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Benign Keratosis: A Useful Term?

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ABSTRACT

Introduction: Seborrheic keratosis (SK), lichen planus-like keratosis (LPLK), and solar lentigo (SL) are common benign skin lesions. These lesions are frequently seen adjacent to each other or can arise from one another. They can sometimes be difficult to differentiate despite having distinct histopathological features.

Objectives: We evaluated dermoscopic images of 80 skin lesions to confirm the term 'benign keratosis' is useful for an undifferentiated SK/LPLK/SL where there are overlapping clinical and dermoscopic characteristics.

Methods: Clinical and dermoscopic images were sourced from a teledermoscopy service database of 13,000 lesions in 7,000 patients. The database was queried for SK, SL or LPLK in sun-exposed sites. Each lesion was evaluated based on specific dermoscopic criteria and the results analyzed.

Results: Lesions were identified with mixed clinical and dermoscopic criteria of SK and SL, and in some, dermoscopic criteria for LPLK were also present.

Conclusions: This study highlights the relationship between these lesions. We confirm the term 'benign keratosis' is useful for mixed lesions or for those that are difficult to classify.

Introduction

Seborrheic keratosis (SK), solar lentigo (SL) and lichen planus-like keratosis (LPLK, also known as lichenoid keratosis), can be difficult to differentiate although each has defined clinical and dermoscopic characteristics [1]. The histopathological features of SK, LPLK and SL differ but as they are benign, only those suspicious of melanoma are subjected

to biopsy. An SK can arise from an SL and an LPLK can arise from an SL or from an SK. There is limited research linking these three lesions [2].

The International Skin Imaging collaboration (ISIC) aims to improve early melanoma detection [3]. ISIC has hosted challenges since 2016 covering lesion segmentation, detection of clinical diagnostic patterns, and lesion classification with the purpose of developing computer-based image analysis tools. The 2019 ISIC challenge classified pigmented lesions into 9 diagnostic categories including 'benign keratosis' (seborrheic keratosis, solar lentigo, and lichen planus-like keratosis) [4]. The ISIC public-access archive includes more than one thousand dermoscopic images classified as 'benign pigmented keratosis' [5].

However, the term 'benign keratosis' is not well known by dermatologists. The classification of these entities by clinical terminology tools is inconsistent.

- ICD-11 (version 09/2020) lists all three entities within the benign squamous cell neoplasm category (seborrheic keratosis XH0949, solar lentigo XHB58, lichen planus-like keratosis XH63L8), and includes a separate entry for benign keratosis, NOS (XH0S03).
- ICD-11 also lists seborrheic keratosis and lichen planus-like keratosis within benign keratinocytic acanthoma (2F21) and solar lentigo within photoaging of the skin (EJ20) [6].
- The SNOMED International SNOMED CT browser (31 January 2021 edition) does not link seborrheic keratosis (disorder code SCTID: 394726009) and solar lentigo (disorder code SCTID: 72100002), and lichenoid keratosis is classified as lichenoid actinic keratosis (SCTID: 403198004) [7].

SK is a common benign epidermal age-related proliferation of keratinocytes [8]. SK can occur anywhere on the body sparing the mucous membranes, palms and soles. There are several histological subtypes which often overlap; they are characterized by acanthosis, papillomatosis, hyperkeratosis and the presence of pseudocysts [9].

SL is a macular hyperpigmented lesion linked to chronic sun exposure. Typical histological features are acanthosis with elongated epidermal ridges with accompanying actinic elastosis [10].

LPLK, also known as lichenoid keratosis, is thought to represent an inflammatory regressive response to a pre-existing cutaneous lesion. The pathogenesis is not completely understood, however most literature suggests LPLK is a regressive form of benign epithelial neoplasm such as an SK or SL [11-13]. LPLK lesions can be seen in multiple regressive stages and therefore can often be confused with other skin tumors including basal cell carcinoma and melanoma [14]. Histological features are lichenoid lymphocytic infiltrate, hyperkeratosis with focal parakeratosis, variable hypergranulosis and focal acanthosis. Eosinophils and plasma cells with Civatte bodies are also noted [15].

