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REVIEW ARTICLE

Optical coherence tomography imaging of melanoma skin cancer

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Abstract

No consensus guidelines exist on the use of optical coherence tomography (OCT) for diagnosis of cutaneous melanoma. The objectives of this review are to provide a descriptive review of the literature on characteristics of cutaneous melanomas seen on high-definition OCT (HD-OCT), speckle variance OCT (SV-OCT), and conventional OCT and to compare their diagnostic ability with that of histopathology. A review of PubMed and Google Scholar identified all available literature on OCT in melanoma skin cancer that included all in vivo and ex vivo studies on human or human tissues and excluded all studies on non-human subjects or animal studies. Two hundred nine abstracts were considered for evaluation, 31 abstracts were selected for manuscript review, and 14 abstracts were included that met all criteria. Diagnoses of MIS and MM using HD-OCT and SV-OCT were consistently reported to correlate with histopathology. However, accuracy of diagnosis using conventional OCT varied. Most authors agreed that it was difficult to differentiate MM from benign nevi using conventional OCT. HD-OCT, SV-OCT, and conventional OCT show promise for visualizing cutaneous melanoma. The use of OCT in diagnosis of melanoma is rarely reported in the literature. There is a need to increase and standardize reporting of OCT for diagnosis of cutaneous melanoma.

Keywords Optical coherence tomography · Melanoma · Skin cancer · Diagnosis

Introduction

The Centers for Disease Control and Prevention (CDC) estimated the melanoma incidence rate at 19.7 per 100,000 individuals living in the USA and projects an increase in incidence for white males and females through 2019 [1]. According to the Surveillance, Epidemiology, and End Results (SEER) program, new melanoma cases have risen 1.5% each year over the past 10 years and are estimated to comprise 5.4% of all new cancer cases in the USA in 2018 [2].

To date, biopsy and subsequent histologic examination by either whole slide imaging or traditional microscopy have been the gold standard for definitive diagnosis of melanoma [3]. However, biopsy has potential complications such as hypersensitivity to anesthetic, bleeding, scarring, and infection secondary to the invasive procedure [4]. To date, noninvasive imaging techniques have been developed to improve the diagnostic accuracy and sensitivity for skin tumors. In vivo assessment of skin offered through noninvasive imaging allows for a view of skin devoid of iatrogenic trauma, which results from biopsy of the skin [5]. These advanced methods include confocal scanning laser microscopy (CSLM), ultrasonography, and optical coherence tomography (OCT), among several others.

OCT in particular provides a promising future for the detection of melanoma skin cancers. OCT was developed in the late 1980s and was originally used in the field of ophthalmology [6, 7]. OCT is a laser-based imaging modality that is centered on Michelson interferometry and uses infrared light [8] to derive cross-sectional two-dimensional and three-

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dimensional images of backscattered light from tissue [9]. Light from an optical source is coupled into optical fibers and then divided in two directions [10]. One direction is toward the tissue sample and the other to a reference mirror [8]. Photons from the skin, which are "backscattered," recombine with the reference signal [10]. When the lengths of the two paths are matched at the coherence length, an interference signal is formed [8]. Today, OCT shows promise in identifying a variety of diseases. Studies have shown that OCT has improved diagnostic efficacy in cervical neoplasia [11], gastrointestinal disease [12], and oral malignancies [13, 14].

Noninvasive modalities may yield earlier detection of melanomas, which may in turn improve survival in melanoma patients. Throughout this article, the role of OCT in the diagnosis of melanoma is further explored. Specific characteristics of melanoma observed via three OCT imaging systems, high-definition optical coherence tomography (HD-OCT), speckle variance optical coherence tomography (SV-OCT), and conventional optical coherence tomography (conventional OCT), are assessed based on published reports. The aim of this descriptive literature review is to compile the existing data to describe characteristics of melanoma seen on OCT based on the current literature.

