# The Anatomical Morphology of the Supraorbital Notch: Clinical Relevance to the Surgical Treatment of Migraine Headaches

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**Background:** Current literature for surgical deactivation of frontal migraine trigger points does not incorporate decompression of the supraorbital foramen or fascial bands at the supraorbital rim (frontal exit) as part of the surgical procedure. To evaluate this primary compression site for the supraorbital nerve, anatomical dissections were performed and a classification system was developed.
**Methods:** Sixty supraorbital regions from 30 ethylene glycol–preserved cadaveric heads were dissected. Particular attention was focused on the morphology of the supraorbital rim, specifically, the presence of a supraorbital notch or supraorbital foramen. The presence or absence of a fascial band completing the notch and the patterns of fascial band variations were documented.
**Results:** A supraorbital foramen was identified 27 percent of the time and a notch was identified 83 percent of the time. When a notch was encountered, a fascial band forming the floor of the notch that completed the encirclement of the supraorbital nerve was noted in 86 percent of supraorbital regions. A classification system was developed to categorize the four common fascial band variation patterns observed.
**Conclusions:** This study verifies the presence of a primary compression site for the supraorbital nerve that is proximal to the glabellar myofascial complex. Knowledge of this compression site and its possible anatomical variations will enable surgeons to perform a more complete supraorbital nerve decompression for migraine amelioration. (*Plast. Reconstr. Surg.* 130: 1227, 2012.)

Surgical deactivation of frontal migraine trigger points has focused attention on the relation of the glabellar myofascial complex to the supraorbital and supratrochlear nerves.[1,2] The intimate anatomy of the branching patterns of the supraorbital nerve within the corrugator supercilii has further been evaluated to guide a more effective deactivation of this trigger point.[3] Knowledge of this anatomy has led to frontal decompression reducing migraine headaches by half in 83.7 percent versus 57.7 percent of a sham surgery cohort, and completely eliminated in 57.1 percent of the surgical arm and in 3.8 percent of sham operations.[4] The surgical technique for frontal trigger point deactivation in published series has focused largely on muscular resection with sensory nerve preservation in the glabellar region. The glabellar myofascial component clearly contributes to peripherally triggered frontal migraines; however, we aim to answer the question of whether more proximal sites of nerve compression may exist accounting for the incomplete relief of symptoms. As peripheral nerve entrapment literature has documented so well, there can be multiple sites of compression along the same nerve.[5] The supraorbital nerve is no different.

The extracranial path of the supraorbital nerve emerges from the orbit onto the forehead through of a foramen, notch, or combination thereof. The presence of a bony foramen varies from 26.6 to 50.0 percent, a notch in the supraorbital rim is present in 50.0 to 71.6 percent, and a double passageway is described in 1.8 to 7.8 percent of supraorbital regions.[6–11] Although these reports detail the potential extracranial paths of the supraorbital nerve, they do not elaborate on

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how the fixed diameter of the foramen or notch impacts the contents that traverse them. If a foramen is present, this point is a definite closed, nonexpanding site. If a notch is present, there can also exist a fascial band that completes the ring of this transition point, much like a "miniature carpal tunnel." These fixed anatomical points create potential compression sites for the supraorbital nerve. Surgeons performing frontal trigger site decompression have identified the presence of a fascial band at the supraorbital rim as a potential compression site but have not routinely incorporated its decompression as part of their surgical procedure. We believe the fascial band, when present, is part of the primary site of proximal compression.

The anatomical variations of this enveloping fascia in relation to the supraorbital nerve notch have not been evaluated. To investigate this potential compression site proximal to the corrugator supercilii, a cadaveric study was performed.

## MATERIALS AND METHODS

Anatomical dissections were performed on 60 supraorbital rims from 30 ethylene glycol–prepared cadaveric heads. Institutional review board approval was obtained for this cadaver study. Age, sex, and medical history were not recorded. Supraorbital dissections were performed beginning at the lateral orbital rim and proceeding medially until the supraorbital neurovascular bundle was identified. The presence of a foramen and/or a notch was documented. When a notch was encountered, further notation of a fascial band and its variation was identified when present.

