

# Treatment of Synovial Cysts in Relation to the Tibial Tunnel of Anterior Cruciate Ligament Grafts by Filling the Tunnel with Acrylic Cement

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## Abstract

**Introduction:** Synovial cyst of the tibial tunnel in connection with anterior cruciate ligament (ACL) reconstruction is a rare but particularly troublesome complication. Medical treatment is often doomed to failure, and surgical treatment usually consists of excising the cyst and filling the tunnel with bone. The aim of this study was to evaluate the results of filling the tunnel with acrylic cement. **Hypothesis:** Filling the tibial bone tunnel with acrylic cement should eliminate communication between the joint cavity and the pre-tibial surface and prevent cyst recurrence. **Patients and Methods:** This retrospective series is composed of 13 patients, 9 men and 4 women, mean age 48.5 years (31 to 64) operated on between 2011 and 2019 for an intra- and extraosseous synovial cyst consecutive to the tibial tunnel of an ACL graft. Between 1983 and 2016, 12 of the patients had had a bone graft without bone block fixation (DI-DT or Mac Intosh) and one patient, a bone-bone transplant (KJ). The cyst was of variable size, located on the anteromedial aspect of the proximal end of the tibia, and often painful, warranting consultation. At the time of the initial operation, 9 patients had undergone meniscectomies (6 medial, 2 lateral, 1 double). In 7 knees, there were 7 cartilage lesions in the femorotibial and/or patellofemoral compartments (one stage 1 lesion, 2 stage 2 lesions, 4 stage 3 lesions, and no stage 4 lesions). Only 2 knees had neither cartilage nor meniscus lesions. After curettage of the bone tunnel +/- remov-

al of the non-resorbed or PEEK interference screw, the tunnel was filled with acrylic cement +/- reinforced with a ligament staple to prevent expulsion. All patients underwent regular follow-up consultations until recovery. **Results:** At a maximum follow-up of 8 years, only 1 cyst recurred, representing a 7.69% failure rate. It was reoperated with another technique, which involved filling the tibial bone tunnel with bone graft taken from a half-bank head. After recovery, the cyst healed definitively. All patients were able to return to their previous activity within 15 days of surgery. **Conclusion:** Filling the tibial tunnel with acrylic cement reinforced +/- with a ligament staple is a reliable and rapid solution for the treatment of intra- and extra-articular synovial cysts in relation to the tibial tunnel of ACL grafts.

## Keywords

Arthro-Synovial Cyst, Tibial Tunnel, ACL Graft, Filling, Acrylic Cement

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## 1. Introduction

Reconstruction of the anterior cruciate ligament (ACL) is an everyday surgical procedure that has been improved over time with new surgical techniques and materials [1] [2].

Arthroscopically-assisted ACL reconstruction has become the standard surgical treatment due to its less invasive nature [3]-[10]. Whatever the surgical technique or the means of fixation of the transplants, the creation of bone tunnels is essential, especially on the tibia.

Tibial tunnel-related arthrosynovial cysts are subcutaneous swellings located on the anteromedial aspect of the proximal end of the tibia, opposite the tibia's extra-articular orifice, and may occur several years after ACL reconstruction. It is usually asymptomatic, but may become painful as its volume increases, which is the usual reason for consultation [11].

For the first 18 months after ACL reconstruction, a small amount of synovial fluid may be seen in the graft fixation tunnel, which may enlarge moderately. [12] [13].

The cyst forms as a result of communication between the joint cavity and the pre-tibial subcutaneous cellular tissue opposite the extra-articular orifice of the tibial tunnel, allowing synovial fluid to pass through [1] [12] [14] [15]. It may also be due to degradation or breakage of the bioresorbable interference screw, which is considered a foreign body and provokes an inflammatory reaction [10] [16]. Leakage may also be caused by the difference in diameter between the graft and the tibial tunnel [14], or even by the eccentric placement of the graft in the tibial tunnel, as well as shearing of the graft as a result of micromovements of the graft when fixed with the non-absorbable screw [15] [17].

The literature describes several types of treatment for tibial tunnel cysts, including conservative treatment with anti-inflammatory drugs and corticosteroid infiltration. With regard to surgical treatment, the usual technique is to resect

the cyst, debride the cystic walls, curettage the tunnel and then fill it with a bone plug, usually extracted from the lateral femoral condyle [18]. Placement of a bone graft in the tibial tunnel can reduce the risk of recurrence [19].

Having encountered failures after corticosteroid puncture-infiltration and after filling with biomaterials (tricalcium phosphate) or bone allograft, the orthopaedic surgery and traumatology department of Grenoble University Hospital/South Hospital, headed by Professor SARAGAGLIA, opted for filling with acrylic cement.

