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Therapeutical Management of the Tibial Plateau Fractures

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ABSTRACT
The study was aimed to identify the role of surgical treatment of tibial plateau fractures, its functional outcome and complications. Demographic data for the patients and details of current clinical and radiological follow-up findings were obtained to assess range of motion, clinical stability, alignment of the knee, and posttraumatic arthrosis (Kellgren/Lawrence score). 64 cases of tibial plateau fractures treated by different surgical methods and variuos implants type were studied from 2013 to 2015 and followed-up for minimum period of 6 months. The systematisation of the casuitry was made using Schatzker and AO classifications. The treatment methods consist of: percutaneous cannulated cancellous screws, ORIF with buttress plate with or without bone grafting, locking or nonlocking plates, external fixator. As complications we found: redepression 4 case, malunion 2 cases, knee stiffness 9, wound dehiscence in 1 cases and non-union or infection in none of our cases. The average flexion of the injured knee was significantly lower in comparison with the contralateral side (124.9°/135.2°). Knee stability did not differ statistically significantly. There were no signs of posttraumatic arthrosis in 45% of cases, mild signs in 30%, clear signs in 18%, and severe signs in 7%. As conclusion we found that surgical management of tibial plateau fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, facilitate early motion and reduce arthrosis risk and hence to achieve optimal knee function. The choice of optimal surgical methods, proper approach and implant is made in relation to fracture type according Schatzker and AO classification.

Keywords: tibial plateau, fractures, treatment, surgery, results

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Introduction

The complexity of the accidents in our region have been accompanied by increased number and severity of fractures and those of tibial plateau are no exception. These are articular fractures and the functional outcome are often affected. The study was aimed to identify the role of surgical treatment of tibial plateau fractures, its functional outcome and complications.

The paper try to establish some efficiently principles of therapeutical approach for these king of fractures such that, the current therapeutic moment, not to become just a step to a future knee arthroplasty.

Materials and methods

We have evaluated 64 patients with closed tibial plateau fractures surgically treated between January 2013 and decembre 2015 in the Orthopedic-Traumatology Clinic of Constanta, Romania, and followed-up for at least 9 months. The systematisation of the casuitry was based on AO and Scatzker classification.

Demographic data of the patients were obtained from data sheet recorded at admitance in the hospital. Posteoperatively and at next visits clinical and radiological evaluations recorded range of motion of the knee, stability and clinical axis of operated knee. The radiologic evaluation of the late results was made by appreciation of posttraumatic arthrosis risk using Kellgren/Lawrence score. The functional evaluation of the knee was made using the Lysholm score.

Results

Table I. Demographic profile of the patients

Criterion	No
Mean age (years)	46 (20-67)
Mean evaluation periode (months)	11
Sex (male/female)	39/25
Simple trauma / high energy trauma	19/45
Falling from high level	34
Car accident	21
Other etiology	9
Type 41 B (AO)	36
Type 41 C (AO)	28

Mandatory radiological investigations to establish the diagnosis and the presurgical planning are: two incidence standard X-rays, standard CT exam, tridimensional CT exam and sometimes MRI. In case of standard CT there are useful axial sections which can establish the localisation of the fracture articular depression, coronal and sagital sections can appreciate the degree of articular depression and sagital sections are useful for the posterior fragments. [1,2]

