Original Research Article

Surgical and functional outcome of early mobilization in proximal tibial Fracture

Abstract

Background: The major cause of proximal tibial fractures attributes to RTA, dominated by male gender with younger age group from high energy trauma. With advancement in newer surgical techniques, improvement in the quality of implants, better soft tissue handling during surgery, and early mobilization in the form of assisted and supervised physiotherapy; the results of surgical outcome are improving. We aim to study clinical and functional outcome after surgery with introduction of early mobilization in various types of Proximal Tibial fractures in terms of ROM and its effect on operative construct.

Methods: This is prospective observational study of 68 cases of Proximal Tibia fractures with 53(77.9%) males and 15(22.1%) females using suitable implants and initiating early physiotherapy from day 2. Follow up at 3rd and 6th week was done to assess the outcome.

Results: Early initiation of physiotherapy showed significant association with improvement in ROM with choice of implant at 3rd week (p value -0.039) and at 6th week (p value-0.000) and type of fracture as well.

Conclusion: The early mobilization after fixation of proximal tibial fractures helps in improving the ROM of the knee joint, strength of quadriceps and hamstrings. Since Schatzker type V and VI are more severe than Schatzker type I and II the outcome also varied with improved results seen in later than the former (14).

Key words : proximal tibial fractures, early mobilization, ROM

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INTRODUCTION : Among all the fractures in the body, tibia is commonly involved in injuries. Increase in RTA, factory accidents and high velocity trauma are the leading cause for proximal tibial fractures. To preserve normal knee function after surgery, it is mandatory to maintain joint congruity, preserve the normal mechanical axis, ensure joint stability and restore full range of motion especially in Indian culture where squatting and sitting cross leg

is routine. The meticulous planning with x rays, Computed Tomography scan of the knee joint with three- dimensional (3D) reconstruction should be obtained to identify the size, location, intraarticular extension of fracture line or depression of the fragment. Aim of this study is to assess role of early mobilization in proximal tibial fractures with conventional methods of physiotherapy in improving ROM, in assessing loss of fixation and post operative complications. Tibial plateau fractures result from direct axial compression, usually associated with a valgus (more common) or varus (less common) component, and an indirect shearing force. With the knee in full extension, the force generated by the injury drives the femoral condyle into the Tibial plateau. The direction, magnitude and location of the force, the position of the knee at the time of impact, and the quality of the bone determine the fracture pattern. Isolated avulsion fractures of the anterior cruciate ligament are not considered fractures of the tibial plateau. Conservative management of these complex fractures with cast and traction always has been ineffective in reducing and maintaining the congruency of the articular surface causing multiaxial malalignment leading to mal-union and secondary degenerative arthritis. Also to add few more are soft tissue contractures, joint stiffness, quadriceps and hamstring weakness and atrophy. Hence the concept of Biological Fixation was developed to avoid above complications. The objective of Biological fixation is to assist the physiological process of bone healing optimally with a minimal amount of operative intervention. Unfortunately the effect of early mobilization on the internal fixation of the fracture construct has been not studied widely for known or unknown reasons. This study projects that “early the rehabilitation started , early is the recovery” in terms of ROM, decreasing the post operative stiffness and improving the osteogenesis as per Wolfs law. Earlier, the period of immobilization was minimum for 6 weeks in the fear of loss of fracture reduction and implant failure which affected negatively to the patient in terms of increasing hospital stay, financial burden, work absentia and overall decreasing the morale of the patient. Problem increases when additional complications like infection steps in, which increases the socio economic burden. Hence the concept of early initiation of physiotherapy

