Brigham Eyebrow Tool for Alopecia: A Reliable Assessment of Eyebrow Alopecia Areata

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There are no tools to evaluate eyebrow involvement in patients with alopecia areata. We developed and assessed the reliability of the Brigham Eyebrow Tool for Alopecia (BETA) as a quantitative evaluation of eyebrow alopecia areata. BETA uses facial landmarks of eyebrow anatomy and is calculated using surface area and density. A total of 50 eyebrow images with varying levels of hair loss were distributed to six board-certified dermatologists at three academic medical centers with standardized instructions and examples. Interrater and intrarater reliability were calculated using intraclass correlation coefficients (ICCs). BETA demonstrated high interrater (ICC = 0.88, confidence interval = 0.83–0.92 right eyebrow scores and ICC = 0.89, confidence interval = 0.85–0.94 left eyebrow scores) and intrarater (ICC = 0.90, confidence interval = 0.85–0.93 right eyebrow scores and ICC = 0.91, confidence interval = 0.87–0.94 left eyebrow scores) reliability. When measured in the same patient with varying degrees of hair loss over time, BETA demonstrated sensitivity to change. BETA is a simple and reliable objective assessment of eyebrow alopecia areata. BETA is easy-to-use and quick to calculate, making it feasible for a variety of clinical and research settings. Although developed for alopecia areata, we hope that BETA will be investigated in other etiologies of eyebrow alopecia to serve as a universal tool for monitoring disease progression, improvement, and response to treatment.


INTRODUCTION

Alopecia areata (AA) is an autoinflammatory disease of hair loss that can have a profound negative impact on QOL, self-esteem, and mental health (Hunt and McHale, 2005; Liu et al., 2016). AA can affect hair on the scalp, face, or elsewhere on the body, with eyebrows and/or eyelashes involved in 76% of patients (Liu and King, 2019). Eyebrow involvement can be particularly distressing, as the eyebrow is a defining facial feature important not only for aesthetics but also for communication, emotional expression, and identity (Harries et al., 2010; Hunt and McHale, 2005; Jabbour et al., 2018; Yalçınkaya et al., 2016). There is no validated instrument to evaluate the degree of eyebrow hair loss in patients with AA. The Severity of Alopecia Tool is a validated assessment for scalp hair loss severity that uses surface area and density, allowing for consistent endpoints for patient evaluation and research (Olsen et al., 2004, 1999). A similar tool is needed for eyebrow alopecia to monitor disease progression, improvement, and response to treatment. We developed the Brigham Eyebrow Tool for Alopecia (BETA) and validated its use for the assessment of eyebrow alopecia in patients with AA.

RESULTS

Interrater reliability (absolute agreement) had an intraclass correlation coefficient of 0.88 (confidence interval = 0.83–0.92) for right eyebrow scores and 0.90 (0.85–0.94) for left eyebrow scores. Intrarater reliability (consistency) had an intraclass correlation coefficient of 0.90 (0.85–0.93) for right eyebrow scores and 0.91 (0.87–0.94) for left eyebrow scores.

When measured in the same patient with varying degrees of hair loss over time, BETA appropriately increased with increased eyebrow hair growth (Figure 1). This pattern highlights the utility of BETA for tracking alopecia over time.

DISCUSSION

Our data suggest that BETA is a reliable and effective tool that provides a standardized, quantitative method to evaluate eyebrow AA. BETA is straightforward, easy-to-use, and quick to calculate, making it feasible for clinical practice and trials. BETA demonstrated high interrater and intrarater reliability across multiple raters.

These findings must be considered in the context of the study design. The BETA was validated in photographs, not in

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live patients. However, given the ease of establishing landmarks from photographs for eyebrow hair loss, the performance in face-to-face patient encounters will likely be very similar. In addition, because there is no existing tool to evaluate eyebrow alopecia, there is no “gold standard” for comparison to our reviewer scoring. The face validity, high reliability of BETA scores between reviewers, and responsiveness to change suggest the reproducibility and accuracy of results using this tool.

Although clinical severity of hair loss is not always predictive of disease impact and QOL in patients with alopecia (Reid et al., 2012), an objective tool to assess AA of the eyebrow is needed to evaluate patients and for research. In combination with forthcoming patient-reported outcomes, we hope this tool will provide a comprehensive assessment of this critical aspect of AA. Future efforts will focus on the continued validation of this tool across other types of alopecia.

MATERIALS AND METHODS

Tool development and design
BETA was developed by alopecia experts at Brigham and Women’s Hospital using existing criteria of landmarks and ratios for eyebrow anatomy, adapted from the original Westmore guidelines (Westmore, 1975; Yalcınkaya et al., 2016). In BETA, the medial eyebrow margin (a) is defined by the vertical line from the mid-nare, and the lateral eyebrow margin (d) is defined by the line from the alar-facial groove through the lateral canthus (Figure 2). The mid-pupillary (b) line is drawn vertically through the pupil, and the eyebrow arch (c) is angled from the top of the philtrum through the pupil. These landmarks aid in establishing the maximum (100%) potential eyebrow surface area.

BETA was modeled similarly to the Severity of Alopecia Tool, which is calculated using scalp surface area and density of terminal hairs. In BETA, hair density is defined as degree of eyebrow hair present on a scale of 0–3 (0 = absent, 3 = very dense), and surface area is defined as the extent of eyebrow area covered (0–100%), accounting for missing or skipped lesions (Figure 2). Each eyebrow score is obtained by multiplying density by surface area (range 0–3). The BETA score is the sum of the right and left eyebrow scores (range 0–6).

Validation
This study was approved by the Partners Institutional Review Board. A set of 50 eyebrow images of patients with varying degrees of eyebrow AA hair loss and gain throughout their treatments were distributed to six board-certified reviewers from three academic medical centers. Each reviewer independently assessed the photographs after reviewing standardized instructions and examples (Figure 2). A total of 25 of the images represented unique patients, whereas the other 25 represented seven patients at different time points with varying levels of eyebrow alopecia. The photographs were presented in random order and included a range of hair loss from the complete absence of eyebrow hair to full density and surface area of eyebrow hair.

Statistical analysis
Internal reliability of BETA was computed using intraclass correlation coefficients (Table 1), in which absolute agreement represents interrater reliability, and consistency represents intrarater reliability.

Data availability statement
Datasets available upon demand.

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<th>B</th>
<th>C</th>
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Figure 1. Average BETA scores over time in the same patient with varying degrees of eyebrow hair loss at monthly intervals during treatment (a–d). Right refers to the patient’s right. Copyright 2019, 2020 Brigham and Women’s Hospital (Boston, MA). All rights reserved. BETA, Brigham Eyebrow Tool for Alopecia.
CONFLICT OF INTEREST

JMK has received consulting fees from Eli Lilly, Concert Pharmaceuticals, and Arena Pharmaceuticals. KPH and AM have received royalty payments from Pfizer for licensing of the Alopecia Areata Assessment tool and have participated in clinical trials related to alopecia from Incyte, Eli Lilly, Concert, and Aclaris. KPH and AM have received consulting fees from Pfizer. AM has received consulting fees from Him and 3Derm and has equity in Lucid and Hims.

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AUTHOR CONTRIBUTIONS

Formal Analysis: CJJ; Investigation: ET, KPH, AM; Project Administration: ET, KPH, AM; Resources: JMK, KJL, DAS, MMS, SJL, AM; Supervision: ET, KPH, AM; Writing - Original Draft Preparation: ET, AM; Writing - Review and Editing: ET, KPH, AM

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