

# Surgical Site Infection After Total Knee Arthroplasty : A Descriptive Study

Sadik Bilgen<sup>1</sup>, Gokay Eken<sup>2</sup>

<sup>1</sup>Assoc. Professor, Department of Orthopedic Surgery, Uludag University School of Medicine, Bursa, Turkey

<sup>2</sup>Chief Assistant, Department of Orthopedic Surgery, Uludag University School of Medicine, Bursa, Turkey

**Abstract**— *Joint replacement operations which are applied to reduce the pain and increase the movement capacity are among the surgical procedures that are used mostly nowadays. Even though a dramatic recovery is seen in the life of the patient after total knee prosthesis, possible prosthesis infection increases cost and causes high morbidity. This study was conducted with the aim to determine rates of surgical site infection after performing primer total knee prosthesis operation in our clinic. Furthermore, it has been intended to understand risk factors which may cause infection and then take precautions. This study was conducted from January 2008 to January 2013, 252 knees underwent primary total knee arthroplasty operations. Among these patients infection rates, relationship to risk factors and infection treatments were analysed. It was observed that in 252 knees, 10 (4%) superficial infections were found, debridement and antibiotics were applied to 3 knees out of 10 and only antibiotic treatment was applied to the rest 7 knees. Deep infection was detected in 4 knees (1,6%) out of 252. Acute deep infection in 1 knee and recovery was provided with debridement and intravenous antibiotics treatment. Late deep infection was not detected in any of patients. Delayed deep infection was detected in 3 (1,1%) of these knees though. Among all risk factors only increased body mass index showed increased superficial wound infection rate. It can be concluded that among the factors like rheumatoid arthritis, diabetes, age, gender, body mass index, just body mass index has an impact on superficial infection rate. Our infection rates were comparable to rates mentioned in universal literature for primary total knee replacement operations.*

**Key words:** *Joint replacement, Surgical site Infection, Arthroplasty*

## I. INTRODUCTION

With the aging population, joint diseases are seen more often today. Pain and limitation of movement ability in these diseases occur and with joint injury over time decrease life quality of the patients considerably. Therefore, joint replacement operations which are applied to reduce the pain and increase the movement capacity are among the surgical procedures that are used mostly now a day. Even though a dramatic recovery is seen in the life of the patient after total knee prosthesis, possible prosthesis infection increases cost and causes high morbidity. According to the research applied in a number of different centers, 0,5%-5% infection rates have been reported after primer total knee arthroplasty.<sup>1,2,3</sup>

Infection mechanism takes place through direct transmission of disease or haematogenous. Some examples of direct transmission are unclean operating theatres, transmission from an infected patient, usage of torn surgical gloves, negligence of the operating staff about sterility and these cases can be taken under control. Transmission through haematogenous occurs following bacteremia. For instance, *Streptococcus viridans* or *peptostreptococcus* after dental intervention, *staphylococcus* species after skin

infections and gram negative enterococcus and anaerobic infections after gastrointestinal genitourinary infections can be experienced.<sup>4</sup>

Swelling, pain and decrease in functional capacity at the knee joint occur following knee arthroplasty and as the infection progresses, periarticular bone stock decreases and implant loosening. Patients who are not treated sufficiently may experience sepsis and life threatening septic shock. In addition, it has been reported that infected knee prosthesis prolongs the duration of hospital stay and increases the cost considerably.<sup>5</sup>

In this research, it has been aimed to determine rates of surgical site infection after performing primary total knee prosthesis operation in Uludağ University Medical Faculty Orthopedics and Traumatology Clinic. Furthermore, it has been intended to understand risk factors which may cause infection and then to take specific precautions.

## II. METHODOLOGY

A Hospital based descriptive type of observational study was conducted on patients of primary total knee arthroplasty operations which were performed in Uludağ University Medical Faculty Orthopaedics and Traumatology Clinic between the years of 2008-2013 have been studied retrospectively. All medical computer records of the patients who had the operation have been scanned. 252 total knee arthroplasty operations were performed on 206 patients. All these 206 cases were taken into consideration for study.

Posterior stabilised Sigma® (Depuy-Johnson ve Johnson, Warsaw, ABD) total knee prosthesis was applied to all patients. Patients with severe collateral ligament injury were not included in the study. Average length of follow-up was 26,8 (24-85) months. All of 252 knees were followed more than 24 months.

