Contents

Facial Anatomy

Facial Characteristics and Age-Related Changes

The face in general plays a crucial role in society, particularly during social interactions. Facial features are highly relevant to revealing one's age, mood, and stress level. They are also relevant to facial attractiveness and facial expression, a pivotal language communicator. Younger-looking individuals have plump facial muscles and tight skin with the ability to fully express themselves during facial communication, whereas aging individuals have drooping muscles and loose skin with less facial expression.

Regardless of how beautiful one's appearance is in their youth, age-related changes and loss of facial volume and features are inevitable. These are often more pronounced and specific to certain areas. A gradual loss of soft tissue occurs in the upper midface region in conjunction with a downward migration of superficial buccal fat. Consequently, the upside-down triangle associated with a youthful look (see Fig 1-1) becomes inverted, with a larger proportion of soft tissue drooping below the midface. While the rate of aging varies among individuals based on genetics, environmental factors, sex, and ethnicity, the following traits are eventually common in all individuals (Fig 2-1):

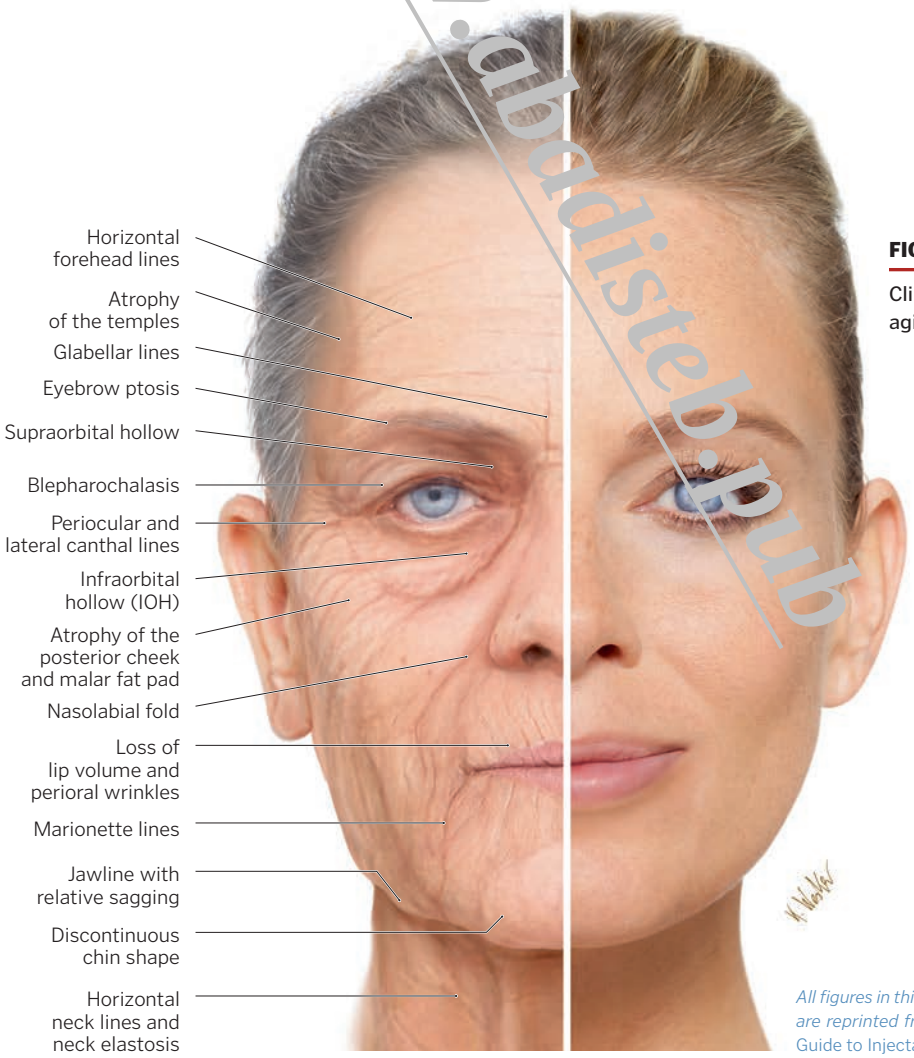


FIG 2-1

Clinical characteristics of the aging face.

