Clinical Anatomy of the Face for Filler and Botulinum Toxin Injection

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Preface

First, I would like to thank my friend, Dr. Kyle Seo, for organizing all the extremely important clinical information and tips. I also wish to thank Dr. Hong-Ki Lee for his insightful inquisitions and questions that made coming up of creative contents possible. Also, I give my thanks to Dr. Jisoo Kim, who played a strong role in the planning of cadaver dissection workshops and in other works related to organizing necessary contents. Without the efforts and sacrifice of the above individuals in providing clinical manuscripts and in revising all of the visuals despite their busy clinical schedules, this book's text and artwork would not have been able to shine. As such, I send infinite thanks to Dr. Kwan-Hyun Youn for providing all of the visuals for this book. I believe that Dr. Youn, an art major graduate with a PhD in Anatomy, has raised our country's medical illustrations to that of world class. Many thanks to the effort of the Medart team led by Dr. Youn to make this book to have many clear, simple, and creative visual contents to be possible.

In the Fall of 2011, my research on clinical anatomy research in relation to aesthetics—and through this, teachings on clinical anatomy—started after receiving advice from John Rogers, a US neurology specialist and medical director of the Pacific Asian region for Allergan Inc., who visited my anatomy lab. Rogers, who had no particular interest in aesthetic treatments, enabled me to devote myself more to this field. Through regional and international educations, I had presented basic information on new methods regarding aesthetic treatment guidelines based on anatomy in order to avoid complications. Then, after hearing that many regional doctors were following anatomic guidelines based on Western research, the coauthors and I designed this book to introduce new methods to fit for Asians, who have slightly different anatomic features. For instance, Asians possess different locations of the modiolus, different directions and changes of facial arteries, and different attachment regions for muscles unlike to Caucasians. All of these and more are explained in detail in this book using research papers presented during my lectures as foundational information. Through this, new injection techniques are described in the book.

Current medical techniques are rapidly changing due to the development of science. As a result, this trend is giving way to a new slogan for medicine such as "borderless" and "above and beyond the border" for a movement working to dismantle academic borders. Biocompatible fillers and botulinum toxin injection development have started to create a new medical field of non-invasive aesthetic plastic surgery, referred to as 'Beauty Plastic Surgery', and the desire for new medical techniques is bringing about developments in clinical anatomy. Likewise, I feel that it is right for clinical doctors from all fields to come together as a virtuous group to jump over the wall of traditional medicine for the development of medical practices. And, as a health personnel studying basic medicine, I feel immense responsibility and a sense of worth in being a part of this movement.

This book includes various images and pictures for simpler understanding of anatomy from 'Plastic and Reconstructive Surgery' and other 80 research papers from acknowledged journals in relation to clinical anatomy. In addition, we worked to include various documents about Koreans so that it may be utilized as a useful document in other areas. It is my wish that, through this book, readers are able to learn clinical techniques related to aesthetic treatments and to grow in knowledge regarding the prevention of complications.

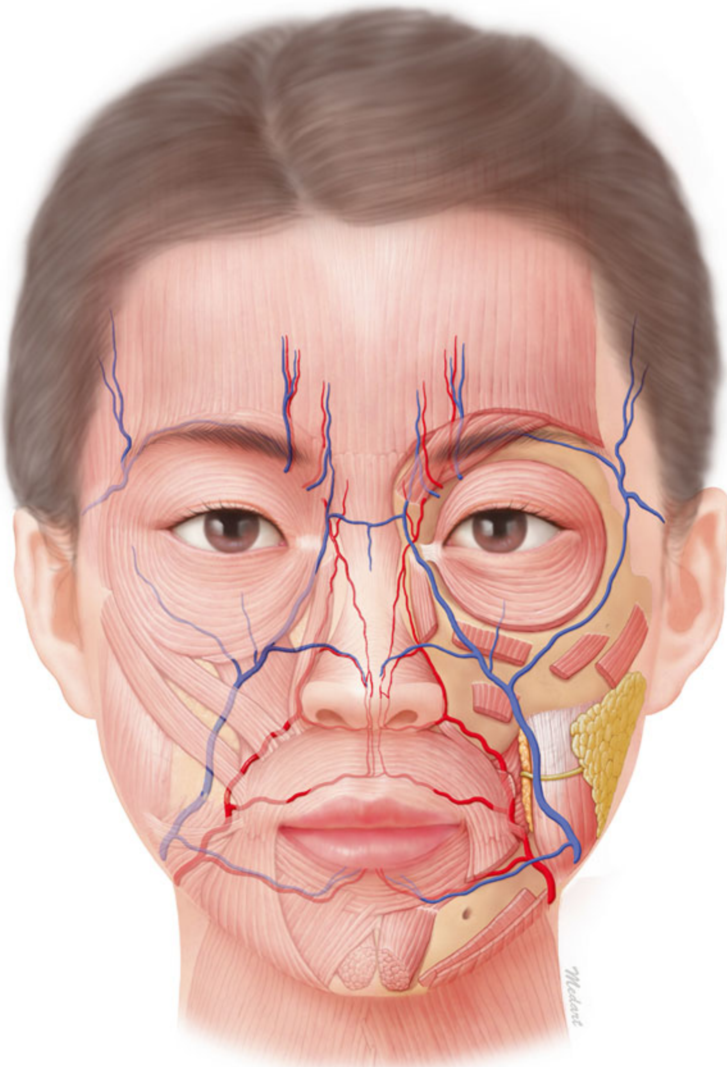
I also thank Professor Kyungseok Hu and my graduate student Sang-Hee Lee, You-Jin Choi, Hyung-Jin Lee, Jung-Hee Bae, Liyao Cong, and Kyuho Lee from Yonsei University College of Dentistry who actively helped search for visual information and aided in other revision works for this book. Lastly, I would like to thank Dr. Yoonjung Hwang, Mr. Sanghoon Kwon, Juyong Lee, Yongwoong Lee and Ms. Hwieun Hur, and Young-Gyung Kim in translating the Korean manuscript of this textbook.

On the behalf of the authors,

Seoul, South Korea Hee-Jin Kim
November, 2015

Contents

1 General Anatomy of the Face and Neck



Hee-Jin Kim (Illustrated
by Kwan-Hyun Youn)

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1.1 Aesthetic Terminology

Inconsistencies exist between anatomical and aesthetic terminology. We attempt to redefine common clinical terms according to anatomical regions (Fig. 1.1).

1.1.1 Basic Aesthetic Terminology

Facial Creases
Facial creases are deep, shallow creases caused by changes in the structural integrity of the skin. It occurs due to loss of skin and muscle fiber elasticity caused by repetitive facial movements and changes in facial expressions. Creases are generally termed wrinkles and lines. Other terms such as furrow, groove, and sulcus are used in the clinical fields.

Skin Folds
Skin folds occur due to sagging, loss of tension, and gravity. Representative skin folds are the nasolabial fold, the labiomandibular fold, etc.

Baggy Lower Eyelids (or Cheek Bags, Malar Bags)
Baggy lower eyelids occur due to a drooping of the adipose tissue underneath the orbicularis oculi m. This should be distinguished from the festoon since the baggy lower eyelid occurs inferior to the orbital margin.

Blepharochalasis
Blepharochalasis occurs due to sagging of the eyelid skin.

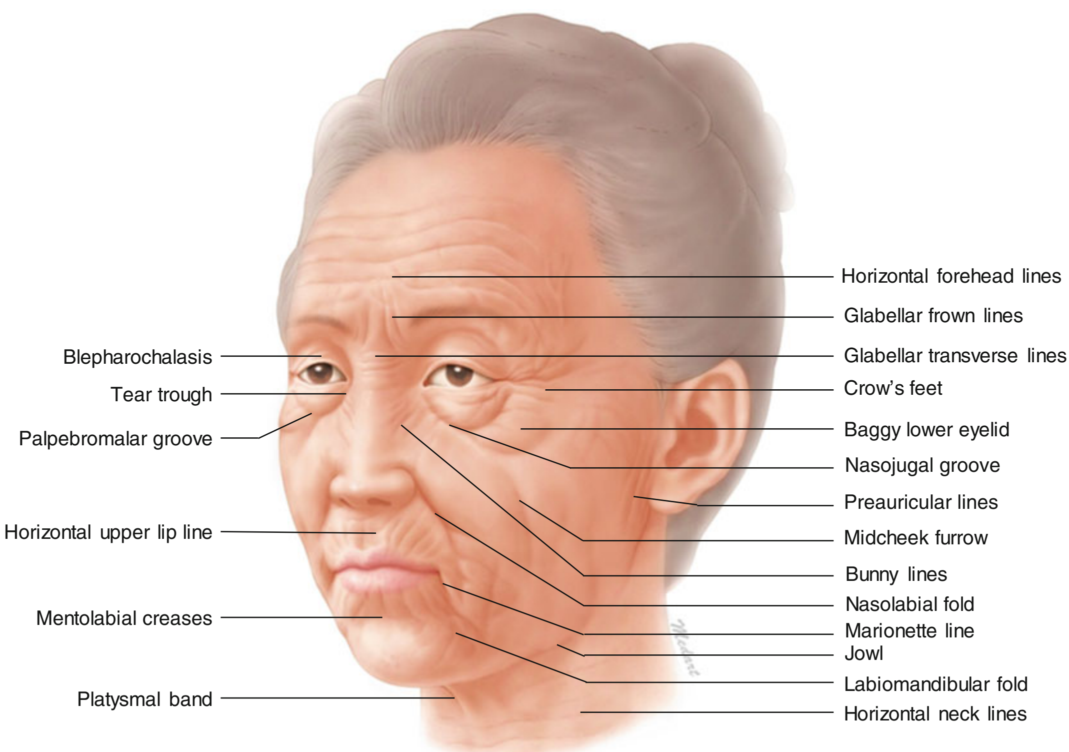

Fig. 1.1 Aging facial creases and wrinkles (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

Bunny Line
The bunny line is the oblique nose furrows lateral to the nose bridge that is pronounced by various facial expressions. The levator labii superioris alaeque nasi m. below the skin and the medial muscular band of the orbicularis oculi m. participate in the formation of the bunny line.

Commissural Lines
Commissural lines are short, vertical lines appearing on each sides of the mouth corner. Occasionally, deep creases may form starting from the perioral regions.

Crow's Feet (Lateral Canthal Wrinkles)
Crow's feet are thin, bilateral wrinkles at the lateral sides of the eyes formed by the orbicularis oculi m.

Festoon
Festoon is the bulged appearance of the lower eyelids caused by a sagging of the skin and of the orbicularis oculi m. and by a protrusion of the inferior orbital fat compartment underneath the orbital septum.

Horizontal Forehead Lines (Worry Lines)
Horizontal forehead lines are horizontal lines across the forehead region where the frontalis m. is located.

Glabellar Frown Lines (Glabellar Creases or Lines)
Glabellar frown lines are vertical creases along the glabellar region caused by the corrugator supercilii muscle fibers.

Glabellar Transverse Lines
Glabellar transverse lines are horizontal lines on the radix that are typically produced during facial distortion. They occur perpendicular to the fibers of the procerus m.

Gobbler Neck (Platysmal Bands)
The gobbler neck appears as bilateral vertical skin bands on the neck along the anterior cervical and submental region. This occurs due to sagging of the medial border of the platysma muscle.

Horizontal Neck Lines
Horizontal neck lines are horizontal skin folds on the anterior cervical region. They are produced by a combination of platysmal muscle fibers and sagging neck skin.

Horizontal Upper Lip Lines (Transverse Upper Lip Lines)
Horizontal upper lip lines are 1–2 horizontal lines located at the philtrum on the upper lip.

Jowl (Jowl Sagging)
Jowl is the protrusion and sagging of the subcutaneous adipose tissue along the mandibular border. The anterior border of the prejowl sulcus clearly signifies the existence of mandibular retaining ligaments.

Oral Commissure
The labial commissure is the region where the upper and lower lips join on each lateral side. The joining point is referred to as the cheilion.

Labiomandibular Fold
The labiomandibular fold spans from the corner of the mouth to the mandibular border and becomes prominent with age. The depressor anguli oris m. (DAO) defines the fold's medial and lateral borders. The attachment of the mandibular retaining ligament causes the labiomandibular fold to be located more anteriorly and medially.

Marionette Line
The marionette line is a long, vertical line that proceeds inferiorly from the corner of the mouth.

It occurs commonly with age but with unknown causes. It is more pronounced in people with less fat tissues than in those with more fat tissues. This line is also called the "disappointment line."

Mentolabial Creases (or Furrows)

Mentolabial creases are horizontal creases (one or more) between the lower lip and the chin (mentum). These creases lie between the orbicularis oris m. and the mentalis m.

Midcheek Furrow (Indian Band)

The midcheek furrow is a downward and lateral band, or furrow, that extends the nasojugal groove from the lateral aspect of the nose to the region superior to the anterior cheek. This band may carry on inferior to the cheek. With age, the cheek and the midface droop inferiorly and medially, and the band forms along the inferior margin of the zygomatic bone at the same height where the zygomatic cutaneous ligament attaches to the skin in this region.

Nasojugal Groove

The nasojugal groove is formed at the border between the lower lid and the cheek and runs inferolaterally from the medial canthus. The nasojugal groove region corresponds with the lower border of the orbicularis oculi m. and becomes more pronounced with the existence of the medial muscular band of the orbicularis oculi m. With age, this groove obliquely continues downward to the midcheek furrow.

Nasolabial Fold (or Nasolabial Groove)

The nasolabial fold starts from the side of the nasal ala and extends obliquely between the upper lip and the cheek. With age, the subcutaneous adipose tissue of the anterior cheek sags, causing the fold to deepen and move downward. The adipose tissue of the anterior cheek cannot descend inferior to the nasolabial fold due to compact attachment of the fascia, the skin, the cutaneous insertions of upper lip elevator muscles, and the zygomaticus major m. into the skin in this area. In addition, the facial area tends to lie underneath the nasolabial fold with variable depths.

Palpebromalar Groove

The palpebromalar groove is the border between the lower lid and the malar region.

Preauricular Lines

Periauricular lines are several vertical skin lines located near the tragion, the ear lobule, and the anterior region of the auricles.

Ptotic Chin

The ptotic chin is a flat and contracted chin associated with a deepened submental crease.

Tear Trough

The tear trough is a line originating from the medial canthus and proceeding inferolaterally along with the infraorbital margin. With age, the inferior and medial portions of the orbit sink due to contraction of the soft tissues (skin, muscle, and fat) covering the area. The tear trough has various forms according to how the medial part of the orbicularis retaining ligament and the fibers of the medial muscular band of orbicularis oculi m. come into contact with the skin.

Temple Depression

Temporal depression is the gradual decrease in volume of the soft tissues of the temporal region expressed with age. The bone structure of the temporal crest becomes more pronounced.

Vertical Lip Line

As aging is processed, the tooth is lost and alveolar bone is absorbed. It leads perioral muscle and lip contracts, so the vertical lip line appears along the vermilion border.

1.2 Layers of the Face

1.2.1 Layers of the Skin

Basic facial soft tissues are composed with five layers: (1) skin, (2) subcutaneous layer, (3) superficial musculoaponeurotic system (SMAS), (4) retaining ligaments and spaces, and (5) periosteum and deep fascia. Facial skin can move over the loose areolar connective tissue layer with the exception of the auricles and the nasal ala, which are supported by the cartilage under the skin. Facial skin contains numerous sweat and sebaceous glands (Fig. 1.2a, b).

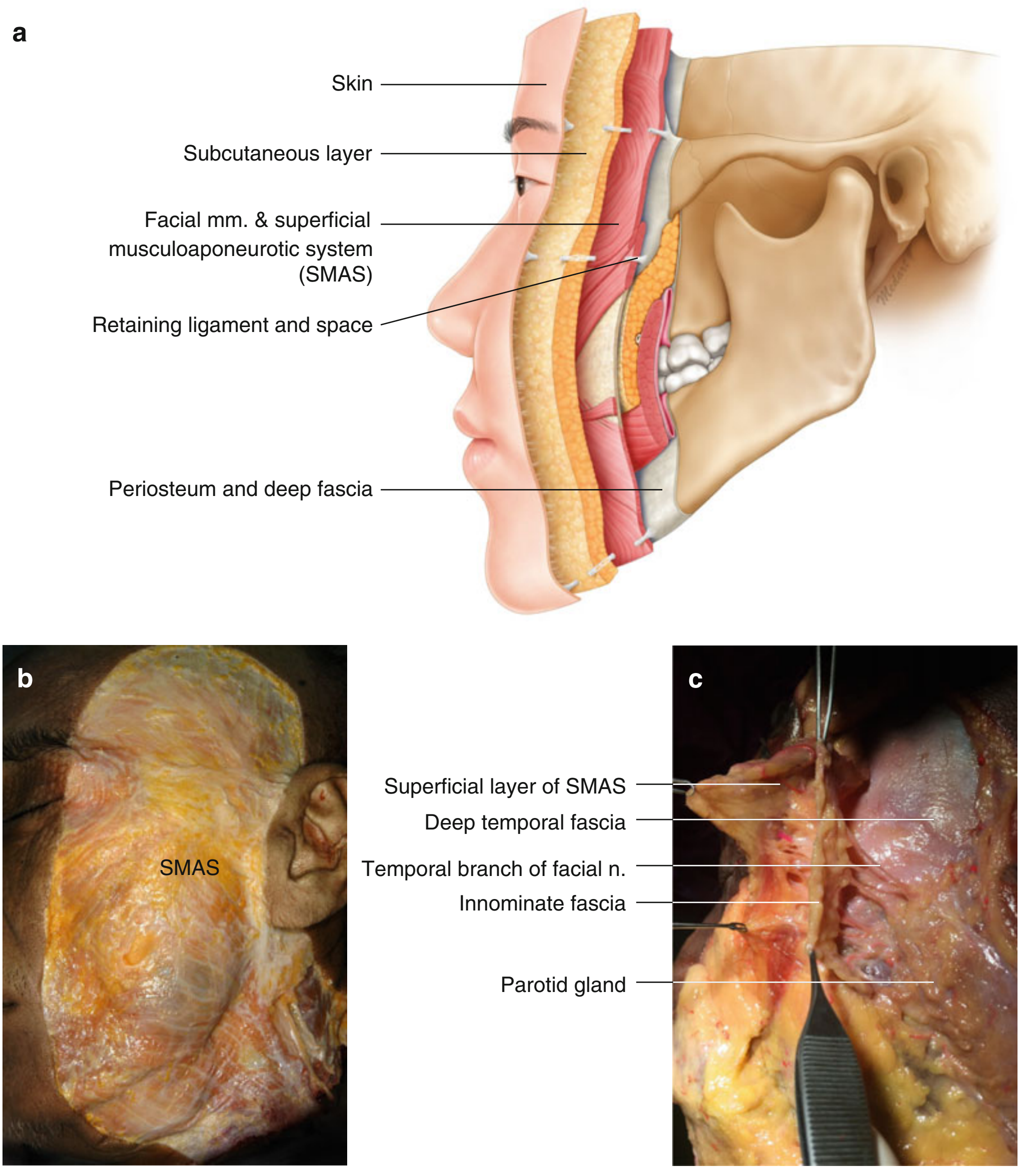

Fig. 1.2 Anatomical layers of the face. (**a**) Basic five layers of the face, (**b**) SMAS (superficial musculoaponeurotic system), (**c**) reflected SMAS at the lateral aspect of the face (Published with kind permission of © Hee-Jin Kim, Kwan-Hyun Youn and Joo-Heon Lee 2016. All rights reserved)

Among the subcutaneous fat tissue of the face, superficial fat is divided into malar, nasolabial fat, and so on. However, the boundary is not visible to the naked eye and the superficial fat may seem to cover the whole face. Deep fat is placed in the deeper part of the facial muscle and is demarcated by dense connective tissues such as the capsules or retaining ligaments. The color and properties of the deep fat show different characteristics from the superficial fat. Suborbicularis oculi fat (SOOF), retro-orbicularis oculi fat (ROOF), buccal fat, and deep cheek fat are included in the deep fat of the face. Fibrous connective tissues pass through facial fat tissues and play in role in connecting the fat tissue, facial muscles, dermis, and bone (Figs. 1.3 and 1.4).

