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Analysis of the Results of Minimally Invasive Locking Plate Osteosynthesis (MILPO) At Various Levels of Tibial Fractures

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Abstract: *Tibial fractures, the most common fractures in adults are commonly treated with casting ,nailing, plating and external fixators. Biological osteosynthesis with relative stability gives best results following early mobilization. Biological osteosynthesis aims at preservation of the blood supply to the fractured fragments and provides biologically favorable environment for the fracture to heal . In the present study we have analysed the advantages of MILPO at various levels of tibial fractures in 20 patients over a period of 2 years . The results are highly encouraging and the advantages are minimal surgical trauma with relative stability and preservation of blood supply to the fracture fragments.*

Key Words: *MILPO , TIBIAL FRACTURES*

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I. Introduction

For tibial shaft fractures Intramedullary(IM) nailing stays as the gold standard treatment option (1). However, it is very challenging in the treatment of proximal and distal tibial fractures. The canal of the tibia is widest in diameter in the metadiaphysis offering the least purchase for fracture reduction with IM nails(2) . Metaphyseal broadening make fracture reduction and nailing technically difficult procedures. Other well known patterns of difficulties are associated with this technique such as intra-articular extension, hardware failure or epiphysometaphyseal fixation difficulty (3). Therefore, some authors advocate the use of plate osteosynthesis in the management of proximal (4 5,)and distal tibial fractures.

II. Procedure

In extra-articular fractures, the objective is to restore the anatomical bone axis. The Less Invasive Stabilization System(LISS) instrumentation is routinely used for locking plates since it not only allows easy extraperiosteal plate insertion but also facilitates screw locking. However, there is no LISS instrumentation available in our setup. Pre operatively the Xrays were assessed for the plate length. The length of the plate in MILPO is usually three times the length of the fracture communition.

Under spinal anesthesia, tourniquet control , the patient is placed supine on the fracture table. A sand bag may be placed underneath the homolateral buttock in order to prevent limb lateral rotation commonly occurring in distal fractures. The fractured limb is prepared and draped for surgery .In the preoperative stage image intensifier is used to achieve satisfactory reduction under traction. The reduction is performed by applying traction in the long axis of the tibia with help of an assistant and the reduction was maintained with femoral distractor when needed. Intra operatively the length of the plate is assessed by placing the plate over the anterior aspect of tibia .

For proximal tibia , through anterolateral / anteromedial approach a 5 cm incision is made starting below the level of the femorotibial joint line. To locate the joint either a image intensifier is used or a pin can be inserted into the joint . A sub muscular tunnel is created using a plate inserter. The proximal tibial locking plate is inserted and adjusted below the joint line and distally to accommodate around four locking screws confirmed with image intensifier. Proximal and distal locking screws were applied in appropriate length.

For distal tibia fracture, through lateral approach the fibula was fixed,if needed with semitubular plate for maintaining the length of tibia . Through anterolateral/anteromedial approach a longitudinal incision centered over the medial malleolus, of about 4/5 cm long, performed in the tibial axis below the fracture and using plate inserter sub muscular/ subcutaneous tunnel was made and the plate was inserted. Under image intensifier guidance the plates were positioned above the joint line and with length of the plate was so chosen to accommodate four locking screws proximal to fracture.

Postoperatively antibiotics were given parentally for two days followed by oral antibiotics for one week. Wound examined on 3rd POD , sutures were removed on 14th POD. Quadriceps and ankle exercise were

started on 1st POD depending on patients tolerance. Partial weight bearing was started after suture removal and full weight bearing after 9 weeks depending on the union evidence on X-rays.