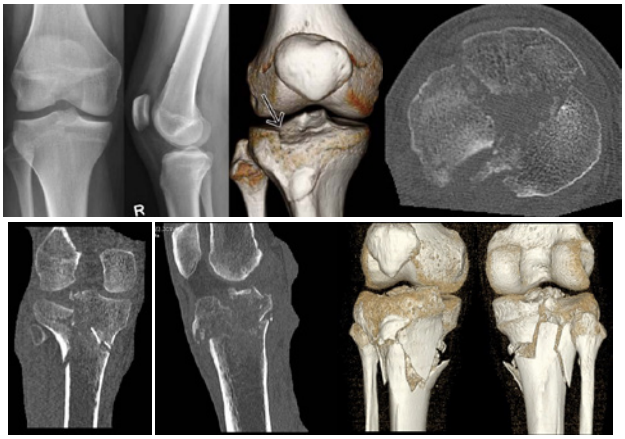


Figure 1 Radiological evaluation for presurgical planning

The statistical evaluation was based on the AO and Schatzker classifications, which are currently the most used for the diagnosis of the tibial plateau fractures. Both are based on the fracture pattern with the degree of the injury and the challenge of the treatment rising with the increasing of the fracture type. It is important to mention that the both clasifications can not describe the degree of fragment displacement, the soft tissue lessions or the local vascular status, important aspects in the case of fractures due to high energy. [3]

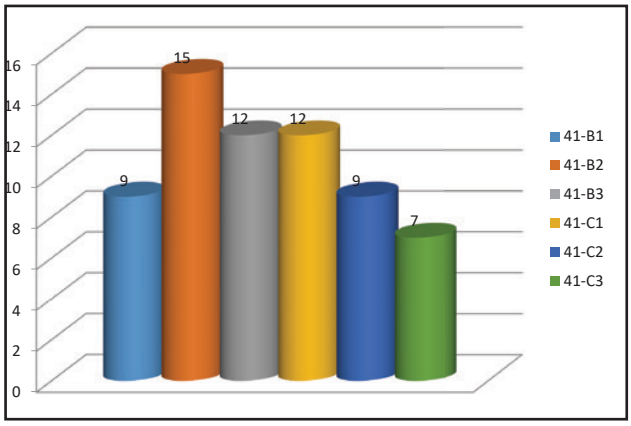


Figure 2 AO Classification

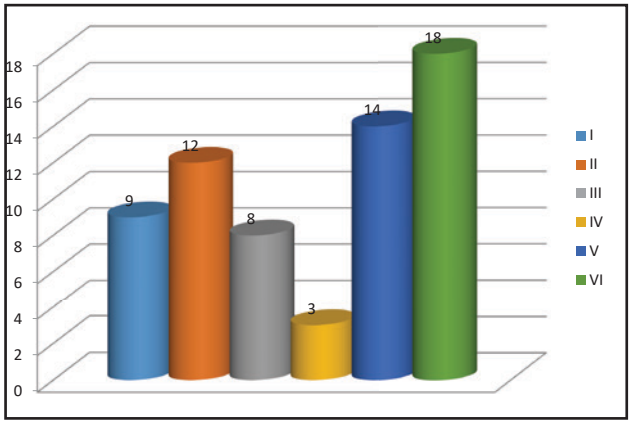


Figure 3 Schatzker classification

Table II. Osteosynthesis methods

Temporary external fixator			6
CRIF*	Cannulated screws		8
ORIF*	1 plate	nonlocking	16
		locking	13
	2 plates	nonlocking	11
		1 nonlocking + 1 locking	10
		locking	6
Bone graft			14

*CRIF – closed reduction internal fixation, ORIF – open reduction internal fixation

