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Original article

Management and results in periprosthetic tibial fracture after total knee arthroplasty:  
two-center 15-case retrospective series at 2 years' follow-up

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## Abstract

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**Introduction:** Periprosthetic tibial fracture after total knee arthroplasty (TKA) is rare, but jeopardizes implant survival.

The main objective of the present study was to assess treatment efficacy, on the hypothesis that surgery provides good long-term results.

**Material and methods:** A two-center retrospective study included 15 patients (6 male, 9 female: mean age,  $71.8 \pm 10.2$  years), managed between 1997 and 2017 for isolated tibial fracture after TKA. Patients were assessed clinically (IKS, inverted Oxford, Parker and SF-12 scores) and radiologically. Complications and revision surgeries were collated. Fractures were classified on the SoFCOT classification: 9 stable implants (4 type B1, 5 type C1), 4 periprosthetic osteolyses (1 type A3, 2 type B3, 1 type C3), and 2 loosening (type A2).

**Treatments comprised:** non-operative treatment (1 bed-ridden patient), 11 osteosyntheses for fracture on stable implant (2 standard plates, 7 locking plates, 2 intramedullary nailings), and 3 implant replacements by cemented long stem models for loosening.

**Results:** Mean follow-up was 28 months (range, 12-120 months). Consolidation was achieved in 13 cases, at a mean 15 weeks. Complications comprised: 4 infections, 2 cases of secondary displacement, and 2 of non-union. Surgical revision was required in 8 cases, including 2 secondary implant revision procedures.

Functional results were good in 10 cases. At last follow-up, mean Parker score was 7 (range, 4-8.5), Oxford score 32 (range, 16-39), and IKS score 150 (range, 85-167) with knee and function scores respectively 78 (range, 55-86) and 75 (range, 30-85).

**Conclusion:** Radiologic and clinical results were encouraging, but with impaired quality of life and a high rate of complications.

**Level of evidence:** IV, retrospective cohort study.

**Key-words**

Total knee arthroplasty, tibial fracture, knee revision, periprosthetic fracture

## 1. INTRODUCTION

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Periprosthetic tibial fracture after total knee arthroplasty (TKA) raises the problem of revision surgery, with difficulties caused by bone remodeling and the need to adapt to existing implants. Rates vary from 0.4% to 1.7% between series <sup>(1)(2)</sup>, usually within 2-4 years of TKA <sup>(3)</sup>. Incidence is increasing<sup>(4)</sup> and some authors<sup>(5)(6)</sup> expect it to double in coming decades.

Presently identified risk factors <sup>(5)(6)(7)</sup> comprise osteoporosis, age, female gender, revision TKA, osteolysis, long tibial stem, non-cemented implant, tibial plateau varus, instability, and deformity<sup>(6)(8)</sup>.

Few studies have been reported, and those that are available concerned small series <sup>(1)(9)(10)(11)</sup> or isolated descriptions of complex cases <sup>(12)(13)(14)</sup>. In 2015, Ebraheim<sup>(3)</sup> found 13 studies for a total 144 periprosthetic tibial fractures; subsequent significant series have been few and far between <sup>(15)(16)(17)</sup>.

Felix<sup>(2)</sup> developed an original classification for these complex entities. The French Society of Orthopedic Surgery and Traumatology (SoFCOT) symposium<sup>(4)</sup> showed that these complex fractures sometimes required exceptional therapeutic solutions.

Non-operative treatment, which was still recommended <sup>(1)(2)(18)</sup> just a few years ago for non-displaced fracture with stable prosthesis <sup>(3)(6)</sup>, is now more or less a thing of the past. The SoFCOT classification <sup>(4)</sup>, inspired by Felix's, classifies fractures by location with respect to the implants, implant stability, and bone stock. Indications for surgery extend to major displacement and tibial component loosening <sup>(3)(19)(20)</sup>. The current trend is resolutely surgical but with consensus only as to the need for early mobilization <sup>(3)(6)(21)</sup>.

The main aim of the present study was to assess the principles and results of management in periprosthetic tibial fracture. The study hypothesis was that surgical strategies provide good long-term results.

## 2. MATERIAL AND METHODS

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A two-center retrospective study included patients presenting with isolated tibial fracture around a knee prosthesis, managed in the Orthopedic and Traumatologic Surgery Departments of the university hospitals of Nancy and Metz (France) between January 10, 1997 and March 31, 2017.

### **2.1. Inclusion and exclusion criteria**

Periprosthetic fracture was defined according to <sup>(22)</sup>: location <15 cm from the joint line, <5 cm from the implant component, or in which internal fixation would cause impingement with the existing

hardware. Exclusion criteria comprised: loss to follow-up, intraoperative fracture, anterior tibial tubercle fracture, and single-compartment prosthesis.

The series comprised 15 patients: 9 right and 6 left knees, including 1 inter-implant fracture. Mean follow-up was 12 months (range, 6-120 months) (Figure 1).

The study was approved by the Research and Innovation Directorate and the review board of Nancy University Hospital (n°176, February 15, 2018).

## **2.2. Endpoints and analysis tools**

Epidemiological data (age, body-mass index (BMI), ASA score, autonomy, residential context) were analyzed according to fracture type on the Felix<sup>(2)</sup> (figure 2) and SoFCOT<sup>(4)</sup> (figure 3) classifications. Treatment modalities were collated.

Radiological criteria comprised consolidation (radiologic fusion), consolidation time, and reduction quality according to Schatzker and Lambert<sup>(23)</sup> and assembly quality according to the AO criteria<sup>(24)</sup>.

