

# Computed tomography measurement of the auricle in Han population of north China

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## Introduction

The auricle is one of the five primary features of the face, and is particularly influential in determining the appearance of the human face. Cosmetic surgery and auricular rejuvenation are becoming increasingly widespread. The morphology of the auricle is highly complex. (see Fig. 1). Many of the existing anthropometry data on the auricle have been gained using direct measurement techniques. In the last few years, three-dimensional (3D) reconstructive techniques have been applied to measure soft tissues. The current study sought to provide anthropometric data on normal auricles in a Han-Chinese sample using a 3D CT reconstruction technique.

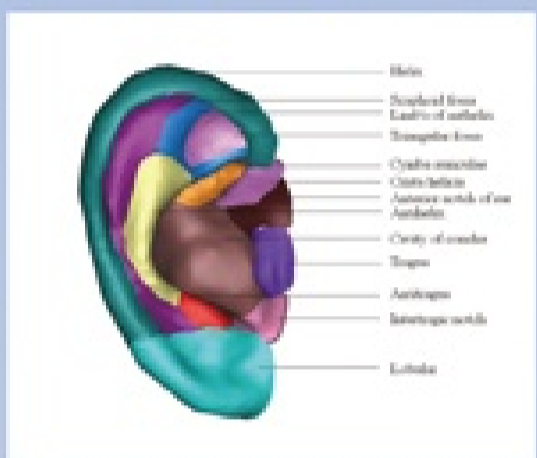


Fig. 1. Anatomical names for each part of the auricle.

## Materials & Methods

We studied the CT data of 485 adult Han-Chinese people (244 males and 241 females). To examine the relationship between auricle dimensions and age, the data were divided into three age subgroups. The ranges of the three groups were as follows: group 1: between 18 and 40 years, group 2: between 41 to 60 years, and group 3: more than 60 years of age.

CT imaging was performed using a helical CT imaging machine (General Electric Company, USA). The protocol included images generated at 120 kV with a 225 mA x-ray. The slice thickness of the reconstructed images was 1.25 mm, and the image matrix size was 512×512. MIMICS 10.01 software (Materialise Co., Leuven, Belgium) was used to create the 3D CT images and measure the 3D reconstructed auricle. All measuring points were determined using 3D reconstructed images. Sixteen anthropometric 'landmarks' on the auricles were used to record twelve dimensional measurements.

The measurements were shown in Fig. 2.

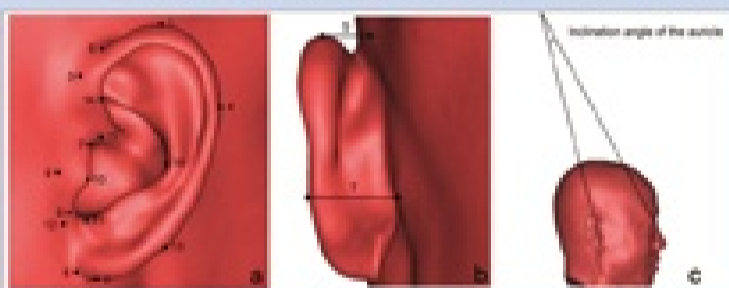


Fig. 2. (a) Landmarks of the auricle. (b) Measurement of the auricle protrusion at the (S) supraaurale and (T) tragal levels. (c) Measurement of Inclination angle of the auricle.

SPSS software 10.0 was used for statistical analysis. Mean and standard deviation (SD) were calculated for each age group in both gender groups. Two-tailed student's t-tests at the 95% confidence interval were used to examine sex-related differences in each age group. Additionally, bilateral variation in each age group and both genders was examined using the same method.

