

Clinical Practice article**Roles of epiluminescence dermoscopy beyond the diagnoses of cutaneous malignancies and other skin diseases**

Keywords: alopecia areata, cross-polarisation, dermatoscope, surface microscopy, pediculosis pubis, pseudofolliculitis barbae

Abstract

Epiluminescence dermoscopy was developed mainly for the diagnoses of melanoma and other skin cancers. This technology is also being increasingly applied for the diagnoses of other cutaneous diseases.

With rising popularity and availability, dermoscopes are taking up other roles. We discussed how dermoscopes facilitate education and counselling for patients and parents of patients, modify health-related behaviour, clinical research, and dermoscope-guided operations and procedures.

1. Introduction

Epiluminescence dermoscopy (ED) has been developed mainly for the assessment and diagnosis of melanoma, melanocytic naevi, and other cutaneous cancers. The diagnoses of other skin diseases are also facilitated by ED [1-3]. We report here roles of ED beyond clinical diagnoses of skin diseases.

19 **2. Education and counselling for patients**

20 **Patient 1**

21 We have previously reported a 40-year-old male consulting us for painful eruptions over his
22 chin [4]. He was obsessed with his hygiene, and was holding his skin tight with his fingers
23 and shaving hard with triple-bladed razors to “remove the dirt and germs” daily. Upon
24 physical examination, we diagnosed pseudofolliculitis barbae and hypertrophic scars.

25 We advised the patient to use electric shavers. However, he refused to accept our diagnosis
26 and advices. We then performed digital epiluminescence dermoscopy (DED), and showed
27 him images of reverted U-shaped ingrown hairs due to over-enthusiastic shaving. He
28 exhibited a complete attitude change, and complied with our recommendations to use electric
29 razors, not to holding the skin taut while shaving, and to allow a no-shaving buffer of three
30 days every fortnight. The disease completely remitted in four weeks.

31 **Patient 2**

32 A 57-year-old male had been suffering from generalised pruritus for more than three months.
33 He was indulging himself with two hot baths applying soap bars every day. He never applied
34 emollients, and was scratching himself constantly.

35 Upon physical examination, we diagnosed asteatotic dermatitis with nodular prurigo and
36 impetiginisation (Figures 1a and 1b). We recommended emollients, but the patient demanded

37 just topical corticosteroids from us, which was previously and repeatedly prescribed by his
38 general practitioner.



Figure 1a Erythematous and excoriating lesions in a male patient with asteatotic dermatitis and nodular prurigo.



Figure 1b Similar lesions on his upper back.

39

40 We showed him Figures 2a and 2b, taken with dermoscope without and with cross-
41 polarisation respectively. We explained that although inflammation was not seen by naked
42 eyes or a scope with magnification (Figure 2a), inflammation was serious in the deeper layers
43 at around the dermo-epidermal junction (Figure 2b).

44 The patient accepted our diagnoses. We recommended body lotions instead of soap bars, and
45 emollients to be applied generously after his baths. We prescribed a five-day course of
46 cefuroxime 250 mg twice daily, and 0.025% fluocinolone with 0.5% neomycin cream to be
47 applied to the indurated areas. Remarkable remissions in symptoms and signs were noted
48 when he attended follow-up three weeks later.

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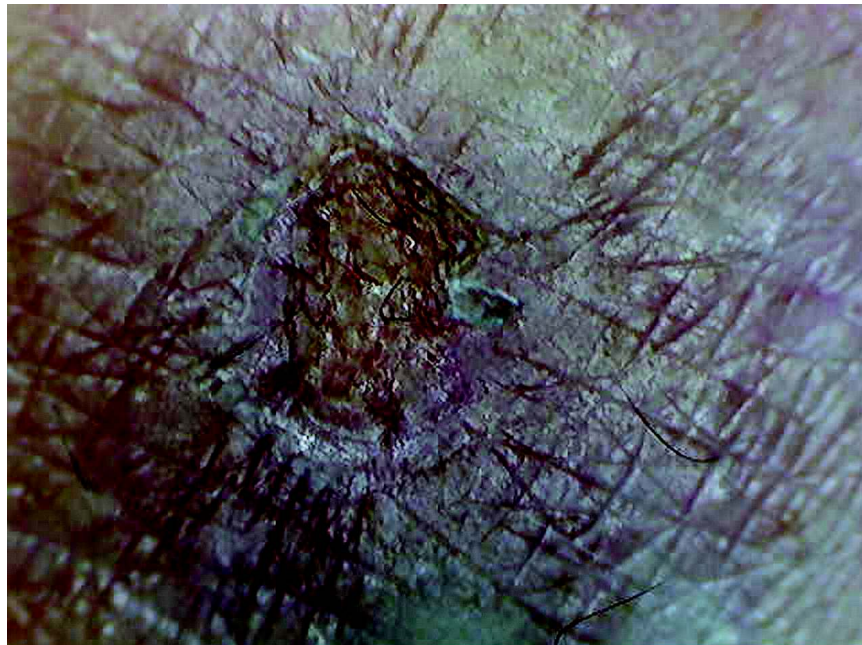