Endpoints comprised functional scores (IKS<sup>(25)</sup>, Oxford<sup>(26)</sup> (inverted), SF12 physical<sup>(27)</sup>, Parker<sup>(28)</sup> and Katz<sup>(29)</sup>), quality of life and autonomy, at post-fracture interview, 6 months and last follow-up. Adverse events up to last follow-up were collated: death, complications, surgical revision, implant revision. Implant survival was defined as implant not requiring post-fracture removal or replacement.

## **2.3. Study population**

### **Epidemiology at inclusion (Table 1)**

Table 1 presents epidemiological data. Nine patients had history of multiple surgeries on the fractured knee; 9 had at least 1 comorbidity: cognitive disorder (n=1), diabetes (n=6), inflammatory rheumatism/corticotherapy (n=2), chronic alcohol abuse (n=1).

### **Epidemiology and fracture classifications (Figure 4)**

Mean implantation-to-fracture interval was 40±32 months. The fracture involved the proximal metaphysis in 12 cases and the shaft in 3. The location was at the implant in 10 cases and at a distance in 5; 1 case involved inter-implant fracture (underlying transplatar nail). Fractures were short transverse or oblique in 7 cases, long spiroid in 1, and 3-fragment or comminuted in 7. On the Felix classification, there was 1 type 1, 9 type 2 and 5 type 3. Figure 4 shows the distribution according to the SoFCOT classification. The implant at the time of fracture was primary in 9 cases and a revision implant in 6. The implant was cemented in 13 cases, with short (≤5 cm) stem in 9 and with long stem (extension to prosthetic stem) in 5.

### **Treatment strategy and indications (Figures 5, 6, 7)**

Time to treatment was 1 or 2 days.

One patient (a 91 year-old woman with dementia and bed-ridden; Parker score 0 and Katz score 12) was managed non-operatively on a palliative strategy, tolerating slight fracture displacement, by 6 weeks' long-leg cast immobilization.

Eleven fractures were reduced and fixed, with 9 plates and 2 anterograde intramedullary nails. Two plates were standard and 7 locking, on a classical approach; cerclage was associated in 2 cases and autologous bone graft to the fracture site in 1 case due to severe bone defect; 4 fractures were SoFCOT type B1, 1 B3 and 2 C1. The 2 cases with intramedullary nailing were type C1, with cemented plateau and short stem, allowing approach, reaming and nailing. Three implant revisions were performed in first line: 2 bipolar, 1 unipolar; long stems were used, with filling by wedge or cement in case of defect; 1 fracture was SoFCOT type B3, 2 A2, 3 on primary TKA, 1 with cemented plateau, 1 without stem and 2 with short stem.

Mean time to resumption of weight-bearing was  $6\pm 3.6$  weeks, except in implant removal/replacement, where weight-bearing was resumed immediately.

#### **2.4. Statistical analysis**

Qualitative variables were reported as number and percentage, and quantitative variables as mean $\pm$ standard deviation, median with quartiles, and range. Intergroup comparison used chi<sup>2</sup> test or Fisher exact test according to sample size for qualitative variables and Student, Kruskal-Wallis or Wilcoxon test according to normality of distribution. Wilcoxon signed ranks tests were used to compare scores between admission and last follow-up. The significance threshold was set at 5%.

### **3. RESULTS**

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Mean follow-up was  $27.5 \pm 36.2$  months (range, 6-120 months).

#### **3.1. Functional results (Table 2)**

Patients graded functional results as good or excellent in 9 cases, although only 2 patients claimed recovery of prior status. At last follow-up, 12 patients were living at home and 2 in a retirement home; 1 patient died of unrelated causes.

Mean Parker score was 7 (range, 4-8.5), Oxford score 32 (range, 16-39), and total IKS score 150 (range, 85-167) with Knee and Function components 78 (range, 55-86) and 75 (range, 30-85) respectively. Mean SF-12 score at last follow-up was 37.1 (range, 26.9-51.6).

#### **3.2. Radiology results**

Consolidation was achieved in 13 of the 15 cases, at a mean  $15.3 \pm 7.5$  weeks. There were 2 cases of non-union, 1 of which was septic: 1 requiring implant revision and the other transfemoral amputation. Reduction and assembly were satisfactory in 13 and 14 cases, respectively.

### **3.3. Complications (Table 3)**

There were no fracture-related deaths. At last follow-up, there had been 13 adverse events, in 8 patients (figure 8): 3 infections, 1 scar disunion, 1 ipsilateral periprosthetic distal femoral fracture, 2 cases of secondary reduction loss (treated non-operatively), 1 lateral popliteal-sciatic palsy, 1 re-fracture under the fixation plate, 1 delayed healing, 1 aseptic non-union, 1 septic non-union related to chronic infection, and 1 fixation hardware infection not involving the TKA. There were 8 surgical revisions (including 1 iterative), with 1 secondary implant revision (cemented long-stem implant) and 1 transfemoral amputation. Survival was 10 implants without revision, 5 with: i.e., 2 in 3 at last follow-up (figures 9 and 10).

Complications and revision rates were higher in case of plate fixation, and especially for non-locking plates (11/9 complications, 7/9 revision procedures;  $p=0.2219$ ), than for first-line removal/replacement (0/3;  $p=0.2231$ ) or intramedullary nailing (0/2;  $p=0.2817$ ).

### **3.4. Comparison according to fracture type (Table 4)**

SoFCOT fracture type showed significant correlation with type of internal fixation ( $p=0.0108$ ): nailing with type C, removal/replacement with type A, locking plate with type B.

