Seasonality of Infection Rates After Total Joint Arthroplasty

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abstract

The correlation between season (fall, winter, spring, and summer) and infection rate in surgical patients is well defined in many specialties. To the authors’ knowledge, there are no data in the literature on this phenomenon in patients undergoing total joint arthroplasty. They hypothesized that there would be an increased infection rate in the summer months in patients undergoing elective total joint arthroplasty. They retrospectively reviewed consecutive patients undergoing elective total hip or knee arthroplasty at a single institution during 1 year by a single surgeon. Wound infections were defined as any patient requiring oral antibiotics for cellulitis, readmission for intravenous antibiotics, a return to the operating room for irrigation and debridement, or excisional arthroplasty and placement of a cement spacer within 90 days of the initial procedure. Seventeen of 750 patients developed an infection, for an overall incidence of 2.2%. There was a statistically significant difference in infection rate according to season: 3 (1.5%) infections occurred in winter, 1 (0.5%) in spring, 9 (4.7%) in summer, and 4 (2.4%) in fall. The incidence was highest during July (4.5%), August (5.4%), and September (4.3%). There was a statistically significant difference in infection rate between summer/fall (3.6%) vs winter/spring (1.0%). There is an increase in the incidence of infection during summer months for patients undergoing total joint arthroplasty. The authors recommend increased surveillance and more thorough pre-operative sterilization procedures during these warmer months.
Total joint arthroplasty is an effective surgical option in restoring function and quality of life for patients with osteoarthritis. Although success rates are high, postoperative complications such as wound infection and periprosthetic joint infection occur and can have devastating consequences.\(^1\)\(^4\) It is estimated that treatment of periprosthetic joint infection in the United States costs more than $550 million annually, resulting in significant health care expenditures nationwide.\(^5\) Morbidity from periprosthetic joint infection can have a profound physical and psychological effect on those afflicted and can range from decreased hip and knee function to, in the most extreme cases, amputation of the affected extremity.\(^5\)\(^7\)

To prevent the consequences of infection following total joint arthroplasty, much effort has been made identifying risk factors for infection. Many pre-, intra-, and postoperative risk factors for the development of periprosthetic joint infection have been identified in the literature.\(^8\)\(^12\) Although many risk factors for infection have already been examined, to the current authors’ knowledge, no investigation has been made into the relationship between seasonality and infection risk. Well defined in other areas of health care, the correlation between the time of year and risk of infection following total joint arthroplasty has yet to be determined.

Seasonal variations in infectious disease patterns in the United States have been well defined. Influenza infections have a peak incidence during the winter months, when increased indoor contact increases transmission rates. This well-documented seasonal variation helps establish nationwide vaccination patterns to prevent disease burden. Both gram-negative and gram-positive infections, including methicillin-resistant \textit{Staphylococcus aureus} (MRSA) and impetigo, have been shown to have a higher incidence during the summer months of July, August, and September when compared with other months.\(^13\)\(^-\)\(^16\) It is believed that higher temperatures and increased humidity lead to increased skin colonization rates of both patients and hospital staff during the summer months.\(^17\)\(^,\)\(^18\) Similarly, the general surgery literature has many articles demonstrating the association of seasonality and infection risk.\(^19\)\(^,\)\(^21\)

The purpose of the current study was to determine whether the same correlation between seasonality and risk of infection exists in total joint arthroplasty. The authors hypothesized that, similar to other surgical specialties, infections following total joint arthroplasty would be increased during the warmer summer months.

**Materials and Methods**

The authors prospectively collected infection data looking for signs and symptoms of superficial and deep infections for 1 year (January through December 2011). The data were then analyzed retrospectively for all patients undergoing elective total joint arthroplasty at a single institution by a single surgeon (A.O.) during this 1-year period. Patients undergoing elective total knee arthroplasty, total hip arthroplasty, total knee revision, and total hip revision were included in this study. Patients undergoing arthroplasty as a result of trauma were excluded. Patients undergoing simultaneous bilateral joint arthroplasty were included twice, with each joint arthroplasty recorded as an individual data point.

Perioperative antibiotics were administered according to a standard protocol adopted at the institution involved in this study: 1 dose of cefazolin preoperatively and continued for 24 hours postoperatively. Patients with a penicillin allergy or a documented history of MRSA infection were given vancomycin. All patients were instructed to use a Hibiclens (Mölnlycke Health Care US, LLC, Norcross, Georgia) wash and chlorhexidine wipes at home the night before surgery. In the operating room, the surgical site was initially prepped with alcohol and then with ChloraPrep (Care Fusion, San Diego, CA) solution, which was allowed to dry for 3 minutes before draping was initiated.

Patients were prospectively monitored for the development of a wound infection postoperatively during their hospital stay and during subsequent follow-up visits in the outpatient office during 1-year follow-up. Wound infections were defined as any patient requiring oral antibiotics for cellulitis, readmission for intravenous antibiotics, a return to the operating room for irrigation and debridement, or excisional arthroplasty and placement of a cement spacer within 90 days of the initial procedure. The date of infection was recorded as the date of the primary surgery, not as the date of symptom onset or secondary intervention.

