

Variability in Imaging Findings in Choroidal Nevus Using Multicolor Imaging Vis-à-vis Color Fundus Photography

Ramesh Venkatesh¹, Arpitha Pereira¹, Sajjan Sangai¹, Kushagra Jain¹, Ishank Gupta¹, Aditya Aseem¹, Vivek Singh¹, Naresh Kumar Yadav¹

¹Department of Retina and Vitreous, Narayana Nethralaya, Bengaluru, Karnataka, India

Abstract

Purpose: To describe the multicolor imaging (MCI) features in a series of patients diagnosed with a choroidal nevus and compare it vis-à-vis color fundus photography (CFP) in identifying the lesion.

Methods: In this retrospective, descriptive case series at a tertiary referral center in South India, all patients diagnosed with the choroidal nevus underwent CFP, optical coherence tomography, MCI, and infrared reflectance (IR) imaging.

Results: In this study, we found that on MCI, the choroidal nevus could be identified in only six of the 12 eyes. The lesions were seen as an area of hyperreflectance on IR image and orange-colored lesion on multicolor image. In one eye, there was a mixed pattern of hyper and hyporeflectance on IR imaging. The remaining five eyes with choroidal nevus lesions were not identified on MCI.

Conclusion: The variable features of the choroidal nevus on MCI are most likely due to the variable melanin content within the nevus cells. Further studies are needed to validate these findings.

Keywords: Choroidal nevus, Color fundus, Infrared reflectance, Melanin, Multicolor imaging

Address for correspondence: Ramesh Venkatesh, Department of Retina and Vitreous, Narayana Nethralaya, #121/C, Chord Road, 1st R Block, Rajaji Nagar, Bengaluru - 560 080, Karnataka, India.

E-mail: vramesh80@yahoo.com

Submitted: 12-Dec-2019; **Revised:** 26-Jan-2020; **Accepted:** 29-Jan-2020; **Published:** 04-Jul-2020

INTRODUCTION

A choroidal nevus is a brown or tan colored mass, having a round or oval configuration, located deep below the retinal pigment epithelium. The estimated prevalence of choroidal nevi in the Indian population is much lower (0.5%) when compared to the Chinese (2.9%) and Caucasian (6.5%) population.¹⁻³ This is possibly due to the increased fundus pigmentation seen in the Indian eyes. Histology of the choroidal nevus suggests that it is a benign lesion. However, malignant transformation can occur. This necessitates regular follow-up to pick up changes in the morphology of the lesion and the occurrence of subretinal fluid (SRF).⁴ Thus, proper documentation of choroidal nevi is necessary. Color fundus photography (CFP) using conventional white flashlight has been used to document choroidal nevi. Multicolor scanning

laser imaging (MI) is a newly introduced innovative, non-invasive, imaging modality developed for Spectralis SD-optical coherence tomography (OCT) (Heidelberg Engineering, Heidelberg, Germany). It has been widely used to describe the findings in various retinal and choroidal pathologies.⁵ In MI, three reflectance images of the retina are simultaneously acquired using three individual lasers, thereby allowing the analysis of changes at various levels within the retina and the choroid. The information from these three images is integrated to form a composite multicolor image.⁶ There are very few reports available in the literature comparing the presentation of the choroidal nevus between MI and conventional CFP.^{7,8} Muftuoglu *et al.* also reported the ability of MI compared to CFP in identifying choroidal nevi. However, the size of the choroidal

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Venkatesh R, Pereira A, Sangai S, Jain K, Gupta I, Aseem A, *et al.* Variability in imaging findings in choroidal nevus using multicolor imaging vis-à-vis color fundus photography. *J Curr Ophthalmol* 2020;32:285-9.

Access this article online

Quick Response Code:



Website:
www.jcurrophthalmol.org

DOI:
10.4103/JOCO.JOCO_15_20

nevus was estimated to be 33% lower than that measured on CFP.⁸ We found a few of our initial cases seen in the out-patient department to show the variable presentation of a choroidal nevus lesion on MI which was quite different to that reported in the literature. Hence, we decided to study the MI features in conjunction with CFP and OCT in the choroidal nevus.

