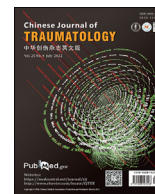


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Case Report

Anterior tibiofemoral dislocation after total knee arthroplasty: A case report and literature review

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ABSTRACT

Anterior tibiofemoral dislocation after total knee arthroplasty is an extremely rare and serious event. Amongst English-published papers, we found only 15 relevant cases, 3 of which presented vascular complications. This manuscript aims to present a 77-year-old woman with a TC-Plus (Smith & Nephew) cruciate-retaining type in first time of knee prosthesis, who suffered an anterior tibiofemoral dislocation and were admitted to our hospital. The clinical management and outcome were evaluated. Furthermore, a review of literature was performed. We concluded that early detection and surgical intervention of vascular injury is the key in the survival of the limbs. If there is still knee instability after acute recovery, it seems that revision surgery with constrained total knee arthroplasty can bring about good clinical and functional results.

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Introduction

Total knee arthroplasty (TKA) is one of the most performed procedures in orthopaedic surgery worldwide. Some studies project a 3%–4% yearly increment of this intervention in the next 10 years. In most cases, the functional results and patient satisfaction are good or very good, and more than 90% of them exceed 15-year survival.¹ The possible complications of TKA is dislocation of the prosthetic knee, with a frequency in literature around 0.15%–0.50% in primary TKA, and 3.30% in revision surgery. Excessive residual ligamentous laxity at the time of the final adaptation of the implant is the main cause of instability in this type of prosthesis.¹ Nevertheless, within knee prosthesis dislocations anterior tibiofemoral dislocation is a very rare event. Amongst English-published papers, we found only 15 cases, 3 of which presented vascular complications.

This manuscript aims to present a case of anterior tibiofemoral dislocation in a primary TKA admitted to our hospital, and the clinical management and outcome of the case were evaluated.

Furthermore, the referenced 15 cases mentioned above describing in a total of 12 publications, were reviewed to discuss the possible causes of instability in a dislocated knee prosthesis and subsequent management of these episodes.

Case report

A 77-year-old woman with a TC-Plus (Smith & Nephew) cruciate-retaining (CR) type knee prosthesis implanted in her left knee 15 years ago was admitted to our hospital with pain and deformity in this knee. She was 155 cm tall and weighed 59 Kg, with a body mass index (BMI) of 24 (65, upper reference limit). No complications with TKA had been reported until then, and 10 years before this incident the patient had received another TKA on her right knee, also without any issues.

Four months before the dislocation episode, the patient had suffered an indirect torsional trauma on her left knee during a fall. Before this accident, the patient was totally independent for daily activities and had an active life. She was then brought to our centre by ambulance. A deformity in antecurvatum was observed with maximal extension, beside instability for both the valgus and varus at 0° and 30°. Moreover, she presented with pain complains, and ecchymosis over the medial epicondyle and fibular head was found. Tibiofemoral dislocation was not present in the patient's radiographs, but two avulsions were noted: one at the medial epicondyle

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and the other at the fibular head (Fig. 1). These findings were not present in the previous imaging studies; none of neurovascular complications was observed following this episode.

The patient was diagnosed with a probable left knee prosthesis tibiofemoral dislocation with several bone avulsions at the medial epicondyle and the fibular head, compatible with medial collateral ligament and lateral collateral ligament injuries, respectively. We inferred that this dislocation reduced itself spontaneously before the patient arrived at our centre. This dislocation episode was managed with long leg splint and no-weight bearing for 6 weeks, and then later replaced with an articulated orthosis with a free range of 0°–90° motion and progressive weight-bearing. During the follow-up period, the patient clinically improved, with a seemingly stable knee and mild pain at the fibular head.

Four months after this traumatic event, when she got up from a sitting position, her left knee gave out and she fell. Upon arrival at our emergency room, a striking deformity in the left knee was noted, with an anterior displacement of the tibia relative to the femur. Thus, anterior tibiofemoral dislocation of the left knee prosthesis was observed on radiographs (Fig. 2). Moreover, distal pulses were absent before closed reduction. A closed reduction of the dislocation was performed urgently under general anaesthesia in the operating room. After reduction, and still, in the operating room, the knee was notably unstable and distal pulses were absent during the Doppler ultrasound examination.

