

## The Facial Artery as a Branch of the External Carotid Artery in Thomas Turner's (1793-1873) Treatise on the Arterial System (1825) and a Comparison with Modern Anatomy

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### Abstract

The aim of the present paper is to contribute to the understanding of the history of the anatomical study of the facial artery. The facial artery plays a fundamental role in the study of the anatomy of the face, and in maxillofacial and vascular surgery. The debate on the understating of this vessel is essential in the educational process, with special focus on the historical development of topographical and descriptive ideas about it. The comparison between the study of facial artery in the work of Thomas Turner (1793-1873) and modern anatomical concepts serves as an excellent educational paradigm. The documentary research method was used this short historical survey. **Conclusion.** Thomas Turner laid the scientific foundation for the accurate anatomical study of the facial artery.

**Key Words:** Facial Artery Types ▪ Education ▪ History of Medicine.

### Introduction

Since ancient times facial surgery has presented challenges in reconstructive and aesthetic surgery. Preoperative knowledge of individual variations of the anatomy of the facial artery and its branches would benefit surgeons. Its course, as depicted classically in the anatomy textbooks, shows it ascending along the side of the mouth and nose, and terminating at the medial palpebral commissure, where it joins the dorsal nasal branch of the ophthalmic artery (1). Various anatomy and surgery treatises had included the facial artery as one of the most significant arteries of the human body. One such scientist was Thomas Turner, whose work entitled *A Practical Treatise On the Arterial System* published in 1825 (2). This historical article gives documentary research to present Turner's opinion concerning the facial artery and to discuss it in comparison with the modern concept of surgical anatomy.

The aim of the present article is to contribute to an understanding of the history of the anatomical study of the facial artery.

### Thomas Turner

Thomas Turner (1793-1873) (Figure 1) was born in Truro in Cornwall, England. At a young age he apprenticed under the British surgeon Nehemiah Duck (1782-1841) at Saint Peter's Hospital in Bristol.

Soon after his apprenticeship, he left for London where during the autumn of 1815 he enrolled as a student under the British surgeon and anatomist Astley Paston Cooper (1768-1841), practicing at the united borough hospitals of Guy's and St. Thomas. In 1816, Turner was admitted both as a member of the London College of Surgeons and as a licentiate of the London Society of Apothecaries. An educational trip to Paris followed and in 1817



Figure 1. Thomas Turner from sketches of the lives and work of the honorary medical staff of Manchester Infirmary, from its foundation in 1752 to 1830 when it became the Royal Infirmary, University of Manchester Press, 1904.<sup>1</sup>

he was appointed house surgeon at Manchester Infirmary. During 1822 Turner proceeded to give lectures at the Literary and Philosophical Society of Manchester on the anatomy, physiology and pathology of the human body. Soon he made plans to open a school. His suggestion was well received by the local authorities and scientific societies, until in October 1824 a suitable building was engaged and

a Medical School opened in Pine Street. The School was successful and, although London College was reluctant, recognition by the Edinburgh's College of Surgeons forced official recognition in 1827. In 1843 Turner was appointed honorary professor of physiology at the Manchester Royal Institution. In 1873 he died in his beloved Manchester. Apart from being a great anatomist and a prolific writer (Table 1), he gained his place in history as the man who developed medical education outside its then traditional base of London (2, 3).

### The Arterial System

In his work, Turner noted that the arterial system is composed of a series of vessels that are like tubes in a cylindrical form (Figure 2). Although they branch, their tubular shape is maintained due to the elasticity of their walls. This elasticity is provided by one of their tunics or coats. This is a property characterizing only arteries. Three coats exist as an external elastic coat, with a middle muscular layer and an internal membrane. According to his opinion, the circulatory system is divided into two trunks, the pulmonary artery and the aorta. The pulmonary artery supplies the lungs, and is responsible for local circulation after respiration, while the aorta supplies blood to the whole human body. Concerning the arteries' topographic anatomy, he believed that they terminate in six ways: i) in anastomoses, ii) in veins, iii) in cells (like in the spleen), iv) in exhalent orifices (like in the dura mater or serous membranes), v) in the excretory