METHODS

In this retrospective case series, we included patients of the choroidal nevus who were seen in the retina clinic of our tertiary eye care hospital. Clinically, choroidal nevus was identified as a brown or tan colored mass having a round or oval configuration located deep below the retinal pigment epithelium. All the required permissions for the review of patients' charts and images and publication were obtained from the hospital's Institutional Review Board. Patients having CFP, MI, infrared reflectance (IR), and OCT images, all obtained on the same day were included in the study. The clinical and imaging features of the patients are shown in Table 1. Color fundus photograph was taken with Topcon TRC-50Dx (Topcon medical systems, Oakland, NJ, USA). The number of choroidal nevi lesions and the presence of pigmentation were noted on CFP. All patients had OCT along with enhanced-depth imaging and MI performed by confocal scanning laser ophthalmoscope using a Heidelberg Spectralis HRA-OCT (Heidelberg Engineering, Dossenheim, Germany). OCT data included the visibility of choroidal nevus, type of choroidal nevus, presence of underlying shadowing, status of the overlying RPE, and presence of SRF or drusen. The lesion

on OCT was classified according to that described by Jonna and Daniels⁹ MI was done using the 30° scanning protocol. The patterns of the lesion on MI were described as dark areas (hypo) or white areas (hyper). The color of the lesion varied from orange to mixed areas of green and orange on MI. Patients having poor quality of images, not allowing the proper description of the lesions, and eyes that had far peripheral lesions that were only partially visible in any imaging modalities were excluded from the study. All the consent forms for collecting and publishing the patient data have been obtained from the patients.

RESULTS

Twelve eyes of 11 patients with a clinical diagnosis of the choroidal nevus were included in the study. There were seven males and four females in the study. The mean age of the patients was 63.2 years. Unilateral involvement was seen in ten patients, whereas 1 patient had bilateral involvement. The choroidal nevus appeared pigmented on the CFP. The total number of lesions noted in the study was 16 (one per eye in 10 cases and 3 each in both eyes in 1 case).

Further, the OCT patterns and characteristics of the nevi lesions are mentioned in Table 1. The composite multicolor image showed the choroidal nevus lesion in only 6 (50%) eyes as a salmon (orange) colored area when compared to the 12 eyes with choroidal nevi lesions identified on CFP. In these six eyes, the choroidal nevi lesions were clearly identified on the IR image as hyperreflective (white areas) corresponding to the location of the choroidal nevi [Figure 1]. In one eye, there was a mixture of dark

