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Tibial Plateau Injury: Mechanical Implantation with Plates and MIPO Approach Tertiary Level Hospital in Bangladesh

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Abstract

Introduction: *Proximal tibial injuries are challenging to treat because of articular surface involvement, frequent congestion, and precariat soft tissue conditions, particularly after high-energy traumas. The treatment is intended to restore the unity of the joint surfaces that supports the typically depressed tibial plateau cartilage, use a strong device to stabilize the fracture and prevent further damage, to enable early recovery. We describe our treatment approach, using closed or open decrease and internal fixation, polyaxy plates, automatic bone-gloss, or other osteoconductive material enhanced by autologous platelet gel, where required. Surgery depends on the timing of the soft tissue and is typically done directly or under the guidance of a skilled surgeon using tissue-sparing techniques as much as feasible.*

Materials and Methods: *A prospective analysis of all (n=58) proximal tibial fractures at the Islamic Bank Medical College Hospital and multicentral tertiary level hospital, Rajshahi, Bangladesh, from January 2019 to June 2021. Patient data were collected by evaluating hospital diagrams, office records, preoperative and after operative radiograph. Fractures were classified in the classification of OTA/AO. In 78 % of the 12-month post-surgery group, the Rasmussen score's evaluation of functional outcomes found positive to outstanding results.* ***Results:*** *Total Number of patient n=58 tibial proximal (intra-articular) fractures have been identified. The mean age was 43 years (range 19–79) at surgery, whereas women and 39 men were 19. The most frequent injury mechanism was linked to traffic accidents (RTA), representing 75% of cases. 09 (18.4%) AO/OTA types A, 31 (53.5%) AO/OTA type B and 18, (31.1%) AO/OTA type C fractures have been identified. Most (90 %) cases (44) were treated with open reduction and internal fixation, using polyaxially anatomical angular stability locking Plates.* ***Conclusions:*** *Internal fixing using locking plates, following the MIPO principles (Minimally Invasive Percutaneous Osteosynthesis), offers an acceptable reduction of fractures with excellent outcomes for the medium-term clinical results.*

Keyword: *MIPO Approach, Tibial Plateau Fracture, Islami Bank Medical College Hospital.*

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Introduction:

The proximal tibia contains tibial plateau fractures in its joint and meta-epiphysis regions. Due to the considerable movement of the pieces, the associated depression and the effects of the cellular sub-chondral bone, and the inevitable cartilage injury, their administration is problematic. Often, the following consequences are catastrophic: identification of the compartment, cartilage loss, damage to the soft tissue envelope, postoperative disease, knee instability/stability, early and late post-traumatic arthritis[1]. These fractures are generally uncommon and bimodal in distribution for men and women. They result from high-energy traumas among young people, while they usually unintentionally fall into low energy in old individuals. Conservative treatment for very simple unreplaced fractures is reserved to represent a small proportion of the overall population of tibial plateau fractures or people with severe co-morbidities with very low demand. For little infants with this kind of injury, operational treatment must be conducted to decrease the anatomy, repair it and move early. Despite the presence of osteoporosis/osteopenia, coexisting health problems, or degenerative joint disorders, these surgical indications and goals continue to grow in patients beyond 55 years [2]. The open reduction and the internal attachment with plates and screws are currently considered the standard gold treatment method. The main pillars of today's clinical practice are the modern locking systems with improved corner stability, reduced

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implantation profile, better design for the surface of the periarticular bone, or compatibility with least-invasive processes-MIPO[3].

In some cases, specific authors propose arthroscopic reduction and internal fixation (pure depression fractures). The substantial risk of compartmental syndrome development due to drainage of irrigation fluids in the tibia compartments and an expansion of the operational time and operating room logistics restrict the extension of the module [4]. Circular ring fixators are a feasible alternative therapy for high-energy fractures and substantial soft tissue damage followed by large intra-articular comminution (AO/OTA category C3) [5].

