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A review of the tragal pointer: anatomy and its importance as a landmark in surgical procedures

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The tragal pointer has long been used as a surgical landmark for the identification of the facial nerve trunk and the maxillary artery in such procedures as parotidectomy, internal fixation of subcondylar and condylar fractures, mandibular osteotomy, temporomandibular joint arthroplasty, and percutaneous blocks of branches of the trigeminal nerve and pterygopalatine ganglion. Aside from its use as an external landmark, it has also been implicated as a contributor to crease formation in the presence of peripheral arterial disease. This article will review the available literature on the tragal pointer's use as an external landmark. (Folia Morphol 2012; 71, 2: 59–64)

Key words: tragal pointer, tragus, facial nerve trunk, maxillary artery, anterior tragal crease, landmarks, peripheral arterial disease

INTRODUCTION

In every surgical procedure, the location and identification of certain anatomic structures is crucial. Surgeons rely on the use of anatomical landmarks for identifying the location of various structures. Good landmarks should be easy to identify, remain in a relatively constant position throughout the procedure, and be easy to palpate. These features allow fast and safe identification of the anatomical structures of importance [11, 13].

The tragal pointer has become an important landmark for locating the facial nerve trunk and maxillary artery intraoperatively. This review discusses the anatomic location of the tragal pointer and its association with surrounding structures such as the facial nerve trunk and the maxillary artery, as well as using it to diagnose peripheral arterial disease [11, 13].

ANATOMY

The external ear is made up of two structures, the auricle or pinna and the external acoustic meatus. The lateral surface of the auricle faces slightly anteriorly and has an irregular concavity to it along with multiple depressions and projections. The helix is a prominent curved rim that most often has a small tubercle posterosuperiorly: Darwin's tubercle. Anterior and parallel to the helix is the antihelix, which superiorly divides into two crura, creating a triangular fossa. Between the helix and the anti-

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helix is a depression called the scaphoid fossa. The concha of the auricle is encircled by the antihelix posteriorly and divided by the anterior end of the helix. The depression between the anterior helix and the inferior crus of the antihelix is the cymba conchae. The cymba concha lies over the suprameatal triangle of the temporal bone and mastoid antrum [5, 14, 15].

The tragus is a small curved flap of tissue comprised of cartilage and is located below the crus of the helix and anterior to the concha. It projects posteriorly over the meatal orifice. The anterior part of the tragus points anterior, inferior, and deep to the superficial surface of the preauricular area. Its anterior end takes on a bluntly pointed shape on its medial aspect and is named the "pointer" (Fig. 1) [7]. The medial aspect of the tragus points inward, forming the anterior and inferior wall of the external acoustic meatus [5]. The antitragus is a tubercle located opposite the tragus. The intertragic notch or incisura intertragica separates both structures [14]. Below the notch is the lobule, which has a soft quality due to its unique fibrous and adipose tissue composition [15].

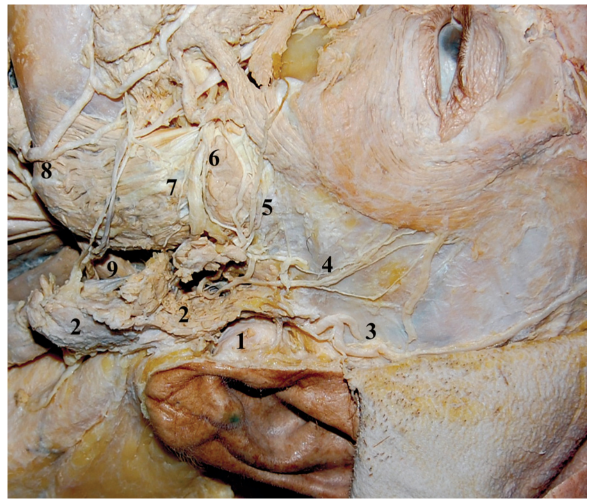

Figure 1. The figure exhibits several landmarks used for the identification of the facial nerve; 1 — tragal pointer; 2 — divided parotid gland to expose the main trunk of the facial nerve; 3 — superficial temporal artery; 4 — temporal branch of facial nerve; 5 — zygomatic branch of the facial nerve; 6 — buccal branch of the facial nerve running alongside the accessory parotid duct and parotid duct (7); 8 — facial nerve; 9 — posterior belly of the digastric muscle.

