



## *Complex Articular Fractures*

**Salvage procedures (e.g. Severe combined / cartilage and bone loss)**




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*Chairman*

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Pathology	Early solutions	Late solutions
Septic arthritis (new born)	Antibiotics/lavage	Prosthetic replacement
DDH	Conservative/osteotomies	Prosthetic replacement
SCFE	Fixation	Prosthetic replacement
Legg Perthes Calvé	Conservative/osteotomies	Prosthetic replacement
Septic Arthritis (adult)	Antibiotics/lavage	Prosthetic replacement
FAI (femoro-acetabular impingement)	Surgical Remodelling (arthroscopy, open)	Prosthetic replacement
Fractures/Dislocation (young)	Reduction/ Fixation	Prosthetic replacement
AVN	Conservative/osteotomies	Prosthetic replacement
Fractures (aged population)	Fixation, Prosthetic replacement	Prosthetic replacement
<b>OSTEOARTHRITIS</b>		PROSTHETIC REPLACEMENT
Metastasis	Fixation, cement, radiation	PROSTHETIC REPLACEMENT

# COMPLEX ARTICULAR FRACTURES

Tibial Schatzker IV

Distal femoral intercondylar

Comminutive patellar fracture

Multi-level fractures

Skin issue

Previous fracture (mal or non-union, previous material)

Osteoporotic bone / pathological fracture

Posterior condylar fracture

Chondral and osteochondral fractures

How to deal with combined menisci and/or ligament injuries

Participant's clinical case

Salvage procedures (e.g. severe combined / cartilage and bone loss)



# COMPLEX ARTICULAR FRACTURES

## Post-traumatic osteoarthritis

- Removal of hardware (one stage, two stages)
- Stiffness
- Infection
- Fixation in deficient supportive bone
- Level of constraint







# Definition and Rationale of TKA in acute setting

- Prosthetic Knee Replacement of fractured epiphyseal knee segments:
  - Proximal tibia (AO/OTA 41)
  - Distal femur (AO/OTA 33)
  - Patella (AO/OTA 34)alone or in combination
- ORIF is considered to bring poor results in elderly patients (comorbidities, stiffness, non union); these patients need satisfactory knee function, early mobilization, early full weight bearing (poor compliance to partial) and in selected younger patients

# Controversial Topic

## Long time discussion

Injury, Int. J. Care Injured 45S (2014) S98–S104



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Injury

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### Total knee replacement in acute and chronic traumatic events

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#### ARTICLE INFO

##### Keywords:

Total knee arthroplasty  
Knee injuries  
Trauma  
Acute  
Chronic

#### ABSTRACT

Total knee replacement (TKR) is a widely used procedure for the treatment of post-traumatic arthritis. This type of solution has also been used recently for the treatment of acute fractures around the knee, particularly in joints that were already arthritic before the trauma. The purpose of this paper is to present our experience with TKR in both acute and chronic traumatic events, highlighting the main problems associated with these conditions and focussing on the indications, principles of technique, tips, tricks and pitfalls of this procedure. The main issues related to post-traumatic arthritis and the problem of TKR in acute fractures are discussed, and our case series of both groups of patients is presented.

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### Aggiornamenti

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Author's personal copy



### Protesi di ginocchio in acuto

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#### ABSTRACT – TOTAL KNEE ARTHROPLASTY IN ACUTE

*Total knee arthroplasty is a reliable solution not only for the primary arthritic knee but also for severe knee fractures, either affected by osteoarthritis or not, or in case of severe bone loss in young patients. In this paper we present our experience and we suggest different technical solutions related to different segmental bones involved.*

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# Emerging literature

Lo SCALFELLO Journal (2022) 36:6-12  
doi number: 10.36190/0350-5276-234

Trauma Meeting

## Knee post-traumatic consequences: possible surgical approach and management when everything goes wrong

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### SUMMARY

Post-traumatic osteoarthritis (PTOA) of the knee is a development of arthritis following an acute trauma, often associated with intraarticular fracture and ligament injury. The knee is affected in 12% of all cases of knee OA, the prevalence of PTOA after a fracture in the literature is between 21-44% and is the result of a combination of unfavorable factors. The number of surgical treatments for post-traumatic arthritis has increased slightly over the years, but is a demanding and common problem for the surgeon because it is associated with poorer outcomes and higher rates of complications. The reasons for this are likely multifactorial, due to technically challenging for the previous surgery and scarring, secondary deformity, bone loss, hardware retained, poor bone quality and ligament incompetence. The aim of this study is to review the possible surgical approaches in these cases, and the management of soft tissue and previous hardware.

**Key words:** post-traumatic, arthritis, knee, wound, hardware

### Introduction

Post-traumatic osteoarthritis (PTOA) of the knee is a development of arthritis following an acute trauma, often associated with intraarticular fracture and ligament injury<sup>1</sup>. It usually occurs after a variety of joint injuries, like sports trauma, motor vehicle accident or fall and is considered a particular type of osteoarthritis. The main difference is that cartilage wear occurs as a result of acute damage and not gradually, as in the case of osteoarthritis<sup>2,3</sup> (Fig. 1).

Knee is affected in 12% of all knee OA cases, the prevalence of PTOA after a fracture in literature is between 21-44%<sup>4</sup> and is the result of a combination of unfavorable factors. A prior knee joint trauma increases the risk to develop PTOA by 3-6 times and with an early appearance of 10 years compared to those without history of injury<sup>5</sup>.

