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Research Paper Investigating Surgical Approaches in the Management of Tibial Plateau Fractures

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ABSTRACT:

Background: The primary objective of this study is to examine the surgical approaches employed in treating intra-articular fractures of the proximal tibia, based on an analysis of 64 cases. Additionally, a comprehensive literature review on the management of upper tibial fractures, with a particular focus on surgical interventions, has been provided. Methods: The study encompasses the surgical treatment of tibial plateau fractures, with inclusion criteria comprising patients aged 18 years and above of any gender. The fractures were diagnosed radiologically, and their classification was based on the Schatzker system. Results: Tibial plateau fractures exhibit a slight right-sided predominance at 60%, with 40% occurring on the left side. The primary cause of these fractures is frequently linked to automobile accidents or road traffic incidents. Males are notably more susceptible, accounting for 90.63% of cases compared to 9.37% in females. In our series, the majority of fractures were either pure cleavage (type-I) or a combination of cleavage and depression (type-II). Patients were admitted and underwent surgery within 2 to 5 days, contingent upon factors such as wound status or the general condition of the patient. Each case was approached individually, and postoperative mobilization was initiated as early as the 3rd day in most cases. The duration of joint immobilization significantly influences the ultimate outcome. Rigid internal fixation was deemed essential whenever feasible. Conclusion: In the evolving landscape of closed tibial plateau fractures, minimal invasive procedures such as Minimally Invasive Plate Osteosynthesis (MIPPO) are poised to play an increasingly significant role. This is particularly evident when employing advanced technologies like the Locking Compression Plate (LCP). The adoption of these techniques holds promise for improved outcomes in the future. Keywords: Locking Compression Plate (LCP), MIPPO, Tibial plateau fractures, surgical management

INTRODUCTION:

Tibial plateau fractures are prevalent and significant intra-articular injuries, often arising from the impact of indirect coronal or direct axial compressive forces. Representing approximately 1% of all fractures, these fractures exhibit a wide array of configurations, involving the medial, lateral, or both plateaus, and displaying diverse degrees of articular depressions and displacements.¹ Each fracture type carries its distinctive morphological characteristics and responds uniquely to treatment modalities. Understanding the force behind the injury is paramount, given that highenergy trauma is frequently associated with substantial damage to soft tissues and neurovascular structures. In addition to

scrutinizing the tibial plateau for bony injuries, a comprehensive assessment should encompass potential meniscal tears and ligament injuries, recognizing the multifaceted nature of these The modern era. fractures. marked bv advances in mechanization and the acceleration of travel, has witnessed a notable surge in the incidence and severity of fractures, and fractures in the upper part of the tibia are no exception to this trend.² High-velocity those particularly injuries, sustained in automobile disasters, coupled with the overall rise in road traffic accidents, pose a growing challenge. The dynamics of these injuries are influenced by the fact that individuals, in their seated positions with flexed hind limbs, experience a substantial impact primarily on the

patella, followed by the tibia and femur in varying proportions and positions when the vehicle abruptly halts. This intricate interplay of forces underscores the complexity of tibial plateau fractures and the need for a nuanced approach to their diagnosis and management in the contemporary context. Injuries to the stationary lower limb resulting from contact with a moving object, often termed as "BUMPER FRACTURES" due to the typical positioning of vehicle bumpers at knee height, present a common yet significant clinical scenario. The exposed knee joint is vulnerable to diverse strains, including angulation, rotation, and shearing forces, particularly when the individual is upright, amplifying the impact with the assistance of body weight and potentially resulting in a consequential fall. The field of medicine, especially orthopedic trauma, has undergone a transformative evolution in the twentieth century. Remarkable advancements in biomechanics, implant quality, principles of internal fixation, soft tissue management, antibiotic usage, and aseptic practices have collectively shifted the treatment approach for fractures from conservative methods to widely accepted internal fixation. Fractures involving the upper tibia pose distinctive challenges, extending beyond the typical constraints associated with bed confinement during Conservative treatment. approaches, irrespective of age, may lead to complications such as knee stiffness, malunion, and nonunion.³ Consequently, the strategy of open reduction and internal fixation, utilizing diverse implants such as buttress plates, cancellous screws, and external fixators, has gained prominence. The overarching goal is to ensure optimal union of fractured segments and enhance the functional capacity of the knee.

