Dermatology Practical & Conceptual

Dermoscopy of Keratinizing Skin Tumors: Cutaneous Squamous Cell Carcinoma, Keratoacanthoma, and Bowen's Disease

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ABSTRACT

Introduction: Cutaneous squamous cell carcinoma (cSCC) is the second most common skin cancer, with incidence rising due to increased ultraviolet exposure, an aging population, and a growing number of immunocompromised individuals.

Objectives: This review presents a comprehensive analysis of dermoscopic features of cSCC lesions, delineating distinct patterns of Bowen's disease (BD) and invasive cSCC, including keratoacanthoma (KA). The primary outcome was the identification of dermoscopic patterns specific to cSCC, while the secondary endpoint involved determining the prevalence of these features across different subtypes.

Methods: We selected studies including individuals with histopathologically proven cSCC who underwent dermoscopic evaluation. Studies with at least five cases of cSCC were included, with no constraint on the study design.

Results: Our analysis reveals that BD typically exhibits white-to-yellow scales and glomerular vessels, whereas KA is characterized by a layered architecture with a central keratin plug, an ivory-white peripheral zone, and a symmetrical distribution of hairpin vessels. In contrast, invasive

cSCC demonstrates a progression from well-differentiated lesions with organized vascular patterns to poorly differentiated forms marked by chaotic, polymorphic vessels and predominant red hues.
Conclusion: These distinct dermoscopic patterns serve as practical clinical guides for differentiating SCC grades of invasion and differentiation, thereby enhancing diagnostic accuracy and patient management.

Introduction

Cutaneous squamous cell carcinoma (cSCC) represents the second most prevalent form of epithelial skin cancer, exceeded only by basal cell carcinoma (BCC) in terms of incidence [1-3]. Recent epidemiological data indicate a steady increase in cSCC diagnoses, driven by an aging population, increasing ultraviolet (UV) exposure, and a growing number of immunocompromised individuals [1-3]. While most cSCCs display locally invasive biological behavior, locoregional recurrence and metastatic spread, particularly in high-risk subtypes, may occur, thereby contributing substantially to skin cancer-associated morbidity and mortality [4-5]. Updated guidelines [6] and a recent operational classification [7] underscore the importance of refined diagnostic algorithms, meticulous risk stratification, and standardized disease management.

Within this evolving landscape, dermoscopy continues to serve as one of the most valuable clinical tools for the noninvasive evaluation of skin lesions [8]. Dermoscopy provides noninvasive, real-time visualization of epidermal and superficial dermal structures, greatly enhancing the clinician's ability to discriminate between benign and malignant lesions [9] and improving management strategies [10,11].

The purpose of our study was to assess the advances of dermoscopy in diagnosing cSCC, specifically highlighting morphological patterns that reliably differentiate cSCC from other cutaneous lesions, as well as the dermoscopic characteristics that distinguish the different forms of cSCC based on their degrees of invasion and differentiation.

Material and Methods

Eligibility Criteria

Population: we selected studies including individuals with histopathologically proven cSCC (invasive cSCC, including keratoacanthoma –KA and Bowen's disease –BD)) who underwent dermoscopic evaluation.

Lesion Classification: any type of cSCC, ranging from BD and KA to poorly differentiated invasive cSCC.

Study selection: Reports with at least five cases of cSCC were included, with no constraint on the study design. Abstracts and studies on mucosal SCC and SCC lesions located on the lips or subungual were excluded.

Outcomes Analyzed: The primary outcome was the identification of dermoscopic patterns specific to cSCC. The secondary endpoint was the prevalence of dermoscopic features across different subtypes of cSCC, namely BD, KA, and poorly differentiated invasive cSCC.

Process of Literature Search

Two reviewers, D.T. and G.P., independently searched PubMed, EMBASE, Google Scholar, and Scopus for comprehensive literature up to 30 November 2024. Search terms included "dermoscopy" OR dermatoscopy" AND "squamous cell carcinoma" OR "SCC" OR "Bowen's disease" OR "intraepidermal carcinoma" OR "keratoacanthoma". Both medical subject headings (MeSH) and the reference lists of pertinent studies were extensively reviewed.

Titles and abstracts of the identified articles were initially screened, with subsequent full-text reviews for eligibility. Data were meticulously recorded in a digital database (Figure 1). Included articles were assessed for risk of bias using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) criteria (Table 1) . Any discordance in data extraction or interpretation was discussed and resolved by consulting a third reviewer (A.DS.).

Results

Our research retrieved 1,223 studies, 18 of which met the inclusion criteria, comprising 1,443 cSCC lesions: 805/1443 were cSCC, 519/1443 were BD, and 103/1443 were KA (Table 2).

