

Efficient removal of black henna tattoos

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Abstract

Background/Objectives: *Para*-phenylenediamine, a dye frequently added to henna tattoos to create the black color, is a potent contact allergen. Severe contact dermatitis may arise within days even after the first application. Our objective was to develop a method for rapid and complete removal of *para*-phenylenediamine-containing black henna tattoos from the skin, an important problem many physicians are confronted with, but for which no simple method exists.

Methods: A database search revealed polyethylene glycol 400, described in removal of *ortho*-phenylenediamine from contaminated skin. We therefore investigated its use in removal of the structurally related ortholog *para*-phenylenediamine present in black henna tattoos.

Results: A protocol was established involving repeated cycles of rinsing of the skin with polyethylene glycol 400 solution. In 5 patients, one of whom had already developed a severe blistering contact dermatitis and another a mild erosive dermatitis, black henna tattoos were successfully removed. Removal was completed in a single session of 1 hour or less, depending on tattoo size, with a maximum of 6 rinse cycles.

Conclusions: We provide a simple and safe method for rapid and effective removal of black henna tattoos. This procedure requires no special equipment and can be applied in virtually any setting.

KEYWORDS

black henna, contact dermatitis, phenylenediamine, polyethylene glycol, tattoo

1 | INTRODUCTION

Although it is well known that *para*-phenylenediamine (PPD) is a potent contact allergen, temporary tattoos with black henna containing PPD still enjoy worldwide popularity among children and adolescents, especially in summertime.¹ This is due to the process being painless and cheap and the tattoo being temporary. PPD is a dye added to create the black color that remains for up to six weeks and to accelerate the drying process.²⁻⁴

In addition, PPD is also a common component of many oxidizing hair dye products.⁵ Contact with hair dyes, either as a consumer of hair dye products or as a hairdresser, is therefore the most common risk factor for the development of a PPD contact allergy, followed by applications of a PPD-containing black henna tattoo (hereafter referred to as black henna tattoo).^{1,6} In a younger age group of 10-20 year-olds, almost all patients with a PPD contact allergy were sensitized by application of such temporary tattoos.^{7,8}

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Importantly, owing to the higher concentration of PPD (up to 64%), a single application of a black henna tattoo is more likely to induce contact sensitization than use of hair coloring products.^{2,6} Pure henna, in contrast, made from dried leaves of *Lawsonia inermis*, is only weakly sensitizing.²

Prolonged presence of the allergen on the skin after even a single application can result in the entire cycle of sensitization phase and triggering of eczema. This is complicated by the fact that the triggering agent remains on the skin and cannot simply be removed, which continues to drive the allergic inflammatory process. The estimated frequency of 2.5% for the development of contact dermatitis from such dyes, along with the lack of a neutralizing agent, highlights a medical need for the efficient and safe removal of black henna tattoos.²

Current methods for permanent tattoo removal, including surgical excision, ablative laser resurfacing, or chemical peels,^{9,10} are impractical or inappropriate for bulk removal of sensitizing PPD from large black henna tattoos. To remedy this less than optimal situation, we propose a method for the efficient removal of PPD-based henna tattoos with polyethylene glycol 400 (PEG 400). We applied this method successfully in five individuals, of whom one had developed a severe blistering contact dermatitis and another a mild erosive dermatitis.

2 | MATERIALS AND METHODS

2.1 | Patients

Patients were anonymized using code identifiers (Table 1). An otherwise healthy 12-year-old boy (patient 1) was referred for a severe blistering reaction with erythema and papules that developed one day after application of a black henna tattoo. The painful blistering was restricted to the tattooed area on the inner aspect of his right forearm. Due to the severe reaction, blisters were punctured and immediately treated with a corticosteroid cream (clobetasol) and an antiseptic solution (0.5% gentian violet), which produces a purple stain (Figure 1A,B). Four of the patient's relatives (patients 2-5) had also obtained henna tattoos at the same time. Clinical examination showed that the patient's 9-year-old brother (patient 2) had already developed erythema and small erosions of the skin. These were visible on close inspection and could easily be overlooked under the black color (see head and grasping pedipalps of the scorpion tattoo, Figure 2A). All patients wished to have their black henna tattoos removed (see Figures 1 and 2 and Figures S1-S3). The removal process described here was performed and completed four days after tattoo application, for all patients.

2.2 | Removal of PPD

After searching the database of hazardous substances (Gefahrstoffinformationssystem, GESTIS) from the German

Institute for Work Safety (Institut für Arbeitsschutz, IFA), which recommends the use of PEG 400-containing wash solutions after accidental contact with concentrated o-phenylenediamine

TABLE 1 Patient data

Patient	Age	Gender	Tattoo location	Figure	IAR	CD
1	12	M	Forearm	1	No	Yes
2	9	M	Shoulder	2	No	Yes
3	13	F	Hand	SI	No	No
4	6	M	Forearm	SI	No	No
5	43	F	Lower leg	SI	No	No

Note: No patients displayed an IAR, but both patient 1 and 2 developed CD.