A link between SL and SK was supported by histological evidence of transformation in 50 cases, and histological SL was documented at the periphery of 50 specimens of LPLK [16]. Biopsies taken from a solitary lesion 5 years apart reported the evolution of a SL into a solitary LPLK [17]. In a series of 100 cases of LPLK evaluated by histology, 28% had an adjacent skin lesion, most commonly SK (8.4%), SL (7%) and actinic keratosis (5.6%) [18]. A further clinicopathologic review of LPLK cases confirmed the most frequently seen adjacent lesions were SL (73%) and SK (6.5%) [2]. Gene mutations (FGFR3 and PIK3CA) have been identified in SL and SK to support a link between them [14].

Objectives

The main objective of the study was to confirm the term 'benign keratosis' is useful, by comparing the clinical and dermoscopic features of typical SK,SL, LPLK and lesions in which overlapping features were present.

Methods

Clinical and dermoscopic images were sourced from a teledermoscopy service database of 13,000 lesions in 7,000 patients [19]. The database was queried for SK, SL or LPLK in sun-exposed sites (scalp, ears, face) (Table 1). Non-randomized lesions were selected that had good quality clinical images typical for SK (N=20), SL (N=20), LPLK (N=20) or having mixed clinical features (N=20), ie SK+SL+/-LPLK), matched for anatomical area and camera (3Gen DermLiteCam V1). Lesions identified as clinically 'benign' were not formally excised, therefore histopathological findings were not available. Each lesion was evaluated using specific dermoscopic criteria for SK, SL, and LPLK (1) (Table 2).

Results

The 80 lesions evaluated were associated with 440 macroscopic, polarized and nonpolarized dermoscopic images (Table 3).

Dermoscopic Criteria of Seborrheic Keratosis (Table 4)

Analysis of SKs revealed that:

- SKs exhibited an average of 3.3 SK criteria.
- Three or more of the five SK criteria were present in 17/20 SKs.
- 'Sharply demarcated border' and 'lines curved and thick (cerebriform)' were each present in 19/20 SKs.

Table 1. Original database collection with patient demographics.

SK Lesion ID	Body site	Age	Patient sex	LPLK Lesion ID	Body site	Patient age	Patient sex
24850537	Left Upper back	87	M	24780438	Left upper back	70	F
44910174	Left Cheek	82	M	15450188	Left cheek	38	F
14640187	Right cheek	66	M	35290193	Right cheek	52	F
14900432	Mid Chest	77	F	14920465	Mid chest	67	F
35110201	Right cheek	75	F	14570191	Right cheek	69	F
45100170	Left Cheek	75	F	44850167	Left cheek	45	F
14610177	Right cheek	65	M	35250227	Right Cheek	47	F
51211379	Right hand	84	M	51741276	Right hand	60	F
47130490	Left upper arm	58	M	46600410	Left upper arm	81	M
34380315	Right neck	38	F	15820368	Right neck	52	F
48560695	Left forearm	89	F	16680881	Left forearm	70	F
44790182	Left Cheek	83	M	44801214	Left cheek	60	F
44930198	Left Cheek	58	F	44750172	Left cheek	71	F
44660189	Left Cheek	77	F	44700216	Left cheek	48	F
35260188	Right cheek	59	F	34970157	Right cheek	63	F
14970432	Mid Chest	59	M	15320478	left upper chest	64	M
16750846	Left forearm	63	M	16790910	Left forearm	64	F
51801330	Right hand	42	F	51931525	Right hand 4th finger	58	F
34870181	Left Cheek	68	M	15300153	Left cheek	59	F
45230235	Neck	69	F	15310170	Left cheek	63	F
SL Lesion ID	**Body site**	**Patient age**	**Patient sex**	**Mixed Lesion ID**	**Body site**	**Patient age**	**Patient sex**
24620618	Left upper back	67	M	24850385	Left upper back	68	M
44740194	Left cheek	81	M	15440181	Left cheek	70	M
35110178	Right cheek	49	M	34980167	Right Cheek	37	F
14950448	Mid chest	47	F	14960432	Mid Chest	46	F
35100193	Right cheek	39	F	35080213	Right cheek	64	F
44750190	Left cheek	62	F	15390168	Left Cheek	47	F
34880184	Right Cheek	75	M	35330191	Right Cheek	76	F
51471278	Right hand	54	M	52371244	Right hand	59	F
33280410	Right upper arm	73	F	16560640	Left upper arm	61	M
34370315	Right neck	61	F	34580281	Right neck	67	F
16840842	Left forearm	79	M	48630614	Left forearm	61	F
44710174	Left cheek	62	F	15250173	Left cheek	78	M
44700165	Left cheek	68	F	44970179	Left cheek	55	F
15260148	Left cheek	39	F	44860211	Left cheek	73	F
34960200	Right cheek	59	F	34960171	Right cheek	75	F
14920475	Mid chest	69	M	15040477	Mid Chest	81	F
16680805	Left forearm	67	F	16860875	Left forearm	65	F
51351218	Right hand	48	F	51731242	Right hand	69	F
15410175	Left cheek	42	F	44940182	Left cheek	60	F
45270290	Neck	59	F	45180268	Right lateral neck	61	F

