Nailfold Capillaroscopy of Healthy Individuals – An Observational Study

Abstract

Background: Nailfold capillaroscopy (NFC) is a noninvasive quick method to visualize capillaries in the nailfold. There is paucity of these studies in healthy individuals in skin of color. **Aim:** To evaluate the morphological characteristics and density of nailfold capillaries in healthy individuals. **Settings and Design:** This observational cross-sectional study was conducted in the Department of Dermatology at a tertiary care hospital. About 150 healthy individuals by consecutive sampling were included in the study. **Materials and Methods:** A total of 150 healthy individuals aged between 20 and 60 years were enrolled from January 2021 to September 2021 after consenting to the study protocol and qualifying the inclusion and exclusion criteria. NFC was performed for various morphological parameters and mean capillary density was also calculated. Comparison was done in male vs female, age group 20–40 vs 41–60, and body mass index (BMI) <24.9 vs >25. **Statistical Analysis:** Different morphological parameters and capillary density were recorded and analyzed. The Mann–Whitney and Pearson's chi square was used according to type of data. **Results:** The study observed tortuous capillaries (45.33%), meandering capillaries (44.66%), neoangiogenesis (38.66%), plexus visibility (36.66%), dilated capillaries (33.33%), receding capillaries (31.33%), angulated capillaries (14.66%), and ramified capillaries (6.6%). The study found significantly decreased plexus visibility in those with BMI >25.Tortuous and receding capillaries were significantly increased in age group >40 years. **Conclusion:** Various capillary morphological findings can be present in normal individuals but their presence in more number of fingers should be considered to be pathological. This data on normal morphology and capillary density add to the physiological NFC findings and thus aid in identifying the abnormalities.

Keywords: *Capillary density, morphological characteristics, nailfold capillaroscopy, proximal nailfold*

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Introduction

Nailfold capillaroscopy (NFC) is a method by which one can visualize the capillaries in the nailfold. NFC is an established method to assess microcirculation in various rheumatic conditions, such as systemic sclerosis, dermatomyositis, systemic lupus erythematosus, and mixed connective tissue disease (MCTD).[1] It has recently been extrapolated in other disorders, such as diabetes mellitus,[1] arterial hypertension,[2] and psoriasis,[3] where the microvasculature is affected and as a potential biomarker for disease activity and treatment response.

In olden times, magnifying lens, wide field microscope, and ophthalmoscope were used to visualize the capillary morphology in nailfold.[3] Nowadays, with technological advances, there are USB dermoscopy instruments that provide magnification up to ×200, thus giving better visualization of capillary morphology, control over image capturing, storage, and analysis.[3,5] There are also softwares available that have an inbuilt measurement tool to assess the quantitative parameters. There are many factors that can influence an individual's nailfold capillary morphology and density, such as age, sex, ethnic group, geographical area, environment, skin thickness, the color of skin, trauma, swelling, systemic illness, drugs, inter-observer variability, and objective factors, such as the type of device, magnification, etc.[6,7]

However, there is a wide intra- and inter-individual variability within the normal population with very little data being published about normal healthy individuals especially in Indian skin.[8] This study aimed to describe the morphological characteristics of capillaries and quantify the capillary density in the Indian

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population with the objective to evaluate the difference in both according to age, sex, and body mass index (BMI).

Materials and Methods

This observational study was conducted from January 2021 to September 2021 at the Department of Dermatology, Venereology, and Leprosy at a tertiary hospital in India after the approval by institutional ethics committee. Total 150 healthy individuals aged between 20 and 60 years from dermatological OPD, including patient's relatives, doctors, PG students, teaching faculty, paramedical staff, and non-paramedical staff were included in the study based on the inclusion and exclusion criteria. Consecutive-sampling method was used and sample size was calculated by Epi info software (Power 95% error 5% attrition rate 0%).[3]Any individual with hypertension, diabetes, on any drug for more than 15 days, pregnant women, lactating women, smoking, any patient with systemic disease (Raynaud's phenomenon, systemic sclerosis, systemic lupus erythmatosus, and connective tissue diseases), trauma, nail paint, nail infection, onychophagia, onychotillomania, and cuticulitis were excluded from the study.

