	
a. Pain	
No pain	6
Occasional pain	5
Constant pain after activity	4
Significant rest pain	0
b. Walking capacity	
Normal walking capacity (in relation to age)	6
Walking outdoors for at least 1 h	4
Short walks outdoors for >15 min	2
Walking indoors only	1
Wheel-chair/bedridden	0
B. Clinical signs	
a. Extension	
Normal	6
Lack of extension (0–10°)	4
Lack of extension > 10°	2
b. Total range of motion	
≥140°	6
≥120°	5
≥90°	4
≥60°	2
≥30°	0
c. Stability	
Normal stability in extension and 20° of flexion	6
Abnormal instability 20° of flexion	5
Instability in extension < 10°	4
Instability in extension > 10°	2
Maximum	30
Excellent	27–30
Good	20–26
Fair	10–19
Poor	<10

FOLLOW UP:

Patients underwent fixation for proximal tibia fracture by MIPPO technique under suitable anaesthesia after obtaining surgical consent and fitness. Patients were advised for non weight bearing mobilization post surgery day 2. Sutures were removed on day 14 +/- 2, physiotherapy (quadriceps strengthening exercise) were advised. Patient were followed up at 1st, 3rd, 6th month. Patient were assessed according to VAS score and Modified Rasmussen Scoring and was updated in the proforma.

ETHICAL CONSIDERATION

The Institutional Ethics Committee granted its approval in terms of ethics. By only using the data gathered for the study's stated aims, the researchers ensured that throughout the whole study, each participant's confidentiality and privacy were protected.

DATA ANALYSIS

Epi Info 7.2.1.0 version and also Microsoft Excel was used for Data analysis.

DESCRIPTIVE STATISTICS:

- a. Frequency
- b. Mean
- c. Standard Deviation

INFERENTIAL STATISTICS:

- a. Paired T test was used to test the association between pre surgery and post surgery score individually during the follow up. The p value <0.05 is considered to be statistically significant.
- b. ANOVA test was used to test the overall significance between all the scores.

RESULTS

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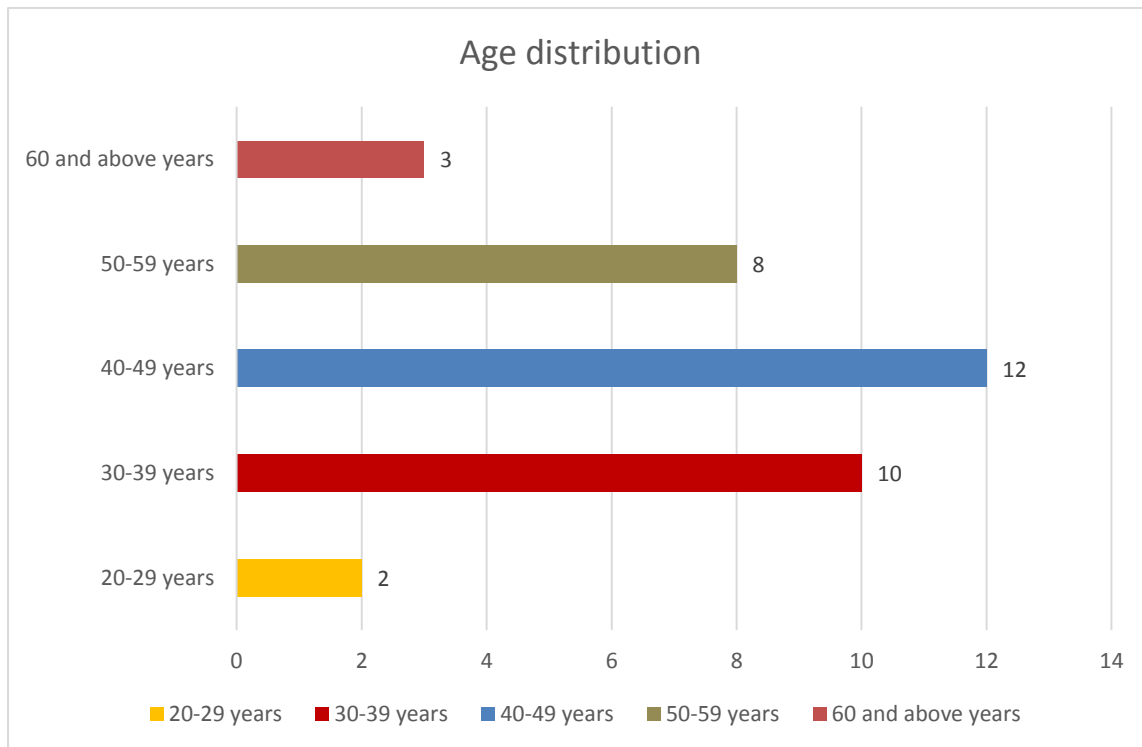
RESULTS

Table 2 : The study population's age distribution:

Age group	Number of participants	Percentage
20-29 years	2	5.71
30-39 years	10	28.57
40-49 years	12	34.29
50-59 years	8	22.86
60 and above years	3	8.57
Total	35	100

Mean:43.91 years, Standard Deviation: 11.05 years.

Figure 11: Showing the age distribution of study population:

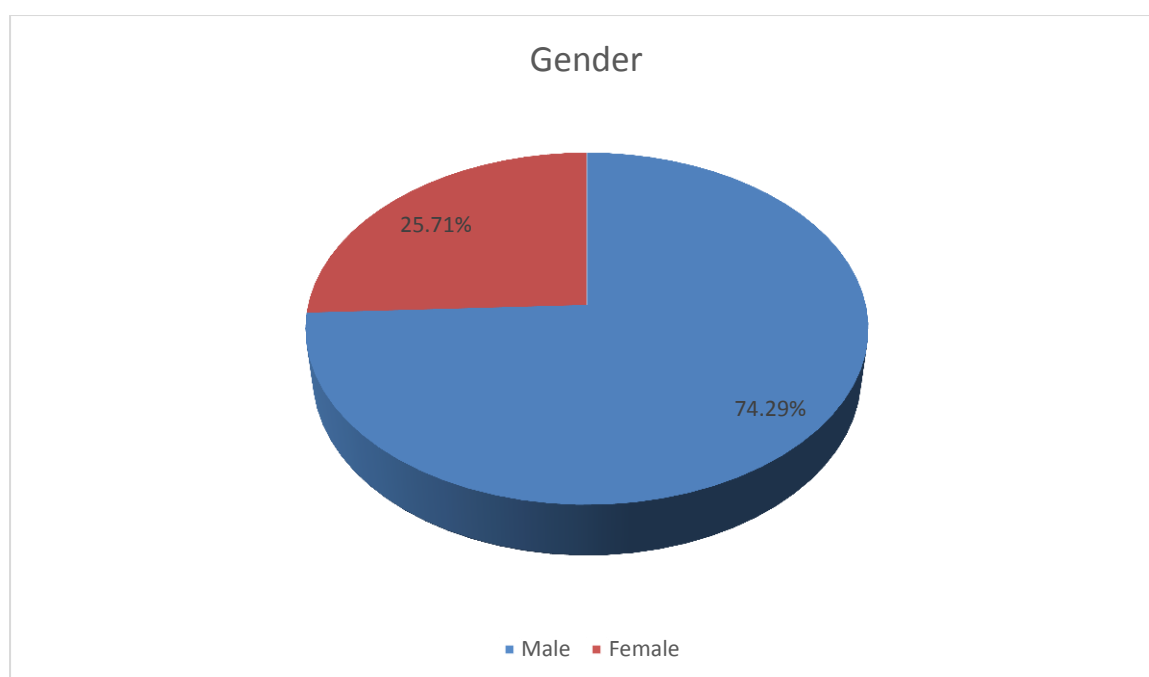


Comment: The age group of 40–49 years old accounted for the majority of the study population (34.29%), followed by 30-39 years old (28.57%). The age group of 50–59 years old made up around one fifth of the population (22.86%). Rest of the study groups contributed to <10% each. The mean age was 43.91 years.

Table 3: Showing the gender distribution of study population:

Gender	Frequency	Percentage
Male	26	74.29
Female	9	25.71
Grand Total	35	100

Figure 12: Showing the gender distribution of study population:

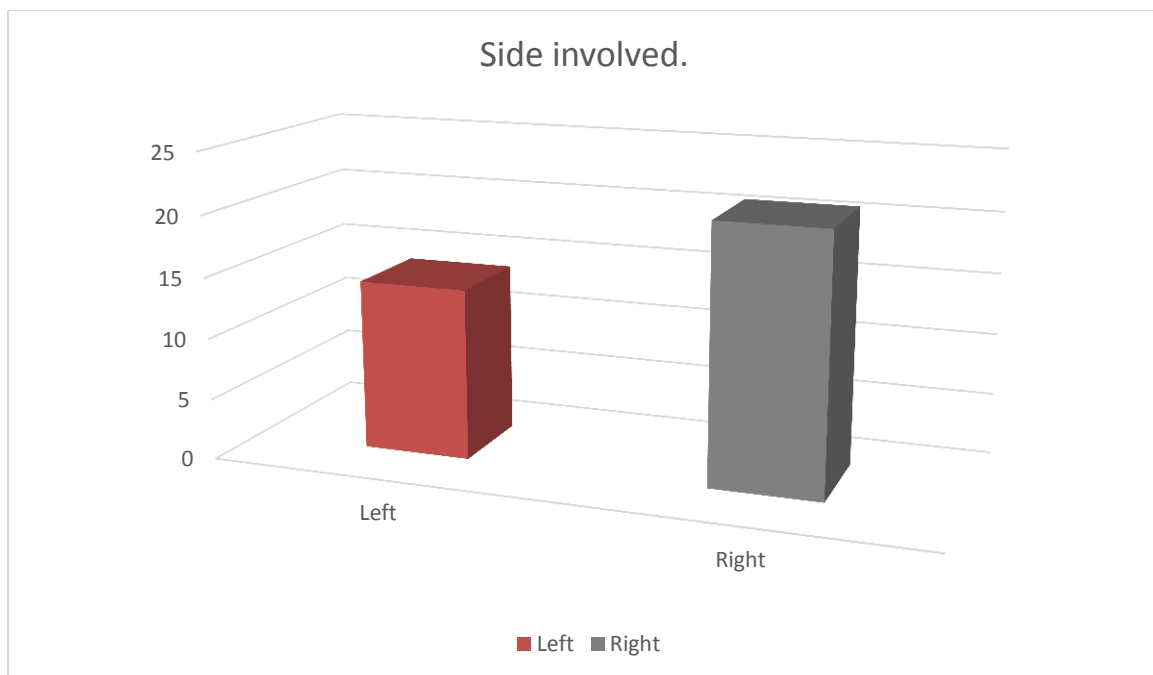


Comment: Among the study population, 74.29% were male. One fourth of them were females.

