Defining Skin Quality: Clinical Relevance, Terminology, and Assessment

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BACKGROUND Flawless skin is one of the most universally desired features, and demand for improvements in skin quality is growing rapidly. Skin quality has been shown to substantially impact emotional health, quality of life, self-perception, and interactions with others. Although skin quality improvements are a common end point in studies of cosmeceuticals, they are rarely assessed in clinical studies of other aesthetic treatments and products. Descriptive terminology for skin quality parameters also varies considerably within the aesthetic field, relying on a range of redundant and occasionally contradictory descriptors. In short, skin quality has not been clearly defined.

OBJECTIVE The goal of this review is to highlight the importance of skin quality to patients and physicians, explore known and unknown factors comprising skin quality, and provide clarity regarding terminology, descriptors, and evaluation tools for assessing skin quality.

MATERIALS AND METHODS A review of the literature on skin quality was performed without limitation on publication date. Relevant articles are presented.

RESULTS AND CONCLUSION We propose a framework of attributes contributing to skin quality rooted in 3 fundamental categories—visible, mechanical, and topographical—with the aim to provide information to help guide clinicians and inform future clinical studies.

According to psychologist Nancy Etcoff,¹ identification of beauty is intuitive, whereas definition of beauty is subjective, mutable, and difficult to formulate into words. As the cornerstones of beauty include smooth, healthy looking skin, what comprises desirable skin is similarly difficult to define. Yet, flawless skin is an important component of facial attractiveness and continues to be one of the most universally desired features.¹⁻³ In a recent global survey, 94% of the 14,584 people interviewed desired to improve their facial skin, and terms such as radiance and healthy, glowing skin are requested by patients seeking improvements in their appearance (unpublished data, Allergan Aesthetics). The encompassing term for this collection of desired outcomes is skin quality.

Skin quality as a concept is gaining traction in the aesthetic field worldwide. Rejuvenation procedures, cosmeceuticals, and minimally invasive injectable therapies are increasingly popular. However, reaching a consistent, objective definition of skin quality has been difficult. Current literature focuses heavily on age-related changes in skin quality, rather than skin quality per se, and descriptive terminology has substantial variability between investigators and geographically (See Supplemental Digital Content 1, Table S1, http://links.lww.com/DSS/A795 for levels of evidence of included literature). The lack of a clear, comprehensive definition precludes identification of clinical indicators and evaluation tools necessary for proper assessment and treatment of undesirable skin quality. In short, skin quality has yet to be clearly defined. Thus, the authors’ goal is to elucidate the importance of skin quality to patients and aesthetic physicians, explore and understand what factors comprise it, and identify the gaps in the authors’ understanding. The authors then propose a novel classification of skin quality attributes to provide clarity for both patients and physicians.

Importance of Skin Quality

Biological and Evolutionary Perspectives

The appearance of one’s skin provides a wealth of information about an individual. Skin health is intricately linked to overall well-being, and clear skin is one of the body’s “visual certificates of health,”¹ reflecting general...
health and vitality, as well as disease and nutritional state.4–10 The visible condition of skin can also validate reproductive health and fertility.11 Attributes of skin quality (e.g., texture and homogenous coloration) contribute to perceptions of facial attractiveness,2 which may then correlate with mate choice and mating success,12 potentially because of the condition of one’s skin indicating the quality of his/her immune system.2 Indeed, increasing evidence supports a link between immune health and facial attractiveness,13–15 although more research is needed to fully understand the contribution of individual skin quality attributes to this relationship. In addition, men may perceive female skin as more attractive and healthier during the fertile (i.e., late follicular) phase of the menstrual cycle,16–18 although data are equivocal and suggest minor variations in chromophore distribution could be the driver.16,19

Present characteristics of skin evolved in consideration of health, disease, and sexual selection. Human’s relative hairlessness was an adaptation to ward off parasites1 and combined with the development of sweat glands to allow for efficient heat dissipation.20 A rich vascular network evolved to support skin’s sweat glands, hair follicles, and multiplying cells,20 while a diverse symbiotic microbiome that varies across sex, age, skin site, and geographical location influences attributes of skin quality and, in cases of dysbiosis, skin disorders.21–25 Variations in skin pigment evolved in response to geographic differences in ultraviolet (UV) radiation, with increased melanin content in high UV areas as a means of photoprotection, and paler skin evolving for lower-light environments and enhanced vitamin D synthesis.1,20,26,27 Anthropologic data also suggest that, within a society, women evolved with lighter skin than men, so that signs of attraction, such as flushing or blushing, would be more apparent.28

