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Role of CT Based Luo Classification for Surgical Management of Proximal Tibia Fracture: An Observational Study

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Abstract: ***Background: Proximal tibia fractures are one of the most common intrarticular fractures. Luo's CT based 3 column concept helps to identify posterior column fractures which are missed on Schatzker's plain radiograph-based classification and better understanding of fracture morphology. Aims and Objective: To analyze the usefulness of CT based radiological assessment of tibial plateau fractures and fixation by 3 column concept given by Luo et al. Material and Method: This study has 25 patients with proximal tibia fractures presenting to Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Mullana-Ambala. Patients were enrolled in the study after due consent is taken.3D CT scan was done in all cases along with plain x-rays. Fractures were analyzed as per Schatzker classification in addition to analysis on 3D CT. Fractures were surgically stabilized on 3 column concepts of Luo. All patients were evaluated for pain, knee ROM, walking capacity using Modified Rasmussen criteria and Visual Analogue scale. Follow up assessment of patients was done at regular interval of 6 weeks, 3 months and 6 months. The functional outcome of surgical intervention was evaluated after assessing patient's subjective complaints, range of motion and stability of the knee joint using modified Rasmussen clinical criteria. Result: In our study of 25 cases, more than 65 % cases are of complex Schatzker type of 4 to 6. Luo's CT based 3 column concept helped to identify posterior column in 36 % of cases. Luo classification helped better understand the pattern and morphology of fracture. The average time for union of fractures was 12.04 ±4.40 weeks. Fixation on basis of this concept and functional evaluation by Modified Rasmussen criteria showed the superiority of 3 column concept classification over Schatzker Classification.***

Keywords: Tibial plateau, Luo, Posterior column, Schatzker

1. Introduction

Tibial plateau fractures are one of the most common intra-articular fractures due to high energy injuries resulting from direct axial or indirect coronal compressive forces. They constitute 8% of the total fractures in elderly and 1% of all fractures (1). The global annual incidence of tibial plateau fracture is 10.3 people per 100, 000 people (2).

Soft tissue compromise in these complex fractures also plays an important role in deciding the timing of surgery. Plating through a compromised soft tissue envelope entails significant risk of complications such as wound dehiscence and deep infection. Staged management consisting of external fixation followed by definitive internal fixation once soft tissue condition improves has been shown to decrease complications (3)

In case of improper restoration of the plateau surface and the axis of the leg, these fractures could lead to development of premature osteoarthritis, injury in ligaments, as well lifelong pain and disability (4). Hence, carefully studying the fracture geometry and planning the number and placement of plates accordingly is a pre-requisite for efficient management of tibial plateau fractures. However, recently a paradigm shift from radiographs-based treatment protocols to CT based management, especially in complex fracture patterns has been observed (5-7). The CT based column concept classification described by Luo et al. has been shown to have a better inter-observer reliability than the radiographic based Schatzker's classification (5, 8). Therefore, the present study was conducted with an aim to investigate the role of Luo Classification in surgical management of proximal tibial fractures.

2. Materials and Methods

The study subjects consisted of 25 Patients with proximal tibia fractures seeking treatment inOut-Patient Department or in Emergency Room at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala between March 2020 and August 2021 who are above18years of age and having radiologically proven proximal tibia fractures were enrolled in the study after due consent is taken.3D CT scan was done in all cases along with plain X-rays. Fractures were analyzed as per Schatzker classification in addition to analysis on 3D CT scan. Fractures were surgically stabilized on three column concept of Luo.

Lateral side was approached via standard anterolateral approach and minimally invasive technique used for fixation with a pre-contoured LCP. Medial and Posterior side was fixed using the standard posteromedial approach as described by Lobenhoffer et al (9). Depending on number of separate fragments (anteromedial, anterolateral, posterolateral, posteromedial), number of plates were chosen. When articular cartilage depression was present, the depression was elevated via a bony window and the void filled with artificial bone graft.

