Define what constitutes a deep prosthetic infection.

Contamination, concentration, and multiplication of microorganisms in a joint surgically treated with prosthetic reconstruction constitute deep prosthetic infection. The most frequent microorganisms found are bacteria, but fungal infections are often seen, especially in individuals who are immunocompromised. Acute infections result from the perioperative contamination of the surgical field, and chronic infections are frequently the result of hematogenous spread from a distant focus, including but not limited to, dental, respiratory, gastrointestinal, or genitourinary origin. Toxins released by the microorganisms combine with the body’s inflammatory response, resulting in steady destruction of juxta-articular bone stock, osteolysis, and implant loosening with dramatic medical and socioeconomic sequelae.

What are the symptoms of deep infections?

The common presentation is deep seated, chronic, and constant pain that persists during resting periods. Early loosening of components and osteolysis may be the only signs, but cellulitis, wound dehiscence, and draining sinuses may also be present in later stages. Unusual presentations include frequent dislocations with total hip replacements and persistent effusion with total knee replacements.

How are deep prosthetic infections different than other infections?

Although the infective process in areas of the body other than a prosthetic joint frequently result in increased warmth, erythema, induration, and abscess formation with constitutional symptoms of fever and chills, a periprosthetic joint infection may not do so. Microorganisms secrete a biofilm on the prosthesis that acts as a barrier to antibiotic penetration, making eradication difficult. Biofilm forms within hours and is highly resilient to general techniques of infection treatment, such as operative debridement, pulse irrigation, and mechanical disruption by vigorous scrubbing.

What are the most common causes of deep infections in total joint replacements (TJR)?

Infections of this nature are generally multifactorial, with several contributory avenues. It is a combination of virulence of microorganisms, host factors, and contamination during the perioperative phase. Acute infections within 6 weeks of the operation are often a result of contamination during or immediately following the procedure. Surgical contamination may result during implantation, and postoperative sources of infection include hematoma, wound dehiscence, and nosocomial origins. Subacute and chronic infections commonly result from hematogenous seeding from a distant focus, including dental, gastrointestinal, and genitourinary foci. Invasive procedures, such as dental work and gastrointestinal endoscopy, should always be preformed while administering pro-
Phylactic antibiotics, as per guidelines from the American Academy of Orthopaedic Surgeons.

What role does imaging play in diagnosing deep infections?
Few conclusive investigative modalities exist for diagnosing joint infections, and those often produce false-negative results, especially in previously unsuccessfully treated cases. These include microbiological cultures, which are often negative following empirical antibiotic therapy, despite persistent infection. Hence, other modalities, including radiological investigations, play an important supportive role. Plain radiographs and computed tomography reveal prosthetic loosening and osteolysis; magnetic resonance imaging contributes to diagnosing osteomyelitic changes; and triple-phase bone scans show an increased uptake of radioisotope around the prostheses. These modalities are inconclusive and need to be evaluated collectively with clinical parameters, hematological testing, and microbiological examinations.

How are deep infections in TJRs treated? How does treatment differ compared with other infections?
Periprosthetic joint infections occur in a small percentage of patients but result in considerable morbidity and decline in functional outcome. It is not only a massive financial burden, but it also has a negative emotional effect on the patient and the treating surgeon. It requires thorough investigation, careful pretreatment planning, meticulous surgical technique, and coordinated care with infectious disease specialists, pharmacists, microbiologists, and internists. Treatment of knee or hip periprosthetic infections varies, and no consensus exists. The modalities include operative debridement and implant retention, resection arthroplasty, 1-stage prosthesis revision, and 2-stage prosthesis revision, which is the gold standard in North America. As a guideline, infections that occur within first 4 weeks postoperatively are treated with debridement and exchange of moving parts; for those that occur after 4 weeks postoperatively, the most reasonable option is 2-stage revision, with explantation and exchange with an antibiotic impregnated spacer at the first stage of the revision followed by a tailored course of intravenous antibiotics and reimplantation after infection resolution (generally after 3 months) for the second stage of the revision. In high-virulence organisms, including methicillin-resistant Staphylococcus aureus, operative debridement should not be chosen; a 2-stage exchange offers better results.

What preventative measures should be taken to reduce the risk of deep infections in TJRs?
Preoperatively, a detailed history of medical comorbidities, past infections, and antibiotic allergies are highly contributory. Presurgical dental screening is imperative and should be implemented for all prospective candidates. Optional screening modalities include nicotine levels, drug screening, and serum drug levels, and discussions concerning the benefits of smoking cessation could be beneficial. Also, the importance of preoperative antibiotics cannot be over emphasized. Careful preoperative preparation of the surgical area at home with surgical cleansing is recommended. Intraoperatively, apart from universal aseptic techniques, isolating the skin by using an adhesive antimicrobial incise drape is useful. Using body suits and laminar air-flow systems, reducing traffic in the operative room, and using pulse lavage systems are helpful. Other measures include careful soft tissue handling and dissection, meticulous hemostasis, and water-tight, layered closure. Postoperatively, isolating the patient in a separate room that is only used for patients undergoing joint replacement is a good practice. Watchful surveillance of the surgical dressing and incision and early intervention, when suspicions are raised, are good practices.

What risks are associated with deep infections in TJRs?
Such infections are difficult to treat and often involve 1 or more operations, several weeks of antibiotic treatment, and multiple investigations and have significant clinical, emotional, monetary, and functional consequences. Untreated or inadequately treated infections may lead to persistent deep-seated chronic resilient disease, further leading to severe bone destruction with prosthetic failure, soft tissue loss, and compromise of the limb as a result of multiple procedures. During the course of treatment, patients could see a decline in status due to medical comorbidities as well.

What progress has been made in the treatment of deep infections in TJRs?
Tremendous advancements have been made in this area because the previous option was limb ablative surgery, including arthrodesis or amputation. With progress in the field of antibiotic therapy and microbiological and serological testing and advances in surgical techniques and implants, limb salvage is a realistic option. Early and confirmed diagnosis with differential synovial fluid cell count, serological tests, such as C-reactive protein and erythrocyte sedimentation rate, synovial fluid C-reactive protein, and leucocyte esterase, is possible. Interval antibiotic spacers are available in either articulating or static types, depending on the surgeon’s preference, and replantation options vary, with options of segmental endoprosthetic reconstruction available. Delivery of heat-stable antibiotics through cement elution has also taken major strides.

What does the future hold for treatment of deep infections in TJRs?
The emphasis is on developing more sensitive testing and making earlier diagnoses. Investigative modalities, such as synovial fluid C-reactive protein, synovial leucocyte esterase, molecular markers such as interleukin-6, and the use of polymerase chain reaction, are under evaluation. Culture of the explanted prosthesis with sonication and other biofilm sampling strategies are also being developed.