Ultraviolet-fluorescent tattoo facilitates accurate identification of biopsy sites

Bertha Baum, DO

Hollywood Dermatology & Cosmetic Specialists

Thanks

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- Thanks to all my teachers, attendings, family and friends.
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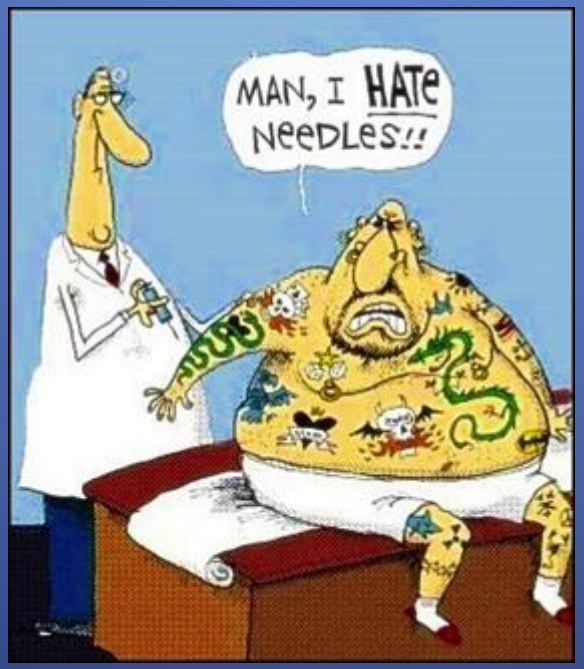
Objective of the study

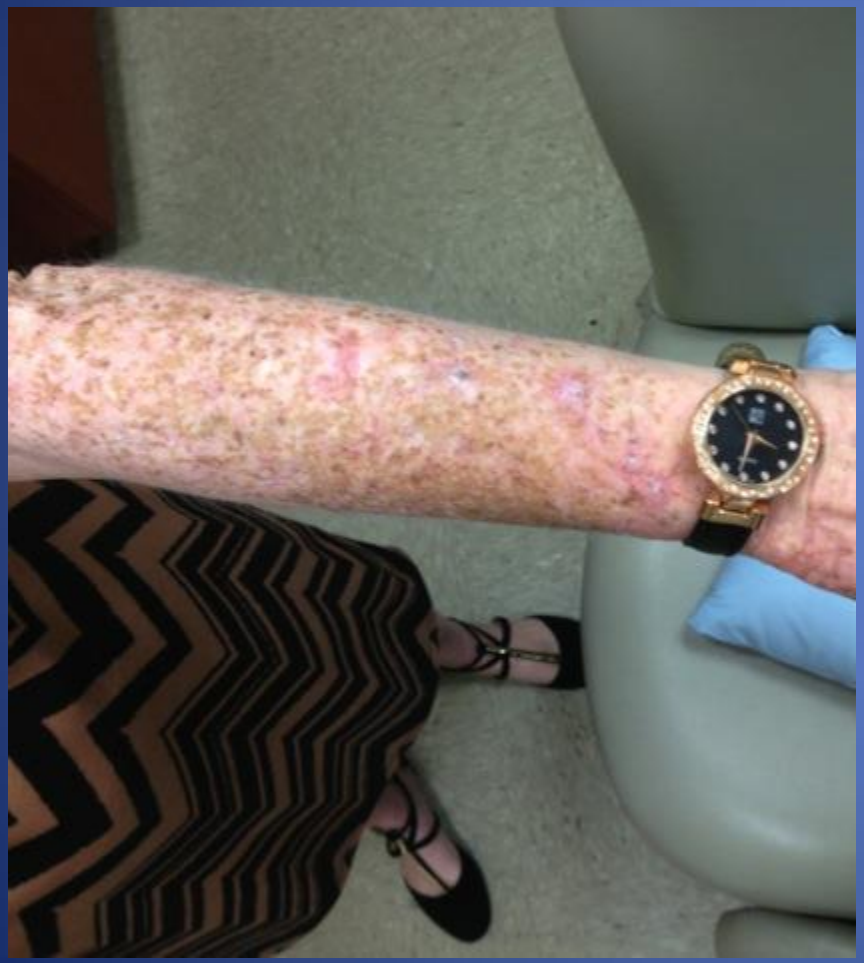
To determine the efficacy of ultraviolet-fluorescent tattoos in facilitating correct identification of biopsy sites in patients suspected of having non-melanoma skin cancer.

