Case Based Discussions: Tibial Plateau Fractures

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Objectives

Tibial plateau fractures

Anatomy

Classification

Surgical approaches

Fixation techniques

Case Based Discussions

Cover the above

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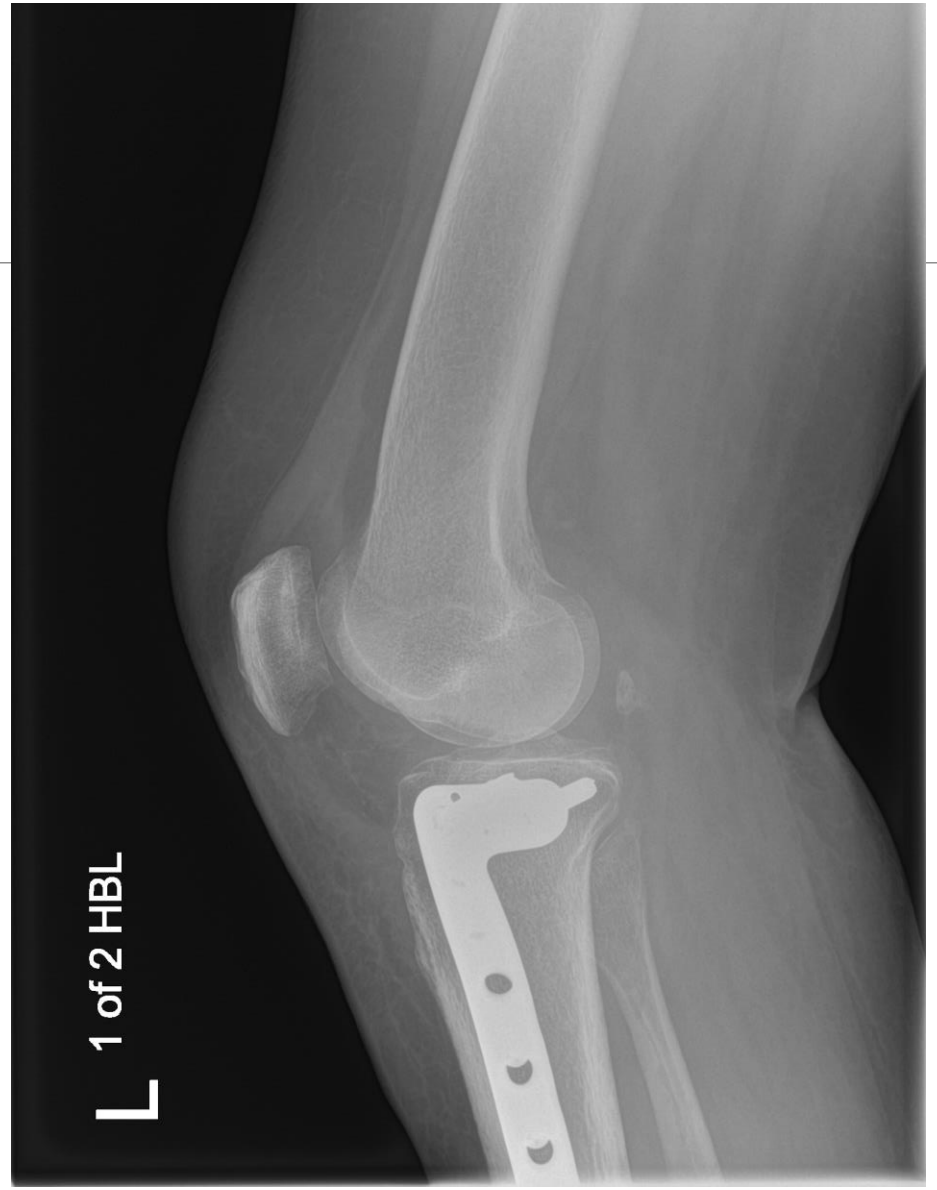
Question

What is ‘normal’ tibial plateau anatomy?



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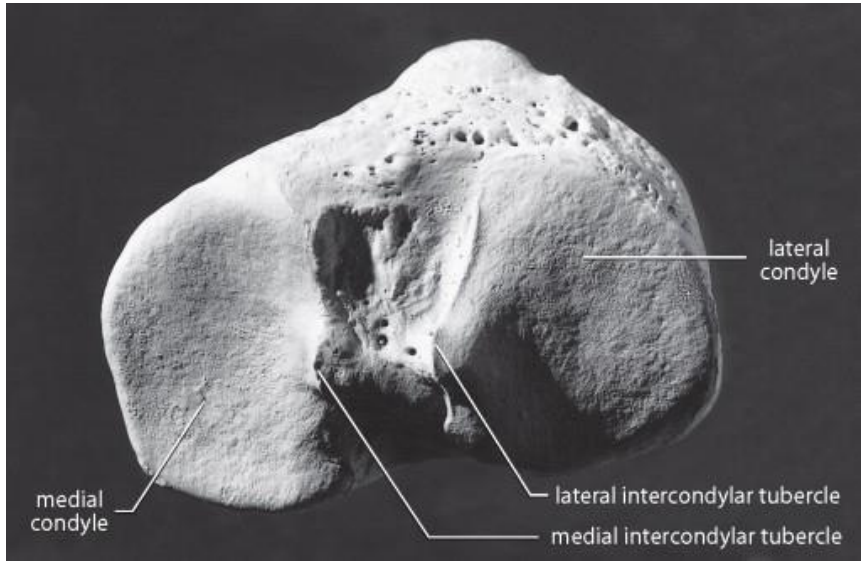
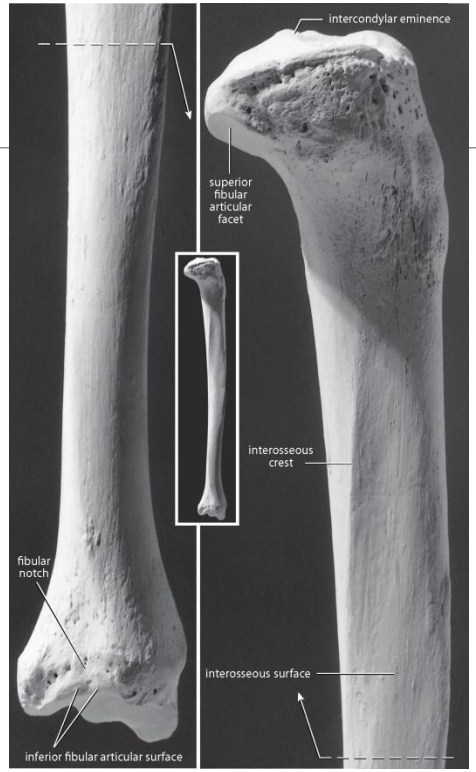
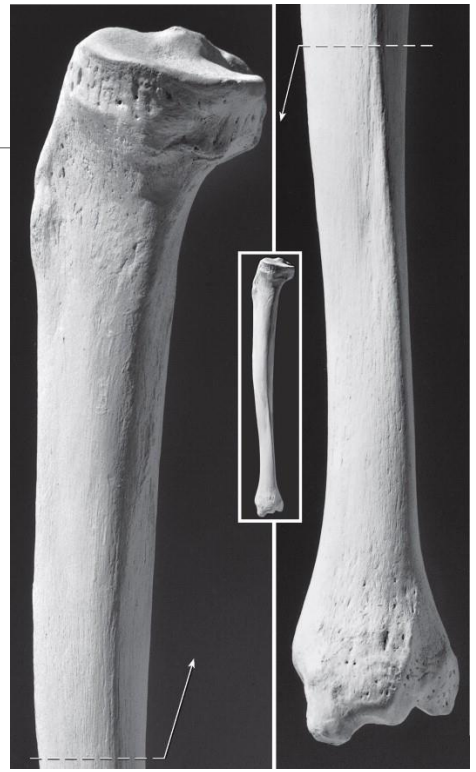
Anatomy







Two columns, each supporting corresponding femoral condyle:

Medial – concave; denser in terms of bone trabeculae; bears 60% of weight through knee

Schatzker J. Compression in the surgical treatment of fractures of the tibia. Clin Orthop 1974; 105:220-39

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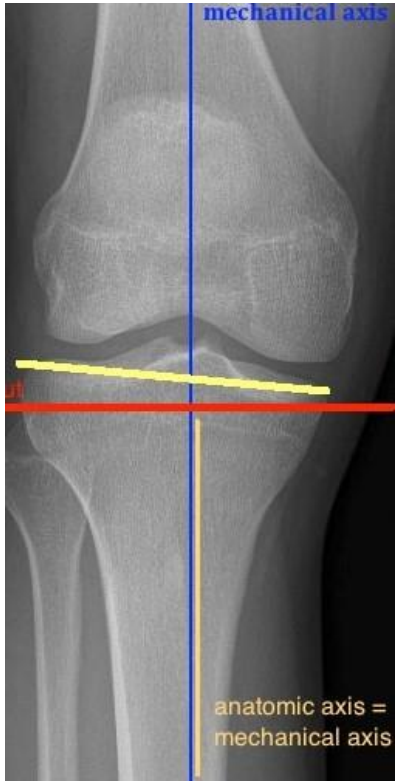
Anatomy



Articular surface of lateral plateau more proximal relative to medial plateau

Tibial articular width wider than femoral articular width

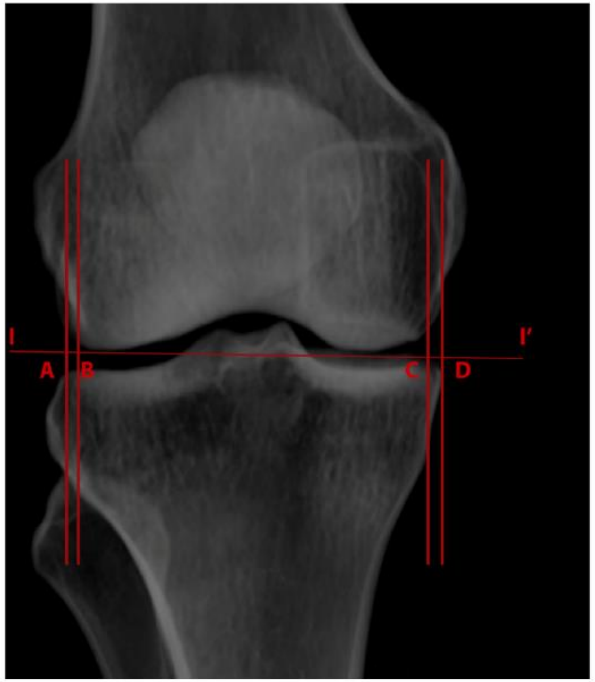


Fig. 3 Knee measurements. A–B, horizontal distance between lateral femoral articular edge and lateral tibial articular edge (dLA); C–D, horizontal distance between medial femoral articular edge to medial tibial articular edge (dMA); I–I', distal femoral joint line

