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A study of extra articular metaphyseal proximal tibia fractures treated with proximal tibia plate using MIPPO technique

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Abstract
Tibia fractures, by its location and by being subcutaneous in most of its length tend to be open very commonly. Due to its precarious blood supply and scanty soft tissue coverage orthopaedic surgeons around the world have been fighting infections and union problems associated with its fractures. Our aim of this study focuses on the outcome of locking plates used in metaphyseal fractures of tibia in terms of union, complications and functional outcome of patients. An Observational prospective study of 30 patients with close or open grade I fractures of proximal tibia (Metaphyseal) without intra-articular extension, with recent (<4 weeks) history of trauma was carried out at Department of Orthopaedics, Medical college and SSG Hospital, Vadodara, Gujarat from Jan 2018 to June 2018. During the follow up, all patients achieved full weight bearing at 20-24 weeks. Twenty four (83.33%) patients could squat or sit cross legged without difficulty. Five (16.66%) patients had slight difficulty doing the same. According to Rasmussen's score, in our study we had 43.33% patients (13) with excellent, 40% patients (12) with good and 16.66% patients (5) with fair clinical results. We had 80% patients (24) with excellent and 20% patients (6) with good radiological results. Extra-articular proximal tibia fractures can be treated successfully through MIPPO technique with fewer and less serious complications, marginally faster union time and superior clinical outcome.

Keywords: Proximal tibia, MIPPO, locking compression plate, schatzker's classification

Introduction
Tibia fractures are a diverse group of fractures that represent a wide spectrum of severity that ranges from single injuries with predictably excellent outcomes after non operative treatment to complex fracture patterns that challenge even the most experience surgeons [1]. Preservation of soft tissue, fracture hematoma and periosteal compression are the key to good results in proximal tibial fracture management. Intramedullary nails and Open reduction with compression plating have failed to give satisfactory results [2]. Indirect reduction was introduced in the 1988 by Mast *et al.* and others. It was an attempt to decrease surgical dissection by relying on ligamentotaxis, blind repositioning of fragments, reduction aids such as the distractor and other methods to maintain soft tissue integrity and preserve bony perfusion.In the 1990s, Krettek *et al.* popularized minimally invasive percutaneos plate osteosynthesis techniques [MIPPO] using conventional implants placed through small incisions and sub muscular/subcutaneous tunnels. As part of the continued development of biological friendly plating, and to facilitate minimally invasive plating techniques, the use of plates that allow screws to lock into the plate to create a fixed angle construct has been gaining popularity. Minimally invasive techniques avoid the long incisions and extensive soft tissue stripping associated with conventional techniques. Minimal Invasive Percutaneous Plate Osteosynthesis (MIPPO) using a locking plate has become alternative technique for proximal tibial fractures. The preservation of periosteal blood supply allowed by MIPPO offers a clear biological advantage over traditional plating, because it reduces iatrogenic damage to surrounding soft tissues [3]. Our aim of this study focuses on the outcome of locking plates used in metaphysealfractures of tibia in terms of union, complications and functional outcome of patients.

Materials & Methods

An Observational prospective study of 30 patients with close or open grade I fractures of proximal tibia (Metaphyseal) without intra-articular extension, with recent (<4 weeks) history of traumawas carried out at Department of Orthopaedics, Medical college and SSG Hospital, Vadodara, Gujarat from Jan 2018 to June 2018. The data for some patients were collected retrospectively from available medical records. Such patients were followed up prospectively for a minimum of six months post-operative time. Patients with Open grade II & III fractures were excluded from our study. Patients were selected as per inclusion criteria of our study and primary treatment were given as per ATLS protocol in the casualty. Pre-operative Xrays were done and fractures were classified according to Schatzker's classification. Closed fractures with edema were splinted and regular calf girth charting was done with oral proteolytic enzymes, intravenous antibiotics and limb elevation. Surgery was done after swelling subsided. After adequate surgical fitness, Spinal, epidural or general anaesthesia was given to the patient as per the anesthetics opinion. But spinal anaesthesia was most preferred. Tourniquette was not used in any case. Surgery was performed on plain table or fracture table for MIPPO in supine position. The knee was flexed on a quadriceps board with variable adjustment or with a bolster under the knee for fracture alignment and ease of reduction. Painting and draping was done under aseptic and antiseptic conditions. Preliminary reduction was done with traction and manipulation under image intensifier before starting the surgical procedure.