Bowen's Disease

The characteristic dermoscopic features of BD (Figure 2A) consist of white-to-yellow surface scales and clusters of glomerular vessels [13,26]. Glomerular vessels, so called because of their resemblance to the glomerular apparatus of the kidney, are tortuous, coiled capillaries that closely correlate with histopathologically engorged blood vessels within the papillary dermis [15]. The term "coiled vessels" is used by some authors as a synonym for glomerular vessels [29].

The prevalence of white-to-yellow surface scales and glomerular vessels showed considerable variation across studies. Scales were observed in 48.6%–96% of BD lesions [17,20,21,30,31,32], while glomerular vessels were detected

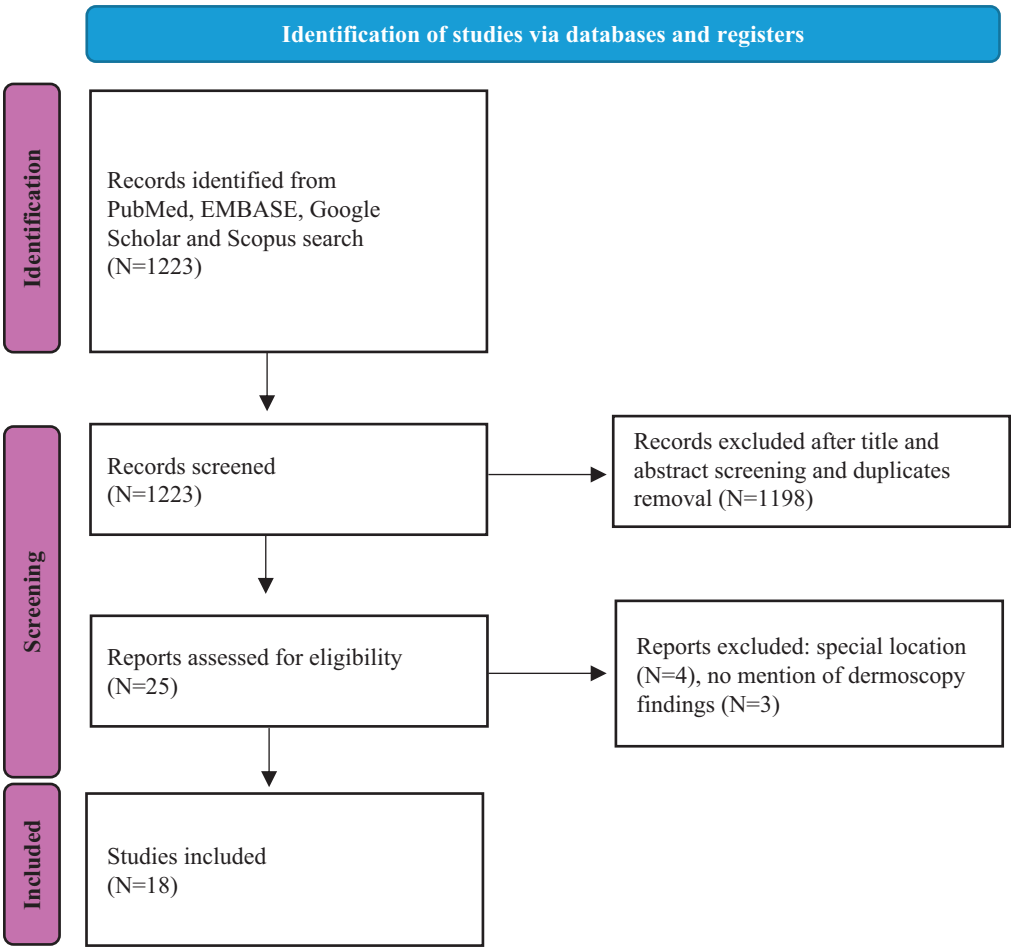


Figure 1. Process following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework.

