



## Case Report

# Fat Necrosis Following Application of a Tourniquet During Total Knee Arthroplasty

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## ABSTRACT

A 60-year-old female underwent a right total knee arthroplasty but developed postoperative pain, swelling, and decreased knee range of motion. An ultrasound scan showed findings suggestive of fat necrosis at the site of previous tourniquet application. Following regular reviews, intensive physiotherapy, and analgesia, symptoms only started to resolve 5 months following the primary surgery. Fat necrosis of the thigh is highly uncommon following the application of tourniquets during total knee arthroplasty. This case was treated successfully without complications using nonoperative measures.

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## Introduction

Total knee arthroplasty is associated with significant bleeding, and using a tourniquet has become a routine step to control intraoperative blood loss [1]. Apart from controlling the amount of intraoperative blood loss, tourniquets offer other advantages, such as better visualization of the operating field and providing drier bone surfaces that would improve cement interdigitation [2]. However, the use of a tourniquet is still controversial. A meta-analysis by Tai et al. noted that using a tourniquet is associated with an increased incidence of complications, such as deep vein thrombosis and wound problems [3]. In addition, they also commented that patients who had a tourniquet applied often complained of postoperative thigh pain. However, factors such as direct pressure onto nerves and soft tissues and reactive hyper-perfusion following deflation of the tourniquet were thought to be significant contributing factors [3]. Conversely, a randomized controlled trial by Goel et al. showed that tourniquets resulted in significantly decreased blood

loss during total knee arthroplasties and did not adversely affect early postoperative outcomes compared to patients with no tourniquets [4].

This case report describes the development of fat necrosis following the application of a tourniquet during routine total knee arthroplasty, which is an extremely rare occurrence. Schmidt-Hermes and Loskant first mentioned the presence of fat necrosis in 1975, who described such lesions in the breast [5]. Most reported cases of necrosis of subcutaneous fat were associated with pancreatitis, subcutaneous injections, trauma, and collagen vascular diseases [5]. The first-ever reported case of fat necrosis of the thigh following a tourniquet for a total knee replacement was by Tamvakopoulos et al. in 2005 [6]. In their case, the lump and pain resolved 6 weeks following the operation [6].

## Case history

The patient has provided written informed consent for publication of the case report. A 60-year-old female underwent a right total knee arthroplasty following a diagnosis of tricompartmental osteoarthritis (Fig. 1). She had undergone a routine preoperative assessment. She was noted to have a surgical history relevant to a low-segment caesarean section, hysterectomy with bilateral salpingo-oophorectomy, appendectomy, and multiple surgeries to

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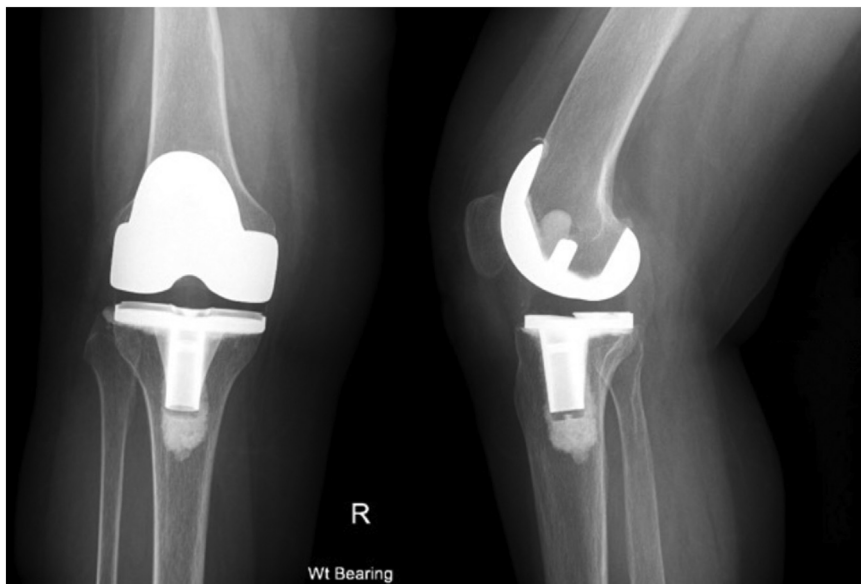
**Figure 1.** Radiographs taken preoperatively (anteroposterior and lateral views) showing evidence of tricompartmental osteoarthritis of the right knee.

remove ganglions from the right hand. Her body mass index was  $28.8 \text{ kg/m}^2$ , with a height of 1.55 meters and a weight of 69.3 kilograms. No nutritional abnormalities were identified during the preoperative assessment. Following medical clearance, she was deemed fit to undergo surgery.