The superficial fascia, or subcutaneous connective tissue, contains an unequal amount of fat tissue, and these fat tissues smoothen the facial contour between facial musculatures. In some areas, fat tissues are broadly distributed. The buccal fat pad forms the bulged cheek and continues to the scalp and the temple region. The facial v., the trigeminal nerve, the facial nerve, and the superficial facial muscle are contained within the subcutaneous tissue (Fig. 4.27).

The SMAS (superficial muscular aponeurotic system) is the superficial facial structure composed of muscle fibers and superficial facial fascia. It is a continuous fibromuscular layer investing and interlinking the facial m. The SMAS extends from the platysma to the galea aponeurotica and is continuous with the temporoparietal fascia (TPF, superficial temporal fascia) and the galea layer. It is known that the SMAS consists of three distinct layers: a fascial layer superficial to the muscles, a layer intimately associated with the facial m., and a deep layer extensively attached to the periosteum of facial bones (Fig. 1.2c).

1.2.2 Thickness of the Skin

The general thickness of the facial skin is described in the figure below. When treating in areas with thin layers of skin, a filler injection should be cautiously performed while trying to avoid shallow filler placement. Upper and lower eyelids, glabellar regions, and nasal regions have an exceptionally thin skin layer. On the other hand, the skin layer of the anterior cheek and the mental region are relatively thicker. During filler treatment, the skin's flexibility and internal space should also be considered along with its thickness (Fig. 1.5).

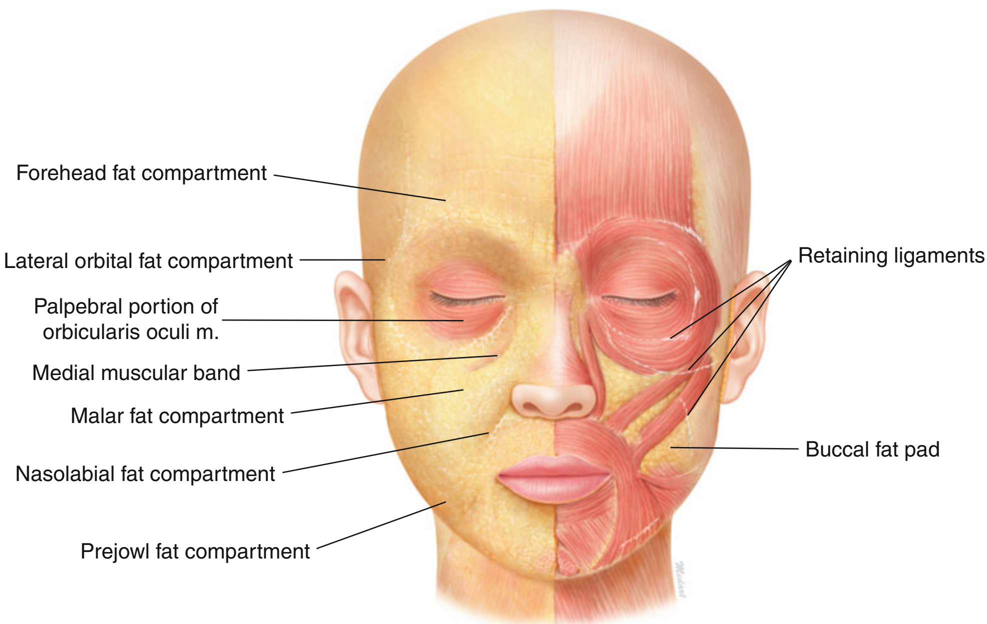

Fig. 1.3 Superficial fat and superficial muscles of the face (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

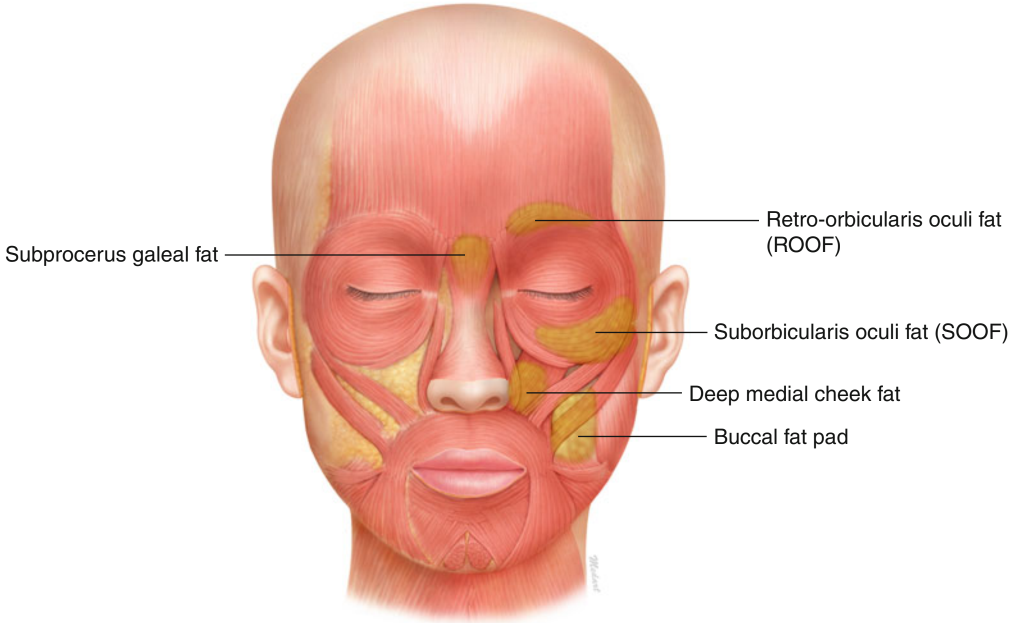

Fig. 1.4 Deep fat compartments of the face (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

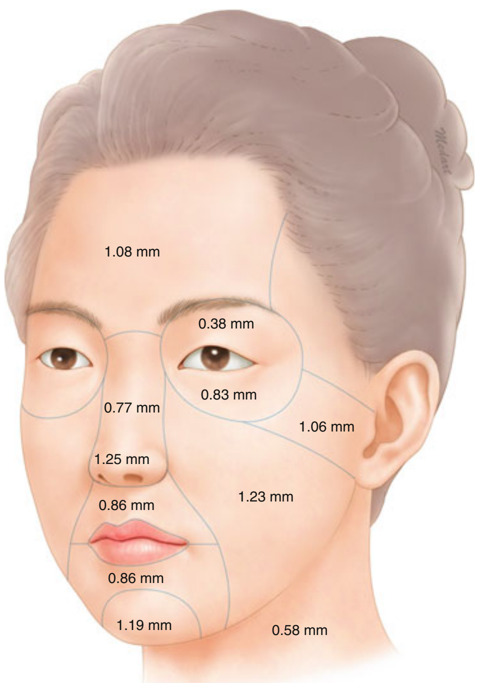

Fig. 1.5 Average skin thickness of the face (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

1.3 Muscles of Facial Expressions and Their Actions

Facial mm. are attached to the facial skeleton, or membranous superficial fascia, beneath the skin, or subcutaneous tissue. The topography of the facial m. varies between males and females and between individuals of the same gender. It is important to define muscle shapes, their associations with the skin, and their relative muscular actions in order to explain the unique expressions people can make.

The face divides into nine distinct areas: (1) the forehead including glabella from eyelids to hair line, (2) temple or temporal region anterior to the auricles, (3) orbital region, (4) nose region, (5) zygomatic region, (6) perioral region and lips, (7) cheek, (8) jaws, and (9) auricle.

These muscles are distributed in different locations and (1) direct the openings of the orifices as dilators or sphincters and (2) form various facial expressions. These facial muscles, located within the superficial fascia, or subcutaneous tissue layers, originate from the facial bone or fascia and attach to the facial skin. They reveal various expressions such as sadness, anger, joy, fear, disgust, and surprise.

Facial mm. are widely distributed in different regions of the face. However, they are generally categorized different regions such as the forehead, the orbital, the nose, and other perioral regions. The platysma m., which is involved in the movement of the perioral region, is also considered a facial muscle (Fig. 1.6).

1.3.1 Forehead Region

The occipitofrontalis m. is a large, wide muscle underlying the forehead and the occipital area. It is divided into the frontal belly of the forehead region and the occipital belly of the occipital region. Clinically, the frontal belly of the occipitofrontalis m. is referred to as the "frontalis muscle" and arises from the galea aponeurosis and inserts into the orbicularis oculi m. and the frontal skin above the eyebrow. The width and contraction of the frontalis m. vary between individuals; during an individual's anxiety and surprise, this muscle produces transverse wrinkles on the forehead.

The frontalis m. is rectangular and possesses bilateral symmetry. Its muscle fibers are vertically oriented and join the orbicularis oculi and the corrugator supercilii m. near the superciliary arch of the frontal bone. The frontalis m. lies beneath the skin of the forehead (3–5 mm in average), though depth can differ considerably (27 mm) between individuals (Fig. 1.7).

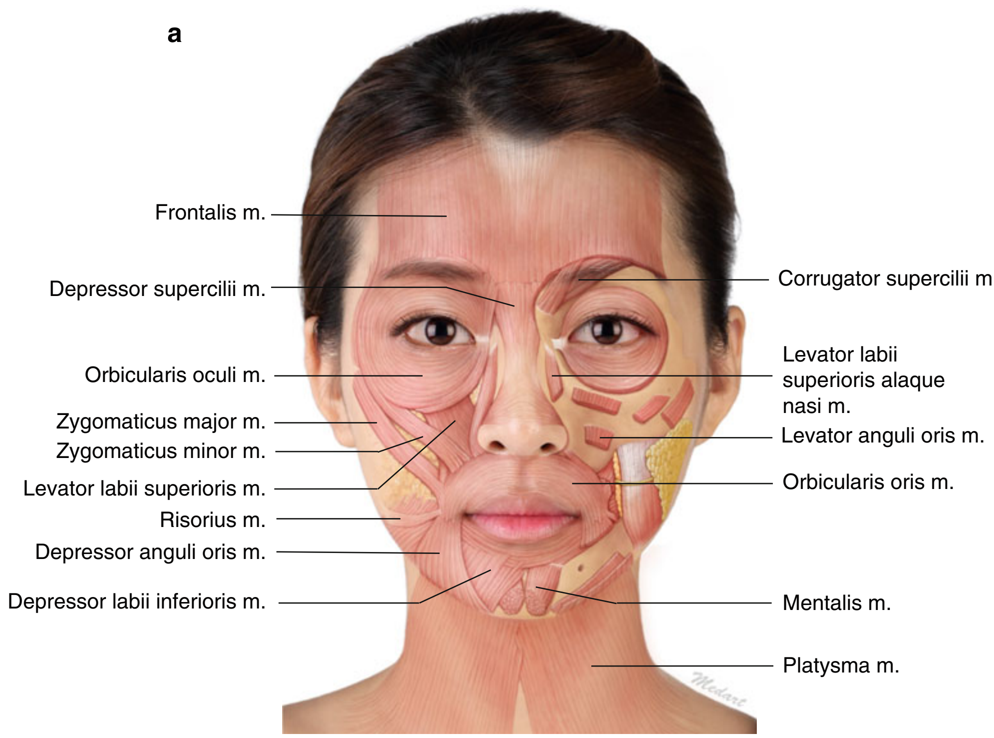

Fig. 1.6 Facial muscles. (**a**) Frontal view, (**b**) lateral view, (**c**) oblique view (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

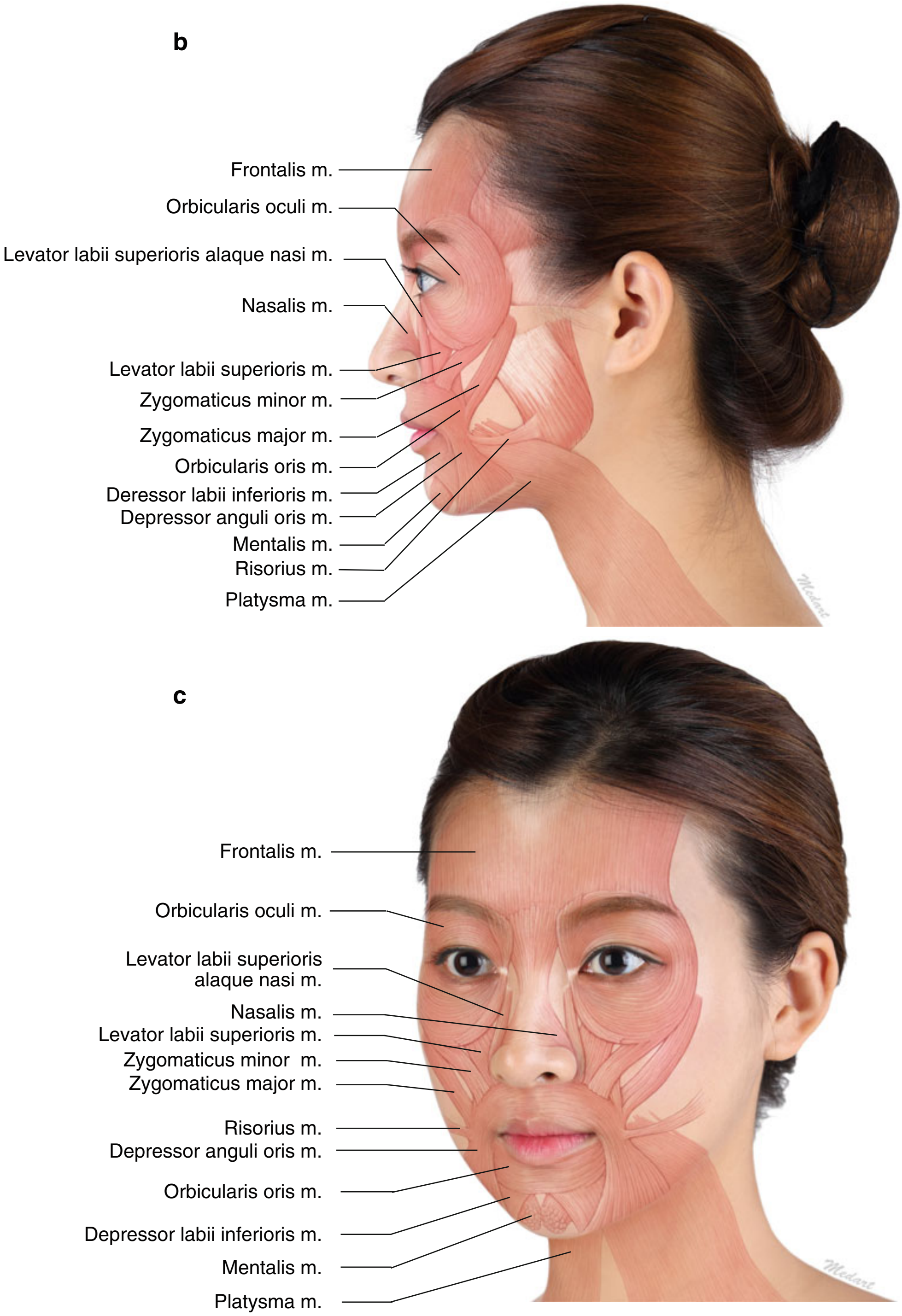

Fig. 1.6 (continued)

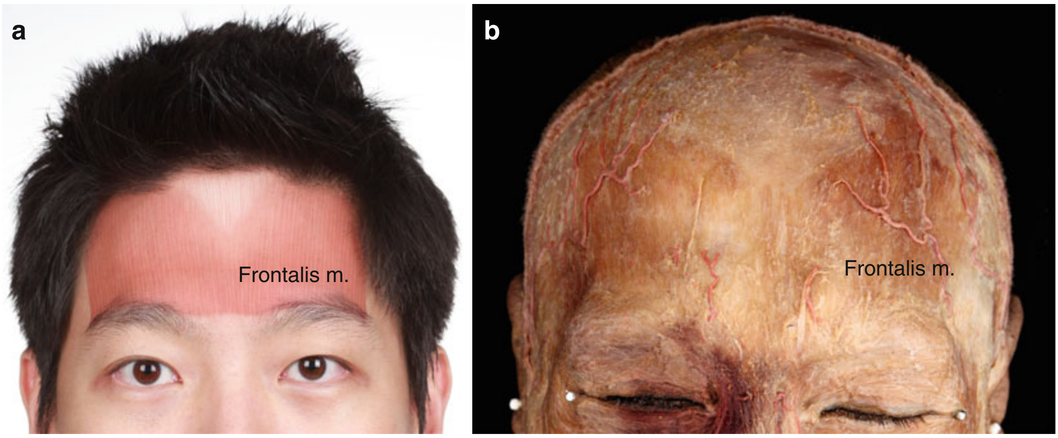

Fig. 1.7 Frontalis muscle of the forehead (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.3.2 Temporal Region (or Temple)

The temporal region is confined within the boundary of the temporal fossa. Within the temporal fossa, a fan-shaped temporalis and its vessels and nerves occupy this concavity. The temporalis m. is divided into two layers: superficial and deep. A majority of the temporalis belong to the deep layer and arise from the broad temporal fossa, whereas the superficial layer of the temporalis m. arises from the internal aspect of the deep temporal fascia (temporalis muscle fascia). The deep temporal fascia (temporalis muscle fascia) is the tenacious fascia attached superiorly to the superior temporal line and inferiorly to the upper margin of the zygomatic arch.

