WHAT IS YOUR DIAGNOSIS?

Figure 1. Image courtesy of Rajiv Nijhawan, MD. The image is published with permission from the patient.

Editorial note: Welcome to the Journal of Investigative Dermatology (JID) Snapshot Dx/Cells to Surgery Quiz. In this monthly online-only quiz, the first question (“What is your diagnosis?”) relates to the clinical image shown, while additional questions concern the findings reported in a JID article by Langton et al. (2019) (https://doi.org/10.1016/j.jid.2018.10.026).

Detailed answers and a list of relevant references are available following the Quiz Questions below.

QUIZ QUESTIONS

1. A 71-year-old Hispanic female presents with concerns of skin changes on her left cheek as seen in Figure 1. Similar changes can be seen in other sun-exposed areas. What is your diagnosis?
   a. Discoid Lupus Erythematosus
   b. Photoaging
   c. Keloid
   d. Melasma
   e. Post-Inflammatory Hyperpigmentation

¹Department of Dermatology, University of Texas Southwestern Medical Center, Dallas, Texas
Correspondence: Benjamin F. Chong, MD, MSCS, University of Texas Southwestern Medical Center, Department of Dermatology, 5323 Harry Hines Blvd, Dallas, Texas 75390. E-mail: ben.chong@utsouthwestern.edu
2. According to the article by Langton et al. (2019), what Cutometer-determined biomechanical property increased in photoexposed but remained unchanged in photoprotected aged skin of color?
   a. Resilience
   b. Fatigue
   c. Viscoelasticity
   d. Elasticity
   e. Total deformation

3. Which of the following characteristics was found on histological examination of photoexposed and photoprotected aged skin of color?
   a. Elastic fibers arranged in abundant candelabra-like arrays near the dermal-epidermal junction
   b. Increased fibrillar collagens in the dermal extracellular matrix
   c. Accumulation of dystrophic elastin within the dermis
   d. Increased elastin at the dermal-epidermal junction
   e. Decreased fibrillin-rich microfibrils and fibulin-5 at the dermal-epidermal junction

See following pages for detailed answers.
Atrophy of the skin results from tation, and the appearance of lentigines (Chien et al., 2018). The hypertrophic, firm, raised nodules of keloids are in sharp contrast to the thin, wrinkled skin texture of photoaged skin.

d. Melasma is a pigmentary disorder that presents as symmetric, reticulated, hyperpigmented patches with irregular borders (Ogbechie-Godec and Elbuluk, 2017). Clinically, melasma usually presents in one of three different facial patterns: centrofacial, malar, and mandibular (Sanchez et al., 1981). A less common fourth pattern of melasma, extra-facial, that typically affects the neck, chest, and upper extremities, has also been observed. Melasma occurs most frequently in women, typically in the third decade of life, and has a predilection for individuals with skin of color (Ogbechie-Godec and Elbuluk, 2017). UV radiation and hormonal changes are both thought to contribute to the pathogenesis of melasma. Unlike photoaging, melasma does not affect skin elasticity and laxity.

e. Post-inflammatory hyperpigmentation (PIH) presents as hyperpigmented macules on the skin at sites of previous inflammatory dermatoses or injury (Davis and Callender, 2010). Inflammation of the skin is thought to result in the overproduction and abnormal distribution of melanin within the epidermis and dermis, causing the visible hyperpigmentation. Skin diseases that are commonly associated with PIH include acne vulgaris, atopic dermatitis, lichen planus, insect bites, and skin infections (Davis and Callender, 2010). PIH is also more commonly experienced by patients with skin of color. PIH, however, does not lead to the skin wrinkling or atrophy seen in photoaging. Furthermore, PIH, with or without medical intervention, tends to improve over time with return of the patient’s baseline skin pigmentation.

2. According to the article by Langton et al. (2019), what Cutometer-determined biomechanical property increased in photoexposed, but remained unchanged in photoprotected, aged skin of color?