Table 2. Dermoscopic criteria for seborrheic keratosis, solar lentigo, and lichen planus-like keratosis.

Seborrheic Keratosis	Solar Lentigo	Lichen planus-like Keratosis
• Sharply demarcated border • Dots or clods white clustered or disseminated • Clods brown-yellow or orange (rarely black) • Lines curved and thick • Lines brown curved parallel thin	• Sharply demarcated • Scalloped border • Homogenous brown pigmentation • Homogenous and structureless pigmentation • Faint reticulation • Fine parallel lines • Fine parallel lines • Ink spot lentigo excluded	• Fine scale • Polymorphous vessels • Dotted vessels • Gray dots • Diffuse gray dotted pattern • Color (white, pink, red, orange, purple, blue-gray, black, light brown, dark brown) • Color red excluded

Table 3. Average number of dermoscopic criteria present in SK/SL/LPLK lesion group.

Lesion type	SK Criteria	SL Criteria	LPLK Criteria
SK	3.3/5 (66%)	1.8/6 (31%)	0.0/5 (0%)
SL	2.0/5 (40%)	5.3/6 (88%)	1.0/5 (2%)
LPLK	0.6/5 (12%)	2.4/6 (34%)	1.8/5 (35%)
Mixed	3.75/5 (75%)	4.4/6 (73%)	0.6/5 (12%)

LPLK = Lichen-planus like keratosis; SK = Seborrheic keratosis; SL = Solar lentigo.

- 'Clods brown-yellow or orange (rarely black)' were present in 16/20 SKs.
- 'Dots or clods white clustered or disseminated' and 'lines brown curved parallel thin' were present in 6/20 SKs.

SK criteria were less common in SLs with the exception of 'Sharply demarcated border' seen in 18/20, a shared characteristic of SL lesions. 'Lines curved and thick (cerebriform)' and 'Lines brown curved parallel thin' were seen in 8/20 and 10/20 SL lesions consecutively.

Table 4. Dermoscopic criteria for seborrheic keratosis in various clinically diagnosed lesions.

Lesion Type	Sharply demarcated border	Dots or clods white clustered or disseminated	Clods brown, yellow or orange (rarely black)	Lines curved and thick (cerebriform)	Lines brown curved parallel thin
SK	19/20 (95%)	6/20 (30%)	16/20 (80%)	19/20 (95%)	6/20 (30%)
SL	18/20 (90%)	2/20 (10%)	2/20 (10%)	8/20 (40%)	10/20 (50%)
LPLK	6/20 (30%)	0/20 (0%)	2/20 (10%)	4/20 (20%)	0/20 (0%)
Mixed	19/20 (95%)	11/20 (55%)	17/20 (85%)	16/20 (80%)	12/20 (60%)

LPLK = Lichen-planus like keratosis; SK = Seborrheic keratosis; SL = Solar lentigo.

