



## Shiseido Discovers Skin's Anti-gravity System "Dynamic Belt"

—Elucidation of the cause of "sagging," which leads to aging of the appearance—

Shiseido Company, Limited ("Shiseido") discovered a system in which the skin resists deformation due to gravity, and named it "Dynamic Belt," in collaboration with Dr. Kyoichi Matsuzaki, Chief of External Plastic Surgery, Faculty of Medicine at the International University of Health and Welfare, together with researchers at Jichi Medical University and the National Institute for Physiological Sciences. "Dynamic Belt" is a mechanism by which the arrector pili muscles, which are present in high density in the face, resist gravitational force. The research team identified the cause of "sagging," or the drooping of the skin due to the force of gravity that results in an aged appearance, which has never been elucidated until now. Based on this research result, Shiseido will accelerate its research and development focused on "sagging," which leads to aging of the appearance due to the gravitational force causing the skin to droop. Part of this research was presented at "The 31<sup>st</sup> IFSCC\* Congress 2020 in Yokohama (2020/10/21–30)" and won the top award.

This research is being conducted based on the Inside/Outside approach of Shiseido's unique R&D philosophy "DYNAMIC HARMONY." We will approach "sagging," the aging of the facial appearance ("outside"), with our state-of-the-art skin analysis technology, and clarify the causes from the "inside" of the skin.

\* IFSCC: The International Federation of Societies of Cosmetic Chemists

### Challenge to "gravity," a cause of aging in appearance

"Sagging," or drooping of the skin due to "gravity," is a major cause of why a person may look older than their true age. However, the mechanism by which the skin resists gravity, and why it is lost and sagging occurs, have not been fully elucidated. This was related to the fact that no means were available to observe changes and movements inside the skin when it is subjected to gravitational deformation, or resists the gravitational force. Therefore, as a first step, the research team has developed "4D-digital skin," a four-dimensional analysis technology that captures skin movement. In the present research, they ventured to elucidate the system in which the skin resists gravity by capturing its movement using this technology.

### "Arrector pili muscles" resist deformation of the skin

First, using 4D-digital skin, the research team analyzed the movement of the skin when it was subjected to deformation by applying uniform force. As a result, they found that the deformation of the skin does not occur uniformly but rather, there are areas that resist deformation (Figure 1). When they looked closely at the site that displayed resistance to deformation, they discovered that it was where the arrector pili muscles were present (Figure 2). The arrector pili muscle is a smooth muscle attached to the hair; it contracts in response to stimuli such as cold weather and emotion, and is the muscle that exerts a great power in causing the hairs to stand on end. The findings suggested that the arrector pili muscles connect the hairs and the superficial layer of the skin, and by restricting the movement of the skin when it is subjected to deformation, it causes the skin to resist deformation.

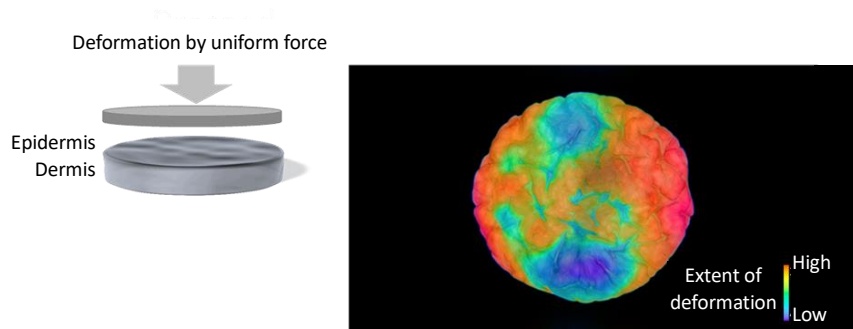


Figure 1. The presence of sites that resist deformation

(Left) Deformation of the skin by uniform force (schematic diagram of the skin viewed from the side).

(Right) The extent of skin deformation is shown in colors (image viewed from the surface side of the skin).