Table 4: Showing the side involved of study population:

Side involved	Frequency	Percentage
Left	14	40
Right	21	60
Grand Total	35	100

Figure 13: Showing the side involved of study population:

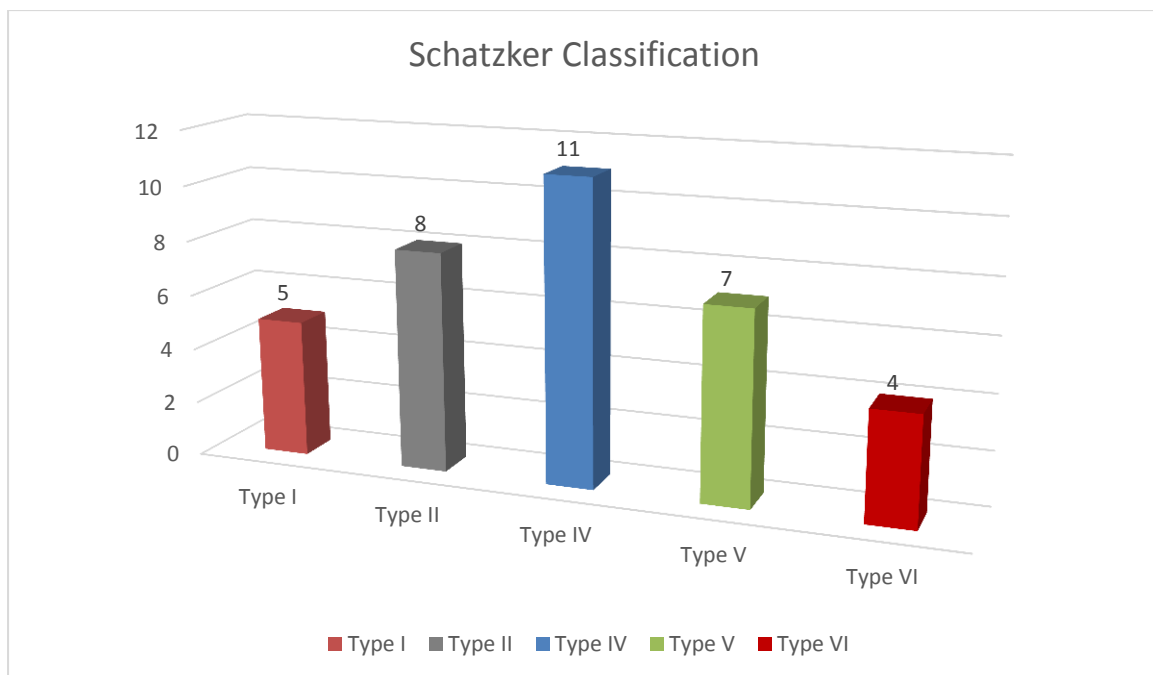


Comment :Among the study population, 60% had injured their right side and 40% of them had injuries to the left side . All the fractures were closed type following RTA.

Table 5: Showing the type of fracture according to Schatzker classification:

Schatzker classification	Frequency	Percentage
Type I	5	14.29
Type II	8	22.86
Type IV	11	31.43
Type V	7	20.00
Type VI	4	11.43
Grand Total	35	100

Figure 14: Showing the type of fracture according to Schatzker classification:

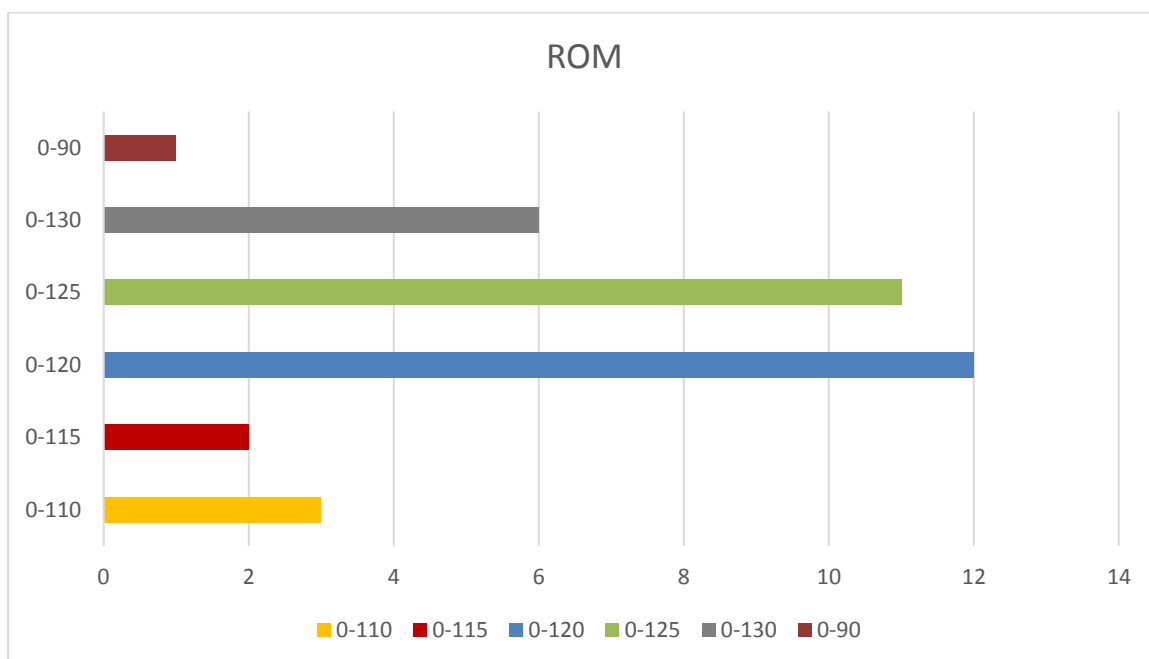


Comment :Among study population, 31.43% had type IV type of fracture, 22.86% had type II fracture, 20% had type V fracture. Around 15% of them had type I fracture and 11.43% had type VI fracture

Table 6: Showing the ROM of study population:

ROM	Frequency	Percentage
0-90	1	2.86
0-110	3	8.57
0-115	2	5.71
0-120	12	34.29
0-125	9	31.43
0-130	6	17.14
Grand Total	35	100.00

Figure 15: Showing the ROM of study population:

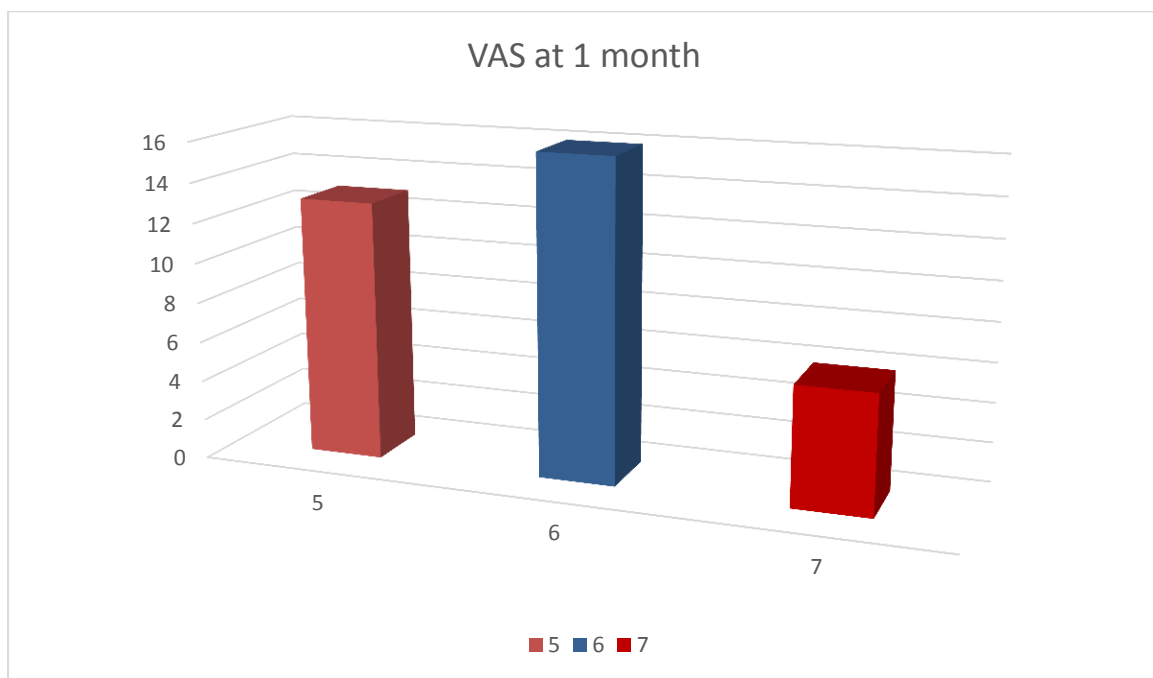


Comment : Among the study population, 34.19% had ROM of 0-120 degrees, 31.43% had ROM of 0 – 125 degrees, 17.14% had ROM of 0-130 degrees, 8.57% hand ROM of 0-110 degrees, 5.71% had ROM of 0-115 degrees, 2.86% had ROM of 0-90 degrees.

Table 7: Showing the VAS post operatively at the end of 1 month :

VAS at 1 month	Frequency	Percentage
5	13	37.14
6	16	45.71
7	6	17.14
Grand Total	35	100

Figure 16: Showing the VAS at the end of 1 month:

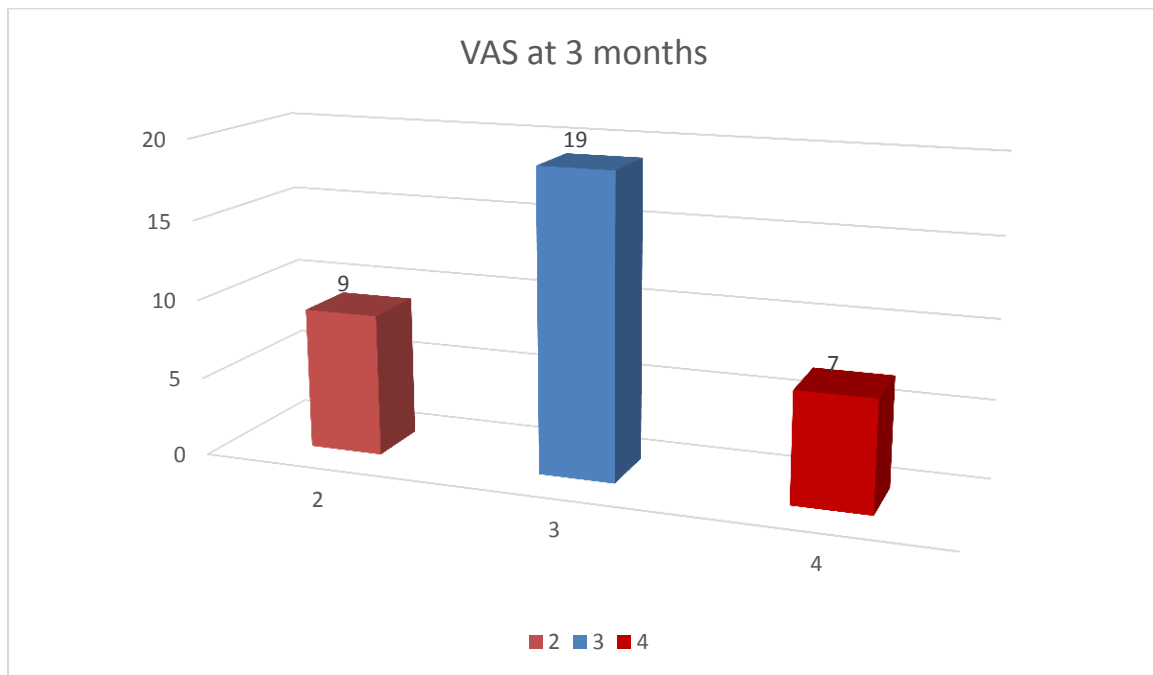


Comment : Among the study population, 45.71% had rated pain score as 6. 37.14% rated it as 5 and a minor percentage (17.14%) of them rated it as 7.