Table 1. QUADAS criteria [44] for included studies.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Rosendahl et al. [12]	Y	Y	Y	Y	Y	Y	Y	Y	UC	UC	UC	N	N	Y
El-Ammari et al. [14]	Y	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	Y	Y
Cameron et al. [15]	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	UC	Y
Payapvipapong K et al. [16]	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	UC	Y
Sgouros et al. [17]	N	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	N	N
Zalaudek et al. [13]	N	Y	Y	Y	Y	Y	Y	Y	UC	N	UC	N	N	Y
Pyne et al. [18]	N	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	N	N
Lallas et al. [19]	N	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	N	Y
Pan et al. [20]	N	Y	Y	Y	Y	N	Y	Y	UC	N	UC	N	N	Y
Manfredini et al. [21]	N	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	Y	Y
Lin et al. [22]	N	Y	Y	Y	Y	Y	Y	Y	UC	N	UC	N	N	Y
Ertop Doğan et al. [23]	N	Y	Y	Y	Y	Y	Y	Y	UC	UC	UC	N	N	N
Yang et al. [25]	N	Y	Y	Y	Y	Y	Y	Y	UC	UC	UC	N	N	Y
Mun et al. [30]	N	Y	Y	Y	Y	Y	Y	Y	UC	N	UC	N	N	N
Papageorgiou et al. [31]	N	Y	Y	Y	Y	Y	Y	Y	UC	Y	UC	N	N	N
Fougelberg et al. [32]	N	Y	Y	Y	Y	Y	Y	Y	UC	UC	UC	N	N	Y

Table 2. Characteristics of the included studies.

Authors	Study Design	Number of patients	Female Sex	Age, mean	BD	KA	Invasive cSCC
Rosendahl C et al.[12] 2012	Retrospective	103	22	68,4	0	43	60
Rosendahl C et al. [12] 2012	Prospective	61	21	71	0	29	32
El-Ammari S et al. [14] 2024	Prospective	72	23	69	0	0	72
Cameron A et al. [15] 2010	Retrospective	52	21	67	52	0	0
Payapvipapong K et al. [16] 2014	Retrospective	52	15	74	52	0	0
Sgouros D et al.[17] 2021	Retrospective	56	19	77	9	7	40
Zalaudek I et al.[13] 2011	Retrospective	243	89	71	71	24	78
Pyne J et al.[18] 2012	Retrospective	294	86	71	0	0	294
Lallas A et al.[19] 2015	Retrospective	143	36	77	0	0	143
Pan Y et al.[20] 2008	Retrospective	50	N/A	N/A	50	0	0
Manfredini M et al.[21] 2017	Retrospective	121	45	79	70	0	52
Lin MJ et al.[22] 2014	Retrospective	58	23	78	0	8	50
Ertop Doğan P et al. 2021[23]	Retrospective	169	62	69	34	22	87
Yang Y.et al. 2017[25]	Retrospective	146	N/A	N/A	146	0	0
Mun et al. 2010[30]	Retrospective	26	12	64	26	0	0
Papageorgiu et al. 2018[31]	Retrospective	89	N/A	N/A	89	0	0
Fougelberg et al. 2023[32]	Retrospective	94	43	73	100	0	0

Abbreviations: BD, Bowen disease; KA, keratoacanthoma; cSCC, cutaneous squamous cell carcinoma; N/A, not available

