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Main Articles

Ear witness

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Abstract
A description is given of some aspects of the normal human auricle. The physiognomy of the auricle is different for every individual which leads to the possibility of identifying people based on their auricles. Indeed this has even led to the reading of earprints similar to fingerprints, a fact not generally known amongst ENT-specialists. This highly specialized knowledge has been developed within a special branch of forensic medicine and criminology, called 'earology' or 'otomorphology'. Two illustrative case histories are presented.

Key words: Ear, external; Forensic anthropology

Introduction

Recently a discussion was started in the lay press in the Netherlands and in Belgium on the possibility of identifying a person based on his/her auricle only. As there are, to our knowledge, no recent ENT-articles on this topic, the old papers date back to the beginning of this century and are in the majority in German at that, we thought some updating might be interesting.

The normal auricle

A normal auricle should have the ridges and grooves of the textbooks. The brim of the auricle (helix) is curved over the bowl of the ear (concha). Often the helix carries a slight prominence, the tuberculum auriculae that also has been called apex auriculae Darwini, tuberculum apicale, spina apicalis Darwini, Woolner-Darwin tubercle,[1,2] or usually, Darwin's tubercle. The helix starts in front of the concha with the crus helicis near the entrance (porus) of the external ear canal. It divides the concha in two. The larger part lies inferiorly (cavum), the smaller part is above (cymba). Parallel with, and in front of the helix runs the anthelix – **not** anti**h**elix which is a misnomer as the ant(e)helix lies in front of the helix and **not** opposite the helix. The anthelix divides anteriorly above the cymba into two diverging ridges, the crurae anthelicis. At the caudal side the anthelix runs into a sudden curve, the antitragus, just opposite the tragus and above the earlobe. Opposite, and in front of, the antitragus is a triangular piece of cartilage, the tragus, that forms the front of the entrance to the ear canal. The tragus is separated from the antitragus by the incisura intertragica. The groove between helix and anthelix is called fossa navicularis, the one between the two crurae anthelicis is the fossa triangularis.

At birth the pinna has a length of about 30 mm. It has not yet its final shape. Shortly after, the auricle grows rapidly by about 4 mm, thereby reaching its definite and unique shape. At the end of the first year it is about 45–50 mm in length. For the next two years it grows evenly, reaching 53 mm at age three. At 10-years-old the ear is 55 mm and at fifteen the adult size approximately has been reached, being slightly less than 70 mm (50–82 mm) with the normal Caucasian male and 3.5 mm smaller for the female. The auricle, however, continues its growth gradually in later life, being about 11 mm larger in males, and about 13 mm in females at age 80, causing a diminishing difference in length between the sexes at that age.[3] This growth is attributed to increase of intercellular tissue, to the appearance of intercellular gaps filled with non-defined protein-poor material and to loss of elastin.[3]

Identifying abnormal and normal auricles

The pinna and deviations of its norm have been commented upon from very early on in most, if not all, holy books to modern cartoons and books of art.[4] More systematic papers on the auricle or pinna appeared in the last part of the 19th and early part of the 20th century. To describe the auricle system-

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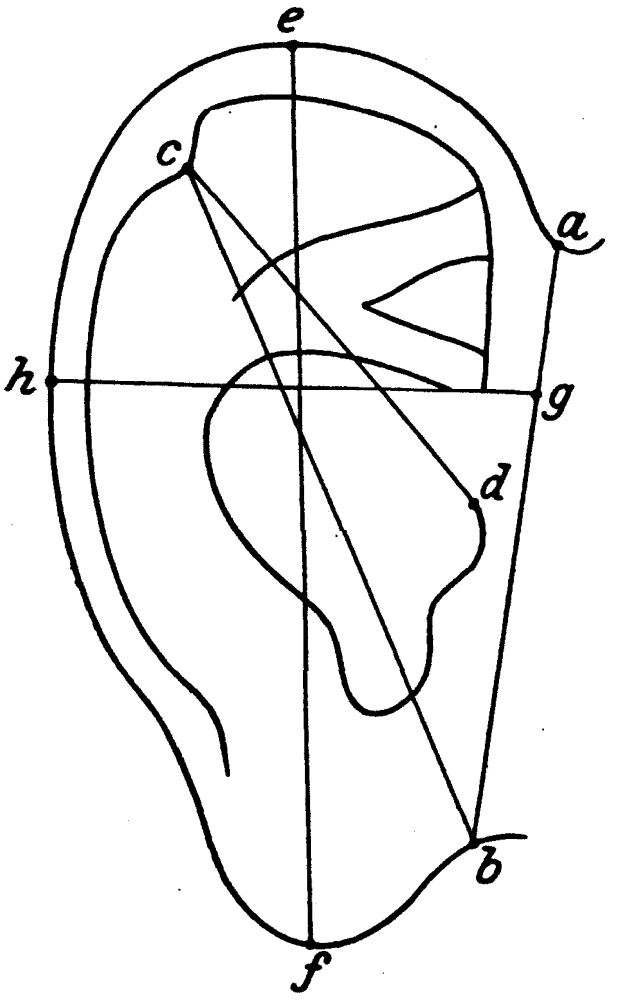