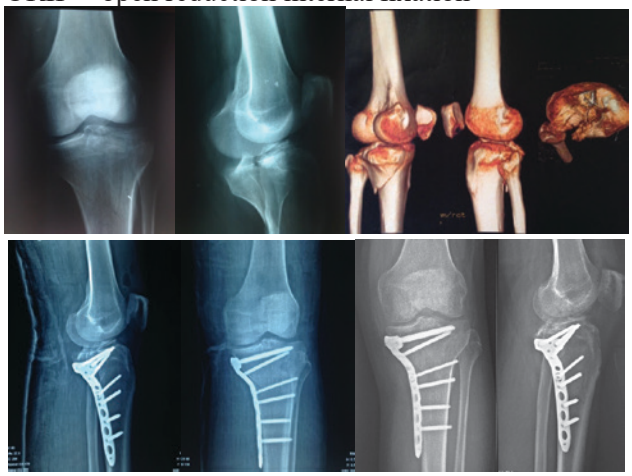


Figure 4 Fracture 41-B1, Schatzker IV, postero-internal fragment, locking plate

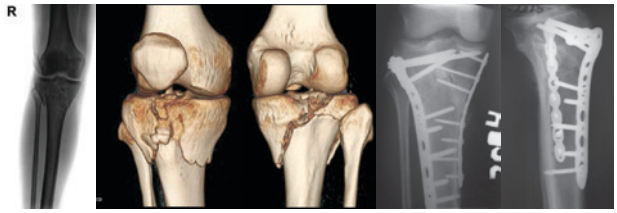


Figure 5 41-C2, Schatzker V – 2 locking plates. Aspect at 6 months. Full weight-bearing.

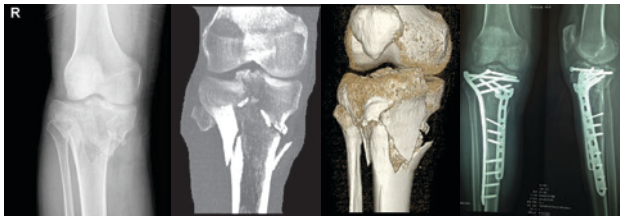


Figure 6 41-C3, Schatzker V, 2 locking plates, aspect at 6 months.

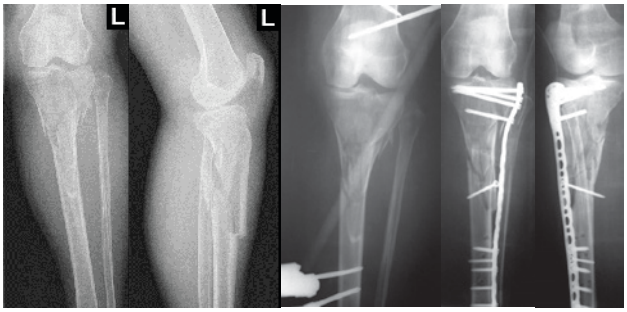


Figure 7 41-C3, Schatzker VI. Staged surgery: external fixation, after 14 days locking plate

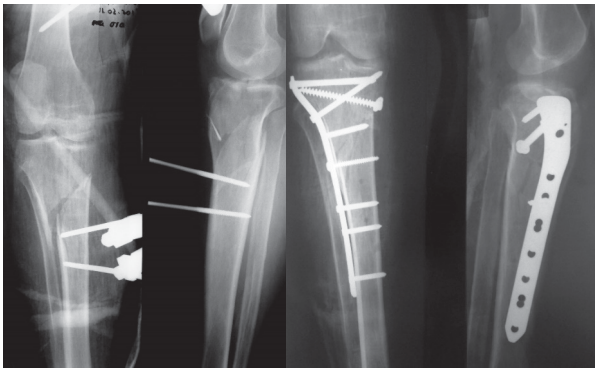
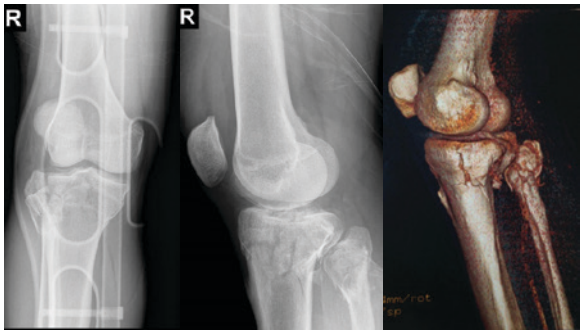


Figure 8 41-C2, Schatzker VI. Staged surgery: external fixation, after 10 days locking plate.