Figure 2a Image of one lesion of the patient with asteatotic dermatitis and nodular prurigo, taken by dermoscopy without cross-polarisation. Some inflammation was seen.

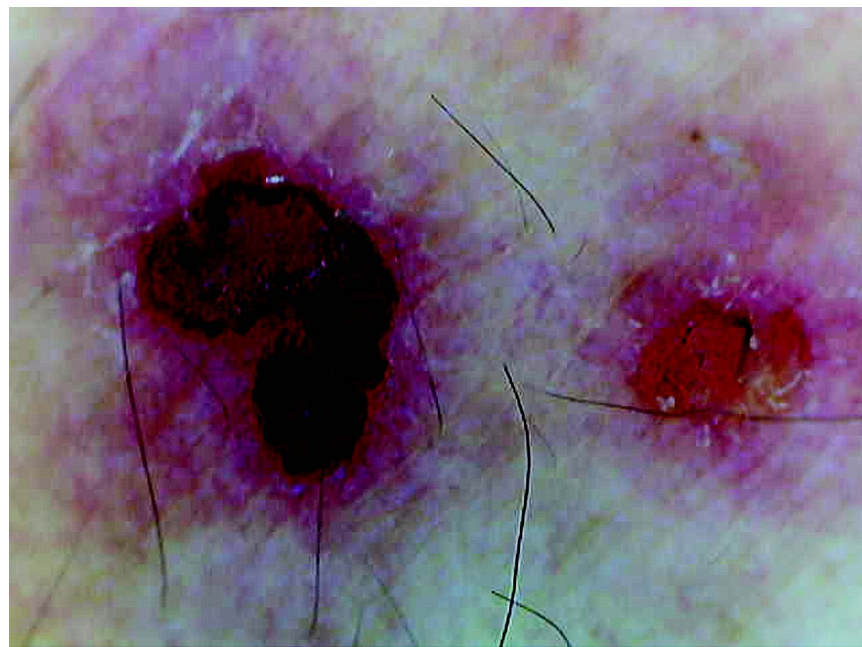


Figure 2b Image of lesions taken by epiluminescence dermoscopy, demonstrating that the inflammation was deep and serious.

51 **Patient 3**

52 A 35-year-old female was referred to us for three-month history of multiple lesions of
53 alopecia areata. No lesion was present in the occipital region. Other hairs including such in
54 the genital regions were unaffected. Figure 3a depicts the central part of the largest lesion on
55 the vertex. We could not identify an *exclamation-mark* in this image. However, we noted
56 two hairs having turned from black and thick (arrowed in blue) to silvery-white and thin
57 (arrowed in red).