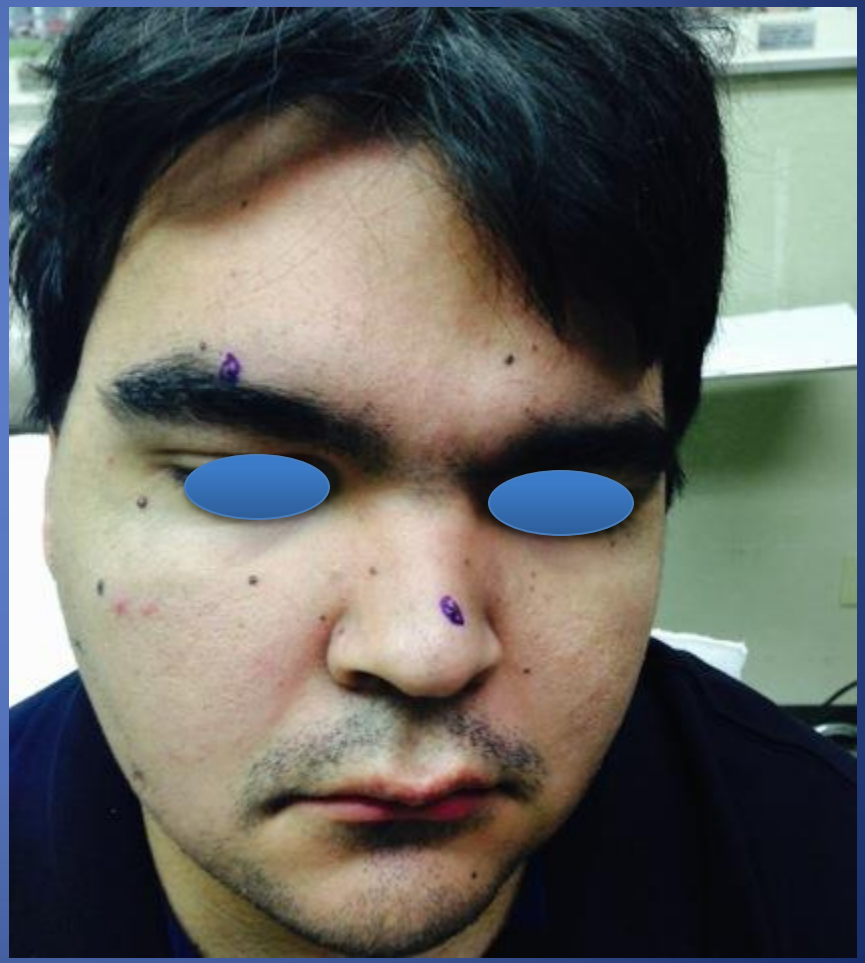


Facts

- In USA, more than 4.3 million patients undergo treatment for non-melanoma skin cancer each year (1).
- Many patients wait weeks to months from the time of biopsy to the time of treatment. During this time, biopsy sites may heal to become imperceptible (2).
- The inability to correctly identify a patient's biopsy site is a common problem and is the most frequent reason for medical malpractice lawsuits (3).

Identify the site?





What is done today?

- Methods to correctly identify surgical sites (2, 4):
  - photography
  - diagrams
  - measurements to anatomical landmarks
  - gauze dermabrasion
  - biopsy site scar visualization
