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Septic arthritis in ACL reconstruction surgery with hamstring autografts. Eleven years of experience

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ABSTRACT

Background: Knee joint infection after ACL reconstruction is a rare complication with a low reported incidence, but the consequences can be devastating. The purpose of the study was to determine the incidence of septic arthritis after primary ACL reconstruction with hamstring auto-graft and the risk factors that may be associated.
Method: A retrospective study of all primary ACL reconstruction from January 2000 to May 2011. Electronic medical records were reviewed to determine the number of infections, operating time, associated procedure, time of presentation after surgery, infection treatment, microbiological cultures and graft retention. At the end of the follow-up (18–108 months) a functional assessment of all the infected patients was performed using the Lysholm score with the Lysholm score.
Results: We analyzed 1564 cases of primary ACL reconstruction with hamstring autograft, of which seven cases were diagnosed with postoperative joint infection (incidence rate of 0.45%). The infectious agent most frequently isolated was a coagulase-negative *Staphylococcus*. Neither intraoperative factors nor age correlated with the development of the infection. The average Lysholm score was 95 points (range 89–100 points). All but two patients retained their reconstructed ACL. The results of the five patients in which the graft was preserved were significantly better than the two patients that had their grafts removed ($p = 0.03$).
Conclusion: We conclude that septic arthritis post ACL reconstruction has a low incidence rate, which if handled at an early stage allows the patients a satisfactory return to their previous activities. Graft retention is important to obtain better functional results.
Level of evidence: IV.

1. Introduction

Anterior cruciate ligament reconstruction has boomed in recent decades, achieving excellent results in terms of stability and knee function [1]. However, this procedure is not without risks. Among them, septic arthritis is a rare complication, but the consequences can be devastating.

In the literature, the reported incidences vary between 0.14% and 1.7% [2–7]. Because of this low incidence, the risk factors are not well known. Controversy exists regarding what is the most appropriate management and what are the functional outcomes in these cases [4,8–10]. Intra-articular infection can lead to graft failure, joint stiffness, and chondral damage [11,12]. This can result in permanent knee function disability that does not meet the high sports performance expectations of the patients undergoing this surgery.

There is a consensus that early diagnosis and treatment is the key factor in avoiding these consequences and reducing the length of hospitalization. Treatment should include the use of antibiotics and joint lavage, however there is still controversy in the literature regarding graft preservation [2,3,13,14]. There is little evidence in the literature on functional outcomes of these patients, especially with long-term follow up.

Our objective was to determine the incidence of septic arthritis after primary ACL reconstruction with hamstring auto-graft for a period of 11 years. This was done to determine the risk factors that may be associated with the development of infection and to evaluate the functional results in cases of postoperative intra-articular infection.

2. Materials and methods

A retrospective review was conducted through the electronic registry of all patients who underwent primary ACL reconstruction with hamstring auto-graft during a period of 11 years and four months, between January 2000 and May 2011. We identified all the cases that had symptoms of septic arthritis after surgical procedure, calculating the related incidences. The follow-up for these infected patients was between 18 and 108 months. The study was approved by the ethics committee of our center.

The sample included 1564 patients who underwent primary ACL reconstruction with hamstring auto-graft, with an average age of 28.3 years (range 14–55 years), with 76% males and 24% females

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Table 1
Demographic and intraoperative characteristics of patients undergoing primary ACL reconstruction with hamstring auto-graft.

Variable		Control group (n) 1557	Infection group (n) 7	Total patients (n) 1564
Gender	Men 1288	1281	7	
	Women 276	276		
Age	Range	14–55 yo	14–51	p > 0.05
	Average	28.3 yo	27.8	
Fixation	TransFix-Delta (®Arthrex)	969	3	
	RigidFix — Tibial Intrafix (®De Puy Mitek)	344	2	
	Endobutton (®Smith & Nephew) — Gentle Threads™ Interference Screw (®Biomet)	251	2	
Previous knee surgery	Yes	20	0	p > 0.05
	No	1544	7	
Concomitant procedure	Meniscectomy	32%	3/7 (42%)	p > 0.05
	Meniscal repair	14%	0	
	Microfractures	1.9%	0	
Intraoperative time	Range	40–120 min	40–123 min	p > 0.05
	Average	70 min	71.8 min	

(Table 1). Three senior surgeons and one junior surgeon performed all the surgeries.

In all cases, ACL reconstruction was performed with arthroscopic assistance, a tourniquet and perioperative prophylaxis with intravenous cefazolin for 24 h. Intravenous clindamycin was given in cases of penicillin allergy. Prior to the surgery the skin was prepared through hand scrubbing with aqueous-based chlorhexidine gluconate (CHG) followed by application of CHG/alcohol based solution. We studied all patients reconstructed with hamstring auto-grafts with different implant fixations. The following implants were used: 62% had TRANSFIX femoral devices and tibial Delta screws (Arthrex®), 22% had a RIGIDFIX femoral system and INTRAFIX tibial screws (De Puy Mitek®) and 16% had Endobutton femoral devices (®Smith & Nephew) and tibial Gentle Threads™ Interference Screw (®Biomet). In all cases, intra-articular drainage and a drain at the site of the graft harvest were used for 24 h. All patients were routinely hospitalized for two nights.