Descriptive statistics for categorical variables were given with frequency and corresponding percentage values. Data showing congruity with normal distribution, T test for independent samples and Mann-Whitney U test for data showing incongruity with normal distribution were applied in comparison among groups. Chi-square (Pearson Chi-Square), Fisher's exact chi-square test (Fisher's Exact Test) and Fisher-Freeman-Halton Test were applied for qualitative variables. Statistical significance in this study was defined as  $p = 0.05$ , statistical analyses were performed using SPSS software V.21 .

Relationships between infection, diabetes mellitus, body mass index, age, gender, length of hospital stay, type of anaesthesia procedure, surgery side of body were analysed. Comorbidities of the patients, besides diabetes mellitus, were also studied. The correlation between prosthesis infections and diseases such as hypertension, asthma bronchiale, hypothyroidism, Behçet disease, coronary artery disease, haemophilia was studied. For this Charlson Comorbidity Index that was described before calculated for each patient and assessed the relationship between infection rates.<sup>6</sup> At this index, certain scores were given for each diseases according to severity. Sum of the scores were calculated for the patients that have multiple diseases. Scoring system is described as; 0 point mild, 1-2 point moderate, 3-4 point severe, more than 5 point very severe.

**Definitions:** The infection was diagnosed taking many different factors into account. Firstly, clinical findings (fever, erythema, discharge etc) were taken into account. From imaging methods, while radiolucency or osteolysis was observed via X-ray, intake increased around prosthesis and infection was

diagnosed via bone scans and indium-labeled white blood cell scans. In bacteriological research, infection was diagnosed with culture reproduction transmitted during surgery, blood cultures and arthrocentesis. During the operation, histological examination can support the diagnose.<sup>7</sup> Also, unhealthy granulation tissue, synovitis, bone destruction (osteoporosis) and loosening of the prosthesis lead to infection again.

While infections which include skin and subcutaneous layer were referred as superficial infections, infections which include bone and prosthesis were referred as deep infections. Time between surgery and infection was also classified. Accordingly, acute deep infection was defined as an infection which occurs in the first 4 weeks and could be treated with debridement and intravenous antibiotics,<sup>7</sup> delayed deep infection was defined as an infection which occurs after 4 weeks but within 2 years of TKR, late deep infection was defined as an infection which occurs after 2 years and is thought to originate from haematogenous.<sup>3</sup>

**Preoperative Preparation:** With the aim of septic focus scan, ear-nose- throat examination was carried out for all patients scheduled for surgery; for female patients, clinical examinations were made by gynaecologists, urologists and dentists. White blood cells, sedimentation, c-reactive protein levels were tested. Urinalysis and urine culture tests were performed. During all these examinations and tests, as soon as an infection situation was experienced, knee prosthesis surgery was cancelled and the patient were excluded from the study.

Patients were trained by the doctors, nurses and physiotherapists. With intend to use the prosthesis healthfully for life and to prevent late prosthesis infection, patients were informed to prevent septic lesion from progression. All patients who complied with the training were taken into operation and included in research. Anaesthetists evaluated the patients' suitability to the operation and informed them about anaesthesia.

**Peroperative Prophylactic Applications:** All operations were performed in the operating room with vertical laminar air flow unit. Air flow was 5253m<sup>3</sup> per hour. Air exchange rate was 29,2m<sup>3</sup> per hour. Temperature was fixed to 20°C and humidity was fixed to 60% in the operating theater. Microbiological air sampling was performed 3 times, including the last one in 2014. Bacteria count was zero in all these samples.

Sterile waterproof clothing and double-layer orthopaedic gloves were used in all operations. All lower limb was painted 3 times from the tourniquet and draped. After drape application, top layer gloves were thrown. Following the induction of anaesthesia, each patient was given 1 g of cephalosporin intravenously with the purpose of prophylaxis before the tourniquet was applied. In the following 24 hours after surgery, 3 more doses of 1 gr cephalosporin were given intravenously.

Data thus collected on a semi structured, pre designed schedule were entered in Microsoft Excel sheet to prepare master chart, tabulated and analysed to get inferences.

