IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 1 Ver. V (Jan. 2015), PP 37-47
www.iosrjournals.org

A Comparative Study - Plating Of Fracture Around Knee Joint By Mipo V/S Conventional Technique.

Dr. Sanjeev Kumar Singh[1], Dr. Nipendra Kishore[2], Dr. Anjali Singh[3], Dr. Prof. Subrata Nag[4], Dr. Sanjeev Hembram[5]

[1]*Assistant Professor, Orthopaedics, Narayan Medical College and Hospital, Sasaram, Bihar*
[2,5]*Senior Resident, Ortho, NMCH,* [3]*secondary DNB Pediatrics TMH Jamshedpur,*
[4]*HOD Anesthesiology, NMCH*

Abstract: *In Fracture around knee joint internal fixation with plate and screw remain gold standard. biological methods of reduction involving use of indirect reduction techniques and new plate designs have been developed so as to preserve the blood supply of injured bone, increase the rate of fracture healing, thus decreasing the need for bone grafting, and incidence of infections and complications. MIPO appear to be next step in evolution of biological plating. MIPO is new technique where indirect reduction is achieved. biological plating whether done with locking or non-locking plates offers better results than conventional plating due to less soft tissue dissection, less periosteal stripping and preservation of fracture haematoma.*

I. Introduction

Ancient indians have practiced treatment of fractures since time immemorial; variety of methods has been used for management of various types of fractures. Use of bamboo sticks, variety of resins and lime which attain hard consistency on drying like modern pop, for fracture stabilization is well documented in **atharwaveda** about 2000 bc, and later by **samhitas of charak** and **shushrutu** about 1000 years bc.

Management of fractures has changed very much over time. It has advanced from bamboo stick, pop to modern minimally invasive surgeries, to robotic and distant operative techniques with which surgeon sitting in london is operating on a patient in delhi.

Fractures around the knee i.e. Distal metaphyseal fractures of femur and proximal tibia have troubled orthopedic surgeons very much because of their common occurrence in present mechanized world. Methods of treatment vary according to type, level of fracture and age of patient and are based on assessment of advantages and disadvantages associated with each.

The goal of fracture treatment is to obtain union of the fracture in the most compatible anatomical position which allows maximal and full restoration of the extremity[1].

Tibial plateau fractures constitute 1% of all fractures and 8% of fractures in the elderly[2]. Isolated injuries to the lateral plateau account for 55% to 70% of tibial plateau fractures, as compared with 10% to 25% isolated medial plateau fractures and 10% to 30% complex bicondylar lesions. From 1% to 3% of these fractures are open injuries[2]. Due to increase in motor vehicle accidents we are faced with more number of complex tibial condyle fractures. Subcutaneous nature and its precarious blood supply make fractures of tibia more complicated. Hence no single method of treatment could apply to all types of fractures. On the contrary extensive muscle mass and pull make distal femur fractures difficult to reduce.

Since 1950 orif has been advocated to restore stable articular congruity and enable early mobilization. This approach often necessitates extensive soft tissue dissection and devitalization, creating an environment, less favorable for fracture healing and more prone to infection. As a result other methods such as intramedullary nailing, percutaneous plating have become the standard treatment for tibia fractures.

However internal fixation with plate and screw remain treatment of choice for most periarticular fractures and other complex fractures inadequately stabilized by intramedullary nailing. Recently more biological methods of reduction involving use of indirect reduction techniques and new plate designs have been developed in an attempt to preserve the blood supply of injured bone, improve the rate of fracture healing, decrease need for bone grafting, and incidence of infections and complications.

Dcp (lc-dcp) reduced plate contact areas by 50% as well as distributing bending forces more evenly across the plate, but the fixation was still dependent on friction obtained by pressure at the plate–bone interface[3]. The point contact fixator (pc-fix) featured minimal (point) contact areas on the bone with improved preservation of periosteal and endosteal blood supply[3]. The less invasive stabilization system (liss) combines a new technical development (angular stable plating system) and revolutionary surgical technique (percutaneous plating facilitated by external aiming device[3].

Mipo appear to be next step in evolution of biological plating. MIPO is new technique where indirect reduction is achieved:

- Without opening fracture site
- Without disturbing fracture haematoma
- By making small skin incision away from fracture site

II. Aims And Objectives

'Evaluation of results of biological plating for fractures around the knee joint', with respect to:

1.1. To find out pattern of fractures around knee joint i.e. proximal tibia and distal femur in Narayan Medical College, Jamuhar, Sasaram, Bihar

1.2. Role of 3D reconstruction x-ray for proper classification of fracture as compared to conventional x-ray.

1.3. Clinical and functional outcome regarding, bone healing, post-op complications and knee function as measured by KOOS score (knee injury and osteoarthritis outcome score)

III. Material And Method

A prospective study was done from Narayan Medical College, Jamuhar, Bihar. Patients of proximal tibia and distal femur metaphyseal fractures with or without intra articular extension treated either by biological plating or conventional plating at department of orthopaedics, were included with predefined inclusion & exclusion criteria in this study. Minimum of six months follow up was used. Patients were assessed on the basis of clinical and functional outcome regarding, bone healing, post-op complications and knee function as measured by KOOS score (knee injury and osteoarthritis outcome score.

3.1. Inclusion Criteria

1. Patients with all the fractures around knee joint with or without metaphyseal extension i.e. proximal tibia and distal femur.
2. Patients in the age group of 18-60 yrs.
3. All the patients with acute and sub-acute trauma of less than 2 weeks.
4. Patients giving consent to undergo the operative procedure.