### Pathogenesis

The pathogenesis of PTOA is not fully understood, but is thought to be a combination of mechanical damage associated with ligamentous laxity and meniscal tears. The acute

## Instructional Lecture: Trauma



## Knee arthroplasty for acute fractures around the knee

Thomas Tampere<sup>1</sup>  
Matthieu Olivier<sup>2</sup>  
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Maxime Fabre-Aubrespy<sup>2</sup>  
Sébastien Parratte<sup>2,3</sup>

- Results of open reduction and internal fixation for complex articular fractures around the knee are poor, particularly in elderly osteoporotic patients.
- Open reduction and internal fixation may lead to an extended hospital stay and non-weight-bearing period.
- This may lead to occurrence of complications related to decubitus such as thrombo-embolic events, pneumonia and disorientation.
- Primary arthroplasty can be a valuable option in a case-based and patient-specific approach. It may reduce the number of procedures and allow early full weight-bearing, avoiding the above-mentioned complications.
- There are four main indications:
  - 1) Elderly (osteoporotic) patients with pre-existing (symptomatic) end-stage osteoarthritis.
  - 2) Elderly (osteoporotic) patients with severe articular and metaphyseal destruction.
  - 3) Pathological fractures of the distal femur and/or tibia.
  - 4) Young patients with complete destruction of the distal femur and/or tibia.
- The principles of knee (revision) arthroplasty should be applied; choice of implant and level of constraint should be considered depending on the type of fracture and involvement of stabilizing ligaments. The aim of treatment is to obtain a stable and functional joint.
- Long-term data remain scarce in the literature due to limited indications.

**Keywords:** elderly; fracture; knee; osteoporosis; total knee arthroplasty

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DOI: 10.1302/2058-5241.5.190059

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www.efortopenreviews.org

### Introduction

Complex epiphyseal knee fractures are rare. In contrast to the high incidence of femoral neck and proximal humerus fractures, epiphyseal knee fractures account only for up to 1% of annual emergency admissions. Furthermore, the sub-type of fracture appears to be gender related, with a male predominance for proximal tibia fractures (overall incidence 13.3/100,000 adults) whereas distal femoral fractures are more frequently seen in women (overall incidence 4.5/100,000 adults).<sup>1-3</sup> Treatment of complex epiphyseal fractures is multifaceted and challenging. Today, especially in young patients, the first choice of treatment remains open reduction and internal fixation. Management of these fractures in the osteoporotic elderly is more demanding as metaphyseal bone loss often limits options for anatomical reconstruction and fixation. Current surgical treatment options, including intramedullary nailing, internal and external fixation, are often complicated by an extended non-weight-bearing period, malunion or non-union.<sup>4,5</sup> Due to the presence of multiple risk factors such as old age, concomitant diseases and osteoporosis, in combination with severe comminution and initial displacement, loss of reduction is described in up to 30-79% of cases, implying loss of function and sometimes a need for subsequent surgery (Fig. 1). To avoid these complications and to shorten the recovery phase, primary total knee arthroplasty (TKA) has been proposed as a first intention solution based on the model of primary hip or elbow arthroplasties for fracture. It is often used as a last resort in the treatment of failed fixation of complex knee fractures.<sup>4,5</sup> The main advantages of primary arthroplasty are the ability to preserve joint function and to allow patients to resume full weight-bearing immediately, while prolonged weight-bearing restriction is often implemented after internal fixation. Due to cognitive and/or physical impairment, older

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ORIGINAL ARTICLE

OPEN ACCESS

## Medium term results of total knee arthroplasty as a primary treatment for knee fractures

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Received 29 October 2017, Accepted 16 December 2017, Published online 16 March 2018

**Abstract - Introduction:** Successful treatment of knee comminuted periarticular fractures associated with osteoporosis and pre-existing arthritis is a challenging task.

**Methods:** This is a prospective study on 27 patients who had comminuted intra and periarticular knee fractures and pre-existing arthritis. Fractures were classified according to Muller's AO classification. Primary knee arthroplasty was performed ± internal fixation following 4 weeks of splinting. A stem was added to the tibial tray and Legacy Constrained Condylar Knee (LCKK) or Rotating Hinge (RH) prosthesis were used depending on the level of ligament damage and bone defects. The Knee Society Score (KSS) and radiological evaluation were performed at 3, 6 and 12 months then annually thereafter.

**Results:** The average age of this group of patients was 63 years (range 59-74). Sixteen knees received primary femoral component and Posterior Stabilized insert, while 8 had LCKK. RH implants were chosen in 2 and distal femoral replacement was necessary in one knee. Twenty five patients were available for the final review at an average 6 years in whom the KSS was 80 (range 75-89) points. All patients achieved full knee extension and average knee flexion of 110° (range 90-135°). One knee needed re-admission for early Debridement Antibiotic Irrigation and Retention (DAIR) but none of the knees was revised or awaiting revision.

**Conclusion:** Knee arthroplasty achieves highly successful outcome when performed as a primary treatment for comminuted intra and periarticular knee fractures in elderly patients. Survival of implants and functional range of movement at midterm are excellent.

**Key words:** Total knee arthroplasty, Knee fractures, Osteoarthritis, Knee.

### Introduction

The dilemma of treating elderly patients with intra or periarticular fractures in presence of knee arthritis is still a challenge to orthopedic surgeons. Internal fixation is usually difficult due to osteoporosis and metaphyseal comminution [1,2]. The elderly patients are usually difficult to mobilize with partial weight bearing strategy. Therefore, early weight bearing can cause failure of fixation. The alternative of non-weight bearing ± immobilization is associated with muscle wasting, joint stiffness and other general complications [3].