was considered. There is no structured protocol especially designed for proximal tibial fracture rehabilitation after surgery. However in our study we followed a set of exercises as described further. Over a period of time there were lots of development in the management of proximal tibial fractures which drastically reduced the intraoperative and post operative complication. Better understanding of biomechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics and asepsis have all made possible the internal fixation of fractures as an acceptable mode of treatment. However the treatment doesn't end here until surrounding soft tissue are healthy and joints are mobile which eventually helps to bring the affected knee within normal range. After the popularity of Minimally Invasive Percutaneous Plate Osteosynthesis Techniques using conventional implants which were placed through submuscular plane , the soft tissue handling was less with advantage of preservation of periosteal blood supply and hence the acceleration of fracture healing. MIPPO technique helped to mobilize early and restore joint function. Most of the information fetched here is from the literature available today but still it is very less in terms of quantity and quality. Unfortunately not much attention had been focused on post operative rehabilitation after proximal tibial fracture fixation and its role to achieve the goal of pre injury level.

METHODS : This study is prospective observational hospital based study conducted from 01 July 2017 to 31st Dec 18. Total 68 patients were included in the study based on the inclusion and exclusion criteria as described.(Table 1).The study was approved by the local ethical committee and subjects were enrolled in a clinical protocol reviewed and approved by the institution. Before the beginning of the study, written informed consent was obtained from each patient. Patients who were included in the study as per inclusion criteria but who were having tense hemarthrosis ,underwent aspiration of the joint under aseptic precautions. For these patients DCO(Damage control Orthopaedics) was followed. They were operated between day 5- day 9 depending on the skin condition. Preoperatively all the patients were given cryotherapy , limb elevation on Bohler Braun splint till they are posted for surgery.

Neurovascular status was assessed and confirmed with relevant investigation in case of doubt. Post operatively patients were given three doses of intravenous antibiotics and appropriate analgesics. After three doses of intravenous antibiotics patients were shifted to oral formulations. From day 2 to day 5 patients were educated and were subjected to conventional physiotherapy protocol followed at our center for quadriceps and VMO exercises. It was supervised till the patient is in hospital and on discharge (day 4-5) they were educated to practice at their residence with special emphasis on non-weight bearing. Appropriate postoperative x rays were taken to assess the reduction. First follow up was after 3 weeks post-surgery for suture removal, assessment of improvement in knee ROM , any post operative complications like gaping of wound , discharge , signs of infection , loosening of implant etc. and second follow up was after 6 weeks post operatively. To allow weight bearing and its effect on Knee biomechanics is out of the scope of this study. We allow weight bearing after 8-10 weeks post operatively depending upon fracture union clinically as well as radiologically; however there are studies who also claim that early and supervised weight bearing improves postoperative results in terms of proprioception and over all soft tissue healing and osteogenic remodeling. This protocol was started as early as on day 2 - day 3 and as late as day 4 depending on the pain tolerance of the patient (Table 2)

Note: In all strengthening exercises, each contraction and stretching was held for 10 - 15 seconds followed by a 3 seconds rest and repeated 10 times. The knee flexion was in the initial period is expected less due to surgical trauma and that was well educated to the patient.

Data was tabulated and analyzed using SPSS (statistical packages for social sciences) version 20 software. Data was presented using suitable diagrams and mean, standard deviation, chi square test etc. were applied on the data. Descriptive statistics were done for all the variables.