An investigation of postoperative septic arthritis was performed in all patients with suspected joint infection symptoms (swelling, increased local temperature, fever). In those cases blood tests (white blood cell count (WBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and articular aspiration were performed. The diagnosis of intra-articular infection was made in patients with altered inflammation parameters and an alteration of joint fluid analysis. All the cases underwent arthroscopic surgical lavage at the moment of diagnosis, which was repeated in those cases in which there were no favorable clinical or laboratory outcomes. Treatment was initiated with broad-spectrum intravenous antibiotics once a culture was taken, and the therapy was adjusted according to its result and bacterial sensitivity. In all, intravenous treatment was continued for four weeks and then orally for two weeks.

After discharge from the hospital, the patients resumed their rehabilitation program, with adjustments according to symptoms and pain. At the end of the follow up there was a functional assessment of all the patients with the Lysholm score and a survey regarding return to sports.

A statistical analysis was performed with the Stata V.11.0 program to evaluate which variables could influence the manifestation of septic arthritis versus the overall patients. We used a simple regression analysis for the variables age, operating time, and type of fixation used; and a Chi-square test for categorical variables (associated intraoperative procedures, previous ipsilateral surgery), considering significant a p-value <0.05. We also analyzed functional outcomes of patients who presented infections with the Mann–Whitney *U* test.

3. Results

We analyzed 1564 cases of primary ACL reconstruction with hamstring auto-graft, of which 7 cases were diagnosed with postoperative joint infection, which has an incidence rate of 0.45%.

Patients diagnosed with septic arthritis had ages ranging from 14 to 51 years. The average operating time of the reconstruction surgery was 71.8 min. In three cases, TRANSFIX® femoral fixation and Delta® tibial interference screw (Arthrex®) were used, in two cases, RIGIDFIX® Femoral Fixations and INTRAFIX® tibial screws (De Puy®) were used, and in two cases, Endobutton femoral device (®Smith & Nephew) and tibial Gentle Threads™ Interference Screw (®Biomet) were used. Three patients had a partial meniscectomy associated with the reconstruction. None of these patients underwent other associated procedures at the same surgical time. None of the patients had previous surgery (Tables 1 and 2). None of these patients had comorbidities.

Intra-articular infection diagnosis was performed between 4 and 30 days post ACL reconstruction. At diagnosis all patients had pain and swelling, only three patients had fever with axillary temperature greater than 38 °C. All patients underwent profuse arthroscopic surgical lavage at the time of clinical diagnosis. The surgeons did not wait for an intra-articular fluid culture confirmation before starting the treatment. Inflammation parameters were monitored every 48 h and repeated surgical lavage was done in those cases in which there was no positive evolution. In five patients, the graft was preserved, only requiring one arthroscopic lavage procedure. In two patients, the joint lavage was repeated several times and in the third lavage the graft and implants were removed because of the persistence of clinical infection, graft macroscopic damage and elevated inflammation parameters. In both cases the time between the primary reconstruction and diagnosis of infection was more than one week (ranging from 17 to 30 days) and both cases revealed tibial tunnel colonization with positive tissue cultures.

The infectious agent most frequently isolated was coagulase-negative *Staphylococcus* in four of the seven cases, followed by *Enterococcus faecalis* in two cases and *Enterobacter cloacae* in one case.

In evaluating intraoperative factors, operating time, associated procedures, type of fixation, and a history of previous knee surgery, did not show a significant correlation with the development of postoperative septic arthritis. There was also no significant correlation based on the age of the patients. Preoperative antibiotic prophylaxis or drains used were not evaluated, since the same protocol was followed in all patients.

As for the functional evaluation at the end of follow-up (12–101 months), the average Lysholm score was 95 points (range 89–100 points, Table 2). We statistically compared the results of the five patients in which the graft was preserved with the two patients in which the graft was removed, being significantly better in the first group ($p = 0.03$).

In all cases ultimate control and eradication of the infection were possible. There were no cases of reinfection after follow-up. Of the seven patients, six were able to return to their pre-injury sports activity level, except the patient who had the graft removed and did not receive revision surgery. He changed his sports activity to satisfactorily low-impact sports until the end of the follow up.

4. Discussion

The incidence of septic arthritis after ACL reconstruction reported in our study (0.45%) is as uncommon as that described in the literature (0.14% and 1.7%) [2,5,9,15]. Special attention should be paid to patients who have sudden progressive pain (main symptom), persistent swelling and fever.

In our study we observed that a significant number of cases of fever in the immediate postoperative period associated with hematomas from the donor area did not constitute joint infection. We observed only fevers higher than 38 °C in three of our cases. However, 100% had progressive pain and swelling.

All our patients had symptoms suggestive of infection after the fourth postoperative day, mostly in the range of four to seven days.

Table 2
Cases of patients diagnosed with postoperative septic arthritis.