Table 1. Thomas Turner's Written Work

| Title and year of publication   |
|---|
| 1. Outlines of a System of Medico-Chirurgical Education, London and Manchester, 1824; 2 <sup>nd</sup> edit. 1826  |
| 2. An Address to the Inhabitants of Lancashire & C., on the Present State of the Medical Profession, London, 1825 |
| 3. A Practical Treatise on the Arterial System, London, 1825  |
| 4. Outlines of a Course of Lectures on the Laws of Animal Life, Manchester, 1825                                  |
| 5. Outlines of a Course of Lectures on the Anatomy, Physiology, and Pathology of the Human Body, Manchester, 1833 |
| 6. Anatomico-Chirurgical Observations on Dislocations of the Astragalus, Worcester, 1843                          |

<sup>1</sup>Thomas Turner [cited 2023 Jan 31]. Available from: [https://en.wikipedia.org/wiki/Thomas\\_Turner\\_%28surgeon%29](https://en.wikipedia.org/wiki/Thomas_Turner_%28surgeon%29).

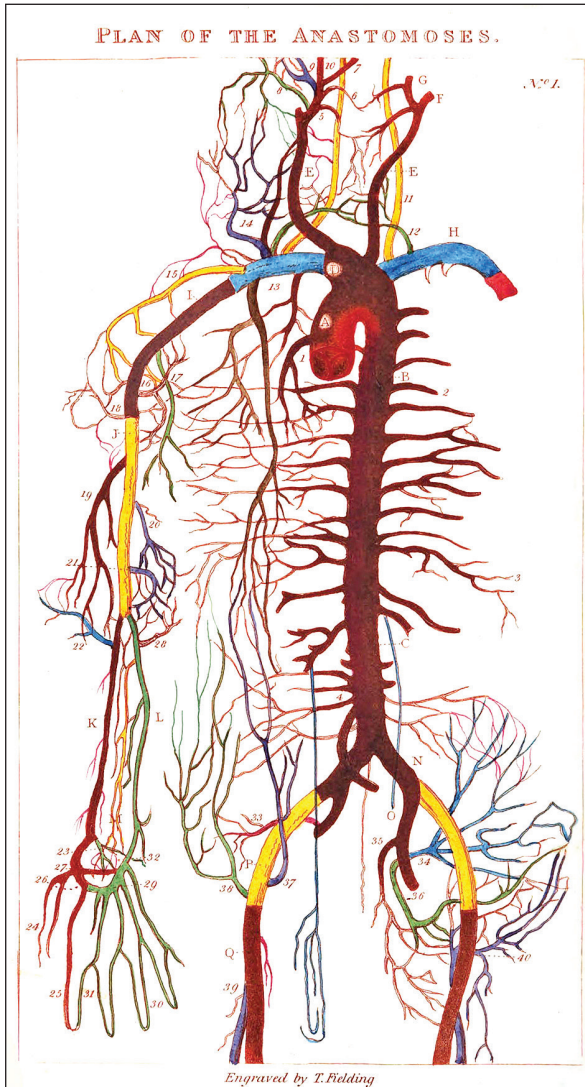


Figure 2. The circulatory system in Thomas Turner's *A Practical Treatise on the Arterial System*, London 1825.<sup>2</sup>

ducts of glands, and vi) in colorless or serous branches. The arterial branches of the head and neck run for the most part in a straight direction, while smaller branches are more or less tortuous in their course (4).

### *The Facial Artery*

Turner described the arterial system by starting with the more central branches, moving to the smaller peripheral ones. In his book, the right common carotid artery, which is shorter than the left, ascends in the neck area by the side of the trachea and opposite to the upper part of the thyroid cartilage. It is divided into internal and external branches. The external carotid artery, in the area of its origin, lies on the inner side of the internal carotid, passing later on in its course outwards towards the angle of the jaw, first concealed by the digastricus and stylohyoideus muscles, and secondly by the parotid gland. Numerous branches arise throughout its course, namely: i) the superior thyroideal, ii) lingual, iii) external maxillary (or facial), iv) ascending pharyngeal, v) occipital, vi) posterior aural, vii) temporal and viii) internal maxillary. All the branches communicate and anastomose with the branches on the opposite side of the cranium. The external maxillary or facial artery supplies blood and nutrients to the muscles and glands under the lower jaw, to the chin, to the lower lip, to the ala of the nose, to the corner of the eye and the forehead (5, 6).

