Demographic and photobiological features of 70 chronic actinic dermatitis patients of lighter and darker skin type

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Demographic and photobiological features of 70 chronic actinic dermatitis patients of lighter and darker skin type

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Question: Are there differences in demographic and photobiological features between people of darker and lighter skin types with chronic actinic dermatitis (CAD)?

Findings: Retrospective review found darker skin type patients with CAD present at a younger age and with reversed sex ratio compared to lighter skin type patients, although phototest reactions are equally severe. Photopatch reactions are also commonly seen in patients with CAD.

Meaning: In contrast to what is classically known about CAD, darker skin type patients are more frequently female and may present at much earlier age. Photopatch reactions are common and can be safely performed in CAD.

Abstract 350 words

Importance: Chronic actinic dermatitis (CAD) is classically described in older, white Caucasian men although there are increasing reports in younger patients of darker skin types, particularly South Asians. Photocontact allergy occurs in CAD but is less studied than the occurrence of contact allergy in this exquisitely photosensitive condition.

Objective: To evaluate for differences in demographic and photobiological features between people of darker and lighter skin types with CAD.

Design: Retrospective review of patients undergoing investigation for photosensitivity who were diagnosed to have CAD, between November 2000 and August 2015.

Setting: Specialist photobiology unit of a tertiary academic referral center.

Participants: Consecutive adult (≥18 years) patients referred for investigation of photosensitivity.

Main Outcome(s) and Measure(s): Patient age, sex, ethnicity, clinical features and phototest outcomes.

Results: A total of 70 patients were diagnosed with CAD: 36 White (not Hispanic or Latino), 31 Asians including 24 South Asian, 4 East Asian, 3 Middle Eastern and 3 Blacks; 37 male, aged 9–83 years at diagnosis, with mean age of onset 42.6 years and mean duration of disease 8.8 years. Forty-one were of lighter skin type (I-IV) and 29 of darker skin type (V-VI). Darker skin type patients with CAD were younger at diagnosis (mean 40.7 vs 58.1 years, p=0.0001) and had earlier onset of photosensitivity (35.5 vs 47.5 years, p=0.01) compared to lighter skin type patients. Notably, the male: female ratio in the lighter skin group was 2:1 while this was 1:2 in the darker skin group. Phototest reactions were equally severe in skin types V-VI and I-IV, with MED to monochromated UVB, UVA and visible radiation, and broadband provocation testing, showing similar results. Photoallergic contact reactions to UV

filters, own suncreen products and NSAID were seen in both groups (total 14 positive reactions), comprising 22.9% of patients tested.

Conclusions and Relevance: CAD presents with earlier age of onset and an inverted male: female ratio in darker compared with lighter skin types. Clinicians should thus be cognizant of CAD presenting in younger, darker skin type females. Photopatch testing should be considered in CAD patients, with coexistent photocontact allergy occurring in a substantial proportion.

Introduction

Chronic actinic dermatitis (CAD) is a photosensitivity disorder classically described in older, white Caucasian men[1]. While the exact cause of CAD remains elusive, it has been proposed this is through increased susceptibility to develop delayed-type allergic responses to endogenous photoallergens and exogenous allergens[2]. It is a clinically distinct condition defined by a persistent dermatitis and/or pseudolymphomatous eruption affecting predominantly photo-exposed sites and monochromator phototesting which typically shows severely reduced minimal erythemal doses (MED) especially in the UVB and shorter UVA wavelengths[3, 4]. It is associated with multiple contact allergies including to sesquiterpene lactones, fragrance, colophony, rubber and sunscreens, but relationship to photocontact allergy is less well known as photopatch testing is less commonly performed. It is increasingly recognised in younger patients[5, 6], especially with darker skin types[7], although the prevalence in these is unknown. We reviewed patients diagnosed with CAD over a 15-year period in a specialised photoinvestigation unit and explored for differences in demographic and photobiological features between lighter and darker skin types.

Materials and Methods

We performed a retrospective review of CAD patients diagnosed in the Photobiology Unit, Dermatology Centre, Salford Royal NHS Foundation Trust, Greater Manchester, UK, between November 2000-August 2015. Ethical approval was waived for this review. All cases were diagnosed by a specialist photodermatologist through clinical and photobiological assessment, the latter comprising monochromator phototesting to narrowband UVB, UVA and visible radiation; provocation testing to broadband UVA and solar simulated radiation (SSR); and photopatch testing to sunscreen filters, sun-protection products, and non-steroidal anti-inflammatory agents (NSAID). Blood and urine sampling was performed as below.

Clinical assessment

Patients referred for photosensitivity assessment attended a standardised four-day photoinvestigation programme. A detailed history was obtained: age of onset, distribution and natural history of the skin condition, seasonal variation, whether it is improved or worsened by use of sunscreens, detailed drug history (at onset of photosensitivity and current), excessive ingestion of foods/drinks with phototoxic constituents namely quinine and psoralens (e.g. tonic water, parsley, parsnip), personal and family history of atopy or photosensitivity, Fitzpatrick sun-reactive skin type[8], ethnicity, occupation and recreational activities. Morphology and distribution of skin lesions were recorded.

Monochromator phototesting

Patients were exposed to narrowband UV and visible radiation from 300-600nm (+/- half maximum bandwidth), using a geometric series of doses at each waveband: 0.0018 to 0.08 J/cm^2 (300 +/-5nm), 0.13 to 4 J/cm^2 (320 +/-10nm), 0.44 to 14 J/cm^2 (330 +/-10nm), 0.9 to 40 J/cm^2 (350 +/-20nm), 1.8 to 57 J/cm^2 (370 +/-20nm), 3.5 to 113 J/cm^2 (400 +/-20nm), 50 J/cm^2 (500 +/-20nm, 600 +/-20nm); (1KW xenon arc lamp, Newport Spectra-Physics Ltd, Didcot, UK, coupled to a 1/4m grating monochromator, Newport Spectra-Physics Ltd). Reference ranges were originally established at another centre in Northern England, UK[9]. Irradiance was measured using a calibrated thermopile (Medical Physics, Dryburn Hospital, Durham, UK) and digital voltmeter (Medical Physics, Royal Liverpool University Hospital, Liverpool, UK).

Provocation testing

Provocation testing was performed on 5x5cm areas of ventral forearm on up to three consecutive days to 15J/cm^2 broadband UVA, using a custom-built circumferential arm exposure unit incorporating Cleo Performance fluorescent bulbs (310-400nm, Phillips Healthcare UK Ltd., Guildford, UK) and, separately, to 10J/cm^2 of SSR (290-400nm, 1KW xenon arc plus atmospheric attenuation filter, Newport Spectra-Physics Ltd).