The study's aims and objectives center on the meticulous restoration of articular congruity and limb alignment through open reduction and rigid internal fixation. Active promotion of early knee motion and muscle power, coupled with a comprehensive exploration of the role of surgical treatment and its impact on functional outcomes and potential complications, forms the foundation of this investigation.

MATERIALS AND METHODS:

This present paper delves into the surgical management of tibial plateau fractures in the cases under study. The primary objective of this dissertation is to comprehensively explore the surgical management of intra-articular fractures of the proximal tibia. The overarching goal is to achieve a stable, pain-free, and mobile joint, thereby thwarting the potential development of osteoarthritis. The study also aims to establish correlations between radiological findings, the specific type of fracture, and the ultimate functional outcomes. By scrutinizing these interconnections, the research endeavors to contribute valuable insights into optimizing surgical interventions for tibial plateau fractures and enhancing the overall quality of patient outcomes.

The inclusion criteria for this study involve patients aged 18 years and above, encompassing both sexes. Fractures were diagnosed radiologically, and their classification based on Schatzker's classification was system. Conversely, individuals below 18 years of age were excluded from the study, along with those deemed medically unfit for surgery and those presenting with compound tibial plateau fractures. Ethical clearance for the study has been secured from the institution. The preoperative phase adhered to a set of routine procedures. Antibiotics were administered before the operation and continued until suture removal. The surgical site was meticulously prepared, and the appropriate sizes of buttress plates, condylar screws, and cortical screws were selected. Joint instability was assessed under anesthesia, and a thorough examination was conducted to identify any associated fractures. Additionally, consideration was given to the potential need for other associated procedures, such as bone grafting. In the course of this series, the utilization of an image intensifier was a common practice for most patients, contributing to the precision and accuracy of the surgical procedures. These standardized protocols were implemented to ensure the ethical and methodical conduct of the study and to enhance the overall efficacy of the surgical interventions for tibial plateau fractures.

In the cohort of 64 patients who underwent surgical intervention, a diverse array of treatment approaches was implemented based on the specific characteristics of their tibial plateau fractures. Percutaneous cancellous screws emerged as a preferred method in 16 cases, providing a minimally invasive yet effective solution. In four cases, the combination of cancellous screws and bone grafting was employed, aiming to enhance stability and promote optimal healing. A substantial portion of the patients, numbering 30, underwent surgical treatment involving the utilization of buttress plates and screws.

Remarkably, within this category, one patient received treatment through the innovative Minimally Invasive Plate Osteosynthesis (MIPPO) technique, showcasing the adaptability of surgical approaches to individualized cases. In 12 cases, а combination of bone grafting and buttress plates with screws was employed, emphasizing comprehensive strategy for addressing а complex fractures. Adding a unique dimension to the treatment paradigm, one case involved the fixation of a buttress plate supplemented with an external fixator, showcasing the versatility of approaches in managing challenging scenarios. Postoperatively, а meticulous rehabilitation protocol was followed. Mobilization commenced 48 hours after the removal of drains, emphasizing the importance of early engagement to prevent complications associated with immobility. During the initial 2-5 days, the range of motion was conservatively limited to 0-20°, ensuring a cautious approach to protect the surgical site. From the 5th day onward, a gradual and controlled increase in the range of motion was introduced, eventually extending to 90° or beyond. This structured and patient-tailored approach reflects а comprehensive strategy not only in addressing the fractures surgically but also in orchestrating plan that optimizes rehabilitation the а functional recovery of each patient.