Much of the authors’ understanding of biological factors comprising skin quality has been elucidated through studies of aging, although a full discussion is outside the scope of this article. Briefly, intrinsic aging is associated with structural and functional deterioration of the skin, with declines in collagen, elastin, chondroitin, and hyaluronic acid, among other components.29–31 Together with other age-related alterations and damage, these changes lead to decreases in barrier function and hydration and concomitant increases in sagging, pore size, wrinkles and deep expression lines, dullness, blotchiness, rough texture, hyperpigmentation, dryness, and erythema.20,35,32–39

Skin aging literature has also highlighted variation in skin quality among individuals of different ethnicities, which remains understood within aesthetics. Despite the widely considered protective effect of increased melanocytes and/or melanin, both intrinsic aging and photoaging occur, rendering skin less resilient and elastic.30 In addition, age-related changes in pigmentation, pore size, elasticity, oiliness, and thickness may differ between men and women of the same ethnicity.41–43 The appearance of facial pores also varies among ethnic groups, with Asians having the smallest pores compared with African American, white, and Hispanic subjects, and African Americans having the most severe impairment of the structure surrounding facial pores.43 Furthermore, the effects of photoaging differ across skin phototypes, with lighter skin more prone to depigmentation, atrophic changes, and skin cancers, and darker skin more prone to hypertrophic skin changes, deep wrinkles, and skin thickening.33 In short, the appearance of skin speaks to the biological underpinnings of health and reproductive fitness, with important, but understudied, differences across ethnicities.

**Psychosocial Impact**

Physical appearance and perceptions of attractiveness are multifactorial and intricately linked.44 As a result, the quality of one’s skin has a strong psychosocial influence on individuals. Poor skin quality can result from a myriad of factors and may negatively impact a person’s emotional health, quality of life, self-perception, and interactions with others.43–47 Importantly, self-perception is affected by interactions with, and judgements by, others. Multiple studies have shown that skin, as a person’s primary interface with their surroundings,26 influences others’ judgments of one’s health, personality traits, youthfulness, and emotional and psychological well-being.48–50 Studies investigating manipulations of skin surface topography in photographs of middle-aged women found that small topographic skin alterations significantly influenced observers’ preferences for specific faces and perceptions of age and attractiveness.19 In another study of facial photographs of women aged 40 to 71 years, removal of age spots, telangiectasia, furrows, lines, and wrinkles significantly impacted raters’ perceptions of age and health.51 Furthermore, increasing evidence suggests that noninvasive facial rejuvenation produces sustained improvements in self-esteem, self-ratings of attractiveness, and decreases self-perceived age.52–56 Together, these data highlight the significant psychosocial impact of skin quality and potential for improvements using aesthetic procedures.

Indeed, improvement of skin quality is an increasingly common objective of clinical studies of aesthetic treatments and the primary goal of such treatments in clinical practice.9,37,57–63 According to a recent prospective, multicenter, observational study of 511 subjects seeking cosmetic procedures, approximately 80% of subjects said a desire for a youthful, more attractive appearance and clear skin motivated them to seek aesthetic treatment; other common reasons included improving psychosocial well-being, looking good professionally, and feeling less self-conscious around others.64 In addition, clinical studies use several instruments (e.g., Skindex-16 and FACE-Q) to measure postprocedure subject satisfaction with skin and the psychosocial impact of treatment,65 highlighting critical links between skin’s appearance and psychosocial factors.

**Attributes of Skin Quality: Approaching a More Rigorous Definition**

**Defining Skin Quality**

Despite the growing awareness and importance of skin quality in human evolution, psychology, aesthetic treatments and practice, and clinical research, there is a dearth of literature...
and a lack of consistency in descriptive terminology for skin quality parameters. Studies of the effects of cosmetic products and procedures on skin quality rely on a range of often redundant, and sometimes contradictory, descriptors that are rarely defined (See Supplemental Digital Content 2, Table S2, http://links.lww.com/DSS/A796). It is imperative to establish scientific rigor surrounding the definition and measurement of skin quality to guide the development and implementation of appropriate treatment strategies.