Functional results at last follow-up were poorer in SoFCOT type B, and the complications rate was higher (8/6,  $p=1$ ) and the consolidation rate lower than in types A or C ( $p=0.5181$ ); there were more cases of non-union ( $p=0.5$ ) and revision surgery (4/6;  $p=0.2817$ ), but without significant difference.

## **4. DISCUSSION**

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The main study findings confirmed the hypothesis: functional results of surgery were satisfactory given the complexity of the fractures, but prognosis was impaired by high rates of complications and revision.

### **4.1. Functional results**

Compared to similar studies, the present results were satisfactory, with 9 good or very good results out of 15, despite the high rate of complications. Quality of life and autonomy were impaired, despite acceptable knee function.

The 2005 SoFCOT symposium series<sup>(4)</sup> comprised 6 SoFCOT type C1 periprosthetic tibial fractures. Nailing was usually feasible. Bone consolidation was achieved without impairing knee function, but patients lost autonomy.

In 38 periprosthetic tibial fractures, with mean age 68.2 years and mean 15.3 months' follow-up (range, 3-24 months), Morwood<sup>(17)</sup> observed 11 proximal tibial fractures (28.9%) (4 Felix 1A, 7 Felix 2A), 6 shaft fractures (15.8%) (Felix 3A) and 21 fractures of the distal third of the metaphysis (55.3%) (Felix 3A). This corresponded to the present distribution, with predominance of SoFCOT types B and C. Treatment comprised 31 cases of plate fixation (82%), 2 of intramedullary nailing (5.3%), 4 of fusion (10.5%), and 1 of external fixation (2.6%). The consolidation rate was 76.3% (29/38) at 6 months, with 9 non-unions. The revision rate of 31.6% was lower than in the present series, with 4 lavages, 5 treatments of non-union, 1 transfemoral amputation and 1 transtibial amputation for infection and 1 megaprosthesis replacement; revision-free implant survival was 35/38.

Schreiner<sup>(16)</sup> reported 9 tibial fractures: 1 Felix type IB, 2 type IIB, 4 type IIIA, and 2 type IIIB. Mean age was 77 years (range, 65-85 years), and mean follow-up 22 months (range, 0-36 months). There were 6 open internal fixations, 1 implant replacement, 1 fusion and 1 amputation. The rate of adverse events with surgical revision was 55.6% (including, as in the present series, scar disorder, infection and re-fracture). Mean IKS score was 29 points (range, 19-39), with 41 (range, 17-72) for Knee and 53 (range, 40-70) for Function.

#### **4.2 Factors for poor prognosis**

The present results were comparable to those reported elsewhere.

For Felix<sup>(2)</sup>, type I fracture is associated with the poorest implant survival and type III with the best. Types IB and IIB frequently require implant revision, as reported by Schreiner<sup>(16)</sup>, as was also the case for SoFCOT types A and B2; results were better for Felix III (SoFCOT C), with poorer survival in Felix I and II (SoFCOT A and B). Morwood<sup>(17)</sup> reported a high rate of non-union in Felix type II (3/7; p=0.409), with 5/7 cases of revision surgery. In the present series, SoFCOT type B showed higher risk of complications and revision surgery, while type A, with first-line removal and replacement, gave good results without revision; there were also very good scores in type C, without complications.

Type B involves the metaphysis, where proximity to the implant restricts screw fixation space<sup>(16)(17)</sup> and prevents reliable primary stability<sup>(15)(30)</sup>, accounting for the high rates of secondary displacement, non-union and implant failure in these fractures that are often comminuted with a diathesis subject to osteoporosis (n=6 in the present series, with a single locking plate).

Thin metaphyseal skin cover is another negative factor in type B, making it difficult to strike a balance between the biology of fracture consolidation and the mechanics of fixation<sup>(31)(32)</sup>. The high rate of



complications in type B<sup>(16)(17)</sup> may also be due to use of a conventional approach, especially as compared to series of minimally invasive surgery, which promotes consolidation<sup>(11)(15)(33)</sup> while reducing rates of infection<sup>(17)(34)</sup>.

#### 4.3 Therapeutic techniques and strategy

The aim is to achieve solid assembly with stable implant and well-aligned limb <sup>(6)(15)(19)</sup>. Internal fixation is to be preferred in case of stable implant and adequate bone stock (SoFCOT type 1).

Several options are reported to deal with the particular technical difficulty caused by insufficient bone stock around the epiphysis <sup>(8)(33)(35)</sup>, hindering anchorage. Locking plates<sup>(9)(13)(15)</sup> improve rotational and angular stability <sup>(20)(35)(36)</sup>, but may be insufficient in periprosthetic tibial fracture; the literature reports high rates of failure <sup>(8)</sup>. In the present series, there were 7 complications and 5 revision surgeries. Schreiner<sup>(16)</sup> reported 4 cases of reduction defect. Locking plates are widely used in SoFCOT types B and C, but types A and B3 incur a high risk of secondary tibial subsidence and require using two plates <sup>(15)(35)(37)</sup>. Insufficient proximal fragment stability is a risk factor for failure <sup>(35)</sup>: fixation uses bicortical screws <sup>(33)</sup> of sufficient length <sup>(38)</sup>, through at least 8 cortices <sup>(15)</sup>, with polyaxial screws in presence of a stem.

Although not systematically applicable, intramedullary nailing is a minimally invasive option <sup>(11)</sup> allowing immediate weight-bearing. Like other authors <sup>(4)(11)</sup>, we used this technique in 2 cases of SoFCOT C1, which is the indication of choice, with excellent results.

