Evaluation of Cohen's Cross-Section Trichometer for Measuring Hair Quantity

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BACKGROUND Until now, there has been no reliable, simple method available for measuring hair quantity that is suitable in clinical practice. Recently, the cross-section trichometer by Cohen has been introduced. This study was designed to test its clinical utility.

METHODS The hair mass index (HMI) is ratio of the cross-sectional area of an isolated bundle of hair and the premeasured area of skin from which it was taken using the trichometer device. The intra- and interobserver reproducibility of measurements at the same location and after relocation were evaluated.

RESULTS For intraobserver reproducibility, the HMI ranged from 3 to 120 (mean difference .2, 95% confidence interval [CI] = −4.7–5.1, correlation coefficient [*r*] = .99. For interobserver reproducibility, the HMI ranged from 18 to 119 (mean difference –.4, 95% CI = −8,0–7,2, *r* = .98). With relocation, the HMI ranged from 2 to 113 (mean difference –1.0, 95% CI = −10.1–8.1, *r* = .97). Measurements took 5–10 minutes per area.

CONCLUSION Measurements were simple to perform, and the data showed high reproducibility. The trichometer is a promising technology for hair quantity measurements and has multiple clinical and research applications.

The authors have indicated no significant interest with commercial supporters.

Hair loss affects many people, and there are no simple, but objective and sensitive methods available for quantifying hair loss in clinical practice.[1–3]

The current evaluation of hair loss is based on different methods that are invasive to varying degrees (from pulling hairs to biopsy), expensive,[1,4] and time-consuming,[3–5] and they often assess only a small area of scalp or cannot be used for follow-up.[2–7] There are also many subjective methods such as photographic documentation[5,6] and questionnaires about patient satisfaction.[5,8] Furthermore, even the World Health Organization (WHO) criteria for toxic effects of chemotherapy, which are used for evaluation of chemotherapy-induced hair loss, appear not to be sensitive[9,10] and reflect the subjective appraisal of patients and observers.[3,5,6,11]

This stresses the need for an operator- and patient-friendly, inexpensive, validated, and reliable method for measuring hair quantity that is suitable for daily clinical practice.[2,5]

The recently introduced cross-section trichometer by Cohen is an instrument that may meet these needs.[12] In the article introducing his device, Cohen showed preclinical results.[12] This study was designed to test the clinical utility and reproducibility of the trichometer.

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Materials and Methods

Volunteers

Volunteers of different ages and different visible hair quantities were included. They had to have a hair length of at least 2.5 cm to be suitable for trichometer measurement.

Measurement Device

Hair quantity was measured using the cross-section trichometer developed by Cohen (Haircheck, Divi International Co., Miami, FL). This mechanical device compresses a bundle of hair in a disposable cartridge from a delineated area of the scalp and measures its cross-sectional area.

The hair mass index (HMI) is the ratio of the cross-sectional area of an isolated bundle of hair and the area of skin from which it was taken. (Cohen called it the Trichometric Index—TI: mm^2 of hair bundle/cm^2 of skin $\times$ 100 (mm^2/cm^2 $\times$ 100)).[12] The measured density (number of hairs/cm^2) and diameter (μm) of hairs are determinants of its quantity.[12]

Measurement Technique

Following the manufacturer's instructions, we defined measurement locations of 4 cm^2 on the scalp using the accessory locating strip, which measures the distance of the location from the nose and is attached to the bridge of a pair of glasses. We marked this area with a four-legged marking template moistened with red ink and fixated the hairs outside the boundary with hair clips. Then we collected the hair bundle within this marked area and measured it using the cross-section trichometer (Figure 1).

Measurements

Measurements were performed at random locations along the midline of the scalp. One observer took two measurements in the same marked area for intraobserver reproducibility, and both observers took measurements in the same area for interobserver reproducibility. We also studied reproducibility of measurements when the mark had faded. The location of the mark was written down, in order to relocate this area for the next measurement.

