Hair Breakage in Patients of African Descent: Role of Dermoscopy

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Key Words

Dermoscopy · Trichoscopy · Hair breakage · African descent · Chemical damage

Abstract

Dermoscopy represents a useful technique for the diagnosis and follow-up of hair and scalp disorders. To date, little has been published regarding dermoscopy findings of hair disorders in patients of African descent. This article illustrates how dermoscopy allows fast diagnosis of hair breakage due to intrinsic factors and chemical damage in African descent patients.

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Introduction

Dermoscopy represents a useful technique in the evaluation of several dermatologic disorders. This method has also been used for the diagnosis and follow-up of hair and scalp disorders [1]. Hair dermoscopy, known as trichoscopy, enables the visualization and analysis of the scalp, hair follicle distribution and hair shafts. To date, little has been published regarding dermoscopy findings

of hair disorders in patients of African descent. Although many diseases affect all hair types, the distinct properties of the hair and scalp in patients of African descent warrant further investigation into the unique trichoscopic patterns on this population [1–3].

Global population forecasts from the US Central Intelligence Agency indicate that of the 1.5 billion people that the world is predicted to gain by 2020, 16% will be from Africa [4]. In light of this, and taking into account the current and predicted changes in global demographics, it is essential for clinicians to be familiar with hair and scalp disorders of people of African descent [5].

Hair and scalp disorders are a significant problem in African descent women. One of the reasons is that African hair is more fragile, has less tensile strength and reaches its breaking point earlier than the hair of other racial groups [6, 7].

Afro-Textured Hair

The physical and chemical properties of all human hair types are similar. However, there are distinct biological and structural differences in relation to Afro-textured hair. These include an elliptically shaped hair shaft,

Fig. 1. Representation of the distribution of orthocortical (O), mesocortical (M) and paracortical (P) cells in straight (left) and curly (right) hair fibers (adapted from Robbins [18]).

situated eccentrically within the follicular epithelium. It differs from the circular or slightly oval-shaped hair shaft of Caucasian hair. Also, there is the retrocurvature of the hair follicle, which is different from the straight shape of Caucasian follicles. Knot formation due to intertwined hair fibers makes combing difficult and predisposes the African hair to breakage during normal grooming. In addition, the African hair has a slower hair growth rate compared with Caucasian and Asian hair, and there is a reduced total hair density [5, 6, 8–16]. As a result, African descent hair is more prone to develop knots, longitudinal fissures and splits along the hair shaft compared with the hair of Caucasian and Asian populations [17].

A possible factor contributing to the shape of African descent hair is the bilateral asymmetric structure of some keratin fibers. The hair fiber contains three types of cortical cells: orthocortical, paracortical and mesocortical cells. There are differences in the distribution of cortical layers between hair types. In the Caucasian and Asian hair, the distribution of the layers is concentric with the orthocortical layer, which is distributed throughout the perimeter of the fiber around the mesocortical layer, which in turn surrounds the paracortical layer (fig. 1) [18, 19]. In African-ethnic hair, the paracortical layer is lo-

cated on the concave side of the hair shaft, the orthocortical layer is located on the convex side, and the mesocortical layer is not present.

In addition to these properties, the water content in African descent hair is slightly lower than in Caucasian hair, and the sebaceous glands often secrete an inadequate amount of sebum, which has an uneven distribution along the shaft due to its spiral shape, leaving the hair with a dry appearance. Moisturizing the hair enables combing without the tugging that can result in hair damage [17, 20].

A study with light and scanning electron microscopy revealed that natural (virgin) African hair removed by combing exhibits a significantly higher incidence of knotting and breaking of the hair shafts compared with Caucasian- and Asian-type hair. In addition, a number of features consistent with structural damage were noted. A high proportion of these hair shafts exhibited trichorrhexis nodosa and broken ends [7, 13].

As mentioned, hair breakage is common because of the intrinsic characteristics of African hair, but there are important damages caused by multiple styling processes as well. Severe hair breakage, predominantly caused by chemical procedures, can generate alopecic patches. Patients complain of no hair regrowth and present a positive ‘tug’ test [2, 21, 22].

Hair Straightening

Hair modifications have been a sign of beauty throughout history. It is known that smoothing procedures may cause irreparable damage to the hair shaft. Approximately 80% of African descent women use chemicals to relax their hair [21]. The practice of repetitive chemical relaxing may contribute to the common scalp disorders seen in these patients [17, 23, 24].

Hair keratin fibers consist of long molecular chains intertwined and firmly attached in different ways through covalent bonds (including disulfide bonds). They have a high content of cysteine; each unit of cystine contains two cysteines interconnected by two sulfur atoms and also weaker interactions such as hydrogen bonding, Coulomb electrostatic interactions and van der Waals forces [25–28].

Hair straightening or lanthionization is a chemical process by which the hair is permanently straightened with the use of a relaxer, which is applied to permanently break disulfide bonds along the hair shaft and release the tight curl pattern [27]. Lanthionization is performed by

metal hydroxides or guanidine, replacing 30% of the cystine amino acid content for lanthionine, which has lower hydrolysis of peptide bonds, allowing modification of the hair pattern [25, 27, 29].

In the African descent population, the terms relaxer and perm may be used as a synonym. In an initial relaxing process, the chemical is applied to the hair closest to the scalp and combed through to the tip to cover the whole 'virgin' area, which has never been relaxed. Depending on how fast the hair grows, these compounds are applied to newly grown hair at several-week intervals. Straightening agents have evolved, from early chemical mixtures containing lye and lard to current lye relaxers made with sodium hydroxide (lye) and no-lye relaxers containing either potassium, lithium or guanidine hydroxide [30].

