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# Factors Affecting the Development of Surgical Site Infection Requiring Revision Surgery After Total Knee Arthroplasty: A Retrospective Case-Control Study

## Total Diz Artroplastisi Sonrası Revizyon Cerrahisi Gerektiren Cerrahi Alan Enfeksiyonu Gelişiminde Etkili Faktörler: Retrospektif Olgu-Kontrol Çalışması

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## ABSTRACT

**Objective:** Surgical site infection (SSI) is one of the important factors leading to revision surgery after total knee arthroplasty (TKA). Nurses play an important role in the diagnosis of risky patients. This study aimed to determine factors leading to the development of SSI that required revision surgery after TKA.

**Methods:** This study was a retrospective case-control study conducted on the causes of SSI requiring revision surgery after TKA in a large hospital. Sociodemographic and medical characteristics of randomly sampled patients with revision (n=77) and the control group (n=77) were compared. Descriptive statistics, chi-square test, independent samples t-test, multiple logistic regression were used for data analysis.

**Results:** The mean age of the patients in the revision and control groups were 68.11±7.62 and 66.48±5.17, respectively. The mean body mass index (BMI) (37.49±5.22) and operative duration (58.24±17.20 min) of the patients in the revision group were significantly higher, while their preoperative (36.36±0.24 ºC), intraoperative (36.30±0.26 ºC), and postoperative (36.56±0.39 ºC) body temperatures were significantly lower ($p<0.05$). It was determined that there was a correlation between patients' ASA scores, duration of antibiotic use, preoperative intra-articular corticosteroid injection and the development of SSI ($p<0.05$), and that high BMI, long duration of surgery, and preoperative intra-

## ÖZ

**Amaç:** Cerrahi alan enfeksiyonu (CAE), total diz artroplastisi (TDA) sonrası revizyon cerrahisine yol açan önemli faktörlerden biridir. Hemşireler riskli hastaların tanısında önemli rol oynamaktadır. Bu çalışmada TDA sonrası revizyon cerrahisi gerektiren CAE gelişimine yol açan faktörlerin belirlenmesi amaçlanmıştır.

**Yöntem:** Bu çalışma, büyük bir hastanede TDA sonrası revizyon cerrahisi gerektiren cerrahi alan enfeksiyonunun nedenleri üzerine yapılmış retrospektif bir olgu-kontrol çalışmasıdır. Rastgele seçilen revizyonlu hastaların (n=77) ve kontrol grubunun (n=77) sosyodemografik ve tıbbi özellikleri karşılaştırıldı. Verilerin analizinde tanımlayıcı istatistikler, ki-kare testi, bağımsız örneklem t-testi, çoklu lojistik regresyon analizi kullanıldı.

**Bulgular:** Revizyon ve kontrol grubundaki hastaların yaş ortalaması sırasıyla; 68,11±7,62 ve 66,48±5,17 idi. Revizyon grubundaki hastaların ameliyat öncesi (36,36±0,24 ºC), ameliyat sırası (36,30±0,26 ºC) ve ameliyat sonrası (36,56±0,39 ºC) vücut sıcaklıkları anlamlı derecede düşük iken ($p<0,05$), ortalama beden kütle indeksi (BKİ) (37,49±5,22) ve ameliyat süresi (58,24±17,20 dk) anlamlı olarak yüksekti. Hastaların ASA skorları, antibiyotik kullanım süresi, ameliyat öncesi eklem içi kortikosteroid enjeksiyonu ile CAE gelişimi arasında ilişki olduğu ($p<0,05$) ve yüksek BKİ, uzun ameliyat süresi ve ameliyat öncesi intraartiküler kortikosteroid

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articular corticosteroid injection were the most important factors causing revision surgery.

**Conclusion:** In revision surgery due to the development of SSI, it can be concluded that high BMI, long duration of surgery, low body temperature, high ASA score, long duration of postoperative antibiotic use, and preoperative intra-articular corticosteroid injection are effective factors.