RESULTS:

The study incorporated a comprehensive observation and analysis of results, considering

various factors such as age, sex, occupation, laterality of fracture, type of fracture, method of treatment, duration of immobilization, complications, and the remarks of different age groups. The age range of participants spanned from the youngest being 24 years to the eldest at 60 years, allowing for a thorough exploration of the impact of age on fracture incidence and healing outcomes.

Age Distribution: The investigation aimed to discern the age incidence within the Indian population, shedding light on the prevalence of tibial plateau fractures across different age groups and elucidating the varied responses to fracture healing. Notably, tibial plateau fractures were frequently observed in the active and productive age group, where individuals engage in a multitude of activities and travels. The distribution of fractures across different age groups was analyzed, considering factors such as force magnitude, age, knee flexion degree, of force loading, and valous/varus rate stresses. Graphical representations were utilized to illustrate the correlation between patient age groups and the number of cases, providing a visual insight into the distribution patterns and helping discern trends in fracture occurrence among different age demographics. The nuanced exploration of age-related factors in tibial plateau fractures serves as a valuable contribution to understanding the unique challenges and responses to treatment in diverse age groups within the Indian population.

Age in years	No. of Cases	Percentage			
21-30	6	9.37			
31-40	34	53.12			
41-50	16	25.0			
51-60	8	12.5			
Total:	64	100			

Table 1 : Age in years

In our series, a notable trend emerges in the age distribution of patients with tibial plateau fractures. The majority, comprising 34 cases, falls within the age group of 31-40 years, suggesting a higher incidence of these fractures during the prime years of activity and productivity. Following closely, the age group of 41-50 years accounts for 16 cases, indicating a continued prevalence of tibial plateau fractures into the subsequent decade. Conversely, the least number of cases are observed in the age groups of 21-30 years and 51-60 years. This distribution aligns with the expectation that tibial plateau fractures are less frequent in the younger age group, possibly due to a more resilient bone structure, and in the older age group where individuals may engage in fewer high-impact activities.



The observed incidence of tibial plateau fractures skewed towards a larger proportion of male patients can be attributed to specific socio-cultural factors prevalent in our Indian setup. This gender-based distribution is reflective of the predominant roles and activities undertaken by males and females in this context. In many instances, the female population is often engaged in indoor activities or agricultural work, contributing to a lower risk of exposure to traumatic events leading to tibial plateau fractures.⁵ Their involvement in activities that typically involve less external movement or travel might contribute to a reduced likelihood of sustaining fractures in the upper tibial region compared to their male counterparts. Conversely, the overwhelming presence of male patients in the study, particularly those involved in outdoor activities and travel, suggests a higher likelihood of exposure to the forces and impacts that can lead to tibial plateau fractures. This gender-based disparity underscores the importance of considering societal and cultural dynamics when interpreting fracture incidence data, allowing for a more context-specific understanding of the distribution and risk factors associated with tibial plateau fractures in the studied population.

	Laterality of Fractures	No. of Cases	Percentage		
	Right	40	62.5		
	Left	24	37.5		

Table-2: Laterality of fractures

In our series, an interesting observation emerges with a slight right-sided predominance in tibial plateau fractures when compared to the left side. This finding suggests a subtle lateral asymmetry in the distribution of these fractures within the studied population. The reasons for such laterality can be multifaceted and may involve various factors such as biomechanics, anatomical variations, or patterns of trauma exposure. It's essential to consider the nuanced interplay of these factors when interpreting the laterality of fractures, as it could potentially provide insights into the specific mechanisms or circumstances leading to tibial plateau injuries in the examined cohort. This laterality observation underscores the importance of a comprehensive analysis, considering not only demographic and activity-related factors but also the potential influence of anatomical and biomechanical considerations on the distribution of fractures in the tibial plateau.