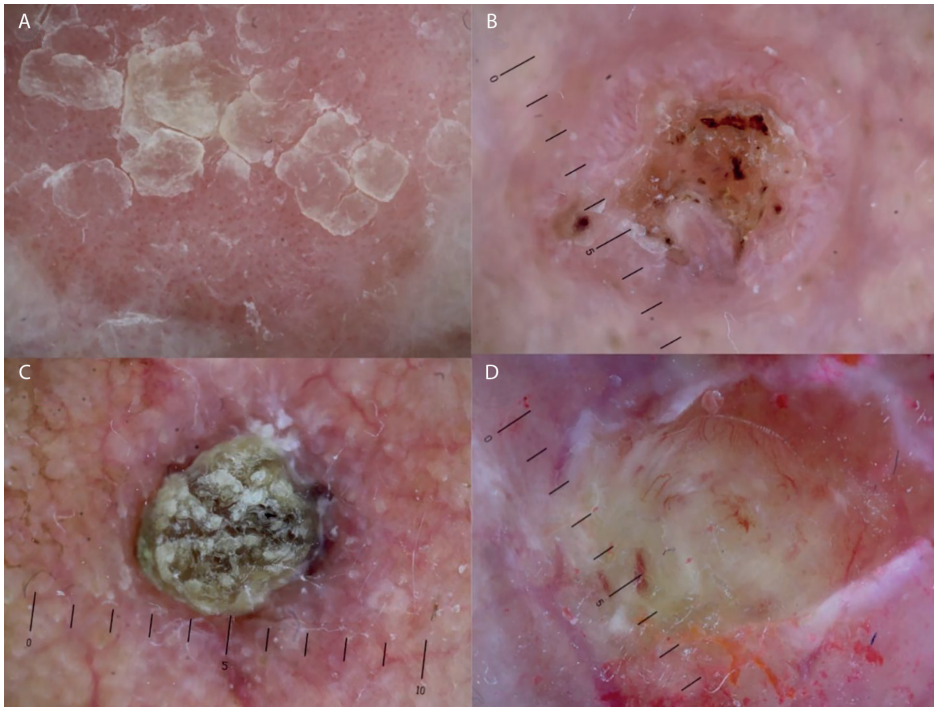


Figure 2. Dermoscopic images of different cutaneous squamous cell carcinoma (cSCC) subtypes. Bowen's Disease (BD) is characterized by dotted or glomerular vessels associated with scales (A). Dermoscopy of keratoacanthoma (KA) reveals a crater-like keratin core surrounded by linear or hairpin vessels, and a faint whitish halo at the periphery (B). Well-differentiated cSCC displays a predominance of keratinization features (C), whereas in poorly-differentiated cSCC, red patterns predominates due to diminishing keratinization associated with the presence of high vascular polymorphism (D).

in 44.2%–88.9% [15,17,20,21,30,31,32] (Table 3). A retrospective analysis comprising 150 cases of superficial BCC, 100 cases of psoriasis and 50 cases of BD, [20] demonstrated that the diagnostic probability of BD was 98% (sensitivity 26%; specificity 100%) in the presence of three main dermoscopic criteria: clustered vascular pattern, glomerular vessels, and hyperkeratosis [20]. In a recent interobserver study on 100 cases of BD, scales also achieved the highest

Table 3. Prevalence of dermoscopic features in BD, invasive cSCC, and keratoacanthoma in included studies.

Study	N	Vascular Structures						Vascular Arrangement			Features of Keratinization					Erosions and Ulcerations		Background Color		
		Coiled	Glomerular	Hairpin	Linear irregular	Serpentine	Polymorphous	Diffuse	Clustered	Peripheral	Scales	Keratin clods	White circles	Central keratin plug	None	Erosions	Ulcerations	White	Pink	Red
Bowen's disease																				
Cameron A et al.[15]	52		23 (44.2)	0	6 (11.5)				3 (5.8)				4 (7.6)					N/A	N/A	
Payapvipapong et al.[16]	52		33 (64)	22 (42)							49 (94.0)		12 (23)				3 (6)		40 (77.7)	
Sgouros D et al.[17]	9		8 (88.9)	0	1 (11.1)		0	1 (11.1)	8 (88.9)	0	7 (77.8)	6 (66.7)	5 (55.6)	0	0	5 (55.6)	4 (44.4)	1 (11.1)	5 (55.6)	
Zalaudek I et al.[20]	71		30 (42.3)	20 (28.2)	1 (1.4)						59 (83.1)	0	6 (8.4)	36 (50.7)	0	34 (47.8)	1 (1.4)			
Pan Y et al.[20]	50		30 (60.0)	18 (36.0)	0		1 (2.0)	1 (2.0)	42 (84)		24 (48.0)					22 (44.0)		4 (8.0)	31 (62.0)	
Manfredini M et al.[21]	70		41 (58.6)				25 (35.7)				53 (75.7)	34 (48.6)	28 (49.9)	16 (22.9)		39 (55.7)				
Mun et al. [32]	26		23 (88.4)		3 (11.5)		2 (7.7)				25 (96.1)					5 (19.2)				
Papageorgiu et al. [32]	89		54 (60.7)	14 (15.7)							58 (65.2)	8 (9.0)				31 (34.8)	34 (38.2)			
Fougelberg et al.[32]	100		77*	26.4*	30.6*						83.3*					45.5*				
Keratoacanthoma																				
Rosendahl C et al.[12]	43	1 (2.3)	24 (55.8)	5 (11.6)	14 (32.6)	26 (60.5)	9 (20.9)		1 (2.3)	4 (9.3)	18 (41.9)	11 (25.6)	11 (25.6)	22 (51.2)	None	5 (11.6)		White	Pink	Red
Rosendahl C et al.[12]	29																			
Sgouros D et al.[17]	7	1 (14.3)	1 (14.3)		4 (57.1)		1 (14.3)	1 (11.1)	8 (88.9)	0	4 (57.1)	3 (42.9)	6 (85.7)	4 (57.1)	2 (28.6)	2 (28.6)	3 (42.9)	2 (28.6)	1 (14.3)	1 (14.3)
Zalaudek I et al.[20]	24		3 (12.5)	9 (37.5)	17 (70.8)						1 (4.1)	12 (50)		9 (37.5)		15 (62.5)	4(16.6)			2 (8.3)
Invasive SCC																				
Rosendahl C et al.[12]	60	1 (2.3)	24 (55.8)	5 (11.6)	14 (32.6)	26 (60.5)	9 (20.9)		1 (2.3)	4 (9.3)	18 (41.9)	11 (25.6)	11 (25.6)	22 (51.2)	None	5 (11.6)		White	Pink	Red
Rosendahl C et al.[12]	32																			
El-Ammari S et al.[14]	72	1 (14.3)	1 (14.3)		4 (57.1)		1 (14.3)	1 (11.1)	8 (88.9)	0	4 (57.1)	3 (42.9)	6 (85.7)	4 (57.1)	2 (28.6)	2 (28.6)	3 (42.9)	2 (28.6)	1 (14.3)	1 (14.3)
Sgouros D et al.[17]	40	1 (2.5)	3 (7.5)	2 (5.0)	24 (60.0)		10 (25.0)	16 (40.0)	0		23 (57.5)	23 (57.5)	28 (70.0)	5 (12.5)	4 (10.0)	4 (10.0)	32 (80.0)	1 (2.5)	8 (20)	4 (10)
Zalaudek I et al.[20]	78	11 (14.1)		30 (38.5)	14 (17.9)						38 (48.7%)		33 (42.3%)	31 (39.4)		23 (29.5)	14 (17.9)			
Pyne J et al.[18]	294																			
Lallas A et al.[19]	143	64 (44.8)		31 (21.7)	88 (61.5)	68 (47.6)	53 (37.1)	72 (50.3)	1 (0.7)		80 (55.9)	38 (26.6)	35 (24.5)	46 (32.2)			25 (17.5)	32 (22.4)		45 (31.5)
Manfredini M et al.[21]	52	17					30				28	36	18	8					30	14
Lin MJ et al.[22]	50	7 (14.0)	21 (42.0)	15 (30.0)	18 (36.0)	23 (46.0)	25 (50.0)			7 (14)	45 (90)	16 (32)	33 (66)	16 (32)		36 (72)				

