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# Infection rates in total knee arthroplasty: A study

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**Abstract**
**Background:** Periprosthetic joint infection is an uncommon complication of Arthroplasty. But it is among the most devastating complication for the pt. as well for the treating Surgeon. Periprosthetic jt. Infection is the third most common cause of revision of TKA after aseptic loosening and pain. According to the National Jt. Registry report of 2013, 22% revision procedures were performed for infection.
The Economic consequences associated with treating periprosthetic infection is substantial.
**Patients and Methods:** This is a retrospective observational study done between Nov. 2016 to August 2017. All the pts. Who underwent TKA in this Hospital, (King Fahad Specialist Hospital) Al-Qassim, Saudi Arabia, during this period and were diagnosed with infection were included in this study.
**Results:** Total of 339 primary TKRs were done in this Hospital. In a span of 9 months, out of which 6 pts. Were diagnosed with infection. Three cases had deep infection another 3 cases had superficial infection. This gives total infection rate of 1.76% deep infection rate of 0.88% and superficial infection rate of 0.88%.
**Conclusion:** The study shows that the infection rate among TKR pts. In this Hospital is on par with the best outcomes in the world. Bilateral staged TKR has higher rate of infection compared to unilateral TKR. Superficial infection responds well to thorough lavage and parenteral (intravenous) antibiotics. Deep infections needed arthrotomy, thorough debridement and change of Polyethylene insert with or without implant removal. S. aureus is the most common organism isolated from cases of deep infection. Multiple factors are involved in the causation of infection which include but are not limited to, like Pt. comorbidities, sterilization techniques, limiting the entry of traffic in the OT and reducing the duration of surgery time in OT.

**Keywords:** Total knee arthroplasty - TKA, total knee replacement - TKR, American academy of orthopaedic surgeons - AAOS, infection, c - reactive proteins - CRP, erythrocyte sedimentation rate-ESR, staphylococcus aureus - S. Aureus, operation theatre - OT, preoperative-pre-op. post-operative-post-op, propionibacterium acnes - P. acnes

## Introduction
Periprosthetic joint infection is an uncommon complication of arthroplasty. But it is among the most devastating complications for the pt. as well as for the surgeon. The economic consequences associated with treating periprosthetic infections are substantial.
After aseptic loosening and discomfort, peri-prosthetic joint infection is the third most prevalent reason for TKA revision. Because of the high morbidity and surgical obstacles, it is one of the most feared consequences for orthopaedic surgeons. According to a 2013 data from the National Joint Registry, 22% of revision surgeries were conducted due to infection.
Alternatives for diminishing TKA infection rate have long been sought, given that these rates continue to be between 0.4% and 2% after primary TKA and between 3.2% and 5.6% after revision arthroplasty. Long-term follow-up has shown a periprosthetic infection rate of 1.55% over the first 2 yrs. after TKA and 0.46% per year after this period, until the tenth year.
According to Kurtz *et al*., there will be a 673 percent rise in demand for TKA by 2030. Although the TKA infection rate appears to be modest, the number of such cases tends to rise as the number of surgeries increases.
The death rate among patients over 65 years old who were awaiting surgery to treat TKA infection varied from 0.4 percent to 1.2 percent, and from 2 percent and 7 percent among those over 80 years old.

## Patients and Methods

This is a retrospective observational study done between Nov 2016 and Aug. 2017. All the pts. Who underwent TKR in this Hospital during this period and were diagnosed with infection were included in the study.

### Inclusion criteria

All the pts. Who underwent TKA in this Hospital during this period and were diagnosed with infection.

### Exclusion criteria

All the pts. Who underwent TKA elsewhere and referred to this Hospital for further management.

### Methods of collecting data

Data was collected from the OT Register; Hospital infection Register and Surgeon's personal records. The details of the infected cases were traced using Medical records Department (Hospital Management System) Files.

### Type of Study

Non-randomized retrospective study.

### Clinical presentation and diagnosis

The AAOS has developed clinical practice guidelines for the evaluation and management of pts. With TKA infection.

TKA infection can be temporarily divided into three types:

- Acute (less than 3 months)
- Subacute (3 to 24 months)
- Chronic (more than 24 months)

Pain, oedema, and a local increase in temperature are all symptoms of acute infections. Erythema is a kind of fever induced by pathogenic organisms like Staphylococcus aureus and Gram-negative bacteria.