Table 8: Showing the VAS at the end of 3 months:

VAS at 3 months	Frequency	Percentage
2	9	25.71
3	19	54.29
4	7	20
Grand Total	35	100

Figure 17: Showing the VAS at the end of 3 months:

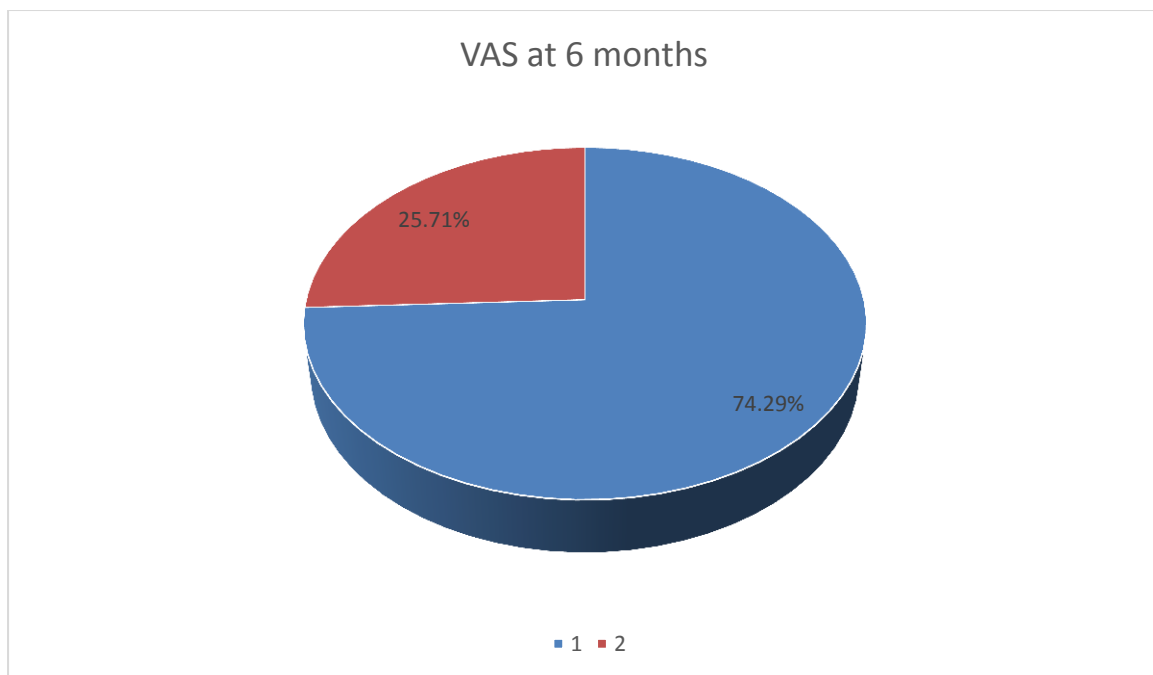


Comment : Among the study population, After three months of follow-up, the VAS was less than five. 54.29% had VAS of 3, one quarter of them had VAS of 2 and one fifth of them had VAS of 4.

Table 9: Showing VAS at the end of 6 months:

VAS at 6 months	Frequency	Percentage
1	26	74.29
2	9	25.71
Grand Total	35	100.00

Figure18: Showing the VAS at the end of 6 months:

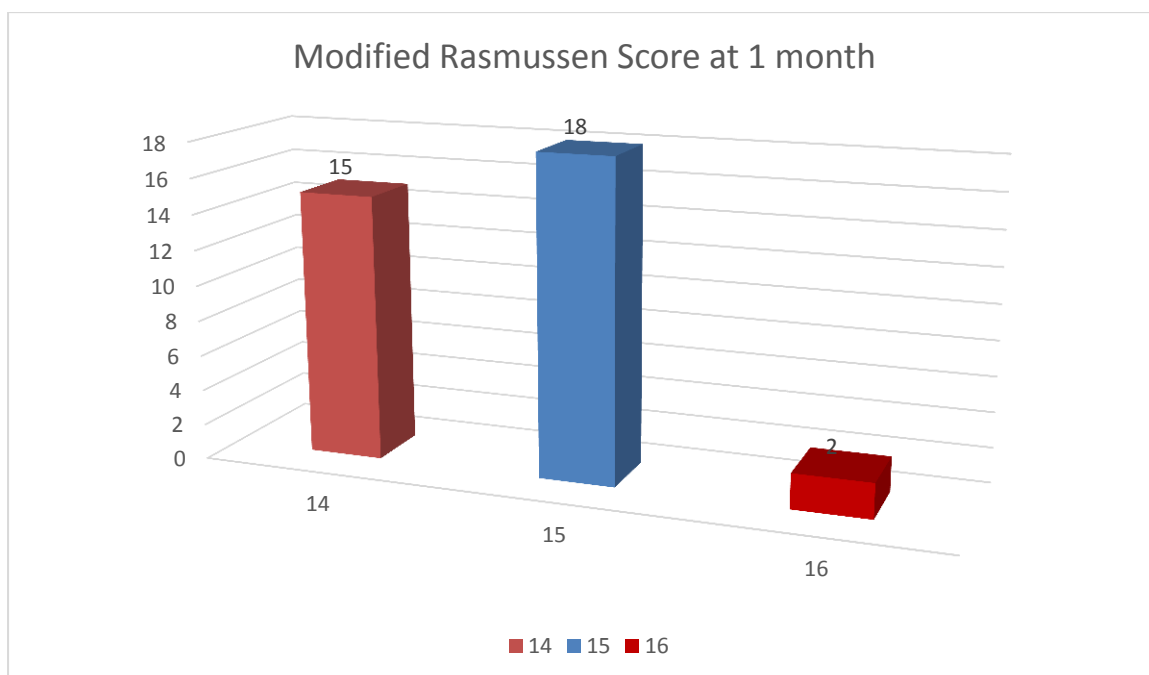


Comment :Among the study population, the highest pain score recorded was 2 in one quarter of them, Three fourths of them had VAS of 1.

Table 10: Showing the Modified Rasmussen Score at the end of 1 month:

Modified Rasmussen Score at the end of 1 month	Frequency	Percentage
14	15	42.86
15	18	51.43
16	2	5.71
Grand Total	35	100

Figure 19: Showing Modified Rasmussen Score at the end of 1 month:

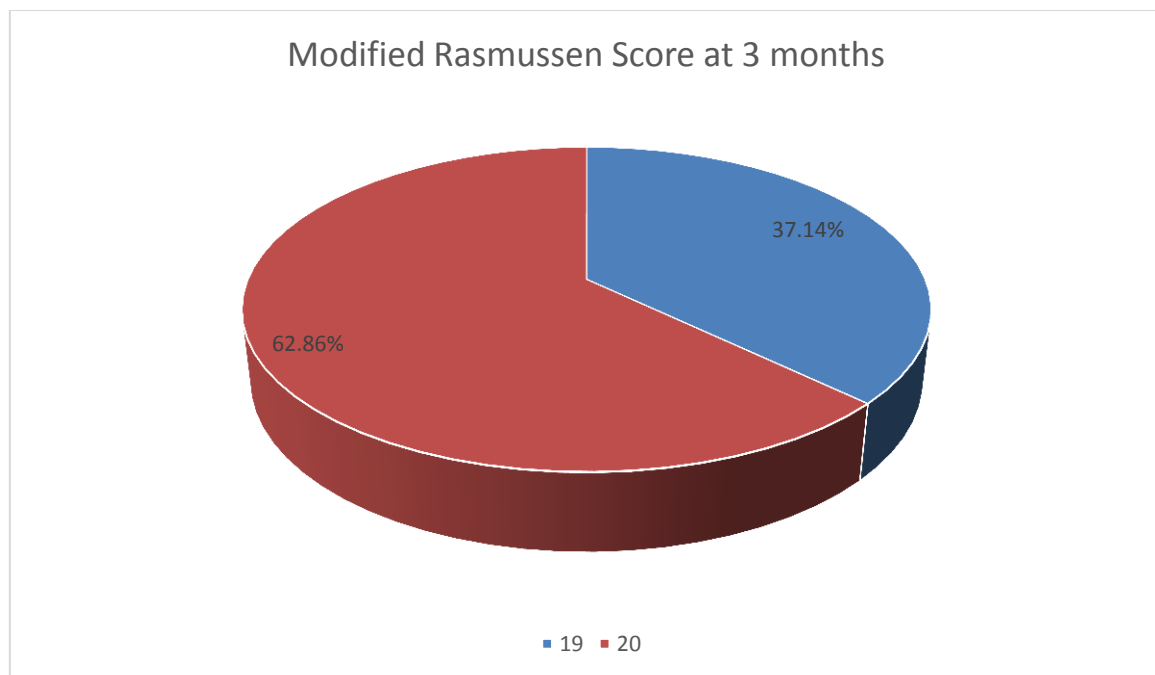


Comment: Among the study population, Modified Rasmussen Score at 1 month post operatively was ranging between 14-16. Half of them had score of 15, 42.86% of them had score of 14 and 5.71% of them had score of 16.

