Aesth. Plast. Surg. 30:81–85, 2006
DOI: 10.1007/s00266-005-6095-1

Aesthetic Plastic Surgery

Morphometry of the External Ear in Our Adult Population

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Abstract. This study aimed to determine the mean values of the different morphometric measurements from right and left ears. These measurements were taken from 341 healthy young adults (150 women and 191 men) ages 18 to 25 years using an electronic digital caliper. The results showed the mean values for total ear height, lobular height and width, distances from tragus to antihelix and to helix, and ear projection and width to be, respectively, 59.7 ± 3 mm, 17.5 ± 1.4 mm, 18.5 ± 2.2 mm, 16.6 ± 1.7 mm, 25.1 ± 2 mm, 16.6 ± 2 mm, and 31.3 ± 2.2 mm for the left ear, and 59.5 ± 3.1 mm, 17.9 ± 1.5 mm, 18.9 ± 2 mm, 16.5 ± 1.8 mm, 25.2 ± 1.9 mm, 17 ± 1.9 mm, and 31.2 ± 2.2 mm for the right ear in the young women. However, in the young men, these values were, respectively, 63.1 ± 3.6 mm, 18.3 ± 1.7 mm, 19.4 ± 2 mm, 17.2 ± 1.8 mm, 26.3 ± 1.9 mm, 17 ± 2.3 mm, and 33.3 ± 2.2 mm for the left ear, and 62.9 ± 3.5 mm, 18.4 ± 1.7 mm, 19.8 ± 1.9 mm, 17.2 ± 1.8 mm, 26.6 ± 1.9 mm, 17.6 ± 2.1 mm, and 33.1 ± 2.1 mm for the right ear.

Key words: External ear—Morphometric measurements

The human ear is the defining feature of the face. Its structures are signs of age and sex. It also is known that the size of the human auricle increases after completion of development [16,17,24]. Moreover, the ear lobe is considered to be an important attribute of beauty in many societies [29]. The appearance and symmetry of the auricle is essential for facial harmony.

Anomalies of the ear such as lobule ptosis, missing external ear, prominent ears, and microtia may result from trauma, surgical resection, tumors, or congenital deformation [8,15]. Some studies of the ear involving various syndromes and anomalies such as microtia have been published, but few studies have investigated the ear in the normal population [4,6,9,11–13,21]. Therefore, knowledge concerning the anatomy of the normal ear is important to the plastic surgeon for planning treatment of ear deformities, and also to the hearing instruments industry [23,27].

This study aimed to determine the mean values of different morphometric measurements from the left and right ears in the study population.

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Materials and Methods

The study group consisted of 341 young adult Turkish people (150 young women and 191 young men) 18 to 25 years of age with no history of trauma or congenital anomalies. Seven surface measurements were taken directly from each ear of the subjects with an electronic digital caliper by the same senior anatomist (P.K.). These measurements, shown in Figs. 1, 2, and 3, were as follows:

- *Total ear height:* Distance between the highest point of the auricle and the lowest point of the ear lobe (Fig. 1).
- *Lobular height:* Distance from the intertragic incisure to the caudal part of the lobule (Fig. 2).
- *Lobular width:* Horizontal width of the lobule at the midpoint of the lobular height (Fig. 2).
- *Distance from the tragus to the antihelix* (Fig. 2).
- *Distance from the tragus to the helix* (Fig. 1).
- *Ear projection:* Distance from the helix to the processus mastoideus at the tragal level (Fig. 3).
- *Ear width:* Distance between the most anterior and posterior points of the ear (Fig. 1).

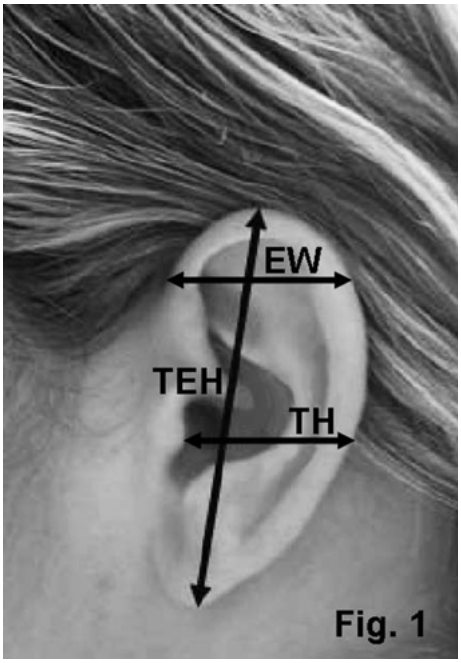

Fig. 1. Morphometric measurements of total ear height (TEH) distance from tragus to helix (TH) and ear width (EW).