3.2. Exclusion Criteria

1. Patients in the paediatric age group.
2. Patients not giving consent for the operative procedure.
3. Patients out of study age group.
4. Severe open fractures i.e. compound grade 3b and 3c.
5. Avulsion fractures around knee joint.

3.3. Procedure

Patients were investigated completely for operative and anesthesia. -purpose. Preoperative planning also included the pre anesthetic check up and necessary implants arrangement.

Biological plating was done on radiolucent fracture table with knee and foot fully exposed. Part to be operated was painted with povidone iodine and draped. Indirect reduction was achieved and was checked under C-ARM. Small skin incision was given away from fracture site and fracture haematoma was not disturbed.

Depending upon the condition of the soft tissue and which tibial condyle is involved, skin incision was placed medially or laterally. Fracture was reduced and held with the help of reduction holding clamp and plate was inserted subcutaneously through the fracture site. Similarly for distal femur fractures trial with MIPO using lateral incision was given. Intercondylar fragments were first reduced and held with K-wires. Reduction of supracondylar fragments was achieved and metaphyseal plate was applied. If extensive comminution was present and the reduction was not acceptable; open reduction and conventional plating was done. Surgical wounds were sutured in layers with or without suction drain.

Depending upon the fracture anatomy T-buttress. L-buttress, cloverleaf, narrow DCP, hockey stick (both locking as well as non-locking) and if required, 6.5 mm cannulated screws were used in tibial fractures. For distal femoral fractures DCS, condylar buttress, hockey stick both locking as well as non-locking and if required, 6.5 mm cannulated screws were used. Placement of the plate was checked under the C-ARM in both AP and Lateral profiles. Reduction was done under C-ARM with manual traction and manipulation. Cortical screws were inserted through separate stab incisions. All the patients were assessed for radiological union, time to partial and full weight bearing, incidence of infection, malunion, delayed union, nonunion, functional assessment using KOOS score and stability of fixation fillig the assessment proforma.

Surgical Approaches [1, 4]

Distal Femur

Minimally Invasive Lateral Approach

This is the most common approach used for fixation of distal femur condylar fractures. A 3-cm incision is made over the lateral femoral condyle, directly over the point of entry of the condylar screw. A primary k-wire is passed for holding reduction of the condylar fragments. The plate is passed through the incision proximally, beneath the vastus lateralis and k-wire is engaged in the distal condylar hole of the plate. Then the condylar screw passed over the k-wire through the distal hole of the plate, the plate is fixed to the femoral shaft proximal to the fracture site with percutaneously placed screws. To minimize the number of incisions required for screw placement, particularly if many screws are to be placed percutaneously, several screws can be placed through one small incision by placing them at an angle through their respective hole in the plate.

Minimally Invasive Medial Approach

This approach is used for:

1. For fractures limited to the medial condyle (type B2 and medial type B3)
2. For severely commuted type C3 fractures when a second medial plate is to be placed in addition to a lateral plate, in conjunction with a lateral approach

A straight medial skin incision of 3cm is made over the thigh, to extend distally over the medial condyle anterior to the adductor tubercle. The deep fascia is incised in line with the skin incision, and the vastus medialis is carefully elevated from the adductor magnus, thereby exposing the medial surface of the distal femur. The medial superior geniculate artery may need to be identified and ligated. To obtain complete exposure of the medial femoral condyle, one should incise the medial patellar retinaculum, joint capsule, and synovium. The surgeon should take care to remain anterior to the medial collateral ligament and to avoid incising the medial meniscus. The femoral artery and vein pierce the adductor magnus one handbreadth above the knee. Caution must be exercised if an attempt is made to extend the exposure proximally at this level.

Minimally Invasive Technique for Proximal Tibia

Medial Approach

This approach is most commonly used for fixation of condyles. About 3cm incision is taken direct over the medial condyle of tibia, anteromedially. Fascia is split and MCL is taken care of. Reduction is achieved and held with the help of reduction holding clamp. Now K-wire is passed through the condyles to stabilize reduction. Clamp is removed. Plate whether it is LCP, hockey stick or buttress is slid subperiosteally to the tibial shaft. Condyles are fixed with cc screws through the proximal holes of the plate. Distally the cortical screws are secured percutaneously to the tibial shaft. Articular congruity is checked in c-arm or by direct visualization by elevating the medial meniscus.

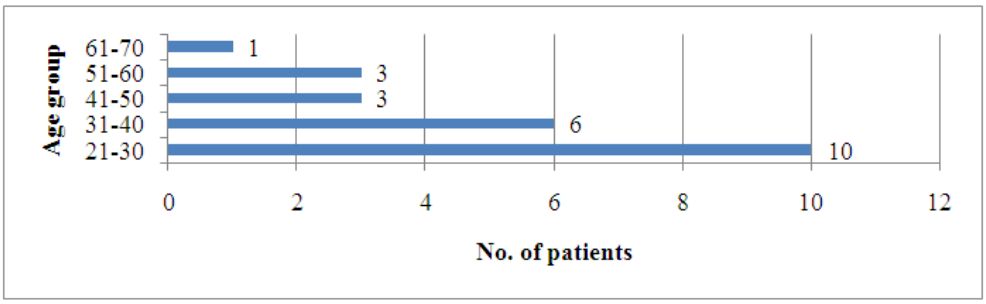
Lateral Approach

This approach is used for placing an antiglide plate on the lateral side when the metaphyseal comminution is extensive. Lateral incision is taken anterolaterally over the lateral femoral condyle. Vertically the incision should lie between the patella and the fibular head. Fasicia is split and LCL is taken care of if the incision is extended posterolaterally. Lateral antiglide plate whether buttress or recon is inserted subperiosteally. Proximally it is secured with cc screws and distally with the help of cortical screws.

