



ARAŞTIRMA / RESEARCH

Effect of autograph used in anterior cruciate ligament reconstruction surgery on postoperative infection rate

Ön çapraz bağ rekonstrüksiyon cerrahisinde kullanılan otogreftin postoperatif enfeksiyon oranına etkisi

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Abstract

Purpose: The aim of this study was to investigate effect of autograft selection on the infection risk following arthroscopic anterior cruciate ligament (ACL) reconstruction surgery.

Materials and Methods: Between June 2004 and October 2018, 840 consecutive patients who underwent primary arthroscopic ACL reconstruction with either a hamstring tendon autograft or a bone patellar tendon bone (BTB) autograft were reviewed retrospectively. Patients were assigned into two groups based on the type of graft used: First group was bone-patellar tendon-bone (BTB) autograft group (n=354) and second group was hamstring tendon autograft group (n=466). These two groups were compared statistically in terms of demographic characteristic and postoperative infection status. After primary ACL reconstruction, local and systemic clinical findings of infection (knee effusion, systemic fever, nausea, weakness) supported by laboratory findings (C-Reactive Protein (CRP), Erythrocyt Sedimentation Rate (ESR)) were defined as infection.

Results: There was a statistically increased risk of infection with hamstring tendon autograft compared to BTB autograft. While the infection rate in the first group (BTB) was 0.3 % (n=1), the infection rate in the second group (Hamstring tendon) was 4.7 % (n=22).

Conclusion: In this study, a higher infection rate was found in primary ACL cases treated with hamstring tendon autograft compared to those using BTB autografts. Orthopedic surgeons should be aware of the increased risk of infection when hamstring autograft is used in ACL reconstruction surgery and should prefer BTB autograft over hamstring autograft in appropriate indication.

Keywords: Anterior cruciate ligament, infection, hamstring tendon autograft

Öz

Amaç: Bu çalışmanın amacı primer artroskopik ön çapraz bağ rekonstrüksiyon cerrahisi uygulanan hastalarda kullanılan otogreft tipinin enfeksiyon sıklığına etkisini araştırmaktır.

Gereç ve Yöntem: Haziran 2004- Mart 2018 tarihleri arası hamstring ve bone-patellar tendon-bone (BTB) otogrefti kullanılarak artroskopik ön çapraz bağ cerrahisi uygulanan 840 olgu retrospektif olarak analiz edildi. Olgular greft tipine göre 2 gruba ayrıldı. 1. grup BTB otogrefti kullanılan (n=354), 2. grup ise hamstring otogrefti kullanılan (n=466) gruptu. Her iki grup demografik özellikleri ve postoperatif enfeksiyon durumlarına göre istatistiksel olarak karşılaştırıldı. Primer ACL rekonstrüksiyonundan sonra, laboratuvar bulguları (C-Reaktif Protein (CRP), Eritrosit Sedimentasyon Hızı (ESR)) ile desteklenen enfeksiyonun lokal ve sistemik klinik bulguları (diz efüzyonu, sistemik ateş, bulantı, zayıflık) enfeksiyon olarak tanımlandı.

Bulgular: Gruplar arasında enfeksiyon bakımından istatistiksel olarak anlamlı fark bulundu. Grup 1'de enfeksiyon oranı %0.3 (n=1) iken; Grup 2'de enfeksiyon oranı %4.7 (n=22) olarak saptandı.

Sonuç: Bu çalışmada, hamstring tendon otogrefti kullanılan primer ACL vakalarında BTB otogrefti kullanılanlara göre daha yüksek bir enfeksiyon oranı bulunmuştur. Ortopedik cerrahlar ACL rekonstrüksiyon cerrahisinde hamstring otogrefti kullanıldığında enfeksiyon riskinin arttığını bilmelidirler ve uygun endikasyonda BTB otogreftini hamstring otogreftine tercih etmekten kaçınmamalıdır.

Anahtar kelimeler: Ön çapraz bağ, enfeksiyon, hamstring tendon otogreft

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INTRODUCTION

Arthroscopic anterior cruciate ligament (ACL) reconstruction is one of the common orthopedic surgeries. Patients can return to their daily active life by stabilizing knee functionally through a successful surgical treatment. There are many graft options for ACL reconstruction including hamstring tendon allograft/autograft, bone-patellar tendon-bone (BTB) allograft/autograft, other allograft/autograft tendons (e.g., Achilles tendon, anterior or posterior tibial tendon), fascia lata grafts, synthetic material as well as the combination of these grafts¹. Among these options, hamstring tendon autograft and BTB autograft are two of the most common grafts used for arthroscopic reconstruction of the ruptured ligament.

