

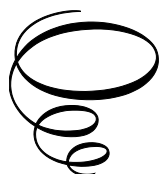
The Mechanism of Facial Aging

The Mechanism of Facial Aging

By

Tomonobu Ezure

**Cambridge
Scholars
Publishing**



The Mechanism of Facial Aging

By Tomonobu Ezure

This book first published 2024

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Copyright © 2024 by Tomonobu Ezure

All rights for this book reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner.

ISBN (10): 1-5275-8755-X

ISBN (13): 978-1-5275-8755-7

TABLE OF CONTENTS

Introduction	1
1. The basics of facial aging	3
1-1. Changes in people's awareness of facial morphology	4
1-2. Changes in facial appearance with aging.....	6
1-3. Sagging.....	7
1-3-1. Cheek sagging.....	9
1-3-2. Sagging beneath the eyes.....	13
1-3-3. Interaction between sagging in adjacent locations.....	14
1-3-4. Diverse changes caused by sagging.....	16
1-3-5. Changes in sagging with aging	17
1-4. Perception determines apparent age	19
1-4-1. Gap in perception of apparent age	19
1-4-2. Gap in perception of apparent age caused by the angle of view	20
1-5. Wrinkles	21
1-5-1. Classification of permanent wrinkles	21
1-5-2. Age-related changes in permanent wrinkles	23
1-5-3. Transient wrinkles	24
1-5-4. Wrinkles associated with facial expression	25
1-5-5. Age-related changes in transient wrinkles	26
1-5-6. Changes in transient and permanent wrinkles by age group.....	28
1-6. Gender differences in the development of aged appearance.....	29
1-6-1. Gender differences in sagging	30
1-6-2. Gender differences in wrinkles	32
2. Mechanisms of facial aging.....	34
2-1. Facial appearance and skin properties	35
2-1-1. Viscoelasticity of skin.....	35
2-1-2. Significance of parameters determined with a Cutometer for skin condition.....	36
2-1-3. Skin elasticity and facial aging	37
2-1-4. Age-dependent decrease of dermal elasticity.....	38

2-2. Propagation of aged facial appearance	39
2-2-1. Transient wrinkles and skin elasticity.....	39
2-2-2. Increase of facial expression induces transient wrinkles	39
2-2-3. Sagging increases the amount of facial expression.....	40
2-2-4. Sagging induces fixed wrinkles	42
3. Skin aging.....	44
3-1. Skin structure.....	44
3-2. Intrinsic aging and photoaging	47
3-3. Epidermis.....	49
3-3-1. Structure of the epidermis.....	50
3-3-2. Components of the epidermis	53
3-3-3. Age-dependent change of the epidermis.....	56
3-4. Dermal layer	58
3-4-1. Structure of the dermal layer	58
3-4-2. Components of the dermal layer.....	58
3-4-3. Age-dependent changes of the dermal layer.....	77
3-5. Anchoring structure of the dermal layer.....	87
3-5-1. Convex structure at the bottom of the dermal layer.....	87
3-5-2. The convex structure contributes to the dermal elasticity	89
3-5-3. Age-dependent loss of the anchoring structure and facial aging	91
3-6. Dermal cavitation	93
3-6-1. Age-dependent dermal cavitation	94
3-6-2. Dermal cavitation decreases skin elasticity, leading to sagging.....	94
4. Facial aging induced by age-dependent change of subcutaneous tissue.....	97
4-1. Subcutaneous adipose tissue (subcutaneous fat).....	97
4-1-1. Structure and basic function of subcutaneous fat.....	97
4-1-2. Subcutaneous fat as a controller of the dermal layer	99
4-1-3. Increment of subcutaneous fat increases sagging	103
4-2. Mimetic muscles.....	106
4-2-1. Structure of mimetic muscles	107
4-2-2. Mimetic muscles and facial aging	108
4-3. Appendages	108
4-3-1. Sweat glands.....	109
4-3-2. Sebaceous glands.....	110

5. Anti-aging skin care.....	112
5-1. Anti-aging skin care targeting the epidermis	112
5-2. Anti-aging skin care targeting the dermal layer.....	113
5-2-1. Solutions focusing on collagen fibers.....	113
5-2-2. Solutions focusing on elastic fibers	115
5-2-3. Solutions focusing on hyaluronic acid.....	115
5-2-4. Solutions focusing on fibroblasts.....	116
5-3. Anti-aging skin care targeting the anchoring structure of the dermal layer.....	117
5-4. Anti-aging skin care targeting the subcutaneous adipose layer....	117
5-4-1. Inducing small adipocytes	118
5-4-2. Utilizing the secretory properties of subcutaneous fat.....	119
5-4-3. Direct action on subcutaneous fat.....	120
5-5. Anti-aging skin care targeting mimetic muscles.....	120
Index.....	122

INTRODUCTION

Youthful appearance is generally considered desirable throughout the world, especially in aging societies. Of course, we cannot change our age, but there are certainly people who look younger than their actual age. On the other hand, sometimes we feel aged when we see our face reflected in a window. What makes the difference? This book aims to explore this question from a variety of viewpoints.

The study of facial aging is a relatively new field, and we have been working on this topic almost from the beginning. Indeed, when we began our research, it was necessary to carry out a lot of basic studies, because so little information was available. As a starting point, we carried out consumer surveys to understand people's opinions about facial aging, set definitions and parameters to score facial appearance, and established methods to measure these parameters. We also developed new methodology to visualize the internal structures of facial skin in three dimensions with very high resolution. Further, we went on to clarify the actual status of aged appearance, as well as people's perception of aged appearance. We identified the factors, both internal and external, that characterize an aged facial impression, and investigated how they change with aging, from the molecular level to the macroscopic, everyday level. Then, we used this information to develop a variety of novel anti-aging solutions.