These minimal approaches when extended through the fracture site can be easily converted to extended approaches for conventional plating.

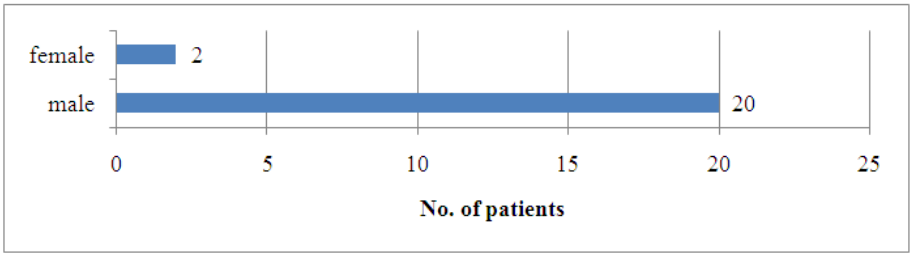
IV. Observation & Result

4.1. Age Incidence



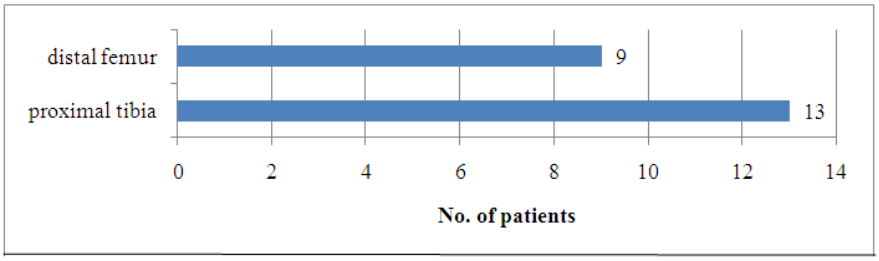
It implies that the fracture incidence is more common the age group of 21-30 as they are more exposed to the outdoor activities. Incidence being 41%.

4.2. Sex Incidence



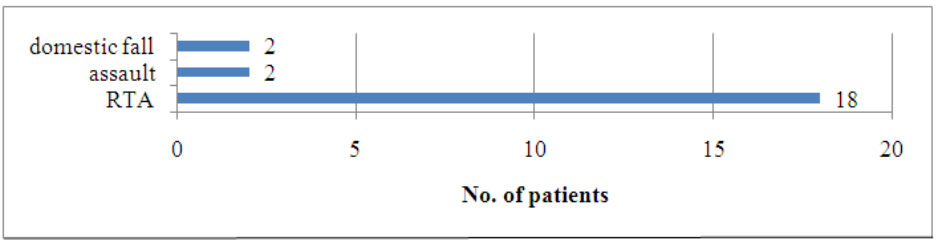
Clearly depicts more fractures around knee in males as they are associated with more outdoor activities. Males being involved in nearly 90.9% cases.

4.3Type of Fracture



Implies that the incidence of proximal tibial fractures is more than distal femur fractures. Incidence being 59.09%.

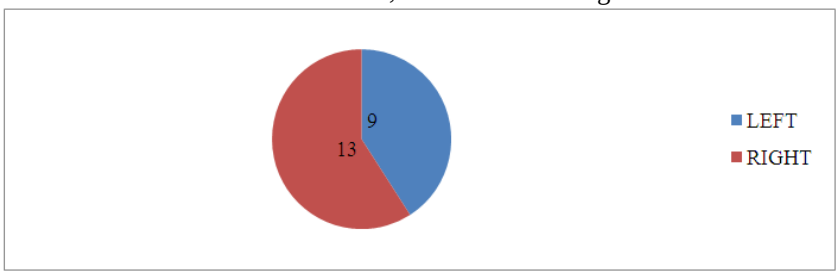
4.4. Mode of Injury



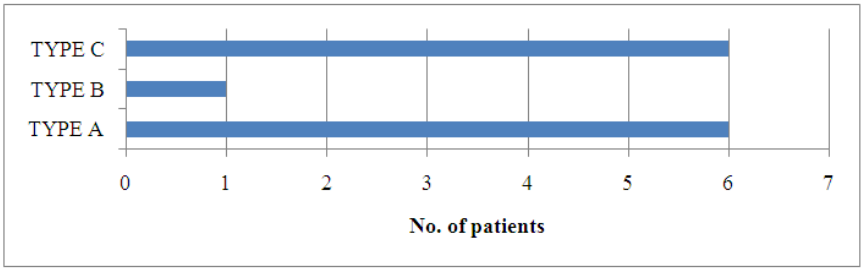
Depicts that around 81.8% of injuries are caused by road traffic accidents

4.5. Side of Involvement

In our study right side was affected more than the left, the incidence being 59.09%.

