

Measurements of the Auricle in the Human Fetus

By

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Summary: The auricular length, auricular base length and auricular width were measured in 94 human fetuses with crown-rump (CR) lengths ranging from 49 mm (approximately 11 weeks of gestational age) to 250 mm (approximately 31 weeks of gestational age). The three measurement values showed linear increases as the CR length increased, suggesting that they are useful parameters to indicate intrauterine growth. The measurement values also suggested that the mandibular and hyoid derivatives did not grow independently, but did grow with maintaining a certain relationship.

It is nearly a century ago when Molenhauer, His, Tartaroff, Schwalbe and many other investigators have elaborated to elucidate the developmental process of the auricle (see Streeter, 1922 for review). Their works were very extensive covering comparative anatomy and anthropology of the auricle and founded the basis of the research. The description of the development of the auricle seems, however, to have subsided in these tens of years. Owing to valuable achievements of the previous investigators, we have certainly known much of the developmental process (Wood-Jonnes and Wen, 1934; Wilson, 1959), and part of the knowledges is utilized for clinical medicine (Tanzer, 1977). However, this does not necessarily mean that we have known enough; many works on the development still remain. We realized recently that we do not know even the growth pattern of the auricle in the second and third trimesters of gestation. This prompted us to perform auricular measurements in our fetus collection. The present study was plotted to determine the growth pattern of the auricle and to discuss the developmental significance of the measurements.

Materials and Methods

Ninety four fetuses were used for the present study. They were collected and preserved on the eugenic protection law and human tissue act. The fetuses were perfused with 10% formalin through

the umbilical vein or simply immersed in the fixative.

Five anthropological points were determined on the lateral surface of the left auricle (Fig. 1). They were otobasion superius, otobasion inferius, supraurale, subaurale and postaurale. The line passing through the otobasion superius and inferius was described as the auricular base line, and the distance between the two points was defined as the auricular base length. The auricular width was defined as a distance between the auricular base line and its parallel line passing through the postaurale. The auricular length was defined as a distance between the two lines passing through the supraurale and subaurale, which were perpendicular to the auricular base line. The crown-rump length was also measured in every fetus. These lengths and width were measured with a slide calipers.

Results and Discussion

The present study surveyed 94 fetuses, of which crown-rump lengths varied from 49 mm to 250 mm (approximately 11 weeks to 31 weeks of gestation according to Kunitomo, 1956). During this period of gestation the auricle showed considerable changes in morphology (Figs. 1 and 2). The scapha helix, which had been a shallow groove, became wide and deep and clearly demarked the helix and antihelix. The concha had been a narrow sulcus formed between the auricular hillocks, but became a spacious

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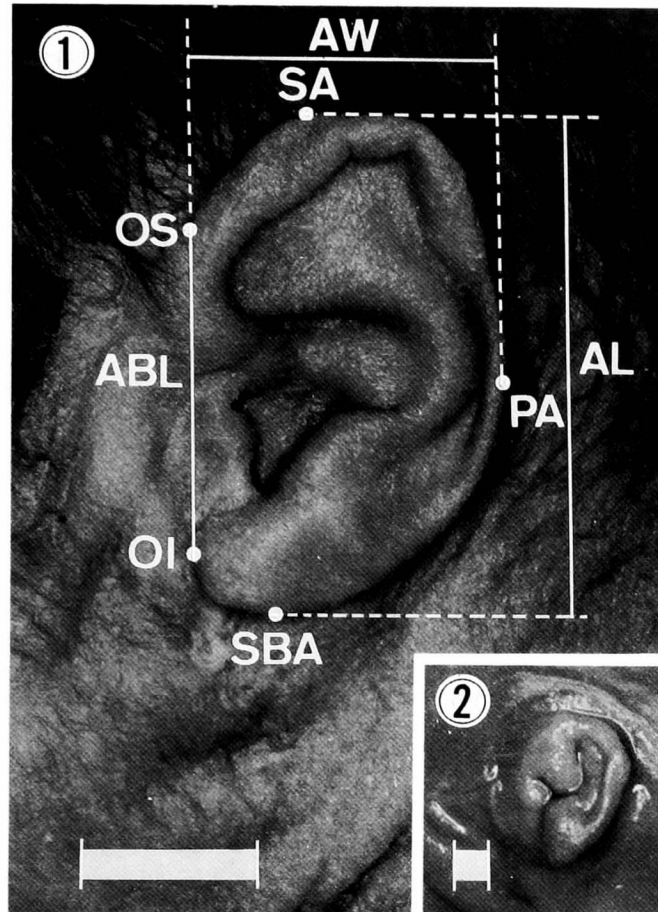