Figure 1. Measurement technique.

Statistical Analyses

Statistical analyses were performed using SPSS (version 13.0 for Windows, SPSS, Inc., Chicago, IL).

We assessed the inter- and intraobserver reproducibility of the HMI measurements and the reproducibility of the HMI measurements after relocation. Intraclass correlations (ICCs) were calculated using the Spearman rho correlation coefficient (R) at the .01 level of significance. Bland Altman plots were made to evaluate measurement differences.[13]

Results

Performing the Measurement

The measurement was not difficult to perform but took approximately 5 to 10 minutes per area (marking included) because the procedure had to be performed very accurately. After a few measurements, we gained enough competence to perform them well.

Intraobserver Reproducibility

For intraobserver correlation, 40 (27 by author MH, 13 by PG) measurements were done. In

accordance with the clinical statistician, one measurement was excluded because very greasy hair at the second measurement caused considerable deviation. Mean HMI was 57 (range 4–119) for the first measurements and 57 (range: 3–120) for the second measurement. Mean difference was .2 (95% confidence interval [CI] = −4.7–5.1). The ICC was .99 (R = .99 for author MH, R = .97 for author PG). R was .98 for measurements less than 40 HMI (n = 15), and .99 for measurements greater than 40 HMI (n = 24).

There were no systematic errors between observer MH and PG and no influence of HMI on the measurement difference.

Interobserver Reproducibility

For interobserver reproducibility, each observer took 19 measurements. Mean HMIs were 67 (range 21–117) and 65 (range 18–119) (mean difference –.4, 95% CI = −8.0–7.2. The ICC of measurements was .97.

There were no systematic differences between the measurements. When excluding two outliers (at a difference of –11 and –7), the mean difference was .6 [95% CI = −3.9–5.2].

Reproducibility of Measurements After Relocating the Measurement Area

For relocation assessment, 36 measurements (28 by author MH, 8 by author PG) were taken. Means of measurements 1 and 2 were 71 (range 2–112) and 72 (2–113), respectively (mean difference –1.0, 95% CI = −10.1–8.1, ICC = .97).

No systematic error occurred between observers PG and MH. At low HMI values there was a smaller range of HMI differences (n = 4).

Discussion

The developer of the cross-section trichometer, Dr. Cohen, showed that the method was suitable for measuring hair quantity (determined by hair density [n/cm^2] and diameter [μm]) of surgical silk fibers and bundles of hair.[12] In our study, the method also seemed suitable for measuring quantity of scalp hair in volunteers. The reproducibility was high, although it was lower in the case of relocation of the measurement area. Therefore, in clinical practice, the following should be taken into account.

First, using a longer-lasting mark might have prevented the increase in 95% CI caused by relocation of the area. A mark with an acupuncture needle dipped in semipermanent black pigment might be suitable (C. Gho, personal communication).

Second, in clinical practice, different observers will probably take measurements in one patient, so HMI differences will most likely be the same as our interobserver variability. Nevertheless, the CI seems acceptable and is broad because of two outliers, so the interobserver reproducibility might be better than shown here. We have no explanations for these incidental large differences.

Furthermore, we did not prescribe standardized hair care other than the advice not to use hair styling products on the day of the measurement. Perhaps when the hair was washed has some influence on HMI because it induces hair loss[14] and diminishes hair grease. This has to be examined before standardized hair care advice might be prescribed.

Finally, we have not compared this method with any other hair-quantifying method or criterion standard, because Cohen already showed a constant ratio of HMI values to hair weight in vitro.

Conclusion

This study showed that Cohen's trichometer is a suitable device to measure hair quantity in clinical practice in a few minutes; intra- and interobserver correlations were good. Nevertheless, the

above-described types of bias should be avoided as much as possible in future.

The cross-section trichometer will be useful for many clinical and research applications, starting with assessing the use of it in measuring chemotherapy-induced hair loss.

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