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Study of fractures treated with anatomical plates in lower limb

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Abstract

Introduction: It is a study of biological plating at various situations. Biological is a least contact plate designed for use in specific anatomical regions such as the proximal & distal femur, proximal & distal tibia. Minimal invasive plate osteo-synthesis by biological plate has the potential of becoming one of the main stays of fracture management in the years to come. Biological fixation principles advocate realigning by manipulation at a distance to the fracture site, leaving comminuted fragments out of the mechanical construct, preserving soft tissues with limited operative exposure.

Materials and method: The study consists of 30 patients with fractures at different locations in the lower limb such as proximal femur, distal femur, proximal tibia and distal tibia. We have treated patients with anatomical plate for respective fracture in the bone. Clinical outcome and function results were evaluated by Harris Hip Score for proximal femur fracture, Knee Society score for distal femur and proximal tibia fracture, Olerud and Molander score for distal tibia fracture.

Result: Out of the 30 patients included in the study, 18 cases were operated with open method and 12 patients were operated with closed method. Average radiological union time was 21.36 week. We have achieved 83.3% of excellent result.

Conclusion: Anatomical plates are pre-contoured plate as per shape of the bone. Anatomical reduction is possible as well as length of the limb is maintained and axial alignment and rotational stability is provided. As plates have groove on inner surface so it preserves the periosteal blood supply which will help in faster healing of the bone. Anatomical plates are best proven option for the comminuted intra-articular fractures of the long bones.

Key words: Anatomical plate, Lower limb fracture, Harris Hip Score, Knee Society score, Olerud and Molander score

Introduction

Anatomical plate is a least contact plate designed for use in specific anatomical regions such as the proximal and distal femur, proximal and distal tibia.

We wanted to know its efficacy of this latest method of fracture fixation. Minimal invasive plate osteosynthesis by anatomical plate has the potential of becoming one of the main stays of fracture management in the years to come.

Biological fixation principles advocate realigning by manipulating at distance to the fracture site, leaving comminuted fragments out of the mechanical construct, preserving soft tissues with limited operative exposure^[1]. Minimal invasive plate osteosynthesis is one such method in which percutaneously inserted plate is fixed at a distance proximal and distal to fracture site through minimal exposure^[2, 3].

Aim of the study was to analyze the use of anatomical (biological) plate in fixing different type of fractures with view for following criteria - to regain length, Rotation, Axial alignment, Healing by secondary callus, Early range of functional movements and return to function.

Materials and method

The study was performed at Dhiraj Hospital, a rural tertiary care teaching hospital associated with SBKS Medical Institute & Research Centre at Vadodara between February 2014 to August 2015. The study included 30 patients operated with anatomical plates in lower limb fracture.

Inclusion Criteria

1. Closed epiphyseal-metaphyseal comminuted fracture
2. Closed metaphyseal fracture with diaphyseal extension

Exclusion Criteria

1. Compound fractures
2. Non-comminuted diaphyseal fracture which are good for closed Intra medullary interlock nail

In our study criteria for results were:

- Union of the fracture
- Able to squat and sit cross legged
- Harris hip score for assessment of fractures of proximal femur
- Knee society score for assessment of fractures of distal femur and proximal tibia
- Olerud and Molander score for assessment of distal tibia fracture

Observation and result

The following observations were made from the data collected during this study of total 30 cases of fracture in lower limb treated by anatomical plate. In our study the majority of patients belonged to age group 41-50 years (46.7%). The mean age of patients of our study is 42.93years. In our study of fractures in lower limb we had 25 males (83.5%) and 5 female (16.7%). Out of the 30 cases, 5 patients had fall from height, 3 patients were fall from steps and 22 patients had road traffic accident.

Site of Fracture

In our study there were 4 (13.3%) cases of distal femur fracture, 6(20.0%) cases of distal tibia fracture, 5 (16.7%) cases of proximal femur fracture and 15(50.0%) cases of proximal tibia fracture. In our study, femur: tibia is 9: 21, due to subcutaneous situation of tibia it is more vulnerable to open and closed injury than femur.

Classification: In our study the fracture were classified according to AO classification, and distributed as follows

Fractured Bone	Type	No. of Cases
Proximal Femur	A1	0
	A3	4
	A3	1
Distal Femur	A	2
	B	0
	C	2
Proximal Tibia	A	8
	B	1
	C	6
Distal Tibia	A	5
	B	0
	C	1
Total		30

Technique of Fixation

Out of 30 cases, 18 (60.0%) cases were operated with open reduction and internal fixation. And 12 (40.0%) cases were operated with closed reduction and internal fixation (MIPO).