All figures in this chapter except Figs 2-11 and 2-12 are reprinted from Sattler and Gout's Illustrated Guide to Injectable Fillers *(Quintessence, 2016).*

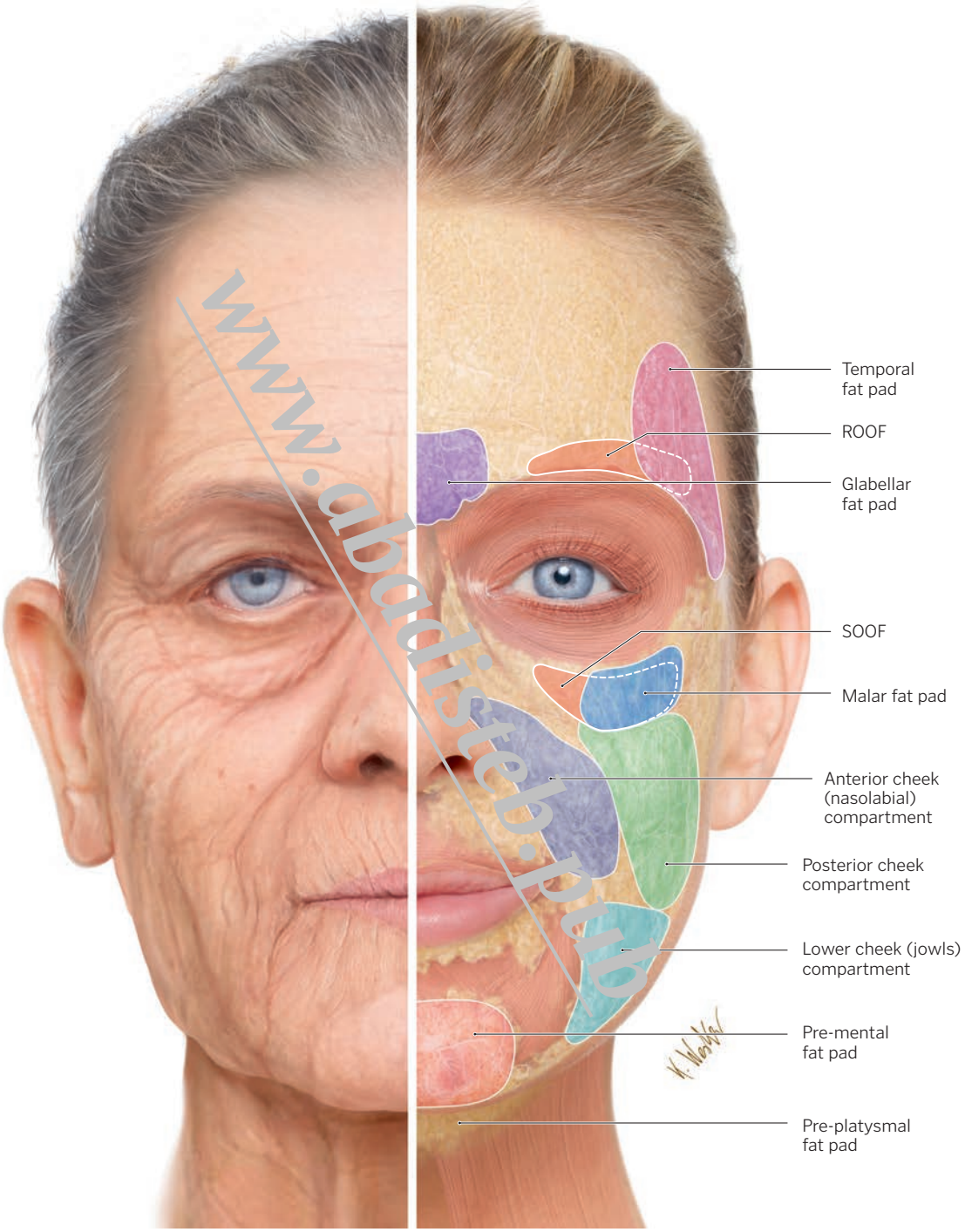


FIG 2-13

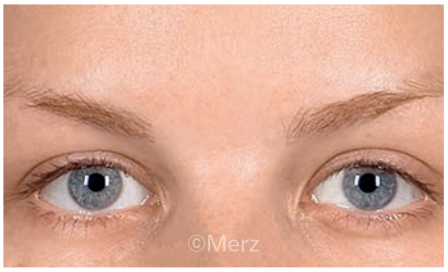
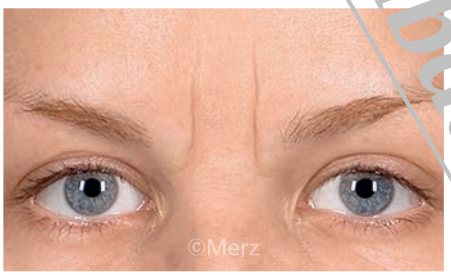
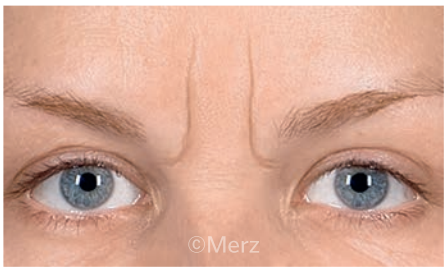
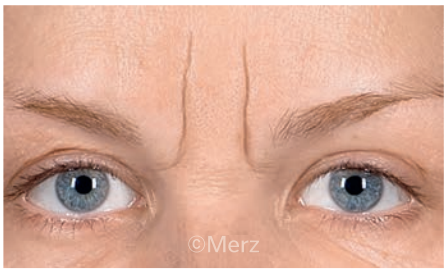
Split view of the clinical signs of aging and subcutaneous fat distribution of the face. It is apparent at first glance that there is a correlation between them. At sites where superficial fat is absent, alongside facial atrophy due to deep fat loss, the clinical signs of aging become apparent at a particularly early age. Sites of fat loss around the eyes and mouth are therefore considered to be facial aging "hot spots."

FIG 3-8

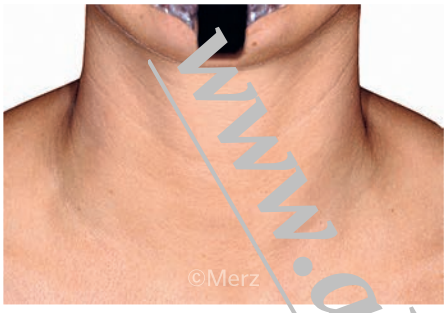
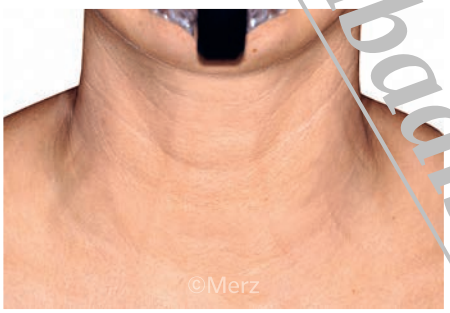
It is highly recommended to hire a professional photographer during the setup and management of digital photography to help set up the overall landscape and lighting. Thereafter, it becomes easy to reproduce images from session to session.

FIG 3-7