Patients were started on continuous passive motion of the knee as well as isometricquadriceps-strengthening exercises on POD 2. Following suture removal, active flexion-

extension of knee with full range of motion encouraged. During the first 3 weeks, toe-touch partial weight bearing was allowed. Progress to full weight bearing after 3 to 6 weeks, as tolerated. For patients with stiffness, passive and active-assisted range of motion exercises done, ranging from 0 to 30 degrees, and gradually increased. Fractures were classified according to Luo's classification. Patient follow-up done regularly at 6 weeks, 3 months and 6 months, post discharge, till completion of union, seen as presence of bridging callus of three out of the four cortices in both AP and Lateral views. If no signs of union till 4 months, it was termed as delayed union. If no signs of union till 6months, it was termed as non-union. The functional outcome of surgical intervention was evaluated after assessing patient's subjective complaints, weight bearing capacity, range of motion and stability of the knee joint using modified Rasmussen clinical criteria.

3. Results

A total of 25 patients satisfying the inclusion and exclusion criteria and operated during the study period were included in the study. According to age group, 40% of the patients were in age group of ≤ 45 years while 60% of the patients were >45 years. Mean age of patients was 48.20 ± 9.82 years. Incidence of tibia fractures was higher among males (64%) as compared to females (36%). Majority of the patients (80%) had injury due to motor vehicle accidents while only 20% of patients had injury due to fall from height. On the basis of Luo Classification of patients, that majority (32%) of the patients had lateral column involved while 20% of the patients had both lateral and medial column involved. It is significant to note that 24% patients had all the 3 columns involved including posterior column. Also, 12% of the patients had medial and posterior column involvement. So, overall, 36% of the patient having an involvement of posterior column were missed on the basis of Schatzker classification. The number and positioning of plates to be used were determined based on axial CT images. Majority (32%) of the patients had lateral buttress plate fixation.24% of the patients had lateral and posteromedial buttress plate fixation. Whereas 20% had lateral and medial buttress plating. Mean flexion was also highest (121.40 ± 7.71) at 6 months while lowest (95.00 ± 7.36) at 6 weeks. However, an intermediate value (108.20 ± 6.96) of mean flexion was observed at 3 months of time interval. Further, a significant difference was observed in mean flexion at various time intervals (p value <0.001). Mean extension lag was observed to be highest (9.20 ± 4.72) at 6 weeks while at 3 months, mean extension lag was almost half (5.00 ± 4.56) and at 6 months mean extension lag was observed to be one-third (3.00 ± 5.00) which shows a decremental pattern for mean extension lag at various time intervals for all the patients under study (p value <0.001). Mean Rassmussen score was calculated at various time intervals for the patients and it was observed that mean score at 6 weeks was 18.96 ± 1.74 while at 3 months mean score was 22.12 ± 2.09 and at 6 months mean score was observed to be 25.56 ± 2.52. Furthermore, a significant difference was observed in mean score calculated at various time intervals (p value <0.001). The average time for union of fractures were 12±4.40 weeks. The fracture union was observed in 92% patients while only 8% patients had non-union. It was also observed that 2 patients had knee stiffness and 1 patient had superficial wound infection which was treated by regular dressings and intravenous antibiotics which went on to heal well. There was 1 case with varus collapse but had a functional active ROM

4. Discussion

Tibia Plateau fractures are usually high energy injuries seen mostly in young adults with RTA being the most common cause (9). In our study too, the mean age was 48.20 years and males were predominantly affected. Most of the fractures were due to RTA (80%). Significant soft tissue compromise is common, which must be taken into consideration while charting out the management strategy. We favor staged management as it allows for soft tissue healing and has been shown to have fewer complications (10, 11). In our study, the mean interval between injury and surgery was 3.48 days and most of the cases were initially managed with calcaneal traction on a Bohler Braun splint. The management of proximal tibia fracture has always been a subject of discussion because of their complexity and variety. Any fracture in and around the joint (especially weight bearing knee joint in the lower limb) is of paramount importance as adverse outcome would result in significant morbidity and quality of life may be affected negatively. Typically, such injury requires early operative management requiring anatomical reduction and absolute fixation to achieve an acceptable functional outcome. Closed treatment of these injuries has had very little success in reducing depressed or displaced fracture fragments; this initiated the need for open reduction and internal fixation in most displaced and unstable fractures. It is also extremely important to do a stable fragment fixation and ligament repair to regain complete range of motion. CT scans has now emerged as method of choice for deciphering size, shape and location of fracture. The infection rate in our study was low and comparable to previous studies (12, 13) due to strict adherence to the protocol of meticulous assessment of soft tissues before any surgical intervention. Luo's classification does overcome the shortcomings of Schatzker and AO/OTA classifications. It is easy to understand and apply and has a high inter-observer agreement. Also, fracture patterns previously not fitting into any Schatzker type can now be classified. Most importantly, it is a management based classification rather than just a descriptive one.