**Keywords:** Surgical site infection, knee arthroplasty, joint revision, risk factors

**ÖZ**

enjeksiyonu uygulanmasının revizyon cerrahisine neden olan en önemli faktörler olduğu saptandı.

**Sonuç:** Cerrahi alan enfeksiyonu gelişimine bağlı revizyon cerrahisinde yüksek BKİ, uzun ameliyat süresi, düşük vücut sıcaklığı, yüksek ASA skoru, uzun postoperatif antibiyotik kullanım süresi ve ameliyat öncesi dönemde eklem içi kortikosteroid enjeksiyonu yapılmasının etkili faktörler olduğu söylenebilir.

**Anahtar sözcükler:** Cerrahi alan enfeksiyonu, diz artroplastisi, eklem revizyonu, risk faktörleri

## Introduction

Total knee arthroplasty (TKA) is a standard treatment method that provides pain reduction/relief, functional recovery, and increased quality of life in patients with knee osteoarthritis and osteonecrosis (1). Besides its benefits such as pain reduction/relief and functional recovery, some patients may achieve poor results after surgery or the implant may fail, which leads to revision (1,2). It has been reported that revision surgery is required after TKA due to mechanical wear, implant loosening or fracture, instability, periprosthetic fracture, and permanent stiffness (2); however, surgical site infection (SSI) is considered the most important reason (2-4). SSIs are infections of the incision or organ or space that occur after surgery (4) [(Berríos-Torres ve ark. (4)]. According to the USHIESA abstract data in Turkey, the rates of SSI after TKA were 0.52, 0.52, 0.45, 0.33, and 0.33% in 2017, 2018, 2019, 2020, and 2021, respectively (5-9). In orthopedic surgery, SSI after implant surgery or TKA is a serious complication that can drastically affect patients' lives (10) and is a disaster both for patients and surgeons (11). Some studies indicated that after TKA, 36.1% (2) and 25.2% (12) of patients underwent revision surgery due to the SSI development. SSI may also increase mortality (13) and morbidity rates, and health care costs (13,14) and repeated surgical intervention such as implant revision surgery (13,14). Contrary to the expectation of a painless and functional knee movement after TKA intervention, when patients are faced with a painful and dysfunctional knee joint, they are adversely affected physically, mentally, and economically by the uncertainty of the process and the stress of reoperation (15). Several factors, such as patients' characteristics, surgical intervention, and perioperative care may lead to the risk of developing an SSI in TKA (11).

Although patient-related factors, such as malignancy (16) and obesity [body mass index (BMI) >30] (17) seem to be effective in deep infection development in the postoperative period of TKA, it is emphasized that long surgical intervention duration (18), inappropriate antibiotic prophylaxis, lack of glycemic control, hypothermia, intra-articular corticosteroid injection, and choice of anticoagulant treatment, are also among the influencing factors (4). But the effect of most of these factors is still not clear. Moreover, not every SSI that develops after TKA causes revision surgery. Revealing the factors that play a role in the development of SSI that causes revision surgery will guide physicians and nurses in the treatment and care of these patients. It is noted in the literature that surgical wound care includes interprofessional teams, and in particular Registered Nurses often lead these teams, making nursing decisions or making recommendations to other healthcare professionals. Because inconsistent and non-evidence based practices or conflicting research evidence and variations in clinician preferences compromise attempts to limit or reduce iatrogenic harm and patients' risk of SSI and other wound complications (19). In this context orthopedic nurses must know the risk factors for SSI that cause revision surgery after TKA and make an early diagnosis, control or eliminate modifiable risk factors as much as possible, identify high-risk patients, and plan and implement evidence-based preventive nursing care interventions in risky patients. In the present study, we explored the factors affecting the development of SSI that required revision surgery after TKA.

## Methods

### Setting and Participants

We conducted a retrospective case-control study in the orthopedics and traumatology clinic of a tertiary hospital in in Turkey between January and August 2022. Orthopedic surgeries in a diverse range of fields, both urgent and elective, are performed in the department including spinal surgery, knee and hip surgeries, shoulder surgeries, trauma surgeries, and orthopedic oncology surgery. Approximately one thousand orthopedic surgeries are performed in the department each year which has 25 beds.

