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## The Points of Attachment of the Palpebral Ligaments: Their Use in Facial Reconstructions on the Skull

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**ABSTRACT:** The discovery in the Smith College Archives of a reference to Whitnall's little-known "malar tubercle" points up the fact that H. H. Wilder used this point of attachment of the lateral palpebral ligament in positioning the lateral canthus of the eye in his face reconstructions on the skull. The present paper offers an equally sure means of positioning the medial canthus.

**KEYWORDS:** physical anthropology, H. H. Wilder, S. E. Whitnall, face reconstruction, eye, malar tubercle

At the meeting in Orlando last year I reported on my visit to the Smith College Archives in search of records pertaining to H. H. Wilder's forensic science research [1]. Even though granted generous program time at the meeting, my report could not include everything I found. Therefore I now offer an addendum to the part of that paper dealing with Wilder's method of face reconstruction on the skull.

This time I shall deal with Wilder's guideline for orienting the eye-openings, which I overlooked in writing my forensic science book [2]. Because of this oversight I was surprised and puzzled when I found in the Archives the drawing shown in Fig. 1. Did it help Wilder in his reconstruction of the eyes in the orbits, I wondered? On closer inspection of the drawing I detected an unfamiliar feature labeled "d" at the point of attachment of the lateral palpebral ligament (actually a raphe). Note that it is located on the inner side of the lateral orbital wall not far from the margin. A handwritten legend (not included in Fig. 1) identifies the feature as the malar or zygomatic tubercle. The attribution of the drawing given in the legend reads: "After Whitnall."

Samuel Ernest Whitnall was a demonstrator in human anatomy at Oxford in 1911 when he published the first known description of the tubercle in question [3]. This was a year before Wilder published his first article on face reconstruction on the skull [4]. Comparison of the drawing in the Smith Archives with the one in Whitnall's publication [3, Fig. 3, p. 429] shows only minor differences. I assume, therefore, that the former is a variant copy of the latter and hence explains the word "after" in the attribution. Be this as it may, Wilder prob-

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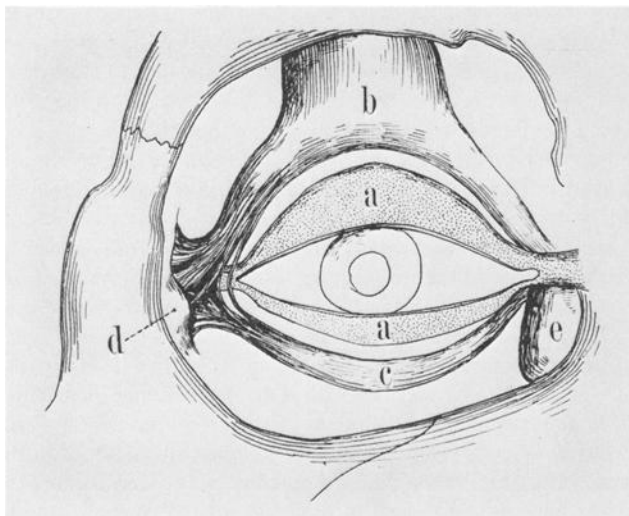


FIG. 1—Drawing in the Wilder Collection, Smith College Archives. Accompanying handwritten legend reads: "Diagram showing the 'Malar Tubercle' of Whitnall, and the associated structures. a. a., tarsal cartilages; b., *m. levator palpebrae superioris*, especially its aponeurosis of insertion; c., suspensory ligaments of the eyeball; d., malar tubercle; e., opening of nasolacrimal duct. After Whitnall." (Courtesy Smith College Archives).

ably was the first one in America to refer to Whitnall's malar tubercle in a forensic science context. Here is what he said about it in 1912 [4, p. 431]:

The position of the two canthi [angles, outer and inner, that form the corners of the eyeopening] is almost precisely determined, the inner by the naso-lacrimal duct [sic, lacrimal sac or fossa], and the outer by a slightly but definitely indicated "malar tubercle," to which attention has recently been directed by Whitnall.

Six years later (1918) essentially the same statement, but lacking the reference to Whitnall, appeared in the identification book that Wilder wrote jointly with Wentworth [5, p. 105].

