Application of a pigment measuring device – Mexameter – for the differential diagnosis of vitiligo and nevus depigmentosus

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Background/purpose: Vitiligo and nevus depigmentosus (ND) present similar hypopigmented macules with significantly different prognoses. Although the distinction between the two diseases is important, differential diagnosis relies on medical history and physical examination, which is far from decisive in some cases. The Mexameter is an objective skin color-measuring device, and has been reported to provide a reproducible and sensitive means of quantifying small skin color differences. In this study, we investigated the usefulness of a Mexameter for discriminating these diseases.

Methods: A selection of 202 hypopigmented skin lesions (182 from vitiligo and 20 from ND) were the objects of this study. Using a Mexameter, MIs were obtained from lesions and symmetrically located control skin. RMIs, ratios of the MIs of lesional skins to control skins, were calculated.

Results: The mean MIs and RMIs were significantly different for vitiligo and ND. The mean RMI of ND lesions was 74 ± 13, which was significantly higher than that of vitiligo lesions (50 ± 24). No ND lesion had an RMI of < 50%.

Conclusion: This study shows that the Mexameter, an objective pigment-measuring device, can be used to achieve a more accurate diagnosis of hypopigmentary disorders, and that the relative melanin index (RMI), which represents the relative pigment levels, might be a more effective parameter than the melanin index (MI) itself for comparing pigmentation differences.

Key words: Mexameter – vitiligo – nevus depigmentosus

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has been reported that this instrument is highly
discriminative and sensitive enough to detect
small differences in skin color, and it has also
been mentioned that its measurement reproduc-
ibility is satisfactory (6).

The present study represents the first report on
the use of this device concerning its applicability
for the differential diagnosis of these hypopig-
mentary disorders.

Material and Methods

Patient selection
Between January and June 2004, patients with
depigmented or hypopigmented skin lesions
were referred to the vitiligo clinic at Seoul Na-
tional University Bundang Hospital. All patients
were examined by a specialized dermatologist to
exclude other hypopigmentary disorders, such as
nevus anemicus, pityriasis alba, or postinflam-
matory hypopigmentation. A diagnosis was
made based on medical history-taking, a physical
examination, and a Wood’s lamp examination
based on the clinical criteria proposed by Coupe
[2]. The following information was assessed for
each patient: age at presentation, family history,
involved sites, lesion stability, Koebner phenom-
enon, preceding skin disease at the affected sites,
and if necessary, a KOH smear for detecting
fungus. Finally, 80 patients were enrolled; a
diagnosis of vitiligo was made in 69 patients
and of nevus depigmentosus in 11 patients.

Quantitative measurements of pigment loss
Melanin indexes (MIs) were determined using a
Mexameter MX16 (Courage-Khazaka Electronic).
This reflectance meter utilizes the optical princi-
ple developed by Diffey et al. (7). It measures
absorbed and reflected light at wavelengths for
hemoglobin (green and red) and for melanin (red
and near-infrared). MI is automatically computed
from the intensities of absorbed and reflected
light at 660 and 880 nm, respectively. The measur-
ing area is 5 mm in diameter (surface 0.20 cm²)
and measurement involves applying a probe to
the skin surface (1.54 cm²) at a constant pressure.
For each patient, representative macules were
selected and MI was read from the center of the
selected lesions (an average of three readings/
macule was recorded). One hundred and eighty-
two such averages were obtained from the 69
patients with vitiligo and 20 from the 11 patients
with ND. Symmetrically located normally pig-
mented areas were selected as control sites and
were also evaluated using the Mexameter. We
calculated the relative melanin indexes (RMIs)
using

\[
RMI(\%) = \frac{\text{MI of an affected lesion}}{\text{MI of a symmetrically located normally pigmented area}} \times 100
\]

All procedures were performed by one inves-
tigator under controlled ambient conditions
(room temperature 22 °C and relative humidity
42%).

Statistical analysis
SPSS software (version 10.0) was used for the
statistical analyses. The vitiligo and ND groups
were compared with MI and RMI using Student’s
t-test. The correlation of the MI of an affected
lesion with the MI of a symmetrically located
control area was tested using Pearson’s correla-
tion test. Statistical significance was defined as
\( P < 0.05 \).