The population of the study consisted of patients who underwent TKA surgery. The number of patients who underwent TKA between 2016 and 2018 in this clinic was 380, and revision surgery was performed due to SSI in 87 of these patients between 2016 and 2020. Among the patients who underwent TKA surgery between the specified dates, the files of those who did not develop SSI (control group), and who underwent revision surgery due to SSI (revision group) were reviewed retrospectively. In retrospective case-control studies, the number of case-controls should either be equal or the number of cases should be twice the number of controls (20). Sample size was calculated using EPITOOLS (Epidemiological

Calculators) (http://epitools.ausvet.com.au). For a case-control study with an assumed odd's ratio (OR) of 4, confidence level of 90%, and statistical power of 80%, the minimum sample size was determined as 77 per group, and 154 for the overall sample size. Those in the control group were selected among the 154 patients hospitalized during the research period and not developing SSI. Those in the revision group were randomly selected among patients who underwent revision surgery for SSI. For the selection of files among these patients, the patient files in the revision group and control group were listed and assigned a number. Then, using a random numbers table, the file numbers to be included in the groups were determined.

**Inclusion criteria:** The revision group included patients who underwent TKA surgery between January 1, 2016 and January 1, 2018 and underwent revision surgery due to the development of SSI between January 1, 2016 and January 1, 2020. The control group consisted of patients who underwent TKA surgery between January 1, 2016 and January 1, 2018 and did not develop SSI between January 1, 2016 and January 1, 2020.

**Exclusion criteria:** Patients a) who had their first TKA surgery in another institution, b) who did not readmit to the hospital after the surgery, and c) whose patient files or records could not be reached were excluded.

**Ethical Statement**

This study was approved by the Ankara Keçiören Training and Research Hospital Clinical Research Ethics Committee (research approval number: 2012-KAEK-15/2437). In order for the medical data of the patients to be used for scientific purposes in the studies to be conducted in the relevant clinic, a verbal explanation was made and written consent was obtained from the accepting patients.

**Data Collection**

The following data were collected by the researchers based on the medical records in a structured Excel spreadsheet:

**1. Sociodemographic characteristics:** Age, gender, marital status and BMI

**2. Medical characteristics:** Reason for revision, presence of chronic disease, chronic disease

**3. Data regarding the SSI:** ASA score, antibiotic prophylaxis, use of antibiotics after surgery, duration of antibiotic use after surgery, postoperative use of anticoagulants, anticoagulant used after surgery, intra-articular steroid injection in the preoperative period, preoperative warming of the patient, intraoperative warming of the patient, postoperative warming of the patient, operative duration, preoperative body temperature, intraoperative body temperature, postoperative body temperature, preoperative blood glucose, and postoperative blood glucose.

The items in the data collection were prepared in accordance with the literature (4,11,12) by the researchers. The blood glucose levels of the patients reflected the average results measured in the last 24 hours in the preoperative period, and in the first 24 hours in the postoperative period. The body temperature indicated the average measured in the last 24 hours in the preoperative period, and during the intraoperative period, as well as the first 24 hours in the postoperative period.

**Statistical Analysis**

Statistical analysis was performed using the SPSS software for Windows, version 25 (SPSS, Chicago, IL, USA). Descriptive statistics; percentages, means, and standard deviations - were used to describe the research data. Chi-square tests were used to compare categorical data, while t-tests for independent samples were used for continuous variables. Significant associated variables were included in the multiple logistic regression model to calculate the OR. The Hosmer-Lemeshow test was used for model fit. A significance of level of $p<0.05$ was set for all analyses.

## Results

Table 1 presents the sociodemographic and medical characteristics of patients and the relationship of some characteristics with revision surgery due to the development of SSI. The groups were similar in terms of age, gender, marital status, educational status and presence of chronic disease.

