Classification of the Aging Lips: A Foundation for an Integrated Approach to Perioral Rejuvenation

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Classification of the Aging Lips: A Foundation for an Integrated Approach to Perioral Rejuvenation

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Abstract

Background Although perioral aging is highly individual with several distinct processes taking part simultaneously, there is scarce systematic information which helps to indicate the right rejuvenation approach among the multitude of proposed procedures. Existing data about perioral aging has not yet been transformed into a consistent therapeutic concept. The intention of this study was to provide a simple, yet reproducible classification and to offer appropriate rejuvenation approaches.

Methods To identify reliable and constant landmarks of the ongoing process of perioral aging, 462 perioral photo documentations were morphometrically analyzed. Based upon the identified landmarks a two-dimensional classification was developed. The classification was validated by three plastic surgeons. Inter- and intra-rater reliability was calculated using Cohen’s kappa coefficient.

Results Perioral aging can be broken down into changes of the lip shape and changes of the lip surface. Both processes can be classified into three stages each: Lip shape according to the shape in profile view, the lip length in relation to the frontal incisors, and the degree of vermilion inversion. Lip surface according to the presence and degree of radial wrinkles and the visibility of the structural elements Cupid’s bow, philtrum, and white roll. Inter-observer reliability was rated very good (kappa values between 0.819 and 0.963) and perfect for intra-observer reliability (1.0).

Conclusion A better understanding of perioral aging leads to a simple classification for the aging lips. Using the classification helps to tailor an appropriate treatment to the individual patient and aids to achieve a natural rejuvenation result.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Perioral · Aging · Rejuvenation · Lips · Wrinkles · Classification

Introduction

A broad variety of approaches for upper lip rejuvenation has been suggested. All of these can be subdivided into 3 categories: Volume augmentation, surface enhancements, and surgical lip lifting approaches. Although several articles have been published which shed light on the aging process of the perioral complex [1–4], these data have not been transformed into consistent therapeutic concepts.

Despite these findings the large majority of physicians dealing with perioral rejuvenation have to rely on personal
experience and often subjective criteria to choose their procedure of choice. Volume augmentation has been achieved by a multitude of substances, such as autologous fat, dermis (autologous or allogenic), SMAS, collagen, hyaluronic acid, gore-tex, silicone in the form of tubes, microparticles or gel, polyacrylamid and gelatin, etc. [5–13]. Resurfacing relies on chemical peels, laser ablation, dermabrasion, or chemodenervation by botulinum toxin injections [14–17]. A wide range of surgical approaches with different excision sites and figures have also been described [4, 18–25]. Most of these procedures address certain aspects of the aged lips, if correctly indicated and performed. However, if applied in an undifferentiated manner they might lead to suboptimal results.

Therefore, the intention of this study was to provide a simple yet reproducible classification of the progressive aging changes of the upper lip and to offer appropriate rejuvenation approaches. Because perioral rejuvenation is requested almost exclusively by female patients this study is based on female subjects.

Materials and Methods

Development of the Classification

The main focus of this investigation was to identify reliable and constant landmarks in the ongoing process of lip aging. In an earlier study, over 240 perioral regions of Caucasian subjects were morphometrically analyzed using patient photographs or cranial MRI scans [2] and 40 histological specimens of upper lips were processed and morphometrically analyzed [1]. To gain further information about the specific patient group undergoing perioral rejuvenation procedures, 22 patients receiving a lip lift were further analyzed pre- and post-operative [4]. The proportions of upper lip prolabium, vermilion height, total lip length as well as surface structure and appearance in profile view were observed. An additional 200 adult Caucasian female patient photographs (age 28–78 years) were analyzed in a similar manner for this study. For this purpose, patients were photographed in a standardized manner by a professional medical photographer. During photography, it is crucial to tell the patient to have a relaxed facial expression without smiling and grimacing, maintain a relaxed closed bite and keep the face straight by aligning the Frankfort line with the horizontal plane. During clinical examination of facial plastic surgery patients and the development process of the classification, it became obvious that besides regular frontal and lateral views it is necessary to evaluate the patient with lips slightly parted. The opening of the mouth has to be the result of slightly lowering the mandible and is not due to activation of the mimic musculature (smiling/paring teeth). Without this special view, it is impossible to reliably determine upper lip elongation, especially in relation to frontal teeth display (compare Fig. 2).

