INVITED ARTICLE

Correspondence between dermoscopic features and epidermal structures revealed by scanning electron microscope

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ABSTRACT

It is already known that some typical dermoscopic patterns seen in melanocytic nevi on the sole have their own favorite site. In the weight-bearing area, melanocytic nevi with a parallel furrow pattern were preferentially observed. Those with a lattice-like pattern were observed in the arch area, whereas those with a crista reticulated pattern were seen in the border area. To investigate the relationship between the distribution of the dermoscopic patterns seen in plantar melanocytic nevi and the 3-D structures of the epidermis, the basal surfaces of the plantar epidermis from 14 skin lesions were observed by scanning electron microscopy (SEM). Our SEM observations revealed that transverse ridges formed a couple of parallel lamellae on the crista profunda limitans (limiting ridges). Between the limiting ridges and the crista profunda intermedia (intermediate ridges), the transverse ridges had different shapes according to the anatomical location of the sole. From these results, it was suggested that the characteristic dermoscopic patterns seen in acquired and junctional melanocytic nevi on the sole simulate the arrangement of transverse ridges.

Key words:  dermoscopy, epidermal structure, melanocytic nevus, plantar epidermis, scanning electron microscope.

INTRODUCTION

It is well known that dermoscopic features are closely related with the sites of the lesions. Plantar melanocytic nevi, for example, show several dermoscopic patterns which are already known to have their own favorite sites. In spite of the fact that numerous histopathological examinations have been performed, the development of this distribution remains to be elucidated. In order to understand this mechanism, more information about the epidermal basal structure is needed. We herein report our observations of the 3-D structure of the basal epidermal surface by scanning electron microscope (SEM), and we also discuss their relationships with the dermoscopic patterns.

EPIDERMAL STRUCTURES OF NON-GLABROUS AND GLABROUS SKIN: CORRESPONDING TO PIGMENT NETWORK AND PARALLEL PATTERN

Human skin can be divided into non-glabrous and glabrous skin. When a melanocytic lesion in non-glabrous skin was observed using a dermoscope, a brown pigment network could be seen. This is due to melanin pigments in keratinocytes and melanocytes.
along epidermal ridges protruding like honeycomb (Fig. 1).

In glabrous skin, epidermal ridges can be seen that lie below every surface furrow as well as every surface ridge when tissue sections are cut perpendicularly to the skin markings (Fig. 2). The undersurface of volar skin seems to be continuous waves, as in the ocean (Fig. 3). These epidermal structures contribute to the formation of parallel pattern in dermoscopy. Transverse ridges are also seen forming bridges across the longitudinal ridges (Fig. 3).

**Figure 1.** Scanning electron microscope photograph showing the basal epidermal surface of non-glabrous skin. This reticulated epidermal ridge is responsible for a pigment network pattern seen in the melanocytic nevus using a dermoscope.

**Figure 2.** (a,b) Cross-sections of the plantar epidermis.

**Figure 3.** Scanning electron microscope photograph showing basal epidermal surface of the sole.
EPIDERMAL STRUCTURES OF PLANTAR SKIN IN VARIOUS SITES CORRESPONDING TO SEVERAL DERMOSCOPIC PATTERNS OF MELANOCYTIC LESIONS

Distribution of several dermoscopic patterns on the sole
Plantar melanocytic nevi are able to be divided into several dermoscopic patterns, which are composed of three typical dermoscopic patterns and the other patterns. These dermoscopic patterns are already known to have their own favorite site. In the weight-bearing area, melanocytic nevi with parallel furrow patterns were frequently seen, whereas in the arch area, the lattice-like pattern was preferentially seen, and the crista reticulated pattern showed a tendency at the border area (Fig. 4).

Methods of SEM
After the excision of various plantar lesions, the specimens were cut perpendicular to the skin markings, and one half was provided for microscopic observations, and the other half was used for electron microscopy. All the samples were then immediately incubated in 2 N NaBr at 37°C. The basal surfaces of the plantar epidermis were observed by SEM.