I have been considering that there are very few resources covering the broad overall concepts of facial aging. Although all of the work described in this book has been published in various peer-reviewed scientific journals, these articles were highly focused on particular topics, and so may seem fragmentary; that is, they were written for specialists and may not be easily understandable to many people. However, this is a topic of great interest to the general public, who often wish to know how to improve their appearance with taking any risk of making matters worse. So, this book aims to provide a straightforward guide to the world of facial aging that will be accessible to all.

With this in mind, I have used a lot of visual materials to help readers easily understand facial aging, from the fundamentals to the latest cutting-edge results. The book begins by describing the actual status of

facial aging, then moves on to the mechanisms involved, and finally focuses on ways to improve aged appearance in a rational way, based on these mechanisms. Each section opens with key bullet points and a short summary for readers who prefer not to get immersed in the details.

Facial aging is a subject close to everyone's heart, and it seems very familiar to people because it is visible from the outside, unlike many aspects of our body. Furthermore, this field is approachable from many different viewpoints, such as dermatology, perception, physics, psychology, and so on. I hope that this book will help readers to broaden and deepen their initial ideas about the unique and complex phenomenon of facial aging. If it can achieve this, and contributes to the explosive growth of this field, I believe it will be very useful for people in general, and this would be very gratifying for me, as a pioneer of this facial aging field.

1. THE BASICS OF FACIAL AGING

- Our facial morphology changes with age.
- Changes in facial morphology are an important factor determining an aged impression.
- In this chapter, we look at how the facial morphology changes with age at each part of the face.

What makes people appear aged as they get older? In Fig. 1, the youthful impression (left photo) has been altered to give an aged impression (right photo) just by using computer graphics to add a single fold on the face. This fold, from the nose to the lips, is called the nasolabial fold (generally, a “laugh line”). We can see from this illustration that just a simple change in facial morphology can have a big influence in producing an aged appearance. Although some studies have found that factors such as skin brightness and blemishes influence apparent age, it is not easy to make a substantial change to aged appearance just by changing the color and texture of the skin through the use of a cosmetic foundation. Also, even when someone is fully clothed, it is possible to roughly guess their age by looking at their face. Thus, changes in facial form with age are clearly the most important factor in determining the impression we get of a person’s age.

The face is a complex assembly of different parts with various functions. For example, the eyes receive visual information, the mouth ingests food, and the cheeks and forehead express emotions such as laughter or anger. The form of each of these individual parts changes with age.

In this chapter, we will look at the changes in various parts of the face that give the impression of age. We will focus mainly on facial aging in women because most studies have been done on women.

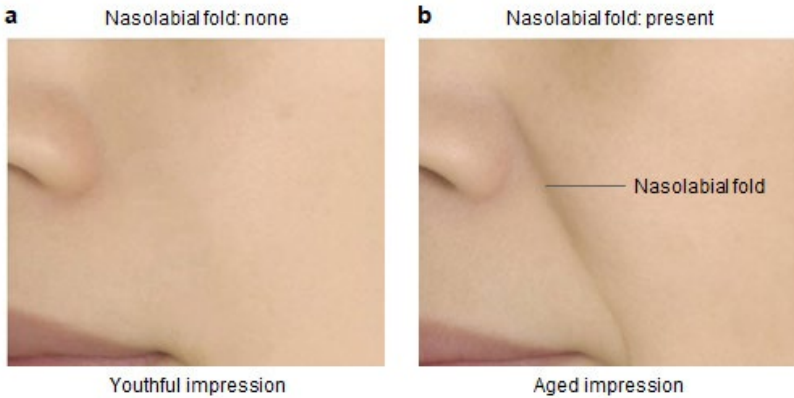


Fig. 1. A nasolabial fold gives the impression of an aged face.

These photographs are of the same young person. a) Unmodified photograph. b) An artificial nasolabial fold was added using computer graphics software. Addition of the nasolabial fold gives the impression of an aged face compared to the photograph without the fold.

1-1. Changes in people's awareness of facial morphology

- A questionnaire is an effective tool for evaluation of changes of facial morphology with aging
- The nature of women's concerns about their skin changes with age.
- Concerns relating to changes in facial morphology become the main focus with increasing age.

Questionnaires about women's skin concerns are a useful tool for investigating the cosmetic developments that women want, and they also make it possible to estimate the changes that occur in women's skin. Furthermore, comparing questionnaire results with actual changes in skin condition allows us to gain an understanding of what degree of skin change is recognized as a serious problem that starts to affect quality of life (QOL). Questionnaires thus provide various types of information, and should be the first step in research and development.

Fig. 2 shows the results of a questionnaire on skin concerns as described by women in different age groups. Conspicuous pores, dry skin, acne, and blemishes rank highest among the skin concerns of women in their 20s. These can be classified as concerns related to skin condition.