## RESULTS

A foramen was present allowing supraorbital nerve passage in 26.7 percent (16 of 60) and a notch in 83.3 percent (50 of 60) of the supraorbital regions (Table 1). Six supraorbital regions contained both a foramen and a notch (Fig. 1). The presence of both a foramen and a notch within the same region represents an intraconal supraorbital nerve branching pattern into its deep and superficial branches (Fig. 2). Variations among right and left supraorbital regions within the same cadaver were apparent. Nine cadavers demonstrated differences from side to side with respect to the presence of a foramen or notch (Fig. 3).

**Table 1. Supraorbital Nerve Emergence Routes at the Supraorbital Rim**

| | Right Supraorbital Region | Left Supraorbital Region | Total (%) |
|---|---|---|---|
| Foramen | 9 | 7 | 16 (26.7) |
| Notch | 25 | 25 | 50 (83.3) |
| Foramen and notch | 4 | 2 | 6 (10.0) |

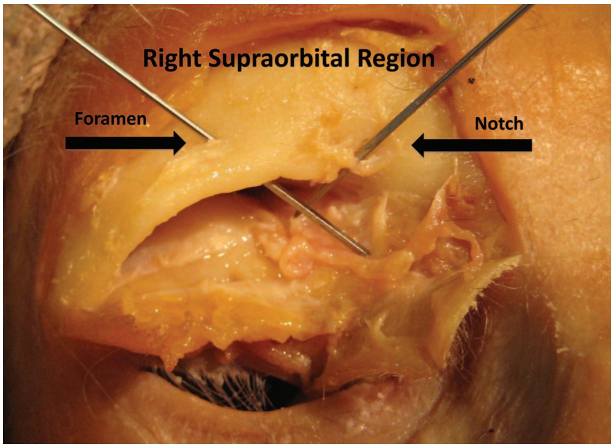


**Fig. 1.** Supraorbital region demonstrating both a foramen and a notch. This represents a proximal branching pattern of the supraorbital nerve with two separate exit sites at the rim.

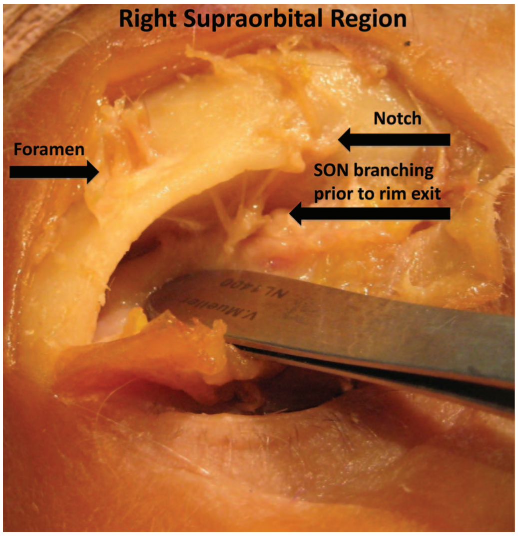


**Fig. 2.** Atypical, intraconal supraorbital nerve (*SON*) branching pattern into its deep and superficial branches proximal to supraorbital rim emergence; this pattern was present in six cadavers. This represents two separate nonexpanding supraorbital nerve exit sites responsible for compression at the supraorbital rim.