Though the superficial layer of the temporalis developed in four-legged animals, the superficial layer in human seems very thin and rudimentary. All the temporalis muscle fibers converge as a tendon and attach to the tip of the coronoid process and to the anteromedial side of the mandibular ramus. The temporalis holds a flat, fan shape due to its broader origin and narrower attachment.

There is a region in which the muscle fibers transition into tendons. The upper half of the temporalis superior to the zygomatic arch is composed only of the muscle belly, and the lower half (roughly two- or three-digit widths) is occupied by a converged tendon and a part of the deep layer of the temporalis that is covered by the aponeurotic structure.

The temporalis m. is divided into three parts: anterior, middle, and posterior temporalis m. While its anterior temporalis fibers proceed almost vertically, the fibers of the posterior temporalis run almost horizontally. The main functions of the temporalis differ according to muscular orientation. A whole temporalis m. raises the mandible for mouth closing, providing tension to prevent the mouth from opening against gravity. The temporalis m. is innervated by the anterior, middle, and posterior deep temporal nerves from the mandibular n. It is supplied by the anterior and posterior deep temporal arteries for the anterior 2/3 of the temporalis and by the middle temporal a. for the posterior 1/3 region as well (Figs. 1.8 and 3.26).

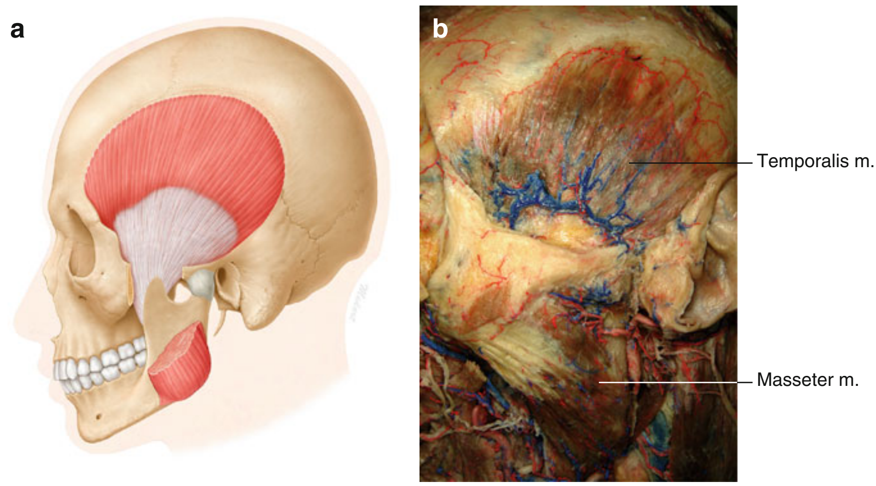

Fig. 1.8 Temporalis muscle of the temporal region (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.3.3 Orbital Region

The shape of the eyes is well framed by moving muscles that surround it, which determine basic facial expressions. Orbicularis oculi m. is a broad, flat, elliptical muscle composed of an orbital part and a palpebral part. The palpebral part is then divided again into a superficial portion (ciliary bundle) and a deep portion (lacrimal part).

The main function of the orbicularis oculi m. is to mediate eye closure. The orbicularis oculi m. has many neighboring muscles (e.g., corrugator supercilii m., procerus m., frontalis m., zygomaticus major m., and zygomaticus minor m.), and various direct and indirect muscular connections exist between the orbicularis oculi m. and the surrounding musculature. These connections may participate in the formation of various facial expressions. In Asians, the lateral muscular band and the medial muscular band of the orbital portion of the orbicularis oculi m. are observed in 54 % and 66 % of the cases, respectively (Figs. 1.9, 1.10, 2.4, and 2.5). Furthermore, it is observed that 89 % of Asians possess direct muscular connections between the zygomaticus minor m. and the orbicularis oculi m.

The corrugator supercilii m. originates from the periosteum of the frontal bone on the medial side of the superciliary arch, proceeds superiorly and laterally, and then merges with the frontalis m. It consists of two distinct bellies—the transverse and oblique belly. The origin of the transverse belly of the corrugator supercilii m. is superior and more lateral than the origin of the oblique belly, and most of them attach to the frontalis m. (Fig. 1.11) and to the superolateral orbital part of the orbicularis oculi m. The transverse belly is located deeper and proceeds in a more horizontal direction than the oblique belly. This muscle makes narrow, vertical wrinkles on the glabellar region and presents an aged appearance by producing these wrinkles with the frontalis m.

The depressor supercilii m. is a fan-shaped or triangular-shaped muscle that originates from the frontal process of the maxilla and from the nasal portion of the frontal bone above the medial palpebral ligament. The depressor supercilii m. proceeds through the glabellar region while being mixed with the corrugator supercilii m., and it intermingles with medial fibers of the orbicularis oculi m. (Fig. 1.10).

Fig. 1.9 Orbicularis oculi muscle of the orbital region. (**a**) Frontal view, (**b**) lateral view (Published with kind permission of © Kwan-Hyun Youn and Byung-Heon Kim 2016. All rights reserved)

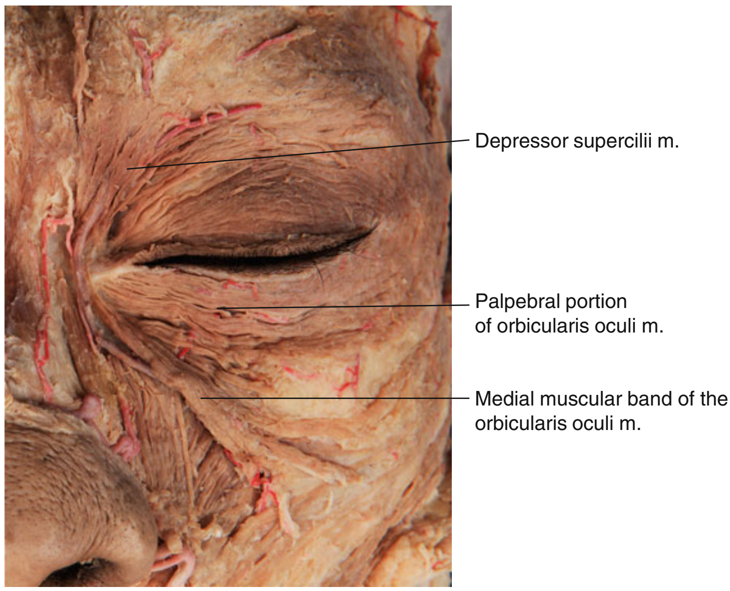

Fig. 1.10 Medial muscular band of the orbicularis oculi muscle and upper lip elevators (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

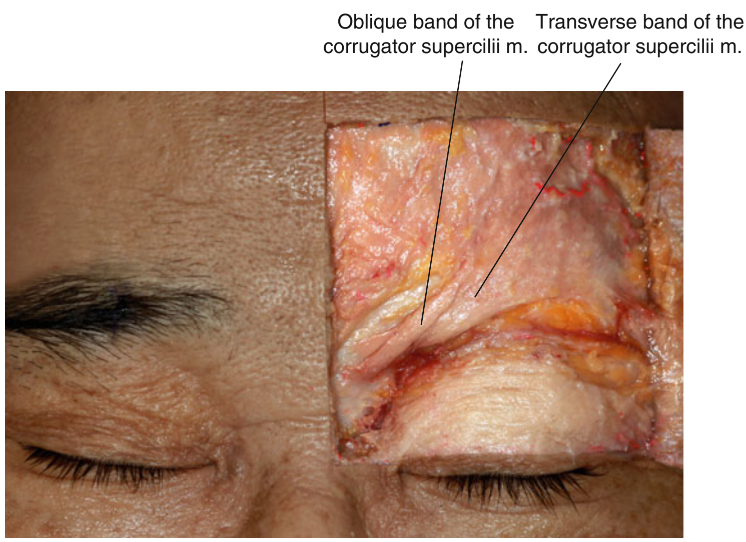

Fig. 1.11 Corrugator supercilii muscle (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

1.3.4 Nose Region

The nose is a dynamic structure that moves nasal cartilages and plays an important role in the nasal physiology. Muscles of the nose and the nose region contain of the procerus m., the nasalis m., and the depressor septi nasi m., along with several other muscles attached to the nasal ala.

The procerus m. is a small muscle that originates from the nasal bone, proceeds superiorly, and attaches to the skin of the radix. Fibers of the frontalis m. at the insertion point are cross-locked. This muscle makes a horizontal line on the radix below the glabella by pulling the medial side of the eyebrow down (Fig. 1.12).

The nasalis consists of a transverse part and an alar part. The transverse part is a C-shaped, triangular muscle raised from the maxilla and the canine fossa to the nasal ala. The transverse part extends from the superficial layer of the levator labii superioris alaeque nasi m. The alar part is a small rectangular muscle arising from the maxilla superior to the maxillary lateral incisor and inserting into the deep skin layer of the alar facial crease of the alar cartilage. The transverse part compresses and decreases the size of the naris, while the alar part serves to enlarge the size of the naris (Fig. 1.13).

The depressor septi nasi m. is located on the deep part of the lip. This muscle arises from the incisive fossa (between the central and lateral incisors) and inserts into the moving part of the nasal septum. It pulls the nose tip inferiorly to enlarge the size of the naris (Fig. 1.12).

Furthermore, it was observed that all of the LLSAN m., 90 % of the LLS m., and 28 % of the additional fibers of the zygomaticus minor m. were attached to the nasal ala.

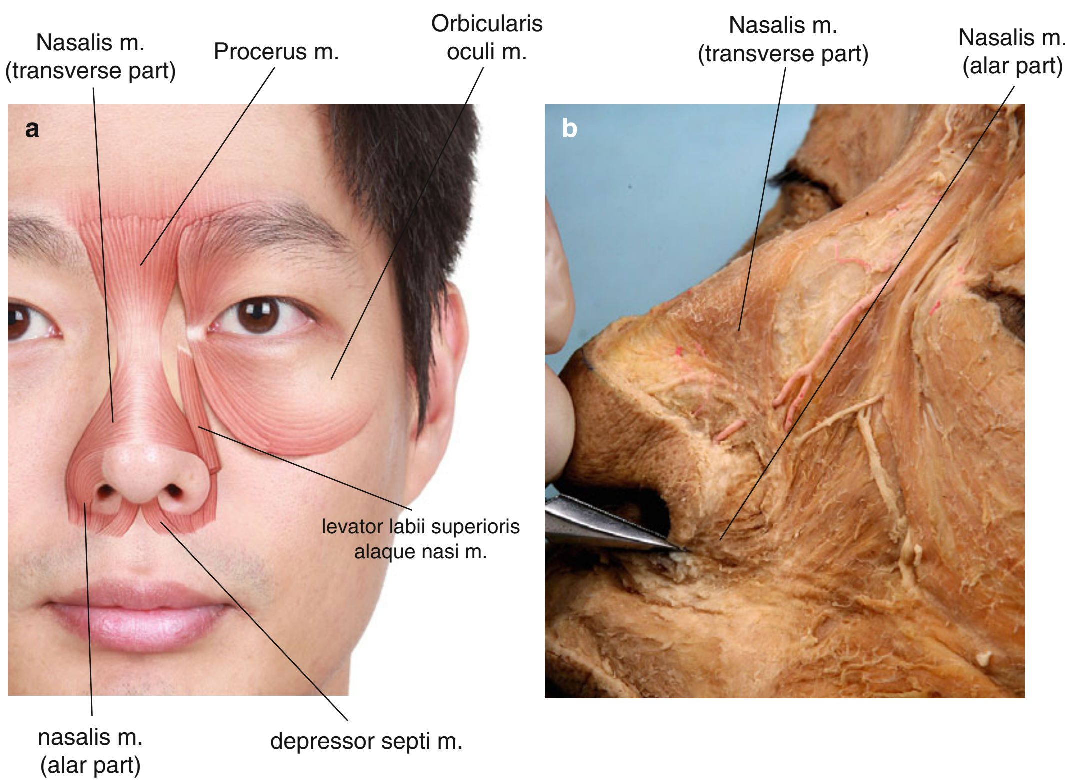

Fig. 1.12 Perinasal muscles (**a, b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016.)

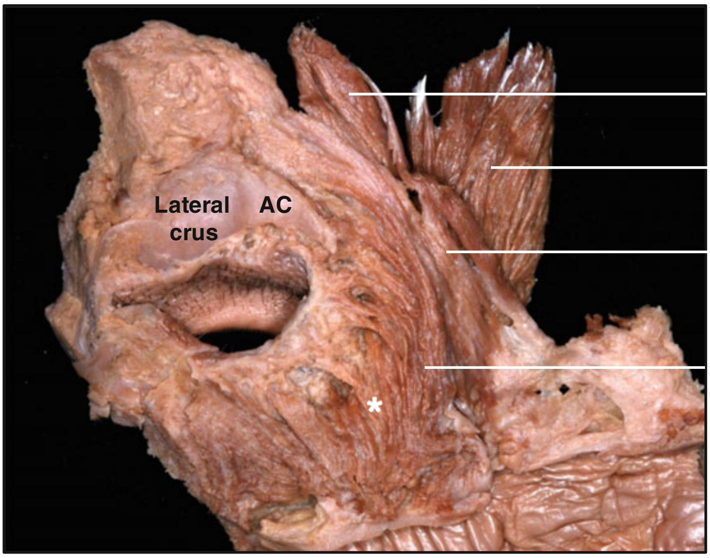

Fig. 1.13 The alar part of the nasalis in the posterior aspect (left side of the specimen). The N-alar is located anterior to the transverse part of the nasalis and is inserted into the alar facial crease and its adjacent deep surface of the external alar skin (*AC* accessory alar cartilage, * point between the alar facial crease and the alar groove) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.3.5 Perioral Muscles

1.3.5.1 Intrinsic Muscles of the Lip and Cheek (Fig. 1.14)

Orbicularis Oris Muscle (OOr)

The orbicularis oris m. is a mouth constrictor surrounding the mouth region. Most muscle fibers are continuations from various muscles in the mouth region. Intrinsic orbicularis oris muscle fibers originate from the alveolar bone of the maxillary and mandibular incisors. This muscle works to close the mouth and pucker the lips.

Buccinator Muscle

The buccinator m. originates from the lateral side of the alveolar portion of maxillary and mandibular molars and from the anterior border of the pterygomandibular raphe. The buccinators consist of four bands: the first band (the superior band) originating from the maxilla, the second band originating from pterygomandibular raphe, the third band originating from the mandible, and the fourth band (the inferior band) originating inferiorly to the third band, extending inferiorly, and medially proceeding inferiorly to the orbicularis oris muscle fibers. The inferior band, unlike other bands, continues bilaterally to the median plane of the mandible (Fig. 1.15).

1.3.5.2 Dilators of the Lips

Muscles Inserted into the Modiolus

Zygomaticus Major Muscle (ZMj)

The zygomaticus major m. originates from the facial side of the zygomatic bone, proceeds inferiorly and medially, joins the orbicularis oris m., and attaches to the modiolus. Thus, the well-known function of the ZMj is elevating the mouth corner. However, the insertion pattern varies, and the fiber running deeper than the levator anguli oris m. is always observed. These fibers insert into the anterior region of the buccinators (Fig. 1.16).

Levator Anguli Oris Muscle (LAO)

The levator anguli oris m. originates from the canine fossa inferior to the infraorbital foramen, joins the orbicularis oris m., and attaches to the modiolus. It serves to elevate the mouth corner (Figs. 1.16 and 1.17).

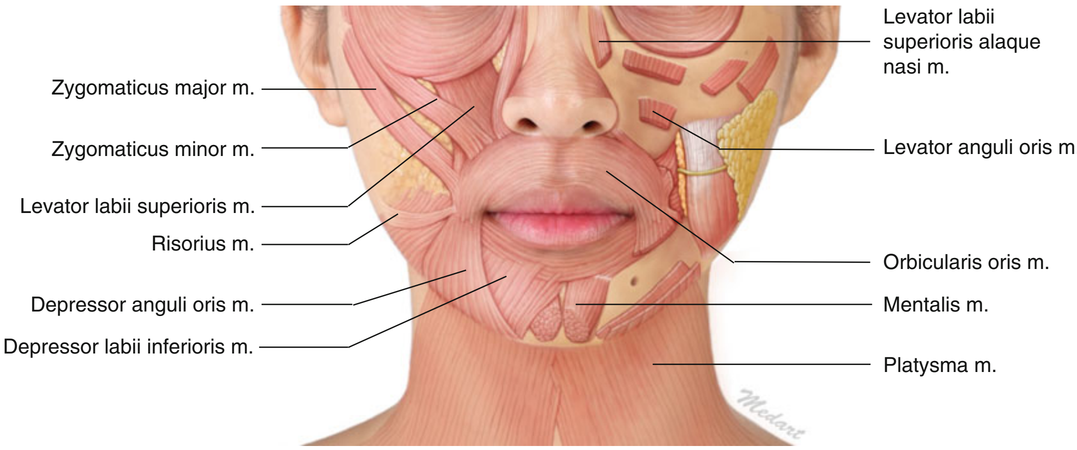

Fig. 1.14 Perioral muscles (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

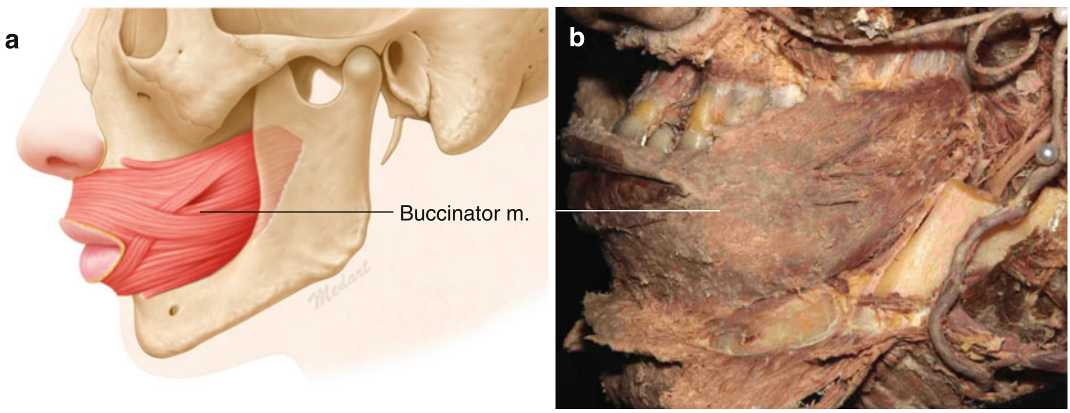

Fig. 1.15 Buccinator muscle (depressor anguli oris muscle (DAO) is reflected superiorly to show the mandibular portion attachment at the buccinators) (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

Depressor Anguli Oris Muscle (DAO)

The depressor anguli oris m. is a triangular muscle that is on the most superficial layer of the perioral m. along with the risorius m. It arises from the oblique line of the mandible and merges with the depressor labii inferioris m. at the origin. This muscle becomes more narrow, proceeds to the mouth corner (modiolus), and merges with the risorius m (Fig. 1.17).