Fig. 1. The auricle at crown-rump length 241 mm. The dots are anthropological points for the measurements; otobasion superius (OS), otobasion inferius (OI), supraurale (SA), subaurale (SBA) and postaurale (PA). AL; auricular length, ABL; auricular base length, AW; auricular width. The bar indicates 10 mm.

Fig. 2. The auricle at crown-rump length 58 mm. Compare with the auricle in Figure 1 and note the difference in the scapha helix, antihelix, concha, antitragus and lobule. The bar indicates 1 mm.

groove in the later fetal life. The lobule was hardly seen in the early stage because of the unproportionally large antitragus. However, it soon appeared and occupied large part of the lower auricular half. These morphological changes began insidiously and proceeded faster in some fetuses but extremely slowly in the other; thus, it was not possible to determine stages for these changes. Streeter (1922) lamented, 'if one studies a great many specimens, covering 30 mm to full term, it will be found that there is great variation, just as exists in the adult ear'. The present study supported his view.

The results of the auricular measurements were presented in Figure 3. The auricular length, auricular base length and auricular width were all increased linearly with the increase in the crown-rump length, suggesting that these measurement values are possible parameters to indicate intrauterine fetal growth. There are several quantitative parameters for evaluation of fetal growth in utero. Crown-heel

and crown-rump lengths are parameters most frequently used in the embryological research (Mall, 1910; Streeter, 1921). Body weight, head circumference and various diameters of the head are important parameters for obstetricians to estimate intrauterine growth and future viability of the fetus (Thompson *et al.*, 1969; Berg and Yerushalmy, 1970). Obviously, the more parameters we have, the more accurately we can evaluate fetal growth. We expect that the auricular parameters are useful not only in the embryological research but also in the clinical field.

The auricle is developmentally derived from the mandibular and hyoid bars. According to Streeter (1922) the increase in the auricular size is largely due to overwhelming growth of the hyoid derivatives. The present study did not necessarily support this view. The mandibular derivatives are the crus helix and tragus, which are located on the auricular base line. Thus, the auricular base length is a parameter that reflects the size of the mandibular derivatives.