A fascial band was identified in 86.0 percent of supraorbital regions (43 of 50) that contained a notch. The fascial bands were further subclassified (Table 2) into three main categories. Type I bands, or "simple," refer to bands that are composed entirely of fascia with a single opening for supraorbital neurovascular passage (Fig. 4). Of the fascial bands present, 51.2 percent (22 of 43) were type I. Type I bands varied on both the amount of fascia present

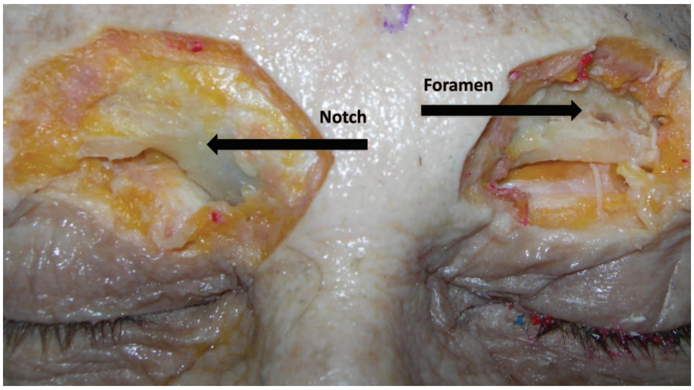


**Fig. 3.** Nine cadavers demonstrated differences from side to side with respect to the presence of a foramen or a notch.

**Table 2. Classification of Fascial Band Variations Present at the Supraorbital Notch***

| Fascial Band Description | Fascial Band Classification | Supraorbital Regions† (%) |
|---|---|---|
| Simple | I | 22 (51.2) |
| Partial bony | II | 13 (30.2) |
| Septum | | |
| Horizontal | IIIA | 4 (9.3) |
| Vertical | IIIB | 4 (9.3) |
| Total count | | 43 |

*Type I fascial bands, or "simple," are composed entirely of fascia with a single opening for supraorbital neurovascular passage at the supraorbital notch (Fig. 4). Type II fascial bands, or "partial bony," are composed of bony spicules with intervening fascia that completes the bridge overlying the supraorbital neurovascular contents (Fig. 6). Type IIIA fascial bands contain a horizontal septum (Fig. 7), and type IIIB fascial bands contain a vertical septum (Fig. 8) that allows for a double passageway for the supraorbital neurovascular bundles within the notch.
†Frequency data of the fascial band types when a notch is present at the supraorbital rim.

and the aperture allowing supraorbital nerve passage through the notch (Fig. 5). Type II bands, or "partial bony," refer to bands that are composed of bony spicules with intervening fascia that completes the bridge overlying the supraorbital neurovascular bundle (Fig. 6). There were 30.2 percent (13 of 43) type II bands. Type III bands, or "septum," are those fascial bands with a septum. This type was divided into two different subtypes depending on whether the septum was found in a horizontal position (type IIIA) (Fig. 7) or a vertical position (type IIIB) (Fig. 8), which allows for a double passageway for the supraorbital neurovascular bundles. There were 9.3 percent (four of 43) type IIIA bands, and 9.3 percent (four of 43) type IIIB bands.

## DISCUSSION

We present the first anatomical study to describe potential proximal compression points for