First-line implant revision should be considered in case of loose tibial component or inadequate bone stock <sup>(11)(14)(20)(39)</sup> (SoFCOT types 2, B3 and A), with a long stem bridging the fracture site. We had very good results with this strategy: systematic consolidation, and early resumption of weight-bearing facilitating discharge home. Functional scores were better, and appeared to be lasting at a mean 4 years' follow-up in this subgroup. Revision rates did not differ from the internal fixation subgroup, and were comparable to those in the literature <sup>(40)</sup>. This option is of real interest in situations at risk of secondary failure (type B)<sup>(34)(40)</sup>. Megaprotheses and allograft are a salvage solution in case of bone defect for frail patients with low functional demand, but with high revision rates, up to 55% depending on the report, which make this an indication of last resort <sup>(6)(34)(39)(40)</sup>.

#### 4.4 Study limitations and strong-points

The study limitations comprise the retrospective design, diversity of fracture types and treatments, number of surgeons, small sample size and relatively short follow-up (although within the range of the literature). Like in most studies (Table 5), sample size limited statistical power.

The study objectives were nevertheless met, with exhaustive and reproducible qualitative and quantitative endpoints, little loss to follow-up, and a follow-up in the upper range of the literature.

## 5 CONCLUSION

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Isolated periprosthetic tibial fracture is rare but complex. The present series was one of the largest to date. Functional results of surgery were good, but quality of life was impaired and the rates of complications and of surgical revision were high despite the means at our disposal, confirming the difficulty of treating these fractures. SoFCOT type B fracture is of especially poor prognosis and should be treated with caution. Most patients undergoing surgical treatment, however, achieved consolidation without need for secondary implant revision.

**Conflicts of interests:**

Outside the present study, DM has interest in FH Orthopedics, and JP FH in Orthofix. CB, BZ, FG and JM have no interests to disclose.

**Funding:**

None.

**Author contributions:**

CB drew up the project, collected and analyzed data, wrote the article. DM was involved in drawing up the project, re-editing and correction. BZ was involved in data collection and re-editing. FG, JP and FH were involved in data collection and analysis. JM was involved in data collection.

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## **FIGURE LEGENDS**

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### **Figure 1: Flowchart**

### **Figure 2: SoFCOT classification (Symposium 2005)<sup>(4)</sup>**

*Type: A (in touch with the implant), B (contact with the stem), C (distal to the implant); 1 (well-fixed implant), 2 (loose implant), 3 (osteolysis).*

### **Figure 3: Felix classification<sup>(2)</sup>**

*Types: I (tibial plateau), II (adjacent to stem), III (tibial shaft, distal to the component), IV (tibial tubercle); A (well-fixed implant), B (loose implant), C (intraoperatively).*

### **Figure 4: Epidemiology of fractures according to SoFCOT classification<sup>(4)</sup>**

### **Figure 5: Example of SoFCOT A2 fracture: prosthesis replacement**

*X-ray of same patient: (a) arrival; (b) postoperative; (c) last follow-up.*

### **Figure 6: Example of SoFCOT C1 fracture: intramedullary nailing**

*X-ray of same patient: (a) arrival; (b) postoperative; (c) last follow-up.*

### **Figure 7: Example of SoFCOT B1 fracture: locking plate**

*X-ray of same patient: (a) arrival; (b) postoperative; (c) last follow-up.*

### **Figure 8: Incidence of main complications**

**Figure 9: Survival curves**

**Figure 10: Incidence of complications according to SoFCOT classification<sup>(4)</sup>**



## TABLES

**Table 1: Epidemiology at time of fracture**

	N	%/mean	SD
<b>Gender</b>			
Male	6	40.0	
Female	9	60.0	
<b>BMI</b>	8	30.3	7.9
<b>Age</b>	15	71.8	10.2
<b>Place of residence</b>			
Home	13	86.7	
Retirement home	1	6.7	
Rehabilitation center	1	6.7	
<b>PARKER<sup>(28)</sup></b>	15	7.0	2.6
<b>IKS KNEE (/100)</b>	15	81.1	19.4
<b>IKS FUNCTION (/100)</b>	15	78.3	30.1
<b>IKS TOTAL<sup>(25)</sup> (/200)</b>	15	159.7	48.7
<b>OXFORD<sup>(26)</sup> (inversed)</b>	15	37.7	12.8
<b>SF12<sup>(27)</sup> (physical)</b>	15	51.6	16.5
<b>KATZ<sup>(29)</sup> (if &gt;65 yo)</b>	13	3.3	3.5
<b>ASA score</b>			
1	0	0.0	
2	9	60.0	
3	6	40.0	
4	0	0.0	

*N (number); SD (standard deviation)*

**Table 2. Comparison of results before fracture and at last follow-up**

	Admission N=15			Last follow-up N=15			p*
	N	%/mean	SD	N	%/mean	SD	
<b>PARKER<sup>(28)</sup></b>	15	<b>7.0</b>	2.6	15	<b>5.9</b>	3.0	0.5926
<b>IKS KNEE (/100)</b>	15	<b>81.1</b>	19.4	15	<b>69.7</b>	21.4	0.6346
<b>IKS FUNCTION (/100)</b>	15	<b>78.3</b>	30.1	15	<b>58.3</b>	36.8	0.3091
<b>IKS TOTAL<sup>(25)</sup> (/200)</b>	15	<b>159.7</b>	48.7	15	<b>128.1</b>	57.5	0.2184
<b>OXFORD<sup>(26)</sup></b>	15	<b>37.7</b>	12.8	15	<b>27.3</b>	15.3	0.2219
<b>SF-12<sup>(27)</sup></b>	15	<b>51.6</b>	16.5	15	<b>39.4</b>	17.7	0.2231
<b>KATZ<sup>(29)</sup> (if &gt;65 yo)</b>	13	<b>3.3</b>	3.5	15	<b>3.8</b>	4.1	0.3653