Based on previously performed studies [1, 2, 4], the identified criteria were transformed into a simple classification. The classification is designed to provide the fundament of a clear, reproducible therapeutic concept to assist in choosing the right procedure for an individualized perioral rejuvenation approach.

Validation of the Classification

To validate the objectivity, inter-observer reliability, and reproducibility of the proposed classification, the photographs of 42 female patients (aged 33–79 years) were presented to three experienced plastic surgeons. After a short introduction, the surgeons were asked to classify the

Fig. 1 Proposed classification of the aging upper lip. Left row (1–3) describes changes in length and form. Right row (a–c) describes surfaces changes
The examination of the exact physiological changes reveals that upper lip aging can be broken down into two processes: surface changes and changes of lip shape. Therefore, the presented classification is designed as a two-dimensional matrix. Although these two processes are not entirely independent, they do progress at varying speeds and one stage of surface change can be accompanied by several stages of shape change and vice versa. Thus, different aspects of lip aging have to be addressed in varying extents in each patient.

The following classification is suggested for the assessment of lip aging (Fig. 1):

The shape change of the aged lip is classified into three stages based on the frontal and lateral view with slightly parted lips:

1. Short concave upper lip with 2–3 mm of upper incisors visible and prominent everted vermilion
2. Moderately elongated and straighter upper lip with upper incisors at the lower border of the upper lip and mild degree of vermilion inversion
3. Strongly elongated upper lip which forms a convex curve around the frontal teeth row. Upper incisors are not visible and vermilion is inverted.

The surface changes of the lips are also classified into three stages:

A. Distinct philtral columns, Cupid’s bow and white roll without static radial wrinkles, minor dynamic radial wrinkles
B. Flattened philtral columns and Cupid’s bow, indistinct white roll, beginning static radial wrinkles, strong dynamic radial wrinkles
C. Invisible philtral columns, Cupid’s bow and white roll, considerable static radial wrinkles

Validation of the Classification

The applicability, objectivity, and reliability of the classification were tested by three plastic surgeons. All of them found the classification simple yet helpful to evaluate the aging changes of the perioral region. Cohen’s kappa coefficients for inter-rater agreement (Surgeon A/B, A/C, B/C) were 0.886, 0.855, and 0.963 (mean 0.901) for the dimension of lip shape change and 0.854, 0.819, and 0.963 (mean 0.879) for surface changes. The mean Cohen’s kappa coefficient of all inter-observer reliability tests was 0.890. The kappa coefficient for intra-observer reliability (doubled photographs) was 1.00 for all surgeons and for both shape and surface changes.

Discussion

Esthetic treatments to the lips can be motivated by two main purposes: Rejuvenation and beautification. In the past, these two modalities have often been intermixed. Especially in the age group above 40, these two concepts become less distinctive and thus suggested treatments have been used interchangeably. Beautification of the perioral region is a very complex challenge and to a high degree dependent on the individual and cultural concept of beauty. Most proposed treatments rely on volume augmentation (although sometimes up to bizarre dimensions). A detailed inquiry into the widely varying cultural and individual requests for lip beautification and a differentiated treatment concept is beyond the scope of this article. Perioral rejuvenation, like any other rejuvenation concept, has the goal of reverting the aging process of this particular esthetic unit. Although the scientific description of perioral aging did not go beyond the status of narrative expert opinions for a long time, recent reports have shed some light and manage to systematically investigate the underlying physiological changes [1–3]. It was the intention to provide a classification which defines different stages of this process, prompting distinct options for rejuvenation.

Medical classifications are often ambiguous and imprecise, thereby failing to produce consistent classification results when applied by different physicians. To avoid this problem, the proposed classification is designed as a two-dimensional matrix. Although surface changes and form changes are not entirely independent processes, the same stage of one aspect can be accompanied by different stages of the other aspect. Therefore, a one-dimensional matrix cannot correctly depict the multiplicity of existing conditions. The two dimensions trigger different therapeutic concepts which are not completely independent of each other but can be combined in different ways.

The indistinctness of medical classifications is often due to the difficulty of pressing a constant ongoing biological process into clear objective stages, which allows different users to come to the same classification result.