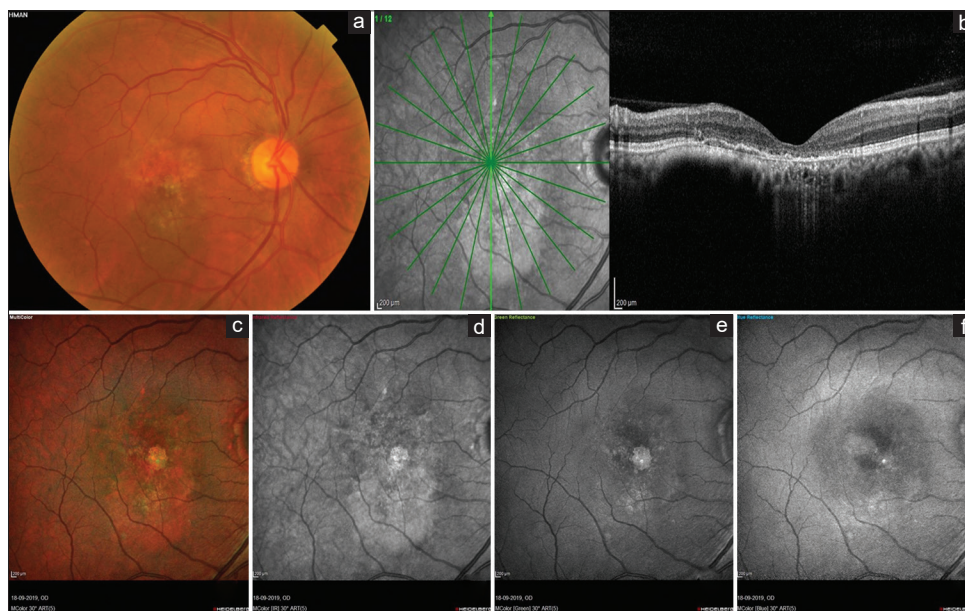


Figure 1: Multimodal imaging of a patient with choroidal nevus with choroidal neovascular membrane in the right eye (patient 8): (a) Color fundus image of the right eye showing a round pigmented lesion inferior to the fovea with the area of retinal pigment epithelial atrophy involving the fovea. (b) The optical coherence tomography scan passing through the lesion identifies the choroidal nevus as a hyperreflective lesion with posterior shadowing. (c) The choroidal nevus is seen as a salmon orange-colored lesion inferior to the fovea with bright yellow-orange area at the foveal center. (d) The lesion is identified on infrared reflectance image as a white patch of hyperreflectance corresponding to the choroidal nevus. (e) On the green reflectance image, the nevus is not visualized. (f) On the blue reflectance image, the lesion is not visualized. The patch of retinal pigment epithelium atrophy is also seen as bright white area at the fovea on the infrared and green reflectance images

Table 1: Clinical and imaging features of patients with the choroidal nevus

Patient number	Age	Sex	Eye	Other retinal findings	CFP			OCT				
					Location of the lesion	Number of lesions	Pigmentation	Description	Type	RPE	SRF	Drusen
1	55	Female	RE	None	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	2	Flat, intact	No	No
2	78	Female	RE	None	Posterior	3	Yes	Only one lesion picked up on OCT; remaining two lesions not seen	0,2	Flat, intact	No	No
3	59	Male	LE	None	Posterior	3	Yes	Not seen	0	Flat, intact	No	No
4	67	Female	RE	None	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	2	Flat, intact	No	No
5	66	Female	LE	DR	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	2	Flat, intact	No	No
6	66	Male	RE	DR, ERM	Posterior	1	Yes	Elevated with anterior bowing of nevus cells with shadowing	2	Elevated, intact	No	No
7	47	Male	LE	None	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	2	Flat, intact	No	Yes
8	60	Male	RE	None	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	2	Flat intact	No	No
9	72	Male	RE	Atrophic RPE at the macula	Posterior	1	Yes	Elevated with anterior bowing of nevus cells with shadowing	2	Irregular RPE, CNVM	No	No
10	64	Male	LE	DR, DME	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	1	Flat intact	No	No
11	61	Male	RE	None	Posterior	1	Yes	Normal	0	Flat intact	No	No
11	61	Male	RE	None	Posterior	1	Yes	Anteriorly placed nevus cells with shadowing	1	Flat intact	No	No

Patient number	MCI			IR	GR	BR
	MC	IR	GR			
1	Mixed orange and green areas	Ill-defined, mixed areas of dark and white	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen
2	Only one lesion seen. Orange color lesion noted superior to fovea	Ill-defined, seen as white area	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen
3	Well-defined orange area	Well-defined white area	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen
4	Well-defined orange area	Well-defined white area	Well-defined white area	Lesion not seen	ERM identified as hyperreflective tissue	ERM identified as hyperreflective tissue
5	Lesion not seen	Lesion not seen	Lesion not seen	Nevus lesion not seen	Nevus lesion not seen	Nevus lesion not seen
6	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen
7	Drusens seen	Drusens seen	Drusens seen	Lesion not seen	Lesion not seen	Lesion not seen
8	Lesion not seen	Well-defined white area	Well-defined white area	Lesion not seen	Lesion not seen	Lesion not seen
9	Well-defined orange area	Well-defined white area	Well-defined white area	Lesion not seen	Lesion not seen	Lesion not seen
10	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen	Lesion not seen
11	Well-defined orange area	Well-defined white area	Well-defined white area	Lesion not seen	Lesion not seen	Lesion not seen

