G69: Are skin swabs useful for isolation of infective organism causing surgical site infection after major orthopaedic procedures?

Shah Jay D, Reznicek, Julie, Paner, Nilo, Kucuckdurmaz Fatih, Baker, Colin, Bakr, Hatem

Response/Recommendation:
No. Skin swabs are not useful for isolation of infective microorganism causing surgical site infection after major orthopaedic surgery. Skin swabs after any major orthopaedic surgery run the risk of identifying the wrong microorganisms or missing the true infective microorganism. Antimicrobial strategy based on these skin swabs can misguide treatment and must not be considered.

Strength of recommendation: Moderate

Delegate Vote:

Rationale:
Infection after any orthopaedic surgery is a disastrous complication. Redness, tenderness, warmth or discharge from or around the wound may, in some cases be localized to the suture line but, in most cases portend to deep seated infection. Diagnosing a deep infection remains a challenge despite tremendous strides being made in serology, microbiology and radiology [1]

Identifying the microorganism by culture is the preferred method and as the adage goes - Well begun is half done - collecting the correct sample is indeed well begun. Deep tissue from around the implant/bone or within the joint is considered to be a must for accurately identifying infective organism.

Though PJI focused definitions [2,3] do not include skin swabs, they are commonly used world over after many other major orthopaedic surgeries as they are easy to collect and avoid invasive procedure for collecting deep samples [4]. Swabbing sinus tract was discussed during the last ICM in 2018, and a recommendation with a strong consensus (96%) was made against the use of skin swab to isolate infective organism(s) [2].

To address the above question, this comprehensive systematic review was conducted, Using the MeSH terms developed by librarians, three databases (Pubmed, Scopus and Embase) were searched to identify 453 potentially relevant studies. After screening by two independent reviewers, 14 studies were deemed to be relevant and meet the inclusion criteria. Full review of these studies was conducted and data was extracted.

In the prospective study by Tetreault et al [5] on 55 infected THA/TKA concordance between superficial swabs versus deep tissue/synovial fluid aspiration culture was evaluated. The criteria for concordance were strict, ensuring the culture and susceptibility patterns correlated. Only 47.3% of skin/wound swabs were matching deep cultures. The false positive rate was 43.4% while the false negative rate for the swabs was 19%.

In another study by Cune et al [4] in their retrospective cohort of 56 acute PJI's kept a broad definition where even one microorganism matched was considered concordant. This makes it difficult to evaluate polymicrobial samples to determine the true infective organism. Excluding the polymicrobial samples there was only 60% concordance between superficial and deep samples. They concluded that though superficial swabs are easy to obtain, deep tissue cultures provided more

meaningful information and should be utilized for proper isolation of the infective organisms. In the latter study, a high PPV was noted when S.aureus or Gram negative bacilli were isolated on superficial swabs (100% and 85%, respectively). A similar analysis by Tetreault et al (5) showed only 52% concordance with S.aureus while only 40% for gram negative organisms. The results for other gram positive bacilli were poor in both studies. More importantly, Tetreault et al [5] suggested that almost 42% cases would have different antimicrobials if based solely on superficial skin swabs which could have negative implications on outcomes as suggested by studies on osteomyelitis as well [6]. There was no difference based on whether the joint was a hip or a knee in either study.

In a similar retrospective study for calcaneal fracture surgery complicated by infection, Backes et al [7] had 33 cases where both deep and superficial cultures were taken. In 40% of the cases the organism isolated in deep culture was different to skin swab. Out of the overall cohort of 55 deep infections, 31% were mistaken for superficial and treated accordingly. The authors recommended an aggressive approach to management to obtain deep cultures and not rely only on superficial swabs for diagnosis of infection or identification of microorganism. Desai et al [8] showed that only 2 discharging pin sites, after K-wires for distal end radius fractures, were culture positive out of 14. Both were treated with antibiotics and achieved complete healing. The other 12 were culture negative and went on to heal with appropriate wound care.

The literature on spine surgeries also highlights similar findings. Dobran et al [9] showed that only 75% of wound swabs were culture positive of which only 62% healed with antimicrobial therapy directed against the microorganism. 38% required further surgery and deep cultures. Gaines et al [10] in their retrospective review of the Isola posterior instrumentation cases had 4 patients with a sinus with 2 cases having scanty S.aureus growth. The concordance rate was 50%, with one deep culture being negative and one showing Streptococcus species (as against S.aureus on skin swab).

Interestingly, Cacopardo et al [11] and Kristopaitis et al [12] in their case reports reported Clostridium species growth on skin/sinus swabs. C.macginleyi was cultured from a paediatric spine instrumentation patient who had developed a recurrent sinus by Cacopardo et al [11]. This responded to antibiotics but required 2 courses for complete eradication. Kristopaitis [12] had a patient after L4-L5 laminectomy who developed meningitis due to C.perfringens. This patient unfortunately succumbed and the autopsy showed cranial and spinal meningitis with choroid plexitis due to C.perfringens.

