

# Prosthetic Joint Infection – How to Deal with it Rationally

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## Abstract

Prosthetic Joint Infection is a devastating complication both for the patient and the surgeon. It depends on many factors including patient factors, surgeon factors, surgery set up. The most important factor in management of PJI is to take care of all modifiable factors that can bring down the rate of infection. One of the critical steps is in prevention of surgical site infections and raising awareness among the surgeons and patients about the role of various screening procedures and avoiding indiscriminate antibiotic abuse. Management option includes one stage or two stage exchange arthroplasty, but the success rates are less than 90%. At times salvage surgeries like fusion, excision arthroplasty or amputation may also be needed. The present article overviews the prevention and management of PJI

**Keywords:** Prosthetic Joint Infection, arthroplasty, revision, salvage

## Background

While arthroplasty as a surgical procedure has been extremely successful in treating disability and pain arising from damaged articular surfaces in all the major joints in the human body [1, 2], one of the most catastrophic complications following it is prosthetic joint infection (PJI) [3]. With increasing volumes of primary arthroplasty performed across all ages, revision for PJI still ranks high amongst the reasons for revision arthroplasty [4, 5]. The dynamics of the incidence of PJI continue to vary across the multiple national registries [6]. Infection burden is calculated as the ratio of implants that are revised for infections to the total number of primary arthroplasties performed in a given time frame. Open source data from various registries shows an infection burden between

0.76% and 1.24% [7]. While this may not seem too high, the burden has continued to rise each year since 2012. In India, as per the ISHKS registry with over 1.5 lakh primary and revision TKAs, as many as 30.6% of the revision surgeries are for infections. (<http://www.ishks.com/pdf/ISHKS-Outcome-2017.pdf>). However, the registry captures only a small number of revisions and hence this number seems unusually high. It is a valid criticism that data from registries may not be capturing the entire number of revisions performed [8, 9] and it has been postulated that the “true” incidence of PJI could be 40% higher than currently reported [10]. Apart from being a bad complication, treatment of PJI is extremely expensive and not entirely a pleasant experience for the patient as well as for the treating physicians [11].

and it may be mentioned here that along with Erythrocyte Sedimentation rate and C-reactive protein serum levels more specific serum biomarkers such as Procalcitonin, Interleukin-6, tumor necrosis factor-alpha and monocyte chemoattractant protein-1 levels are newer tests that may help in clinching the diagnosis [12]. The role of routine Xray imaging and scans is essential to rule out other causes of the patients’ complaints.

## Factors influencing decision making

The international consensus meeting on periprosthetic joint infection in Philadelphia in 2012 has come up with an exhaustive list of recommendations for each stage of treating PJIs [13]. A major part of the methods listed are based on the consensus statement. Once a patient is determined to have an infected joint, the next step involves planning of the treatment. The time after the index surgery can alter the management protocol. The management of Acute versus chronic (late) PJI is as expected, not the same. Persistent wound soakage, continuous

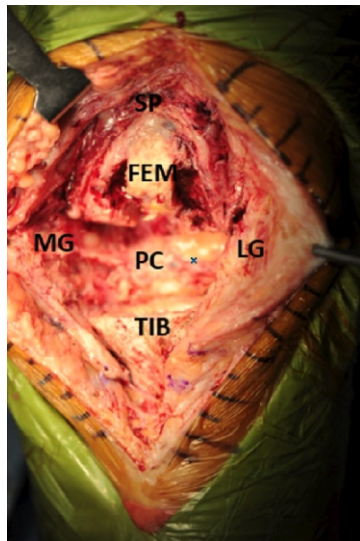
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Once an arthroplasty is suspected to be infected, no effort must be spared to confirm the diagnosis and ascertain the microbe responsible. The discussion about these are beyond the scope of this chapter



**Figure 1:** Areas of sample collection for culture and sensitivity during debridement. SP- Suprapatellar pouch, MG- Medial gutter, LG- Lateral gutter, PC- Posterior capsule, FEM- Femur surface and intramedullary, TIB- Tibia surface and intramedullary



**Figure 2:** Skin complications following infection of a total knee arthroplasty. (A) Necrosis of the skin flap anteriorly over the knee and patella. (B) Coverage of the knee provided with anterolateral thigh free flap performed concurrent with a stage 1 revision and antibiotic cement spacer implantation.

culture negative PJI [15].