*N (number); SD (standard deviation)*

*\* Fisher exact test for qualitative variables; analysis of variance or Kruskal-Wallis test for quantitative variables*

**Table 3. Complications and surgical revisions according to treatment**

	<b>Nail</b>	<b>Plate</b>	<b>Prosthesis replacement</b>
<b>Total</b>	2	9	3
<b>Complication</b>	0	11	0
<b>Surgical revision</b>	0	9	0
<b>p*</b>	0.2817	0.2219	0.2231

*\* Fisher exact test for qualitative variables; analysis of variance or Kruskal-Wallis test for quantitative variables*

**Table 4. Comparison of results at last follow-up according to SoFCOT fracture type<sup>(4)</sup>**

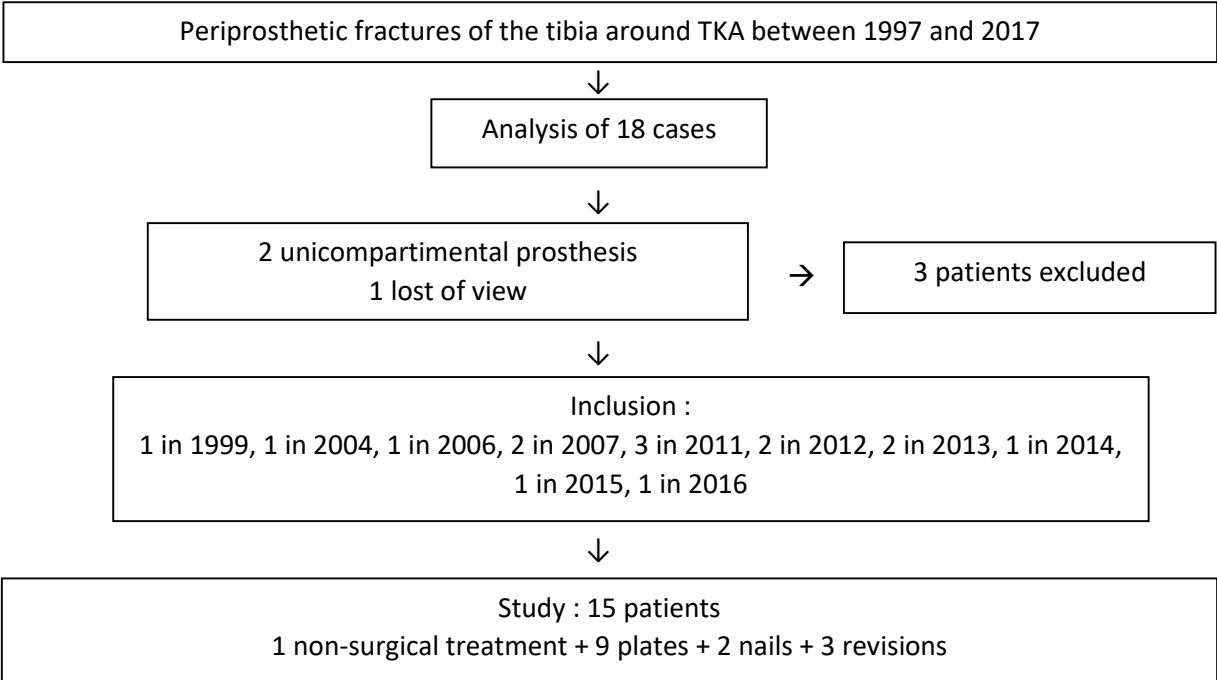
	Total N= 15			A N=3 (20.0%)			B N=6 (40.0%)			C N=6 (40.0%)			p*
	N	%/mean	SD	N	%/mean	SD	N	%/mean	SD	N	%/mean	SD	
				n			n			n			
<b>Early complications &lt;3 months</b>													0,2817
	6	<b>40.0</b>		1	<b>33.3</b>		4	<b>66.7</b>		1	<b>16.7</b>		
<b>Late complications 3-6 months</b>													1,0000
	4	<b>28.6</b>		1	<b>33.3</b>		2	<b>33.3</b>		1	<b>20.0</b>		
<b>Late complications &gt; 6 months</b>													1,0000
	3	<b>23.1</b>		0	<b>0.0</b>		2	<b>33.3</b>		1	<b>20.0</b>		
<b>Healing (weeks)</b>	12	<b>92.3</b>		3	<b>100.0</b>		4	<b>80.0</b>		5	<b>100.0</b>		1.0000
	12	<b>15.3</b>	7.5	3	<b>10.7</b>	2.3	4	<b>15.5</b>	8.7	5	<b>18.0</b>	8.5	0.5181
<b>Non-union</b>	3	<b>30.0</b>		0	<b>0.0</b>		2	<b>40.0</b>		1	<b>50.0</b>		0.5000
<b>Surgical revision</b>	6	<b>40.0</b>		1	<b>33.3</b>		4	<b>66.7</b>		1	<b>16.7</b>		0.2817
<b>PARKER<sup>(28)</sup></b>	15	<b>5.9</b>	3.0	3	<b>7.3</b>	2.1	6	<b>4.7</b>	3.8	6	<b>6.5</b>	2.4	0.5926
<b>KATZ<sup>(29)</sup> if &gt;65 yo</b>	15	<b>3.8</b>	4.1	3	<b>2.0</b>	3.5	6	<b>5.8</b>	4.9	6	<b>2.7</b>	3.2	0.3653
<b>IKS knee</b>	15	<b>69.7</b>	21.4	3	<b>83.0</b>	4.4	6	<b>60.5</b>	27.7	6	<b>72.3</b>	17.2	0.6346
<b>IKS function</b>	15	<b>58.3</b>	36.8	3	<b>80.0</b>	8.7	6	<b>41.7</b>	41.2	6	<b>64.2</b>	37.5	0.3091
<b>IKS TOTAL<sup>(25)</sup></b>	15	<b>128.1</b>	57.5	3	<b>163.0</b>	11.1	6	<b>102.2</b>	67.9	6	<b>136.5</b>	54.5	0.2184
<b>OXFORD<sup>(26)</sup></b>	15	<b>27.3</b>	15.3	3	<b>37.0</b>	4.4	6	<b>19.2</b>	16.2	6	<b>30.5</b>	15.3	0.2219
<b>SF12<sup>(27)</sup></b>	15	<b>39.4</b>	17.7	3	<b>49.5</b>	5.6	6	<b>30.6</b>	19.3	6	<b>43.1</b>	17.8	0.2231
<b>Loose implant</b>	4	26.7		<b>3</b>	<b>100.0</b>		0	0.0		<b>1</b>	<b>16.7</b>		<b>0.0088</b>
<b>Treatment</b>													<b>0,0108</b>
Non-operative	1	6.7		0	0.0		1	16.7		0	0.0		
Standard plate	2	13.3		0	0.0		1	16.7		1	16.7		
Locking plate	7	46.7		0	0.0		<b>4</b>	<b>66.7</b>		3	50.0		
Nail	2	13.3		0	0.0		0	0.0		<b>2</b>	<b>33.3</b>		
Prosthesis replacement with long stem	3	20.0		<b>3</b>	<b>100.0</b>		0	0.0		0	0.0		