## Results

Measurements	Males				Females			
	18-40 years (n = 122)		41-60 years (n = 122)		18-40 years (n = 121)		41-60 years (n = 120)	
	Left	Right	Left	Right	Left	Right	Left	Right
Length of the auricle(mm)	58.92(4.0 <sup>*</sup> )	58.12(3.7 <sup>*</sup> )	61.23(3.1)	61.23(3.1)	62.75(3.5)	62.52(3.7)	56.62(4.6)	55.92(3.1)
Width of the auricle(mm)	32.81(2.7 <sup>*</sup> )	32.25(4.4 <sup>*</sup> )	31.42(2.5)	31.42(2.5)	34.52(2.7)	34.22(2.6)	30.91(4.8)	31.52(3.3)
Inclination angle of the auricle(°)	45.52(2.7)	45.02(2.8)	47.52(2.4)	47.52(2.4)	48.41(2.6)	48.12(2.5)	42.91(1.5)	42.32(1.9)
Length of tragus(mm)	14.21(2.2 <sup>*</sup> )	13.41(2.7 <sup>*</sup> )	15.82(2.3)	14.32(2.3)	15.82(2.3)	15.82(2.3)	12.31(2.5 <sup>*</sup> )	11.52(2.8 <sup>*</sup> )
Height of tragus(mm)	5.31(2.5 <sup>*</sup> )	5.01(2.4 <sup>*</sup> )	4.21(2.8 <sup>*</sup> )	5.52(2.7 <sup>*</sup> )	4.41(2.6)	5.91(2.8 <sup>*</sup> )	5.01(4.2 <sup>*</sup> )	4.81(4.2 <sup>*</sup> )
Lobular length(mm)	17.12(2.4)	17.32(2.7 <sup>*</sup> )	19.42(2.5 <sup>*</sup> )	19.32(2.5)	20.62(2.6)	20.52(2.6)	16.92(2.2 <sup>*</sup> )	16.82(2.2 <sup>*</sup> )
Lobular width(mm)	19.41(2.8 <sup>*</sup> )	19.41(2.7 <sup>*</sup> )	19.82(2.9 <sup>*</sup> )	19.72(2.9 <sup>*</sup> )	20.12(2.7 <sup>*</sup> )	20.22(2.6 <sup>*</sup> )	19.31(2.1 <sup>*</sup> )	19.31(2.1 <sup>*</sup> )
Conchal length(mm)	25.92(2.7)	25.32(2.3)	26.32(2.5)	26.22(2.5)	25.92(2.8)	24.62(2.7)	24.52(2.8 <sup>*</sup> )	23.92(2.8 <sup>*</sup> )
Conchal width(mm)	17.92(1.9 <sup>*</sup> )	17.82(1.9 <sup>*</sup> )	18.12(2.2 <sup>*</sup> )	18.12(2.2 <sup>*</sup> )	18.12(2.2 <sup>*</sup> )	18.12(2.2 <sup>*</sup> )	17.82(2.2 <sup>*</sup> )	17.72(2.2 <sup>*</sup> )
Protrusion at supraaurale level(mm)	15.71(1.7)	15.51(1.7)	14.32(1.3)	14.32(1.3)	14.12(1.4)	14.32(1.4)	14.52(1.1)	14.32(1.1)
Protrusion at tragal level(mm)	28.62(2.7)	21.24(1.0)	26.14(2.1 <sup>*</sup> )	19.62(1.9 <sup>*</sup> )	19.82(1.6)	20.01(1.7)	19.22(1.3)	18.92(1.7)
Inclination angle of the auricle(°)	15.26(2.7 <sup>*</sup> )	14.86(1.9 <sup>*</sup> )	15.55(4.9 <sup>*</sup> )	15.55(4.9 <sup>*</sup> )	14.96(2.3 <sup>*</sup> )	15.26(2.7 <sup>*</sup> )	14.76(2.0 <sup>*</sup> )	15.26(4.1 <sup>*</sup> )

Table 1. The auricle measurements for 244 males and 241 females.

The results for both right and left auricles of 244 males and 241 females are presented in Table 1. The results revealed that all linear dimensions of auricles, except for height of tragus and conchal length and width, increased significantly with age for both males and females. In contrast, protrusion at the supraaurale level and the tragal level showed a reduction of between 4% and 9% for males and a reduction of between 4% and 10% for females from group 1 to group 3. The auricular inclination angle did not show any significant change with age.

To further analyze changes in auricular dimensions with advancing age, the length and width (height) of the auricle, tragus, lobule and concha were integrated into respective indices. The auricular and lobular indices exhibited a tendency to decrease as age increased, for both males and females (Fig. 3.A and Fig. 3.B). However, the tragal and conchal indices showed a reduced tendency (Fig. 3.C and Fig. 3.D).

