Objective and Subjective Measures of Melasma

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Melasma is a cutaneous disorder involving the face and, less frequently, the neck and forearms, that is characterized by tan, brown, or gray-blue macules or patches. Variations in the clinical appearance of melasma are related to where the pigmentation occurs within the skin. In epidermal-type melasma, melanin is deposited in the basal and suprabasal layers, and a tan or brown color is observed. In contrast, in dermal-type melasma, melanin-containing macrophages are present in the superficial and deep dermis, and a gray-blue color is observed. In mixed-type melasma, melanin is present in both the epidermis and the dermis, and a brown, gray, or combination brown-gray color is observed.

The extent of melasma ranges from mild to severe. Additionally, there are seasonal variations in severity. Various therapeutic modalities are employed for treating melasma. Objective and subjective measures of melasma severity at baseline and various time points during treatment are important for clinicians and patients alike. There are numerous methods of measuring melasma severity and improvement, ranging from observer assessment based on several predetermined scales to instrumentation that quantitatively analyzes the degree of pigmentation.

MELASMA SEVERITY ASSESSMENTS

Melasma severity may be subjectively measured, or scored, on a point scale. The points on the scale are somewhat arbitrary and often employ 4 to 8 gradations for quantifying the degree of pigmentation.

On the hyperpigmentation/melasma status scale, a score of 0 denotes absence of melasma, meaning that the color of melasma lesions approximates that of the surrounding normal skin or that minimal residual hyperpigmentation is present; 1 represents mild melasma, meaning that the color is slightly darker than that of the surrounding normal skin; 2 indicates moderate melasma, meaning that the color is moderately darker than that of the surrounding normal skin; and 3 represents severe melasma, meaning that color is markedly darker than that of the surrounding normal skin.[1]

Alternatively, the color designation of melasma may be as follows (compared with baseline): −3, color is much darker; −2, color is darker; −1, color is slightly darker; 0, color is unchanged; 1, color is slightly lighter; 2, color is lighter; 3, color is much lighter; and 4, color is absent.

Additionally, the physician's global assessment and patient's global assessment scales are commonly used for evaluating treatment-related improvement in melasma. These scales may consist of 3 to 5 gradations. The physician's global assessment scale rates improvement in melasma as follows: 0, completely clear, with no evidence of hyperpigmentation; 1, almost clear, with only minor visual evidence of hyperpigmentation; and 2, significant evidence of hyperpigmentation.[1] The patient's global assessment scale rates improvement as: 1, completely cleared; 2, nearly cleared; and 3, significant hyperpigmentation present.[1] The clinical response to treatment scale uses the following scores (compared with baseline): −2, much worse; −1, worse; 0, no change; 1, improved; and 2, much improved.[2]

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The severity-score rankings lend themselves to significant interobserver variability. To more accurately quantify melasma severity and any change during treatment, Kimbrough-Green et al[3] developed the Melasma Area and Severity Index (MASI) score. The calculation of the MASI score is based on the Psoriasis Area and Severity Index derived by Fredriksson and Pettersson.[4] The MASI score assesses the area (A), homogeneity (H), and intensity of pigmentation. The calculations are based on the 4 areas of the face: forehead (F), right malar region (MR), left malar region (ML), and chin (C). These correlate to 30%, 30%, 30%, and 10% of the total area of the face, respectively. Each area is then assigned a numerical value for the percentage of melasma pigmentation present in that area (A_F, A_{MR}, A_{ML}, and A_C) as follows: 0, no involvement; 1, less than 10% involvement; 2, 10% through 29% involvement; 3, 30% through 49% involvement; 4, 50% through 69% involvement; 5, 70% through 89% involvement; and 6, 90% through 100% involvement. The darkness (D) of the pigmentation is rated as follows: 0, absent; 1, slight; 2, mild; 3, marked; and 4, severe. The homogeneity of the pigmentation is rated as follows: 0, minimal; 1, slight; 2, mild; 3, marked; and 4, maximum. The MASI score is then calculated by adding the darkness and the homogeneity ratings, multiplying the sum by the numerical value of area involved, and then multiplying by the percentages of the 4 areas. The maximum score obtainable is 48; the minimum, 0. Therefore, the equation for calculating the MASI score is: $0.3\ (D_F+H_F)\ A_F+0.3\ (D_{MR}+H_{MR})\ A_{MR}+0.3\ (D_{ML}+H_{ML})\ A_{ML}+0.1\ (D_C+H_C)\ A_C$.

