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Identification of premature agers through a data driven approach and Dynamic Facial Imaging

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Introduction, Objectives, and Methods

Introduction

- Skin aging is a complex biological process influenced by genetics, epigenetics, and cellular metabolism, as well as ultraviolet light and toxic chemical exposures. These factors lead to cumulative structural changes in the skin that affect skin appearance. One of the most noticeable signs of aging, the formation of wrinkles, can also be caused by repeated mechanical stress during facial expression, and the pattern of expression lines eventually evolves into persistent wrinkles observed at rest in the future.[1] The individual aging process varies, but early detection of populations at risk of accelerated aging can be quite informative.

Objectives

- To utilize a data-driven approach on expert grading parameters to identify parameters that define the appearance of the pre-aging population.
- To gain insights on the effect of age on skin movements during facial muscle activation and the effect of skin movement on the appearance of fine lines and wrinkles.

Methods

- K-means clustering analysis was performed on expert grading data of 14 different clinical signs of aging in a clinical study of 180 female participants aged 18-50 years, with all Fitzpatrick Skin types (AAD poster #62373), to separate all participants into 3 clusters of similar clinical grade: low, medium, or high signs of aging.

- The dynamic expressions lines were evaluated through Dynamic Facial Imaging, high-resolution slow-motion videography of standardized repetitive facial skin movements, such as a smile. The appearance of fine lines and wrinkles before a smile, during a smile, and after a smile of a fixed region around the crow's feet area were analyzed with wrinkle analysis algorithm.[2]

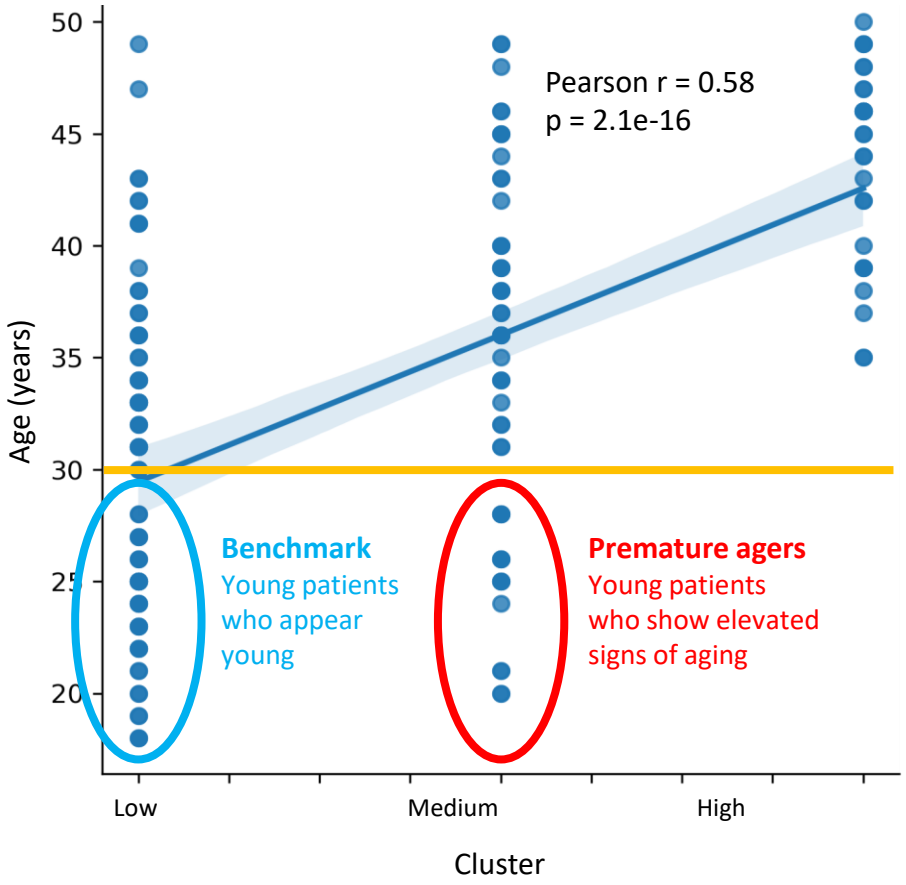
1. Hillebrand GG, et al. New wrinkles on wrinkling: an 8-year longitudinal study on the progression of expression lines into persistent wrinkles. *Br J Dermatol*. 2010;162:1233-1241. doi: 10.1111/j.1365-2133.2010.09709.x. 2. Cula GO, et al. Assessing facial wrinkles: automatic detection and quantification. *Skin Res Technol*. 2013;19:e243-e251. doi: 10.1111/j.1600-0846.2012.00635.x

Data-driven approach with clinical grading identified young patients with accelerated aging

All patients were grouped into 3 different clusters based on their similarity in clinical grading

Mean clinical grading (0: none to 9: severe)	Clusters		
	High	Med	Low
Global fine lines	4.23	2.86	1.41
Cheek wrinkles	2.35	0.48	0.09
Crow's feet wrinkles	4.74	1.89	0.76
Global firmness	2.87	0.98	0.26
Dark circle	3.65	2.66	1.74
Discreet pigmentation	3.42	2.73	1.06
Lack of radiance	4.39	2.82	1.23
Lack of clarity	3.10	2.75	1.13
Mottled hyperpigmentation	4.65	3.29	1.20
Overall evenness	4.42	3.07	1.38
Overall photodamage	4.65	2.79	1.28
Sallowness	3.26	1.98	0.78
Tactile roughness	2.58	1.96	1.40
Undereye wrinkles	5.00	1.70	0.74