Patients with subacute infections (coagulase-negative Staphylococcus and Propionibacterium acnes) can have non-obvious signs and symptoms, such as chronic discomfort, implant loosening, or both, making aseptic loosening a differential diagnosis. Chronic illnesses appear in a variety of ways, with signs and symptoms that are comparable to those seen in acute and subacute illnesses. It is possible to determine if the patient has a high or low risk of infection based on the examination and clinical history, which is crucial for the treatment strategy that follows.

**Table 1:** Stratification of the risk factors. Reproduced with modifications from "The diagnosis of periprosthetic joint infections of the hip and knee. Guideline and evidence report". Adopted by the American Academy of Orthopaedic Surgeons Board of Directors, June 18, 2010. American Academy of Orthopaedic Surgeons, 2010;18(12):760-770.

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|---|---|---|---|---|
| High likelihood of infection | | One or more symptoms, and at least one or more:<br>1) Risk factor OR<br>2) Clinical examination OR<br>3) Early loosening of an implant (detected on radiograph) | | |
| Low likelihood of infection | | Pain or joint stiffness and none of the items below:<br>1) Risk factor OR<br>2) Clinical examination OR<br>3) Early loosening of an implant (detected on radiograph) | | |
| Symptoms | Risk factors - literature | Risk factors - consensus | Clinical examination | Others |
| 1- Joint pain<br>2- Joint stiffness | 1- Previous joint infection<br>2- Superficial infection<br>3- Obesity<br>4- Duration of surgery > 2.5 h<br>5- Immunosuppression | 1- Recent bacteremia (< 1 year)<br>2- Metachronic infection<br>3- Skin disorders<br>4- Drugs with intravenous action<br>5- Active infection at other site<br>6- Recent infection or colonization by Staphylo MRSA (< 3 years) | 1- Edema, reddening and heat<br>2- Fistula associated with surgical site | 1- Early loosening of implant (< 5 years), detected on radiograph |

### Blood Investigations

Laboratory testing are a crucial element of the infection investigation process.

In patients with a suspected TKA infection, CRP levels and ESR rates are measured. CRP and ESR levels recover to pre-surgery levels around 30 to 80 days, according to Carvaljo Junior *et al*. After a straightforward TKR, respectively. CRP and ESR cut-off values for diagnosing TKA infection were n14.5 mg/L and 19mm/H, respectively, according to Piper *et al*.

Interleukin 6 is another significant laboratory tool for diagnosis (IL-6). According to a recent meta-analysis, IL-6 levels had the greatest diagnostic accuracy, followed by CRP, ESR, and leukocyte counts. Other indicators, such as alpha-1 glycoprotein acid and procalcitonin, have developed, although they are still unsuitable for clinical use.

### Joint Fluid Aspiration

The drainage of synovial fluid from the joint is crucial. The total leucocyte count and the % of polymorphonuclear leucocytes should be determined in the laboratory. Subacute or chronic infection is defined as a count of more than 3000 leucocytes per millilitre (ML) with a neutrophil count of at least 60%. A positive predictive value of 94 percent has been found for counts of more than 27,800 leucocytes/ML in acute cases.

The goal of aspirate culture is to identify the organism and determine its sensitivity pattern. Aerobic organisms, anaerobic organisms, and fungus should all be cultured, with enough time to observe their growth.

Parvizi *et al*. revealed that a colorimetric test for identifying leukocyte esterase in synovial fluid is extremely sensitive and specific for diagnosing TKA infection, and that it also has the advantages of being quick and inexpensive.

### Plain Radiography

Imaging can be utilised to supplement the examination, but it is not required for identifying or ruling out an infection. AP and Lat are both simple. Radiographs are useful, so they're compared to past photos. Periosteal responses, component movement, and osteolysis are all symptoms that infection may be present.

**Nuclear Scanning**

Scintigraphy using Technitium-99m bone scanning has a high sensitivity but low specificity for infection, and because of bone remodelling, it can yield false positive findings for up to a year after the main surgery. TKA infection was diagnosed with an accuracy of 81 percent using indium-111-labeled leukocytes. Triphasic bone scintigraphy, according to the American Academy of Orthopaedic Surgeons, should be utilised in situations where there is a high risk of TKA infection after negative cultures.

