ORIGINAL ARTICLE

# Knee prosthetic joint infection : Interest of early debridement, antibiotics, and implant retention strategy

## Intérêt du lavage débridement dans les infections péri prothétiques précoces du genou

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**Abstract**

**Introduction**: Peri joint infections (PJI) are terrible complications that result in high morbidity and a significant financial impact on healthcare costs. Management of PJI requires a multidisciplinary approach. Debridement, antibiotics, and implant retention (DAIR) with or without modular components exchange is attractive as it prevents the unnecessary removal of implants.

**Methods**: It was a single-center, observational, descriptive, and retrospective study, carried over a period of 7 years. DAIR was defined as successful if not followed by a revision surgery. the recovery is considered by the absence of and biological signs of infection during the follow up period. The necessity of re-revision or removal of the prothesis represents a failure of the DAIR.

**Results**: We included 15 patients. The mean age in our series was 69,8. The mean delay of infection onset was 24.8 days. Debridement and irrigation were used in all cases, while modular components were changed in 9 cases which represents 60% of cases. Intraoperative samples were positive in 11 patients which represents 73%. Staphylococcus aureus was the most implicated germ. The outcome was considered favourable in 11 patients which represents 73% of the cases. Patients who had modular components had higher success rates (78% vs 67%) without a significative difference. A delay higher than 3 weeks led to a higher percentage of unfavourable outcomes without a significative difference.

**Conclusion**: Multidisciplinary approach should be implemented to achieve favourable outcome. DAIR with modular components exchange is considered as an effective option for patients developing an early PJI.

**Key words**: Arthroplasty, Infection, Knee, Debridement, Antibacterial agents

**Résumé**

**Introduction**: Les infections péri-prothétiques (IPP) représentent une complication majeure des arthroplasties. Le lavage débridement, avec conservation de l'implant est considéré comme une option valable pour traiter une IPP précoce, car il permet de conserver l'implant et de réduire la durée et le coût du traitement.

**Méthodes**: Il s'agit d'une étude monocentrique, observationnelle, descriptive et rétrospective réalisée sur une période de 7 ans. La guérison est définie par l'absence de signes et biologiques d'infection lors de la période de suivi. La nécessité d'une révision ou d'une dépose de la prothèse représente un échec du traitement.

**Résultats**: Nous avons inclus 15 patients. L'âge moyen dans notre série était de 69,8 ans. Le délai moyen d'apparition de l'infection était de 24,8 jours. Le lavage débridement a été utilisé dans tous les cas, tandis que le changement du polyéthylène a été effectué dans 9 cas (60 %). Les prélèvements per-opératoires ont été positifs chez 11 patients (73%). Le staphylocoque aureus était le germe le plus identifié avec 6 cultures positives. Le résultat a été considéré favorable chez 11 patients (73%). Les patients ayant eu un changement du polyéthylène avaient un taux de réussite plus élevés (78% vs 67%) sans différence significative. Un délai supérieur à 3 semaines est corrélé à un taux d'échec plus élevé sans différence significative.

**Conclusion**: Le lavage débridement, avec conservation de l'implant est une méthode valide avec une efficacité variable. La connaissance des facteurs influant le traitement des IPP précoces est nécessaire pour obtenir de meilleurs résultats.

**Mots clés**: Arthroplastie, Infection, Genou, Débridement, Agents antibactériens

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## Introduction

Due to the increase in prosthetic implantation in last decades, the rate of peri-prosthetic infections following knee arthroplasties is also increasing (1). Peri joint infections (PJI) are terrible complications that result in high morbidity and a significant financial impact on healthcare costs. Management of PJI is complex and requires a multidisciplinary approach combining surgical treatment and efficient antibiotic therapy. Debridement, antibiotics, and implant retention (DAIR) , is attractive to both surgeons and patients because it can prevent the unnecessary removal of implants especially in early PJI which occurs within 3 months making the procedure less invasive (2). Modular component exchange is suggested to give a better surgical outcome as it, reduces the bacterial load, dissolve the biofilm, and improve the efficiency of debridement. DAIR's effectiveness rate varies considerably, from 12 to 80 % (3), depending on population epidemiological characteristics, patients' comorbidities, delay of infection onset, stay duration in hospital prior to surgery and the identified germ and its sensitivity to antibiotics. This study's goal was to study the effectiveness of the DAIR strategy for treating early knee PJI.