After briefing about the study procedure and taking written informed consent, the participants were made to sit comfortably for 15 min at ambient temperature and their general information and basic parameters including height, weight, blood pressure, pulse rate, temperature, fasting blood sugar, lipid profile, and baseline investigations were done. Their hand was kept at the heart level, and with the help of an ultra-micro-thin marker, a mark was made in the center of each finger in the ring and little fingers of right, followed by the left hand [Figure 1].[3] Dermoscopic examination was carried out by USB dermoscope (Dinolite AM413ZT; 20-220×; 1.3 megapixel) in polarized mode with liquid paraffin as interphase media. Photographs were captured first on 50×zoom for the panoramic view then on 200×zoom to study the capillary morphology [Figure 2]. Glare during the NFC was minimized by moving the dermoscope and changing it to an appropriate angle. During the procedure, pressure on the finger was avoided to minimize blanching. Images were stored and analyzed with the help of an inbuilt dinocapture 2.0 software.

Morphological characteristics

Dilated, meandering, tortuous, ramified, receding, angulated, giant, bizarre capillaries, neoangiogenesis, microhemorrhages, avascular area, and sub papillary plexus visibility were the morphological characteristics considered for the study [Figure 3-6]. Any capillary finding was considered only when it was present in two or more fingers of an individual (except tortuous capillaries that is considered when more than 5%). For schematic diagram and definition of various morphological characteristics, refer to article.[1,3,6,7]

Capillary density

Capillary density is defined as the number of capillaries in a 1-mm span of the distal row in each finger or toe.[9] With the help of an ultra-thin marker, a mark was done in the center of the proximal nailfold and then images were captured on both sides of the mark and later analyzed with calibration software of dermoscope. Capillary density was measured and counted in a distal-most row of the capillary loop. The number of capillary loops on each side of a mark within 1-mm area was manually counted in the ring and little fingers of both hands.[4,10] This gave the number of capillaries in the 2-mm area of each finger. The total numbers of capillaries were divided by 2 for the capillary density of that finger [Figure 1]. For calculating capillary density in a particular individual, the sum of all individual finger capillary density is then divided by 4. Capillary density was recorded as the number of capillary loops/per mm.

Statistical analysis

All the findings were recorded in the case record form (CRF) and the data from CRF were entered in the
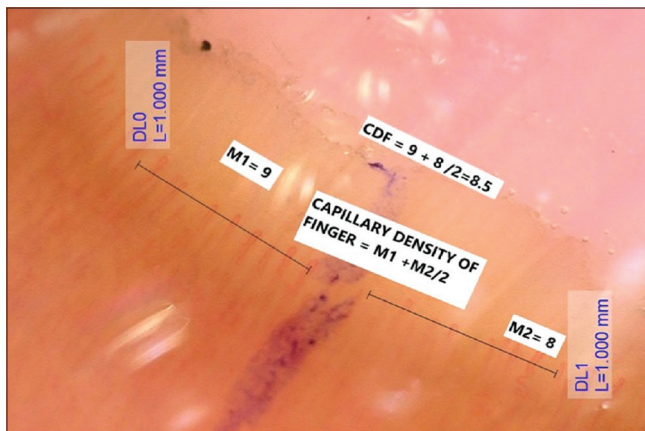

Figure 1: Calculation of Capillary Density: A mark was done in the center of the proximal nailfold and then 1-mm area was calibrated on both sides of the mark with the help of calibration software of dinolite dermoscope
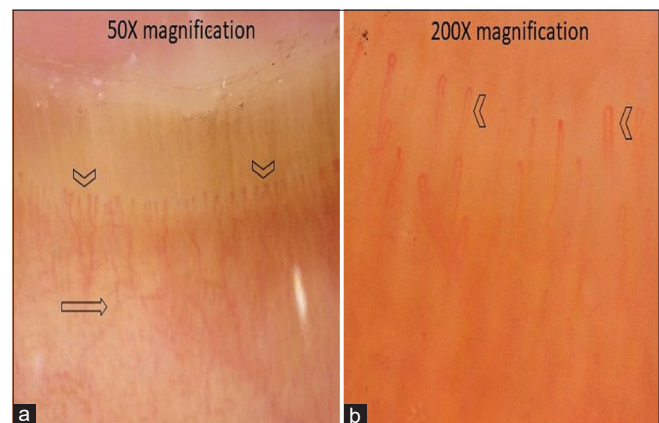

