Step by Step Dissection and Surgical Applied Anatomical Correlations of the Facial Nerve: A Review for the Neurosurgical Trainee using 3D Photogrammetry

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Background/Objective: The facial nerve is a complex structure that plays a crucial role in facial expression, conveying taste, and parasympathetic innervation to several glands. Its course from the brainstem to its extracranial terminal branches is often complex and can be highly variable, making the precise understanding of its anatomy difficult. Two dimensional photographs are traditionally how the anatomy of the facial nerve is depicted; however, these representations can be difficult for learners to understand the spatial relationship of the facial nerve to surrounding structures. 3D photogrammetry is a new visualization technique that constructs a realistic three-dimensional model from overlapping two-dimensional images. These three-dimensional models may allow for a better spatial understanding of the facial nerve and its relationship to surrounding structures. This study reviews the anatomy of the facial nerve using 3D photogrammetry and highlights the benefits of 3D photogrammetry in anatomical modeling and medical education.

Methods: A step by step dissection of one cadaver was performed to depict the entire course of the facial nerve from the brainstem to its terminal extracranial branches. At each sequential step a smartphone camera with photogrammetry software and SLR camera was used to capture photographs of the specimen. These images were then uploaded to a 3D photogrammetry application, and a three-dimensional model was created. This 3D Model was created at each step and captures the surgical anatomy of the facial nerve from its exit in the brainstem to its terminal motor branches in the parotid gland.

Results: Six realistic models were created demonstrating an accurate 3D representation of the anatomy of the facial nerve. One model showed the extra-temporal segment of the facial nerve after parotidectomy (Figure 1). One model showed the course of the facial nerve after a retrolabyrinthine approach. One model showed the course of the facial nerve after a combined petrosal (Figure 2A,B). One model showed the course of the facial nerve after a translabyrinthine approach (Figure 2C). One model showed the course of the facial nerve after the cerebral hemisphere and cerebellar cortex were removed (Figure 3). One model showed the intrapontine segment of the facial nerve and transition of the mastoid segment to the extratemporal segment of the facial nerve (Figure 4).

Conclusion: 3D photogrammetry allows for the creation of a three-dimensional model that realistically depicts the complex course of the facial nerve and its spatial relationship to surrounding structures. The use of 3D photogrammetry allows for a better understanding of the spatial anatomy of the facial nerve and can be a valuable tool in medical education.