To evaluate the inter-rater reliability of the proposed classification three different plastic surgeons rated 42
patient photographs in a blinded fashion. The resulting Cohen’s kappa values are all well above 0.8, indicating a very good degree of inter-rater reliability according to Altman \[26\] or an almost perfect level of agreement in accordance to Landis and Koch \[27\] (compare Table 1). The intra-rater reliability tested by repeated testing of the same subject photographs was evaluated with a perfect kappa score of 1.00 for all three testers. These results can be judged as extremely satisfying, especially because the proposed classification is capable of demarcating clear stages of the continuous and indistinct ongoing aging processes of the complex anatomical perioral region. These results also compare favorably to a similar evaluation of an anatomically related classification to judge lip fullness \[28\]. Consequently, the goal to create a classification that can be used by experienced plastic surgeons reliably and is simple enough to be of value in daily practice could be accomplished.

There is no need for any classification if the classification result does not trigger specific consequences. And like in any other area of esthetic surgery, it is essential that different patients with differently pronounced aspects of their individual aging process are offered individually tailored therapeutic options. Although this claim is beyond discussion in almost any field of esthetic surgery, it is our impression that for perioral rejuvenation a lot of “one procedure fits all” concepts are still being advocated, although more and more integrated approaches to perioral rejuvenation are being presented \[29, 30\]. This does not implicate that personal experience and/or prevalence can be replaced. Yet, only by recommending those procedures for each stage of the classification which most effectively address the underlying physiological changes, a causal treatment concept can be achieved (Table 2). This tool is also intended to facilitate the objective evaluation of proposed rejuvenation treatment outcomes.

For lips classified as 1 and/or A no rejuvenation procedure is necessary (Fig. 2). It should be pointed out that like in most other areas of facial morphometrics, the perioral aging process is a very individual process with a wide variance. While one individual may have a very pronounced philtrum and cupid’s bow with prominent white roll and full, pouting vermilion, another individual might present with thinner lips and far less prominent structural components of the upper lip, although being of the same age. The aging process therefore has to be evaluated individually for each patient, taking into account the changes that have occurred in this individual (possibly by comparing the current situation to older photographs). As mentioned above, the fact that rejuvenation is not indicated in 1A lips, does not affect possible beautification possibilities for these patients, yet, like stated above, complex individual preferences and widely diverging cultural backgrounds put this topic beyond the scope of this article \[31\].

The elongation of class 2 lips is not as pronounced that a lip shortening procedure is absolutely indicated, but the option should be discussed with the patient (Fig. 3). Especially if a structural augmentation is planned in these patients, the result will be more natural and a “pumped up” look is avoided if the elongation is simultaneously corrected.

Table 1 Interpretation of Cohen’s kappa values for inter/intra-rater reliability

<table>
<thead>
<tr>
<th>Value</th>
<th>Definition according to Landis and Koch [27]</th>
<th>Value</th>
<th>Definition according to Altman [26]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–0.19</td>
<td>Poor</td>
<td>&lt; 0.20</td>
<td>Poor</td>
</tr>
<tr>
<td>0.20–0.39</td>
<td>Fair</td>
<td>0.21–0.40</td>
<td>Fair</td>
</tr>
<tr>
<td>0.40–0.59</td>
<td>Moderate</td>
<td>0.41–0.60</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.60–0.79</td>
<td>Substantial</td>
<td>0.61–0.80</td>
<td>Good</td>
</tr>
<tr>
<td>0.80–1.0</td>
<td>Almost perfect</td>
<td>0.81–1.00</td>
<td>Very good</td>
</tr>
</tbody>
</table>

Table 2 Treatment options for each classification category

<table>
<thead>
<tr>
<th>Category</th>
<th>Suggested treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape change</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Rejuvenation not necessary</td>
</tr>
<tr>
<td>2</td>
<td>Tailor structural and volume augmentation to increased length—discuss shortening procedure</td>
</tr>
<tr>
<td>3</td>
<td>Lip lift—Careful with isolated augmentation</td>
</tr>
<tr>
<td>Surface change</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Rejuvenation not necessary</td>
</tr>
<tr>
<td>B</td>
<td>Evaluate resurfacing with laser or peeling, add definition to white roll and philtrum with fillers or fat</td>
</tr>
<tr>
<td>C</td>
<td>Deeper resurfacing, filler/fat for vertical rhytides and restoration of lip structure</td>
</tr>
</tbody>
</table>

