

Modalities of Surgical Treatment of Tibial Plateau Fractures In Rims Hospital, Imphal

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Abstract

Background: Tibial plateau fractures involve the articular surface of the tibia resulting from a combination of axial loading with varus or valgus stress. Inadequate and inappropriate treatment may result in significant functional loss. Tibial plateau fractures constitute 1% of all fractures and 8% in the elderly. Peak age is 30-40 years old in men and 60-70 years in women

Objective: The purpose of this prospective study is to evaluate the effectiveness of the different surgical modalities of treatment of tibial plateau fractures and their functional outcomes in RIMS Hospital, Imphal

Material and Methods: In Regional Institute of Medical Sciences, Imphal, Manipur, thirty consecutive patients aged between 18 to 65 years with tibial Plateau fracture were treated with various surgical modalities and followed up for a period of 2 years starting from September, 2013 to August, 2015. The fractures were classified using Schatzker's classification. The functional outcomes were assessed by using Rasmussen's criteria.

Results: In this study, there were 6 type I (20%), 11 type II (36.6%), 3 type III (10%), 3 type IV(10%) , 5 type V (16.7%), and 2 type VI (6.7%) fractures treated by open reduction and internal fixation. Depending on the modalities used, the patients were divided into four groups viz., the cannulated cancellous (CCS) group, buttress plate (BP) group, buttress plate with cannulated cancellous group and locking compression plate (LCP) with cannulated cancellous group. There were 8, 13, 7 and 2 patients in the groups respectively. The most common mechanism of injury was RTA followed by a fall from height and sports related injury. 35% had concomitant soft tissue injury. Femoral shaft fracture was the most common associated fracture (3 cases), 2 cases had multi-trauma injuries. According to Rasmussen functional score, 21 cases (70%) had an excellent result, 6 (20%) had a good result, 2 (6.67%) had a fair result and 1 (3.3%) had a poor result. Wound infection occurred in one patient with uncontrolled type II diabetes and was resolved with debridement, repeated dressing and i.v antibiotics.

Conclusion: Based on this study, it is concluded that thorough analysis of the fracture pattern and choosing the best modality of surgical treatment for significantly displaced tibial plateau fractures is very important, and which, followed by a careful open reduction and stable internal fixation shows excellent functional and radiologic results at 2 years follow up visit. Also that the functional scores of the injured knee at 1 year postoperatively is believed to adequately predict future knee function for years to come

Keywords: tibial plateau fracture, schatzker's classification, buttress plates, cannulated cancellous screws, rasmussen's criteria.

I. Introduction

Fractures that involve the proximal tibia affect knee function and stability. Generally, these injuries fall into two broad categories – low energy and high energy fractures. The tibial plateau fractures are usually caused by motor vehicular accidents or bumper strike injuries, once called bumper fractures. Sport injuries, falls and less violent trauma also caused them, especially in elderly with osteoporosis. The tibial plateau fractures produced by high energy mechanisms may be associated with neurological and vascular injury, compartment syndrome, deep vein thrombosis, contusion, crush injury to the soft tissues or open wounds.¹The spectrum of associated injuries, potential complications and outcomes vary with fracture pattern. Injuries to this joint can result in functional impairment, as they affect knee alignment, stability and movement. These fractures constitute about 1% of all fractures and 8% of fractures in elderly.²

The tibial plateau fractures have been studied and reported extensively and exhaustively but still controversy exists over their management, whether surgical or conservative. Various modalities of treatment are available but no ideal treatment has yet evolved. Intra-articular fractures of proximal tibia are difficult to treat.³ The primary goal in the treatment of proximal tibial articular fracture includes restoration of articular congruity, axial alignment, joint stability, and functional motion⁴.

II. Treatment

The tibial plateau fractures are treated by a wide range of surgical methods depending on the fracture pattern, choice and expertise of the operating surgeon. Some of the modalities used in various studies include k-wires, screws, buttress plate, compression plate, and external fixators etc. which were used singly or in combination⁵.