In treating people with a tibial plateau fracture, a comprehensive assessment of the degree of the local injury is essential. The method and Outcome of the therapy are strongly connected to the soft tissue envelope condition. Temporary stabilization is frequently required via a knee stretching external fixator, allowing for resuscitation of the soft tissue, relief of discomfort, further data on fracture structure (usually CT scanning), and definitive therapy at the optimal time [7]. Other key variants include aging, competing health problems, smoking history, occupation, functional abilities, and personal goals in forecasting immediate and long-term results [6]. This research aims to assess the perioperative and functional results after surgical treatment of tibial board fractures utilizing locking plates and the MIPO technology of a single institute.

Materials and Methods:

A prospective analysis of all proximal tibial fractures at the Islamic Bank Medical College Hospital, Rajshahi Bangladesh, from January 2019 to June 2021. Patient data were collected by evaluating hospital diagrams, office records, preoperative and after operative radiographs. The pathological, pediatric, and extraarticular tibial (AO/OTA type 41. A) proximal fractures have all been eliminated. In each instance, demographics, mechanisms, and circumstances at the time of the accident, information about the hospitalization, surgical description, post-operational rehabilitation, complications, clinical and functional outcomes over a period of 12 months after the surgery were gathered. AO/OTA[7] classified the fracture, and Gustilo-Anderson[8], and the Rasmussen score[9], was utilized to quantify functioning at the previous visit. Follow-up evaluation was carried out at fixed times, including 4, 8, and 12 weeks, 5–7 months, and 12–13 months post-operation. The range of mobility of the knee using a goniometer was measured. In extension and 20^0 (degree) of knee flexion, Varus and Valgus instability were evaluated compared to the normal side. The grade of joint depression and frontal angulation was assessed using radiographs. The decrease was considered good if the remaining depression was 2 mm or less, acceptable if 2 to 5 mm, and bad if more than 5 mm. Malalignment was defined as angulation of more than 58 on the frontal or sagittal planes. Descriptive statistical techniques were utilized to present our findings in detail.

Results:

Over three and a half years, 58 tibial proximal (intra-articular) fractures have been identified. The mean age was 43 years (range 19–79) at surgery, whereas women and 39 men were 19. The most frequent injury mechanism was linked to traffic accidents (RTA), representing 75% of cases, Table I.

Table-I: Patients' demographicss.

	Frequency	% Age
Male	39	22.62
Female	19	11.02
Age	Mean 43 years	(Range 19–79)
Follow-up	Mean 18 months	(Range 12–18)
Mechanism of injury		
Automobile collision	19	33%
Motorcycle collision	16	28%
Fall	12	21%
Pedestrian	8	14%
Sport-related injury	3	5%

Table I. Nine (18.4%) AO/OTA types A, 31 (53.5%) AO/OTA type B and 18, (31.1%) AO/OTA type C fractures have been identified (Table II). Only those instances with articular extension fractures (49 cases type B–C) were further analyzed. Three fractures were open, two grade I and one grade II. Three were open. One patient had a closed injury caused by concomitant popliteal artery disruption.

Table-II: The case distribution according to the AO/OTA fracture classification.

AO/OTA classification	Number, %	Surgical treatment
41 B1	5, 10.2%	2 CRIF with screws 3 ORIF with a single plate
41 B2	7, 14.3%	3 ARIF with screws 4 ORIF with a single plate
41 B3	19, 38.8%	ORIF with a single plate
41 C1	6, 12.2%	ORIF with a single plate
41 C2	7, 14.3%	ORIF with a single plate
41 C3	5, 10.2%	2 ORIF with single plate 3 ORIF with double plate

ORIF: open reduction and internal fixation.

ARIF: arthroscopic reduction and internal fixation.

CRIF: close reduction and internal fixation.

