The Corrugator Supercilii Muscle Revisited

Nicanor G. Isse, MD; and Mohammed M. Elahi, MD

Background: Few studies have examined the anatomy of the central forehead as it pertains to vertical glabellar furrows.

Objective: This study sought to critically examine the corrugator supercilii muscle (CSM) in situ, in relation to surrounding bony and soft tissue landmarks.

Methods: Anatomic dissection of 10 fresh cadaveric hemi-heads was performed, focusing on the CSM origin and insertion, with emphasis on regional fascial relations, neurovascular structures, and osseous topography.

Results: The CSM originates along the supraciliary arch. The muscle is attached at its medial and superior margin, whereas the lateral and inferior margins are free. The muscle originates from a bony plateau on the supraciliary arch. The CSM travels laterally, with most of the muscle passing through the fibers of the orbicularis oculi and the frontalis. The dermal insertion of the muscle is under the central portion of the eyebrow. The nerve supply enters at the lateral aspect of the muscle approximately 5 mm cephalic to the lateral brow. The action of the CSM is to elevate the medial aspect of the brow and depress the lateral segment of the brow.

Conclusion: The CSM does not appear to be the primary determinant of vertical glabellar frown lines. (Aesthetic Surg J 2001;21:209-215.)

The aesthetic of the central forehead has received increasing attention from plastic surgeons in recent years, paralleling the introduction of endoscopic forehead access in 1992.1-3 Vertical frown lines in the glabellar region are a particular concern for the contemporary patient interested in rejuvenation of the upper third of the face.4-6

The complex surgical anatomy of this region has led to controversy and confusion regarding the actual relation of the muscles to these furrows. Most surgeons focus attention on the corrugator supercilii muscle (CSM) as the culprit in the development of glabellar frown lines, primarily on the basis of classic anatomic descriptions.4-7 In many instances, however, correlates to surgical anatomy are not consistent.8,9 The purpose of this study was to better elucidate the origin and course of the CSM and its relation to glabellar frown lines and associated structures in the central forehead.
Materials and Methods

Five fresh cadaver heads (10 hemi-heads) were obtained from the Department of Anatomy, University of California at Los Angeles (UCLA), for critical evaluation of the CSM. A midline forehead incision was performed with removal of regional skin in a medial to lateral direction to the temporal crest. Dissection of successive soft tissue and muscular structures superficial to the CSM mass was performed carefully, detailing the relations. The origin and insertion of the corrugator muscle was noted, preserving anatomic relations to the surrounding fascia, neurovascular structures, and osseous landmarks.

Results

The CSM originates from a broad osseous origin along the supraciliary arch, contrary to previous studies (Figure 1). The muscle is clearly attached to the underlying periosteum at its entire superior, medial, and deep surfaces (Figures 2 and 3). Dissection of the muscular origin reveals a bony plateau in a region of hyperostosis on the supraciliary arch where the muscle consistently is seated (Figure 1). The trapezoidal CSM muscle travels a transverse direction laterally, slightly superior, which confirms previous findings\(^1\); the lateral two thirds of the muscle pass through the fibers of the orbicularis oculi, and the frontalis and the most lateral fibers terminate in the dermis lateral to the supraorbital nerve (“corrugator dimple”) (Figure 4). Most of the corrugator muscle is located under the eyebrow, except for the most medial and superior portion, where the corrugator fibers are superior to the eyebrow. The medial third of the muscle, however, does not appear to traverse through the orbicularis oculi to the dermis.

Most of the branches of the supraorbital and super-trochlear nerves run on the superficial surface of the muscle; others run through the substance of the muscle itself (Figures 3 to 5). The motor nerve supply (corrugator nerve) is a branch of the temporal branch of the facial nerve that enters at the lateral aspect of the muscle as it travels deeper through the orbicularis, frontalis, and corrugator muscles (Figure 6). The presumed action of the CSM is to elevate the medial aspect of the brow with concurrent depression of the lateral segment of the brow, effects that do not appear to contribute to vertical glabellar frown lines (Figure 7).
Discussion

The CSM has been recognized as a major muscle component of the glabellar and central forehead regions.\textsuperscript{11-13} It has received widespread attention from plastic surgeons operating in this area and is considered to be the major determinant of vertical glabellar furrows by many authors.\textsuperscript{5,7-9,11} Nevertheless, surgical-anatomic correlations do not confirm this fact. Myectomy of the CSM, no
doubt, improves these furrows and has been cited as evidence to support its preeminent role; however, we have shown, from an anatomic point of view, that this is unlikely.