CORRECT ANSWER: c. Viscoelasticity

In this study, Langton et al. (2019) utilized a Cutometer to assess the effects of aging on the biomechanical properties of skin of color. Two groups of African American patients—young (23.9 ± 3.6 years) and aged (70.8 ± 5.9 years)—participated in the study. Skin from the buttock and dorsal forearm was analyzed. Given the relative photoprotection of buttock skin, this site was interpreted to undergo intrinsic
agging only. Highly photoexposed dorsal forearm skin was deemed to withstand both photo- and intrinsic aging.

Three viscoelastic parameters were measured in this study: the viscoelastic deformation that follows the immediate deformation induced by Cutometer suctioning ($U_v$, mm), the ratio of $U_a$ to immediate deformation ($R_6$), and the difference between total skin recovery ($U_a$) and immediate retraction ($U_r$) after suction removal ($U_a - U_r$, mm). In the skin of the buttock, there was no significant difference between aged and young in any of these parameters. In the skin of the dorsal forearm, however, there was a significant increase in all three ($U_v: P < 0.01; R_6: P < 0.001; U_a - U_r: P < 0.001$). Skin at this site also had a significantly smaller immediate deformation upon suctioning commencement in aged individuals ($U_v: P < 0.05$). A previous study (Takema et al., 1994) found similar results in individuals with Fitzpatrick phototypes I–III.

Given these results, chronically photoexposed skin of color can be said to become more viscous with age. This means that the skin loses its ability to adjust to external loads as efficiently as it once did. Skin of color at photoprotected sites that undergoes intrinsic aging only, on the other hand, preserves its ability to do so.

**Discussion of incorrect answers:**

a. Resilience in this study was the ability of the skin to return to its original state after an initial deformation. Residual deformation ($R_1$) equaled the difference between the total skin deformation after suction was applied ($U_v$, mm) and total skin recovery after suction was removed ($U_a$, mm). The larger $R_1$ was, the less resilient the skin. Skin of color at both sites had high resiliency in the young cohort and a significant increase in $R_1$ between aged and young skin (buttock: $P < 0.01$; dorsal forearm: $P < 0.001$). This meant aging negatively impacted the skin’s resilience. The authors hypothesize that this might be a consequence of age-related changes in the organization of dermal elastic fiber networks.

b. Fatigue ($R_4$) at each site was calculated by subtracting the first minimum value following Cutometer suctioning from the last minimum value and represented the skin’s ability to return to its original state after repeated suctioning cycles. Each Cutometer suctioning event consisted of suctioning for three seconds followed by relaxation for three seconds, repeated a total of 10 times. Minimum values were recorded at the end of each relaxation period and represented maximal skin retraction following suctioning withdrawal. Both buttock and forearm skin demonstrated minimal fatigue in young individuals and a significant fatigue increase in aged individuals (buttock: $P < 0.01$; dorsal forearm: $P < 0.001$). A separate paper (Dobrev, 2005) that studied skin from the right temporal region and right volar forearm found similar differences in fatigue between aged and young skin. The skin’s ability of returning to its baseline after undergoing repeated external stress therefore worsens with age, regardless of amount of photoexposure.

d. Three separate parameters were recorded to assess the elasticity of skin: total skin recovery after suction removal/total skin deformation after suction application ($R_2$), immediate retraction after suction removal/total skin deformation after suction commencement ($R_5$), and immediate retraction after suction removal/total skin deformation after suction application ($R_7$). The closer these values are to 1, the more elastic the skin site. Though both buttock and dorsal forearm skin were highly elastic in the young cohort, all three parameters significantly decreased at both sites in aged individuals (buttock: $R_2: P < 0.01; R_5: P < 0.001; R_7: P < 0.001$; dorsal forearm: $R_2: P < 0.001; R_5: P < 0.001; R_7: P < 0.001$). These results are consistent with those of previous studies (Boyer et al., 2009; Cua et al., 1990) that demonstrated worsening elasticity in older adults. Langton et al. (2019) propose that the dermal-epidermal junction (DEJ) flattening and the changes in dermal elastic fiber organization that occur with age could contribute to loss in elasticity, as they result in a weakened dermal-epidermal interface and an epidemis that is less resistant to shearing forces (Lavker et al., 1987).

e. Total deformation after initiation of Cutometer suctioning ($R_0$) is not significantly different between old and young skin at either the buttock or dorsal forearm. Total deformation equals the initial deformation ($U_e$) after beginning suctioning plus the viscoelastic deformation ($U_v$) that immediately follows $U_e$. Though $U_e$ significantly decreased ($P < 0.05$) in older dorsal forearm skin, it was compensated by a concurrent significant increase in $U_v$ ($P < 0.01$). There was no significant difference between young and old buttock skin in either $U_e$ or $U_v$.

