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REVIEW ARTICLE

Eyebrow and Eyelash Alopecia: A Clinical Review

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Abstract
Madarosis is characterized by either complete or partial loss of eyebrow or eyelash hair. Etiologies for madarosis are varied, and accurate diagnosis is the first step in clinical management. Many studies have described findings related to specific causes of madarosis, but few have summarized the collective literature. The purpose of this review is to provide an updated overview on the symptomatology, diagnosis, trichoscopy findings, and treatment of eyebrow and eyelash alopecia.

Key Points

Etiologies of eyebrow and eyelash alopecia include autoimmune, endocrinologic, genetic, infectious, neoplastic, nutritional, and traumatic conditions.

Trichoscopy is a useful tool to aid in diagnosis of alopecia areata, frontal fibrosing alopecia, tinea infection, and trichotillomania, and treatment is focused on targeting the underlying disease.

1 Introduction

Complete or partial eyebrow and eyelash loss can present as an isolated finding or as the presenting manifestation of an underlying systemic pathology. Madarosis often refers to the loss of eyebrow or eyelashes, whereas milphosis specifically refers to loss of eyelashes. Due to the many functional and cosmetic roles of eyebrows and eyelashes, madarosis can cause significant distress to patients, necessitating recognition of potential associated underlying diseases and treatments. Etiologies of madarosis are varied, and include autoimmune, endocrinologic, infectious, genetic, neoplastic, nutritional, and traumatic conditions. Madarosis can be classified as scarring or non-scarring, depending on the cause. Given the extensive breadth of etiology, prompt and accurate diagnosis is the first step in clinical management. Unfortunately, few standardized diagnostic pathways and treatment regimens exist in the management of eyebrow and eyelash alopecia, further underscoring the importance of early recognition and treatment. In this review, we provide a summary of the function, anatomy, and life cycle of eyebrows and eyelashes, in order to comprehensively review the causes, clinical features, and approach to madarosis.

2 Anatomy, Life Cycle, Function, and Clinical Significance

2.1 Anatomy

Human eyebrows are composed of short, obliquely set hairs arranged in arches supra-orbitally. The medial eyebrow hairs are nearly vertically oriented and become progressively more horizontal laterally along the brow [1]. The shape and orientation of eyebrows allows the eyebrows to protect our eyes from light, sweat, and dust. Although the number of eyebrow hairs varies widely amongst the population, the density of eyebrows typically remains stable over time [2]. The eyebrows and nearby glabellar region contain numerous sebaceous glands [3].

The eyelashes consist of curved sensory hairs originating from the eyelid margins. Compared to scalp skin, which is comprised of the epidermis, dermis, and hypodermis, the

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skin of eyelids contains a thinner epidermis and no hypodermis [4]. Eyelashes are rooted approximately 2 mm deep into the dermis and lack the arrector pili muscles associated with most other hair follicles [4, 5]. Humans typically have about 90–160 eyelashes on the upper lids, spread across five to six rows, and 75–80 eyelashes on the lower lids, dispersed between three to four rows [5]. Distribution of eyelashes among different rows ensures that eyelashes can be shed without leaving unprotected gaps [6]. Eyelash follicles are maintained by the holocrine glands of Zeis and the apocrine glands of Moll, which secrete sebum and immunologic enzymes to maintain eyelash health [7].

2.2 Life Cycle

The life cycles of the eyebrows and eyelashes differ from other pilosebaceous units on the body, and understanding their unique physiology is essential to diagnosis and treatment of associated disease. Contrary to scalp hair follicles, which have anagen phases of 2–8 years, the anagen phase of eyebrows typically lasts for 2–3 months, catagen for 2–3 weeks, and telogen for 2–3 months [8, 9]. Eyelashes also have a shorter life cycle of approximately 4–11 months [5]. Eyelashes can grow about 0.12–0.14 mm per day in the anagen stage [10], which lasts for about 4–10 weeks [5]. The catagen phase of eyelashes is approximately 15 days, and the telogen between 4 and 9 months [5]. It is believed that eyebrow and eyelash length is limited by the short anagen phase.

Eyebrow and eyelash thinning and whitening can occur as a presentation of *physiologic aging* [11, 12]. However, in other individuals, mainly men, advancing age can also present as eyebrow thickening, rather than thinning. The mechanisms of these age-related hair changes are unclear.

2.3 Function and Clinical Significance

In humans, eyebrows and eyelashes serve multifaceted purposes, ranging from protection of the eye to emotional expression. Overlying the orbital ridge and eye, the eyebrows and eyelashes protect these underlying structures from external assault, including sweat, rain, light, dust, microorganisms, and other particulate matter [6]. It has been hypothesized that the density and organization of eyelashes plays a role in the aerodynamic flow of air around the eye and in the protection of the cornea [10]. An essential component of non-verbal communication, eyebrows are also integral to the expression of emotions [10]. They are well-documented to serve an important cosmetic function, with their enhancement documented as early as ancient Egypt [13, 14].

Due to the varied functional and emotive purposes of eyebrows and eyelashes, as well as the visibility of the hairs, madarosis has been associated with significant emotional and psychologic distress. In one study on body image in women with breast cancer, 52% of women who experienced alopecia or loss of eyebrows and eyelashes reported fearing what others thought of them and 25% reported newfound anxiety due to their eyebrow and eyelash alopecia [15]. Loss of eyebrows and eyelashes can also negatively impact self-image, further underscoring the importance of diagnosis and treatment [16, 17].

