High accuracy of recognition of common forms of folliculitis by dermoscopy: An observational study

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Background: Clinical differentiation of folliculitis types is challenging. Dermoscopy supports the recognition of folliculitis etiology, but its diagnostic accuracy is not known.

Objective: To assess the diagnostic accuracy of dermoscopy for folliculitis.

Methods: This observational study included patients (N = 240) with folliculitis determined on the basis of clinical and dermoscopic assessments. A dermoscopic image of the most representative lesion was acquired for each patient. Etiology was determined on the basis of cytologic examination, culture, histologic examination, or manual hair removal (when ingrowing hair was detected) by dermatologist A. Dermoscopic images were evaluated according to predefined diagnostic criteria by dermatologist B, who was blinded to the clinical findings. Dermoscopic and definitive diagnoses were compared by dermatologist C.

Results: Of the 240 folliculitis lesions examined, 90% were infections and 10% were noninfectious. Infectious folliculitis was caused by parasites (n = 71), fungi (n = 81), bacteria (n = 57), or 7 viruses (n = 7). Noninfectious folliculitis included pseudofolliculitis (n = 14), folliculitis decalvans (n = 7), and eosinophilic folliculitis (n = 3). The overall accuracy of dermoscopy was 73.7%. Dermoscopy showed good diagnostic accuracy for *Demodex* (88.1%), scabietic (89.7%), and dermatophytic folliculitis (100%), as well as for pseudofolliculitis (92.8%).

Limitations: The diagnostic value of dermoscopy was calculated only for common folliculitis. Diagnostic reliability could not be calculated.

Conclusion: Dermoscopy is a useful tool for assisting in the diagnosis of some forms of folliculitis. (J Am Acad Dermatol 2019;81:463-71.)

Key words: cytology; dermoscopy; diagnostic tests; differential diagnosis; folliculitis; pseudofolliculitis.

Folliculitis is an inflammatory skin disease characterized by asymptomatic, itchy, or mildly painful, single or multiple, erythematous papules and pustules located around the hair shaft. Although any hair-bearing region may be affected, folliculitis is usually localized to the face, scalp, thigh, axilla, and inguinal area; individuals of all ages and races are affected by this condition.[1]

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The treatment of folliculitis lesions varies according to the type of folliculitis. Even though folliculitis is often caused by infectious agents, it may also be associated with noninfectious causes. The latter cases are mainly pseudofolliculitis caused by ingrown hairs, folliculitis decalvans, and eosinophilic folliculitis.[2,3] Gram-positive bacteria, especially *Staphylococcus aureus*, are the main infectious agents involved in folliculitis, but gram-negative bacteria, fungi, viruses, and parasites may also cause this condition.[4]

Because of the common assumption of a gram-positive bacterial origin, topical and/or systemic antibiotic treatments are often routinely recommended without establishing an etiologic diagnosis, with consequent possible misdiagnosis and mistreatment. Indeed, clinical differentiation of the various forms of folliculitis may be challenging, and additional tests are often required to reach a definitive diagnosis.[5-7]

According to the available literature, cytologic examination is the first-line diagnostic test to establish folliculitis etiology because of its reliability, cost-effectiveness, and rapidity. However, further tests and analyses are sometimes needed in cases of inconclusive cytologic findings (eg, histopathologic examination and culture).[4]

Although distinguishing follicular from nonfollicular papules and/or pustules in areas with terminal hair is relatively easy, clinical differentiation of pustules is challenging in areas with vellus hair.[8] In the last few years, dermoscopy has also been shown to be useful in assisting in the diagnosis of several nontumoral skin conditions, including some forms of folliculitis.[8-14] However, the diagnostic accuracy of dermoscopy use for the recognition of various forms of folliculitis has not been determined. Here, we have aimed to address this issue by evaluating follicular lesions of various etiologies and calculating the accuracy parameters for each dermoscopic finding.

CAPSULE SUMMARY

- The diagnostic accuracy of dermoscopy for recognition of folliculitis etiology was not known; we determined the overall accuracy of dermoscopy to be 73.7%. Dermoscopy showed good diagnostic value for *Demodex* (88.1%), scabietic (89.7%), and dermatophytic (100%) folliculitis, as well as for pseudofolliculitis (92.8%).
- Dermoscopic evaluation of folliculitis has the potential to prevent unnecessary diagnostic tests and unnecessary treatments.