Photopatch testing

Photopatch with control patch testing was performed to a series of 25 agents[10]: 19 UV filters, 4 NSAID (Chemotechnique Diagnostics, Vellinge, Sweden) and 2 prescribable sunscreen-products, from 2009-2015. Prior to 2009, the photopatch series comprised 10 agents[11]: 9 organic UV filters and one sunscreen-product. Patients' own sunscreen-products were also applied. Duplicate patches were applied (day 1) to skin of the mid-back for 24 hours following which one set was irradiated (day 2) with between 0.5-5J/cm^2 broadband UVA (310-400nm; UVAL 801, Herbert Waldmann GmbH & Co. KG, Villingen-Schwenningen, Germany). The UVA was dosed according to depth of erythemal response on day 2 at the UVA provocation site, i.e. 5J/cm^2 was used if mild erythema was seen, 2.5J/cm^2 if moderate erythema and 0.5-1J/cm^2 if severe erythema was seen. Readings were made at 24 and 48 hours post-UV (days 3, 4) to examine for a crescendo response, using the International Contact Dermatitis Research Group (ICDRG) grading[11,12].

Other relevant investigations

Routine assessment comprised plasma and urine porphyrin scan; serum autoantibody screen, IgE and 25-hydoxyvitamin D (25OHD). Skin biopsy was rarely indicated.

DLQI

The Dermatology Life Quality Index (DLQI) [13] questionnaire was used to assess impact of skin disease on quality of life. As clinical photosensitivity can fluctuate depending on season and ambient UV/visible radiation, questionnaires focusing on events in the last week may underestimate impact, thus questionnaires assessed impact both in the last week and over the last year[14]. There is a maximum potential score of 30, higher scores equating to greater impairment of life quality [13].

Statistical methods

The data were analysed using ANOVA (StatsDirect Ltd. v2.7.9, Altrincham, UK). Statistical significance was accepted at the $P < 0.05$ level. Data are mean ± SD.

Results

Demographic and clinical characteristics

A total of 2025 patients were photoinvestigated between 2000 –2015. Characteristics of the 70 patients diagnosed with CAD are shown in Table 1. There were 33 female and 37 male, aged 9–83 years at diagnosis, with mean age of onset 42.6 years and mean duration of disease 8.8 years. Five patients (7.1%) were ≤21, 19 (27.1%) were 22-40, 18 (25.7%) were 41-60, 28 (40%) were >60 years old. Forty-one were of lighter skin types (I-IV) and 29 were darker skin type (V-VI), comprising: 36 White (not Hispanic or Latino) (25 male, mean age 61.1 years, mean onset 50.8 years), 31 Asians including 24 South Asian (9 male, mean age 41.9 years, mean onset 36.4 years), 4 East Asian (3 Chinese/Chinese-White, 1 Laotian; 3 male, mean age 45.8 years, mean onset 36.3 years), 3 Middle Eastern (2 Saudi Arabian, 1 Kuwaiti; all female, mean age 37 years, mean onset 32 years), and 3 Blacks (1 Libyan, 1 Somalian, 1 Afro-Caribbean; all female, mean age 29.7 years, mean onset 25.3 years).

A background of atopic eczema was found in 37.1% (26/70), and a further 14% (10/70) without eczema had other features of atopy, including asthma and allergic rhinitis. Additionally, of the 44 non-atopic patients, 4 had a history of contact allergic dermatitis, 3 of hand eczema and 2 had unspecified eczema. Darker skin type patients with CAD were younger at diagnosis (40.7 vs 58.1 years, $p=0.0001$) and had earlier age of onset of photosensitivity (35.5 vs 47.5 years, $p=0.01$) compared to lighter skin type patients. A detailed drug history was taken; 8 patients were taking potentially photosensitizing drugs, but only in 3 did the medication pre-date photosensitivity, with latent period ≥5 years.

Patients showed characteristic clinical and photobiological features of CAD (figure 1). This typically presented as a photodistributed eczematous and sometimes lichenified condition,

including face, 'V' of chest, nape of neck, dorsal forearms and hands, and with sharp demarcation between affected and sun-protected areas. In darker skin patients, responses on monochromator phototesting could be more evident from the raised and palpable nature of responses than from the erythema (figure 1f).

Narrowband (monochromator) phototesting

For each wavelength tested a mean MED for the patients was calculated using the lowest dose point at which a response was seen for that wavelength; this value may not represent the absolute threshold in cases where patients responded to the lowest dose tested. Severely reduced MED at 24 hours were seen in all patients, with the action spectrum predominantly in the UVB and shorter UVA range, but often spreading to longer wavelength UVA and including the 400nm border of visible light, but infrequently beyond this (Table 1, Figure 2). Four patients had normal UVB thresholds but were classified as CAD due to their severely low UVA thresholds and consistent clinical findings. Mean MEDs for the different wavebands were similar for darker and lighter skin types, except at 400nm where this was lower in the lighter group.

Broadband provocation testing

All patients had positive provocation to broadband UVA and SSR (figure 1c, 1d), most developing an erythemal response after the first test, often followed by development of eczematous features (particularly scaling) if the test was repeated.

Photopatch and patch testing

Detailed photopatch testing was performed concurrently with phototesting. Despite the challenge posed by UVA irradiation in such severely photosensitive patients, in total 61 underwent photopatch testing with control patch testing; a further 5 had the control patch testing component alone. The irradiation dose used ranged from 0.5 to 5 J/cm^2 (1 had 0.5 J/cm^2, 34 received 1 J/cm^2, 12 had 2.5 J/cm^2 and 14 had 5 J/cm^2). Overall, 14/61 (22.9%)

patients had positive photopatch reactions; 11 of lighter skin type (29.7% of I-IV, 11/37) and 3 of darker skin type (12.5% of V-VI, 3/24). Most had 1 reaction on photopatch testing (8/14; figure 1g) while 3 patients had 2 reactions and 3 had 3 reactions. Details of the photopatch positives are shown in Table 2. Of note, of the 14 patients with a positive photopatch test, 9 were given only 1 J/cm^2 UVA, 2 had 2.5 J/cm^2 and 3 had 5 J/cm^2.

We additionally found 15/66 (22.7%) of our patients showed contact reactions to our photopatch test panel, comprising 12/40 (30%) of skin type I-IV and 3/26 (11.5%) of V-VI. Standard patch testing for contact allergy was also performed in 25 patients by their dermatologist (21 patients of skin type I-IV, 4 of V-VI); most frequently seen positive contact reactions were to fragrance, nickel, Balsam of Peru and thiazolinone (Supplementary Table 1).

Other relevant investigations

Plasma and urine porphyrin scan were negative in all patients. Anti-nuclear antibody (ANA) was positive in 17/70 patients (11 skin type I-IV, 6 skin type V-VI). The majority (14 patients) had a low titre of 1:100 and 3 had a titre >1:1000; these did not appear clinically relevant, and DNA and ENA antibodies were negative. Serum IgE was elevated in 71% (35/49) patients, with a similar proportion in light (69%, 20/29) and dark (75%, 15/20) skin types (Table 1). Vitamin D status is shown (Table 1). Skin biopsy was rarely performed as CAD was diagnosed on clinical/phototest findings; one patient had biopsy of his naturally occurring condition, revealing histological features of chronic dermatitis.