Failed fixation of knee peri-articular fractures can be salvaged by total knee arthroplasty (TKA). However, knee arthroplasty for non or malunited fractures is associated with higher incidence of complications when compared to TKA for arthritis. In one series the rate of intraoperative and postoperative complications reached 30% for each. Additionally the functional range of movement (ROM) and

survivorship were inferior to the results of TKA for arthritis [4]. Notably, joint stiffness, infection and damage of the extensor mechanism were reported when total knee replacement was performed as a salvage procedure for complicated tibial plateau fractures [5,6].

There is paucity in the literature in regard to the use of primary TKA as a treatment for intra and peri articular fractures. Additionally, published series included small numbers of patients and only short term results were reported [7-9].

In this article results of total knee arthroplasty as a primary treatment for intra and peri-articular fractures of arthritic knees in elderly patients is reported at the medium term follow up.

### Material and methods

Twenty seven patients with acute intra and peri-articular fractures around arthritic knees had TKA ± internal fixation as a primary and definitive treatment. Nine of these fractures were distal femoral fractures and

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# Data searching and analyzing - 1

- 1) ORIF in fractures around the knee: high risk of complications, such as infections, loss of reduction, malalignment, delayed union or nonunion, and risk for the development of post-traumatic osteoarthritis (OA)
- 2) Primary total knee replacement (TKR) is an under-reported treatment option.  
We are discussing to propose it as a first-line treatment, especially in fragile patients.  
Prosthetic replacement is already a well accepted solution for fractures of the femoral neck , prox humerus and elbow
- 3) Quite a good number of papers published on prosthetic replacement in fractures:
  - Total number of cases is low
  - Quality of the papers is low (III-IV therapeutic level)
- 4) Many other papers show good results also for ORIF (at least for tibial plateau)



# Data searching and analyzing - 2

Roerdink WH, Oskam J, Vierhout PA (2001)

Arthroscopically assisted osteosynthesis of tibial plateau fractures in patients older than 55 years.

Arthroscopy 17:826–831

Su EP, Westrich GH, Rana AJ, et al (2004)

Operative treatment of tibial plateau fractures in patients older than 55 years.

Clin Orthop Relat Res 240–8

Shimizu T, Sawaguchi T, Sakagoshi D et al (2016)

Geriatric tibial plateau fractures: Clinical features and surgical outcomes.

J Orthop Sci 21:68–73

Oladeji LO, Worley JR, Crist BD (2019)

Age-Related Variances in Patients with Tibial Plateau Fractures.

J Knee Surg

Kim JK, Hwang KT, Soh HS et al (2021)

Comparison of tibial plateau fracture surgical outcomes between young and elderly patients: are outcomes really poorer in the elderly?

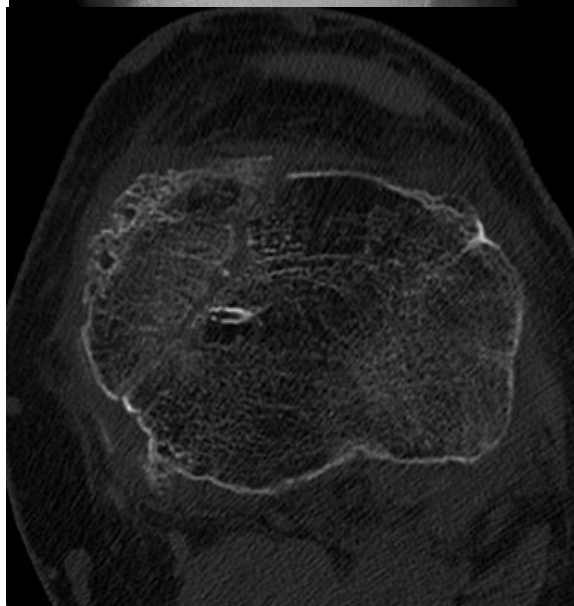
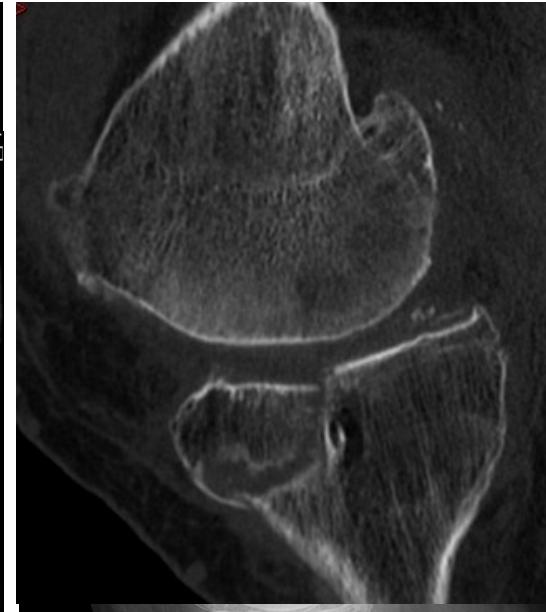
Arch Orthop Trauma Surg

5) Lack of data to define the proper indications (expertise/skill of the surgeon in one field compared to the other is playing the main role)