3 Methods

We performed a literature search on PubMed/MEDLINE for articles that described trichoscopy and treatment of eyebrow and eyelash alopecia published before June 2022. The names of each disease/disorder were queried as search terms, along with the keywords "eyebrow" OR "eyelash" AND "hair loss" OR "alopecia" AND "trichoscopy" OR "treatment." Published, peer-reviewed articles were reviewed and selected. Two reviewers screened titles and abstracts for relevance, and articles that were not in English, presented redundant information, or did not relate to trichoscopy or treatment of eyebrow or eyelash alopecia in humans were excluded. Discrepancies were resolved by a third reviewer. We further searched the references and related articles. Additional articles on eyebrow and eyelash anatomy, life cycle, function, and clinical significance of madarosis were selectively included. A total of 136 articles were included in this review.

4 Etiologies and Trichoscopy Findings

Eyebrow and eyelash alopecia are often accompanied by other affected areas of hair loss, which may assist in diagnosis. In cases of isolated eyebrow and eyelash involvement, we recommend trichoscopy as the first best step to distinguish among different conditions.

4.1 Autoimmune

Alopecia areata (AA) involving the eyebrows presents as bilateral, patchy eyebrow loss, whereas eyelash involvement often presents as bilateral, patchy eyelash loss in the upper and lower eyelids (Fig. 1). Although isolated eyelash involvement is rare, eyelash alopecia has been reported as the presenting sign of AA, particularly of severe AA [18, 19].

Trichoscopic features of AA of eyebrows and eyelashes are often subtle [20]. Exclamation point hairs are not very numerous, but cadaverized hairs and yellow dots are usually visible (Table 1). Severity of the disease can be assessed using the clinician-reported outcome (ClinRO) and the

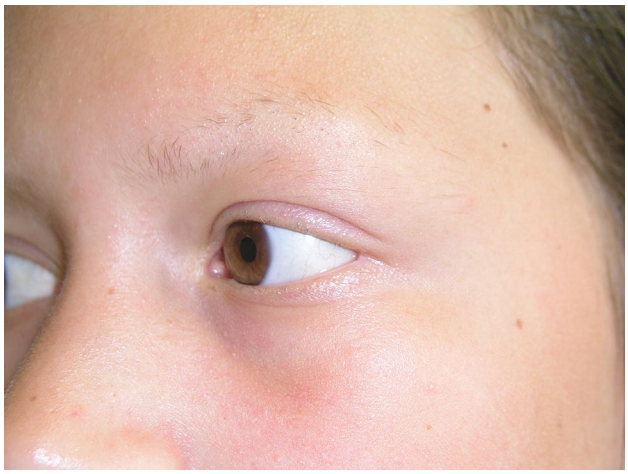

Fig. 1 Patient with alopecia areata presenting with patchy eyebrow loss and patchy eyelash loss of the upper and lower eyelids

patient-reported outcome (PRO) for eyebrow and eyelash loss [21]. ClinRO and PRO are based on a scale rating from 0 (no involvement) to 3 (complete loss). [21]. Other newly developed scales include the Brigham Eyebrow Tool for Alopecia (BETA) and Brigham Eyelash Tool for Alopecia (BELA). The BETA utilizes eyebrow landmarks, surface area of involvement, and hair density to calculate an eyebrow score [22], while the BELA utilizes eyelash count, distribution, and prominence of hairs of the upper lashes to establish its score [23]. These validated scores may be effective means of quantitatively monitoring progression of AA of the eyebrows and eyelashes, as well as treatment response over time [22, 23].

The prevalence of eyebrow and eyelash involvement is not precisely known. In a cross-sectional study conducted in Japan of 587 patients with AA, 19.8% (116/587) reported current eyebrow hair loss and 10.1% (59/587) reported current eyelash hair loss [24]. Prevalence was much higher in a Danish cohort study of 1494 patients with AA, with approximately 62.8% reporting current eyebrow loss and 56.4% reporting current eyelash loss [25]. Of these, 36.2% of patients reported having no or barely any eyebrow hairs (PRO score of 3), 10.3% reported having large gaps or thinning (PRO score of 2), and 16.3% reported minimal gaps or thinning (PRO score of 1), whereas 32.2% reported having no or barely any eyelashes (PRO score of 3), 5.8% reported having large gaps or thinning (PRO score of 2), and 18.4% reported minimal gaps or thinning (PRO score of 3) [25].

Frontal fibrosing alopecia (FFA) is a cicatricial alopecia that leads to loss of frontoparietal hair, bilateral eyebrows in up to 96% of patients, and eyelashes in up to 34% of patients [26]. Eyebrow loss often begins on the lateral eyebrow (Fig. 2a–b), with subsequent thinning, partial, or complete loss [27]. Although eyebrow loss is a common feature of FFA, its frequency varies among different studies and ethnic groups. In a cohort study of 58 Asian females with FFA, 69.0% (40/58) had eyebrow loss, and 5.2% (3/58) had eyelash loss [28]. Eyebrow alopecia was the first symptom of FFA in 3.4% (2/58) of these patients [28]. Interestingly, the authors found that 83.3% of patients with linear pattern FFA experienced eyebrow loss, compared to only 52% of patients with the pseudo-fringe sign [28]. In a retrospective analysis of 118 white and 21 black patients with FFA, eyebrow involvement was observed in 63.6% (75/118) and 52.4% (11/21) and eyelash involvement was observed in 2.5% (3/118) and 9.5% (2/21), respectively, with no significant differences in frequency found [29]. Eyebrow loss preceded loss of scalp hair in 43.7% (66/151) of patients in one study in Brazil and Italy [30].