Moderate correlation with statistical significance between clusters and age



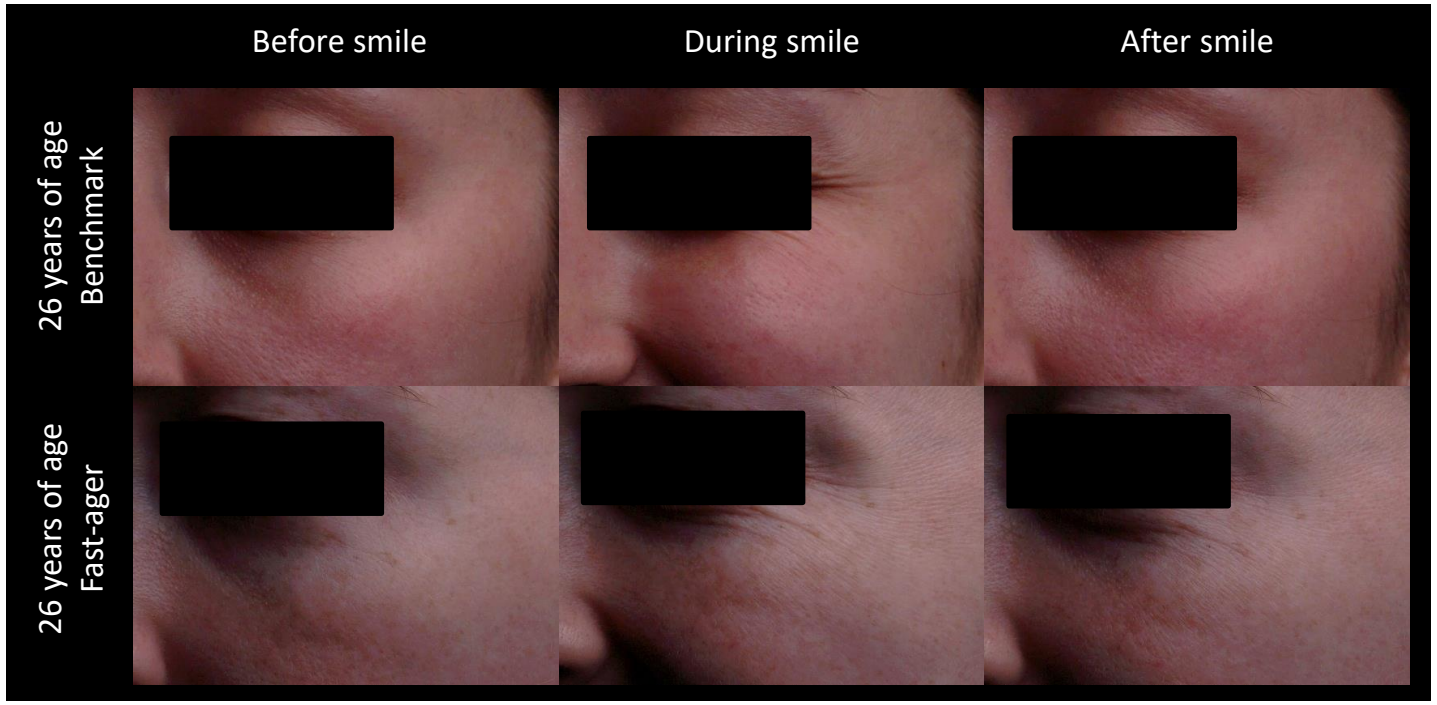
- The average age for the 3 clusters were 29.9, 34.7, and 43.7 years, respectively, with significant correlation between clusters and chronological age.
- The biggest differences between patients with low and medium signs of aging were mostly around pigmentation (see highlighted in Table).
- Premature agers were identified for patients under 30 years of age, who had elevated signs of aging (medium cluster) compared with benchmark (low cluster).

Premature agers have biggest increase in pigmentation-related signs of aging with 4.1x more residual wrinkles after repetitive facial movements

Among patients under 30 years of age, 31% of patients were identified as fast-agers with largest increase around pigmentation

Mean clinical grading (0: none to 9: severe)	Benchmark (N=38)	Fast-ager (N=17)
Global fine lines	1.26	2.18
Cheek wrinkles	0.08	0.18
Crow's feet wrinkles	0.50	1.41
Global firmness	0.13	0.65
Dark circle	1.50	2.18
Discreet pigmentation	1.08	3.06
Lack of radiance	1.45	2.71
Lack of clarity	1.34	2.35
Mottled hyperpigmentation	1.26	3.41
Overall evenness	1.50	3.00
Overall photodamage	1.29	2.41
Sallowness	0.50	1.41
Tactile roughness	1.47	2.06
Undereye wrinkles	0.58	1.29

Example of patients with same age showing significant difference in appearance of residual wrinkles after smiling between benchmark and fast-ager groups



Mean detected wrinkle pixels	Before smile	After smile	Residual wrinkle
Benchmark (N=38)	9519	9971	452
Fast-ager (N=17)	7333	9189	1856

Conclusions

- Using a cluster analysis approach, all patients were placed into 3 different groups based on the clinical grading on their signs of aging. The groups corresponded to low, medium, and high signs of aging and had significant correlation to patients' actual age.
- Premature agers under 30 were identified based on their elevated signs of aging, which were higher across all parameters; however, the biggest increases were parameters related to pigmentation.
- Analysis of Dynamic Facial Imaging on the appearance of fine lines before and after smiling showed patients identified as premature agers had on average 4.1x more residual wrinkles after repetitive smiling, which suggests that premature agers may form persistent wrinkles sooner than their peers.
- Our novel approach to identifying individuals at risk of accelerated aging can be a useful tool for guiding consumers in their selection of skincare routines.