Three images taken of the same person in *(a)* underlit, *(b)* normal, and *(c)* overlit intensities. Notice the subsequent histograms for each image. Ideally, a well-spanned histogram should be observed following image capture.

	Glabellar lines at rest	Nasolabial lines	
0 No wrinkles			**0** No lines
1 Mild wrinkles			**1** Mild lines
2 Moderate wrinkles			**2** Moderate lines
3 Severe wrinkles			**3** Severe lines
4 Very severe wrinkles			**4** Very severe lines

(cont)

	Neck	Back of the hands	
0 No horizontal lines and no elastosis			**0** No volume loss, no skin aging
1 Mild horizontal lines and no elastosis			**1** Mild volume loss, no skin aging
2 Moderate horizontal lines and initial elastosis			**2** Moderate volume loss, initial skin aging
3 Severe horizontal lines and severe elastosis			**3** Severe volume loss, severe skin aging
4 Very severe horizontal lines and very severe elastosis			**4** Very severe volume loss and very severe skin aging

(cont)

FIG 6-5

Newer centrifugation protocols allow production of a liquid formulation of PRF found in the top 1- to 2-mL layer of centrifugation tubes following a 3- to 5-minute protocol. This liquid can be collected in a syringe and reinjected into defect sites or mixed with biomaterials to improve their bioactive properties.