The most relevant trichoscopy findings of eyebrow FFA include tapered and broken hairs, multiple pinpoint dots, short thin/vellus hairs, hair growing in different directions, dystrophic hairs, black dots (cadaverized hairs), red dots (follicular openings with increased vasculature), and yellow dots (follicular infundibula with sebum or keratotic material) (Fig. 2c) [30–32]. In contrast to scalp FFA, affected eyebrows often demonstrate non-scarring features on dermoscopy and histology, including preservation of the follicular ostia and sebaceous glands, respectively [30, 33]. The reversibility of some eyebrow loss in FFA could be attributed to these features. Since the most common findings of eyebrow FFA (yellow dots, multiple pinpoint dots, and short thin/vellus hairs) are also seen in noncicatricial alopecia, these findings alone are not enough to reach the diagnosis [30]. Dystrophic hairs, whitish areas with absent follicular openings (signifying cicatricial hair loss), and hairs growing in different directions are more specific trichoscopy findings of eyebrow FFA that can assist in diagnosing patients with isolated eyebrow loss [34]. The presence of red dots on eyebrow trichoscopy may be a favorable prognostic factor for eyebrow regrowth [30, 35]. The presence of pili torti may be a sign of fibrosis and a predictor of poor treatment response [32].

The most common findings on eyelash trichoscopy include dystrophic hairs (75%), black dots (50%), visualization of hair bulbs (50%) (typically on the upper eyelids), and ingrown hairs (46.9%) [26]. Trichoscopy may be able to detect early eyelash changes in FFA. In one study of 50 patients with FFA, eyelash loss was observed clinically in 17 patients (34%), but in 32 patients (64%) with trichoscopy, underscoring its utility for early detection of eyelash involvement [26]. Eyelash loss is an independent predictor of FFA severity (95% CI 1.74–8.59; $P = 0.001$) [36].

Newly proposed criteria set forth by the International FFA Cooperative Group recommend diagnosis based on the presence of 4 or more points from a list of clinical and pathologic findings typical of FFA [37]. The presence of at

Table 1 Common etiologies, presenting symptoms, trichoscopy, diagnosis, and treatment of eyebrow and eyelash alopecia

Etiology	Eyebrow and eyelash presentation	Eyebrow trichoscopy	Eyelash trichoscopy	Treatment
Alopecia areata	Patchy eyebrow loss bilaterally Bilateral patchy eyelash loss in upper and lower lids	Exclamation mark hairs are not very numerous. Cadaverized hairs, yellow dots, and black dots [20] are usually visible	Exclamation mark hairs, cadaverized hairs, yellow dots	Eyebrows: no standard treatment. Successful reported treatments include baricitinib 4 mg/day [82], ILTA 2.5 mg/mL (0.5 mg to each eyebrow) [81], topical tofacitinib 2% gel twice daily [84], oral tofacitinib 15 mg (case reports) [121, 122], pulsed diode laser at 904 nm (case report) [87] Eyelashes: no standard treatment. Successful reported treatments include baricitinib 4 mg/day [82], bimatoprost 0.03% solution once daily [88], topical tofacitinib 0.005% eye drops once daily [84]
Frontal fibrosing alopecia	Non-scarring alopecia starting on the lateral eyebrow Regrowth of eyelash hair in different directions [26]	Tapered and broken hairs, hair growing in different directions, black, red, or yellow dots, dystrophic hairs, pili torti, and white areas of skin lacking follicular openings [31, 32]	Dystrophic hairs, black dots, hair bulbs typically on the upper eyelids, and ingrown hairs [26]	Eyebrows: no standard treatment. Successful reported treatments include light-emitting diodes (630 ± 5 nm) [31], ILTA 2.5 mg/mL monthly [96], finasteride 2.5 mg/day (case series) [123], topical bimatoprost 0.03% solution (case series) [94], low dose oral minoxidil (case series) 95 Eyelashes: no standard treatment
Keratosis follicularis spinulosa decalvans	Scarring alopecia of the eyebrows presenting as sparse eyebrows Sparse eyelashes	Yellow dots and dystrophic hairs [45]	Yellow dots and dystrophic hairs [45]	No standard treatment. Successful reported treatments include dapsone (100 mg/day) and topical corticosteroids to decrease inflammation (case report) [124], topical emollients and keratolytics to improve skin texture (case report) [45]
Leprosy	Loss of eyebrows and eyelashes bilaterally in approximately 9.3–36.5% of patients [47, 48]	Reduced hair density, multiple vellus hairs, pigment distortion, targetoid pigmentation, pinpoint white dots, and white-yellowish areas lacking structures [49]	Not reported	Multiple-drug therapy with dapsone, rifampin, and clofazimine can be used to treat leprosy, but eyebrow regrowth is exceptional [50]
Tinea faciei/blepharo-ciliaris	Pink to red scaly, inflammatory patches and plaques over eyebrows Itchy erythematous patch involving the eyelid and broken eyelash hairs [57]	Comma hairs, corkscrew hairs, bent hairs, morse code hairs, zigzag hairs [56]	Scaling, broken hairs, bent hairs, and morse code hairs [57]	Topical antifungals ± oral terbinafine or oral itraconazole (case report) [57]
Trichotillomania	Isolated eyebrow hair loss without erythema Isolated alopecia only upper or lower eyelashes rather than both [74]	Black dots, broken hairs at different lengths, hook hairs, tulip hairs, and the V sign [73]	Broken hairs of different length, especially in the longer eyelashes [72, 74]	Psychotherapy [105]