A routine right total knee arthroplasty was carried out using a midline incision and a medial parapatellar approach. During the procedure, the patient was supine with a tourniquet applied to the right thigh and inflated to 300 mmHg for 65 minutes. The patient was also started on rivaroxaban postoperatively for prophylaxis against deep vein thrombosis. She remained stable throughout the immediate postoperative period. A radiograph of her right knee showed good position and alignment of the implants (Fig. 2). A physiotherapist assessed the patient postoperatively, and she was deemed stable to be discharged home.

During the first week following surgery, the patient noted the development of increasing pain, discoloration, and swelling of the right thigh and knee. A Doppler ultrasound scan was done to rule out evidence of deep vein thrombosis in her right lower limb. After another 2 weeks, the patient underwent computed tomography scanning of her right knee due to persistent pain, which showed that the implants were well-positioned and intact.

The patient was seen again as there was no pain improvement in her right thigh and knee. She could not fully extend the right knee due to pain on examination. The wound over the anterior aspect of the right knee had healed completely. Swelling and palpable lumps were present throughout the subcutaneous tissue of the right thigh and knee, at and below the level where the tourniquet would have been sited. There was tenderness on palpation of the medial and lateral aspects of the distal thigh, associated with dysesthesia in the



**Figure 2.** Radiographs taken postoperatively (anteroposterior and lateral views) showing the prosthesis in situ following right total knee arthroplasty.

same areas of tenderness. The neurovascular examination was otherwise normal. The range of movement of the right knee during the review was 20 to 60 degrees in flexion and extension. Inflammatory markers were also taken to screen for an infection, which showed normal erythrocyte sedimentation rate and C-reactive protein levels. A repeat radiograph of her right knee showed no change in the prosthesis position. Given this persistent pain with no evident focus, an ultrasound scan was carried out, which showed ill-defined diffuse echogenicity of fat with interspersed small subcutaneous fluid pockets and increasing acoustic shadowing, suggesting evidence of evolving fat necrosis (Fig. 3). The patient was referred for physiotherapy to improve her range of movement and was given regular analgesia.

The patient was followed up and regularly monitored for any changes. Pain, swelling, and knee range of movement only started to resolve 5 months after the operation following extensive physiotherapy and pain management. A repeat ultrasound scan showed that the fat necrosis had almost entirely resolved (Fig. 4). She was reviewed 7 months following the surgery and was noted to be mobilizing without walking aids and managed to resume light work duties since the pain had resolved.

## Discussion

Fat necrosis is a benign condition where lobules of adipose tissue are thought to develop vascular insufficiency following trauma [7]. However, the incidence of trauma in cases of fat necrosis is documented in less than one-third of patients. In their retrospective review, Kiryu et al. noted a history of trauma in only 13 cases who developed fat necrosis [8]. Still, they also commented that most lesions were present in areas that would be subjected to minor traumas, thus favoring the theory of the association between trauma and fat necrosis [8].

Fat necrosis usually presents as a tender mass [8]. Histologically, lesions usually consist of a core of necrotic fat cells surrounded by a fibrous capsule [7]. On radiological evaluation, areas of fat necrosis may appear as small, spiculated, nonencapsulated lesions or large, encapsulated mass-like lesions that may need to be differentiated from malignant soft-tissue tumors [9].

The case described is a very rare occurrence. However, the use of tourniquets remains controversial given the conflicting evidence regarding their risks and benefits [2]. A prospective, single-blinded trial by Liu et al. published in 2014 had shown that patients who did not have a tourniquet inflated during a total knee arthroplasty experienced less pain in the immediate postoperative period than the group with a tourniquet applied [10]. However, a systematic review by McCarthy Deering et al. in 2019 found no significant

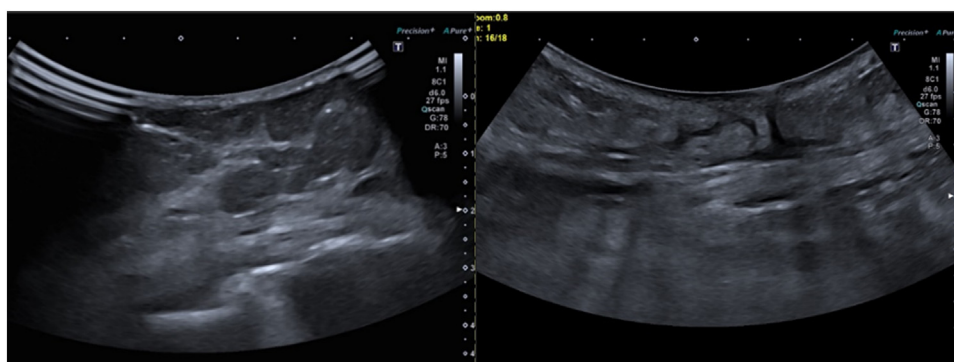
differences in pain scores and range of movement in patients who had a tourniquet applied intraoperatively and those who did not [2].