CASE 14: DISTAL TIBIA MEDIAL PLATING




CASE 20: DISTAL TIBIA LATERAL PLATING


CASE 1:PROXIMAL TIBIA LATERAL PLATING


CASE 8: PROXIMAL TIBIA MEDIAL PLATING


CASE 10:SEGMENTAL TIBIA LATERAL PLATING

CASE 18: DISTAL TIBIA LATERAL PLATING BROAD LCP

FUNCTIONAL ASSESSMENT

ANALYSIS OF RESULTS -TABLE 1

PROXIMAL TIBIA						
SERIAL NO/ NAME	**AGE/ SEX**	**AO CLASSIFICATION**	**GUSTIIIO-ANDERSON CLASSIFICATION**	**PROCEDURE**	**SCORE AMERICAN KNEE SOCIETY SCORE**	**COMPLICATION**
1KARTHI	28 /M	41A3.2	OPEN GRADE 2	Lateral plating	90/ EXCELLENT	NIL
2SIVA	37 /M	41A2.1	CLOSED	Lateral plating	95/ EXCELLENT	NIL
3KUMERASA	38 /M	41A2.1	CLOSED	Lateral plating	95/ EXCELLENT	NIL
4 ISEBAL	50 /F	41A2.1	CLOSED	Lateral plating	73/ GOOD	NIL
5 KARUPAIYA	55 /M	41A2.1	CLOSED	Lateral plating	71 / GOOD	NIL
6JAGAN	46 /M	41B3.3	CLOSED	Lateral plating	80/ GOOD	NIL
7KAATHAN	60 /M	42B2.3	CLOSED	Lateral plating	78/ GOOD	DELAYED INFECTION
8DHARMA	35 /M	41A3.1	CLOSED	Medial plating	85/ EXCELLENT	NIL
SEGMENTAL TIBIA						
S.NO/NAME	**AGE/SEX**	**AO CLASSIFICATION**	**GUSTIIIO-ANDERSON CLASSIFICATION**	**PROCEDURE**	**SCORE AMERICAN KNEE SOCIETY SCORE**	**COMPLICATION**
9 URUMAN	45 /M	42C2.1	CLOSED	Lateral plating	80/ GOOD	DISTAL FRACTURE NONUNION.
10 SELVAN	52 /M	42C2.1	CLOSED	Lateral plating	85/ EXCELLENT	NIL
DISTAL TIBIA						
SERIAL NO	**AGE/SEX**	**AO CLASSIFICATION**	**GUSTIIIO-ANDERSON CLASSIFICATION**	**PROCEDURE**	**SCORE KARLSSON & PETERSONS SCORE**	**COMPLICATION**
11 JAMAL	38/M	43A2.3	CLOSED	Medial plating	95/ EXCELLENT	NIL
12 KUMUTHA	42/F	43A3.2	CLOSED	Medial plating	80/ GOOD	NIL
13 SAKTHIVEL	48 /M	43A3.3	CLOSED	Medial plating	85/ EXCELLENT	SUPERFICIAL INFECTION
14 BALASUND	52 /M	43A3.1	CLOSED	Medial plating	95/ EXCELLENT	NIL
15 SWAMI	50 /M	43A3.1	CLOSED	Medial plating	95/ EXCELLENT	NIL
16 BALA	14 /M	43A1.1	CLOSED	Lateral plating	95/ EXCELLENT	NIL
17 DAKSHA	55 /M	43A2.2	CLOSED	Lateral plating	60/ POOR	NIL
18ARAVIND	16 /M	42B2.1	CLOSED	Lateral plating	95/ EXCELLENT	PERI IMPLANT FRACTURE
19. MURUGA	49 /M	43.A3.1	OPEN GRADE 3A	Lateral plating	95/ EXCELLENT	NIL
20.THIRU	34 /M	43A1.1	CLOSED	Lateral plating	95/ EXCELLENT	NIL

TABLE 2:

FRACTURE LEVEL	**TOTAL CASES:20**	**LATERAL PLATING CASES:14**	**MEDIAL PLATING CASES:6**	**OPEN COMPOUND**
PROXIMAL TIBIA	**8**	**7**	**1**	**1**
DISTAL TIBIA	**10**	**5**	**5**	**1**
SEGMENTAL TIBIA	**2**	**2**	**NIL**	**NIL**

The table 1 shows case by case details as witnessed by follow up .All the fractures were classified according to AO classification with sub groups. In case of proximal tibial fractures mean age of the patients was 43.62 years. In case of distal tibial fractures mean age of patients was 39.8years. Most of the patients were in the age group of 30-50years. Of the 8 patients with proximal tibial fractures 7 were males and 1 was female.

Of the 10 patients with distal tibial fractures 9 were males and 1 female. 2 patients had segmental fractures with mean age of 48.5years both were males. Road traffic accidents were the commonest mode of trauma . In proximal tibial fracture 1 case (case 2) had grade2 compound. In distal tibial fracture 1 case (case 19) had grade3A compound initially treated with debridement &ex-fix for the wound to settle followed by lateral plating.

In this study of 8 cases of proximal tibial fractures, 7 patients(i.e. 87.5%) had achieved 0 to 110 of movement at the knee, in 1 patients (i.e.12.5%) range of movement at the knee achieved was 0-5 (extension gap) to 90-110 (flexion) .The range of motion at ankle on average was 15.2 degrees of dorsiflexion (range 10-20 degrees) and planter flexion averaged 25 degrees (range 15-35degrees). In segmental fractures the range of motion at the knee was 0 to 110 degrees and at the ankle dorsiflexion was 15-20 degress and plantar flexion was 15-30 degrees .

The overall results in case of proximal tibial fractures were tabulated into three groups i.e. excellent, good and poor, according to the criteria laid down by AMERICAN KNEE SOCIETY SCORE (Insall Modification 1993) Out of a total of 8 cases all had an acceptable result (4 excellent and 4 good) . In case of distal tibial fractures the results were evaluated as per KARLSON AND PETERSONS SCORE which are based on 100 points system. The results were excellent in 8, good in 1 case and fair in 1 case. Overall there was one case who had early infection in the distal tibial group that healed after appropriate antibiotics and antiseptic dressing. One case of delayed infections in proximal tibia subsequently progressed to uneventful bony union. The rehabilitation was not affected by late infection. In one case of distal tibia fracture,patient had a peri-implant fracture underwent for implant removal with exchange of a longer plate . One case of segmental fracture went for non union at distal fracture site. Patient was advised for bone grafting ,as the patient is comfortable with his daily activities the patient did not turn up for surgery.

