Polarized Microscopy as a Helpful Tool to Distinguish Chronic Nonscarring Alopecia From Scarring Alopecia

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Background: Nonscarring alopecia differs from scarring alopecia on pathologic examination by the preservation of follicular units and lack of follicular dropout. However, long-standing cases of active nonscarring hair loss can show follicular dropout on pathologic examination and can be difficult to interpret.

Observations: We describe a patient with nonscarring alopecia that was misdiagnosed as scarring alopecia due to difficulty in distinguishing between scarred tracts (follicular dropout) and long-persisting fibrovascular streamers. Polarized light microscopy permits us to distinguish follicular scars from fibrous streamers because the fibrous streamers are birefringent negative for collagen. The main advantages of polarized microscopy are that it is fast and cost free and can screen all sections within minutes; it is also easy to interpret for beginners because there is a built-in control of birefringent-positive dermal collagen.

Conclusion: Polarized light can be used in the pathological evaluation of hair loss to distinguish between the follicular scars in scarring alopecia and the fibrovascular streamers in long-standing nonscarring alopecia.


Report of a Case

A 58-year-old woman presented with a 10-year history of progressive diffuse hair loss and scalp itching. Scarring alopecia without specific features was previously diagnosed on a scalp biopsy specimen by 2 independent dermatopathologists. A physical examination revealed diffuse hair thinning. Dermoscopy of the scalp showed hair diameter variability without loss of follicular openings (Figure 1). Two 4-mm punch biopsy specimens were obtained from the upper parietal scalp for horizontal and vertical sections. At the isthmus and infundibular levels, they showed a reduced number of follicular units (n=6) and terminal hair follicles (n=14). The ratios of anagen to telogen (79% to 21%; reference range, 93.5% to 6.5%) and terminal to vellus (2.8 to 1; reference range, 7 to 1) were decreased as a sign of increased hair shedding, shortened hair cycle, and follicular miniaturization. There were 10 fibrovascular streamers in the lower dermis and the subcutis. Differen-
tial diagnosis between scarring and nonscarring alope-
cia was difficult because of (1) the presence of 5 focal
areas where follicular units were absent and replaced by
compact pink-gray connective tissue (Figure 2A) and
(2) the presence of 2 compound follicular structures rep-
resenting the fused outer root sheaths of 2 adjacent fol-
lies. These structures were present only at the level above
the isthmus, closer to the infundibulum, and were sur-
rounded by mild inflammatory infiltrate and loose thin
fibroplasia (Figure 2B).

To establish whether the focal areas of follicular drop-
out were follicular scars or avascular fibrous streamers, we
used polarized light microscopy because human collagen
is known to be birefringent on polarization. The results
showed that all 5 areas of follicular dropout were not bi-
refringent, in contrast to the normal collagen in the der-
nis (built-in control) (Figure 3). This allowed us to di-
agnose these structures as long-standing fibrous streamers.

The compound follicular structures shown in Figure 2B
were assessed as normal infundibular ostia that fused into
compound follicles at the upper follicular level. Al-
though they resembled the fusion of the outer root sheaths
wrapped up by fibrosis seen in scarring alopecia, they were
present only above the isthmus and at no lower level. The
diagnosis of long-standing chronic androgenetic alope-
cia was established.