Fig. 2 Frontal and lateral photograph of a type 1 and type A lip in a 34-year-old female. Note the short, ramp shaped, concave prolabium with everted vermilion (pouting) and visible upper incisors. No wrinkles are present and the Cupid’s bow, philtrum, and white roll are well defined.
In class 3 lips (Fig. 4), the elongation is the main aspect of the aged perioral impression and should be addressed with a lip lifting procedure. Different techniques have been described by Rozner, Austin, Guerissimi, and others [18, 21–25]. While we prefer the Austin-type bullhorn excision at the nasal base and could show that this technique adequately corrects the length increase and inversion [4], other techniques may be preferred by other surgeons. Solely relying on injection techniques for volume augmentation in these lips will most likely lead to unnatural results. It even is to be stated, that the longer the upper lip becomes the less augmentation is possible if unnatural results are to be avoided. It might be beneficial to exclusively address radial wrinkles, reconstruct the lip structures (philtrum, white roll), and treat the neighboring esthetic units of the nasolabial fold and the corner of the mouth.

The surface changes in class B lips (Fig. 5) benefit from a milder form of resurfacing, for example by dermabrasion or ablative laser treatments with the downside of potential hypo/hyperpigmentation. Alternatively, deep radial wrinkles can be very well addressed by dermal fillers [38, 47–50] or autologous material [35–37, 51]. Orbicularis oris myotomy has been described but has not reached widespread acceptance [37]. To achieve a natural rejuvenation result, the complete structural loss of the philtrum and Cupid’s bow in these lips has to be corrected. This is best achieved by linear introduction of the preferred filler material. We prefer bio-compatible and resorbable materials, such as hyaluronic acid or autologous fat, the latter being somewhat less predictable due to varying resorption and a higher difficulty to sculpt precisely, yet offering a longer lasting effect and possible positive effects on skin micro-structure [52]. Hyaluronic
acid offers the advantage of being reversible in case of overcorrection or inhomogeneous results and do not require the deleterious correction procedures known to have been required after introduction of materials like silicone or polymethyl methacrylate [53–56].

Any proposed treatment algorithm will be limited by the fact that not all influencing factors can be included. This certainly holds true for the herein proposed classification as well. Like stated in the introduction, this concept focuses on the female lip and morphometrical results, which have been obtained in Caucasian patients. Although male patients rarely present with rejuvenation requests centering around the mouth, the existent data suggest that similar processes take place in the male mouth [2, 3], possibly at a slower pace and more concealed by facial hair. The lower lip plays an astonishingly minor role in perioral aging, although structural enhancements (white roll) and especially volume introduction should always be matched to the upper lip. Ethical factors and differences in facial appearance, scars, the influence of the underlying bony structures with their distinct changes over time and the overall quality of the skin as well as a wide variance of individual appearance all influence the evaluation of the perioral region and have to be taken into account.

Special consideration has to be paid to dentition. It is obvious that severe malocclusion, malalignment, or deficient teeth are important to detect as these factors negatively affect the hard tissue foundation for the lips. It is also well known that frontal incisor length decreases with increasing age [57], and consequently one of the used reference points of our classification is not time-stable by itself. Yet, as in other areas of facial surgery, the absolute dimension of a certain structure is not as important as the relative dimension compared to a neighboring structure (e.g., drooping nasal tip makes a dorsal hump look bigger). Therefore, if the shortening of the upper teeth is not corrected by esthetic dentistry, it should make the observer even more aware of upper lip lengthening and possible corrective measures.

However, as a rule of thumb, patients should be advised to correct their dental deficiencies before considering esthetic treatments of the perioral soft tissues. A stable dental situation provides a solid fundament for further soft tissue and consequently one of the used reference points of our classification is not time-stable by itself. Yet, as in other areas of facial surgery, the absolute dimension of a certain structure is not as important as the relative dimension compared to a neighboring structure (e.g., drooping nasal tip makes a dorsal hump look bigger). Therefore, if the shortening of the upper teeth is not corrected by esthetic dentistry, it should make the observer even more aware of upper lip lengthening and possible corrective measures.

We consider the proposed classification a valuable tool to systematically evaluate the individual stage of perioral aging and develop a suitable rejuvenation concept for each patient.

Conclusion

A better understanding of the physiological changes of perioral aging leads to a clear and simple classification for the aging upper lip. By using the classification a differentiated rejuvenation approach can be tailored to the individual need of each patient. This will help to achieve more natural and satisfying outcomes.

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