The hypothesis was that filling with acrylic cement would prevent cyst recurrence at low cost and zero morbidity.

The aim of this study was to evaluate the results of filling the tibial tunnel with acrylic cement, and in particular the rates of possible recurrence at a minimum follow-up of 3 months and a maximum follow-up of 8 years.

## 2. Patients and Methods

### 2.1. Patients

These were 13 patients, operated on between 2011 and 2019 for a subcutaneous synovial cyst in relation to the tibial tunnel of an ACL graft. This therapeutic approach (filling the tibial tunnel with acrylic cement in the management of synovial cysts in relation to the tibial tunnel of anterior cruciate ligament grafts) had been decided upon by the Orthopedic Surgery and Traumatology Department of the Grenoble Hospital/South Hospital since 2011. Our sample is exhaustive, including all patients who presented with the cysts and were operated on using this method from 2011 until 2019, the year in which this work was carried out. All had pain opposite the cyst, which was the main reason for consultation.

### 2.2. Methods

#### 2.2.1. Surgical Technique

The patient was positioned supine, knee bent at 45°, with a pneumatic tourniquet at the root of the thigh. Continuation of the previous incision, with resection of the scar to allow immediate access to the cyst; removal of the cyst. Locate tibial tunnel and remove interference screw where present. Careful curettage of the tunnel, leaving in place the transplant that had been left pedicled on the tibia during the first operation. Filling of the tibial tunnel with CMV2 acrylic cement to plug the hole, closure of the subcutaneous skin and skin without any drainage (Figure 1).

#### 2.2.2. Post-Operative Care

All patients were treated as outpatients with no postoperative restrictions. Local care with betadine was performed every two days until complete healing and removal of the sutures on the twenty-first postoperative day. Postoperative follow-up was uncomplicated for all patients, with no inflammatory or infectious features observed.



**Figure 1.** Front and side X-ray of the knee showing the tibial tunnel filled with acrylic cement.

### 2.2.3. Assessment Methods

All patients were reviewed clinically and radiologically by the surgeon at least 3 months after the operation, in search of a mass corresponding to the cyst in the tibial tunnel, and any pain in the area of the tibial tunnel.

## 3. Results

### 3.1. The Series

The 13 patients included 9 men and 4 women, with an average age of 48.5  $\pm$  11.5 years (31 to 64). The left side was more affected, with 7 patients, and 50% of all patients were over 50 years of age. The mean time to onset of tibial tunnel cyst after ACL reconstruction was 9 years and 2 months, with extremes ranging from 1.1 to 30.3 years.

The initial ligament graft was 8 times a DI-DT, 4 times a Mac Intosh quadricepsplasty and 1 time a bone-bone transplant (KJ). In 9 cases, an interference screw was used, 6 in PEEK and 3 Ligafix (tricalcium phosphate). In 4 cases, no interference screw was used. Both left and right sides were involved (**Table 1**).

6 patients had initially undergone corticosteroid puncture-infiltration, which had been unsuccessful.

At initial surgery, 23% of patients had normal cartilage and 76.9% had cartilage lesions of stages 1 to 3, located on the patella, trochlea, medial and lateral femoral condyles and medial tibial plateau. Meniscectomy was performed in 9 patients, for a rate of 69.2%.

Radiographically, there was a clear, homogeneous lacuna, delimited by a border corresponding to a shell (**Figure 2**). Magnetic Resonance Imaging (MRI) enabled the exact location, volume and shape of the cyst to be determined, as well as its relationship with neighbouring structures, which is crucial for the pre-therapeutic assessment.



**Figure 2.** Radiograph of the knee, front and side, showing the cyst in the tibial tunnel, opposite the anterior tibial tuberosity.

