Ultimately, most studies of surface topography, surface roughening and implant surface design focus primarily on osteocompatibility. Even though surface roughness influences bacterial adhesion and survival, we were not able to identify any well controlled studies on bacterial growth on different orthopaedic implant topographies. Large registry studies show largely no difference of survival between various implants. Perhaps the material itself, such as tantalum [18], may provide an advantage in the face of periprosthetic infection. Nevertheless, roughened Ti surfaces definitely provide an osteoconductive advantage. Considering the "race for the surface" theory, such materials should then provide a certain competitive advantage against infection, even though we have a hard time recommending a specific surface topography at this time. Further research, new techniques in surface preparation, and the advantage of designer surfaces will likely allow for further delineation of this question in the near future.

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QUESTION 4: Does the type of bearing surface influence the incidence of surgical site infections/periprosthetic joint infections (SSIs/PJIs) after total hip arthroplasty (THA)?

RECOMMENDATION: There is a higher incidence of PJIs with metal-on-metal (MoM) THA; however, there is no difference in risk of PJIs among other bearing surfaces.

LEVEL OF EVIDENCE: Strong

DELEGATE VOTE: Agree: 84%, Disagree: 10%, Abstain: 6% (Super Majority, Strong Consensus)

RATIONALE

THA bearing surfaces have been developed primarily to optimize wear properties. However, there has been recent interest in differing propensities for infections among bearing types. It has been hypothesized that some bearing couples may have a disproportionately negative influence on local tissue immunocompetence, resulting in development of clinically manifested PJI that would otherwise remain silent [1].

In a study of 276,878 patients from the Australian Orthopaedic Association National Joint Replacement Registry, a higher rate of revision for PJI was observed with large-head MoM THA as compared to other bearing surfaces [2]. In a smaller retrospective case series of 124 patients, MoM THA had a 4-fold higher infection rate than historical cohorts of other bearing surfaces from the same institution [3]. Furthermore, Lee et al. performed a meta-analysis comparing MoM to ceramic-on-ceramic bearings, finding MoM bearings were associated with a higher risk of revision for PJI (odds ratio (OR) = 6.21, p = 0.015) [4].

Multiple prospective randomized trials, as well as a systematic review/meta-analysis, have demonstrated no difference in infection rate between metal-on-polyethylene, ceramic-on-ceramic, and ceramic-on-polyethylene bearings [5–8]. Hu et al. performed a meta-analysis of five randomized controlled trials comparing ceramic-on-ceramic and metal-on-polyethylene bearings and found no difference in deep infection rate [9]. A registry study by Pitto et al. found ceramic-on-ceramic bearings to have a lower risk of revision for PJI compared to other bearings [10]. However, this work did not incorporate Body Mass Index or medical comorbidities into its multivariate analysis, which are known to have a significant effect on PJI risk [11].

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QUESTION 5: Does the use of a modular femoral neck implants during primary total hip arthroplasty (THA) affect the risks of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: Modular femoral neck implants are associated with increased revision rates due to hardware failure, metal corrosion and adverse local tissue reaction (ALTR). In patients with failed THA as a result of use of a modular femoral neck, a higher incidence of subsequent SSIs/PJIs is expected.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 72%, Disagree: 21%, Abstain: 7% (Super Majority, Strong Consensus)

RATIONALE

Modular femoral neck systems were introduced as an alternative to fixed neck systems to allow surgeons better ability to restore the biomechanics of the hip including neck angle, offset, anteversion and leg length [1,2]. However, modular femoral neck THA implants are associated with high early revision rates and poor long-term survivorships [3–8]. Reported modes of failure include hardware fracture [9–12], aseptic loosening [13] and metal corrosion resulting in ALTR [14–21]. In fact, some designs have been recalled because of high revision rates as a result of metal debris from the modular junction [3,6,22]. The additional metal junction is vulnerable to mechanical failure, component disassociation, mechanically assisted crevice corrosion (MACC) as well as metal ion release [4,5,14,17,19,20]. All modular junctions have the potential to release metal ions as a result of corrosion, wear and micromovement [2,15,18,21,23,24].

Previous literature has suggested that metal-on-metal (MoM) bearing surfaces in THA predisposed patients to higher infection rates when compared with other bearing surfaces [25–31]. It has been posited that MoM wear and corrosion particles could change the periprosthetic environment and increase the risk of infection [29]. Potential reasons for this increased risk include changes in the immune system by wear particles such as reduced cell proliferation [29,30,32]. Since modular femoral neck systems release metal wear particles and produce ALTR similar to MoM implants, are they also at risk of increased rate of PJI?

A comprehensive analysis of the incidence of SSI or PJI after the use of modular femoral necks in primary THA has not been published. Thus, the available evidence on this topic is low-level.

Duwelius et al. compared 284 patients with non-modular stems to 594 patients with modular neck stems performed by one surgeon and with similar demographics [1]. There were no statistically significant differences in either deep or superficial infection at a mean follow-up of 2.4 years (0.7% PJI in modular group vs. 1.4% in non-modular group). Furthermore, in a review of the Australian Orthopaedic Association National Joint Replacement Registry data, there was no difference in the rate of revision for infection for modular neck prostheses (0.7% of 9,289 modular neck primary THAs) compared with non-modular prostheses (0.6% of 253,165 non modular primary THAs) [8].

With the limited literature available, the presence of a modular femoral neck does not appear to increase the risk of SSI/PJI in primary THA. However, it is important to note that the clinical presentation of ALTR caused by a modular neck prostheses, head-neck junction, or MoM articulation, may mimic that of infection, and is in fact associated with a higher incidence of PJI [27,33,34] and can cause a false positive alpha-defensin test [35,36]. For this reason, gross purulence was removed from the PJI diagnostic criteria given its low specificity for PJI [37]. Thus, the reason for revision may have been misdiagnosed in some cases. In addition, many of the articles reporting higher incidence of PJI in the MoM population were before the wide acceptance of the MusculoSkeletal Infection Society/International Consensus Meeting (MSIS/ICM) definition of PJI or are Medicare database studies. PJI must be included in the differential diagnosis of all symptomatic modular femoral neck THA using recently established criteria [38].