

Contact Alternatives to Nickel

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Abstract: Allergic contact dermatitis to nickel is a continued health concern internationally. Nickel has been found to be the most prevalent and relevant allergen in tested populations for the last 3 decades. Furthermore, recent data from the North American Contact Dermatitis Group demonstrate positive patch-test reactions to nickel at approximately 19.5% of their tested population and a significant increase in the positivity rates for the last decade (*Dermatitis*. 2013;24:10–21. *J Am Acad Dermatol*. 1998;38:911–918). Because of the rise in allergic contact dermatitis rates to nickel, the American Contact Dermatitis Society recognized nickel to be the 2008 Allergen of the Year (*J Am Acad Dermatol*. 2009;60:1067–1069; *Dermatitis*. 2008;19:3–8). This article recognizes the importance of nickel avoidance and highlights potential alternatives.

Nickel is ubiquitous with a wide range of utilizations including weapons, coins, dental and medical implants, clothing, personal care products, cell phones, and household products. Most commonly, localized dermatitis to nickel occurs in areas where the greatest amount of nickel exposure occurs; however, affected areas that may not have direct contact could be from an id reaction because of autosensitization from immune cells circulating in the body.¹ Systemic contact dermatitis, which can have a wide spectrum of clinical presentation, can also occur from ingestion of nickel through diet or accidental ingestion of nickel-containing items such as coins as was reported in a 2-year-old boy.^{2,3} Of note, researchers are hoping to identify whether there are certain populations at higher risk for developing allergic contact dermatitis (ACD) to nickel, and recent research has linked null mutations in the filaggrin gene to those who are nickel sensitive.⁴

Nickel allergy at times can be identified based on history and clinical presentation alone, such as well-demarcated localized earlobe dermatitis from nickel in jewelry or recurrent periumbilical eczematous plaques from nickel found in belt buckles. If nickel allergy is suspected, an avoidance regimen can be recommended until the confirmatory epicutaneous patch testing is performed. Patch testing is the criterion standard for the diagnosis of ACD and is important to do to identify specific allergens and common coreactors, such as is seen with cobalt and nickel.⁵

Comprehensive education regarding nickel avoidance and product alternatives is imperative to ensure sustained clinical improvement in patients with nickel allergy and to prevent relapse of dermatitis or potential progression to a systematized presentation.^{1,6}

Self-avoidance of patients alone may yield complete clinical resolution foregoing the need for consultation and patch testing, and thus, reported prevalence rates could actually be low estimates of true nickel allergy prevalence.

There are multiple online resources that help patients with ACD to avoid their culprit allergens such as Contact Allergen Management Program, a service offered through the American Contact Dermatitis Society, and the Contact Allergen Replacement Database, developed by Mayo Clinic, both of which provide lists of products void of the allergens.⁷ Nonickel.com is also a useful Web site for patients to access that provides them educational information on nickel allergy and the ability to purchase nickel-free items that may be difficult to find in stores.

This article provides another resource for clinicians on tips and recommendations on nickel avoidance and available alternatives to educate their patients who have ACD to nickel. One of the most important tools that assist patients with nickel allergy is the commercially available nickel spot test that uses dimethylglyoxime/ammonia (DMG-A) to detect nickel content in products and can be easily purchased online. When DMG-A rubs anything with a nickel content of at least 1:10,000, a pink precipitate forms. Any potential item that could contain nickel should be tested with the nickel test kit before using it, especially because the tester does not harm the object in any way. An analog color scale provided to each patient may help in determining the relative nickel content in each item tested.⁸

CLOTHING

Various components of clothing such as zippers, snaps, and belt buckles can contain nickel. Brassiere underwires can be another potential source, especially because sweat in these areas can readily dissolve nickel, and the corrosion of metallic nickel or nickel-bearing alloys combined with pressure, sweat, moisture, and friction can increase the degree of nickel allergy.⁹ Alternative support bras are widely available that are made from newer fabrics

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The authors have no funding or conflicts of interest to declare.

DOI: 10.1097/DER.0b013e3182a5a1bf

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and do not have metal-based underwire support, but rather use supportive elastic or plastics.

Levi Strauss jeans limit the nickel content in their jeans significantly, and their 501 jeans specifically are recommended for patients with allergy to nickel. Belt buckles and sometimes snaps on pants are common causes of periumbilical nickel ACD. To prevent direct contact of the nickel, iron-on knee patches can be ironed over the inside aspect of the pant closure, or the closure can be exchanged for a plastic one and the belt buckle for brass. Patients can also coat the jean snaps with a barrier hardener (ie, several coats of red nail polish or a commercially available product such as Nickel Guard).¹⁰ Snaps on bras can be similarly painted, or bras with plastic-coated snaps should be purchased. Of note, nail polish could cause a secondary contact dermatitis from its own chemicals.