ILTA intralesional triamcinolone acetonide

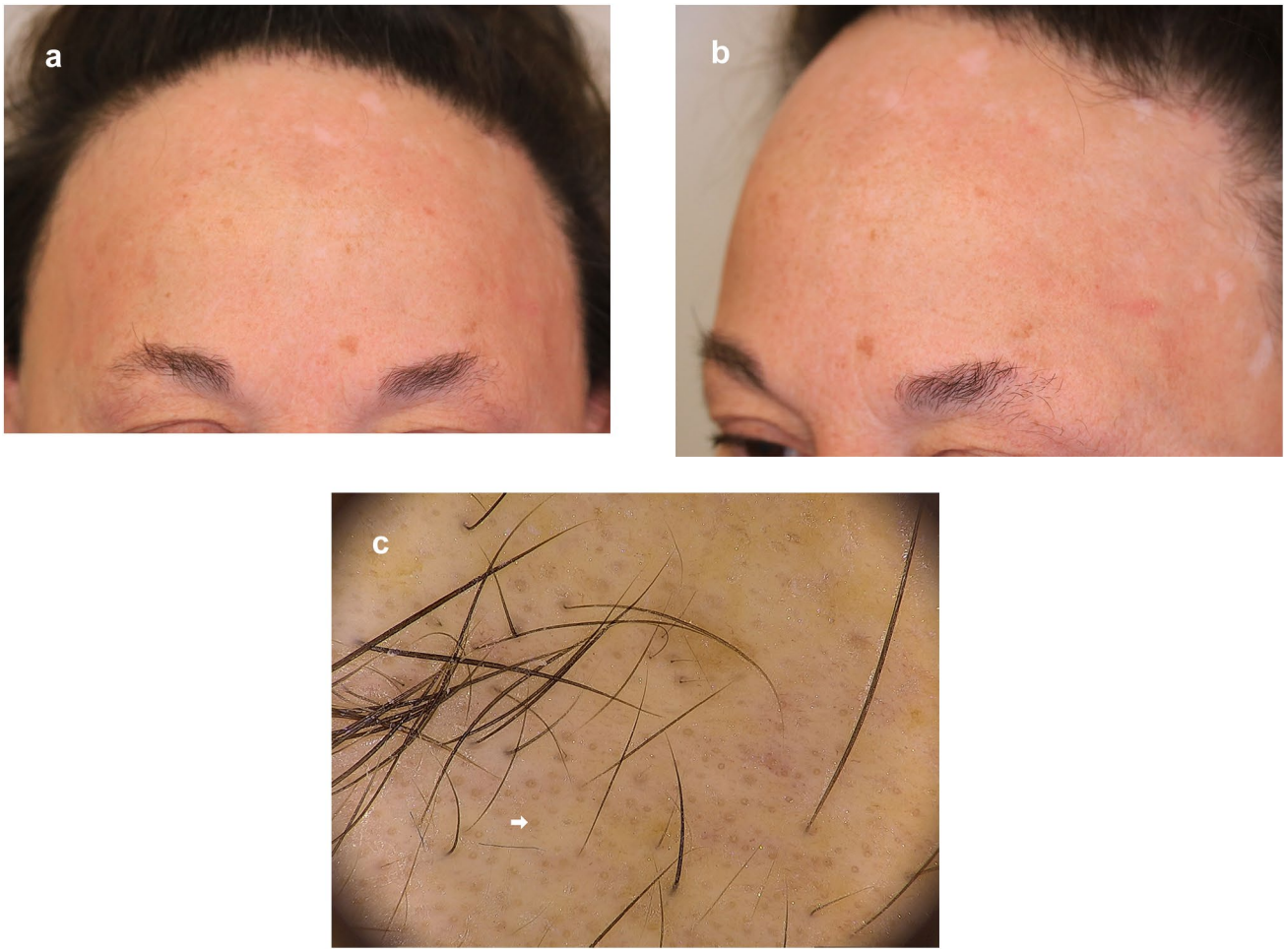

Fig. 2 **a**, **b** Patient with frontal fibrosing alopecia presenting with bilateral eyebrow loss on the lateral eyebrow. **c** Trichoscopy findings of eyebrow frontal fibrosing alopecia include hair growing in different directions and yellow dots (arrow)

least 50% eyebrow loss in the absence of AA accounts for 1 point, whereas a positive biopsy of the affected anterior or temporal scalp or eyebrow contributes 2 points toward the diagnosis (Table 1) [37].

Localized scleroderma is a disorder of excessive collagen deposition that can present as unilateral atrophy of the frontoparietal region above the eyebrow. Known as "*en coup de sabre*" (French for "the blow of the sword") for its resemblance to the scar of a sword wound, linear morphea of the paramedian forehead and scalp can be accompanied by eyebrow depression and hair loss [38]. In a case review of 50 pediatric patients with localized scleroderma, eyebrow and eyelash loss occurred in 4% and 12% of patients, respectively [39].

Discoid lupus erythematosus (DLE) is an autoimmune disorder that can uncommonly present with erythema and scaly plaques on the bilateral or, rarely, unilateral eyelids, with a predilection for the lower and lateral eyelids [40, 41]. In one case report, loss of eyelashes has been reported as an isolated symptom occurring prior to the onset of erythema, scaly plaques, and scarring alopecia of the scalp [42].

4.2 Endocrine

Hypothyroidism can present with loss of the lateral third of the eyebrow (i.e., Hertoghe sign or Queen Anne's sign), which is a classic, but nonspecific sign of hypothyroidism. Severe hypothyroidism has also been reported to present with eyelash alopecia [43].