Given these findings, we consulted with the vascular surgery reference service, which recommended a computed tomography angiography, and thus a thrombosis of the popliteal artery was proved (Fig. 3). With this diagnosis, a popliteal-popliteal bypass was performed, and the dislocation was then stabilized with an external fixator type “Hoffmann II” (Stryker) in the same procedure (Fig. 4). During the hospital stay, the patient evolved without complications, nor neurological and vascular deficits.

The patient was discharged a week later, and allowed partial weight bearing on the affected limb. She kept the fixator for 4 months without any complications. Afterwards, the fixator was removed on a scheduled surgery, which observed that a non-tolerable instability in the frontal and sagittal plane both in extension and in flexion was still present intraoperatively. Therefore, the surgical replacement of the knee prosthesis was scheduled for later, since the soft tissues around the fixator pins were sub-optimal for a prosthetic surgery at the time.

Nine weeks later, we proceeded with the replacement of the knee prosthesis by implanting a hinge-constrained prosthesis:

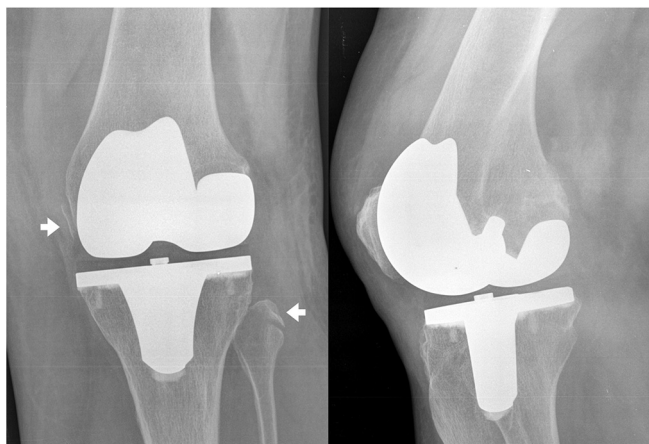


Fig. 1. Medial epicondyle and fibular head avulsions after first trauma episode.



Fig. 2. Anterior tibiofemoral dislocation of total knee arthroplasty.

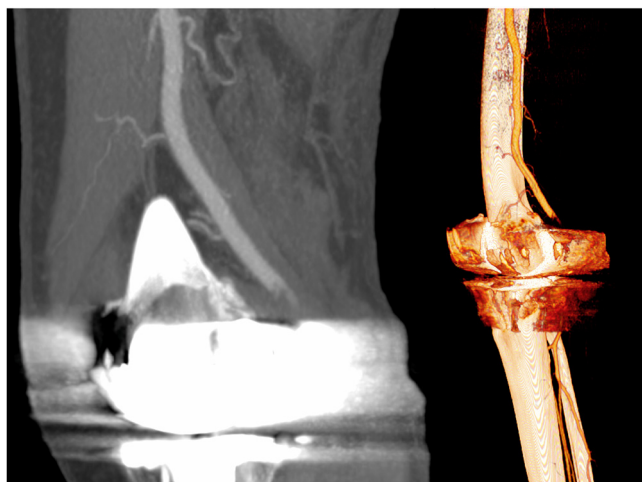


Fig. 3. Computed tomography angiography showing the thrombosis of the popliteal artery.

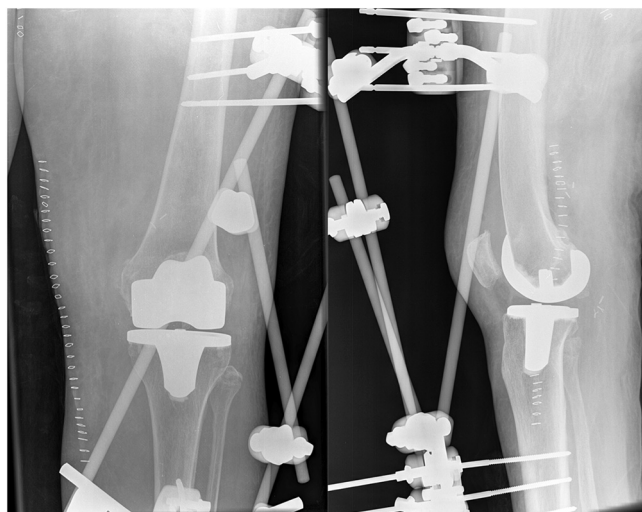


Fig. 4. Dislocation stabilized with external fixator.