DLQI

A subset of patients completed the DLQI questionnaire (33 (week) and 31 (year); Table 3) as this was routinely introduced in 2011. Comparison of the week and year scores revealed no significant difference (p=0.86). Impact on life quality was “very large” (DLQI 11-20) to

213 "extremely large" (DLQI 21-30), with 45% of patients having a DLQI week score >10 and
214 77% DLQI year score >10, and this was similar in darker and lighter skin patients.
215
216 **Discussion**
217 The patient demographics in our review highlight differences in gender distribution and age
218 of onset of photosensitivity in lighter (I-IV) and darker (V-VI) skin type patients presenting
219 with CAD. The former are predominantly older males, consistent with the earlier CAD
220 literature, while the latter are more often younger females. We found a ratio of 2 female: 1
221 male in the darker skin types, i.e. a reversal of the 1:2 ratio seen in lighter skin types. This is
222 consistent with the Michigan, USA study of African Americans with photodermatoses by
223 Kerr and Lim[14], which found the ratio in 15 Afro-Caribbean CAD patients was 2 female:1
224 male. Hence, this pattern may be more widespread in darker skin type patients, and across
225 continents. Wadhwani et al[15], in New Delhi, India reported the ratio of 1 female: 3.2 male in
226 50 patients, although the diagnosis of CAD was made without monochromator phototesting.
227 Of note was the very young presentation to our unit of some patients with CAD, with 5
228 patients aged ≤21 years. The youngest was a 9 year-old girl of mixed White-Chinese heritage,
229 skin type IV, who developed photosensitive features 1 year earlier while the other younger
230 patients were of South Asian (3) and Afro-Caribbean (1) descent, who developed similar
231 features 4-7 years prior.
232 The photobiological characteristics in our CAD patients were typical of the literature,
233 classically showing markedly reduced MED to UVB and with UVA involvement (Table 1,
234 Supplementary Table 2). Predominantly UVA involvement was reported in 25/507 (5%)
235 patients in a large study of this rare disorder reported from Dundee, Scotland[2]. This was
236 consistent with our finding of severe UVA sensitivity alone in 4/70 (5.7%) patients (2 lighter
237 skin, 2 darker skin); notably none had a history of photosensitizing drug use. In our review,

lighter and darker skin types were as severely affected on monochromator phototesting, having markedly reduced erythemal thresholds especially in the 300nm waveband, with phototesting frequently producing palpable lesions.

Photopatch testing with control patch testing is a routine part of photosensitivity investigation in our unit, due to finding frequent positives in the photosensitive patient group, and uses the European Academy of Dermatology and Venereology (EADV) standardised battery of sunscreen filters and NSAIDs[10,11]. Positive photocontact reactions were seen in 22.9% of all patients tested, while contact reactions to patch controls alone were seen in another 22.7% patients. Benzophenone-3 was the most common sunscreen filter causing photocontact and contact reactions in people of both lighter and darker skin types (Table 2). Barber et al[17] found positive photopatch reactions in 5/47 CAD patients, with musk ambrette (4/5 patients) the main photoallergen, although only 6 potential photocontact allergens were included in this older, 1980-1981 study. Menage reported 12% positive photopatch reactions in 89 CAD patients tested (to musk ambrette, oxybenzone and PABA, between 1987-1992)[1]. Our data, produced from photopatch testing of virtually all presenting CAD patients, and using a wide, standardised contemporary battery, provide a salient addition to the literature.

Most of our CAD patients showing a positive photopatch reaction were irradiated with only 1J/cm^2 UVA, indicating this low dose is sufficient to elicit a positive response; this is of practical significance in these severely photosensitive patients where lesion provocation could complicate the procedure. We cannot rule out that the low UVA dose might have been insufficient to activate some photoallergens; thus there could be an even higher rate of associated photocontact allergy. While reluctance by some departments in subjecting severely photosensitive patients to UVA irradiation for photopatch testing is understandable, we show a substantial positive response of 22.9% of CAD patients, indicating this is an informative investigation to pursue, with complications mitigated by using a small UVA dose.

Conversely, coexistent contact allergy is well-reported in CAD[1]. Results of contact testing to a standard patch test battery were available in ~one-third of our patients (25/70), provided by the referring dermatologists. The more common contact allergic reactions were to fragrance, Balsam of Peru, thiazolinone, sesquiterpene lactones, colophony, nickel and cobalt; the latter 2 possibly reflecting the background atopy of many of the patients [18, 19,20]. Sesquiterpene lactones contact sensitivity, known to be associated with CAD but thought to be declining in prevalence in CAD patients[21], is still a relatively frequent allergen in our review. Positive patch test reactions to para-phenylenediamine, possessing cross-reactivity with sesquiterpene lactones[22], are also seen in CAD[7], although a role in pathogenesis remains unproven.

Parthenium dermatitis, a common cause of plant (Parthenium hysterophorus) dermatitis in India, is classically an airborne contact dermatitis[23] but is reported to develop into a photodermatitis resembling CAD[24]. Such plants are native to tropical America, India and Australia, while the patients in our review have lived mostly in the UK.

Within the 2,025 patients undergoing photoinvestigation over this 15 year period, a further 378 (18.7%) were diagnosed with photoaggravated eczema (PAE). These had reduced erythemal thresholds predominantly in the UVA rather than UVB range, and of a less exquisitely severe degree. However, this does bring into question the relationship between the more severe PAE, and the small percentage of CAD patients with severely low UVA rather than UVB thresholds, i.e. whether they represent a continuum rather than completely distinct disorders. Serum IgE was elevated in approximately 70% of CAD patients assessed, with similar proportion seen in lighter and darker skin types (Table 1), consistent with the reported association of CAD with atopy[5,6].

Vitamin D status, measured as circulating 25OHD in 30 patients (2011 onwards) showed >half (53%) of patients assessed were in the vitamin D deficiency range (<25nmol/L), where the bone disorders rickets (in children) and osteomalacia (adults and children) most often

288 occur. Interestingly, both lighter and darker skin type patients were similarly affected, while
289 non-photosensitive darker skin people typically have lower status than lighter skin types,
290 including in Greater Manchester, UK (53.5N)[25]. This illustrates the vigilant sun
291 avoidance/photoprotection these severely photosensitive patients adopt[26]. Low vitamin D
292 status is well-documented in photosensitivity; in a mixed diagnosis group, insufficient
293 25OHD levels (≤50 nmol/L) were found in 47% patients in summer, increasing to 73% in
294 winter, while deficient levels were seen in 9% and 32% respectively[26]. It is recommended
295 vitamin D status is assessed in patients with photosensitivity, and supplementation instituted
296 where there are insufficient/deficient levels[27,28].
297 Week and year DLQI scores were obtained in 33 and 31 patients respectively (Table 3). The
298 largest category of patients (15/33) had scores >10, indicating a 'very large' to 'extremely
299 large' effect on quality of life[29], similar in both lighter and darker skin type patients. This is
300 consistent with a multicentre study of 790 UK photodermatoses patients, where 39% of 127
301 CAD patients had DLQI >10.
302 The main limitation of our review was its retrospective nature, although all patients were
303 assessed according to standardised clinical and phototest proforma. Interpretation of MED in
304 darker skin type patients is sometimes visually challenging, while the palpable "doughy"
305 texture assists detection of responses. This may be assisted in future by devices objectively
306 determining variations in skin perfusion[30]. Photopatch tests batteries will continue to evolve
307 to reflect current photoallergen prevalences.
308 In conclusion, our review found that a substantial proportion of CAD now presents in
309 younger, darker skin females; similar photosensitivity and impact on life quality is seen as for
310 the typically presenting older Caucasian males. This largest series of photopatch testing
311 reported in this exquisitely photosensitive disorder shows the investigation can be
312 successfully performed, with a high yield of photopatch positivity.