Male

79 years

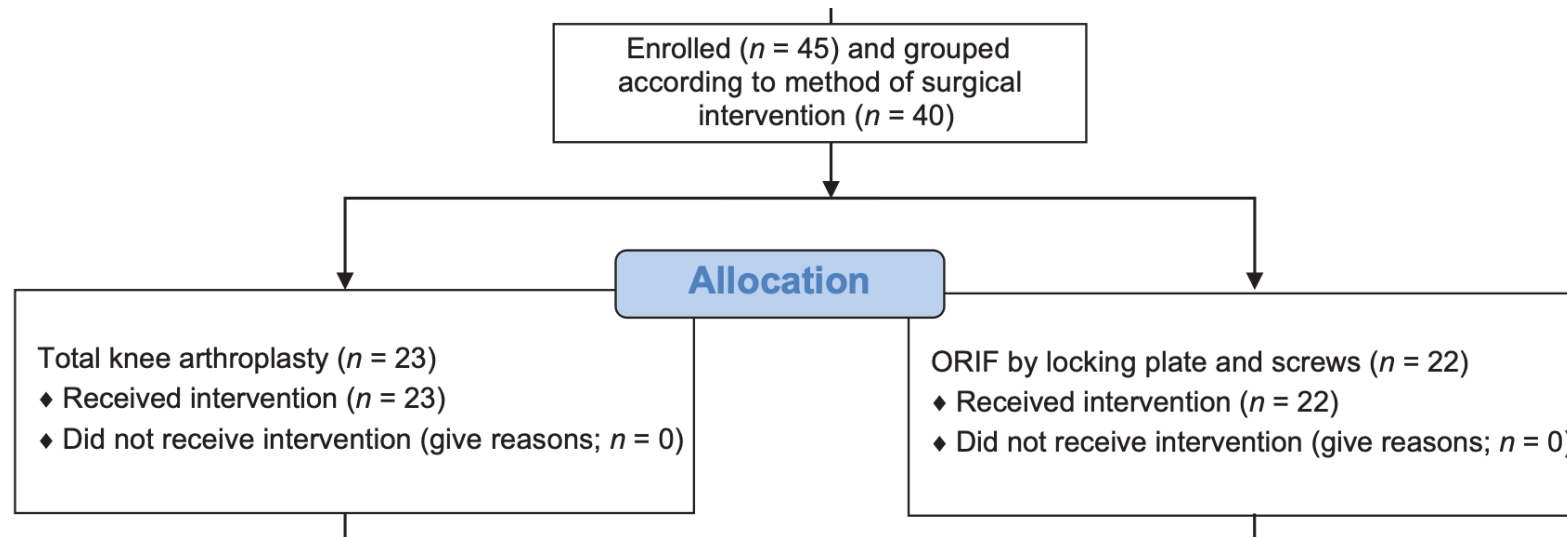
Previous tricompartmental  
arthritis



# Primary Total knee Arthroplasty: A Viable Surgical Option for Complex Tibial Plateau Fractures in Elderly - 1

Ahmed Abdelbadie, MD<sup>1</sup> Ayman El-Hennawy, MD<sup>1</sup> Asser Sallam, MD, PhD<sup>1</sup> 


J Knee Surg, 2019



The optimal treatment of complex tibial plateau fractures in elderly is still controversial. The aim of the study was to retrospectively analyze the clinical and radiological outcomes of primary total knee arthroplasty (TKA) versus open reduction and internal fixation (ORIF) in elderly patients presenting with acute complex tibial plateau fractures.

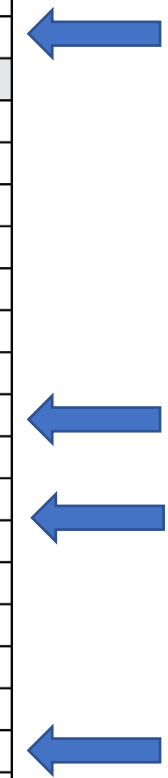
# Primary Total knee Arthroplasty: A Viable Surgical Option for Complex Tibial Plateau Fractures in Elderly

- 2

Ahmed Abdelbadie, MD<sup>1</sup> Ayman El-Hennawy, MD<sup>1</sup> Asser Sallam, MD, PhD<sup>1</sup> 