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RESULTS :- There were 68 patients enrolled in the study as per inclusion and exclusion criteria with 53 (77.9%) males and 15 (22.1%) females. The youngest patient in our study was 20 years old and oldest was 59 years of age with 33% of the patients belonged to age group of 30-39 years with significant male preponderance. Majority of the cases were type V and VI with the total of 29 (42.65%) cases and least were type II cases making a total of 6 (8.8%) . Type 1 were 14 (20.6%) and type III and IV were 10 (14.7 %) and 9 (13.2 %) respectively. On follow up at 3rd week maximum number to patient have achieved the goal of improvement in ROM with an average of 10^0-15^0/ week with the exception of few who were non-compliant. Distribution of patient in terms of ROM at 3rd and 6th week are shown below (Fig:1). While at 6th weeks total 13 (19.1%) patients have achieved full ROM and 9 (13.2%) patients were able to reach the target of 100^0 (Fig 2). We used variety of implants depending on fracture geometry and displacement to achieve and maintain reduction and stable fixation. We also have used combination of implants in 7 (10.3%) cases. The association between early mobilization on range of motion at 3rd week and choice of implant was found to be statistically significant with chi square value 32.435, df 20 and p value 0.039 (p value < 0.05). However due to small sample size (n=68) and expected count of <5 was observed in 29 cells. The statistical association may not be the true representation of the real value. (Chi square = 50.188 df= 25 p value = 0.002) (Table 3). At the At the end of 6th week the association between choice of implant and ROM was significant (Chi-square = 63.568, df = 20, p value=0.000). Expected count of < 5 was observed in 26 cells (Table 4). To calculate the association between early mobilization at 3rd week and type of fracture the various cells were clubbed together. ROM at 3rd week 40^0, 50^0 and 60^0 were clubbed in one cell and 70^0, 80^0 and 90^0 were clubbed in another cell. The type of fracture I , II and III were clubbed in one cell based on lateral side fixation and type IV, V and VI other than only lateral side fixation were clubbed based on the side used for stabilization of the fracture (Table 5). The association between the two was found to be statistically significant with chi square value 10.9487, df = 1 and p value = 0.000937 (<0.05).

To calculate the association between early mobilization at 6^{th} week and type of fracture the various cells were clubbed together . Range of motion at 6^{th} week 100^0 , 110^0 and 120^0 were clubbed in one cell and 130^0 and 140^0 were clubbed in another cell. The type of fracture type I, II and III were clubbed in one cell based on lateral side fixation and type IV , V and VI other than only lateral side fixation were clubbed based on the side used for stabilization of the fracture (Table 6). The association between the two was found to be statistically significant with chi square value 39.7338, df = 1 and p value = 0.001.

There was no statistically significant association found in following parameters:-

a) Age and early mobilization

b) Loss of fixation and early mobilization

The above findings conclude that early mobilization can be safely carried out irrespective of age and without fear of loss of fixation .

In our series only one patient had screw back out which lead to condylar widening on his follow up at 6 weeks.

DISCUSSION :- Tibial plateau fractures are difficult to treat because of their intra-articular nature, cancellous bone involvement, and proximity to a major weight bearing joint. ORIF is required for depressed or displaced and unstable fractures to regain early and complete ROM. Proper physiotherapy and compliance of patient are equally important to achieve good results. Keeping these points in mind, the present study was carried out with the purpose to assess the functional outcome of various modalities of surgical treatment in different types of tibial plateau fractures and to compare our results with literature. There is no particular number or figure on the amount of articular depression that can be accepted. In our study, the indications for the surgery was either 5mm or more displacement, articular depression or step. Passive and active mobilization has shown to benefit the injured soft tissue (surgical or traumatic insult) by increasing local blood supply of tissue by mobilization. This helps in providing nutrition to the tissues necessary for repair. By stretching of the knee joint gradually up to the tolerable limits during early post operative days, the contractile proteins

of the muscle fibers also remain viable. Ultimately it leads to suppleness of the joint there by increasing its ROM and preventing over all stiffness and chances of DVT. On the other side immobilizing a particular joint causes adverse effects on internal milieu like synovial adhesions, disorganization of collagen fibrils and increase in collagen degradation, alteration of matrix turnover with increase in matrix degradation than formation which increases the stiffness of the joints. To add further more it decreases water content, glycosaminoglycans and degree of orientation of matrix collagen fibrils within ligaments. Prolonged immobilization also increases subperiosteal osteoclastic resorption at fibro osseous junction. It decreases tensile strength of the bone ligament interface affecting the healing of the surgical construct and also increases chances of DVT in high risk patients. Hence by providing early mobilization overcomes the above cascade , there by improving the chances of healing near to the pre injury level. This is particularly more important for high performing athletes who desires to return to normal sports activity. The type of implant was decided based on fracture geometry , intra articular comminution (step / depression) and mediolateral involvement. Skin condition around the involved knee before surgery was one of the most important factor. As per study conducted by Dr. Ramnath et.al for Functional Outcome of Proximal tibia fractures treated with L.C.P by locking plates shown excellent results with less complications. Achieving anatomical reduction is easy with locking plates and helps in early mobilization and obtaining good functional outcome in tibial condylar fractures [(1)]. This theory was supported by our study and similar results were obtained with respect to fracture reduction ,stabilization and which eventually improved ROM. Similar results were obtained at the Retrospective Study done at Goa medical college on Outcome of Proximal Tibia Fractures Treated With Dual Plating [(2)]. When a skeletal muscle with an intact nerve supply is stretched, it contracts which is called as normal stretch reflex. During stretch of the muscle, more the muscle fibers that are stretched more the length is achieved. During physiotherapy the rationale behind to hold the stretch for certain period is to recruit more stretch receptors to allow greater lengthening of the muscles. The golgi tendon organ