Table 11: Showing Modified Rasmussen Score at the end of 3 months:

Modified Rasmussen Score at 3 months	Frequency	Percentage
19	13	37.14
20	22	62.86
Grand Total	35	100

Figure 20: Showing Modified Rasmussen Score at the end of 3 months:

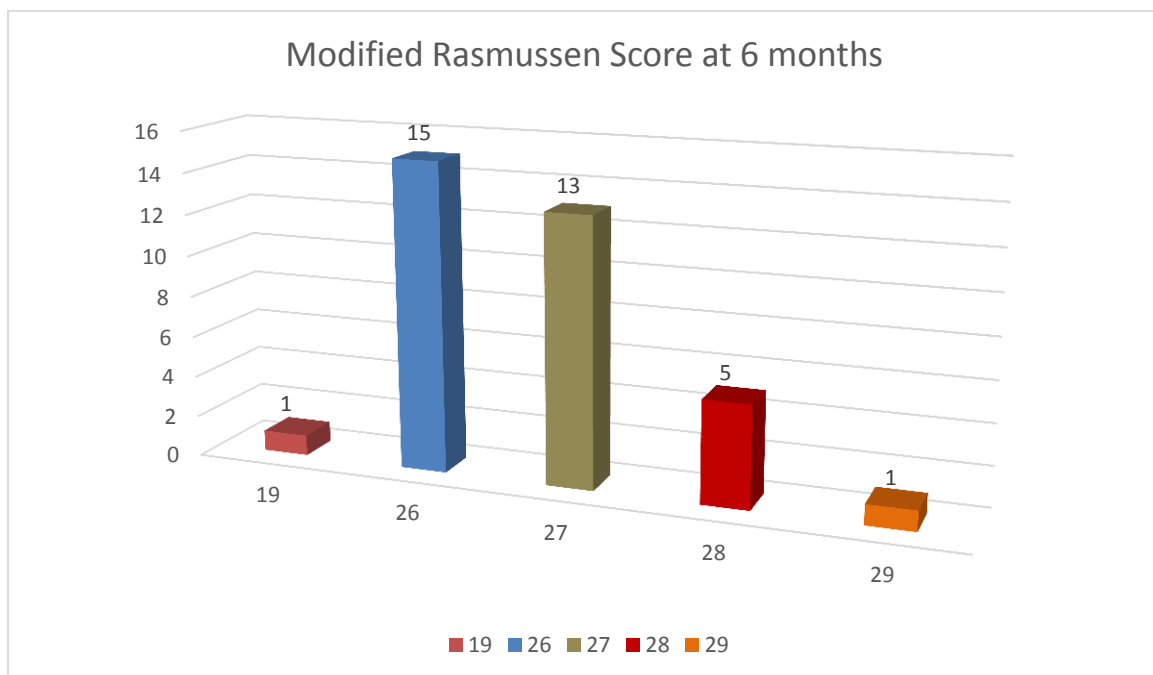


Comment :Among the study population, Modified Rasmussen Score at 3rd month ranged between 19-20. 62.86% had a score of 20, 37.14% had a score of 19

Table 12: Showing Modified Rasmussen Score at the end of 6 months

Modified Rasmussen Score at 6 months	Frequency	Percentage
19	1	2.86
26	15	42.86
27	13	37.14
28	5	14.29
29	1	2.86
Grand Total	35	100

Figure 21: Showing Modified Rasmussen Score at the end of 6 months:

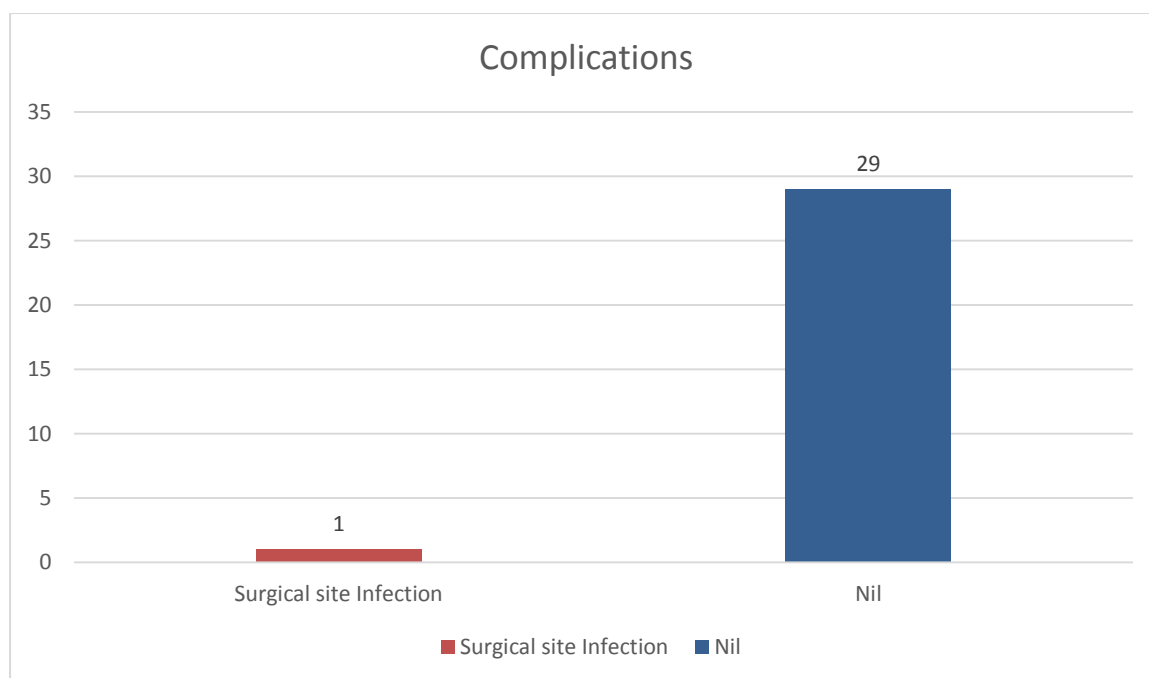


Comment : Among the study population, Modified Rasmussen Score @ 6 month ranged between 19-29. 42.86% had a score of 26, 37.14% had a score of 27 and 14.295 had a score of 28. Only one case had a score of 29 and one case had a score of 19.

Table 13: Showing complications of surgery:

Complications	Frequency	Percentage
Surgical site infection	1	2.86
Nil	34	97.14
Grand Total	35	100

Figure 23: Showing complications of surgery:

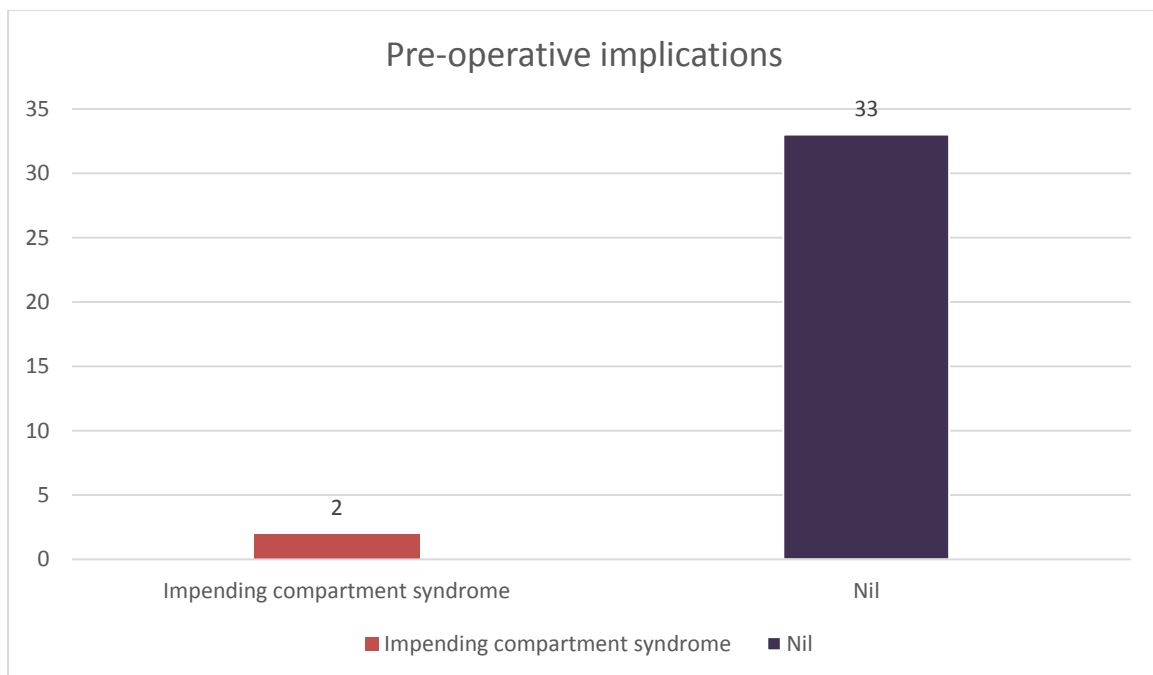


Comment : Among the study population, 97.14% didn't report any complications, 2.86% reported surgical site infection.

Table 15: Showing pre-operative implications:

Pre-op implications	Frequency	Percentage
Impending compartment syndrome	2	5.71
Nil	33	94.29
Grand Total	35	100

Figure 23: Showing the pre-operative implications:

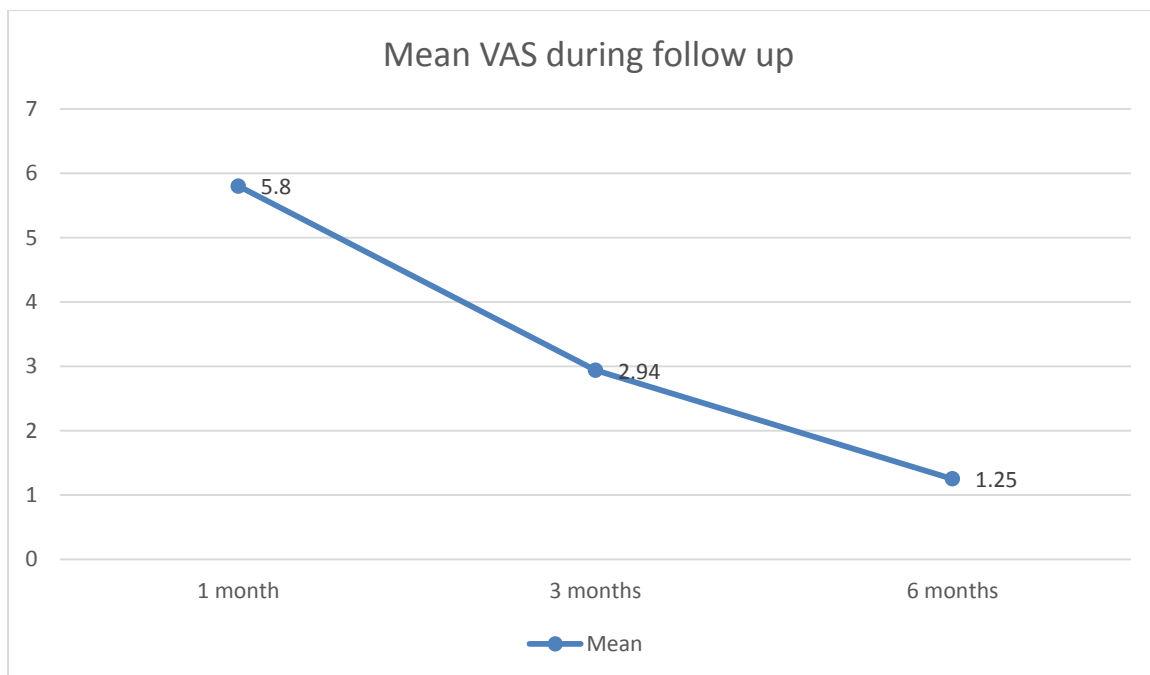


Comment : Among the study population, 2 cases developed impending compartment syndrome.