Methods

A priori inclusion and exclusion criteria were established to select studies evaluating OCT in melanoma skin cancer. To the best of our knowledge, all in vivo and ex vivo studies on human or human tissues in the English language were included in this descriptive review. Studies were excluded if the patient population did not consist of human subjects, if there was no melanoma of the skin, and if the study is not in the English language. A literature search was conducted using PubMed and Google Scholar (Table 1). All search results from database inception to October 2017 were considered for inclusion. Two reviewers (ARE and JMB) independently reviewed all studies for inclusion and exclusion criteria. In the case of disagreement, the two reviewers compared their findings and reached a consensus on classification. After duplicates were removed, 209 abstracts were considered for inclusion, 31 abstracts were selected for manuscript review, and 14 met all criteria and were included (Fig. 1). Among these 14 studies examined [15–28], we collected data regarding inclusion criteria, study design, number of melanomas, melanoma type, OCT device details, sensitivity, specificity, diagnostic results, features visualized through OCT, and performance compared to other diagnostic devices if available.

Results

Conventional OCT, HD-OCT, and SV-OCT systems were used by different researchers in the diagnosis of cutaneous melanoma. Many of these studies compared OCT to other diagnostic methods such as reflectance confocal microscopy, dermoscopy, and biopsy with subsequent histopathological assessment (gold standard). The results of the 14 studies can be found in Table 2.

High-definition OCT: observations and comparison to histopathology

Studies that examined the use of HD-OCT [15, 16, 19, 20, 26] reported similar observations using the cross-sectional and en face modes of the device for visualizing melanoma. Features of melanoma seen on HD-OCT included atypical melanocytes in the upper part of the acanthotic dermis, roundish pagetoid cells, epidermal disarray, loss of maturation progression with depth, and distorted rete ridges. Together, 67 melanomas were visualized using HD-OCT, however 20 of which may have been accounted for twice due to consecutive reports by Gambichler et al., leaving 47 unique melanomas. Multiple studies reported a statistically significant correlation between HD-OCT measurements and histopathology. Boone reported that there was a statistically significant correlation between the HD-OCT measurements and histopathology for the 15 superficial spreading melanomas (SSMs) assessed. Two consecutive reports by Gambichler et al. of 20 and 27 malignant melanomas (MMs), respectively, showed that HD-OCT measurements correlated to histopathology with a sensitivity of 74.1% (53.7–88.8%) and specificity of 92.4% (83.2–97.5%).

Table 1 Literature search strategy

Database	Search entry	Results
PubMed	"Melanoma" [Mesh] AND (("Tomography, Optical Coherence" [Mesh] OR "optical coherence tomography" [All Fields]) OR "oct" [Title/Abstract]) AND ("humans" [MeSH Terms] AND English [lang])	209
Google Scholar	"Melanoma" AND (("Tomography, Optical Coherence" OR "optical coherence tomography" [All Fields]) OR "oct") AND ("humans" AND English)	209