Fracture Union

In our study of total 30 cases, 18 cases were operated with open reduction internal fixation had mean radiological union time of 22.39 weeks. And 12 cases which were operated with closed reduction internal fixation had mean radiological union

time of 20.30 weeks.

As per natural process compound fractures took more time to heal as compared to simple fracture.

Chart No. 10: Union in Individual Fractured Bone

Fractured Bone	No. of Cases	Avg. Union Time (Weeks)
Proximal Femur	5	22.6
Distal Femur	4	22.25
Proximal Tibia	15	21.3
Distal Tibia	6	20.83

Complications: In our study of 30 cases, complication of delayed union was in 1 case; infection was in 3 cases which was treated with antibiotic therapy and dressing. One case had infection with delayed union who was diabetic who was later managed by debridement and antibiotic therapy.

Follow Up

In our study of 30 cases we have minimum follow up of 6 months and maximum follow up of 24 months, with mean follow up of 16.47 months.

In our study of 30 cases, 5 (16.7%) cases were having pain and 4 (13.33%) were having abnormal gait at the time of final followup.

In our study of 30 cases only one case had difficulty in squatting and cross leg sitting.

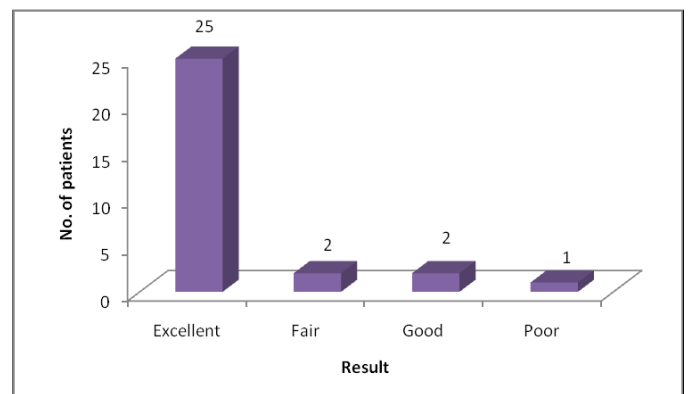
Result

Result of Regional Fractured Bone

In our study of total 30 cases, in 5 cases with proximal femur fracture we got 80.0% excellent result and 20.0% poor result. In 4 cases with distal femur fracture we got 75.0% excellent result and 25.0% fair result. In 15 cases with proximal tibia fracture we got 86.7% excellent result, 6.7% good and 6.7% fair result. In 6 cases with distal tibia fracture we got 83.3% excellent result and 16.7% good result

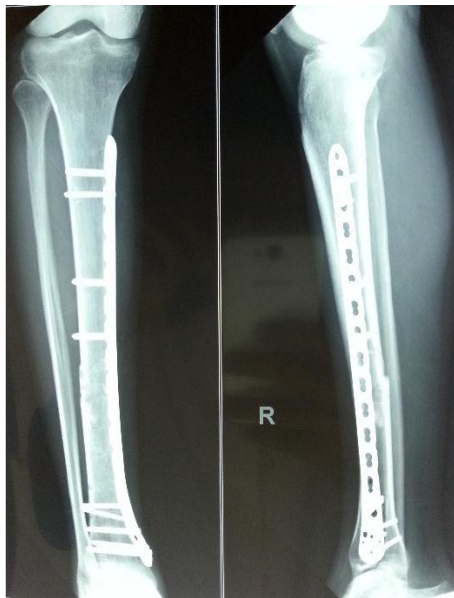
Result (Open v/s Closed): Total 18 cases were operated with open reduction internal fixation in which we got 77.8% excellent result, 11.1% fair result, 5.6% good result and 5.6% poor result. And total 12 cases were operated with closed reduction internal fixation in which we got 91.7% excellent result and 8.3% good result

Overall Result: In our study of total 30 cases. We got 83.3% of excellent result, 6.7% fair result, 6.7% good result and 3.3% poor result. Poor result was because of patient was diabetic and got infection.





Pre-Operative Radiograph



Post-operative Radiograph

Statistical analysis and discussion

Anatomical (Biological) plate is a least contact plate designed for the use in specific anatomical regions such as proximal femur, distal femur, proximal tibia, distal tibia. This study was conducted to know the efficacy of this latest method of fracture fixation. Minimal invasive plate osteosynthesis by anatomical plate has the potential of becoming one of the main stay of fracture management in the years to come. Biological fixation principles advocate realigning by manipulating the distance to the fracture site, leaving comminuted fragments out of the mechanical construct, preserving soft tissue with limited operative exposure. Minimal invasive plate osteosynthesis (MIPO) is one such method in which percutaneously inserted plate is fixed at a distance proximal and distal to fracture site through minimal exposure^[4].