Abbreviations: CD, contact dermatitis; IAR, immediate allergic response; SI, Supporting information.

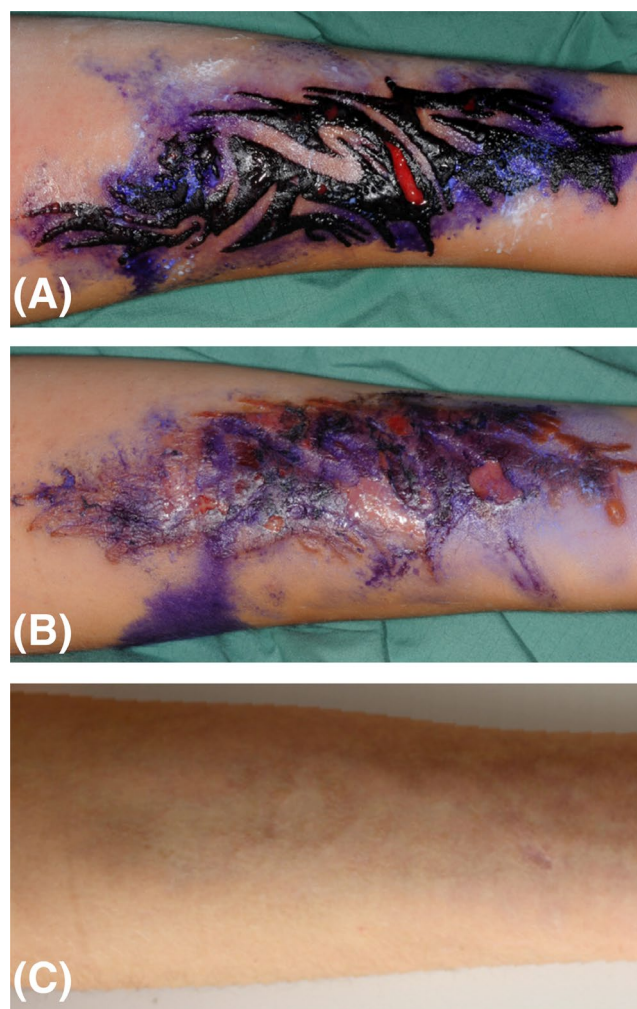


FIGURE 1 Removal of PPD stains in a patient with severe blistering at the site of tattoo. Blisters were first treated by puncture and drainage and application of 0.5% gentian violet solution. Skin erosions are seen (A). The black stain was removed after washing with PEG 400 solution, whereas the stain of the 0.5% gentian violet was resistant to PEG 400 (B). Complete healing of skin lesions is shown (C)

FIGURE 2 Gradual removal of PPD stains in a patient with erythema and superficial erosions. Erythema and superficial erosions at the site of tattoo (A) are more clearly seen after 2 or 4-5 rounds of treatment (B, C respectively) with PEG 400 solution

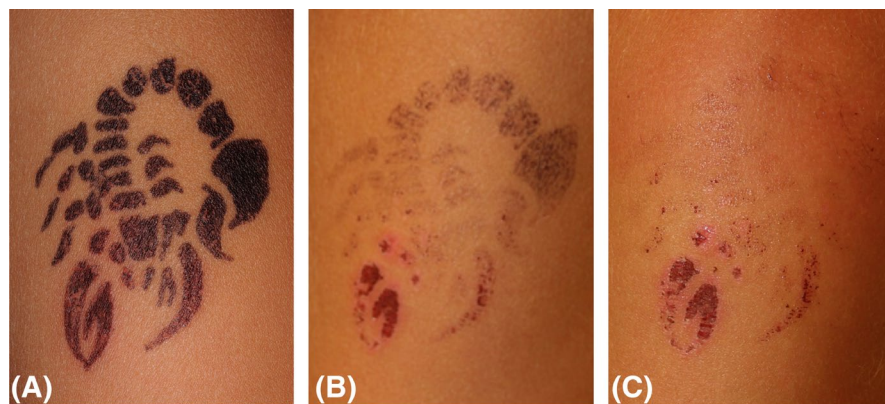


FIGURE 3 Scheme for removal of PPD stains using a PEG-400 solution. Using nitrile gloves, cotton balls soaked in PEG 400 solution are used to gently wipe the skin area covered by a tattoo. The area is then flushed liberally with water before a new cycle is begun. To remove most stains, up to 4 cycles are required, taking up to one hour of time



(1,2-phenylenediamine), we hypothesized that PEG 400 solutions might also remove the chemically related *p*-phenylenediamine (1,4-phenylenediamine)-containing stain in black henna tattoos. PEG 400 is a polymer which is solid below 10°C but which becomes fluid at room temperature. It is considered nontoxic and is not metabolized. It is widely used in clinical studies, including children, both as an ingested reference compound for intestinal permeability and topically as an emollient.¹¹⁻¹³ It is present in various pharmaceuticals and in cosmetic products and is easily obtainable.