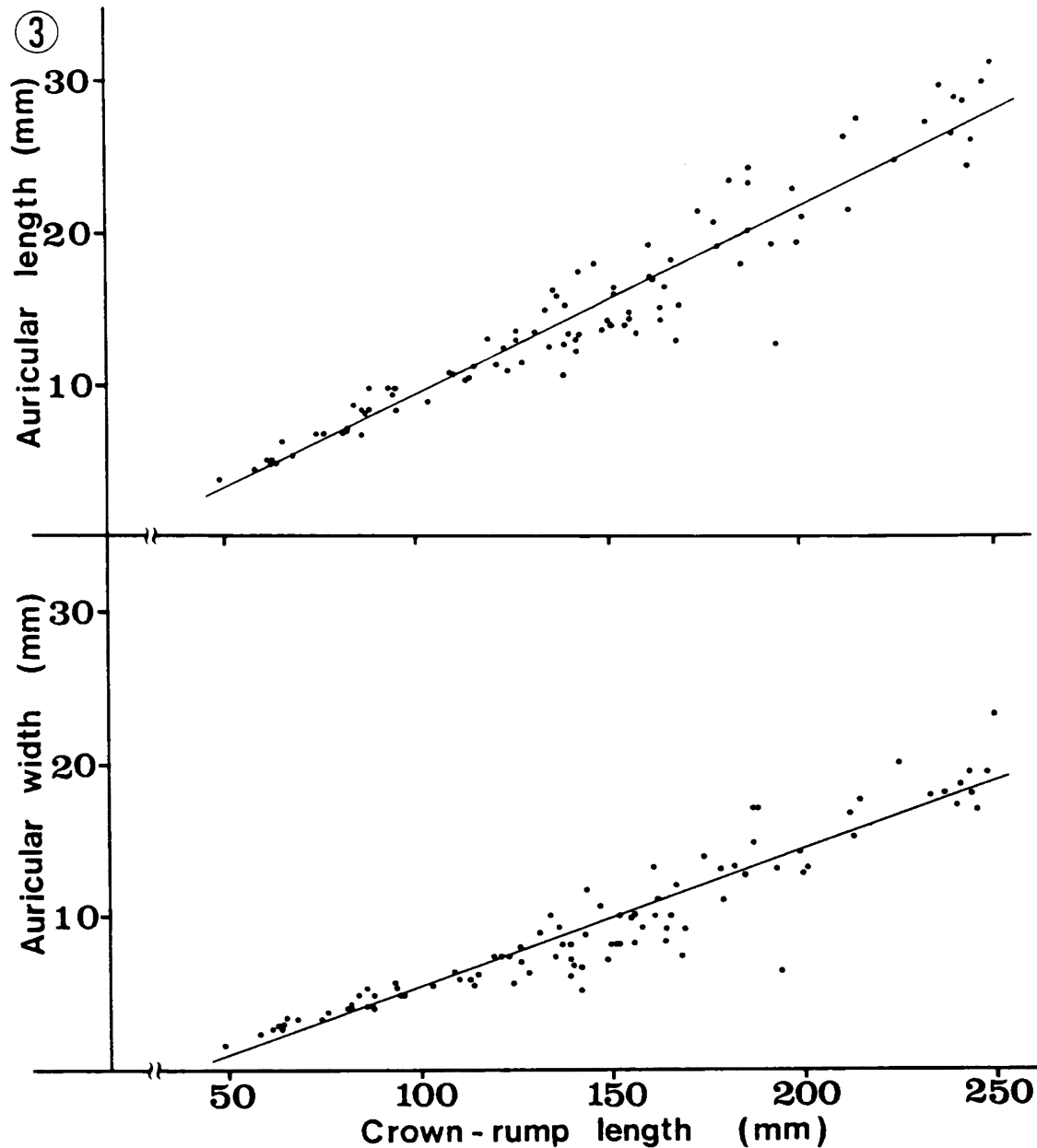


Fig. 3. The relation of the auricular length (y) to the crown-rump length (x) is expressed as, $y = 0.12x - 3.1$ ($r = 0.96$, $p < 0.001$). The relation of the auricular width (y) to the crown-rump length (x) is expressed as, $y = 0.09x - 3.8$ ($r = 0.94$, $p < 0.001$). The graph to show the relation of the auricular base length (y) to the crown-rump length (x) is not presented here but their relation was expressed as, $y = 0.09x - 0.76$ ($r = 0.95$, $p < 0.001$).

The hyoid derivatives are the helix, antihelix, anti-tragus and lobule. Since the anthropological points, supraurale and subaurale, to measure the auricular length are located on the helix and lobule, the auricular length is considered to reflect the size of the hyoid derivatives. Therefore, the ratio of the auricular base length to the auricular length reveals the growth ratio of the mandibular derivatives to the hyoid derivatives. This relation of the two lengths was shown in Figure 4. The auricular base length (y) on the auricular length (x) was expressed by the regression line, $y = 0.69x + 1.7$ ($r = 0.97$, $p < 0.001$). This result means that the hyoid and mandibular derivatives did not grow independently, but did grow

with maintaining a certain relationship. For the present authors the coefficient 0.69 of the regression line does not seem to bring about 'overwhelming' growth of the hyoid over mandibular derivatives.

