# Frontalis Anatomy:

## Key considerations for aesthetic practice

### ABSTRACT

Understanding key anatomical concepts of the face is important in order to be able to treat a patient effectively in any aesthetic treatment. With a robust anatomical knowledge of the occipito-frontalis muscle, the clinician can appreciate how each patient's anatomy may vary and how the clinician's choice of injection placement with botulinum toxin A reflects this. Recent detailed anatomical studies of this area provide further clarification regarding static, dynamic and functional anatomy. Through critical analysis of this data, it is possible to tailor treatments on an individual basis.

**KEY WORDS;** Frontalis, Midline dehiscence, Botulinum toxin A, Anatomy.

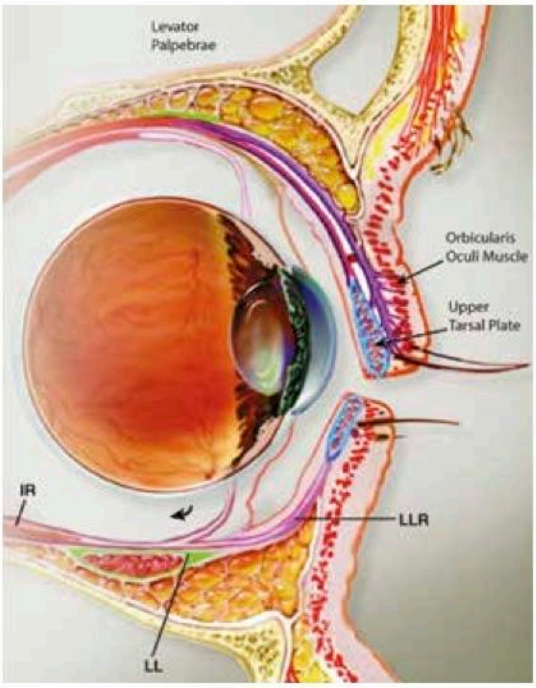


Figure 1

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### INTRODUCTION

In this article the anatomy of the frontalis muscle will be revisited and reviewed. We will examine how this awareness will enable the effective placement of Botulinum toxin A. It is widely accepted that botulinum toxin achieves a desired softening of established horizontal rhytides and offers near eradication of rhytides that are largely dynamic in nature.[1] in this article we aim to provide an accurate overview of the muscle, related vessels, arteries and nerve supply to ensure a safe and effective treatment outcome and cosmetic result.

### ANATOMY

The frontalis (more accurately termed the Occipito-frontalis) is a quadrilateral, flat and exceptionally thin muscle, with no bony attachment.[2] It forms part of a group of elevator muscles, which elevate the brow. The musculoaponeurotic group consists of the frontalis, the galea aponeurotica and the occipitalis. The medial fibres of frontalis closely interweave with muscle fibres of the brow depressors at the level of the glabellar and interdigitate with the procerus, the corrugator supercilli, depressor supercilli, and orbicularis oculi.[3] Hence there is no bony insertion; below the dermal insertion there is a potential space. If this area is inadvertently injected with botulinum toxin it may result in spread of the toxin down to the orbital septum, resulting in ptosis. The frontalis fibres extend posteriorly over the forehead to fuse with the galea aponeurotica in the occipital area. Here, the occipital bellies arise by tendinous fibres from the lateral two thirds of the highest nuchal line of the occipital bone and the mastoid part of the temporal bone. Its lateral most fibres are intertwined and blended with orbicularis oculi over the external angular process of the frontal bone, onto which it inserts.[4] The galea aponeurotica is a continuous musculo membranous sheet, which extends from the external occipital protuberance and supreme nuchal lines to the brow. The aponeurosis is continuous laterally with the temporal fascia: principally membranous, it contains the occipitofrontalis muscle. This muscle represents the third layer in the scalp equivalent to the SMAS layer in the face.[5]