PATIENTS AND METHODS

Patients

Consecutive patients who visited the Dermatology Department of Başkent University Hospital in Adana, Turkey, between November 2012 and November 2018 and in whom folliculitis had been diagnosed on the basis of clinical and dermoscopic assessment (papules or pustules centered around a hair) were considered eligible for the study. The study was reviewed and approved by the institutional review board at the University of Başkent, Ankara, Turkey. The Declaration of Helsinki protocols were followed, and the patients provided written informed consent.

Study design

The study was designed as an observational study. For each patient, a dermoscopic image of the most representative lesion (the most inflamed papule or pustule) was acquired and recorded with use of a digital dermoscopy device (FotoFinder R2.200 [Teachscreen Software GmbH, Bad Birnbach, Germany]) by dermatologist A (M.D.). When an ingrowing hair was detected by dermoscopy, it was removed with use of a needle to confirm the diagnosis of pseudofolliculitis (Fig 1) and no additional tests were performed. In other cases, cytologic samples (4 per patient) were obtained from the lesions and evaluated under a microscope (see the section Cytologic assessment). When cytologic assessment indicated the presence of bacteria or fungi, culture was performed to isolate the etiologic agent. When cytologic findings were typical of viral or parasitic folliculitis, no additional tests were performed. When cytologic findings were negative, histopathologic examination was performed. Fig 2 summarizes the diagnostic algorithm used.

Once etiologic diagnosis was reached, most characteristic dermoscopic images were sent electronically to dermatologist B (E.E.), who was blinded to the clinical findings and final diagnosis, for dermoscopic assessment. Only common forms of folliculitis for which reliable dermoscopic features were available from the literature data or personal observations were considered (see the section Dermoscopic assessment), including *Demodex*-associated folliculitis, scabietic folliculitis, *Malassezia* folliculitis, dermatophytic folliculitis, staphylococcal folliculitis, *Pseudomonas aeruginosa*–associated folliculitis, pseudofolliculitis, and folliculitis decalvans.

Finally, dermoscopic diagnosis was compared with etiologic diagnosis by dermatologist C

(A.H.E), who was blinded to the preceding analyses, to assess the diagnostic accuracy of dermoscopy.

Cytologic assessment

Cytologic specimens were obtained from folliculitis lesions by the skin scraping method. A total of 4 different cytologic samples were obtained from each patient. One sample was used for potassium hydroxide examination, and the other 3 samples were stained by using May-Grünwald Giemsa stain, gram stain, or acid-fast stain.[4] Cytologic evaluation was performed according to the algorithm showed in Fig 2.

Dermoscopic assessment

Dermoscopic images (1920 × 1080 pixels) were evaluated for the presence of diagnostic criteria selected according to the available literature data and preliminary observations (Table I and Fig 3). Additional findings, characterized by low sensitivity or low specificity (eg, pustules, unspecific vessels, crusting, scaling), were not considered in the analysis.

Statistical analysis

Diagnostic accuracy parameters for selected dermoscopic findings were calculated if observed in at least 10 patients to ensure statistically significant numerosity. Specifically, for each feature the following were calculated: sensitivity (true positives ÷ [true positives + false negatives]); specificity (true negatives ÷ [true negatives + false positives]); positive predictive value (true positives ÷ [true positives + false positives]); and negative predictive value (true negatives ÷ [true negatives + false negatives]). The global diagnostic accuracy of dermoscopy was calculated as the percentage of correct diagnoses. Possible comparative analysis of accuracy parameters was performed by using the Fisher exact test or chi-square test according to sample numerosity, with statistical significance set at $P < .05$ and without corrections for multiple comparisons. All analyses were performed by using SPSS software (version 22, IBM, Armonk, NY).

RESULTS

Patients

A total of 240 folliculitis lesions from 240 patients (132 females and 108 males) were included in the study. The mean age of the patients was 28 years (range, 2-76 years). The face was the most common localization of lesions (35%). Other affected areas included the trunk (30.4%), scalp (21.3%), groin (7.5%), and extremities (5.8%). Of the 240 lesions, 216 (90%) lesions were infectious and 24 (10%) were noninfectious (Table I). The definitive diagnosis was made by cytologic analysis (n = 215), histopathologic examination (n = 14), or ingrown hair removal (n = 14).