**Tissue Analysis**

At least three samples should be taken from various places during operation, ideally after antibiotics have been stopped. Traditional laboratory culturing procedures have been demonstrated to have a sensitivity of 60% in studies. The sensitivity has been enhanced to 83.3 percent using sonication procedures. Histological investigation can be undertaken in cases with negative cultures before or during surgery, using peri-operative frozen-section biopsy or repeated joint puncture after a six-week gap. The clinical history, test changes, and culture findings are all used to help identify the infectious illness. According to Berberi *et al*., it is critical that the therapy be led by the full inquiry rather than simply the outcomes of culturing. When they looked at 897 instances of peri-prosthetic infection, they discovered that 7% of them had false negative cultures. All of these instances were treated surgically or with drugs, with a five-year success rate of more than 70%.

**Etiology**

**Risk Factors**

Diabetes, malnutrition, smoking, use of steroids, poor control of anti-coagulation, obesity, malignancy, alcoholism, urinary tract infections, frequent blood transfusions, and revision surgery have all been linked to TKA infection. According to current recommendations, such variables should be recognised and a multidisciplinary intervention done before any surgery is performed, with the goal of improving the patient's health.

Diabetes patients had a 3.1-fold increased risk of TKA infection. Merchant *et al*. and Van den Bergh *et al*. both reported on the benefits of strict glycaemic index management both before and after surgery.

TKA infection was shown to be 3.3 times more likely in people with a BMI greater than 40. Obesity has also been linked to wound problems, as indicated by Winiarsky *et al*. in research in which 22% of obese patients had surgical wound infection and a greater frequency of deep infection.

**Prevention**

Use of anti-microbial prophylaxis, care in preparing the pts. Skin before the operation, reducing the number of personnel in the Operating Room, restricting the amount of people entering and exiting the operating room, use of laminar air flow in Operating theatres and body exhaust suit have reduced the intra-operative contamination rates. Forty yrs. ago, for every 10 pts. Who underwent TKA, one would develop infection.

**Intra and Post-operative Factors**

Infection is also linked to the persistence of drainage throughout the post-operative period and wound problems. According to Galat *et al*., the infection rate was greater in the group of patients who developed a haematoma. Parvizi *et al*. also found that infection rates were increased in instances with prolonged drainage through the surgical site and in patients with RNIs greater than 1.5.

**Treatment**

TKA infection treatment goals include eradication of the infection, pain alleviation, and re-establishment of function. Segawa *et al*. defined four clinical phases of TKA infection that are useful for guiding the treatment:

1. Infection identified at the time of the procedure
2. Acute post-op infection
3. Identifying some yrs. after the original procedure, coming from a distant focus.
4. Chronic infection

Surgical therapy is typically the only option for a TKA that has become infected. Antibiotics alone are not an effective therapy unless there is a major co-morbidity that makes surgery a relative contra-indication.

**The surgical options include**

1. Washout
2. Debridement, anti-biotics and implant retention
3. One or two stage revision TKA
4. Arthrodesis
5. Amputation.

Prosthetic joint infection (PJI) surgery can be costly, since it may necessitate repeated surgeries, long-term antibiotics, a protracted hospital stay, and more expensive implants for revision surgery.

The optimum outcome of therapy for an infected total knee arthroplasty is implant retention without infection. Some surgeons prefer to debride the knee, especially in cases of acute infection, to minimise the infective organism burden and augment debridement with systematic antibiotics. Their goal is to keep the implant in place and avoid more invasive/complex surgery. With a 2.3-year follow-up, Byren *et al*. found that the infection-free survival rate following D+R therapy was 82 percent. Trebse *et al*. used a D+R protocol on 24 patients with an 86 percent success rate over three years, and found that the presence of a stable implant, the absence of fistulas contiguous with the prosthetic component, and the duration of symptoms less than three weeks were all indicators of a good prognosis. There are no prospective or randomised controlled studies.

When there is excellent skin covering, no comorbidities, and infection is not caused by multi-resistant organisms, replacement in a single treatment is a suitable alternative. Using this technique, Jamsen *et al*. 34 found that infection eradication rates varied from 73% to 100% after 122 months of follow-up.

For an infected prosthesis, two-stage revision arthroplasty is considered the gold standard. It does, however, provide major difficulties for both the patient and the physician. The patient is concerned about two procedures that will result in a lengthy time of decreased mobility as well as severe anaesthesia and surgical risks. Removing a well-fixed prosthetic while removing bone cement presents major complications for the surgeon. This puts the remaining bone stock at danger, making reconstruction harder, increasing the risk of peri-operative and post-operative problems, and potentially jeopardising the soft tissue envelope.