In the literature, there have been several studies directly comparing the clinical and functional outcomes of using hamstring tendon autograft and BTB autograft techniques in ACL reconstruction²⁻⁵. Overall, they reported that there were no statistically significant differences in the clinical and functional outcomes between the techniques²⁻⁵ except a higher incidence rate of postoperative anterior kneeling pain in BTB autograft group reported in few studies⁵⁻¹¹. Both autograft types have well-documented advantages and disadvantages. The advantages of BTB autograft technique include its easy accessibility, its potential for bone-to-bone healing, strong bone-to-bone fixation, providing prompt bone healing, a short graft fixation distance, and great architectural properties. Furthermore, Mae et al.⁶ reported that morphology of BTB autograft was superior to that of hamstring tendon autograft at second-look arthroscopy after ACL reconstruction. On the other hand, the advantages of hamstring tendon autograft technique include the need of smaller (cosmetic) incision, lower rate of donor-site complications/morbidity, and its compatibility with opening double-band and femoral tunnel with a desired angle. Its disadvantages are the difficulties in tendon-to bone healing, risk of femoral tunnel widening^{7,8}, postoperative hamstring muscle weakness⁸⁻¹⁰, and increased knee laxity¹¹.

In a study of Miller et al. on graft selection in ACL surgery, they compared the advantages and disadvantages of autograft and allografts compared to each other indicated which grafts are suitable for which patient. According to this study, they recommend BTB autograft for high demand

individuals (playing, cutting, pivoting or jumping sports and skiing) and hamstring autograft for lower demand or older individuals¹². However, the use of hamstring autograft in ACL reconstruction has increased in recent years because of its relative donor site morbidity¹³.

Postoperative knee joint infection following ACL reconstruction in normal population has been reported to be rare with the incidence rate of 0.14% to 1.4%¹⁴⁻¹⁹. On the other hand, for the professional athletes, it was reported as high as 5.7%²⁰. In the literature, only few studies investigated the association between incidence rate of infection and type of the graft, and concluded that incidence rate of the infection can be associated with the selected type of graft^{1,14-22,23}. The aims of this study were (I) to investigate the association between the incidence rate of postoperative infection and type of grafts (BTB vs. hamstring tendon autograft) used in arthroscopic ACL reconstruction, and (II) to whether surgeon should also consider infection risk when selecting a graft.

MATERIALS AND METHODS

For this retrospective study, all data were obtained from the medical history of patients in the hospital archive. Therefore, informed consent was not obtained from the patients. The study approval was obtained from SANKO University Medical Faculty Ethics Committee (decision no 12, dated 31.01.2019). This study was conducted in accordance with Helsinki Declaration Rules.

All the patients' information were obtained from the hospital archive, including the demographic information of the patients, time of infection, time of debridement, laboratory values, existence of positive culture, microorganisms grown in the culture, and type of antibiotics administered to patients. Between June 2004 and October 2018, the records 120 of 960 ACL were excluded from the study because revision ACL, cartilage surgery and meniscus root tear repair were performed. 840 consecutive patients undergoing primary arthroscopic ACL reconstruction with the use of either hamstring tendon autograft or BTB autograft were reviewed retrospectively.

Patients who underwent multiligamentous surgeries and revision ACL surgeries, patients who underwent ACL surgery with repair of meniscus root and cartilage surgery due to cartilage problems and

patients with predisposing diseases such as diabetes were excluded from the study. However, ACL reconstruction with partial meniscectomy and meniscus repair were included in this study. The patients were then assigned into two groups: the hamstring tendon autograft group (N=466) and the BTB group (N=354). These two groups were compared in terms of demographic characteristics and postoperative infection status.

Infection criteria include local and systemic findings of infection after primary ACL reconstruction (knee effusion, systemic fever, nausea, fatigue) along with supporting the condition with laboratory findings (ESR, CRP) as well as having at least one wash. No radiological examination was performed to diagnose the patients. Superficial and surgical wound infections were not also included in the study.

All surgeries were performed in the same operating room, having laminar airflow with a positive and hepa filter and the room temperature keeps constant generally between 18 and 20°C. During the ACL surgery, 2 assistant nurses, 1 anesthesiologist and 1 room staff were also assisted to the surgeons in the operating room. As a washing solution, a saline solution was used in the surgery.

Surgical technique

In our clinic, BTB autograft was used in primary ACL surgeries between 2004 and 2010 while hamstring autograft was used in primary ACL surgeries between 2010 and 2018. Briefly, in the BTB autograft group, BTB autograft with 2 cm thickness was harvested at the beginning of the operation. The tibial tunnel was prepared with the help of a tibial guide pin while femoral tunnel was prepared with transtibial technique. The BTB autograft was then fixed to the tunnels with cannulated screws.