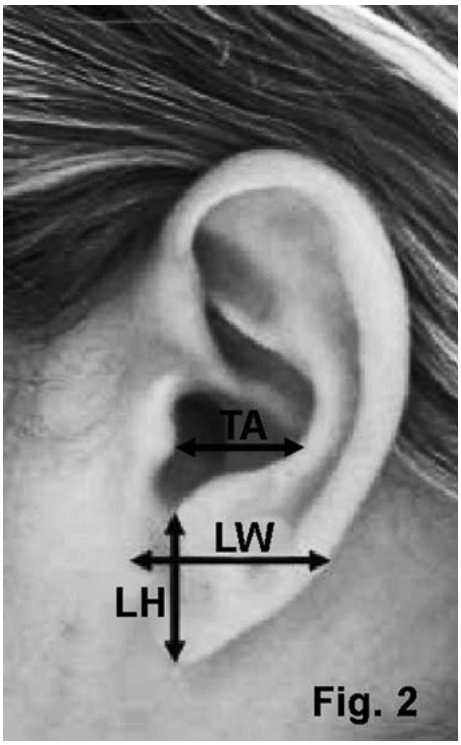

Fig. 2. Morphometric measurements of lobular height (LH), lobular width (LW) and distance from tragus to antihelix (TA).

The data were divided into groups representing the right and left ears of females and males. The SPSS 10.0 program was used for the statistical analysis of the measurement results. From these measurements, means and standard deviations were calculated.

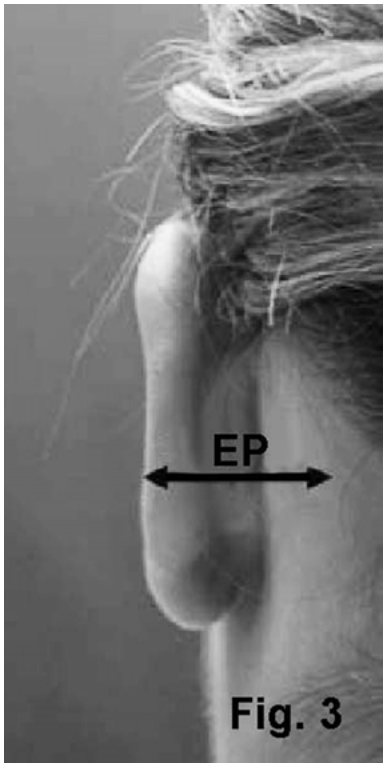

Fig. 3. Morphometric measurement of ear projection (EP).

Results

The morphometric measurement results from the external ear are shown in Table 1.

Discussion

The ear is a defining feature of the face. Its shape gives information about age and sex. Moreover, the auricles are important keys to the natural and aesthetically pleasing human face. Differences between the left and right parts of the human face, especially differences between the paired structures, are well known in healthy people [14]. In their report, Rubin et al. [3,24] wrote that "the human ear, an atrophic appendage on each side of the head, can scarcely be called beautiful." The external ear is composed of three primary components: the helix–antihelical complex, the conchal complex, and the lobule [4].

The total ear height is important in the evaluation of congenital anomalies (e.g., the small ear in Down's syndrome) [6,11–13]. The ear reaches its mature height at 13 years in males and at 12 years in females [13,17]. Moreover, the ancient Chinese believed that each part of the ear represented a different prospect, maintaining that total ear height shows association

Table 1. Different morphometric ear measurements for 191 men and 150 women

Measurements	Sex	Side	Mean (mm)	Standard deviation (mm)
THE	Male	Left	63.1	3.6
		Right	62.9	3.5
	Female	Left	59.7	3.0
		Right	59.5	3.1
LH	Male	Left	18.3	1.7
		Right	18.4	1.7
	Female	Left	17.5	1.4
		Right	17.9	1.5
LW	Male	Left	19.4	2.0
		Right	19.8	1.9
	Female	Left	18.5	2.2
		Right	18.9	2.0
TA	Male	Left	17.2	1.8
		Right	17.2	1.8
	Female	Left	16.6	1.7
		Right	16.5	1.8
TH	Male	Left	26.3	1.9
		Right	26.6	1.9
	Female	Left	25.1	2.0
		Right	25.2	1.9
EP	Male	Left	17.0	2.3
		Right	17.6	2.1
	Female	Left	2.0	2.0
		Right	1.9	1.9
EW	Male	Left	33.3	2.2
		Right	33.1	2.1
	Female	Left	31.3	2.2
		Right	31.2	2.2

TEH, total ear height; LH, lobular height; LW, lobular width; TA, distance from tragus to antihelix; TH, distance from tragus to helix; EP, ear projection; EW, ear width.

with long life and status. For example, the kings of old China are said to have had long ears [28]. In a study consisting of North American whites, it was observed that the total height of the left ear was 62.4 mm in men and 58.5 mm in women, and that the same measurement was 70.1 mm in Japanese people [1,13]. In the current study, the height of the left ear was found to be 63.1 mm in men and 59.7 mm in women. Our results are more similar to the measurements for North Americans than those for Japanese.