N (%) presented in each box, unless otherwise stated. (*) The reported results are mean values from an 8-expert interobserver agreement.

concordance (Fleiss' κ=0.55) among the investigated dermoscopic criteria [32].

Dermoscopy of pigmented BD was initially reported by Zalaudek et al. [28], who analyzed 10 pigmented BD cases and described brown globules in a patchy distribution (90%) as well as gray or brown structureless areas (80%). Subsequently, Cameron et al. [15] evaluated 52 pigmented BD and found that brown or gray dots had a linear distribution pattern in 21.2% of cases. However, a pattern of structureless pigmentation predominated in 48.1% of lesions, and a combination of structureless pigmentation and dots was observed in 34.6% of pigmented BD. Most cases exhibited a monomorphic vascular pattern (82.9%), with prevailing glomerular vessels (44.2%) and a linear distribution of the vessels in 11.5% of cases [15].

A dermoscopic classification of BD into three subtypes based on distinct patterns has been proposed [16]: i) the classical subtype, which is defined by glomerular vessels (described in 94% of cases), whitish scales (53%), and a pinkish-white area (53%) as characteristic features; ii) the pigmented subtype, characterized by scales (75%), structureless pigmentation (75%), and pigmented streaks (75%); iii) the partially pigmented subtype, defined by the presence of black, brown, gray, or blue pigmentation covering less than 50% of the lesion. It consistently presents with glomerular vessels (100%) and often includes scales, a pinkish-white area (61%), and structureless areas (61%).

Two additional dermoscopic features have been recently identified: the double-edge sign and clusters of brown structureless areas [25]. The double-edge sign, observed in 30% of cases, consists of two parallel pigmented edges at the lesion's periphery, corresponding histopathologically to two strips of hyperpigmented basal keratinocytes separated by a hypopigmented acanthotic area [25]. Clusters of brown structureless areas, detected in 38.4% of lesions, appear as large, aggregated pigmented structures typically located at the lesion's periphery, which may correlate with marked acanthosis and an increased number of pigmented basal keratinocytes [25].

Keratoacanthoma

Dermoscopy of KA (Figure 2B) shares many features with cSCC, and only few studies investigated separately how to differentiate these two entities [12,17,22]. In a retrospective analysis of 60 invasive cSCCs and 43 KAs, central keratin (90.9% vs. 28.7%) and blood spots (77.3% vs. 62.1%) were identified as key dermoscopic features distinguishing KA from cSCC [12].

Indeed, the characteristic dermoscopic pattern of KA is defined by a layered architecture: a central keratinous crater composed of a dense, amorphous yellow-white mass, reflecting rapid keratinocyte proliferation and aberrant differentiation, surrounded by an ivory-white peripheral zone, corresponding to compressed collagen and inflammatory changes [12,17]. Linear or hairpin vessels are located around the core radiating symmetrically outward. [12,17]. At the periphery of the tumor, a faint whitish halo may demarcate the lesion's advancing edge [12]. Additional diagnostic clues include hemorrhagic foci (appearing as red-black globules) due to intralesional bleeding and central blood vessels that maintain a structured, radial arrangement [22].