N (number); SD (standard deviation)

\* Fisher exact test for qualitative variables; analysis of variance or Kruskal-Wallis test for quantitative variables

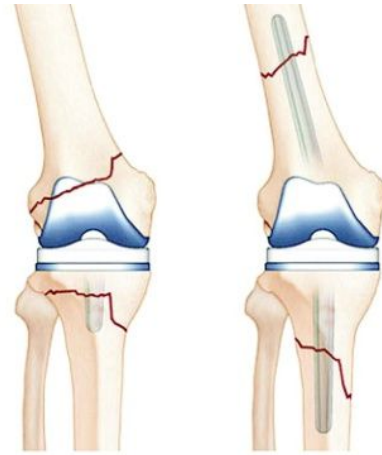
**Table 5 : Recent available studies of isolated postoperative tibial fracture around TKA**

<b>Authors</b>	<b>Year</b>	<b>N</b>	<b>Age</b>	<b>Follow-up</b>	<b>Osteosynthesis /Prosthesis replacement</b>	<b>Complications /Infection</b>	<b>Fracture healing</b>	<b>Surgical revision</b>	<b>IKS total at last follow-up</b>
<b>Present study</b>	<b>2019</b>	<b>15</b>	<b>72</b>	<b>28 months</b>	<b>11/3</b>	<b>8/4</b>	<b>86.7%</b>	<b>66%</b>	<b>128.1</b>
<b>Morwood<sup>(17)</sup></b>	<b>2019</b>	<b>38</b>	<b>68</b>	<b>15 months</b>	<b>33/0</b>	<b>12/6</b>	<b>76.3%</b>	<b>31.6%</b>	<b>/</b>
<b>Schreiner<sup>(16)</sup></b>	<b>2019</b>	<b>9</b>	<b>77</b>	<b>22 months</b>	<b>6/1</b>	<b>6/3</b>	<b>66.7%</b>	<b>55.6%</b>	<b>95</b>
<b>Kim<sup>(15)</sup></b>	<b>2016</b>	<b>16</b>	<b>63</b>	<b>30 months</b>	<b>16/0</b>	<b>3/2</b>	<b>87.5%</b>	<b>12.5%</b>	<b>172</b>