Total knee arthroplasty is associated with significant blood loss which may necessitate blood transfusions [11]. However, there is still debate whether a tourniquet affects the amount of blood loss associated with total knee arthroplasty [12]. In their prospective, double-blinded, randomized controlled trial, Goel et al. noted that the group who did not have a tourniquet applied intraoperatively had experienced a significantly increased amount of blood loss compared to patients who had a tourniquet applied [4]. However, there was no difference in functional outcome scores and pain scores between the 2 groups [4]. A meta-analysis published by Li et al. showed that patients who had a tourniquet applied during surgery had a significantly decreased intraoperative amount of bleeding [13]. Nevertheless, there was increased postoperative bleeding compared to patients who did not have a tourniquet applied. Following a review of the results, the authors also commented that the 2 groups showed no significant difference in the total amount of blood lost (the sum of intraoperative and postoperative blood loss) [13].

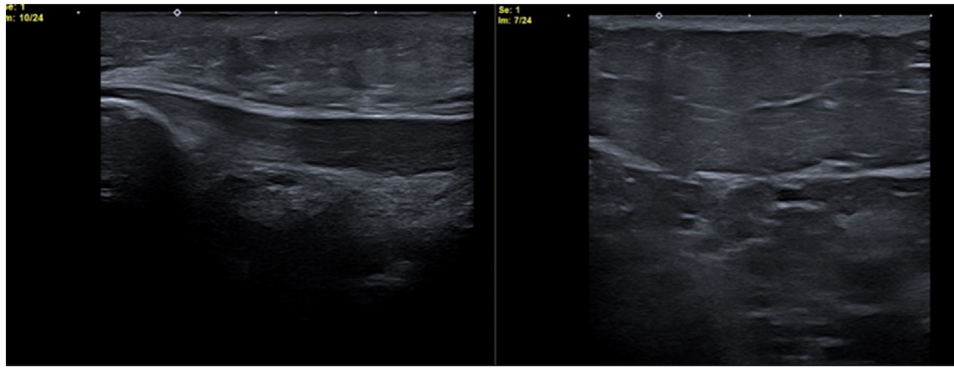
Tourniquets are also theoretically associated with a higher risk of thromboembolic events due to blood stasis in the lower limbs [3,13]. Interestingly, Li et al. showed that the incidence of development of deep vein thrombosis was higher in the tourniquet group, but this was not found to be statistically significant [13].

The duration of the tourniquet and the cuff pressure used are also important factors that might lead to adverse effects. While there are no definite guidelines for the recommended duration and ideal cuff pressure, it is understood that these may play an essential role in the level of postoperative pain [14,15]. In this case, a cuff pressure of 300 mmHg was used for 65 minutes, and the cuff was sized appropriately for the patient's size, who did not have particularly large thighs. A prospective observational study by Kamath et al. in 2021 noted a statistically significant association between tourniquet inflation time and pain in both upper and lower limbs [15]. A randomized controlled trial by Pinsornak et al. in 2021 noted that the severity of pain was lowest in patients who had a cuff pressure calculated as the systolic blood pressure +75 mmHg and highest in patients with a cuff pressure calculated as systolic blood pressure +150 mmHg during total knee arthroplasty [16]. However, they noted that the quality of a bloodless field at the tibial cutting surface was better in the latter group. In addition, there was a significantly increased incidence of postoperative wound complications in the group with the highest cuff inflation pressure but no difference in total blood loss between the groups [16].

While planning to perform a total knee arthroplasty, it is essential to consider all the possible methods to minimize perioperative bleeding. Drugs such as anticoagulants should be stopped



**Figure 3.** Ultrasound images showing inhomogeneity of fat with interspersed fluid pockets. The acoustic shadowing and diffuse hypoechoogenicity are very suggestive of fat necrosis.



**Figure 4.** Ultrasound images showing that the previously described changes have reversed as noted by the resolution of fluid pockets and the fat being homogeneously hyperechoic.

or bridged accordingly with alternative methods [17]. During operation, the surgeon should also consider the use of tranexamic acid. Single or multiple doses of this antifibrinolytic drug have been shown to reduce intraoperative bleeding and avoid blood transfusions following major surgery [18]. Tranexamic acid was also safe for use in patients at higher risk of thromboembolic events [19]. Zhao et al. also noted that patients who had received multiple doses of tranexamic acid without a tourniquet experienced less total blood loss and inflammatory reactions with better early knee scores than patients who had a tourniquet applied [20]. In addition, cell salvage can also be considered as it decreases the risk of exposure to allogenic blood [21].

### Summary

When planning a total knee arthroplasty, one must take the necessary measures, both preoperatively and intraoperatively, to avoid blood loss as much as possible. Although there is conflicting evidence regarding using a tourniquet, it still offers its benefits when used judiciously during surgery.

### Conflict of interest

The authors declare there are no conflicts of interest.

For full disclosure statements refer to <https://doi.org/10.1016/j.artd.2022.06.005>.

### Informed patient consent

The patient has provided written informed consent to participate in this case report.

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