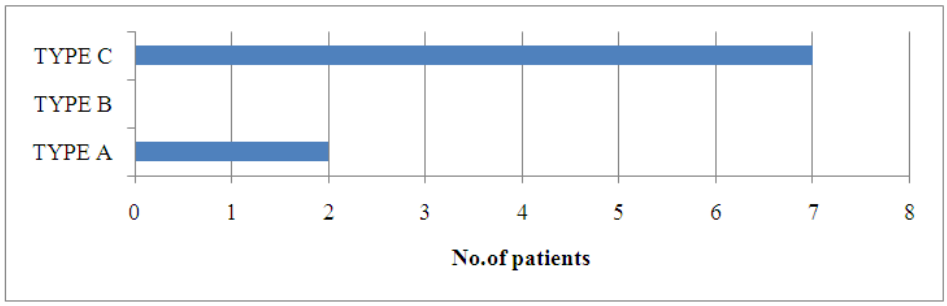


4.6. Fracture Classification for Proximal Tibia



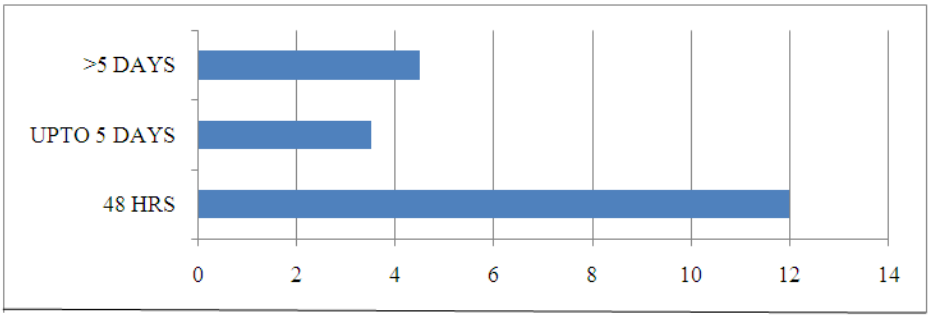
Incidence of type A and C fractures was equal in the study being 27.27%.

4.7. Fracture Classification for Distal Femur



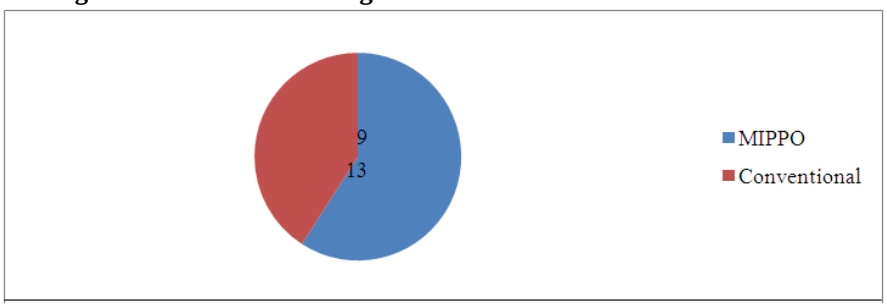
The incidence of type C fractures was much higher than the others indicating high velocity injuries. Incidence was 31.8%.

4.8. Time Interval between Injury and Surgery



Majority of the surgeries i.e. 54.54% were performed within the first 48hrs of admission.

4.9. Biological Plating v/s Conventional Plating



About 59% of surgeries were done with MIPPO and about 31% were done with conventional mode. Mippo being 13 and conventional being.

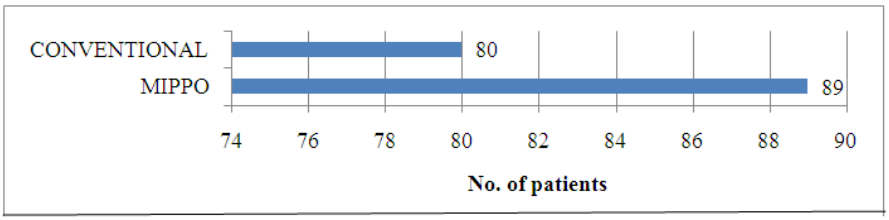
4.10. Associated Injury

Fracture patella	**2**
Fracture mandible	**2**

4.11. Bone Grafting

Required	**3**
Not necessary	**19**

4.12. Koos Score: Mippo V/S Conventional



On an average KOOS score for the fractures around the knee was better in MIPPO than conventional mode indicating better functional outcome. Average KOOS for MIPPO being 89 and for conventional plating being 80.

4.13. Koos Score (statistical analysis)

Group	n	mean	SD	t-value	p-value
Biological	13	88.84	9.38	**2.35**	**0.02 Significant**
Conventional	9	80.00	7.50		

4.14. Complications

Varus malalingment	**2** (1-MIPPO,1-CONVENTIONAL)
Fracture collapse	**1** (MIPPO)
infection	**1** (CONVENTIONAL)