Thamyongkit S, Fayad LM, Jones LC, Hasenboehler EA, Sirisreetreerux N, Shafiq B. The distal femur is a reliable guide for tibial plateau fracture reduction: a study of measurements on 3D CT scans in 84 healthy knees. J Orthop Surg Res. 2018;13(1):224

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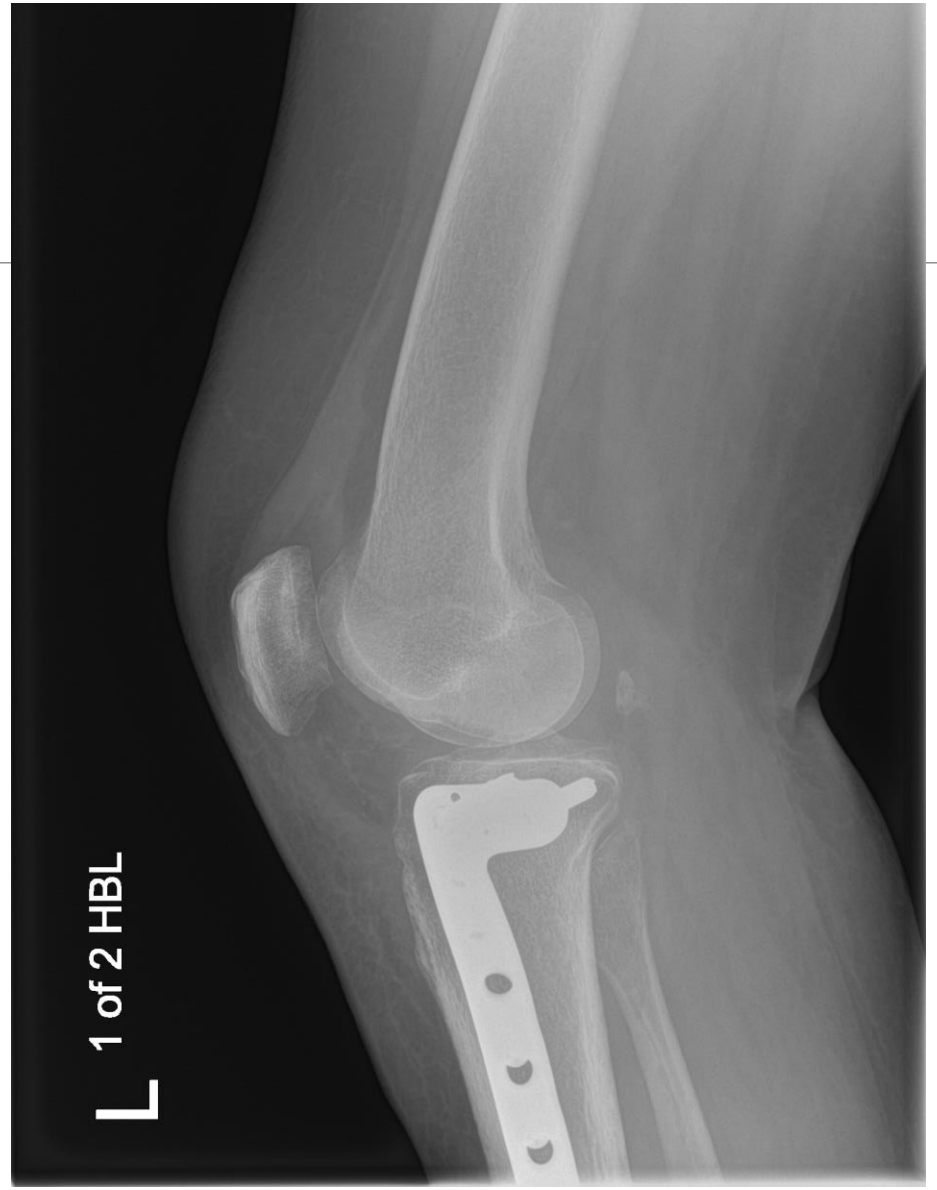

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Question

Who gets tibial plateau fractures?

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Epidemiology

Changing patient at risk age

Tibial plateau – 0.9% of fractures; 1.2/10 000/year

Commoner in Females (58.5% v 41.5%)

Bi-model age distribution Median age 59 years

- Males 37 years; secondary to high energy mechanisms
- Females 73 years; secondary to falls

Wood AM, Aitken SA, Hipps D, Heil K, Court-Brown C. The Epidemiology and changing face of tibial plateau fractures and other intra-articular proximal tibial fractures: The Edinburgh Experience. Orthopaedic Proceedings, Vol 97-B. No Suppl 8. Feb 2018.

Elsoe R, Larsen P, Nielsen NP, Swenne J, Rasmussen S, Ostgaard SE. Population-based epidemiology of tibial plateau fractures. Orthopedics. 2015; 38(9):e780-6.

Case 1

Classification

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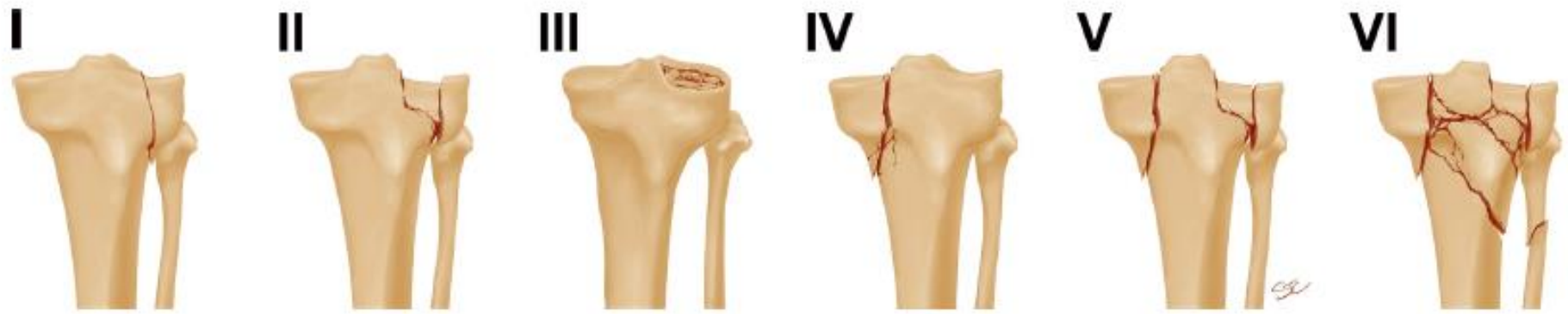
Classification



Type I – split wedge of lateral tibial plateau

Type II – split wedge depression of lateral tibial plateau

Type III – pure depression of lateral tibial plateau

Type IV – split wedge of medial tibial plateau

Type VI – bicondylar tibial plateau fracture

Two-dimensional representation of fracture.
Based on:

- Age of patient
- Bone quality
- Morphologic architecture of fracture
- Energy of trauma

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Case 1

Management?

Investigations?

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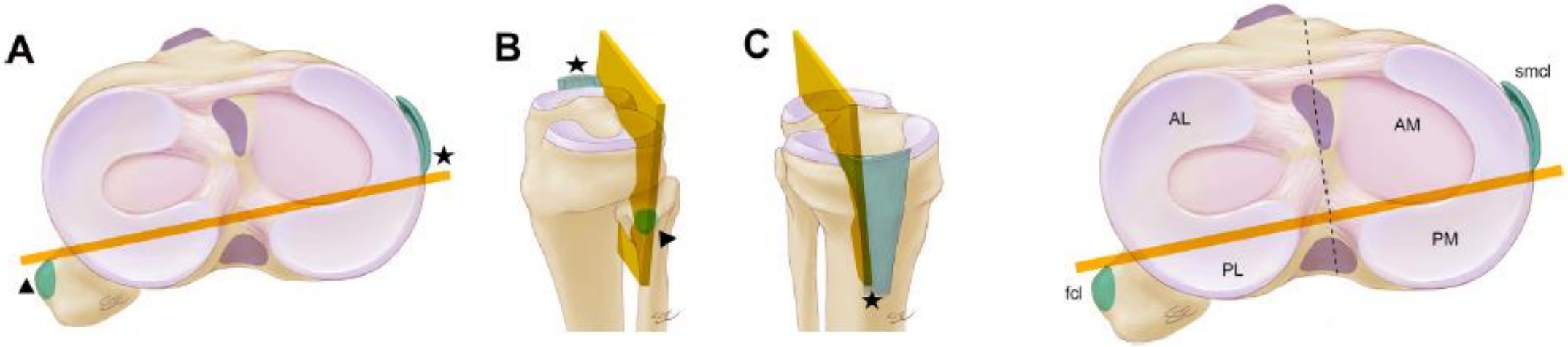
Question

Do you know of any modifications to the Schatzker's classification?

Classification



The ‘Virtual equator’:

▲ Fibular collateral ligament – lateral tubercle of the fibular

★ Superficial medial collateral ligament – posterior margin of attachment

Note:
Landmarks reproducible with CT/MRI
Posterior half smaller

Kfuri M and Schatzker J. Revisiting the Schatzker classification of tibial plateau fractures. Injury. 2018;49:2252-63.