All patients' standard radiography controls were conducted in the tibia (anteroposterior and lateral) and the knee (anteroposterior, side, and oblique views). A CT scan with 3-dimensional (3D) reconstruction was performed to determine articular fragments' size, position, and extent for additional examination. 40 All patients were operatively treated. Routine given is perioperative intravenous antibiotics and prevention against deep-venous thrombosis. A temporary external fixation was used in one patient, while 12 were temporarily immobilized with a splint during the monitoring period. The time between the accident and operation varied from 4 to 14 days[10].

Most (90 %) cases (44) were treated with open reduction and internal fixation, using polyaxially anatomical angular stability locking Plates. Nine of these patients additionally received grafting (both autologous and synthetic) to maintain subchondral bone and articular surface depression[11]. The aside hockey stick approach was utilized for open reduction and internal fixation in all patients; in 29 instances, a MIPO method was feasible using a 5 cm proximal incision (Fig. 1).

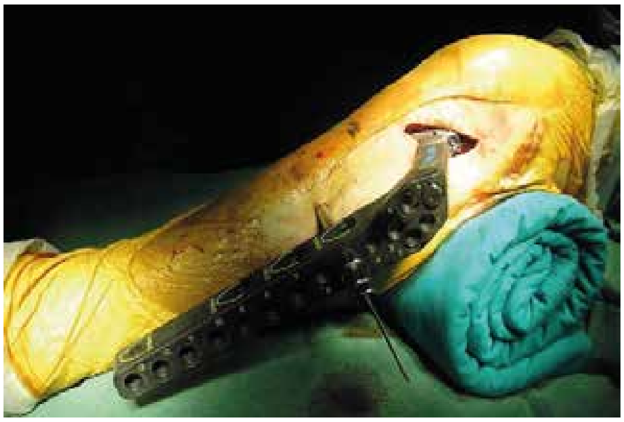

Fig. 1. Clinical picture demonstrating intra-operative placement of a lateral locking plate utilizing minimum invasive percutaneous osteosynthesis methods.

In three instances (type C3), a medial approach was used to reduce and further fix the medial condyle[12]. Five fractures (10%) were subjected to cannulated screw-mini-osteosynthesis. Three of them were arthroscopic operations (type B2 fractures). A standard intro-lateral portal and an antero-medial for the instruments were used for the arthroscope. Indirect reduction of the depressed joint surface via a lower Trans osseous tunnel was reached, checked by arthroscopy, and cancellous screwed 6.5 mm cancellations were fixed. In the initial postoperative phase, passive movement of the operated knee began for all patients. For the first 8 weeks, toe-touch weight-bearing with two crutches was permitted. Following this time, progressive weight-bearing was allowed, based on the development of healing on the X-ray control. In most of these instances, full weight-bearing was permitted after 9–12 weeks. These patients' mean follow-up after surgery was 18 months (range 9–36). Two follow-up patients have been lost. Those others for a physical and radiographic examination, 47 individuals were contacted and evaluated using the clinical score of Rasmussen. 44 patients (94%) were advanced to the bone union during an average period of 4.2 months (range 3–7) (Figs. 2a–c, 2b—c, 3a, and b). The other three patients experienced a non-union: in one instance, the non-union was made more difficult by breaking down the implants utilized (double plating).

Nevertheless, this union was cured with a polyaxially sealed plate and autologous bone grafting following re-plating. The two other instances were replaced by the implanted initially and unincorporated synthetic bone substitute with an autologous bone graft and an overhaul of osteosynthesis with a new polyaxially plate. Three months following the revision operation, these patients were healed. In a high-energy fracture, 5 months later, the first treatment using an external fastener was transforming into a plate fixation.

Three patients developed superficial infections which retarded wound healing and required a brief course of antibiotics. An instance of severe wound drainage infection developed four months following surgery. It was created by deposition, plate removal, and nailing, and bone healing lasted three months. In MIPO-treated individuals, no infections occurred. Two months after surgery, one patient suffered a pulmonary embolism and had deep vein thrombosis.

Fig. 2. (a) A high-energy bicondylar fracture of the right tibial plateau anteroposterior radiograph coronal (b) and sagittal (c) CT-scan reconstruction graphics.

