INVESTIGATIVE REPORT

Shiny White Streaks: A Sign of Malignancy at Dermoscopy of Pigmented Skin Lesions

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The aim of this study was to evaluate the practical importance of the presence of shiny white streaks (SWS) (chrysalis or crystalline structures in polarized dermoscopy) for suspicion of malignancy, diagnosis of melanoma, and pre-operative estimation of Breslow thickness and its correlation with total dermoscopy score (TDS). SWS were present in 13.6% of 800 consecutive excised lesions. The presence of SWS was associated with malignancy (odds ratio (OR) 10.534, 95% confidence interval (95% CI) 6.357–17.455, p<0.0005), in the context of melanocytic lesions with invasive melanoma (OR 10.333, 95% CI 3.812–28.014) and melanomas with high TDS (OR 6.286, 95% CI 1.673–23.619), but was also a factor in the diagnosis of featureless and some thin melanomas. These results corroborate the clinical applicability of SWS in aiding the diagnosis of malignancy and helping to raise the general dermatologist’s awareness in cases of doubt and featureless lesions. Key words: dermoscopy; shiny white streaks; polarized light; chrysalis; melanoma; basal cell carcinoma.

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Dermoscopy has proven valuable in aiding the diagnosis of melanoma compared with naked-eye examination (1–3). In fact, not only can dermoscopy yield a 10–27% higher sensitivity than clinical diagnosis of melanoma, the use of the dermatoscope also improves recognition of its simulants, such as benign tumours (e.g. seborrheic keratosis (4)) or malignant tumours (e.g. pigmented basal cell carcinomas (BCC)) (4).

Previous studies have shown a good correlation between selected dermoscopy criteria and the histopathology of melanoma for the pre-operative evaluation of tumour depth (5, 6). In these studies, the presence of some dermoscopic features such as pigment network and radial streaming were associated with radial growth, whereas grey-blue areas and dotted vessels were related to the vertical growth phase. Furthermore, the dermoscopy ABCD rule was tested as a predictor of melanoma thickness, with increasing total dermoscopy score (TDS) values being related to increasing thickness of the lesions (7).

Among the dermoscopic algorithms described in the literature (8–14), the ABCD rule is a simple, easily learned, simplified semi-quantitative approach that calculates the TDS for the diagnosis of melanoma, with reported sensitivity varying from 84.4% to 97.9% and specificity from 74.5% to 90.3% (10, 13). It is of note that, in spite of the increment in sensitivity in melanoma diagnosis, there is still a chance of misdiagnosing melanoma (false-negative cases (15)), depending on dermoscopic expertise (3, 16, 17). Even so, despite the experience of the dermoscopists, melanomas diagnosed in follow-up programmes of high-risk patients were misclassified by TDS (50% of cases) and the majority did not present a multi-component or unspecific pattern, as observed in a recent study (18). The authors suggested that early-diagnosed melanomas might not yet present characteristic features of melanoma, thus imposing difficulties in their early recognition.

With the recent use of polarized dermatoscopes (PD), some differences compared with contact non-polarized dermoscopy (NPD) in the dermoscopy image have been pointed out regarding: colour (melanin appears darker), visualization of structures (improvement in visualization of vessels, but not of peppering or regression, nor of superficial structures such as milia-like cysts and comedo-like openings), as well as recognition of structures not seen under NPD. PD appears to block the superficially reflected light more efficiently than non-polarized dermatoscopes, accounting for these differences in image and depth of structure visualization: NPD allows better visualization of superficial structures, whilst PD allows better appreciation of deeper structures, such as collagen and vessels (19, 20).

Shiny white streaks (SWS) (also named chrysalis or, as recently proposed, crystalline structures) were described as shiny, bright, often orthogonal, linear streaks, seen only under PD, in dermatofibromas, scars, melanomas, BCCs (21–24) and, more recently,
melanocytic naevi, mainly Spitz naevi (25). Recently, a
classification of SWS types has been proposed accord-
ing to different diagnoses (26). Differing from negative
pigment network, which was described by Menzies and
revised recently by Bassoli et al. (27) as relatively light
areas making up the “cords” of the network, and darker
areas filling the holes; SWS are often linear unconnected
white lines that do not make up a network pattern (28).
SWS were related to angular dependence of polarized
light and collagen orientation in the underlying stroma
of tumours with an increased amount of dermal col-
lagen, but its definite histopathological counterpart is
unknown (21, 25, 26, 29).

It has been suggested that SWS may be of importance
in the diagnosis of melanoma, as a clue to their diffe-
rentiation from naevi, and in the identification of more
advanced lesions (26).