JEWELRY

Historically, women are more often affected from ACD to nickel than men,^{11,12} likely because of various factors such as early sensitization from ear piercings that causes a disruption of the skin barrier and increased exposure to nickel-containing jewelry.¹³ Of note, higher rates of sensitization are reported in men who have undergone piercing, and the rates increase with a greater number of piercings.¹⁴ Costume jewelry is mostly developed from metal alloys such as nickel, cobalt, and palladium; thus patients should be recommended to avoid costume jewelry when possible, but often times this is not practical. There are companies that create nickel-free jewelry such as Simply Whispers (<http://www.simplywhispers.com>), James Avery sterling silver (<http://www.jamesavery.com>), and Argentium silver (<http://www.argentiumsilver.com>).

Another option is to ensure that any jewelry purchased is returnable, so that if it is positive with the nickel test kit, it can be returned. Platinum, sterling silver, and pure gold (18K or greater) are less likely to elicit dermatitis. White gold should be avoided because nickel and/or palladium may be used to lighten the color of the alloy. Tightly fitting pieces such as rings or watch backs may produce more intense localized reactions because of the increased contact with the skin and potentially from the added effect of perspiration. Certain parts of jewelry can also be replaced with nickel-free alternatives such as nickel-free earring posts. Sentimental jewelry pieces such as wedding bands can be covered with barrier creams or with hardeners such as clear nail polish. Another option is to have the jeweler coat the inner surface of the ring with platinum or rhodium, although rhodium plating may need to be replated every 6 to 8 months. Blomdahl also manufactures medical plastic earrings that are nickel-free (<http://www.allergymatters.com>). Dog tag dermatitis from nickel in lanyards has also been reported among members of the military, and plastic-coated chains can be found in most military uniform shops or online at <http://www.armysurplusworld.com>.¹⁵

PERSONAL CARE PRODUCTS

Personal care products such as nail clippers, tweezers, safety pins, eyelash curlers, and razors often contain nickel. The Tweezerman brand manufactures stainless steel alternatives that are unlikely to cause allergy. Stainless steel care products and jewelry may not release enough nickel to cause an allergic reaction under normal circumstances, however, they may do so with prolonged contact, heat, and sweat or if the stainless steel has a high sulfur content, which could potentially release more nickel.¹⁶ All razor blades and even electric razor screens should be tested with nickel spot testing. When possible, stainless steel or titanium-plated razors should be used. In addition, using razors with lubricants is recommended because creams containing propylene glycol, petrolatum, and lanolin have been shown to reduce the absorption of nickel through the skin.¹⁷ Nickel-free safety pins have also become available.¹⁸

HOUSEHOLD ITEMS

Keys, alkaline batteries, scissors, doorknobs, thimbles, tools, coins, utensils, pens, pencils, and cigarette lighters are all household items that often contain nickel. Plastic guards or electrical tape placed over the heads of keys limit direct nickel exposure. Alternatively, whenever possible keys should be replaced with brass.¹⁹ Only plastic pens and pencils should be purchased. The handles of tools and scissors can be wrapped with electrical tape. In addition, rubber-handled tools and scissors can be bought, or rubber or vinyl gloves can be used when handling metal tools. Patients who develop dermatitis on their thighs should avoid placing many of these household items such as coins and keys in their pant pockets directly and instead place them in coin pouches.

Nickel is frequently used in alloys, which are combinations of metals that are used to create a new metal with different properties and can be found in certain items such as doorknobs, handles, engineering materials, and tools. There are alloys that do not contain nickel such as the alloy brass, which consists mainly of copper and zinc.¹⁷ Pewter, bronze, pure copper, and many titanium alloys are other alternatives that are mostly free of nickel.¹⁷ There is still always the possibility that nickel has been added, so patients should be advised to still use a nickel test kit on these objects to ensure that they are not a potential source of allergy. It has been observed that polished nickel (nickel plating on brass that is polished without a coating of lacquer) poses a greater risk of exposure compared with brushed or satin nickel (nickel plating on brass that has been dulled and coated with lacquer), so lacquer provides some protection from nickel exposure.²⁰ Three coats of Krylon Crystal Clear Acrylic Spray Gloss (Krylon Products Group, Cleveland, Ohio), which is an acrylic polymer coating, has also shown to create a protective barrier over common household items that contain nickel without changing the appearance of the object.²⁰

ELECTRONICS

Both cellular phones and their respective cases can release nickel and cause dermatitis.^{21–23} Rubber cases and hands-free accessories that have been tested negative with DMG-A can be recommended to patients. Nickel may even be released from laptop computers,²⁴ so plastic external keyboards and mice may limit nickel exposure.

MEDICAL AND DENTAL DEVICES

Cardiovascular devices, orthopedic prostheses, dental implants, intratubal sterilization implants, and metal eyeglass frames all can contain nickel. Cobalt-chromium coronary stents and stainless steel stents have been used in percutaneous coronary interventions, and it has been debated whether hypersensitivity reactions to nickel play a role in restenosis pathophysiology.^{25,26} In most patients with allergy to nickel, stainless steel implants containing nickel will be tolerated. However, in a small number of patients with allergy to nickel, these will not be tolerated and may result in significant problems (often requiring removal of the implant). Alternatives to stainless steel are at times desired in patients with severe allergy,²⁷ and a recent case report of a woman with severe ACD to nickel reported a successful aortic valve replacement with a nickel-free ON-X prosthesis (On-X Life Technologies, Inc, Austin, Tex) and sternal closure with #2 FiberWire (Arthrex, Naples, Fla) nickel-free sutures in order to avoid stainless steel materials.²⁸ In regards to eyeglasses, nickel-free metal eyeglass frames are widely available; however, nickel-free plating may wear with time and even frames marketed as being *hypoallergenic* actually may have a significant nickel content.²⁹ Plastic frames or nickel kit tested pure titanium frames may be a safer alternative.