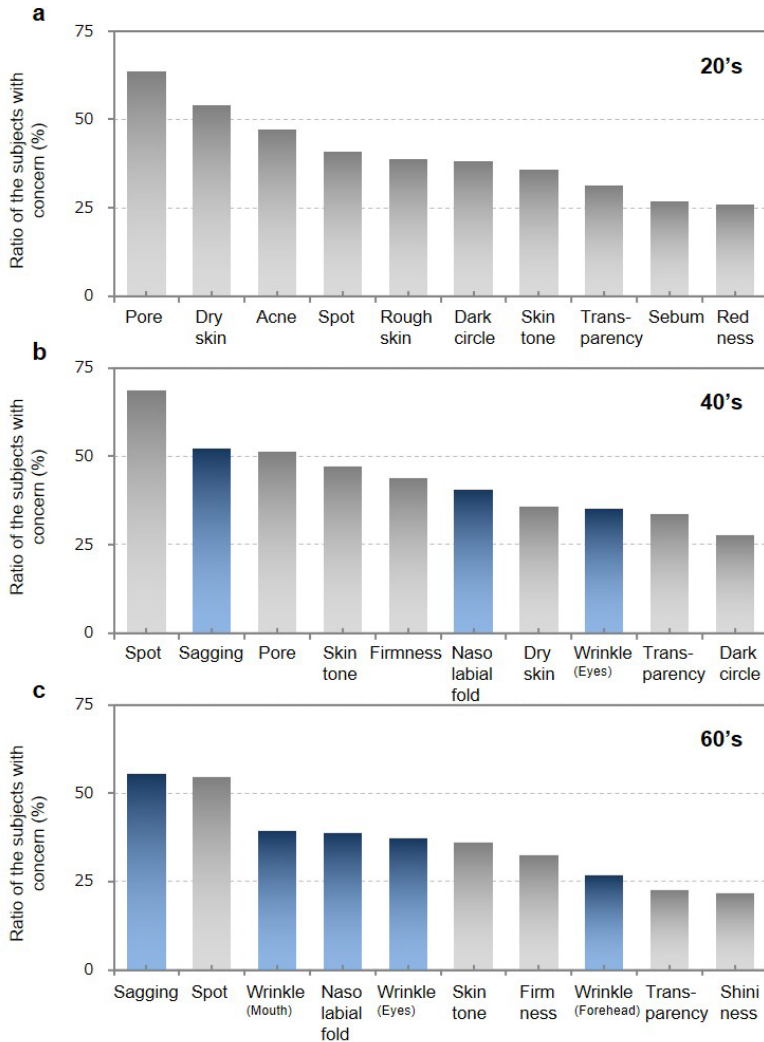


Fig. 2. Age-dependent changes in concerns regarding the skin.

The bar charts show the major concerns about the skin of subjects in their a) 20's, b) 40's, and c) 60's. Items related to morphology are indicated by dark bars. Concern about morphological changes becomes greater with aging. These results were obtained from a questionnaire survey of around 400 subjects, who could choose more than one concern.

By contrast, women in their 40s have concerns such as sagging and nasolabial folds, which relate to changes in facial morphology, as well as concerns relating to skin condition. Concerns relating to changes in morphology rank highest among women in their 60s.

So, how does facial morphology change with age? We will consider this in the following sections.

1-2. Changes in facial appearance with aging

- Major changes in morphology occur in different areas of the face with increasing age.
- Sagging and wrinkles are the key to understanding the complex changes in facial morphology.

In Fig. 3, we can see a typical example of changes in facial morphology with aging. Let us examine these, starting with the upper facial area. There are deep wrinkles horizontally across the forehead, and vertical wrinkles between the eyebrows. There are also wrinkles radiating from the corners of the eyes, and the upper eyelid hangs over the eye. There is descendent morphology, called sagging, beneath the eye and in the cheek, and nasolabial folds, marionette lines, have appeared. Moreover, the facial contours have become indistinct.

We can understand all of these diverse changes by looking at them from the perspective of sagging and wrinkles. First, let us look at sagging as a change due to gravity.

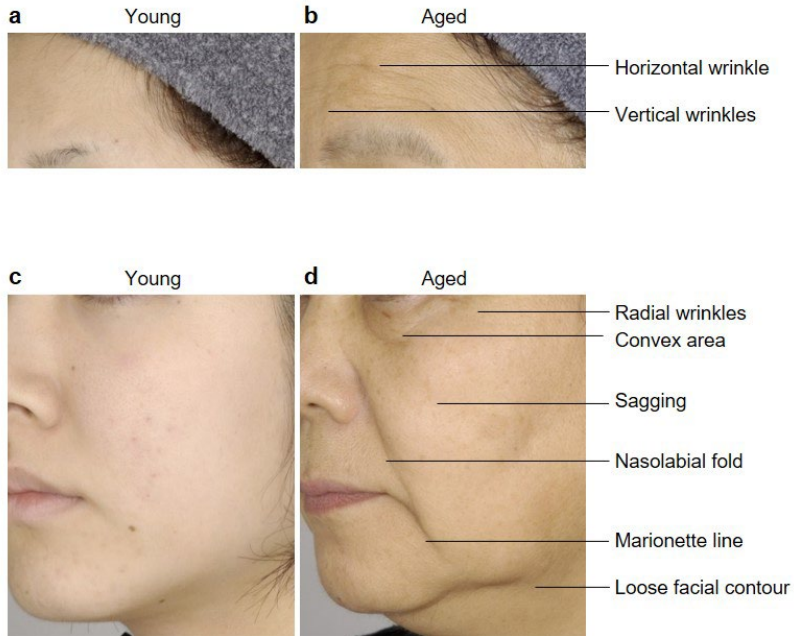


Fig. 3. Changes of facial morphology with aging.

Upper area of a) a young face, b) an aged face and lower area of c) the young face and d) the aged face. Facial morphology drastically changes with aging, with sagging of the cheek, appearance of nasolabial folds and marionette lines, and expansion of the facial contour.

1-3. Sagging

- Sagging is a morphology in which the skin droops downward under the influence of gravity.
- Various other changes in facial morphology occur as a result of sagging.

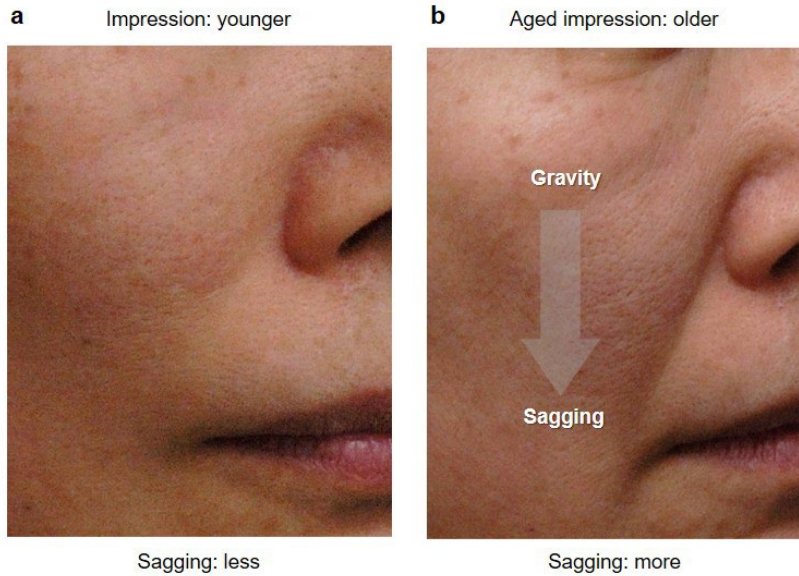


Fig. 4. Sagging gives the impression of an aged face.

