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Case report

Metal allergy after first metatarsophalangeal total joint replacement – Case report

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ABSTRACT

A 62-year-old female patient presented with a symptomatic metal allergy six weeks after first metatarsophalangeal total joint replacement using ROTOGLIDE™ implant. Preoperatively, there was no history of hypersensitivity. The symptomatic dermatitis was evaluated using dermal patch testing. The implant had to be removed.

The possible agents for the allergic reaction are discussed.

1. Introduction

Metal sensitivity remains unpredictable and a poorly understood aspect of surgical implants, and it is not limited to hip and knee arthroplasty [1]. The prevalence of metal sensitivity in the general population is reported to be up to 25% for nickel, up to 9% for cobalt, up to 6% for chromium, and up to 3% for titanium [2,3]. Metal implant hypersensitivity is a type IV delayed reaction that involves activating T-lymphocytes and cytokines which are released to recruit macrophages [4].

First metatarsophalangeal (MTP-1) total joint replacement using the uncemented ROTOGLIDE™ (Small Bone Innovations, Morrisville, Pennsylvania/USA) is one option for treatment in advanced stage of hallux rigidus [5]. Both stems of metatarsal and phalangeal components are porous titanium-coated. The cobalt–chromium–molybdenum (Co–Cr–Mo) offset of metatarsal component is convex shaped preserving the sesamoids by having a smaller arc of curvature on the plantar aspect, and the circularly Co–Cr–Mo offset of phalangeal component is planar. The intercalated polyethylene (PE) component glides on the metatarsal with a groove in a dorsal planar direction, and rotates distal with a stem into the phalangeal component. Up to now there has been no report of an allergic reaction using the ROTOGLIDE™ implant.

2. Case report

A 62-year-old female patient presented with increasing pain in MTP-1 joint left since six years. The anterior–posterior (AP) radiograph showed advanced stage of hallux rigidus, and pedobarography revealed unphysiological load pattern (Fig. 1a). There was no history of metal allergy. The ROTOGLIDE™ was inserted through a medial incision (Fig. 1b). The postoperative radiological evaluation showed correct positioning of implant without in-congruency of implant components (Fig. 1c).

Six weeks after injury, the patient developed aseptic painful swelling in her left foot combined with pronounced circular dermal reactions on her lower leg (Fig. 2a). The *in vivo* testing for delayed-type hypersensitivity which involves a dermal exposure of an antigen revealed nickel allergy; but no allergies to cobalt, chromium, and titanium. The removal of implant was performed. Intraoperatively, both components were not loose and did not showed in-congruency, and a macroscopic pronounced metallosis surrounding the stem of metatarsal component was seen. The histological examination of free tissue samples demonstrated multiple metallic debris particles, however, only a differentiation between ferrous and non-ferrous particles without specific assignment for single elements was possible by the pathologist (Fig. 2b). The patient could be mobilized with the resection arthroplasty (Fig. 2c), but not pain-free. The overlying dermatitis showed regression in the course but had not completely regressed eight weeks after removal of implant. The MTP-1 joint arthrodesis as salvage procedure is not desired by the patient.

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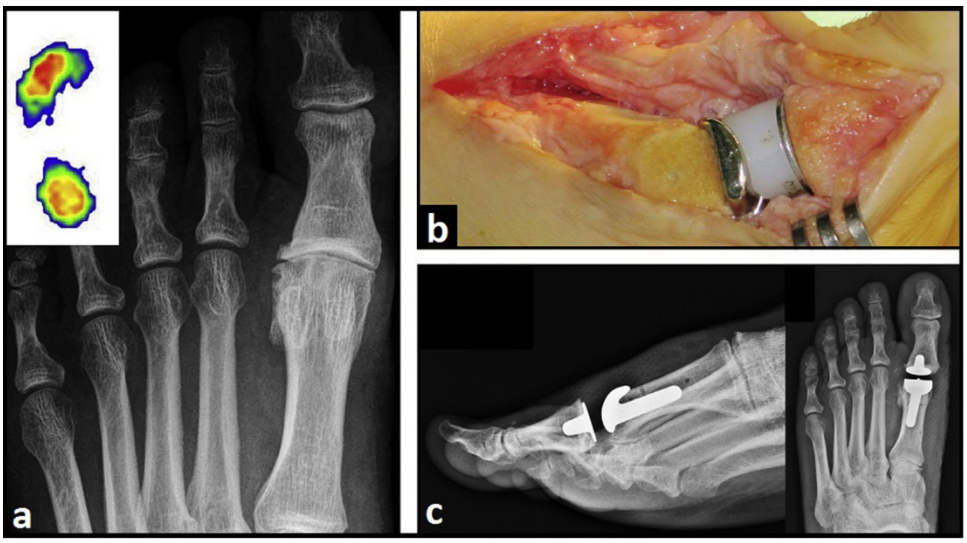

Fig. 1. (a) Preoperative AP radiograph and pedobarography; (b) clinical photo after insertion of ROTOGLIDE™; (c) postoperative lateral and AP radiographs demonstrating correct positioning of implant.