When the status of patients undergoing revision surgery due to SSI and certain characteristics was examined, it was determined that there was a relationship between the ASA score, duration of postoperative antibiotic use, and preoperative intra-articular corticosteroid injection and revision surgery due to the development of SSI ($p<0.05$) (Table 1).

Sociodemographic and medical characteristics of patients and their intergroup comparison are given in Table 2. Accordingly, in the revision group, the mean body BMI (37.49±5.22) was statistically significantly higher, the mean operative duration (58.24±17.20 min) was statistically significantly longer, while preoperative (36.36±0.24 ºC), intraoperative (36.30±0.26 ºC), and postoperative (36.56±0.39 ºC) body temperatures were statistically significantly lower ($p<0.05$). It was determined that the difference between the mean preoperative and postoperative blood glucose levels of the patients was not statistically significant ($p>0.05$).

Table 3 presents the results of the logistic regression analysis conducted to determine factors effective in revision surgery requirement due to the development of SSI. Goodness-of-fit analysis of the model was conducted using the Hosmer & Lemeshow test, and it was seen that the model-data fit was adequate (chi-square =12.301 and $p=0.138$). Accordingly, it was determined that BMI [relative risk (RR): 1.089, 95%, confidence interval (CI): (1.008-1.176)], operative duration [RR: 1.211, 95%, CI: (1.153-1.271)], and the administration of preoperative intra-articular corticosteroid injection (RR: 4.431, 95%, CI: (1.848-10.623) statistically significantly increased the rate of revision surgery due to the development of SSI ($p<0.05$).

**Table 1.** Sociodemographic and medical characteristics of the patients and the relationship of some characteristics with revision surgery (n=154)

| Characteristics | Revision group (n=77) n (%) | Control group (n=77) n (%) | $x^2$ | df | p |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Female | 60 (77.9) | 57 (74.0) | 0.32 | 1 | 0.57 |
| Male | 17 (22.1) | 20 (26.0) | | | |
| **Marital status** | | | | | |
| Married | 59 (76.6) | 66 (85.7) | 2.08 | 1 | 0.14 |
| Single | 18 (23.4) | 11(14.3) | | | |
| **Education** | | | | | |
| Primary school | 70 (90.9) | 71 (92.2) | 0.09 | 2 | 0.95 |
| High school | 6 (7.8) | 5 (6.5) | | | |
| University | 1 (1.3) | 1 (1.3) | | | |
| **Reason for revision** | | | | | |
| Septic loosening | 48 (62.33) | | | | |
| Septic arthritis | 29 (36.36) | | | | |
| **Presence of chronic disease** | | | | | |
| Yes | 65 (84.4) | 70 (90.9) | 1.50 | 1 | 0.22 |
| No | 12 (15.6) | 7 (9.1) | | | |
| **Chronic disease**† | | | | | |
| Diabetes mellitus | 34 (44.2) | 46 (59.7) | | | |
| Hypertension | 45 (58.4) | 50 (64.9) | | | |
| Heart failure | 8 (10.4) | 15 (19.5) | | | |
| Peripheral circulatory failure | 3 (3.9) | 1 (1.3) | | | |
| Coronary artery disease | 14 (18.2) | 0 (0.0) | | | |
| History of cerebrovascular event | 1 (1.3) | 2 (2.6) | | | |
| Chronic obstructive pulmonary disease | 4 (5.2) | 0 (0.0) | | | |
| Cirrhosis of the liver | 0 (0.0) | 0 (0.0) | | | |
| Hypothyroidism | 6 (7.8) | 7 (9.1) | | | |
| Rheumatoid arthritis | 3 (3.9) | 2 (2.6) | | | |
| **ASA‡ score** | | | | | |
| 1 | 5 (6.5) | 24 (31.2) | 15.33 | 1 | **0.00** |
| 2 ve üzeri | 72 (93.5) | 53 (68.8) | | | |
| **Antibiotic prophylaxis** | | | | | |
| Yes | 77 (100.0) | 77 (100.0) | | | |
| **Use of antibiotics after surgery** | | | | | |
| Yes | 77 (100.0) | 77 (100.0) | | | |
| **Duration of antibiotic use after surgery** | | | | | |
| 1 day | 52 (67.5) | 69 (89.6) | 11.14 | 1 | **0.00** |
| 2 days or more | 25 (32.5) | 8 (10.4) | | | |
| **Postoperative use of anticoagulants** | | | | | |
| Yes | 77 (100.0) | 77 (100.0) | | | |
| **Anticoagulant used after surgery**† | | | | | |
| LMWH‡ | 77 (100.0) | 77 (100.0) | | | |
| Coumadin | | | | | |