Seasons were divided into summer (July, August, September), fall (October, November, December), winter (January, February, March), and spring (April, May, June). Infection rates were calculated as a percentage of infections out of total cases performed during each season. Infection rates were then compared using the chi-square test, with a \(P\) value less than .05 considered significant.

**Results**

A total of 750 patients were identified and included in this study. A total of 17 infections were identified, with an overall infection rate of 2.2%. Infection rates were highest during the summer months (July, August, September) (Figure 1). Each month had an infection rate of 4.5% (July), 5.4% (August), and 4.3% (September). The other seasons were found to have an infection rate of 2.4% (fall), 1.5% (winter), and 0.5% (spring) (Figure 1). The infection rates among the seasons were found to be significantly different \((P=.031)\). The total number of infections in each season was 9 (summer), 4 (fall), 3 (winter), and 1 (spring) (Figure 2). There was also a statistically significant difference in the rate of infection...
between summer/fall months (3.6%) vs winter/spring months (1.0%) (P=.013). A stepwise reduction in the rates of infection can be seen in Figure 3.

**Discussion**

To the authors’ knowledge, this represents the first study to examine the association between seasonality and infection rates following total joint arthroplasty. The results of the study support the initial hypothesis that infection rates following total joint arthroplasty are higher during the warmer summer months. There were a total of 9 postoperative infections during the months of July, August, and September, resulting in an infection rate of 4.7%. This rate continued to decline in a graduated fashion throughout the remainder of the year (Figure 3). The difference in infection rates among the seasons was found to be statistically significant (P=.031). In addition, a significant difference in infection rates was found between summer/fall and winter/spring (3.6% and 1.0%, respectively) (P=.013).

Several community- and hospital-acquired infections exhibit a peak incidence during the summer and early fall.13-16 Multiple investigations have proven that warmer temperatures and increased humidity promote colonization and multiplication of bacteria, both in the natural environment and on human skin.22-24 Increased skin hydration from increased sweat production and high ambient humidity provides an ideal environment for bacterial growth. The optimal conditions seen during the summer lead to an increase in bacterial population numbers in the environment and on human skin.23-25 Exposure, colonization, and transmission of organisms are all increased as a result of higher pathogen populations during this time of year.26,27 This increase may explain the higher infection rates following total joint arthroplasty seen in the current study. Although not measured directly, the number of bacteria on the skin of patients and operating room personnel is likely higher during the months of July, August, and September than at other times of the year, potentially leading to the reported increase in infection rates.

Although an increase in infections was seen in the summer, these results are not attributable to the so-called July effect because all of the patients in this study underwent surgery at a nonteaching community hospital. The July effect refers to the increase in medical errors and surgical complications, including infection, seen at teaching hospitals in July.28-30 During this month, residency programs are repopulated with new interns and residents beginning the next phase of their training.31,32 The inexperience of new house staff is reported to increase morbidity and mortality.30-33 In surgery specifically, 1 study using a nationwide cohort of more than 20,000 surgical patients found an 18% increase in postoperative morbidity and a 41% higher mortality risk in July and August vs patients undergoing surgery from mid-April to mid-June.34 However, in the current study, all surgeries were performed by the same attending physician; no other physicians or residents took part in any of the cases included in this study. This important detail eliminates the July effect as a potential explanation for the increased infection rates during the summer.

This study has several limitations. A distinction was not made between superficial infections such as cellulitis and deep infections that required a return trip to the operating room. Both types of infections are important complications following total joint arthroplasty. Superficial infections often lead to patient anxiety and dis-
satisfaction, increased cost, and increased readmission rates for antibiotic treatment and pose an increased risk for the development of a subsequent deep infection. However, deep infections represent a more clinically significant and meaningful complication for most surgeons due to the additional surgical intervention, cost, and involvement their treatment requires. Because the type of infection was not specified in the current study, the seasonal variation found in overall infection rates following total joint arthroplasty may not apply to deep infections. Further investigation into seasonality and deep infection rates in particular is warranted. In addition, the results from this study were prospectively collected over a 1-year period; infections presenting after this time frame may have been missed.

**CONCLUSION**

The results of this study have shown that infection rates following total joint arthroplasty exhibit a seasonal trend. Similar to other surgical subspecialties, infection rates following total joint arthroplasty appear to be higher during the warmer, more humid summer months. Although the time period of this study only encompassed 1 year, the seasonal variation in temperature and humidity remains relatively constant from year to year. As a result, the effect of seasonality on infection rates should remain constant, and a 1-year study period would adequately portray annual trends. To the authors’ knowledge, this study represents the first investigation to demonstrate seasonal variation in infection following total joint arthroplasty. The results may have important implications for clinical practice. A more thorough preoperative sterilization procedure may be warranted when a patient is undergoing total joint arthroplasty in the summer. A regimen aimed at decreasing the elevated bacterial counts on patients’ skin may help reduce the infection rates seen during this season. A stricter adherence to decontamination and sterilization of operating room personnel and equipment may also need to be followed during this time. Postoperatively, an increased vigilance for the development of wound infections should also be maintained during these months. As the economic burden of peri-prosthetic joint infection continues to rise, additional investigation into the association between total joint arthroplasty and seasonality is warranted.

**REFERENCES**