Although both photos are of the same person, the photo on the right makes the person look much older than the photo on the left. The difference is their posture. a) Lying down horizontally in a face-upwards position. b) Sitting up with the face vertical. In the vertical position, the cheek sags, and this gives the impression of an older face. Thus, sagging is a critical cause of aged appearance.

The two photos in Fig. 4 appear to show people of different ages. The woman on the right appears to be older, but in fact, the two photos are of the same person. The difference is the posture of the woman when the photos were taken. In the photo on the left, the woman was lying down horizontally, face upwards, whereas in the photo on the right, she was sitting upright, her cheeks sag downward because of gravity, and her facial morphology changes greatly as a result. We can therefore see that aged appearance arises from changes in the facial morphology due to gravity – in other words, sagging.

Sagging occurs with aging in various parts of the face, and it is especially noticeable in the cheeks, upper eyelids, and beneath the eyes. Sagging at each of these different sites proceeds in the same way, under the influence of gravity. However, its aspects are different due to the different characteristics of each particular site and its relation to the whole face.

1-3-1. Cheek sagging

In the cheeks, sagging is noticeable in the upper cheek, lower cheek, and outer cheek (Fig. 5). Between these sites are areas that show little sagging.

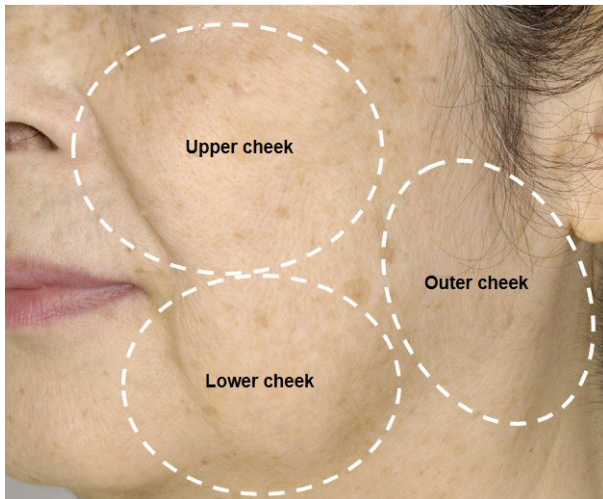


Fig. 5. Sagging areas of the cheek.

Sagging is observed at the upper cheek, lower cheek and outer cheek. Areas between these locations do not sag.

1-3-1-1. Upper cheek sagging

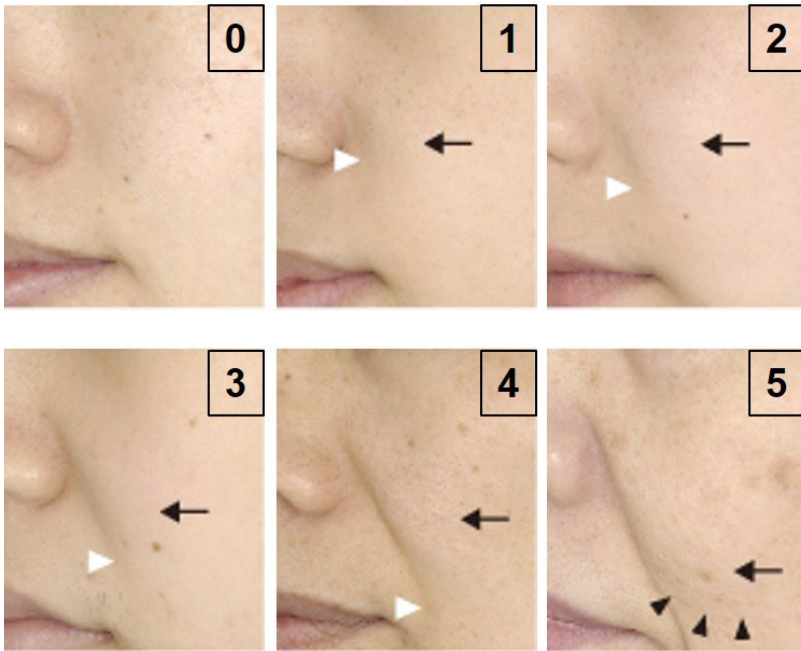


Fig. 6. Photograph-based evaluation criteria for upper cheek sagging.

0, No sagging: morphology in this area is smooth.

1, Slight sagging: a slightly convex area (arrow) is visible near the ala of the nose. A slight nasolabial fold (white arrowhead) is visible.

2, Mild sagging: the convex area and nasolabial fold are clearly visible.

3, Moderate sagging: the convex area is clearly visible and the nasolabial fold extends beyond the midpoint between the ala of the nose and the corner of the mouth.

4, Severe sagging: the convex area is enlarged and the nasolabial fold reaches the corner of the mouth.

5, Very severe sagging: the convex area approaches the corner of the mouth and the contour of the bottom of this area (arrowheads) becomes visible.

To evaluate these morphological changes quantitatively, we need clear criteria. Evaluating the severity of morphological changes just based on an observer's impression, using several grades such as mild, moderate, and severe, is a common approach, but reproducibility is a big issue; the results can vary in different evaluations even by a trained evaluator, and there is a

difference in the results reported by different evaluators. Here, the position of the nasolabial fold (the fold from the ala of the nose to the corner of the mouth) is the key indicator representing the progression of sagging (Fig. 6). It can clearly classify the severity of sagging, and reproducibility is quite high.

1-3-1-2. Lower cheek sagging

Fig. 7 shows the advance of lower cheek sagging with aging. Again, the photos illustrate the evaluation criteria for judging the extent of sagging in this region. As sagging advances, a fold appears from the corner of the mouth toward the contour of the face. This is called the marionette line, as it resembles the shape of the mouth of a marionette. Also, sagging causes a bag-like convex area in the lower part of this area, and when this reaches the contour of the face, the contour becomes unclear.