III. Materials And Method:

This is a hospital based prospective study done in the Department of Orthopaedics, Regional Institute of Medical Sciences, Imphal between the period of September, 2013 to August, 2015 in 30 patients with tibial plateau fractures admitted in our hospital and have undergone operation for the same, after due approval from the ethical committee of the institute and informed written consent were obtained. During the study period, the patients were divided into four groups depending on the modalities used as cannulated cancellous screws (CCS) group, buttress plating (BP) group, buttress plating (BP) with CCS group and locking compression plate (LCP) with CCS group. The fractured limb is first immobilized with Cramer wires and plain radiographs of AP and lateral views of the injured leg including the knee joint were taken to assess the fracture pattern, comminution, geometry and the dimensions of the fracture. Routine investigations were sent and CT scan was taken for five patients in which X-rays were indecisive. Patients with mental and physical inability to cooperate and presence of serious complicating medical conditions and inability to obtain informed written consent for operation were excluded.

All the patients in this study were operated upon under spinal anaesthesia. The patients were positioned supine and an Esmarch tourniquet was applied in the upper thigh followed by skin preparation and draping in the usual orthopaedics fashion. Two surgical approaches were used to reduce and internally fix tibial plateau fractures- the anterolateral approach and the posteromedial approach. They were used in isolation for fractures on the lateral and medial side of the knee respectively, and together for patterns that involve both condyles.

i). The Anterolateral approach: This was the most common approach used to surgically reduce and internally fix tibial plateau fractures. The incision was based at the Gerdy's tubercle and was extended distally over the anterior compartment. An L-shaped incision in the origin of the anterior compartment muscles provided access to the anterolateral surface of the tibia.

ii) The Posteromedial approach: This was the second commonest approach and was used to reduce and fix the medial side of the proximal tibia, particularly the posteromedial fragment.

Cannulated cancellous screws (CCS):

This was used in Schatzker's Type I and few type II fractures. They were fixed with two/more transverse cancellous screws, also called raft screws. A total of eight patients were treated with this modality.

Buttress plating (BP) :

This was used for type II to type V with side specific/dedicated plates. Elevation of the depressed plateau enmasse with or without bone grafting of the metaphysis in patients of type II, III and IV fractures. Thirteen patients were treated with this modality.

Types: T plate, L plate and Hockey stick plate.

Buttress plating (BP) with CCS:

This is used for type II to type V with side specific/dedicated plates. Elevation of the depressed plateau enmasse with or without bone grafting of the metaphysis is done as in buttress plating. Seven patient had been treated with this method.

Locking Compression plate (LCP) with CCS:

This was used for type VI fracture patterns. Two patients were treated with this modality.



Plate 1. Skin incision



Plate 2: Showing fixing the fracture by the buttress plate.



Plate 3. Showing type I fracture treated with CCS (Cannulated Cancellous Screws).

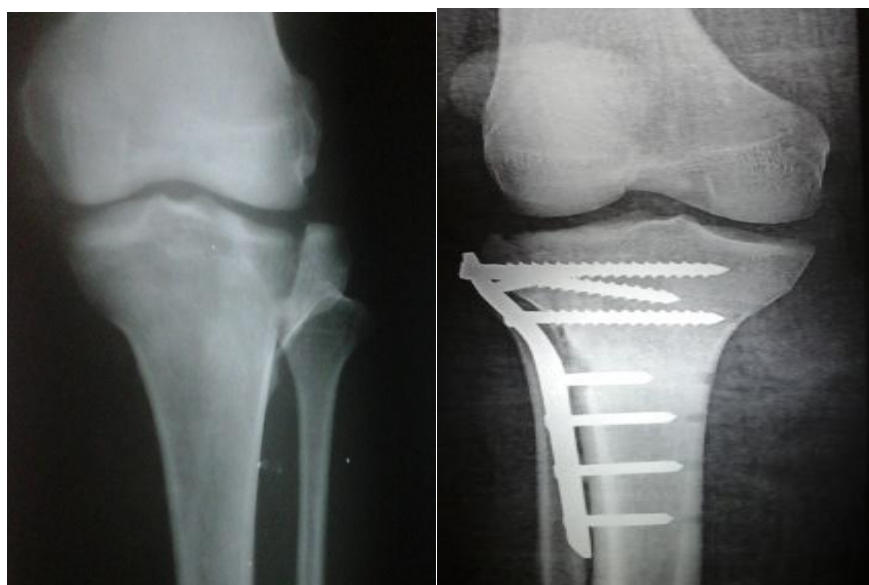


Plate 4. Showing type II fracture treated with buttress plating.