**COMMENT**

The difficulty of classifying cases of long-standing ac-
tive chronic alopecia areata or long-standing androge-
netic alopecia as either nonscarring or scarring on pa-
therapy is known. It comes from the difficulty of dis-
inguishing between scarred tracts (follicular drop-
out) and long-persisting fibrovascular streamers, which,
after time, lose their vascularity and acquire a more com-
 pact sclerotic appearance. The first description of fi-
brous streamers was made by Headington in his origi-
nal article on horizontal sectioning. The streamer is an
angiofibrotic whorl that can be seen at different levels
(from the subcutis to the upper dermis) and, depending
on its “longevity,” may show many small blood vessels
and remnants of trichilemmal gray vitreous membrane
(grayish hue). In horizontal sections at the level of the
reticular dermis, the perifollicular vascular plexus of the
streamer disappears so that it looks like delicate colla-
gen. It has been proposed to use elastic tissue stains to
demonstrate the elastic fibers in a streamer vs the ab-
sence of elastic tissue in a follicular scar. Elastic stains
have been shown to outline the fibrous tracts in scarring
alopecia while remaining negative in the tract. We
show that polarized microscopy is a fast and simple
method for identifying follicular scars from fibrous stream-
ers. Polarized microscopy is mostly used in hair prac-
tice to assess abnormalities of the hair shafts. Similar to
hair shafts, human collagen has the ability to pass light
in a particular plane (birefringence). The present ap-
proach has several advantages over the elastic stains:
(1) it is fast and cost free for most laboratories because
the microscopes of dermatopathologists are usually
equipped with a special attachment for screening speci-
mens for foreign bodies under polarized light (the usual
price of such an attachment is $200-$500), (2) it can
screen all levels of the horizontal and vertical sections (>20 sections can be screened within minutes), (3) it does not require recuts that may no longer show the specific features, and (4) it is easy to interpret for beginners unfamiliar with special staining techniques because there is a built-in control of birefringent-positive dermal collagen. In the case of true follicular scars, the tract appears highly birefringent. The birefringence is better appreciated at higher magnifications (×20 and ×40) because the fibrous tract is composed of finer collagen fibers compared with the thick collagen bundles of the surrounding reticular dermis (Figure 4). The recognition of follicular dropout as fibrous streamers in the present patient and in other cases of chronic active nonscarring alopecias that persist for years confirms the fact that these alopecias (excluding chronic traction) may be reversible. It has been suggested that follicular cycling may continue for as long as the follicular streamer is viable.10

In our experience, a common mistake in hair pathology is the interpretation of compound follicular infundibulum surrounded by mild fibroplasia and sparse inflammation as a feature of scarring alopecia. The pitfall comes from the evaluation of the compound follicular structures only at the level of the upper follicle and not at all levels. At this level, the outer root sheaths of 2 or 3 follicles normally often fuse so that 2 or 3 hair shafts emerge from the same follicular ostium.7 Scalp biopsies of androgenetic alopecia often show mild perifollicular infiltrate and mild perifollicular fibroplasia at the upper follicular level.11 When this is seen around compound follicles at the upper follicular level, this finding can be wrongly taken as a feature of scarring alopecia. A good example of androgenetic alopecia showing this feature can be found in the article by Whiting12 on horizontal sections of male pattern androgenetic alopecia. Helpful clues that distinguish compound follicles in nonscarring alopecia from those in scarring alopecia are summarized in the Table.

Polarized microscopy is a helpful technique for distinguishing cases of long-standing active nonscarring alopecia from scarring alopecia. It is particularly useful in
horizontal sections of long-standing alopecia areata with the presence of only vellus/miniaturized follicles and many follicular dropout areas (Figure 5). Another implication is when the pathologist has only vertical sections to establish the diagnosis and they contain fibrous streamers but not hair follicles.

Being aware of these pathologic findings can spare our patients the major distress from the diagnosis of irreversible hair loss and can improve the outcomes with the correct treatment.

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REFERENCES

Table. Compound Follicles in Nonscarring Alopecia vs Scarring Alopecia

<table>
<thead>
<tr>
<th>Assessment Plan</th>
<th>Nonscarring Alopecia</th>
<th>Scarring Alopecia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicular level</td>
<td>Only close to or at the infundibulum level</td>
<td>At the lower and upper follicular levels</td>
</tr>
<tr>
<td>Fusion of the outer root sheaths</td>
<td>Symmetrical</td>
<td>Symmetrical/asymmetrical</td>
</tr>
<tr>
<td>Pattern of perifollicular fibrosis</td>
<td>Loose thin fibroplasia of the connective tissue sheaths</td>
<td>Thick concentric onionlike fibrosis or mucinous fibrosis</td>
</tr>
<tr>
<td>Inflammatory infiltrate</td>
<td>Mild perifollicular</td>
<td>Perifollicular (possible interfollicular) lichenoid or interface</td>
</tr>
<tr>
<td>Pattern Level</td>
<td>At the upper level only (androgenetic alopecia)</td>
<td>At the lower and upper levels</td>
</tr>
<tr>
<td>Apoptosis in the outer root sheaths</td>
<td>Absent</td>
<td>Possible</td>
</tr>
</tbody>
</table>

Figure 5. Useful application of the polarized microscopy in a case of long-standing alopecia areata. A, A horizontal section of long-standing alopecia areata totalis shows a few vellus/miniaturized follicles and 2 areas of absent hair follicles (possible follicular dropout) (arrows) (hematoxylin-eosin, original magnification ×2). B, The same section under polarized light shows negative birefringence in the same zones of possible follicular dropout (arrows), whereas the interfollicular dermal collagen is birefringent (polarized light, original magnification ×2).