J Knee Surg, 2019

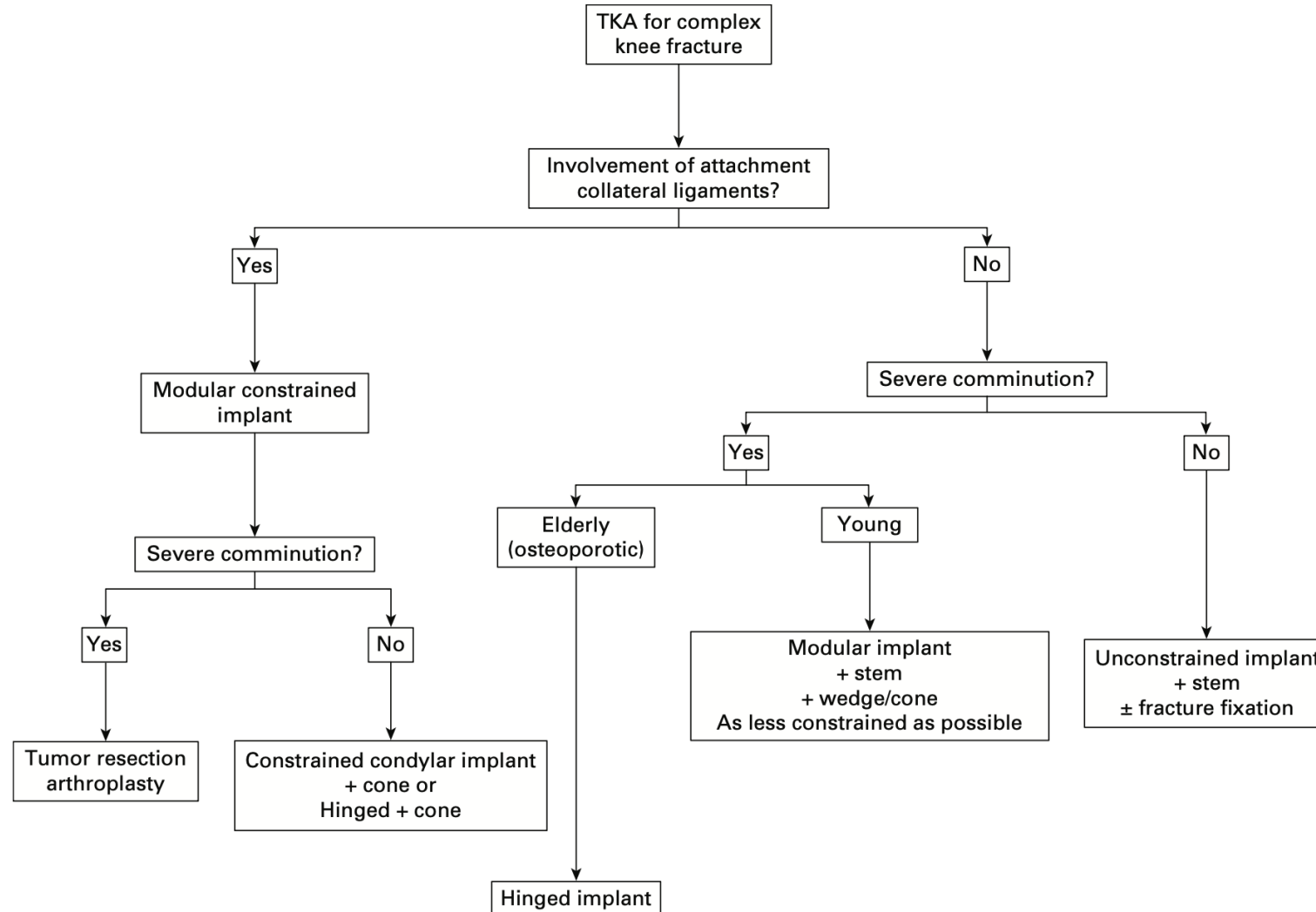
	TKR group	ORIF group	p-Value
Duration of surgery, min (mean, range)	120 (100–140)	130 (120–180)	0.13
Full weight-bearing, d (mean, range)	4.5 (2–42)	88.2 (80–100)	0.00
Implant data:			
Single locking plate (no, %)	–	21 (100%)	–
A Nex-Gen complete knee solution LPS-Flex:	22 (100%)	–	–
– Polyethylene thickness, mm (median, range)	13 (10–17)		
– Contained defects (no, %)	10 (45.5)		
Structural bone graft	6 (27.3)		
Metal wedges	4 (18.2)		
– Non-contained defects (no, %)	12 (54.5)		
Postoperative flexion, degrees (mean, range)	115 (100–140)	95 (80–140)	0.003
Postoperative extension lag, degrees (mean, range)	1.4 (0–5)	5.7 (0–15)	0.005
Postoperative KSS knee score (mean, range)	83 (50–100)	70 (55–90)	0.00
Postoperative KSS function score (mean, range)	84 (60–100)	72 (60–90)	0.00
Complications (no, %)	4 (18.2)	8 (38.1)	0.15
– Varus	0	3 (14.3)	
– Valgus	2 (9.1)	2 (9.5)	
– Loosening	0	0	
– Infection	1 (4.5)	2 (9.5)	
– Periprosthetic fractures	1 (4.5)	0	
– Peroneal nerve palsy	0	1 (4.8)	



...we believe primary TKA is a useful viable treatment alternative for elderly patients with a complex fracture of the tibial plateau.

# Knee arthroplasty for acute fractures around the knee

EOR | volume 5 | 2020





Should we elaborate a table of criteria with scores (like for PJI) for giving the indication to TKA?

- Location and type of fracture
- Comminution
- Age of patient
- Barthel or other index?
- Osteoporosis
- Potential for healing?
- ...



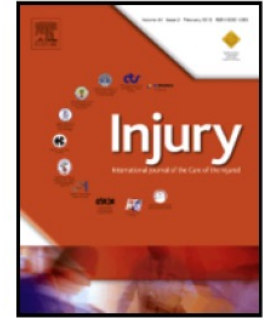


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Injury

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## Fractures around the knee in elderly patients: Balancing fixation and arthroplasty approaches, a multicenter experience., ☆, ☆☆

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# Total Knee Replacement Indication Scoring System (TKRISS) for Knee Fractures Based on AO Classification

## Age

- ≤ 70 years: 0 points
- 71-80 years: 1 point
- 80 years: 2 points

## Pre-Traumatic Arthritic Status

- No pre-traumatic arthritis: 0 points
- Mild to moderate arthritis: 1 point
- Severe arthritis: 2 points

## AO Classification - Fracture Type For AO 41 (Proximal Tibia)

Type A: 0 points

Type B:

- B1: 1 point
- B2: 1 point
- B3: 2 points

Type C: 2 points

- C1: 1 points
- C2: 2 points
- C3: 3 points

# Total Knee Replacement Indication Scoring System (TKRISS) for Knee Fractures Based on AO Classification

## Clinical Frailty Scale (CFS)

CFS 1-2 (very fit to FIT): 0 points

CFS 3 (managing well) 1 point

CFS 4-6 (mild frailty to moderate frailty): 2 points

CFS 7 (severe frailty) 1 point

CFS 8-9 (vulnerable) or higher: 0 point

## Smoking

Non-smoker: 2 points

Former smoker (>1 year without smoking): 1 points

Current smoker: 0 points

## Diabetes

No diabetes: 2 points

Controlled diabetes: 1 points

Uncontrolled or severe diabetes: 0 points

## Malnutrition

No or mild malnutrition: 1 point

Moderate Malnutrition: 2 points

Severe malnutrition: 1 point

# Total Knee Replacement Indication Scoring System (TKRISS) for Knee Fractures Based on AO Classification

## Indication Levels for TKA

- Low Indication: Total score 0-5
- Moderate Indication: Total score 5-8
- Strong Indication: Total score  $> 9$