  - patient assistance among others
- When patients and physicians try to identify the site together, they are incorrect in 4-12% of cases (2, 5). Disagreement between patient and physician can lead to delay in treatment and increased costs (6).

Failures

The use of biopsy site photography:

- decrease the number of wrong site surgeries (2)
- its adoption has been encouraged (2, 5, 7)
- pre-operative biopsy photos are often not provided or are of insufficient quality when patients are referred for treatment (8).

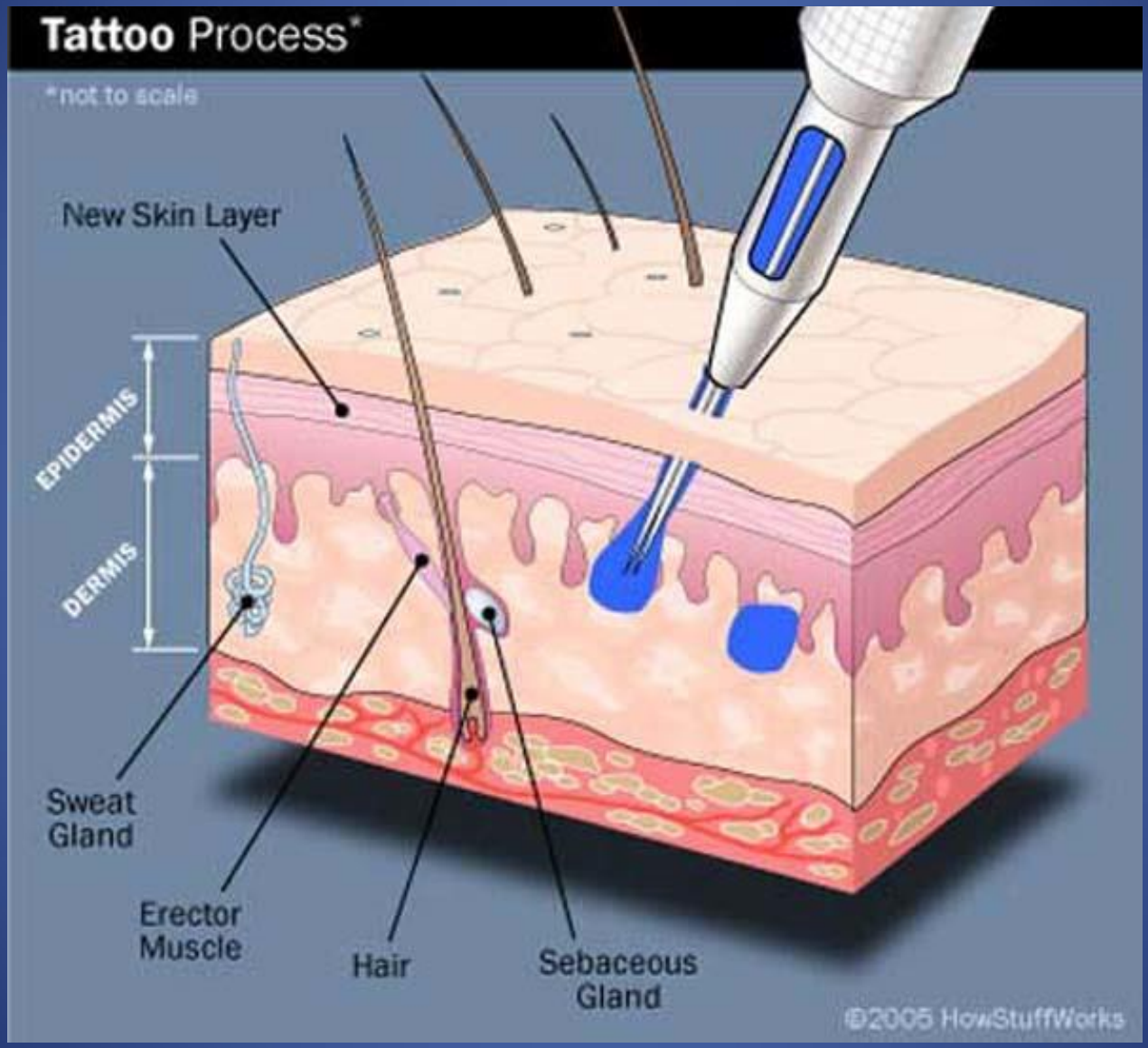
Having a system to accurately identify biopsy sites is imperative to prevent wrong site surgery.

