Overview of Implant Infections in Orthopaedics Department: Retrospective Study

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Abstract
In this study, our aim was to evaluate the antibiotic susceptibility of bacteria isolated from orthopedic implant infections. Within two years operated 1996 patients in an orthopedics and traumatology clinic were retrospectively investigated. Seventy-six (76/1996, 3.8%) orthopedic implant infections were detected. Isolated bacteria and their antibiotic susceptibility patterns were analyzed. The bacteria isolated from implant related infections and antibiogram were evaluated retrospectively in our orthopaedics and traumatology clinic. Staphylococcus aureus was the predominant organism (30.3%). Gram negative bacteria were isolated in 65.8% of our patients. No resistance was determined against vancomycin and linezolid in gram positive bacteria. Imipenem, amikacin and cefepim were seen as the most effective antibiotics for gram negative bacteria.

Keywords
Orthopaedic Implant; Infection; Antibiotic Susceptibility
Implant Infections

Introduction
Orthopaedic infections are the most frequently seen hospital infections [1]. These infections lead to a need for revision surgery, delayed wound healing, increased antibiotic use and prolonged hospitalisation [1]. The tendency of serious recurrences of orthopaedic implant infections causes high morbidity rates and a serious increase in the costs of treatment [2]. Bacterial biofilms which develop on the implant create a protective mechanism of host defence and antimicrobial treatment [3].

Implant infections are classified in 3 groups according to the source [4];
• During or immediately after the operation (perioperative)
• By a blood pathway
• By a proximity pathway
Symptoms are classified in 3 groups according to the time of onset [4];
• Early infection (<3 months)
• Delayed or low-grade infection (3-24 months)
• Late infection (>24 months)

The aim of this study was to make a retrospective evaluation of infections which developed in patients who had orthopaedic implants, and the sensitivity of generally used antibiotics.

Material and Method
A retrospective evaluation was made of 1996 patients who underwent applications of partial or total joint prosthesis, plate, screw, external fixator or intramedullary nailing within a 2-year period at the Orthopaedics and Traumatology Clinic of our hospital. Prophylactic 1 g cephazolin was administered to all patients preoperatively. In patients who developed postoperative infections, the micro-organisms produced from wound site culture samples and antibiotic sensitivity status were retrospectively evaluated. In those with postoperative signs of macroscopic infection (joint pain, redness, fever, swelling or fistula discharge), routine microbiological evaluations were made of debridement or swab samples obtained from the patient and of bacteria colonisations on the fixation material taken with a curette. All the samples were taken under aseptic conditions and reached the laboratory without any contamination. Before taking the samples, it was attempted to prevent contamination with disinfectants such as povidone iodine or hydrogen peroxide. The laboratory evaluations were made with the standard laboratory procedures of gram staining, colony characteristics, traditional biochemistry tests and an automated identification and antibiogram system (BD Phoenix™ Automated Microbiology System, USA). Empiric cephazolin therapy was given to all infected patients until culture and antibiotic susceptibility test results become available.

Results
Retrospective evaluation was made of a total of 1996 patients who underwent fracture fixation using fixation materials such as external fixator (1141/1996, 57.1%) or underwent arthroplasty surgery with partial or total joint prosthesis (463/1996, 23.2%). Mean age of patients was 52 years (range: 14-92 years). Fifty-five point six percent of patients were male (1109/1996), and 44.4% were female (887/1996). Of these patients, infection developed in 76, which was determined by bacterial proliferation in the obtained samples. Seventy-six patients were infected and 30 patients (30/76, 39.5%) were in plate, screw or intramedullary nail group, 21 patients (21/76, 27.6%) were in hemiarthroplasty or total arthroplasty group and 25 patients (25/76, 32.9%) were in external fixation group. Infection rate was determined as 3.8%.

Discussion
Postoperative infection complications have been reported to be seen at rates of 1%-4%, and the rates are higher following revision surgery [5]. In the current study, the rate of infection developing in all the implants was determined as 3.8% at 76 of 1996 cases.

Treatment of infection increases the financial cost of the primary treatment 3-4-fold [5]. Better control of infection can be considered to have a positive effect on reducing treatment costs.