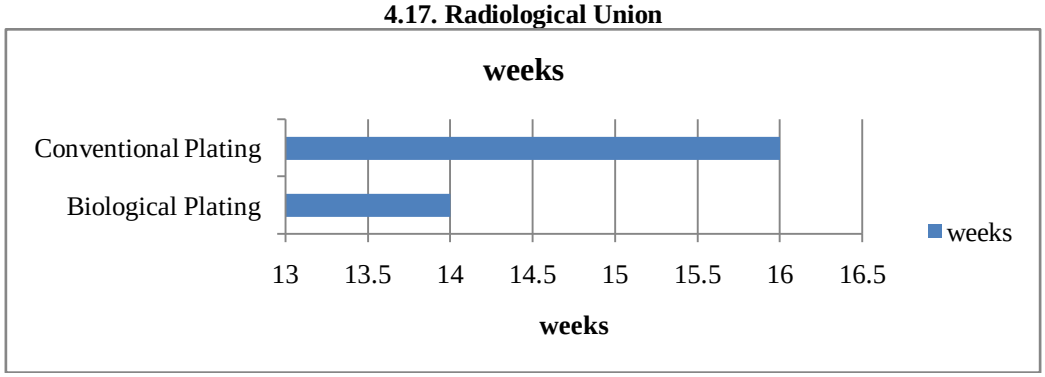
4.15. Range of Motion

R.o.m	Average
Mippo	**0-97 degrees**
Conventional	**0-122 degrees**

4.16. R.O.M (statistical analysis)

R.o.m	N	Mean	Sd	T-value	
Biological	13	121.53	25.44	**2.04**	**0.05 significant**
Conventional	9	96.66	31.62		

4.17. Radiological Union



Time taken for radiological union was on an average 9weeks for MIPPO and 10weeks for conventional plating depicting early radiological union with biological plating.

4.18 Radiological Union (statistical analysis)

Group	n	mean	SD	t-value	p-value
Biological	13	13.56	1.66	**2.44**	**0.02 Significant**
Conventional	9	16.44	1.73		

V. Discussion

'Bio-logical' internal fixation avoids the need for precise reduction, especially of the intermediate fragments, and takes advantage of indirect reduction. This principle applies equally to locked nailing, bridge plating, and internal fixator-like devices. Indirect reduction aims only to align the fragments. It avoids exposure of the bone thus reducing the surgical trauma. Flexible fixation is advocated to induce formation of callus and is achieved by using wide bridging of the area of the fracture. Pure splinting without compression results in flexible fixation. The aim is to produce the best biological conditions for healing rather than absolute stability of fixation and this approach has been shown to give early solid union.

Biological internal fixation does not compromise the restoration of early and complete function of the bone, limb and patients, but recognition of the optimum requirements for bone healing now takes precedence, with mechanical stabilization being less rigid while still allowing painless function and reliable healing. The aim is to reduce the infrequent but possibly severe complications such as sequestration and infection which may be produced by bone necrosis, with less emphasis on avoidance of delayed or non-union, which is more easily managed.

Differential indications for conventional versus biological internal fixation

When the blood supply to the fracture is severely damaged and the bone is necrotic recovery takes many months. Conventional compression fixation then allows for long-term protected internal remodeling. When the blood supply is good, or can be restored within bridges between the soft tissues and bone, biological

internal fixation is considered to be the method of choice. The two methods of stabilization cannot be equally applicable to the same fracture site. Based on the strain theory, either absolute stability or elastic flexible fixation of a gap is required. Thus, combinations of different techniques must be carefully considered

In this study twenty three cases of proximal tibial and distal femoral metaphyseal fractures with or without intra articular extension treated by Biological plating or Conventional plating at department of orthopaedics, Narayan Medical College Jamuhar, were included. T-buttress, L-buttress, hockey stick, condylar buttress and locking plates were used. Study was done from 1st October 2012 to 1st October 2014.

5.1. Age/Sex Incidence

In our study out of 23 patients, 22 completed the study. The mean age of the patients was 36 years and there were 20 males and 2 females. The reason being that in the younger patients there is more outdoor activities, so they are more prone to vehicular accident and females in rural area being house wives are less exposed to road traffic accidents.

- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park, Woo-Kie Min and Poong-Taek Kim**[5] in 2006 reported results of MIPO in proximal tibial fractures in 23 patients and concluded that it was more common in males and the mean age was 54yrs.
- **Chr. Krettek et al**[6] (2001) had evaluated a minimally invasive approach for proximal tibial fractures in six patients and found that there were five males and one female, ranging in age from 28-54 years.

We conclude that most of the patients are males and are more exposed to the traumatic stimulus.

5.2. Mode Of Injury

In our study most of the injuries were caused by road traffic accidents affecting mostly males. In our study we had 20 RTA injuries and 2 falls and 2 assaults.

- **P Kanabar, V Kumar, PJ Owen**[7] reported higher incidence of falls in their study.
- **K. Kolb**, **P. Grützner, H. Koller, C. Windisch, F. Marx and W. Kolb**[8] reported that most of the injuries were caused due to road traffic accidents.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] too had more of road traffic accidents injuries in their study.
- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park. Woo-Kie Min and Poong-Taek Kim**[5] too had more of RTA's in their study.
- **Cory Collinge et al**[10] (2000) had evaluated the results of treatment of complex tibial periarticular fractures using percutaneous technique in seventeen patients and found that fifteen patients had injury due to RSA. One due to fail and in another due to airplane crash.

  As in sync with other studies most of the fractures around the knee are mostly caused by road traffic accidents.

5.3. Type Of Fracture And Fracture Classification

In our study of 23 patients for fractures around the knee we had 13 proximal tibial fractures and 9 distal femur fractures out of 22 patients who completed the study. In distal femur fractures there were 7 type 3c fractures and 2 type 3a fractures. Whereas in proximal tibial fractures 6 each were type 3c and 3a fractures.In all there were 13 fractures around the knee where severe comminution was present. This signifies that most of the injuries are caused by high energy trauma.