An acquired deformity that develops with aging may include elongation or ptosis of the ear lobe. This condition has been attributed to loss of elastic fibers and gravitational forces [7,20,21]. Earrings are an additional weight on the ears, and they therefore affect ear lobe height [2]. Using measurement parameters similar to those used in the current study, the ear lobe height is reported in different dimensions as 1.3 to 2.5 cm [2,5,19–21,24]. This measurement was found in our study to be 1.8 cm in the young men and 1.7 cm in the young women.

In aesthetic earlobe reconstruction, the primary aim is to achieve a more youthful appearance [5]. Therefore, our study group consisted of young adults. Brucker et al. [5] reported the ear lobe width to be 1.95 cm in men and 1.97 cm in women, whereas this measurement was 1.94 cm in the men and 1.85 cm in the women of our youthful population.

The distances from the tragus to the helix and to the antihelix are essential for the diagnosis of auricular deformities, and also for planning hearing aid material. In the current study, the distances from the tragus to the helix and to the antihelix were found to be 26.3 and 17.2 mm, respectively, in men, whereas the same measurements were found to be 25.1 and 16.6 mm, respectively, in women.

Most of the hearing deficits in children with bilateral microtia are managed with hearing aid materials. Although these materials have some advantages, there have been problems with their fixation to the mastoid [4]. They are applied with adhesives or headbands. These adhesives are difficult to use, and moreover, they may cause dermatitis and local skin reactions [18].

Because of these problems, bone-anchorage with osseointegrated implants was performed. With this approach, the implants are anchored to the mastoid [4]. The location of the hearing material must be planned carefully during the auricular reconstruction for a successful result. Moreover, prominent ear is a common congenital anomaly, and extrinsic muscles of the ear are related to the position of the auricle on

the cranial surface [10,15,25,26]. The helix protrudes 1 to 2 cm from the skull, with the projection increasing from superior to inferior. This relationship is used for otoplasty to avoid deformities such as telephone deformity [4].

In our study group, ear projection was measured as 17.10 mm in the young men and 16.61 mm in the young women. This measurement was generally reported to be 15 to 20 mm [22,27].

Among the craniofacial syndromes, disproportionately wide ears are observed mostly in Apert and Crouzon syndromes, and narrow ears mostly in cleft lip and palate patients [11,12]. The mature width of the ear is achieved in males at 7 years and in females at 6 years [13]. A study consisting of 100 males and 100 females found the ear width to be 32.4 mm for the left ear and 33 mm for the right ear in men, and to be 31.9 mm for the left ear and 32.4 mm for the right ear in women [3]. However, DellaCroce et al. [9] reported the ear width to be 30.5 mm. We found some differences between other studies and our results, which showed 33.3 mm for the left ear and 33.1 mm for the right ear of 191 young men, as compared with 31.3 mm for the left ear and 31.2 mm for the right ear of 150 young women.

When our results are compared with literature findings, some differences in the values of ear width are found. There is a significant difference especially in the values of total ear height between Japanese individuals and our population. We consider that these discrepancies could be a result of factors such as race, genetic variables, individual constitution, age, and measurement method.

Analysis of our data with regard to sex showed some similarities between men and women, except for two measurements: total ear height and ear width. Both of these measurements were larger in men.

In conclusion, a knowledge of normal ear dimensions is important in the diagnosis of congenital malformations, syndromes, and acquired deformities, as well as in the planning of treatment. It also is helpful for the hearing instruments industry. This study demonstrates the mean values of the different morphometric measurements from the left and right ears in 341 Turks. As a result, we believe the data presented in this study have yielded parameters for ear morphology that will prove useful in determining ear anomalies and variations, and may help the clinician to reproduce an anatomically correct ear during its reconstruction.

