



SHANKHA MARMA: ANATOMICAL AND CLINICAL CORRELATION WITH THE PTERION AND MIDDLE MENINGEAL ARTERY

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Abstract: *Shankha Marma*, described in *Sushruta Samhita* as an *Asthi Marma*¹, is located at the temple region, superior to the lateral canthus of the eye, between the ear and forehead². Anatomical studies correlate this site with the Pterion³, a region where multiple cranial bones converge, overlaying the middle meningeal artery⁴⁻⁵. This area is clinically significant due to its vulnerability to trauma, which can lead to life-threatening conditions such as epidural hematoma⁶⁻⁷. Although some scholars suggest the Pterion's multi-bone convergence could categorize *Shankha Marma* as a *Sandhi Marma*, classical texts specifically classify it as an *Asthi Marma*, indicating a need for precise anatomical interpretation.

This study aims to clarify *Shankha Marma*'s classification through a detailed anatomical analysis, focusing on the temporal bone's relationship to the middle meningeal artery⁸. Findings support that only the temporal bone is closely associated with the artery, justifying *Shankha Marma*'s designation as an *Asthi Marma* and underscoring the importance of maintaining traditional Ayurvedic classifications within their unique framework. This integrative approach fosters a better understanding of *Marma* points in the context of modern anatomy, enhancing diagnostic and Surgical applications in Ayurvedic practice.

Keywords: Shankha Marma, Pterion, Middle Meningeal Artery, Asthi Marma

INTRODUCTION: *Marma* are delicate points in the human body where any injury can lead to death or serious disability among them *Shankha Marma* is classified as an *Jatrurdhwa / Shirogata Marma* in Ayurvedic texts, occupies a vital location at the temple area also known as Temporal bone which is derived from Latin word 'Tempos' which means time, it is called so, as the temporal region will be the first site to show the signs of aging, few suggest that as per the modern anatomy *Pterion*, could be identified as the *Shankha Marma*. The proximity of the Pterion to the middle meningeal artery, an important artery that supplies the meninges makes it a critical site, as trauma can result in epidural hematoma and other neurological emergencies, while considering the *Pterion*'s multi-bone convergence might classify *Shankha Marma* as a *Sandhi Marma*, Ayurvedic texts consistently categorize it as an *Asthi Marma*, emphasizing the relevance of need to re-examine the anatomical and clinical implications of *Shankha Marma*, reinforcing its traditional classification as injuries to this *Marma* is often seen as blunt injury in certain sports like Boxing, Mixed martial arts fighters, Cricket etc and relevant to current era.

MATERIALS AND METHODS: This study involved a review of classical Ayurvedic text *Sushruta Samhita* to establish the characteristics and classification of *Shankha Marma*. Anatomical literature was also reviewed, focusing on structures around the Pterion and their relationships to the middle meningeal artery. The anatomical proximity of the temporal bone to this artery, and its potential clinical implications, were examined to assess the appropriateness of *Shankha Marma*'s classification as an *Asthi Marma*.

Using terms such as Pterion, Middle meningeal artery, and *Shankha Marma*, yielded 40 articles. Of these, three articles were deemed directly relevant to the present study and were analysed in detail. These references provided critical insights into the anatomical and clinical correlations essential to this investigation..

REVIEW OF LITERATURE

Shankha Marma: *Marma* is derived from the fact that these vital points of body, upon injury can lead to death. Shankha is also considered as one among the *Prana*'s, *Shankha Marma* is one among *Asthi Marma*¹ located at the temple area, just above the outer canthus and between the ear and forehead², measuring $\frac{1}{2}$ *Angula* in dimension⁹ injury to which can lead to sudden death¹⁰. Ayurvedic texts emphasize that injury to Shankha Marma can lead to sudden death, underscoring its critical clinical significance.

Pterion: The pterion, a critical anatomical landmark, is located at the anterior part of the temporal fossa, characterized by an H-shaped suture where four cranial bones converge: the frontal, parietal, greater wing of the sphenoid, and temporal bones. This region is situated approximately 4 cm above the midpoint of the zygomatic arch and 2.5 cm posterior to the frontozygomatic suture. Clinically significant structures lie in close proximity to the pterion. Deep to this region, the middle meningeal vein, the anterior division of the middle meningeal artery, and the stem of the lateral sulcus of the brain (Sylvian point) are located¹¹.

Middle Meningeal Artery (MMA)¹²: The middle meningeal artery (MMA) is of critical importance in both anatomy and clinical medicine, particularly for surgeons, as it is the most common source of extradural haemorrhage, a life-threatening surgical emergency.