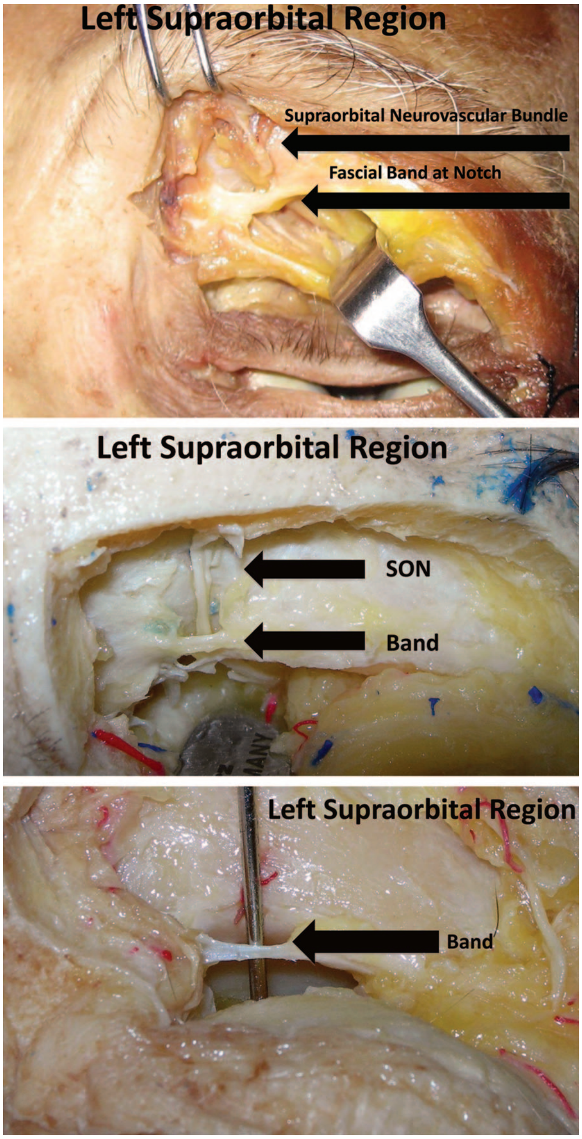


**Fig. 4.** Type I, or "simple," bands refer to bands that are composed entirely of fascia with a single opening for supraorbital neurovascular passage. *SON*, supraorbital nerve.

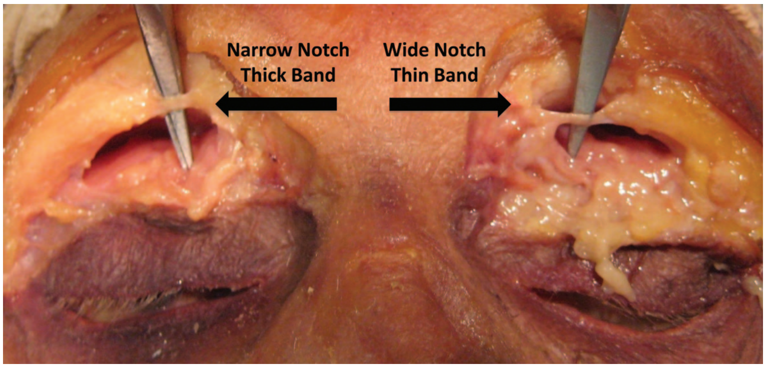


**Fig. 5.** Aperture size discrepancies for the supraorbital nerve emergence at the supraorbital rim. Both the quality of the fascial band and the size of the notch determine supraorbital nerve compression at this fixed anatomical point.