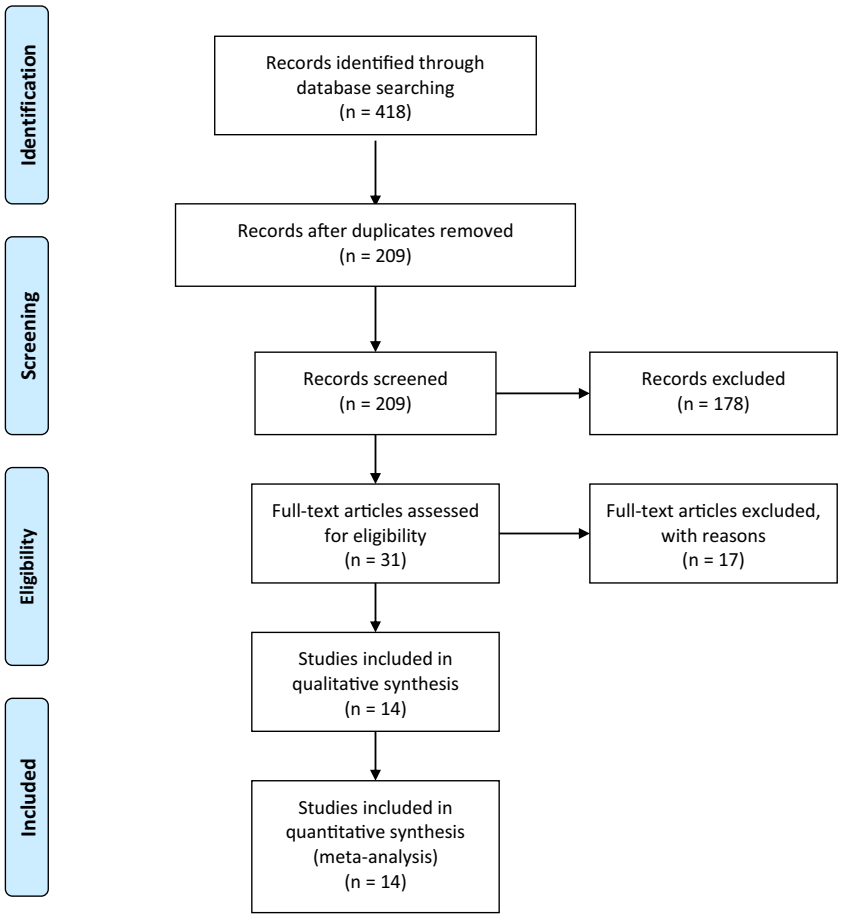

Fig. 1 PRISMA flow diagram

Speckle variance OCT: observations and comparison to histopathology

Three studies reported the use of SV-OCT [17, 23, 25] for melanoma. All three studies assessed melanoma in situ (MIS) lesions and described observations of the lesions on SV-OCT as irregularly distributed vessels organized in larger columns [17, 23], and shadows that significantly correlated with MIS [25]. However, Moraes et al. were the only study that assessed MM using SV-OCT, and reported that shadows in addition to loss of bright collagen correlated significantly with MM [25]. All three studies reported that SV-OCT findings significantly correlated to histopathology.

Conventional OCT: observations and comparison to histopathology

The results of studies that assessed the use of conventional OCT [21, 22, 24, 27–29] varied. Most authors agreed that melanomas showed more architectural disarray, less definition, and absence of lower border of lesions compared to benign nevi [21, 22, 27–29], while others stated that the difference was difficult to visualize in lesions greater than 0.5 mm [24] and an inability to differentiate MM from benign nevi [18]. Compared to histopathology diagnostic results, some authors found that conventional OCT findings correlated to histopathology [22, 27, 29], while others did not [18, 21, 24]. It should be noted that studies that showed a significant correlation between conventional OCT and melanoma diagnosis were smaller cohorts with less than 10 melanomas per study while the reports of no such correlation between conventional OCT and ability to diagnose melanoma were mainly larger cohorts that consisted of 40 [21] and 67 [24] melanomas. Gambichler et al. [21] noted that 20% of MM cases did not show evidence for malignancy in OCT images and Meyer et al. [24] reported a Spearman correlation coefficient of $r = 0.2$ between histopathology and conventional OCT measurements.

Discussion

This descriptive review compiles and shares available data on the role of OCT in diagnosis of cutaneous melanoma. Noninvasive modalities may yield earlier detection of melanomas, which may in turn improve survival in melanoma patients [30, 31].

Table 2 Data from the 14 published studies using OCT for diagnosis of cutaneous melanoma