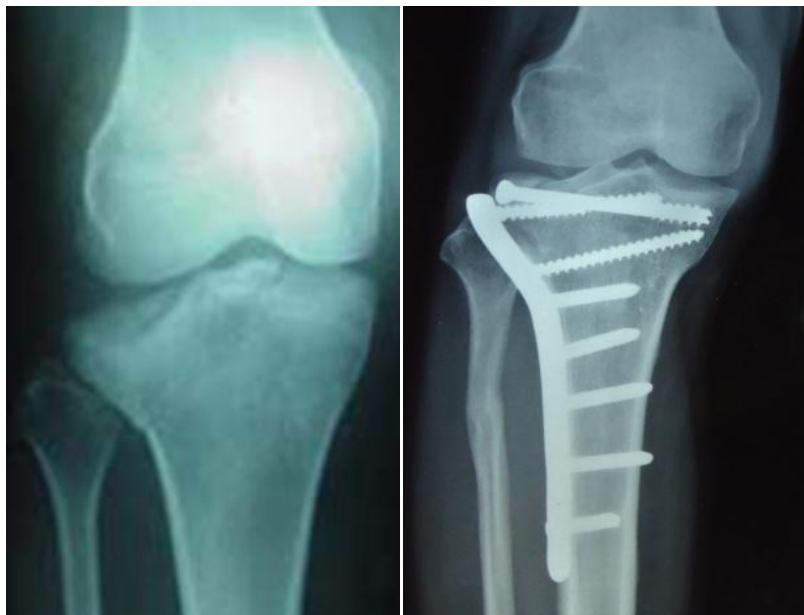


Plate 5. Showing type III fracture treated with BP with CCS.



Plate 6. Showing type IV fractures treated with medially placed buttress plate



Plate 7. Showing type V fracture with double buttress plating.

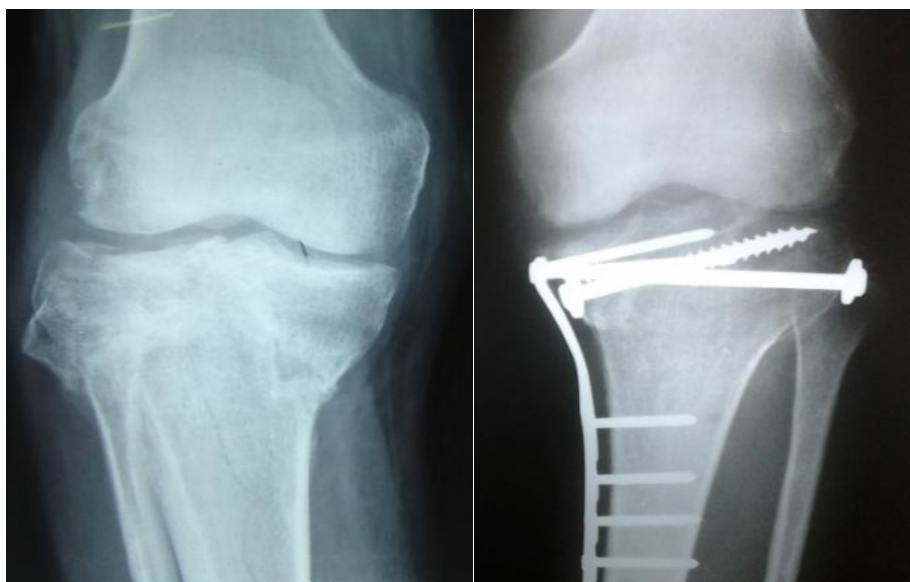


Plate 8. Showing type VI treated with LCP with CCS.