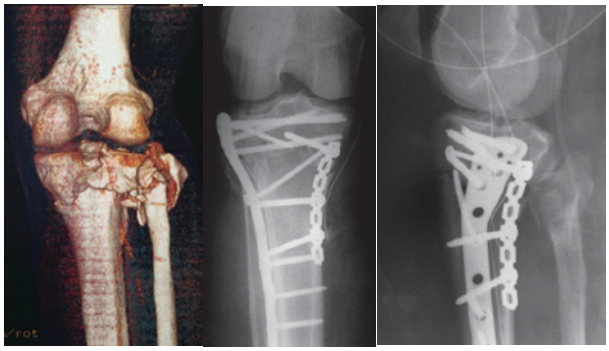


Figure 9 41-C2, Schatzker V –1 locking and 1 nonlocking plate, aspect at 6 months.

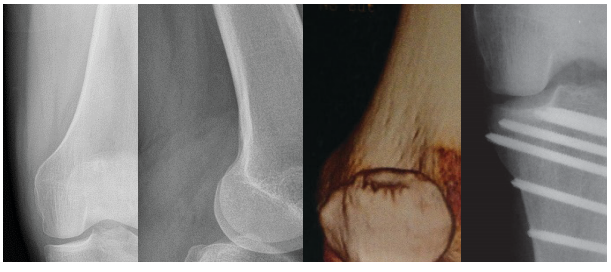


Figure 10 41-B3, Schatzker II. Locking plate and bone graft. Aspect at 1 year.

Postsurgical complications represented 25% of the casuistry and consist of: wound dehiscence - 1, secondary depression - 4, vicious consolidation - 2, knee stiffness – 9 cazuri. MRI made after 1 year showed meniscal lessions as follows: lateral meniscus lesion 53% of casuistry, medial meniscus lesion 19%, anterior cruciate ligament lesion 21%.

The presence of arthrosis after 1 year postoperatory was radiologically evaluated using Kelgren/Lawrence score.