Surprisingly, Turner gave no more details concerning all the branches. However, the knowledge of the era, as presented in the case of Blandin in 1834, also mentioned the superficial malar arteries as vessels with their origin in the external maxillary artery. Blandin furthermore indicated that the zygomaticus major muscle proceeds towards the commissure, outside of which it unites with both the levator and the depressor anguli oris muscles, directly covering the facial artery. It seems that Turner's book was limited to being an educational tool, a purpose mentioned on its cover page, when Turner mentions his position as lecturer (Figure 3). Moreover, the term external maxillary began to disappear and the nomenclature defined the artery under the name "facial" (4, 5).

<sup>2</sup>Thomas Turner. *A Practical Treatise on the Arterial System*. Longman, Hurst, Rees, Orme, Brown, and Green : [printed for] J. Aston, London, Manchester, MDCCCXXV. [1825].

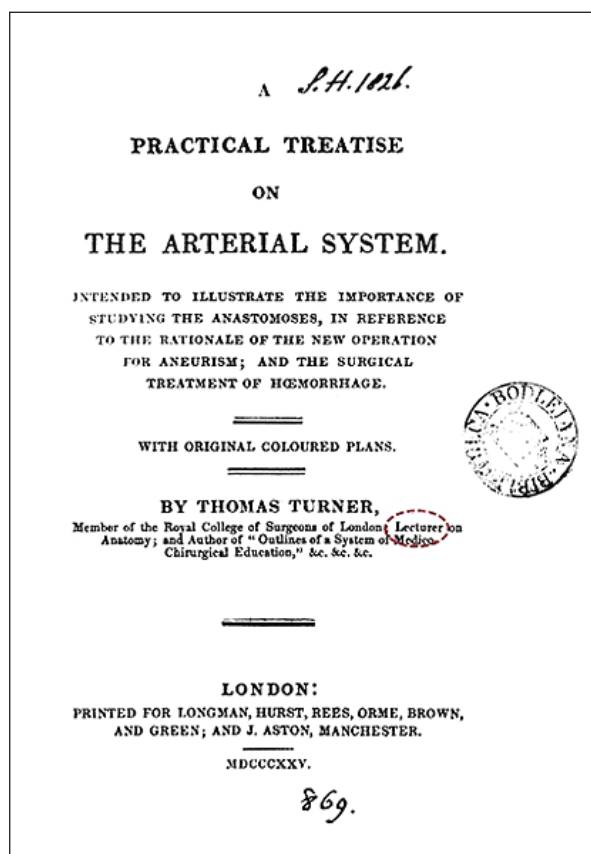


Figure 3. The front page of Turner's book, A Practical Treatise on the Arterial System, 1825, with the term Lecturer marked with a red circle.<sup>3</sup>

## Discussion

As anatomy demonstrates nowadays, the facial artery arises in the area of the carotid triangle, originating from the external carotid artery over the lingual artery and down from the ramus of the mandible. Its root is obliquely below the digastric and stylohyoid muscles, and it curves upwards over the body of the mandible at the antero-inferior angle of the masseter. It then passes forward and upward across the cheek, along the side of the nose, ending at the medial commissure of the eye, where it changes into the angular artery. The external carotid artery is presented in modern textbooks as having eight branches: i) the superior thyroid, ii) the ascending pharyngeal, iii) the lingual, iv) the

<sup>3</sup>Thomas Turner. A Practical Treatise on the Arterial System. Longman, Hurst, Rees, Orme, Brown, and Green : [printed for] J. Aston, London, Manchester, MDCCCXXV. [1825].

facial, v) the occipital, vi) the posterior auricular, vii) the maxillary and viii) the superficial temporal arteries. Some very rare branches of the artery are: the superior laryngeal, tonsillar, sternocleidomastoid and sublingual. The inferior and superior labial branches of the facial artery are sometimes underdeveloped or missing, and are replaced by an enlarged contralateral vessel (6, 7).

The facial artery is a superficial vessel of the face, covered by the fat of the cheek. It has two major branches, the cervical one, consisting of: the ascending palatine artery, the tonsillar branch, the submental artery, and the glandular branches; and the facial one, consisting of: the inferior labial artery, the superior labial artery, the lateral nasal branch to the nasalis muscle, and the angular artery, which is the terminal branch. The muscles supplied with arterial blood by the facial artery are: the buccinator, levator anguli oris, levator labii superioris, levator labii superioris alaeque nasi, levator veli palatini, masseter, mentalis, mylohyoid, nasalis, palatoglossus, palatopharyngeus, platysma, procerus, risorius, styloglossus and the transverse portion of the nasalis. Although the nomenclature represents its unexpected proximity (Table 2), the presentation of local anatomy depicts some deficits concerning the topographical description of the various entities and vessel courses in Turner's work (8, 9).