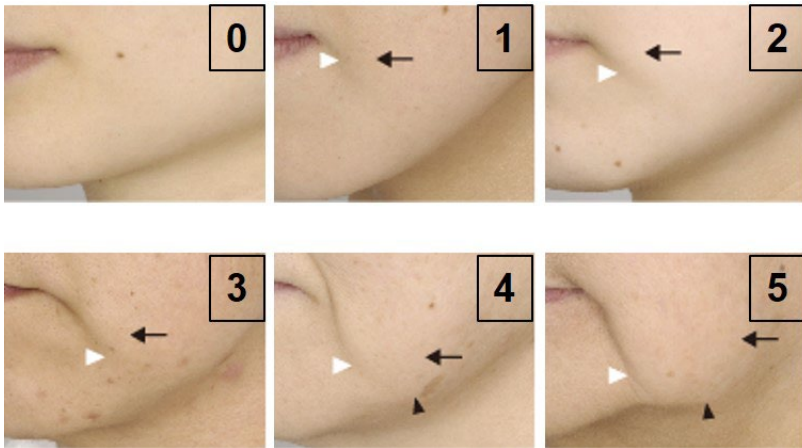


Fig. 7. Photograph-based evaluation criteria for lower cheek sagging.

0, No sagging: the morphology in this area is smooth.

1, Slight sagging: a slight convex (arrow) area is seen near the corner of the mouth. A slight marionette line (white arrowhead) is visible.

2, Mild sagging: a convex area is seen.

3, Moderate sagging: the convex area extends beyond the midpoint between the corner of the mouth and the mandibular outline.

4, Severe sagging: the contour of the bottom of this area (arrowhead) reaches the mandibular outline.

5, Very severe sagging: the contour of the bottom of this area extends beyond the mandibular outline.

1-3-1-3. Outer cheek sagging

Similarly, Fig. 8 shows the advance of outer cheek sagging with aging, and the photos illustrate the evaluation criteria for judging the extent of sagging. The outer areas of the cheek are originally flat, and it is hard to see the advance of sagging at glance. Also, no folds are found in this area, unlike other areas, where folds (nasolabial folds, etc.) occur. Nonetheless, changes in morphology are noticeable at the lower part of this area, if we look carefully. Sagging advances to the contour of the face, extending past the contour and increasing to the extent that the boundary between the face and the neck becomes indistinct.

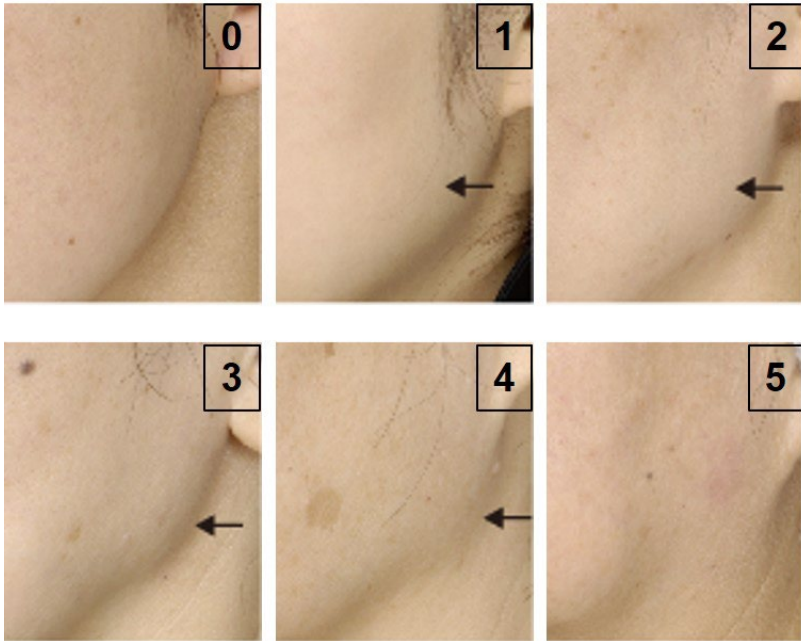


Fig. 8. Photograph-based evaluation criteria for outer cheek sagging.

0, No sagging: the morphology in this area is smooth.

1, Slight sagging: a slightly convex area (arrow) is seen.

2, Mild sagging: a convex area is visible.

3, Moderate sagging: the convex area reaches the mandibular outline and the mandibular outline becomes poorly defined.

4, Severe sagging: the convex area extends beyond the mandibular outline.

5, very severe sagging: the mandibular outline disappears.

1-3-2. Sagging beneath the eyes



Fig. 9. Photograph-based evaluation criteria for the lower eyelid.

0, No sagging: morphology in this area is smooth.

1, Slight sagging: a slightly convex area (arrow) is seen near the ala of the nose. A slight groove (white arrowhead) is visible.

2, Mild sagging: the convex area and groove are clearly visible.

3, Moderate sagging: the convex area is clearly seen and the groove reached the midpoint between the ala of the nose and lateral canthus.

4, Severe sagging: the convex area is enlarged and the groove extends beyond the midpoint.

5, Very severe sagging: the convex area extends all over the lower eyelid and the groove reached the corner of the lateral canthus.

6, Extremely severe sagging: convex area takes a baggy form (black arrowhead).

Fig. 9 shows the advance of sagging beneath the eyes with aging. In this case, the extent of sagging is classified into seven stages, and the photos illustrate the evaluation criteria. A slightly convex area develops at the inner side of the eye (the inner canthus) with aging. When this happens, a slight fold appears at the side of the nose. The convex area gradually descends, and the indentation becomes a clear fold, which is called the nasojugal groove. As sagging advances further, the formation of bags is seen in the lower part of this area.