Study	Melanomas/ total lesions examined	Melanoma type	OCT device details	Sensitivity (%)/specificity (%)	Comparison to other diagnostic methods		Features of melanoma visualized on OCT
					Type	Results	
Boone[15]	4/26	SSM	HD-OCT (Skintell, Agfa Healthcare, Mortsel, Belgium) Wavelength: 1000–1700 nm Power: < 3.5 mW Bandwidth: 100 nm Axial resolution: 3 μm Lateral resolution: 3 μm Penetration depth: 570 μm Field of view: 1.8 mm × 1.5 mm	N/S/N/S	RCM, dermoscopy, histopathology	Lateral resolution of OCT is 1/3 of RCM; Field of view of OCT is 11 times greater than RCM; RCM allows observation of vascular flow and rolling leukocytes in vessels	XS mode: atypical melanocytes in upper part of acanthotic epidermis; non-specific pattern of DEJZ observed with irregular and broadened rete ridges EF mode: cobblestone or irregular honeycomb pattern superficial layer; epidermal disarray in areas of pagetoid spread; atypical melanocytes upper epidermis Combined XS and EF: meshwork pattern determined architecture of DEJZ, inhomogenous loose junctional nests with atypical cells, dermal dense and sparse nests with loose aggregates observed in ¾ of cases, loss of maturation progression with depth, melanocytes deeper in dermis indistinguishable from those in superficial papillary dermis
Boone[16]	15/45	SSM	HD-OCT (Skintell, Agfa Healthcare, Mortsel, Belgium) Wavelength: 1000–1700 nm Power: < 3.5 mW Bandwidth: 100 nm Axial resolution: 3 μm Lateral resolution: 3 μm Penetration depth: 570 μm Field of view: 1.8 mm × 1.5 mm	μ_{raf1}: 93.3%/83.3%; SES: 80.0%/93.3%; $z_{1/2}$: 93.3%/86.7%	Histopathology	Correlated to histopathology findings	High significance between each melanoytic group and optical property measurements. A reduction in μ_{raf1} and SES and increase of $z_{1/2}$ could be noticed with increasing malignancy of melanocytic lesions. Roundish pagetoid cells, atypical cell clusters at dermo-epidermal junction, totally disarranged dermal/epidermal pattern and large vertical icicle-shaped structures
De Carvalho[17]	1/1	MIS, JN	Vivosight SV-OCT (Michelson Diagnostics Ltd., Orpington, Kent, UK) Wavelength: 1305 nm Power: N/S Bandwidth: N/S Axial resolution: < 5 μm Lateral resolution: < 7.5 μm Penetration depth: 1.0–2.0 mm Field of view: 6 mm × 6 mm	N/S/N/S	Dermoscopy, RCM, histopathology	SV-OCT findings corresponded to dermoscopy, RCM, and histopathology	SV-OCT EF mode: showed transversal section vessels organized in larger columns, irregularly distributed. In en face view, vascular pattern characterized by numerous densely packed dots progressively becoming irregular cloud-like structures with depth. Vessels increased in number, thicker lumina, tortuous course
De Giorgi[18]	1/10	MM	OCT (SkinDex 300#, ISIS optronics GmbH, Mannheim, Germany) Wavelength: 1250–1350 nm Power: 20 μW Bandwidth: N/S Axial resolution: 5 μm Lateral resolution: 3 μm	N/S/N/S	Dermoscopy, histopathology	OCT did not correlate to histopathology for melanoma, differential diagnosis between benign nevi and MM is not possible using OCT because resolution is not high enough	N/S

Table 2 (continued)

Study	Melanomas/ total lesions examined	Melanoma type	OCT device details	Sensitivity (%)/specificity (%)	Comparison to other diagnostic methods		Features of melanoma visualized on OCT
					Type	Results	
			Penetration depth: 0.9 mm Field of view: 1 × 0.9 mm				
Gambichler[19]	40/75	MM	OCT-scanner (SkinDex 300, ISIS optronics GmbH, Mennheim, Germany) Wavelength: 1300 nm Power: < 3.5 mW Bandwidth: 70 nm Axial resolution: 0.9 μm Lateral resolution: 1 μm Penetration depth: 1 mm Field of view: 3 × 5 μm^2	N/S/N/S	Histopathology	20% of MM did not show evidence for malignancy in OCT images	Marked architectural disarray, clear dermal-epidermal border, large vertical icicle-shaped structures not observed in benign nevi
Gambichler[20]	20/48	MM	HD-OCT (Skintell, Agfa Healthcare, Mortsel, Belgium) Wavelength: 1000–1700 nm Power: < 3.5 mW Bandwidth: 100 nm Axial resolution: 3 μm Lateral resolution: 3 μm Penetration depth: 570 μm Field of view: 1.8 mm × 1.5 mm	N/S/N/S	Histopathology	Correlated to histopathology findings	Roundish pagetoid cells, atypical cell clusters at dermal-epidermal junction, totally disarranged dermal/epidermal pattern and large vertical icicle-shaped structures
Gambichler[21]	27/93	SSM, LMM, NM, ALM	HD-OCT (Skintell, Agfa Healthcare, Mortsel, Belgium) Wavelength: 1000–1700 nm Power: < 3.5 mW Bandwidth: 100 nm Axial resolution: 3 μm Lateral resolution: 3 μm Penetration depth: 570 μm Field of view: 1.8 mm × 1.5 mm	74.1% (53.7–88.8%)/92.4% (83.2–97.5%)	Histopathology	Correlated to histopathology findings	Roundish pagetoid cells, atypical cell clusters at dermal-epidermal junction, totally disarranged dermal/epidermal pattern and large vertical icicle-shaped structures
Hinz[22]	3/26	MM	Swept Source OCT System (OCS1300SS; Thorlabs, Dachau, Germany) Wavelength: 1325 nm Power: N/S Bandwidth: 100 nm Axial resolution: 12 μm Lateral resolution: 15 μm Penetration depth: 1 mm Field of view: 6.0 mm × 2.26 mm	N/S/N/S	HFUS, biopsy	Spearman's correlation coefficients OCT vs histology: $r = 0/734$ ($p < 0.0001$); HFUS vs histology: $r = 0.390$ ($p = 0.049$)	Compared to benign lesions, dermal-epidermal borders in MM were less defined and the architecture showed disarray
Markowitz[23]	1/1	MMIS		N/S/N/S	Dermoscopy	Dermoscopy does not show features of vascular	SV-OCT of the MMIS revealed diffuse thin, irregular vessels dispersed throughout the