Fig. 5. Complete rupture of collateral ligaments and posterior cruciate ligament.

rotating hinge knee type (RHK - Zimmer), without complications. Intraoperatively, the complete lesion of the collateral ligaments, both medial and lateral, as well as the posterior cruciate was observed (Fig. 5). However, there is no significant wear of polyethylene, of which the components were neither loosening nor malposition. At the 8th month post-surgery, the patient had no pain at the knee, with a range of 0°–90° joint balance, both passive and active, without neurovascular complications and no signs of prosthetic loosening in the radiograph (Fig. 6). For 3 years the patient continued with the follow-up without new events.

Discussion

Anterior tibiofemoral dislocation, in patients with a prior functioning knee prosthesis, is an extremely rare and serious event.² The first dislocations of knee prosthesis were described by Insall et al.³ but they were posterior dislocations. Wang et al.⁴ were the first authors to describe an anterior tibiofemoral dislocation of a knee prosthesis in 1997, with 3 cases of anterior tibial displacement after CR TKA. Since this article to the present day, we found only 12

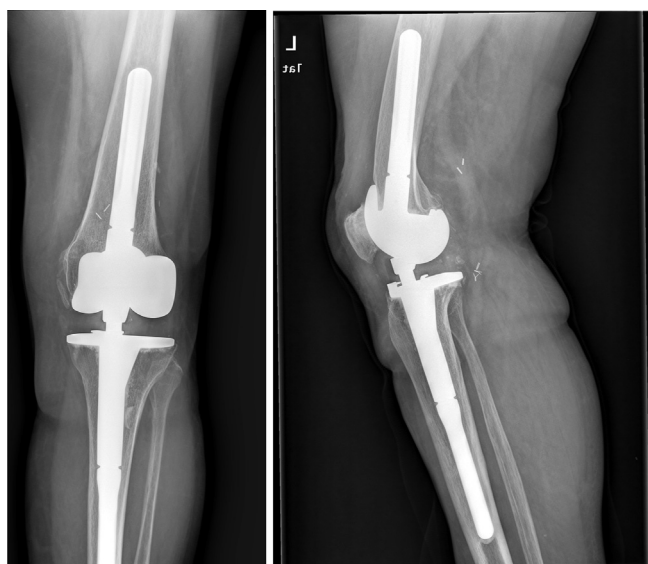


Fig. 6. Rotating hinge knee prosthesis 8 months after revision surgery.

previous cases of anterior dislocation of knee prosthesis reported in English (Table 1).

The patients mentioned above aged from 52 to 89 years old. Our patient was 77 years old at the time of the dislocation episode. In Rouquette et al.'s 2018 review¹ (including both posterior and anterior knee prosthesis dislocation), patients' age ranged from 46 to 85 years old, and the mean age was 67.5 years. This data are similar with our review, and thus we have dismissed the patient's age as a crucial factor in anterior dislocation of the knee prosthesis. Except for a case described by Wang et al.⁴, all the anterior dislocation episodes that were found in the literature occurred in women, including ours. In Rouquette et al.'s¹ review, 64.4% of all knee prosthesis dislocations happened in women. This could be due to three factors, which prevalence amongst the general population usually varies with the patient's sex: prevalence of TKA, body weight and ligamentous laxity. First of all, knee prosthesis is implanted more often in women than in men (56% according to the 2017 Swedish Registry⁵ and 56.8% according to the 2017 English Registry⁶). Contrarily, in 2014 in Europe,⁷ 30.5% of all women were overweight compared to 44.7% of all men, and both genders had a 15.9% prevalence of obesity. Lastly, according to several literature,^{8,9} there seems to be a significantly higher knee ligamentous laxity in women in general. Considering all these findings, in the opinion of these authors, there are only few studies supporting evidence that the higher knee ligament laxity in women may be related to explaining this epidemiological finding.

In our review of the published papers, since the arthroplasty surgery, the time between TKA and the first anterior dislocation episode ranges from 6 months to 16 years. In the case described above, dislocation took place 15 years after the implantation of the knee prosthesis. In their review, Rouquette et al.¹ established a mean time of 27.1 months (roughly 2 years) ranging from less than a month to 18 years; however, they pointed out that it doubles in case of anterior dislocation (mean time of 65.9 months or roughly 5.5 years). We would like to stress that in our review all the authors described that the polyethylene wore out severely. Thus, we could infer that the range of time and the wear of implant are more preponderant in anterior dislocation than in posterior ones. It is necessary to highlight the fact that no excessive polyethylene wear or malposition of the components was found in our patient during the procedure.