Case	Culture	Age (yo)	Time between surgery and diagnosis of infection (days)	Graft retention	Lysholm score
1	Coagulase-neg *Staphylococcus*	24	5	Yes	100
2	*Enterococcus faecalis*	51	7	Yes	95
3	Coagulase-neg *Staphylococcus*	16	4	Yes	96
4	Coagulase-neg *Staphylococcus*	14	5	Yes	100
5	Coagulase–neg *Staphylococcus*	24	6	Yes	95
6	*Enterobacter cloacae*	30	30	No	89
7	*Enterococcus faecalis*	36	17	No revision surgery with patellar allograft	90

Those that occurred after the second week had worse outcomes, eventually requiring graft removal.

Different clinical studies show that most postoperative infections occur within the first month; Williams [5] in a series of 7 patients reported a diagnosis on average of 21 days, Indelli [2] between 9 and 34 days, McAllister [9] between 8 and 18 days and other studies between 2 and 45 days [3,15–17].

In addition to the clinic, the diagnosis is based on laboratory studies and joint fluid analysis that will confirm the infection if the culture is positive. In general the patients had a normal white blood cell count while their ESR and CRP were elevated [9,15], which themselves were useful to us when we suspected this type of diagnosis as well as controlling the evolution of the infection. The most commonly isolated germ according to the literature corresponds to *Staphylococcus aureus* [2,3,5,9], which is present in 31% of the cases, seconded by *Staphylococcus epidermidis* [17] in 13%. In our studies *S. epidermidis* (coagulase-negative) was the organism most commonly found (44%), which does correlate with that described by other authors. Judd [15] in his study of 11 cases presented 8 patients with positive cultures for *S. epidermidis*, Van Tongel [17] reported 63.3% of positive cultures for this organism and Torres-Claramunt [14] showed 10 of 15 patients with confirmed *S.* coagulase-negative. Our cases with atypical pathogens required multiple cleaning surgeries and finally the removal of the graft to control the infection. We do not have an adequate explanation for the absence of *S. aureus* in this group of patients.

As for the implant selection, only Judd [15] reports a significant relative risk using post and Washer-Lock®. He compares this with other implants used for other types of graft, so he attributes the development of infection to both the choice of fixation and soft tissue involvement that implies harvesting of the hamstring tendons. In our study we compared different fixations used with the same type of graft, without significant differences between them, therefore we do not believe that the type of implant can be considered as a risk factor. We think that a greater involvement of soft tissue grafts could promote infection in relation to local hematomas that could be colonized; therefore we are unable to show this variable in our studies. We did not show an association in developing infection versus operation time, previous surgery on ipsilateral knees or other surgical procedures associated with the reconstruction.

There is agreement in the literature [2,18] for the onset of early treatment with lavage and arthroscopic debridement, antibiotics and implant retention, if it has no signs of contamination. In our case studies we started immediate treatment at diagnosis, always trying to retain the graft. The graft had to be removed in two patients (28.5%). The literature reports removal rates ranging from 0% to 87.5% [2,3,5,9,15,16].

Burks [3] recommends removing the graft if it looks compromised at the arthroscopic scene or if there is difficulty in controlling the infection, doing early revision surgery to complete antibiotic therapy with the certainty of having eradicated the infection. In the two cases in our studies that had their grafts removed, the symptoms appeared after more days of evolution from the date of the surgery compared to those cases that preserved the graft. On the other hand, the cultures were positive for atypical pathogens (*E. cloacae*, *E. faecalis*), confirming the tibiaL tunnel colonization with positive tissue cultures, which could influence the persistence of infection in these cases. Indelli [2], in his series of six patients, reports better results in patients with positive cultures for *S. epidermidis*, suggesting that the decision to preserve the graft could be made in patients with positive cultures with less virulent germs. It also needs to be noted that of the three patients in Indelli's series who were infected with *S. aureus*, the graft had to be removed from two patients (both with a diagnosis of infection after 7 and 20 days) and only one got a satisfactory graft retention evolution of which the diagnosis was made within two days.

Regarding the evolution of these patients from the functional point of view, the literature generally reported good results with average Lysholm scores ranging from 71 points [15,17] up to results of over 90 points [3,6,9,16]. In our studies we obtained an overall median score of 95 points, showing a statistically significant difference in favor of patients in whom the grafts were preserved. We know that the number of patients studied was small and that one of the patients who had the graft removed, did not receive a further reconstruction surgery, which could affect the results.

We believe that acting early in infection control and trying to preserve the graft helps to get good results because there is a consensus that chondral damage resulting from the infection process and a late start in the rehabilitation process are the main causes of unfavorable functional results in the long term [19]. We were unable to determine demographic and intraoperative factors associated with the development of infection, so that timely clinical suspicion becomes the most important factor to achieve a timely diagnosis.

We conclude after this review that septic arthritis post ACL reconstruction has a low incidence rate, which if handled at an early stage allows patients a satisfactory return to their previous activities. Graft retention as far as possible is important for obtaining better functional results.

5. Conflict of interest

We confirm that we do not have any conflict of interest to disclose.

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