RE: Right eye, LE: Left eye, RPE: Retinal pigment epithelium, DME: Diabetic macular edema, DR: Diabetic retinopathy, ERM: Epiretinal membrane, CFP: Color fundus photography, OCT: Optical coherence tomography, SRF: Subretinal fluid, MC: Multicolor, MCI: MC imaging, IR: Infrared reflectance, GR: Green reflectance, BR: Blue reflectance, CNVM: Choroidal neovascular membrane

and white areas within the lesion on the IR image [Figure 2]. In the remaining 5 eyes, the lesions were not identified on IR images [Figure 3]. On the blue and green reflectance images, choroidal nevi were not picked up in any patient.

DISCUSSION

In this study, we compared the imaging characteristics of choroidal nevi on MI vis-à-vis CFP. The results of our study

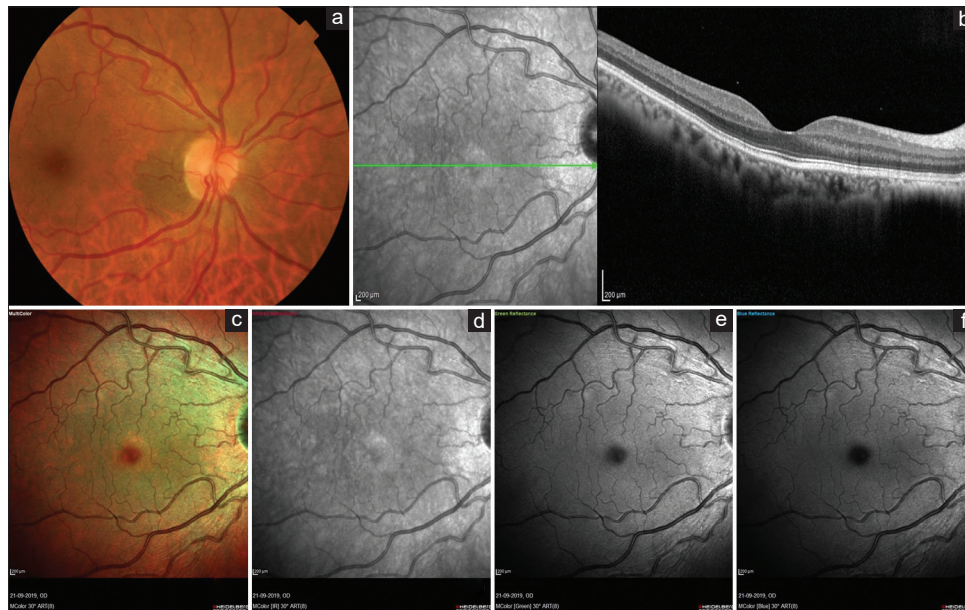


Figure 2: Mixed reflectance on multicolor imaging in a patient with choroidal nevus in the right eye (patient 1):(a) Right eye color fundus photograph showing the pigmented choroidal nevus lesion temporal to the optic nerve head. (b) Optical coherence tomography scan passing through the lesion showing hyperreflective nevus cells with shadowing along with normal choroidal thickening. (c) The choroidal nevus is seen as a mild orangish ill-defined lesion on multicolor image. (d) The lesion is as an ill-defined peripapillary area with variable reflectance on the infrared reflectance image. (e) On the green reflectance image, the lesion is not visualized. (f) Blue reflectance image does not show the choroidal nevus lesion