Eleven of the revised cases presented CR type after TKA, compared to four with a posterior-stabilized type. This difference could be since, in CR type, stability and more so in flexion, relies on the posterior cruciate ligament (PCL). Several studies have shown an important correlation between the degree of arthrosis and PCL's histological degeneration.¹ Moreover, conditions like rheumatoid arthritis, renal insufficiency or metabolic disorders, like diabetes, produce a gradual PCL deterioration.¹⁰ Thus, we consider that CR type knee prosthesis's indication should be adjusted due to the apparent increased risk of anterior dislocation. In our case, the patient did not present any of the conditions described above.

Furthermore, different risk factors were suggested as possible causes that could lead to an anterior dislocation. Evidently, almost all of the causes leading to knee prosthesis's instability are showing in Table 2. Moreover, over a normal functioning implant, a high BMI or an important trauma could trigger the episode with no other instability factors implied.² It clearly seems that the traumatic mechanism needed for an anterior dislocation is a violent hyper-extension plus a rotational element.¹¹ In our case, enough intensity trauma produced a complete rupture of both collateral ligaments and the PCL, therefore resulting in the instability that led to the tibiofemoral anterior dislocation in the second traumatic episode.

Since it is such a rare event, there is no consensus about the management of the prosthesis after the reduction of the dislocation

Table 1
Description of included studies and individual data extraction.

Study	Age (years)	Gender	Time TKA-dislocation	Follow-up problems	Primary TKA	Main risk factor	Vascular complications	Neurological complications	Management	Outcome
Addevico et al. ² (2018)	72	Female	3 years	None	CR	Traumatic	Popliteal artery	Tibial and common fibular nerve	Revascularization syndrome	Not recovered
Ahn et al. ¹¹ (2015)	65	Female	8 years	None	CR	Traumatic	None	None	Rotating hinge knee prosthesis	Satisfactory
Conti et al. ¹⁷ , 2014	74	Female	10 years	Alzheimer	PS	Polyethylene wear	None	None	Conservative treatment	Satisfactory
Sato et al. ¹⁸ (2012)	82	Female	16 years	3 months of catching and pain	CR	Polyethylene and tibial plate wear	None	None	Polyethylene revision	Satisfactory
Lee et al. ¹⁹ (2012)	55	Female	11 years	None	PS	Polyethylene wear and multifactorial	None	None	Conservative treatment	Inestable revision pending
Yan et al. ¹² (2010)	89	Female	8 years	1 year of catching and pain	PS	Severe preoperative deformity	None	None	Press fit condylar sigma prosthesis	Satisfactory
Villanueva et al. ¹⁵ (2010)	65	Female	Not found	Pain and instability	CR	Tibial plate malpositioning and instability	Ascending geniculate artery	Common fibular nerve (transitory)	PS prosthesis	Satisfactory
Aderinto et al. ¹⁶ (2009)	67	Female	6 years	Obesity	CR	Obesity - 109 kg	Popliteal artery (bypass ok)	Tibial and common fibular nerve	External fixator	Amputation pending
Wazir et al. ²⁰ (2007)	72	Female	10 years	None	CR	Polyethylene wear	None	None	Conservative treatment	Satisfactory
Tuoheti et al. ¹³ (2004)	52	Female	11 years	Subluxation 1 year before. Conservative treatment	CR	PCL degeneration and osteoporosis	None	None	Total stabilizer prosthesis	Satisfactory
Mine et al. ¹⁴ (2004)	66	Female	16 months	Tibial revision and patellar tendon rupture 8 m. after primary	PS	Traumatic: patellar tendon rupture	None	None	Rotating hinge knee prosthesis	Satisfactory
Pao et al. ¹⁰ (2003)	56	Female	1.11 months 2.5 years	Metabolic disorders	CR	PCL degeneration	Popliteal artery	Tibial and common fibular nerve	Conservative treatment (1st episode)	Amputation (2nd episode)
Wang et al. ⁴ (1997) ^a	1.73 2.68 3.79	1.Female 2.Female 3.Male	1. 3 years 2. 6 years 3. 6 months	3rd: knee sprain	1.CR 2.CR 3.CR	1.PCL dysfunction 2.PCL dysfunction 3.Charcot + instability	None	None	1.PS 2.PS 3.PS	1.Satisfactory 2.Satisfactory 3.Unsatisfactory

TKA: total knee arthroplasty, CR: cruciate-retaining, PS: posterior-stabilized, PCL: posterior cruciate ligament.

^a Three cases in the study.

Table 2
Main risk and contributing factors (n = 15).