Table 15: Showing mean VAS score during the follow up period:

Mean VAS score	Mean $\pm$ Standard Deviation	P value
1 month	5.8 $\pm$ 0.71	<0.00001
3 months	2.94 $\pm$ 0.68	
6 months	1.25 $\pm$ 0.44	

Figure 24: Showing mean VAS score during the follow up period:

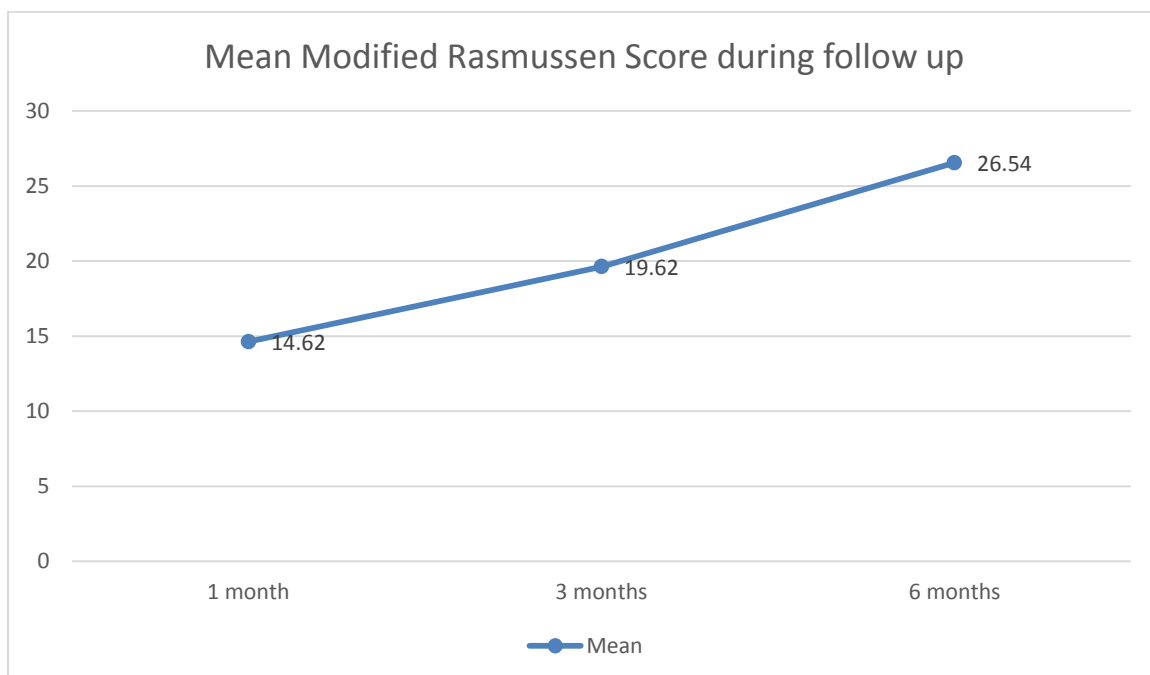


Comment :Among the study population,The VAS score decreased over the course of the follow-up period and this decline (5.8 Vs 2.94 Vs 1.25) was significant statistically with <0.00001 of P value.

Table 16: Showing mean Modified Rasmussen Score:

Mean Modified Rasmussen Score	Mean $\pm$ Standard Deviation	P value
1 month	14.62 $\pm$ 0.59	<0.00001
3 months	19.62 $\pm$ 0.49	
6 months	26.54 $\pm$ 1.54	

Figure 25: Showing Mean Modified Rasmussen Score during the follow up period:

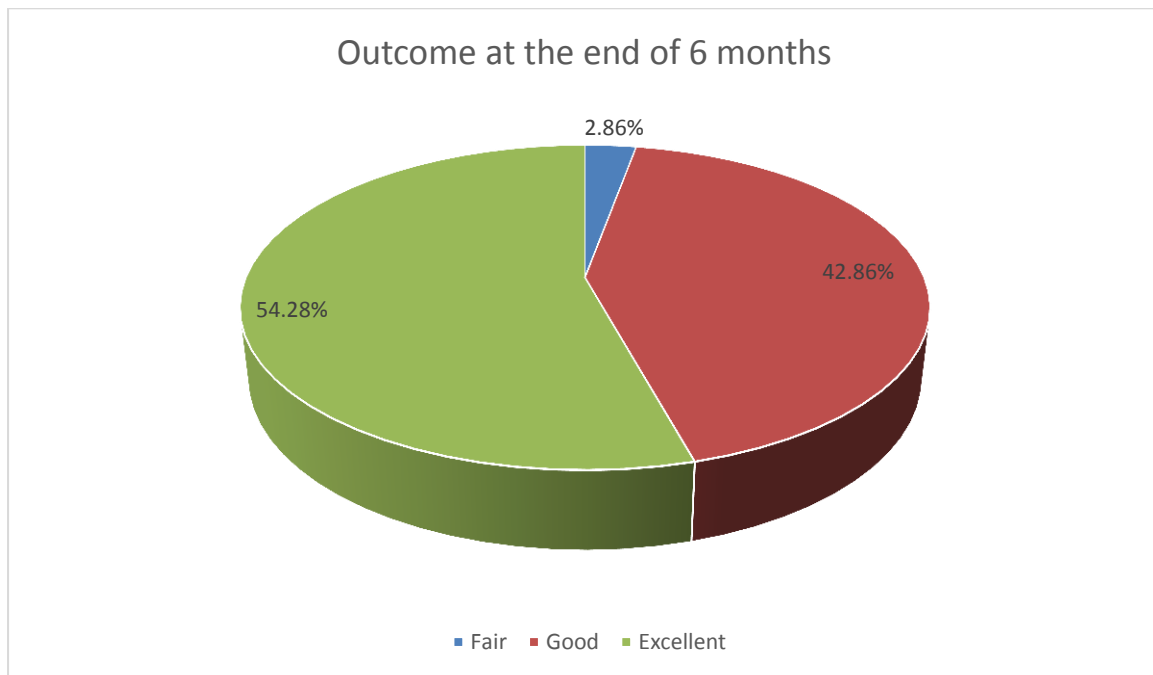


Comment : Among the study population, there was a rise in the Mean Modified Rasmussen Score during the follow up period and this rise (14.62 Vs 19.62 Vs 26.54) was significant statistically with <0.00001 of P value.

Table 17: Showing the outcome at the end of 6 months:

Outcome	Frequency	Percentage
Fair	1	2.86
Good	15	42.86
Excellent	19	54.28
Grand Total	35	100

Figure 26: Showing the outcome at the end of 6 months



Comment :Among the study population, Outcome at the end of 6 months was excellent in 54.28%, good in 42.86% and fair in 2.86%.

DISCUSSION



DISCUSSION

The results of the study were discussed below:

Age distribution:

In the present study, among the study population, Most of them (34.29%) were in the forty–fourty-nine age range, and 28.57% in the thirty- thirty-nine age range. Around one fifth of the population belonged to the age group of fifty- fifty nine years (22.86%). Rest of the study groups contributed to <10% each. The mean age was 43.91 years.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	The age group of 40–49 years old accounted for the majority of them (34.29%), followed by 30-39 years old (28.57%). The age group of 50–59 years old made up around one fifth of the population (22.86%). Rest of the study groups contributed to <10% each. The mean age was 43.91 years.
Kayastha H et al ³⁶	Twenty percent of the patients in their study were over 40 years, and sixty-six percent of

	the patients were in the 20–40 age. A total of 14% of the population was under 20 years old.
Vora J et al ³⁷	The age group of 31–40 years old accounted for 33.33% of the total number of patients, followed by 51–60 years old (30%), and 20–30 years old (10%).
Sahu SK et al ³⁸	The age range of 20 to 50 years old comprised the highest proportion of patients (68%).
Verma PK et al ³⁹	Seventy percent of the patients were in the 20–40 age range. The remaining age groups made up 30%.
Gupta P et al ⁴⁰	The age range of the age group was 18 to 70 years old, with a mean age of 42.7 years.

Gender distribution:

Of the study population, 74.29% of participants were male, one-fourth of them were females.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	74.29% were male. One fourth of them were females.
Vora J et al ³⁷	Compared to females, males were more frequently affected (24: 6).
Verma PK et al ³⁹	Only 5 (13%) of them were females and 35 (87%) were males.
Gupta P et al ⁴⁰	22 men and 8 women were present.

Side involved:

In the present study, among the study population, 60% had injured their right side and 40% of them had injuries on the left side . All the fractures were closed type following RTA.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	60% had injured their right side and 40% of them had injuries on the left side. All the fractures were closed type following RTA.
Vora J et al ³⁷	All of them were closed fractured due to high velocity trauma.
Verma PK et al ³⁹	Unilateral fractures were more prevalent than bilateral ones, with slightly left-side predominance.
Gupta P et al ⁴⁰	Thirteen cases had left tibial fractures and seventeen involved right ones; twenty cases resulted from RTA, five from falls at home, and five from physical attack.

Schatzker Classification:

In the present study, among the study population, 31.43% had type IV type of fracture, 22.86% had type II fracture, 20% had type V fracture. Around 15% of them had type I fracture and 11.43% had type VI fracture.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	31.43% had type IV type of fracture, 22.86% had type II fracture, 20% had type V fracture. Around 15% of them had type I fracture and 11.43% had type VI fracture.
Kayastha H et al ³⁶	In 23.33% of the patients, tibial fractures of type VI were the most common kind of fracture. Type I and Type IV fractures came next, occurring in 20% of the cases, respectively. Type V fractures accounted for 16.67% of instances, Type II fractures for 13.33% of cases, and Type III fractures for 6.67% of cases.
Vora J et al ³⁷	53% had type I type of fracture, 16.7% had type II fracture, 13.33% had type III fracture. Around 6.67% each of them had type IV and

	Type VI fracture and 3.33% had type V fracture.
Sahu SK et al ³⁸	The largest number of fracture types were Schatzker's types 4 and 5.
Verma PK et al ³⁹	12.5% had type I type of fracture, 12.5% had type II fracture, 20% had type III fracture. Around 22.5% each of them had type IV and 17.5% had Type VI fracture and 15% had type V fracture.

VAS score:

In the present study, among the study population, at the end of 1st month 45.72% had rated pain score as 6. 37.14% rated it as 5 and a minor percentage (17.14%) of them rated it as 7. After three months of follow-up, the VAS was less than five. 54.29% had VAS of 3, one quarter of them had VAS of 2 and one fifth of them had VAS of 4. the highest pain score recorded was 2 in one quarter of them, Three fourths of them had VAS of 1 at the end of 6 months. There was a statistically significant decline in the VAS score (5.8 Vs 2.94 Vs 1.25), during the follow-up period (1st Vs 3rd Vs 6th month), with a P value of less than 0.00001, among the study population.

Modified Rasmussen Score:

In the present study, among the study population, Modified Rasmussen Score at 1 month post operatively was ranging between 14-16. Half of them had score of 15, 42.86% of them had score of 14 and 5% of them had score of 16. Modified Rasmussen Score at 3 month ranged between 19-20. 62.86% had a score of 20, 37.14% had a score of 19. Modified Rasmussen Score at 6 month ranged between 19-29. 42.86% had a score of 26, 37.14% had a score of 27 and 14.29% had a score of 28. Only one case had a score of 29 and one case had a score of 19. During the follow-up period(1st Vs 3rd Vs 6th month), there was an increase in the Mean Modified Rasmussen Score; this increase (14.62 Vs 19.62 Vs 26.54) was statistically significant with a P value of <0.00001.