Follow up:

Stitches were removed at 10-14 post operative days and then patients were called for followed up every 3 weeks for the first 12 weeks after surgery, then once a month for the next 3 months and then every 6 months for a period of one year. Thorough clinical examination followed by local examination of the operated site and the whole limb were done and compared with the other side in terms of range of motion, power, tone, muscle wasting etc. All relevant findings were recorded. In each visit, radiological assessment of union and fracture callus quality were done in addition to functional limb assessment by Rasmussen's.⁶

Table 1. Rasmussen's functional grading

Subjective complains	Points	Excellent	Good	Fair	Poor
Pain					
No pain	6				
Occasional ache, bad weather pain	5				
Stabbing pain in certain position	4	5	4	2	1
Afternoon pain, intense, constant pain around the knee after activity	2				
Night pain at rest	0				
Walking capacity					
Normal walking (in relation to age)	6				
Walking outdoors at least I hour	4	6	4	2	1
Short walk >15 minutes	2				
Walking indoors only	1				
Wheelchair or bedridden	0				
Clinical signs					
Extension					
Normal	6				
Lack of extension (0 ⁰ -10 ⁰)	4	6	4	2	1
Lack of extension (>10 ⁰)	2				
Total range of motion					
At least 140 ⁰	6				
At least 120 ⁰	5				
At least 90 ⁰	4	5	4	2	1
At least 60 ⁰	2				
At least 30 ⁰	1				
0 ⁰	0				
Stability					
Normal stability in extension and 20 ⁰ of flexion	6				
Abnormal stability in 20 ⁰ of flexion	5	5	4	2	1
Instability in extension (<10 ⁰)	4				
Instability in extension (>10 ⁰)	2				
Sum (Minimum)		27	20	10	6

IV. Observations And Results

The mean age of fracture i.e., time period from day of injury to operation for all the fractures in the present study was 10.75 days. Those fractures under CCS group were operated at mean age of 8days, those in

BP group at 10 days, those in BP group with CCS at 12 days and those in the LCP with CCS group at 13 days. Of the two cases in LCP with CCS group, one was diabetic with a poorly controlled blood sugar level and the other had open fracture with severe soft tissue damage. The mean operating time for CCS group was 52.115 minutes, BP group was 74.664 minutes, BP with CCS group was 81.244 minutes and that of LCP with CCS group was 92.212 minutes. The duration of hospital stay ranges from 7 days to 34 days with 20 patients out of thirty being stayed in the hospital for 11-20 days. One case of LCP with CCS group was stayed for 34 days for poor wound healing. She was a known case of uncontrolled Type II diabetes mellitus.

The mean time of weight bearing for CCS group was 8.4 weeks, BP group was 12.6 weeks, BP with CCS was 12.8 weeks and that of the LCP with CCS group was 16.73 weeks. The mean duration of fracture union for CCS group was 15.30 weeks (range 12-18 weeks), that of BP group was 18.2 weeks (range 14-22 weeks), that of BP with CCS group was 22.70 weeks (range 18-26 weeks) and that of LCP with CCS group was 25.4 weeks (range 24-27 weeks). Sixteen patients attained at least 140 degrees ROM constituting 53.33% and nine patients attained 130-140 degrees constituting 30% while one patient attained less than 110 degrees ROM.

Overall, 21 patients (70%) had excellent functional outcome, 6 patients (20%) had good outcome, 2 patients had fair outcome while only one had poor outcome as per Rasmussen's criteria. The CCS group had the best functional outcome followed by the BP group. With regards to the fracture patterns, the Schatzker's type I had the best outcome with 100% excellent outcome following ORIF, followed by type II with 91% excellent outcome while type VI had the worst outcome. Incidentally, the patient with the poor outcome had co-morbidities in the form of poorly controlled type II diabetes mellitus and osteoporosis.

Table 2: Showing functional outcome based on fracture types

Type	No. of cases	Excellent	Good	Fair	Poor
I	6	6	-	-	-
II	11	10	1	-	-
III	3	2	1	-	-
IV	3	2	1	-	-
V	5	1	3	1	-
VI	2	-	-	1	1
Total	30	21	6	2	1

Table 3: Showing functional outcome based on modality of treatment

Outcome	CCS group	BP group	BP with CCS group	LCP with CCS group	Total
Excellent	7	10	4	-	21 (70%)
Good	1	3	2	-	6 (20%)
Fair	-	-	1	1	2 (6.67%)
Poor	-	-	-	1	1 (3.3%)
Total	8	13	7	2	30 (100%)

Complications

Infection:

Superficial infection occurred in one patient who was a known case of type II Diabetes Mellitus and was resolved with repeated dressing, antibiotics and blood sugar control. The patient was already osteoporotic at the time of admission based on radiographs. She developed stiffness of the knee with ROM less than 110 degrees at her latest visit. There was delayed healing of the fracture.