We used standard cotton balls soaked with a PEG 400 solution to repeatedly and carefully dab the affected skin area to extract the PPD. To prevent inadvertent redistribution of PPD on the skin, rubbing was avoided and cotton balls were frequently replaced.

Thereafter, the affected area was rinsed under running tap water (approximately 5 minutes) before the next cycle of PEG 400 treatment was started (Figure 3). For skin protection, single-use nitrile gloves were worn by the person applying PEG 400.

3 | RESULTS

The clinical data from our five patients with black henna tattoos are shown in Table 1. Four patients were children and one an adult. None of the patients showed signs of urticaria or angioedema as has been described in single cases after contact with PPD.¹⁴ Using the method presented here (Figure 3), up to six cycles of PEG 400 extraction and flushing with water were needed and sufficient

to remove the black stain. The total time requirement for treatment was dependent on tattoo area, but the longest time needed was about 1 hour. All patients tolerated the treatment without difficulty.

For patient 1 (Figure 1A), skin wounds were first cleansed with an antimicrobial wash lotion before application of the PEG 400 solution to the stained areas. After removal of the black dye, only the purple color of the 0.5% gentian violet solution remained on the patient's forearm (Figure 1B). Remarkably, 1 week after tattooing, the patient reported a disseminated contact eczema with erythema and papules spread on his right abdomen and his left eyelid (Figures S1-S3), thought to represent an id reaction. However, he experienced complete wound healing without scarring within three weeks (Figure 1C). Skin patch testing after two months showed a strong positive reaction to PPD (+++), confirming the diagnosis of a severe allergic contact dermatitis against this substance.

In patient 2, the erythema and multiple, variously sized erosions in the "scorpion" tattoo were more readily visible after partial and complete removal of the dye (Figure 2B,C). Complete healing was achieved without particular treatment within days.

The remaining three patients did not present with adverse skin reactions. One young girl (patient 3) had a black henna tattoo on the back of her hand, a boy child (patient 4) had a dragon tattoo on a forearm, whereas a second girl (patient 5) bore a smaller henna tattoo on her lower leg, applied above a permanent "sun" tattoo. As expected, the permanent tattoo of patient 5 was not affected by the wash procedure, while the henna tattoo was completely removed (Figures S1-S3). Notably, none of these patients showed any sign of dermatitis within six months following treatment.

4 | DISCUSSION

Contact dermatitis due to PPD is a worldwide problem. In the United States, PPD has been labeled as a strong sensitizer by the Consumer Product Safety Commission since 1961.¹¹ Especially in black henna tattoos, the combination of a strong sensitizer, high concentration in the applied staining paste, and the extended time of skin contact can induce rapid sensitization and severe contact dermatitis. In Europe, the prevalence of contact sensitization to PPD in black henna tattoos is five times higher than in the general population (where it is about 0.8%) with higher frequency in younger age groups.¹ Skin reactions usually occur within 8-14 days after application of a tattoo, though especially in children it may appear as early as 4-7 days following the first contact.²

Of our patients, the 12-year-old boy (patient 1) experienced a severe blistering reaction only one day after tattoo application, and his 9-year-old brother (patient 2) reported a mild dermatitis within four days. The rapid development of skin reactions suggested that these patients had already been sensitized to PPD. This was corroborated by the parents of patient 1, who recounted an incident five years previously with mild blistering after application of a tattoo. No prior contact with PPD could be traced for patient 2;

thus he may represent a rare case of de novo sensitization within four days of skin painting. Patient 1 also developed a widespread dermatitis within a week after tattooing, three days after tattoo removal. This indicates that removal of PPD at day 4 was too late to interrupt the immunological process due to strong sensitization to PPD in both patients. Fortunately, no clinical signs of dermatitis were seen in the other patients upon tattoo removal or within a 6-month follow-up period.

Apart from severe skin reactions to black henna tattoos, sensitization to PPD risks further complications because of cross-reactivity to other compounds in hair dye products, in textile dyes, to chemicals in rubber, latex and even to ester-type local anesthetics. Especially for children, the group with the highest prevalence of reactions to black henna tattoos, this could result in significant and lasting consequences for health and future career prospects.^{2,15-18}

The prompt and gentle removal of black henna tattoos is therefore desirable, not only for individuals already displaying clinical symptoms, but also to reduce the risk of sensitization to PPD in others. A method that has been reported to be effective in black henna tattoo removal is ablative laser resurfacing using a 2,940-nm erbium-doped yttrium aluminum garnet (Er:YAG) laser.¹⁰ However, limiting factors include a requirement of specialist equipment and personnel, the cost of treatment, and the risk of generalized allergic reactions following laser treatment.¹⁹

To our knowledge, the method presented here is the first technique to allow for the safe, efficient, and gentle removal of black henna tattoos. The removal of a henna tattoo in a single therapy session also minimizes the risk for scarring and for lasting health consequences. In addition, the method is cheap, requires neither specialist equipment nor specialist personnel, and is suitable for use in any clinic or doctor's practice.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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