FIG 6-6

Layer separation produced on a fixed-angle centrifuge. Note the uneven separation at the junction between the red blood cells and PRF.

two layers (Fig 6-5). Produced on a horizontal centrifuge with spin cycles of 5 minutes at 300g, liquid PRF is very rich in cells and growth factors.

This new formulation can be utilized for a variety of procedures, including knee injections for the management of osteoarthritis, temporomandibular joint (TMJ) injections for the management of TMJ disorders, as well as various procedures in facial esthetics to improve collagen synthesis naturally. The principle behind liquid PRF remains the same—it contains a larger proportion of leukocytes and blood plasma proteins due to the low-speed centrifugation concept. Because liquid PRF contains the highest proportion of platelets and growth factors by volume, it remains the optimal PRF formulation for small-volume injections such as those used for facial esthetics. Upon injection, liquid PRF will subsequently clot, facilitating a better ability to maintain deficient volumes such as those observed in facial wrinkles (eg, nasolabial folds). It has been discovered that clotting occurs better with slightly higher g-forces and/or centrifugation times. Therefore, should the clinician desire to produce a more dense fibrin scaffold (ie, to fill deeper facial voids), a heat-treated PRF protocol may be utilized to extend the resorption of PRF from 2–3 weeks to 4–6 months (extended PRF [e-PRF]). The protocols for the production of e-PRF are highlighted in chapter 12.

In 2019, a breakthrough article demonstrated that horizontal centrifugation allowed for better blood separation than traditional centrifugation methods.[64] Because all PRF centrifuges were developed using fixed-angled rotors, one of the disadvantages was the accumulation of cells along the outside glass walls caused by high g-force (Fig 6-6). Furthermore, with traditional centrifuges, separation cannot occur effectively because larger cells (such as red blood cells) typically trap and pull smaller platelets to the bottom of PRF tubes (Fig 6-7). With horizontal centrifugation, on the other hand, the separation of cell layers is linear without accumulation of cells along the outer centrifugation tube wall (see Fig 6-7).

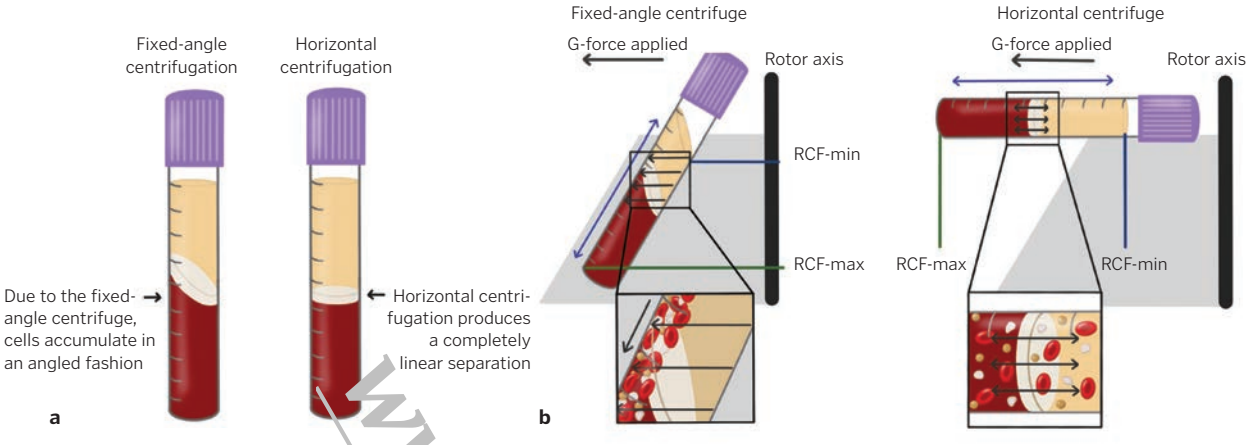


FIG 6-7

Illustrations comparing fixed-angle and horizontal centrifuges. *(a)* Following centrifugation on fixed-angle centrifuges, blood layers do not separate evenly, and as a result, an angled blood separation is observed. In contrast, horizontal centrifugation produces an even separation. *(b)* With fixed-angle centrifuges, separation of blood layers based on density is achieved due to the difference in RCF-min and RCF-max. Note how even at the same RCF-min, the RCF-max on a horizontal centrifuge is much greater, which favors more effective cell layer separation. Because of the large RCF values (about 200–700g), on a fixed-angle centrifuge cells are pushed toward the back of centrifugation tubes and then downward or upward based on cell density. These g-forces produce additional shear stress on cells as they separate along the walls of centrifugation tubes. In contrast, horizontal centrifugation allows for the free mobility of cells to separate into their appropriate layers based on density, allowing for more optimal cell separation as well as less trauma/shear stress on cells.