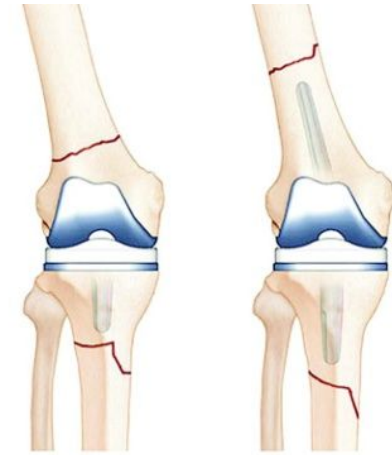




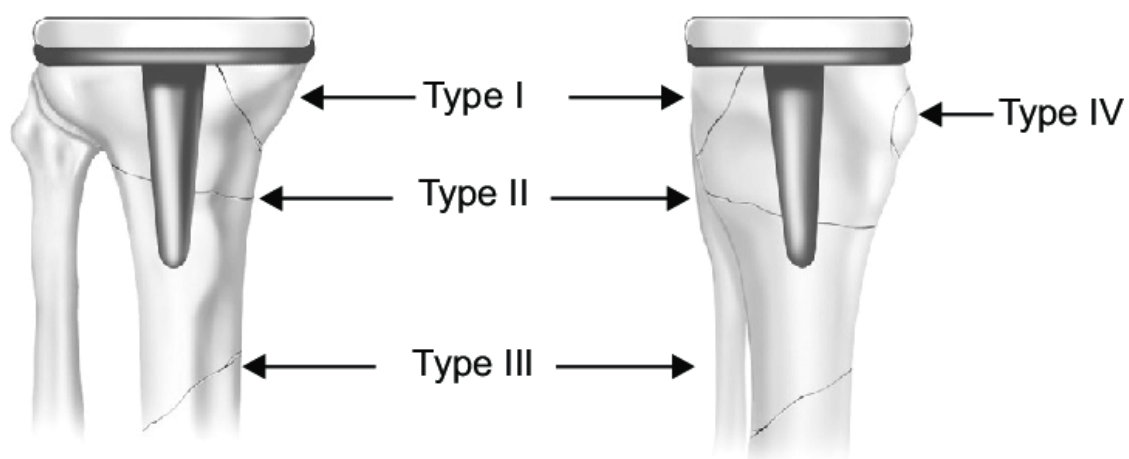
Type A



Type B



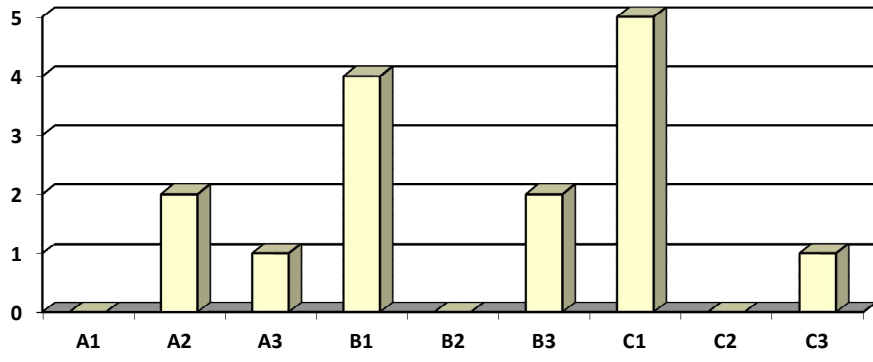
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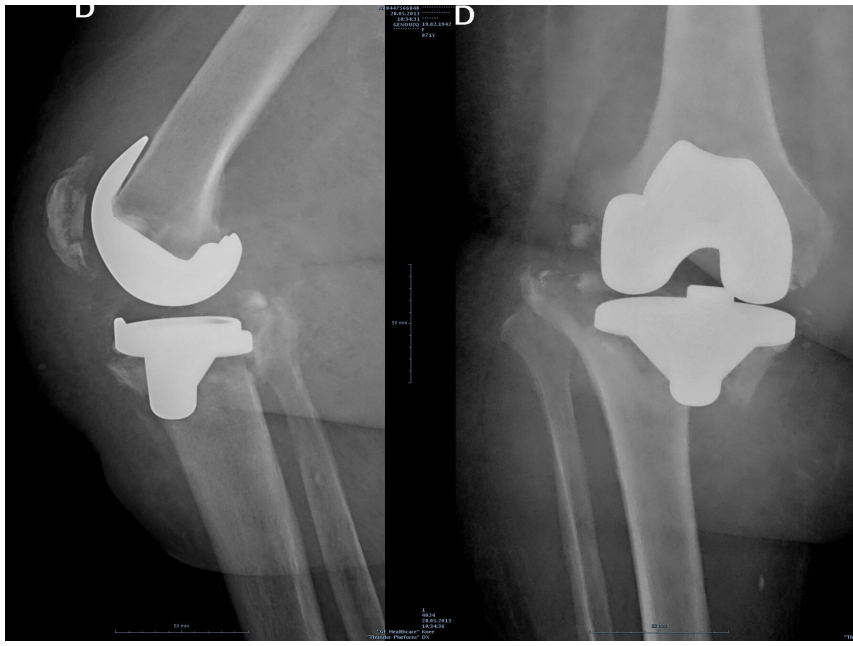


