A Comparative Study of the Pneumatization of the Mastoid Air Cells and the Frontal and Maxillary Sinuses

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The paranasal sinuses and the mastoid air-cell systems are evaginations of the mucous membrane of the nasal and nasopharyngeal cavities. Separate theories regarding their pneumatization have been suggested. However, correlation studies between the two systems giving a possible clue to a common pneumatizing process have been few [1, 2].

One hundred adult patients without ear disease and minimal nasal symptoms were studied. Using a planimeter, we measured (1) the areas of frontal and maxillary sinuses from the Water view of the paranasal sinuses and (2) the areas of the air-cell system from the Law view of the mastoids. The mean and the standard deviations were obtained from each air-cell system. The Pearson correlation coefficient (r) [3] was calculated for each sinus (1) with each mastoid air-cell system, (2) with each other, and (3) with the same sinus on the opposite side. The statistical significance of the correlation coefficient and its probability level were determined by comparison with the theoretical correlation coefficient given in the table of correlation coefficients for the appropriate degree of freedom.

The results from our study show no correlation between the areas of the paranasal sinuses and the mastoids ($r = .1512–.1699$, $p > .05$). However, a remarkable correlation was found between the frontal sinuses ($r = .7169$; $p < .001$), maxillary sinuses ($r = .7203$; $p < .001$), and the mastoids ($r = .7991$; $p < .001$).

Five percent of our patients had aplasia of both frontal sinuses, 3% had aplasia of one frontal sinus, and 2% had nonpneumatized mastoids. The maximum areas were frontal sinus, 17.9 cm^2; maxillary sinus, 9.5 cm^2; and mastoids, 15.2 cm^2.

Three theories of pneumatization are (1) the pneumatizing drive of the mucous membrane of the middle ear for the mastoids [4] and that of the mucous membrane of the nose for the paranasal sinuses [5]; (2) the positive air pressure and resorption of the spongiosa in the frontal and the maxillary bones for the paranasal sinuses [5] and resorption of the mesoderm in the mastoid bone for the mastoid air-cell systems [4]; and (3) heredity for the mastoids [1] and the paranasal sinuses [6]. The lack of correlation found in our study makes both the pneumatizing-drive theory and positive-air-pressure theories unlikely as the common pneumatizing process. However, any of these processes may be operating alone in the pneumatization of either system. Heredity can still be considered as a factor common to the pneumatizing process of both systems. Further correlative radiologic studies of the parents and their siblings and other genetic studies are warranted to confirm the heredity factor.

Our study revealed good correlation between the sizes of each pair of paranasal sinuses (frontal and maxillary), which disagrees with the findings of Walander [2]. The good correlation between the two mastoid air-cell systems agrees with Tumarkin's findings [7]. The good correlations in the sizes between the frontal and maxillary sinuses on the same side ($r = .3796$; $p < .001$ for the right side, and $r = .2295$; $p < .05$ for the left side) suggest that the paranasal sinuses develop by a common process of pneumatization, whereas the pair of mastoid air-cell systems may develop from a different process. Variation in size is much more marked in the frontal sinus (SD = 3.22 and 3.23, on the right and left sides, respectively) and the mastoid air-cell systems (SD = 4.10 and 3.99 on the right and left sides, respectively). The mean areas of the frontal sinus (4.34 cm^2) and the mastoid air-cell system (6.87 cm^2) are smaller in the Indian population than those mean areas in the European population [2, 8].

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REFERENCES

1. Diamant M. Otitis and pneumatisation of the mastoid bone. *Acta Otolaryngol [Suppl]* (Stockh) **1940;**41
2. Walander A. Consideration on variation of size of frontal sinuses. *Acta Otolaryngol* (Stockh) **1965**;60:11–14
3. Colton T. *Statistics in medicine*. Boston: Little Brown, **1974**:207
4. Mawson SR, Ludman M. *Diseases of the ear*, 4th ed. London: Edward Arnold, **1979**:12–13
5. Salinger S. The paranasal sinuses. *Arch Otolaryngol* **1936**;24:204–240
6. Shea JJ, Memphis T. Morphological characteristics of the sinuses. *Arch Otolaryngol* **1936**;23:484–487
7. Tumarkin A. On the nature and vicissitudes of the accessory air space of the middle ear. *J Laryngol Otol* **1957**;73;34–44
8. Flizberg K, Zsigmond M. The size of the mastoid air cell system. *Acta Otolaryngol* (Stockh) **1965**;60:23–29