THE IMPORTANCE OF A PALPABLE LANDMARK FOR IDENTIFICATION OF THE TRUNK OF THE FACIAL NERVE

Surgeons often rely on a list of reference points by which to predict the location of anatomical structures to be preserved. These reference points are based on anatomical landmarks. For example, during parotidectomy or repair of preauricular facial trauma, the tragal pointer is often used to approximate the facial nerve trunk. More specifically, Wetmore [17] described the importance of the tragal pointer in relation to identifying the extratemporal branch of the facial nerve during a parotidectomy procedure. The approach described begins with a modified Blair incision. This incision follows the preauricular crease curving posteriorly toward the hyoid bone. The skin flap is then elevated in the plane of the superficial parotid fascia. The elevation of this flap is continued to the anterior aspect of the parotid gland, and then along the superior half of the incision separating the superior part of the gland from the cartilaginous and bony aspects of the ear canal. After the parotid gland is dissected away from the ear, the dissection is carried deep along the tragal cartilage until the tragal pointer is palpable. The main trunk of the facial nerve is typically located medial and inferior to this palpable landmark.

In assessing the accuracy and reliability of commonly used facial nerve trunk landmarks, Pather and Osman [10] examined the relation of the facial nerve trunk to the tragal pointer, tympanomastoid suture, attachment of the posterior belly of the digastric muscle, external auditory meatus, transverse process of the axis, angle of the mandible, and the styloid process. According to their results (Table 1), the posterior belly of the digastric muscle, the tragal pointer, and the transverse process of the axis are good landmarks for the identification of the facial nerve trunk. However, despite the fact that the tragal pointer was found to be a good landmark, its cartilaginous nature, mobility, and often asymmetric and irregular tip make it less reliable than these other two landmarks. Furthermore, the transverse process of the axis is seen as a superior landmark to the tragal pointer due to its bony nature, ease of palpation and dissection, and the minimal risk posed to the facial nerve when it is used for its identification [10].

In a follow up study, Rea et al. [13] investigated the precision of four of the most commonly used soft tissues and bony structure landmarks used in the identification of the facial nerve trunk during anterograde parotidectomy. These structures included the posterior belly of the digastric muscle, the tragal pointer, the junction of the bony and cartilaginous ear canal, and the tympanomastoid

Table 1. Distance of the facial never trunk to seven commonly used anatomical landmarks

Structure	Distance (mean) [mm]
Tragal pointer	24.3–49.2 (34)
External auditory canal	7.3–21.9 (13.4)
Posterior belly of digastric	9.7–24.3 (14.6)
Tympanomastoid suture	4.9–18.6 (10.0)
Styloid process	4.3–18.6 (9.8)
Transverse process of the axis	9.7–36.8 (16.9)
Angle of the mandible	25.3–48.69 (38.1)

Table 2. Average distance of the facial nerve trunk to four commonly used landmarks in anterograde parotidectomy

Structure	Average distance [mm]
Posterior belly of the digastric muscle	5.5 ± 2.1
Tragal pointer	6.9 ± 1.8
Cartilaginous ear canal	10.9 ± 1.7
Tympanomastoid suture	2.5 ± 0.4

Table 3. Distance of the maxillary artery branch point to surrounding structures

Structure	Mean distance [mm]
Medial boarder of the subcondylar portion of the mandible	6.8
Tragal pointer	16.2 (anterior) and 21.4 (deep)
Frankfort horizontal plane	25.7
Tip of the condyle in the vertical plane	22.4

suture. The results of the measurements found that the closest structure to the main trunk of the facial nerve was the tympanomastoid suture, while the farthest landmark was the cartilaginous external canal (Table 2). With regard to the tragal pointer, the investigators observed considerable variability in the size, shape, and direction in which it "pointed", which was not always in the direction of the facial nerve trunk. Consequently, the tympanomastoid suture was found to be a superior landmark for the identification of the facial nerve trunk. Notwithstanding its superiority, the tympanomastoid suture did, however, display a statistical difference in the distance between sexes. This finding may be due to larger skull, deeper mandibular ramus, larger mastoid process, and larger nuchal crest rigidity and rugose muscle attachments in males [8, 18].

ASSOCIATION OF THE TRAGAL POINTER WITH THE MAXILLARY ARTERY

The maxillary artery is the largest terminal branch of the external carotid artery. Its location near the neck of the mandible predisposes it to iatrogenic injury from surgical procedures (e.g. internal fixation of subcondylar and condylar fractures, mandibular osteotomies, temporomandibular joint arthroplasties, and percutaneous blocks of the branches of the trigeminal nerve or pterygopalatine ganglion) in this area. Thus, this artery may sustain puncture or severing injuries that can lead to significant haemorrhage. In order to avoid such complications, the tragal pointer has been used as a landmark.