Origin and Course: The MMA arises from the first part of the maxillary artery within the infratemporal fossa. Its pathway can be divided into distinct regions:

- **Infratemporal Fossa:** The artery ascends upwards and medially, positioned deep to the lateral pterygoid muscle and superficial to the sphenomandibular ligament. It uniquely passes through a loop formed by the two roots of the auriculotemporal nerve before entering the cranial cavity.
- **Entry into the Middle Cranial Fossa:** The MMA enters the cranial cavity through the foramen spinosum. Within the middle cranial fossa, it runs an extradural course, with the accompanying middle meningeal veins located closer to the bone than the artery itself. As it courses forward and laterally, the MMA grooves the squamous portion of the temporal bone and bifurcates into two primary branches: the frontal (Anterior) and parietal (Posterior) branches.

Branches and Clinical Relevance

- **Frontal Branch:** The larger of the two, the frontal branch traverses forward and laterally, crossing the pterion, a weak cranial point where the frontal, parietal, temporal, and sphenoid bones meet. This branch is closely associated with the motor cortex of the cerebral hemisphere, emphasizing its clinical significance in traumatic brain injuries, where damage can lead to motor deficits.
- **Parietal Branch:** The parietal branch runs posteriorly along or near the superior temporal sulcus, approximately 4 cm above the zygomatic arch. It terminates near the posteroinferior angle of the parietal bone, branching further into smaller vessels.

Additional Branches: The MMA predominantly supplies the bone and red bone marrow of the cranial diploe, with limited contribution to the dura mater. Within the cranial cavity, it provides:

1. Ganglionic branches to the trigeminal ganglion.
2. Petrosal branches to the hiatus for the greater petrosal nerve.
3. Superior tympanic branches to the tensor tympani.
4. Temporal branches to the temporal fossa.
5. Anastomotic branches to the orbit, forming connections with the lacrimal artery.

RESULTS: The convergence of bones at the Pterion includes the frontal, parietal, sphenoid, and temporal bones. However, only the temporal bone is closely associated with the middle meningeal artery. This artery runs in a groove on the inner surface of the temporal bone, making it vulnerable to direct trauma in this region. Other bones at the Pterion, while contributing to the structural junction, do not provide this close relationship with the artery, reinforcing the traditional classification of Shankha Marma as bone-related (*Asthi Marma*).

DISCUSSION: The text *Sushruta Samhita* is written under a surgeon's point of view, text provides descriptions on the underlying structures such as *Mamsa*, *Sira*, *Snayu*, *Asthi* and *Sandhi*¹³, dimensions of the *Marma* points in terms of finger width measurements all of which when clubbed together can provide precise anatomical landmarks for the important blood vessels or nerves, which are having potential to induce shock or permanent nerve damage causing death or disabilities¹⁴, thus it becomes important for a surgeon to know these anatomical landmarks while performing his surgeries and avoid those sites as much as possible¹⁵. Anatomical understanding of *Shankha Marma* provides a unique perspective when viewed through both traditional Ayurvedic and modern anatomical lenses. While some interpretations might associate it with *Pterion*, which would have made this *Marma* a *Sandhi Marma* but classical Ayurvedic texts identify *Shankha Marma* specifically as an *Asthi Marma*, relating it to bone structure.

In *Sushruta Samhita*, the classification as an *Asthi Marma* is significant, as it underscores the connection between *Shankha Marma* and the temporal bone rather than focusing on the broader junction of bones at the *Pterion*. Anatomically, even though the pterion involves the convergence of multiple cranial bones, among them only the sphenoid and temporal bones are closely

related to the middle meningeal artery, a key vessel that supplies the meninges, or protective layers, of the brain^{4,16}. This artery runs in a groove on the inner surface of the temporal bone, known as the middle meningeal artery groove^{5,16}. Injuries such as fractures or trauma to the temporal bone will directly affect this artery's integrity⁷. On the contrary, the middle meningeal artery though enters the skull through the foramen spinosum in the sphenoid bone it is not exposed to direct injury compared to the temporal bone.

Characteristics of Middle Meningeal Artery Bleeding: Due to high-pressure arterial flow, bleeding from the middle meningeal artery is rapid, causing swift elevation of intracranial pressure⁶. The rapid blood accumulation can compress the brain, resulting in severe neurological symptoms or death if immediate medical intervention is not provided¹⁷.

Potential Consequences of Injury:

1. Vascular Damage: Trauma to the pterion can fracture the thin bone and potentially tear the middle meningeal artery^{7,16}.
2. Epidural Hematoma: Rupture of the middle meningeal artery can lead to epidural hematoma (collection of blood between the brain's outer membrane (dura mater) and the skull), rapidly increasing intracranial pressure^{6,17}.
3. Hypovolemia: Severe bleeding from arterial damage can lead to hypovolemia, especially if other vessels are also affected, potentially progressing to hypovolemic shock if bleeding is significant and not promptly controlled¹⁸.

CONCLUSION: The classification of Shankha Marma as an *Asthi Marma* aligns with anatomical findings that underscore the temporal bone's close relationship with the middle meningeal artery at the Pterion site. This supports Ayurveda's categorization and its functional and clinical implications. The findings emphasize the importance of respecting traditional Ayurvedic frameworks while integrating insights from modern anatomy, fostering an enriched understanding of *Marma* points.

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