Table 2 (continued)

Study	Melanomas/ total lesions examined	Melanoma type	OCT device details	Sensitivity (%)/specificity (%)	Comparison to other diagnostic methods		Features of melanoma visualized on OCT
					Type	Results	
			Vivosight SV-OCT (Michelson Diagnostics Ltd., Orpington, Kent, UK) Wavelength: 1305 nm Power: N/S Bandwidth: N/S Axial resolution: < 5 μm Lateral resolution: < 7.5 μm Penetration depth: 1.0–2.0 nm Field of view: 6 mm × 6 mm			pattern, OCT correlated to histopathology findings	entire en face field irrespective of the small lesion size
Meyer[24]	67/100	MM	OCT Ganymede 930s imaging system (Thorlabs, Newton, NJ, USA) Wavelength: 930 nm Power: 3 mW Bandwidth: 100 nm Axial resolution: 6.0 μm Lateral resolution: 8.0 μm Penetration depth: 1 mm Field of view: N/S	N/S/N/S	HFU, histopathology	Ultrasound vs histology: $r = 0.807$ OCT vs histology: $r = 0.2$	Difficult to visualize melanocytic lesions especially for lesions > 0.5 mm
Moraes[21]	19/39	MIS, MM	Vivosight SV-OCT (Michelson Diagnostics Ltd., Orpington, Kent, UK) Wavelength: 1305 nm Power: 5–6 mW Bandwidth: > 147 nm Axial resolution: < 7.5 μm Lateral resolution: < 7.5 μm Penetration depth: 1.0–2.0 nm Field of view: 6 mm × 6 mm	N/S/N/S	Histopathology	Correlated to histopathology findings	MIS: shadows correlated significantly with MIS MM: shadows and loss of bright collagen correlated significantly with MM
Oliveira[20]	1/1	MM	HD-OCT (Skintell, Agfa Healthcare, Mortsel, Belgium) Wavelength: 1000–1700 nm Power: < 3.5 mW Bandwidth: 100 nm Axial resolution: 3 μm Lateral resolution: 3 μm Penetration depth: 570 μm Field of view: 1.8 mm × 1.5 mm	N/S/N/S	Dermoscopy, RCM, histopathology	HD-OCT enables an in vivo examination of skin to a greater depth than RCM, reaching reticular dermis	Loss of normal epidermal and dermal layering in both slice and en face modes, hyperkeratosis, acanthosis; DEJZ not seen in XS mode; atypical melanocytes observed in upper part of acanthotic epidermis; epidermal disarray seen in en face imaging together with large melanocytes with abundant reflective cytoplasm and hyporeflective nucleus relating to a pagetoid spread; junctional melanocytic aggregates distorted rete ridges resulting in homogenous loose junctional nests with atypical melanocytes; intraepidermal bright horn cysts were observed

Table 2 (continued)