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Classification

Schatzker		Modified
I	Unicondylar	A; P
II	Unicondylar	A; P
III	Unicondylar	A; P
IV	Unicondylar	A; P
V	Bicondylar	AM; AL; PM; PL
VI	Bicondylar	AM; AL; PM; PL

e.g. Type I A; Type III A + P; Type V AL + PM

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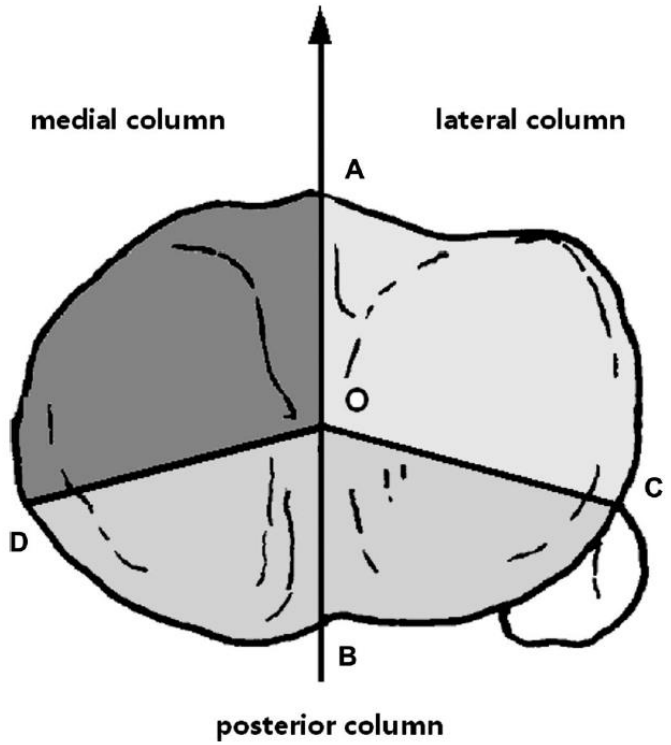
Principle of ‘three-column fixation’



Fracture Patterns:

- Zero column
- One column
- Two columns
- Three-columns

Fracture in column considered when cortical split is present (e.g. pure depression not counted)

Meeting point is the middle of the two tibial spines

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Case 1

Columns?

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Case 1

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Question

How would you assess this patient clinically?

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Case 2

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Clinical Assessment

History – mechanism; relevant co-morbidities; EtOH; Smoker

Examination – soft tissues (e.g. swelling, contusion, blisters, open fracture); associated fractures; associated soft tissue injuries; neurovascular assessment

Investigations

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Case 2

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Case 2

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Question

Would you expect this injury to be associated with a vascular injury?

Vascular Injury

- n=178 in 2014; 4 (2%) vascular injuries
- Schatzker II, IV and VI (2)
- 3 required revasculisation and 1 managed non-operatively

‘When it (vascular injury) occurs, it is apparent (Rutherford IIb ischaemia). A detailed physical examination can likely identify clinically significant vascular injury…..’

- ABI <0.9 indicative of potential vascular compromise
- CT angiogram/vascular referral

Desikan SK, Swenson A, Hemingway J, Singh N, Tran N, Quiroga E. Incidence and outcome of vascular injury in the setting of tibial plateu fractures: a single-center review. 2017 Western Vascular Society Annual Meeting.
Halvorson J, Anz, A, Langfitt M, Deonanan JK, Scott A, Teasdall RD, Carroll EA. Vascular injury associated with extremity trauma: initial diagnosis and management. J Am Acad Orthop urg. 2011; 19(8):495-504.

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How would you classify this fracture?

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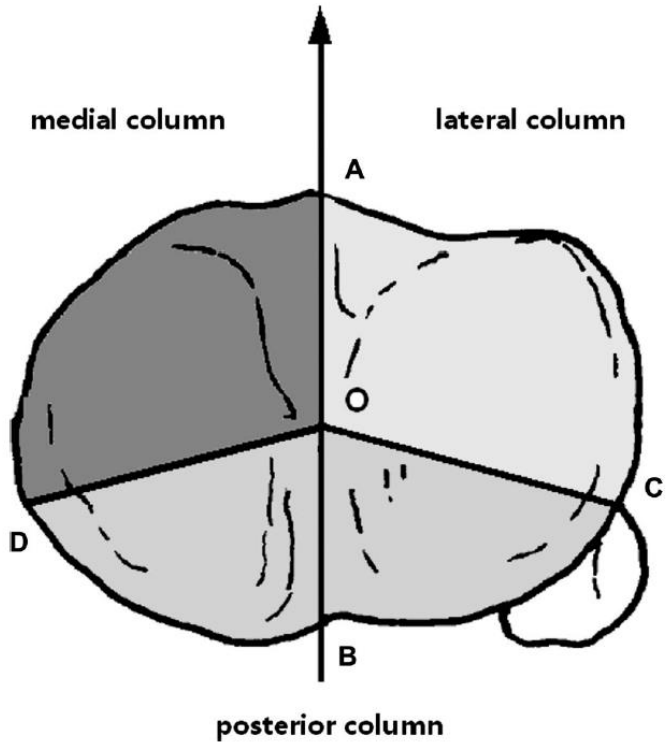

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Question

What are the principles of surgical fixation in this case?

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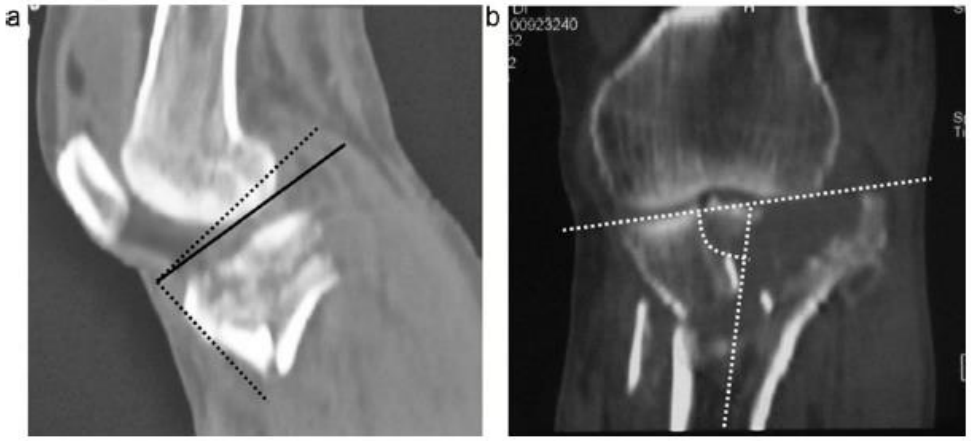
‘Updated three-column fixation’



Residual deformity on present on imaging is result of injury mechanism:

1. Position of knee at time of injury (Flexion/Extension) measured by posterior tibial slope angle (pTSA) – decrease = extension
2. Direction of deforming force (Varus/Valgus) measured by medial tibial plateau angle (mTPA) – decrease = varus

Wang Y, Luo C, Zhu Y, Zhan Y, Qiu W, Xu Y. Updated Three-Column Concept in surgical treatment for tibial plateau fractures – a prospective cohort study of 287 patients. Injury. 2016;47(7):1488-96.

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‘Updated three-column fixation’

The application of “updated Three-Column Concept” in surgical treatment for tibial plateau fractures (injury mechanism, approach and main implant).

Type		Injury mechanism		N.	Approach	(Main) buttress plate
		Knee position	Possible force			
One-Column Fx	L	Extension	Valgus	47	Lateral	L
	M	Extension	Varus	13	Medial	M
	P	Flexion	Valgus	12	Reversed L	PL
			Varus	5	Posteromedial	PM
Two-Column Fx	L+P	Flexion	Valgus	48	Lateral (+reversed L)	L
		Extension			Lateral	L
	M+P	Flexion	Varus	56	Reversed L	PM
		Extension			Medial	M
	L+M	Extension	Valgus	16	Lateral	L
			Varus		Medial	M
Three-Column Fx		Extension	Valgus	13	Lateral + posteromedial	L
		Extension	Varus	19		M
		Flexion	Valgus	22	Lateral + posteromedial (or reversed L)	L
		Flexion	Varus	28		PM

N., number; Fx, fracture; M, medial; L, lateral; P, posterior; PM, posteromedial; PL, posterolateral; Reversed L, reversed L-shaped.

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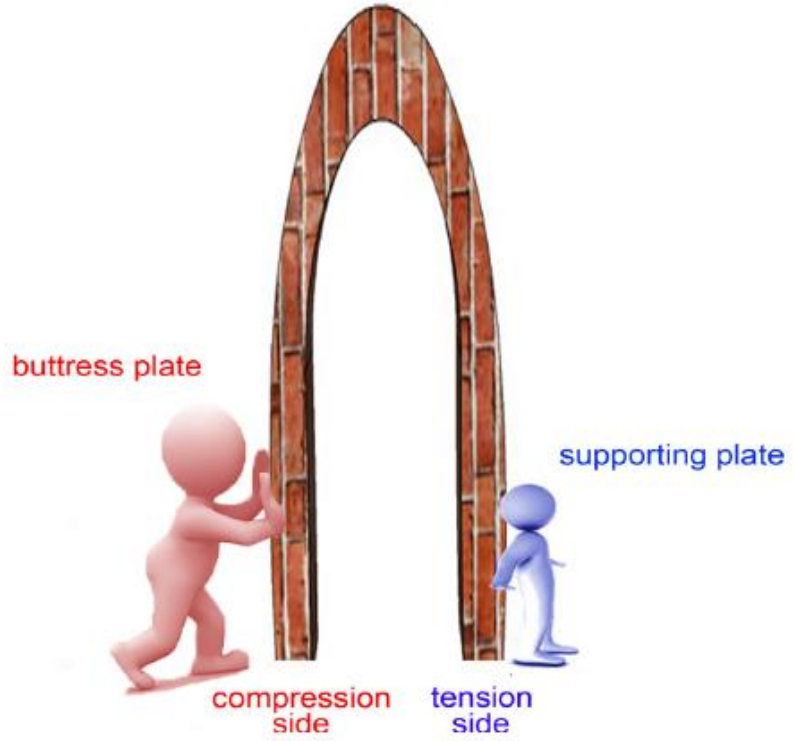
‘Updated three-column fixation’



1. Primary plating with main buttress function on compression side of fracture
2. Secondary plating with supporting function on tension side if comminuted or unstable

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Question

Based on the ‘updated three-column fixation’ principle, where would you place your fixation?