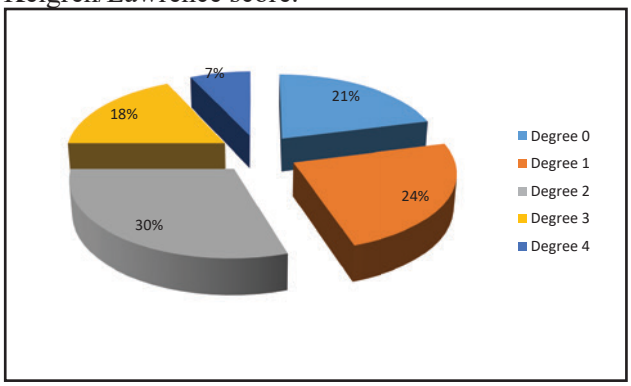


Figure 11 Kellgren/Lawrence score

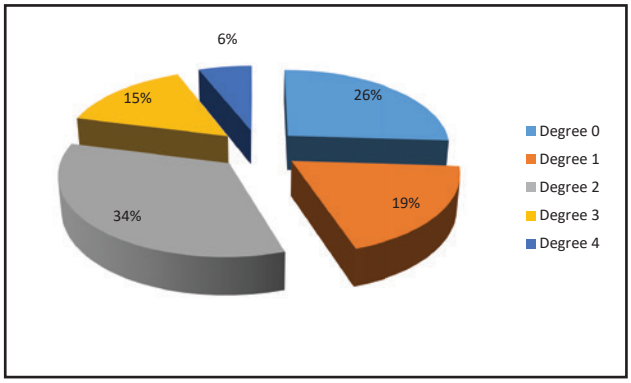


Figure 12 Kellgren/Lawrence 41-B

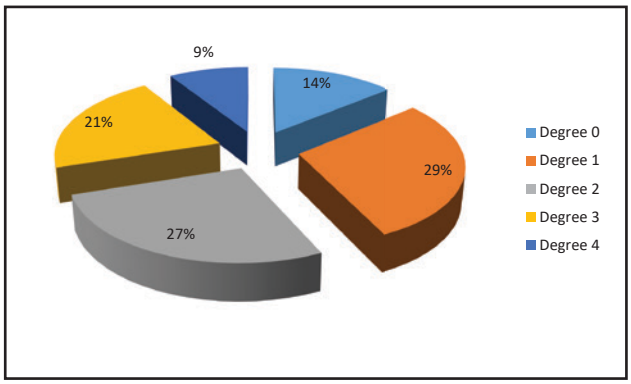


Figure 13 Kellgren/Lawrence 41-C

Another important aspect was represented by the functional evaluation of the knee at 1 year postoperatively based on Lysholm score.

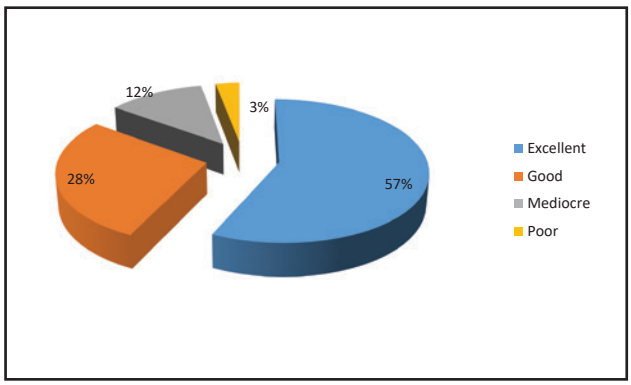


Figure 14 Lysholm score

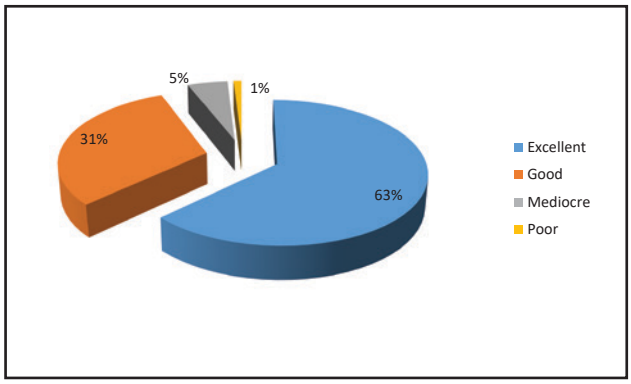


Figure 15 Lysholm 41-B

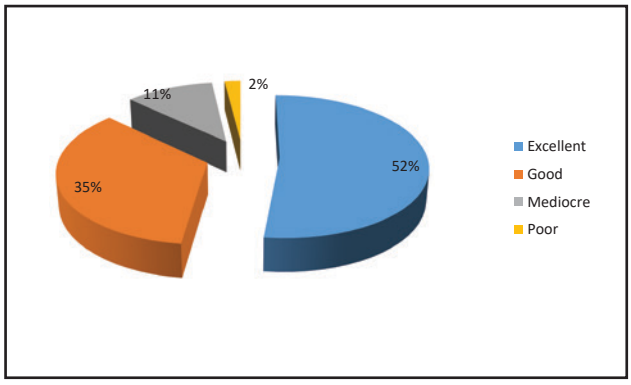


Figure 16 Lysholm 41-C

Discussion

The objectives of the treatment are tipically for any articular fractures and aim to avoid posttraumatic arthrosis: anathomic reduction, strong stability and remake of articular function. The principles of therapeutic approach are the classical AO principles: anathomic reduction, stable internal fixation, prezervation of vasularisation and early mobilisation of the ankle joint.