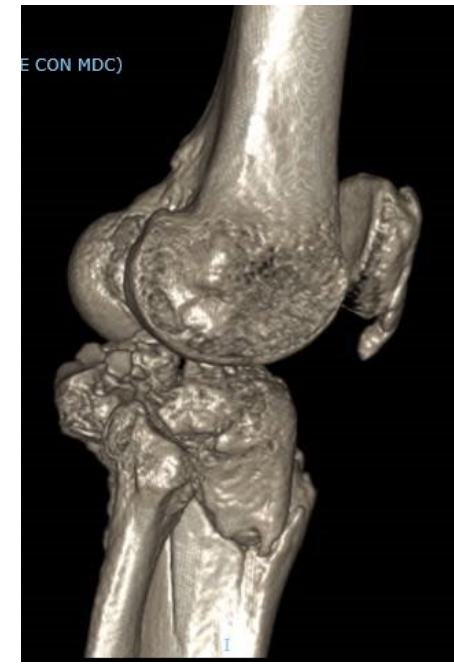
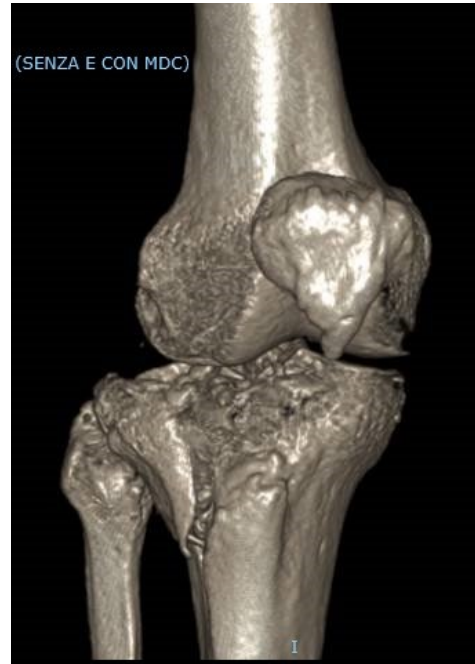


# TKA in Tibial plateau fractures

- Technically demanding (Joint line, slope, comminution)
- “Less” difficult comparing to distal femur
- Soft tissue damage
- TT involved !!!
- Bone loss: Contained vs uncontained defects
- Bone quality



- Man 66 years old, low demanding
- Tibial plateau fracture
- Compression of popliteal artery



- Man 66 years old, low demanding
- Provisional reduction and fixation of the fragment compressing the popliteal artery
- Vascular surgeon advice: doppler and observation
- EX-Fix



- 10 days later:

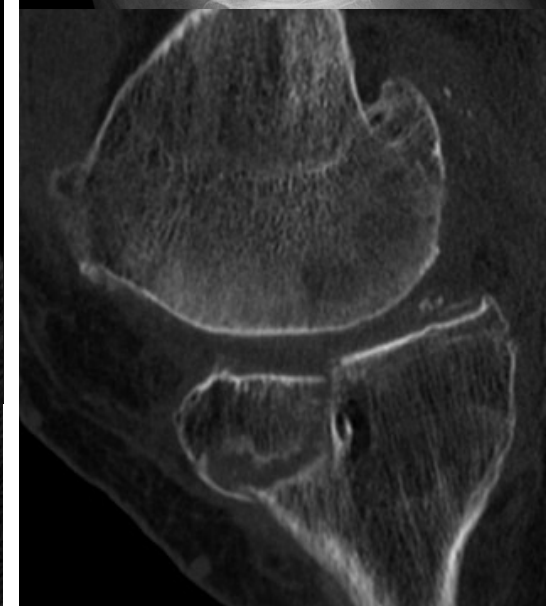
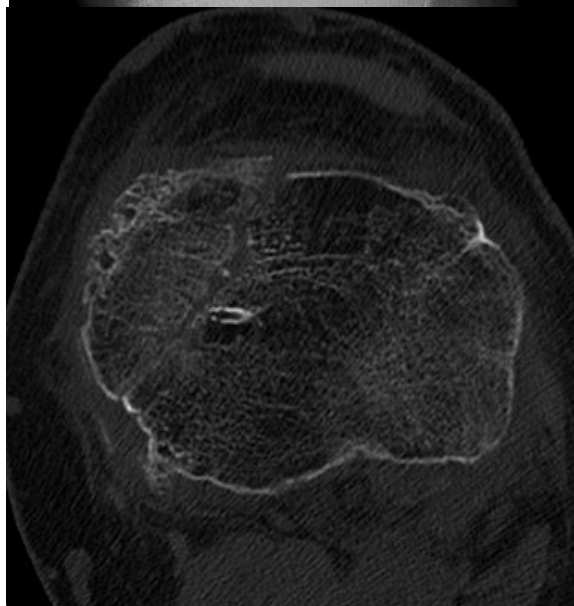
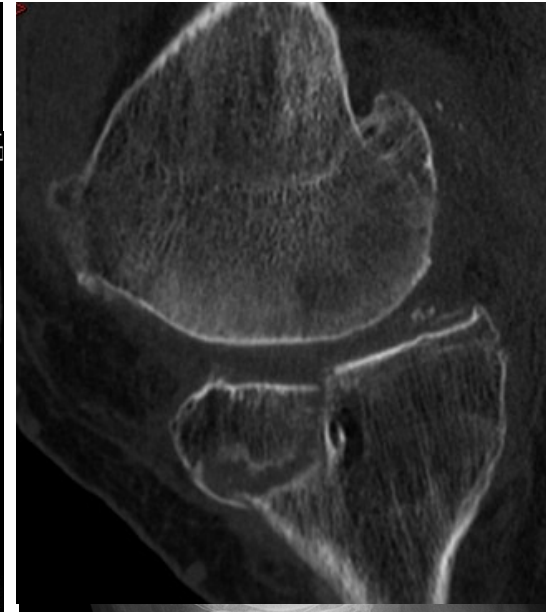
- TKA with LCCK
- Long stem
- tibial cone and 1 screw