Arthrodesis and amputation are possibilities for immunocompromised individuals and those who would not benefit from a new arthroplasty.

Systemic antibiotic medication should be continued in addition to surgical treatment. For patients with TKA infection who have unfavourable skin covering, it is suggested that they get therapy for six months. Even against slow-growing pathogens or biofilm producers, the antimicrobial agent should be bactericidal. Given the rising levels of resistance, the susceptibility of the germ should be assessed before beginning any therapy, and alternate regimens should be considered. *In vitro*, *in vivo*, and in clinical studies, a combination of Rifampicin and quinolones has been most commonly employed, with favourable outcomes *in vitro*, *in vivo*, and in clinical trials. Options such as linezolid, sulfamethoxazole trimethoprim, and minocycline are available, yet no clinical trials have been published to support their usage. The best approach is to talk to the hospital infection control committee about the optimal antibiotic treatment for each patient.

**Results**

A total of 339 primary total knee arthroplasty cases were done from Nov.2016 to Aug. 2017 (period of 9 months) out of which 6 cases were diagnosed to have infection.

3 cases had deep infection and 3 cases had superficial infection. This gives total infection rate at 1.76% and deep infection rate at 0.88% and superficial infection rate at 0.88%.

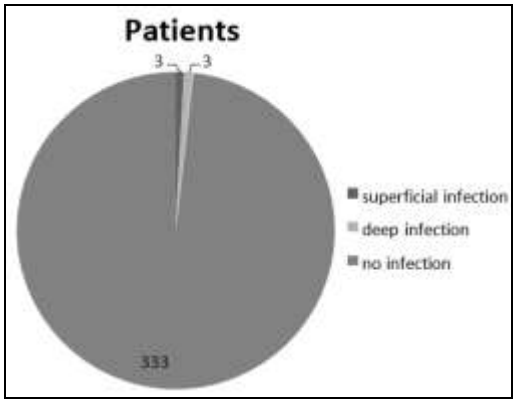


**Fig 1:** Patients

There was no difference in the rate of infection between males and females.

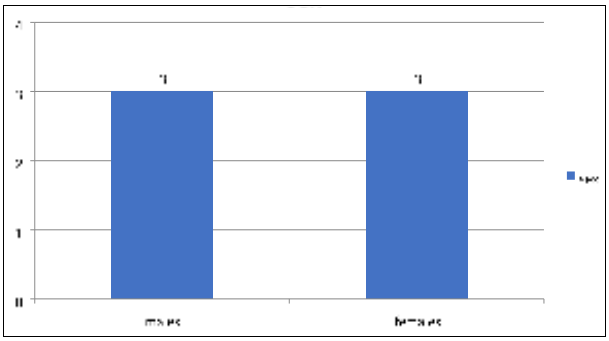

**Fig 2:** Sex

Mean age for infection was 62 (age range-50 to 74)

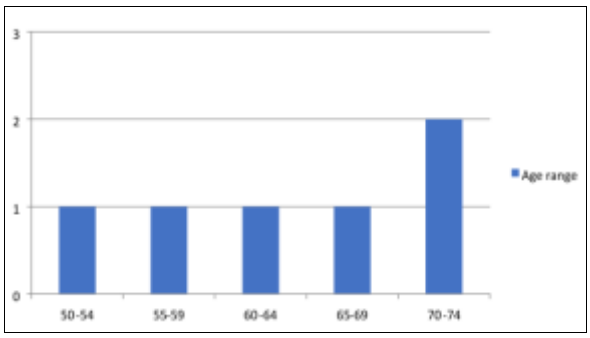


**Fig 3:** Age range for infection

Infection occurred within 6 weeks in 1 patient, between 6 weeks and 3 months in 3 pts. and after 3 months in 2 pts.