Risorius Muscle

The risorius m. is a thin and slender muscle. This muscle is predominantly located 20–50 mm lateral to the mouth corner and 0–15 mm below the intercheilion horizontal line. Most fibers originate from the superficial musculoaponeurotic system (SMAS), the parotid fascia, and the masseteric fascia. It sometimes also originates from the platysma m. Its fibers insert into the modiolus and pull the mouth corner when smiling (Fig. 1.18).

Muscles Inserting into the Upper and Lower Lip Between the Labial Commissure and the Midline

Levator Labii Superioris Muscle (LLS)

The levator labii superioris m. originates from 8 to 10 mm inferior to the infraorbital margin of the

Fig. 1.16 Zygomaticus major muscle (ZMj) inserting to the modiolar region. ZMj is divided into the superficial and deep band. Deep band of the ZMj is inserted to the anterior border of the buccinators which is deep inside the levator anguli oris muscle. In this photograph, inferior muscular slip of the ZMj is shown (bifid ZMj) which inserts into the depressor anguli oris (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

Fig. 1.17 Depressor anguli oris muscle (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

maxilla and inserts into the lateral side of the upper lip. The levator labii superioris m. is rectangular shaped rather than triangular shaped, and its medial fibers are attached to the deep side of the alar facial crease. Also, 90 % of the muscle is mixed with the alar part of the nasalis m. A part of the deep tissue of the levator labii superioris m. extends to the skin of the nasal vestibule (Figs. 1.19 and 4.34).

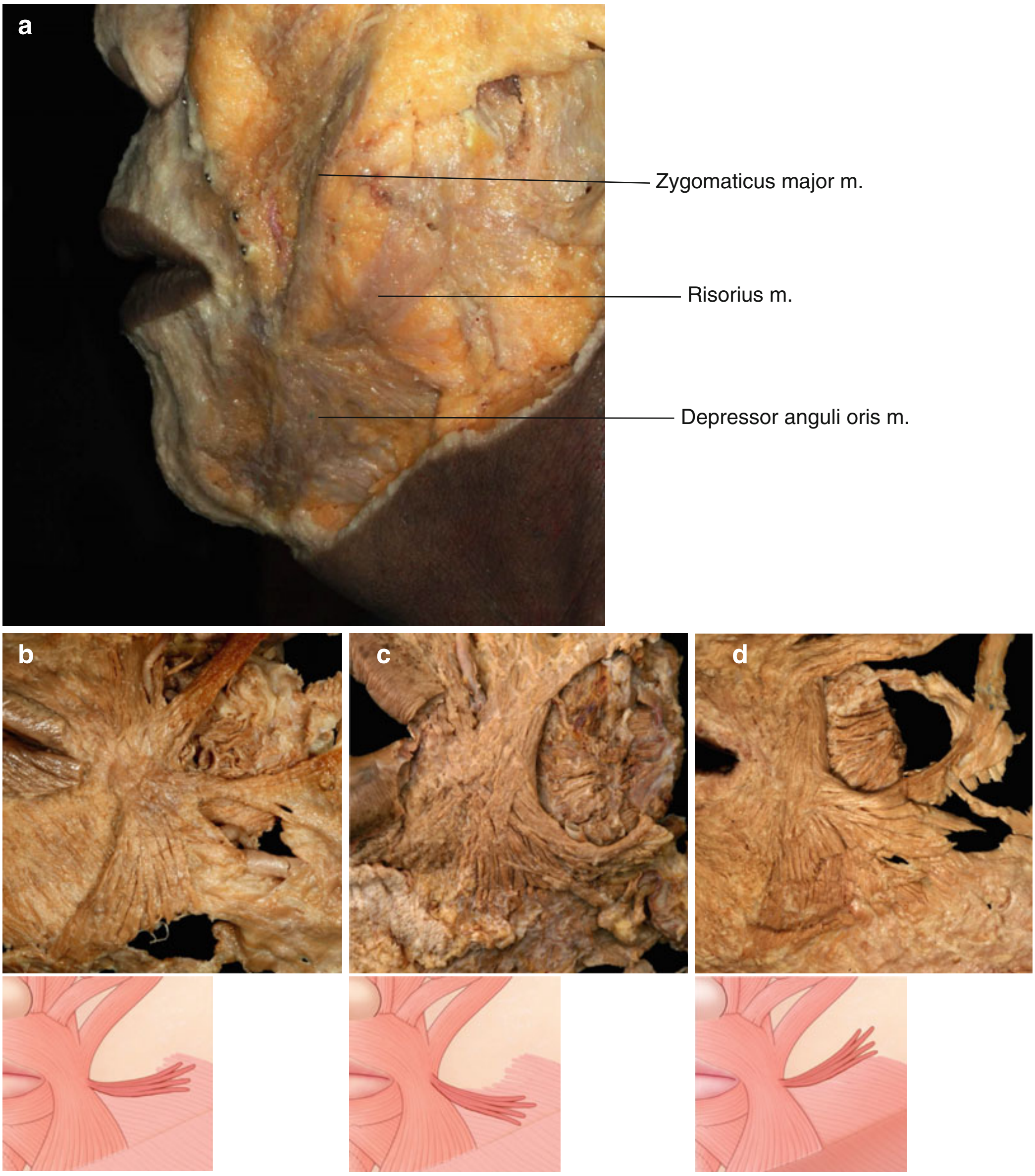

Fig. 1.18 Risorius muscles. (**a**) Three patterns of the risorius muscle, (**b**) platysma-risorius, (**c**) triangularis-risorius, (**d**) zygomaticus-risorius (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

Levator Labii Superioris Alaeque Nasi Muscle (LLSAN)

The levator labii superioris alaeque nasi m. originates from the frontal process of the maxilla and inserts into the upper lip and the nasal ala. The levator labii superioris alaeque nasi m. is divided into superficial and deep layers. The superficial layer proceeds inferiorly to the surface layer of the levator labii superioris m., and the deep layer proceeds even deeper than the levator labii superioris m. The deep and superficial layer of the levator labii superioris m. originates from the frontal process of the maxilla and inserts between the levator anguli oris and the orbicularis oris m. (Fig. 1.19).

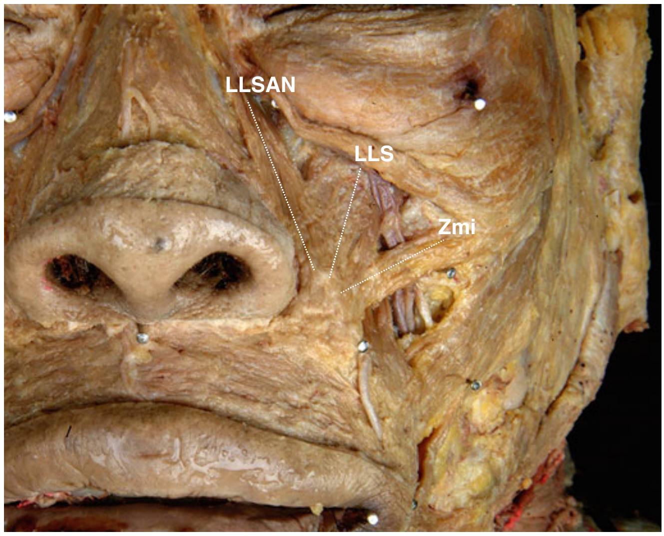

Fig. 1.19 Major upper lip elevators. This muscle group includes the levator labii superioris alaeque nasi (*LLSAN*), levator labii superioris (*LLS*), and zygomaticus minor (*ZMi*) muscles (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

Modiolus

The modiolus is a fibromuscular structure that decussates between the orbicularis oris m. and the dilators of the lips ending at the lateral border of the cheilion. The modiolus m. lies either superior or inferior to the intercheilion line. It is strongly associated with facial expression, beauty, aging, and formation of the nasolabial fold. In Asians, the modiolus lies 11.0 ± 2.6 mm lateral, 8.9 ± 2.8 mm inferior to the cheilion, and inferior to the intercheilion line. These characteristics are mostly common in Asians, differing from Caucasians whose modiolus lies on or is superior to the intercheilion line.

Muscles that terminate at the modiolus implement formations of subtle and detailed facial expressions. The modiolus m. is a dense, compact, and mobile muscular node formed by a convergence of muscle fibers from the zygomaticus major, the depressor anguli oris, risorius, the orbicularis oris, buccinators, and the levator anguli oris. In 21.4 % of Koreans, the modiolus showed tendinous tissue instead of muscular tissue as described above, and this area of convergence consisted of dense, irregular, and collagenous connective tissue (Fig. 2.33).

Zygomaticus Minor Muscle (Zmi)

The zygomaticus minor m. originates from the zygomatic bone and inserts into the upper lip. In Korean cases, 28 % showed additional fibers inserting into the nasal ala in addition to the upper lip (Figs. 1.19 and 2.26).

Depressor Labii Inferioris Muscle (DLI)

The depressor labii inferioris m. originates from the oblique line of the mandible and inserts into the lower lip (Figs. 1.17 and 1.20).

Upper Lip Elevators (Fig. 1.19)

The shape of the upper lip is directed by upper lip elevators, which consist of the levator labii superioris alaeque nasi, the levator labii superioris, and the zygomaticus minor m. These muscles are used to elevate the upper lip and create smiling or sad facial expressions. Upper lip elevators are categorized into two layers with the levator labii superioris alaeque nasi m. and the zygomaticus minor m. being located on the medial and lateral side, respectively, and partially or completely covering the levator labii superioris, which is located on a deeper layer. These three muscles are localized on the lateral side of the nasal ala. Upper lip elevators are attached to the surface of the orbicularis oris m. and are involved to form the nasolabial fold.

Contracting Muscle of the Chin

Mentalis Muscle

The mentalis m. elevates the chin and the lower lip and provides major vertical support for the lower lip. Resection of the mentalis m. may cause the patient to drool and may affect the denture

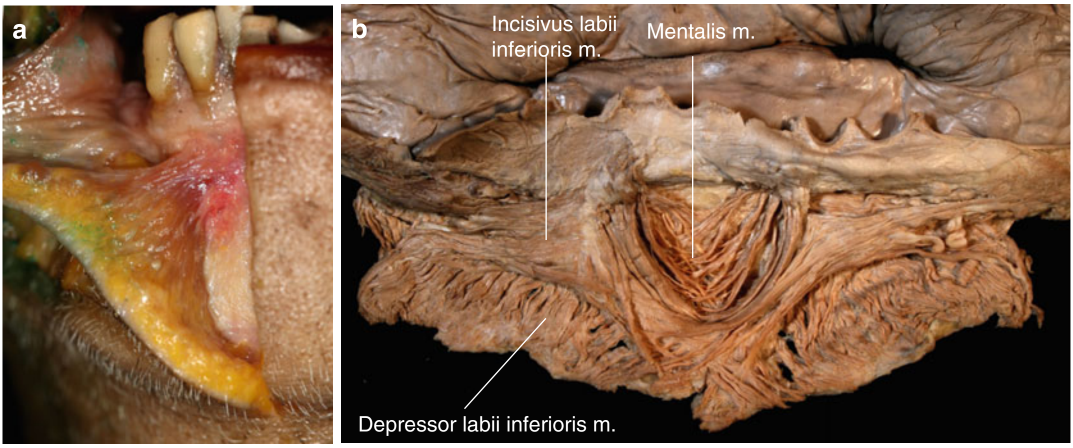

Fig. 1.20 Mentalis muscle after removal of the mandible. (**a**) Anterior aspect. (**b**) Posterior aspect (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

Fig. 1.21 The layers of the perioral musculature (*yellow* first layer, *blue* second layer, *pink* third layer, *purple* fourth layer) (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

stability. This muscle is cone shaped with its apex originating from the incisive fossa of the mandible. Its medial fibers descend anteromedially and cross together, forming a dome-shaped pattern. Contraction of the mentalis m. produces a wrinkle in the skin of the mentum (Fig. 1.20).

Layers of the Perioral Muscles

The perioral m. is categorized into four layers according to depth, which is then further specified into three superficial layers and one deep layer (Fig. 1.21).

Superficial Layer

First layer

Depressor anguli oris, risorius, superficial layer of the orbicularis oris m., and superficial layer of the zygomaticus major m.

Second layer

Platysma, zygomaticus minor, and levator labii superioris alaeque nasi

Third layer

Levator labii superioris, deep layer of the orbicularis oris m., and deep layer of the depressor labii inferioris m.

Deep Layer

Fourth layer

Levator anguli oris, mentalis, deep layer of the zygomaticus major m., and buccinator

1.3.6 Platysma Muscle

The platysma m. attaches to the lower border of the mandible and to the mandibular septum and also merges with the facial m. around the lower lip. It consists of two types of fibers. A flattened bundle passes superomedially to the lateral border of the depressor anguli oris, and the other type remains deep into the depressor anguli oris and reappears at its medial border. Lack of decussation creates a cervical defect, resulting in an elasticity reduction in the cervical skin and giving rise to the so-called gobbler neck deformity with age (Fig. 2.41). Asians experience fewer cases than Caucasians of lacking decussation, which then leads to fewer cases of the "gobbler neck." Platysmal fibers do not merely decussate but also sometimes show cases of interlacing from each side or of one side of the muscle overlapping and covering the other side (Figs. 1.22 and 1.23).

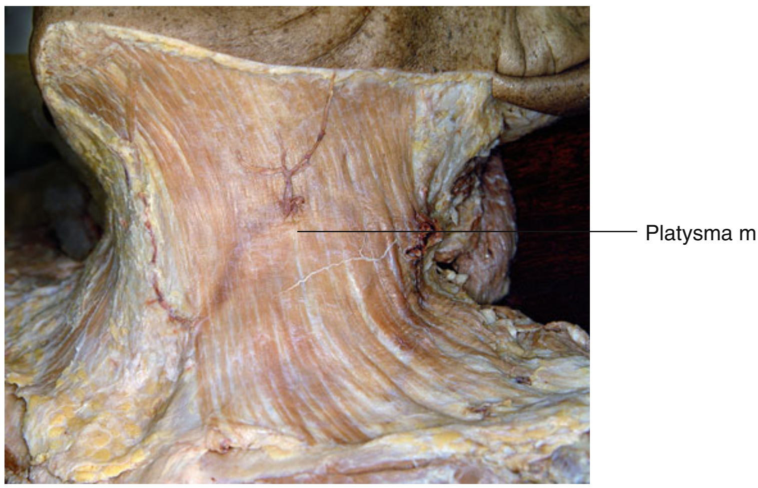

Fig. 1.22 Platysma muscle of the superficial cervical region (Published with kind permission of © Hee-Jin Kim 2016. All rights reserved)

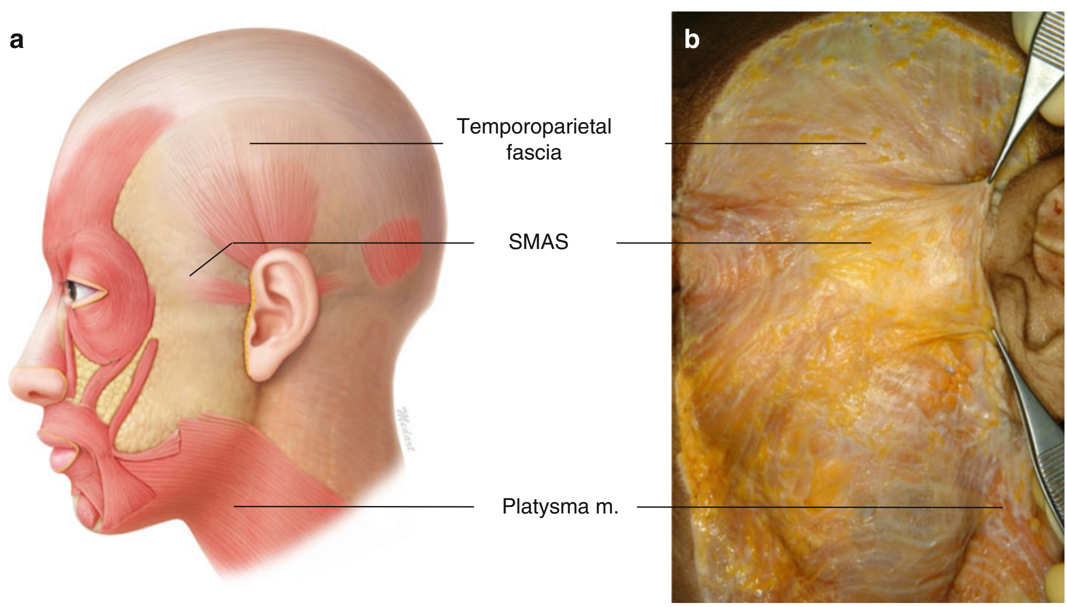

Fig. 1.23 Superficial musculoaponeurotic system (SMAS). (**a**) Illustration. (**b**) Stretched SMAS (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.4 SMAS Layer and Ligaments of the Face

The superficial musculoaponeurotic system (SMAS) is a continuous fibromuscular layer investing and interlinking the muscles of facial expression. It has been found to consist of three distinct layers: a fascial layer superficial to the musculature, a layer intimately associated with the mimic m., and a deep layer extensively attached to the periosteum of the bones of the face. In addition to its usefulness as a deep layer to tighten during an aging face surgery, it serves as a guide to the depth of key neurovascular structures.