Main risk	Description	n	
Patient Comorbidities (previous to surgery)	Basal condition:		
	• Obesity (BMI > 30)	1	
	• Overweight	2	
	Previous diseases:		
	• Alzheimer	1	
	• Severe rheumatoid arthritis + osteoporosis	1	
	• Diabetes + renal insufficiency	1	
	• Charcot arthropathy	1	
	Severe preoperative deformity:		
	• Congenital Femur Antecurvatum	1	
	Surgical related issues	Ligament imbalance:	
		• Frontal plane - collaterals (mainly MCL)	6
• Sagital plane - PCL		7	
Implants malposition			
• Excessive tibial tilt		1	
• Tibial plate mal rotation		1	
• Femur implant malposition		1	
Extensor mechanism incompetence			
• Quadriceps atrophy		1	
• Patellar tendon rupture		1	
High-energy trauma in previous well-functioning implant		3	
Polyethylene wear (>10 years after primary implant of knee prosthesis)		5	

BMI: body mass index, MCL: medial collateral ligament, PCL: posterior cruciate ligament.

once vascular conditions are solved (or not present at all); therefore, the treatment should be individualized. Some authors are in

favor of conservative management of approximately 3 months with splinting and no-weight bearing for 4–6 weeks,¹¹ and afterwards

with functional orthosis and progressive weight-bearing until full ligaments healing. If instability persists after this treatment, revision surgery should be considered, through constrained type TKA. It is also recommended to wait at least 3 months before revision surgery to decrease neurovascular complications (structures damaged in the dislocation episode).²

We presume that, in our case, management of the first traumatic episode (4 months before the anterior dislocation) was correct, taking into account the bibliographic findings and the patient's evolution. Perhaps a more thorough evaluation of residual TKA's instability should have been carried out, especially by a skilled knee arthroplasty orthopaedic surgeon to assess the prospect of a prosthesis revision at the time. Of all the authors reviewed, solely 4 of them have revised constrained type TKA's,^{11–14} as done with our patient. In all cases, there was a good clinical and functional result after revision surgery.

In native knee dislocations, the estimated incidence of vascular injury ranges between 30% and 60%,² whereas for knee prosthesis dislocations it is much lower (about 5%),¹ since the traumatic energy needed is much lower to trigger the event. In our review, 4 cases had associated neurovascular injury at the knee: 1 case had an injury of the ascending geniculate artery and transitory palsy of the fibular nerve,¹⁵ while 3 cases presented an injury of the popliteal artery and sciatic nerve palsy. From the latter, one of them required the amputation of the injured limb,¹⁰ while the other two presented a poor evolution, currently awaiting amputation.^{2,16} Such catastrophic consequences of these vascular injuries translate in a need by the authors to recommend the appropriate vascular studies after the dislocation episode, even if pulse and ultrasound findings are normal, since surgical examination of the vascular injury should be carried out in the first 8 h after the trauma.¹⁷

In our case, the patient suffered an injury of the popliteal artery, which required a local bypass. Therefore, an external fixator was required to stabilize the knee, thus preventing bypass alterations. Different from the cases described in the revised literature, our patient recovered from the vascular episode and was able to be subjected to the revision surgery of TKA.

This study has, however, some limitations. First of all, our study is a case report of an extremely rare event, with only a handful of cases published. Also, selected only English-written papers have restricted even more the hypothetical sample size of our review. Therefore, it is very difficult, at present, to extract high quality evidence from that analysis.

Anterior tibiofemoral dislocation of knee prosthesis is an extremely rare and serious event. Therefore, its treatment is yet to be fully standardized. What is clear is that dislocation should be reduced urgently and that the limb's vascular status should be assessed through a computed tomography angiography as soon as possible. In our case, early detection and surgical intervention of the vascular injury was the key in the survival of the limb. If knee instability is still present after acute recovery of the episode, it seems plausible that revision surgery with constrained TKA leads to good clinical and functional results.

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There are no financial conflicts of interest to disclose.

Ethical statement

The authors obtained written informed consent from the patient.

Declaration of competing interest

No potential conflict of interest by the authors.

Author contributions

Alejandro Almoguera-Martinez: conceptualization, methodology, data curation, writing – original draft, writing review and editing. Catarina Godinho-Soares: software, data curation, writing – review and editing. Valentín Calcedo Bernal: supervision, validation. José-Antonio Pareja Esteban: supervision. Marta Garcia-Lopez: supervision. Miguel Ángel Plasencia Arriba: resources

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