5. Conclusion

Proximal tibial fractures are one of the most common fractures being managed in orthopaedic clinics. These factures require the joint congruity to be restored by surgical fixation to achieve good functional outcomes. It is also important to understand the fracture anatomy. Schatzker's Radiographic classifications have being used for long but have been found to be inadequate to completely describe the fracture anatomy. In the present study the application of CT based 3 column classification to these fractures resulted in better planning of surgical fixation. Various parameters were observed in our study such as, mean flexion; mean extension lag and mean Rassmussen score showed significant

difference with 80% of the patients having satisfactory knee function.

Our study concludes usefulness of Luo's three-column classification of tibia plateau fractures based on 3D CT scan which helps to identify posterior column fractures likely to be missed on plain radiographs and helps in better patient management

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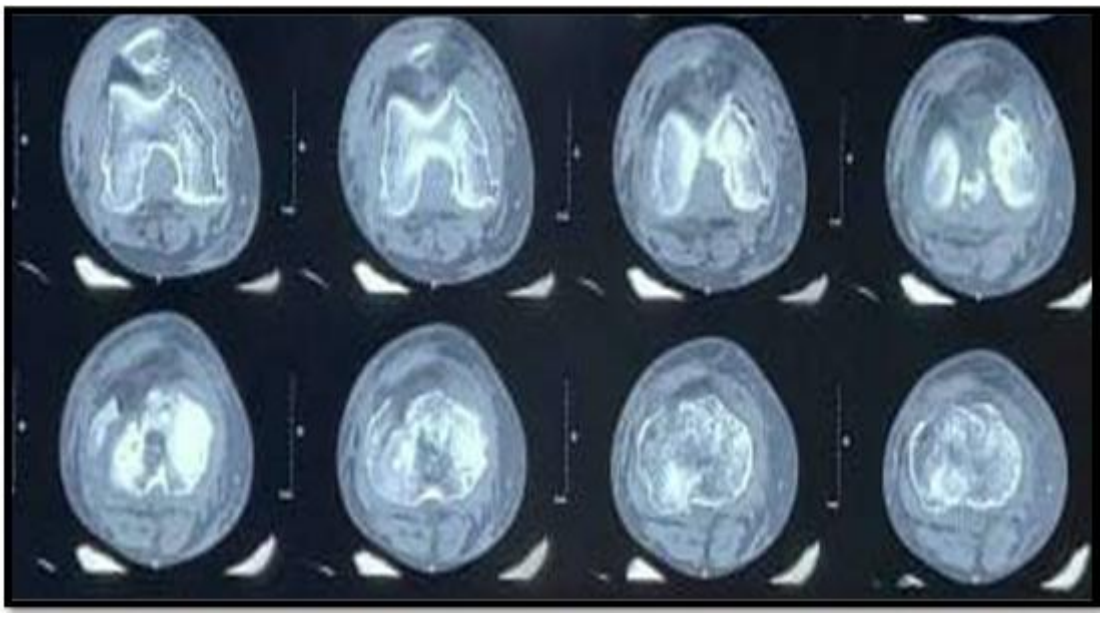

Figure 1: CT Scan Depicting Three Column Involvement

Pre-OP X-Ray

Post-OP X-Ray

SHOWING ROM ACHIEVED.