Table 5. Dermoscopic criteria for solar lentigo in various clinically diagnosed lesions.

Lesion Type	Sharply demarcated border	Homogenous brown pigmentation	Structureless (~10%)	Faint reticulation (criss-cross network)	Scalloped border	Fine lines parallels
SK	19/20 (95%)	2/20 (10%)	0/20 (0%)	4/20 (20%)	7/20 (35%)	4/20 (20%)
SL	18/20 (90%)	17/20 (85%)	16/20 (80%)	20/20 (100%)	20/20 (100%)	13/20 (65%)
LPLK	6/20 (30%)	0/20 (0%)	18/20 (90%)	9/20 (45%)	14/20 (70%)	0/20 (0%)
Mixed	19/20 (95%)	0/20 (0%)	17/20 (85%)	16/20 (80%)	19/20 (95%)	15/20 (75%)

LPLK = Lichen-planus like keratosis; SK = Seborrheic keratosis; SL = Solar lentigo.

SK features were present to a lesser degree in LPLK lesions. A 'Sharply demarcated border' was present in 6/20 LPLKs, 'Lines curved and thick (cerebriform)' in 4/20 and 'Clods brown-yellow or orange (rarely black) were present in 2/20. No LPLKs had 'dots or clods white clustered or disseminated' or 'lines brown curved parallel thin'.

All 5 SK criteria were present in 6/20 of the mixed lesions; 19/20 had a 'sharply demarcated border' and 'dots or clods white clustered or disseminated', 'clods brown-yellow or orange (rarely black)' and 'lines brown curved parallel thin' were commonly seen.

- The mixed lesion group had an average of 75% SK criteria.
- The SL and LPLK groups had an average of 40% and 12% SK criteria respectively.

Dermoscopic Criteria of Solar Lentigo (Table 5)

Analysis of SLs revealed that:

- SLs exhibited an average of 5.28 SL criteria.
- Four or more of the SL criteria were present in 19/20 SL lesions.
- 'Faint reticulation' and 'scalloped border' were each present in all 20 SL lesions.
- 'Homogenous brown pigmentation' was present in 17/20 SL lesions.
- 'Structureless (amalgamate homogenous and structureless pigmentation)' was present in 16/20 lesions and 'fine lines parallel' was present in 14/20 lesions.

SL criteria were less common in the SK group except for 'sharply demarcated border', which was present in 19/20 SL lesions. 'Faint reticulation' and 'scalloped border' were seen in 4/20 and 7/20 SK lesions consecutively.

Certain SL criteria were high in LPLK lesions. 'Structureless (amalgamate of homogenous and structureless pigmentation)' was present in in 18/20 and 'scalloped border' in 14/20 LPLK lesions. 'Homogenous brown pigmentation' and 'fine lines parallel' were present in none of the LPLKs.

All mixed lesions had three or more SL criteria. None had 'homogenous brown pigmentation'. 'Scalloped border' was present in 19/20 and 'structureless' in 17/20 of mixed lesions.

- The mixed lesion group had an average of 73% SL criteria.
- The SL and LPLK groups had an average of 88% and 34% SL criteria respectively.

Dermoscopic Criteria of Lichen Planus-Like Keratosis (Table 6)

- LPLKs exhibited an average of 1.75 LPLK criteria:
- 'Diffuse gray dotted pattern' was present in all 20 LPLK lesions.
- 'Gray dots' were present in 10/20 LPLK lesions.
- There were no 'polymorphous vessels' in LPLK lesions and 'fine scale' was present in only 1/20 LPLK lesions.

No LPLK criteria were present in SK lesions. SL findings were less common also with 3 out of the 5 criteria having

Table 6. Dermoscopic criteria for lichen planus-like keratosis in various clinically diagnosed lesions.