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Case 2

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Case 2

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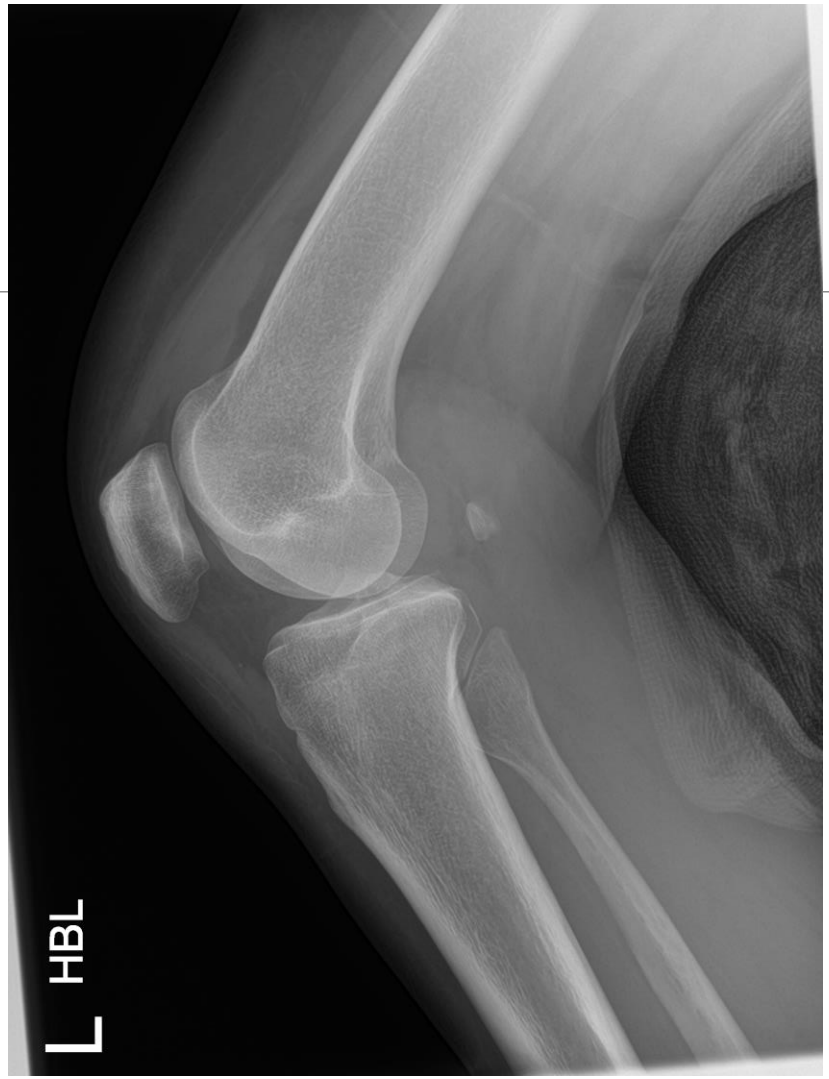
Case 3



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Question

How would you classify this fracture?

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Question

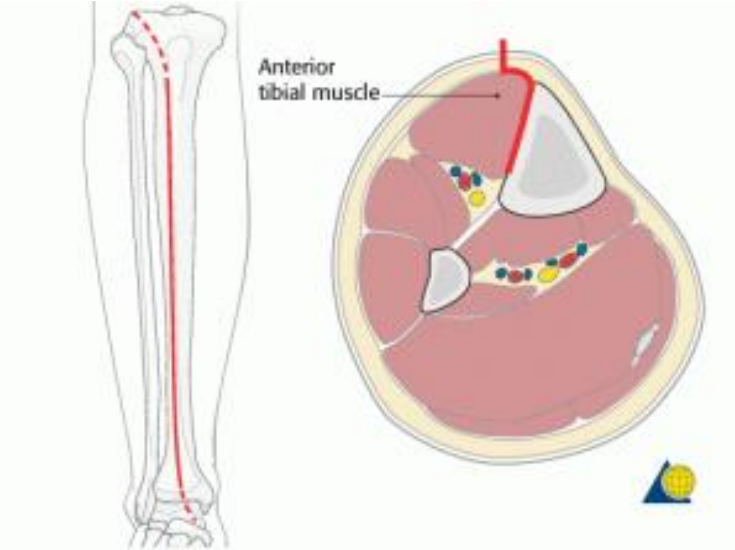
What are the surgical approaches you would consider?

Surgical Approaches

Antero-lateral:

Lazy ‘S’ incision

Linear (para-midline) incision



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Question

Benefits of a midline v lateral incision?

Post-traumatic arthritis

n=888 between 1995 and 2008

25 undergone TKR (2.8%)

Risk factors – increasing age, split depression fracture, female

Although tibial plateau fractures are commonly associated with degenerative radiographic changes, the incidence of symptomatic OA severe enough to require TKR is low.

n=314 between 1987 and 1994, ten-year FU

4 undergone TKR (1.3%)

Davidson E, Oliver W, White T, Keating J. Tibial plateau fractures: when will I need a knee replacement? Orthopaedic Proceedings, Vol 96-B, No Suppl 3.
Mehin R, O'Brien P, Brasher P,Broekhuyse HM, Blachut P, Meek RN, Guy P. Endstage arthritis following tibia plateau fractures: 10 year follo up. Orthopaedic Proceedings, Vol.93-B, No Suppl 3.

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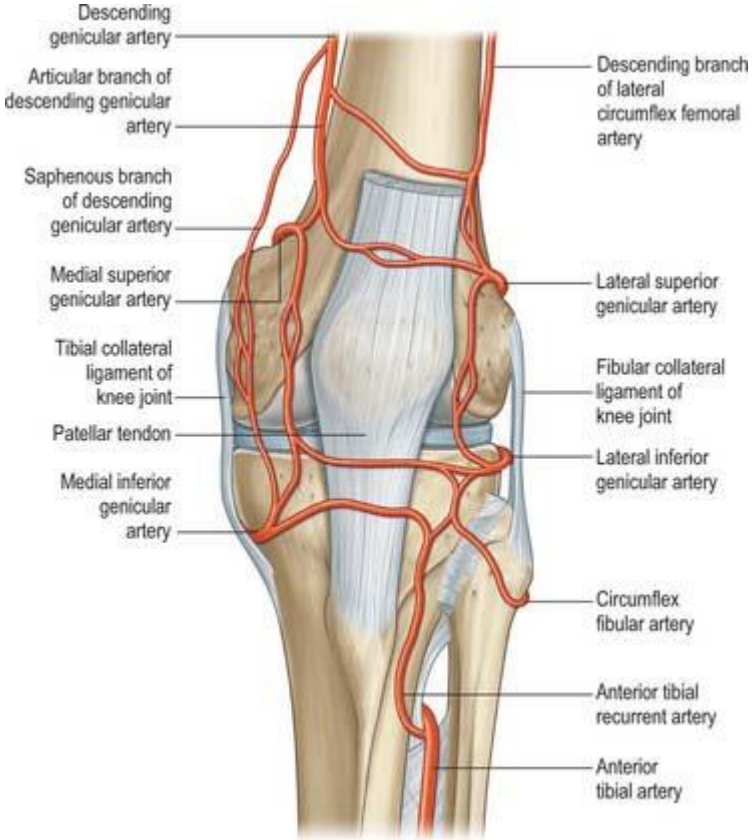
Knee - Vascular supply



No muscle or intermuscular septum to provide direct arterial perforating vessels to the skin

Majority of supply arises from medial side via the saphenous branch of the descending genicular artery

- Incorporate old scar if possible, if not, use lateral most scar
- Minimum skin bridge of 2.5cm

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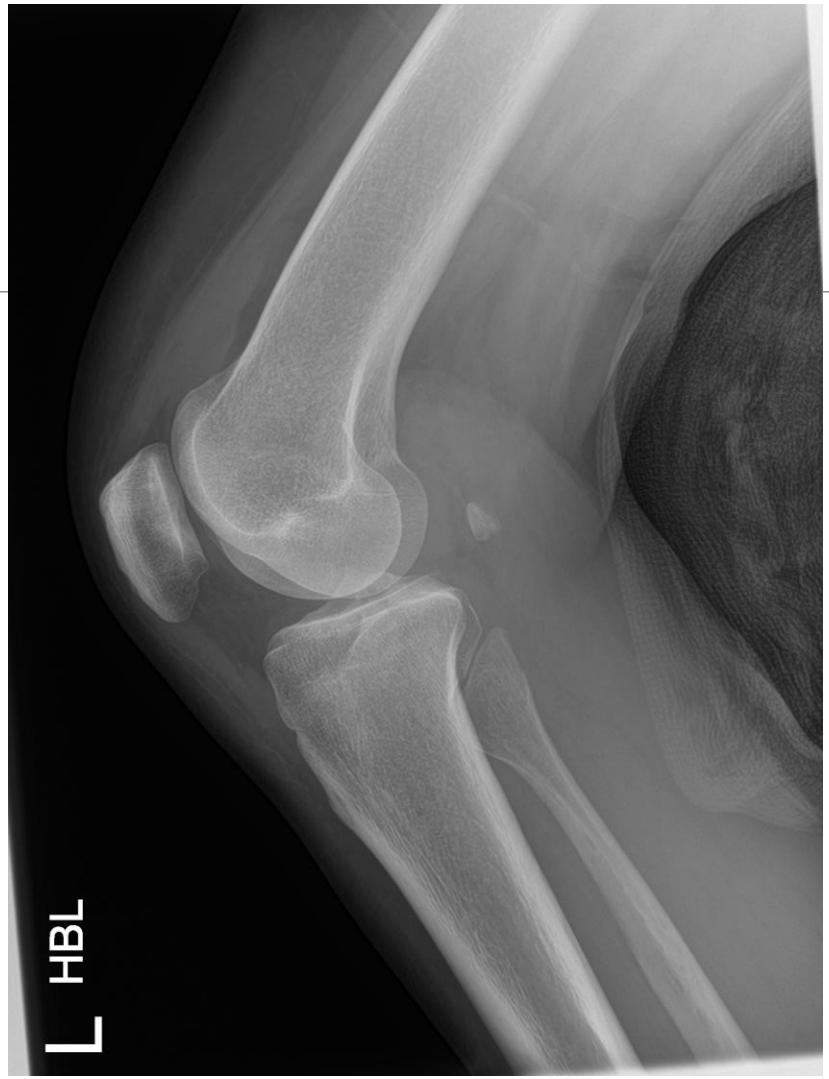
Case 3