Figure 2: Normal nailfold capillary pattern at 50× (a) and 200× (b). Normal elongated inverted "U" shaped or hairpin-like capillaries (arrowhead) and sub papillary plexus (arrow) (Dinolite AM413ZT polarized mode)
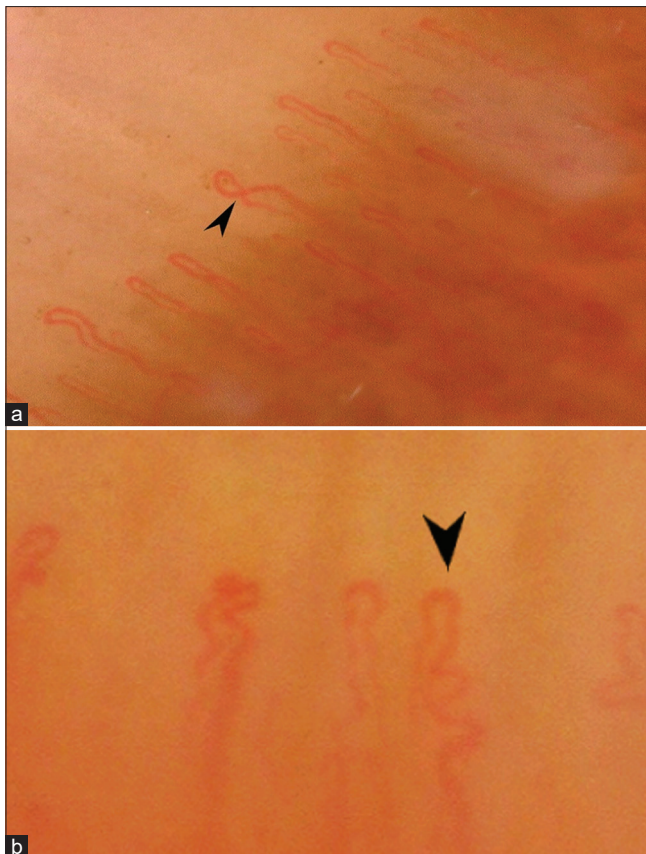
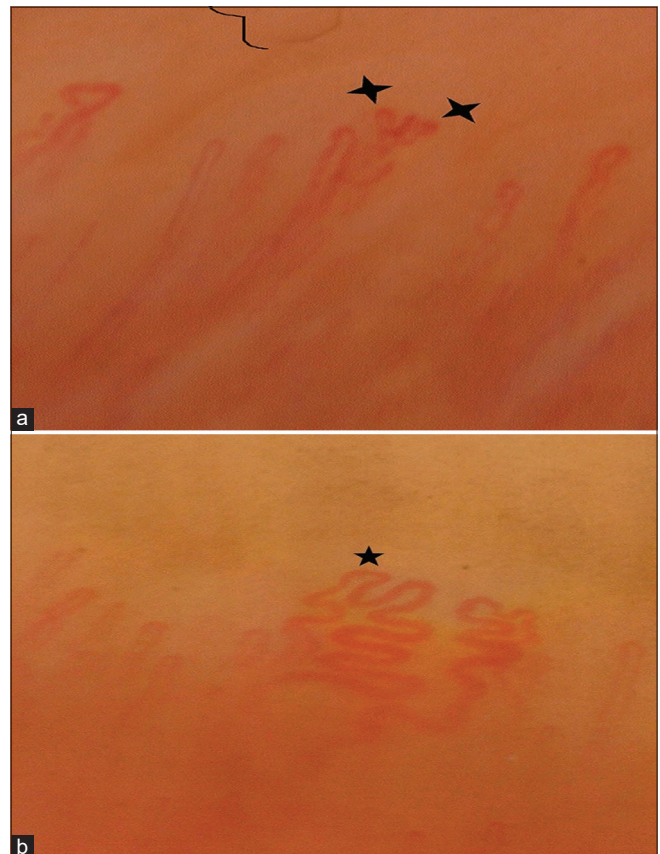Figure 3: (a) meandering capillaries and (b) tortuous capillaries (Dinolite AM413ZT, magnification 200x)

Figure 4: (a) neoangiogenesis and (b) ramified capillaries (Dinolite AM413ZT magnification 200x)

master chart. Analysis of the collected data was done with the help of GraphPadInStat 3 software. The morphological parameters were analyzed by applying the Pearson's chi square test and capillary density using the Mann–Whitney test.

Results

A total of 150 healthy individuals were included in the study, and the NFC parameters were compared according to gender, age, and BMI. The demographic data are shown in Table 1.