Although the MASI score is a more precise scale for measuring melasma, quantitative measurements with specifically designed portable optoelectronic instruments offer a completely objective assessment of melasma severity.[5] These instruments quantify pigmentation based on reflectance spectroscopy—that is, by measuring the intensity of light reflected from the skin. Two commonly used types of instruments are tristimulus-reflectance colorimeters and narrowband-reflectance spectrophotometers. Commonly used tristimulus-reflectance colorimeters are the Minolta Chroma Meters CR-200 and CR-300 and the Photovolt ColorWalk. The 3 commercially available narrowband reflectometers are the Dia-Stron Erythema/Melanin Meter, the Cortex Technology DermaSpectrometer, and the Courage-Khazaka Mexameter®. Tristimulus-reflectance colorimeters are capable of measuring all colors, unlike the simpler narrowband-reflectance colorimeters, which measure only the intensity of erythema and melanin. It is that measurement of melanin that is valuable in assessing melasma.

The Mexameter MX 16, a narrowband-reflectance spectrophotometer, contains 16 diodes emitting light at 3 wavelengths: 568 nm (green), 669 nm (red), and 880 nm (infrared).[6] Hemoglobin, the chromophore primarily responsible for erythema, absorbs primarily in the green spectrum (568 nm); melanin, which is responsible for pigmentation, absorbs in all wavelengths but especially in the red spectrum (669 nm). The melanin index is calculated from the intensity of the absorbed and reflected light at wavelengths 660 nm and 880 nm. Therefore, the degree of hyperpigmentation in a patient with melasma may be quantified with a Mexameter reading for melanin ranging from white (1) to black (1000). The erythema index is computed from the absorption and reflectance of light at 565 nm and 660 nm, respectively. Similarly, the diodes of the DermaSpectrometer emit light at wavelengths of 568 nm (green) and 655 nm (red) and, based on absorption and reflectance, determine erythema and melanin indices.

With tristimulus-reflectance colorimeters, a pulsed xenon arc lamp is used as the light source, and light reflected from the skin is analyzed at 3 wavelengths: 450 nm, 560 nm, and 600 nm. The skin-color data are then presented in the form of the L*a*b* indices (the quantification of color was standardized by the International Commission on Illumination). The L* parameter expresses color brightness, where white has a value of 100 and black has a value of 0. The a* parameter represents the red-green axis and correlates with the erythema content of the skin. The b* parameter changes along the yellow-blue surface.[5] The L* parameter and the b* parameter correlate with the melanin content of the skin.

The 2 types of reflectometers, tristimulus and narrowband, quantify the melanin that is present in melasma lesions and the changes associated with improvement from treatment. Shriver and Parra[7] compared the reflectometers. The narrowband-reflectance spectroscope is preferred, as the melanin index is less likely to be influenced by hemoglobin levels in the skin.

Finally, Wood light is useful for assessing melasma. Although Wood light does not qualitatively measure melasma severity, it can accurately assist in determining the presence or absence of pigmentation. It can also distinguish between pigmentary changes and changes from vascularity or scarring. Wood light emits at a wavelength of 360 nm, which absorbs and highlights epidermal melanin but does not absorb or highlight dermal melanin.

CONCLUSION

There are several useful techniques, objective and subjective, that are available for measuring melasma. In addition to visual assessment and rating scales by

physicians and patients, instrumentation based on reflectance spectroscopy is a valuable tool.

REFERENCES

1. Taylor SC, Torok H, Jones T, et al. Efficacy and safety of a new triple-combination agent for the treatment of facial melasma. *Cutis.* 2003;72:67-72.
2. Griffiths CE, Finkel LJ, Ditre CM, et al. Topical tretinoin (retinoic acid) improves melasma: a vehicle-controlled, clinical trial. *Br J Dermatol.* 1993;129:415-421.
3. Kimbrough-Green CK, Griffiths CE, Finkel LJ, et al. Topical retinoic acid (tretinoin) for melasma in black patients. a vehicle-controlled trial. *Arch Dermatol.* 1994;130:727-733.
4. Fredriksson T, Pettersson U. Severe psoriasis—oral therapy with a new retinoid. *Dermatologica.* 1978;157:238-244.
5. Takiwaki H. Measurement of skin color: practical application and theoretical consideration. *J Med Invest.* 1998;44: 121-126.
6. Clarys P, Alewaeters K, Lambrecht R. Skin color measurements: comparison between three instruments: the Chromameter®, the DermaSpectrometer® and the Mexameter®. *Skin Res Technol.* 2000;6:230-238.
7. Shriver MD, Parra EJ. Comparison of narrow-band reflectance spectroscopy and tristimulus colorimetry for measurements of skin and hair color in persons of different biological ancestry. *Am J Phys Anthropol.* 2000;112:17-27. ■