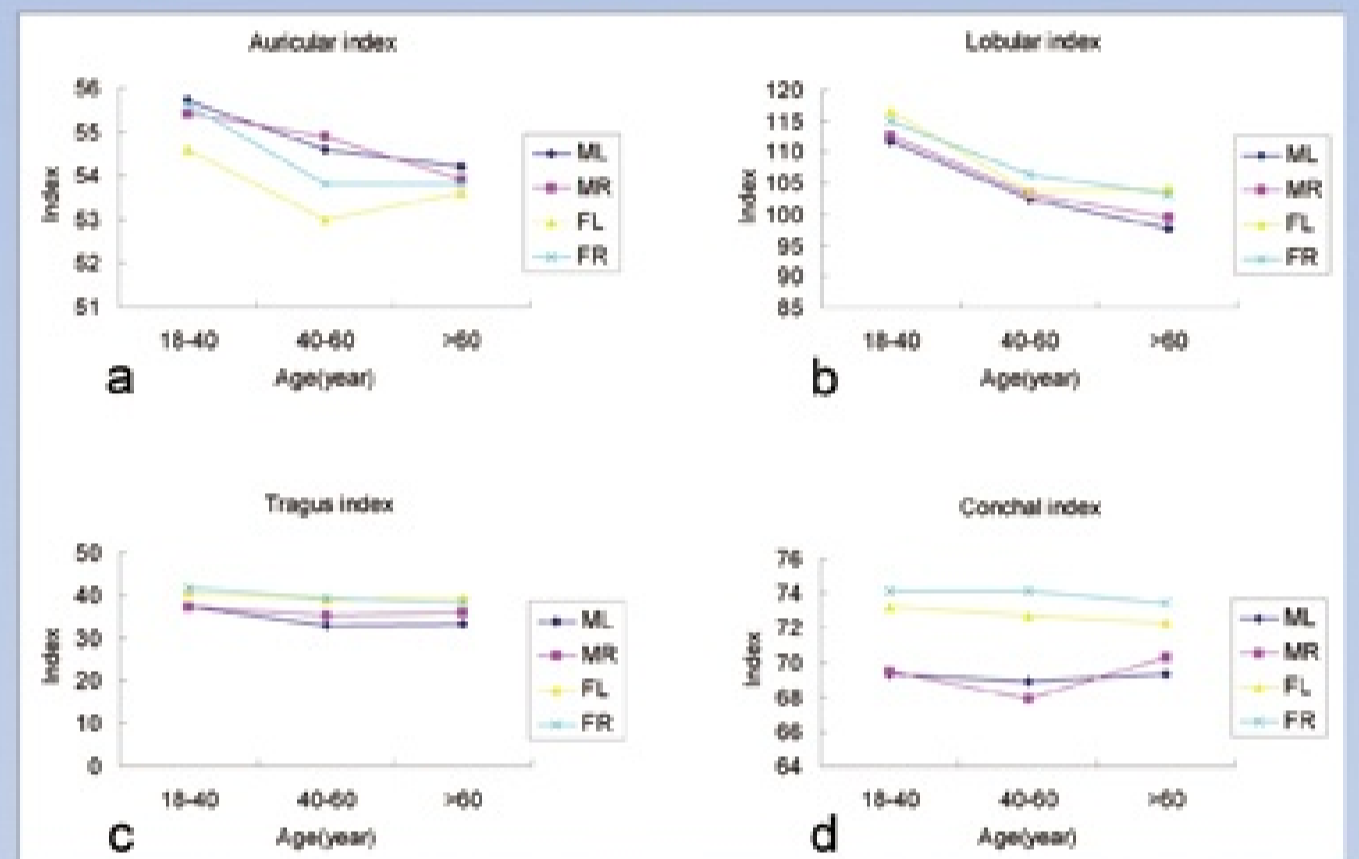


Fig. 3. Auricular index (a), lobular index (b), tragus index (c) and conchal index (d) in three age groups for both sexes. (M: Male, F: Female, L: Left, R: Right)

From Fig. 4 it can be seen that the percentage of the three types of earlobes was almost identical for males and females. The proportions of each earlobe type were as follows: male: acute angle 31.7%, right angle 29.4%, obtuse angle 38.9%. Female: acute angle 30.0%, right angle 31.1%, obtuse angle 38.9%. Earlobes were of the same type bilaterally in all individuals surveyed.

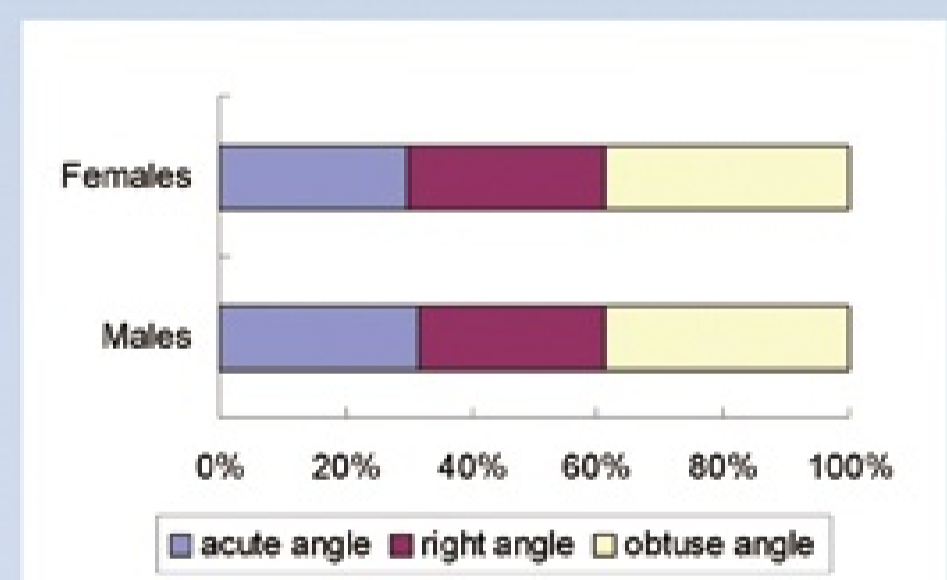


Fig. 4. The percentage of the three types of earlobes for males and females.

## Conclusion

This study exhibits the different morphometric measurements from normal auricles in 485 Han-Chinese using a 3D CT reconstruction technique. The results obtained in our study produced many effective parameters for auricle morphology, especially the relationship between auricle morphology and advancing age. We believe that the data presented in this study have many advantages over data obtained by traditional direct measurement techniques. These findings have potential implications for the diagnosis of congenital malformations, syndromes, and acquired deformities, in the planning of cosmetic surgery, and for the hearing instruments industry.