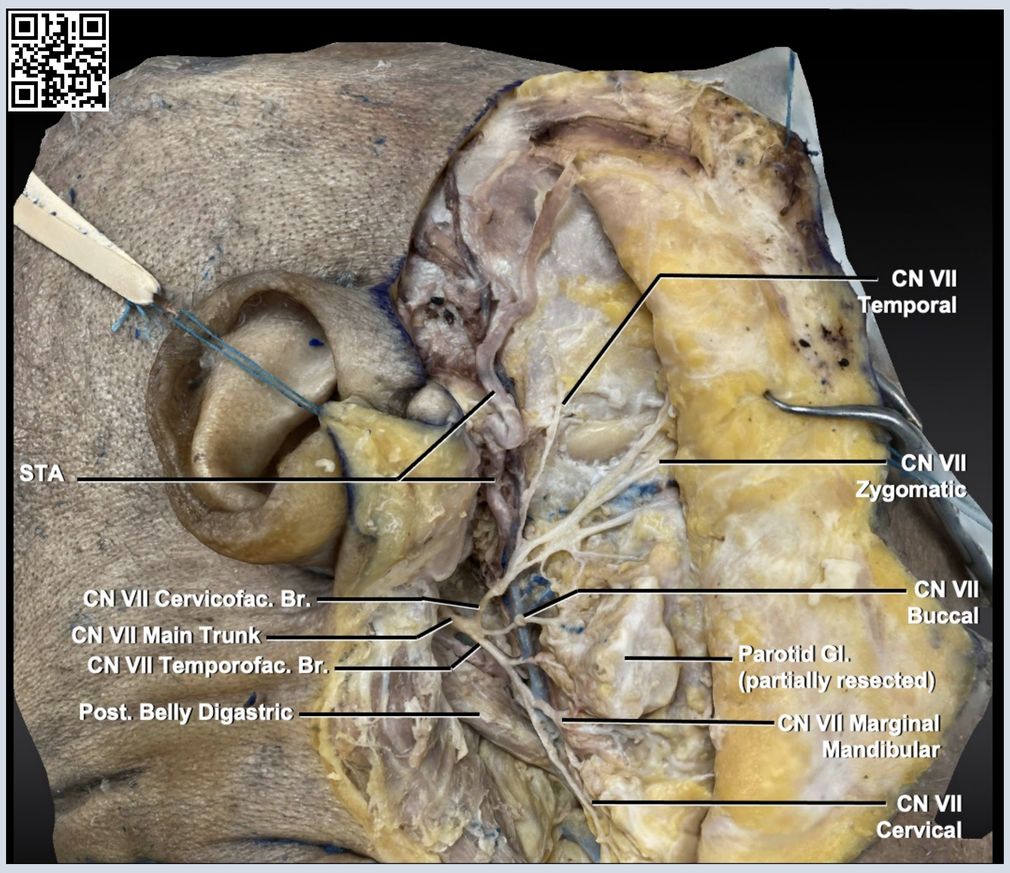

FIGURE 1: Extra-temporal segment of facial nerve after parotidectomy.