Orbay et al. [9] in their study examined the distance of the first and second portions of the maxillary artery to the tragal pointer, Frankfort horizontal plane, and tip of the condyle (Table 3). These selected anatomic landmarks are important during surgical procedures such as bilateral condylectomies, gap arthroplasties, and internal fixation of bilateral subcondylar fractures in order to avoid iatrogenic injuries to the maxillary artery. The focus of the study was to obtain measurements of the distance between these structures and the maxillary artery in order to create a catalogue for intraoperative identification and location of the maxillary artery. From the results the authors [9] observed that there was substantial variation in the course (even in the same cadaver) and depth of the maxillary artery and that the most vulnerable segment of the maxillary artery is that which courses close to the medial border of the subcondylar region.

ASSOCIATION WITH PERIPHERAL ARTERIAL DISEASE

Recently, imaging studies have shown that the maxillary artery is affected by atherosclerotic changes [2, 3, 16]. Interestingly, artherosclerotic plaque buildup in the maxillary artery causes distention of its walls. With this distension the overlying structure, the parotid gland, is pushed superficially. The posterior aspect of the superior half of the parotid gland is fixed by dense fibrous tissue at the point of the tragal pointer. The anterior tragal crease is created by the superficial displacement of the parotid gland and the downward angle of the tragus (Fig. 2). The presence of this crease has been proposed to be of clinical use to detect the presence of asymptomatic peripheral arterial disease and consequently coronary artery disease [12].

Prior to the anterior tragal crease another external indicator, Frank's sign, was proposed as clinically important for the detection of asymptomatic peripheral arterial disease. Frank's sign, or diagonal ear lobe crease, is defined as a crease that extends diagonally from the tragus across the ear lobe to the posterior edge of the auricle [4]. Lesbre et al. [6] studied the sensitivity and the predictive value of Frank's sign to detect coronary artery disease. The criteria selected for a positive diagnosis of coronary artery disease was stenosis of 75% or higher in one of the three main coronary arteries. Frank's sign was found to have sensitivity, specificity, and positive predictive values of 75%, 57.5% and 80.3%, respectively. From the results no correlation was found between Frank's sign and the severity of coronary artery disease. It was the opinion of the author that Frank's sign is a marker for coronary artery disease, independent of known risk factors. Interestingly, the presence of Frank's sign is found in 66% of those with asymptomatic coronary artery disease. However, the absence of Frank's sign cannot exclude the diagnosis of coronary artery disease.

In a similar study of the diagonal earlobe crease, another Davis et al. [1] compared the specificity, sensitivity, and positive predictive value of the diagonal earlobe crease in cases of coronary artery disease and diabetic retinopathy. It was found that the presence of a diagonal earlobe crease was higher in those with coronary artery disease than it was in those without. From the results it was found that the diagonal earlobe crease has a sensitivity and specificity of 60% and 48%, respectively, in regards to asymptomatic coronary artery disease. The sensitivity and specificity of the diagonal earlobe crease to detect diabetic retinopathy was 61% and 47%, respectively. It is the opinion of this author that a diagonal ear lobe crease has no value in predicting the presence of asymptomatic coronary artery disease or diabetic retinopathy [1].

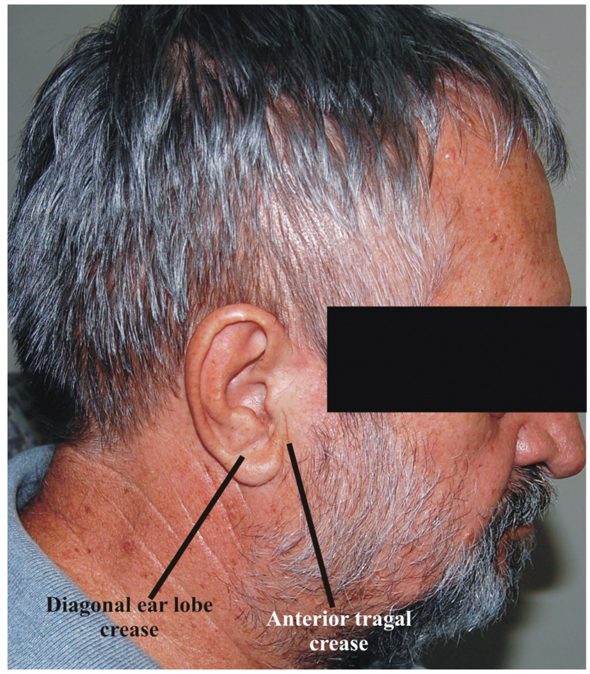

Figure 2. This figure demonstrates an anterior tragal crease. This crease is typically is created by the superficial displacement of the parotid gland and the downward angle of the tragus.