Rohrich and Pessa[6] described findings from their study of thirty hemifacial cadaveric dissections, which demonstrate the subcutaneous fat of the face partitioned discretely as opposed to a confluent mass. The authors describe the subcutaneous forehead fat to be divided into 3 segments with borders identified through the use of Methylene blue dye in the following arrangement. They are described in the following 'compartments':

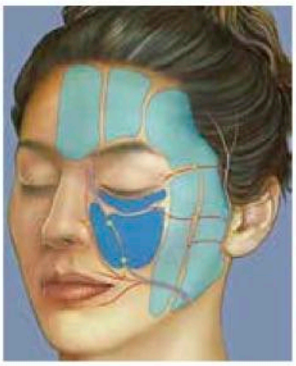

Figure 2

**Central compartment:** A midline region with an inferior border at the nasal dorsum. The authors suggest the lateral border is a dense facial plane, referred to as a central temporal septum with the supra-trochlear vessels running along this area.
**Middle forehead compartment:** Situated on either side of the central fat and located medially to the superior temporal septum, bordered inferiorly by the orbicularis retaining ligament of the superior orbit.
**Lateral temporal cheek fat:** Spans the forehead to the cervical region with superior and inferior temporal septa representing the superior boundaries.

Mendelson describes how the face may be viewed and treated as five distinct layers[7], the principles of which hold relevance in relation to the use of toxin in treating the frontalis:

**Layer 1:** Skin
**Layer 2:** Superficial fascia, also referred to as the subcutaneous layer.
**Layer 3:** Superficial muscular aponeurotic system, commonly referred to as the SMAS. This can be seen on dissection as a strong fibrous sheet which covers the whole face and holds the muscles in place.
**Layer 4:** Loose areola, also referred to as the gliding plane
**Layer 5:** Deep fascia, which is a thin layer of connective tissue.

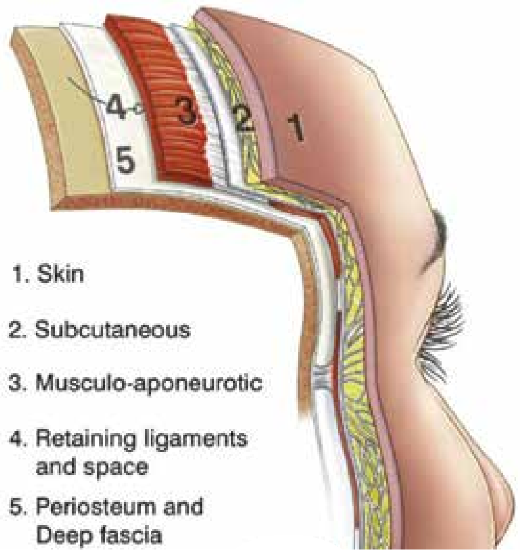


Figure 3

This concept of the face having five distinct layers is noteworthy for the injector as the first three layers (skin, superficial fascia and SMAS) move cohesively as one over the loose areolar layer, which is comprised of loose connective tissue and provides a gliding plane, which is crucial for facial expression. The lateral temporal septum also separates the deep temporal compartment with the temporalis muscle from the medial forehead compartment containing the frontalis muscle. The most lateral part of the eyebrow does not have any frontalis fibres attached to it; the lateral fibres of orbicularis oculi act as 'brow depressor' and relaxation of these fibres with botulinum toxin injection will allow the lateral brow to 'lift'.

## ARTERIAL SUPPLY

The face and scalp are highly vascularised and supplied by five arteries which stem from the internal and external carotid artery; supratrochlear, supraorbital, superficial temporal, posterior auricular and occipital.[8] The majority of the skin and subcutaneous tissue of the face is supplied by branches of the external carotid artery. The ophthalmic artery moves anteriorly through the optic canal to enter the orbit, dividing into the supraorbital and supratrochlear branches which exit through their respective foramen, along the superior orbital rim.[9] The supratrochlear branch emerges in the area of the corrugators and moves superiorly with branches extending in its path. Within the corrugator complex, the artery is vulnerable to injury from needle puncture through injection of toxin and the clinician is advised to exercise caution here due to its superficial path. The supraorbital branch exits the orbit in the midline of the superior orbital rim and travels deeper in subcutaneous tissue, to the frontalis. The supraorbital and supratrochlear arteries run with corresponding nerves, the suproaorbital artery is the larger of the two and anastomoses with the superficial temporal artery to connect the internal and external carotid systems. This is a key anatomical consideration for the injector when placing any product in this area due to the potential risk of serious vascular complications.