Tattoos in medicine

- Tattoos are regularly used in the fields of surgery and radiation oncology to correctly identify tumor locations (9, 10).
- However, these marks are permanent, and many patients dislike their appearance and seek future removal (11).
- Ultraviolet tattoos, also known as invisible tattoos, are composed of a special ink that is invisible in natural light but fluoresces when exposed to a Wood's lamp (360nm), more commonly known as a black light.

Invisible tattoo ink

http://www.wholesaletattoosupplies.com

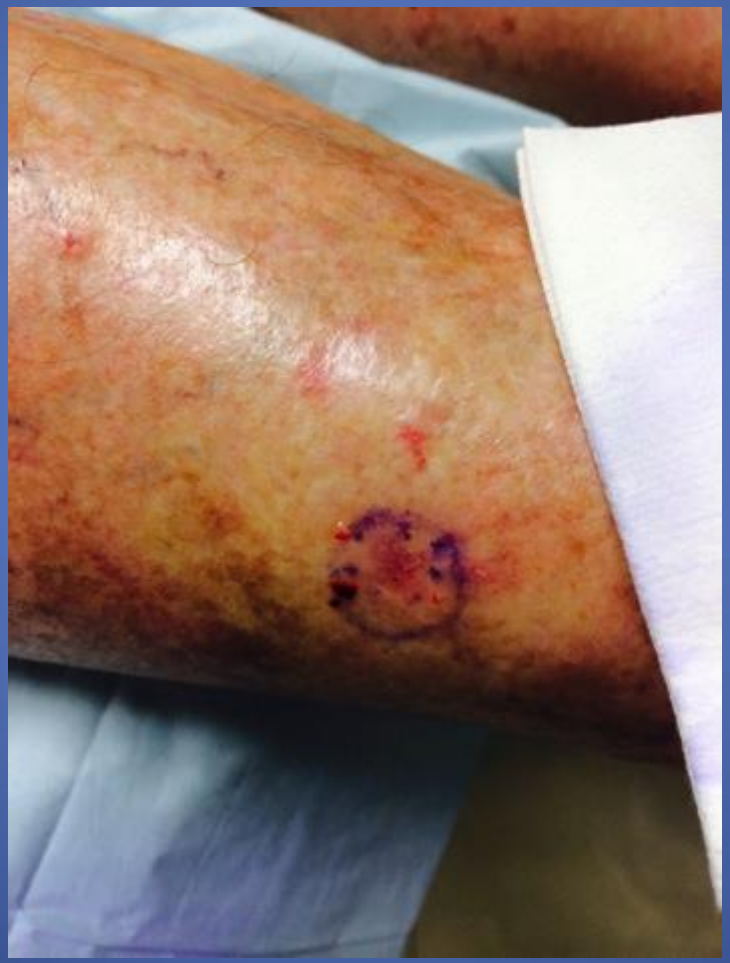


https://www.youtube.com/watch?v=EIR5pPiM3Bg

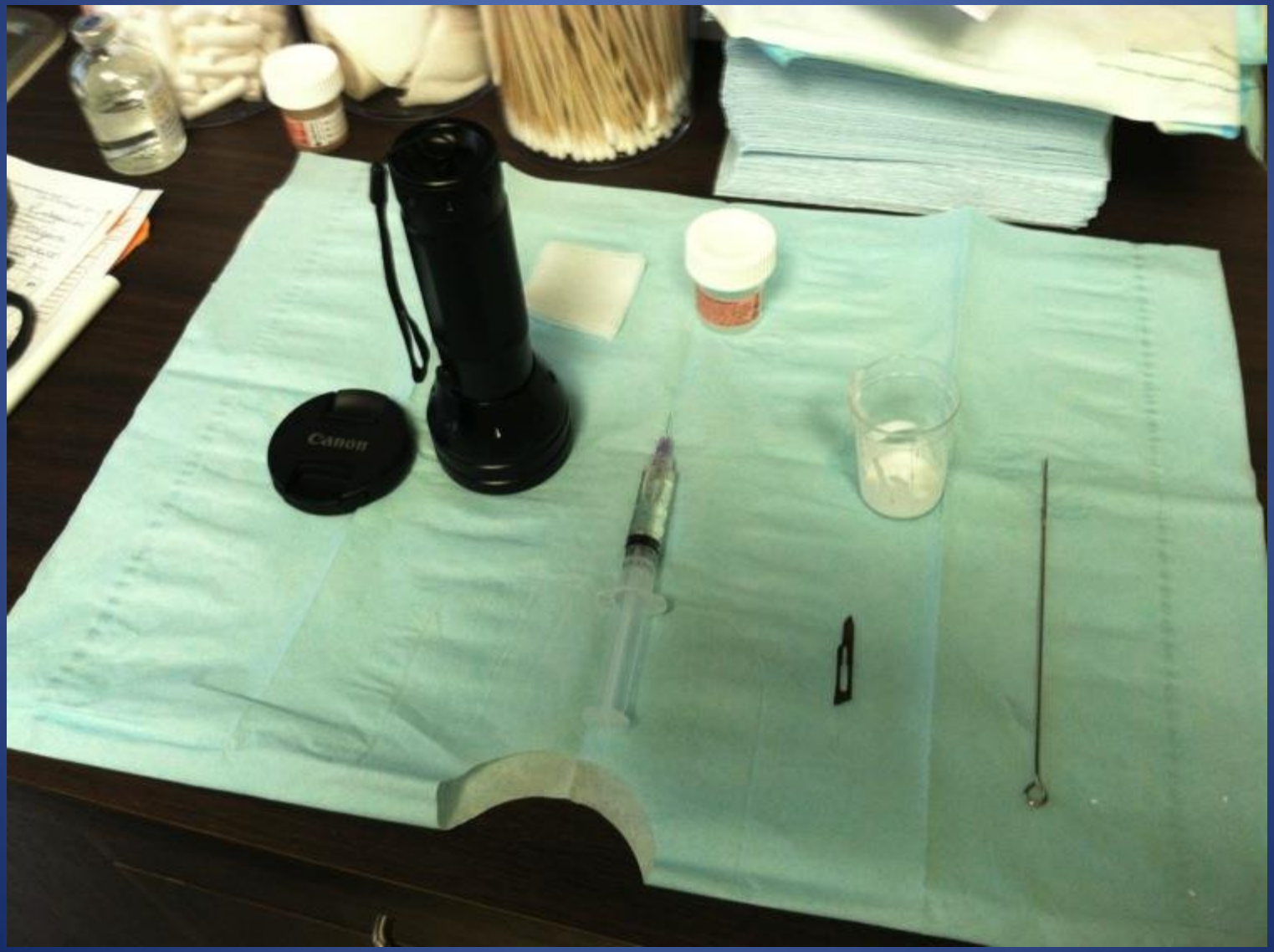
Methods

- Between November 2013 and October 2014 , patients 18 years of age or older undergoing a skin biopsy for a suspected non-melanoma skin cancer in our outpatient dermatology clinic were invited to participate in this study.
- Participants received written information about the study in either English or Spanish, and informed consent was obtained from each patient. The project proposal was approved by the Nova Southeastern Institutional Review Board.

