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Manuscript Title: Synthetic hair extensions causing irritant contact dermatitis in patients with a history of atopy: a report of 10 cases

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Abstract

1.Introduction

We present a case series of ten, atopic, African women who developed irritant contact dermatitis after the addition of synthetic hair extensions.

2.Methods

Ten consecutive African female patients who presented with a pruritic cutaneous eruption on the neck over a period of 2 years are described. Patients underwent skin patch testing using both standard and hair commercial patch test panels and samples of their own hair extensions. Hair care products were not tested.

3.Results

All ten patients used synthetic hair extensions. A strong history of atopy was documented for all ten patients and examination was significant for eczematous, lichenified plaques at the location of contact with the free end of the hair extension. Patch test results yielded no relevant reactivity and a diagnosis of irritant contact dermatitis was made for all patients. The lesions resolved completely on removal of the hair extensions and the use of topical steroids and emollients dependent on eczema severity.

4.Conclusion

Artificial hair extensions should be considered as a potential irritant, resulting in irritant contact dermatitis. Patients with a history of atopy are at risk of developing irritant contact dermatitis from synthetic hair extensions.

1.Introduction

The study of hair practices in African and African American women is a growing, yet an under-recognized, area in the field of dermatology [1]. An array of hair modification techniques is utilized among people of African ancestry including the addition of exogenous hair. Exogenous hair can take many forms and styles and includes hair extensions, hair weaves and wigs. Extensions describe the addition of exogenous synthetic or human hair, to the scalp or hair [1]. The extensions can be braided into strands of natural hair, sewn into corn rows, clipped onto grouped shafts of natural hair or glued onto the scalp [1]. It is a sought-after style to give the appearance of fuller, longer hair. It is also believed that the use of extensions will help natural hair growth, giving it a rest from chemical or thermal processing [2,3]. Although these hairstyles are temporary, the addition of hair extensions can lead to undesired and sometimes permanent effects. Reports of hair breakage, traction alopecia, and even full thickness wounds have been documented as a result of such practices [3-6]. Anaphylaxis to natural rubber latex adhesive used to apply hair extensions to the scalp was reported in a single case [7]. Others have developed allergic contact dermatitis to glues used in the application of wigs [8-9].

We report a case series of 10 South African women of African ancestry who developed irritant contact dermatitis to artificial hair extensions that were braided or sewn into cornrows of natural hair and in one case chemically straightened hair. All 10 patients gave a personal and/or family history of atopy.

2.Methods

Ten consecutive African female patients who presented to an outpatient private dermatology clinic over a period of 2 years, with a pruritic cutaneous eruption on the neck, are described.

Following a detailed history and clinical examination by the same dermatologist, patients underwent skin patch testing using both standard and hair commercial patch test panels and samples of their own hair extensions. Hair care products were not tested.

Patch testing was performed, read and interpreted according to the Contact Dermatitis International Research Group Guidelines [10]. All patients were patch tested using a standard series of 45 commercial allergens (including fragrances, rubber additives, some dyes, formaldehyde and formaldehyde-releasing preservatives and resins), and a hair series of 9 commercial allergens both prepared from Trolab/Hermal and Chemotechnique allergens (Mednon, Box 485, Bergvliet 7864 Cape Town, South Africa). A samples of each patient's own hair extension under saline moistened filter paper was also included. Allergens were applied in Finn chambers to the upper back. After 48 hours of occlusion the chambers were removed, and the back checked for reactions, 24 hours later (96 hours after application).

3.Results

All ten patients had either a personal or familial history of atopy (**Table 1**) but no known specific allergies and none had received medical treatment prior to presentation. They had developed itchy, dry, eczematous, lichenified patches and plaques on their necks. The eczema was localized to areas of skin in contact with artificial hair dependent on the hair style adopted (**Figures 1 and 2; Table 1**). The rest of the skin examination was normal. Patients had used extensions for varying periods of time ranging from 6 months to 4 years. They were worn intermittently for periods of 2 weeks to 3 months before being removed or replaced. During the period of use, hair washing and grooming was infrequent and dictated by the hair style. None of the patients connected the neck rash to the hair extensions although all confirmed the onset of the lesions occurred after the hair extension additions. Extensions were added professionally by sewing

them onto cornrows of natural hair (2 cases) or chemically straightened hair (1 case) with wool or by braiding them into strands of their natural hair (7 cases). No other additional hair treatments were used by the patients. Hair grooming products varied between patients, dependent on personal preference but no new hair grooming products had been used prior to the development of the rash (**Table 1**). As hair grooming products were unchanged and deemed unrelated to the eczema due its limited localization, hair care products were not patch tested. The patch test yielded no reactivity to any known hair allergens or sample of the patient's hair extension. Reactions to nickel (++, +++; 1 patient each), cobalt (++; 1 patient) and paraben mix (++; 1 patient) were recorded but felt not to have relevance to the clinical presentation. Results are summarized in **Table 1**.