Study	Melanomas/ total lesions examined	Melanoma type	OCT device details	Sensitivity (%)/specificity (%)	Comparison to other diagnostic methods		Features of melanoma visualized on OCT
					Type	Results	
Welzel[27, 34]	N/S	LMM	OCT (N/S) Wavelength: 830 nm Power: 3 mW Bandwidth: N/S Axial resolution: 15 μm Lateral resolution: N/S Penetration depth: 1 mm Field of view: N/S	N/S/N/S	Histopathology	Correlated to histopathology findings	Irregular structures in lower epidermis that corresponded to the tumor cell aggregates in the histological section. Basement membrane zone that could be detected in healthy skin was absent in LMM tumor
Wessels[25, 27]	9/40	MIS, SSM, NM, LMM	OCT system (Santec Inner Vision 2000; Santec Corporation, Photonics Valley Ohkusa Campus, 5823 Ohkusa-Nenjyozaka, Komaki, Aichi 485-0802, Japan) Wavelength: 1300 ± 60 nm Power: 3 mW Bandwidth: 60 nm Axial resolution: 10 μm Lateral resolution: 20 μm Penetration depth: 2 mm Field of view: 15 mm × 15mm	89% (95% CI 52–100%)/61% (95% CI 42–78%)	Histopathology	Correlated to histopathology findings	Absence of lower border of lesion indicated increased risk of being melanoma, clear dermal-epidermal in a few OCT images

XS, cross-sectional mode; *EF*, en face mode; *SSM*, superficial spreading melanoma; *MM*, malignant melanoma; *NM*, nodular melanoma; *MIS*, melanoma in situ; *LMM*, lentigo maligna melanoma; *ALM*, acrolentigenous melanoma; *DEJZ*, dermal-epidermal junction; *N/S*, not specified; *RCM*, reflectance confocal microscopy; *JN*, junctional nevus; *HFUS*, high-frequency ultrasound; μ_{raf1}, relative attenuation coefficient first layer; *SES*, skin entrance signal; $z_{1/2}$, tissue half-value thickness

OCT technology as a diagnostic tool for melanoma

OCT allows assessment of real-time skin architecture at a depth of approximately 0.5–1.5 mm [32]. The resolution offered by OCT is originally noted as 3–15 μm [33]; however, more recent variations of OCT such as HD-OCT have achieved resolution as low as 1–3 μm [32]. OCT resolution does not allow for observation of single-cell morphology; however, lesion architecture can be assessed [34]. Although certain factors such as the inability to visualize the basement membrane zone and cellular features [35] have been seen as setbacks in using OCT to identify early melanoma, the advancement of technology has identified various methods of distinguishing melanomas from other nevi through OCT. For example, OCT displays certain characteristics of melanomas such as clear architectural disarray and an indistinct dermo-epidermal junction [33].

Although OCT may have lower sensitivity for detecting early melanomas, some authors have reported OCT to have the highest overall sensitivity for detecting melanoma compared to other techniques such as reflectance confocal microscopy, ultrasonography, and multispectral imaging [32]. Additionally, OCT yields a higher resolution and contrast [36] than ultrasound as well as a greater detection depth than CSLM [37]. The mechanism of OCT is comparable to that of ultrasonography; however, instead of sound waves, OCT uses light waves [38].

Conventional OCT is known to have limited ability in studying the skin from a cellular perspective. Recently, many new variations of OCT have been developed to visualize more specific aspects of the skin, which may be beneficial in differentiating malignant melanoma from benign nevi.

HD-OCT has been speculated to enhance OCT's diagnostic accuracy of malignant melanoma [9]. This may be due to the increased lateral resolution of high-definition of OCT, which is 1 to 3 μm, compared to conventional OCT, which has a lateral resolution of 10 to 15 μm [20]. Although HD-OCT can differentiate between the architecture and cytology of pigmented skin lesions and cells in the epidermis and upper dermis [20], it is unknown if its resolution is sufficient to discriminate between early melanomas and atypical or dysplastic nevi [32].

SV-OCT is a variation of OCT which identifies the microvasculature of the skin [8]. SV-OCT may be useful to differentiate the vasculature in benign nevi and malignant melanoma [39], primarily due to its ability to visualize the neovascularization that occurs during tumor growth [32].