Cytology

Cytologic examination was performed for 226 patients (14 patients had pseudofolliculitis). Cytologic examination led to the following diagnostic findings in 215 cases (95.1%): *Demodex* parasites (n = 40), *Sarcoptes scabiei* (n = 28), hyphae (n = 27), pseudohyphae (n = 2), bacteria (n = 57), budding spores (n = 52), acantholytic cells and multinucleated giant cells (n = 3), molluscum bodies (n = 3), and numerous eosinophils (n = 3) (Fig 2). No cytologic diagnosis was made for the remaining 11 lesions.

Histopathology and culture

Histopathologic examination was performed for 14 patients (5.8%), including 11 patients whose condition could not be diagnosed by cytologic examination and 3 patients characterized by numerous eosinophils on cytologic examination. Histologic examination revealed perifollicular lymphocytic inflammation, tufting, and follicular hyperkeratosis in 7 patients, consistent with the diagnosis of folliculitis decalvans. Three patients showed multiple eosinophils without bacteria, parasites, or fungal elements. *Demodex* parasites were detected in 2 patients with *Demodex* folliculitis. Parasitic eggs and fecal deposits within the stratum corneum were detected in 1 patient with scabietic folliculitis. Histopathologic examination revealed intracytoplasmic eosinophilic inclusion bodies in material from 1 patient with molluscum folliculitis.

Culture was performed for 57 lesions that were positive for bacteria by cytologic examination. *S aureus* (96.5%) was the most common cause of bacterial folliculitis, with other lesions caused by *P aeruginosa* (3.5%). *Malassezia* species were determined in 32 of 52 patients (61.5%) with *Malassezia* folliculitis. Specifically, *Malassezia globosa* was the most frequently (37.5%) isolated species, followed by *Malassezia furfur* (34.4%), *Malassezia sympodialis* (25%), and *Malassezia arunalokei* (3.1%). The most common isolated agent of tinea capitis was *Trichophyton violaceum* (51.9%), followed by *Trichophyton mentagrophytes* (33.3%) and *Microsporum canis* (14.8%).

Dermoscopy

Correct etiologic diagnosis by dermoscopic examination was made in 177 out of 240 patients (73.7%) with folliculitis (Table I). In general, the