Briefly, in the hamstring tendon autograft group, hamstring tendon autograft was harvested with a longitudinal incision made from medial tuberositas tibia to inferior. The tibial tunnel was then prepared with the help of a tibial guide pin. Femoral tunnel was prepared from anteromedial portal with the help of guide pin. Elevator system was used for the fixation on the femoral side while staple and cannulated screws were used for the fixation on the tibial side. Drainage tube was removed on the postoperative second day. The patients were initially followed-up every three days during the dressing of the surgical wound until removing the sutures at postoperative fourteenth day. The patients were also followed-up at

one month, six weeks, three and six months after the surgery.

Statistical analysis

All statistical analyses were performed with IBM SPSS Statistics 23. Kolmogorov-Smirnov test was used for assessing normality of continuous variables. The differences between the two groups were compared with the independent samples t-test for continuous variables and with the chi-square test for categorical variables. Descriptive statistics were given as means, standard deviations, frequencies, and percentages. In all tests, the significance level was 0.05.

RESULTS

In the 14-year study period between June 2004 and October 2018, a total of 840 ACL reconstructions were performed at our institution. There were no statistical differences between the two groups in terms of age ($p=0.672$) and gender ($p=0.722$). There were totally 354 cases in the BTB group and the mean age of these cases was 34.2 years old. Among 354 patients in the BTB group, there were 339 male and 15 females. On the other hand, there were totally 466 patients in the hamstring autograft group with the mean age of 33.7 years olds. In this group, 443 of the patients were male while 23 of them were female. In the BTB autograft group, postoperative infection occurred only in 1 of the 354 patients (0.3%) at the second postoperative month. In the result of intraoperative culture, coagulase-positive *Staphylococcus aureus* organism was isolated. The patient was treated with one arthroscopic irrigation and debridement procedure, followed by one month of 400 mg teicoplanin antibiotics treatment. The patient was totally recovered following the antibiotics treatment.

In the hamstring tendon autograft group, the infection occurred in 22 of the 466 patients (4.7 %). Time after surgery until the occurrence of infection varied from one to six months. The infection was identified in the 18 patients at the first postoperative month, in the 3 patients at the second postoperative month, and in 1 patient at the sixth postoperative month. Interestingly, during a second-year period between 2014 and 2015 in the hamstring tendon autograft group, the incidence rate of the infection was so high (12.5 %) with an unidentified reason. *Staphylococcus aureus* organism was cultured in 17 of the 22 patients. 2 patients whose infection was

identified at the first postoperative month had two irrigation and debridement procedures once a week, with graft and hardware removal at the second debridement. Other patients had one irrigation and debridement procedure, followed by one month of 400 mg teicoplanin, and 6 weeks of oral sodium

fusidate antibiotics treatment, respectively (Table 1). There was a statistically increased risk of infection with hamstring tendon autograft compared to BPTB autograft ($p < 0.001$). Overall, the rate of incidence of hamstring autograft infection is 15.6 times higher compared to the rate of the BTB autograft.

Table 1. Comparison of groups according to age, gender and infection rates.

| Group | Age (Years) | Gender (F/M) | Infection (Number/Rate) |
|------------------|-------------|--------------|-------------------------|
| Group I (n=354) | 34.2 | 15/339 | 1(%0.3) |
| Group II (n=466) | 33.7 | 23/443 | 22(%4.7) |

Group I: Group undergoing anterior cruciate ligament reconstruction surgery using BTB autograft;

Group II: Group undergoing anterior cruciate ligament reconstruction surgery using Hamstring tendon autograft.

F: Female. M: Male.

DISCUSSION

The most important finding of this study is that the risk of infection is higher in hamstring autograft compared to BTB autograft in ACL reconstruction surgery. In patients who had hamstring autografts, 15.6 times more infections were observed when compared to BTB autograft. While the infection rate of Hamstring autograft was 4.7%, the rate of infection in BTB autograft was 0.3%. Second important finding is that the risk of infection should be always taken into consideration for the selection of autograft type in ACL reconstruction surgery. Moreover, BTB autograft should be a more preferable graft based on the findings of the current study. This result does not imply that the BTB autograft should be used in every ACL reconstruction. However, the possibility of infection should be always taken into account when selecting autograft. Thus, BTB autograft should be preferred more frequently.