Whitnall included in his article describing the tubercle [3] the results of his survey of 2000 human skulls from 23 racial groups (sex ratios not given) and 29 anthropoid skulls (21 chimpanzees and 8 gorillas). In the human sample he detected the presence of the tubercle in all but 4.5%. Of the anthropoids only 2.8% lacked it. Whitnall also measured the distance from the tubercle to the point where the zygomaticofrontal suture crosses the orbital margin and came up with an average figure of 11 mm.

Since 1911 further investigations of the malar tubercle have been conducted by three other anatomists, in order, a Russian, a Finn, and a Brazilian [6-8]. Together they surveyed just over 2000 more human skulls, again from a large number of racial groups. The presence of the tubercle seems not to have been as evident to them as to Whitnall, because on average they reported it lacking in 15% of males and 24% of females. This compares with Whitnall's 4.5% of absences for the combined sexes. Only one of these more recent investigators reported the average distance between the tubercle and the zygomaticofrontal suture: 10.5 mm [8], a figure only half a millimetre less than Whitnall's. The significance of these figures is that they can be used to locate the site of attachment of the lateral palpebral ligament (or raphe) when the tubercle is absent.

Noteworthy at this point is the fact that when Gerasimov published his book on face restoration in 1949 [9] he described and illustrated the malar tubercle (p. 43), but without reference to Whitnall. By 1971, however, when his last book appeared in English translation [10], he neglected to mention the tubercle (p. 60).

So much for the positioning of the outer or lateral angle of the eye-opening. As for the positioning of the inner or medial angle, neither Whitnall nor Wilder defined it beyond saying that the medial palpebral ligament crosses the lacrimal sac or fossa. Obviously more precise information about the attachment of this ligament is needed. With the situation on the lateral side of the orbit in mind, it occurred to me that, although in the absence of a tubercle on the medial side the precise location of the ligamentous attachment here would have to be established through cadaver dissection, once the point is located the distance between it and the frontomaxillary suture could be measured.

By good fortune, I happened to mention this thought to Dr. R. T. Koritzer, a dentist, who occasionally visits me in the Museum. His response was a kind invitation to try my hand at dissecting the medial side of the orbit in some heads reserved for his use in the Department of Anatomy at Georgetown University. So one morning last summer I went there with him and worked out the anatomical relationships in question in five heads. In each one, using a strip of millimetre graph paper to measure with, I determined that the distance from dacryon to the midpoint at the end of the attachment of the lateral palpebral ligament is approximately 10 mm, a figure close to those obtained by earlier investigators on the lateral side of the orbit. Dacryon, of course, is the point of junction of the lacrimomaxillary, frontomaxillary, and frontolacrimal sutures. When in doubt about the course of the lacrimomaxillary suture, I used a nearly equivalent point, namely, the one where the upward projection of the anterior lacrimal crest meets the frontomaxillary suture.

Subsequently, back in the Museum I selected from the Terry skeletal collection some skulls with well-developed Whitnall tubercles. On each of these skulls I located by measurement (using my 10-mm figure) the endpoints of attachment of the medial palpebral ligaments. I marked these points and both Whitnall tubercles with white dots. Also, I marked in the same way the four sutural points on the borders of the orbits from which the measurements were taken. Having done this, and having mounted the skulls in the Frankfort plane, I had them photographed in frontal view. Figure 2 is one of these photographs after the two sets of