**Table 1.** Continued

| Characteristics | Revision group (n=77) n (%) | Control group (n=77) n (%) | $x^2$ | df | p |
|---|---|---|---|---|---|
| **Intra-articular steroid injection in the preoperative period** | | | | | |
| Yes | 48 (62.3) | 34 (44.2) | 5.11 | 1 | **0.02** |
| No | 29 (37.7) | 43 (55.8) | | | |
| **Pre-operative warming of the patient** | | | | | |
| Unknown | 77 (100.0) | 77 (100.0) | | | |
| **Intraoperative warming of the patient** | | | | | |
| Yes | 77 (100.0) | 77 (100.0) | | | |
| **Post-operative warming of the patient** | | | | | |
| Unknown | 77 (100.0) | 77 (100.0) | | | |

$x^2$: Chi-square test, †More than one option is ticked, ‡American Society of Anesthesiologists

**Table 2.** Intergroup comparison of some sociodemographic and medical characteristics of the patients

| Characteristics | Revision group (n=77) (mean ± SD) | Control group (n=77) (mean ± SD) | t-test* | p |
|---|---|---|---|---|
| Age (min-max= 45-85) | 68.11±7.62 (min-max =54-85) | 66.48±5.17 (min-max =57-83) | 1.55 | 0.12 |
| BMI† | 37.49±5.22 | 35.49±4.46 | -2.55 | **0.01** |
| Operative duration (min) | 58.24±17.20 | 33.96±9.08 | 10.95 | **0.00** |
| Preoperative body temperatures | 36.36±0.24 | 36.50±0.16 | -4.27 | **0.00** |
| Intraoperative body temperatures | 36.30±0.26 | 36.60±0.23 | -7.49 | **0.00** |
| Postoperative body temperatures | 36.56±0.39 | 36.72±0.44 | -2.27 | **0.02** |
| Preoperative blood glucose | 104.48±28.64 | 103.05±31.66 | -0.73 | 0.46 |
| Postoperative blood glucose | 100.23±22.76 | 99.41±23.13 | 0.21 | 0.83 |

*Independent sample t-test, †Body mass index

**Table 3.** Factors affecting revision surgery due to the development of SSI†

| Risk factor | RR* (95%) | CI** | p |
|---|---|---|---|
| BMI‡ | 1.089 | (1.008-1.176) | 0.031 |
| Operative time (min) | 1.211 | (1.153-1.271) | 0.000 |
| Intra-articular corticosteroid injection in the preoperative period | 4.431 | (1.848-10.623) | 0.001 |

†Surgical site infection, ‡BMI: Body mass index, *Relative risk, **Confidence interval

## Discussion

This study was conducted to determine factors causing the development of SSI in patients who had undergone revision surgery due to SSI after TKA.

Despite new infection prevention strategies, antibiotic prophylaxis remains the cornerstone of SSI prevention. However, the duration of prophylaxis remains controversial and varies by guidelines, ranging from the endorsement of a single preoperative dose to antibiotics discontinued within or 24 hours after the operation (21). The Center for Disease Control and Prevention (CDC) recommends not to apply additional doses of prophylactic antimicrobial agents in prosthetic joint arthroplasty in clean and clean-contaminated procedures after the surgical incision is closed in the operating room, even in case of a surgical drain (4). In addition, the International Consensus Meeting on Periprosthetic Infections has recently recommended administration of 1 dose of antibiotics preoperatively and administration of antibiotics for 24 hours postoperatively in 2013 (22). In a study, antibiotic prophylaxis was administered to patients who underwent TKA for 1 day postoperatively, and