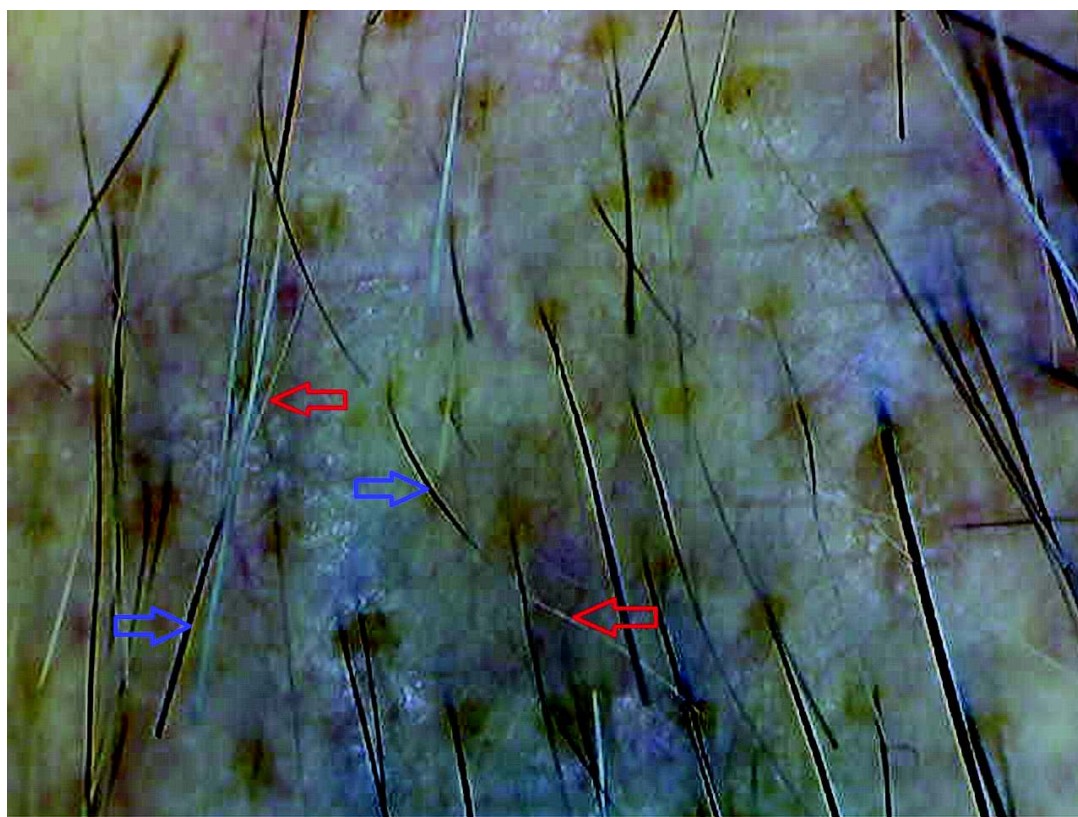


Figure 3a Dermoscopic image of a lesion on the scalp of a patient with alopecia areata. The disease was progressing as previously thick and dark hairs (arrowed in blue) were turning into thin and grey ones (arrowed in red).

59 Other than prescribing the appropriate treatments for her, we spent much time talking to her
60 about the generally good prognosis of alopecia areata. We also kept all of her dermoscopic
61 images. Four months later, we took Figure 3b which was in the vicinity of Figure 3a. Much
62 improvement was seen. Although other lesions were still showing no remission, we
63 convinced her that the activity of this organ-specific autoimmune disease was sinking, as
64 evidenced by her sequential dermoscopic images.

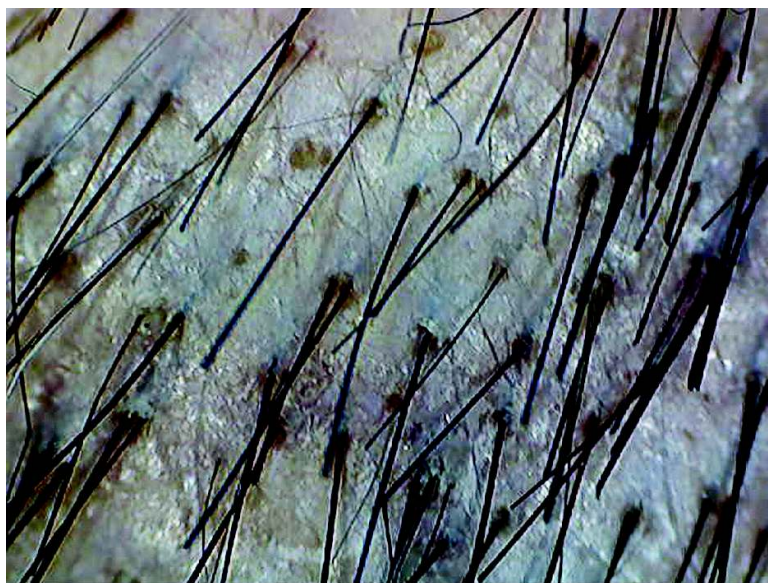


Figure 3b Thicker and darker hairs depicted by dermoscopy four months later, depicting that the disease was becoming less active.