**Table 1.** Representation of all patients with the items studied.

	N°1	N°2	N°3	N°4	N°5	N°6	N°7	N°8	N°9	N°10	N°11	N°12	N°13
Sex	M	F	M	M	M	F	F	M	M	M	M	F	M
Age	30	56	51	40	37	57	60	50	62	30	65	55	41
Type of ACL graft	DI-DT	KJ	DI-DT	Mac I	DI-DT	DI-DT	DI-DT	Mac I	DI-DT	DI-DT	Mac I	Mac I	DI-DT
Year of ACL transplant	2016	2008	2011	2000	2013	2013	1983	2010	2014	2013	1989	1984	2007
Operated side	Left	Left	Left	Right	Right	Left	Right	Left	Left	Right	Right	Right	Left
Meniscectomy	Yes	-	Not	Yes	Yes	Yes	Not	Yes	Yes	Yes	Not	Yes	Yes
Medial	Yes	-	Not	Yes	Yes	Yes	Not	Yes	-	Yes	Not	Yes	Not
Lateral	Not	-	Not	Not	Not	Yes	Not	Not	-	Yes	Not	Not	Yes
State of cartilage	Wronged	Good	Wronged	Wronged	Wronged	Wronged	Good	Wronged	Wronged	Wronged	Wronged	Good	Good
Patella	Not	Good	Yes.2	Not	Yes	Yes	Good	Yes(3)	Yes.2	Yes.2	-	Good	Good
Trochle	Fente	Good	Yes.3	Not	Yes	Yes	Good	Yes(3)	Yes.2	Yes.2	-	Good	Good
Medial condyle	Not	Good	Not	Grade 3	Not	Not	Good	Not	Not	Not	-	Good	Good
Lateral condyle	Not	Good	Not	Not	Not	Not	Good	Not	Not	Not	-	Good	Good
Medial board	Not	Good	Not	Not	Not	Not	Good	Not	Not	Not	-	Good	Good
Side tray		Good	Not	Not	Not	Not	Good	Not	Not	Not	-	Good	Good
Using an interference screw	Yes	Not	Yes	Yes	Yes	Yes	Not	Yes	Yes	Yes	Not	Yes	Yes
Screw type	PEEK	0	PEEK	PEEK	PEEK	PEEK	0	LIGAFIX		LIGAFIX	0	PEEK	LIGAFIX
Year of appearance of the cyst	2019	2014	2012	2011	2016	2016	2013	2014	2015	2015	2013	2014	2017
Imagerie (Rx, IRM)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rx	Not	Yes	Yes	Not	Not	Not	Yes	Yes	Not	Not	Not	Not	Yes
IRM	Yes	Not	Not	Not	Not	Not	Not	Not	Not	Not	Yes	Yes	Not
Rx + IRM	Not	Not	Not	Yes	Yes	Yes	Not	Not	Yes	Yes	Not	Not	Not
Infiltration puncture	Not	Not	Yes	Yes	Not	Non	Yes	Yes	Yes	Not	Yes	Not	Not
After-effects of surgery	Simple	Simple	Simple	Simple	Simple	Pain	Simple	Simple	Simple	Simple	Simple	Simple	Simple
Results on the cyst	Good	Good	Good	Good	Good	Good	Good	Good	Good	Recidivism	Good	Good	Good

A total of 5 patients had undergone standard radiography combined with MRI, 5 only radiography and 3 only MRI (**Table 1**).

### 3.2. Results

All patients were reviewed clinically and radiologically for postoperative complications of a general nature, notably infection and scar disunion, but also specific to the operation, including a mass and pain at the surgical site. Radiologically, the aim was to look for images corresponding to lacunae suggestive of cysts.

The post-operative course was straightforward, with no immediate complications. At a minimum follow-up of 3 months and a maximum follow-up of 8 years, we found 1 failure with cyst recurrence (7.7%) (**Table 1**). The patient was reoperated on using another technique involving impaction of a bone graft taken from a bone bank half-head. One year after the revision surgery, there was still no recurrence. The majority of patients had not received corticosteroids prior to surgery.

The correlation coefficient (age and appearance of the cyst) calculated was estimated at 0.4, meaning that there was no evidence of a marked relationship between age and the time to appearance of the synovial cyst. So we can't say that the older you are, the greater the delay between ligamentoplasty and the appearance of the cyst.

### 4. Discussion

Among the complications following ACL reconstruction, the formation of a tibial tunnel cyst is rare and can occur even years later. Once the cyst has formed, there is a communication channel between it and the joint, known as the pedicle. According to the literature, pre-tibial cysts should be considered as a possible complication of ACL reconstruction when tibial fixation is performed using the bioresorbable interference screw and flexor tendons (rectus internus and semitendinosus) without bone block [8] [9] [10] [14] [19] [20] [21]. Tibial cyst formation following the use of metal interference screws is not well documented [22].

Synovial cyst formation in the tibial tunnel in connection with ACL reconstruction may have several etiologies: incomplete incorporation of the tendon graft material inside (difference in diameters between the graft and the tibial tunnel), eccentric positioning of the graft in the tibial bone tunnel, necrosis of the graft, use of grafts without a bone block that consolidates and seals the tunnel [21], inflammatory reaction of the interference screw, which can act as a foreign body, especially if it is bio-resorbable, micromovements of the graft in the tunnel, when the graft is fixed with a metal screw, as it does not produce an inflammatory reaction [12]. The formation of synovial cysts in the femoral tunnel is not described in relation to ACL reconstruction. This may probably be due to gravity, as the fluid cannot flow up the femoral tunnel, but can only follow the

tibial tunnel as a result of gravity.