A study by Alam et al [13] from the world's largest TOFA registry showed peri-portal swab did not correlate with diagnosis of infection in multivariate regression analysis. Of the 57 patients with positive deep cultures only 42 had positive periportal swabs. 45% of bacterial strains on deep culture were missed on periportal skin swab. Similar to results from Tetreault et al (5) in 58% the antibiotics based on superficial swabs would be incorrect potentially leading to treatment failure.

A study done with a mixture of orthopaedic surgical procedures by Ochs et al [14] strongly recommended deep samples over superficial after having a concordance rate of only 40% in their study. The sensitivity of the swabs is only 44% in identifying the microorganism with reduced colony count.

Conclusion:

Though skin swabs are easy to obtain and can identify microorganisms, they should not be considered representative of deep infection as many times the isolated organisms may be the microbiome of the skin and not the true pathogen causing the infection. Basing treatment strategies on skin swab cultures is erroneous, especially for deciding the antimicrobial regimen and can lead

to treatment failures. The studies show an unsatisfactory concordance rate with deep sample culture and we hence do not consider using skin swabs useful for identifying the infective microorganism after major orthopaedic surgery.

References:

1. Villa JM, Pannu TS, Piuzzi N, Riesgo AM, Higuera CA. Evolution of diagnostic definitions for periprosthetic joint infection in total hip and knee arthroplasty. J Arthroplasty. 2020;35(3S):S9–S13.
2. Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, Chen AF, et al. The 2018 definition of periprosthetic hip and knee infection: an evidence–based and validated criteria. J Arthroplasty. 2018;33:1309–1314.e2.
3. McNally M, Sousa R, Wouthuyzen-Bakker M, Chen AF, Soriano A, Vogely HC, Clauss M, Higuera CA, Trebše R. The EBJIS definition of periprosthetic joint infection. Bone Joint J. 2021 Jan;103-B(1):18-25.
4. Cuñé J, Soriano A, Martínez JC, García S, Mensa J. A superficial swab culture is useful for microbiologic diagnosis in acute prosthetic joint infections. Clin Orthop Relat Res. 2009;467:531–535
5. Tetreault MW, Wetters NG, Aggarwal VK, Moric M, Segreti J, Huddleston JI, et al. Should draining wounds and sinuses associated with hip and knee arthroplasties be cultured? J Arthroplasty. 2013;28:133–136. doi:10.1016/j. arth.2013.04.057.
6. Ulug M, Ayaz C, Celen MK, et al. Are sinus-track cultures reliable for identifying the causative agent in chronic osteomyelitis? Arch Orthop Trauma Surg 2009;129:1565.
7. Backes M, Spijkerman IJ, de Muinck-Keizer RO, Goslings JC, Schepers T. Determination of Pathogens in Postoperative Wound Infection After Surgically Reduced Calcaneal Fractures and Implications for Prophylaxis and Treatment. J Foot Ankle Surg. 2018 Jan-Feb;57(1)
8. Desai A, Dramis A, Thompson N, Board T, Choudhary A. Discharging pin sites following K-wire fixation of distal radial fractures: a case for pin removal? Acta Orthop Belg. 2009 Jun;75(3):310-5
9. Dobran M, Marini A, Gladi M, Nasi D, Colasanti R, Benigni R, Mancini F, Iacoangeli M, Scerrati M. Deep spinal infection in instrumented spinal surgery: diagnostic factors and therapy. G Chir. 2017 May-Jun;38(3):124-129.
10. Gaine WJ, Andrew SM, Chadwick P, Cooke E, Williamson JB. Late operative site pain with isola posterior instrumentation requiring implant removal: infection or metal reaction? Spine (Phila Pa 1976). 2001 Mar 1;26(5):583-7.
11. Cacopardo B, Stefani S, Cardì F, Cardì C, Pinzone MR, Nunnari G. Surgical Site Infection by Corynebacterium macginleyi in a Patient with Neurofibromatosis Type 1. Case Rep Infect Dis. 2013;2013:970678.
12. Kristopaitis T, Jensen R, Gujrati M. Clostridium perfringens: a rare cause of postoperative spinal surgery meningitis. Surg Neurol. 1999 Apr;51(4):448-50; discussion 450-1.
13. Alam, S. H., Hoellwarth, J. S., Tetsworth, K., Oomatia, A., Taylor, T. N., and Al Muderis, M.: Development of an evidence-based diagnostic algorithm for infection in patients with transcutaneous osseointegration following amputation, J. Bone Joint Infect., 9, 49–57.
14. Ochs, B.G., Kommerell, M., Geiss, H.K. *et al.* Mikrobiologische Diagnostik in der septisch-orthopädischen Chirurgie. *Orthopäde* 34, 345–351 (2005).