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QUESTION 6: Does the use of recently-introduced technologies (navigation, robots, etc.) influence the incidence of surgical site infection/periprosthetic joint infection (SSI/PJI) after orthopaedic procedures?

RECOMMENDATION: The use of computer-navigation, patient-specific instrumentation and robot-assisted surgery during total joint arthroplasty has not been shown to increase the risk of subsequent SSI/PJI. However, an increase in operative time that may occur as a result of use of these technologies may increase the risk of subsequent SSI/PJI.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 84%, Disagree: 9%, Abstain: 7% (Super Majority, Strong Consensus)

RATIONALE

There has been an influx of new technology in the realm of total joint arthroplasty (TJA) over the past two decades with the aim of improving outcomes. New technologies include computer-assisted arthroplasty, robotic-assisted arthroplasty and patient-specific instrumentation (PSI). Some of these technologies are gaining acceptance in the field of hip and knee arthroplasty. There is, however, a paucity of literature regarding the use of these technologies in other orthopaedic procedures and the link between the use of these technologies and the potential for an increase the rate of subsequent of SSI/PJI.

Computer-assisted surgical (CAS) navigation was introduced in the 1990s and has steadily gained traction in recent years. There are three distinct types of CAS arthroplasty including imageless, preoperative image-based and intraoperative image-based systems. Imageless systems feature accelerometer-based or optical navigation systems, whereas image-based CAS use radiological imaging to form 3D models of the patient's specific anatomy [1,2]. The main aim of CAS in arthroplasty is to improve component position and restore the mechanical axis [3,4].

While there are many studies examining the radiological and functional outcomes of CAS, only a limited number examine rates of SSI/PJI in computer-navigated arthroplasty. Regardless, both retrospective and prospective studies report similar rates of infection between CAS and conventional arthroplasty, with patient follow-up ranging from 12 weeks to 10 years [5–17]. Meta-analyses comparing the outcomes of navigated versus conventional knee arthroplasty performed by Bauwens et al. and Moskal et al. also revealed similar rates of postoperative infection for the two patient groups [18–19]. The longer operative time associated with full computer-navigated surgery are a potential risk factor for PJI, but does not appear to affect the rates of PJI in the current literature [7–21].

In most types of navigation-assisted surgery, several temporary pins must be placed (an exception being small handheld navigation devices), either within the operative field or percutaneously through separate stab incisions, hence introducing the possibility of contamination of the operative field and pin-site infections. However, studies by Kamara et al. and Owens et al. revealed low incidence of pin-site infections (0.36% and 1.2%, respectively), concluding that the complication rates due to temporary pin insertion is low [22,23].

Robotic systems were developed to improve the accuracy of implant selection, placement, alignment and bone resection during arthroplasty [1,24,25]. There have been no reports of increased rates of prosthetic joint infection after robot-assisted arthroplasty. Song et al. performed simultaneous bilateral total knee arthroplasty (TKA) on 30 female patients (1 knee replaced by robotic-assisted implantation and the other by conventional implantation) in a prospective randomized study and found no major adverse events related to the use of the robotic system (such as deep infection or loosening requiring revision) [26]. It is recognized that the cohort size in the latter study was excessively small to examine the issue of infection. Hill et al. proposed higher infection rates as a possible limitation to the use of robotic systems in arthroplasty due to the use of an autonomous system, yet there is limited data to support this assertion at this time [27].

PSI was recently introduced with the aim of improving component alignment and potentially reducing the risk of subsequent revision. For this, MRI, CT and/or plain radiographs are utilized by manufacturers to develop three-dimensional models of the patient's anatomy prior to surgery. From these, disposable cutting blocks are fabricated which are specific to each patient. In theory, PSI can reduce operative time as well as the number of surgical instrument trays required to perform TKA, which may in theory reduce the risk of PJI [28–30]. The literature is, however, sparse regarding infection rates post-arthroplasty for patients who have undergone TKA using PSI. Schoenmakers et al. followed 200 consecutive patients who had undergone PSI-aided arthroplasty by a single surgeon for 5 years and reported rates of prosthetic joint infection similar to those found in conventional arthroplasty [31]. Alvand et al. performed a prospective randomized controlled study comparing PSI versus conventional unicompartmental knee arthroplasty, and found similar rates of superficial infection between the two groups [32].

At present, there is no definitive literature to suggest that the rates of SSI/PJI are increased or decreased when TJA is performed using the recently introduced technologies such as robotics, navigation or patient-specific implants. Most studies examining these new technologies are not adequately-powered to examine the rates of SSI/PJI. Larger-scale studies are needed to evaluate this issue.

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