Orthopedic prostheses can contain as high as 35% in regards to nickel content,³⁰ which could potentially affect both the patient and the medical personnel working with these items.³¹ Common metals used for orthopedic implants include stainless steel, titanium, titanium alloys, and vitallium, which contain cobalt, chromium, and molybdenum.¹⁷ Some orthopedic surgeons avoid all nickel-containing and cobalt-containing implants in patients with presumed allergy. If presurgically a metal allergy is suspected, an orthopedic patch-test tray containing the following metal allergens (in addition to the acrylates) can be used for patient testing: nickel sulfate, cobalt chloride, potassium chromate, aluminum hexahydrate, copper sulfate, palladium chloride, titanium(IV) oxide, molybdenum(V) chloride, gold sodium thiosulfate, niobium(V) chloride, and vanadium chloride or vanadium pentoxide. Some clinicians advocate for obligatory patch testing before implantation in patients who have had a previous history suggestive of allergy to jewelry or other metals,³² although this recommendation is controversial, given the relatively low rates of implant allergy. If postsurgically a metal allergy is suspected, although allergy to metal implants is uncommon, the surgeon has a much more difficult time determining whether the implant should

be replaced because there is no guarantee that the alternative metal would be successful.

Zimmer (<http://www.zimmer.com>) is an orthopedic implant manufacturer that provides a comprehensive breakdown of metal composition in its implants and has implants with alternative alloys for patients with metal allergies. DuPuy is another manufacturer of orthopedic implants and can even develop custom prostheses that take approximately 6 weeks to manufacture. Another alternative implant made of zirconium, niobium, and ceramic is the Oxinium knee implant (Smith & Nephew, <http://www.strongasanox.com>).¹⁷

Nickel is also commonly used for dental devices such as crowns, bridges, and fillings and has been documented to cause both oral dermatitis and even esophagitis and gastritis.^{33,34} There are nickel-free alternatives made of alloys of gold, palladium, platinum, and silver through companies such as Argen (<http://www.argen.com>) and Dorado Dental Supply (<http://www.doradodentalsupply.com>). Nickel has also been used for dental implants, specifically for the posts that are embedded into the jaw onto which the artificial tooth is placed, and these posts can be made of nickel or cobalt-chrome alloys, although titanium is also available (Zimmer Dental, <http://www.zimmerdental.com>). Braces may also contain nickel, and for patients with allergy to nickel, the Invisalign system (<http://www.invisalign.com>), Legacy M brackets, and NexAlloy archwires (<http://www.nexadental.com>) are available alternatives.

TABLE 1. Nickel-Avoidance Diet

Avoid	May Ingest
Large amounts of baking powder	Small amount of baking powder
Canned foods	Fresh or frozen foods
Chocolate	Vanilla
Cocoa	
Dried fruits (dates, figs, etc)	Fresh or frozen foods
Gelatin	
Legumes	
Licorice	
Nuts (hazelnuts, peanuts, almonds)	
Oatmeal	
Peanuts/peanut butter	
Potatoes	
Red kidney beans	
Seeds	
Shellfish	Beef, chicken, egg, turkey
Soy products	
Spinach	
Tap water (first quart)	Subsequent quarts of tap water
Tea	
Vitamins containing nickel	
Whole wheat/multigrain/oats/buckwheat	Rice, rice cakes, corn, popcorn, cornflakes, cornmeal, rye

DIET AND SMOKING

Although the topic of avoidance of nickel in foods is debatable, patients sensitive to nickel have been reported to react to ingestible sources of nickel such as chocolate and peanut butter, and clearance of their dermatitis has only been achieved through dietary avoidance.³⁵ Although patients with allergy to nickel can develop a wide spectrum of cutaneous reactions from even low amounts of daily nickel ingestion, individuals without allergy to nickel do not develop symptoms even at high levels of nickel intake.^{36–38} A low-nickel diet (Table 1) has been reported to be successful in the management of nickel allergy.^{39,40} Smoking also represents a significant form of nickel exposure because a typical cigarette contains 2.32 to 4.20 mg/kg (milligrams per kilogram) of nickel.⁴¹

CONCLUSION

Although avoidance measures and use of alternatives are imperative in the management of patients with ACD to nickel, enacting legislation and regulations that limit the release of nickel in products that have prolonged contact to the skin helps to decrease the rates of nickel sensitization. Denmark and Europe have successfully passed legislation that regulates the allowable release of nickel in products,^{42,43} which has had a significant impact in decreasing sensitization rates.^{44,45} Although there has been a strong push for it, the United States has yet to pass similar legislation.^{46,47} Manufacturers can help mandate that their products limit the quantity of nickel release, as has been done by Levi Strauss.

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