- As mentioned in other studies like Wei Ting Lee *et al.*^[5] (proximal femur fracture), G.N. Kiran Kumar *et al.*^[6] (distal femur fracture), Sandeep V Gavhale *et al.*^[7] (proximal tibia fracture) and Philip A. McCann^[8] (distal tibia fracture) in our study also major group of patients were belonging to 5th decade with mean age of 42.93

years.

- Male sex is seen in predominance in our series out of 30 cases (male: female = 25:5). This is comparable to results seen in studies by Wei Ting Lee *et al.* (proximal femur fracture), G.N. Kiran Kumar *et al.* (distal femur fracture), Sandeep V Gavhale *et al.* (proximal femur fracture) and Philip A. McCann (distal tibia fracture)
- According to our observation out of 30 cases, 9 cases were of proximal and distal femur, which were operated with open reduction internal fixation, united in average 22.44 weeks. Out of remaining 21 cases of proximal and distal tibia, 12 cases were operated with MIPO technique with average union in 20.30 weeks and remaining 9 cases were operated with open reduction internal fixation which united in average 22.33 weeks. So patients who were operated with MIPO technique had early union than patients operated with open reduction internal fixation, because of minimal soft tissue stripping and preservation of periosteal blood supply.
- According to our study total 5 cases had pain at the time of final follow up and out of which 4 cases were having abnormal gait due to pain at the fracture site. And only one patient had difficulty in cross leg sitting and squatting due to pain. All the 5 patients who had either infection or delayed union complained of pain at the time of final follow up.
- In study by Wei Ting Lee *et al.*^[5], proximal femur fracture operated with proximal femoral locking compression plate, they had 26 patients with proximal femur fracture and 73.1% had excellent result with mean fracture union time of 40 weeks. In our study total 5 cases were operated with proximal femur locking compression plate and we had excellent result in 80.0% patients with mean fracture union time of 22.6 weeks.
- In our study there were 4 cases of distal femur operated with locking compression plate with 75.0% excellent result which was similar to the study by R. Pascarella *et al.*^[10].
- In study by Jain D *et al.*^[11], 34 patients of proximal tibia fracture were treated with locking plates with 82.3% good to excellent result. In our study we had 86.7% of excellent result.
- In Reudi and Allgower^[12] study of lower end tibia fracture operated with open reduction and internal fixation 74% had good to excellent results. Cory collinge *et al.*^[13] operated with MIPO technique and had 78% of excellent result. In our study we had operated 5 cases with MIPO technique and 1 case with open reduction and got total 83.3% excellent result.
- According to our study out of 30 cases, 9 cases of femur fracture achieved 77.8% excellent, 11.1% fair and 11.1% poor result. In 21 cases of tibia fracture, 12 cases were operated with MIPO technique and we got 91.7% excellent result and 8.3% good result. Remaining 9 cases were operated with open reduction internal fixation in which we got 77.8% excellent result, 11.1% good and 11.1% fair result.
- Overall result of our study is, out of 30 cases 25 (83.3%) cases are excellent, 2 (6.7%) cases got good result, 2 (6.7%) cases got fair result and 1(3.3%) got poor result. We had only one patient with proximal femur fracture with poor result because of infection and diabetes mellitus and 2 patients with fair result because of superficial infection. Remaining 27 cases were falling in excellent to good result. These results are comparable to

studies of Reudi and Allgower ^[12] , Jain D *et al.* ^[11] and others

Summary and conclusion

Minimal invasive technique of fracture fixation has evolved after invention of anatomical (biological) plate according to the area of bone like proximal and distal metaphysis with diaphysis. The anatomical locking plate has made revolution in internal fixation of long bone fractures particularly in metaphyseal region or upper diaphyseal region .It preserves the periosteal blood supply which helps preserve biology and active faster union.

The only drawback of this fixation is weight bearing should be delayed till radiological union at the fracture site is achieved. MIPO plating with anatomical plate will preserve local hematoma and produces less damage to the soft tissue. Entry of the plate and distal incision are far away from the fracture complex and that is why the local consolidation of haematoma will not be disturbed which indirectly helping in rapid formation of the callus. As well as anatomical locking plate virtue will also help in preserving and maintaining the periosteal blood supply.

Second drawback of these plate is that inter-fragmentary compression is difficult to achieve by locking screw which can solved by providing dual hole (cortical and locking). At times, the anatomical plate can be augmented with lag screw from outside the plate and then anatomical plate is used as neutralisation plate when there is intra-articular extension.

Thus, anatomical plates when used with proper technique can provide the best results with MIPO approach, providing a faster rate of union and early functional recovery of patient.

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