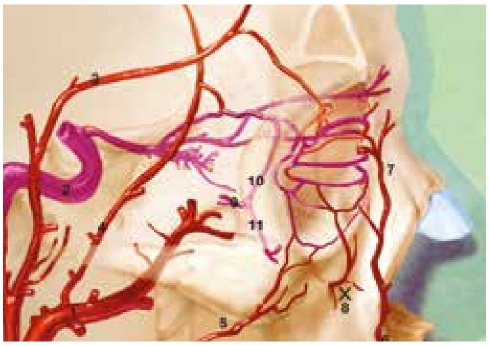

Figure 4

The external carotid runs along the lateral aspect of the neck, dividing into two branches, below the dermis, anteroinferior to the tragus of the ear. One is the superficial temporal artery, a terminal branch of the external carotid that lies superiorly in front of the ear and crosses the zygomatic arch, branching widely into the skin that overlies the temporalis fascia in the sub-cutaneous tissue (Level 2). The skin crease anterior to the ear marks the surface for the superficial temporal artery. The middle temporal artery pierces the fascia, supplies temporalis and anastomoses with the deep temporal branches of the maxillary artery. The second branch of the terminus of the external carotid is the internal maxillary artery, which runs deeply. Numerous anastomoses and interconnections occur between the arteries in the upper face, which the injector must be aware of when placing product in this area.

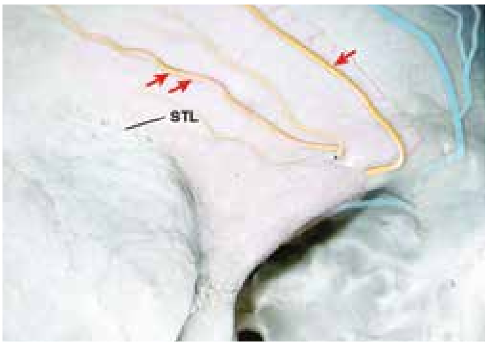


Figure 5

## VENOUS DRAINAGE

Facial veins have a remarkably similar distribution pattern to that of the arteries and venous drainage of the face generally follows the arterial pattern, with flow in the opposite direction. The supraorbital and supratrochlear veins run with the corresponding arteries and nerves.[10] The supraorbital vein begins in the forehead where it interweaves with the superficial temporal vein and passes inferiorly then superficially to the frontalis muscle and meets with the supratrochlear vein medially across the orbit to form the angular vein. The superficial temporal vein drains the forehead and scalp.[11]

## NERVE SUPPLY

The Cranial nerve V11 (the facial nerve), which activates muscles of facial expression, emerges from the skull through the stylomastoid foramen and produces the posterior auricular nerve, which passes upwards behind the ear to supply the auricularis posterior and the occipital belly of occipital frontalis.[12] The nerve then approaches the posteriomedial surface of the parotid gland. Just before entering, or when inside the branches of the gland divide allowing the cervicofacial and temporofacial branches to develop. Within the substance of the gland each divides and rejoins and divides again to finally emerge from the gland in 5 main branches:

temporal, zygomatic, buccal, mandibular and cervical. The temporal branches emerge from the upper border of the gland, underneath the SMAS and masseteric fascia; it then crosses the zygomatic arch to pass in a deep supraperiostial level. It transitions subcutaneously to innervate the frontalis and presents as fine branches within the subcutaneous layer (Level 2).