313

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Study concept and design: Haylett, Rhodes
Acquisition, analysis, and interpretation of data: Tan, Haylett, Ling, Rhodes
Drafting of the manuscript: Tan
Critical revision of the manuscript for important intellectual content: Rhodes
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Figure Legends

Figure 1. Clinico-photobiological features of CAD in white Caucasian (a,c,e,g) and South Asian (b,d,f) patients. (a,b) Photodistributed eczema; (c,d) Provocation test positive; (e,f) Monochromator phototesting shows markedly reduced MED; in darker skin erythema is less visible but raised lesions are evident; g) positive photocontact reaction.

Figure 2. Action spectrum of CAD in darker and lighter skin types. Figure shows %patients with reduced MED at each waveband on monochromator phototesting (300±5nm, 320±10nm, 330±10nm, 350±20nm, 370±20nm, 400±20nm, 500±20nm, 600±20nm). Total patients n=70; skin type I-IV n=41; skin type V-VI n=29.

Table 1. Demographic, clinical and narrowband phototesting findings in CAD patients with lighter and darker skin type

Clinical & photobiological features		All patients (n=70)	Skin type I-IV (n=41)	Skin type V-VI (n=29)	p value, ANOVA (I-IV vs V-VI)
Age (years) at presentation[a]		50.9 ± 2.3	58.1 ± 2.5	40.7 ± 3.5	0.0001
Age (years) of photosensitivity onset[a]		42.6 ± 2.4	47.5 ± 2.9	35.5 ± 3.9	0.01
Duration of condition (years)[a]		8.8 ± 1.27	10.6 ± 2	6.3 ± 0.85	0.1
Sex ratio (M:F)		1.12 : 1	1.92 : 1	1 : 1.9	
Skin type I, II, II/III, III, IV, V, VI		8, 13, 2, 13, 5, 28, 1	8, 13, 2, 13, 5	28, 1	
Involvement: Summer/holidays only 2 seasons 3 seasons All seasons Not stated		 3 5 18 29 15	 2 (4.9%) 2 (4.9%) 7 (17.1%) 21 (51.2%) 9 (21.9%)	 1 (3.5%) 4 (13.8%) 10 (34.4%) 8 (27.6%) 6 (20.7%)	
History of atopic eczema		26	13 (31.7%)	13 (44.8%)	
Serum IgE Ku/L[a]		1888 ± 725	2339± 1115	1234 ± 745	P = 0.46
Serum IgE: > 85 ku/l No record		35 (71%) 21 (30%)	20 (69%) 12 (29%)	15 (75%) 9 (31%)	
25OHD nmol/L		34.3 ± 5.23	35.0 ± 7.26	33.7 ± 7.7	p=0.91
Vitamin D status: Deficient (<25 nmol/L) Insufficient (25-50nmol/L) Sufficient (>50 nmol/L)		 16/30(53%) 8/30 (27%) 6/30 (20%)	 8/14 (57.1%) 3/14 (21.4%) 3/14 (21.4%)	 8/16 (50%) 5/16 (31.2%) 3/16 (18.7%)	
No. (%) patients with low MED on narrow band testing	300 ± 5nm 320 ± 10nm 330 ± 10nm 350 ± 20nm 370 ± 20nm 400 ± 20nm 500 ± 20nm 600 ± 20nm	66 (94.3%) 70 (100%) 63 (91.3 %)[b] 51 (72.8%) 43 (62.8%) 24 (34.3%) 1 (1.43%) 0	39 (95.1%) 41 (100%) 37 (92.5%)[c] 28 (68.3%) 26 (63.4%) 18 (43.9%) 0 0	27 (93.1%) 29 (100%) 26 (89.6%) 23 (79.3%) 17 (58.6%) 6 (20.7%) 1 (3.4%) 0	
Narrowband MED J/cm^{2d}	300 ± 5nm 320 ± 10nm 330 ± 10nm 350 ± 20nm 370 ± 20nm 400 ± 20nm 500 ± 20nm 600 ± 20nm	0.004± 0.0004 0.26 ± 0.007 1.63 ± 0.23 6.46 ± 0.88 13.61 ± 1.66 49.4 ± 4.18 >50J/cm^2 >50J/cm^2	0.004±0.0005 0.26 ± 0.008 1.61 ± 0.29 6.5 ± 1.03 12.66 ± 1.96 42.85 ± 4.99 >50J/cm^2 >50J/cm^2	0.004 ± 0.0007 0.27 ± 0.01 1.66 ± 0.39 6.3 ± 1.56 15.01 ± 2.98 58.69 ± 6.9 >50J/cm^2 >50J/cm^2	p = 0.63 p = 0.52 p = 0.90 p = 0.90 p = 0.49 p = 0.06

[a] data shown is Mean ±SD

[b] 69 and [c] 40 patients were tested at this waveband

[d] 1,2, 5 and 7 patients had MED>highest dose at 300, 350, 370 and 400nm, respectively

Table 2. Photopatch (PC) and control (C) patch test results in CAD patients

Test agent	Number (%) of reactions					
	All skin types		Skin type I-IV		Skin type V-VI	
	PC	C	PC	C	PC	C
Benzophenone-3	6 (9.8)	2 (3.03)	3 (8.1)	1 (2.5)	3 (12.5)	1 (3.8)
Benzophenone-4	2 (3.3)		2 (5.4)			
Butylmethoxy dibenzoyl methane	1 (1.6)		1 (2.7)			
Diethylamino hydroxybenzoyl hexyl benzoate		1 (1.5)		1(2.5)		
Ethylhexyl methoxycinnamate	3 (4.9)		2(5.4)		1(4.2)	
Ethylhexyl dimethylamino benzoate	1(1.6)	1 (1.5)	1(2.7)	1(2.5)		
Isoamyl-p-methoxycinnamate	1 (1.6)		1(2.7)			
Methylbenzylidene camphor	2 (3.3)	1(1.5)	2(5.4)	1(2.5)		
PABA	1 (1.6)		1(2.7)			
Methylene bis-benzotriazolyl tetramethylbutylphenol		1(1.5)		1(2.5)		
Etofenamate	1 (1.6)		1(2.7)			
Own product	13 (21.3)	20 (30.3)	12(32.4)	18(45)	1(4.2)	2(7.7)