### III. RESULTS

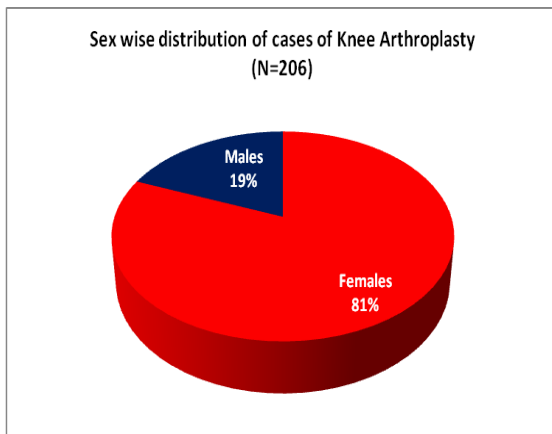
All medical computer records of the patients who had the operation have been scanned. 252 total knee arthroplasty operations were performed on 206 patients with mean aged 66.7years and range 29-93Years. Out of these 206 cases, 167 (81%) of whom were female and 39 (19%) of whom were male. (Figure 1)

Out of these 252 knee arthroplasty, 233 (92.5%) had osteoarthritis, 18 (7.1%) had rheumatoid arthritis and 1 (0.4%) had haemophilic arthropathy. (Figure 2)

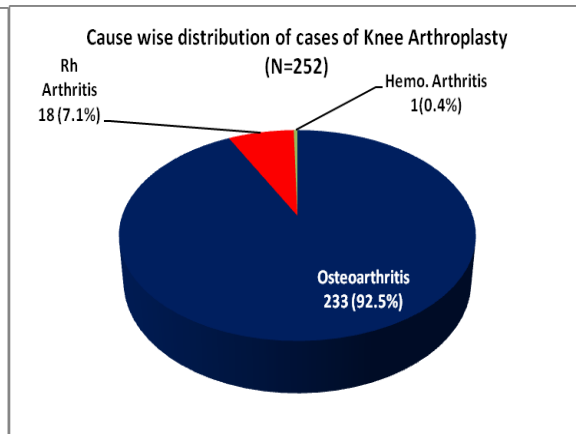
Bilateral total knee arthroplasty operations were performed on 38 (22.7%) of female patients and 8(20.5%) of male patients at different sessions. It shows that bilateral was performed on about 1 patient out of 4. This difference sex wise not found significant. (Figure 3)

All types of infections, microorganisms which were identified as active, operation years and treatments were explained in Table -1.

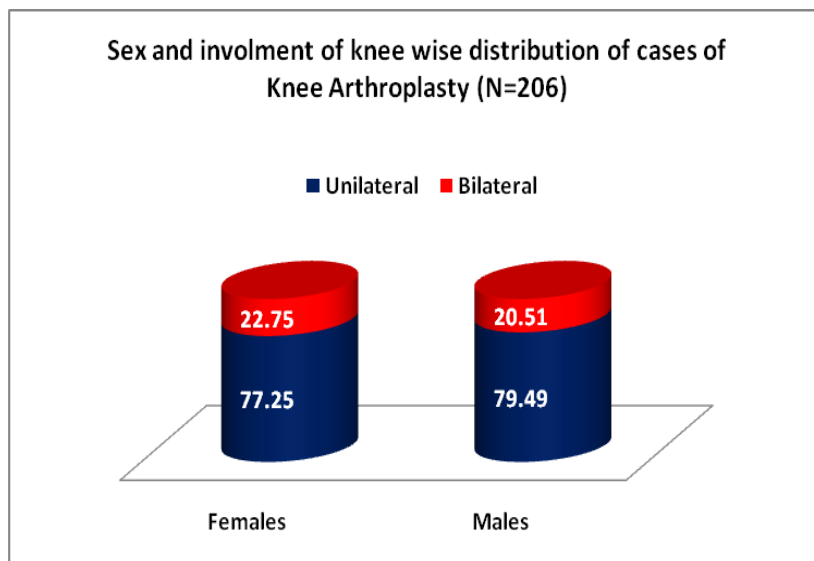
**Figure 1**



**Figure 2**



**Figure 3**



In 252 knees, 10 (4%) superficial infections were found, debridement and antibiotics were applied to 3 knees out of 10 and only antibiotic treatment was applied to the rest 7 knees. It was seen that all of them had total recovery and had no complaints in their last controls. (Table 1)

Deep infection was detected in 4 knees (1,6%) out of 252. Acute deep infection which occurred two weeks after the operation was detected in 1 knee and recovery was provided with debridement and intravenous antibiotics treatment. No infection findings were detected in the last control. (Table 1)

Late deep infection was not detected in any of the 252 knees which have been followed more than 2 years. Delayed deep infection was detected in 3 (1,1%) of these knees after 4 weeks, within 2 years. In 1 patient out of these 3, as the result of the culture which was sent from the applied arthrocentesis material showed lack of growth, debridement and intravenous antibiotics treatment were applied and total recovery was assured; the other two patients had swelling in the knee and complaints about pain in the 48<sup>th</sup> and 28<sup>th</sup> weeks after the first operation and as a result of methicillin sensitive staphylococcus growth from the applied arthrocentesis material, two-stage knee prosthesis revision surgery was applied and both patients had a full recovery at last control. (Table 1)