FIG. 1

System of lines used to compare different auricles, after G. Schwalbe (Schwalbe[5]). ab, base of auricle; cd, real length; ef, largest overall length; gh, largest overall width; bc, distance between lower insertion to Darwin's tubercle.

atically Schwalbe used five lines to map the auricle (Figure 1).[5,6] In the description of the helix he paid much attention to Darwin's tubercle, distinguishing six different varieties. In addition to this he systematized the description of the tragus, the antitragus, the shape of the brim of the helix, the lobulus and the angle of the auricle to the skull. Taking all these together he arrived at a systematized pinna-file and to some ear indices (Figure 1):

(1) the physiognomic ear index from the equation: 100.hg/ef.

(2) the morphological ear index from the equation: 100.ab/cd

He conducted studies on the length of the auricle within the population of Straszburg and found a length for men of 65.9 mm on the right side and 65.5 mm on the left. For females he found 62.3 and 61.5 respectively.

Differences between left and right were denied by Pellnitz. He found that the pinnae of approximately one fifth of the population are equally-sized, while four fifths are different, being evenly distributed between right and left.[3]

The female Bushman have the smallest ears (46 mm), while the Patagonians have the longest ones,[7] if the mythical Panotic people are not taken into account, a people that were mentioned for the first time in the lost book of Shylax 508 BC.[8]

Other measures have also been used to map the auricle such as auricular protrusion, angle of ear inclination and ear location in relation to other fixed points, such as the eyes, nose, mouth and chin.[9]

Abnormally shaped auricles such as donkey-, sail-, cup-, lop-, bat-, satyr-and Stahle ears, macro-, micro- and anotia and their surgical corrections received quite an extensive coverage in literature, which has been recently summarized.[10] Other papers describe the auricles of well known people, for instance Mozart's left ear anomaly, that ran in the family, and that lacked a well-defined concha.[11]

Apart from abnormal pinnae including those, that are traumatized by disease, operations or mechanical trauma, we might also add the personal touch that many people give to their ears using ear ornaments that might serve as a characteristic mark. To carry an earring, often only at the left auricle, is a very old tradition. They were used as ornaments, a talisman, an alternative to the obolos as a payment to the old ferry-man Charon on the river Styx, as a wallet[12] and for a variety of mythical, ritual or religious reasons, as a characteristic of a certain trade or tribe and even as a therapy against aural polyps.[13–15] Although rhinologists are inclined to claim Cleopatra's nose as a mascot, otologists have a claim also. Plinius[16] stated that Cleopatra dissolved a pearl in her drink that she took from her earring and drank at the occasion of the banquet she gave in honour to Anthony.

In short the auricle is so variable that it seems possible to identify people on grounds of the physiognomy of their pinna. Indeed this has been done for medical purposes to identify newborns by making use of a so-called oto-photometer.[17] Identification of people based on their ears has been coined 'otomorphology' by Garnett[16] and 'earology' by Iannarelli.[18] The literature on this subject is mainly to be found in ethnology, anthropology, forensic and criminology journals and books. Pinnae allow for identification of both the living and the dead, for victims and for offenders. The unique and individual design of the external ear is comparable to the epidermal ridge patterns on fingers and thumbs. Earology makes use of identification through photographs, through systematized descriptions of auricles and through earprints. The general description of the pinna follows the same rules as those laid down by Schwalbe.[5–7] Iannarelli studied the growth of the pinna during life, found for the white male a length of 65–72 mm at age 20 and of 68–75 mm at age 60–70 years and for females 57–65 and 67–70 mm respectively. He therefore found as did Pellnitz[3] a larger growth in later life of the female's then of the male's ear. Iannarelli, however, attributes this lengthening to the sagging of the ear lobe. Iannarelli found that the general form of the pinna in the USA, is in approximately 65 per cent of the population