## Methods

Our study concerned patients who presented with knee periprosthetic joint infection. We Included all patients aged more than 18 years, presented with knee periprosthetic joint infection after a primary knee arthroplasty, which occurred during the first 3 months following prothesis implantation, initially treated with DAIR with a minimum of 18 months follow-up. We did Not include patients presented with periprosthetic joint infection after a revision arthroplasty or patients presenting a joint septic arthritis prior to the arthroplasty. Patients who underwent surgery and were lost to follow-up before the minimum setback or unusable patients' medical records were excluded.

It was a single-center, observational, descriptive, and retrospective study, carried over a period of 7 years from January 01, 2016, to December 31, 2022. Clinical signs of early PJI which occurred prior to 3 months (4) are commonly characterised by fever, pain, swelling, redness, or warmth at the site of the implant, meanwhile biological signs are elevated white blood cells (WBC) count and high C-Reactive Protein (CRP) level. Early PJI was diagnosed According to Zimmerli criteria which consists of growth of the same germ in 2 or more cultures of synovial fluid or periprosthetic tissue, purulence of synovial fluid or at the implant site, acute inflammation on histopathological examination of periprosthetic tissue or presence of a sinus tract communicating with the prosthesis.

The followed strategy to treat early PJI consists of surgical irrigation, debridement, antibiotic therapy, and implant retention with or without polyethylene compounds exchange. Debridement involves the removal of the hematoma, fibrous membranes, sinus tracts, devitalized bone and soft tissue while using more than 3 Liters of saline and antiseptic solutions such as sterile dilute povidone-iodine (4).

DAIR was defined as successful if not followed by a revision surgery. the recovery is considered by the absence of clinical (fever, local pain, redness, warmth) and biological (CRP level less than 10 mg/l) signs of infection during the follow up period (4). The necessity of re-revision or removal of the prothesis represents a failure of the DAIR.

statistical analysis

Data acquisition and statistical study were conducted using the software IBM SPSS statistics. For quantitative variables, we calculated means, medians and the standard deviations and we determined the extreme values of the variables' range (minimum and maximum). For categorical variables, we calculated simple and relative frequencies (percentages). The comparison of two means on independent series was made by the "Student's test". Percentage comparisons on independent series were performed by the "Pearson's chi-square test", and in case of invalidity of this test by the "two-tailed Fisher's test".

## Results

We included 15 patients in our study. The mean age in our series was 69.8 with extremes ranging from 55 to 74 years, with a clear predominance of females (82%). The average body mass index (BMI) was 28,2 kg/m2. We had 6 diabetic patients, which represents 40%. Most of our patients had an ASA score superior or equal to 2 as 55% of patients had an ASA II score. Cemented prothesis were used in all cases. The mean delay of infection onset was 24.8 days with extremes ranging from 10 to 67 days. The clinical signs found among our patients were pain, warmth, redness, fever, and functional impotence.

**Figure 1.** clinical presentation of PJI after TKA showing a swollen knee with inflammatory local signs

The total number of patients with an ESR>50mm, CRP>30mg/L and WBC>10000 cells/ml was 8, representing 31% of the total number of infections. Debridement and irrigation were used in all cases, while modular components were changed in 9 cases which represents 60% of cases. Intraoperative bacteriological sampling was systematically performed in all 15 surgical infections. Intraoperative samples were positive in 11 patients which represents 73%. Staphylococcus aureus was the most implicated germ with 6 positive cultures; Methicillin-Sensitive Staphylococcus aureus was found in 4 times meanwhile Methicillin-resistant Staphylococcus aureus (MRSA) was identified in 2 times. The combination of Rifampicin + Ofloxacin was the most used in 9 cases. The average duration of antibiotic therapy was 51 days. The outcome was considered favourable in 11 patients which represents 73% of the cases.