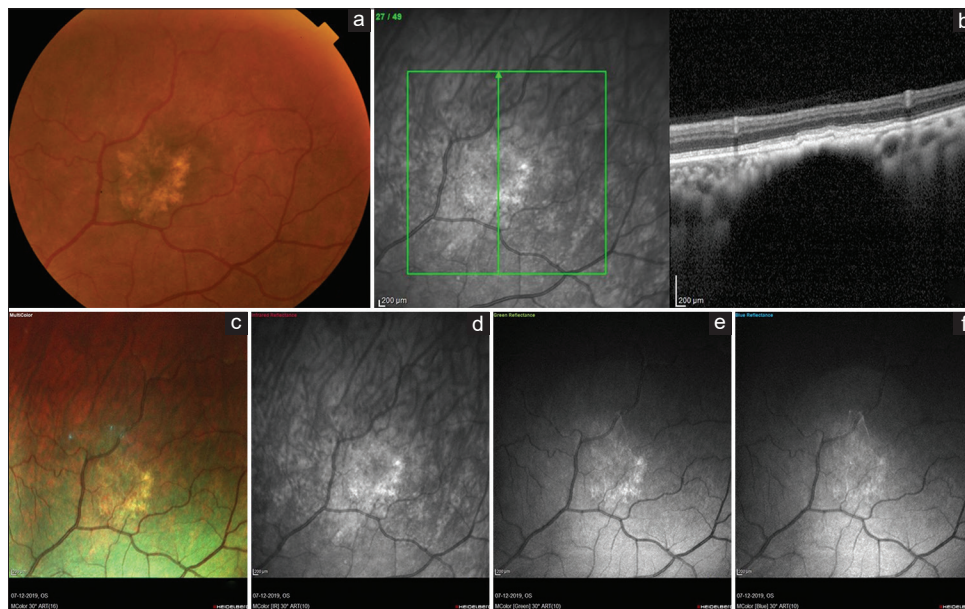


Figure 3: Multimodal imaging features in a patient with choroidal nevus (patient 6):(a) Left eye color fundus photograph showing the pigmented choroidal nevus lesion along the superotemporal arcade with overlying multiple yellow drusen-like deposits. (b) Optical coherence tomography scan passing through the lesion showing hyperreflective nevus cells with shadowing along with overlying irregular retinal pigment epithelium. (c) Choroidal nevus is not well-identified on the composite multicolor image. Drusen-like deposits are prominently visible on the multicolor image. (d) On the infrared reflectance image, the choroidal nevus is not visualized. The drusens are visualized as bright hyperreflective spots. (e) On the green reflectance image, the choroidal nevus is not visualized. The drusens are visualized as bright hyperreflective spots. (f) On the blue reflectance image, the choroidal nevus and the drusens are not visualized

highlight the variable presentations of choroidal nevi on MI when compared to CFP. In this study, we have also described the various patterns of choroidal nevus lesions seen on OCT.

In the blue and green reflectance images, the choroidal nevus lesions were not visible. This is due to the poor penetration and increased absorption of the blue and green lasers by the melanin in retinal pigment epithelium. As a result, these lights are unable to reach the underlying choroidal nevus cells. The poor absorption of the infrared wavelength light by the melanin allows the visualization of structures at the level of the outer retina, retinal pigment epithelium, and choroid. Thus, the higher wavelength infrared light is useful in depicting and characterizing the choroidal nevus lesion.⁶

In our case series, the IR images were able to pick up the choroidal nevus as a white hyperreflective area in 6 of the 12 eyes documented on CFP. They were seen on composite multicolor images as salmon (orange) colored lesions. In one eye, the IR image showed mixed areas of hyper and hyporeflectance within the lesion. Of the remaining seven eyes, the lesions were not picked on the IR images. No uniform correlation was noted between the type of OCT pattern of the choroidal nevus lesion, the amount of pigmentation of nevus on CFP, and MI imaging features in the study.