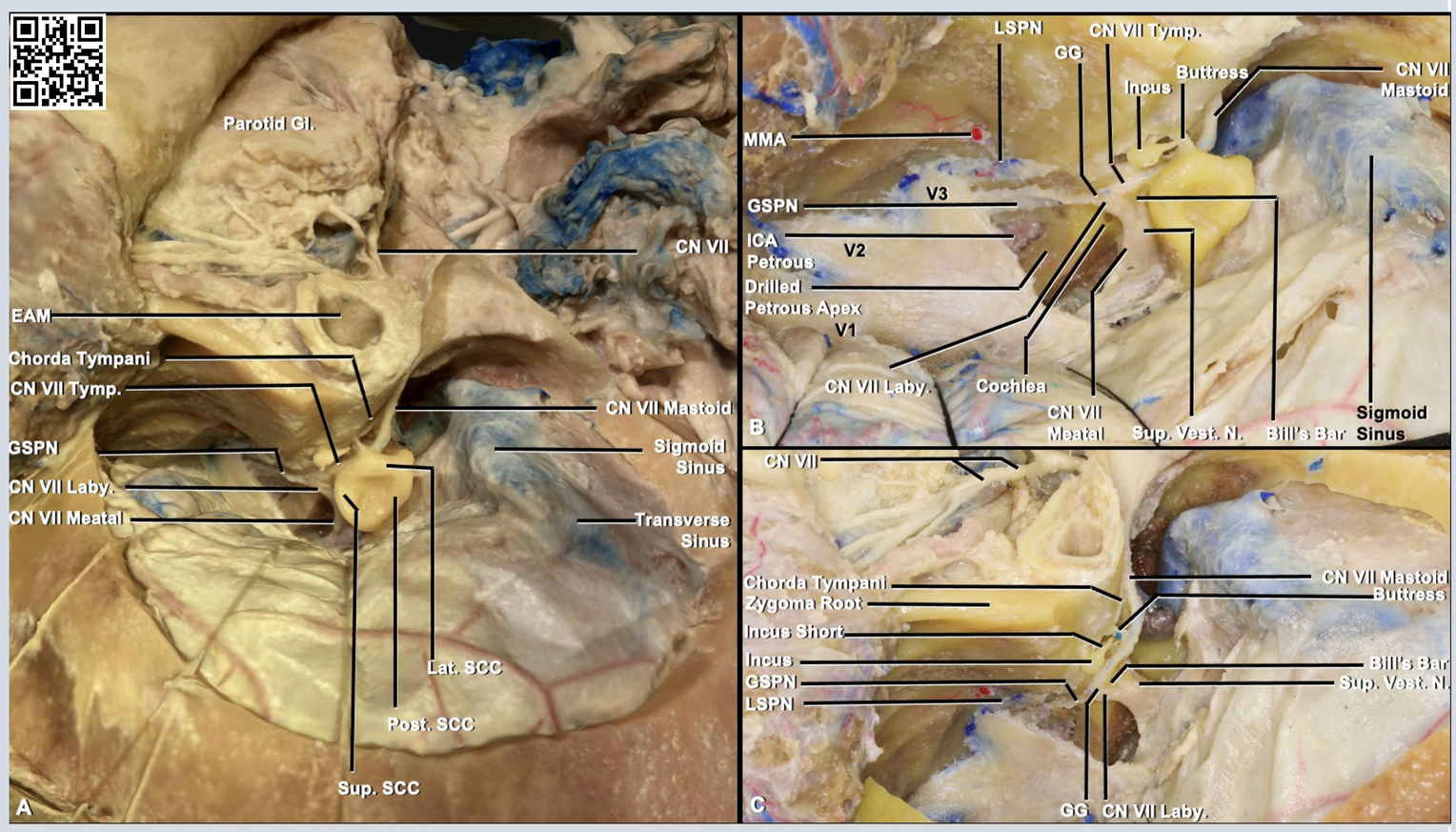

FIGURE 2: A) Course of the facial nerve after retrolabyrinthine approach. B) Magnified view of retrolabyrinthine approach. C) Course of facial nerve after translabyrinthine approach.

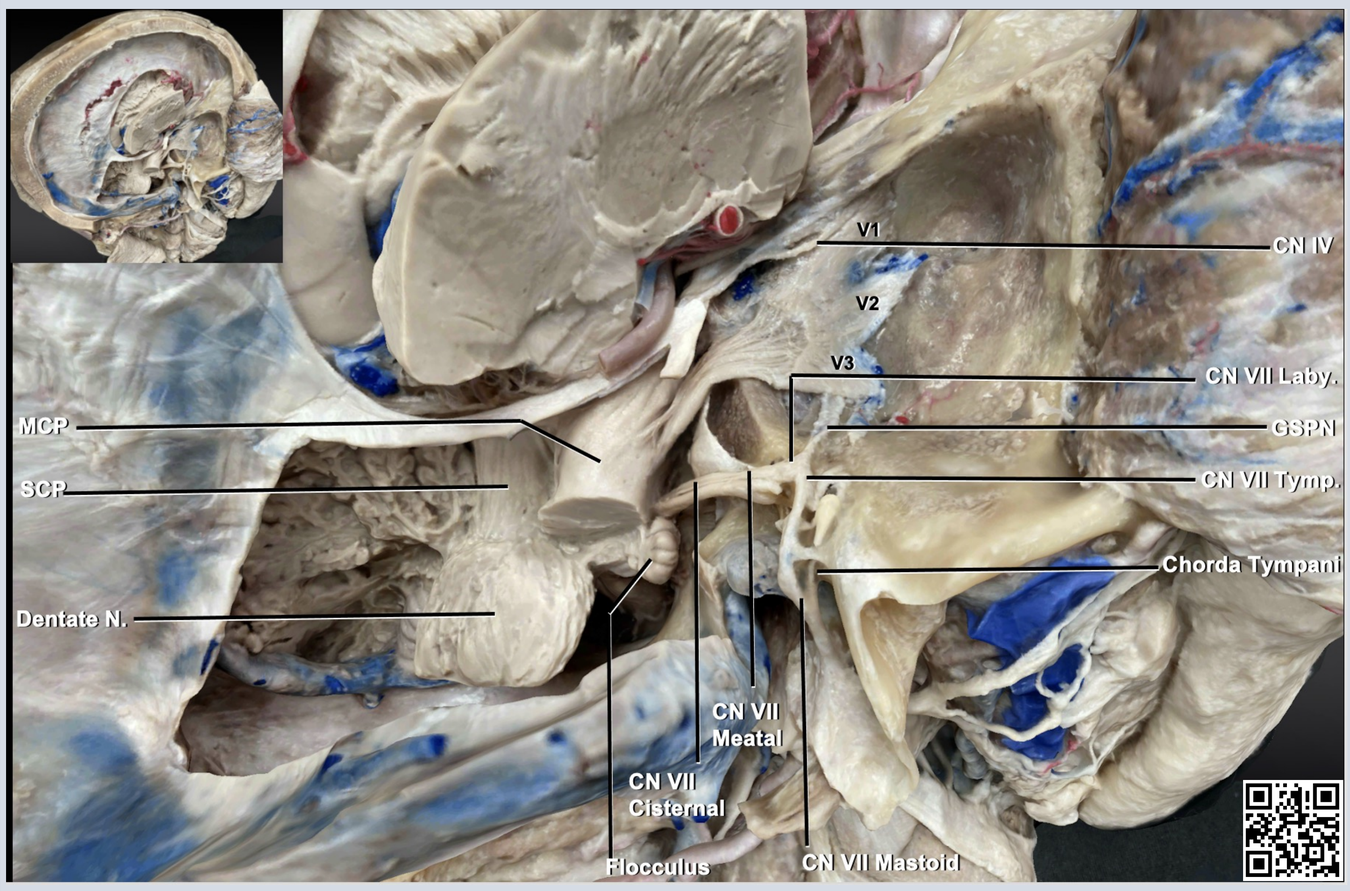

FIGURE 3: Course of facial nerve after cerebral hemisphere and cerebellar hemisphere removed.