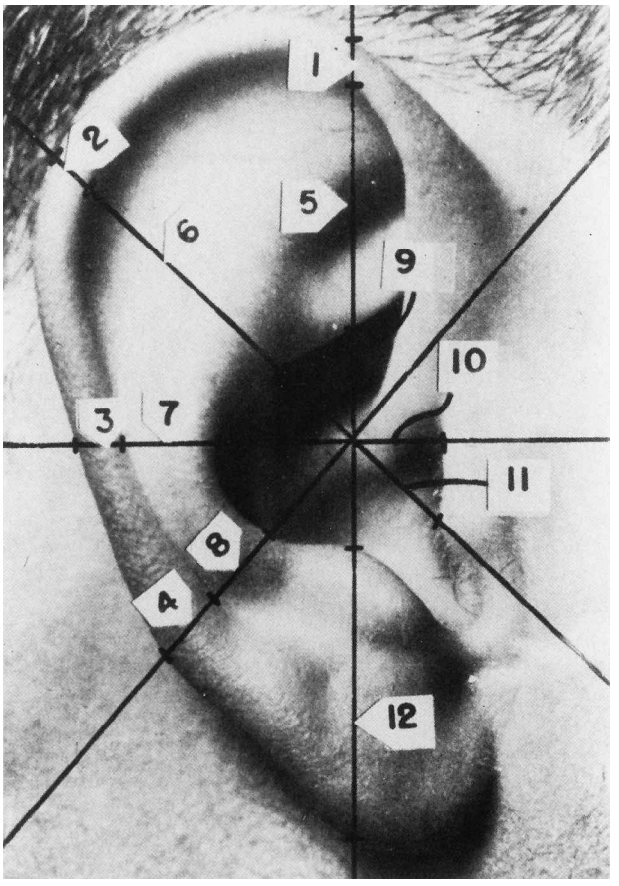

FIG. 2

System of lines used to compare different auricles, after A. Iannarelli.[18] (Reproduced with kind permission of the author).

oval, in 30 per cent triangular, in three per cent rectangular and in two per cent round. In subpopulations these numbers vary somewhat, but not dramatically. The general position of the ear in relation to the eyebrow level has been described by him as high set, normal set and low set, meaning the upper helix above, flush or beneath that level. In the same token the ear can be classified as deep set, close, shallow or protruding in its approximity to the skull, indicating the space between the auricle and the side of the head. Peculiarities of the external ear, such as freckles, moles, scars and other distinctive distortions should be recorded as well. It turns out that even identification of each half of a pair of identical twins is possible with earology, a fact that was rediscovered by Iannarelli, but had already been described by Mrs Ellis in 1900.[16]

To document auricles a special camera set-up has been designed. The pictures are enlarged to standard size and put into a frame of axes (vertical, horizontal and two diagonal) in order to compare them properly and to allow comparison of auricles during growth. Hereafter they are put onto special identification cards and properly classified by taking all the measurements through overlay transparencies and by making use of the axis-system. (Figure 2). Iannarelli proved that it is possible to identify the owner of an earprint impression in the same way as it is possible to identify a person from their fingerprints. Impressions of the auricle are left by the thin layer of perspiration and body oil on the skin. Good impressions are left on surfaces such as glass, plastic and other fairly smooth materials.

In the office perfect impressions are made with inked or inkless printing pads. The latter use non-toxic food colours or baby-oil printing. Those impressions then are compared visually with photographs from auricles and with transparencies made with the same overlay method that is used for the auricles' photographs.

If an earprint is found somewhere, comparison with a previously taken earprint or with the earprint taken from a suspect is not too difficult. Criminals usually take care to use gloves or to wipe off areas that they may have touched with their fingers. They usually take less care to do the same with their ear prints.

With this technique it is even possible to calculate the height of someone who left an earprint while eavesdropping. The head's inclination when eavesdropping turns out to be within narrow limits, bringing the head down 30–60 mm, while the variety of the distance between the top of the skull and the ear canal varies between 130–140 mm.[19] Earprints recently became accepted in courts in the Netherlands, in the UK and in the USA as a proof of someone's identity.

Two illustrative case-histories, one from the Netherlands and one from the UK are presented.

