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An investigation of infection rate and seasonal effect level in total joint replacement cases**Resit Sevimli¹, Okan Aslanturk², Kadir Ertem¹, Ahmet Harma¹, Gokay Gormeli³, Aydin Arslan⁴**¹*Inonu University Turgut Ozal Medical Center Department of Orthopaedics and Traumatology, Malatya, Turkey*²*Malatya Research and State Hospital, Department of Orthopaedics, Malatya, Turkey*³*Istanbul Liv Hospital, Department of Orthopaedics and Traumatology, Istanbul, Turkey*⁴*Medicalpark Anadolu Hospital, Department of Orthopaedics, Istanbul, Turkey*

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Abstract

This study aims at evaluating gender, age range and seasonal differences in patients who developed articular infection after undergoing joint prosthesis in our clinic. This study is a retrospective screening of advanced articular arthrosis patients who had undergone total joint arthroplasty of the upper and lower extremities between 2009 and 2016. Of 504 patients who had been treated with total joint replacement, our study includes 468 patients we could follow up or contact by phone and who had been applied 559 primary or revision total knee arthroplasty. The mean age of these patients was 58.9 (ranging from 41 to 74). We detected infection in 22 (3.9%) total joint arthroplasty patients. Of these 14 (63.63%) were females and 8 (36.36%) were males. There was no statistically significant difference between infection rates in terms of seasonal distribution nor gender or age range. In the light of our findings, we concluded that gender, age range and seasonal differences have no effect on infection rates in total joint replacement cases.

Keywords: Joint replacement, infection, gender, age, seasonal difference**Introduction**

Applications of joint prosthesis are among frequently applied surgical methods. Latest advances in medical technology and surgical techniques have greatly reduced the risk of prosthetic infection. In recent years, surgery of joint replacement has indeed given successful results with increased functionality and quality of life particularly for patients whose quality of life is impaired due to pain and limitation of movement brought about by advanced stage arthrosis. Consequently the promising levels of average life expectancy, it is anticipated that total joint replacement will be performed in greater numbers in the coming years [1].

However, this increase in the number of applications also means an increase in the number of complications even if this may not apply to the rate of complications. As rare as it may be, infection is one of these complications of primary prosthetic surgery and its results can be very destructive [2,3]. It is known that infection rates are higher especially after revision surgeries [4]. Infection comes with other drawbacks such as surgical debridement for treatment of prosthetic infection, removal of prosthesis, necessity to apply antibiotic spacer and even amputation should the patient fail to

respond to other treatments [5,6]. Even so, these treatments may accompany additional morbidity and mortality [7] not to mention that treatment of prosthetic infection also precipitates large expenses in health care system [8].

The aim of our study, therefore, is to report the rate of infection and to explore whether seasonal differences in infection rates are observed in patients who underwent total joint replacement.

Materials and Methods

Within the scope of our study, we retrospectively screened patients who had undergone total joint arthroplasty of the upper and lower extremities due to advanced stage articular arthrosis between 2009 and 2016. Following the approval of ethics committee (file number 2017/8-11) of the Scientific Research and Publication Board, our university's we started analysing the cases with follow-up records as well as those we could contact over phone were. Patients who did not attend post-surgical follow-up examinations along with those who had passed away or were unable to be reached by phone were excluded from the study.

As for the surgical process, all patients were applied antibiotic prophylaxis before and up to 24 hours after the operation for infection prophylaxis. One additional dose of antibiotics was administered intraoperatively to each patient who stayed in the operation theatre for more than 3 hours. For prophylaxis, patients without any history of penicillin allergy were administered

cefazolin whereas an intravenous administration of clindamycin was preferred for individuals with penicillin allergies. Surgeries of the lower extremity were performed under general, spinal or combined epidural-spinal anaesthesia while cases of upper extremity surgeries were operated under general anaesthesia. The pneumatic tourniquet was used to apply total joint prostheses of the elbow, knee and ankles. The hemovac drain was used in all patients. The drain was removed within 48 hours after surgery. If there were no wound site problems after pain management and mobilisation were achieved, patients were discharged.

Throughout the course of our study, infection was defined as development of cellulite requiring the use of antibiotics at wound site during or after hospital stay or the necessity of re-hospitalization for anti-biotherapy, debridement, washing or removal of the prosthesis or re-operating patients for antibiotic spacer administration. Infections in the first 3 weeks after surgery were defined as “acute infections.” We adopted the term “subacute infections” for infections that occurred between post-operative 3 and 6 weeks and “late infections” for those developing 6 weeks after surgery.

Statistical analysis

All data were evaluated by using SPSS 22 software (IBM, SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). We performed logistic regression analysis to determine the factors (gender, age range and seasonal differences) that affected joint infection rates. Differences with a p-value of <0.05 were considered statistically significant.