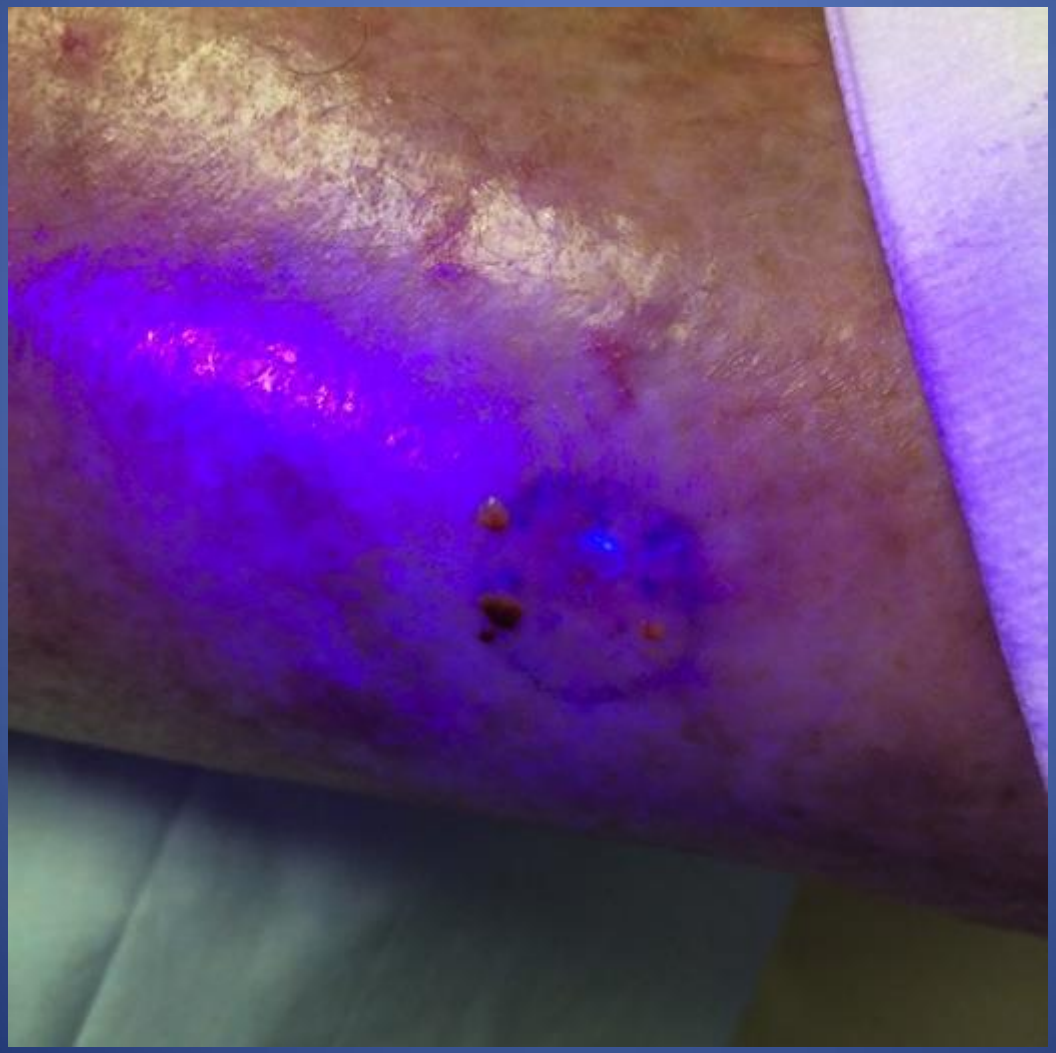
Technique



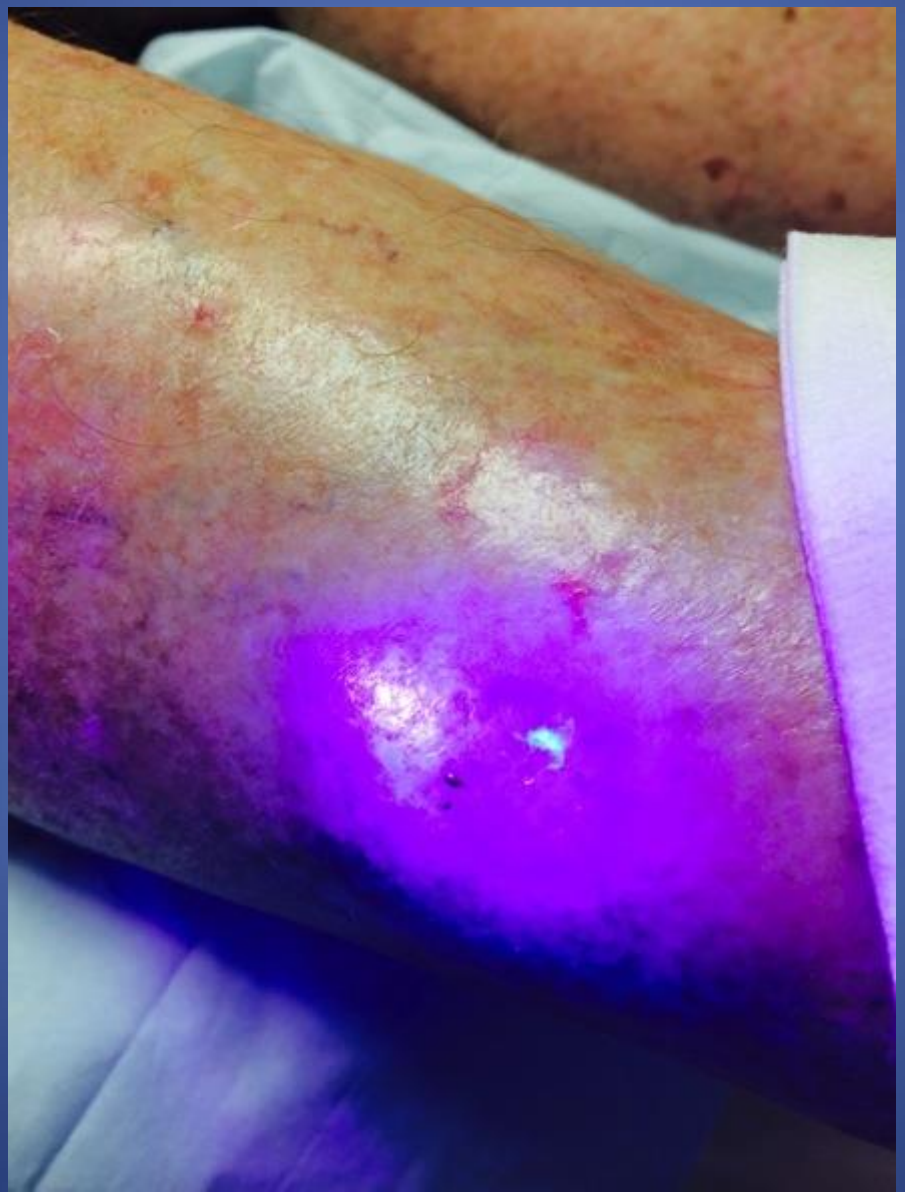
Materials



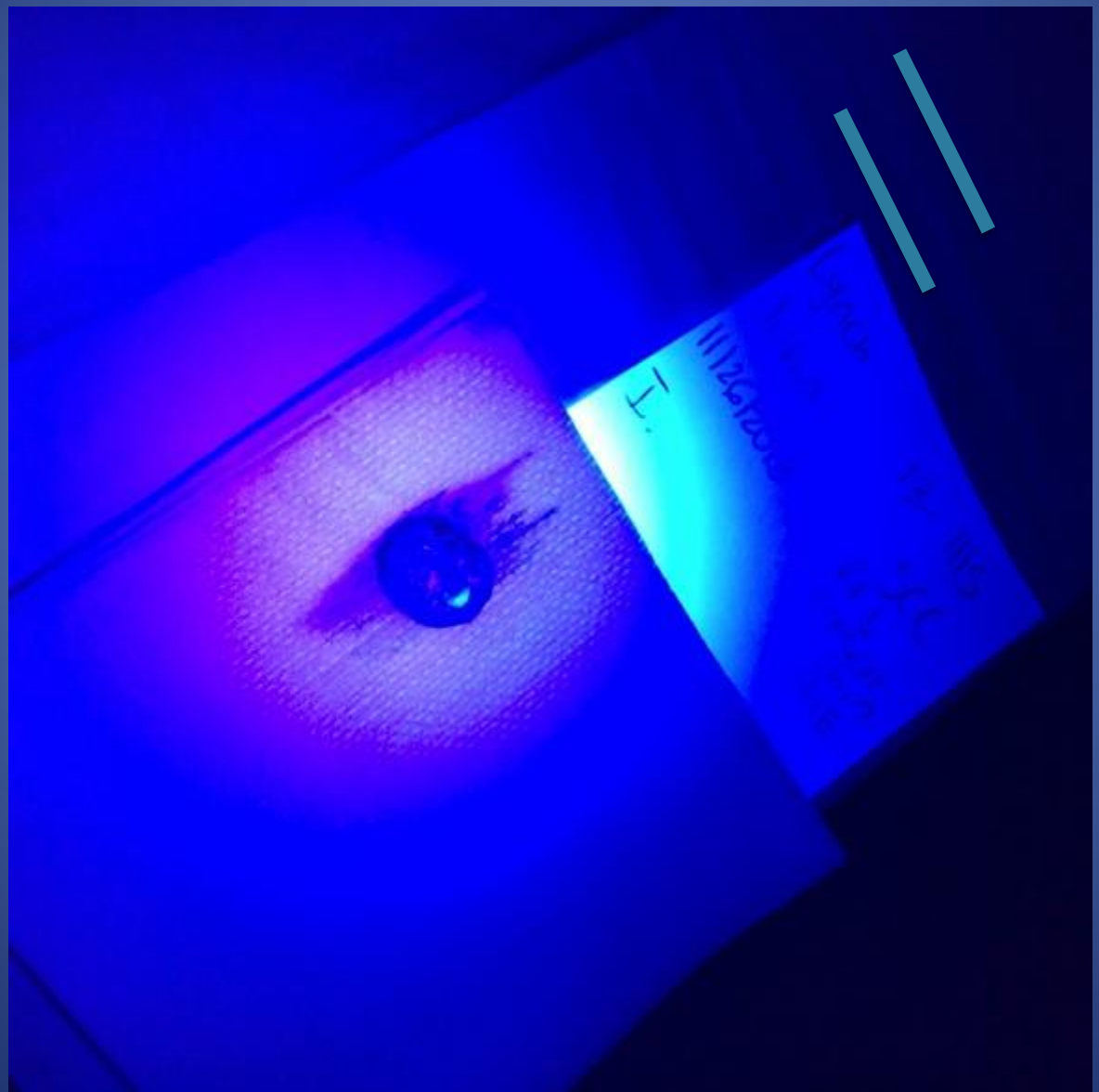
Tattoo immediately after



Tattoo at follow up visit



Tattoo removal



Patients

- 31 patients (11 women, 20 men; mean age 74 [range 53-96 years])
- 51 biopsies were performed in total with one to four biopsies per patient
- Most of the biopsy sites occurred on the extremities
- Out of the 51 total biopsies, 48 were nonmelanoma skin cancers including 39 squamous cell carcinomas (SCC) and 9 basal cell carcinomas. Two biopsy lesions were diagnosed as actinic keratoses and 1 was nonmalignant, acroangiodermatitis.