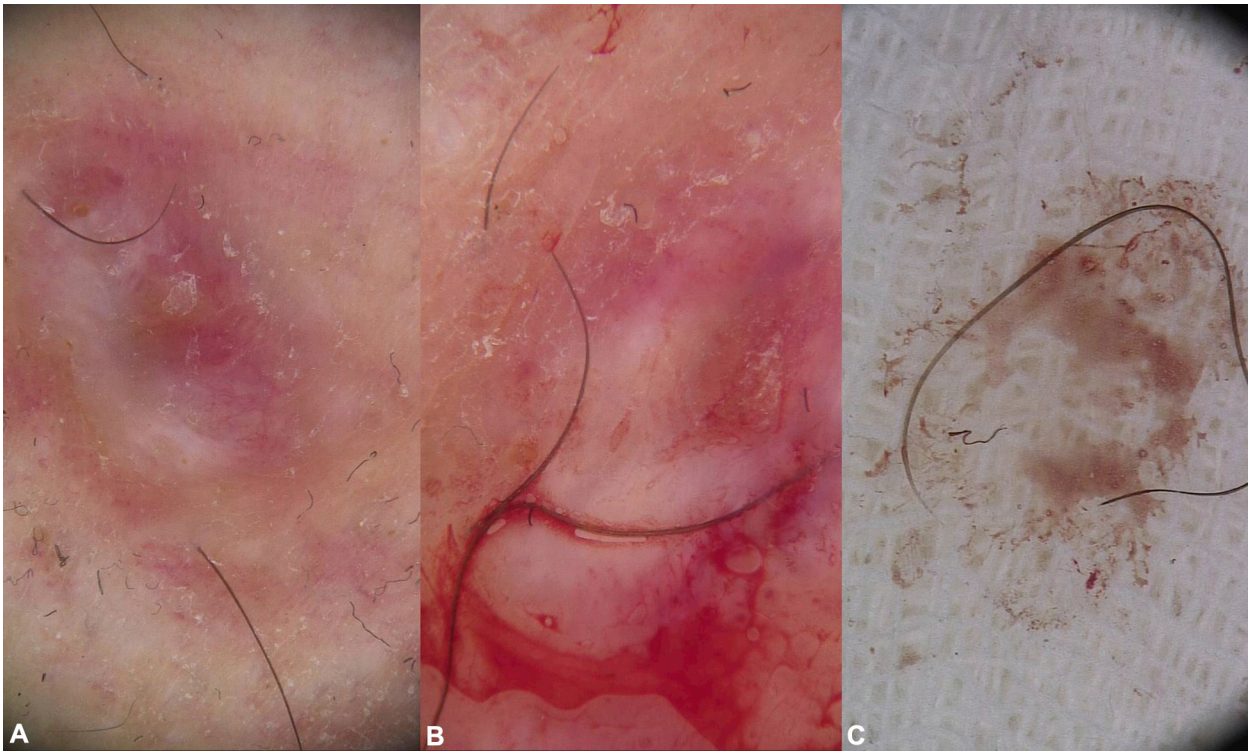

Fig 1. Pseudofolliculitis. **A**, Dermoscopy reveals erythema, white areas, and ingrown hair (U-shaped). **B**, Ingrowing hair was removed by using a needle. **C**, Extracted hair.

diagnostic accuracy of dermoscopy was 72.7% and 83.3% in infectious and noninfectious folliculitis, respectively. Specifically, in the infectious group, the highest diagnostic value was obtained for parasitic folliculitis (88.7%), followed by fungal folliculitis (76.5%). Although all patients with dermatophytic folliculitis were able to have their condition diagnosed by dermoscopic examination, only 62% of patients with *Malassezia* folliculitis could have it diagnosed by dermoscopy. The diagnostic accuracy of dermoscopic examination in bacterial folliculitis was low.

Regarding dermoscopic features of parasitic folliculitis, both the specificity and sensitivity of *Demodex* tails were slightly higher (albeit not statistically significantly [$P > .05$]) than those for *Demodex* follicular openings (100.0% vs 97.0% and 66.7% vs 54.8%, respectively) in *Demodex*-associated folliculitis (Fig 4, *A* and *B*), whereas the hang glider sign and burrow had equal sensitivity (82.8%) and specificity (100%) for the diagnosis of *S scabiei* folliculitis (Fig 4, *C* and *D*).

For fungal folliculitis, the specificity of dotted vessels in the absence of other diagnostic criteria was 93.1% because it was rarely detected in other folliculitis types (Fig 4, *E* and *F*). However, the sensitivity of such a finding was 67.3%. Further, although the specificity of all dermoscopic features of dermatophytic folliculitis was 100.0%, only broken hairs displayed acceptable sensitivity (74.1%) (Fig 4, *G* and *H*).

Staphylococcal folliculitis displayed the lowest diagnostic accuracy (50.9%), as only nonspecific findings were noted for all patients. The accuracy for *Pseudomonas*-associated folliculitis was not calculated because of the small sample size.

Although hair tufts were noted in all cases of folliculitis decalvans, no accuracy parameters were calculated because of the small sample size (Fig 4, *I* and *J*). Pseudofolliculitis showed a good diagnostic accuracy, with 92.8% of cases correctly diagnosed by highlighting of U-shaped ingrowing hairs on dermoscopic assessment (Fig 4, *K* and *L*). The sensitivity and specificity of such a finding were 92.8% and 100%, respectively.

DISCUSSION

In the current study, we investigated the diagnostic value of dermoscopy in the differentiation of folliculitis. We determined the diagnostic accuracy of dermoscopy as 73.7%. The diagnostic accuracy was high in patients with *Demodex* folliculitis (88.1%),