Presurgical planning is mandatory and is based on standard X-rays in two incidences, and especially on plane CT and tridimensional CT scan. CT scan is also mandatory in case of the tibial plateau fractures because it brings useful elements for the diagnosis which can be missed on usually radiological investigations. Single radiographs do not allow an exact fragment identification and the initial fracture classification can change in 5% to 24% (mean 12%) of cases and treatment can change in up to 25% of cases after CT scan imaging. MRI exam made after 1 year postoperatively showed an important number of meniscal lessions associated which make obvious his utility, although the costs are high and many hospital are not in posession of MRI [2,3].

Essential aspects which must be taken in consideration for presurgical planning are:

Evaluation of articular depression: approach by submeniscal arthrotomy and reduction is verified in frontal and sagital plan.

Remake of correct widening of the plateau: anathomic raport to the condyles, good reduction is obtained by butress effect realised through locking plates. Lack of reduction will lead to secondary meniscal lessions.

Fixation of the articular fragments – metaphyseal fixation by plates which have the role of remaking of the lateral and medial columnes (when is necessary).

Articular support – the filling of the metaphiseal deffect by using cacellous bone graft harvested from iliac crest (14 cases).

Evaluation of the meniscal lessions – reinsertion when is necessary.

In case of the Schatzker V-VI or 41-C fractures we must take in account that there were produced by high energy trauma and imposed active monitorising of the soft tissue evolution, compartmental pressure monitorising and possible vascular lessions. Sof tissue damages in fractures around the knee is of critical importance, especially in high-energy injuries. The use of a staged approach using external fixator is recommended in such cases [4].

The most important question which must be put is – when is the optimal surgical moment? The waiting periode of time in that cases is between 7 and 12 days. The ability to controle the soft tissue evolution is the most important aspect of the therapy.

"Damage control" is a popular concept for the treatment of tibial plateau fractures and that means the use of an external fixator to realise temporary stability for the patients with local soft tissue problems for a beter soft tissue management. That therapeutical approach have leaded to a very low rate of soft tissue related complications. The provisional external fixator (proximal femoral metaphyseal, distal in tibial dyaphisis) ensure: bone and soft tissue stabilisation, controlls the length, axis and rotation of the fragments, ensure indirect reduction by ligamentotaxis. The indication of the external fixation are: fracture instability on plaster cast, risk of compartmental syndrome or soft tissue lessions (contusion, haematoma, abrasions, phlyctenas). The positions of the fixator pins must anticipate the future surgical approaches and the lengths of the implants which will be used for osteosynthesis. Knee-spanning external fixators can be used to reduce the fracture fragments by the process of ligamentotaxis. It is imposed a radiological evaluation after the applying of the fixator as important surgical step as presurgical therapeutic planning [5].

The surgical approaches for the fracture sites depends on the fracture pattern and soft tissue quality. The approaches we used were classical: anterolateral, posteromedial and combined. When it was needed we used a posterior approach, allthough is difficult to be made, but ensure anathomic reduction and strong stabilisation of the strictly posterior fragments (coronal fragment). In case of fractures without displacement it was used a minimal invasive approach which preserve local vascularisation [6].

Adequate stabilisation of the posterolateral or posteromedial fragments cannot be normally approached through traditional anterolateral and medial approaches. In some cases with slight displacement, the posteromedial fragment can be big enough to be reduced percutaneously and fixed from anterior to posterior, and the posterolateral depression can be elevated through a metaphyseal window on the anterolateral aspect of the tibial.

The use of laterally applied locking plates does not eliminate the need for the second posteromedial approach to reduce and stabilize displaced medial plateau fractures. For the lateral plateau we used especially locking plates and for medial plateau fractures we preffered non-locking plates for a better butress efect on fracture displacement [7].

Postoperative care is an important aspect of the treatment and consist of: carefully monitorising of the soft tissues, 24 hours dreinage, early mobilisation of the knee, plaster cast only in cases on not very stable osteosynthesis for maximum 6 weeks, full extension of the knee is very important, partial weight-bearing was made after 6-8 weeks, full weight-bearing after 12 weeks or after radiological consolidation signs (bridge callus or absence of fracture line in two incidences).