4.3 Genetic

Keratosis follicularis spinulosa decalvans (KFSD) is an X-linked disorder of keratinization that causes follicular hyperkeratosis and scarring alopecia of the eyebrows, eyelashes, and scalp. The disease typically begins on the face and presents as sparse eyebrows and eyelashes, but can

also ultimately cause ophthalmic abnormalities including blepharitis, conjunctivitis, and photophobia [44]. Trichoscopy of eyebrows and eyelashes can show yellow dots and dystrophic hairs [45]. Other uncommon genetic causes of madarosis and their presentations are listed in Table 2.

4.4 Infectious

Lepromatous leprosy may interfere with hair growth, leading to eyebrow and eyelash loss early in the disease, preceding the characteristic development of leonine facies [46]. Eyebrow and eyelash loss bilaterally is seen in approximately 9.3–36.5% of patients with lepromatous leprosy [47, 48]. In a cross sectional study of 23 patients, trichoscopy findings included reduced hair density, multiple vellus hairs, and distorted pigmentation of skin [49] (Table 1). Treatment did not produce regrowth of eyebrows in these patients, but eyebrow regrowth has been reported in one case report after two months of treatment [50].

Cutaneous syphilis may also result in patchy alopecia of the scalp, beard, eyebrows, and eyelashes [51]. Eyebrow loss occurs during the secondary stage of syphilis and typically affects the lateral side of the eyebrows, known as the "omnibus sign" [52, 53].

Tinea faciei, *tinea blepharo-ciliaris*, and *periocular tinea* are ringworm infections of the face, eyelids and eyelashes, and eyelids only, respectively. Caused by *Microsporum*, *Trichophyton*, or *Epidermophyton* species, fungal infections may result in partial unilateral or bilateral hair loss of the eyebrows and eyelashes [54, 55]. Trichoscopy of affected eyebrows may show comma hairs (51%), corkscrew hairs (32%), bent hairs (27%), morse code hairs (22%), and zigzag hairs (22%) (Table 1) [56]. Trichoscopy of the eyelashes reveals widespread scale, broken hairs, bent hairs, and morse code hairs (Table 1) [57]. With adequate trichoscopy and/or clinical findings, empiric treatment with topical and/or oral antifungals can be initiated prior to culture results.

Viral infections: Varicella zoster virus (VZV) can infect the ophthalmic division of the trigeminal nerve, and reactivation of VZV can cause scarring of the eyelid [58]. A few cases have reported unilateral loss of upper lid eyelashes related to VZV [59, 60]. Though exceedingly rare, madarosis has also been reported in *HIV* [61].

4.5 Neoplastic

Neoplastic conditions, particularly hematologic malignancies, have been associated with eyebrow alopecia, although most of this information is limited to reports of isolated cases. One such report describes an adult patient who developed eyebrow alopecia in the setting of mycosis fungoides, and histopathology showed a folliculotropic infiltrate of atypical lymphocytes sparing the epidermis [62]. Another report described a 56-year-old female with a history of chronic lymphocytic leukemia (CLL) with infiltrates to the skin (i.e., leukemia cutis) presenting with erythematous papules and bilateral eyebrow alopecia [63]. Rarely, eyebrow loss may also be secondary to the presence of primary cutaneous tumors, such as one case of madarosis associated with pleomorphic adenoma [64].

Chemotherapeutic agents used to treat neoplastic conditions can also contribute to madarosis. In particular, agents such as taxanes, doxorubicin, and cyclophosphamide have been seen to cause hair loss approximately 1 week to 1 month after initiation [65]. In an observational study of 68 cancer patients treated with fluorouracil/epirubicin/cyclophosphamide (FEC) and taxane, eyebrow and eyelash loss were reported in 56 patients (82.4%) and 53 patients

Table 2 Uncommon genetic causes of madarosis and their presentations

Disorder	Clinical presentation	Hair symptoms
T cell immunodeficiency, congenital alopecia, and nail dystrophy (TIDAND) [125–127]	Pitted, curved, or ridged nails	Loss of scalp, eyebrow, and eyelash hair
Ectodermal dysplasia [128, 129]	Abnormalities in tissues derived from ectoderm (e.g., hair, teeth, nails, lens or retina of eyes, inner ears, fingers, and toes)	Sparse eyebrows
Graham–Little–Piccardi–Lassueur syndrome (GLPLS) [130]	Triad of cicatricial scalp alopecia, loss of pubic and axillary hairs, and follicular papules	Non-scarring eyebrow and eyelash thinning
Hereditary hair loss [131]	No other symptoms	Thin eyebrows
Inherited biotinidase deficiency [132]	Erythroderma of the trunk, face, and scalp	Eyebrow alopecia
Lamellar ichthyosis [133]	Dark scales with erythema, fissuring, pruritis of the skin	Eyebrow and eyelash loss
(Nonbullous) congenital ichthyosiform erythroderma [134]	Finer white scale and underlying redness of skin	Scarring alopecia of scalp and eyebrows
Vogt–Koyanagi–Harada (VKH) disease [135, 136]	Ocular problems (e.g., blurred vision, choroiditis, retinal detachment), vertigo, tinnitus, neurologic symptoms	Depigmentation of the scalp, eyebrows, and eyelashes in chronic cases

(77.9%), respectively [65]. Younger patients may regrow hair sooner, suggesting a potential linear association between the patient's age and time to recovery from chemotherapy-induced alopecia of the eyebrow and eyelash [65]. Eyebrow and eyelash hair loss has been reported to be permanent in approximately 5% of cases, and patients should be informed of this risk prior to chemotherapy initiation [66]. Endocrine therapy-induced hair loss, due to usage of medications such as selective estrogen receptor modulators and aromatase inhibitors, can also present with alopecia of eyebrows and eyelashes. In a retrospective cohort study of women taking endocrine therapies who developed alopecia, 28.3% (26/92) had involvement of eyebrows or eyelashes [67].