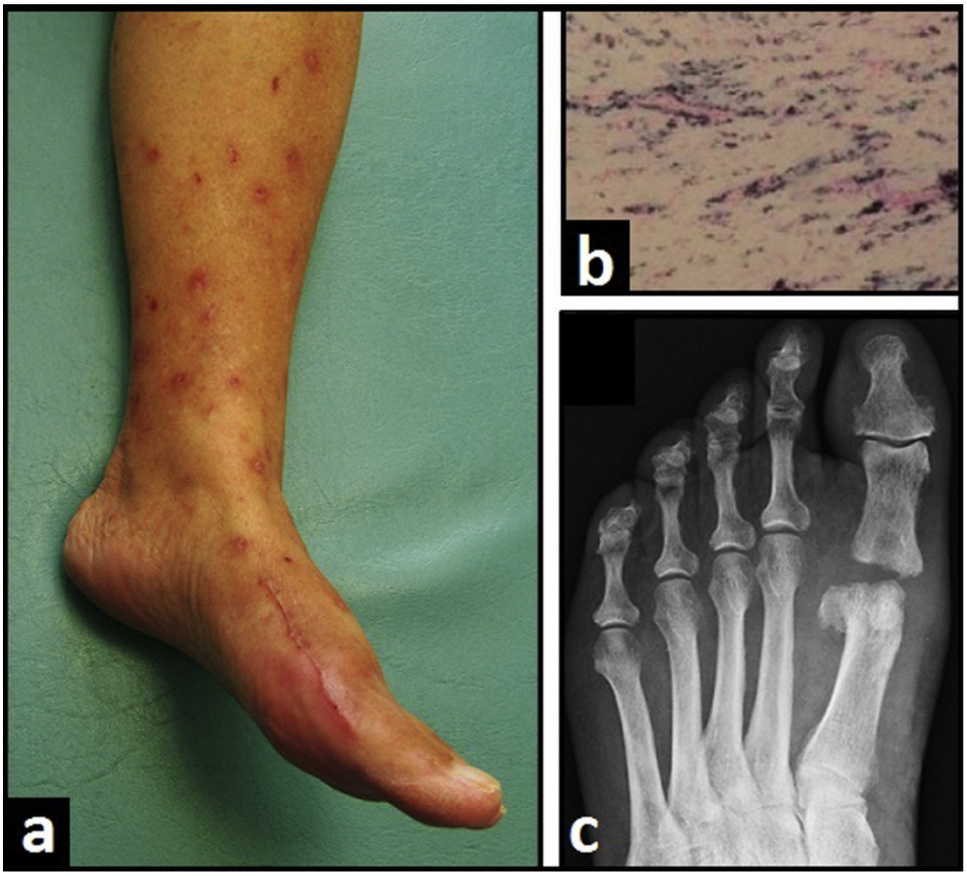

Fig. 2. (a) Clinical photo showing pronounced allergic dermal reaction; (b) histological tissue examination (iron staining) demonstrating metallic wear particles (blue-stained: ferrous particle; black-stained: non-ferrous particle); (c) AP radiograph with MTP-1 joint resection arthroplasty after removal of implant.

3. Discussion

Currently, the association between metal corrosion *in vivo*, metal allergy, and device failure is not clearly understood [6]. Most implants in extremity surgery consist of stainless steel, containing 13–16% nickel and 17–19% chromium, or titanium alloy containing approximately 90% titanium and trace amounts of nickel [4]. The testing on metal hypersensitivity can be carried out *in vivo* as in our case report or *in vitro* with the T-lymphocyte transformation test which is more specific than dermal patch testing [4]. When a patient is referred for a suspected allergy following implantation of a metal implant, dermal patch testing is recommended [1].

The symptoms of metal allergy may be a local reaction, *i.e.* systemic overlying dermatitis [1,7] or less commonly a systemic allergic reaction which was described when using stainless steel instruments for intravenous injections [8]. However, metal

hypersensitivity does not automatically lead to relevant symptoms or implant failure, up to 25% of patients with well-functioning hip arthroplasties may be hypersensitive, and upward of 60% of patients with failed or problematic implants may have hypersensitivity [4].

If the removal of implant is a reasonable option, it should be pursued for definitive treatment [1]. If it is not safe or reasonable at a particular time but the dermatitis is symptomatic, a 3-week course of tapered prednisone is an option [9]. If a patient with advanced stage of hallux rigidus has a known metal allergy preoperatively, other reliable therapeutic options should be preferred.

Symptomatic metal allergy eight to 16 weeks after insertion was also described in two patients who underwent arthroplasties in the small carpometacarpal (CMC) joint of the thumb using the titanium-coated ELEKTRA™ (Small Bone Innovations, Morrisville, Pennsylvania/USA) implant [10], however, this type has a metal-on-metal articulation. Using this type, there are also reported to be slightly elevated chrome or cobalt values in 20% of patients correlating with patient's disability [11], and aseptic loosening due to pronounced metallosis was described in one patient one year after insertion [12]. Early metallosis as possible cause for implant loosening in the small CMC 1 joint of the thumb is unusual, it has mainly been observed in metal-on-metal bearing with severe titanium wear in the bigger and highly loaded wrist joint at a mean follow-up of 52 months ranging from 24 to 73 months [13].

The ROTOGLIDE™ implant has a metal-on-PE articulation. Using such an articulation in the small CMC joint of the thumb, elevated serum chrome or cobalt values were only found in 4% of patients [11]. The core material of ROTOGLIDE™ components contains less than 0.1% nickel; thus, it cannot be said if macroscopic finding of metallosis correlate with the histological evaluation and symptomatic nickel allergy in our described case. The weak point is that there is no possibility for differentiation between single ferrous or non-ferrous elements by the pathologist. The macroscopic finding of pronounced metallosis surrounding the metatarsal stem in our case six weeks after insertion is unusual, maybe it is caused by metallic wear particles by using the saw blade for resection of first metatarsal head or metatarsal reamers at time of insertion.

Conflict of interest

The author disclosure that no financial conflict of interest exists with any commercial entity whose products are described, reviewed, evaluated, or compared in the manuscript.

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