it was not effective in the development of SSI (21). In another study conducted with patients who underwent total joint arthroplasty, it was determined that there was no significant difference between patients who received a single dose of antibiotics and those who were administered antibiotics for 24 hours postoperatively in terms of SSI development (23). In this study, it was determined that there was a relationship between the duration of postoperative antibiotic use and revision surgery due to the development of SSI. Although only a single dose of antibiotic prophylaxis is recommended for the prevention of SSI development, antibiotics are still administered for up to 3 days for certain reasons in clinical practice. The fact that we could not determine the reason for continuing antibiotic use in the current study showed that the guideline on antibiotic use was not fully adopted. However, it remains an important factor in the development of SSI since prolonging the antibiotic prophylaxis beyond 24 hours is ineffective in terms of reducing SSI rate; and it increases hospital costs, places patients at risk of systemic toxicity, and adversely affects individual and community microflora, thereby facilitating the rise of pharmacological resistance (11).

The goal of intra-articular injections is to achieve prolonged concentrations of the corticosteroid in the synovial fluid and synovium, thereby imparting the maximum anti-inflammatory effect locally while minimizing plasma concentrations and the risk of systemic effects (24). Corticosteroid injections and hyaluronic acid injections are widely used to alleviate pain and inflammation in patients who are not ready or eligible to undergo Total Hip Arthroplasty or TKA (25). However, it is emphasized that intra-articular corticosteroid injection increases the risk of developing complications, such as skin and fat atrophy, tendon rupture, exacerbation of pain, septic arthritis, and periprosthetic joint infection (25). In a study, it was determined that there was a significant increase in periprosthetic joint infection in patients who received an intra-articular hip injection 3 months before TKA (26). In another study, intra-articular steroid injection administered within 0 to 2 weeks before TKA was found to be statistically correlated with postoperative infection rates, while injections performed more than 2 weeks before were not associated with postoperative infection (24). In a study comparing patients who underwent TKA within 1 year after an intra-articular steroid injection and those who had not received injections, there was no statistically significant difference in terms of the development of SSI. In one study, intra-articular injections of the knee with corticosteroids, hyaluronic acid, or other drugs prior to TKA were found to increase the risk of periprosthetic joint infection, and this association was time-dependent: the shorter the interval between injection and TKA, the higher the risk of periprosthetic joint infection (27). In this study, it was determined that there was a relationship between preoperative intra-articular corticosteroid injection and revision surgery due to the development of SSI. Although we could not determine the exact time that patients received corticosteroid injections before TKA, it might be concluded that this finding supported the information that corticosteroids had immunosuppressive effects as well as an anti-inflammatory response, and they remained in the joint after being absorbed by synovial cells, leading to post-TKA infection (24).

In clinical practice, patients' general health and comorbidity levels at the time of surgery are routinely assessed through the American Society of Anesthesiologists (ASA) physical status classification (28). In a meta-analysis study, it was determined that the risk of periprosthetic joint infection development was higher in patients who underwent total knee and hip arthroplasty with an ASA score of II and higher (29). In another study, it was determined that the risk of periprosthetic joint infection development was high in patients with ASA scores of III and IV (3). In this study, most of the patients had an ASA score of II and higher, and this was associated with revision surgery due to the development of SSI. It can be concluded that the ASA score reflects the assessment of the comorbidity levels of patients (28) and that an ASA score of II or higher in patients undergoing TKA is a risk factor for the development of SSI, which will require revision surgery.

The duration of the surgical intervention may longer depending on the factors related to the patient or the surgeon (10). Long operative duration is among the risk factors for SSI in orthopedic surgery (11). Inprevious studies, it was indicated that the risk of developing SSI was significantly higher in patients with a longer operation duration (3,30,31). In another study, it was determined that operative surgery did not affect the development of SSI (32). In this study, although the mean operative duration of the revision surgery group was shorter than those reported in the literature, it was significantly higher than the mean operative duration of the control group. This finding supports the finding (10) that wound contamination and wound cell damage increase with the prolongation of operative duration.