439 Table 3. DLQI scores for the past week and past year

DLQI		Total patients (n=33 - week n=31- year)	Skin type I-IV (n=22 - week, n=21 - year)	Skin type V-VI (n=11 - week, n=10 - year)	p value, ANOVA (I-IV vs V-VI)
DLQI score[a]	Week (n=33)	10.7 ±7.19	9.73 ± 7.61	12.63 ± 6.15	p=0.28
DLQI score[a]	Year (n=31)	13.7 ±6.56	12.76 ± 6.15	15.7 ± 7.27	p=0.25
DLQI Impact (Week) number (%) patients	No impact (score 0-1)	3 (9.1%)	3 (13.6%)	0	
	Small impact (score 2-5)	6 (18.2%)	5 (22.7%)	1 (9.1%)	
	Moderate impact (score 6-10)	9 (27.3%)	5 (22.7%)	4 (36.4%)	
	Very large impact (score 11-20)	11 (33.3%)	6 (27.2%)	5 (45.4%)	
	Extremely large impact (score 21-30)	4 (12.1%)	3 (13.6%)	1 (9.1%)	
DLQI Impact (Year) number (%) patients	No impact (score 0-1)	0	0	0	
	Small impact (score 2-5)	5 (16.1%)	4 (19%)	1 (10%)	
	Moderate impact (score 6-10)	2 (6.5%)	1 (4.8%)	1 (10%)	
	Very large impact (score 11-20)	19 (61.3%)	14 (66.7%)	5 (50%)	
	Extremely large impact (score 21-30)	5 (16.1%)	2 (9.5%)	3 (30%)	

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441 [a] Scores shown are mean ±SD

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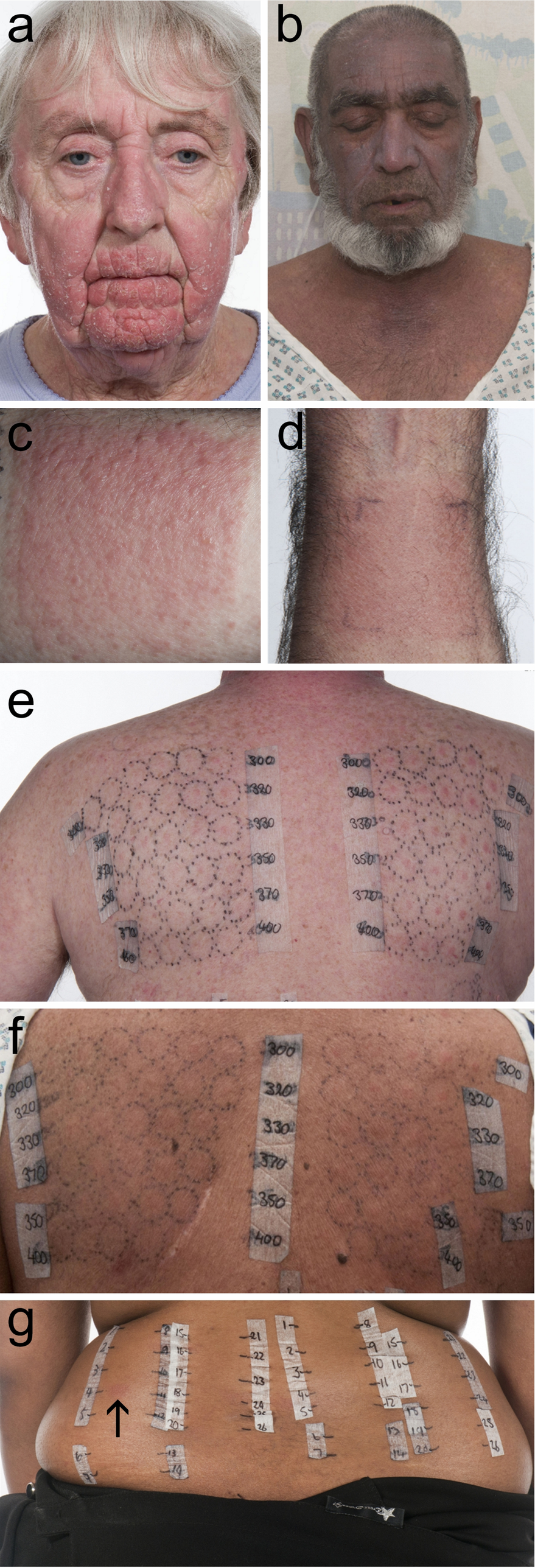
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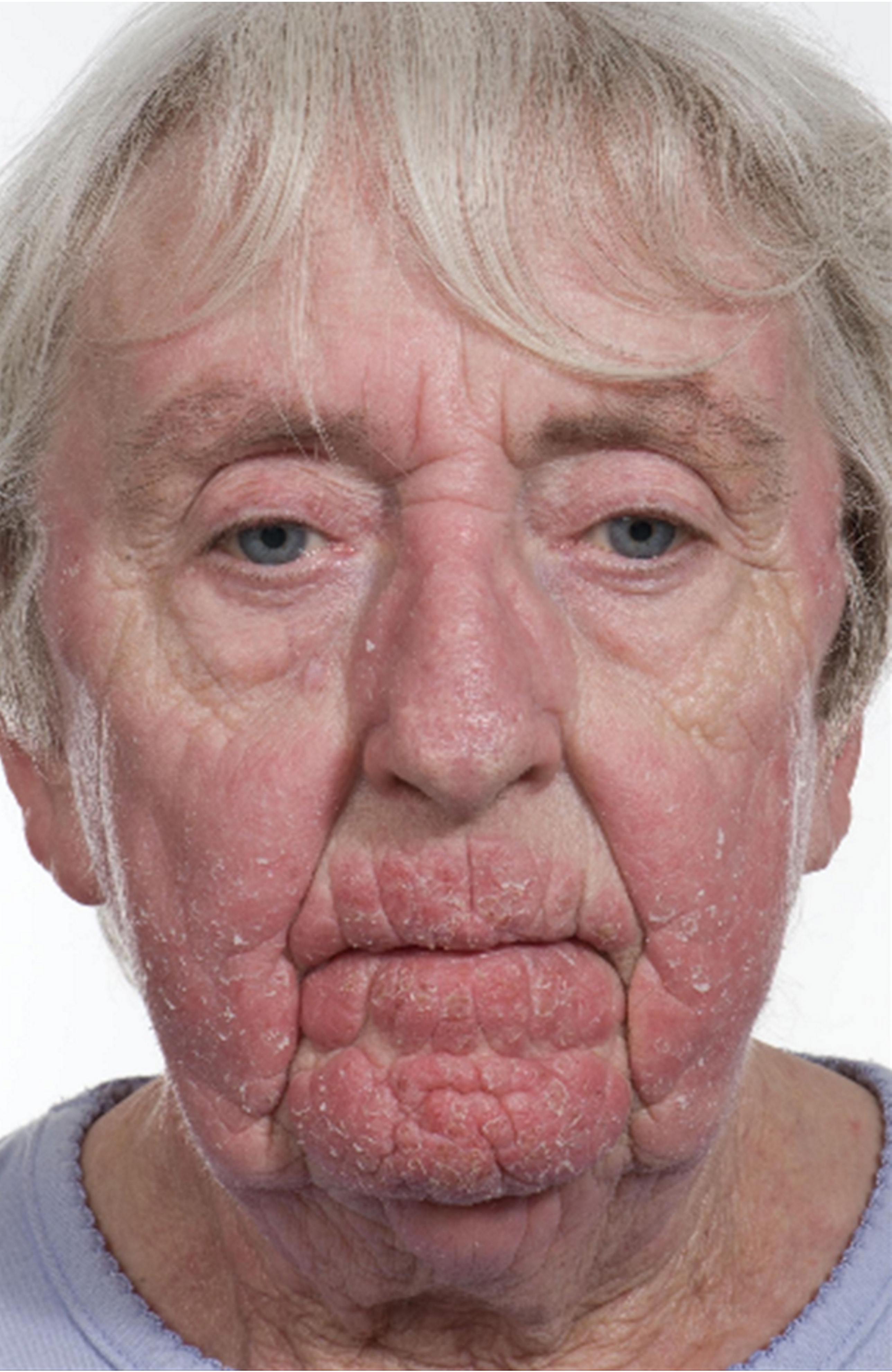