Male

79 years

Previous tricompartmental  
arthritis





- Persona PS
- Stubby stem
- Liner CPS 10 mm
- Antero-medial bone graft  
(autologous from the  
box)

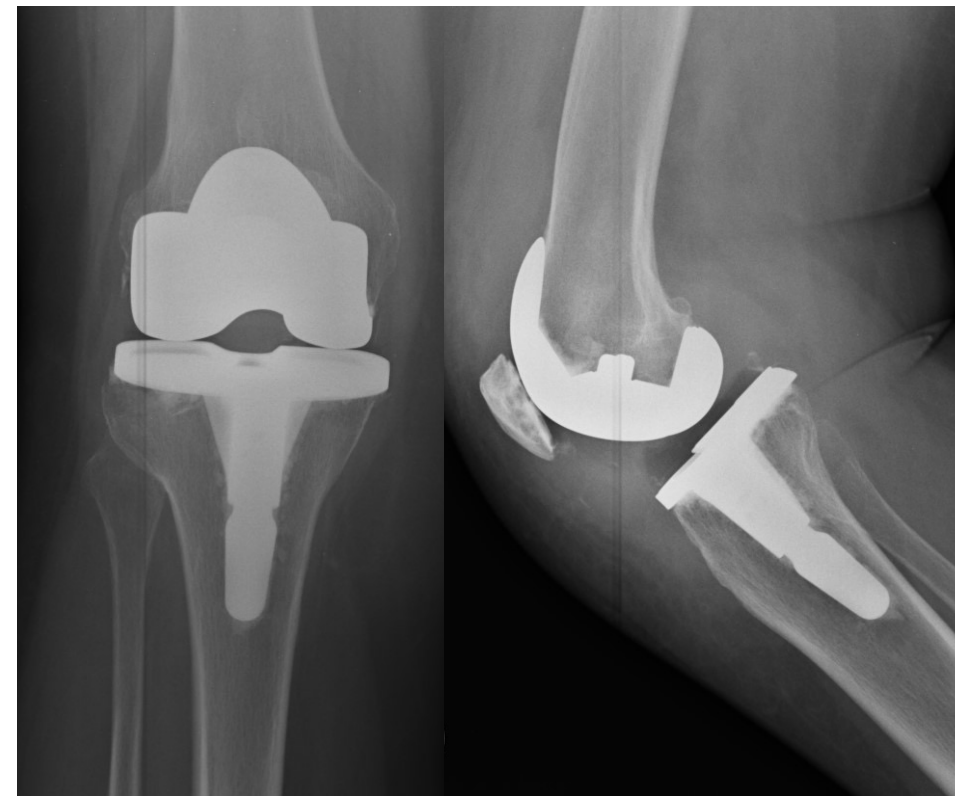


- Female

- 64 ys



- Persona
- Short Stubby Stem
- Liner PS10
- Patella 29



Follow-up 2 years

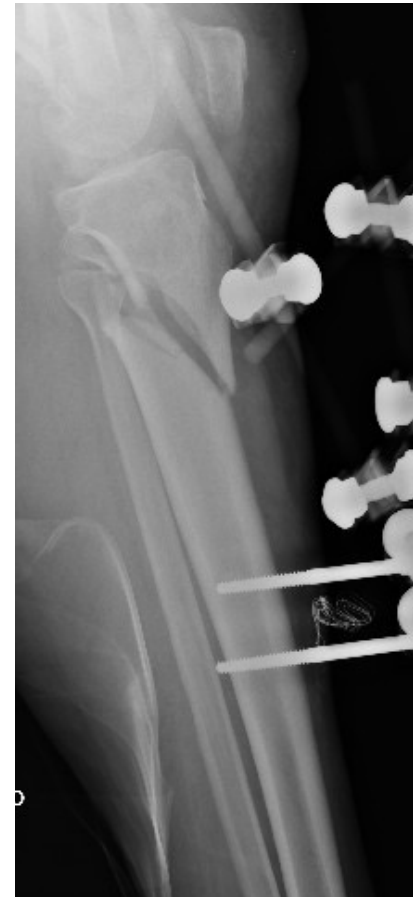
# Floating Knee

- Male
- Diabetes
- Obesity
- Complex endocrinal situation



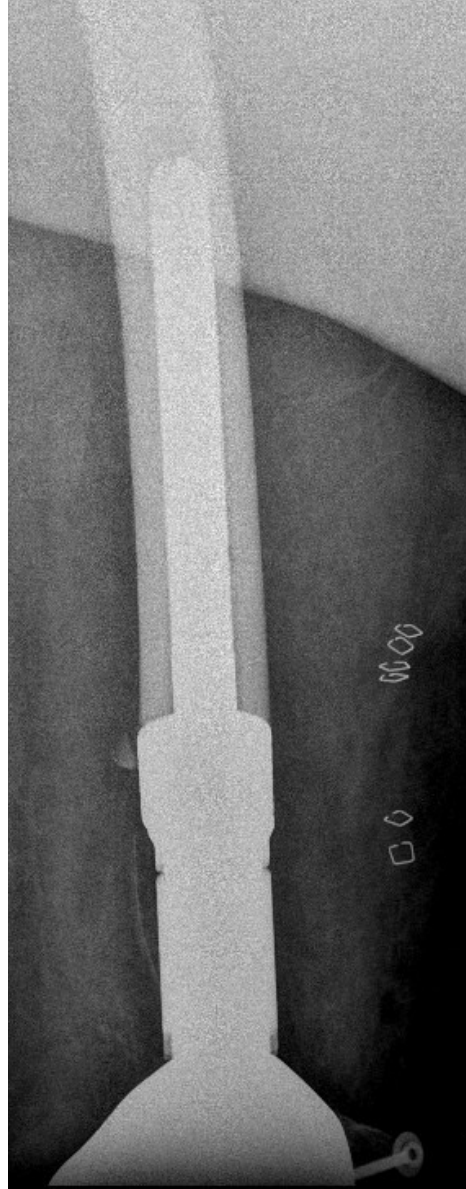
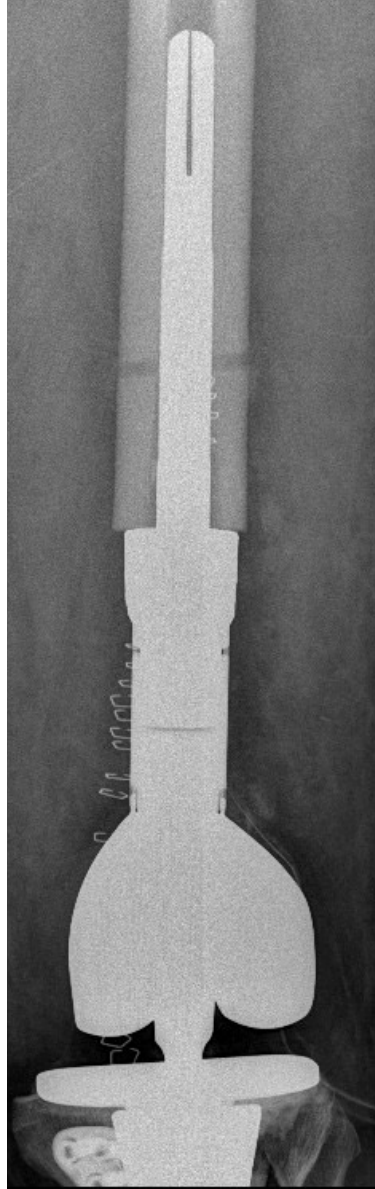
# Floating Knee

- "Damage control":  
External fixation





# Floating Knee





# Floating Knee

- Fu 1 year



# Distal femur

- F, 64 y
- road accident
- ORIF tibial plateau (1987)
- left TKA (2 years before)



# Reconstruction



# Patients

- GENERAL

- 1) Age (biological impairment to heal)
- 2) Comorbidities (ASA classification: reverse relationship)
- 3) Osteoporosis

- LOCAL

- 1) Complex articular fracture with pre-existing symptomatic osteoarthritis (femur or tibia)
- 2) Complex fracture of the tibial plateau with severe articular involvement (caveat: TT detachment/disruption)
- 3) Complex fracture, multifragmented of the distal femur
- 4) As above, floating knee
- 5) Complete femoral metaphyseal destruction (also in younger patients but low demandig or high morbidity patients?)

## Indication Levels:

- Low Indication: Total score 0–5
- Moderate Indication: Total score 5–8
- Indication: Total score > 9

# Indications (implants)

## TYPE OF IMPLANT

- |  |   |