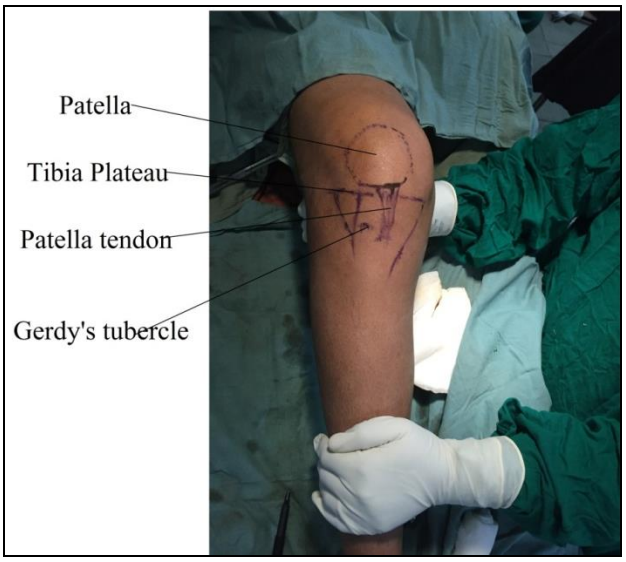

Fig 1: Landmarks for proximal incision in MIPPO proximal tibia plating.

Small incision of 3-4 cm length was taken starting just distal to the knee joint line and extending distally with anterior convexity to end just near tibia shin. The subcutaneous tissue was cut in the line of the incision & the origin of the tibialis anterior muscle was stripped off. The periosteum was not stripped off. The plate was now slided across the fracture site under IITV image control (under submuscular plane). Before and after the implant was slided, indirect reduction was achieved as far as possible mainly by longitudinal traction and manipulation under image intensifier. Provisional k-wires were used to maintain reduction. At least 3 screws were passed proximally in metaphyseal bone for adequate stability. Locking cancellous screws were preferred for better stability. The distal incision was kept directly over the holes of the plate, just lateral to the shin of tibia over the lower end of the plate. Depending on the quality of bone, cortex or locking screws were used to fix the plate distally.

Fig 2: MIPPO proximal tibia plate insertion & fixation.

In all our patients we used proximal locking compression tibia plate. Plate placement and its length were evaluated according to the fracture geometry visible on antero-posterior and lateral X-rays of view of the affected limb. Proximal & distal incisions were closed in layers. Sterile dressing applied. Before shifting the patient out of the operation theatre, distal pulses were confirmed. Above knee slab was applied.

Fig 3: Pre-operative & Post-operative x-rays of proximal tibia fracture.

Post operatively wounds were evaluated on 3rd and 10th day if otherwise clean. Depending on the post-operative fracture stability and pain tolerance of the patient, quadriceps strengthening exercises, knee and ankle mobilization exercises and non-weight bearing-crutch walking were started. After suture removal between 10-15th day, the patient

was discharged with either partial or non-weight bearing crutch walking depending upon the stability of the fixation. Follow up was conducted regularly at the interval of 4 weeks in the outpatient department. At the time of follow up a thorough clinical evaluation was done for progress of union, healing of trauma wound and joint stiffness. Once the fracture had shown early signs of union, partial weight bearing was started on the injured limb. On follow up the patients were evaluated clinically and radiologically according to Modified Rasmussen's criteria for clinical and Radiological evaluation.