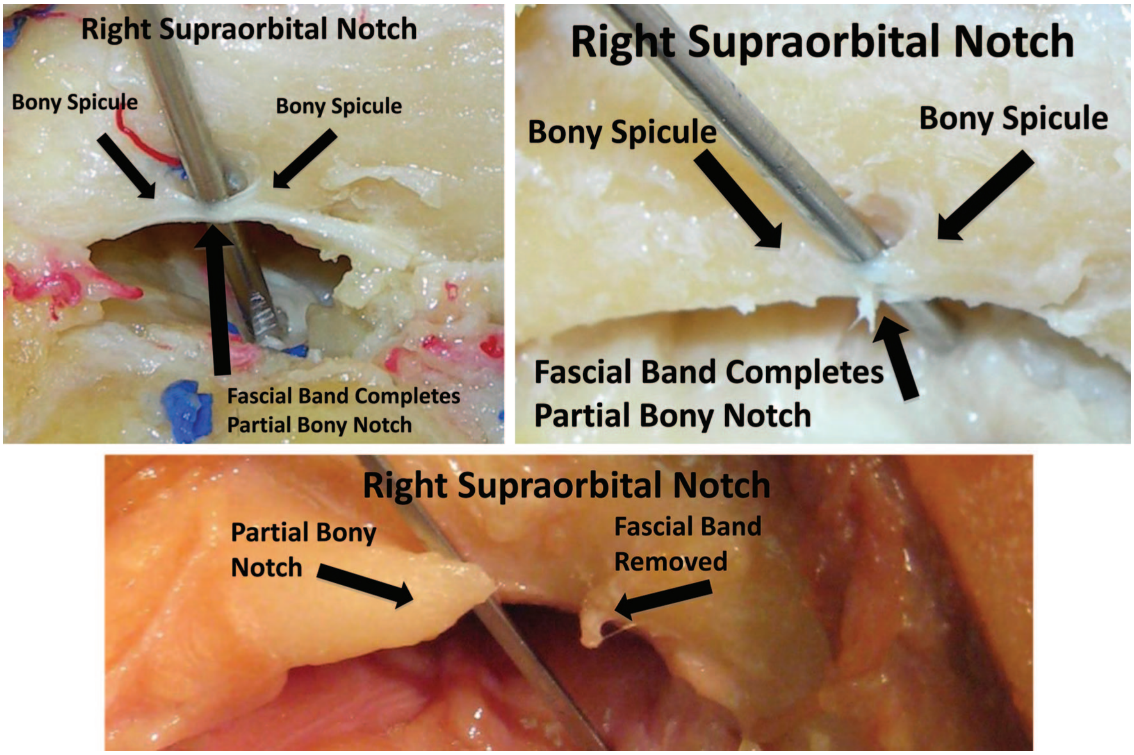


**Fig. 6.** Type II, or "partial bony," bands refer to bands that are composed of fascia and bone that complete the bridge overlying the supraorbital neurovascular bundle.

the supraorbital nerve as it emerges onto the supraorbital rim. The first division of the trigeminal nerve, or the fifth cranial nerve, gives off the frontal branch that enters the orbit through the superior orbital fissure. Within the confines of the orbit, the supraorbital nerve and supratrochlear nerve emerge from branching of the frontal branch. The supraorbital nerve has a variable route through a bony foramen or notch as it passes onto the forehead. It is obvious that a complete bony foramen serves as a compression point to this nerve. However, it is also important to recognize that a supraorbital notch has various fascial band morphologies that can completely encircle the nerve, making it vulnerable to compression as well.

The surgical relevance of supraorbital nerve compression at the supraorbital rim became apparent in a 1999 series of five patients by Sjaastad et al. Sjaastad et al. surgically resected "a ligament, band

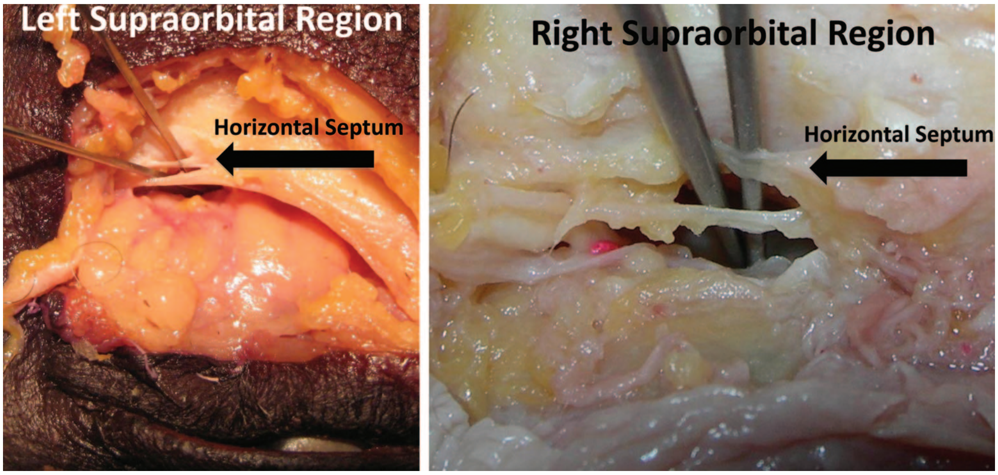


**Fig. 7.** Type IIIA, or "horizontal septum," bands are those fascial bands with a horizontal septum that allows for a double passageway for the supraorbital neurovascular bundles. Simply decompressing the outer fascial band at the notch will not completely decompress the totality of the supraorbital nerve because of proximal branching.