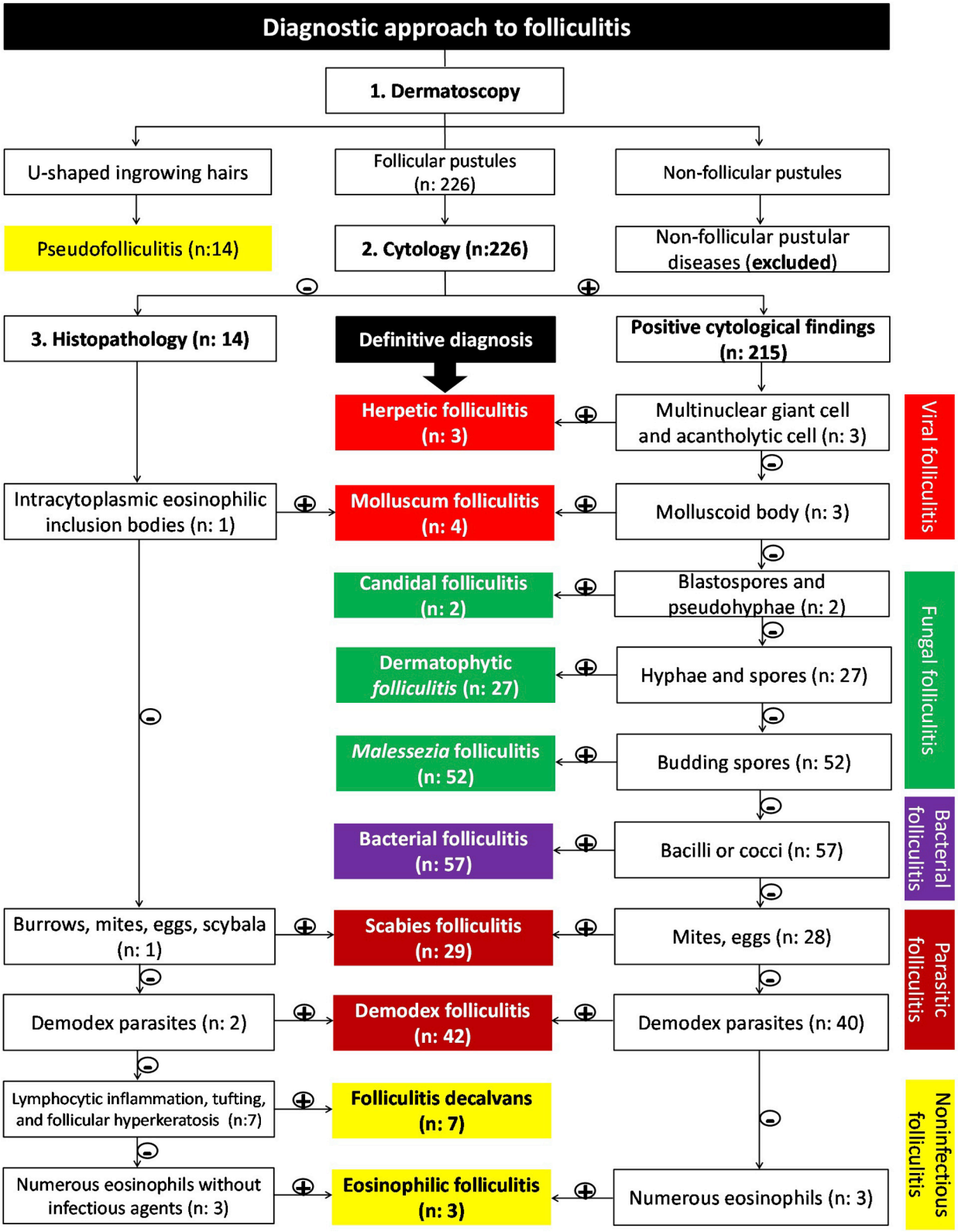

Fig 2. Diagnostic flowchart of the study patients.