Lesion Type	Fine scale	Polymorphous vessels	Dotted vessels (small red dots)	Gray dots	Diffuse gray dotted pattern
SK	0/20 (0%)	0/20 (0%)	0/20 (0%)	0/20 (0%)	0/20 (0%)
SL	0/20 (0%)	0/20 (0%)	0/20 (0%)	1/20 (5%)	1/20 (5%)
LPLK	1/20 (5%)	2/20 (10%)	2/20 (10%)	10/20 (50%)	20/20 (100%)
Mixed	3/20 (15%)	0/20 (0%)	0/20 (0%)	4/20 (20%)	4/20 (20%)

LPLK = Lichen-planus like keratosis; SK = Seborrheic keratosis; SL = Solar lentigo.

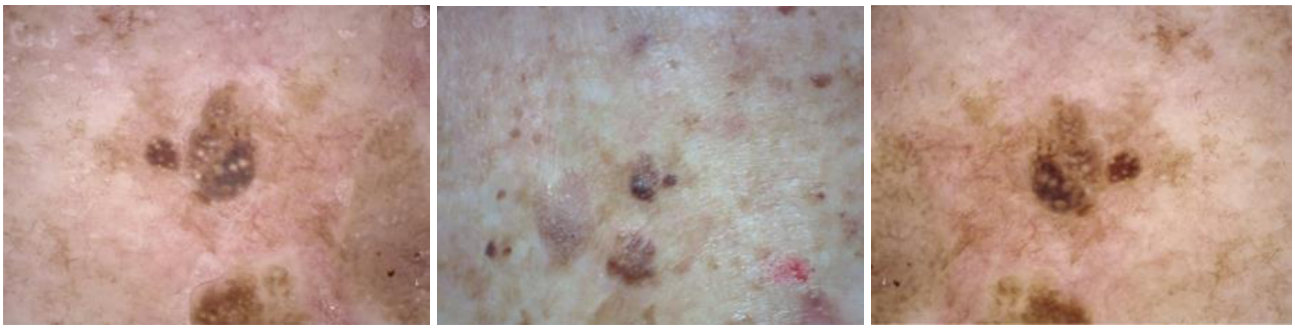

Figure 1. Mixed Lesion displaying appearance of SK arising from SL. Lesion ID 15040477. Dermoscopy features —sharply demarcated border, dots or clods white clustered or disseminated, clods brown yellow or orange (rarely black), Lines curved and thick (cerebriform), lines brown curved parallel thin, faint reticulation (criss-cross network), scalloped border, fine lines parallels.

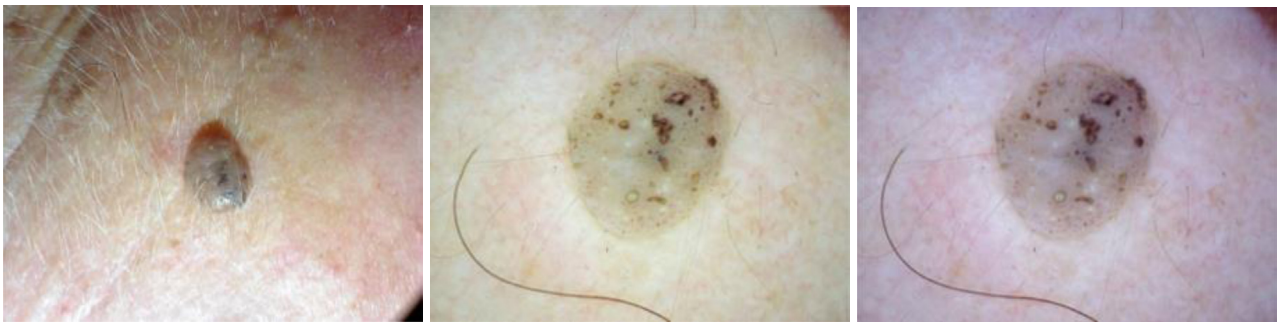

Figure 2. Seborrhoeic Keratosis classical lesion. Lesion ID 35110201. Dermoscopy features — sharply demarcated border, dots or clods white clustered or disseminated, clods brown-yellow or orange (rarely black), lines curved and thick (cerebriform), lines brown curved parallel thin.