### Surgical Options for management:

The goal of treating a PJI is to eradicate the infection and as far as possible to avoid complex invasive surgical procedures. The protocols are essentially surgical interventions, except in scenarios which preclude intervention due to co-morbidities acting as a relative contraindication [16]. The graded options for management of PJI include lavage, open debridement, antibiotics and implant retention (DAIR), one or two stage

collection of fluid in drains and signs of sepsis and bacteraemia are immediate pointers for intervention. Acute PJI should be managed aggressively. While the exact time that can be allowed to lapse before active intervention is not precisely known, persistent drain for more than 72 hours should raise high index of suspicion for PJI. It is recommended to avoid antibiotics as they might mask an underlying infection. Active wound care alone is advocated as majority of the wounds spontaneously stop draining by the 4th day. If, after 5 days, there is persistent drainage, surgical intervention involving fasciotomy, thorough irrigation and debridement along with exchange of the modular components must be done. Multiple wound cultures (minimum 3) must be collected. Attention should be paid to meticulous wound closure in layers. Antibiotic treatment should be initiated as per culture sensitivity once the microbe is identified. Associated co-morbidities must be dealt with simultaneously as conditions causing immunocompromised situation such as uncontrolled diabetes can worsen the prognosis in PJI. Malnutrition, anaemia, anticoagulation

should also be addressed prior to the surgical intervention.

When a patient presents within 3 months after the index arthroplasty with signs of infection, the strategies for management are altered. In presence of swelling and inflammatory signs, a diagnostic joint aspiration may be carried out to relieve the immediate pain and collect samples for culture sensitivity. A formal incision and drainage along with a thorough wound lavage may be an option in patients who are otherwise healthy and have well fixed implants.

It is recommended to withhold antibiotic treatment peri-operatively until samples are collected as incidence of culture negative PJI has been reported in upto 30% of the suspected PJI cases [14]. It may be prudent to withdraw antibiotics for a period of at least 2 weeks and repeat microbiology cultures obtained. Fungal, mycobacterial and fastidious bacteria can also be reason why cultures may turn out negative. It is also important to rule out non-infectious conditions which may present similar to a PJI. Metal-on-metal failure, trunnionosis and gout should not be mistaken for

revision, arthrodesis and finally amputation. 2-stage revision arthroplasty is the gold standard for treating PJI [14, 17]. It is a challenging endeavour which requires large resources and also subjects the patient to a substantial risk of 2 extensive surgeries along with its costs and complications. Hence an attempt is made to retain the original well fixed implants if the conditions are suitable.

### Debridement, Antibiotics and Implant retention (DAIR)

Debridement of the joint to reduce the bacterial load in acute infections and an extensive synovectomy is carried out. The modular portion of the implants must be removed to gain access to all parts of the joint so that all remnants of tissues harbouring the organism can be excised. Appropriate numbers of samples are acquired for culture and the antibiotic with the widest sensitivity is administered. A thorough lavage with either plain pulsed saline or diluted with a chemical antiseptics such as chlorhexidine can be used, taking care to remove and prevent the biofilm from forming. During closure, the sinus

tracks must be excised along with an adequate skin margin. A suction drain in situ is left in until the discharge decreases to minimal amounts. The success of DAIR is dependent on multiple factors, most important being the innate immune response of the patient [18]. The quality of the local soft tissues to allow precise wound closure is also important. The presence of a draining sinus is a relative contraindication for DAIR as it has been shown to have a higher failure rate. The duration for antibiotic treatment is not precisely predictable and must be tailored for every patient's need and microorganism in consultation with the infectious disease specialist and the hospital infection board. There are reports which show negligible difference irrespective of whether antibiotics were administered for 3 months or 6 months [19]. The virulence of the microbe and host factors determine the duration for antibiotic cover. Long term suppression therapy may be considered when surgery carries a substantial risk due to medical reasons. DAIR should be attempted in the acute presentation of PJI within 4 weeks after the index surgery. It should be thorough and the progress monitored with regular clinical examination and periodic evaluation of serum biomarkers. PJI may persist or worsen in spite of these measures and that will necessitate a more radical surgical intervention [20].

### Single stage revision

The single stage or one stage revision of the infected PJI has gained acceptance in recent times although it is not confirmed if the outcomes and re-infection rates are better than that of the two stage revision that is accepted as the gold standard. The single stage surgery avoids the extended durations of hospitalization, increased periods of immobilisations and the tremendous

economic burden on the health care systems [21]. It reduces the overall cost of the treatment and is expected to improve the outcomes.

For a successful one stage revision, meticulous pre-and peri-operative planning is essential. One of the most important factors is a positively identified microbial organism which is not resistant to available antibiotics. Meticulous removal of the primary hardware and cement along with an aggressive soft tissue debridement and bony tissue must be carried out. Radical synovectomy along with excision of joint capsule may be necessary. The operating surgeon must be acquainted with the implant system being used for the revision and all specific instrumentation needs to be available during the surgery. Due to the extended duration for the procedure, adequate blood must be available and anti-fibrinolytic agents such as tranexamic acid may be considered. Allografts should be considered in cases of extensive bone loss along with metal augments in the indicated cases. Antibiotic impregnated cement is typically used to fix the implants. Pre-mixed antibiotic loaded cement may be used if the offending bacteria are susceptible to it.