Table-3: Schatzker's Classification

Type of Fracture	÷S	No. of Cases	Percentage
Pure Cleavage		20	31.25
Cleavage with de	pression	12	18.75
Central depression	n	4	6.25
Medial Condyle F	racture	8	12.5
Bicondylar fractu	re	12	18.75
Metaphysio dissociation	diaphyseal	8	12.5

Figure2: Schatzker's Classification



In our series, a predominant pattern emerges in the classification of tibial plateau fractures, with the majority falling into type I and type II categories. Specifically, these fractures are identified as pure cleavage fractures (type I) and cleavage combined with depression fractures (type II). Type I fractures typically involve a pure split within the articular surface of the tibial plateau. On the other hand, type II fractures extend beyond simple cleavage, involving a combination of cleavage and depression of the fractured fragments. These classifications are instrumental in characterizing the nature and severity of the fractures. providing valuable insights into the patterns of force and trauma that led to the injuries in the studied population. The prevalence of type I and type II fractures may be indicative of the specific mechanisms or forces involved in tibial iniuries within the plateau cohort. Understanding the distribution of fracture types is crucial for tailoring appropriate treatment strategies and predicting potential complications and outcomes associated with fracture This nuanced each category. classification system enhances the precision of diagnosis and guides the implementation of effective therapeutic interventions for tibial plateau fractures.

DISCUSSION:

Tibial plateau fractures, among the most common intra-articular fractures, represent significant traumatic injuries resulting from various incidents such as road traffic accidents, falls from height, or acts of violence. These fractures, often associated with other bony or soft tissue injuries, particularly around weightbearing knee joints, can lead to substantial morbidity and impact the overall quality of life. Managing upper tibial fractures with intraarticular extension poses a considerable challenge for orthopedic surgeons.⁶ In pursuit of addressing this challenge, our study focuses on the surgical treatment of 32 tibial plateau fractures, aiming to comprehensively analyze and present the clinical outcomes. The analysis encompasses factors such as the patient's age, sex distribution, occupation, mode of injury, laterality of the fracture, fracture types, treatment modalities, complications, associated injuries, and functional outcomes. Notably, the absence of a universal scoring system for assessing the functional outcome of these fractures prompted us to utilize the Rasmussen score in our study. This subjective scoring system provides valuable insights into the functional recovery of patients following surgical intervention. Our endeavor is to offer a nuanced understanding of various types of tibial plateau fractures within the Indian context. acknowledging the impact of modernization, mechanization, and industrial development, which contribute to an increased incidence of automobile accidents. Consistent with existing literature, our study reveals that the majority of tibial plateau fractures occur between the ages of 20 and 60 years. The peak incidence is noted in the productive age group of 31-40 years, aligning with findings from previous

studies by Boune in 1981 and Seppo in 32, both highlighting a similar age incidence pattern.⁷ This correlation underscores the relevance and applicability of our study's findings within the broader context of tibial plateau fractures and emphasizes the need for tailored interventions considering age-specific factors.

In our series, a striking gender distribution is observed, with a substantial majority of male patients (90.63%). This skew towards males can be attributed to the socio-cultural dynamics of our Indian setup, where the female population is predominantly engaged in indoor or agricultural activities and tends to have less exposure to travel-related incidents. This underscores the influence of societal roles and activities on the incidence of tibial plateau fractures, emphasizing the greater exposure of males to potential traumatic events.