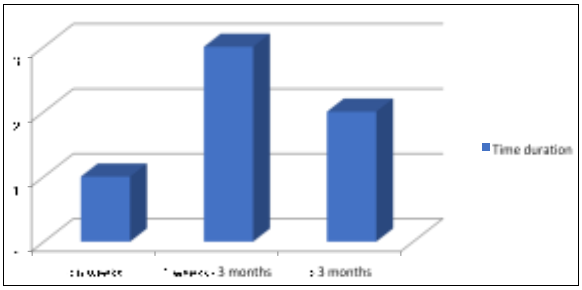


**Fig 4:** Time duration

Co-morbidities: 3 pts. had no co-morbidities, 2 pts. had hypertension with morbid Obesity (BMI >40), 1 pt. had Hypothyroidism.

Out of total of 339 cases of primary TKA, 133 pts. underwent unilateral TKR and 103 pts. underwent bilateral staged TKR. Out of 133 unilateral TKR Pts, only 1 pt. got infected.

Out of 103 bilateral staged TKR pts, 5 pts, got infected in either knee, (among which 3 were second knee of bilateral staged TKR).

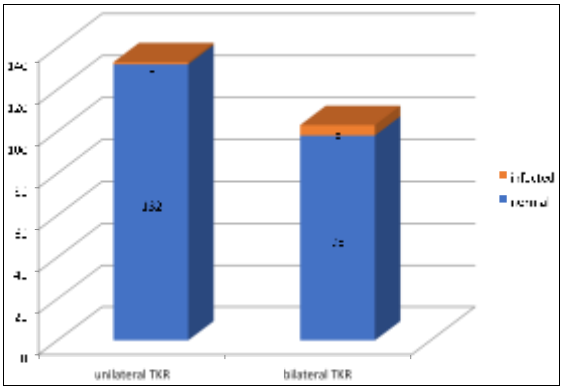


**Fig 5:** Infection and normal

The Organism responsible for majority of deep infection was S. aureus. While the organism responsible for majority of superficial infection was Proteus. All the organisms were sensitive to Linezolid and Clindamycin.

Out of 3 superficial infected cases, 1 case was treated conservatively with parenteral (Intravenous) anti-biotics and the other 2 responded to thorough Lavage.

Out of 3 deep infected case, 2 cases responded well to arthrotomy, debridement and polyethylene insert change. One case was initially treated with washout, but later needed repeat arthrotomy, debridement and polyethylene insert change.

There was no relation of the infected cases to the operation theatre where surgery was performed. There was no relation of the infection to the pre-op antibiotic administered. The average duration of surgery in the infected cases was 2 hrs and 20 minutes (ranging from 2 hrs to 3 hrs 30 minutes) and the average duration of time pt. was in the operation theatre was 3 hrs and 30 minutes (range from 3 hrs to 4 hrs and 30 minutes) which is much more than the average time taken for TKR in this hospital. This might be a contributing factor for causing the infection.

The sterilization method used for sterilizing the bone saw was by using formalin tablets in case of all the deep infections and one superficial infection. In the other two cases, ethylene oxide sterilization was done. The use of formalin tablets for sterilization also could be another contributing factor for causing the infection.

The number of times the OT doors were opened for entry and exit of OT personnel including technicians, nurses, anaesthetists, Asst. surgeons and the operating surgeon during the TKR surgery averaged about 25 per surgery. This is more than the average number of times the doors were opened during normal TKR surgery (n<18). This also might be a contributing factor for causing the infection.

**Conclusion**

The study shows that the infection rate in TKR in this Hospital is on par with the best outcomes in the world.

Bilateral staged TKR has higher rate of infection compared to unilateral TKR.

Superficial infection responds well to washout and Parenteral (intravenous) anti-biotics.

Deep infection needs arthrotomy, thorough debridement and change of polyethylene insert at the least, with or without implant removal.

S. Aureus is the most common organism isolated from cases of deep infection.

Multiple factors are involved in the causation of infection which include but are not limited to, pt. co-morbidities, sterilization techniques, limiting the entry of Personnel in the OT and

reducing the duration of surgery and pt. time in OT.

**Recommendations**

Being extra-vigilant in pts. With co-morbidities like hypertension, Hypothyroidism, Obesity, diabetes mellitus etc.
Minimizing the entry and exit of OT personnel during surgery.
Thorough cleaning and sterilization of the instruments.
Reduction in the duration of surgery and time pt. spends in the operating theatre.
Maintaining proper records of established infected cases and their regular follow-up.
Culture and sensitivity of all suspected cases and quantitative sensitivity of each anti-biotic for a better choice of using anti-biotics in controlling infection.

**Conflicts of interest:** There are no conflicts of interest.

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