The incidence rate of the postoperative knee joint infection after ACL reconstruction has been known to be low and range from 0.14% to 1.4%¹²⁻¹⁷. On the other hand, it was reported as high as 5.7% for the professional athletes¹⁸. Although the incidence rate of infection is rare, the treatment of infection is troublesome, involving multiple surgeries, prolonged antibiotics administration, and graft and hardware removal with secondary revision surgery^{14-16,21-23}. In the literature, there are limited numbers of studies investigating the association of the incidence rate of infection with the type of graft used in ACL reconstruction^{1,14,22,23}. Judd et al.²² in 2006, reviewed retrospectively 1615 primary ACL reconstructions over an 8-year period between 1994 and 2002, and

found 11 postoperative infections (0.68%) in the patients. All the infections in this study occurred during a 3-year period between 1999 and 2001, resulting in the calculated incidence rate of 2.6%. When comparing the incidence rate of infection based on selected graft type, they reported that all infections occurred in the ACL reconstruction group treated with hamstring tendon autograft²².

In this study, we aimed to contribute to the literature by investigating the frequency of infection rates after the ACL reconstruction in our clinic. As a result of the study, we detected 22 infections in 466 cases (4.7%) with hamstring autografts while only 1 infection (0.3%) in 354 cases with BTB autograft. The overall infection rate was 2.5% in all cases.

In the study of Malletis et al.²³ in 2013, they investigated the effect of graft selection on the incidence rate of infection after ACL reconstruction using BTB autograft, hamstring tendon autograft and allograft (all types) in 10,626 cases. They classified the infection as superficial and deep infection. They reported that there was no statistically significant difference in superficial infection between graft selections but infection rate in hamstring autograft significantly increased in deep infection. In the study, deep infection was observed in 10 patients (0.34%) of 2995 BTB autografts and in 24 patients (0.74 %) of 3257 hamstring autografts, and in 17 patients (0.39%) of 4404 allografts. The overall infection rate was found 0.48 %. They further reported that the infection rate in the hamstring tendon autograft group was 8.24 times higher than the infection rate in the BTB autograft group²³.

Our incidence rate of infection after arthroscopic ACL reconstruction was 0.3% in BTB autograft group and 4.7% in the hamstring tendon autograft

group and is consistent with the numbers reported in the previous studies. We further reported that the rate of incidence of hamstring autograft infection is 15.6 times higher than the rate of the BTB autograft. In fact, the exact reason of why ACL reconstruction with hamstring tendon autograft has increased risk of infection compared to that of BTB autograft is still unknown. However, one possible reason could be associated with bacterial contamination during autograft preparation process for ACL reconstruction. Hantes et al.²⁴ in 2008 investigated the possible bacterial contamination during the BTB and hamstring tendon autograft preparation process for ACL reconstruction, and reported that bacterial contamination rate was 13% in the hamstring tendon autografts, and 10% in BTB autografts²⁴. In addition, Plante et al.²⁵ and Guelich et al.²⁶ reported that the bacterial contamination rate was 23% in hamstring tendon autografts, and was 9.7% in Achilles or anterior tibialis tendon allografts, respectively. However, in the study of Guelich et al.²⁶, it is not clear whether the allografts are contaminated during graft harvesting or graft preparation.

Since hamstring tendon autograft preparation takes longer time compared to those of BTB autograft and allografts^{27,28}, the longer preparation time is considered as a risk factor of the contamination. Furthermore, multifilament suture often used in the hamstring tendon graft preparation and skin contact during graft implantation could be considered as other risk factors of the contamination²³. However, it is still unexplained why both bacterial contamination and infection rates are lower in soft tissue allografts compared to hamstring tendon autografts although both grafts have similar preparation, implantation, and fixation procedure. As reported in the study of Malletis et al.²³, there was no statistically significant difference between allografts and BTB autografts in terms of infection rate though the increased risk of infections with hamstring tendon autografts was 8.2 times that of BTB autografts.

This study is also not without limitations. In our clinic, BTB autografts were mostly used between 2004 and 2009. Later on, with the increasing popularity of the hamstring autografts, we switched to the use of hamstring autograft. During the study period, the operating room conditions did not change, but the personnel changed. We could not investigate the possible effect of this situation on the infection rate. On the other hand, we could not

determine the possible effect of susceptibility to infection, such as smoking. In addition, we could not compare the operative time of hamstring and BTB autograft and the meniscus repair techniques used in meniscus repair. All these are also among the limitations of this study.

In this study, the postoperative infection rates were 0.3 % in BTB autograft and 4.7% in hamstring tendon autograft, and are in good agreement with the previously reported values. We also observed a 15.6-times higher risk of postoperative infections in hamstring tendon autograft compared to BTB autografts. Although the infection rate after ACL reconstruction is rare, it is important that orthopedic surgeons should be aware of the increased risk of infection when hamstring autograft is used in ACL reconstruction surgery and should not avoid preferring BTB autograft to hamstring autograft in appropriate indication.

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