The closer the color is to red, the greater the amount of deformation, and the closer the color is to blue, the smaller the amount of deformation. Despite that the skin was subjected to deformation by applying uniform force, the extent of skin deformation varied at different sites (differences in color).

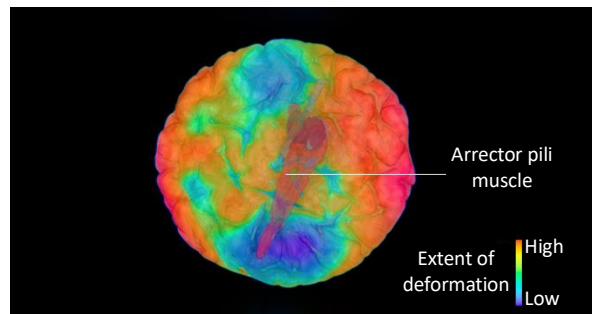


Figure 2. Arrector pili muscles present at sites where resistance to deformation is observed

The arrector pili muscles tend to be present at sites where resistance to deformation is observed (sites where the color is close to blue in the figure) (image viewed from the surface side of the skin)

**"Dynamic Belt," an anti-gravity system created by a dense array of arrector pili muscle groups**

The group proceeded with the analysis and confirmed that the arrector pili muscles are present in high density in the facial skin, and that they are aligned in the opposite direction to the direction of gravitational force (Figure 3). For this reason, the summation of forces that resist deformation, which are produced by this series of arrector pili muscle groups, was considered the mechanism underlying the skin's resistance to gravity. This system was termed "Dynamic Belt."

Meanwhile, it was confirmed that with age, the number of arrector pili muscles decreases, and the state of action of arrector pili muscles becomes worse (Figure 4). Accordingly, it was presumed that age-related changes in arrector pili muscles lead to loss of "Dynamic Belt," making it difficult for the skin to resist gravity; consequently, sagging occurs.

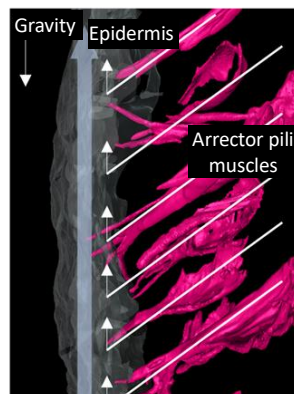


Figure 3. Aligned high-density arrector pili muscles

CT image of the skin viewed from the side. Each arrector pili muscle suppresses the movement of the skin (white arrows), and by the summation of these forces, it is possible to resist the deformation of the skin due to gravity. (Arrector pili muscles are shown in red for improved visibility)



Figure 4. Changes in arrector pili muscles caused by aging

CT images of the skin viewed from the side (arrector pili muscles are shown in red, and the epidermis in brown, for improved visibility)

In the future, Shiseido will apply these findings to various beauty solutions with the aim of realizing the corporate mission, "BEAUTY INNOVATIONS FOR A BETTER WORLD."

Shiseido's R&D philosophy: "DYNAMIC HARMONY"

Shiseido Formulates its Unique R&D philosophy "DYNAMIC HARMONY" (2021)

<https://corp.shiseido.com/en/news/detail.html?n=0000000003252>

The DYNAMIC HARMONY special website:

<https://corp.shiseido.com/en/rd/dynamicharmony/>

PDF version only

<Reference information>

**Driving Shiseido's research forward**

■ A leading figure in global cosmetics research and development: Tomonobu Ezure, Ph.D., Shiseido Fellow

Dr. Ezure is the only researcher with the title of Fellow in the 150-year history of Shiseido since its foundation. He has won four consecutive awards at International Federation of Societies of Cosmetic Chemists (IFSCC) Congresses, and has received awards at various academic meetings in Japan and abroad, including the European Society for Dermatological Research and the Japanese Society of Aesthetic Dermatology. He gave a keynote speech on skin aging research at the IFSCC 2022 Congress in London. He continues to lead the research field of "sagging," the change of facial morphology due to aging, as a pioneer. His books include "*Kao no roka mekanizumu (Mechanisms of facial aging)*" (Nikkan Kogyo Shimbun), "*Atarashii sukin kea (New skin care)*" (Nikkan Kogyo Shimbun), and "*Tanin mesen de tarumi kea (Sagging care from the view of others)*" (Kodansha).