Occupationally, the study reveals that tibial plateau fractures are more prevalent among individuals with high levels of activitv. movement, and travel. Businessmen constitute the majority of cases at 37.5%, followed by agriculturists at 25%, laborers at 15.25%, and housewives at 9.37%. This distribution aligns with the notion that individuals with more active lifestyles or professions involving significant movement and travel may be at a higher risk of sustaining these fractures.⁸ The primary mode of injury identified in our study is automobile accidents, accounting for a significant 75% of cases. Falls from height represent the next common mode at 12.5%, followed by violence at 9.37%. These findings align with trends observed in other studies, emphasizing the significant impact of road traffic accidents on the incidence of tibial plateau fractures. Notably. there is a relatively balanced distribution in the laterality of fractures, with the right tibia affected in 62.5% of cases and the left tibia in 37.5%. This symmetry suggests that the occurrence of tibial plateau fractures is not strongly influenced by the side of the limb, but rather by external factors such as the nature of trauma and the mechanisms involved. These comprehensive findings contribute to a better understanding of the demographic and contextual factors influencing tibial plateau fractures in the Indian population. In our approach, we deliberately refrained from imposing rigid criteria dictating a specific method of fixation based on the type of fracture, opting instead for a patient-centered strategy. underwent meticulous Each case а individualized assessment, and the treatment plan was tailored to the unique characteristics and requirements of the particular fracture.9 Utilizing Schatzker's classification, our study revealed a diverse distribution of fractures across various types. Notably, Type I fractures were the most prevalent, constituting 31.2% of cases. This stands in contrast to the findings of a Tampere Hospital, Finland study, which reported lower incidences of Type I fractures and a higher prevalence of Type II fractures. Conservative treatment was selectively employed for cases where surgical intervention was deemed unsuitable or for those with minimal articular step-off (<3mm), and these specific instances were not included in our study. A noteworthy challenge encountered during the study was the occurrence of infection and wound dehiscence, leading to an increased necessity for immobilization. The management of these complications included the use of a muscle flap cover in one patient, which proved successful promoting in healing. The identification of nosocomial infection as a contributing factor potential to these complications underscores the importance of vigilant infection control measures in the Despite surgical setting. the inherent complexities presented by associated bony fractures. ligament injuries, and various complications, our adherence to a standardized surgical care protocol involving diverse fixation methods resulted in favorable outcomes. Remarkably, we achieved a balance of 44% excellent results and 44% good results, culminating in an overall 88% acceptable outcome according to the Rasmussen Score.¹⁰ A subset of cases, constituting 6%, was categorized as fair, while another 6% were classified as poor in terms of functional outcome. These results hold their own when compared to established studies utilizing the Rasmussen Score, affirming the efficacy of our treatment approach. Noteworthy within our study was the surgical treatment of one case using the Minimally Plate Osteosynthesis (MIPPO) Invasive technique, which resulted in an excellent outcome. This case provides insight into the potential benefits of a less invasive surgical approach, coupled with robust fixation methods and an assertive physiotherapy regimen. The retrospective analysis suggests that a judicious combination of these elements could mitigate complications and accelerate the achievement of therapeutic goals in the context of tibial plateau fractures. This underscores the importance of ongoing refinement and

adaptation of treatment strategies to optimize both efficacy and patient outcomes in the dynamic field of orthopedic care.

CONCLUSION:

The conclusion of our study on the surgical management of tibial plateau fractures yields crucial insights. First and foremost, the incidence of these increasing fractures. particularly in the context of high-velocity injuries such as automobile accidents. underscores the evolving challenges in orthopedic care. It emphasizes the pressing need for effective treatment strategies, given that a significant portion of those affected are individuals in their productive years. The meticulous consideration of soft tissue status and its timely repair emerges as a pivotal factor influencing outcomes, highlighting the integral role of preoperative assessments. Furthermore, our findings affirm the advantages of surgical intervention, especially in cases involving depressed and displaced fractures. Surgical treatments offer the opportunity for achieving anatomical reduction and rigid fixation, fostering knee stability. This stability, in turn, facilitates early knee motion, mitigating the risk of posttraumatic osteoarthritis and optimizing overall knee function. The conclusion drawn from this study is clear: the surgical management of tibial plateau fractures, while undeniably challenging, provides a promising avenue for attaining excellent anatomical outcomes and restoring optimal function to the knee. The remark by Hohl, emphasizing the toughness of these fractures, serves as a poignant reminder of the complexities inherent in their management and the continuous commitment required from orthopedic professionals to address these challenges effectively.

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