Table III shows the median knee bending and extension range for each follow-up visit. There have been three patients with significant postoperative rigidity. One recovered a complete range of motion after 1 year of intense physiotherapy; two underwent an anesthetic manipulation, which was unsuccessful in one of them who had 58 flexure and 958 knees bending 2 years after the procedure.

Table-III: The progress of the range of knee motion (ROM) following surgery of tibial plateau fractures.

Follow-up (weeks)	Mean loss of extension(^{0})	Mean range of flexion
Discharge	6	79
4	3	87
8	1	112
12	0	123
26	0	127
54	0	131

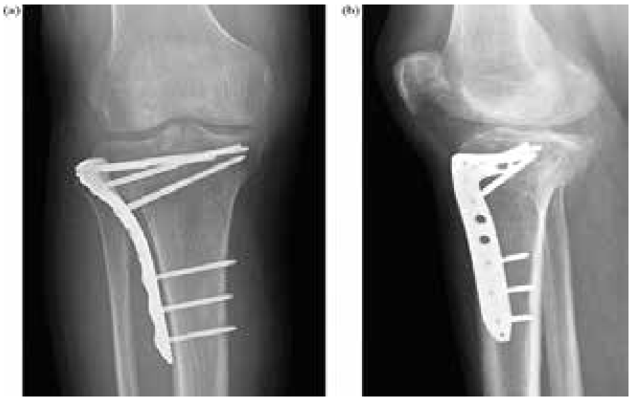

Fig. 3. (a) After open reductions postoperative x-ray with locking plate and internal fixations. (b) Lateral X-ray taken 2 years after surgery lateral tibial plateau has a residual deformity.

The average Rasmussen score was 25 after 6 months (range 14-30), whereas 27 in 1 year after the operation (range 19-30). The maximum score in this scoring system is 30. Of the 47 patients surveyed in the final follow-up, 41 patients (87 %) at 6 months and 44 patients (94 %) at 1 year were successful to outstanding. In three instances, malediction was found in five residual joint depression (>5 mm) and residual split depression in the other two after immediate postoperative radiography. In 68 of varus, one patient healed. In the 41 other instances (87 %), the final X-ray evaluation achieved an excellent or good reduction without any indication of degenerative surface alterations[17].

Discussion:

Significant early and late secondary complications result in severe damage to the tibial plateau. Prompt diagnosis, comprehensive preoperative evaluation of the damage of the ossic and soft tissue,[13] appropriate soft-tissue monitoring and revival, anatomical reduction, and early sound fixation, and rigorous rehabilitation typically over one-year post-harm. For excellent clinical outcomes[14], are essential [15]. The inherent limitations of this retrospective study relate not only to their design but also to their absence of randomization between different treatment methods, their small numbers, the short one-year follow-up (Fig: 3). The accuracy and replicability of radiographic measures are mainly made for articular congruity.

Nevertheless, it reflects the patients treated with a single institution's systematic treatment, rehabilitation, and follow-up procedure. The overwhelming majority of instances have been fixed using modern placing methods, enabling steady angling through MIPO procedures. As a cornerstone to determining definitive fixation and as a significant predictor for some problems such as infections and delayed wound healing, careful soft tissue conditions were assessed. In this series and by other writers, both the utility of a stage method and a delayed fixation until local circumstances are optimized. The external tension provides temporary fixation but may become permanent if ligamentotaxis and manipulation can reduce satisfactorily[16].

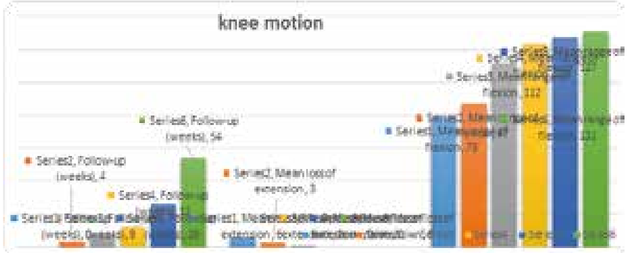

Fig 4: Progress of the knee (ROM).