In morphological findings, dilated capillaries in 33.33% (50), neoangiogenesis in 38.66% (58), meandering capillaries in 44.66% (67), tortuous capillaries in 45.33%(68), ramified capillaries in 6.6% (10), plexus visibility in 36.66% (55), receding capillaries in 31.33%(47), angulated capillaries in 14.66%(22), and microhemorrhage in 5.33% (8) were observed [Table 2]. However, there was no significant difference in morphological characteristics of capillaries in both sexes, but the study found plexus visibility decreased in individuals with BMI greater than 25 that was statistically significant (*P*-value 0.0222). Tortuous capillary (*P*-value of 0.0002) and receding capillary (*P*-value 0.0229) were more frequently seen in the age group greater than 41 years and were statistically significant. Parameters, such as giant capillaries, bizarre capillaries, and sclerodermoid

Table 1: Demographic data of study participants

Group	Frequency
Gender	
Male	72 (48%)
Female	78 (52%)
Age	
20-40 years	78 (52%)
41-60 years	72 (48%)
BMI	
<24.9	84 (56%)
≥25	66 (44%)

BMI=Body Mass Index

pattern (presence of giant capillaries, avascular zone, hemorrhage, and ramified capillaries all together) were not noticed in any participants.

Capillary density [Table 3] higher in females, in individuals with BMI greater than 25, and those with age more than 40 but the difference was statistically not significant. The highest capillary density was 9.25/mm and the lowest was 4.75/mm.

The morphological characteristic in individual fingers was also studied and the result is shown in Table 4. About 10% (15) of the healthy individuals did not show any morphological variables and had normal inverted U-shaped loops only. Various capillary morphology were occasionally

Table 2: Result of various morphological characteristics

	Dilated	Neoangio genesis	Meandering	Tortuous	Ramified	Plexus	Micro hemorrhage	Receding	Angulated
Male (72)	25	29	34	29	4	29	4	23	9
%	34.72	40.27	47.22	40.27	5.55	40.27	5.55	31.94	12.5
Female (78)	25	29	33	39	6	26	4	24	13
%	32.05	37.17	42.30	50	7.69	33.33	5.12	30.76	16.66
P	0.8624	0.8247	0.549	0.3026	0.8442	0.3797	0.9074	0.8768	0.6244
BMI <24.9 (84)	30	38	42	36	5	38	4	24	15
%	35.71	45.23	50	42.85	5.95	45.23	4.76	28.571	17.85
BMI >25 (66)	20	20	25	32	5	17	4	23	7
%	30.30	30.30	37.87	48.48	7.57	25.75	6.06	34.84	10.60
P	0.6007	0.0909	0.1879	0.6016	0.9474	0.0222	0.7253	0.5187	0.3108
20-40 years (78)	22	31	34	23	3	32	5	17	11
%	28.20	39.74	43.58	29.48	3.84	41.02	6.41	21.79	14.10
41-60 years (72)	28	27	33	45	7	23	3	30	11
%	38.88	37.5	45.83	62.5	9.72	31.94	4.61	41.66	15.27
P	0.225	0.9092	0.911	0.0002	0.2654	0.3254	0.8074	0.0229	0.9699

BMI=Body Mass Index

Table 3: Capillary density

	Capillary density	*P*
Male	6.696	0.3634
Female	6.755	
BMI <24.9	6.624	0.0505
BMI >25	6.858	
Age 20-40	6.655	0.1193
Age 41-60	6.804	

BMI=Body Mass Index

seen in normal healthy individuals but only observed in one or two fingers.

Discussion

Studying the changes in the microcirculation can aid in the diagnosis and prognosis of many microangiopathies, and nailfold capillaries are an easily approachable site for the same.[2] In this study, the effect of various factors, such as gender, age, and BMI that can affect the various parameters were explored.

The normal physiological pattern of a nailfold capillary loop looks like a hairpin or an inverted elongated "U" with an arterial and a venous limb connected by an apical loop.[11] This occurs because, on the dorsal surface of the distal appendages, the papillae bend as they progress towards the nail making them parallel to the skin surface near the nailfolds. Similar bend happens to the capillary loops that are visualized longitudinally at the nailfold edge.[12]

The mean capillary density in this study was 6.68/mm, which is lower compared to the previous studies where Andrade *et al*.[11] found capillary density 9.11/mm, Bhakuni *et al*.[13] 8.7/mm, and in India, Jakhar *et al*.[3] 7.63/mm.