During the surgery, adequate skin margins along with the draining fistulae if any are excised. Plastic surgeon's services may be required if there is necessity of flap cover for loss of soft tissue. The implants are removed with all precautions to maintain adequate bone-stock for the re-implantation. If necessary, osteotomies or bony windows need to be employed. After complete removal of the implants, a pulsed lavage followed by intramedullary reaming is completed. The canals are packed with antiseptic soaked swabs and the entire team re-scrubs along with a re-draping of the patient. The new joint is implanted

while addressing the inadequate bone stock with allografts or even antibiotic cement. In recent times, the use of tantalum augments in form of wedges or cones has gained popularity. The implants are secured in place with the antibiotic impregnated cement. Post operatively systemic antibiotics are continued for at least 2 weeks. Patients with adequate bone stock and less intensive soft tissue involvement can be allowed immediate full weight bearing mobilisation. In the other patients, a balance has to be found between the necessary immobilisation for healing and function of the joint.

One stage revision inherently carries a risk of reinfection. However, the reinfection rates are between 10-15% and are as comparable to most series with two stage revisions. One stage revisions have a shorter period of antibiotic cover post operatively. Due to the critical pre and peri operative requirements, one stage revision may not always be a feasible option for the patients. The surgeon and his team may not be adequately experienced in handling such an extensive procedure and hence the two stage procedure might be a better alternative in those cases.

### Two stage revision

The two stage revision for PJI was pioneered by Insall and his group and has been the gold standard for the management of this difficult complication [22]. The discovery and insights of how bacteria adhere to implants and form a biofilm improved the management of PJI. The presence of the extracellular slimy biofilm produced by the bacteria leads to poor antibiotic penetration in an already immunocompetent environment of the implanted prosthesis [23]. This basically implied that complete eradication of the PJI is only possible with complete removal of the foreign



body. This has to be supplemented by local antibiotic delivery to achieve optimum bactericidal activity in the infected joint.

In a two stage revision, a complete and meticulous debridement is achieved by removal of implants and a radical synovectomy that may include capsulectomies if indicated. A spacer which elutes antibiotics over an extended period is then placed in the cavity and the joint is closed with a suction drainage in situ. Multiple tissue samples are sent for culture and the appropriate drug administered intravenously for an extended period, usually six weeks. There may be occasions to perform a second debridement if the patient fails to improve clinically as indicated by continuous drainage or rising serum biomarkers. The antibiotic treatment may also be modified if the cultures reveal unusual organisms or slow-growing microbes. The microbiologist and the infectious disease specialist must be recruited in tackling the problem as a team.

The two stage treatment aims at

preventing further serious complications and the infection is controlled with multiple modalities. The intervening time interval also allows for addressing any medical comorbidities that may contribute to improving the general health of the patient. The two stage revision is a challenging protocol and is monetarily more expensive for the patient as well as the healthcare systems. The prolonged antibiotic therapy along with restricted mobility and function of the limb can also take a psychological toll on the patient. The functional outcome of these patients is consistently shown to be lower as evidenced by the various reports [17]. The overall mortality following successful PJI treatment is known to be high and in spite of the heroic efforts, there is always the possibility of re-infection. In such a scenario, other surgical options such as excision arthroplasty, arthrodesis and amputation may also have to be considered.

### Conclusion

PJIs will continue to be a major cause of

revision surgery in the future, with the increasing numbers of primary arthroplasty across the globe. The management of PJIs is difficult and exacts a large monetary price on the healthcare delivery system as well as an inordinate amount of psychological burden on the patient. One of the critical steps is in prevention of surgical site infections and raising awareness among the surgeons and patients about the role of various screening procedures and avoiding indiscriminate antibiotic abuse [24]. The current standard of a two-stage exchange arthroplasty has less than 90% success rates [25]. The remainder of the patients must have alternative options in spite of undergoing multiple surgeries and interventions. In these dire cases, salvage surgeries such as fusion, resection arthroplasty and amputation have to be considered as viable options, especially if the general physical condition of the patient prohibits heroic attempts at reconstructing the joint involved.

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**Conflict of Interest: NIL**  
**Source of Support: NIL**

#### How to Cite this Article

Patil S, Shekhar A, Tapasvi S. Prosthetic Joint Infection – How to deal with it Rationally. *Journal of Clinical Orthopaedics* July-Dec 2017; 2(2):11-15