In a 15-year study by Phillips et al evaluating deep prosthetic infections, rates were reported of 0.57% (34/5947) following hip replacement and 0.86% (41/4788) following knee replacement [6]. In the current series of evaluations, of 463 patients with major joint partial or total arthroplasty, infection was determined in 21 (4.5%). Mean age of these patients was 79 years (range: 67-88 years) and at least one of comorbid factors (Diabetes mellitus, renal failure, hypertension or chronic obstructive pulmonary disease) were present in 91% of them. Mean age of patients with periprosthetic infection was 79 years (range: 67-88 years) and they all had at least one comorbid factor. The most commonly isolated bacteria were Staphylococcus aureus in 23 cases (30.3%) and Pseudomonas aeruginosa in 20 cases (26.3%), followed by Acinetobacter spp. in 10 (13.2%), Escherichia coli in 7 (9.2%), Serratia marcesens in 4 (5.3%), Klebsiella pneumoniae in 4 (5.3%), Enterobacter cloaca in 3 (3.9%), Proteus mirabilis in 1 (1.3%), Enterobacter sakazaki in 1 (1.3%), Coagulase negative staphylococci in 2 (2.6%) and Enterecoccus spp. in 1 (1.3%). In the gram positive bacteria, resistance to linezolid and vancomycin was not determined, while in the gram negatives, imipenem, amikacin and ceftazidime were determined as the most sensitive antibiotics. Isolated bacteria and antibiotic susceptibility patterns are detailed in table 1.
determined in 20 patients (30.3%). However, of all the infections, the majority (65.8%) were gram-negative based infections. In a study by Al-Maiyah et al, proliferation was determined at 9% in cultures taken from the gloves at 20-minute intervals during total hip arthroplasty surgery, and of the bacteria produced, 99% were reported to be gram-positive [9]. In long-term hospitalisation of bedridden patients with poor perianal care, gram negative contamination has been shown to be greater (74.7%) [10]. Khosravi et al determined mostly Staphylococcus aureus (21%) in orthopaedic implant infections, but overall, gram negative bacteria were isolated at a high rate of 66% [11]. The lower rate of gram positive bacteria determined in the current study can be thought to be due to insufficient postoperative care and patient compliance.

In orthopaedic implant surgery, antimicrobial prophylaxis in the surgical field has been helpful in reducing infections from 4-8% down to 1-3% [12]. One gram cephazolin was used as prophylactic agent for all our patients. If guidance cannot be taken from the culture result in acute or chronic infections, vancomycin is the first treatment choice for gram positive bacteria and 3rd or 4th generation cephalosporins can be selected for gram negative bacteria [13]. In another study, vancomycin was recommended for gram positive bacteria and gentamycin for gram negative bacteria [5]. In the gram positive bacteria, resistance to linezolid and vancomycin was not determined, while in the gram negatives, imipenem, amikacin and cefepime were determined as the most sensitive antibiotics. The finding in the current study that the sensitivity of S. aureus to vancomycin was higher than that of gram negative bacteria to imipenem and quinolone, is consistent with literature [11]. When administering prophylaxis until isolation of the agent, narrow spectrum antibiotics may be selected [14]. Cephazolin was used for empiric antibiotic treatment in our clinic until isolation of infectious agent.

In conclusion, knowledge of the majority of isolated bacteria and antimicrobial sensitivity patterns guides the choice of antibiotic. Despite all the precautions, it must be taken into consideration that there could be an increase in orthopaedic implant infections in long-term bedridden, elderly patients with poor personal care.

### Competing interests
The authors declare that they have no competing interests.

### References

### Table 1.

<table>
<thead>
<tr>
<th>Antibiotic Sensitivity</th>
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<tbody>
<tr>
<td><strong>Number</strong></td>
</tr>
<tr>
<td>Penicillin</td>
</tr>
<tr>
<td>-------------</td>
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<tr>
<td>Gram (+)</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
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<tr>
<td>Coagulase negative Staphylococcus</td>
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<tr>
<td>Enterococcus spp.</td>
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<tr>
<td>Gram (-)</td>
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<tr>
<td>Pseudomonas aerugiosa</td>
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<tr>
<td>Acinetobacter spp.</td>
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<td>Escherichia coli</td>
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<td>Serratia marcescens</td>
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<td>Klebsiella pneumoniae</td>
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<td>Enterobacter cloacae</td>
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<tr>
<td>Proteus mirabilis</td>
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<tr>
<td>Enterobacter sakazakii</td>
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<td>TOTAL</td>
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