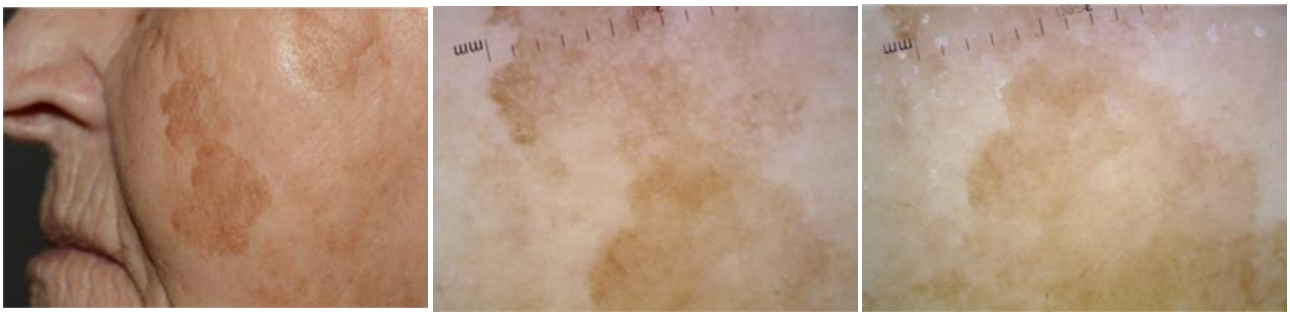

Figure 3. Solar Lentigo classical lesion. Lesion ID 44740194. Dermoscopy features — sharply demarcated border, homogenous brown pigmentation, structureless (approx. 10%), faint reticulation (criss-cross network), scalloped border, fine lines parallel.

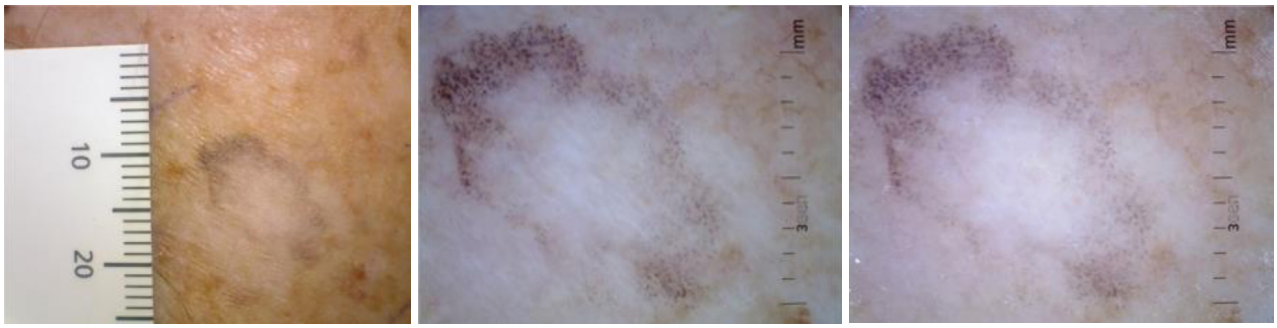

Figure 4. Lichen Planus-like Keratosis classical lesion. Lesion ID 46600410. Dermoscopy features — structureless (approx. 10%), faint reticulation (criss-cross network), scalloped border, grey dots, diffuse grey dotted pattern.

a 0/20 result. 'Gray dots' and 'Diffuse gray dotted pattern' were present in no SL lesions.

LPLK criteria were more common in the Mixed lesions compared to classic SL and SK. 'Diffuse gray dotted pattern' and 'Gray dots' were seen in 4/20 Mixed lesions.

Conclusions

Analysis of the lesions selected for this study confirms that the specific dermoscopic criteria suggested in dermoscopedia for SK, SL and LPLK can be observed in the other clinically diagnosed lesions [1].

Our clinically selected SL and Mixed lesions displayed the highest number of listed dermoscopic criteria followed by SK and LPLK lesions. We found that dermoscopic criteria for clinically typical SL and SK overlap. 'Sharply demarcated border' was found in 19/20 (95%) of SKs and 18/20 (90%) of SLs. The SK features, 'lines curved and thick (cerebriform)' and 'lines brown curved parallel thin' were commonly seen in SL. SL features of 'faint reticulation' and 'scalloped border' were found in otherwise typical SK.