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66 Throughout these months, although the patient was enduring an inevitable phase of
67 depression, she could still continue her work as a company secretary. Through viewing ED
68 images with us, she kept on hoping for complete disease remission, which did happen another
69 four months later.

70 **3. Modifying health-related behaviour**

71 A 40-year-old male consulted us for pruritus in the genital region. He had history of
72 *Chlamydia trachomatis* serovars D-K infection and genital human papillomavirus infection.
73 He was heterosexual, and was having multiple sex partners.

74 Examination with DED revealed multiple nits (Figure 4), although no adult of *Pthirus pubis*
75 was visualised. We showed the patient this image. Being confronted with such alarming
76 image, and having realised that condoms offer less protection for pediculosis pubis
77 infestation than for *C. trachomatis* serovars D-K and *Neisseria gonorrhoea* infections, he was
78 convinced that his sexual behaviour should change for the better.

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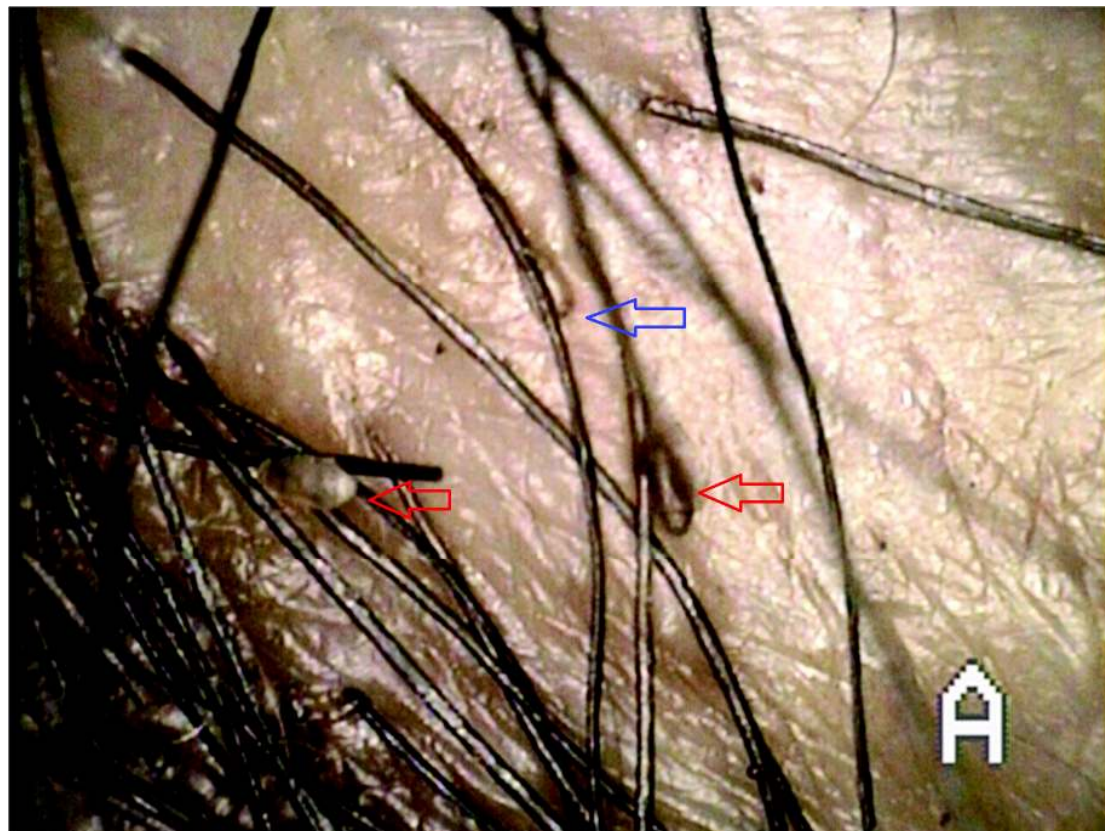


Figure 4 Dermoscopic image of the genital region near the root of the penis of a patient, showing nits of *Pthirus pubis*. Two viable nits are arrowed in red. One empty nit is arrowed in blue.

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81 **4. Education for healthcare professionals**

82 While taking medical students with us in our clinics, medical students found themselves
 83 fascinated by the extent of dermatological features and signs in DED images which they
 84 could view concomitantly as we examined our patients. This is one form of problem-based
 85 learning, which would arouse situation interest in their active educational process [5].