As late complications we noticed 2 cases of vicious consolidation and only 9 cases of knee stiffness. Mean flexion of the knee was significantly lower comparative with the normal knee (124.9° vs. 135.2°), but knee stability was same. Arthrosis after 1 year was well functional tolerated, but it must be followed-up for a longer period of time for a better evaluation.

25% of our casuistry presented serious arthrosis that meaning a Kellgree/Lawrence score of 4 or 5 degree. 21% of 41-B fractures according AO classification had serious arthrosis and 30% of 41-C fractures had serious arthosis, a higher rate for 41-C due to their important comminution and displacement. Knne function after one year was evaluated using Lysholm functional score which revealed 15% of bad results from the casuistry. The functional results of the knee were better for 41-B fractures than 41-C fractures. The severity of an injury to the tibial plateau is associated with the functional outcome. A good articular reduction with use of of the described

surgical procedures positively affects patient outcome. There is a direct association between the adequacy of the articular reduction and the severity of the injury, allthough patients with more severe injuries can still receive a satisfactory functional recovery.

Conclusions

The choice of the optimal surgical technique, proper implant and right type of surgical approach are made personalised in relation with the fracture pattern acording to Schatzker and AO classifications. Tridimensional CT scan is essential for a good understanding of the fracture and for the presurgical therapeutical planning. Evaluation of meniscal and ligamentous lessions by using the MRI should be mandatory.

Double surgical approach should be made always for the bicondyllar fractures, with the remaking of the medial column first. More stable fixation will ensure beter results. Minimal invasive technique should be applied as much as possible is.

Soft tissue management is on the first place, as part of damage control surgery. Traction on the knee intraoperatively, through different methods, is essential for the reduction of the fragments. The butress effect is superior in case of the osteosynthesis with nonlocking plates, with comparable stability with the locking plates. The anathomic reduction of the articular surface is the key objective to prevent later arthrosis. The submeniscal arthrotomy to view the reduction is mandatory. The bone graft is always necessary in case of the fracture with articular depressure.

The main objective of the treatment is early mobilisation, but full weight-bearing is lately permited, when there is radiological evidence of callus formation. There isn't important differences regarding arthrosis risk between fractures type B or C. Arthrosis is generally well tolerated clinically in case of the tibial plateau fractures.

References

1. Humphrey, C., Dirschl, D. & Ellis, T. (2005). Interobserver reliability of a CT-based fracture classification system. *J Orthop Trauma.* 19, 616–622
2. Chan, P.S., Klimkiewicz, J.J., Luchetti, W.T., Esterhai, J.L., Kneeland, J.B., Dalinka, M.K. & Heppenstall, R.B. (1997). Impact of CT scan on treatment plan and fracture classification of tibial plateau fractures. *J Orthop Trauma, 11*(7), 484-489.
3. Schatzker, J., McBroom, R. & Bruce, D. (1979). The tibial plateau fracture. The Toronto experience 1968--1975. *Clin Orthop Relat Res*(138), 94-104.
4. Narayan, B., Harris, C. & Nayagam, S. (2006). Treatment of high energy tibial fractures, *Strat Traum Limb Recon*. 1,18-28.
5. Weigel, D.P. & Marsh, J.L. (2002). High-energy fractures of the tibial plateau. Knee function after longer follow-up. *J Bone Joint Surg Am, 84-A*(9), 1541-1551.
6. Westmoreland, G.L., McLaurin, T.M. & Hutton, W.C. (2002). Screw pullout strength: a biomechanical comparison of large-fragment and small-fragment fixation in the tibial plateau. *J Orthop Trauma, 16*(3), 178-181
7. Barei, D.P., Nork, S.E., Mills, W.J., Coles, C.P., Henley, M.B. & Benirschke, S.K. (2006). Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. *J Bone Joint Surg Am, 88*(8), 1713-1721. doi: 10.2106/jbjs.e.00907