Due to the complicated knee structure joints and the necessity of anatomical degradation as for all intraarticular fractures, the open reduction combined with bone grafting is considered as a gold standard approach for the last decades, in any case with a cancellous bone depression and rigid internal fixation with plate and screws[17]. However, in 1971, Lucht and Pilgaard 25 reported that 78 % of their patients had a favorable result, although joint depression was up to 10 mm. Contemporary reduction methods and new implant products enable the surgeon to secure fastening without damaging the soft tissue. As in previous comparable studies[18], minimally invasive methods with bone fixation and soft tissue sparing systems provided an excellent combination in our research group (Fig: 3).

However, problems still arise in many instances, compromising the healing of the fractures and the final functional result. This study's accumulative rate of local and systemic issues was 19,1% (9/44 cases). Many writers describe infection/wound dehiscence/malunion-non-early arthritis, which reaches 20–50 % in high-energy instances in particular[19]. A number of authors[20] found radiological evidence for osteoarthritis in the 20-37% of young patients, aged 42-57 years, 3-7 years, after surgery. In elderly individuals [21], comparable alterations in 60% of patients, of whom only 8% were jointly replaced.

Conclusions:

The result of the challenging majority of tibial plateau fractures mainly depends on threefold criteria. Initially, the soft tissues typically need a staggered approach to renewing the soft tissue, minimally invasive surgical methods, and careful handling when open reduction is carried out, secondly, by restoring the congruity of the joint surface and, where applicable, by utilizing autografts and bone substitutions as structural supports and void fillers. Finally, through the stability of the mechanical environment, via fixation and reinforcement of tibial bone proximal metaphysical, utilizing early joint mobility implants and devices.

Conflict of Interest: None.

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References:

1. Dirschl DR, Dawson PA. Injury severity assessment in tibial plateau fractures. Clin Orthop. 2004 Jun;(423):85-92.
https://doi.org/10.1097/01.blo.0000132626.13539.4b
PMid:15232431

2. Dirschl DR, Del Gaizo D. Staged management of tibial plateau fractures. Am J Orthop Belle Mead NJ. 2007 Apr;36(4 Suppl):12-7.

3. Farouk O, Krettek C, Miclau T, Schandelmaier P, Guy P, Tscherne H. Minimally invasive plate osteosynthesis and vascularity: preliminary results of a cadaver injection study. Injury. 1997;28 Suppl 1:A7-12.
https://doi.org/10.1016/S0020-1383(97)90110-8

4. Belanger M, Fadale P. Compartment syndrome of the leg after arthroscopic examination of a tibial plateau fracture. Case report and review of the literature. Arthrosc J Arthrosc Relat Surg Off Publ Arthrosc Assoc N Am Int Arthrosc Assoc. 1997 Oct;13(5):646-51.
https://doi.org/10.1016/S0749-8063(97)90196-1

5. Hall JA, Beuerlein MJ, McKee MD. Canadian Orthopaedic Trauma Society. Open reduction and internal fixation compared with circular fixator application for bicondylar tibial plateau fractures. Surgical technique. J Bone Joint Surg Am. 2009 Mar 1;91 Suppl 2 Pt 1:74-88.
https://doi.org/10.2106/JBJS.G.01165
PMid:19255201

6. Egol KA, Tejwani NC, Capla EL, Wolinsky PL, Koval KJ. Staged management of high-energy proximal tibia fractures (OTA types 41): the results of a prospective, standardized protocol. J Orthop Trauma. 2005 Aug;19(7):448-55; discussion 456.
https://doi.org/10.1097/01.bot.0000171881.11205.80
PMid:16056075

7. Tscherne H, Lobenhoffer P. Tibial plateau fractures. Management and expected results. Clin Orthop. 1993 Jul;(292):87-100.
https://doi.org/10.1097/00003086-199307000-00011

8. Gustilo RB, Gruninger RP, Davis T. Classification of type III (severe) open fractures relative to treatment and results. Orthopedics. 1987 Dec;10(12):1781-8.