In a recent study SWS were observed more com-
monly in invasive melanomas compared with in situ
melanomas, and melanomas with SWS were thicker
than those without SWS, suggesting that the presence of
this dermoscopic parameter may be related to a higher
chance of dermal invasion and thicker tumours (26).

The aim of this study was to evaluate the importance
of the presence of SWS in the suspicion of malignancy, in
the diagnosis of melanoma and in the prognostic evalua-
tion regarding depth of invasion (Breslow) in melanoma.

MATERIALS AND METHODS

All lesions excised from January 2010 to August 2011 in the
Melanoma Unit of Hospital Clinic, Barcelona, with dermoscopy
images were included in this retrospective study.

Dermoscopy images were retrospectively evaluated using
images obtained with a DermLite Foto (3GEN, LLC, Dana Point,
CA), and a Canon PowerShot G7 (Canon Inc, Japan).

Only lesions with a histopathological diagnosis were included
in the study. Lesions were primarily analysed for the presence or
absence of SWS. In the case of surgical scarring due to a previous
partial biopsy (e.g. lentigo maligna melanoma (LMM) on the face),
the examination of the SWS did not include this part of the tumour.
The lesions were then matched to the histopathological diagnosis.
In cases of melanoma, the following clinical and histopathological
parameters were also obtained: lesion site, Breslow thickness and
histopathological subtype, 69 were SSM (55.2%), 46 LMM (36.8%), 5
melanoma metastasis (4%), 3 NM (2.4%) and 2 SM (1.6%).

Regarding the lesion site, 47 melanomas were located on the head,
38 on the trunk, and 40 on the limbs. Scarring from a previous biopsy was observed
in 18 melanomas (5 SSM and 13 LMM). The majority of melanomas had a TDS score higher than or equal
to the threshold for malignancy (5.45; 67.6%), with mean TDS: 5.97. Nevertheless, 25 melanomas scored
less than 5.44 (32.4%), including 17 that scored in the
benignancy range (< 4.75; 22.7%) (Table I).

RESULTS

A total of 800 dermoscopic images were analysed for the
presence or absence of SWS. The data-set is shown in
Table I, including benign and malignant, melanocytic
and non-melanocytic tumours (Figs 1–6).

Of the melanoma set (n =125), 56 were in situ
(44.8%), 69 invasive (55.2%; mean Breslow thickness
1.7 mm), 27 were thin melanomas (48.2%; <1 mm;) and
29 were thick (51.8%; ≥1 mm). There were 13
melanomas with no Breslow thickness noted in the
histopathological record (4 recurrent melanomas, 5 me-
tastasis, 4 not evaluable). As regards histopathological
subtype, 69 were SSM (55.2%), 46 LMM (36.8%), 5
metastasis (4%), 3 NM (2.4%) and 2 SM (1.6%).

Shiny white streaks in pigmented skin lesion dermoscopy

Pearson’s χ² test was used to evaluate the association between
categorical variables. If the expected frequency was <5, Fisher’s
test was used (Table I). The 95% CIs were obtained by
the exact binomial method, and the overall risk (OR) calculated.
Means and median were calculated. Student’s t-test was used to
test the null hypothesis of quantitative variables.

SWS was present in 41 melanomas (6/56 in situ, 31/56
with measurable Breslow thickness and 4/13 other le-
sions, i.e. metastasis, recurrent melanoma, melanomas
without measurable Breslow thickness) (Figs 1, 3 and
4), these being 24 SSM (58.5%), 11 (26.8%) LMM, 3
NM (7.4%), 2 SM (4.9%) and 1 metastasis (2.4%); while
only 1.6% of all excised melanocytic naevi presented
SWS (Table I).

The presence of SWS was associated with a 10-fold
increased risk of malignancy (melanomas, BCCs, SCCs,
neuroendocrine carcinoma) (see Table I).
only 6 out of 56 (10.7%) in situ melanomas presented SWS, while 35 of 69 of the invasive melanomas (50.7%)

had SWS ($p<0.005$). The presence of SWS correlated with a 10.33-fold increased risk of a diagnosis of invasive melanomas compared with in situ melanomas (OR 10.33, 95% CI 3.812–28.014, $p<0.005$). In invasive melanoma, the mean Breslow value for melanomas with SWS was 2.28 mm, significantly higher than in melano-