Concerning the incidence of cyst occurrence, between 2011 and 2019, Professor SARAGAGLIA operated on 700 ACLs, among whom 13 patients had presented with a synovial cyst of the tibial tunnel in connection with ACL reconstruction. This represents a rate of around 2%. This is much higher than the approximately 1% incidence found by Zicaro *et al.*, who operated on almost 1600 ACLs using DI-DT soft transplants, between 2008 and 2016, in which only 14 patients developed a tibial tunnel synovial cyst in association with ACL reconstruction [23].

We studied 13 patients who developed tibial tunnel cyst after ACL reconstruction between 2011 and 2019. Our series is similar to that of Zicaro *et al.* [23], who evaluated 14 patients over 8 years.

Of the 13 patients in our series, only 1 had recurred, giving a failure rate of 7.7%. The operative technique in our series consisted in placing the patient supine, knee bent at 45°, with a pneumatic tourniquet at the root of the thigh. Continuation of the previous incision, with resection of the scar to allow immediate access to the cyst; removal of the cyst. Locate tibial tunnel and remove interference screw where present. Careful curettage of the tunnel, leaving in place the transplant that had been left pedicled on the tibia during the first operation. Filling of the tibial tunnel with CMV2 acrylic cement to plug the hole, closure of the sub- and skin without any drainage. This failure rate of 7.7% is roughly similar to that found by Zicaro *et al.*, who noted 1 case of recurrence out of 14 patients who underwent tibial tunnel cyst surgery in connection with ACL reconstruction, a failure rate of 7.1%. Their surgical technique involved simple resection of the cyst and fascial and skin closure.

The patient with recurrent synovial cyst in our series was treated using a different technique, which involved filling the bone tunnel with a bone graft taken from a half-head of bone bank, and healing was achieved in one go. However, the patient with recurrent synovial cyst in the study by Juan Pablo Zicaro *et al.* required a total of 3 surgeries for definitive treatment. After the first recurrence, the cyst was drained by suction, and during the second recurrence, the cyst was more extensively curetted, removing the remains of the tunnel walls and suture without filling the cavity or tibial tunnel with bone grafts, suspecting that the etiology of the cyst was a foreign body reaction. The interval between the first and second recurrence was 3 months [24].

Follow-up of patients who underwent tibial tunnel synovial cyst surgery in connection with ACL reconstruction was a minimum of 3 months in our series. This was closer to removal of the cyst than Lomnas GG, who described follow-up of patients 5 to 6 months after removal of the synovial cyst [3].

The mean age of our patients 48.5 years is higher than other series in the literature 43 years for Luis Eduardo *et al.* [21], 39 for Guillem Gonzalez-Lomas *et al.* [3] and 38 for zicaro *et al.* [23]. We can therefore see that the age is more than 10 years higher than the usual series of ACL reconstruction [3] [21] [23]. We cannot say that the older the patient, the greater the risk of developing a tibial tun-

nel cyst in association with ACL reconstruction. Moreover, in our series, 69% of patients with cartilage lesions and 69% with meniscectomies developed cysts (**Table 1**).

The mean time to cyst onset was 9.2 years (14 months to 30 years). This is well above the 2 years 2.6 years, 2.9 years 3 years and 3.8 years found respectively by Gonzalez-L *et al.* [3], Juan Pablo Zicaro *et al.* [23], Luis Eduardo Pedigoni Bulisani *et al.* [21].

Conservative treatment (corticosteroid puncture-infiltration) did not produce the expected results, as recurrence was almost 100% and required surgical management. In our series, return to sport was rapid, within 15 days of cyst removal, whereas other authors had described a return to sport at 3 months post-operatively [21].

## 5. Conclusion

Synovial cysts of the tibial tunnel are a rare or infrequent complication of anterior cruciate ligament reconstruction. They generally occur a few years after anterior cruciate ligament reconstruction. The diameters of the tibial tunnel, interference screw and transplant influence its formation. The location and method of fixation of the transplant remain the most important factors. Men are more likely to be affected, and the right side is predominant. Puncture infiltration is not an absolute preoperative treatment. Despite the therapeutic methods used— infiltration puncture, conventional open surgery to remove the cyst, followed by filling of the tibial tunnel with either bone plug or acrylic cement—recurrence cannot be ruled out. Filling with acrylic cement gives good results.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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