Outcome at the end of 6 months:

After six months, the study population's outcomes were excellent in 54.28% of cases ,good in 42.86% of cases, and fair in 2.86% of cases.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	After six months, the results were excellent in 54.28% of cases, good in 42.86% of cases, and fair in 2.86% of cases
Kayastha H et al ³⁶	According to the Rasmussen score, of the thirty cases, sixty-six percent had an excellent functional outcome, fourteen percent had a good functional outcome, sixteen percent had a fair functional outcome, and 3.33% had a poor functional outcome.
Vora J et al ³⁷	Five percent of patients performed at good to excellent levels (19 patients excellent; 6 patients good). One patient did poorly, and four achieved fair results. Sanders' 40-point functional evaluation scale served as the basis for the evaluation.

Sahu SK et al ³⁸	According to the Rasmussen Score, 26 patients had excellent outcomes, 6 had fair results, and 3 had poor results.
Verma PK et al ³⁹	Twenty three cases gave excellent results; twelve cases showed with good results. According to the Rasmussen Score, only three of the cases had fair results, and two had poor results.
Gupta P et al ⁴⁰	10 cases (33%) had good results, 2 cases (7%) had fair results, and 18 cases (60%) had excellent results. Assessment was conducted using SJLAM criteria (1964).

Complications:

In the present study, among the study population, 97.14% didn't report any complications, 2.86% reported surgical site infection.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	97.14% didn't report any complications, 2.86% reported surgical site infection.
Vora J et al ³⁷	Of the patients, 8 (93.33%) had no early post-operative problems. As one patient (3.33%) developed local site infection and one (3.33%) patient experienced wound gaping
Sahu SK et al ³⁸	Two patients experienced wound infections, one patient experienced joint stiffness, and the remaining patients all suffered varus deformity.
Verma PK et al ³⁹	One patient, who had a compound fracture, developed an infection right after surgery. This patient was given antibiotics and had extensive debridement. Due to severe articular surface comminution, two patients

	experienced limited range of motion, stiffness in their joints, and continuous pain.
Gupta P et al ⁴⁰	One case of superficial wound infection was observed during early post operative period which resolved within a week with antibiotics.

Pre-operative implications:

In the present study, among the study population, 2 cases developed impending compartment syndrome.

The findings of the present study can be compared with the following studies:

Author	Findings
Present study	2 cases developed impending compartment syndrome.
Vora J et al ³⁷	Of the patients, 8 (98.3%) had no pre-operative problems, while 2 (6.66%) had head injuries.

CONCLUSION

CONCLUSION

From the study findings it can be concluded that proximal tibia fractures treated with Minimally invasive percutaneous plate osteosynthesis technique had significant functional improvement. Modified Rasmussen score significantly improved from the first month to the third and sixth month. At one, three and six months, the VAS score showed a substantial reduction in pain. In this study, a lower rate of complication was seen.

MIPPO favor biological environment for further healing(biological fixation) as it preserves vascularity and fracture hematoma. Fracture healing is noted with better outcome as compared to other methods.

Difficulty noted was visualization of fracture fragment, and learning curve.

LIMITATIONS

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LIMITATION

- Despite the positive outcomes observed in this study, several limitations need to be addressed. Firstly, the findings might not be as broadly applicable given the limited sample size. To validate these findings, more extensive sample sizes would be needed in future research.
- Second, the follow-up period was relatively short, and longer-term outcomes were not assessed. To assess the long-term functional outcomes and the reliability of the surgical procedure, longer-term follow-up studies are necessary.
- Third, radiological result was excluded and only functional outcome was evaluated.
- Lastly, Due to the study's single-center design, selection bias may have been introduced. Multi-center studies could help in obtaining a more diverse and representative sample.

SUMMARY

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SUMMARY

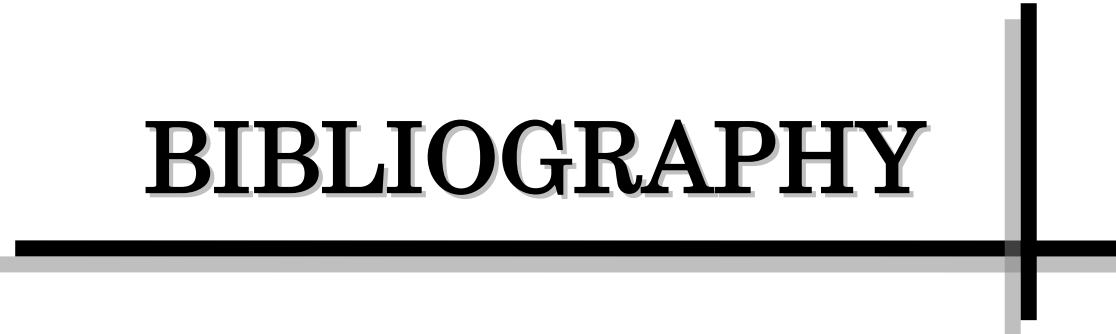
- Among the study population ,The age group of 40–49 years old accounted for the majority of the study population (34.29%), followed by 30-39 years old (28.57%). The age group of 50–59 years old made up around one fifth of the population (22.86%). Rest of the study groups contributed to <10% each. The mean age was 43.91 years.
- Among the study population, 74.29% were male. One fourth of them were females.
- Among the study population, 60% had injured their right side and 40% of them had injuries on the left side. All the fractures were closed type following RTA.
- Among the study population, 31.43% had type IV type of fracture, 22.86% had type II fracture, 20% had type V fracture. Around 15% of them had type I fracture and 11.43% had type VI fracture.
- Among the study population, 34.19% had ROM of 0-120 degrees, 31.43% had ROM of 0 – 125 degrees, 17.14% had ROM of 0-130

degrees, 8.57% hand ROM of 0-110 degrees, 5.71% had ROM of 0-115 degrees, 2.86% had ROM of 0-90 degrees.

- Among the study population, 45.72% had rated pain score as 6. 37.14% rated it as 5 and a minor percentage (17.14%) of them rated it as 7 VAS at 1st month follow up.
- Among the study population, After three months of follow-up, the VAS was less than five. 54.29% had VAS of 3, one quarter of them had VAS of 2 and one fifth of them had VAS of 4 at 3rd month follow up.
- Among the study population, the highest pain score recorded was 2 in one quarter of them, Three fourths of them had VAS of 1 at 6th month follow up.
- Among the study population, Modified Rasmussen Score at 1 month post operatively was ranging between 14-16. Half of them had score of 15, 42.86% of them had score of 14 and 5% of them had score of 16.
- Among the study population, Modified Rasmussen Score at 3 months ranged between 19-20. 62.86% had a score of 20, 37.14% had a score of 19.

-
- Among the study population, Modified Rasmussen Score at 6 months ranged between 19-29. 42.86% had a score of 26, 37.14% had a score of 27 and 14.295 had a score of 28. Only one case had a score of 29 and one case had a score of 19.
 - Among the study population, 97.14% didn't report any complications, 2.86% reported surgical site infection.
 - Among the study population, 2 cases developed impending compartment syndrome.
 - Among the study population, During the follow-up period(1st Vs 3rd Vs 6th month), there was a statistically significant drop in the VAS score (5.8 vs. 2.94 vs. 1.25), with a P value of less than 0.00001.
 - Among the study population, During the follow-up period(1st Vs 3rd Vs 6th month), there was a statistically significant increase in the Mean Modified Rasmussen Score (14.62 Vs 19.62 Vs 26.54), with a P value of less than 0.00001.

BIBLIOGRAPHY

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ANNEXURE

A decorative graphic element consisting of a thick horizontal black line and a thick vertical black line intersecting at a right angle. The intersection point is located to the right of the word 'ANNEXURE'. The horizontal line extends to the left of the word, and the vertical line extends upwards and downwards from the intersection point.

ANNEXURE

**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,
TAMAKA, KOLAR - 563101.**

PATIENT INFORMATION SHEET

**STUDY TITLE: “- A STUDY OF FUNCTIONAL OUTCOME OF PROXIMAL
TIBIA FRACTURES TREATED WITH MINIMALLY INVASIVE
PERCUTANEOUS PLATE OSTEOSYNTHESIS TECHNIQUE -A PROSPECTIVE
STUDY”**

Study location: R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Details- Patients presenting with proximal tibia fracture in the Emergency department of R.L. JALAPPA HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR

Patients in this study will have to undergo routine blood investigations (CBC, RFT, serum electrolytes, blood grouping, HIV, HCV, HBsAG), chest x ray, ECG and x-ray of knee with proximal tibia –AP and lateral view, CT knee. And the procedure Minimally invasive percutaneous plate osteosynthesis.

Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study, we will collect information (as per proforma) from you or a person responsible for you or both. Relevant history will be taken. This information collected will be used only for dissertation and publication.

All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. The expenses estimated for the patient for above study will be handled by the principle investigator.

You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

CONFIDENTIALITY

Your medical information will be kept confidential by the study doctor and staff and will not be made publicly available. Your original records may be reviewed by your doctor or ethics review board. For further information/ clarification please contact

Dr. BASANTH REDDY A,
Department of ORTHOPAEDICS, SDUMC, Kolar
CONTACT NO: 9632477845

**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,
TAMAKA, KOLAR - 563101.**

INFORMED CONSENT FORM

I Mr./Mrs. _____ have been explained in my own understandable language, that I will be included in a study which is **“A STUDY OF FUNCTIONAL OUTCOME OF PROXIMAL TIBIA FRACTURES TREATED WITH MINIMALLY INVASIVE PERCUTANEOUS PLATE OSTEOSYNTHESIS TECHNIQUE - A PROSPECTIVE STUDY”**

I have been explained that my clinical findings, investigations, postoperative findings will be assessed and documented for study purpose.

I have been explained my participation in this study is entirely voluntary, and I can withdraw from the study anytime and this will not affect my relation with my doctor or the treatment for my ailment.

I have been explained about the interventions needed possible benefits and adversities due to interventions, in my own understandable language.

I have understood that all my details found during the study are kept confidential and while publishing or sharing of the findings, my details will be masked.

I have principal investigator mobile number for enquiries.

I in my sound mind give full consent to be added in the part of this study.

Signature of the patient:

Name:

Signature of the witness:

Name:

Relation to patient:

Signature of researcher:

Name of the researcher:

Place:

ಮಾಹಿತಿಯ ಒಪ್ಪಿಗೆ ನಮೂನೆ

ನಾನು ಶ್ರೀ / ಶ್ರೀ. _____ ಅನ್ನು ನನ್ನ ಸ್ವಂತ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ, ಇದು ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ: "ಪ್ರಾಕ್ಸಿಮಲ್‌ನ ಕಾರ್ಯಕಾರಿ ಫಲಿತಾಂಶ ಟಿಬಿಯಾ ಮೂರನೇ ಚಿಕ್ಕತೆ, ನೀಡಲಾಗಿದೆ ಇದರೊಂದಿಗೆ ಸಣ್ಣ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಪೆಕ್ಯುಟೇನಿಯಸ್ ಪಾಲ್ವೆ ಆಸ್ಪಿಯೋಸಿಂಥೆಸಿಸ್ ಟೆಕ್ನಿಕ್", ಎಂಬ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನನ್ನು ಸೇರಿಸಲಾಗುವುದು.