'Sharply demarcated border' was present in 19/20 of the mixed group which correlates with these lesions being predominantly SL or SK. The mixed lesions displayed significant findings for both SK and SL criteria, and LPLK criteria were less common. SK criteria had the highest result with an average of 3.4/5 (74%) of mixed lesions displaying SK criteria. Three out of five SK criteria had higher overall findings in Mixed lesions than in the SK group. SL criteria were also common with an average of 4.4/6 (73%) of Mixed lesions. Mixed lesions chosen had less LPLK criteria at 0.6/5 (12%).

'Dots or clods white clustered or disseminated' are typical of SK but in our sample, this feature was present in 11/20 Mixed lesions and in fewer SK lesions (6/20). It may be a less common characteristic of SK or reflect the small sample size. As expected, few LPLK lesions exhibited SK criteria. A 'sharply demarcated border' was seen in 30% of LPLKs. We noted that 2/20 of the clinically typical SK lesions with the lowest positive result for SK criteria had a thick scale reducing dermoscopic feature detail.

The SL criterion 'scalloped border' was present in all 20 SL and Mixed lesions. 'Faint reticulation' was seen in 16/20 Mixed lesions. LPLK lesions also displayed SL features. A high percentage of classic LPLK lesions displayed specific SL criteria including 'Structureless' (18/20), 'Scalloped border' (14/20) and 'faint reticulation (criss-cross network)' (9/20). LPLK may arise from an SL with sections of the lesion representing regressive structures of SL. 'Faint reticulation' and 'scalloped border' were seen in all 20 SL lesions confirming that these criteria have high specificity to SL. 'Homogenous brown pigmentation' showed high specificity in SL lesions and was uncommonly observed in other lesion groups. This is a classical feature of an SL; the mixed lesions had a combination of features and therefore could not be classified as 'homogenous'.

The key dermoscopic features in the LPLK Lesions were 'diffuse gray dotted pattern 'in all 20 classic LPLK lesions and 'gray dots' in 10/20. LPLK lesions are most easily clinically recognised in the late regressive stage as early phase lesions are nonspecific. Only 2/20 LPLK lesions in our selective sample displayed 'polymorphous vessels' and 'dot vessels'. 'Fine scale' was not displayed within any LPLK lesions however was noted in 3/20 mixed lesions. Fine scale was difficult to detect on the clinical and dermoscopic images as a contact fluid had been applied. The largest color variation group seen in LPLK was 'light brown/grey' in 11/20 LPLK lesions and reflects the classic regressive features in this sample of LPLK lesions. 'Light brown/dark brown were most common in the SK, SL and Mixed groups. Few LPLK features were present in classic SL or SK lesions, however SK and SL features were displayed in LPLK lesions. SL criteria were more common with an average of 2.4/6 (34%) features present. SK features were also seen with 'lines curved and thick (cerebriform) seen in 4/20 lesions and the common SL/SK feature of 'sharply demarcated border' seen in 6/20 lesions. This indicates overlap between these lesions.

Mixed lesions displayed evidence of end-stage regressive LPLK features with the commonest features present being 'Gray dots' (4/20) and 'Diffused gray dotted pattern' (4/20). Other features were infrequent. Mixed lesions displayed a high proportion of SL/SK criteria alongside these regressive LPLK findings. This points to a relationship between the evolution of these lesions as previously documented in the literature.

Benign keratoses arise in most older people. Lesions we had clinically diagnosed as SK had overlapping dermoscopic criteria for SL, and others we diagnosed as SL had dermoscopic criteria for SK. We identified some lesions with mixed clinical and dermoscopic criteria of SK and SL, and in some, dermoscopic criteria for LPLK were also present. This study highlights the relationship between these lesions. We can confirm that the term 'benign keratosis' would be useful for mixed lesions or for those that are difficult to classify. This would include lesions with overlapping SL and SK features and those with features of intermediate or end-stage regressive LPLK features wherein the features of origin are characteristic of a primary SL or SK.

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