Anteroposterior

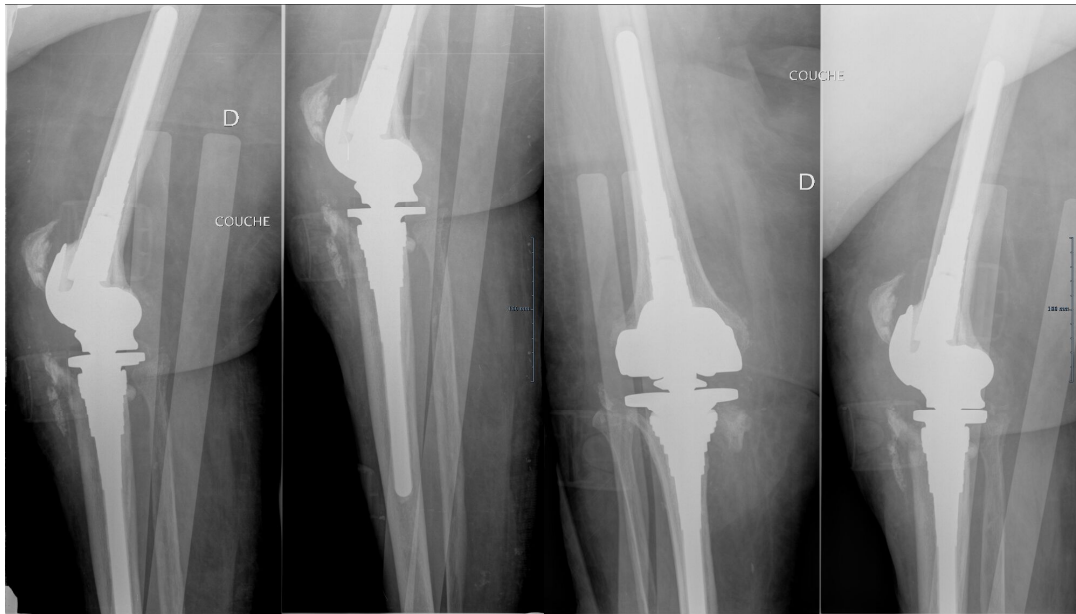
Lateral







(a)



(b)



(c)



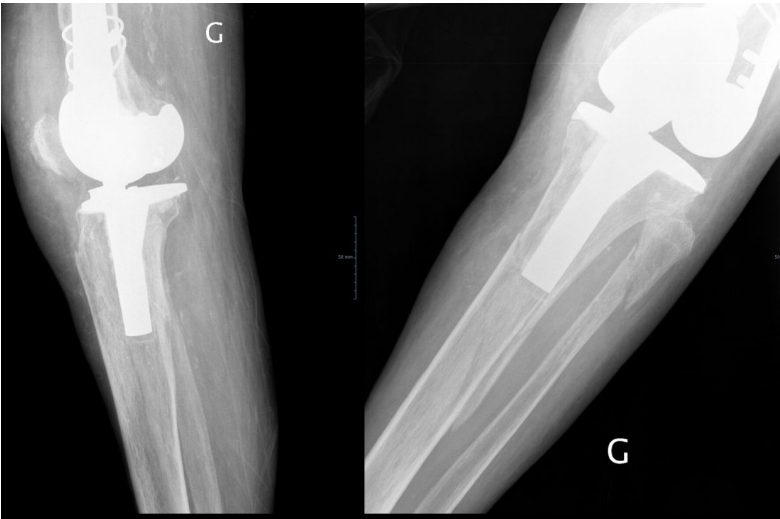
(a)



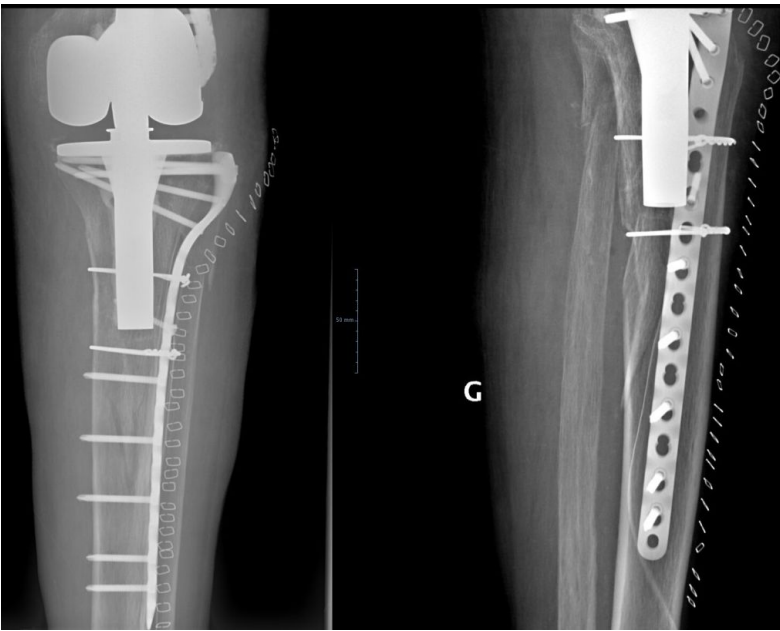
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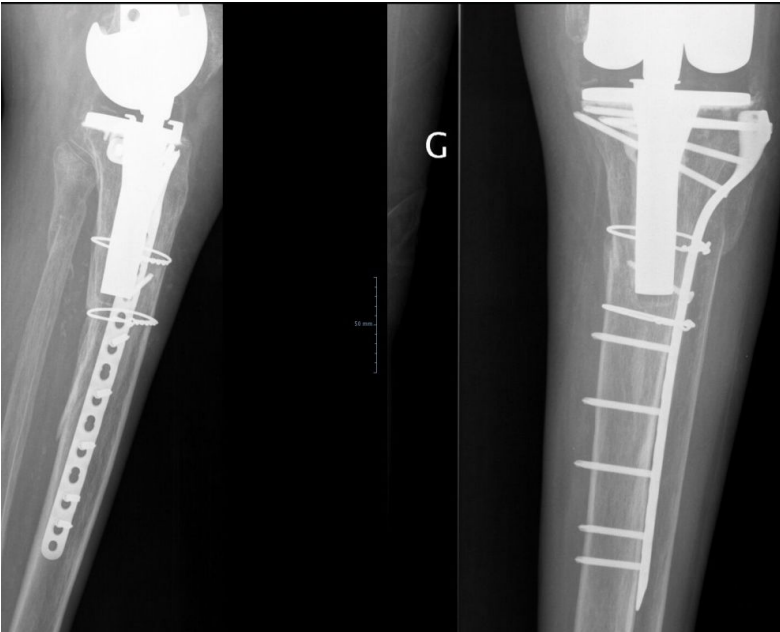
(c)



(a)



(b)



(c)