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Cases</th>
<th>SWS</th>
<th>p-value</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
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</thead>
<tbody>
<tr>
<td>Melanoma in situ</td>
<td>56</td>
<td>6</td>
<td>0.0005</td>
<td>10.333</td>
<td>3.812–28.014</td>
</tr>
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<td>Invasive melanoma</td>
<td>56</td>
<td>31</td>
<td>0.005</td>
<td>4.463</td>
<td>1.444–13.792</td>
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<td>Breslow thickness &lt; 1 mm</td>
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<td>10</td>
<td>0.009</td>
<td>4.463</td>
<td>1.444–13.792</td>
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<td>Breslow thickness ≥ 1 mm</td>
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<td>21</td>
<td>0.006</td>
<td>6.286</td>
<td>1.673–23.619</td>
</tr>
<tr>
<td>Others</td>
<td>13</td>
<td>4</td>
<td>0.006</td>
<td>6.286</td>
<td>1.673–23.619</td>
</tr>
<tr>
<td>TDS &lt; 5.45°</td>
<td>25</td>
<td>3</td>
<td>0.006</td>
<td>6.286</td>
<td>1.673–23.619</td>
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<tr>
<td>TDS ≥ 5.45°</td>
<td>52</td>
<td>24</td>
<td>0.006</td>
<td>6.286</td>
<td>1.673–23.619</td>
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<tr>
<td>Total melanoma</td>
<td>125</td>
<td>41</td>
<td>0.006</td>
<td>6.286</td>
<td>1.673–23.619</td>
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<td>Other malignant tumours</td>
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<td>pBCC</td>
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<td>Not significant</td>
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<td>Superficial BCC</td>
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<td>41</td>
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<td>Trichilemmal BCC</td>
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<td>7</td>
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<td></td>
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<tr>
<td>Total BCC</td>
<td>133</td>
<td>142</td>
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<tr>
<td>Squamous cell carcinoma</td>
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<td>Merkel</td>
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<td>Not significant</td>
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<td>Total malignant</td>
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<td>&lt;0.005</td>
<td>10.534</td>
<td>6.357–17.455</td>
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<td>Naeve</td>
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<td>300</td>
<td>&lt;0.005</td>
<td>10.534</td>
<td>6.357–17.455</td>
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<td>Seborrheic keratosis</td>
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<tr>
<td>Dermatofibroma</td>
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<td>6</td>
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<tr>
<td>Other benign lesions</td>
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<td>91</td>
<td>Not significant</td>
<td>Not significant</td>
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<tr>
<td>Actinic keratosis</td>
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<td>32</td>
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<td>Not significant</td>
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<tr>
<td>Lichen planus like keratosis</td>
<td>9</td>
<td>7</td>
<td>Not significant</td>
<td>Not significant</td>
<td></td>
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<tr>
<td>Solar lentigos</td>
<td>19</td>
<td>17</td>
<td>Not significant</td>
<td>Not significant</td>
<td></td>
</tr>
<tr>
<td>Total benign</td>
<td>520</td>
<td>499</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

only invasive melanomas with measurable Breslow were included.

Includes lesions without measured Breslow thickness (i.e. metastasis, relapses). These lesions were not included in the in situ/invasive evaluation).

Only melanomas not located in face or acral sites were included.

Lesions described in b were also not included in the evaluation of thin/thick melanomas.

Comparing total malignant with total benign

Fig. 1. Clinical image (upper left) of a symmetrical, keratotic pigmented lesion on the leg of a 35-year-old woman. Dermoscopy (main image) shows a black and bluish, symmetrical lesion, with a total dermoscopy score (TDS) of 3.3 within benignity level (3 colours; black, blue-grey, white = 1.5 + all abrupt borders = 0.8 + 2 dermoscopic features; homogeneous areas and globules = 1). Presence of shiny white streaks aided the suspicion of melanoma. Histopathological diagnosis was a Spitzoid melanoma, Breslow 1.5 mm, Clark IV.

Fig. 2. Clinical image (upper left) and dermoscopy (main image) with polarized light of a basal cell carcinoma showing multiple shiny white streaks associated with the presence of prominent, perfectly focused, arborizing vessels, ulcerations and blue ovoid nests.
Shiny white streaks in pigmented skin lesion dermoscopy

Melanomas without SWS (0.9 mm) \((p<0.005)\). Melanomas with SWS had a 4.46-fold increased risk of being thick melanomas (see Table I).

Of all LMM with SWS, 4 were \textit{in situ}, 5 invasive and 2 had no Breslow value available. Interestingly, invasive LMM with SWS were thicker than SSM with SWS, the mean and median Breslow values for LMM with SWS were 4.62 mm and 3.6 mm, respectively, and for SSM with SWS 1.43 mm and 1.03 mm.