Results

- Follow up visits for treatment occurred 7 to 161 days after tattoo application (mean 49 days). Two patients (5 SCCs biopsies) were lost to follow up; they did not respond to attempts to contact them. Another patient with two biopsy proven SCCs refused treatment and declined tattoo removal.
- None of the participants have experienced any adverse reactions related to the tattoo to date.

Level of Fluorescence (LOF)

- All tattoo sites corresponded with photos taken at the time of biopsy.
- The majority of lesions (84%) demonstrated very visible fluorescence (LOF 3) at follow up; those tattoos had been present for an average of 46 days.
- Four (9%) tattoos had a LOF of 2 at follow up; those had been present for an average of 49 days.
- Three (7%) had a LOF of 1 at follow up; those tattoos had been present for an average of 92 days.

Identification

- In 35% of cases, the patient was unsure of the biopsy site before Wood's lamp illumination. Illumination was helpful to the physician in identifying the correct site in 7% of cases. None of the tattoos were visible in natural light.
- The majority of patients were treated with Mohs micrographic surgery or surgical excision. After surgical treatment, none of the patients had visible evidence of residual tattoo.

Age	Sex	Biopsy Site	Diagnosis	Treatment	Fluorescence Level at F/U	Days B/W Tattoo and Treatment or F/U	Tattoo Present After Tx?	Patient Identify Site Without Woods Light?	Physician Identify Site Without Woods Light?	Did Tattoo Site Correspond With Photo?	Presence of Adverse Reaction?
81	M	R Medial Shoulder	SCC	Refused	1	127	Y	N	Y	Y	N
		R Lateral Shoulder	SCC	Refused	1	127	Y	N	Y	Y	N
96	F	R Knee	SCCIS	Mohs	3	7	N	N	Y	Y	N
80	M	R Forearm	SCC	Mohs	3	41	N	Y	Y	Y	N
		L Posterior Arm	SCC	Mohs	3	16	N	Y	Y	Y	N
		R Pretibia	SCC	Mohs	3	43	N	Y	Y	Y	N
71	M	Posterior Ear	BCC	Mohs	3	37	N	Y	Y	Y	N
		L Forearm	BCC	Mohs	3	50	N	Y	Y	Y	N
53	F	R Dorsal Hand	AK	Liquid Nitrogen	2	21	N	Y	Y	Y	N
71	M	R Posterior Ear	SCC	Mohs	3	14	N	Y	Y	Y	N
73	M	R Upper Lateral Pretibia	SCC	Mohs	2	56	N	Y	Y	Y	N
		R Lower Lateral Pretibia	SCC	Mohs	3	56	N	Y	Y	Y	N
72	F	L Lateral Lower Leg	SCC	Mohs	3	37	N	Y	Y	Y	N
91	M	R Upper Cutaneous Lip	SCCIS	Mohs	2	58	N	N	Y	Y	N
78	F	R Anterior Pretibia	SCC	Mohs	1	22	N	N	Y	Y	N
		R Posterior Lower Leg	SCC	Mohs	3	14	N	N	Y	Y	N
68	M	R Lateral Mid Leg	SCC	Mohs	3	64	N	Y	Y	Y	N
54	F	L Mid Back	BCC	Mohs	3	41	N	N	Y	Y	N
		L Lower Back	BCC	Mohs	3	41	N	N	Y	Y	N
69	F	L Dorsal Medial Forearm	SCC	Mohs	3	28	N	Y	Y	Y	N
		L Anterior Forearm	SCC	Mohs	3	28	N	Y	Y	Y	N
		R Forearm	SCC	Mohs	3	28	N	Y	Y	Y	N
81	F	R Anterior Pretibia	SCC	Mohs	3	24	N	Y	Y	Y	N
53	F	R Dorsal Medial Arm	SCC	Mohs	3	19	N	Y	Y	Y	N
		R Dorsal Ulnar Arm	AK	Liquid Nitrogen	3	19	N	N	Y	Y	N
70	M	R Temple	SCC	Mohs	3	63	N	Y	Y	Y	N
74	M	R Medial Hand	SCC	Mohs	3	70	N	Y	Y	Y	N
78	M	L Dorsal Hand	SCC	Excision	3	149	N	N	Y	Y	N
65	M	R Dorsal Arm	BCC	Mohs	3	161	N	N	Y	Y	N
		R Dorsal Hand	SCC	Mohs	3	56	N	Y	Y	Y	N
70	M	L Forearm	SCC	Excision	2	61	N	Y	Y	Y	N
74	M	L Dorsal Hand	SCC	Mohs	3	57	N	Y	Y	Y	N
78	M	L Upper Back	BCC	Mohs	3	33	N	Y	Y	Y	N
		L Thigh	BCC	Mohs	3	33	N	Y	Y	Y	N
82	M	R Upper Back	SCC	Mohs	3	38	N	Y	Y	Y	N
58	F	R Back	BCC	Mohs	3	49	N	Y	Y	Y	N
84	M	R Forearm	SCC	Mohs	3	29	N	Y	Y	Y	N
53	M	Chest	SCC	Mohs	3	50	N	Y	Y	Y	N
76	M	R Lateral Superior Forearm	SCCIS	Mohs	3	60	N	N	N	Y	N
		R Lateral Inferior Forearm	SCCIS	Mohs	3	60	N	N	N	Y	N
		L Forearm	BCC	Mohs	3	60	N	Y	Y	Y	N
82	M	R Anterior Elbow	SCC	Mohs	3	59	N	Y	Y	Y	N
		R Posterior Lower Arm	SCC	Mohs	3	59	N	N	N	Y	N
		R Posterior Upper Arm	SCC	Mohs	3	31	N	N	Y	Y	N
		R Posterior Elbow	SCC	Mohs	3	31	N	N	Y	Y	N
69	M	R Posterior Shoulder	SCC	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A
		Posterior Neck	SCC	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A
		R Elbow	SCC	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A
90	F	L Arm	SCC	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A
		R Inner Arm	SCC	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A
85	F	R Lateral Foot	Acroangioder matitis	N/A	Lost to F/U	N/A	N/A	N/A	N/A	N/A	N/A