**Table 1**  
**Distribution of study subjects as per type of Infection and Treatment**

S. No.	Infection	Operation Year	Microorganism	Treatment
1	<b>Superficial Infection (N=10)</b>	2010	No Growth	Oral Antibiotics
		2011	MRSH	IV And Oral Antibiotics
		2011	No Growth	Oral Antibiotics
		2011	No Growth	Oral Antibiotics
		2012	MSSA	Debridement and IV Antibiotics
		2012	No Growth	Debridement and IV Antibiotics
		2012	Morganella	Debridement and Oral Antibiotics
		2013	No Growth	IV Antibiotics
		2013	No Growth	IV Antibiotics
		2013	No Growth	IV Antibiotics
2	<b>Acute Deep Infection (N=1)</b>	2013	No Growth	Debridement and IV Antibiotics
3	<b>Delayed Deep Infection (N=3)</b>	2008	MSSA	2 – Stage Revision and Antibiotics
		2013	MRSA	2 – Stage Revision and Antibiotics
		2013	No Growth	Debridement and IV Antibiotics
4	<b>Late Deep Infection (N=0)</b>	None	-	-

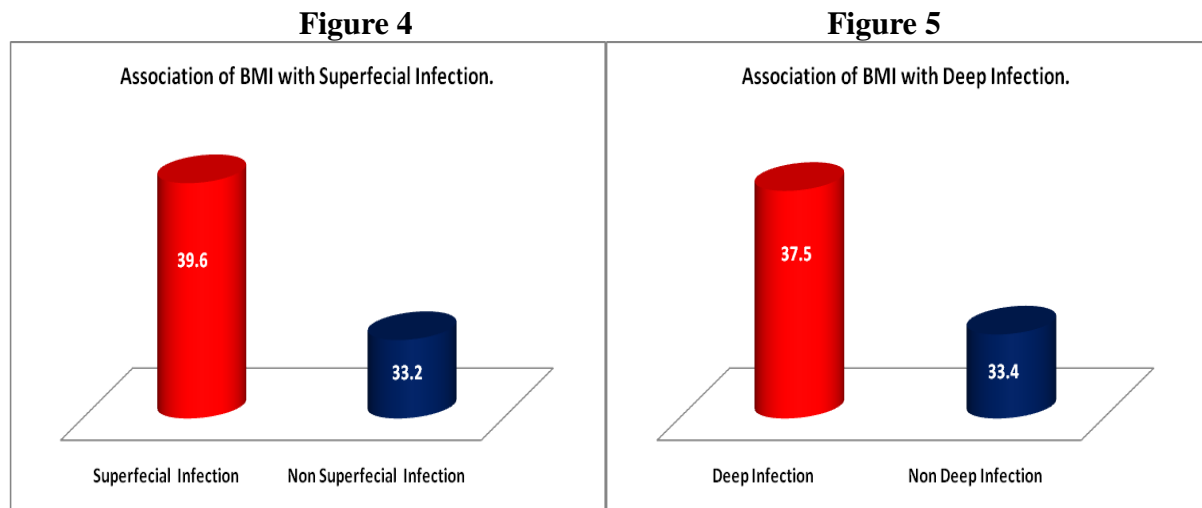
**(ab: antibiotic, iv: intravenous, mrsh: methicillin-resistant staphylococcus haemolyticus, mssa: methicillin-sensitive staphylococcus aureus, mrsa: methicillin-resistant staphylococcus aureus)**

While superficial infection was detected after total knee arthroplasty in 10 knees (4,9%) out of 205 of female patients, 47 of male patients did not experience superficial infection but that difference is not statistically significant ( $p=0,216$ ). When the relationship between patient age and infection frequency was examined, no significant correlation was found. (Table 1)

Osteoarthritis was most commonly seen arthritis type which results knee arthroplasty (92,5%). Romatoid artrit was found in 7,1% of the knees and haemophilic arthropathy was found 0,4%, respectively. When the correlation between arthritis etiology and infection was examined, it was seen that before arthroplasty, osteoarthritis was present at all knees which had infection; nevertheless, no statistically meaningful correlation between arthritis etiology and infection was found ( $p = 0.450$ ). 51 patients 62 knees (24,6%) with diabetes, and 155 patients 190 kness (75,4%) without diabetes were found. When the knees of the patients with diabetes were examined, 3 knees (4,8%) had superficial infection, 2 knees (3,2%) had deep infection; as to patients without diabetes, 7 knees (3,6%) had

superficial infection, 2 knees (1,1%) deep infection but the correlation between either infection types and diabetes was not found statistically meaningful ( $p=0,976$ ,  $p=0,546$ ). (Table 1)