This difference in the imaging characteristics could be explained on the basis of the melanin content within the nevus cells. Literature on the histology of choroidal nevus is relatively sparse. Choroidal nevus is located at varying depths within the choroid packed with densely pigmented nevi cells or proliferation of benign melanocytes with the presence of overlying drusen and mild disruption of the photoreceptors or a combination of both.^{10,11} The absorption spectrum of melanin is maximum for the visible light (low wavelength) while the light of high wavelength (infrared spectrum) has the least absorption.¹² Thus, nevi containing higher melanin have reduced absorption and increased reflectance of the incident infrared light compared to the surrounding normal retina. As a result, the lesion is seen as an area of hyperreflectance (white area) on IR image and orange color on multicolor image. On the other hand, nevi containing increased melanocytes with normal melanin content show no visible change on IR and multicolor images compared to the surrounding retina. Saurabh *et al.* have reported a case of choroidal nevus showing increased hyperreflectance on MI and increased lesion size compared to CFP.⁷ This could be as a result of the choroidal nevus having a higher melanin content compared to the surrounding normal retina. Muftuoglu *et al.* have reported that MI underestimates the size of choroidal lesion by 33% when compared with CFP.⁸ This could possibly be due to the lower melanin content within these lesions, thereby not allowing the infrared wavelength light to pick up the true extent of the lesion. The differing melanin content in the choroidal nevus is also responsible for the different patterns seen in enhanced-depth imaging of OCT.⁹

The major limitation of this study is the small sample size. Furthermore, the findings in this study are limited to Indian ethnicity with pigmented fundus and might not be generalizable to

other ethnicities. The results of our study provide an opportunity to look at the MI features in a larger series of patients with choroidal nevus. The type of MI feature in choroidal nevus could possibly be used in the near future as a predictor of progression to malignancy.

In conclusion, the melanin content in a choroidal nevus determines its imaging features on MI. Due to the variable presentation of the choroidal nevus lesion on MI, currently, CFP seems to be a better imaging modality for disease identification and progression. Future studies correlating the type of MI feature with progression to malignancy in choroidal nevus could be useful.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Nangia V, Jonas JB, Agarwal S, Khare A, Lambat S, Panda-Jonas S. Choroidal nevi in adult Indians: The Central India Eye and Medical Study. *Br J Ophthalmol* 2012;96:1443-4.
- Jonas JB, You QS, Xu L, Wang YX. Choroidal nevi in adult Chinese. *Ophthalmology* 2008;115:1102-0.
- Sumich P, Mitchell P, Wang JJ. Choroidal nevi in a white population: The Blue Mountains Eye Study. *Arch Ophthalmol* 1998;116:645-50.
- Singh AD, Kalyani P, Topham A. Estimating the risk of malignant transformation of a choroidal nevus. *Ophthalmology* 2005;112:1784-9.
- Feng HL, Sharma S, Stinnett S, Asrani S, Mruthyunjaya P. Identification of posterior segment pathology with *en face* retinal imaging using multicolor confocal scanning laser ophthalmoscopy. *Retina* 2019;39:972-9.
- Tan AC, Fleckenstein M, Schmitz-Valckenberg S, Holz FG. Clinical application of multicolor imaging technology. *Ophthalmologica* 2016;236:8-18.
- Saurabh K, Roy R, Sinharoy S, Shah D, Nangia P. Measurement of size of pigmented choroidal nevus: Superiority of multicolor imaging compared to conventional color fundus photography. *Indian J Ophthalmol* 2018;66:1501-3.
- Muftuoglu IK, Gaber R, Bartsch DU, Meshi A, Goldbaum M, Freeman WR. Comparison of conventional color fundus photography and multicolor imaging in choroidal or retinal lesions. *Graefes Arch Clin Exp Ophthalmol* 2018;256:643-9.
- Jonna G, Daniels AB. Enhanced depth imaging OCT of ultrasonographically flat choroidal nevi demonstrates 5 distinct patterns. *Ophthalmol Retina* 2019;3:270-7.
- Pernick N. Uvea: Nevi of Choroid or Iris. Available from: <http://www.pathologyoutlines.com/topic/eyeuveanevichoroid.html>. [Last accessed on 2020 Jan 02].
- Madigan MC, Vader M, Ton H, Van der Velden P, Jager MJ. Human choroidal nevi histopathology revisited. *Acta Ophthalmol (Copenh)* 2015;93. Available from: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1755-3768.2015.0507>. [Last accessed on 2020 Jan 02].
- Song W, Zhang L, Ness S, Yi J. Wavelength-dependent optical properties of melanosomes in retinal pigmented epithelium and their changes with melanin bleaching: A numerical study. *Biomed Opt Express* 2017;8:3966-80.