The authors propose a framework of attributes contributing to skin quality in healthy skin rooted in 3 fundamental categories: visual, mechanical, and topographical (Figure 1, Table 1). Visual attributes are purely visible, even after completely smoothing away topographic imperfections on the skin, and are assessed by light’s reflection onto the skin. Topographical attributes are perceived by touch and viewed by topographic imagery. Mechanical attributes are related to how skin moves and can be measured by physical manipulation or deformation of the skin. To overcome inconsistencies in terminology currently applied to skin quality, Table 1 defines individual attributes based on the authors’ clinical experience and Supplemental Digital Content 2, Table S2, http://links.lww.com/DSS/A796 includes a review of the limited descriptions in the literature; a summary of considerations related to each attribute follows. It is important to note that these categories are not mutually exclusive; individual attributes may fit into multiple categories. Furthermore, scars, which relate to all 3 proposed categories of skin quality (as they are palpable, affect the movement of skin at the scar site, and are readily visible), were not included as a skin quality attribute because they are a secondary skin lesion rather than a primary attribute of skin quality.

### Visual Attributes

Uneven pigmentation, which often refers specifically to variations in melanin, is a primary visual attribute based on skin’s melanin content; darker skin is richer in melanin.1,2

| Attribute       | Definition                                          |
|-----------------|-----------------------------------------------------|
| Uneven pigmentation | Variation in melanin                              |
| Redness         | Erythema or visible hemoglobin                       |
| Dullness/sallowness | Absence of glow; yellow or grayish undertone         |
| Radiance        | Ability of skin to “glow” or reflect light           |
| Oiliness/shine  | Excess sebum on the skin surface                    |
| Dryness         | Lack of moisture; dehydration                       |
| Roughness       | Uneven, not level texture                           |
| Fine lines      | Light wrinkles                                      |
| Coarse lines    | Deep wrinkles                                       |
| Pores           | Surface landmark of pilosebaceous unit               |
| Crepiness       | Fine cigarette paper wrinkling of skin              |
| Hydration       | Water content; moisturization                       |
| Laxity          | Loose skin                                          |
| Elasticity/pliability | Ability to recoil with manipulation            |
| Firmness        | Relative ability to be stretched                    |
| Thickness       | Density of the epidermis and dermis                 |

*Figure 1. Proposed framework of skin quality attributes.*
Photoaged skin may show areas of hypopigmentation or hyperpigmentation, whereas melasma appears as hyperpigmented patches in a characteristic distribution, both giving the appearance of mottling or blotchiness. Redness (erythema) relates to underlying skin color and relative vascular burden and visibility through the skin. 

Dullness and sallowness refer to the lack of natural radiance and may be associated with a yellow undertone to the skin. These are additional visual signs of poor skin quality, which may result from myriad causes. On the opposite side of the spectrum is the ability of the skin to reflect light, which the authors term radiancy or “glow”; radiancy is both visual and tactile because it depends on hydration levels and the amount of dead or dry skin accumulation blocking light reflection. Oiliness/shine and dryness are similarly visual and tactile attributes. Oiliness, or excess sebum production, may result from intrinsic (hormonal) or extrinsic (oxidative stress) factors. Hydration is perceptible by sight, touch, and biomechanics; that is, the moisture level of the skin can be seen and felt and affects the skin’s ability to be manipulated.

Topographical Attributes
Topographical attributes are also visible, but are measured by topographic methods. These attributes include smoothness or roughness (texture); this component is an important indicator of the presence or absence of aging or photodamage, considering extremely coarse skin may signal elastosis, and smooth skin is considered younger-looking. Topographical attributes also include the presence of fine or coarse lines or wrinkles. Enlarged pores relate to topographical properties of skin and have been correlated to increased sebum production, advancing age, and male sex. Skin crepiness may appear where underlying structural support is lost (e.g., fat and/or muscle atrophy, degradation of collagen and elastin fibers), leaving thin skin hanging loosely in its place.

Mechanical Attributes
Elasticity, or recoilability, is a mechanical property of skin that decreases with compromised integrity of the network of dermal elastic fibers. Firmness of the skin relates to its pliability and has been an important effectiveness measure in studies of aesthetic treatments. Thickness and tightness of the skin—overly thick or thin skin and tight or loose skin—are also mechanical properties impacted by aging, whether intrinsic or extrinsic; excessive thickness and sagging skin have been attributed to variations in epidermal and dermal thickness or morphologic changes related to sun exposure and aging.

Skin Quality Assessment and Measurement
Objective measurement of skin quality includes a variety of techniques (See Supplemental Digital Content 3, Table S3, http://links.lww.com/DSS/A797). Skin elasticity and firmness can be measured by a Cutometer probe, which generates a dislocation/relaxation curve based on manipulation of the skin with the application and release of negative pressure. Other probe-based techniques for elasticity and firmness assessment are dermal skin torque meter, indentation, or angular rotation techniques.