The mean body mass index of the patients was detected as 33.5 (obese). While the mean body mass index of the patients who had superficial infection was 39,6. Also it was 33,2 in patients who had no superficial infection. That difference was statistically significant ( $p=0,001$ ). While the mean body mass index of the patients who had deep infection was 37,5 and it was 33,4 in patients who had no deep infection. That difference was not statistically significant ( $p=0,191$ ). (Figure 4 & 5)



Length of hospital stay was assessed for each patient and mean duration was found 7 (3-27) days. Patients that had superficial infection were 8,5 (5-20) days. Also patients that had not superficial infection were 7 (3-27) days. Patients with and without deep infection mean hospital stay were found same and 7 days. This difference in hospital stay was not found significant ( $p>0.05$ ).

There was no significant difference between these parameters like surgery time, types of anaesthesia, and surgery side and Charlson Comorbidity Indexes for superficial and deep infections

#### IV. DISCUSSION

This present study observed that after total knee arthroplasty, deep infection rate was found 1,6%. When the literature was examined, infection rates after total knee arthroplasty vary between 1-2%.<sup>8,9</sup> While Peersman and his friends reported infection rate as 1,45% after total knee arthroplasty, Fan and his friends reported infection rate as 1%.<sup>10,11</sup> Taking precautions to prevent infection after arthroplasty is easier than infection treatment. For this purpose, preoperative routine systemic infection scans and treatment of possible infection sources before the operation decrease rates of infection after arthroplasty.

Preoperative prophylactic antibiotic treatment is applied to prevent infections. Accumulated haematoma during postoperative period enables us to obtain bactericidal effects. In the literature, the most common two microorganisms which are isolated in infection after total knee arthroplasty are reported as *Staphylococcus aureus* and *Staphylococcus epidermidis*.<sup>10,12,13</sup> It is a known fact that first generation cephalosporins among *Staphylococcus* species are quite effective. We also used intravenous cefazolin as a routine in preoperative infection prophylaxis in our study. In our study, 14 knees had infection, 5 out

of them had culture reproduction, MSSA in 2 knees, MRSH in 1 knee, MRSA in 1 knee and Morganella strains in 1 knee were isolated.

It is reported that vertical laminar air flow among the other infection precautions decreases infection rates after operation significantly. Postoperative infection of than other measures used were reported to significantly reduce infection rates. In a study which was conducted by Lidwell and his friends<sup>14</sup> it is seen that vertical laminar airflow decreases the amount of particles of the surgery room from 164 CFU / m<sup>3</sup> to 2 CFU / m<sup>3</sup>. On the other hand, in a study which was conducted by Brandt and his friends,<sup>15</sup> it is reported that laminar air flow does not decrease infection rates after arthroplasty. In another study which was conducted by Bloom and his friends,<sup>16</sup> a significant decrease is reported in infection rates along with antibiotic prophylaxis, well patient cover, vertical laminar air flow. In our study, low infection rates were obtained through vertical laminar air flow, double orthopedic gloves use, proper purification and cover techniques, microbiological air sampling at regular intervals.

When risk factors after total knee arthroplasty are studied, in the literature diabetes were shown as a main reason frequently. Yang and his friends<sup>16</sup> found deep infection rate as 5,5% in 109 knees with diabetes. England and his friends<sup>17</sup> found deep infection rate as 7% in 59 knees. In our study, 8% of the patients with diabetes and 4, 7% of the patients without diabetes had infection. However, there is not a significant difference. That situation contradicts with the information in the literature. When rheumatoid arthritis, another risk factor, is examined in the literature, it was reported that it increases postoperative infection rates.<sup>18,19</sup> In our study, none of the patients with rheumatoid arthritis had infection and there was no significant correlation between arthrosis etiology and infection.

## V. CONCLUSION

Primary total knee arthroplasty infection rates can be kept low when necessary preoperative, intra-operative and postoperative infection precautions are taken into account. It is found that among the factors like rheumatoid arthritis, diabetes, age, gender, body mass index, just body mass index has an impact on superficial infection rate. This means that when body mass index increases, superficial infection rate also increases. Our infection rates were comparable to rates mentioned in universal literature for primary total knee replacement operations.

## CONFLICT

None declared till date.

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