Tortuous capillaries seen in 45.33% were the most common finding in this study and similar was observed in other published studies of Hoerth *et al*., Kabasaka *et al*., and
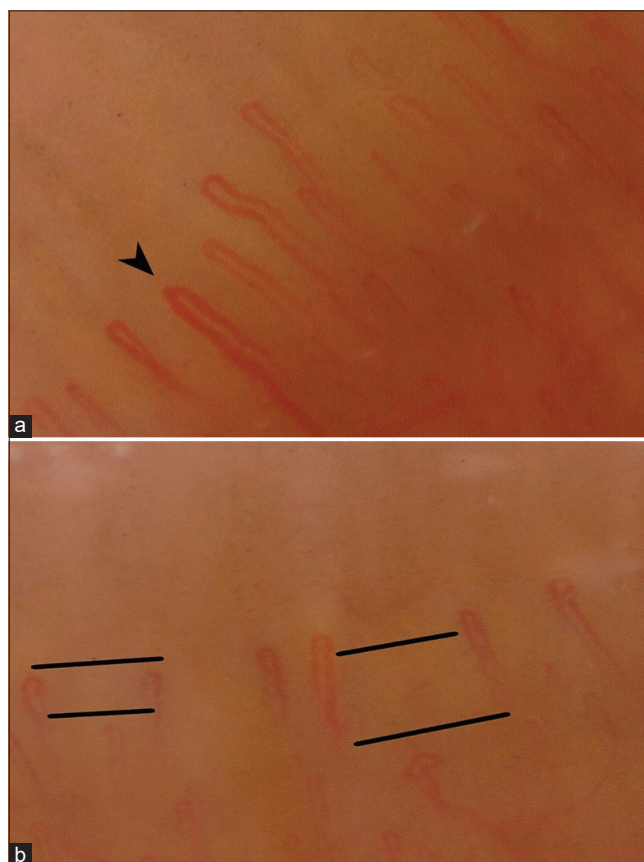
Figure 5: (a) dilated capillaries and (b) receding capillaries (Dinolite AM413ZT polarized mode magnification 200x)

Jakhar *et al*.[3,6,14] In this study, they were noticed more commonly in people aged >40 years that was statistically significant.

Dilated and meandering capillaries along with neoangiogenesis were the dominant morphology in this study. Neoangiogenesis was present in 38.66%, where as Hoerth *et al*.[14] found it in 27%.

Table 4: Result of morphological characteristics in individual fingers

	Observed in one finger of patient	Observed in two fingers of patient	Observed in three fingers of patient	Observed in four fingers of patient
Tortuous capillaries (68)	29	29	8	2
Dilated capillaries (50)	31	15	2	2
Meandering capillaries (67)	46	20	1	0
Neoangeogenesis (58)	46	9	3	0
Receding capillaries (47)	35	11	1	0
Angulated capillaries (22)	17	4	1	0
Ramified capillaries (10)	10	0	0	0
Microhaemorrhages (8)	4	4	0	0
Plexus visibility (55)	21	34	0	0

Figure 6: (a) angulated capillaries and (b) microhemorrhages (Dinolite AM413ZT magnification 200x)

In this study, meandering capillaries were found in 44.66%, whereas Jakhar *et al.*[3] and Andrade *et al.*[11] found the same in 14% and 25%, respectively. Individuals with dilated capillaries (33.33%) in this study were higher compared to 6% as seen by Jakhar *et al.*[3] In this study, angulated and receding capillaries were found in 14.66% and 31.33%, respectively. Receding capillaries were seen more frequently in group of individuals with 40–60 years of age (*P*-value 0.0229), which was statistically significant compared to individuals between 20 and 40 years of age. Ramified capillaries (6.66%) and microhemorrhages (5.33%) were noted in less number of individuals compared to Hoerth *et al.*[14] who observed it in 47% and 48%, respectively.

No individuals had any giant capillary, avascular zone, bizarre capillary, and sclerodermoid pattern that is supported by other studies. [3,5,7,13,14]

This study showed plexus visibility present in 36.66%, whereas Jakhar *et al.*[3] reported it to be 40% in age group 24–70 years. This study also observed that people with a BMI of more than 25 had low plexus visibility (*P*-value 0.0222) that is statistically significant. Most subjects had type 4 to 5 skin type.

The interesting finding of this study is that BMI does have its effect on plexus visibility that has not yet been described in any literature. Also, receding capillaries can be considered as an early marker for an avascular zone that is pathological but receding capillaries were noticed in one or two fingers, and not in all fingers of normal individuals. So, NFC findings should be observed in all the fingernails to avoid false-positive findings.

Limitation

Effects of various known and unknown factors influencing the parameters of this study, such as inter-observer variation, seasonal variation, etc., were not analyzed. The NFC findings in only fourth and fifth fingers were studied.

Conclusion

The morphology and capillary density in the nailfold capillaries of healthy individuals were studied and analyzed. The study concludes that various capillary morphology findings such as tortuosity, dilated, meandering, bushy capillaries, etc., can be present in normal individuals but their presence in more than two fingers should be considered for it to be pathological. This data on normal morphology and capillary density will add to the physiological NFC findings, and thus aid in identifying the abnormalities.

Declaration of patient

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.

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