9. Rasmussen PS. Tibial condylar fractures. Impairment of knee joint stability as an indication for surgical treatment. J Bone Joint Surg Am. 1973 Oct;55(7):1331-50.
https://doi.org/10.2106/00004623-197355070-00001

10. Canadian Orthopaedic Trauma Society. Open reduction and internal fixation compared with circular fixator application for bicondylar tibial plateau fractures. Results of a multicenter, prospective, randomized clinical trial. J Bone Joint Surg Am. 2006 Dec;88(12):2613-23.
https://doi.org/10.2106/JBJS.E.01416
PMid:17142411

11. Hsu CJ, Chang WN, Wong CY. Surgical treatment of tibial plateau fracture in elderly patients. Arch Orthop Trauma Surg. 2001;121(1-2):67-70.
https://doi.org/10.1007/s004020000145
PMid:11195122

12. Barei DP, Nork SE, Mills WJ, Henley MB, Benirschke SK. Complications associated with internal fixation of high-energy bicondylar tibial plateau fractures utilizing a two-incision technique. J Orthop Trauma. 2004 Dec;18(10):649-57.
https://doi.org/10.1097/00005131-200411000-00001
PMid:15507817

13. Hu Y-L, Ye F-G, Ji A-Y, Qiao G-X, Liu H-F. Three-dimensional computed tomography imaging increases the reliability of classification systems for tibial plateau fractures. Injury. 2009 Dec;40(12):1282-5.
https://doi.org/10.1016/j.injury.2009.02.015
PMid:19535056

14. Gaston P, Will EM, Keating JF. Recovery of knee function following fracture of the tibial plateau. J Bone Joint Surg Br. 2005 Sep;87(9):1233-6.
https://doi.org/10.1302/0301-620X.87B9.16276
PMid:16129749

15. Lachiewicz PF, Funcik T. Factors influencing the results of open reduction and internal fixation of tibial plateau fractures. Clin Orthop. 1990 Oct;(259):210-5.
https://doi.org/10.1097/00003086-199010000-00030

16. Katsenis D, Dendrinos G, Kouris A, Savas N, Schoinochoritis N, Pogiatzis K. Combination of fine wire fixation and limited internal fixation for high-energy tibial plateau fractures: functional results at minimum 5-year follow-up. J Orthop Trauma. 2009 Aug;23(7):493-501.
https://doi.org/10.1097/BOT.0b013e3181a18198
PMid:19633458

17. Ebraheim NA, Sabry FF, Haman SP. Open reduction and internal fixation of 117 tibial plateau fractures. Ortho-

pedics. 2004 Dec;27(12):1281-7.
https://doi.org/10.3928/0147-7447-20041201-18
PMid:15633959

18. Krettek C, Gerich T, Miclau T. A minimally invasive medial approach for proximal tibial fractures. Injury. 2001 May;32 Suppl 1:SA4-13.
https://doi.org/10.1016/S0020-1383(01)00056-0

19. Partenheimer A, Gösling T, Müller M, Schirmer C, Kääb M, Matschke S, et al. [Management of bicondylar fractures of the tibial plateau with unilateral fixed-angle plate fixation]. Unfallchirurg. 2007 Aug;110(8):675-83.
https://doi.org/10.1007/s00113-007-1271-1
PMid:17497119

20. Marti RK, Kerkhoffs GMMJ, Rademakers MV. Correction of lateral tibial plateau depression and valgus malunion of the proximal tibia. Oper Orthopadie Traumatol. 2007 Mar;19(1):101-13.

21. Su EP, Westrich GH, Rana AJ, Kapoor K, Helfet DL. Operative treatment of tibial plateau fractures in patients older than 55 years. Clin Orthop. 2004 Apr;(421):240-8.
https://doi.org/10.1097/01.blo.0000119247.60317.bc
PMid:15123954