Basal surface of the plantar epidermis in the weight-bearing area (Fig. 5)
On SEM observation, the basal surface of the epidermis showed two kinds of ridges, namely, long longitudinal ridges, which were composed of crista reticulated pattern.

Figure 4. Distribution of medial surface of plantar melanocytic nevi showing each dermoscopic pattern.

Figure 5. (a) Scanning electron microscope photograph showing the basal epidermal surface of the dorsal great toe. (b) ★ indicates site of the lesion. (c) Typical dermoscopic feature seen in melanocytic nevi in the weight-bearing area showing a parallel furrow pattern.
Figure 6. (a) Scanning electron microscope photograph showing the basal epidermal surface of the nevus on the arch area. (b) ★ indicates site of the lesion. (c) Typical dermoscopic feature seen in melanocytic nevi in the arch area showing a lattice-like pattern. This figure was used from reference no. 5.

Figure 7. (a) Scanning electron microscope photograph showing the basal epidermal surface of the lateral border of a sole. (b) ★ indicates site of the lesion. (c) Typical dermoscopic feature seen in melanocytic nevi on the lateral border showing a crista reticulated pattern with parallel furrow pattern.
profunda intermedia (intermediate ridges) and crista profunda limitans (limiting ridges), and short transverse ridges. The dermoscopic features seen in the melanocytic nevi located in this area were parallel furrow pattern or fibrillar pattern.

**Basal surface of the plantar epidermis in the arch area (Fig. 6)**

The transverse ridges were formed by a couple of densely packed parallel lamellae on the limiting ridges as well as lines forming bridges across the adjacent intermediate ridges. These transverse ridges seen between the longitudinal ridges were lower in height and thicker in width than those in the weight-bearing area. A lattice-like pattern is preferentially seen in this area dermoscopically.

**Basal surface of the plantar epidermis in the border area (Fig. 7)**

In the border area, neither intermediate nor limiting ridges appeared clearly. The transverse ridges formed a regularly banded network pattern. These band-like structures were composed of double or triple parallel lamellae, and were continuous with the adjacent network structure. In the center of the network structure, eccrine sweat ducts protruded regularly into the dermis in a line. The dermoscopic observation shows a crista reticulated pattern in this area.

**Basal surface of the melanocytic nevus in the weight-bearing area (Fig. 8)**

In transverse ridges on limiting ridges, nevus cells were observed proliferating and forming some small nests.

**Correspondence between the epidermal structures and dermoscopic features in soles**

Nevus cells are already known to have a characteristic nature to accumulate and form nests. In the weight-bearing area, transverse ridges form the double to triple parallel lamellae on limiting ridges. These transverse ridges were thick in width and shallow in depth. Such structures might be of substantial help in

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**Figure 8.** (a) Scanning electron microscope photograph showing the basal surface of the melanocytic nevus of a sole. (b) ★ indicates site of the lesion. (c) Dermoscopic feature seen in this melanocytic nevus showing a parallel furrow pattern. (d) Magnified SEM photograph of the reddish circumscribed square zone showing the nests of nevus cells in transverse ridges on limiting ridges.
proliferating and forming nests for nevus cells. In contrast, between the longitudinal ridges, the transverse ridges were thin in width but deep. On these transverse ridges it might be difficult for nevus cells to proliferate and form nests. In this way, accentuated melanin pigmentation might occur on the limiting ridges, enabling us to visualize the parallel furrow pattern using a dermoscope.

In the arch area, transverse ridges were seen forming a couple of lamella on the limiting ridges as well as lines forming bridges to cross the longitudinal ridges. These transverse ridges were wide and shallow, and thus a lattice-like pattern was produced.

In the border area, on both the network structures and the band-like structures, melanin pigmentation occurred, and thus the crista-reticulated pattern associated with the parallel furrow pattern could be produced.

Based on our above findings, it is assumed that the transverse ridges played an important role in determining the dermoscopic pattern seen in the acquired and junctional melanocytic nevi on glabrous skin.5

REFERENCES
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