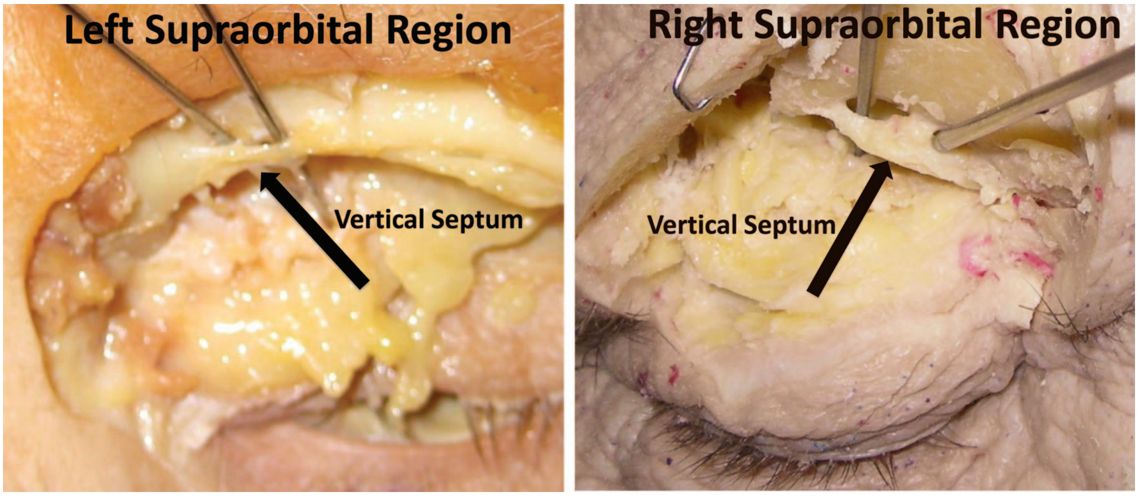


**Fig. 8.** Type IIIB, or "vertical septum," bands are those fascial bands with a vertical septum that allows for a double passageway for the supraorbital neurovascular bundles. Simply decompressing the outer fascial band at the notch will not completely decompress the totality of the supraorbital nerve because of proximal branching.

or bony excrescence" that was present at the supraorbital rim and thus relieved first-division trigeminal neuralgia symptoms.[12] Based on the findings of Sjaastad et al. and the anatomical knowledge that the supraorbital nerve has variable branch points before traversing the supraorbital rim, multiple compression sites proximal to the glabellar unit are possible.

The results of our anatomical study demonstrated that 86.0 percent of supraorbital regions with a notch present had a definite fascial band encasing the supraorbital neurovascular bundle. Within the same cadaver, we noted a high degree of variability from one side to the other with respect to the course of the supraorbital nerve and the structures surrounding it. These side-to-side anatomical differences and the diameter of the apertures may account for the clinical unilateral migraine symptomatology that will be discussed in a subsequent clinical report.

We developed a classification system of fascial bands surrounding the supraorbital nerve in an attempt for future interstudy comparison (Fig. 9). Although type I bands were the most commonly encountered, surgeons must be aware of the other variations that exist to completely decompress the