The face, like other body parts, also has several ligament structures, which firmly supports surrounding tissues. This retaining ligament is broadly and firmly attached from the periosteum, or fascia, to the dermis. These strong retaining ligaments in the face can be divided into true (osteocutaneous) and false (fasciocutaneous) ligaments according to its strength, attachment, and function.

The true retaining ligament originates from the periosteum, attaches to the dermis, and gives strong support to the soft tissue. True retaining ligaments consist of the orbicularis retaining ligament, the zygomatic ligament, the zygomatic cutaneous ligament, the lateral orbital thickening, the mandibular ligament, etc.

There are multiple false retaining ligament attachments that exist at sequential facial planes. These attachments emanate from the dermis and attach to the underlying SMAS, but it does not retain strongly. The false retaining ligaments are particularly strong over the forehead, eyes, nose, lip, and chin areas. They are of intermediate strength over the lateral cheek and neck areas and tend to be relatively loose over the medial cheek and temple areas (Figs. 1.24 and 1.25). Therefore, they easily lose elasticity and sag with age, causing changes in facial features due to fat redistribution and drooping. False retaining ligaments consist of the masseteric cutaneous ligament, the platysma-auricular ligament, etc.

Superior Temporal Septum

The superior temporal septum's fascia adheres to the superior temporal line of the skull. This structure appears to be merging with the temporal fascia and the periosteum of the skull. This merging ends as a temporal ligamentous adhesion at the lateral third of the eyebrow and occurs 10 mm superior to the supraorbital margin with a height of 20 mm and a width of 15 mm.

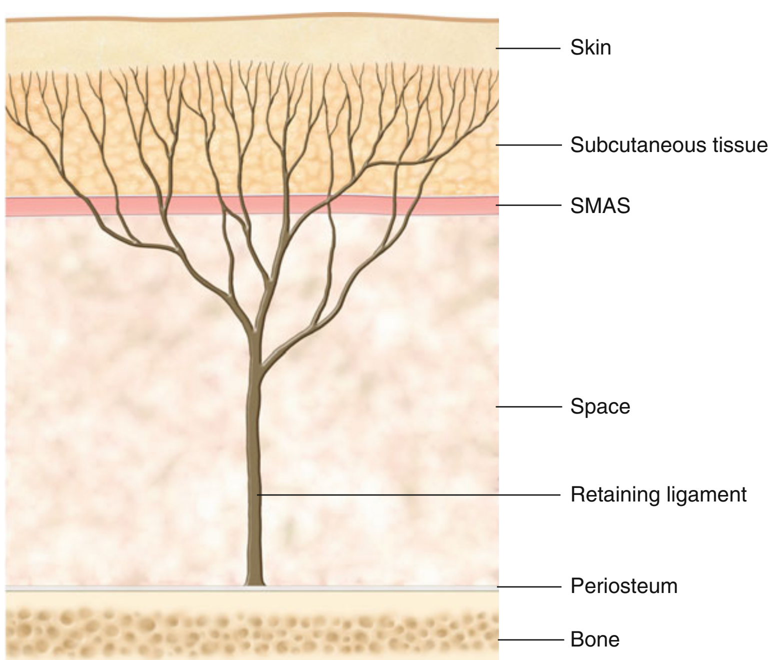

Fig. 1.24 Schematic illustration of the retaining ligament from the periosteum to the skin (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

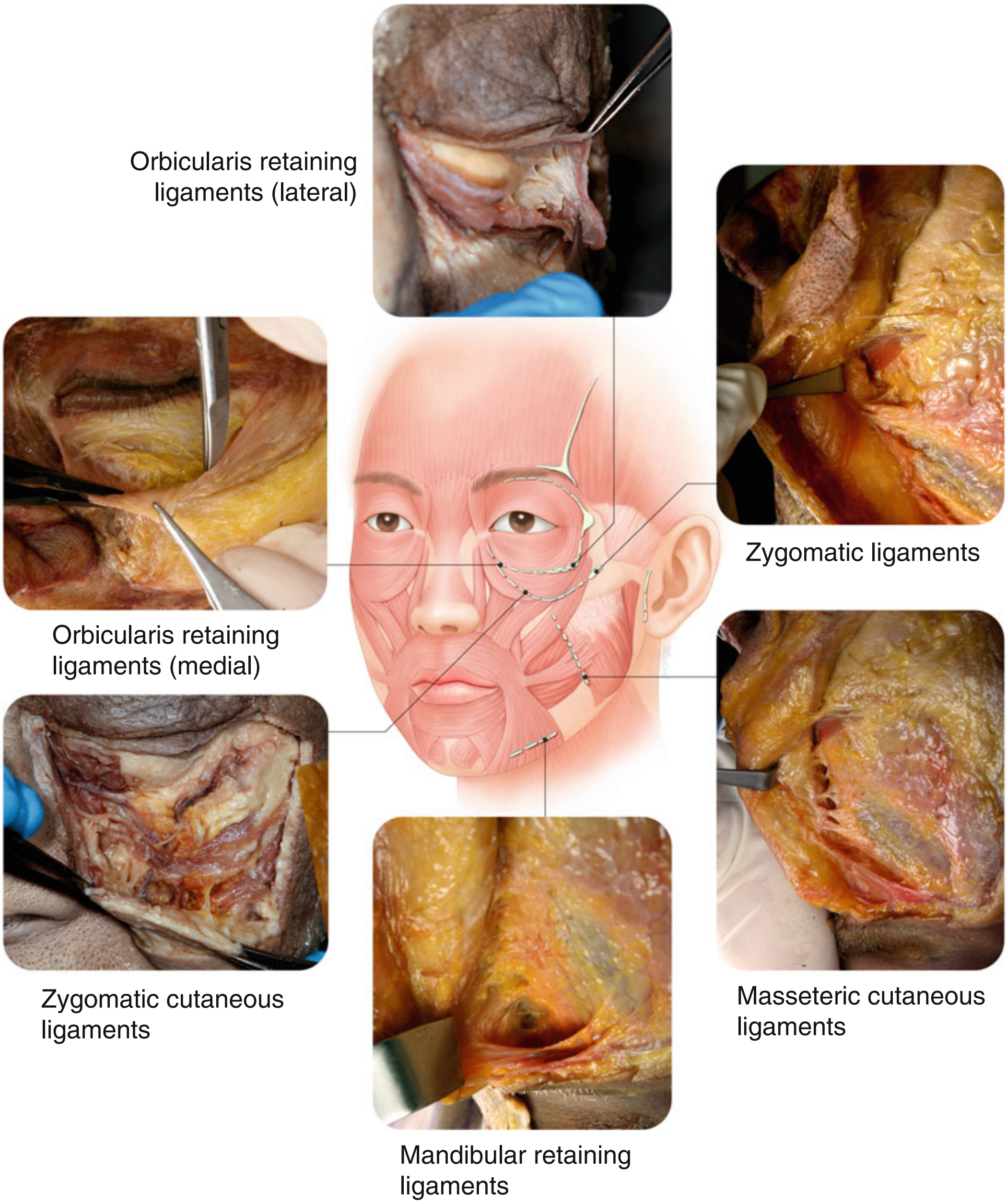

Fig. 1.25 The retaining ligaments of the face (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

Zygomatic Ligament
The zygomatic ligament, also known as the McGregor's patch, is located posterior to the origin of the zygomaticus minor m. This structure is a true retaining ligament that connects the lower margin of the zygomatic arch to the skin.

Zygomatic Cutaneous Ligament
The zygomatic cutaneous ligament originates from the periosteum of the zygomatic bone, proceeds along the lower margin of the orbicularis oculi m., and attaches to the skin on the anterior portion of the zygomatic bone. The soft

tissues in this area are maintained by the ligament, which droops with age in the form of a malar mound (or baggy lower eyelid).

Orbicularis Retaining Ligament
The orbicularis retaining ligament is located superiorly, inferiorly, and laterally along the orbital rim. It attaches to the lateral periosteum of the orbit and extends to the deep portion of the orbicularis oculi m.

Lateral Orbital Thickening
Lateral orbital thickening is located on the superolateral side of the orbital margin and originates from the orbital retaining ligament.

Mandibular Retaining Ligament
The mandibular retaining ligament connects the periosteum of the mandible, located right underneath the origin of the depressor anguli oris m., to the skin.

Masseteric Cutaneous Ligament
The masseteric cutaneous ligament is a false retaining ligament originating from the anterior border of the masseter m. This ligament attaches to the SMAS and to the skin covering the cheek. It attenuates with age and causes the SMAS to sag and jowl.

Platysma-Auricular Fascia (PAF)
The platysma-auricular fascia is a compact fibrous tissue located inferior to the ear lobule where the lateral temporal-cheek fat compartment and the postauricular fat compartment merge.

1.5 Nerves of the Face and Their Distributions

The trigeminal n. and the facial n. are major nerves distributed on the face. The trigeminal n. consists of three parts: the ophthalmic n., the maxillary n., and the mandibular n. The trigeminal n. passes through the foramina of the skull and divides into independent facial sensory nerves (Fig. 1.26). On the other hand, the facial n. has one nerve trunk that passes through the stylomastoid foramen and separates into two divisions

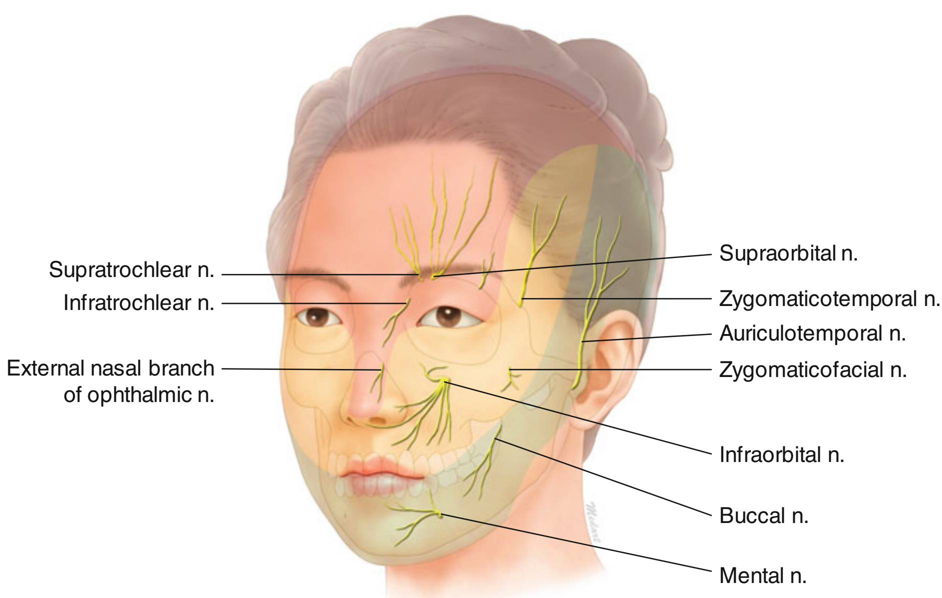

Fig. 1.26 The cutaneous sensory distribution of the face (*red zone* area of the ophthalmic nerve (V1) branches, *yellow zone* area of the maxillary nerve (V2) branches, *green zone* area of the mandibular nerve (V3) branches) (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

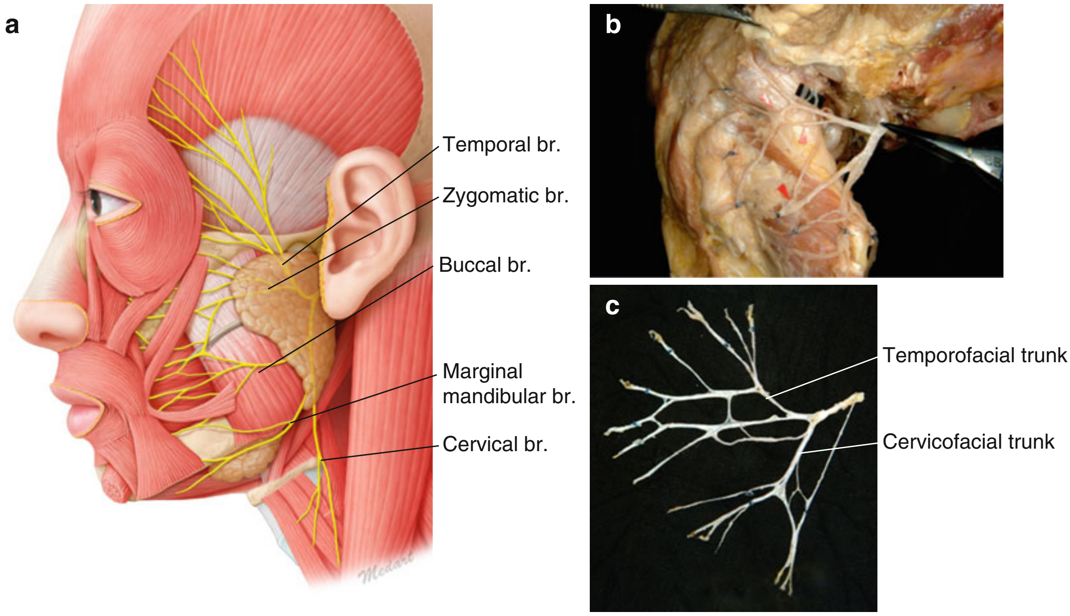

Fig. 1.27 Trunk of the facial nerve (**a**, **b**, **c**) and its temporofacial (*upper*) and cervicofacial (*lower*) divisions (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

(temporofacial and cervicofacial divisions) within the parotid gland. Later, it branches off into five different nerve bundles transmitting motor impulses to facial mm. (Fig. 1.27).

1.5.1 Distribution of the Sensory Nerve

Supraorbital n., supratrochlear n. (ophthalmic n.): forehead, glabellar region
Infratrochlear n. (ophthalmic n.): glabella, radix
Infraorbital n. (maxillary n.): external nose, nasal septum, lower eyelid, upper lip
Buccal n. (mandibular n.): cheek, cheilion
Mental n. (mandibular n.): lower lip, mentum, cheilion

1.5.2 Distribution of the Motor Nerve

The facial n. consists of temporal, zygomatic, buccal, marginal mandibular, and cervical nerve branches that transmit motor impulse to facial and neck muscles. There are several small nerve branches with complicated, random distribution patterns to the muscles. Therefore, it is difficult to determine nerve distribution region of boundaries for each muscle (Fig. 1.27).

1.5.3 Upper Face

1.5.3.1 Distribution of the Sensory Nerve

The upper face includes the forehead, the glabella, the radix, and the upper and lower eyelids. The supraorbital n. distributes to the forehead, the glabella, and the upper eyelid with its long, distinct branch and runs to the forehead and the glabellar region. Furthermore, the minor branches of the supraorbital n. distribute to the upper eyelid in a triangular pattern. The supratrochlear n. is distributed to the upper eyelid and the medial side of the glabella. The inferior palpebral branch of the infraorbital n. moves superiorly past the infraorbital foramen and is distributed to the lower eyelid in a triangular pattern. Also, several minor branches of the zygomaticofacial n. become distributed to the inferior and medial side of the lower eyelid.

1.5.3.2 Distribution of the Motor Nerve

The temporal branch of the facial n. moves superomedially toward the upper eyelid and is distributed to the muscles on the lateral side of the upper eyelid. The zygomatic branch of the facial n. distributes the orbit and the muscles on the lateral side of the lower eyelid as it runs superior to the inferior palpebral branch of the infraorbital n. Generally, the temporal branch transmits motor ability to the frontalis m., the corrugator supercilii m., and the superior portion of the orbicularis oculi. The zygomatic branch is distributed to the inferior portion of the orbicularis oculi m. and to the origins of the zygomaticus major and minor m.

Typically, the buccal branch of the facial n. runs superiorly along the lateral side of the nose to the radix. Therefore, the procerus m., the medial portion of the corrugator supercilii m. on the glabella, and the radix are innervated by the temporal branch and by the buccal branch (Figs. 1.28 and 1.29).

1.5.4 Midface

1.5.4.1 Distribution of the Sensory Nerve

The midface includes the cheek region and the nose. The infraorbital n. of the trigeminal n. plays a vital role in the cutaneous sensation in the midface. The external nose is mostly innervated by the infraorbital n. with the exception of some parts that are innervated by the external nasal branch of the nasociliary n. (from ophthalmic n.). The lateral nasal branch of the infraorbital n. proceeds along the nasal ala with some distributing to the nose tip near the midline. The internal nasal branch of the infraorbital n. is distributed to the mucosal of the nasal septum. The superior labial branch of the infraorbital n., one of the most distinct branches, is distributed to the area that spans from the medial portion of the upper lip to the cheilion. The infraorbital n. is distributed among the general infraorbital region from the infraorbital foramen to the upper lip.