References

1. Asai Y, Yoshimura M, Nago N, Yamada T: Correlation of ear length with age in Japan. *BMJ* **312:**582, 1996
2. Azaria R, Adler N, Silfen R, Regev D, Hauben J: Morphometry of the adult human earlobe: A study of 547 subjects and clinical application. *Plast Reconstr Surg* **111:**2398–2402, 2003
3. Balogh B, Millesi H: Are growth alterations a consequence of surgery for prominent ears? *Plast Reconstr Surg* **89:**623–630, 1992
4. Beahm EK, Walton RL: Auricular reconstruction for microtia: Part 1. Anatomy, embryology, and clinical evaluation. *Plast Reconstr Surg* **109:**2473–2482, 2002
5. Brucker MJ, Patel J, Sullivan PK: A morphometric study of the external ear: Age and sex-related differences. *Plast Reconstr Surg* **112:**647–652, 2003
6. Chou CT, Tseng YC, Tsai FJ, Lin CC, Liu CS, Peng CT, Tsai CH: Measurement of ear length in neonates, infants, and preschool children in Taiwan. *Acta Paediatr Taiwan* **43:**40–42, 2002
7. Constant E: Reduction of hypertrophic earlobe. *Plast Reconstr Surg* **64:**264, 1979
8. Coward TJ, Watson RM, Scott BJJ: Laser scanning for the identification of repeatable landmarks of the ears and face. *Br J Plast Surg* **50:**308–314, 1997
9. DellaCroce FJ, Green S, Aquilar EF: Framework growth after reconstruction for microtia: Is it real and what are the implications? *Plast Reconstr Surg* **108:**1479–1484, 2001
10. Ellis DAF, Keohane JD: A simplified approach to otoplasty. *J Otolaryngol* **21:**66, 1992
11. Farkas LG: Ear morphology in Treacher Collins', Apert's, and Crouzon's syndromes. *Arch Otorhinolaryngol* **220:**153–157, 1978
12. Farkas LG, Lindsay WK: Ear morphology in cleft lip and palate anomaly. *Arch Otorhinolaryngol* **206:**57–68, 1973
13. Farkas LG, Posnick JC, Hreczko TM: Anthropometric growth study of the ear. *Cleft Palate Craniofac J* **29:**324–329, 1992
14. Ferrario VF, Sforza C, Ciusa V, Dellavia C, Tartaglia GM: The effect of sex and age on facial asymmetry in healthy subjects: A cross-sectional study from adolescence to midadulthood. *J Oral Maxillofac Surg* **59:**382–388, 2001
15. Guyuron B, DeLuca L: Ear projection and the posterior auricular muscle insertion. *Plast Reconstr Surg* **100:**457–460, 1997
16. Heathcote JA: Why do old men have big ears? *BMJ* **311:**1668, 1995
17. Ito I, Imada M, Ikeda M, Sueno K, Arikuni T, Kida A: A morphological study of age changes in adult human auricular cartilage with special emphasis on elastic fibers. *Laryngoscope* **111:**881–886, 2001
18. Linstrom CJ, Aziz MH, Romo T: Unilateral aural atresia in childhood: Case selection and rehabilitation. *J Otolaryngol* **24:**168, 1995
19. McKinney P, Giese S, Placik O: Management of the ear in rhytidectomy. *Plast Reconstr Surg* **92:**858, 1993
20. Mowlavi A, Meldrum G, Wilhelmi BJ, Ghavami A, Zook EG: The aesthetic earlobe: Classification of lobule ptosis on the basis of a survey of North American Caucasians. *Plast Reconstr Surg* **112:**266–272, 2003
21. Mowlavi A, Meldrum G, Wilhelmi BJ, Zook EG: Incidence of earlobe ptosis and pseudoptosis in patients seeking facial rejuvenation surgery and effects of aging. *Plast Reconstr Surg* **113:**712–717, 2004
22. Murakami CS, Quatela VC: Reconstruction surgery of the ear. In: Cummings CW, Fredrickson JM, Harker LA, Schuller DE, Richardson MA (eds). Pediatric otolaryngology head and neck surgery. 3rd

ed. Mosby Year Book: St. Louis, MO, pp. 439–454, 1998
23. Posnick JC, Al-Qattan MM, Whitaker LA: Assessment of the preferred vertical position of the ear. *Plast Reconstr Surg* **91:**1198–1203, 1993
24. Rubin LR, Bromberg BE, Walden RH, Adams A: An anatomic approach to the obtrusive ear. *Plast Reconstr Surg* **29:**360–370, 1962
25. Smith DW, Takashima H: Protruding auricle: A neuromuscular sign. *Lancet* **1:**747, 1978
26. Smith DW, Takashima H: Ear muscles and ear form. *Birth Defects* **16:**299, 1980
27. Tolleth H: Artistic anatomy, dimensions, and proportions of the external ear. *Clin Plast Surg* **5:**337–345, 1978
28. Woo PN, Lip PL: ... and that thick ears signify greater wealth. *BMJ* **312:**582, 1996
29. Yotsuyanagi T, Yamashita K, Sawada Y: Reconstruction of congenital and acquired earlobe deformity. *Clin Plast Surg* **29:**249–255, 2002