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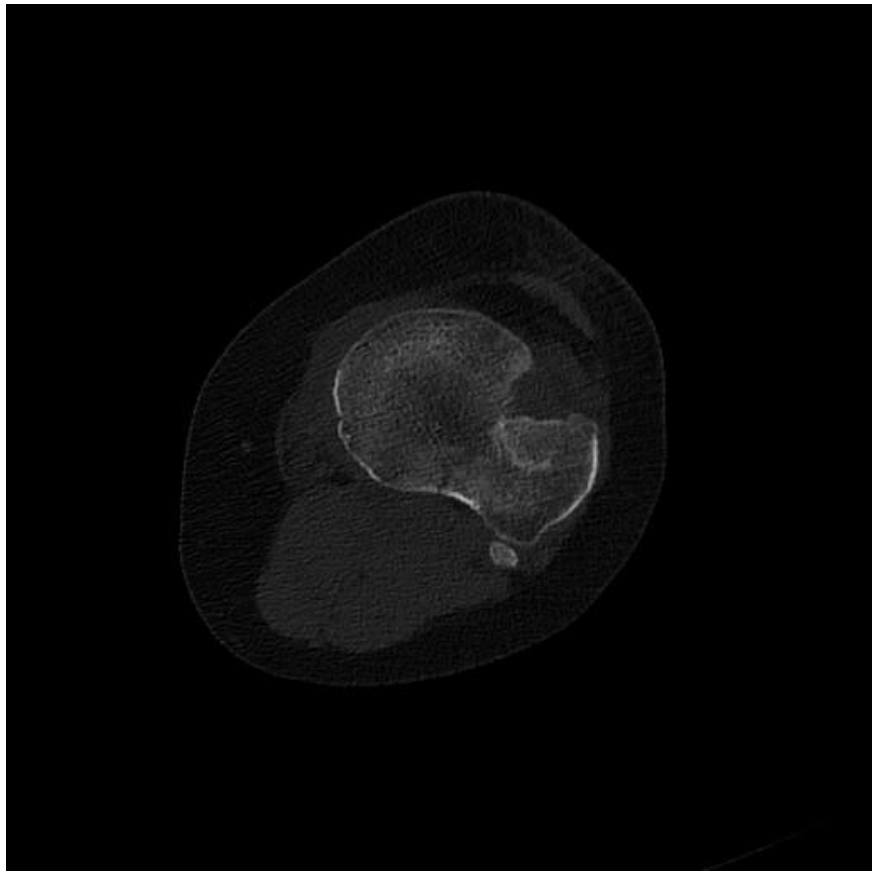
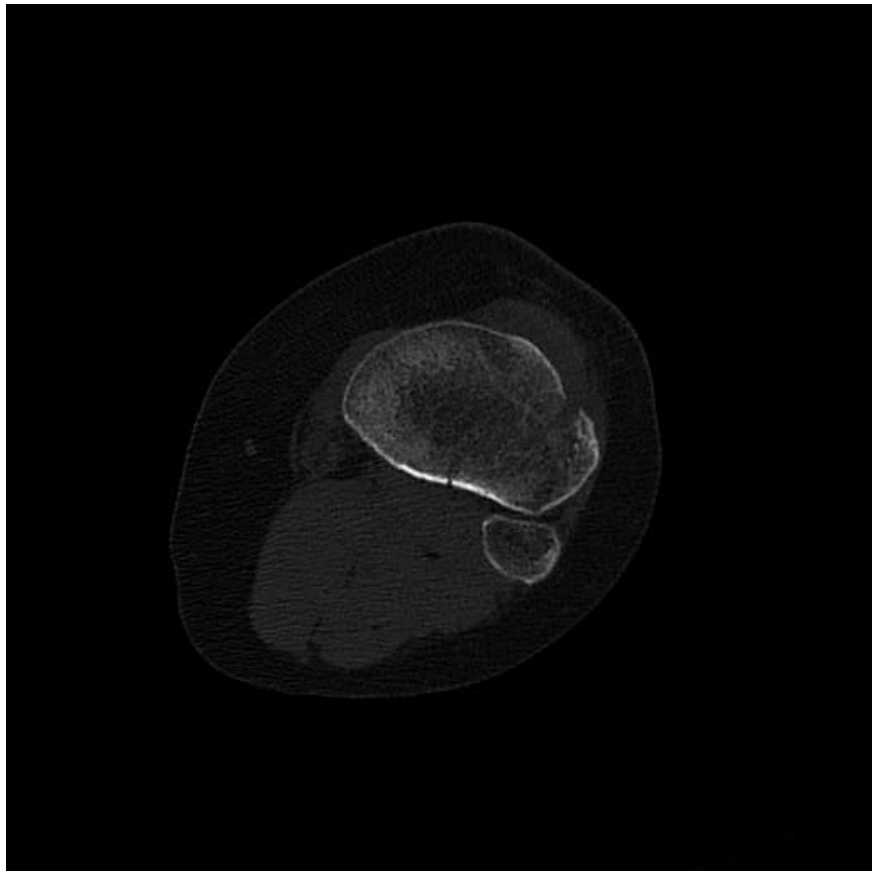
Case 3





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Case 3

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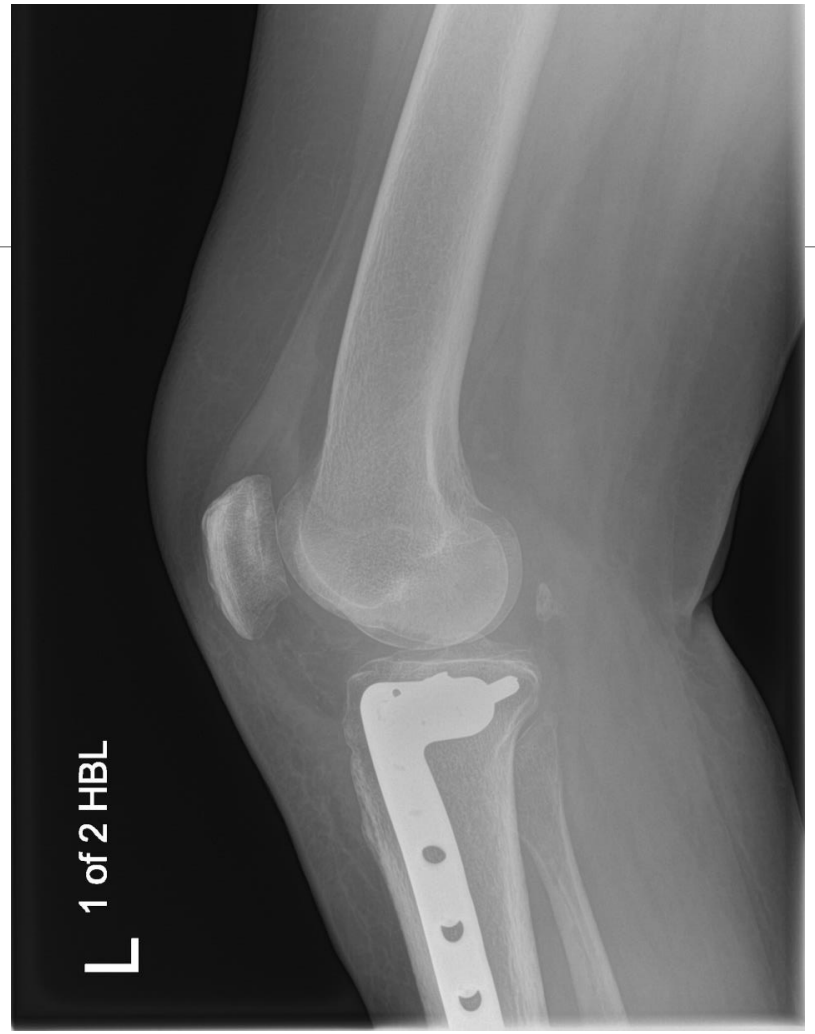

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Case 4

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Question

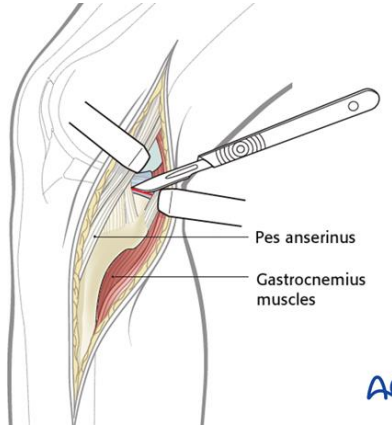
What are the surgical approaches you would consider?