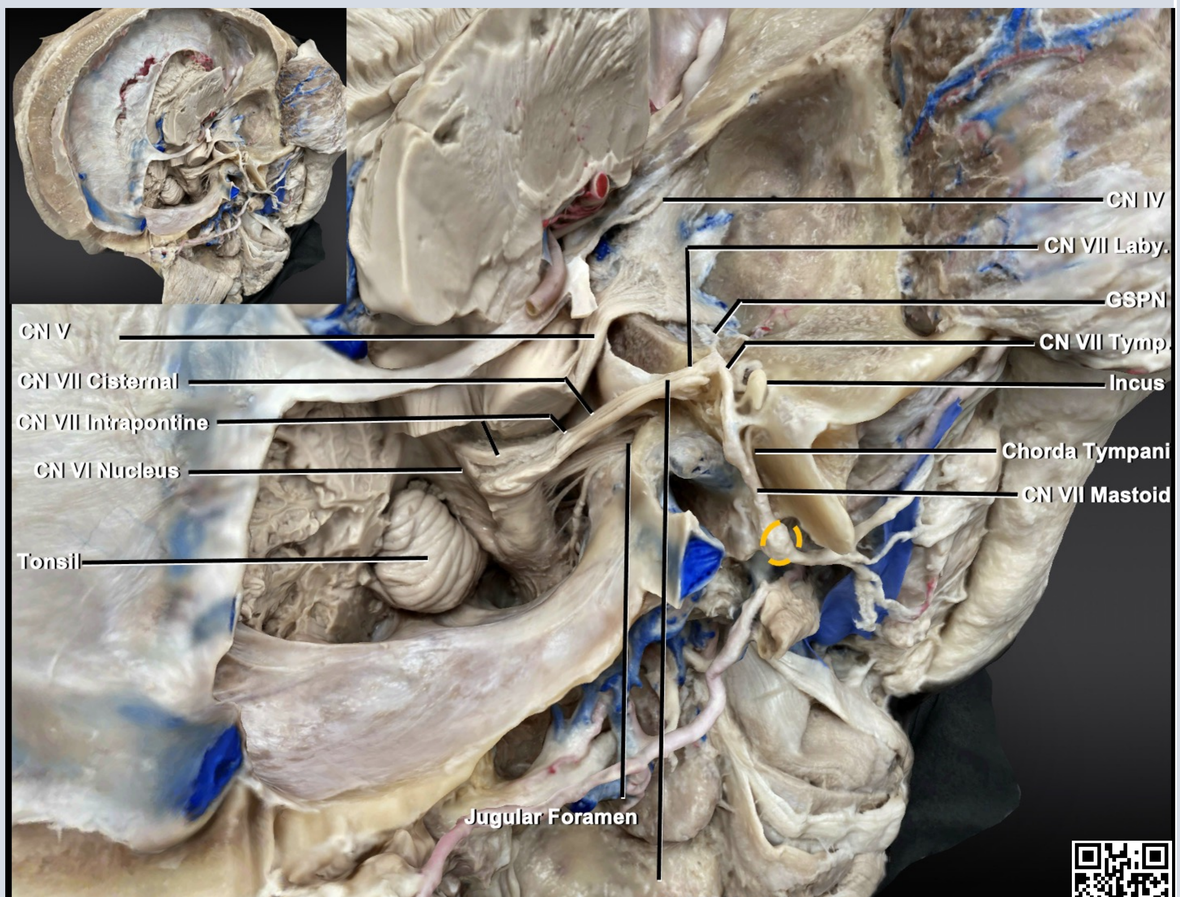

FIGURE 4: Intrapontine segment of facial nerve and transition from mastoid to extra-temporal segment of facial nerve.

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