(1) A series of some twenty burglaries were committed in the triangle of Amsterdam, Utrecht and Leyden in the Netherlands. Earprints were collected from quite a few sites, 33 in all. The earprints were sent to the second author (CvdL) at the Institute for Criminal Investigation and Crime Science, without any reference. Earprints of two suspected persons were added. The earprint of one of the suspects was identified six times and the earprint of the other suspect was identified four times. On 24 May 1995 both suspects were convicted by the district court in Amsterdam. Both appealed against the conviction. However on 22 December 1995 both were convicted at the Court of Appeal. In both trials the earprints were the conclusive evidence.

(2) On the morning of 7 May 1996 a 94-year-old deaf female, living alone, was found to have been killed during the night of 6–7 May in her home in Huddersfield (UK).[20] The offender(s) entered the house through a forced window at the back of the house. The investigation yielded a few purple fibres, four earprints of a left auricle and one of a right auricle on the window beneath the forced one. Three experts, two British and one Dutch (the second author (CvdL)), received the earprints of 16 suspected persons with only a number attached to them. The three experts independently identified the same person out of the 16 as the owner of the earprints on the window. Eventually this person was tried in December 1998 at Leeds Crown Court and convicted by an unanimous verdict by the jury. The judge sentenced him to life imprisonment.

Conclusion

Earology or otomorphology, words probably not widely known among ENT-specialists and otologists, is a field developed amongst anthropologists, criminologists and forensic doctors. It makes use of the fact that auricles of every individual are different, even among identical twins, and that earprints may be compared with fingerprints in their highly personal characteristics.

References

1 Nova et Vetera. The Woolner-Darwin tubercle. *Br Med J* 1946;772
2 Millard DR, Pickard RE. Darwin's tubercle belongs to Woolner. *Arch Otolaryngol* 1970;**91**:334–5
3 Pellnitz D. Über das Wachstum der menschlichen Ohrmuschel. *Arch Ohrenheilk* 1958;**171**:334–40
4 Willemot J. A l'écoute de l'oreille et de son histoire. In: Willemot J, Pirsig W, Stephens SD, Van Cauwenberge P, Pahor AL, eds. *De Historia Auris et de Cultura.* Brussels: Lapperre, 1994;9–108
5 Schwalbe G. Zur Methodik statisticher Untersuchungen über die Ohrformen von Geisteskranken und Verbrechern. *Arch Psychiat Nervenkr* 1875;**27**:641–3
6 Alexander G. Die Anthroplogie des Gehörorganes. In: Denker, A. und Kahler O. eds. *Handbuch der Hals-Nasen-Ohen-Heilkunde. Die Krankheiten des Gehörorgans.* Erster Teil. Berlin: Springer-Verlag, 1926;100–9
7 Alexander G. Die anatomischen Varietäten des Gehörorganes. *Ibid* 1926;109–114
8 Beins JFA. *Misvorming en verbeelding.* Thesis Groningen. Van Oorschot, Amsterdam 1948
9 Farkas LG. Growth of normal and reconstructed auricles. In: Tanzer RC, Edgerton MT, eds. *Symposium on Reconstruction of the auricles.* Saint Louis: CV Mosby Company, 1974;24–31
10 Weerda H, Siegert R. Classification of auricular malformations. *Face* 1998;**5**:157–8
11 Holl M. Mozarts Ohr. *Mitt. Anthropol. Gesell. Wein.* 1901;**31**:1–12
12 *38th Annual Report of the Bureau of American Ethnology.* Washington Government, 1924
13 Weiser-Aall L. *Menn med Öreringer i Norge.* Utgitt av Norsk Folkemuseum, Oslo 1957
14 Kindler W. Das Mysterium um die menschliche Ohrmuschel 1. *Z Laryngol Rhinol Otol* 1969;**48**:653–63
15 Kindler W. Das Mysterium um die menschliche Ohrmuschel 2. *Z Laryngol Rhinol Otol* 1969;**48**:753–62
16 Ellis MA. *The Human Ear. Its Identification and Physiognomy.* London: Adam and Charles Black, 1900
17 Adamson JE, Horton CE, Crawford HH. The growth pattern of the external ear. *Plastic Reconstr Surg* 1965;**36**:466–70
18 Iannarelli A. *Ear identification.* California: Paramont Publ Company, 1989
19 van der Lugt C. Determining a person's height based upon the distance of a located earprint. *J Forensic Identification* 1997;**47**:406–19
20 Greer L. *The Dorothy Wood Case.* Police Review, 5 November 1999; 29–30

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