		Patient able to ID			Physician able to ID		
		No	Yes	P-Value	No	Yes	P-Value
Sex	Female	6 (13%)	8 (18%)	0.518	0 (0%)	14 (31%)	0.542
	Male	10 (22%)	21 (47%)		3 (67%)	28 (62%)	
Diagnosis	SCC	8 (18%)	7 (16%)	0.104	2 (4%)	13 (29%)	0.254
	Other	8 (18%)	22 (49%)		1 (2%)	29 (64%)	
Treatment	Mohs	12 (13%)	26 (18%)	0.224	3 (7%)	35 (78%)	0.998
	Other	4 (22%)	3 (47%)		0 (0%)	7 (16%)	
Location	Arm	7 (13%)	8 (18%)	0.460	3 (7%)	12 (27%)	0.045
	Leg	3 (22%)	10 (47%)		0 (0%)	13 (29%)	
	Other	6 (13%)	11 (18%)		0 (0%)	17 (38%)	
Age	74 or less	4 (13%)	19 (18%)	0.013	0 (0%)	23 (51%)	0.108
	75 or older	12 (22%)	10 (47%)		3 (7%)	19 (42%)	
Days	41 or less	8 (13%)	15 (18%)	0.067	0 (0%)	23 (51%)	0.108
	41 or more	8 (22%)	14 (47%)		3 (7%)	19 (42%)	

Discussion

- In cases of suspected non-melanoma skin cancer, we have demonstrated an easy, accurate, and discrete method of marking biopsy sites with invisible tattoo ink.
- Our method could be altered to involve ink inoculation with a punch biopsy tool, a blade, or a needle and could be used for biopsies of other cutaneous lesions.

Factors in LOF values

- The small amount of variability in fluorescence levels seen at follow up may be due to a variety of factors.
- A negative trend between fluorescence intensity and the length of time the tattoo remained in the skin was observed.
- Depth of the biopsy and the amount of ink inoculation in the dermis may have varied slightly among patients.
- Bleeding or the use of hemostatic agents may have also played a role. Importantly, every tattoo was visible at follow up.

Future: Better identification

- Like previous studies, our results indicate an inability of dermatologists and patients to correctly locate biopsy sites with absolute confidence and accuracy.
- While biopsy site photography can be helpful, photographs vary in quality, and are not always readily available.
- Based on our results, if a patient had an invisible tattoo marker but not a suitable photograph, the biopsy site would still be easily identifiable.

Adverse effects of tattoo ink?

- Tattoo ink is not FDA-regulated, and some authors have expressed concerns about the safety of ultraviolet tattoos.
- Specifically, invisible tattoo ink has been reported to cause granulomatous reactions (13, 14, 15).
- We acknowledge this potential complication; however, the amount of ink applied to the biopsy site during our described procedure is much less than the amount applied in traditional ornamental tattooing.

Is it safe?

- Furthermore, the vast majority of these tattoos will be removed with treatment of the suspected skin cancer, and if they are not, the biopsy sites will likely be small and easily amenable to excision if desired.
- None of our 31 patients developed any adverse reactions from the tattoo ink.
- More studies are needed, and a larger group of people should be used.

Conclusions

- In conclusion, our results demonstrate that **ultraviolet ink tattoos provide an easy, inexpensive, reliable, and effective method of marking biopsy sites on the skin**.
- This method has the potential to **improve patient safety and decrease malpractice costs** by reducing the number of wrong site surgeries in dermatology.

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THANKS