Observations and Results

The study represents 30 patients (27 Males & 3 Females) of fracture proximal tibia without intra-articular extension treated at Medical College & S.S.G. Hospital, Vadodara from Jan 2018 to June 2018.Thus, majority (63.33%) of our patients were males between 31-50 years of age. This can be attributed to outdoor activities being performed predominantly by young males and use of motor bikes. Road Traffic Accidents (24 cases- 72.27%) were the main reason for causing tibia fractures. There was more distribution of patients in the strenuous (labourer) age groups (21cases-63.63%). In our study 72.72 % (~73%) patients were operated within first week of trauma. 27.27 % (~28%) patients were operated within 1-2 weeks because of local swelling and oedema. Mean surgery interval was 3.5 days. The Average duration of hospital stay was 7 days. Majority of patients were discharged between 5to 9post-operative days.3 patients had hospital stay of more than 10 days because of infection.

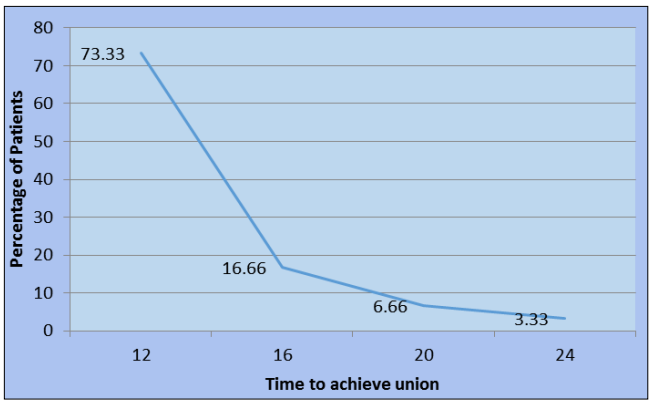

Fig 3: Time to achieve union in proximal tibia fractures fixed with MIPPO Techniques.

All 30 patients having union at 6 months of their follow up. Average time of Union is 10.6 weeks (95% CI for the mean 9.1871 to 12.0129 weeks). Overall 10% patients required additional procedures like flap surgery, implant extraction etc. which were not a part of the standard method decided in this study.

Out of 30 patients included in this study, 3 patients had superficial skin infection at surgical site which healed eventually by wound care, one patient had deep infection which required implant removal and one had implant failure and non-union which required medial plating.

Sixty percent of patients had full range of movement at knee joint. None of the patients underwent manipulation under anaesthesia. Mean loss of extension is 3.83° (Range 5-20°). Mean knee flexion is 147.33° (Range 10-160°). Passive motion of the operated limb was started for all patients in the immediate post-surgery period. Toe-touch weight bearing with the use of two crutches was allowed at 8-12 weeks. Progressive weight bearing was permitted following this period depending on the progress of healing on the X-ray control. Full weight bearing was allowed at when fracture union was achieved. Eighteen patients stared weight bearing at 8-12 weeks of follow-up. Twenty two patients started weight bearing at 12-16 weeks of follow-up with the progression of study, all patients achieved full weight bearing at 20-24 weeks. Twenty four (83.33%) patients could squat or sit cross legged without difficulty. Five (16.66%) patients had slight difficulty doing the same.

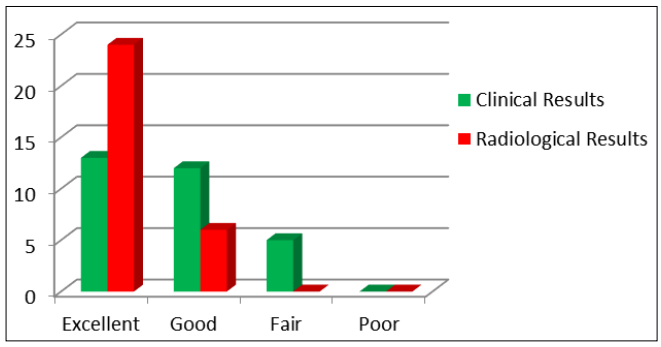

Fig 4: Clinical &Radiological results as per Rasmussen's score.

According to Rasmussen's score, in our study we had 43.33% patients (13) with excellent, 40% patients (12) with good and 16.66% patients (5) with fair clinical results. We had 80% patients (24) with excellent and 20% patients (6) with good radiological results.

