The Trichoscopy Derived Sinclair Scale – enhancing visual assessment through quantitative trichoscopy

Short running title: The Trichoscopy Derived Sinclair Scale

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Abstract

Introduction

The Sinclair Scale of hair midline density is commonly used in clinical dermatology practice as a tool to evaluate the severity of female pattern hair loss (synonym androgenetic alopecia, AGA) and to monitor patient response to treatment. The Sinclair Scale involves a visual evaluation of central hair parting line width, that is performed quickly and with no optical instrumentation. Another approach used to score severity of hair loss is quantitative trichoscopy. While quantitative trichoscopy is more accurate in terms of reproducibility and objectivity, it is more time consuming.

Materials and Methods

Patients with different stages of AGA were evaluated using both the Sinclair Scale and quantitative trichoscopy. A correlation analysis was performed between the Sinclair Scale and different parameters derived from statistical analysis of trichoscopy images. A novel parameter, cumulative hair thickness density was introduced.

Results

Very good correlation was observed between Sinclair Scale and the cumulative hair thickness density. The quality of correlation is sufficient to estimate Sinclair Scale from cumulative hair thickness density. A formula to calculate the “Trichoscopy Derived Sinclair Scale” from trichoscopy statistics was derived.

Discussion

We propose the term “Trichoscopy Derived Sinclair Scale” to describe the hair midline density as derived from trichoscopy and to differentiate this assessment of midline hair density from the traditional one based on visual inspection alone.

Key words: female pattern hair loss, androgenetic alopecia, dermoscopy, hair thickness, quantitative trichoscopy, Sinclair Scale

Learning points: Assessment of hair loss severity with Trichoscopy Derived Sinclair Scale based on quantitative trichoscopy is proposed.

Introduction

The Sinclair Scale of hair midline density was introduced in 2005 and since then has become a popular tool to evaluate the severity of female pattern hair loss (androgenetic alopecia, AGA) as it may be performed quickly and with no optical instrumentation [1].

Trichoscopy is a non-invasive and inexpensive method of diagnosing hair disorders, including abnormalities of hair shafts, as well as scarring and non-scarring alopecia types [2,3,4]. Trichoscopic evaluation consists of qualitative and quantitative hair assessment. The currently available quantitative analysis is usually presented in form

of a chart demonstrating parameters directly measured in trichoscopy images registered with a digital videodermoscope, namely hair densities, diameters and follicular unit distributions [5].

Materials and Methods

290 female and 90 male patients with different stages of AGA were examined between February and October 2017 at the Sinclair Dermatology Centre in Melbourne. All patients were evaluated against the visual Sinclair Scale. Trichoscopy examination included registration of 5 high resolution images using FotoFinder leviacam. The frontal (midline, 2 cm from hairline), temporal (3 cm above ear) and occipital (across occipital protuberance) areas have been imaged. The statistical analysis of trichoscopy images was performed using TrichoLAB system to derive:

- hair density,
- average hair thickness,
- follicular unit density,
- cumulative hair thickness density (CHTD) (total diameter of hair growing in scalp area unit).

These statistical trichoscopy measures were subject to covariance analysis aimed at finding measures best correlated with Sinclair Scale and for a given Sinclair Scale value – those which remain insensitive (uncorrelated) to other parameters.

Results

Example correlation plots are presented in Figure 1. The upper image indicates that the same Sinclair Scale may be observed in patients with more hair of lower diameter and less hair if their of higher diameter. Although both of these measures, thickness and density, are correlated with Sinclair Scale, none of them may be used as sole basis to estimate Sinclair Scale. The lower image presents correlation for cumulative hair thickness density and hair diameter.

Covariance analysis revealed that for a given Sinclair Scale the cumulative hair thickness density does not correlate with other statistical measures and is very well correlated with Sinclair Scale as shown on graph below, making it a perfect basis for statistical derivation of Sinclair Scale (see Figure 2).

It is proposed to use the term Trichoscopy Derived Sinclair Scale to describe the hair midline density calculated from cumulative hair thickness density measured in trichoscopy:

Trichoscopy Derived Sinclair Scale = $3.9 \times \log(1/\text{CHTD}) + 2.4$

The Trichoscopy Derived Sinclair Scale proved to be very well correlated with visually assessed Sinclair Scale as in more than 75% of cases the difference between the scales was below 1 (Figure 3).

Discussion

To elucidate results of the correlation analysis, a simple model of statistical estimation of scalp midline width is proposed. If hair is parted and combed to sides, hair may be assumed to be aligned as presented in Figure 4.

Very close to a parting line most of scalp is bare. Skin gets gradually covered with hair as areas more distant from parting line are observed.

Complete scalp coverage is reached at the point where cumulated hair thickness is equal to the assessed section of parting line. This is observed at the distance $1/\text{CHTD}$ away from parting line.

To follow, one may estimate the width of the parting line with hair coverage less than 50% to be $1/\text{CHTD}$.

To summarize, it has been demonstrated that one can successfully estimate Sinclair Scale using quantitative trichoscopy. It is proposed to use the term Trichoscopy Derived Sinclair Scale to describe the hair midline density calculated from cumulative hair thickness density measured in trichoscopy.

Although visually assessed Sinclair Scale is quicker to use and requires no optical instrumentation, the Trichoscopy Derived Sinclair Scale is more objective and reproducible. The high correlation of the scales allows to use them interchangeably.

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Figure legends

Figure 1. Correlation between hair density and average hair thickness for patients with Sinclair Scale 2 (upper figure).

Correlation between cumulative hair thickness density (CHTD) and average hair diameter for patients with Sinclair Scale 2 (lower figure).

Figure 2. Correlation between cumulative hair thickness density and the Sinclair Scale.

Figure 3. Comparison of the Sinclair Scale and the Trichoscopy Derived Sinclair Scale.

Figure 4. Schematic hair parting. Brown lines indicate hair. The width of the parting may be estimated to be $1/CHTD$ when less than 50% of scalp skin is covered with hair. Brown lines indicate hair.

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