Additionally, *radiation therapy* for ocular tumors has also been reported to cause reversible madarosis by triggering hair loss in the anagen stage [9, 68]. In a retrospective review of 63 patients with ocular tumors, madarosis was a complication in 28.6% (10/35) of eyes treated with proton beam radiation [68]. At high doses of radiation (typically 50–60 Gy), eyebrow loss may be permanent due to damage to the epithelial stem cells or dermal papilla [9].

4.6 Nutritional

Nutrient deficiency of zinc has been reported to cause eyebrow and eyelash alopecia. Sparse eyebrows and hair secondary to zinc deficiency has been reported in a patient on parenteral nutrition [69]. Acrodermatitis enteropathica, an inherited disorder of abnormal zinc absorption, has also been shown to cause diffuse eyebrow and eyelash loss [70].

4.7 Traumatic

Causes of eyebrow and eyelash loss from trauma include *trichotillomania*, or hair loss from repetitive pulling or overplucking of hair. Trichotillomania can present clinically as irregular, patchy alopecia of the eyebrows and/or eyelashes, with hair shafts of varying lengths (Fig. 3) [71]. Eyebrow and/or eyelash hairs may be nonuniform, tufted, or tortuous, and hair follicles may be prominently visible [72]. Trichoscopy shows broken hairs of different lengths, black dots, hook hairs, tulip hairs, and the V sign [73]. Eyelash alopecia is typically limited to the longer eyelashes of the upper eyelid [72, 74]. Patients may state that the eyelashes bother them when blinking, justifying removal of those eyelashes [75].

Rarely, patients may present with eyebrow alopecia after a burn injury with hot liquids or fire that may lead to formation of scar tissue below the brow.

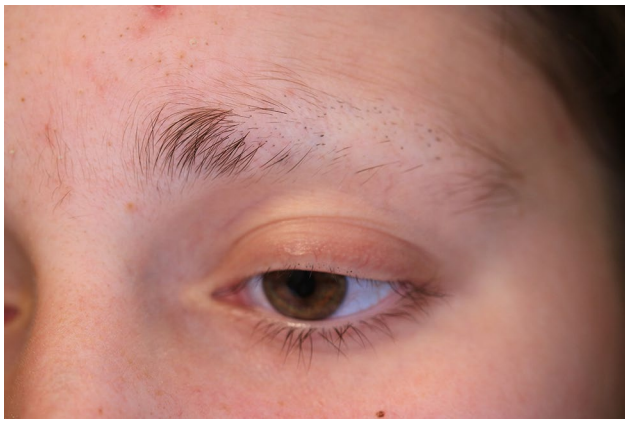

Fig. 3 Patient with trichotillomania presenting with irregular, patchy alopecia of the eyebrow, with hair shafts of varying lengths, prominently visible hair follicles, and eyelash alopecia limited to eyelashes of the upper lid

4.8 Primary Dermatoses

Atopic dermatitis can present with loss of the lateral third of the eyebrows (Hertoghe sign) in up to 39% of patients, as well as eyelid dermatitis, though involvement of more than just the lateral third of the eyebrow is possible [76]. Although alopecia can be caused by chronic rubbing, eyebrow loss has also occurred in patients without a history of eyebrow manipulation [77]. It is hypothesized that inflammation may itself be responsible for the alopecia.

Another primary dermatosis, *seborrheic dermatitis*, can cause madarosis that presents as scaling and erythema of the eyebrows. Eyebrow loss can be a result of repeated scratching due to pruritis [78]. Trichoscopy often reveals casts surrounding the eyelashes [79].

Psoriasis can cause inflammation of the eyelids (i.e., blepharitis) and psoriatic plaques, and severe cases of eyelid psoriasis can cause loss of eyelashes [80].

5 Treatments

5.1 Autoimmune

AA: Topical and intralesional steroids have long been utilized for eyebrow alopecia. Intralesional triamcinolone acetonide (ILTA) (2.5 mg/mL; 0.5 mg to each eyebrow) can be injected every 4–6 weeks for a maximum of 6 months [81]. Moderate potency topical corticosteroids and topical minoxidil 5% can also be used on the eyebrows, though studies have not been conducted on the efficacy of these treatments.

The JAK inhibitor baricitinib was approved by the US Food and Drug Administration (FDA) for treatment of AA. In two randomized controlled phase 3 clinical trials

of baricitinib for AA (BRAVE-AA1 and BRAVE-AA2), researchers randomly assigned a total of 1200 patients to receive 4 mg baricitinib, 2 mg baricitinib, or placebo for 36 weeks and assessed eyebrow and eyelash outcomes using the ClinRO [82]. Of 188 and 161 patients taking 4 mg baricitinib with reported eyebrow outcomes, 35.2% and 38.9% experienced a terminal score of 0–1 (full coverage or minimal gaps) and a reduction (improvement) in ClinRO eyebrow score of at least 2 points from baseline, compared to 4.4% and 5.5% in the placebo group, respectively ($p < 0.001$) [82]. In 167 and 140 patients taking 4 mg baricitinib compared to placebo for 36 weeks with reported eyelash outcomes, 36.2% and 36.8% experienced a terminal score of 0–1 and a reduction in ClinRO eyelash score of at least 2 points from baseline, compared to 4.4% and 6.9% in the placebo group, respectively ($p < 0.001$) [82]. Although results suggest that baricitinib holds promise in treating eyebrow and eyelash AA, these clinical trials excluded patients who previously had an inadequate response to oral JAK inhibitors and patients who had an episode of at least 8 years without hair regrowth, limiting the generalizability of results [82].