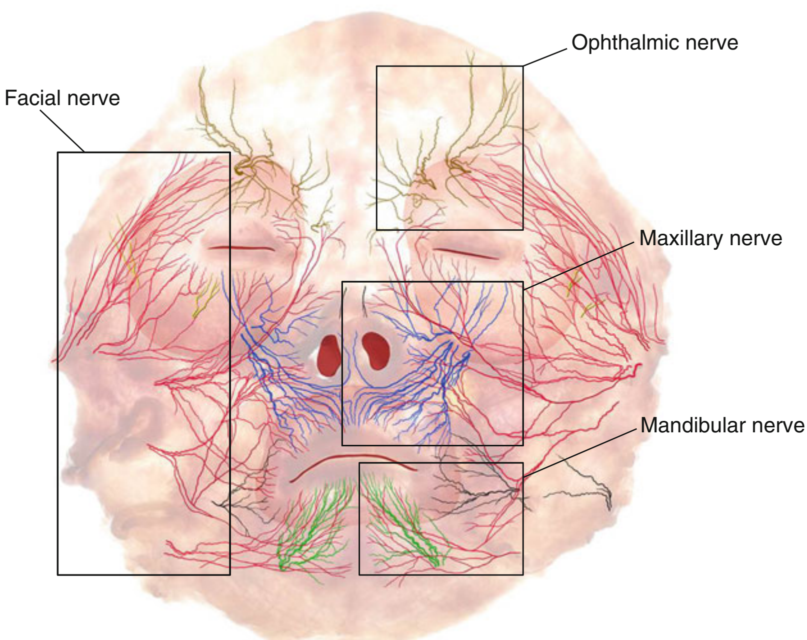

Fig. 1.28 Sensory and motor nerve distribution on the face (V1, ophthalmic nerve; V2, maxillary nerve; V3, mandibular nerve; VII, facial nerve) (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

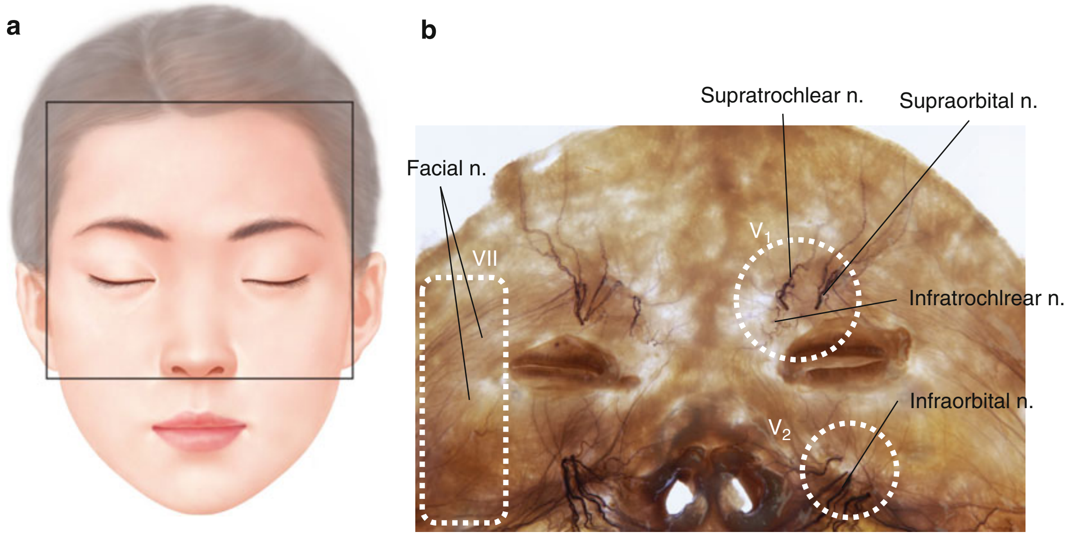

Fig. 1.29 Sensory and motor nerve distribution at the forehead and periorbital region. This specimen was prepared to show the intramuscular nerve distribution by Sihler's technique (V1, ophthalmic nerve; V2, maxillary nerve; VII, facial nerve) (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.5.4.2 Distribution of the Motor Nerve

The buccal branch of the facial n. proceeds medially and has small branches that are dispersed to the cheek. These branches superimpose with the superior labial branch of the infraorbital n. The buccal branch and the infraorbital n. lie superimposed with each other in the superior 3/4 of the infraorbital region. The buccal branch is distributed to the levator labii superioris alaeque nasi, the levator labii superioris, and the zygomaticus minor m. The buccal branch also is distributed to the zygomaticus major, the risorius, and the superior portion of the orbicularis oris m. (Figs. 1.28 and 1.30).

1.5.5 Lower Face

1.5.5.1 Distribution of the Sensory Nerve

In the lower face, the mandibular n. distributes to the lower lip and to the mentum. The buccal n. proceeds medially along the occlusal plane to the cheilion. The mental n. runs through the mental foramen and is distributed to the lower lip which includes the cheilion and the mandible. The superior labial branch of the infraorbital n., the buccal n., and the angular branch of the mental n. is distributed to the mouth corner. Furthermore, there are nerve plexus formed between the infraorbital n. and the buccal n. and also between the buccal n. and the mental n. superior and inferior to the cheilion.

1.5.5.2 Distribution of the Motor Nerve

The marginal mandibular branch of the facial n. is distributed to the mentalis, the depressor anguli oris, the depressor labii inferioris, and the inferior portion of the orbicularis oris m. The actual anatomy of the trigeminal n. and the facial n. is quite different from that found in the textbook. The cutaneous n. of the trigeminal n. and the motor n. of the facial n. are not distinguished as some of the few, distinct nerves. Even though some of the major branches can be observed during dissection surgeries with the naked eye, they are intertwined with other small branches such as nets. Therefore, it is best to describe the distribution pattern of nerves with a plane rather than with several distinct lines (Figs. 1.28 and 1.31).

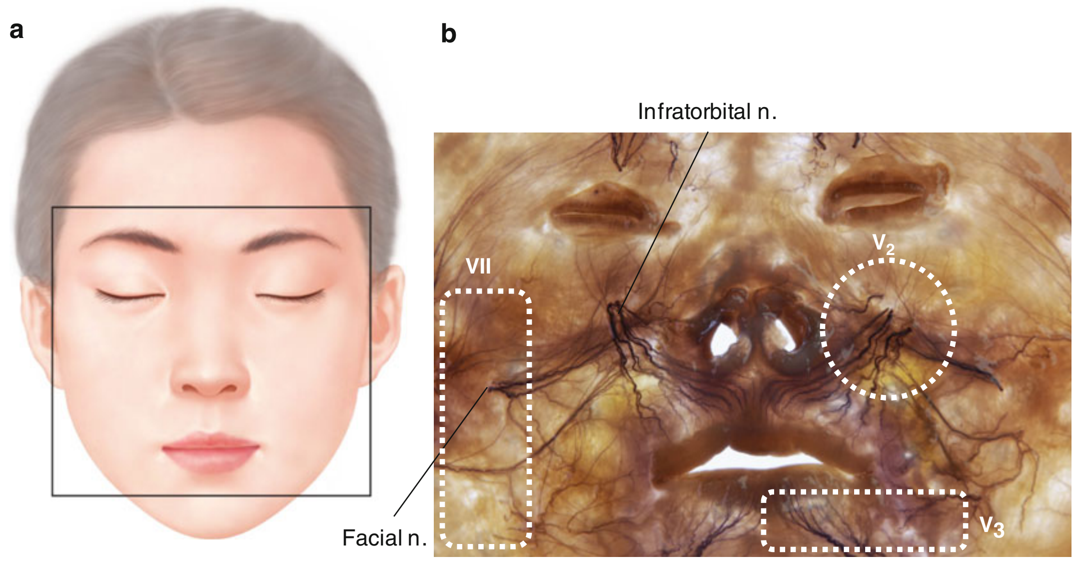

Fig. 1.30 Sensory and motor nerve distribution at the midfacial region. This specimen was prepared to show the intramuscular nerve distribution by Sihler's technique (V2, maxillary nerve; V3, mandibular nerve; VII, facial nerve) (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

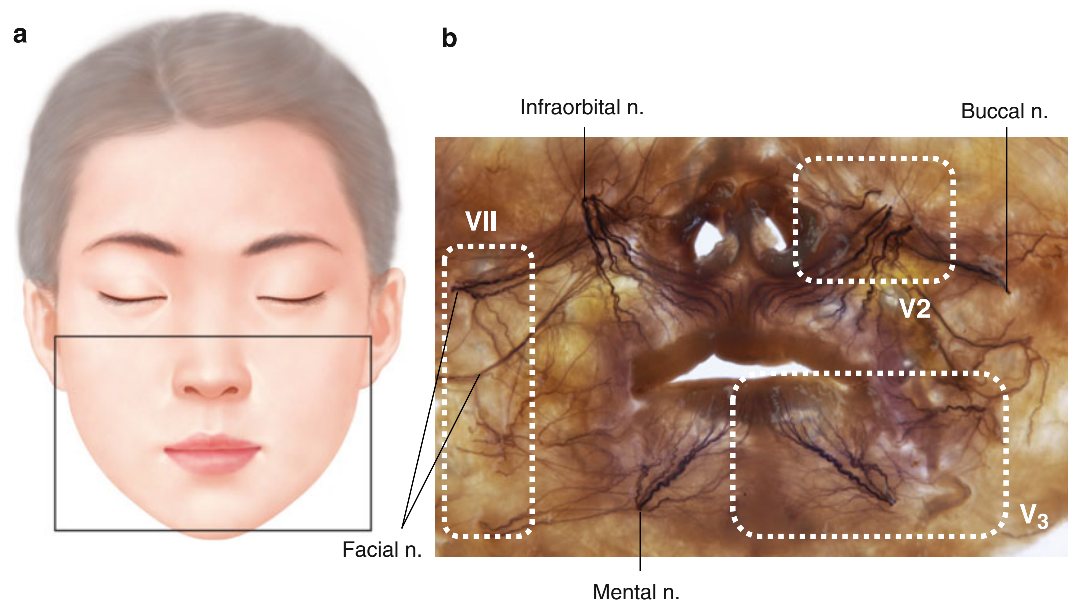

Fig. 1.31 Sensory and motor nerve distribution at the perioral and lower face region. This specimen was prepared to show the intramuscular nerve distribution by Sihler's technique (V2, maxillary nerve; V3, mandibular nerve; VII, facial nerve) (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.6 Nerve Block

1.6.1 Supraorbital Nerve Block (SON Block)

The supraorbital n. originates from the supraorbital notch, which can be identified on the supraorbital rim. If the supraorbital notch cannot be found externally, it can be replaced by the supraorbital foramen. The supraorbital notch is located medial to the mid-pupillary line on the frontal bone. Insert the syringe immediately inferior to the eyebrow and inject anesthetics proximal to the supraorbital notch. It is necessary to take caution to avoid injecting the anesthetics into the orbit. If the lateral branch has not been anesthetized with a general infraorbital nerve block, it is suggested to perform additional anesthesia by inserting the syringe 1 cm superior to the orbit toward the medial portion of the eyebrow (Fig. 1.32).

1.6.2 Supratrochlear Nerve Block (STN Block)

In 30 % of cases, the supratrochlear n. arises together with the supraorbital n. from the supraorbital notch and can perform nerve blocks along with SON blocks. However, in the majority of cases (70 %), the supratrochlear n. originates separately from the frontal notch, which requires an injection 15 mm lateral from the facial midline, which can be approximated by placing the index finger on the midline of the forehead. In this case, an additional injection is required (Fig. 1.32).

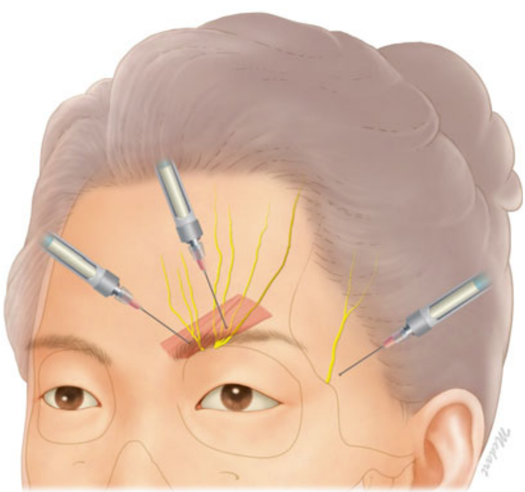

Fig. 1.32 Supraorbital and supratrochlear nerve block (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

1.6.3 Infraorbital Nerve Block (ION Block)

The infraorbital nerve block is an extremely useful technique to use in aesthetic surgery procedures as both intraoral and extraoral approaches could perform effectively. Both approaches target the infraorbital foramen, which the infraorbital n. passes. The infraorbital foramen is located on the upper third where the line between the nasal ala superior to the vertical line passing the cheilion and the point at the same height as the infraorbital margin is divided into three sections (Figs. 1.33 and 1.49).

In the extraoral approach, inject anesthetics targeting the location of the infraorbital foramen as described above. However, the transcutaneous, nasolabial approach of approaching from the marionette line rather than by vertical insertion also exists. This approach injects at the site where the superior portion of the marionette line and the alar groove meet to form the upside-down V-shape and then runs superolaterally. The transcutaneous nasolabial method allows for a more intricate approach to the infraorbital foramen (Fig. 1.33a).

In the intraoral approach, place the syringe parallel to the longer axis of the maxillary second premolar and inject the needle slowly and superiorly. Inject anesthetics when the target is located (Fig. 1.33b). Both approaches require caution to avoid injecting the anesthetic inside of the orbit. In such cases, diplopia may occur.

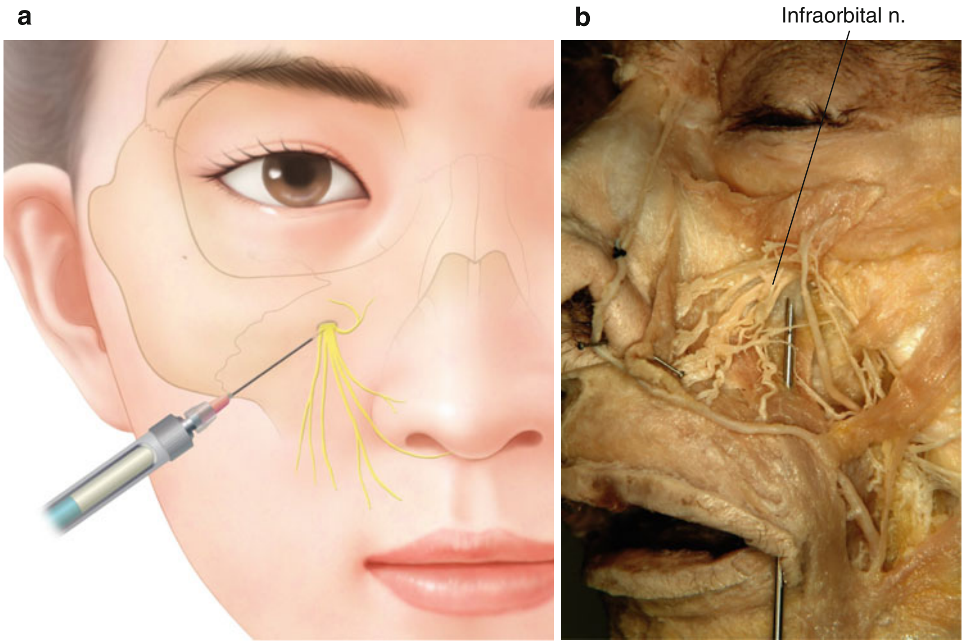

Fig. 1.33 Extraoral (**a**) and intraoral (**b**) approaches for the infraorbital nerve block (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.6.4 Zygomaticotemporal Nerve Block (ZTN Block)

The meeting point of the frontal bone and the zygomatic bone is presented as an eminence point lateral to the eyebrow. The zygomaticotemporal n. originates laterally to this region and innervates the lateral portion of the eyebrow and the glabellar region. However, facial landmarks are unclear. Therefore, a nerve block does not always perform well (Fig. 1.32).

1.6.5 Mental Nerve Block (MN Block)

Similar to the infraorbital nerve block, a mental nerve block can also be completed via the extraoral or the intraoral approach. Both approaches target the mental foramen 2 cm vertically inferior from the cheilion. For the extraoral approach, inject the syringe posterior to and superomedially while targeting the mental foramen (Fig. 1.34a, c). In the intraoral approach, inject slowly, inferiorly, and posteriorly at the mandibular second premolar region (Fig. 1.34b, c).

1.6.6 Buccal Nerve Block (BN Block)

The buccal nerve enters the oral mucosa near the maxillary second molar, its main trunk running medially. As it proceeds medially through the dentition, the main trunk of the buccal n. lies in a slightly inferior position. The main trunk of the buccal n. supplies the entire buccal area including the mucosa and skin of the lateral area of the mouth corner. The main trunk gives off some branches not only near the main trunk running inferomedially, but also in the other regions. The buccal nerve block should be performed with a needle approaching the buccal aspect of the mandibular second molar. After placing a needle parallel to the occlusal plane, inject the anesthetic slowly along the buccal aspect of the mandibular second molar or oblique line of the mandible (Fig. 1.35).