|--|---|
| 1) AO/AOT 41 – Schatzker 1,2,3, (Ligaments competent):             | PS, half augment, short fully cemented stems  |
| 2) AO/AOT 41 – Schatzker 4,5,6, (Ligaments competent or amenable): | PS, cones, longer stems – If TT detached, fixation mandatory                                    |
| 3) AO/AOT 41 – Schatzker 4,5, (Ligaments incompetent):             | CCK   |
| 3) AO/AOT 33 (B1, B2,) (uniting condyle):                          | CPS, CCK, fully cemented short stems  |
| 4) AO/AOT 33 B3  | PS, CPS, with posterior augment, Fully cemented short stems                                     |
| 5) AO/AOT 33 C1 (uniting condyles):                                | CCK, diaphyseal cone, possible metaphyseal cone, long uncemented stem, mid length cemented stem |
| 6) AO/AOT 33 C2  | CCK, metaphyseal cone, diaphyseal cone, long uncemented stem, mid length cemented stem          |
| 7) AO/AOT 33 C2, C3  | Segmental prosthesis  |

# Take home message – Salvage procedures ?

1. The indications for TKA in acute knee fractures are undoubtful and clear
2. Pre-existing osteoarthritis is not mandatory for the indication of TKA in acute fractures, while age, co-morbidities and type of fracture are.
3. We need a series of established criteria with scores to give indication for TKA (approved algorithm)
4. This (complex) surgery must be performed in referral centres with all technical options and specific peri-operative management and post-op care