ನನ್ನ ವೈದ್ಯಕೀಯ ಅವಿವರಣೆಗಳು, ತನಿಖೆಗಳು, ಶಸ್ತ್ರಚಿಕಿತ್ಸಾ ನಂತರದ ಫಲಿತಾಂಶಗಳನ್ನು ಮೌಲ್ಯಮಾಪನ ಮಾಡಲಾಗುತ್ತದೆ ಮತ್ತು ಅಧ್ಯಯನ ಉದ್ದೇಶಕ್ಕಾಗಿ ದಾಖಲಿಸಲಾಗುತ್ತದೆ ಎಂದು ನಾನು ವಿವರಿಸಿದ್ದೇನೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನನ್ನ ಭಾಗವಹಿಸುವಿಕೆ ಸಂಪೂರ್ಣವಾಗಿ ಸ್ವಯಂಪ್ರೇರಿತವಾಗಿದೆ ಎಂದು ವಿವರಿಸಲಾಗಿದೆ, ಮತ್ತು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನಾನು ಅಧ್ಯಯನವನ್ನು ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು ಮತ್ತು ಇದು ನನ್ನ ವೈದ್ಯರೊಂದಿಗೆ ಅಥವಾ ನನ್ನ ಅಸ್ವಸ್ಥತೆಯ ಚಿಕಿತ್ಸೆಯ ಮೇಲೆ ಯಾವುದೇ ಪರಿಣಾಮ ಬೀರುವುದಿಲ್ಲ.

ನನ್ನ ಸ್ವಂತ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ಮಧ್ಯಸ್ಥಿಕೆಯಿಂದಾಗಿ ಸಂಭವನೀಯ ಪ್ರಯೋಜನಗಳು ಮತ್ತು ವಿಪತ್ತುಗಳ ವಿಷಯದಲ್ಲಿ ನಾನು ವಿವರಿಸಲ್ಪಟ್ಟಿದ್ದೇನೆ.

ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಕಂಡುಬರುವ ನನ್ನ ಎಲ್ಲಾ ವಿವರಗಳನ್ನು ಗೌಪ್ಯವಾಗಿಡಲಾಗುತ್ತದೆ ಮತ್ತು ಫಲಿತಾಂಶಗಳನ್ನು ಪ್ರಕಟಿಸುವ ಅಥವಾ ಹಂಚಿಕೊಳ್ಳುವಾಗ, ನನ್ನ ವಿವರಗಳನ್ನು ಮರೆಮಾಡಲಾಗಿದೆ ಎಂದು ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ತನಿಖೆಗಾಗಿ ನಾನು ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ ಮೊಬೈಲ್ ಸಂಖ್ಯೆಯನ್ನು ಹೊಂದಿದ್ದೇನೆ.

ಈ ಅಧ್ಯಯನದ ಭಾಗವಾಗಿ ನಾನು ಪೂರ್ಣ ಒಪ್ಪಿಗೆಯನ್ನು ನೀಡುತ್ತೇನೆ.

ಈ ಅಧ್ಯಯನದ ಭಾಗದಲ್ಲಿ ಸೇರಿಸಲು ನನ್ನ ಸಂಪೂರ್ಣ ಮನಸ್ಸಿನಲ್ಲಿ ನಾನು ಸಂಪೂರ್ಣ ಒಪ್ಪಿಗೆ ನೀಡುತ್ತೇನೆ.

ರೋಗಿಯ ಸಹಿ:

ಹೆಸರು:

ಸಾಕ್ಷಿಯ ಸಹಿ:

ಹೆಸರು:

ರೋಗಿಗೆ ಸಂಬಂಧ:

ಸ್ಥಳ:

ತನಿಖಾಧಿಕಾರಿಯ ಸಹಿ:

ಅಧ್ಯಯನ ತನಿಖಾಧಿಕಾರಿಯ ಹೆಸರು:

ದಿನಾಂಕ: ____/____/____

ANNEXURE

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,
TAMAKA, KOLAR - 563101.

UHID No:

CASE NO:

**“A STUDY OF FUNCTIONAL OUTCOME OF PROXIMAL TIBIA
FRACTURES TREATED WITH MINIMALLY INVASIVE
PERCUTANEOUS PLATE OSTEOSYNTHESIS TECHNIQUE - A
PROSPECTIVE STUDY”**

1. BASIC DATA

Name Age/Sex

Address

Mobile No.

Date of Procedure Date of Admission/OP Date of Discharge

History:

Mechanism of injury:

General physical examination:

Vitals:

Pulse-

B.P-

RR-

Temp-

Systemic examination:

CVS-

RS-

PS-

CNS-

Preexisting systemic illness:

Diabetes/Thyroid disorder/ Cervical Spine/ CVS/RS/ CNS/locomotor/ TB/
anemia/ Hypertension/ malnutrition/others

Local examination:

Side : Left/Right/Bilateral

Deformity : Present/Absent

Swelling : Present/Absent

Tenderness : Present/Absent

ROM @ knee : Full / Restricted Distal sensation : Present/Absent Distal

pulsation : Palpable /Absent Any other associated fractures:

RADIOLOGICAL INVESTIGATIONS:

X ray Knee with proximal tibia – antero-posterior and lateral view . CT Knee

2. DIAGNOSIS:**3. INVESTIGATIONS:**

-CBC,

- BT,

- CT,

-
- Blood grouping
 - Blood urea,
 - Serum creatinine,
 - RBS
 - HIV,HCV, HBsAg status

4. TREATMENT:

OPERATIVE TREATMENT: MINIMALLY INVASIVE PERCUTANEOUS
PLATE OSTEOSYNTHESIS

Operation date – Type of anesthesia:

Approach used:

Implant used:

5. POST PROCEDURE

Observation in surgical ICU

Immobilization of Knee

NSAID's

Antibiotics Prophylactic/therapeutic/Nil

Complications:

Early:

Delayed :

Late:

Local complications

1. Necrosis of skin

2. Infection: a) suspected/established.

b) superficial/deep.

c) mild/moderate/severe.

3. Hematoma

4. Others

Further treatment of complications

None/Hematoma aspirated/Open dressing/Debridement/Suction

irrigation/Plastic/Procedure/Physiotherapy

6. TIME OF DISCHARGE:

Rom assessment

Overall functional assessment according to Modified RESMUSSEN score

Complications

1. Early

2. Delayed

3. Late

RANGE OF MOTION:

MOVEMENT	1 MONTH	3 MONTHS	6 MONTHS
FLEXION			
EXTENSION			

TOTAL MODIFIED RASMUSSEN SCORE

TOTAL MODIFIED RASMUSSEN SCORE	1 MONTH	3 MONTHS`	6 MONTHS
a)Subjective Pain Walking capacity			
b)Clinical signs Extension Total ROM			
c)Stability			
TOTAL SCORE			

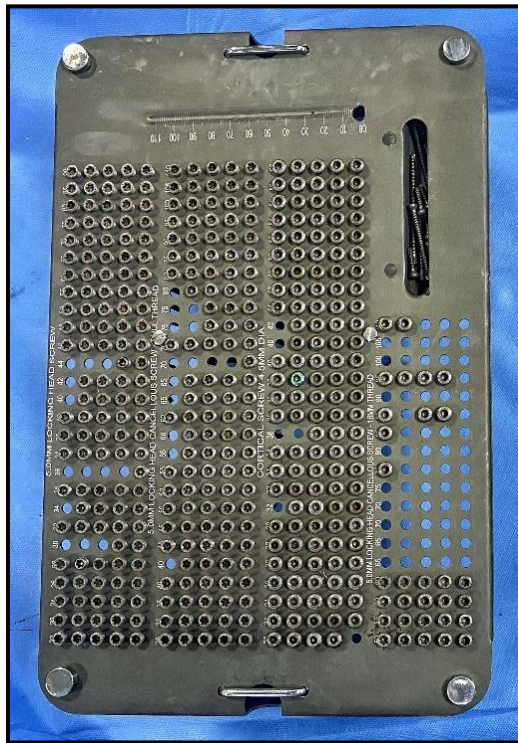
IMAGES

ANNEXURE

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION
AND RESEARCH, TAMAKA, KOLAR - 563101.

DATA COLLECTION PHOTOS

LOCKING COMPRESSION PLATES AND SCREWS



CASE 1

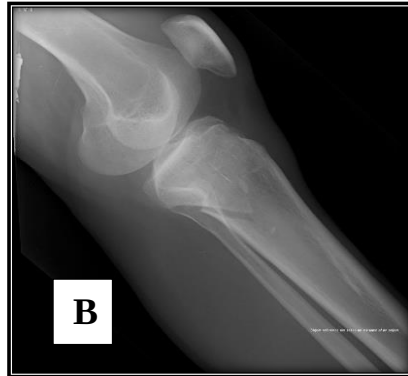


Figure A & B - Showing pre op x ray with proximal tibia fracture; **C & D** - Intra operative images; **E & F**-Post op x rays