Table I. Diagnostic accuracy of dermoscopy for common forms of folliculitis

Form of folliculitis	n	Diagnostic accuracy*	Sensitivity	Specificity	NPV	PPV
Infectious folliculitis	216	72.7				
Viral folliculitis	7					
Herpetic	3					
Molluscum contagiosum	4					
Parasitic folliculitis	71	88.7				
Demodex spp	42	88.1				
Demodex tails†	28		66.7	100	93.4	100
Demodex follicular openings‡	23		54.8	97	91	82.1
Sarcoptes scabiei	29	89.7				
Hang glider sign	24		82.8	100	97.7	100
Burrow	24		82.8	100	97.7	100
Fungal folliculitis	81	76.5				
Malassezia folliculitis	52	67.3				
Dotted vessels	35		67.3	93.1	91.1	71.4
Candida spp.	2					
Dermatophytes	27	100				
Broken hairs	20		74.1	100	96.8	100
Corkscrew-like hairs	6		22.2	100	91	100
Black dots	2		7.4	100	89.5	100
Zigzag hairs	2		7.4	100	89.5	100
Morse code hairs	1		3.7	100	89.1	100
Bacterial folliculitis	57	49.1				
Staphylococcus aureus	55	50.9				
Central round pustule with peripheral sparse dotted vessels	28		50.9	96.2	86.9	82.4
Pseudomonas aeruginosa	2					
Noninfectious folliculitis	24	83.3				
Pseudofolliculitis	14	92.8				
Ingrown hair	13		92.8	100	100	100
Eosinophilic folliculitis	3					
Folliculitis decalvans	7					
Hair tufts	7					
Total	240	73.7				

NPV, Negative predictive value; *PPV*, positive predictive value.
*Stated if the total number exceeds 10.
†Creamy or whitish gelatinous follicular plugs protruding from follicular openings.
‡Round creamy or whitish follicular plugs surrounded by an erythematous halo.

scabies folliculitis (89.7%), and dermatophytic folliculitis (100%).

According to the available literature, bacterial culture, fungal culture, and histopathologic examination are the most common methods used to investigate the causes of folliculitis.[4] Although polymerase chain reaction is used for the diagnosis of many infectious diseases, this molecular diagnostic method is not routinely used in the case of patients with folliculitis.[4] Accordingly, the polymerase chain reaction method is used in Western Europe and the United States but gives positive identification of only 27% of late-stage lesions.[15]

Dermoscopy, a noninvasive diagnostic method, is mainly used to distinguish pigmented lesions and diagnose many nonpigmented diseases. Currently, dermoscopy is also used in general dermatology. For pustular lesions, the first aim of dermoscopy is to distinguish vellus-type hair.[8] This inexpensive and noninvasive diagnostic method is also used to distinguish folliculitis from pseudofolliculitis.[12] In addition, dermoscopic findings of infectious folliculitis, such as *Demodex* folliculitis, scabies folliculitis, and dermatophytic folliculitis, have been described.[8,12,13,16] In the case of noninfectious folliculitis, dermoscopic diagnostic findings of folliculitis decalvans have been reported. Here we have shown that multiple (>10) hairs emerging from a single dilated follicular orifice (tufted hairs, polytrichia, or dolly hairs) are the most sensitive and specific

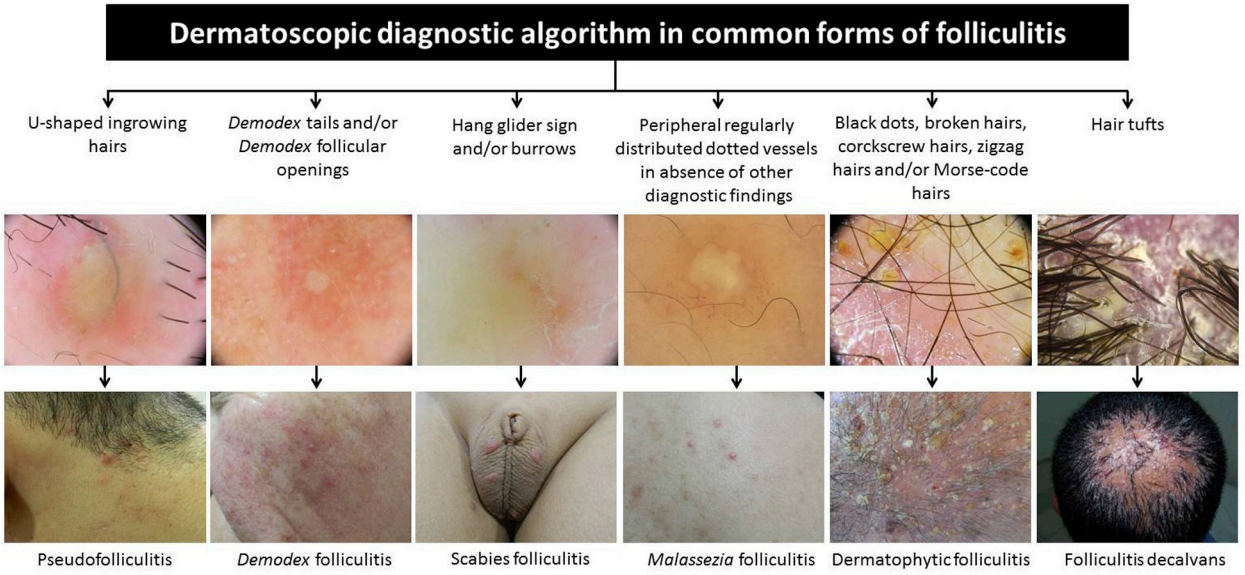

Fig 3. Dermoscopic diagnostic algorithm for the analysis of folliculitis lesions.