The CDC recommends maintaining normothermia in patients for the prevention of SSI. Although surgery or operating room nurses, and anesthesia professionals apply various warming strategies (e.g., forced-air warming, warm blankets) during the perioperative period, some surgical patients experience inadvertent hypothermia when their core body temperature drops below 36 °C (33). A decrease of 2 °C in the core temperature of the patient leads to impaired soft tissue oxygen transmission and decreased collagen deposition due to peripheral vasoconstriction, leading to deterioration in the wound healing process, while increasing the risk of SSI three times (34). In a study, it was determined that there was no relationship between intraoperative hypothermia and wound infection in patients who underwent TKA (35). In another study, it was found that involuntary hypothermia caused a higher rate of hematoma in patients who underwent TKA, and a higher rate of deep SSI development in patients who underwent THA (36). In this study, preoperative, intraoperative and postoperative body temperatures were found to be statistically significantly lower in those undergoing revision surgery due to SSI. Hypothermia can also adversely affect immune function and increase the risk of developing an SSI when subcutaneous vasoconstriction and subsequent tissue hypoxia disrupt neutrophil function (33).

Therefore, it can be concluded that care interventions aimed at maintaining the body temperature within normal limits during the pre-, peri- and post-operative period in patients undergoing TKA remain important.

One of many adverse health effects of obesity is an increased risk of SSI (37). In previous studies, it was determined that high BMI was strongly associated with revision surgery and implant revision or removal after THA and an independent risk factor for the development of SSI (17,38). In a systematic review, it was shown that the rate of medium to long-term revision was increased following primary TKA in morbidly obese patients, and that the risk of perioperative complications such as superficial wound infection also increased (39). In this study, in parallel with the literature, it was determined that the mean BMI of the patients in the revision group was statistically significantly higher. Increased skin thickness in the surgical area prolongs the duration of surgical intervention, causing larger incisions, excess seroma formation, and prolonged wound drainage. In addition, patients with obesity have lower oxygen pressure due to poor vascularized subcutaneous adipose tissue (40,41). Immune cells and healing tissues have high metabolic needs for oxygen, and inadequate oxygen level decelerates the whole process (41). This may increase the risk of postoperative fat necrosis and wound complications (40). In addition, higher drug doses are required to achieve sufficient antibiotic concentration for perioperative prophylaxis in patients with obesity (41). This finding can be interpreted that high BMI in patients undergoing TKA leads to the development of SSI, and therefore revision surgery.

### Study Limitations

This research has some limitations. Since the study was a retrospective study, the reason for antibiotic use in patients who received postoperative antibiotic prophylaxis could not be questioned. In addition, it was not recorded how long some patients had an intra-articular injection before surgery. Therefore, a comparison for this information could not be made.

## Conclusion

In patients undergoing TKA, SSI remains an important problem leading to revision surgery. It is necessary to acknowledge the risk factors and take necessary precautions to prevent the development of SSI after TKA. Many factors, such as patients' characteristics, surgical intervention, and perioperative care, affect the risk of developing SSI after TKA. In this study, the most important factors in the development of SSI leading to revision surgery were determined as ASA score, the duration of postoperative antibiotic use, preoperative intra-articular corticosteroid injection, long operative duration, high BMI average, and low pre-, intra- and post-operative body temperature.

### Ethics

**Ethics Committee Approval:** This study was approved by the Ankara Keçiören Training and Research Hospital Clinical Research Ethics Committee (research approval number: 2012-KAEK-15/2437).

**Peer-review:** Externally peer reviewed.

### Authorship Contributions

Concept: H.Ö.C., Design: H.Ö.C., M.A., Data Collection or Processing: H.C., A.K., Analysis or Interpretation: H.Ö.C., H.C., Literature Search: H.Ö.C., Writing: H.Ö.C., M.A., H.C., A.K.

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