Results

Clinical characteristics
Table 1 summarizes the clinical characteristics of
the patients with vitiligo and nevus depigmento-
sus. The ages at initial presentation ranged from 1
to 72 years (mean 30.5 years) in the vitiligo group,
and from 1 month to 7 years (mean 3.1 years) in
the ND group. The mean disease duration was 42
months in the vitiligo group and 19 months in the

<table>
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<th>TABLE 1. Demographic profile of patients</th>
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ND group. The male-to-female ratios of the two groups were almost equal. In the vitiligo group, the localized type was more common than the generalized type. Of the 11 patients with ND, six (55%) had the isolated type and four (45%) had the segmental type.

**MIs and RMIs of vitiligo and nevus depigmentosus**

The mean MI of ND lesions was 138.17 ± 43.87, which was significantly higher than that of vitiligo lesions (79.11 ± 40.24, *P* = 0.000). However, MIs of affected skin varied according to the level of background pigmentation presented as MIs of symmetric control area. Scatter plots showed a positive correlation in both the ND and the vitiligo groups, and the correlation coefficient was *r* = 0.861 (*P* = 0.000) and *r* = 0.327 (*P* = 0.000), respectively (Fig. 1). In order to eliminate the confounding effect of regional color differences, we utilized RMI. The mean RMI of ND lesions was 74 ± 13 (range 50–95), which was significantly higher than that of vitiligo lesions (50 ± 24, range 0–97, Table 2).

**Discussion**

Vitiligo is an acquired depigmentation disorder, whereas nevus depigmentosus is thought to be a congenital disorder. Reports show that ND presents at various ages, although this is probably owing to delayed detection. Although lesions are present in infants and young children, a color contrast may not be visible until the skin is tanned. A multicenter study performed in Korea showed that 20.2% of NDs are first detected after the age of 3 (8). The clinical criteria have been widely used for the differential diagnosis of vitiligo and ND, and are challenging in some cases, especially in childhood patients or in those with early-stage disease (3, 8, 9). On the other hand, the diagnosis of generalized vitiligo, which is symmetrically distributed, is straightforward. However, focal or segmental vitiligo characterized...
by isolated or a few macules resemble ND. Recent studies have shown that segmental variants of ND account for as many as 50% of cases (3, 8). Furthermore, segmental vitiligo tends to have an earlier onset and to be more stable than generalized vitiligo, and to overlap more so with the clinical features of ND. Because these hypopigmentary disorders have quite different prognoses and psychological impacts, their differential diagnosis is of importance. A biopsy may be helpful, but the presence of melanocytes cannot be assumed to exclude a diagnosis of vitiligo because early (6 months) and repigmenting macules of vitiligo also contain melanocytes (4, 10). In addition, the presence of melanocytes even in long duration vitiligo lesions has been reported (11). These findings demonstrate that the presence or absence of melanocytes cannot be taken as a differential point in the diagnosis of hypopigmentary disorders.

Recently, several devices have been introduced to measure melanin pigment in the skin, especially for cosmetic research purposes. However, these devices are rarely used in clinical practice. In the present study, we used a Mexameter MX16 (Courage-Khazaka Electronic) and investigated whether this device is useful for the differential diagnosis of ND and vitiligo. Variations of skin color in vitiligo have made the establishment of guidelines difficult, but based on our findings, an RMI of >74% can be suspected as ND [odds ratio (OR) = 4,697, 95% confidence interval (CI) = 1,779–12,404]. In addition, another important finding of the present study was that all ND lesions had an RMI of >50%. Thus, our findings suggest that vitiligo is indicated for any lesion with an RMI of <50%. These findings may mean that RMIs determined at several sites could help clinicians make a differential diagnosis in these hypopigmentary disorders. However, it should be noted that our sample size was small, and thus more extensive study is necessary to confirm the results and to set guidelines.

In conclusion, despite the limitation of small numbers, our findings indicate that the current commercially available Mexameter provides a clinically accessible and straightforward means of increasing diagnostic accuracies in hypopigmentary disorders.

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