3. Which of the following characteristics was found on histological examination of photoexposed and photoprotected aged skin of color?

**CORRECT ANSWER:** e. Decreased fibrillin-rich microfibrils and fibulin-5 at the dermal-epidermal junction

Immunohistochemistry analysis of intrinsically aged buttock skin demonstrated depletion of both fibrillin-rich microfibrils ($P < 0.001$) and fibulin-5 ($P < 0.001$) at the DEJ. Staining of chronically photoexposed skin at the dorsal forearm showed
significant changes; abundance of fibrillin-rich microfibrils was significantly reduced at the DEJ \( (P < 0.001) \), and fibrillin-5 was nearly completely gone at the DEJ and throughout the papillary dermis \( (P < 0.001) \). Because the loss of these elastic fibers was found in biopsies taken from individuals whose aged skin had demonstrated impairment in elasticity and other biochemical functions, Langton et al. (2019) postulated that the former could have contributed to the latter.

**Discussion of incorrect answers:**

a. In young skin from both the buttock and dorsal forearm, components of elastic fibers, specifically elastin, fibrillin-rich microfibrils, and fibrillin-5, were arranged in candelabralike arrays. These arrays were near the DEJ and connected elauin fibers from the superficial papillary dermis to oxytalan fibers at the DEJ. By contrast, immunohistochemical staining of aged buttck skin highlighted a decrease in the number of these structures and a loss of the organizing architecture. Analysis of photoaged dorsal forearm skin revealed a loss of elastic fiber architecture and truncation of elastin and fibrillin-rich microfibrils at the DEJ. Similar to the effects of diminishing the quantity of elastic fibers, the authors believe that this loss of underlying structure contributes to the deterioration of skin biomechanical function.

b. Picrosirius Red staining and polarized light microscopy were used to visualize fibrillar collagens within the dermal extracellular matrix (ECM). When compared with each other, there was no significant difference in fibrillar collagen composition between young buttck and forearm skin. However, when these sites were compared with intrinsically aged buttck and photoaged forearm skin, respectively, both demonstrated a significant loss of organized fibrillar collagens \( (P < 0.01 \) in both). Immunofluorescence studies confirmed that collagen 1 was significantly reduced in the papillary derms of both aged buttck and forearm skin \( (P < 0.01 \) in both). Given that fibrillin collagen within the dermal ECM contributes to skin tensile strength, the authors concluded that the loss of these proteins contributed to the biomechanical impairment of aged skin of color, though to a lesser extent than DEJ convolution or remodeling of the dermal elastic fiber network.

c. In contrast to the results of past studies that saw the accumulation of dystrophic elastin within the derms of aged skin (Han et al., 2014), Langton et al. (2019) did not find any significant change in dystrophic elastin content within the derms of older African American individuals. Solar elastosis, as this phenomenon has been termed previously, is believed to contribute significantly to the biomechanical changes seen in chronically photoexposed, lightly pigmented skin (Langton et al., 2017). Therefore, Langton et al. (2019) suggest that the mechanisms driving skin aging in highly pigmented skin may differ from those driving aging in lightly pigmented skin.

d. Through immunohistochemical analysis of chronically photoexposed skin at the dorsal forearms, Langton et al. (2019) found a significant reduction in the amount of elastin fibers when compared with young dorsal forearm skin \( (P < 0.001) \). As with fibrillin-rich microfibrils and fibrillin-5, this depletion of elastin fibers is believed to negatively impact skin elasticity. When comparing intrinsically aged and young buttck skin through immunohistochemistry, no significant differences in elastin abundance were present.

**REFERENCES**