All patients had hair extension removal and in 5 patients, the eczema was treated with emollients and moderately potent topical steroids. The decision to treat depended on the severity of eczema (moderate-severe) to provide faster symptom relief. The lesions resolved fully, including pigmentation, in all 10 patients (**Table 1**).

4. Discussion

Hair extensions are added to natural or chemically treated hair for style and to create the appearance of fuller, longer hair. Extensions can be composed of human hair or synthetic hair and the method of incorporating the extensions varies based on personal preference. Addition of extensions, if done with minimal tension and appropriate technique can reduce trauma on the natural hair fiber [11]. Aside from local, physical damage to the hair shaft and follicle, the use of extensions may result in local skin reactions due to the chemicals and substances used to treat hair prior to attachment or used in the attachment and removal process *per se* as discussed below. Adverse systemic effects such as precipitating anaphylaxis secondary to natural rubber glue used

to attach the extensions to the scalp [7]. *Darlenski et. al.* reported a single case of scalp dermatitis in an African to the allergen paraphenylenediamine found in the black dye of synthetic hair extensions [12]. *Yang et.al.* observed patchy traction alopecia with residual hair matting in Caucasian patients with glued-in hair extensions [13]. Here, we present a case series of ten patients who experienced irritant contact dermatitis due to synthetic hair extensions affecting the lateral sides of the neck dependent on the hair style adopted.

According to *Whitehurst* [15], the greatest revenue generating products in the \$507 billion African American hair care industry in 2009, were hair weaves.

Synthetic hair is composed of various polymers such as modacrylic, vinyl chloride, vinylidene chloride, polyester or nylon, that are strung into strands and modified to fit the appearance of human hair [15]. The process of polymer production and the chemicals used to produce synthetic human hair are not easily accessible especially to those who buy hair weaves and hair extension. They cannot make informed decisions because of lack of knowledge of the product, its composition, construction and the potential impacts on the skin. The article from *Lesia Whitehurst* describes the various processes used in the production of synthetic hair to illustrate polymer science to learners but does not specifically address potential allergens or irritants of synthetic hair *per se* [15]. Like natural hair, synthetic hair is a polymer. It is composed of fine plastic fibers, manufactured to mimic human hair. In its basic form, it is made from heated acrylic strung into individual waxy, plastic hair fibers which are then bound into extensions which lack the movement and texture of real hair. More sophisticated forms of synthetic hair are manufactured and treated to mimic the texture and luster of human hair. Polyfilament, rarely monofilament, fibers are combined into chains via melt or solvent spin techniques creating of a range of fibers from straight to curly with coarse to smooth surfaces that mimic specific

properties of natural hairs [15]. While polymer science is described by Whitehurst [15], the processes to which the basic synthetic hair are subjected, to render it more life-like and manageable, are not reviewed in any academic publication and represent a large gap in the knowledge of those who manage patients with hair grooming related problems.

Hair extensions have the potential to induce contact dermatitis (CD), either allergic, irritant or a mixture of both. Allergic contact dermatitis (ACD) is a delayed hypersensitivity reaction (type IV) to an immunogen after initial sensitization, precipitating a cell mediated hypersensitivity immune response [16]. Clinically, contact dermatitis lesions are inflammatory, predominantly eczematous, presenting as acute, weeping, vesico-papules and crusting, as chronic lichenified plaques (secondary to scratching and itching) or sub acutely as a combination of both presentations. The patients may complain of itching, burning or stinging. CD can occur in any individual, but atopy predisposes to CD because of its associated epidermal barrier dysfunction.

Hair care products contain large numbers of chemicals, many of which are irritants or sensitizers [17,18]. *Stallings and Sood* provide a review of the hair-care practices and regimes of female African Americans and the potential for exposure to sensitizing agents at various steps in the hair grooming process. They identify fragrances, preservatives, dyes, and alternative surfactants found in sulfate-free shampoos as important sensitizers for this group of women. Regarding hair additions the sources of sensitization include permanent para dyes and adhesives used for attachment including acrylic based adhesives which are pressure sensitive. They emphasize that hair care CD may present with hyperpigmentation, lichenification and minimally observable erythema which is often limited to areas on or around the scalp and ears [19]. *Ojo et. al.* found that African patients had significantly more sensitization to para-phenylenediamine which is found in hair dyes, compared to white patients. The authors speculate the difference can be

attributed to the increased prevalence of use and the need for higher concentrations of hair dyes to obtain the desired look [20].

Irritant contact dermatitis (ICD) is a nonimmunological inflammatory cutaneous reaction caused by an external agent [16,20]. ICD can be caused by mechanical, physical, or chemical damage to the skin.