86 We had a crude model of the skin with us (Figure 5). Twelve levels of cross-polarising were
87 available for our DED. We would explain to the students that “we are now viewing deeper
88 into the subdermal region, where features of panniculitis should be seen for this lady with
89 erythema nodosum...” This is a lot more interesting than a histopathological figure. When
90 attending us again, students would be fluent in discussing with us the histology of the skin,
91 and meanings of basic histopathological features of skin diseases such as spongiosis or
92 parakeratosis.



Figure 5 A simple and inexpensive model of the skin. Coupled with digital epiluminescence dermoscopic images taken in different layers of the skin, this model would enhance students in understanding histology of the skin and histopathologies of skin diseases.

94 We expect our students to have basic knowledge of the histology and histopathology of the
95 skin when the students had finished their attachment with us. This could be dry and boring.
96 In stark contrast, when we portray that ED images are a bridge between histopathology and
97 clinical signs (Table 1), students would be delighted to learn *deeper*, literally and figuratively.
98 By the end of the attachment, most students would request us to allow them to scope the skin
99 of patients by themselves.

100 We would also share ED images to physicians in various stages of specialisation, and
101 paramedical professionals such as nursing students taking electives in skin diseases.
102 Moreover, data banks for ED images are being kept by us and other institutions, mainly for
103 postgraduate education and research.

104 Table 1 Comparison of the three modalities to skin examination for non-cancer skin diseases

	Physical examination by naked eyes	Epiluminescence dermoscopy	Lesional histopathology
Applicability for skin diseases	All skin diseases	Still in active explorations	Histopathological features are non-specific to some skin diseases. A list of differential diagnoses should be made available for the histopathologist
Magnification	1X	8X – 50X	10 X – 800 X
Depth of examination	Skin surface	Skin surface to sub-dermal fat	Stratum corneum to sub-dermal fat
Cost for setting up	Nil	100 – 5000 USD	Nil
Cost per examination	Nil	Nil	20 – 200 USD
Specific training for the clinicians	None necessary for qualified dermatologists	Additional training necessary	None necessary for qualified histopathologists
Time for the examination	In minutes for most circumstances	Probably a little longer than for naked eyes	At least 20 – 30 minutes for written consent and performing the biopsy; one to two hours for the histopathologist

	Physical examination by naked eyes	Epiluminescence dermoscopy	Lesional histopathology
Time needed for result	Immediate	Immediate	Four to ten days
Can patients see the image?	Yes	Depends on the settings of the facility	No
Risk of cross-infectivity	Negligible if clinicians wash their hands after any examination	Yes. Disinfection, sterilisation, or using disposable heads will minimise such	No
Discomfort for patients	Negligible	Negligible apart for infants and young children	Yes. Lesional punch biopsy or excisional biopsy are invasive procedures
Complications	No	No	Infection and bleeding on the biopsy site, might traumatisate perilesional nerves and blood vessels.
Leaving a scar	No	No	Yes. However, the scar would be small except for patients with tendencies to develop hypertrophic scars and keloids.

	Physical examination by naked eyes	Epiluminescence dermoscopy	Lesional histopathology
Further possible enhancements	Magnifying glass, diascopy, examination under Wood's light	Adjustment for the levels of cross-polarisations, adapters and lens for higher magnifications, adapters to connect to cameras and video-cameras	Direct immunofluorescence, immunohistochemical staining, <i>in-situ</i> hybridisation
Possible developments in the future	New clinical signs will be discovered for new diseases. Diagnostic criteria for some skin diseases. Evidence-based studies to substantiate or rectify validities and reliability of clinical signs.	More explorations for dermoscopic diagnoses for non-cancer skin diseases. Dermoscope-guided skin operations. Computer storage and comparison with appearances of previous lesions.	Technical developments to increase the validity and reliability of the findings. Algorithms for histopathological features

5. Research

ED has been reported to be applicable in diagnosing and assessing a wide range of diseases beyond melanomas and cutaneous malignancies [1-3]. Variants of ED have also been utilised to examine diseases of the hairs [6-8], nails [6,9,10], and capillaries [9]. The range of research involving ED is thus extremely wide. We hereby quote several specific arenas.