It was unfavourable in 4 patients, as 2 had re-revision, 2 had implant removal, 1 of which had a onetime prothesis replacement and the other one had a 2-time surgery, with the use of a spacer during the first operation during a period of 75 days, before the 2nd prothesis replacement. Comparison between patients who were declared free of infection after DAIR and patients with unfavourable outcomes showed shows that the proportion of diabetic patients is higher in group 2 without a significative difference. patients who had modular components had higher success rates (78% vs 67%) without a significative difference. (P= 0.287). A delay higher than 3 weeks led to a higher percentage of unfavourable outcomes without a significative difference. It also showed a lower percentage of success when Staphylococcus aureus is identified.

## Discussion

This study is open to critics as it shows some limitations such as the retrospective mono-centric aspect of the study. Also, the limited number of patients represents a limitation. Meanwhile, the relevance of the subject which is widely studied throughout the world with different results and characteristics depending on the population and the country represents a strength of our study, as few studies report results of DAIR in south Mediterranean population.

### Age

Compared to other studies, the mean age is a little higher, as a systematic review led by Lango & al. (5) which included 10 eligible studies led mainly in the United States and Europe, showed that the mean age of patients varies between 55.3 and 67.8 (6–12). The slight differences between our series and literature may be explained by the fact that patients consult for arthrosis at an advanced age and status.

### Medical history

A study including 7181 Primary Hip and Knee Replacements showed Diabetes diagnosed during surgery doubled the risk of periprosthetic joint infection. The study also showed that the impact of diabetes on the infection rate was more significant for hip replacements than knee replacements (13). The study led by Chen & al. (14) showed that diabetes mellitus (P = 0.01) is associated with failure of DAIR. In literature an ASA score higher than 2 is significantly associated with an increased risk of periprosthetic joint infection (15,16).

### Delay of infection onset

Our results shows that a delay higher than 3 weeks led to a higher percentage of unfavourable outcomes, without a significant difference. Our results are in line with the literature as short duration of symptoms is considered as a major prognostic factor when it comes to infection control enabling implant preservation, ensuring good functional results (17). Many authors mention that DAIR remains the treatment of choice for PJI presenting within 4 weeks from arthroplasty (18,19). A study led by Kuiper & al. (20) showed that DAIR would be successful if the duration of the infection is a short as possible.

### Role of biofilm

Micro-organism, in the form of a biofilm, resists to environmental aggression by using the ability to grow on the implant surface and the necrotic tissue (21). Biofilm takes 4 weeks to become mature, forming a complex hydrated polymeric matrix where germs live clustered (22). Biofilm germs can resist up to 1000 times more to growth-dependent antibiotics compared to micro-organisms found before biofilm formation (23). Before having a mature biofilm, the bacteria are more vulnerable to antibiotics, and theoretically DAIR strategy should be more effective (24), this can explain why DAIR is more efficient when done after a short period of symptoms.

### Exchange of modular compounds

Literature review showed that modular component exchange is suggested to give the best possible surgical access to the implant, reduce the bacterial load, dissolve the biofilm, and improve the efficiency of debridement (22). During the surgery, proper debridement and potential biofilm elimination is facilitated by the removal of modular components, which allows for better visualization of the joint. However, judging the necessity of exchanging the modular components during DAIR surgery is difficult, due to the lack of conclusive evidence. The main limitation of the polyethylene exchange is its cost. The percentage of polyethylene exchange is higher in our hospital is high as costs are fully covered by the hospital.

### Microbiology

According to literature, the most common micro-organism responsible for most early PJI are high-virulence bacteria such as Staphylococcus aureus and gram-negative bacteria (Escherichia coli, Enterobacter,

Klebsiella, Pseudomonas aeruginosa) (18). Numerous studies have shown that a Staphylococcus aureus infection is associated to a greater risk of failure (25–28).

## Conclusion

In conclusion, knee periprosthetic joint infection still represents a major complication of TKR which is increasing due to the increasing number of joint replacements. It should be prevented threw minimizing risk factors of infection and optimizing preoperative preparation and diagnosed and treated carefully as it can influence the vital and the functional prognosis. Multidisciplinary approach including preoperative decision, surgical treatment and efficient antibiotic therapy should be implemented to achieve favourable outcome. DAIR with modular components exchange is considered as an effective option for patients developing an early postoperative periprosthetic joint infection as it gives the option of implant retention and lowering the treatment duration and its cost.

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