Corneometers measure hydration by evaluating epidermal capacitance in the stratum corneum, while other instruments measure electrical impedance to assess skin hydration. Measurement of changes in pigment uses light absorption and reflectance to assess melanin and hemoglobin with Mexameter or full spectrum color analysis using standard CIEL*a*b* protocol with Chroma Meter. Assessment of topography or morphology often rely on high-definition imaging techniques and 3D fringe projection or modeling. The number and precision of measurement tools for skin quality assessment continues to grow (See Supplemental Digital Content 3, Table S3, http://links.lww.com/DSS/A797), but as reviewed below, substantial knowledge gaps remain.

Treatments Targeting Skin Quality Improvements
Current treatments and procedures targeting skin quality improvements include rejuvenation procedures (e.g., chemical peels, microneedling, laser, high-intensity focused ultrasound, and dermabrasion), cosmeceuticals, and oral supplementation (i.e., “nutraceuticals”), among others. Increasing evidence supports skin quality changes, including improved texture, elasticity, pliability, hydration, and oiliness, from minimally invasive injectable procedures (e.g., botulinum toxin and intradermal fillers). However, larger, well-controlled studies are needed to better understand the effects of neurotoxins and fillers on skin quality. As with measurement and assessment tools, knowledge gaps remain in our understanding of treatments for skin quality improvement.

Gaps in our Understanding and Knowledge
There remain inconsistencies and gaps in the literature regarding how skin quality attributes are described, defined, and tested (See Supplemental Digital Content 2 and 3, Table S2 and Table S3, http://links.lww.com/DSS/A796 and http://links.lww.com/DSS/A797). The rare definition of a specific skin quality characteristic, such as hydration or elasticity, is generally based on mechanical parameters or calculations derived from measurement tools and instruments (e.g., Corneometer). Thus, clinical practice expertise shapes the evaluation and interpretation of most attributes, which may lead to variability in clinical practice and study. Similarly, although skin quality can be broken down into component parts, some attributes may be dependent on others. For example, redness may reflect the degree of microscopic vascularity visible under Fitzpatrick phototype I skin.

Measurement tools for skin quality also have other limitations. Objective measurements are often used in isolation and are allocated mainly to studying the effects of...
of aging, which lack substantiation in assessments of overall skin quality.\textsuperscript{68,74} Furthermore, since skin properties differ based on the area of the face (e.g., chins have the highest pH\textsuperscript{89}) and probe-based tools can only analyze small portions of facial skin, these measurements may not provide accurate representation of overall facial skin quality. Furthermore, objective measurement tools may only be able to assess one attribute at a time and may identify statistically significant, but nonclinically relevant, changes in skin quality. Future studies should consider use of multiple objective tools, as well as combining objective and subjective photonumeric grading of skin quality parameters. However, subjective assessment tools (e.g., clinical rating scales) are generally not inclusive of all skin types or ethnicities,\textsuperscript{70,90} which needs to be addressed.

Imaging, in particular, is a useful tool for objectively measuring skin quality attributes (See Supplemental Digital Content 3, Table S3, http://links.lww.com/DSS/A797). Image acquisition (e.g., exposure and angle) and analysis parameters are not currently standardized in aesthetics, but the growing availability of increasingly sensitive instruments, computer-aided image analyses, and artificial intelligence with machine learning make these methods promising for obtaining high-quality, objective measurement of skin quality attributes. Finally, aesthetic procedures and a desire for skin quality improvements are gaining in popularity among individuals with skin of color, although we still have a limited understanding of distinctions in skin quality attributes across ethnicities.\textsuperscript{63,93–98}

\section*{Conclusion}

The importance of facial attractiveness is well documented and undeniable. Since the early 20th century, clinical literature has highlighted the substantial influence of physical appearance on attractiveness and the psychological benefits of cosmetics and aesthetic procedures.\textsuperscript{44,99} Almost 100 years later, attaining a healthier, more attractive appearance and clear skin is a major motivation in seeking aesthetic procedures.\textsuperscript{100} The undercurrent in these observations is a desire for impeccable skin quality. Although there is no shortage of literature detailing the effects of visible skin condition on physical, psychological, and emotional well-being and the substantial psychosocial impact of aging skin, limited data are available explicating the topic of skin quality parameters and their rapidly growing importance in clinical settings. This review aims to address this literature gap, focusing on clarity regarding terminology, descriptors, and evaluation tools of skin quality. This information is intended to help guide clinicians who treat subjects concerned about skin appearance and inform future clinical studies.

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