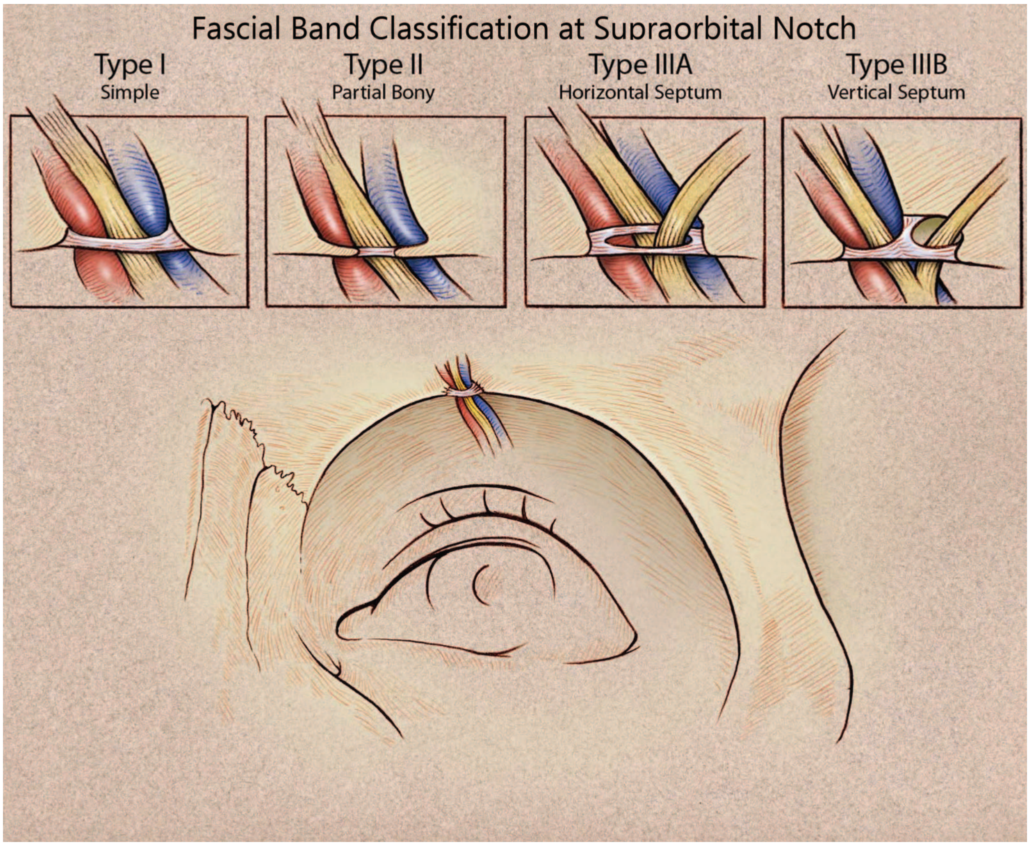


**Fig. 9.** Fascial band classification, with common variants of the supraorbital notch and its fascial morphology enveloping the supraorbital neurovascular bundle.

supraorbital nerve. This is analogous to an upper extremity first dorsal compartment, or De Quervain, release. Failure to completely release the multiple slips of the abductor pollicis longus can predictably lead to recalcitrant wrist pain.

This anatomical cadaver study introduces the hypothesis that the presence of a band, whether fascial or partial bony, may incite a frontal peripherally triggered migraine proximal to the glabellar myofascial unit. When present, the encircling bony foramen or fascial band at the notch is a defined anatomical factor that relates to a decreased space for the supraorbital neurovascular bundle to traverse. In certain patients with either a tight notch aperture or a large neurovascular bundle (e.g., diabetics), this represents a proximal extracranial compression site that makes the nerve more susceptible to further entrapment along its course. Future studies aim to implement an office-based tool, such as handheld ultrasound, to visualize the supraorbital anatomy preoperatively to guide operative technique/band identification for amelioration of symptoms.

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## Evidence-Based Medicine: Questions and Answers

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A: A good rule of thumb is as follows (these papers are not amenable to LOE grading):

- Animal studies
- Cadaver studies
- Basic science studies
- Review articles
- Instructional course lectures
- CME courses
- Editorials
- Correspondence

As far as what is or is not ratable, the standard is to exclude basic science, bench work, animal, and cadaveric studies because the information gained from these studies is not something that can be applied directly to patient treatment decisions.

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