1-3-3. Interaction between sagging in adjacent locations

Sagging occurs at different sites on the face. This means that rather than the whole face descending uniformly, sagging progresses differently at each site. This can be easily understood from the fact that there are people who have, for example, noticeable sagging only beneath the eyes. Also, there are areas such as the nose where there is little sagging. This is because various parts of the face have different structures. In areas where the skin is firmly supported by hard structures such as retaining ligaments, there are few changes in morphology due to movement or gravity. Because each site has different characteristics, distortion of the morphology occurs between sites with large amounts of sagging and neighboring regions with little sagging. Let us examine this in more detail, taking the nasolabial fold as an example.

1-3-3-1. Nasolabial folds

As shown in Fig. 6, the nasolabial fold is the fold that appears with aging from the side of the ala of the nose to the corner of the mouth on each side. The nasolabial fold is generally described as a wrinkle, possibly because this linear form looks like a wrinkle, and becomes deeper with facial expression, which is a cause of wrinkle formation.

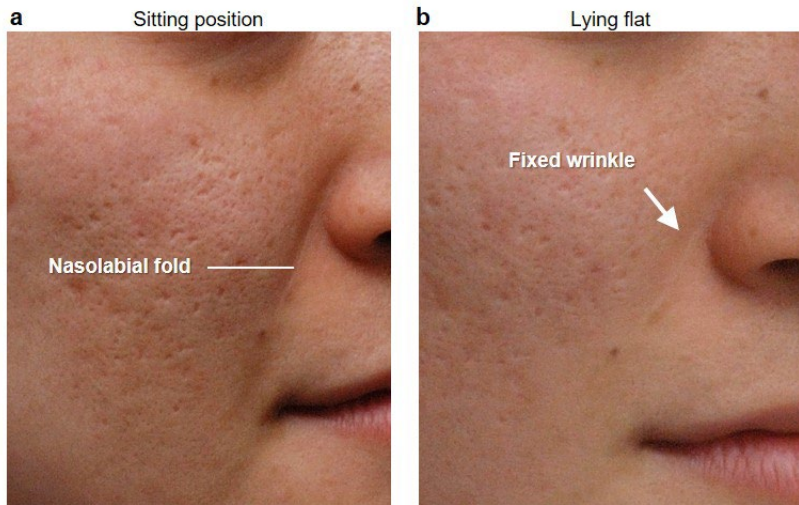


Fig. 10. The nasolabial fold disappears with change of the body position.

a) A nasolabial fold is observed in the sitting position, but b) disappears when the same subject is lying flat. Fixed wrinkle is not prominent at the nasolabial fold.

The photo on the left in Fig. 10 is the face of a middle-aged woman seated in an upright posture, and on the right, she is lying down with her face upward. Lying down changes the direction in which gravity acts on the face, and sagging is reduced as a result. This causes the nasolabial fold to disappear. Notably, where there was a nasolabial fold, hardly any wrinkle in the skin can be seen (right photo); indeed, only a small proportion of people do have wrinkles at this site. This means that the nasolabial fold mainly involves sagging rather than wrinkling, and this is because the nasolabial fold forms the boundary between the descending upper cheek and the region around the nose, where there is little sagging (Fig. 11).

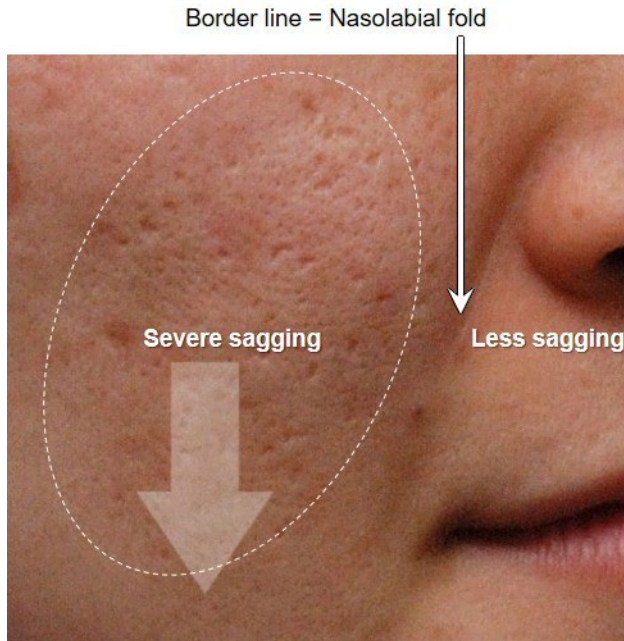


Fig. 11. The nasolabial fold represents the border between the sagging region at the cheek and the non-sagging area around the mouth.

Similarly, lower cheek sagging is the main factor in the formation of the marionette line, which appears at the boundary with the area around the mouth. In the case of the nasojugal groove, sagging beneath the eyes is the main factor, and a fold appears between this sagging area and the area around the nose.

These boundary lines form clear folds, and we can evaluate the extent of sagging by using these folds as indicators of morphological changes. Indeed, folds such as nasolabial folds and marionette lines are often employed by artists to give an impression of aging.

1-3-4. Diverse changes caused by sagging

Thus, sagging occurs at different sites on the face with aging. As well as the sagging itself, various changes occur between the sagging locations and neighboring areas. These changes can be summarized as follows.

As shown in Fig. 12, when sagging occurs, the upper area becomes flat, a fold forms at the side, and the lower area becomes baggy or unclear in morphology. Sagging occurs at different sites in the face, and as sagging progresses at each site, changes occur above, to the side, and below each site. As a result, diverse changes to the face can occur overall. Therefore, sagging is the major factor in causing the appearance of facial aging.