Invasive Cutaneous Squamous Cell Carcinoma

Clinically, well-differentiated cSCC exhibits a nodular or exophytic growth pattern with a predominantly white or white-yellow color, reflecting the presence of keratinized structures [19]. Dermoscopic features characteristic of well-differentiated invasive cSCC (Figure 2C) include keratin/scales, blood spots, white circles, white structureless areas, hairpin vessels, linear-irregular vessels with perivascular white halos, and ulceration [12,13,18]. White circles, first described as targetoid hair follicles, are characterized by distinct bright white rings encircling a dilated infundibulum [13,17]. Histopathologically, they correspond to orthokeratosis and parakeratosis of the infundibular epidermis [17]. White circles demonstrated high specificity (87%) and a positive predictive value of 92% to differentiate cSCC and KA from actinic keratosis (AK) and BD [12]. White clods [12], also known as keratinizing pearls [24], are white-yellowish rounded structures characteristic of well-differentiated cSCC. White clods correspond to concentric neoplastic squamous cells, with increased keratinization toward the center [23,24].

The progression from a well-differentiated to a poorly differentiated cSCC (Figure 2D) typically corresponds to a shift from white-yellow keratinizing features to red, vascular-rich patterns marked by hemorrhage and increased vascular polymorphism. Furthermore, poorly differentiated cSCC are often clinically flat lesions [19].

Poorly differentiated cSCC appears predominantly red due to reduced keratinization and the presence of dense, disorganized vascular networks [13,19]. The vascular pattern is polymorphic, with branched and serpentine vessels [2] that become more prominent with tumor depth.

In addition, a significant increase in vessel density (>50 vessels per lesion) is identified, which markedly contrasts with the sparse vascularity (1–10 vessels) of well-differentiated cSCC [18,19]. Bleeding is also more common, underscoring tumor aggressiveness [13].

Pyne et al. [18] were the first to systematically assess vascular patterns in relation to cSCC differentiation, reporting that well-differentiated cSCCs predominantly displayed dotted vessels (85.9%) and glomerular vessels (50.9%) (Table 4). These features significantly decreased in non-well-differentiated tumors (82.0% and 38.5%, respectively;

Table 4. Dermoscopic cSCC features across different grades of differentiation.

			Vascular Pattern									Features of keratinization					Predominant Pattern	
		Cases	Dotted vessels	Glomerular vessels	Hairpin vessels	Comma vessels	Linear irregular vessel	Linear regular vessel	Arborizing vessels	Polymorphous vasculature	Diffuse vessels distribution	Whitish scales	Central Keratin distribution	Diffuse Keratin distribution	White circles	Whitish structureless areas	White/Yellow	Pink/ Red
El-Ammari et al.	Well differentiated	59	44 (74.6%)	36 (61%)	44 (74.6%)	9 (15.3%)	50 (84.7%)	8 (13.8%)	11 (18.6%)	54 (91.5%)	40 (67.8%)	44 (74.6%)	39 (69.6%)	17 (30.4%)	44 (74.6%)	49 (83.1%)	38 (64.4%)	3 (5.1%)
	Non-well differentiated	13	5 (38.5%)	3 (23.1%)	5 (38.5%)	4 (30.8%)	11 (84.6%)	0 (0.0%)	9 (69.3%)	12 (92.3%)	8 (61.5%)	5 (38.5%)	3 (37.5%)	5 (62.5%)	4 (30.8%)	5 (38.5%)	3 (23.1%)	2 (15.4%)
	P-value		0.016	0.014	0.016	0.176	0.637	0.180	0.001	0.705	0.448	0.016	0.045		0.004	0.002	0.022	
Lallas et al.	Well differentiated	48	20 (41.7%)*		16 (33.3%)*		17 (35.4%)*			14 (29.2%)	9 (18.8%)	38 (79.2%)	27 (56.3%)	8 (16.7%)	18 (37.5%)	25 (52.1%)	45 (93.7%)	1 (2.1%)
	Moderately Differentiated	45	22 (48.9%)*		8 (17.8%)		24 (53.3%)*			16 (35.6%)	19 (42.2%)	33 (73.3%)	18 (40.0%)	9 (20.0%)	14 (31.1%)	13 (28.9%)	37 (82.2%)	4 (8.9%)
	Poorly Differentiated	50	22 (44.0%)*		7 (14.0%)		37 (74.0%)*			53 (37.1%)	44 (88.0%)	9 (18.0%)	1 (2.0%)	4 (8.0%)	3 (6.0%)	5 (10.0%)	4 (8.0%)	40 (80.0%)
	P-value		0.78		0.05		<0.01			0.22	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	
Pyne et al.	Well Differentiated	255	219 (85.9%)	130 (50.9%)	135 (52.9%)*		96 (37.6%)	69 (27.1%)	7.5%	Present								
	Non-well differentiated	39	32 (82.0%)	15 (38.5%)	28 (71.8%)*		24 (61.5%)	16 (41.0%)	11 (28.2%)	Present								
	P-value						<0.005		<0.001	<0.01								
Manfredini et al.	Well/ moderately differentiated	40	15 (37.5%)							21 (52.5%)		21 (52.5%)	8 (20.0%)		16 (40.0%)	31 (77.5%)		26 (65.0%)
	Poorly differentiated	11	4 (36.4%)							9 (81.8%)		7 (63.6%)	1 (9.1%)		2 (18.2%)	5 (45.4%)		11 (100%)
	P-value		0.63							0.06		0.37	0.63		0.56	0.04		