Shiseido Fellow  
Tomonobu Ezure, Ph.D.

■ Challenge to skin sagging, a major concern for our customers

When I started skin care research, cosmetic products primarily addressed fine wrinkles and dark spots, which are problems on the surface of the skin. However, the concern of our consumers, as a matter of fact, was that the shape of the face changes greatly with age. If this is a cosmetic problem, it is my mission to deal with it—so I started my research. We have been conducting research on "Dynamic Belt" directly for about 5 years, and indirectly for about 10 years, including the conceptual stage. This time, we worked on elucidating the anti-gravity mechanism of the skin, but because there was no way of visualizing such properties of the skin, we pioneered and were the first in the world to develop a technology to capture the skin four-dimensionally (4D) and advanced our research. This led us to discover "Dynamic Belt," the system of skin's resistance to gravitational deformation. We will continue further our research and development aimed at meeting the expectations of customers around the world who are troubled by "sagging."

【Main News Releases】

Shiseido Develops Eye Care Exercises to Improve Droopy Eyelids and Forehead Wrinkles (2011)

[https://corp.shiseido.com/jp/newsimg/archive/0000000001298/1298\\_p8d24\\_jp.pdf](https://corp.shiseido.com/jp/newsimg/archive/0000000001298/1298_p8d24_jp.pdf)

Shiseido Clarifies Skin Structure of Supporting Face Shape for the First Time in the World (2015)

[https://corp.shiseido.com/jp/newsimg/archive/0000000001927/1927\\_w4y67\\_jp.pdf](https://corp.shiseido.com/jp/newsimg/archive/0000000001927/1927_w4y67_jp.pdf)

Shiseido Discovers That Age-Related Dermal Cavitation Leads to Sagging Skin (2015)

[https://corp.shiseido.com/jp/releimg/2512-j.pdf?rt\\_pr=tr437](https://corp.shiseido.com/jp/releimg/2512-j.pdf?rt_pr=tr437)

Shiseido Elucidates Mechanism of Age-Related Dermal Cavitation (2016)

[https://corp.shiseido.com/jp/newsimg/1958\\_c8k91\\_jp.pdf](https://corp.shiseido.com/jp/newsimg/1958_c8k91_jp.pdf)

Shiseido Clarifies “Propagation of Aging” in the Inner Skin (2018)

[https://corp.shiseido.com/en/newsimg/2569\\_s9z51\\_en.pdf](https://corp.shiseido.com/en/newsimg/2569_s9z51_en.pdf)

Shiseido Elucidates the "Fibroblast Network" of Cells in Dermis (2020)

[https://corp.shiseido.com/jp/newsimg/2898\\_m8o89\\_jp.pdf](https://corp.shiseido.com/jp/newsimg/2898_m8o89_jp.pdf)

Shiseido Develops “Digital 3D Skin”, a New Skin Analysis Technology Using AI (2020)

[https://corp.shiseido.com/jp/newsimg/2897\\_n7c87\\_jp.pdf](https://corp.shiseido.com/jp/newsimg/2897_n7c87_jp.pdf)

Shiseido Reveals Pressure Awakens Skin Regeneration Ability(2020)

[https://corp.shiseido.com/en/newsimg/2912\\_t2c91\\_en.pdf](https://corp.shiseido.com/en/newsimg/2912_t2c91_en.pdf)

Shiseido Develops “4D-Digital Skin” (Electronic Skin), Finally Reconstructing Skin Movement on Computer(2021)

[https://corp.shiseido.com/en/newsimg/3257\\_q7r26\\_en.pdf](https://corp.shiseido.com/en/newsimg/3257_q7r26_en.pdf)