Turner failed to recognize that the facial artery may be absent in favor of a nasal branch of the ophthalmic artery at the medial side of the orbit, the transverse facial, or the maxillary artery, depending on the variation. He also neglected some points of origin, as the facial artery may arise from a common trunk with the lingual artery (4). Recent studies, such as the one presented by Midy et al. in 1986, in which they surveyed the application of the anatomic vascular bases of the facial flaps, described three types of proximal facial artery. The facial artery, according to their conclusion, represents a global description of vascularization concerning the face area and the principal anastomoses, being a paramount key factor in facial flaps and the plastic surgery of the face. Occasionally, the facial artery arises above its usual position, then descends beneath the angle

Table 2. Nomenclature of the Branches of the External Carotid Artery

| Branches in Turner's work      | Branches in modern anatomy books |
|--------------------------------|----------------------------------|
| Superior thyroideal            | Superior thyroid                 |
| Lingual                        | Lingual                          |
| External maxillary (or facial) | Facial                           |
| Ascending pharyngeal           | Ascending pharyngeal             |
| Occipital                      | Occipital                        |
| Posterior aural                | Posterior auricular              |
| Temporal                       | Superficial temporal arteries    |
| Internal maxillary             | Maxillary                        |

of the jaw to assume its ordinary course. The arch formed above the submandibular gland can extend some distance beneath the ramus of the jaw, lying between the lateral pterygoid and styloglossus muscles. Three more variables were described in the 1986 study. The first variation presented an artery which arose at the level of the angle of the mandible, ran around the submandibular gland to the mandible, lastly entering the face area. The second type was described arising from the external carotid artery rather distally, deep to the posterior belly of the digastric artery, continuing along the inner circumference of the mandible, finally traveling through the submandibular gland (10, 11). Nevertheless, in 2013 Furukawa et al proposed a classification of anatomical variations of the facial artery depending on its termination pattern and recognizing four different types. In the first, the facial artery terminates proximal to the superior labial artery, in the second it terminates distal to the superior labial artery near the nasolabial fold, in the third the artery extends to the lateral nasal-alar or angular branch, while in the fourth the facial artery is double with a dominant lateral angular branch (12). In 2019, Koziej et al. used Furukawa's classification, however, they recognized a fifth type of facial artery when it is hypotrophic with the dominant transverse facial artery and its course replaces the facial artery from the superior labial artery to the angular artery (13).

This deficit concerning a more accurate description of the facial artery's anatomy probably derives from the fact that Turner did not have the opportunity at the time to conduct a much more

significant number of dissections, due to the shortage of corpses, to acquire better experience, focusing on vascular courses. Corpses were only available to esteemed professors by order of magistrates and hospital directors (14). Moreover, publication of vascular variations was scarce before the era of the Japanese physician and anthropologist Buntaro Adachi (1865-1945) (15), while scientific medical publications experienced logistic barriers and only Societies, Universities and the upper classes could afford them until the formation of new classes (Quakers, industrial workers etc.) (16). Above all, during Turner's time and until the mid-19th century, the development of maxillofacial surgery did not allow surgical exploration in deeper body layers, while the surgical instruments then used were not precise enough for more delicate surgical maneuvers, which prohibited a more accurate description of the facial artery and its branches. The facial artery became a fundamental vessel for facial surgeons in reconstruction and the blood supply to the area (17).

## Conclusion

It is clear, after a comparison with modern research on the facial artery (18) that the work of Thomas Turner, although it did not manage to describe the route and the relationships of all arteries in the area completely, it nevertheless laid the scientific foundation for the accurate anatomical study of each artery branch, a cluster of vessels which play a significant role in the blood supply to the face and surgical anatomy.

**What Is Already Known on This Topic:**

*A modern anatomical study on facial artery, its variations and its topographical placement is known.*

**What This Study Adds:**

*This study uses the example of the anatomical studies by Thomas Turner (1793-1873), especially in relation to the facial artery, to demonstrate how the anatomical study of the human body and especially the facial artery has developed gradually, and how the anatomical studies of the past help modern anatomical studies.*

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**Conflict of Interest:** The authors declare that they have no conflict of interest.

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