N (%) presented in each box, unless otherwise stated.

*Authors did not separately distinguish between the two features.

P<0.005). Later, Lallas et al. [19] confirmed that well-differentiated cSCCs were strongly associated with scales (79.2%), centrally located keratin (56.3%), white circles (37.5%), perivascular whitish halos (39.6%), and whitish structureless areas (52.1%). Expanding on these findings, Manfredini et al. [21] demonstrated that poorly differentiated cSCCs showed a marked increase in polymorphic vessels (81.8% vs. 52.5% in well/moderately differentiated) and predominant red patterns (100% vs. 65%), reinforcing the progressive disorganization of vascular and keratin features with tumor dedifferentiation. An additional study by El Ammari et al. [14] confirmed that, compared to non-well-differentiated tumors, well-differentiated cSCCs had significantly higher frequencies of dotted vessels (74.6% vs. 38.5%), glomerular vessels (61% vs. 23.1%), and diffuse vessel distribution (74.6% vs. 38.5%). Conversely, non-well-differentiated lesions showed a higher prevalence of linear irregular vessels (84.6% vs. 13.8%) [14].

Discussion

Cutaneous SCC encompasses a spectrum of lesions that arise from transformed keratinocytes within the epidermis, ranging from in situ disease to fully invasive, moderately or poorly differentiated cSCCs [17-19]. Although these subtypes share certain clinical and histopathological similarities, their dermoscopic features can differ significantly, providing critical clues for correct identification and management (Figure 3). Moreover, inflammatory dermatoses such as psoriasis, lichen planus, and lupus-can also present with vascular patterns that may mimic cSCC, necessitating a detailed comparative approach to improve diagnostic specificity [33,35].

BD is clinically characterized by a solitary red or brown patch or plaque with well-defined borders and whitish scales and located on sun-exposed areas. Clinical differential diagnosis may include, among others, warts and psoriasis. Dermoscopically, dotted or glomerular vessels associated with scales are distinctive of BD [16,25,32]. A classification scheme focusing on vessel arrangement and scaling patterns could facilitate the discrimination of BD from psoriasis, superficial BCC, and other red, scaly dermatoses [16,20]. Benign lesions exhibit a wide range of vascular patterns, but they often appear homogeneously distributed within the lesion, and scaling is typically more uniform than in cSCC [27,33]. Thus, thorough examination of the vessel distribution, presence of keratin plugs, and lesion architecture can differentiate inflammatory from neoplastic conditions [34].

The emergence of central keratin plugs, ulceration, hyperkeratosis, and polymorphic vessels characterizes the progression toward invasive cSCC [13, 14].

When evaluating a clinically suspicious hyperkeratotic nodule, it is crucial to assess both vascular pattern (e.g., linear-irregular, dotted, or glomerular vessels) and keratin-related features (such as central keratin plugs and surface scale) [12]. The specific arrangement of vessels and the presence or absence of central keratin allow to differentiate between BD, KA, and invasive cSCC.

KA is clinically distinguished by its rapid growth and a classic dome-shaped or crateriform appearance [17,22,37]; under dermoscopy it typically shows a crater-like keratin core, appearing as a central mass of yellowish-white scales or keratin [22]. Glomerular, linear irregular, radially oriented hairpin vessels and atypical vessels are often found in keratinizing lesions; however, compared to AK and BD, invasive SCCs and KAs develop a more polymorphic vascular pattern, with an increased frequency of hairpin and linear irregular vessels [22]. When comparing the dermoscopic vascular features of KA and invasive cSCC, KAs typically exhibit a more symmetrical and well-organized vessel distribution. Hairpin vessels, often with whitish halos, are commonly arranged in a structured, symmetrical pattern around the central keratin plug [18,22]. In contrast, poorly differentiated invasive cSCC presents with polymorphic and more chaotic vascular patterns [37]. However, histopathological correlation is often necessary, especially if there is any suspicion of progression or if the lesion lacks the classic "volcano-like" clinical morphology [18, 36].