The first would be for diagnosis and diagnostic criteria of skin diseases. We have previously reported on the clinical [11] and technological [12] aspects of visualising peripheral collarette scaling in pityriasis rosea by ED. We then proceeded to establish and validate a set of diagnostic criteria for this paraviral exanthem [13,14]. During this process, we have seriously considered incorporating ED findings as part of the diagnostic criteria. However, we based our decisions on evidence. Our quantitative analyses including subgroup analyses and meta-analyses indicated that the inclusion of ED findings would be helpful for several sub-groups such as children with pityriasis rosea and some variants of pityriasis rosea [15,16]. The sensitivity, specificity, and positive and negative predictive values as a whole were not elevated if ED findings were incorporated as part of the criteria [17].

We thus deliberated not to incorporate ED in our diagnostic criteria for pityriasis rosea. However, as ED is being applied to many cutaneous ailments, other investigators would incorporate ED findings into diagnostic criteria of other skin diseases. Many dermoscopic features have, for example, been described for alopecia areata [18-20].

125 Another role is that ED might facilitate investigations on pathogenesis of skin diseases, and
126 improve outcomes of treatments directly. One example would be focal vitiligo. It is known
127 that there exists two reservoirs of melanocytes on our skin – perifollicular and interfollicular
128 [21,22]. The immunopathogenesis of focal vitiligo is incompletely known. For some reasons,
129 the organ-specific or tissue-specific autoimmunity attacks the interfollicular reservoir of
130 melanocytes first, before attacking the perifollicular reservoirs [21,22].

131 Should this immunopathogenesis be true, it would be expected that a zone would exist with
132 spots of pigmentation around hair follicles. Such pattern has indeed been found
133 macroscopically. We discovered and reported for the first time the visualisation of such
134 pattern at the dermoscopic magnification level [23]. We then further reported that
135 identification of such zones by ED could enhance the localisation of regions with high
136 autoimmune activity, and hastened efficacy of drug treatments [24].

137 The third scenario is that punch biopsy for confirmation of compatible histopathology needs
138 to be performed as an inclusion criteria in some studies. Three issues arise here. Firstly,
139 histopathological features in skin biopsies are often non-specific, and could only substantiate,
140 but not confirm, a diagnosis. A list of differential diagnoses should therefore be delivered to
141 the pathologist. Secondly, research plans which need clinically unnecessary invasive
142 procedures might incur higher thresholds to pass ethics approval. Lastly, patients or parents
143 of patients would decline the invasive procedure of a punch biopsy merely for clinical
144 research.

145 The utilisation of ED could solve some of these problems. If dermoscopic findings are
146 characteristic enough to confirm, or strongly substantiate, a diagnosis, punch biopsies would
147 become unnecessary in some circumstances. The ethics committee would then approve the
148 research protocol, and the study or control subjects would be a lot willing to be recruited in
149 the study which require a gentle touch of a dermoscopic head only.

150 In other words, if our understandings of dermoscopic findings are adequate enough, these
151 findings could be integrated to the inclusional or exclusional criteria for the recruitment of
152 study and control subjects, in observational studies as well as in interventional trials.

153 **6. Dermoscope-guided operations**

154 Many medical and surgical procedures are being guided by imaging equipments.
155 Instrumental guidance increases the chance of accurate attainment, removal, or destruction of
156 body cells, tissues, or organs. For skin cancers, Mohs surgeries maximise the cure rate,
157 minimise the recurrence rates, and provide good cosmetic results. ED is being used by many
158 clinicians in various parts of Mohs surgeries [25-27]. This *per se* is adequate substantiation
159 for the applicability of ED in skin procedures.

160 However, many clinicians performing skin operations for cancer or other diseases might not
161 have adequate support to conduct Mohs surgery. At the very least, an *in situ* pathologist
162 might not be present in their medical facilities. With the availability of robust but accurate
163 dermoscopic systems, delicate procedures can be done on the skin under instrumental
164 guidance (Figure 6).