dermoscopic finding of folliculitis decalvans. However, tinea capitis with folliculitis decalvans-like dermoscopic findings has also been reported.[17] Other additional, nonspecific dermoscopic findings are perifollicular erythema arranged in a starburst pattern, yellowish tubular scaling, crusting, and follicular pustules.[11]

The development of multidrug-resistant bacteria creates significant health problems. One of the most important underlying reasons is the frequent and unnecessary use of antibiotics.[18] In patients with folliculitis, it is important to differentiate bacterial etiology from other infectious causes to avoid unnecessary use of antibiotics.[4] Although bacterial culture is usually sufficient in cases of bacterial folliculitis, additional tests, such as cytologic examination, fungal culture, and histopathologic examination are required for other forms of folliculitis. We have shown here that the diagnostic accuracy of dermoscopy is 81.4% for folliculitis other than bacterial folliculitis. The diagnostic accuracy for *Demodex* folliculitis, scabies folliculitis, and pseudofolliculitis was even higher. Hence, when performed before other diagnostic tests, dermoscopic examination could prevent unnecessary examinations, reduce cost, and provide rapid diagnosis.

Malassezia folliculitis lesions are confused with bacterial folliculitis, candidiasis, and acne vulgaris. For the diagnosis of *Malassezia* folliculitis, Wood's lamp examination, cytologic examination, and histopathologic examination may be used.[19] Because the diagnostic accuracy of cytologic examination is higher than histopathologic examination, performing cytologic examination before taking a biopsy is recommended.[20,21] Recently, some dermatologic manifestations of *Malassezia* folliculi have been described. Jakhar et al[9] reported that *Malassezia* folliculitis presents as folliculocentric papule and pustules with surrounding erythema. Perilesional hypopigmentation or brownish discoloration occurs when the lesion is regressing. However, preliminary observations of 52 cases in the current study indicated that peripheral, regularly distributed dotted vessels in the absence of other diagnostic findings were the main dermoscopic clue of such a condition. Nonetheless, we evaluated only active papular pustules of patients and excluded postinflammatory lesions. Therefore, the frequency of postinflammatory changes, such as hypopigmentation or brownish discoloration, was not obtained.

Although dermoscopy provides important findings for the diagnosis of some types of infectious folliculitis, there are no specific findings of herpetic folliculitis, eosinophilic folliculitis, and *Candida* folliculitis. However, it is possible to distinguish between these 3 types of folliculitis cytologically. Hence, if the cytologic examination shows only bacteria, diagnosis should be based on bacterial culture. Both herpes zoster folliculitis and herpes simplex folliculitis are characterized by the presence of acantholytic cells and multinuclear giant cells. Hence, if immunofluorescence is performed, herpes simplex folliculitis can be distinguished from herpes zoster folliculitis.[4,22]

There are some limitations to the current study. The diagnostic value of dermoscopy was not calculated for patients with molluscum folliculitis, herpetic folliculitis, or folliculitis decalvans because