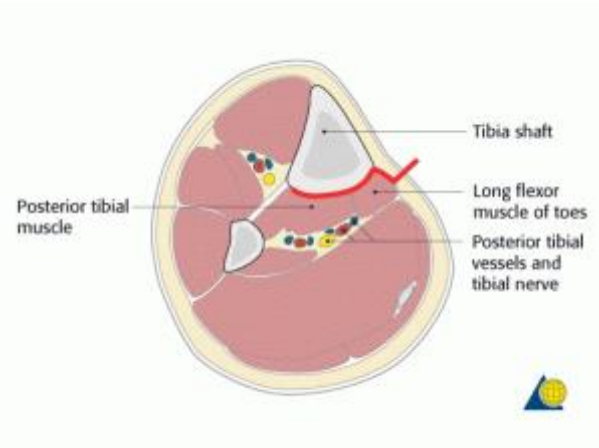
Surgical Approaches

Medial:

Lazy ‘S’ incision

Linear (para-midline)





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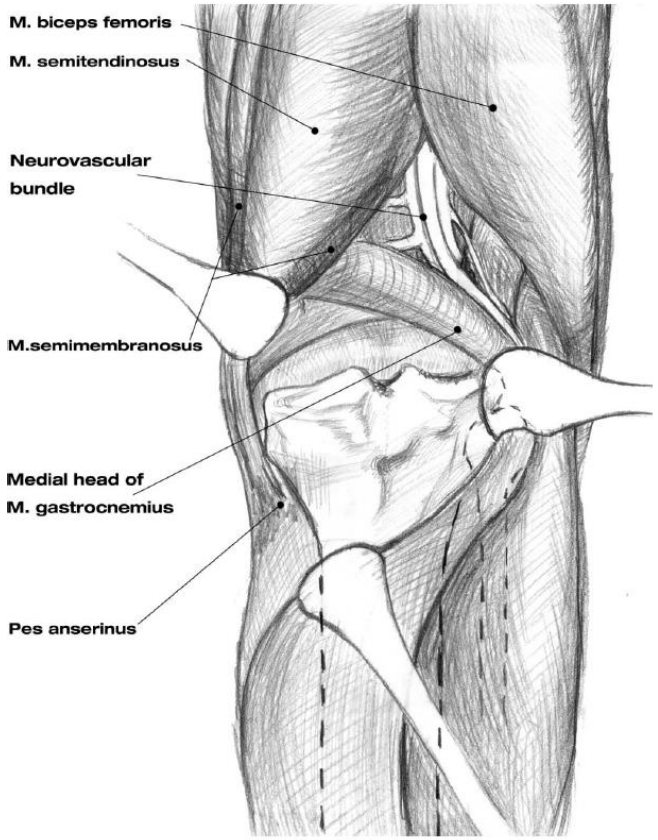
Surgical Approaches

Postero-medial:

Inverted L shaped incision



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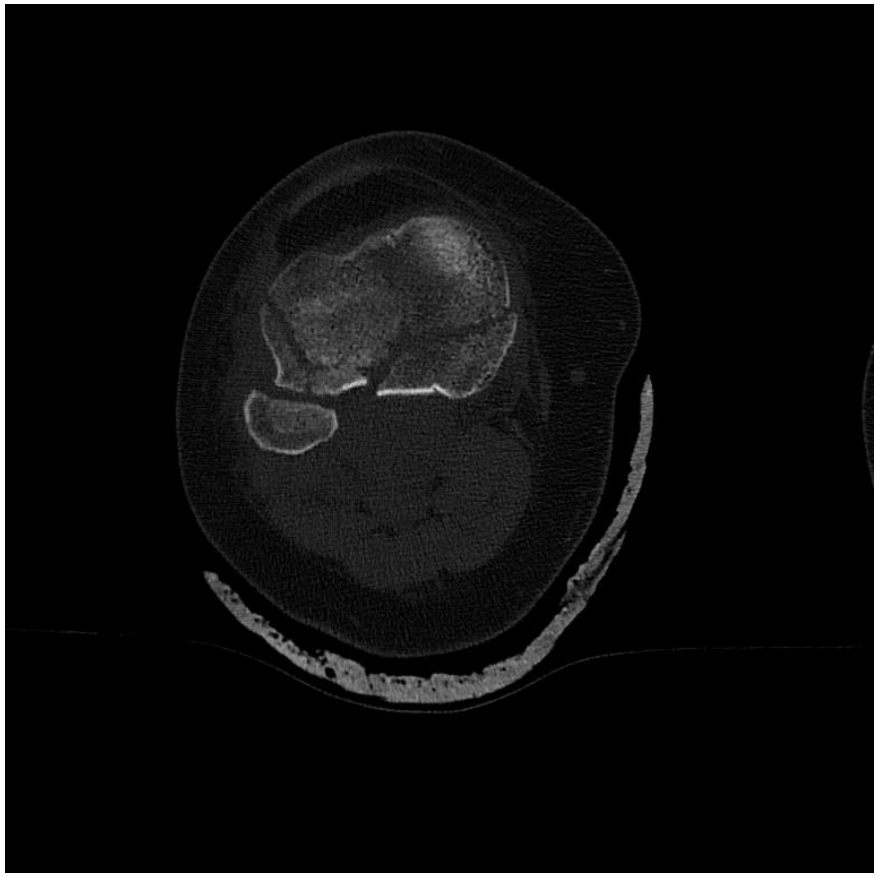
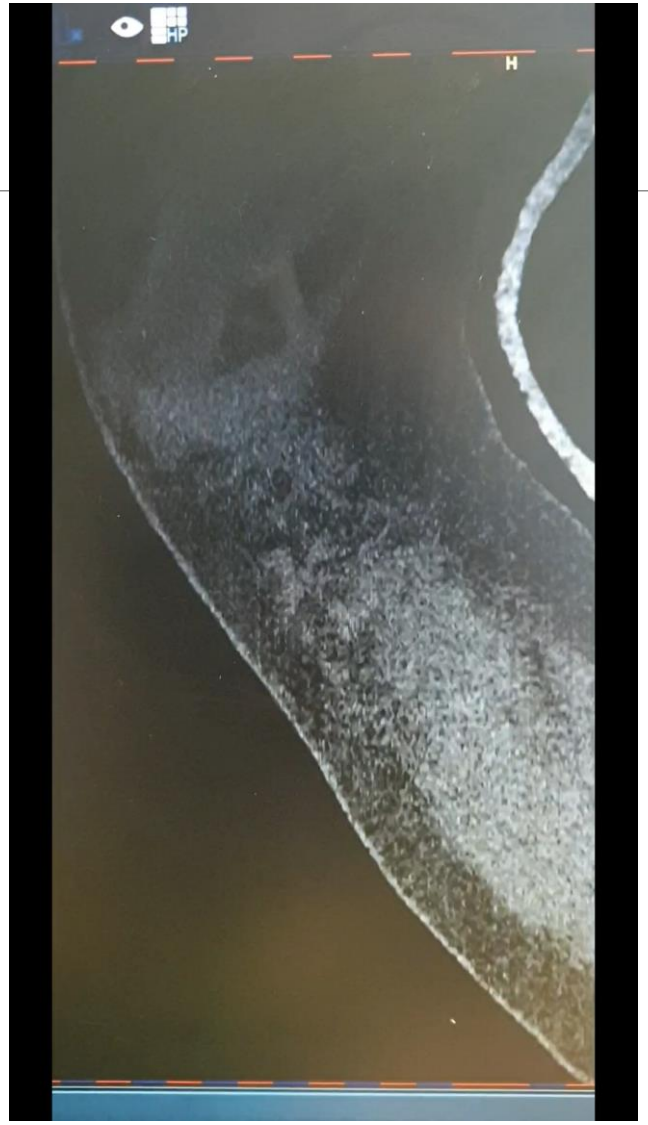
Case 4





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Question

How would you classify this fracture?

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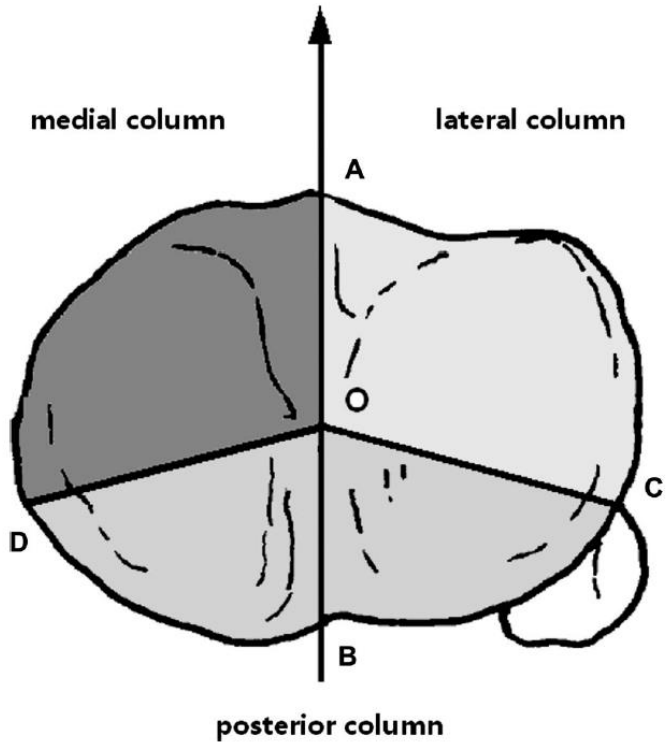
Principle of ‘three-column fixation’



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Case 4

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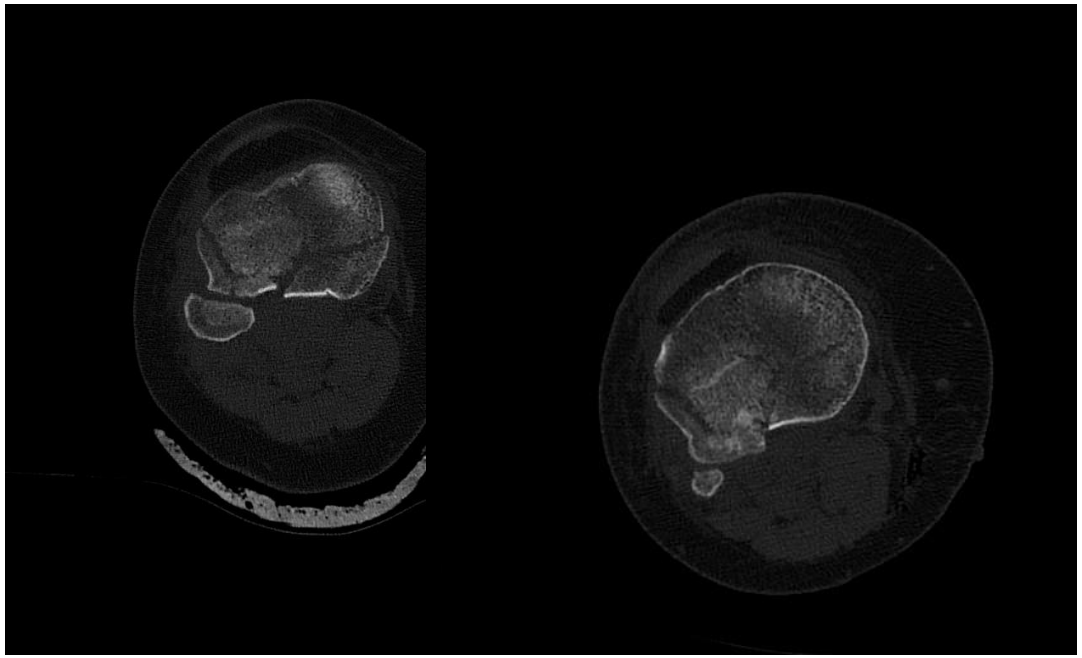