The main action of the CSM is elevation of the head of the brow and concurrent depression of the lateral aspect of the eyebrow. The CSM is synergistic with the frontalis medially and with the orbital portion of the

Figure 4. Insertion of right corrugator muscle. **a, c,** The lateral two thirds of the muscle inserts on the overlying skin, sending its fiber through the frontalis and orbicularis muscles; **b,** the medial one third of the muscle is free of any insertion to the overlying tissue and contains its own investing fascia to allow gliding of the overlying tissue; most of the corrugator fibers insert between the supratrochlear and supraorbital neurovascular bundles (c), though the fibers extend laterally beyond the supraorbital nerve (a).

Figure 5. Relation between the corrugator muscle and other muscles. **a,** The supraorbital nerve runs through the lateral portion of the corrugator muscle; **b,** deep origin of the corrugator muscle; **c,** glabellar or medial origin of the corrugator muscle; **d,** the vertical portion of the medial orbicularis oculi muscle runs superficial to the corrugator muscle and around the supratrochlear nerve to insert in the orbital portion of the frontal bone; **e,** origin of the depressor supercilii muscle from the nasal process of the frontal bone.
orbicularis muscles laterally. Thus the CSM is antagonistic to the procerus muscle and to the orbital portion of the orbicularis oculi for the head of the eyebrow. This muscle is equally antagonistic to the frontalis for the lateral third of the eyebrow and is synergistic for the medial third. The resultant muscle action leads to the development of horizontal lines in the central forehead. Remarkably, this fact was recognized in 1862 by Duchenne de Boulogne in his classic work titled *The Mechanism of Human Facial Expression*, in which he systematically stimulated each of the muscles of the face in isolation to assess their function. Duchenne referred to the corrugator muscle as the “muscle of pain” and recognized the effects of puckering and elevation of the medial brow with lowering of the lateral brow on direct stimulation.

The improvement in vertical furrowing after corrugator resection is related to this muscle’s passive function on the medial brow, which is brought about by the action of the depressor supercili muscle. Corrugator resection most likely injures or includes partial or complete resection of the depressor supercili muscle, in addition to contributing fibers from the medial portion of the orbicularis oculi and/or procerus muscles.

**Conclusion**

This study has better defined the origin and insertion of the CSM. Specifically, we have shown that the muscle originates above the supraorbital rim,
which in turn corresponds to a position at or above the eyebrow. The region of corrugator muscle origin corresponds to a bony plateau or depression, which we suggest would be better termed the corrugator plateau or the corrugator facet for anatomic accuracy. We have defined the region of the corrugator facets where the muscle is consistently seated and have also shown that the muscle is clearly fixed at its medial, entire superior, and deep margins. We have not encountered a transverse and oblique head to the corrugator muscle, as has been suggested by other authors. Most importantly, the effects of muscular action are to elevate the medial brow and depress the lateral brow, yielding a sinusoidal configuration to the eyebrow. Corrugator muscle function contributes to frown lines mainly in the region of the mid forehead (horizontal lines), not in the area of the glabellar frown lines.

References

Commentary
by David M. Knize, MD
Englewood, CO

Drs. Nicanor G. Isse and Mohammed M. Elahi have made a valuable contribution to the growing body of literature describing the anatomy of the upper face. They more clearly define the site of bony origin of the corrugator supercilii muscle from the superior-medial orbital rim, and they add useful, descriptive anatomic terms. The suggested terms corrugator plateau and corrugator crest, used in describing the bony attachment of the corrugator supercilii muscle, are excellent.

The authors confirm the anatomy of the transverse head of the corrugator supercilii muscle and its passage through the orbicularis oculi and frontalis muscles to reach its dermal insertion. However, they do not describe the oblique head of the corrugator supercilii muscle, which inserts into dermis just superior to the medial end of the eyebrow near the dermal insertion sites of the depressor supercilii muscle and the medial head of the orbicularis oculi muscle. In an anatomic study designed to simulate the action of the glabellar muscles done in conjunction with a clinical nerve-block study, these 3 muscles acted to depress the medial ends of the eyebrows and produce the oblique lines perpendicular to the medial eyebrows sometimes seen there. That study further showed that the transverse head of the corrugator supercilii muscle moved the eyebrows medially to produce the characteristic vertical glabellar skin lines.

The authors propose and I agree that corrugator supercilii muscle contraction lowers the lateral eyebrow segment while elevating the medial eyebrow segment, as shown in their Figure 7. There is no question that contraction of this muscle in synergy with the lateral orbicularis oculi muscle depresses the lateral end of the eyebrow, as the authors describe. Because the antagonistic frontalis muscle is generally attenuated or absent above the lateral third of the eyebrow, little frontalis muscle support exists there to oppose the action of these 2 muscles. Note the absence of characteristic transverse forehead lines produced by frontalis muscle contraction above the lateral eyebrows in Figure 7, while the usual transverse forehead skin creases remain over the more medial forehead where frontalis muscle is essentially unopposed by corrugator supercilii muscle.