Lye relaxer systems must be applied by a cosmetic professional. They produce faster results but irritate the scalp and may damage the hair shaft. Subcategories of this group include 'with-base' (high percentage of sodium hydroxide) and 'no-base' ones (high grade of oil phase) which reduce irritation of the scalp [19, 27, 29].

No-lye relaxers work with the same principle as lye relaxers but are less alkaline and less irritating for the scalp and are commonly utilized at home. However, they are also harmful for the hair shaft and commonly cause hair breakage; the most commonly used no-lye relaxers include potassium hydroxide, lithium hydroxide and guanidine hydroxide [31]. Straightening products based on guanidine carbonate have the inconvenience of requiring to be mixed with an emulsion (containing calcium hydroxide and activator fluid) but are less irritating to the scalp and can be used at home [20].

Other no-lye relaxers are ammonium thioglycolate and ammonium sulfite, which are much weaker and not used in African hair [20, 29]. Thioglycolate is not compatible with the hydroxides, and simultaneous application of the products on the same area may cause irreparable damage, with a higher risk of rupture.

In the last few years, cross-linking treatments have become very popular since they are less aggressive for the hair shaft, and many women of African descent utilize these treatments in addition to relaxers. These treatments, known as the Brazilian keratin treatments, use formaldehyde or its derivatives, formalin or methylene glycol [32], to cross-link keratins within the hair shaft, using heat to obtain the desired shape. The cross-linking chemistry itself is not really damaging to the hair, and the majority of the damage comes from excessive heat. Keratin treatments can be applied to already relaxed or color-treated hair.

The claim that keratin treatments can strengthen the hair after multiple uses raised an important option for women with hair shaft damage. One proposed mechanism by which the keratin treatment is said to strengthen the hair suggests that the hydrolyzed keratin diffuses into the cortex of the hair shaft and is cross-linked to the hair keratin. This added keratin is claimed to fill defects and restructure the hair shaft. However, there is no scientific evidence to support this theory, and concerns have been raised about safety due to high formaldehyde concentrations which are associated with respiratory and hemopoietic malignancies [33].

Chemical straighteners may damage the hair shaft in several ways [30, 31]. Mainly, they remove the monomolecular layer of fatty acids covalently bound to the cuticle, including 18-methyl eicosanoic acid, which is important to prevent penetration of water into the hair shaft. In addition, they change the physical properties of the hair shaft by breaking and rearranging the disulfide bonds [34].

On the biochemical level, a study of Khumalo et al. [35] observed a reduction in the levels of cystine in chemical-exposed hair when compared to virgin hair. As explained above, cystine is responsible for the intrinsic resistance of the shaft and thus is considered fundamental for hair strength; a low cystine level is considered an indicator of fragility risk.

Examination and Trichoscopy Findings

Hair weathering is the deterioration of the hair shaft from root to tip due to cosmetic and environmental factors. The clinical presentations of hair weathering can be heterogeneous and may include trichorrhexis nodosa and trichoptilosis, among other findings. Patients usually consult the doctor complaining of poor hair growth or of patchy or diffuse alopecia (fig. 2). If specifically asked, they admit noticing hair breakage with minimal manipulation of the hair; however, in most cases, they do not attribute the alopecia to hair shaft damage. Examination reveals breakage of the hair shafts at variable distances from the scalp. This can be demonstrated by the hair pull test or by the 'tug' test, which reveal short hair fragments that lack roots (fig. 3).

Examination with trichoscopy shows trichorrhexis nodosa with swelling nodes of the hair fibers and splitting of their tips [36–42] (fig. 4). The nodular thickenings are about 25% thicker than the adjacent parts of the shaft [40, 42, 43]. Hairs eventually break at these points, leaving brush-like ends (fig. 5).

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Fig. 2. Hair breakage. The hair pull test reveals short hair fragments with absence of the root.

Fig. 3. Patient with a history of hair straightening, complaining of increased hair shedding and alopecic patches of 1 year of evolution.

Color version available online

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Fig. 4. Acquired trichorrhexis nodosa. Segmental increase in the hair diameter (like nodules) and splitting of their tips.

Fig. 5. Trichorrhexis nodosa. Hairs eventually break at the nodule points, leaving brush-like ends.

Fig. 6. Central trichoptilosis (longitudinal split in the central part of the shaft).

Another finding in the shaft, which can be associated with chemical and physical damage, is trichoptilosis. This is characterized by longitudinal fractures on the shaft, consisting in the division of the distal end; it may also be centrally located, defined as a shaft longitudinal split without tip involvement [40, 43–46] (fig. 6).

Typically, patients who present these shaft alterations complain of hair breakage with minimal handling. A pull test examination reveals shaft fragmentation at several distances from the scalp. These abnormalities of the shafts can be easily observed through trichoscopy.

Summary

Hair disorders are a significant problem in women of African descent. This article provides personal data on the usefulness of trichoscopy in the systematic assessment of hair breakage due to intrinsic factors and chemical processes in African descent patients, besides explaining the biology of African-textured hair as well as the practices of straightening. The mainstays of treatment involve minimizing damage to the hair and advice for healthy care practices.

Statement of Ethics

The authors have no ethical conflict to disclose.

Disclosure Statement

The authors have no conflicts of interest to declare.

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