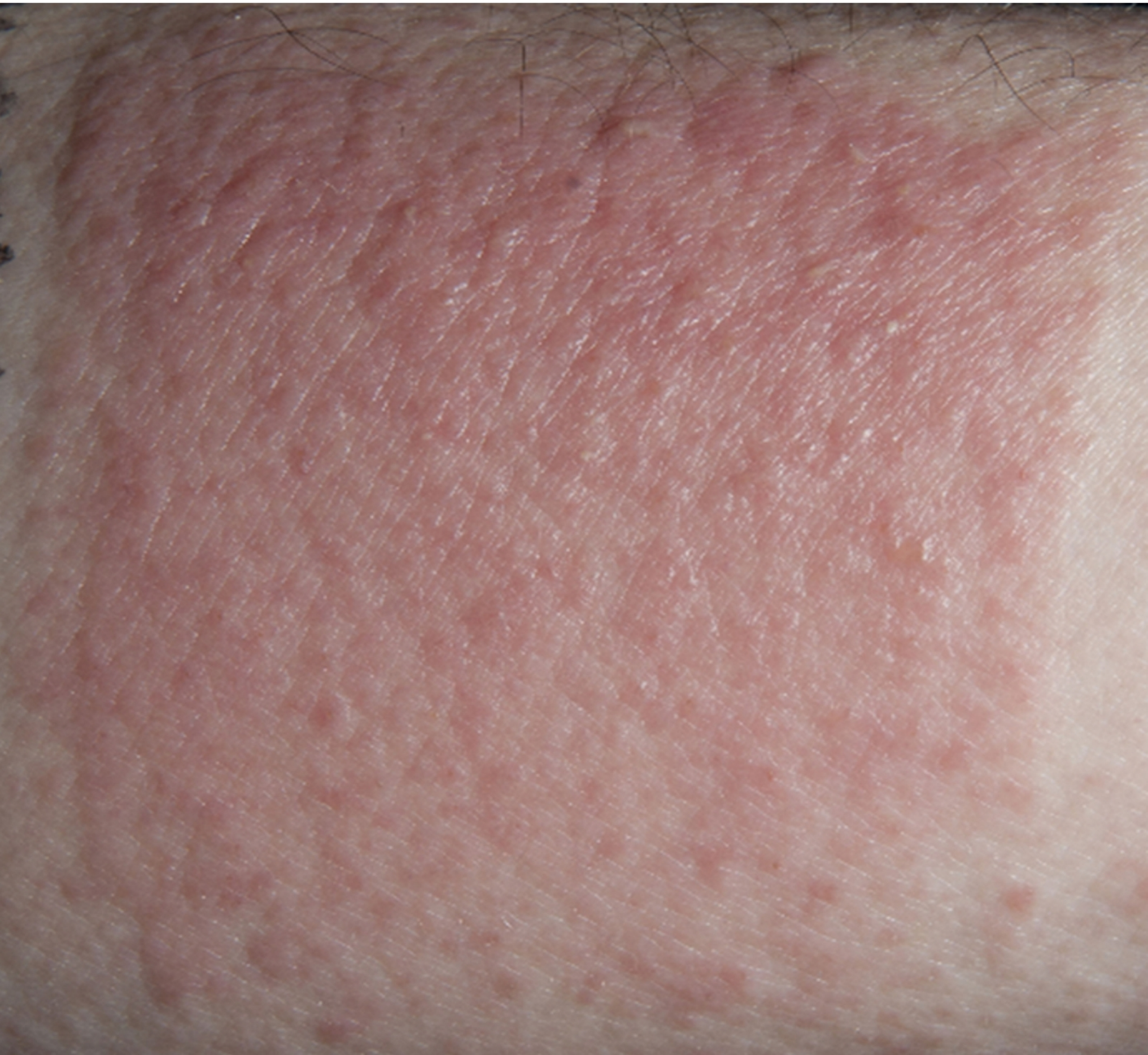

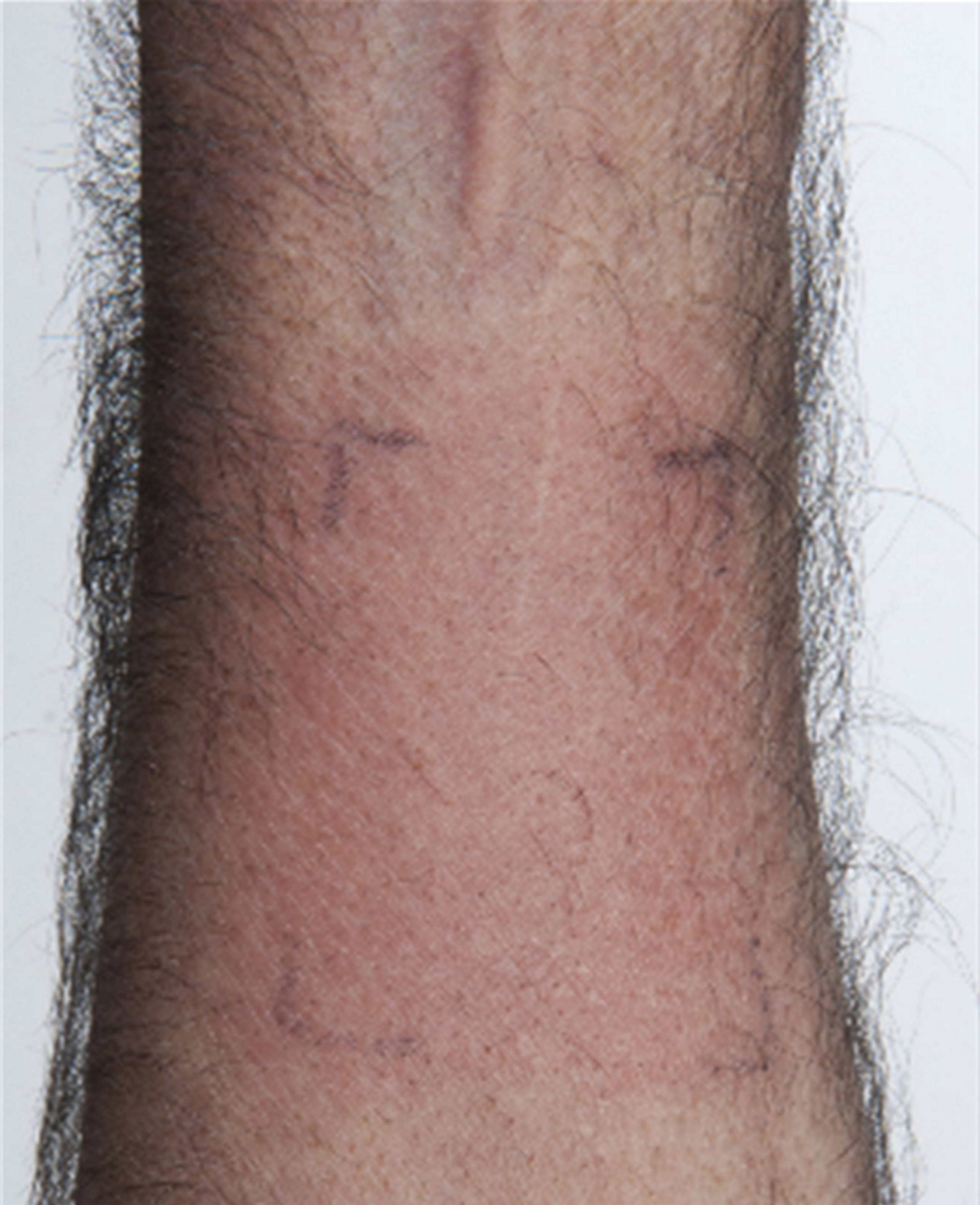

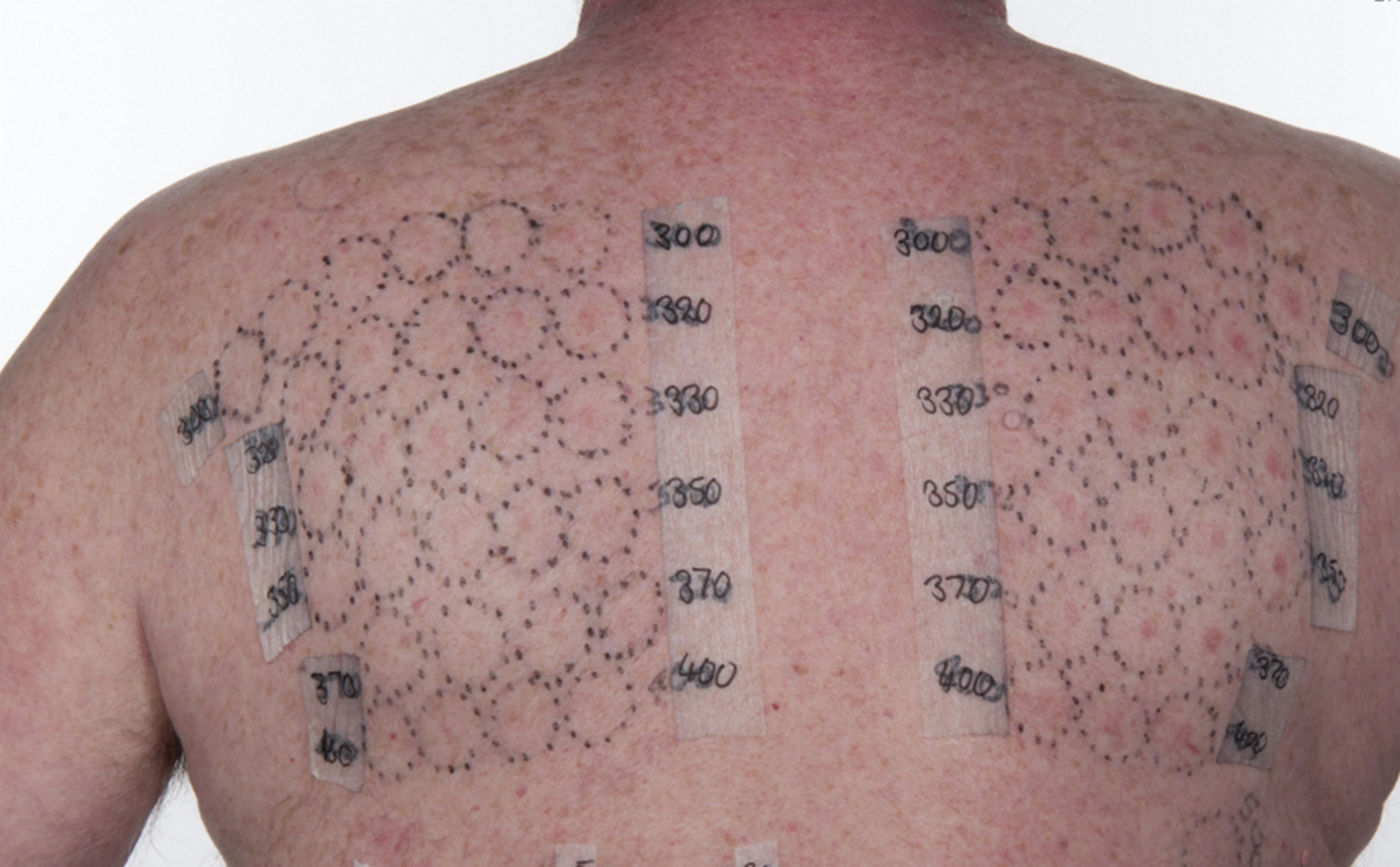
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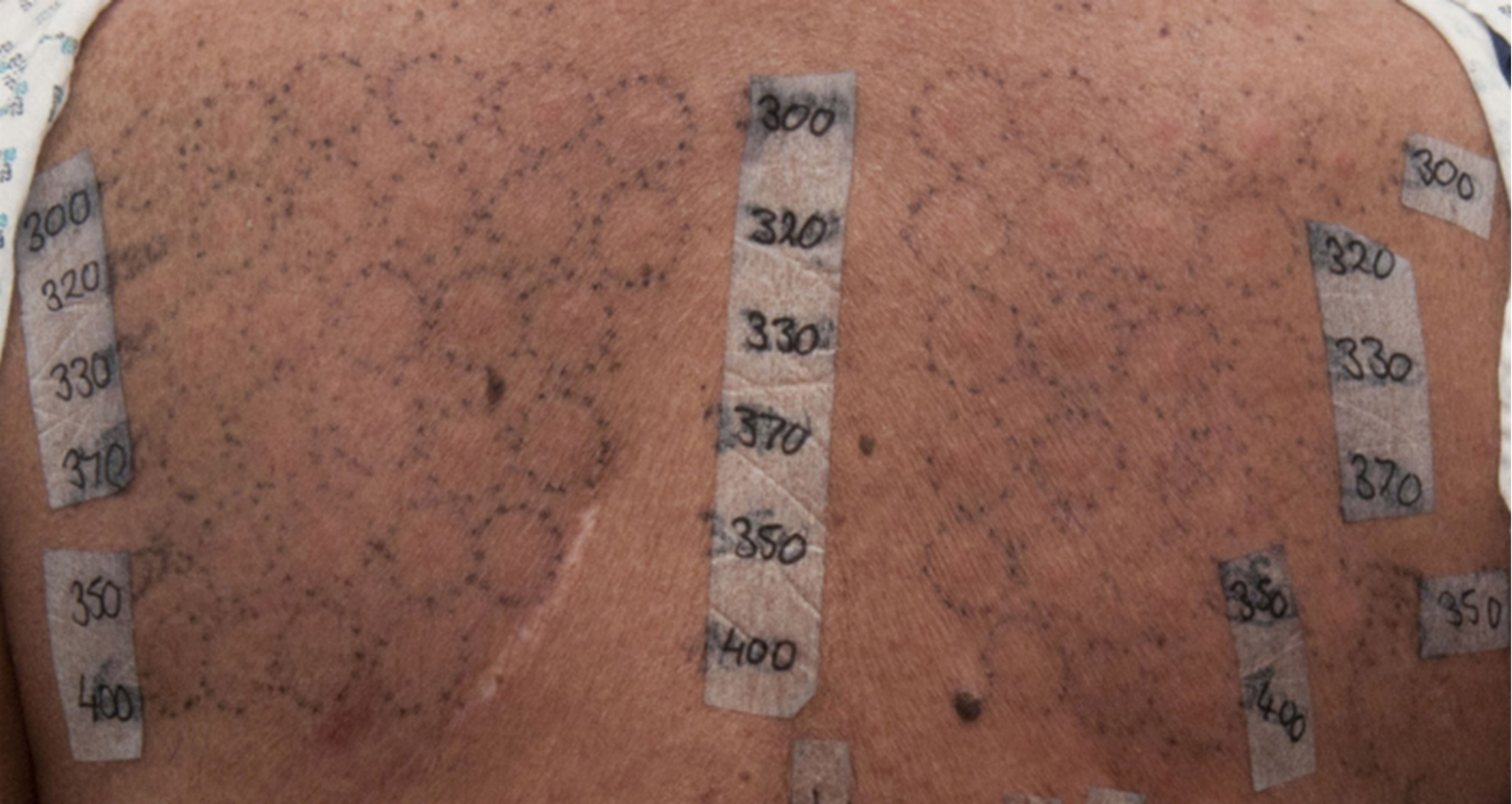
