

Orthopedic Prostheses: Is There Any Point in Patch Testing?

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The aging of our population and the availability of new medical technologies have contributed to tremendous growth in the number of patients with implanted orthopedic and other devices. As experts on contact dermatitis, we are periodically asked to evaluate patients who have a history of metal allergy prior to surgery. We are sometimes faced with patients who have experienced complications after implant surgery or (more rarely) who have developed skin disease temporally related to surgery. To address these controversial issues, we asked three experts to discuss the role of patch testing in regard to patients with orthopedic implants. Mark D.P. Davis, MD, is an associate professor in the Department of Dermatology, Mayo Clinic, Rochester, MN; Christen M. Mowad, MD, is Assistant Professor of Dermatology, Geisinger Medical Center, Danville, PA; and Pamela Scheinman, MD, is Director of the Contact Dermatitis and Occupational Dermatology Unit and Assistant Professor of Dermatology, Tufts-New England Medical Center, Boston, MA.

- *In which clinical settings do you consider patch testing for patients with orthopedic implants?*

Dr. Davis: I do not think there is evidence to support patch testing in this situation. However, we are asked to do this by orthopedic surgeons both from our institution and from others.

Dr. Mowad: I patch-test when the patient has had joint loosening or develops a generalized or localized reaction after implantation. The debate as to whether the loosening of an orthopedic implant is from metal allergy remains controversial. Did the joint loosen because of metal allergy or did implant degradation products that were released because of loosening allow sensitization? I also do patch testing when a patient known to have metal allergy is preparing for joint replacement.

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Advice and Dissent addresses relevant issues in contact dermatitis through panel discussion or point/counterpoint debates. We look forward to input from the readership, including suggestions and commentary.

Dr. Scheinman: I consider patch testing in a patient who has a rash that begins predominantly in the area overlying an implant and then occasionally generalizes. This may be associated with pain and radiographic evidence of loosening of the implant. Metal-to-metal prostheses are more commonly associated with metal allergy than are metal-to-plastic prostheses. I would certainly also consider patch testing in a patient who happens to have an orthopedic implant and who has some seemingly nonprosthesis-related dermatitis (ie, eyelid or waistband dermatitis).

- *What metals do you test with?*

Dr. Davis: I test to cobalt sulfate 1%, gold chloride 0.5% alcohol, copper sulfate 2%, silver nitrate 1% aqueous (aq), palladium chloride 2%, potassium dicyanoaurate 0.1% aq, ammonium tetrachloroplatinate 0.25% aq, aluminum powder 100%, mercuric chloride 5%, mercury 0.5%, chromium chloride 5%, mercury ammonium chloride 1%, tin 50%, zinc 2.5%, cadmium chloride 1% aq, ferric chloride 1% aq, manganese chloride 2% aq, zinc chloride 2% aq, molybdenum chloride 1%, beryllium sulfate tetrahydrate 1% aq, amalgam 5%, rhodium 1%, titanium alloy disc, potassium dichromate 0.5%, nickel sulfate 2.5%, gold sodium thiosulfate 0.5%, cobalt chloride 1%, Vitallium as is, stainless steel as is, titanium as is, and cobalt-chromium disc. I also test to p-tert-butylphenol 2%, tetraethylene

glycol dimethacrylate 2%, ferric chloride 1% aq, hydroquinone 1%, 1,4-butanediol dimethacrylate, triethylene glycol dimethacrylate 2%, ethylene glycol dimethacrylate 2%, triethylene glycol diacrylate 0.1%, bisphenol A 1%, ethyl methacrylate 2%, N-butyl methacrylate 2%, 2-hydroxyethyl methacrylate 2%, benzoyl peroxide 1%, methylmethacrylate 2%, and epoxy resin 1%.

Dr. Mowad: I test to the North American Contact Dermatitis Group (NACDG) series and acrylates. This allows for testing to several metals as well as other possible allergens (ie, rubber allergens or acrylates). I also try to obtain components of the implant from the manufacturer. The lymphocyte transformation assay is another way to test for allergy. The test isolates monocytes from the blood, exposes them to metals, and measures proliferation.

Dr. Scheinman: I test for the metals in the NACDG standard series (nickel, cobalt, chromium, and gold) plus titanium and vanadium (Chemotechnique Diagnostics, Malmö, Sweden). If the patient gives a clinical history of metal allergy, I will add metals from the Chemotechnique dental series (palladium, tin, copper, aluminum, and mercury) and silver (nitrate) as this information will be potentially helpful for future dental, occupational, jewelry, and other exposures.

- *Do you test with other allergens beyond the NACDG standard series?*

Dr. Davis: Yes, we test to all the components of the particular orthopedic implant: the metal components obtained from the manufacturer ("sensitivity discs") and the plastics and glues if they are part of the implant.

Dr. Scheinman: Depending upon the distribution of the rash, I may add other series. For instance, if there is a preponderance of rash on the anterior thighs, upper arms, or upper back, I will add a textile series; if there is waistband dermatitis, I will add a rubber additive series.