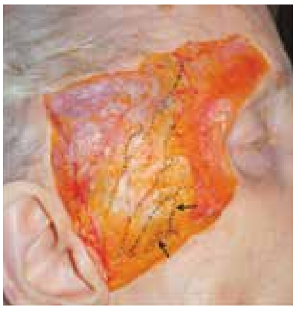

Figure 6

The trigeminal nerve (cranial nerve V) provides sensory innervation of the face through its three branches: the ophthalmic nerve, the maxillary nerve and the mandibular nerve.[13] The ophthalmic and maxillary nerves serve most relevance to this anatomical discussion. The ophthalmic nerve is the superior point of division for the trigeminal nerve and divides into three branches: the lacrimal, the frontal, and the nasociliary branches. The lacrimal nerve supplies the lacrimal gland, the upper eyelid, the conjunctiva and the lateral angle of the eye. The frontal nerve subdivides again into two branches: supratrochlear and supraorbital, with the supratrochlear nerve supplying the medial angle of the eye, the upper eyelid and part of the glabellar. The supraorbital nerve emerges from the superior orbital segment through the supraorbital foramen, supplying the lateral canthus, the upper eyelid, and the temporal and frontoparietal regions of the head. The maxillary nerve is a further division of the trigeminal nerve; it gives off an orbital branch, then divides again to supply the lateral part of the upper eyelid, and a temporomaxillary branch, supplying the anterior temporal region. It continues from below the orbital margin, through the infraorbital foramen as a large branch, leading to the infraorbital nerve, which supplies the lower eyelid, the nose laterally, upper lip and the cheek.[14]

## FRONTALIS MIDLINE DEHISCENCE CONSIDERATIONS

Superiorly to the nasion the frontalis fibres continue for a varied distance before an aponeurosis develops in the space between the two bilateral muscle segments. The point of divergence of the two muscles is regarded as the point of dehiscence or midline attenuation point.[15] Many taught methods of injection placement with toxin advocate a midline injection point. However, a recent study by Spiegel et al in 2009 sought to define the anatomy of the frontalis muscle and accurately capture the height and dimensions of the midline dehiscence.[16] The authors demonstrated in male cadavers a considerable variation in their medial frontalis muscle border, presenting as either a 'W' shape or a stair-step shape. Female cadavers

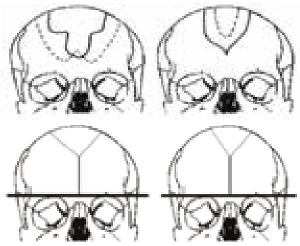

Figure 7

demonstrated less irregularity with a smoother border and muscle fibres higher in midline, and were noted to have a higher relative dehiscence with less lateral spread. In three out of the nine female cadavers, a continuous muscle showed with no point of dehiscence and active muscle evident high on the forehead, demonstrated to 6cm above the orbital rims. Further findings from the data reported the frontalis muscle with a 3.5cm midline dehiscence in men and 3.7cm in women.

The angles that the left and right muscles formed with the midline were also found to be more acute in female cadavers, which is important as this indicates that it may be necessary to place botulinum toxin more laterally in males to avoid placing product in areas containing no muscle tissue.

The findings from this study signify the importance of identifying the midline attenuation point in selecting either a surgical or pharmaceutical treatment to improve the appearance of forehead rhytides, and enforce the importance of identifying the anatomical differences between male and female subjects in relation to this highly variable muscle. Results from the study should enable the clinician to conserve product usage by decreasing the likelihood of injecting toxin into areas of the forehead without muscle tissue.

## CONCLUSION

It has been our aim in this paper to provide insight around the anatomical characteristics of the frontalis muscle. The variability of individual frontalis anatomy and importance of understanding and treating accordingly has been discussed together with key findings from recent frontalis anatomical research, to equip the practitioner with accurate insight in treating the frontalis muscle for cosmetic rejuvenation. It is vital to understand anatomy to ensure a safe and appropriate treatment and to enhance the cosmetic result. The content of this paper has been compiled to concisely support clinicians in gaining a clearer understanding of the characteristics of the frontalis muscle, by drawing upon current research to encourage critical thinking and an evolving practice.

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