Results

Our study includes 468 of the 504 total joint replacement patients whom we were able to follow up. These patients had previously undergone 559 primary or revision total knee arthroplasty applications. Of these arthroplasties, 251 (44,90%) were primary total knee prosthesis (TKP), 181 (32,37%) were primary total hip prosthesis (THP), 57 (10,19%) were revision THP, 55 (9,83%) were revision TKP, 5 (0,89%) were total ankle prosthesis, 5 (0,89%) were primary total shoulder prosthesis, 3 (0,53%) were total elbow prosthesis, and 2 (0,36%) were revision total shoulder prosthesis cases.

Infection was detected in 22 (3,9%) of total joint arthroplasty patients. Of these 14 (63,63%) were females and 8 (36,36%) were males. The mean age of the patients was 58,9 (ranging between 41 and 74 years) (Table 1). We did not observe infection in patients who undergoing primary or upper extremity arthroplasty. However, 6 (2,39%) of 251 primary TKP patients, 4 (2,2%) of 181 primary THP patients, 7 (12,7%) of 55 revision TKP patients, 4 (7,01%) of 57 revision THP patients and 1 (20%) of 5 primary ankle arthroplasty cases suffered infection (Figure 1).

Infections were treated by debridement and anti-biotherapy in 11 (50%) patients. The other half of the infected patients (50%) were applied two-stage prosthesis revision surgery. Of 6 infected patients after primary TKP 2 (33,33%) were treated by two-stage prosthesis revision while 4 (66,66%) were treated by surgical debridement and anti-biotherapy. All of the 4 infected patients after primary THP administration were treated by surgical debridement and anti-biotherapy. Of 7 infected patients after revision TKP, six (85,7%) were treated by two-stage revision surgery while 1 patient (14,28%) was treated by debridement and antibiotics. As for a total of 4 infected patients after revision THP, 2 (50%) were treated by

two-stage revision surgery while the other 2 (50%) were treated by debridement and anti-biotherapy. One case of infected ankle prosthesis was also treated by debridement and anti-biotherapy. The erythrocyte sedimentation rate control (ESR) and C reactive protein (CRP) levels checks were performed weekly. Treatment response was considered negative both for ESR and CRP.

Table 1. Gender and age distribution of the patients

	Number of patients	Mean age
Female	14	61.85 (the age range of 46-74 years)
Male	8	53.75 (the age range of 41-71 years)
Total	22	58.9 (the age range of 41-74 years)

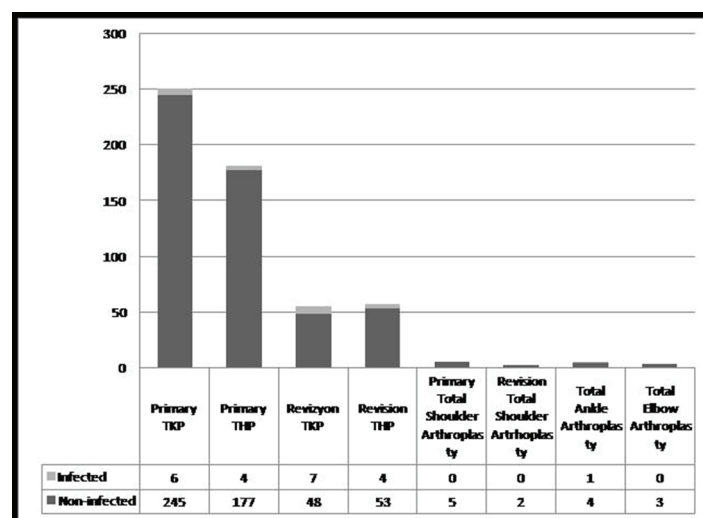


Figure 1. The number of applied prosthesis and infected prosthesis

The observed infection types are as follows: 4 (18,18%) acute infection cases; 5 (27,72%) subacute infection cases; and 13 (59,09%) late infection patients (Figure 3). We did not detect infection in 15 (68,18%) patients but we detected *S. aureus* in 4 (18,18%) patients. In addition, we observed *acinetobacter* species in 1 (4,54%), *Proteus mirabilis* in 1 (4,54%), and *S. epidermidis* in another (4.54%) patient as infectious agents, respectively.

We diagnosed infection in five cases who had undergone operation in autumn and winter. As seen in the table with seasonal distribution of infections, infection was present in patients operated in spring and summer months (Figure 2). Nonetheless, there was no statistically significant difference between infection rates in terms of seasonal distribution (p: 0,832). Similarly, we did not note any statistically significant difference between the distribution of infected patients and gender (p: 0,286) (Figure 3).