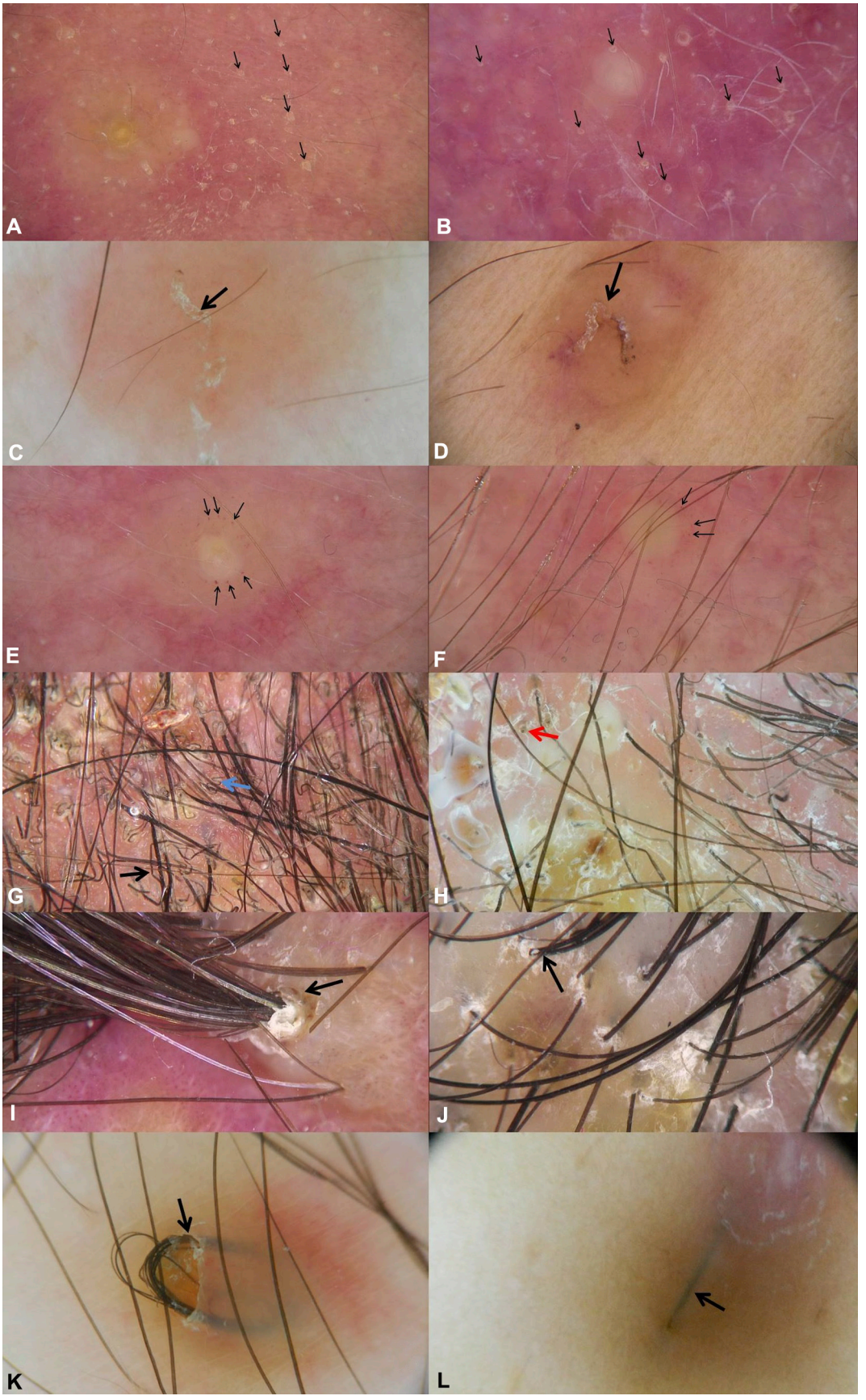

Fig 4. Dermoscopic findings of folliculitis. *Demodex* tails (*arrows*) in *Demodex* folliculitis (**A** and **B**); burrow (*arrow*) in scabietic folliculitis (**C** and **D**); dotted vessels (*arrows*) in *Malassezia* folliculitis (**E** and **F**); corkscrew-like hair (*blue arrow*), zigzag hair (*black arrow*), and black dot (*red arrow*) in dermatophytic folliculitis (**G** and **H**); hair tuft (*arrow*) in folliculitis decalvans (**I** and **J**); and ingrown hair (*arrow*) in pseudofolliculitis (**K** and **L**).

the sample size was too small. Further, the diagnostic reliability could not be calculated because only 1 dermatologist performed dermoscopic evaluation.

In conclusion, we have demonstrated that dermoscopy provides important findings for the diagnosis of *Demodex* folliculitis, scabietic folliculitis, *Malassezia* folliculitis, and dermatophytic folliculitis. If the result of dermoscopy is negative, cytologic examinations, culture, and histopathologic examinations should be performed.

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