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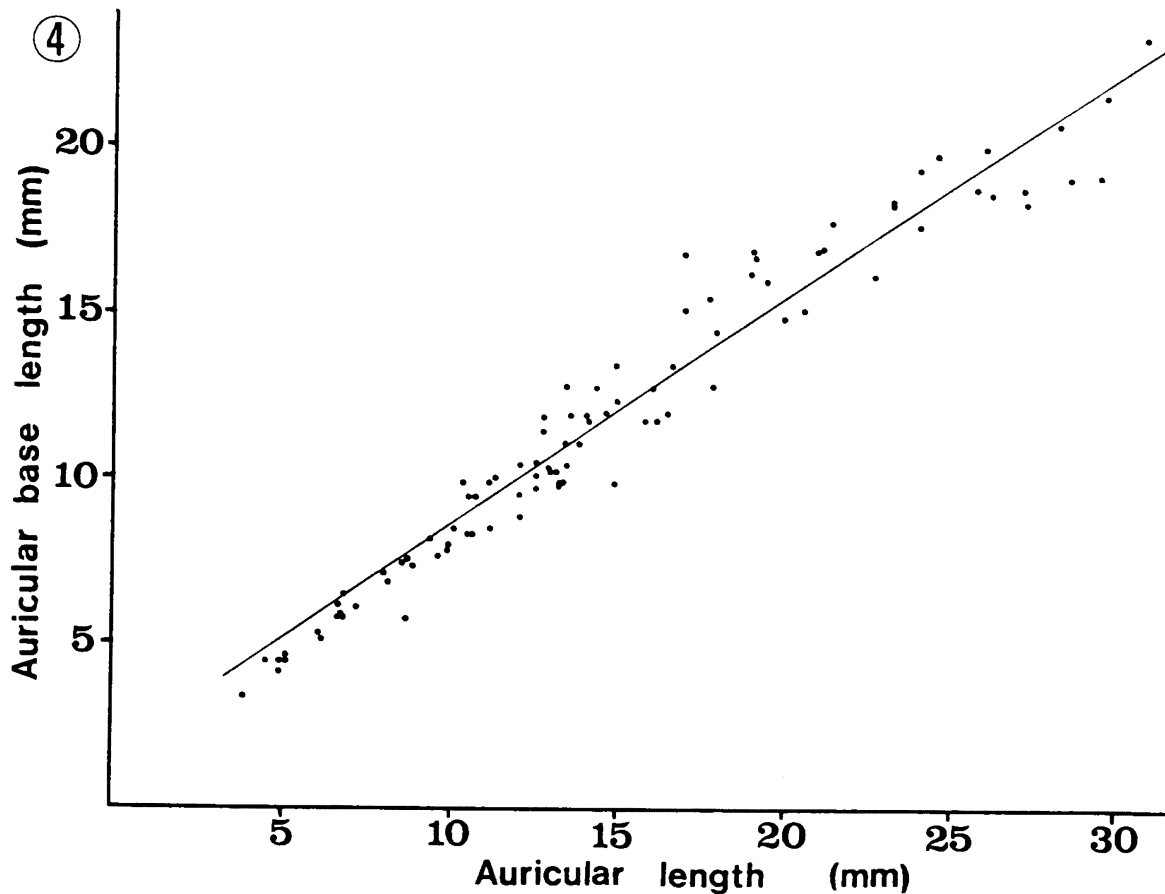


Fig. 4. Note the proportional increase in the auricular base length (y) with the auricular length (x). The regression line is $y = 0.69x + 1.7$ ($r = 0.97$, $p < 0.001$).

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