Use of other JAK inhibitors have also shown promising results for eyebrow and eyelashes. In a retrospective study including 119 patients treated with tofacitinib for AA, complete eyebrow and eyelash regrowth were achieved in 34.5% (41/119) and 38.7% (46/119) of patients, respectively, after treatment for ≥ 6 months [83]. Topical tofacitinib 2% gel twice daily for the eyebrows and 0.005% eye drops once daily for eyelashes have also been shown to be efficacious, resulting in partial or complete regrowth of 66.7% (12/18) of cases of eyebrow AA and 100% (4/4) of cases with eyelash AA [84]. Complete regrowth of upper eyelashes in localized AA have also been achieved with tofacitinib 2% solution applied to the upper eyelid once to twice daily for 7 months [85]. Fewer studies have been conducted on ruxolitinib, though one patient has been reported to experience complete eyebrow regrowth after 12 weeks of treatment with topical 0.6% ruxolitinib cream [86].

Successful use of other novel treatments has been reported in small uncontrolled studies, though these treatments are not standard of care. In a clinical trial of three patients with recalcitrant eyebrow AA, four sessions of treatment with a pulsed diode laser at 904 nm resulted in complete eyebrow regrowth of five out of six eyebrow patches [87]. Although excimer lasers (308 nm) have successfully resolved scalp patches of AA, no studies have been conducted on eyebrows or eyelashes.

Of the prostaglandin analogs, bimatoprost is a commonly utilized treatment. In one study of 41 subjects with alopecia universalis (AU), application of topical 0.03% bimatoprost to the eyelid margin once daily for a year led to slight, moderate, or complete eyelash growth in about 70.3% of patients [88]. However, in another study of 26 AA patients, application of topical latanoprost for 4 months did not show statistically significant eyelash regrowth [89]. A similar lack of efficacy of latanoprost was seen in other experimental studies [90, 91].

FFA: In a retrospective chart review of FFA cases, ILTA at 10 mg/mL, 0.125 mL per eyebrow, was injected at varying time intervals and numbers of sessions in ten patients with partial eyebrow loss and one with complete eyebrow loss [92]. Signs of eyebrow regrowth at 2- to 6-month follow-up visits were found in all patients with partial eyebrow loss (10 of 11 patients) [92]. Notably, 20 patients with eyebrow loss related to FFA who did not receive ILTA injections did not experience eyebrow regrowth [92]. A single case report also found eyebrow regrowth with oral dutasteride (0.5 mg/day) and pimecrolimus 1% cream twice a day [93]. Other possible treatments of eyebrow loss in FFA include topical prostaglandin analogs and oral minoxidil. In one study of three patients with eyebrow loss refractory to topical minoxidil and clobetasol lotion, application of topical bimatoprost ophthalmic solution 0.03% twice daily for 9 months resulted in eyebrow regrowth in two of three patients who had non-scarring features on dermoscopy [94]. In a case series of seven FFA patients treated with oral minoxidil (0.5–2.5 mg/day) for 6 months, partial eyebrow regrowth was observed in five of seven and almost complete regrowth in two of seven [95].

Usage of laser therapy has been reported to effectively result in eyebrow regrowth, though studies with high-quality evidence are lacking. In one study of 16 patients with FFA, there was a significant increase in total eyebrow hair count after ten treatments with light-emitting diodes (LEDs) at 630 ± 5 nm [31]. Treatment should be initiated as early as possible, as results range from diminished response to no response in patients with complete eyebrow loss [96, 97].

Patients with severe scarring alopecia of the eyebrow may require hair transplantation, although the presence of scar tissue may impair graft uptake and hair growth. In a cohort study, eight out of ten patients with FFA showed initial hair growth and satisfactory results after hair transplantation using unaffected follicles harvested from the occipital region, but transplanted hairs were lost after 3–4 years in all but one patient [98].

In *localized scleroderma*, one successful case of eyebrow reconstruction using follicular unit transplantation has been reported [99].

In *DLE*, early diagnosis and treatment with oral hydroxychloroquine are important to prevent scarring and permanent eyelash loss [41].

5.2 Endocrine

Hypothyroidism: Adequate treatment of hypothyroidism has been reported to restore normal telogen-anagen hair proportions in one small study of nine patients [100], though the response of eyebrow alopecia to thyroxine treatment has not been well documented.

5.3 Genetic

There are no specific treatments for eyebrow or eyelash alopecia from *KFSD*. Ophthalmologic referral is important to prevent eye complications.

5.4 Infectious

Treatment of infectious diseases results in varying outcomes for eyebrow and eyelash alopecia, though current data relies on smaller uncontrolled studies. Treatment of *lepromatous leprosy* has not been reported to result in eyebrow regrowth [49] except in an isolated case report with one patient who was treated with dapsone, rifampin, and clofazimine for 2 months [50]. Patients with leprosy should be treated with this standard-of-care regimen regardless of eyebrow involvement. In *syphilis*, timely treatment with benzathine penicillin G has been reported to result in complete eyebrow regrowth in two case reports [51, 101]. Eyebrow and eyelash alopecia due to *tinea faciei* has been reported to be reversible after treatment with topical and/or oral antifungals in two case reports [54, 102].