Evrengul et al. [3] studied the association of bilateral diagonal ear lobe crease and its predictive value in patients with asymptomatic coronary artery disease. Four hundred and fifteen patients were examined for the presence of bilateral diagonal ear lobe crease and underwent an angiography looking for the presence of coronary artery disease. The results of the study found bilateral diagonal ear lobe crease to be a significant independent variable as well as a positive predictive factor for those with coronary artery disease, hypertension and a family history of coronary artery disease. Bilateral diagonal ear lobe crease was found to have a sensitivity of 51.3%, specificity of 84.8%, positive predictive value of 89.4%, and negative predictive value of 41.2%. It is the opinion of the author that the presence of bilateral diagonal ear lobe crease was a significant risk factor for coronary artery disease.

Ramos et al. [12] compared and investigated the correlation of the diagonal earlobe crease and anterior tragal crease among patients with documented peripheral artery disease of the lower limbs to those without documented peripheral arterial disease. The results of the study showed a higher percentage of diagonal ear lobe crease and anterior tragal crease among those with peripheral arterial disease than those without. The percentage of a diagonal ear lobe crease was 73% vs. 25% while that of anterior tragal crease was 80% vs. 43% in the peripheral arterial disease group and the control group, respectively. As a result, the diagonal ear lobe crease and the anterior tragal crease were independently associated with peripheral arterial disease and could be used as an external indicator for identification of asymptomatic peripheral arterial disease and consequently coronary artery disease.

DISCUSSION

The four commonly used landmarks in identification of the facial nerve trunk during surgical procedures are: the tragal pointer, the posterior belly of digastric muscle, the junction of the bony and cartilaginous ear canal, and the tympanomastoid suture. Multiple cadaveric studies have been conducted to determine the reliability of these landmarks in a large series of specimens. From the multiple studies conducted a general consensus has not been formulated on which external landmark is the most consistent and superior in identifying and locating the facial nerve trunk. In reference to the tragal pointer, the studies have shown it to fulfil the criteria as a consistent landmark for locating the facial nerve trunk, but when compared to the other commonly used landmarks it has been shown to be inferior. Due to the lack of consensus on which single landmark is the best to use, it is now becoming a standard of care to utilise more than one of the common external landmarks when identifying and locating the facial nerve trunk prior to surgical procedures.

The location of the tragal pointer has not only been used as a landmark for identifying and locating the facial nerve trunk but also the maxillary artery. As with the investigations concerning its precision as a landmark for the identification of the facial nerve trunk, there have also been studies of its accuracy in identifying and locating the maxillary artery. These studies compared the tragal pointer to other commonly used landmarks such as the condyle, the subcondyle, and the sigmoid notch and revealed that there was significant variation in the course and the depth of the maxillary artery. Due to the significant variations, locating the maxillary artery preoperatively is still difficult even with the use of the most consistent landmarks.

Although the reliability of the tragal pointer as an external landmark has come into question, it may have another important clinical use. The location of the tragal pointer to the maxillary artery has an effect on the topographical anatomy in the preauricular area. In the development of atherosclerosis plaques in the maxillary artery, the artery distends. As the artery distends it pushes the overlying parotid gland superficially. As the parotid gland is pushed superficially the posterior attachment, which is fixed to the tragal pointer by dense fibrous tissue, causes a pivot point in which a crease develops. The presence of an anterior tragal crease is proposed as an external sign for asymptomatic peripheral arterial disease, and by extension, coronary artery disease. As shown in this review there are significant variations to the size, shape, and the distance of the tragal pointer to other proximal structures such as the maxillary artery. Due to these variations, the development of the anterior tragal crease may not be as reliable as once thought.

CONCLUSIONS

The four commonly used landmarks in identification of the facial nerve trunk during surgical procedures are: the tragal pointer, the posterior belly of digastric muscle, the junction of the bony and cartilaginous ear canal, and the tympanomastoid suture. Multiple cadaveric studies have been conducted to determine the reliability of these landmarks. Based on our review of the literature regarding the tragal pointer as a landmark, a more reliable bony landmark or multiple landmarks should be considered for locating the facial nerve trunk and maxillary artery.

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