OCT findings in malignant melanoma

Malignant melanoma bears many evident unique features in comparison to benign nevi, which can be noted through OCT. In a pilot study by Boone et al., melanocytic lesions of 26 patients were imaged with HD-OCT, reflectance confocal microscopy (RCM), and dermoscopy prior to excision, and results showed a strong correspondence between HD-OCT image and histopathologic features [16].

Malignant melanomas display a more chaotic architectural organization in comparison to benign nevi [34], chiefly due to their large melanocytes with a prolific cytoplasm [32]. Atypical melanocyte expression initially begins in the acanthotic epidermis as the melanoma gains the ability to expand closer to the dermo-epidermal junction [4]. Additionally, these melanocytes display a stromal reaction, which consists of plump bright cells, small bright cells, and the presence of fibrosis [16]. The plump bright cells represent a lymphocytic infiltrate as they parallel melanophages and small bright cells [16].

The vertical location of the atypical melanocytes results in different histological landmarks and cytological features. In a malignant melanoma, which is merely superficially spreading, atypical melanocytes are found prominently in the upper part of the epidermis [16]. Pagetoid spreading becomes evident once these haphazard melanocytes begin to proliferate within the stratum spinosum [35]. These large and round pagetoid cells are strongly reflecting and suggestive of malignant melanoma [15]. Furthermore, pagetoid cells are known to occur in areas where epidermal disarray is observed [16]. Once these atypical melanocytes permeate the dermis, they form compact infiltrates which result in malignant melanoma's hallmark appearance of vertical icicle-shaped structures [8].

Another structural consequence of these atypical melanocytes is that they have the tendency to form junctional sheets, or irregular junctional aggregates that disfigure the rete ridges and lead to both junctional nests [16] and dermal nests [8]. As a result, the rete ridges in malignant melanoma take on a broadened shape [32] in contrast to the rete ridges of benign nevi, which are characterized by finger-shaped and elongated rete ridges [8]. The dermo-epidermal junction of benign nevi is generally defined and clearly delineated [8], whereas the dermo-epidermal junction of malignant melanoma is markedly less defined due to infiltrative nature of the tumor growth [11] and irregularity of rete ridges [33].

Alterations in vessel morphology of malignant melanomas are also a common finding and increase as the melanoma becomes more invasive [36]. Specifically, vascular patterns can be studied via SV-OCT in both en face and transversal sections [32]. Changes in tissue reflectivity, which result as blood cells pass through the infrared scanning beam of the SV-OCT, are identified by software analysis, allowing the imaging of the skin's microangiography [17]. The transversal sections imaged with SV-OCT of malignant melanoma revealed irregular organization of vessels whereas the en face sections display multiple densely organized dots increasing in irregularity with depth [17]. In contrast, these dots display a regular pattern in benign nevi, indicating more consistent architecture

[17]. As melanomas gain the ability to invade deeper layers of the skin, these dots tend to arrange themselves in a linear fashion with a branching pattern [36]. Tremendously convoluted vascular patterns, and even the formation of vessel aneurysms, are noted particularly in deeply invasive melanomas [36].

Note that the currently available studies assessing OCT for diagnosis of melanoma used different variables to evaluate OCT's imaging potential. Factors such as sensitivity, specificity, and strength of correlation were selectively and inconsistently reported by the studies—thereby precluding potential meta-analyses. Although this paper represents hitherto the most comprehensive compilation of data, it must be interpreted with caution, as the small number of studies and lack of structured reporting introduce potential for bias.

Conclusion

This study compiles the most comprehensive available data on the use of OCT in the diagnosis of cutaneous melanoma. Results from HD-OCT and SV-OCT, in particular, correlate with those from histopathological cancer cell identification in a statistically significant manner. HD-OCT offers a high lateral resolution which can aid in the identification of architectural features useful in distinguishing MM from benign nevi. SV-OCT focuses on microvasculature and may be particularly useful in visualizing tumor-associated neovascularization.

OCT yields the high resolution and contrast which allows for greater detection depth versus CSLM. However, OCT has been reported to have lower sensitivity in detecting early melanomas. OCT shows promise as a relatively quick and noninvasive method for the diagnosis of melanoma. However, the current data is limited and more consistent reporting is necessary to develop a definitive conclusion on its efficacy.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This review is in compliance with ethical standards.

Informed consent Not applicable to this review article.

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