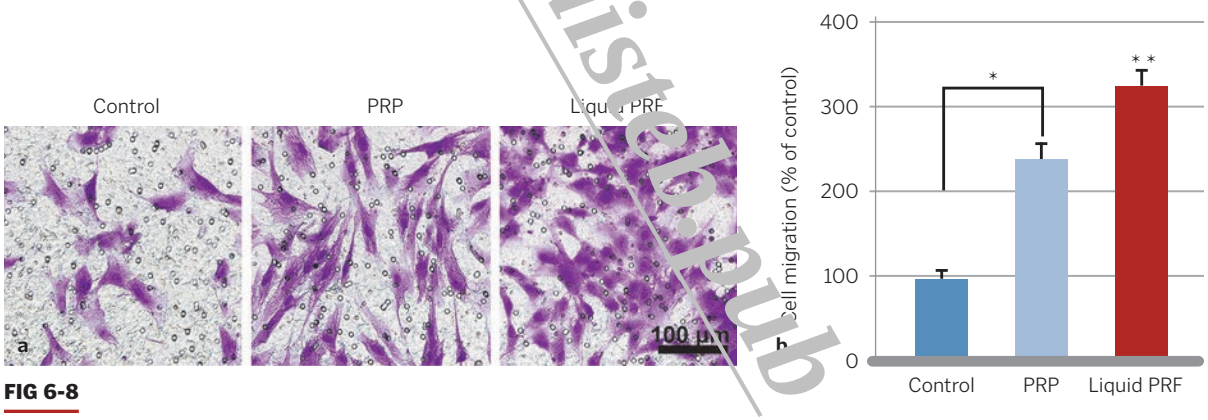


FIG 6-8

(a and b) Migration assay of human skin fibroblasts cultured with liquid PRF and PRP after 24 hours. (Scale bars = 100 µm. An *asterisk* denotes a significant difference between two groups at $P < .05$, and a *double asterisk* denotes a value significantly higher than all other treatment groups at $P < .05$.) This assay was performed in triplicate with three independent experiments.

Regenerative potential of PRP vs liquid PRF

In a recent study, dermal skin fibroblasts were cultured with either liquid PRF or PRP and investigated for their ability to promote/influence cell viability, migration, spreading, proliferation, and mRNA levels of known mediators of dermal biology, including PDGF, TGF-β, and fibronectin.[65] All platelet concentrates were nontoxic to cells, demonstrating high cell survival. Skin fibroblasts migrated over 350% more in liquid PRF when compared to the control and PRP (200% increase; Fig 6-8). Liquid PRF also significantly induced

FIG 6-12

Blood collection procedure for PRF. *(a)* First, a tourniquet is tied about 3 inches above the elbow. *(b)* A vein light is then utilized to locate the vein. *(c)* An alcohol wipe is used to disinfect the area. *(d)* A bandage is then typically attached to a nearby location (in this case, the practitioner's glove) to speed use. *(e)* The butterfly needle is then inserted into the vein at a 15- to 30-degree angle and parallel to the vein. *(f)* Backflow is observed within the butterfly needle. *(g)* The collection tubes are then inserted, and vials of blood are collected. *(h)* Following blood draw, a bandage is placed over the puncture site and the butterfly needle removed. *(i)* Compression is applied to the puncture site.

FIG 6-15

(a to e) Use of liquid PRF for facial injections utilizing different-sized needles. (Courtesy of Dr Ana Paz.) This topic is covered in great detail in chapter 8.

Conclusion

One of the advantages of PRF as a regenerative strategy is that it does not specifically induce the proliferation or differentiation of one specific tissue type. It can therefore be utilized with many regenerative strategies either alone or in combination with other biomaterials for a variety of procedures. Ongoing research continues to investigate the amount of volume augmentation that can be achieved utilizing PRF. Furthermore, very recent research has shown that the plasma layer can additionally be heated and used thereafter as a much slower-resorbing "filler" when compared to liquid PRF, for example for lip augmentation (see chapter 12).