5.5 Neoplastic

The most promising treatment for *chemotherapy-induced* eyelash alopecia is topical bimatoprost. In a clinical trial of 96 patients who were treated with chemotherapy, usage of topical bimatoprost 0.03% on the eyelashes for 6 months after chemotherapy resulted in significantly longer upper eyelash length, thickness, and darkness ($p = 0.02$, < 0.01, and < 0.01, respectively) [103].

5.6 Nutritional

In a patient with chronic diarrhea due to sucrase deficiency, supplementation with oral zinc was reported to result in growth of thicker and more pigmented eyebrow and eyelashes in one case report [104].

5.7 Traumatic

As no pharmacologic therapy has been FDA-approved for *trichotillomania*, the mainstay treatment remains psychotherapy [105]. *N*-acetylcysteine (NAC), a glutathione and glutamate modulator, at a dosage of 1200–1800 mg/day has been used to treat scalp trichotillomania, but there are no reports of its efficacy in treating eyebrow and eyelash trichotillomania [106].

Hair transplantation by follicular unit extraction (FUE) has been successfully performed for eyebrow alopecia from *burn injury* using pretreatment with combined non-ablative fractional laser (NAFL) and microfat injection [107]. A strip micrograft using FUE technique, with eyebrow hairs as the donor site, has also been successfully conducted for traumatic madarosis of the upper and lower eyelid in one case report [108].

5.8 Primary Dermatoses

In *atopic dermatitis*, treatment with emollients and topical corticosteroids have been reported to result in partial eyebrow regrowth in one case report [77]. Partial eyebrow regrowth was also observed in one patient treated with subcutaneous dupilumab [109].

Seborrheic dermatitis is associated with colonization with *Malasezzia* spp., and treatment with a topical antifungal, low-potency corticosteroid cream, or topical calcineurin inhibitor to the eyebrows has been found to be both safe and effective [110, 111].

5.9 Other

Because eyelash follicles express prostaglandin F2α receptors, prostaglandin analogs can affect their growth. LATISSE® (bimatoprost ophthalmic solution 0.03%) once daily was approved by the US FDA in 2008 for eyelash hypotrichosis and has been shown to increase eyelash pigmentation, length, and thickness [112].

In one randomized controlled trial including 357 patients with *idiopathic* or *unspecified* eyebrow loss, the efficacy of topical bimatoprost 0.03% applied once or twice daily was compared to a non-medicated control [113]. Improvements in eyebrow fullness and thickness were noted in both bimatoprost groups when compared to the control ($p < 0.001$) [113]. Another randomized trial with 39 participants used 2% minoxidil lotion applied to the eyebrows twice daily for 16 weeks and found significant improvement in both global photographic scores and hair count with the use of minoxidil when compared to vehicle [114].

Cosmetic treatments for eyebrow and eyelash alopecia include topicals to help regrow hairs such as *copper peptides*, as well as techniques to camouflage hair loss such as microblading, microshading, and tattooing. In a cohort study of six patients, daily application of a peptide solution to the eyebrows and eyelashes for 12 weeks significantly increased eyelash length ($p = 0.014$) and clinically improved eyebrow thickness on digital photography [115].

Microblading is a semi-permanent tattooing technique that utilizes small needles to deposit pigment superficially in the epidermis and papillary dermis to create an illusion of eyebrow hairs [116]. Using a similar technique, *microshading* is the process of depositing pigmented dots throughout the eyebrow to create the appearance of eyebrow makeup. Microblading and microshading result in fuller-appearing eyebrows for 12–18 months. Due to loss of superficially

deposited pigment over time, the procedure needs to be repeated at regular time intervals [116].

Eyebrow tattooing presents more permanent effects by depositing tattoo ink deeper into the dermis [117]. Due to deposition of foreign bodies, tattooing causes an inflammatory reaction that can be seen as lymphocytic infiltrate in the dermis on histopathology [118]. In a study of 28 patients undergoing blepharoplasty, histopathologic analysis of excised upper eyelid tissue revealed significant dermal fibrosis in patients with eyebrow tattoos compared to those without ($p = 0.02$) [119]. Ultrasonography of this tissue before excision also revealed increased soft tissue thickness in patients with eyebrow tattoos ($p < 0.001$) [119]. In addition to these local skin reactions, other risks are involved. The US FDA has investigated the safety of permanent tattooing and has found complications including infections, allergic reactions, and formation of granulomas and keloids [120]. Although permanent tattooing is an option for camouflaging eyebrow madarosis, patients should be properly counseled on risks associated with this treatment.

6 Conclusion

Eyebrow and eyelash alopecia have many different etiologies. Although often presenting with other concomitant symptomatology, eyebrow and eyelash alopecia may be the only presenting symptom, as seen in multiple cases of AA [18, 19, 89]. Although autoimmune and genetic etiologies of alopecia have greater variability in clinical response, prompt diagnosis and treatment are important to minimize hair loss. Trichoscopy is a useful tool to aid in diagnosis of common causes of eyebrow and eyelash alopecia including AA, FFA, tinea infection, and trichotillomania. After determining the diagnosis, treatment is focused on targeting the underlying etiology of disease and preventing or reversing the progression of hair loss. This review highlights the etiologies, trichoscopy findings, and importance of swift clinical recognition and management of madarosis.

Declarations

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