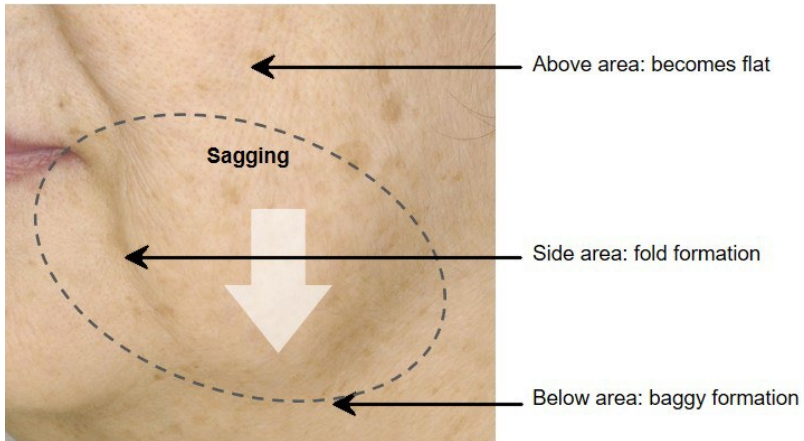


Fig. 12. Sagging causes morphological changes in all adjacent regions.

Sagging cause morphological changes in the surrounding areas. The area above the sagging region is flattened, while boundaries with adjacent non-sagging areas at the side form folds, and a baggy shape is produced below the sagging area.

1-3-5. Changes in sagging with aging

Fig. 13 shows how the extent of sagging advances with age. Upper cheek sagging is shown as an example. The vertical axis shows the extent of sagging, evaluated using the sagging criteria illustrated in Fig. 6.

First, it can be seen that sagging gradually progresses with aging, instead of suddenly advancing in any particular age group. It advances by around one stage for each decade (10 years) of age.

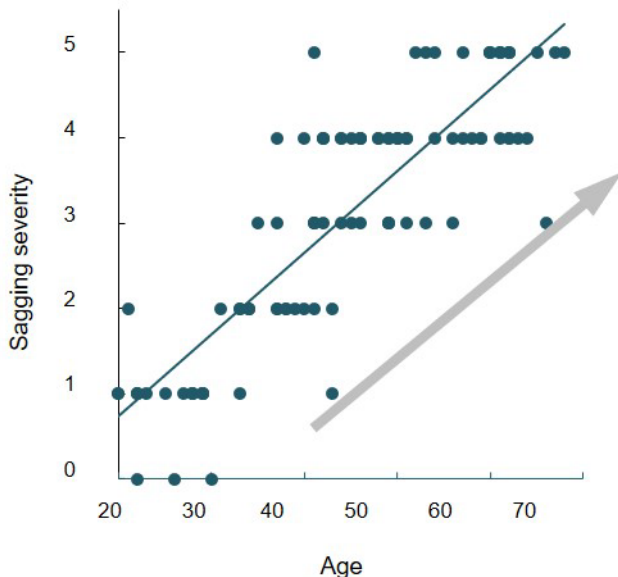


Fig. 13. Age-dependent change of upper cheek sagging.

Sagging increases gradually with aging, and is already apparent in the 20s. The severity of sagging increases by about one grade every 10 years. Sagging progresses similarly in all areas of the cheek (108 female subjects in their 20s to 60s).

Sagging has already reached stage 1 by the 20s, and this is the stage at which sagging can be confirmed. If we compare this to the questionnaire mentioned earlier (Fig. 2), we notice something extremely interesting. Sagging is already found in the 20s (stage 1), but women in this age group do not mention sagging as a concern. Sagging is only raised as a concern in the 40s, by which time it has already reached stage 3, where sagging is clearly recognizable as a distinct morphology.

This suggests that we have to consider the perception of facial morphology, as well as the actual state of facial morphology, in order to address the aging of appearance. We will look at this perception next.

1-4. Perception determines apparent age

- There is a gap between how a woman perceives her own apparent age and how others perceive it.
- This gap is due to differences in the angle from which the face is viewed.
- Sagging is hard to see when viewed from the front.

1-4-1. Gap in perception of apparent age

Many women perceive their apparent age as being lower than their actual age. This difference in perception can be confirmed experimentally as follows.

First, women are shown the table of sagging criteria and asked to rate the extent of their own sagging (self-perceived sagging). Next, the women are photographed at an angle of 45 degrees, and asked to rate the extent of sagging by comparing the photographs to the same sagging criteria (actual sagging). When the ratings are compared, a gap between self-perceived and actual sagging can be seen (Fig. 14). The women perceived their own sagging as being about one stage less than it actually was. Calculated in terms of age, they perceived themselves as about 10 years younger than their true age. It should be noted that these evaluations of actual sagging correspond to the evaluations made by others. This means that people perceive a woman to be older than she perceives herself to be. What explains this gap in perception?

Self recognition of sagging

Self assessment without photo
(from the front)



Actual sagging

Self assessment from photo
taken at 45 degree angle

Fig. 14. Difference between self-recognized and actual sagging severity.

The test procedure was as follows. Subjects judged their own sagging severity from the front based on the sagging evaluation criteria (self-recognition of sagging). Then they looked at a photo taken from an angle of 45 degrees, and again judged the sagging severity (actual status). Self-recognized sagging is less than actual sagging.

1-4-2. Gap in perception of apparent age caused by the angle of view

Fig. 15 shows two photographs of the same person, one taken from the front, and the other taken at an angle of 45°. In the photo taken from the front, sagging can hardly be seen at all. The angle at which sagging is most noticeable is 45°. Sagging is less noticeable at angles less than 45°, approaching a full-frontal view, while the facial morphology itself is harder to see at angles greater than 45°, approaching a lateral view. At the same time, sagging can be clearly confirmed from an angle. When both photos are judged, the extent of sagging is rated higher in the photo taken at an angle of 45°. Women usually look at themselves head on in the mirror, mainly from the front. Thus, it is difficult to grasp the extent of sagging, and as a result, women do not readily notice their own facial sagging. Other people, however, are able to view the face from different angles, and therefore do notice sagging. Thus, differences in the angle from which the face is viewed explain the gap between a person's self-perception of their sagging and the perceptions of other people.