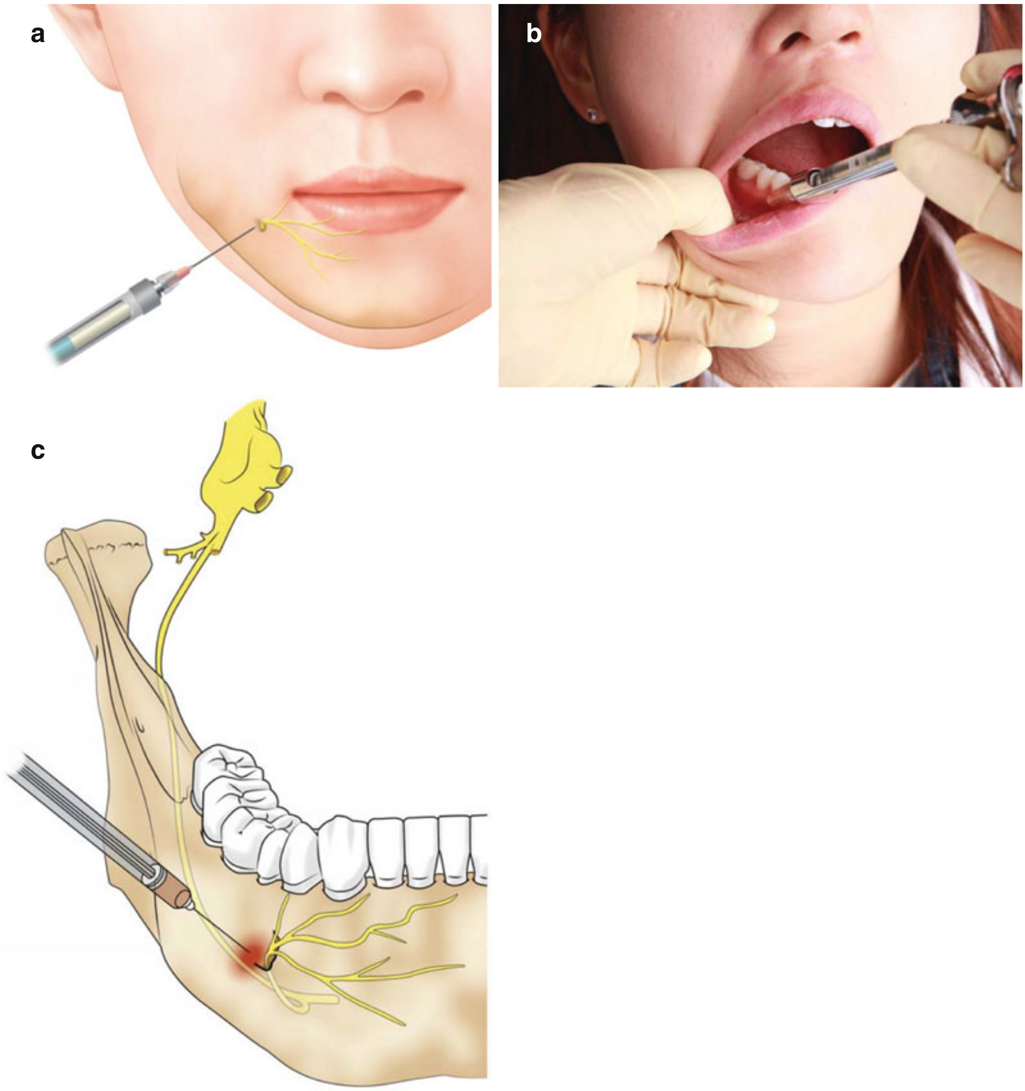

Fig. 1.34 Extraoral (**a**) and intraoral (**b**) approaches for mental nerve block ((**c**) an illustration showing the anesthetized area) (Published with kind permission of)

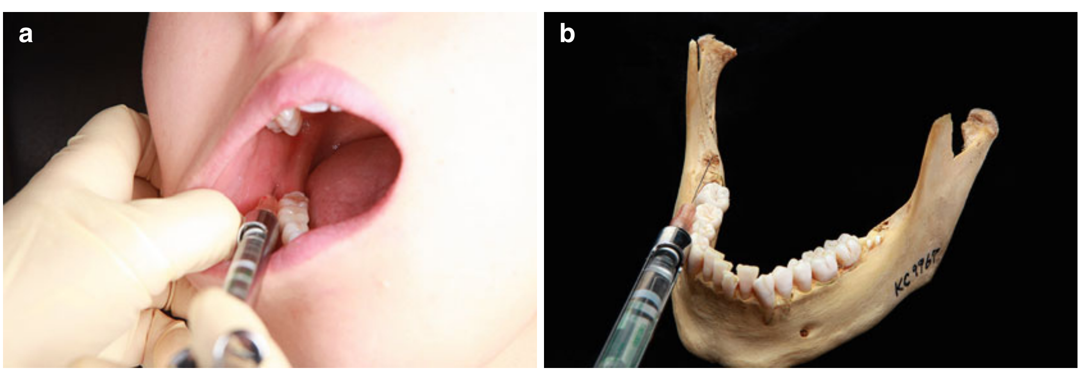

Fig. 1.35 Buccal nerve block (**a**, **b**) (Published with kind permission of)

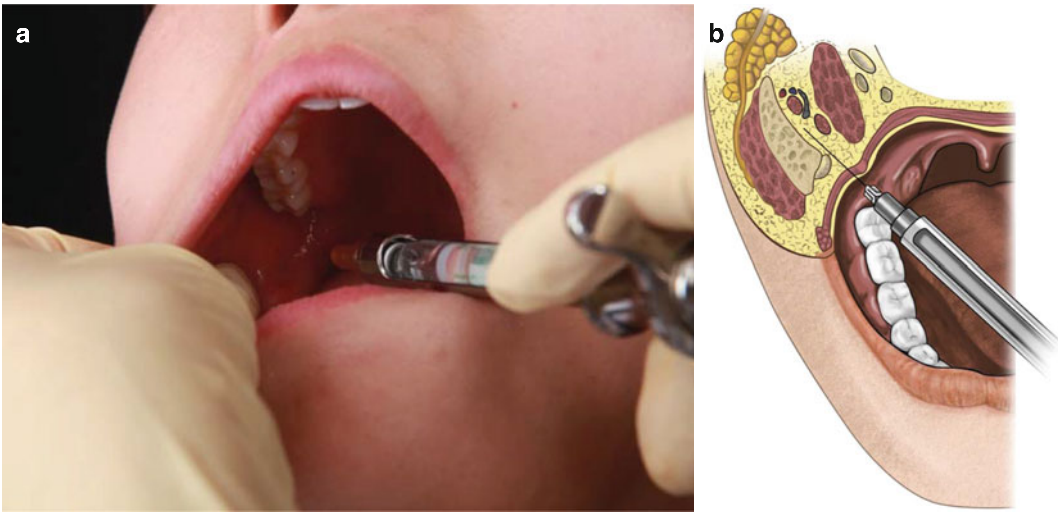

Fig. 1.36 Inferior alveolar nerve block (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.6.7 Inferior Alveolar Nerve Block (IAN Block)

In order to completely anesthetize the skin on the lower chin, it is necessary to intraorally approach the inferior alveolar n. Slowly inject a long needle 1 cm superior to the occlusal plane of the first premolar on the opposite side of the target toward the central point on the retromolar triangle. If the needle comes into contact with the ramus of the mandible, pull it back slightly and inject anesthetics (Fig. 1.36).

1.6.8 Auriculotemporal Nerve Block (ATN Block)

For an auriculotemporal nerve block, inject 2 cc of anesthetics anterior to the tragus. If the auriculotemporal n. is blocked, the sensation of the tragus, the anterior auricle, and the external auditory meatus also become blocked. Anesthetizing other parts of the auricle requires a great auricular nerve block (Fig. 1.37).

1.6.9 Great Auricular Nerve Block (GAN Block)

The great auricular n. proceeds superiorly along the anterior surface of the sternocleidomastoid m. Place a hand on the patient's temple in order to distinguish the sternocleidomastoid m. and mark its boundary. Then inject the anesthetic 6.5 cm along the line from the external acoustic pore to the midpoint between the boundaries of the sternocleidomastoid m. (Fig. 1.37).

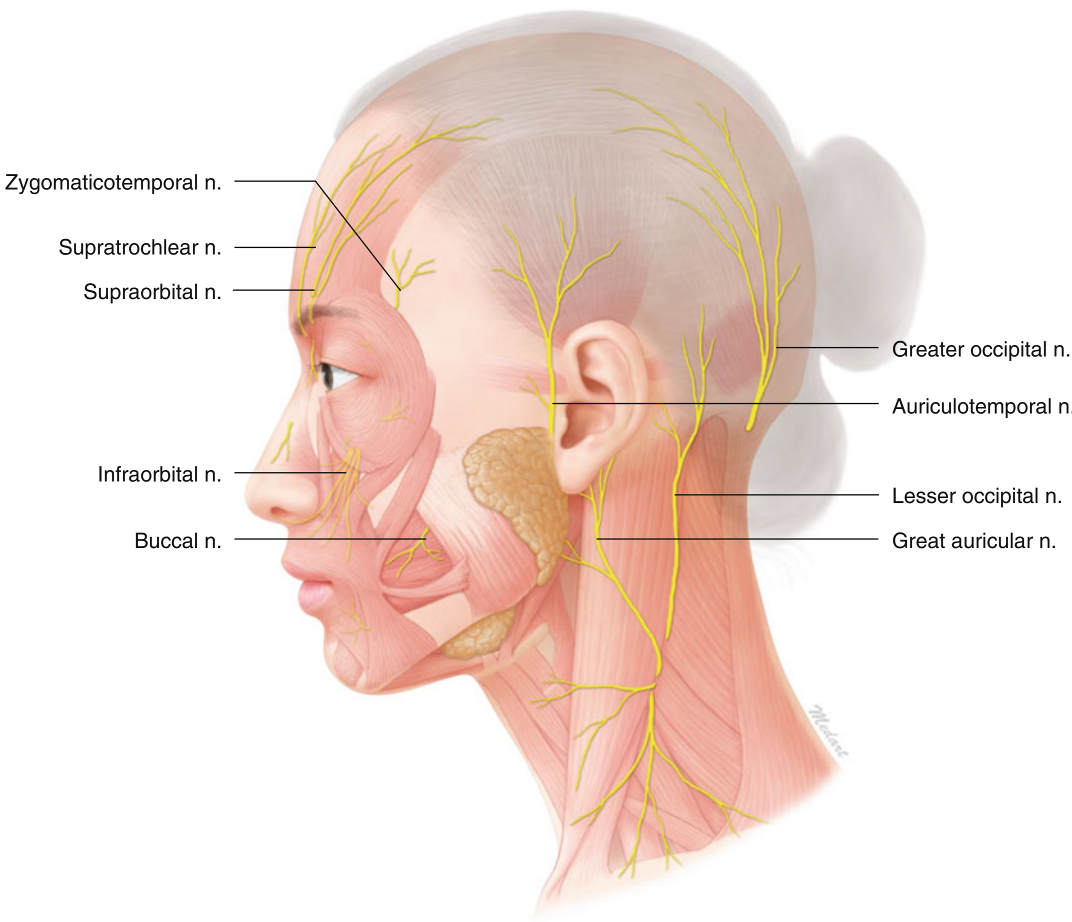

Fig. 1.37 Topographic anatomy of peripheral sensory nerve branches of the head and neck (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

1.7 Facial Vessels and Their Distribution Patterns

Facial blood vessels are extremely important. As filler injections become more common, blood vessel-related issues, such as skin necrosis and blindness, will become more prominent. Therefore, more in-depth studies on blood vessel pathways in terms of injection techniques are required.

Clinically, facial blood vessels do not follow one specific pattern. Dissections show many variations of this pattern. Furthermore, facial blood vessels contain not only arteries but also veins and their branches. It is impossible to perfectly avoid every single blood vessel during blind injections. However, with enough knowledge of these vessels, it is possible to minimize risks and perform a safe injection.

Chapter 1 deals with general and typical patterns of the facial a., and Chaps. 3, 4, and 5 describes patterns, depths, and variations of vessel types that branch according to their regions and their clinical significances.

The blood supply of the head and neck is mostly given by the common carotid a. The right common carotid a. and the right subclavian a. are arising from the brachiocephalic trunk. On the other side, the left common carotid a. and the left subclavian a. are arising independently from the aortic arch. At the level of the superior border of the thyroid cartilage, the common carotid a. divides into internal and external carotid arteries. The pulse of the common carotid a. can be felt when touching the anterior border of the sternocleidomastoid m. at the level of the thyroid cartilage.

The internal carotid artery has no other arterial branches except the ophthalmic a. before reaching the brain. The internal carotid a. runs anteromedially through the carotid canal and enters the middle cranial fossa. The internal carotid a. supplies blood to the cerebrum, and a portion enters the orbit area, arrives at the superomedial side of the orbital, and supplies blood to the eye, the orbit, and the lacrimal gland.

The external carotid a. originates from the common carotid a. in the area of the carotid sheath. Although the origin of the external carotid a. lies anteriorly and medially from the internal carotid a., it locates further laterally as it ascends. This artery divides into eight branches.

The facial blood supply is given by the internal carotid a. and the external carotid a. These arteries are accompanied by the corresponding sensory n. On the superficial layer of the skin, branches of the external carotid a. (facial a., superficial temporal a., facial branches of the maxillary a.) and branches of the internal carotid a. (supraorbital a. branching from the ophthalmic a., supratrochlear a., infratrochlear a.) supply blood to this layer (Figs. 1.38 and 1.39).

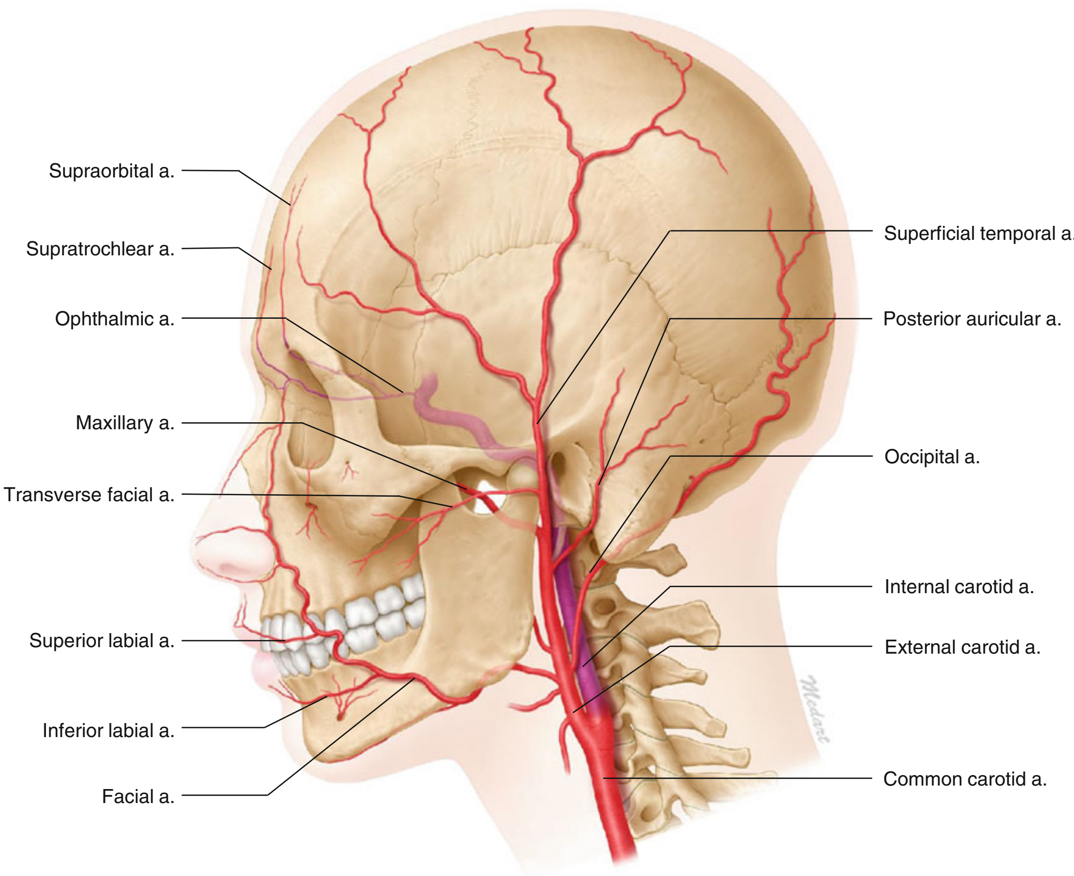

Fig. 1.38 External and internal carotid arterial system and their branches (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

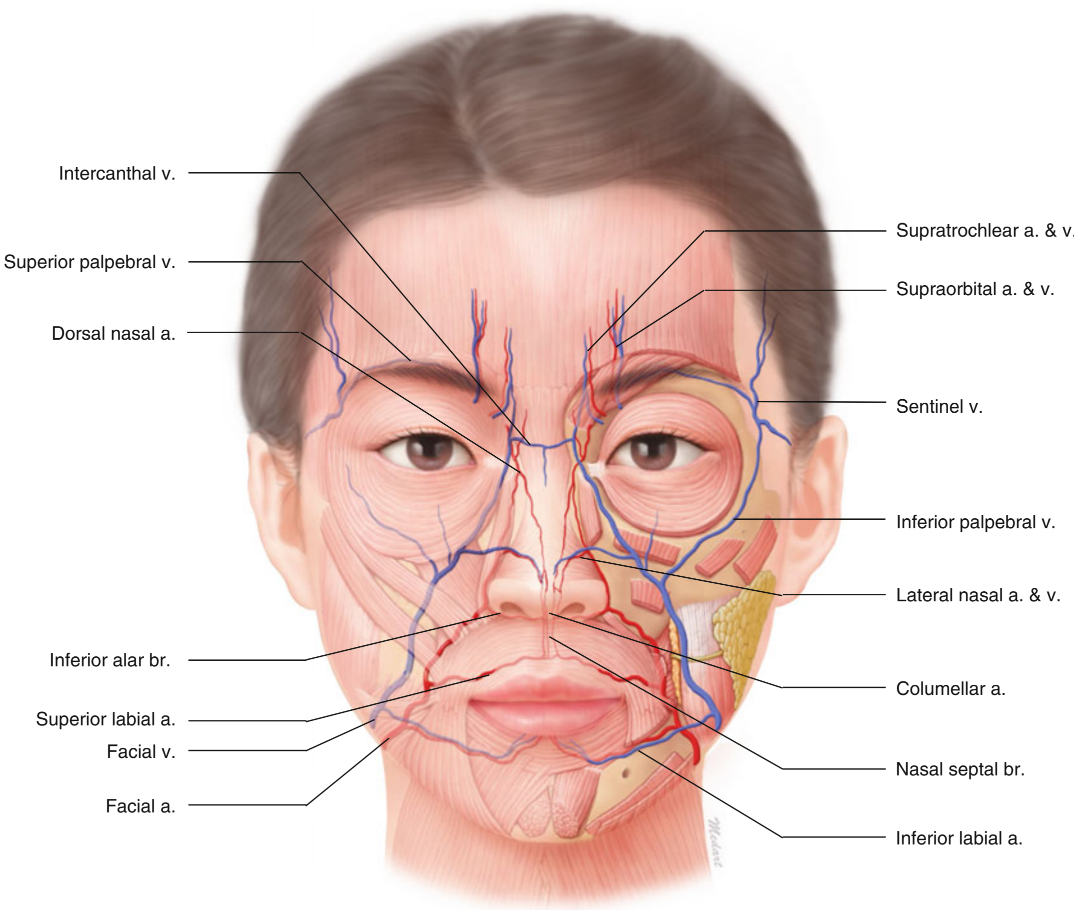

Fig. 1.39 General courses and locations of the artery and vein on the face (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

1.7.1 Facial Branches of the Ophthalmic Artery (Fig. 1.40)

1.7.1.1 Supraorbital Artery

The supraorbital a., together with the supraorbital n., originates from the supraorbital notch, or the supraorbital foramen, and supplies the upper eyelid, forehead, and the scalp region.

1.7.1.2 Supratrochlear Artery

The supratrochlear a. runs more medially than the supraorbital artery and supplies the upper eyelid, the forehead, and the scalp.