CASE 1 CLINICAL IMAGES

CASE 2

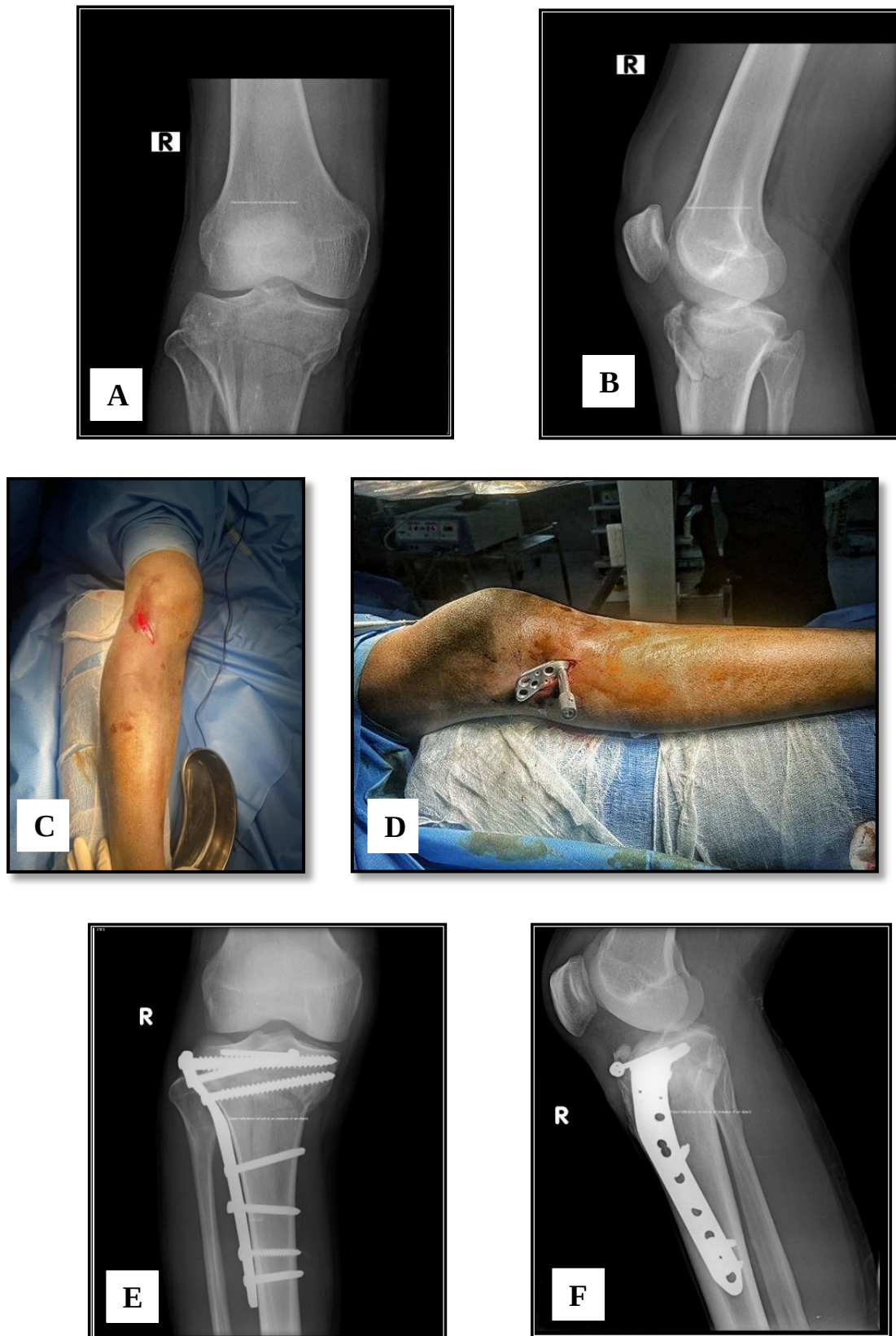


Figure A & B - Showing pre op x ray with proximal tibia fracture; **C & D** - Intra operative images; **E & F** - Post op x rays



CASE 2 CLINICAL IMAGES

CASE 3

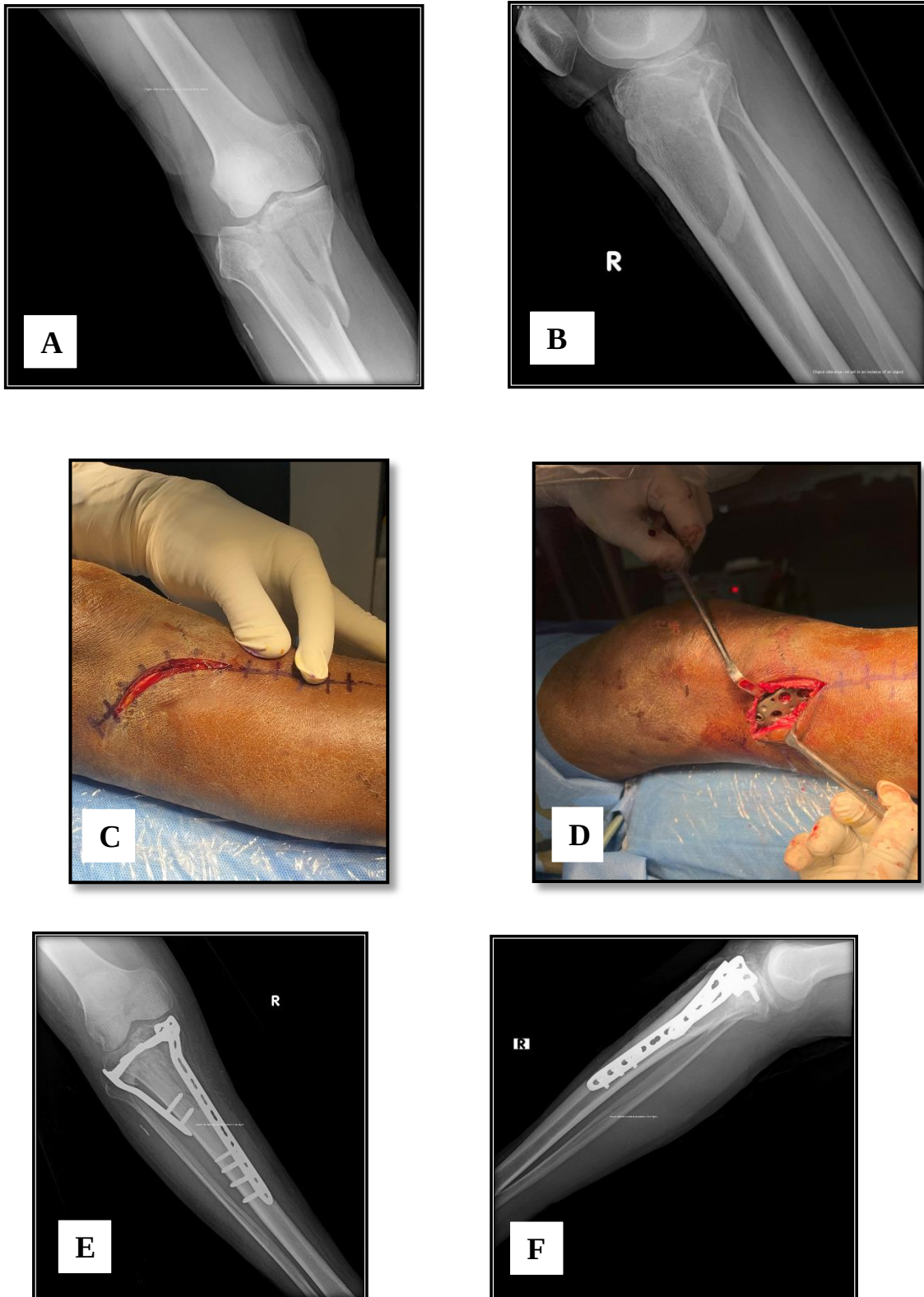


Figure A & B - Showing pre op x ray with proximal tibia fracture; **C & D** - Intra operative images; **E & F**-Post op x rays.



CASE 3 CLINICAL IMAGES

CASE -4





Figure A & B - Showing pre op x ray of left proximal tibia fracture; **C & D** – 1 month follow up x rays; **E & F**-3 months follow up x rays, **G & H**-6 months follow up x rays.

MASTER CHART

A decorative graphic consisting of a thick horizontal line and a thick vertical line intersecting at the right end of the horizontal line. The lines are black with a slight gray shadow or offset.

ANNEXURE

KEY TO MASTER CHART

M- MALE

F- FEMALE

RTA-ROAD TRAFFIC ACCIDENT

ROM – RANGE OF MOTION

VAS – VISUAL ANALOG SCORE

SL.NO	HOSPITAL NO	AGE	SEX	SIDE	MODE OF INJURY	OPEN/CLOSED	SCHATZKER TYPE	ROM	VAS SCORE				MODIFIED RASMUSSEN SCORE			COMPLICATION	PRE OP IMPLICATION	
									1ST MONTH	2ND MONTH	3RD MONTH	1ST MONTH	3RD MONTH	6TH MONTH				
1	91295	30	M	LEFT	RTA	CLOSED	TYPE 5	0-120	5	3	1	14	20	26			IMPENDING COMPARTMENT SYNDROME	
2	155367	30	M	LEFT	RTA	CLOSED	TYPE 2	0-125	5	3	2	15	19	26				
3	160390	40	M	RIGHT	RTA	CLOSED	TYPE 5	0-120	6	4	1	16	20	26				
4	163396	52	M	RIGHT	RTA	CLOSED	TYPE 6	0-125	7	3	1	16	20	27				
5	166672	45	M	RIGHT	RTA	CLOSED	TYPE 5	0-120	7	3	2	14	20	26				
6	173438	36	M	RIGHT	RTA	CLOSED	TYPE 5	0-120	6	4	1	15	20	27				
7	199540	25	M	RIGHT	RTA	CLOSED	TYPE 2	0-123	6	3	1	14	20	26				
8	55656	46	M	LEFT	RTA	CLOSED	TYPE 6	0-90	6	2	1	15	19	19			IMPENDING COMPARTMENT SYNDROME	
9	85244	34	M	LEFT	RTA	CLOSED	TYPE 5	0-130	6	2	1	15	20	28				
10	218024	32	M	RIGHT	RTA	CLOSED	TYPE 4	0-120	5	2	1	15	19	26				
11	249321	38	M	RIGHT	RTA	CLOSED	TYPE 2	0-125	5	3	1	14	20	27				
12	67690	32	FM	RIGHT	RTA	CLOSED	TYPE 4	0-124	5	3	2	15	20	27				
13	237265	35	M	RIGHT	RTA	CLOSED	TYPE 1	0-110	6	4	1	15	19	26				
14	176508	50	M	RIGHT	RTA	CLOSED	TYPE 2	0-125	7	3	1	15	19	27				
15	291221	28	M	LEFT	RTA	CLOSED	TYPE 1	0-130	7	3	2	14	20	28	Surgical site infection			
16	146528	40	FM	LEFT	RTA	CLOSED	TYPE 4	0-120	6	4	1	15	19	26				
17	236213	52	M	RIGHT	RTA	CLOSED	TYPE 5	0-120	6	3	1	14	20	26				
18	187450	44	M	LEFT	RTA	CLOSED	TYPE 6	0-125	6	2	1	14	20	27				
19	341971	38	M	RIGHT	RTA	CLOSED	TYPE 2	0-120	6	2	1	15	19	26				
20	353896	40	M	RIHT	RTA	CLOSED	TYPE 1	0-130	5	2	1	15	19	29				
21	314709	45	M	LEFT	RTA	CLOSED	TYPE 4	0-110	5	3	1	14	20	26				
22	339748	43	F	RIGHT	RTA	CLOSED	TYPE 2	0-120	5	3	2	15	19	27				
23	278598	73	M	RIGHT	RTA	CLOSED	TYPE 4	0-115	6	4	1	14	20	26				
24	307110	65	M	RIGHT	RTA	CLOSED	TYPE 6	0-125	6	3	1	15	19	27				
25	371768	48	F	LEFT	RTA	CLOSED	TYPE 4	0-115	5	3	2	14	20	26				
26	347339	52	F	RIGHT	RTA	CLOSED	TYPE 4	0-130	6	4	1	14	20	28				
27	358564	42	F	RIGHT	RTA	CLOSED	TYPE 2	0-110	5	3	1	14	20	26				
28	217524	54	F	LEFT	RTA	CLOSED	TYPE 4	0-125	6	2	1	14	20	27				
29	256969	44	FM	LEFT	RTA	CLOSED	TYPE 4	0-125	6	2	1	14	20	27				
30	379616	58	FM	LEFT	RTA	CLOSED	TYPE 2	0-130	5	2	1	15	19	28				
31	349646	32	M	RIGHT	RTA	CLOSED	TYPE 1	0-120	5	3	1	15	20	27				
32	321681	52	M	LEFT	RTA	CLOSED	TYPE 5	0-125	5	3	2	14	20	26				
33	347344	60	M	RIGHT	RTA	CLOSED	TYPE 1	0-120	6	4	2	15	19	27				
34	263218	58	M	LEFT	RTA	CLOSED	TYPE 4	0-120	7	3	1	15	20	27				
35	351816	44	M	RIGHT	RTA	CLOSED	TYPE 4	0-130	7	3	2	15	19	28				