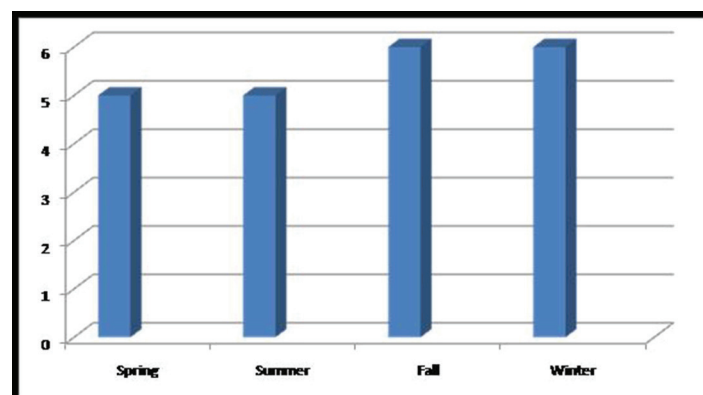


Figure 2. The seasonal distribution of infections

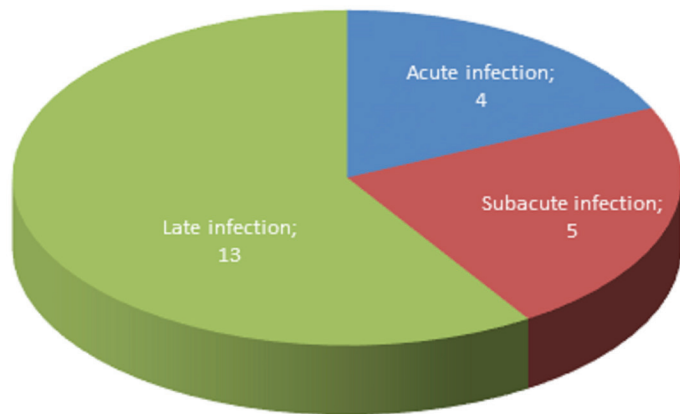


Figure 3. Distribution of infections in terms of their appearance time

Discussion

Periprosthetic joint infections are rare complications that follow joint replacement surgery yet they still have the potential to cause additional morbidity and mortality. Furthermore, they may prove to be a serious financial burden for health care system [1-6]. It is reported in the literature that there is a significant difference in infection rates between primary and revision joint prosthesis for the favour of primary joint surgery [7,9]. Throughout our survey we came across only two studies with regards to the difference in prosthetic infection and its relation to seasonal changes [10,11]. Our study concentrates on infection rates after total joint replacement in our clinic and their seasonal distribution.

The relatively few patients included in the study and its retrospective design can be considered as limitations to our study. In this respect, the retrospective nature of the study entails problems such as lack certain data, some uncontrollable accompanying causes, probability of biased information, and a variety of ways applied in accessing details about patients.

Research on prosthetic infection reports *S. aureus* as the most common cause of prosthetic infection [12,13]. It has been shown that about 10% of infectious agents could not be cultured [12,13]. However, infectious agents could not be detected in most of the patients included in our study. We think that antibiotic use for different reasons might have suppressed culture process. Our findings on the infection rates after primary joint prosthesis (around 2%) are parallel with the data reported in the literature [2,14,15]. Infection rate in revision arthroplasty surgeries is reported to be much higher compared to the figures in primary arthroplasties [4,7,9,15-18].

As far as the relation between prosthetic infections and gender distribution is concerned, different outcomes have been reported. Bozic et al and Namba et al report high infection rates in women during their studies [14,19] while Dale et al and Reina et al note that the infection rates in men were higher [20,21]. In line with Bozic et al and Namba et al, our study also reflects that prosthetic infections are more common in women.

Researchers report that the most frequently isolated infectious agents of prosthetic infections are coagulase-negative staphylococci and staphylococcus aureus [22]. However, we were unable to culture infectious agents in a vast majority of our patients (68,18%). We believe that the reason behind this situation may be uncontrolled antibiotic use by patients. It is determined that high erythrocyte sedimentation rate (ESH) and CRP values were sensitive and specific for prosthetic infections [23]. It is also shown in different

studies that negative results of both tests indicate lack of infection. Therefore, these negative results may have increased the reliability of the study in this regard [24].

There is not enough data in the literature on whether prosthetic infections exhibit seasonal distribution. To our knowledge, there are only 2 studies related to this subject [10,11]. The first of these was conducted by Kate et al, who investigate 17 infected cases among 750 total knee replacement patients. They report a higher incidence of infection during the summer months [10]. The other, carried by Uçkay et al, reports that there is no statistically significant difference between knee circumference infection and seasons. The latter of the studies, however, investigates not only joint prosthesis but also general situations [11].

Conclusions

Although our study does not suggest any statistically significant difference between infection and seasonal changes, we observed that the number of infections seen in summer was higher than those in other seasons.

In the light of the present study, it can be concluded that gender, age range, and seasonal differences do not effect infection rates in total joint replacement cases.

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Conflict of interest

The authors declare no conflict of interest.

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