Loss of fixation:

Loss of fixation occurs in one type II fracture treated with CCS (Cannulated Cancellous Screws) which however united with no complications till the last visit.

Knee stiffness:

It occurred in one type VI fracture patients with poorly controlled type II diabetes mellitus and osteoporosis.

Malunion:

Malunion in slight varus occurs in one case of type V fracture treated with LCP with CCS.

Prominent and painful hardwares:

Prominent and painful hardwares were reported by 3 patients, one in LCP with CCS group and one each in Buttress plating group and BP with CCS group. They subsided with removal of the implants after consolidation of the fractures. There were no intra operative complications noted in our study in all the groups.

V. Discussion

The proximal tibial fractures are increasing day by day mainly due to the ever increasing road traffic accidents. The spectrum of injuries to the tibial plateau is so variable that no single method has proven uniformly successful.⁷ Optimal treatment of tibial plateau fractures has been an issue of discussion for several

decades. During the last decades, studies analyzing surgically treated tibial plateau fractures have shown good results.⁸ At the same time, surgical treatment options for the same are also being modified continuously. Any fracture around the knee joint is of paramount importance as it would result in significant morbidity and quality of life. Hence the treatment of such type of fractures has become a challenge for orthopaedic surgeons

In this study, the average age of patients was 38.50 years with the range being 19 years to 65 years. 63.30% (19 patients) were in the age group of 31 to 50 years. In terms of frequency of fracture patterns, the Schatzker's type II has maximum occurrence with 11 cases (36.60%) followed by type I fracture with 6 cases (20%). Right side was predominantly involved with 18 cases (60%) while the left side with 12 cases (40%). Males were predominantly affected with 24 cases (80%) while females with 6 cases (20%). Road traffic accident was the most common mode of injury with 22 cases (73.30%) followed by fall with 6 cases (20%) and 2 cases of sport injuries constituting 6.7%. None of the fractures were operated upon as emergency. We feel that operating upon first week after the injury is technically a bit easier.

With regards to complications, superficial infection occurred in one diabetic patient which resolved after repeated dressing, antibiotics and blood sugar control but knee stiffness occurred as a consequence of prolonged immobilization due to poor wound healing. Loss of fixation occurs in one type III fracture treated without bone grafting which however united with no complications at the last visit. Malunion in slight varus occurred in one case of type V fracture but no notable discomfort was reported at last follow up visit. Thus, slight loss of reduction and malunion do not hamper the functional outcome at 2 years but regular follow up is suggested for late complications. Prominent and painful hardware were reported by 3 patients but subsided completely with removal of the implants after consolidation of the fractures. Range of knee movement was better in patients starting mobilization early post-operatively. Results were believed to improve with experience, careful preoperative planning, and thorough knowledge of anatomy. Good intra-operative radiographs are needed to decrease the incidence of mal-reduction while learning. Comparison is done with other literatures on their study on Schatzker's type I-VI fractures:⁹

Table 3: In terms of time of surgery, full weight bearing and knee ROM

	Time to definitive surgery (days)	Full weight bearing (weeks)	Knee ROM (Range of motion)	Functional outcome
Watson et al. 1998	12	12	0 - 108 ⁰	Knee society score
Keogh et al 1992	Not mentioned	8 - 12	Not mentioned	Rasmussen score
Koval et al. 1992	4	12	0 - 128 ⁰	MotionPainDeformity AmbulationReturn to walk
Sament et al 2012	2	12	90%>90	Rasmussen score

Table 14: Clinical and radiological outcomes listed by surgical approach in literatures¹⁰

Authors	No. of patients	Follow-up (months)	Complications	Radiological outcomes	Clinical outcomes	Range of movements (⁰)
Single approach Gosling et al	69	12	Deep infection (1%), superficial infection (6%), NU (4%)	Anatomical reduction (78%), Loss of reduction (14%)		
Staged protocol Egol et al	53	16	Deep infection (5%), NU (4%), Revisions (16%)	100% within 5 ⁰ of anatomical reduction, arthritis (5%)	WOMAC 91	1-106
Dual approach Canadian OTS	40	24	Deep infection (20%), ROH (20%), Revision (10%) Deep infection (10%), MU (7%)	Arthritis (29%) Anatomical reduction (93%), moderately severe arthritis (10%)	HHS 68 HHS 88.6	4-113 135
Marti et al	109	168	Superficial infection (8%), Flexion contracture (8%)	100% union	100% good	5-110