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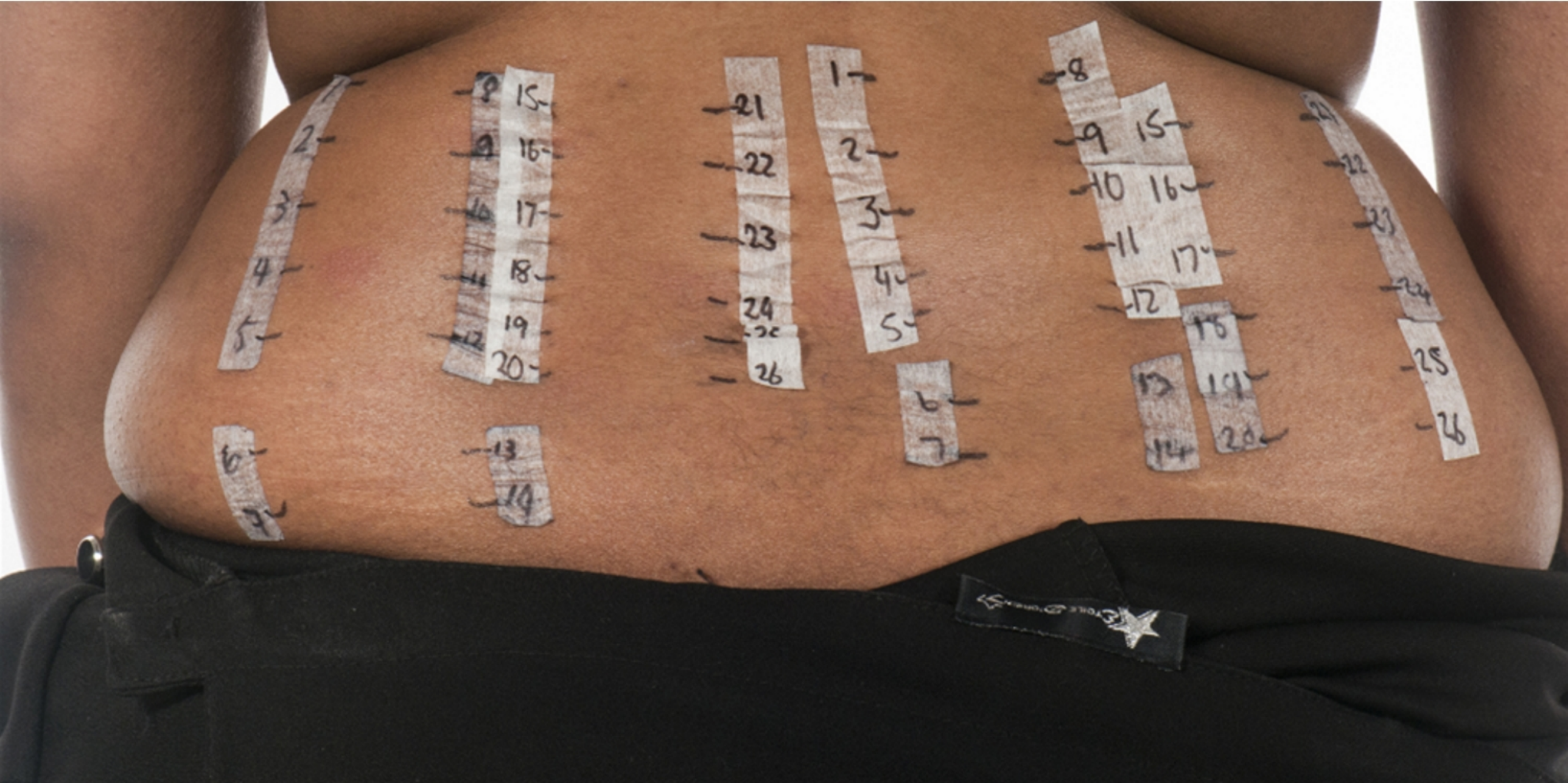
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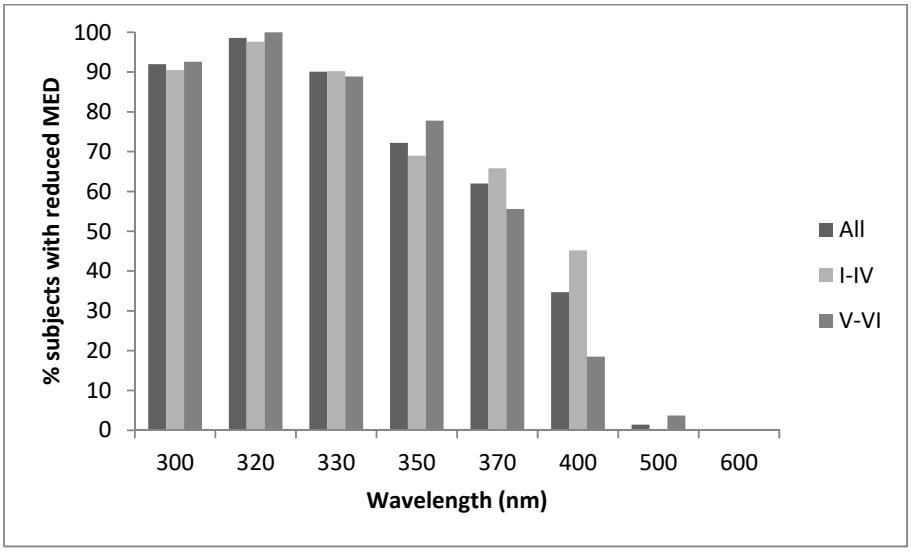
Fig. 2


100
90
80
70
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10
0
% subjects with reduced MED
300
320
330
350
370
400
500
600
Wavelength (nm)
All
I-IV
V-VI