also helps to relax the stretched muscle through its function. In the initial phases of training of muscles the mechanical adaptations occurs that are followed by neural adaptations. Theoretically stretching techniques are mainly three types (Table 7).

Static stretching- application of low force with long duration (30 sec). It is slow controlled movement with importance on postural awareness.

Dynamic stretching – application of controlled movement through available ROM. In ballistic type forcing a part of the body beyond its ROM. Not practiced due to risk of injury.

Precontraction stretching – Proprioceptive neuromuscular facilitation stretching (PNFS) -it is a type where contraction of the muscle being stretched or its antagonist before stretching. It triggers the inverse stretch reflex which prevents injury to the involved muscle.

Limitations :- For this study we followed up patients till the end of 6 weeks only so the post operative weight bearing was not considered in our study. For more detailed study longer follow up is required.

Conclusion :- Outcome of early mobilization in proximal tibial fractures is strongly depends on thorough understanding the fracture geometry, classifying the type of fracture ,understanding the biomechanics and choosing the suitable implant. The role of less tissue handling during surgery with stable fixation also helps in stability of the construct and better healing potential. Conventional methods of physiotherapy for quadriceps strengthening and VMO exercises , when instituted early has proven to be beneficial in improving ROM to normal in Schatzker's type I , type II and type III and to near normal for Schatzker's type IV, type V and type VI. Regular physiotherapy advised helps preventing disuse atrophy of quadriceps muscle and also helps in maintaining tone of the muscles.

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Fig.1 : Distribution of patients according to (ROM) at 3rd week

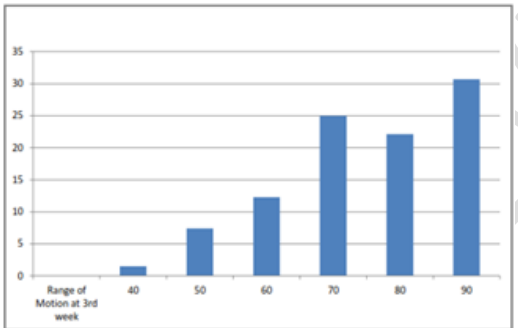

Fig 2: Distribution of patients according to (ROM) at 6th week.

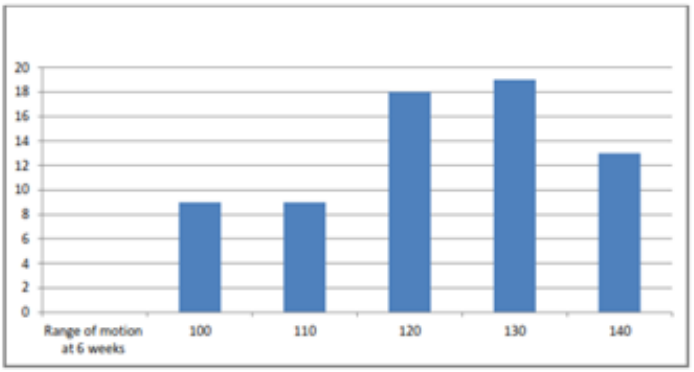

Fig 3 : Schatzker's type II , ROM at end of 3 weeks post operative

Fig 4: Schatzker's type V, ROM at end of 3 weeks .