Discussion

In this era, high velocity trauma and industrial accidents lead to increased number of tibia fractures. Fractures of the tibia are a cause of ongoing management problems and debate, and remains challenging for orthopaedic surgeons [4]. Treatment of extra-articular proximal tibial fractures is challenging, and it is associated with higher rates of complications when compared with treatment of diaphysealtibial fractures [5]. Prompt diagnosis, thorough pre-operative assessment of the bony and soft tissue trauma [6], adequate soft tissue monitoring and resuscitation, anatomic reduction and sound fixation allowing early joint movement and intensive rehabilitation [7] are mandatory for good clinical results [8]. The usefulness of a staged approach and delayed fixation until local conditions are optimized has been documented by authors [9]. Although spanning external fixator was less often used in our series, we could statistically prove that delay in surgery does not affect final outcome.

The implementation of contemporary reduction techniques and novel implants allow the surgeon to attain stable fixation without compromising the surrounding soft tissues. In our study group as well as in other similar studies [10] minimally invasive techniques with application of locking plating systems offered the ideal combinations in terms of bone fixation and soft tissue sparing. We had one case of non-union in our series. Non-union is rare after low energy fracture, owing to the predominance of cancellous bone and its rich blood supply [11]. Is is mostly seen in Schatzker VI at metaphyseal-diaphyseal junction [12]. However the average time to union (10.6 weeks) in our study corresponds to published studies in the Indian scenario. Incidence of infection/wound dehiscence/malunion/early arthritis up to 20-50° esp. in high energy cases [13] have been reported.

Rasmussen scoring system as applied to our study showed good to excellent results in around 43.33% (13) of the patients. 40% (12) had good and 16.66 % (5) had fair results;

whereas Rasmussen's radiological scores did not match the functional scores. Duwelins and Connolly [14] reported good results after non-operative or limited surgical approaches and noted that excellent clinical outcomes did not correlate well with the radiographic appearance of the knee. Martin *et al*. [15] found that when observers make measurements independently of each other their measurements are different from each other by at least 12 mm 10% of the times. We cannot readily rule out objective bias in our radiological assessment. A similar study by Dr. Mohammad Asimuddin and Dr. Marthand Kulkarni [16] involving 20 closed tibia plateau fractures treated with conventional plates showed excellent Rasmussen score in 47% and good in 38.1%, poor in 9.6% of cases. These results are almost similar to that seen in our study.

With the introduction of locking plates, many limitations of conventional plating have been overcome. The angle stable locking screws allow screw fixation of the opposite condyle with a single plate thus avoiding extensive soft tissue dissection [10]. Obtaining proper alignment is technically demanding with the Locking plate system. To obtain optimal alignment when using the Locking plate system, it is important to understand that the unique properties of this fixed-angle plate and screw construct affects fracture alignment differently than traditional plating systems. A single lateral locking plate using MIPO technology ensured good outcomes in treatment of proximal tibial fractures (AO/OTA type 41-C) with diaphyseal involvement [17].

The indications and uses for locking plate technology continue to be defined. One important problem to avoid is the creation of an over stiff construct by placing locked screws when not needed (more than what is needed). The resultant relative lack of motion at the fracture site can, in some situations, be too stiff to allow fracture healing. This has led some to refer to locking plates as "nonunion generators." Thus, the indications and correct utilization of locking plates is important to understand so they are not used inappropriately and compromise fracture healing. In addition, newer techniques such as "hybrid" plating (use of both locking and non-locking screws in a single construct) and far cortical locking (obtaining purchase in far cortex while bypassing proximal cortex) have evolved to combat these problems sometimes seen with locking plate.

Conclusion

In this study, we found that extra-articular proximal tibia fractures can be treated successfully through MIPPO technique with fewer and less serious complications, marginally faster union time and superior clinical outcome. Furthermore, plate fixation with MIPPO technique facilitates early functional exercise and a reasonable outcome.

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