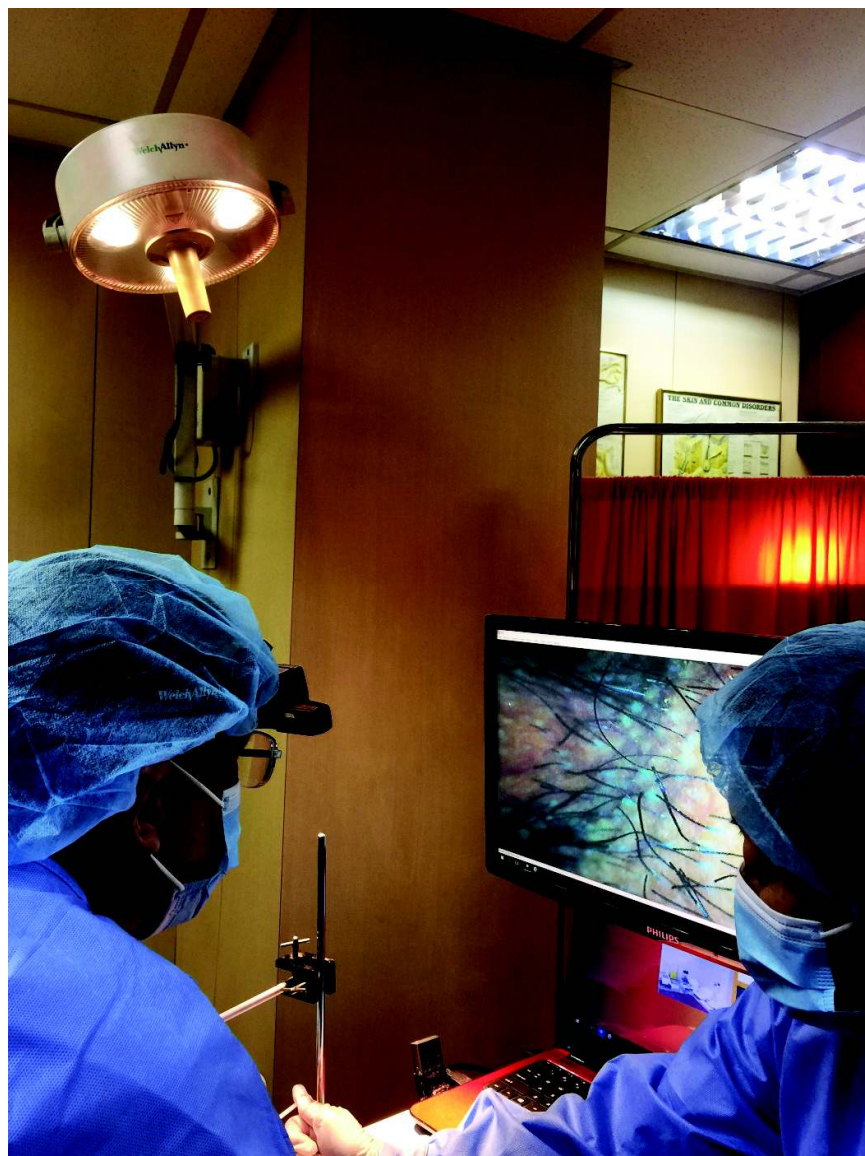


Figure 6 The author (left) performing dermoscopy-guided carbon dioxide laser ablation for a patient with multiple small-sized acrochordons.

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166 The skin is skin-deep. The threshold of dermoscope-guided operations is thus substantively
 167 lower than such of operations in general surgery, neurosurgery, or gynaecology. If something
 168 goes wrong in a laparoscopic cholecystectomy, a switch to laparotomy might be indicated. If

169 the dermoscope goes wrong in a dermatoscope-guided operation, the clinician might merely
170 switch his eyesight from the monitor to the patient and proceed with the operation smoothly.
171 Dermoscopy is commencing to be applied to a wide range of surgical procedures for skin
172 diseases [28-30].

173 However, as for the introduction of any medical or surgical procedure, we should be
174 constantly aware of training of clinicians and the assisting staff, and limitations of the guiding
175 and cutting equipments.

176 **7. Concluding remarks**

177 Apart from clinical applications to diagnose melanomas, other skin cancers, and other skin
178 diseases, ED could play active roles in educating patients, modifying health-related
179 behaviours such as sexual behaviour, education of medical students and other healthcare
180 professionals in training, and clinical research. ED-guided procedures and operations present
181 new frontiers to achieve higher precisions and lower risk of complications. However,
182 clinicians should be aware of their own training and experience to proceed in wider
183 applications of ED, and that all equipments are under regular and proper maintenance to
184 tackle these tasks.

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