- **K. Kolb, P. Grützner, H. Koller, C. Windisch, F. Marx and W. Kolb**[8] also reported that most of the injuries were caused by high energy trauma and comminution was present.
- **P Kanabar, V Kumar, PJ Owen**[7] reported in their study that 8 fractures were type 33A and 9 were type 33C signifying high energy nature of these injuries.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] in their study of 36 patients reported 27 type c patients and 9 type a patients.
- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park, Woo-Kie Min and Poong-Taek Kim**[5] treated 23 patients with proximal tibial fractures with double plating they reported that in their study there were 13 cases of type c fractures.
- **Cory Collinge et al**[10] (2000) had evaluated the results of treatment of complex tibial periarticular fractures using percutaneous technique in seventeen patients and found that twelve patients presented with compound grade-III fractures and five with closed fractures.

This signifies that most of the fractures around the knee are caused by high energy trauma and are associated with severe comminution. We conclude that as high energy trauma is the causative factor, type c fractures are more common in both distal femoral and proximal tibial fractures.

5.4. Union/ Delayed Union / Nonunion

In patients treated with biological plating union occurred at an average of 14 weeks and the patients treated with conventional plating the union occurred at an average of 16 weeks. Radiological union of the fracture i.e. characterized by cortical bridging of the fracture in both AP and lateral views of follow up x-rays, was considered as a landmark for union.In our study we explain this with less periosteal stripping, preservation of fracture haematoma and better tissue handling. There were no cases of delayed or non-union.

- **P Kanabar, V Kumar, PJ Owen**[7] in their study of 17 patients of distal femur fractures with LISS plating reported 1 nonunion and one delayed union.ie. 5.8% had delayed union and 5.8% had non-union.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] in their study of MIPO of proximal tibial fractures in 35 patients reported 2cases of delayed-union and no cases of non-union. They had 8% of delayed unions among 25 patients that completed study.
- **Chr. Krettek et al** [11] (2001) had evaluated a minimally invasive approach for proximal tibial fractures in six patients. The average time to healing was between 12 and 20 weeks postoperatively
- **Cory Collinge et al**[10] (2000) had evaluated the results of treatment of complex tibial periarticular fractures using percutaneous technique in seventeen patients and found that in nine patients with compound fractures, three patients had delayed and three non-union.

We conclude that union depend on stable fixation and bone grafting where comminution is present. Delayed union is said to be present then there are no sign of union at 24 weeks. Union generally occurs at 12-16 weeks. In case of non union re-surgery and bone grafting have availed good results.

5.5. Malunion

In our study we had one cases of varus malalingment for proximal tibia AO A3 and one case of fracture collapse in proximal tibia. In one case malalingement occurred in fracture treated with biological plating and in one case of fracture treated with conventional plating. Both the cases were proximal tibial fractures. Varus maalingment occurred as a result of improper reduction on day one. Because of comminution and usage of non locking plate the fracture went into varus. In one distal femoral fracture. Fracture collapse occurred as a result of early weight bearing done against advice. We had a 9% rate of malunion in the study.

We would like to conclude that as the reduction is not obtained under the direct eye of the surgeon, the chances of malunion are higher in patients treated with biological plating in inexperienced hands.

- K**. Kolb, P. Grützne, , H. Koller, C. Windisch, F. Marx and W. Kolb**[8] in their study on distal femoral fractures fixed with dcs reported malalingment in 5 cases out of 41 cases i.e. 12.1% cases had malunion. 2 patients developed varus and 3 developed valgus malalingment.
- **P Kanabar, V Kumar, PJ Owen**[7] reported malunion in 1 case out of 17 cases i.e. in 5.8% of cases. The 1 case reported had valgus malalingment.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras** [9]reported malalingment in 4% of cases.
- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park, Woo-Kie Min and Poong-Taek Kim**[5] reported malalingment in 2 out of 23cases i.e. in 8.6% of cases...

We conclude that the chances of Malunion in Biological plating in inexperienced hands as the reduction is not achieve under the direct eye of the surgeon. Others factors that contribute to malunion are unstable fixation and early weight bearing on part of the patients.

5.6. Infection

We had infection in 1 patient in 22 cases out of 22 who completed the study. We had 4.5% infection rate in that matter. None of the patient got infection in long term. It may be attributed to better soft tissue handling and proper antibiotic cover.The one infection that occurred was in case treated with conventional plating of proximal tibia. Here we would like stress upon that chances of infection are less in patients treated with Biological plating as there is less soft tissue stripping and minimal handling.

- **K. Kolb, P. Grützne, H. Koller, C. Windisch, F. Marx and W. Kolb**[8] reported infection in 2 patients out of 41 patients. Their infection rate was 4.8%.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] reported infection in 2 cases out of 25 that completed study. Their infection rate was 8%.
- **Oleurd**[12] reported 25 % infection rate in his series of 16 patients treated for distal femoral fractures by operative means. Infection rate was 4.4 % in study done by Mize et al[54].
- **Bolhofner[13]** reported less than 1% infection rate in a series of 57 patients.

We conclude that chances of infections are less in Biological plating as soft tissue stripping is less, with no periosteal stripping and no exposure across the fracture site.

5.7. Secondary Procedures

In our study there were 2 case that required re-operative procedures. The one had varus malalingment and the other developed a secondary fracture due to fall. In all there were 9% of patients that required re-operative procedures. 1 case with varus malalingment that required reoperation was due to inadequate reduction achieved in c-arm while doing Biological plating of proximal tibia. We would like to confer upon that there can be such complications in Biological plating in inexperienced hands.