1.7.1.3 Dorsal Nasal Artery

The dorsal nasal a. originates from the medial canthus of the orbit together with the infratrochlear n. and supplies the medial portion of the upper eyelid, the lacrimal sac, and the dorsum of the nose.

1.7.1.4 Lacrimal Artery

The lacrimal a. is the last, small part of the ophthalmic a. that originates from the lateral side of the supraorbital margin and supplies the lateral side of the upper eyelid.

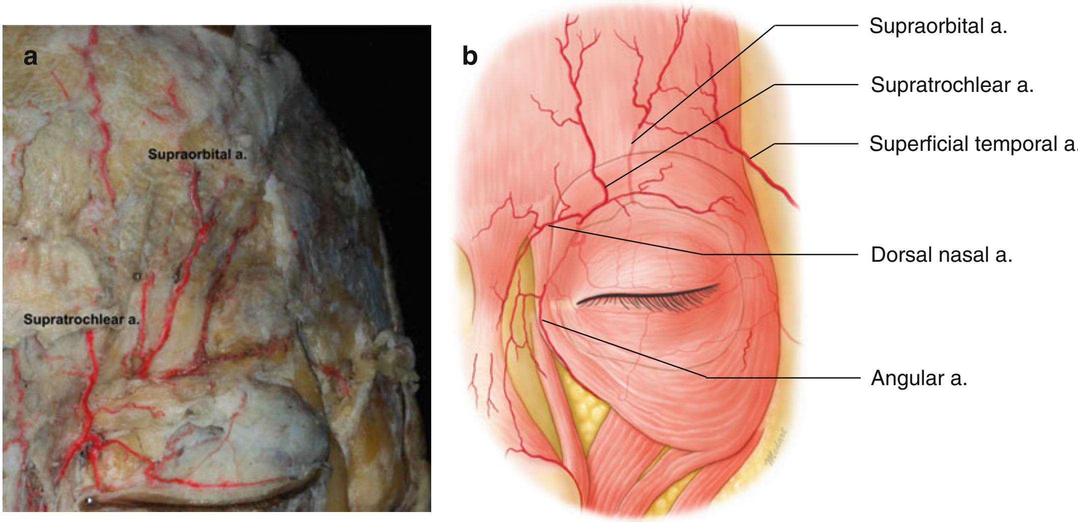

Fig. 1.40 Periorbital arterial distribution of the ophthalmic artery (internal carotid arterial system) (**a**, **b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.7.1.5 External Nasal Artery

The external nasal a. runs through the junction between the nasal bone and the nasal cartilage. It supplies the intermediate zone of the external nose inferior to the nasal bone.

1.7.2 Facial Branches of the Maxillary Artery (Fig. 1.41)

1.7.2.1 Infraorbital Artery

The infraorbital a. exits the infraorbital foramen inferior to the orbit and branches to the inferior palpebral branch, the nasal branch, and the superior labial branch.

1.7.2.2 Zygomatic Artery

Two branches of the zygomatic a. (zygomaticofacial branch and zygomaticotemporal branch) pass along the zygomatic canal on the lateral wall of the orbit. The zygomaticofacial branch exits the zygomaticofacial foramen and supplies the zygomatic region and the cutaneous layer of the cheek. The zygomaticotemporal branch exits the zygomaticotemporal foramen and supplies the cutaneous layer of the temporal region.

1.7.2.3 Buccal Artery

The buccal a. runs to the muscle internally between the ramus of the mandible and the masseter m. It branches to the surface of the cheek and supplies the cutaneous and mucosal layer of the cheek and the molar gingiva on the buccal side.

1.7.2.4 Mental Artery

The mental a. branches from the inferior alveolar a. inside the mandibular canal. It exits the mental foramen along with the mental n. and supplies the chin, the lower lip, and the mandibular incisive gingiva.

1.7.3 Facial Artery

The facial a. branches from the external carotid a., winds through the antegonial notch, passes the masseter m. anteriorly, and runs tortuously to the nasion and the glabella. It is known that the facial a., which runs superomedially through the face, branches to the inferior labial a., the superior

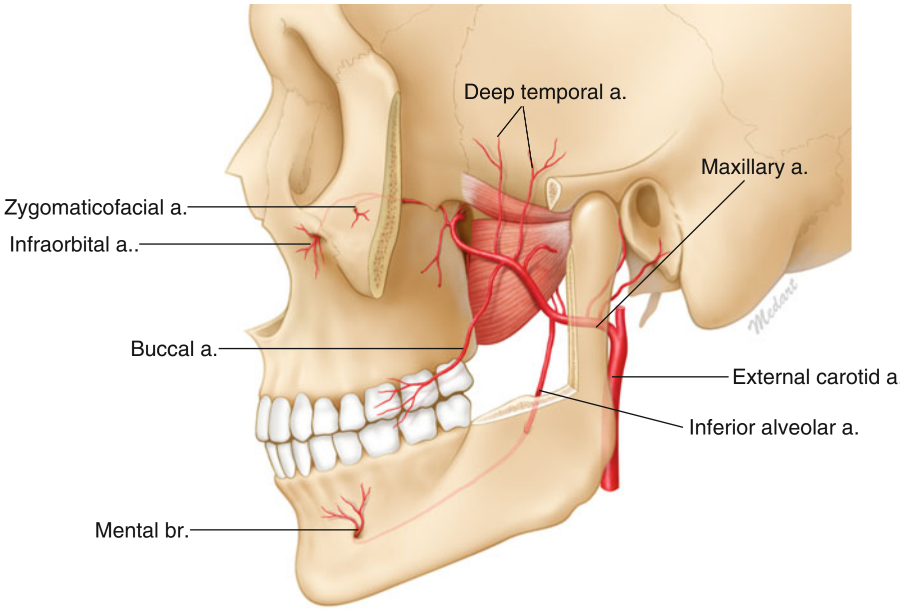

Fig. 1.41 Maxillary artery and its branches (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

labial a., and the lateral nasal a. and terminates as the angular a. (Fig. 1.42). The facial a. is described in many textbooks as running from the mandibular angle to the radix and is in charge of most of the blood supply to the face. The facial a. continues all the way to the angular a. in only 36.3 % cases among 91 Korean hemifaces. In other races, the angular a. was observed in 4 % of French hemi-faces, 12 % of Japanese hemi-faces, 22 % of Turkish hemi-faces, and 68 % of British hemi-faces. Although the research presented differences of angular a. occurrences among various ethnicities, the actual cause for that difference is still unclear, because the fractions of populations observed to possess angular a. were quite different between French and British populations despite both of them being Caucasian. What is quite apparent, however, is the fact that general documentation stating that the facial a. proceeds to the angle of the orbit seems erroneous (Fig. 1.42).

Facial a. symmetry is observed in only 30 % of the cases, and regions with sparse blood supply are supplied additionally by branches of the superficial temporal a. (transverse facial a., supraorbital a., supratrochlear a.), branches of the ophthalmic a., and branches of the maxillary a. (infraorbital a., mental a.). The more prominent arteries on the opposite side of the face can also supply these regions.

1.7.3.1 Facial Artery Branches

Superior, Inferior Labial Branch

The facial a. proceeds obliquely and superiorly to the angle of the mouth, and branches of the superior labial a. to the upper lip and branches of the inferior labial artery to the lower lip appear.

Inferior Alar Branch

The inferior alar branch divides off from the facial a. immediately adjacent to the nasal ala and runs to the columella. It merges with columellar branches from the superior labial a. and forms an artery that runs through the columella all the way to the nasal tip.

Lateral Nasal Branch

The lateral nasal branch supplies the nasal ala and the nasal bridge, divides lateral to the nasal

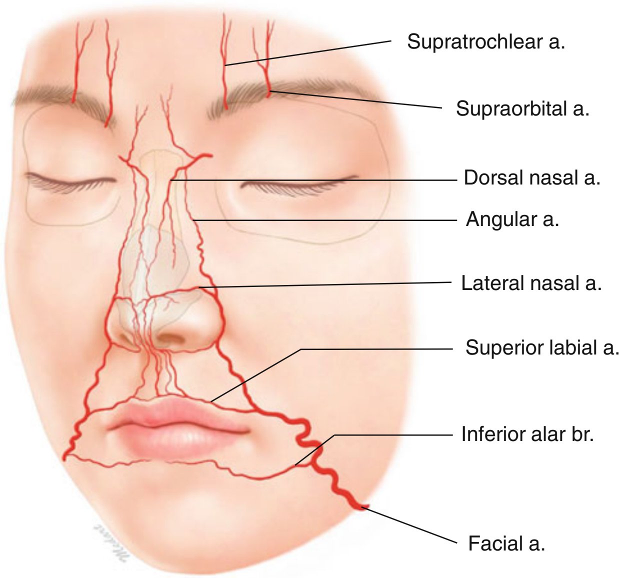

Fig. 1.42 General concept about the course of the facial artery. This concept is controversial according to many studies of the facial artery (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

ala, and runs along the lateral side of the nose. It continues to the nasal branch of the infraorbital a. and the external nasal branch of the ophthalmic a.

Angular Artery

The angular a. is the terminal artery of the facial a. after it branches from the lateral nasal and runs superiorly to the canthus. It terminates at the medial canthus region and branches to the medial side of the eyelid and the nose. The angular a. sometimes branches from the ophthalmic branch rather than from the facial a., but it is observed to be the terminating branch of the facial a. in 51 % of the cases.

1.7.3.2 Typical Distribution Patterns of the Facial Artery

Branches of the facial a. are categorized into four types depending on their directions, locations, and supplying regions (lower lip, upper lip, nasal, and infraorbital region). The branching pattern can be generally organized into three categories depending on the region: type I (nasolabial pattern; 51.8 %), type II (nasolabial pattern with infraorbital trunk; 29.6 %), and type III (forehead pattern; 18.6 %) (Fig. 1.43).

1.7.4 Frontal Branch of the Superficial Temporal Artery

The superficial temporal a. is the terminal branch of the external carotid a. that emerges from the facial side between the temporomandibular joint and the ear and runs superiorly to the scalp. It branches to the transverse facial a. immediately inferior to the ear and is located about 2 cm inferior to the zygomatic arch. The superficial temporal a. branches to both the frontal branch and the parietal branch 37 mm superior and 18 mm anterior from the tragus. The frontal branch runs obliquely toward the forehead and has either one branch (94.8 %) or two branches (5.2 %) that approach the frontalis m. past its lateral border and supply the region (Fig. 1.44). The superficial temporal a. passes the lateral side of the head along with auriculotemporal n. It branches to the transverse facial a. approximately 1 cm inferior to the zygomatic arch, runs superiorly, and divides into the frontal branch, which supplies the lateral side of the forehead, and into the parietal branch, which supplies the parietal region. The transverse facial a. runs anteriorly, merges with the branch

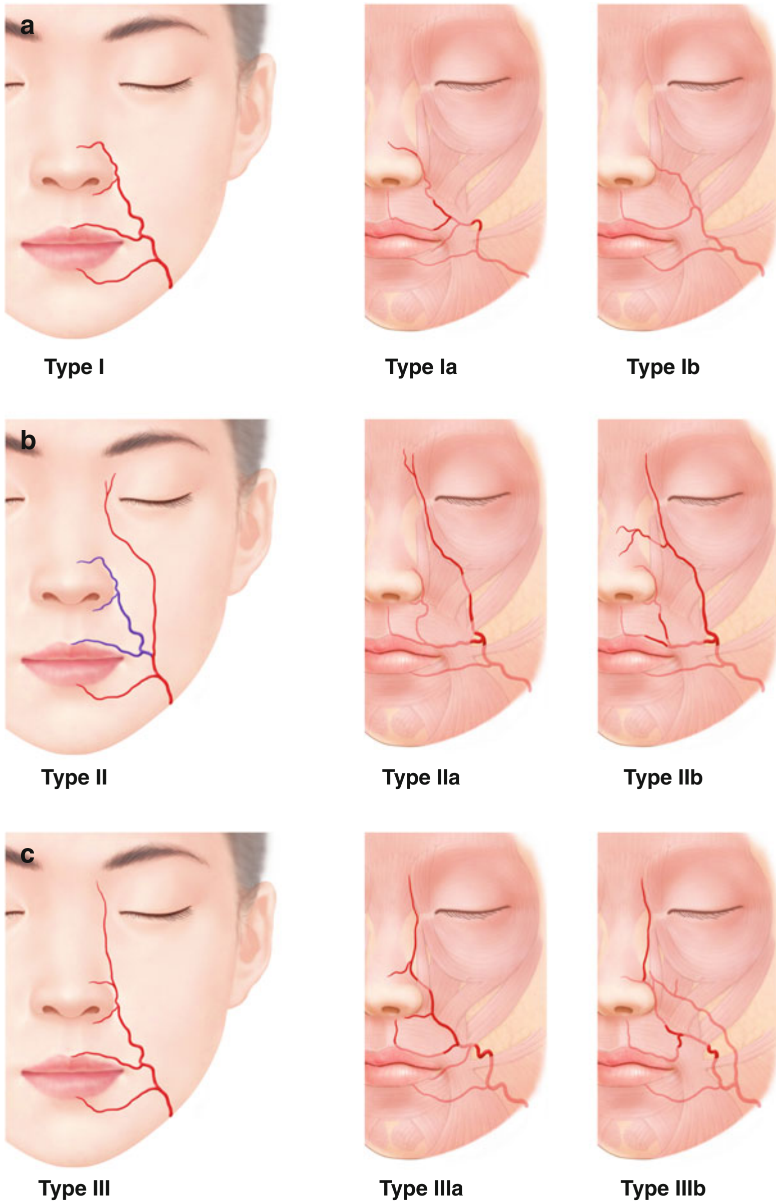

Fig. 1.43 Three patterns of the facial artery (FA). (**a**) *Type I* nasolabial pattern, (**b**) *type II* nasolabial pattern with infraorbital trunk, (**c**) *type III* forehead pattern (*Ag* angular a., *LN* lateral nasal a., *IA* inferior alar br., *SL* superior labial a., *IL* inferior labial a., *FA* facial a.) (Published with kind permission of © Kwan-Hyun Youn 2016. All rights reserved)

of the facial a., and supplies the parotid gland and the cheek.

1.7.5 Facial Veins

The facial v. follows the same distribution pattern as the facial a. with a few differences. Typically, the facial v. presents a greater amount of pattern variation than the facial a. (Fig. 1.45).

1.7.5.1 Veins with Cutaneous Nerves and Arteries

The facial v. runs in the direction opposite from the corresponding facial a. Veins of the forehead, the scalp, and the upper eyelid run to the superior ophthalmic v. on the orbit. The veins of the upper lip, the lateral side of the nose, and the lower eyelid run through the infraorbital v. to the infratemporal region and the pterygoid plexus.

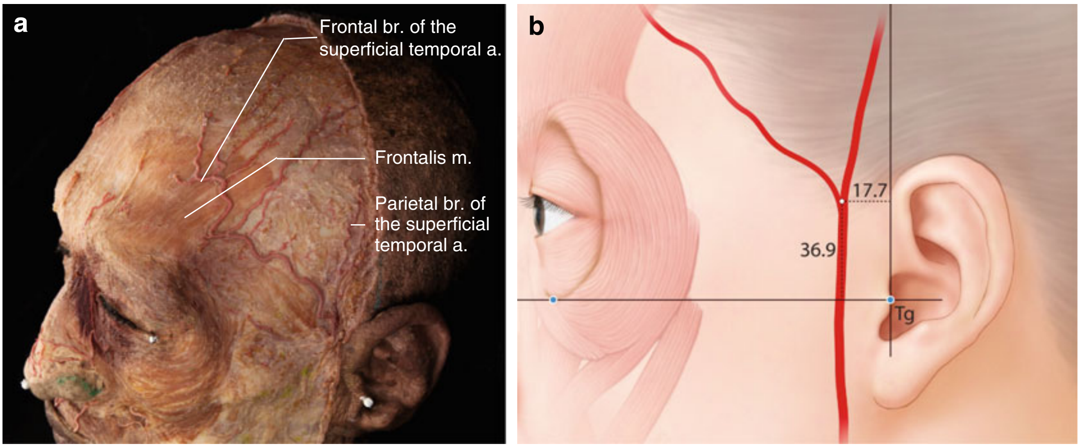

Fig. 1.44 Frontal and parietal branches of the superficial temporal artery (**a**) and location of the ramification point of the frontal branch of the superficial temporal artery (**b**) (Published with kind permission of © Hee-Jin Kim and Kwan-Hyun Youn 2016. All rights reserved)

1.7.5.2 Facial Vein

The facial v. parallels the facial a. in most instances. However, it runs more posteriorly than the facial a. and is less tortuous in the opposite direction of the facial a. The facial v. branches as follows (Fig. 1.45).

Angular Vein

The angular v. is formed through the merging of the supraorbital v. and the supratrochlear v. at the canthus. The angular v. branches into two different branches with one flowing into the orbit and continuing to the superior ophthalmic v. and the other proceeding superficially and running inferiorly along the face as a facial v (Fig. 1.46a).

Intercanthal Vein

The intercanthal v. has been observed at the glabella and the radix in 71 % of the cases and is located along the midpupillary line on the subcutaneous layer. 63.4 % of the cases showed that the intercanthal v. was observed along the line connecting the bilateral canthus, and the other 7.3 % of the cases showed that the vein was observed inferior to the same line. All the observed intercanthal veins run through the more superficial subcutaneous layer rather than the procerus m. (Figs. 1.46b and 1.47).

Facial Vein

The facial v. obliquely runs posteroinferiorly toward the mandibular angle, receiving many tributaries.

External Nasal Vein

The external nasal v. originates from the lateral side of the nose and connects to branches of the infraorbital v.

Deep Facial Vein

The deep facial v. connects to the pterygoid plexus in the deep layer of the face.

Labial Vein

The labial v. originates from the upper lip and the lower lip. The superior labial v. connects to the infraorbital v. The inferior labial v. connects to the mental v. The facial v. continues inferiorly along the antegonial notch toward the neck. The facial v., unlike the facial a., runs through the superficial portion of the mandible.

1.7.5.3 Retromandibular Vein

The superficial temporal v. runs inferiorly, merging with the branch from the parotid gland and exits the lower margin of the parotid gland. The retromandibular v. is bifurcated into the anterior and posterior branch at the mandibular angle.