It is clinically often difficult to distinguish ACD from ICD and very often the two conditions occur concurrently. Irritant contact dermatitis is a diagnosis of exclusion when no allergen can be identified by history, clinical contact pattern or a positive patch test [20].

The ten patients presented had a history of atopy but no known specific allergies. All patients presented with itchy, dry, lichenified, hyperpigmented patches and/or plaques localized to the sides of the neck (**Figures 1 and 2**). The rest of the skin examination was normal. Interestingly none of the patients linked the neck rash to the use of, or contact with, hair extensions.

The negative results on patch testing supports the diagnosis of ICD, possibly due to mechanical irritation of the skin by the hair extension fibers [20]. Alternately, the patch tests were limited and did not include the relevant allergen(s). All patients were advised to remove or stop wearing synthetic hair extensions or wigs, with resultant clearance of neck eczema and secondary pigmentation. Once ICD is diagnosed, further exposure to irritants, especially the causative irritant, should be avoided. The normal epidermal barrier is maintained with regular use of emollients [16,20]. Inflammation can be treated with topical corticosteroids or topical calcineurin inhibitors [16].

5. Conclusion

To our knowledge this is the first report of artificial hair induced irritant contact dermatitis in atopic patients. The impaired epidermal barrier present in atopic patients could explain the predisposition to this irritant contact dermatitis. We suggest that patients with a background history of atopy should recognize this potential complication to using artificial hair especially when related to chemical processes sometimes used to attach and remove the artificial hair or to treat natural hair prior to its use.

Despite weaves being the largest revenue generator of a billion-dollar hair care market [15], women who buy hair weaves and hair extension cannot make informed decisions because of the lack of knowledge of the product composition, construction and health impacts. We suggest further research reviewing the specific components of artificial hair fibers manufacture and treatment to better understand which polymers and treatments are used and to identify potential sensitizers and irritants, so the public is better informed.

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Figure 1

Eczematous patches due to synthetic hair, on the left side of the neck, with clearing post treatment with topical steroids and emollients.



Figure 2a

Eczematous papules on left side of the neck due to use of synthetic hair



Figure 2b.

Close up showing excoriated papules on the left side of the neck and upper back.

Patient	Age	Sex	Ethnicity	Atopy history		Synthetic hair extension		Hair care products	Eczema		Patch tests results			Extension removal outcome	
				Family	Personal	Duration of use	Attachment method		Location	§Duration	Standard battery	Hair series	Own hair extension	Topical therapy	Response
1.	30	F	African	yes	yes	1yr	Braided into natural hair	Dark & Lovely hair spray and shampoo	Left neck	4wks	*nickel ++ *cobalt ++	negative	negative	none	Cleared
2.	25	F	African	yes	yes	9m	Sewn on to chemically relaxed hair cornrows	Dark & Lovely hair spray and shampoo	Left neck	3wks	*nickel +++	negative	negative	#Steroid Emollients	Cleared
3.	48	F	African	yes	yes	2yrs	Braided into natural hair	Sta- ~~sof-fro~~ spray and shampoo Original hair mayonnaise Cantu hair repair	Left neck	4wks	negative	negative	negative	none	Cleared
4.	35	F	African	no	yes	6m	Braided into natural hair	Black hair pearl Organics shampoo, Stay- ~~sof-fro~~ spray lotion	Right neck	3wks	negative	negative	negative	#Steroid Emollients	Cleared
5.	45	F	African	yes	yes	7m	Braided into natural hair	Dark & Lovely hair spray and shampoo	Bilateral neck	8wks	*paraben mix +++	negative	negative	none	Cleared
6.	28	F	African	no	yes	2yrs	Sewn on to natural hair cornrows	Aunt Jackie's hair cream Dark and lovely hair spray Shea Moisture Organics shampoo	Left neck	7wks	negative	negative	negative	none	Cleared
7.	30	F	African	yes	yes	8m	Braided into natural hair	Dark & Lovely hair spray and shampoo	Left neck	4wks	negative	negative	negative	#Steroid Emollients	Cleared
8.	24	F	African	yes	yes	4yrs	Sewn on to natural hair cornrows	Dark & Lovely hair spray and shampoo	Right neck	8wks	negative	negative	negative	#Steroid Emollients	Cleared
9.	38	F	African	yes	yes	1yr	Braided into natural hair	Dark & Lovely hair spray and shampoo	Left neck	3wks	negative	negative	negative	none	Cleared
10.	35	F	African	yes	yes	6m	Braided into natural hair	Cantu hair repair Pantene shampoo Shear moisture balancing conditioner	Left neck	2wks	negative	negative	negative	#Steroid Emollients	Cleared

F female; §Average period of continuous extension use; * Not clinically relevant to presentation; # betamethasone valerate ointment