On the broader aspect as conferred from our and other studies the need for secondary procedures is less when doing MIPO or LISS in experienced hands as the chances of screw loosening and backout are less. It is attributed to the stable and sturdy construct provided by these procedures.

- **K. Kolb, P. Grützne, H. Koller, C. Windisch, F. Marx and W. Kolb**[8] had secondary procedures in 5 patients out of 41 patients; 2 with varus malalingment and 3 with valgus malalingment. All the patients required osteotomy with bone grafting. Their percentage of secondary procedures was 12.1%.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] had no patient that needed secondary procedure out of 25 patients that followed study. There was no loss of reduction or gross malalingment.
- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park, Woo-Kie Min and Poong-Taek Kim**[5] had 2 patients that required secondary procedures one due to infection and other due to screw irritation. Their percentage for secondary procedures was 8.6%.
- **Cory Collinge et al**[10] (2000) had evaluated the results of treatment of complex tibial periarticular fractures using percutaneous technique in seventeen patients and found that six fractures united after second procedure and one patient having osteomyelitis required multiple debridements.
- **Chr. Krettek et al** [11](2001) had evaluated a minimally invasive approach for proximal tibial fractures in six patients and one of the patients had revision surgery for deep intraarticular infection

We conclude that re-operative procedures are a results of complications that occur during or after surgery. They can be on part of surgen or on part of the patient or may be result of infection. Hence re-operative procedures differ from one study to another.

5.8. Bone Grafting

In our study there were 3 patients that required bone grafting out of total 23 patients ie 13.6% patients. 2 patients operated with conventional plating of distal femur required bone grafting as there was extensive comminution. The other had a depressed tibial condyle with comminution and bone grafting was done for elevation of depressed fragment.

- **K. Kolb, P. Grützne, , H. Koller, C. Windisch, F. Marx and W. Kolb**[8] used bone grafting in 5 patients along with corrective osteo7tomy for malaligments. 2 patients were of varus malalingment and 3 of valgus malalingment.(12.1%)
- **P Kanabar, V Kumar, PJ Owen**[7] used bone grafting in 2 patients who had non-union out of 17 patients they evaluated.ie.11.7% of patients.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[9] did not use bone graft in any of the cases.
- **Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon, Byung-Chul Park, Woo-Kie Min and Poong-Taek Kim**[5]: from a total of 23 cases all fractures united without using any of the bone grafts.

We conclude that bone grafting is required usually in conventional plating and in cases of comminution and where bone loss is present. Biological plating generally does not require bone grafting. Secondarily bone grafting may be require in cases of non-union.

5.9. Locking Plates

In our study we used locking plates, condylar buttress plates, t-butress, l-buttress, and hockey stick plates for fixing fractures around the knee. Locking plates were mainly used in patients of older age group with osteoporotic bones and in patients with extensive comminution. Locking plates were also used in patients where biological plating was done.

In patients where locking plate were used had early mobilization conferring this to the sturdy and stable construct provided by them. Full weight bearing was allowed at 12 weeks in these patients as compared to others where it was allowed at 14 weeks. Range of motion was better in patients operated with locking plates.

- **Kyle F. Dickson., John Munz**[14] (2007) recommended locking plates in large aging population continuing active lifestyles. If used appropriately, locked plating can result in good patient outcomes with recreation of bony architecture and restoration of function.
- S**.L. Ezekiel Tan, Zsolt J. Balogh**[15](2009) stated that locked plating have evolved simultaneously with the minimally invasive techniques, which together provide an elegant safe option for restoring function in welltrained, experienced hands.

- **Wade R. Smith, Bruce H. Ziran, Jeff O. Anglen and Philip F. Stahel**[16](2007) while describing the tips and tricks in locking plates concluded that Locking plate technology offers improved fixation stability in osteopenic bone and for comminuted and periarticular fractures. The initial results in series that included a variety of fractures are encouraging, although it is increasingly apparent that failures do occur and the causes of failure should be examined.

We conclude that locking plates are a useful option in patients with osteoporotic bones and patients with poor bone stock. Locking plates when used in biological plating give stable and sturdy construct.

5.10. Range Of Motion

In our study of 23 patients the average range of motion achieved was 0-110 degrees. In the cases operated with Biological plating the average range of motion was 0-122 degrees whereas with conventional plating it was 0-97 degrees. It was attributed to the stable and sturdy construct provided by them and the early range of motion achieved with Biological plating.

- **K. Kolb, P. Grützne,, H. Koller, C. Windisch, F. Marx and W. Kolb**[8] in their series of patients with distal femoral fractures reported average range of motion of 120degrees.
- **P Kanabar, V Kumar, PJ Owen**[7] in their series of 17 patients operated with MIPO or LISS of distal femur reported average range of motion of 0-100 degrees.
- **Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras**[46] in their series of 35 of proximal tibial fractures operated with MIPO reported average range of motion of 105 degrees.
- **Cory Collinge et al**[9] (2000) had evaluated the results of treatment of complex tibial periarticular fractures using percutaneous technique in seventeen patients and found that the range of motion in patient with open fractures averaged 5 degree full extension to 122 degree flexion (range 0-130) and ankle ROM averaged 20-degree plantar flexion and 10-degree dorsifiexion.

We conclude ROM around the knee is better in patients treated with biological plating as their is minimal handling and the construct is stable. At the same time clinical experience plays and important role in functional out come.