In this study of 8 cases of upper end tibial fractures, 2 cases had mild persistent pain at the site of implant at 6 months after the tibial plating. Out of total 10 cases of distal tibial fractures there was no pain in 9 cases; 1 cases had pain with walking or running, but no change in activities of daily living .In segmental fracture the patients were comfortable on their daily activities. There was one case of non union and the patient was advised for bone grafting .No deep vein thromboses were seen in my study.

III. Discussion

The principle of relative stability was achieved through MILPO, by bridging the fracture with resultant external callus formation induced by micro-motion by early mobilisation. The long working length of the construct is the key to allow healing through callus. MILPO, being a fixed angle and locking plate, not compressing the periosteum allows , internal—external fixator principle as advocated by Ilizarov and others. The percutaneous insertion technique respects the soft tissues.

When compared with intramedullary (IM) devices, there is little, if any endosteal blood supply disruption and the fracture haematoma is left relatively undisturbed. This is biologically favourable . Intramedullary nailing is reported to have the least infection rates compared with other techniques(6) but the technique is associated with other complications such as malunion, angular malalignment , anterior knee pain , compartment syndrome and fat embolus syndrome (7) . Avoiding the need for operative insult to the knee joint with its proven sequelae also very importantly meets the Hippocratic principle of 'Primum non nocere'.

In simple fractures MILPO should be compared with moulded casting or bracing, of which Sarmiento remains one of the world's most ardent proponents. In the fast moving world however, the risks of surgery for a healthy, ambulant and working individual can be outweighed by the escape from 3 to 6 months of bulky casting and its continual monitoring in order to ensure good alignment and outcome. Sarmiento's article regarding proximal third tibial fractures indicates a 12% angular deformity which is not seen with this technique. Achievement of reduction held with a correctly anatomical contoured plate is key to achieving as near anatomical result as possible.

On various studies conducted on external fixation techniques showed, higher incidence of complications such as imperfect articular reductions, malunion , pin loosening and pin tract infections(8) . Open reduction and internal fixation with plate has the advantage of lowest rate of angular malunion compared to external fixation or intramedullary nailing but the disadvantage is the high infection rates (9) . MILPO however relies primarily on the indirect reduction of the fractures using various techniques and in this way, the fracture environment is better preserved, as well as the blood supply to the bony fragments is not disturbed, which finally leads to decreased infection rate and better fracture healing. MILPO offers several theoretical advantages compared to conventional open plating technique. A mechanically stable fracture-bridging osteosynthesis can be obtained without significant dissection and surgical trauma to the bone and surrounding soft tissues. As a consequence, the vascular integrity of the fracture and the osteogenic fracture hematoma are preserved(10,11). According to Ahmad et al, the construct should be placed close to the bone despite the internal fixation mechanical features of the device. An experimental study was performed on Sawbone , they conclude that a

bone/implant distance lower than 2 mm will provide a better compressive and torsional strength. A bone/implant distance greater than 5 mm leads to a major plastic distortion.

Medial MILPO has been widely used for treatment of tibial fractures because of its relative simplicity. Good clinical outcomes have been reported because of the minimization of soft tissue injury through biological fixation, preserving blood flow and hematoma (12). However, the plates used for medial MILPO can cause skin irritation because they are located directly under the skin and the subcutaneous soft tissues which are thin on the medial side of tibia. Moreover ,in cases with extensive soft tissue injury on the medial side, medial MILPO cannot be performed . At times skin necrosis and plate exposure can occur as complication when a medial plate is inserted (13,14).

Lateral MIPO was introduced to resolve the shortcomings of medial MILPO. Sohn and Kang [15] concluded that lateral MILPO is an useful alternative method for achieving high functional recovery with good healing and low incidence of complications for patients with an open distal tibia fracture. The main problem of lateral MILPO is that percutaneous insertion of plates is difficult compared with medial MILPO. Moreover, neurovascular structures can be injured by application of excessive traction during plate insertion, and they can also be injured when the anterolateral approach is used. Wolinsky and Lee [16] reported that the superficial peroneal nerve can be easily identified in the anterolateral approach of the distal tibia because it has a consistent subcutaneous path. However, the risk of deep peroneal nerve and anterior tibial artery injury is high, because both course along the posterior half of the tibial shaft proximally and cross the distal third of the plate. However MILPO does not allow direct visualization of the fracture and the surgeon is dependent on image intensifier to confirm that an adequate reduction has been achieved. Radiation exposure during application of the plate to the bone and screw fixation is the disadvantage of this technique.

IV. Conclusion

In conclusion, MILPO for treating various levels of tibial fractures gives a good clinical and radiological results. Based on the faith of this small series MILPO technique can be a good alternative for the nailing and with the hope that this technique will evolve further for the betterment of the patient.

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