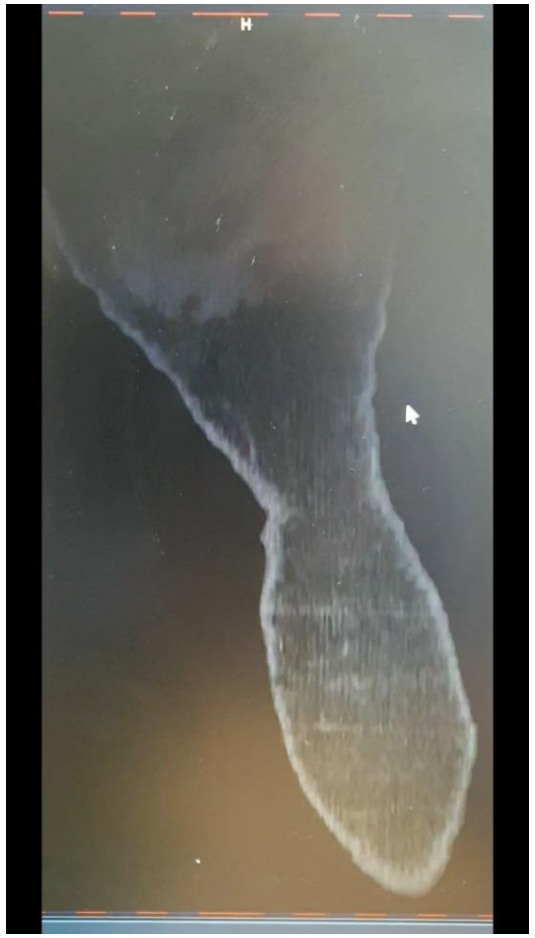

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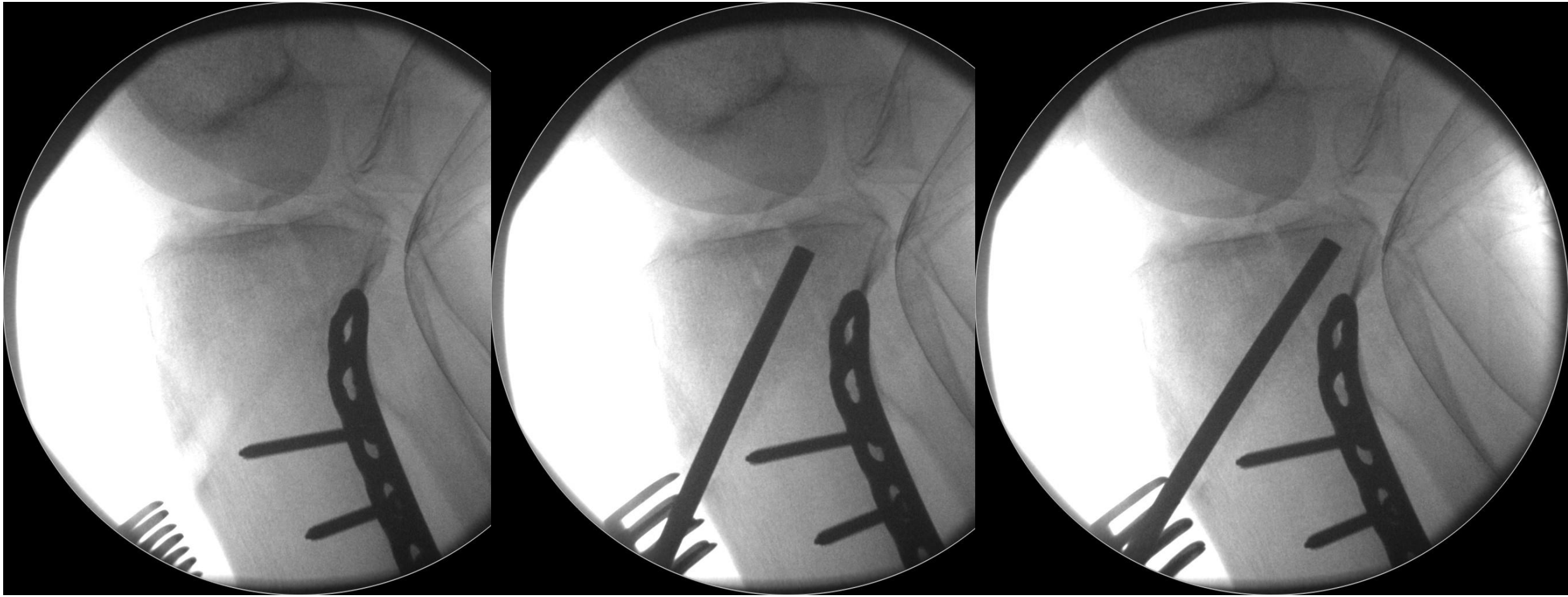
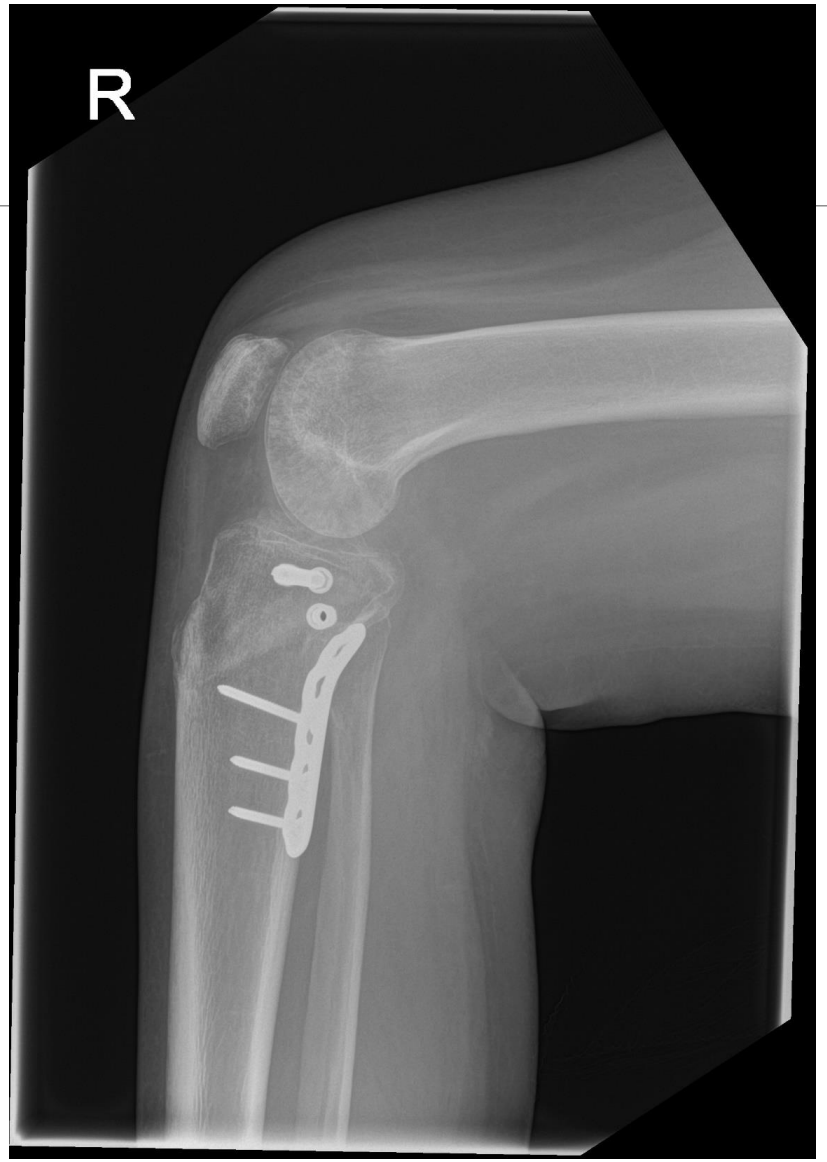