5.11 Koos Score

In our study to assess the functional outcome of all the 23 patients we used KOOS score ie the knee injury and osteoarthritis outcome score. The score includes pain, symptoms, activities of daily living, sports and recreation and quality of life. The higher score indicates fewer problems.In our study the average score was 85. The patients operated Biological plating had an average score of 89 whereas the patients with conventional plating had an average score of 80. We owe this to the lesser anatomical disturbances enforced on the limb in minimal invasive surgeries and the sturdy construct provided by them.

To date there has been no major study that has used KOOS score as the functional assessment scale. Other scores that have been used in other studies have been the Ramussen's and the Neer's score. We preferred this score in our study as it uses parameters like pain, symptoms, activities of daily living, sports and recreation, and quality of life, all at the same time.

We conclude that KOOS Score is a reliable score in fracture around the knee joint. It gives excellent assessment of the clinical progress, subjective as well as functional well being of the patient.

VI. Summary And Conclusion

In our study we treated 23 fractures around the knee joint i.e. the metaphyseal region of proximal tibia and distal femur. We evaluated the results of biological as well as conventional plating in these fractures. We used locking as well as non locking plates for biological as well as conventional plating. Non-locking plates yielded same functional outcome as locking plates except for fractures that were severely comminuted or in older osteoporotic bones.

The mean age of patients in the study was 37.65 yrs. Most of the injuries were as a result of road traffic accidents. The mean range of motion for biological plating was 122 deg whereas for conventional plating was. 97 deg. Time taken to radiological union for biological plating was 12 weeks whereas for conventional plating was 14 weeks. For assessing the functional outcome we used KOOS score as the measuring scale. It was used for the first time in any study and yielded excellent assessment of the functional parameters.

We had 100% union rate and 3 complications with no significant differences in biological and conventional plating. We attribute this to meticulous tissue care and proper rehabilitation offered to the patient. Bone grafting was required in 3 patients and it depended on the fracture pattern. The 3 complications were attribute to-firstly improper fixation techniques while doing biological plating, secondly fracture collapse due to early weight bearing, and lastly one case of superficial infection.

On the basis of these observations we conclude that biological plating whether done with locking or

non-locking plates offers better results than conventional plating. We attribute this to less soft tissue dissection, less periosteal stripping and preservation of fracture haematoma. All these factors when combined with a stable fixation give the bone a near anatomical environment to heal and this results in early union and better functional outcome.

References

[1]. Rock wood and greens fractures in adults, seventh edition., Campbells operative orthopaedics, Terry canale, eleventh edition.
[2]. Hohl M. Part I : fractures of the proximal tibia and fibula. In : Rockwood C, Green D, Bucholz R, eds. Fractures in adults, 3rd ed. Philadelphia : JB Lippincott, 1991 : 1725-1761.
[3]. Thomas A. Russell, An Historical Perspective of the Development of Plate and Screw Fixation and Minimally Invasive Fracture Surgery With a Unified Biological Approach, Techniques in Orthopaedics® **22**(3):186–190 © 2007 Lippincott Williams & Wilkins, Inc
[4]. Surgical approaches in orthopaedics, Stanley hoppenfeild, 3rd edition.
[5]. Chang-Wug Oh, Jong-Keon Oh, Hee-Soo Kyung, In-Ho Jeon1, Byung-Chul Park, Woo-Kie Min1 and Poong-Taek Kim, Double plating of unstable proximal tibial fractures using minimally invasive percutaneous osteosynthesis technique, Acta Orthopaedica 2006; 77 (3): 524–530.
[6]. Krettek C, Gerkfa T, Miclau T. A minimally invasive medial approach for proximal tibial fractures. Injury. 2001 May; 32 Suppl 1:SA4-13.
[7]. P Kanabar, V Kumar, PJ Owen, Less invasive stabilisation system plating for distal femoral fractures, Journal of Orthopaedic Surgery 2007;15(3):
299-302.
[8]. K. Kolb et al, The condylar plate for treatment of distal femoral fractures: A long-term follow-up study , j. Injury, April 2009, Pages 440-448.
[9]. Jackson A. Lee & Stamatios A. Papadakis & Charles Moon & Charalampos G. Zalavras, Tibial plateau fractures treated with the less invasive stabilisation system, International Orthopaedics (SICOT) (2007) 31:415–418.
[10]. Collinge C, Sanders R, DiPasquale T. Treatment of complex tibial periarticular fractures using percutaneous techniques. Clin Orthop. 2000 Jun;(375): 69-77.
[11]. Krettek C, Muller M, Miclau T.Evolution of minimally invasive plate osteosynthesis (MIPO) in the femur Injury. 2001 Dec;32 Suppl 3:SC14-23. (2001).
[12]. Olerud S:operative treatment of supracondylar and intercondylar fracture of femur: technique and results in 15 cases, J Bone Joint Surg,54A:1015, 1972.
[13]. Bolhofner BR, Carmen B, Clifford P: The results of open reduction and internal fixation of distal femur fractures using indirect reduction technique. J Orthotop Trauma 10:372,1996.
[14]. Kyle F. Dickson, 2007,techniques in orthopaedics, Locked Plating: Clinical Indications.
[15]. S.L. Ezekiel Tan, Zsolt J. Balogh, injury 2009, Indications and limitations of locked plating.
[16]. Wade R. Smith, Bruce H. Ziran, Jeff O. Anglen and Philip F. Stahel, J Bone Joint Surg Am. 2007;89:2298-2307, Locking Plates: Tips and Tricks.