<Same person>

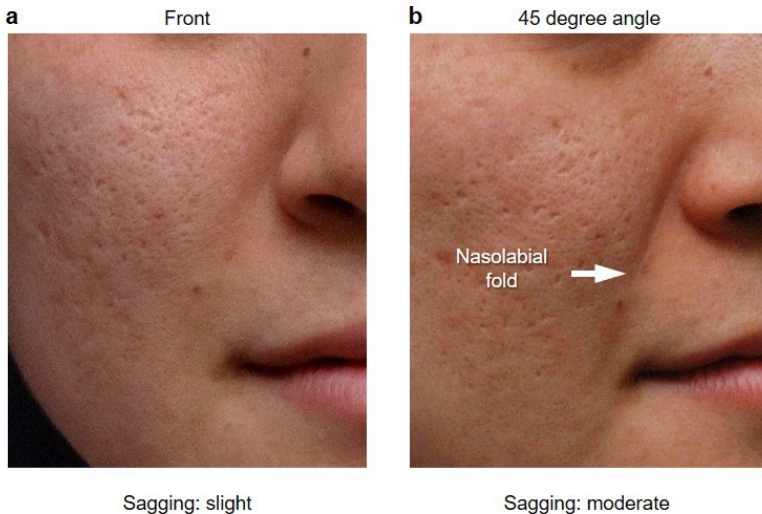


Fig. 15. Difference of aged impression depending on the viewing angle. The two photos are of the same person. a) Sagging is less seen from the front, b) but it is clearly observable as a nasolabial fold at the angle of 45 degrees.

1-5. Wrinkles

- Wrinkles are fine furrows on the skin.
- Wrinkles are classified into transient wrinkles, which appear temporarily as a result of facial expression or movement, and permanent wrinkles, which are permanently etched in the skin.
- Both of these types of wrinkles increase with aging.

Compared with nasolabial folds and marionette lines, wrinkles are relatively fine furrows on the skin surface.

Wrinkles can be classified into two types: transient wrinkles, which appear temporarily as a result of facial expression or body movement, and permanent wrinkles, which are etched into the skin. Much research has been carried out on permanent wrinkles; they have been defined in detail, measurement methods established, and their main causes clarified.

Transient wrinkles, however, are less well studied. This is because of their relation to complex yet poorly defined facial expressions. However, we developed a way to handle this issue, and we were able to establish a method of evaluation for transient wrinkles. We then used it to study transient wrinkles and their causes.

Here, we first consider classical, permanent wrinkles, and then transient wrinkles, and finally we look at the relationship between these two types of wrinkles.

1-5-1. Classification of permanent wrinkles

The most frequently used classification is that of Kligman, who grouped permanent wrinkles into three types (Fig. 16). This method classifies wrinkles found when there is no facial expression and the face is in a state of repose.

1. Linear wrinkles: Wrinkles with a linear structure. These include wrinkles such as furrows radiating from the corner of the eye (crow's feet) or horizontal furrows across the forehead (forehead wrinkles), and become more noticeable following exposure to sunlight.
2. Glyphic wrinkles: Wrinkles forming a crisscross pattern due to the intersection of wrinkles running in different directions. This morphology is found in areas that are exposed to sunlight, such as the face and neck.
3. Crinkles: Fine, ruffled morphology on relaxed skin. This morphology is observed in sun-protected areas of the skin of elderly people.

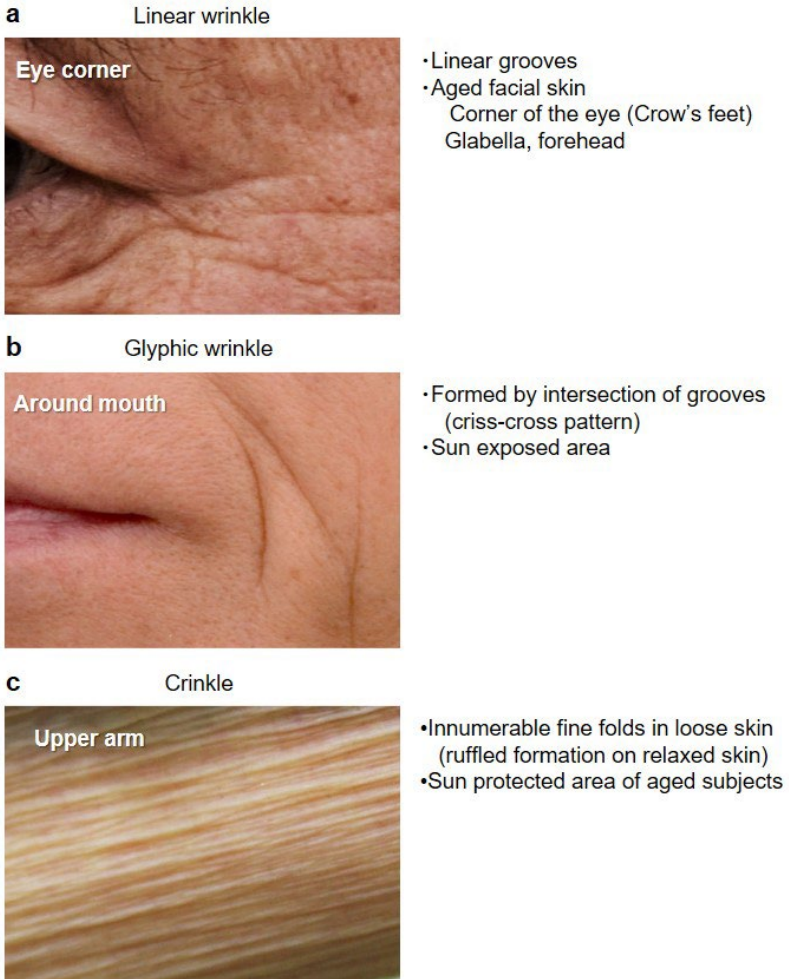


Fig. 16. Classification of wrinkles according to Kligman.

a) Linear wrinkles: formed in aged skin, at the corner of the eye, glabella and forehead. b) Glyphic wrinkles: formed by the intersection of grooves in sun-exposed areas. c) Crinkles: multiple fine folds in loose skin in sun-protected areas of aged persons.