SWS statistical findings regarding the dermoscopic parameters evaluated for melanoma are summarized in Table SI1.

The mean TDS score for melanomas with SWS was 6.61 and without SWS 5.62 \((p<0.05)\). When controlled for TDS, SWS were more frequent in TDS scores higher than 5.45 \((p<0.05)\) (Fig. 3). Notwithstanding the small number of cases, SWS were also observed in 3 cases with TDS < 4.75 (3.8%), 1 of which was a Spitzoid melanoma (Fig. 1).

The BCC data-set is detailed in Table SI1. Of all the BCCs, 30.8\% presented SWS (Fig. 2) and there was no statistically significant difference regarding histopathological subtype.

Interestingly, SWS were also observed more frequently in BCCs with ulceration \((p<0.005)\) (Fig. 2). None of the other criteria evaluated presented a statistically significant difference.

As previously described, SWS were only visible when polarized light was used and

\[ \text{http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1683} \]
SWS change according to the angle of polarization (Fig. 3). The angle that enhances SWS is 90° contrary to the angle that enhances regression structures (Fig. 4).

DISCUSSION

As an example of structures seen only under PD, SWS were described in a variety of lesions including melanomas, BCCs, dermatofibromas, biopsy scars and melanocytic naevi (22–25). SWS has been suggested to represent dermal fibroplasia seen in benign lesions such as dermatofibromas and scars, and in malignant lesions, due to tumour-induced stromal reaction and extracellular matrix changes (21).

It has been suggested in previous studies (Table SII1) (22, 25, 26) that SWS may be of importance in the diagnosis of melanoma, as a clue to their differentiation from naevi. In fact, we observed SWS in 32.8% of melanomas, while only 1.6% of all excised melanocytic naevi presented SWS, thus corroborating the results from previous studies. Table SII1 compares the results of 4 different studies.

Apart from its usefulness in melanoma diagnosis, the presence of SWS implied a 10-fold increased risk of malignancy (melanomas, BCC, SCC, neuroendocrine carcinoma) (OR: 10.534, 95% CI 6.357–17.455, \( p < 0.0005 \)) (Fig. 5). Thus, with the exception of dermatofibromas in which SWS were frequently observed, the presence of this dermoscopic parameter is a strong clue to malignancy.

Recently, Balagula et al. (25) described the presence of SWS in 1.8% of lesions, melanocytic as well as non-melanocytic, in contrast with the 13.4% in our study. This difference is probably due to differences in the data-set of each study: only 264 lesions in the former study, whilst only lesions with histopathological diagnosis were included in our study (800 lesions) (Table SII1). We observed SWS in 32.8% of melanoma, similar to the 31% observed by Di Stefani et al. (22) (Table SII1). The percentage of BCCs with SWS in our sample (30.8%) was smaller than in previous reports (47.6% and 42.4%) (25, 26). It is notable that SWS did not correlate with any histopathological subtype of BCC. In a recent study by Lieberman et al. (26) the presence of SWS of any length was present in 3 cases with TDS in the benignancy range (4.75; 3.8%). However, SWS were also observed in 3 cases with TDS in the malignancy range (4.75; 3.8%), highlighting the possible importance of SWS in the diagnostic aid of featureless melanomas, such as the case of Spitzoid melanoma (Fig. 1).

Melanomas with the following dermoscopic diagnostic criteria had a greater possibility of displaying SWS: presence of structureless areas, irregular blotch; also multi-component or unspecific pattern (Table SI1).

In contrast to previous data in the literature, our study obtained a significant association between SWS and regression, such that melanomas with regression were 3.2 times more likely to display SWS than those without (Table SII1). This fact could be related to the previously suggested histopathological correlation to SWS, dermal fibroplasia, since regression may be related to further stromal reaction and thus justify the increased detection of SWS in melanomas with regression. Also, the presence of SWS in our study was associated with other dermoscopy criteria that are associated with dermal invasion, such as blue-white veil, milky-red globules or polymorphous vessels in melanoma, or white patch in dermatofibromas, or deep blue colour in blue naevus (Fig. 6), reinforcing the hypothesis that the optical artefact responsible for SWS is located in the dermis (Fig. 5). We have observed that the change in the angle of polarization may enhance observation of either SWS or regression structures such as peppering. We speculate that the reflection of light related to dermal fibroplasia, which on the one hand favours SWS observation, may on the other hand interfere with the visualization of other structures such as peppering (Fig. 4).
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The authors declare no conflicts of interest.

REFERENCES