*NU, nonunion; ROH, removal of hardware; MU, malunion

VI. Conclusion

Based on the results of this study, it is concluded that open reduction and internal fixation should be the treatment of choice for all tibial plateau fractures with significant displacement which was taken as displacement of more than 4 mm. And that the modalities of treatment used in the treatment of tibial plateau fractures in

RIMS hospital during the study period were well chosen leading to satisfactory functional outcomes. The complication rate was also low and in acceptable range as compared to those reported in the literatures.

Since the same fracture patterns were treated by different modalities as per the choice and expertise of the operating surgeons, thorough analysis of the fracture pattern and choosing the best modality of surgical treatment was of utmost importance. These, followed by a careful open reduction and stable internal fixation were responsible for the excellent functional and radiologic outcomes of the study. The functional scores of the injured knee at 1 year post-operative is believed to adequately predict future knee function for years to come.

The limitation of our study was small sample size in all the groups and absence of long term follow-up. A randomized control trial, preferably triple blinded, involving a large number of patients with long term follow-up is clearly indicated to bring out the best treatment modality for each type of tibial plateau fracture.

Summary

The management of tibial plateau fractures has long been a subject of controversy. The spectrum of treatment ranges from simple casting and bracing, skeletal traction and early motion to open reduction and internal fixation. A brief review of recent literatures reveals that surgeons are exploring many different avenues of treatment for these fractures. Thus, a prospective study was conducted with due approval of the Institution Ethics Committee, RIMS during the period starting from September 2013 to August 2015 in RIMS hospital, Imphal. A total of 30 patients aged between 18 years and 65 years who underwent operative treatment for tibial plateau fractures were included. All the patients were operated under spinal anaesthesia. The anterolateral and posteromedial incisions were used either singly or in combination depending on the type of modality used. Intra-articular alignment were obtained by elevation of depressed articular fragment and fixed with plates and screws. Patients were followed up at regular intervals for 2 years. The results were evaluated using the functional grading of Rasmussen et al. The overall outcome of each surgical method of treatment of tibial plateau fractures in RIMS was also assessed.

The patients were divided into four groups based on the modalities of treatment used during the study. The average age of patients was 38.50 years. 19 patients (63.30%) were in the age group of 31 to 50 years. The Schatzker's type II had maximum occurrence (36.60%) followed by type I fracture (20%). Road traffic accident was the most common mode of injury (73.30%). The mean age of fracture for all the fractures in the present study was 10.75 days.

The operating time for the same fracture patterns differs from surgeons to surgeons. Maximum time was spent while using the LCP with CCS as the modality of treatment. The mean duration of fracture union for CCS group was again least (15.30 weeks) and that of LCP with CCS was maximum (25.4 weeks). 25 patients (83.33%) attained at least 130 degrees ROM while one patient attained less than 110 degrees ROM.

Overall, 21 patients (70%) out of 30 had excellent functional outcome while only one had poor outcome. The CCS group had the best functional outcome followed by the BP group. The Schatzker's type I had 100% excellent outcome, followed by type II with 91% excellent outcome while type VI had the worst outcome. Incidentally, the patient with the poor outcome had co-morbidities in the form of poorly controlled type II diabetes mellitus and osteoporosis. Range of knee movement was better in patients starting mobilization early post-operatively.

In the Stokel and Sadasivan¹¹ study, type II had the best outcome which is in contrast to the present study. In both, type VI has the worst outcome.

Superficial infection occurred in one patient who was a known case of type II Diabetes Mellitus and was resolved with repeated dressing, antibiotics and blood sugar control. Knee stiffness occurred in the same patient. Prominent and painful hardware were reported by 3 patients. They subsided with removal of the implants after consolidation of the fractures.

There was one case of loss of reduction in Type III fractures treated without bone grafting while there was no such case in those where bone grafting was done, further study on the advantages of bone grafting for such fractures is recommended. Bicondylar fractures were treated with BP with CCS or double BP. While the former had the advantage of a single lateral incision and reduced wound complications, the later had the advantage of a more rigid construct. A comparative study is recommended to determine the better modality of the two in the treatment of such fractures.

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