Case 4



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Case 5

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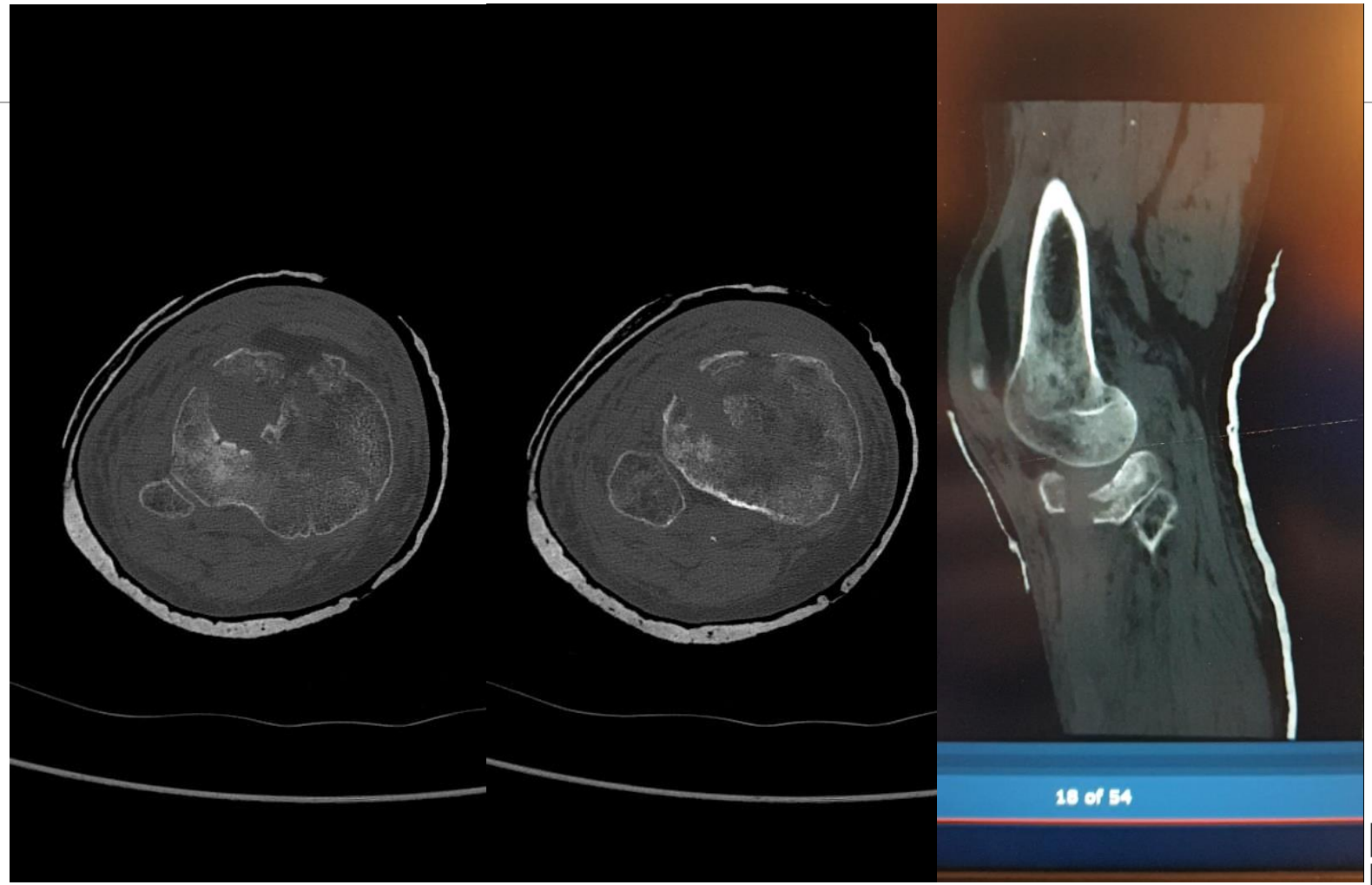
Case 5



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Question

What are the principles of surgical fixation in this case?

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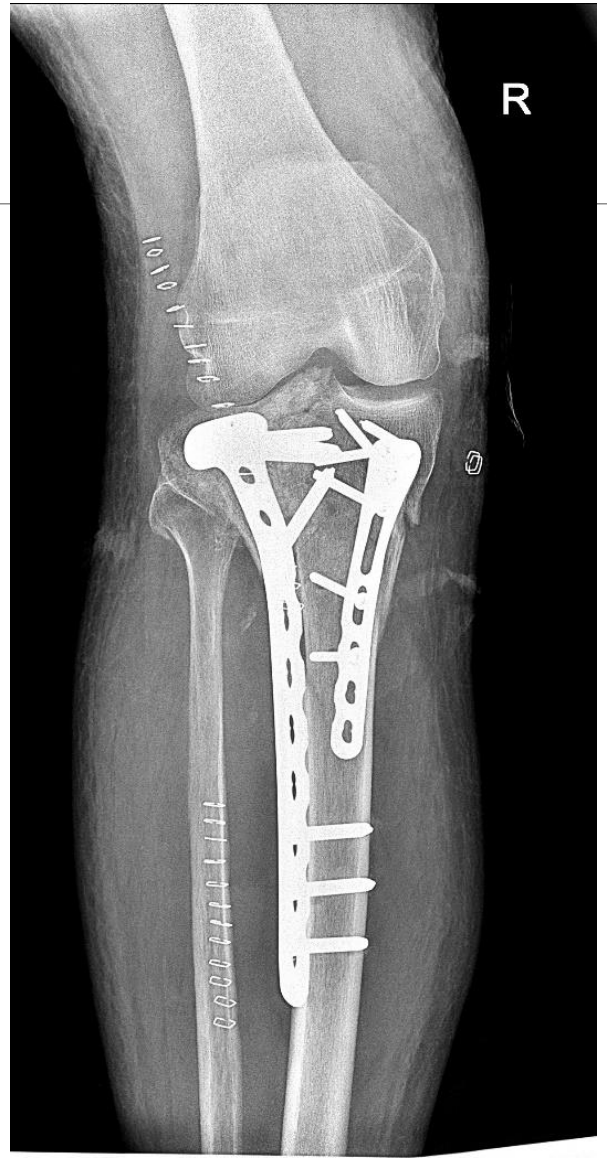

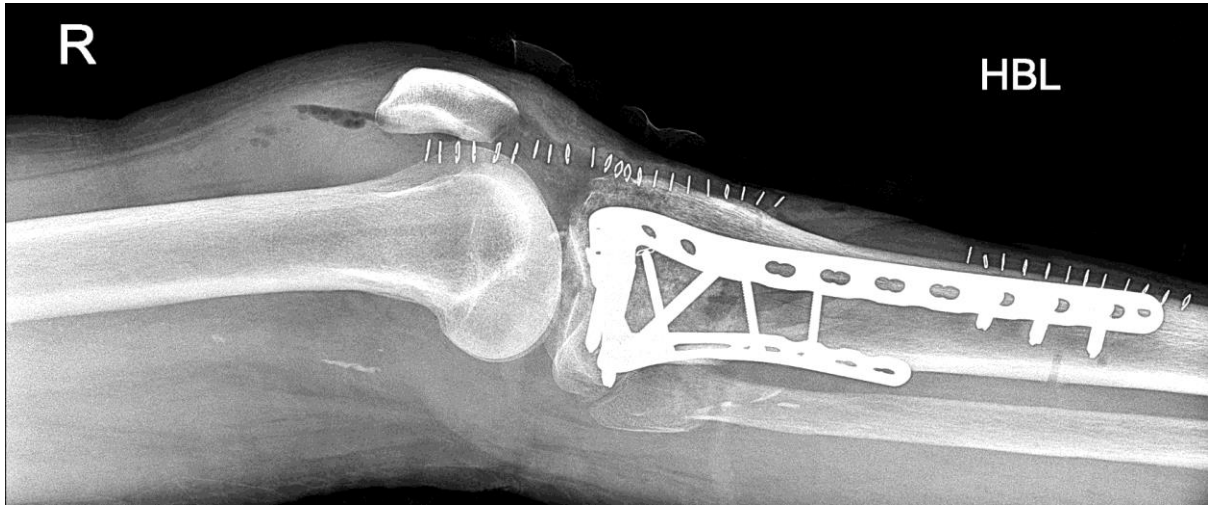

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Question

What are the complications of a tibial plateau fracture fixation?

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Complications

n=279

Deep infection – 3.6%

Superficial infe

Early implant f

Fracture non-union – 0.7%

VTE – 2.9%

Further operation for implant removal/stiffness – 9.5%

Table 1
Total complications of the posterior reversed L-shaped approach.

	During operation		Post operation		
Complication	Popliteal artery rupture	Nutrient vessels of m. gastrocnemius rupture	Infection	Wound complications*	Skin paresthesia
Rate	1.1%(1/95)	1.1%(1/95)	0	0	2.1%(2/95)
Cause/other	K-wire from anterior to posterior	Cutting medial head of m. gastrocnemius			Distal area of the posterior reversed L-shaped approach
Treatment	Stitched	Stitched			Disappeared without intervention

* Wound complications: haematoma, dehiscence, nonunion, skin necrosis.

Kugelman D, Qatu A, Haglin J, Leucht P, Konda S, Egol K. Complications and unplanned outcomes following treatment of tibial plateau fractures. Injury 2017;48:2221-9.

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Complications

n=95

Complications – 4%

Table 1
Total complications of the posterior reversed L-shaped approach.

	During operation		Post operation		
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Qiu WJ, Zhan Y, Sun H, Xu YF, Wang YK, Luo C. A posterior reversed L-shaped approach for the tibial plateau fractures – a prospective study of complications (95 cases). Injury. 2015;46:1613-8.

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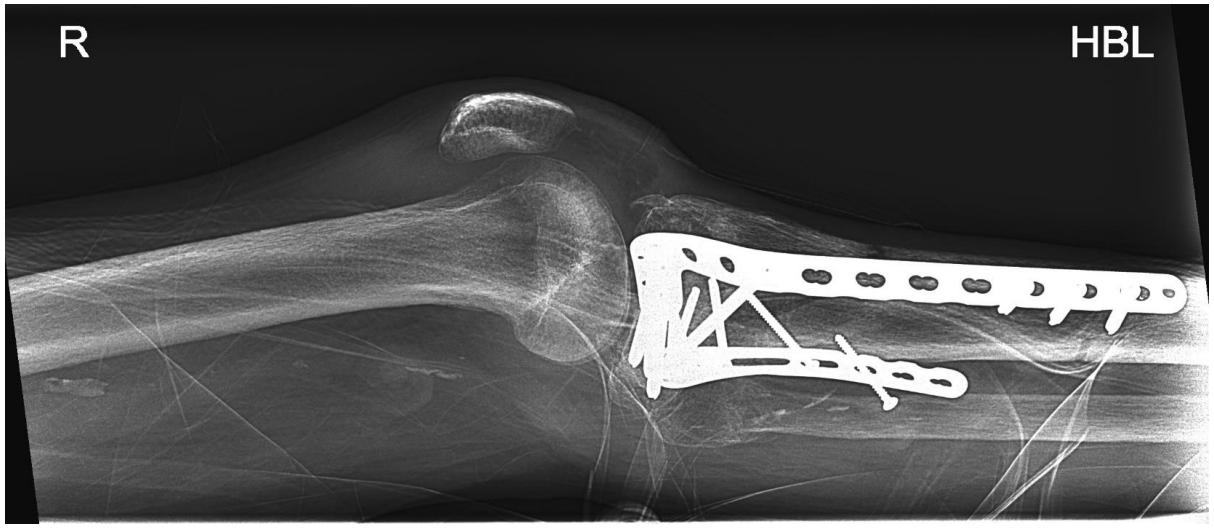
Case 5



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Patient selection

Alcoholic; Non-compliant

Failure of fixation; Infection; Stiffness

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Further reading

Arthroscopically assisted?

Circular frames?

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Objectives

Tibial plateau fractures

Anatomy

Classification

Surgical approaches

Fixation techniques

Case Based Discussions

Cover the above

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