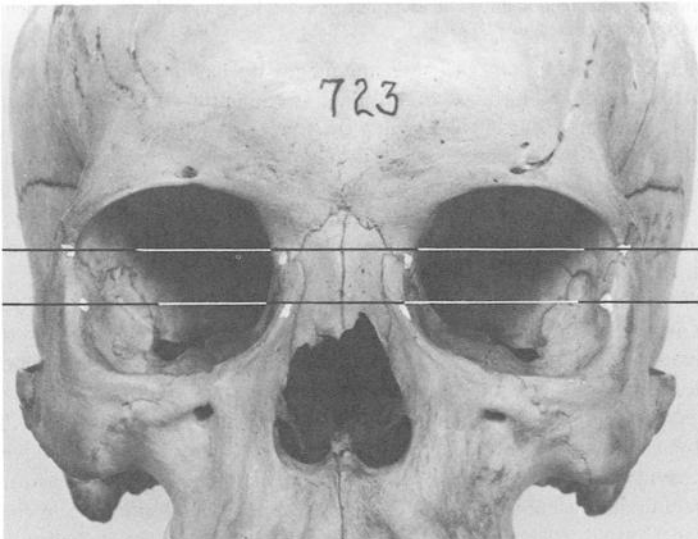


FIG. 2—Frontal view of a skull posed in the Frankfort plane. White dots indicate the points of attachment of the palpebral ligaments and the points directly above them on the sutures between the frontal and facial bones. The pair of dots on the lateral side of the orbits are connected horizontally by lines. Note that these lines pass close to the pairs of dots on the medial side of the orbits. (Terry Collection No. 723, black female, age 22).

white dots were connected by lines. It shows that the two lines are practically horizontal and parallel to each other.

Although for the present purpose I have placed the end point of the attachment of each medial palpebral ligament well up on the sloping side of the frontal process of the maxillary bone, and 10 mm from dacryon, the ligament hugs the bone from as far laterally as the lacrimal sac or fossa. At that point according to Arey [11, p. 1214],

The medial palpebral ligament is U-shaped, its anterior and posterior limbs embrace the lacrimal sac . . . the stronger anterior limb extends over the front wall of the entire upper half of the lacrimal sac and attaches to the tarsi; a thin continuation bends around the lateral wall of the sac and then passes behind it to the posterior crest of the lacrimal bone.

The significance of this statement is that the anterior surface of the lacrimal sac and not the end point of attachment of the medial palpebral ligament on the side of the frontal process of the maxillary bone better represents the level of the medial angle of the eye-opening [3, Fig. 4 and 11, Fig. 875].

Finally, to show that the horizontal alignment of the points on the orbital margins used to orient the eye-openings when reconstructing the eyes comes near to matching the alignment of the angles of the eyes in life, Fig. 3 is presented. Here the eyes of two men, one 30 years of age, the other 70, are shown looking straight ahead, thus approximating in the living head the position of the skull when posed in the Frankfort plane. Note that the lower lids contribute most of the appearance of horizontality. The age changes are particularly striking.

In my book [2, p. 257] I commented on the difficulty that an artist, let alone an anthropologist lacking art training, has in reconstructing the face on the skull and ending up with a likeness. In this connection I stated that "Many artists have a hard enough time getting a sitter's eyes and mouth right when they are simply copying what is before them." I did not then connect this statement with the illustration in the same book shown in Fig. 4. Obviously, the artist who made this drawing, while generally achieving a suggestive likeness, exposed

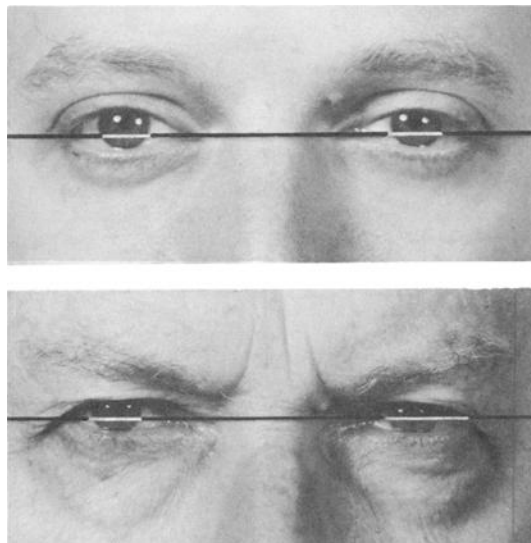


FIG. 3—The eyes of two men (upper, 30 years old, lower, 70 years old) photographed looking straight ahead. Horizontal lines have been drawn through the angles of the eye-openings. Note that, although the alignment of the eye-openings can be somewhat masked by age changes in the upper lids, the pupils retain their position just above the lines.



FIG. 4—Photograph of a girl compared with a drawing made from her skull some six months later [12, figs. 1 and 3]. Note that the eye-openings in the drawing are not in alignment.

through the shaping of the eye-openings his lack of awareness of their normal horizontal alignment, which is not surprising in view of the little attention given now-a-days to Wilder's guideline.<sup>2</sup>

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