Invasive cSCC has a polymorphic vascular pattern: hairpin, glomerular, serpentine, and linear-irregular capillaries may coexist within the same lesion, reflecting an increasingly disorganized tumor vasculature [18,19]. Hyperkeratosis is typically prominent, sometimes forming a central keratin plug or mass, and may be interspersed with necrotic spots or hemorrhagic crusts, indicating deeper tissue destruction. White circles (dilated follicular openings with central keratin) [12,13] and white clods (aggregates of hyperkeratotic material) can be observed [12,23,24]. White or yellowish structureless zones can also appear, corresponding to keratin or necrotic areas [18,19]. In well-differentiated cSCC, hairpin vessels with a relatively organized or peripheral distribution may predominate, whereas poorly differentiated tumors frequently exhibit more pronounced ulceration or necrotic crusts, leading to visible areas of hemorrhage [14,19].

Conclusion

In conclusion, dermoscopic examination of cSCC provides valuable insights into tumor differentiation and progression. Characteristic features such as keratin plugs, scales, white circles, hairpin vessels, glomerular vessels, and linear-irregular vessels can guide clinicians toward a more accurate diagnosis. Furthermore, advances in dermoscopy allow a more nuanced understanding of the morphological variations within cSCC subtypes. The identification of subtypes

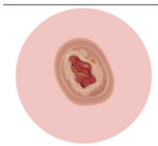
	Dermoscopic Criteria	Definition	Histopathological Correlate
	Keratin/Scales	Amorphous, yellow-white to light-brown areas without any recognizable structure	Parakeratosis and Hyperketatosis
	White Circles	Bright white (keratotic) plugs encircling a dilated follicular opening, mostly over a white structureless area	Acanthosis and hypergranulosis of the infundibular epidermis; typically associated with well-differentiated cSCC
	Erosion/Ulceration	Structureless dark red to brown areas with a serous crust.	Erosion: loss of the epidermis; ulceration: loss of the epidermis and superficial dermis
	Rosettes	Four round bright white dots arranged in a four-leaf clover pattern	Hyperkeratosis of the follicular open
	White Clods	White rounded structures	Keratin Pearls (whorl-shaped, concentric rings of keratin around a central core, typically seen in histopathological examination of well-differentiated cSCC)
	Harpin Vessels	Vascular loops, usually surrounded by whitish halo	
	Linear-irregular vessels (serpentine)	Linear or slightly curved, irregularly shaped, sized and distributed red structures	
	Glomerular/Coiled Vessels	Tortuous Capillaries	

Figure 3. Dermoscopic criteria of cSCC and their histopathological correlate [43].

of vascular patterns and keratinization has been pivotal in differentiating between well-differentiated and poorly differentiated forms of cSCC, which has profound implications for treatment decisions and prognostic evaluations. For instance, assessment of tumor differentiation can directly inform the choice of excision margins, favoring narrower margins in well-differentiated tumors and wider margins in poorly differentiated ones, reducing the reliance on preliminary biopsies [38, 39]. Moreover, accurately distinguishing BD from invasive cSCC by dermoscopy may obviate, in selected cases, the need for surgery, allowing for less-invasive treatments such as photodynamic therapy [40].

However, this review has several limitations: there was significant heterogeneity among the studies related to

interobserver variability and the absence of standardized, consensus-based lexicon [32]; most included studies were retrospective case series with small sample sizes (often <100 lesions), and the vast majority of data derive from fair-skinned (Fitzpatrick I–III) populations, limiting applicability to darker skin types.

As we move forward, integrating dermoscopy with other diagnostic modalities, such as confocal microscopy (RCM) and line-field confocal optical coherence tomography (LC-OCT), [37] will enhance our diagnostic capabilities and enable in vivo visualization of the histopathological correlates of dermoscopic features, effectively bridging the gap between non-invasive imaging and conventional histopathology [41, 42]. Moreover, longitudinal studies and multicenter collaborations are needed to establish standardized dermoscopic criteria for cSCC that can be universally applied across different skin types and clinical settings. This comprehensive approach will not only strengthen the diagnostic process but also streamline therapeutic strategies, ultimately improving patient care in dermatological practice.

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