Table 1: Inclusion and exclusion criteria.

Inclusion Criteria:	Exclusion Criteria:
• Patients who underwent surgical modality of treatment for the particular proximal tibial fracture classified as per Schatzker's classification. • Patients above 18 years of Tibial plateau fractures with 5mm or more displacement or depression or step	• Age less than 18 years, • All open fractures • Fractures with <5mm displacement or depression or step • Fractures with neuro vascular injury • All floating knee injuries. • Compartment syndrome • Other injuries which hampers post op recovery and mobilization (polytrauma)

Table 2: Physiotherapy protocol

Phase 1	Immediate post op period (0-1 weeks)
Rehabilitation goals	• Reduce swelling and oedema • Minimize pain • Start knee flexion as per pain tolerance. • Knee flexion to be gained 10^0-15^0/week and strict non weight bearing.
Actions / Interventions	**Swelling management** – • Ice pack application and elevation • Active ankle pumps • Long extension knee brace **Range of Motion / mobility** • Knee passive range of motion and active assisted range of motion • Static quadriceps exercises
Phase 2	1-3 weeks
Rehabilitation goal	• Improve knee flexion further with a target of 10^0-15^0 /week • Improve strength of quadriceps and hamstrings by resisted exercises and dynamic strengthening exercise by application of weights. • 90^0 of flexion to be achieved by end of 3 weeks

Action / Interventions	• Continue static quadriceps exercise and with weights applied. • VMO exercises • Hip abductor strengthening exercises and resisted quadriceps exercise. • SLR with brace locked in full extension. • Patella and soleus stretching exercises • Continue ice pack application if swelling persist. Continue to remain non weight bearing
Phase 3	3-6 weeks
Rehabilitation goals	Further increase in knee ROM to normal or near normal (up to 140^0). Non weight bearing till further advice
Actions / Interventions	Repeat as phase 2 with increase in frequency and repetitions.

Table 3. Assessment of knee ROM at end of 3 weeks post operatively with various implants

ROM at 3rd week (in degrees)	Cancellous Cannulated screws	Dual platting	Lateral platting	Medial platting	Combined	MIPPO	Total
40	0	1	0	0	0	0	1
50	0	4	0	0	0	1	5
60	0	6	0	0	0	2	8
70	1	8	0	2	3	4	18
80	6	2	3	2	1	1	15
90	12	0	3	3	3	0	1
Total	19	21	6	7	7	8	68

Table 4. Assessment of knee ROM at end of 6 weeks post operatively with various implants

ROM at 6th wk (in degrees)	Cancellous Cannulated screws	Dual platting	Lateral platting	Medial platting	Combined	MIPPO	Total
100	0	7	0	0	0	2	9
110	0	7	0	0	0	2	9
120	1	7	0	2	4	4	18
130	10	0	3	4	2	0	19
140	8	0	3	1	1	0	13
Total	19	21	6	7	7	8	68

Table 5. Association between early mobilization in type of fractures and ROM at 3rd week

ROM at 3rd week	Type I , Type II and Type III	Type IV, Type V and Type VI	Total
40 ,50 and 60	01	29	30
70, 80 and 90	14	24	38
Total	15	53	68
Chi square value 10.9487, df = 1 and p value = 0.000937 (<0.05).			

Table 6. Association between early mobilization in type of fractures and ROM at 6th week

ROM at 6th week	Type I , Type II and Type III	Type IV, Type V and Type VI	Total
100^0,110^0 &120^0	03	27	30
130^0 and 140^0	33	5	38
Total	36	32	68
Chi square value 39.7338, df = 1 and p value = 0.001			

Table 7. Stretching techniques

Static (most common)	Dynamic	Pre-Contraction
• Active • Passive	• Active • Ballistic	• PNF and other techniques