- *How do you counsel patients who present for testing before surgery?*

Dr. Davis: I advise them that the evidence that patch testing is helpful in predicting a reaction to the implant is very scanty whether the results are positive or negative. I tell them that we do not at this time know what the relevance of a positive patch-test result will be for them. If they want to proceed with the patch testing, I advise them that if the patch-test results are negative, then it may be more likely that they will have no problems with the implant; if they have a reaction to one of the materials, then it is best to avoid that material. Again, I

emphasize that we just do not really know whether a positive patch-test result will predict a reaction to the implant. It seems obvious that it would, but it has not been proven.

Dr. Mowad: Counseling patients prior to patch testing is extremely important. Patients and their surgeons need to know the limitations and controversies of testing. The patch test is a cutaneous system limited by the inability to recreate the environment of the implant. False-positive and false-negative reactions can occur, and reproducibility is sometimes an issue. Furthermore, patch testing has relevance only to allergy that presently exists and is not predictive of future allergy. Even in the setting of positive reactions to metals, investigators have demonstrated that some patients are asymptomatic, and they argue that imbedding the metal into bone may induce tolerance.

Dr. Scheinman: For patients who have clinical histories consistent with metal allergy (ie, rash under costume jewelry, belt buckles, or coins in pockets), I counsel that there is a strong likelihood that they will have positive patch-test results for at least one metal if not to several. I also stress that the prevalence of nickel allergy in the general population is high; however, allergy to orthopedic implants, especially those with metal-to-plastic articulation, is low. Implant metals are fairly inert and resistant to corrosion by physiologic fluids.

- *Which clinical symptoms do you feel suggest allergy?*

Dr. Davis: Dermatitis overlying the implant temporally related to placement of the implant.

Dr. Mowad: A generalized eruption that develops after implantation or a localized eruption over the implant is suggestive of allergy, and patch testing should be pursued. Static implants (ie, screws) are often involved in localized reactions. Loosening of a joint is more complex and controversial. The joint may have loosened as a result of allergy, or the loosened joint may have allowed an allergen to be released, resulting in sensitization.

Dr. Scheinman: Predominance of an eczematous rash in the vicinity of an implant (with or without generalization), weeks to months after implantation, is suspicious for allergy. If there is associated pain and clinical failure of the implant, this further suggests allergy.

- *How do you advise referring orthopedists if test results are negative?*

Dr. Davis: I advise them that they can leave the implant in situ and that it is unlikely that the implant is contributing to any symptoms.

Dr. Mowad: Prior to patch testing, surgeons and patients must know the limitations and controversies already mentioned. Given this understanding, when patch-testing is negative, the best implant for the patient should be selected by the surgeon, with a “wait-and-see” approach.

Dr. Scheinman: If patch-testing is negative in a patient with a history consistent with previous metal allergy and if the implant contains nickel, I would consider patch-testing with nickel sulfate 5% aq as there have been reports of false-negative results when the “standard” nickel sulfate 2.5% in petrolatum is used. If this additional testing is negative, I state that I have no objective evidence that allergy to the implant metals is causing the rash. However, since there are various implant metals for which I have not tested, allergy to these cannot be ruled out. I specify to the referring orthopedist all the metals to which the patient has been tested.

- *And what if test results are positive for metals in the implant?*

Dr. Davis: We don’t know what this means, and neither does anyone else! If the result is positive, again, this does not mean the implant should necessarily be removed.

Dr. Mowad: If testing is positive for a specific metal (eg, nickel), recommendations are more difficult. For the patient with a previously failed joint, if it is possible to still select a desirable implant, the positive allergen should be avoided. However, avoiding stainless steel in nickel-allergic patients often results in the selection of an implant that is not as durable. Therefore, these recommendations need to be made in concert with the surgeon. To further complicate the issue, we have discussed studies that show that some nickel-allergic patients can tolerate stainless steel implants.

Dr. Scheinman: If the clinical symptoms/signs discussed above are present, I suggest removal and replacement with an implant that does not contain documented allergenic metals if at all possible.

- *How do you determine relevance?*

Dr. Davis: As with other allergens, this is dependent on correlating the history, clinical examination results, and patch-test results. Ultimately, the only way to determine relevance is to see if the symptoms disappear when the implant is removed and re-appear when the implant is replaced, but this is not practical in most cases.

Dr. Mowad: Clinical relevance is most clearly determined when (1) the dermatitis or skin findings develop after implantation, (2) patch-testing is positive for a particular component of the implant (ie, nickel), and (3) removal of the implant results in clearing of the skin finding. Patch testing to the removed implant should be conducted to further prove the causal effect of the implant. In the case of nickel positivity, a nickel spot test on the implant should be performed.

Dr. Scheinman: If the allergenic metal was present in the original implant and if the clinical signs or symptoms resolve with replacement of the implant with one not containing documented allergens, then I feel that the patch testing yielded clinically relevant results.

Suggested Readings

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