

## THE GROWTH DIRECTION OF THE FRONTAL SINUS AND ITS ROLE IN THE FORMATION OF PNEUMOSINUS DILATANS

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The main purpose of this paper is to present two cases of pneumosinus dilatans and to discuss the etiology of the disease, based on the results obtained in the study on pneumatization of the frontal sinus.

The first case concerns a 29 year-old Japanese male, who complained of having a swelling on his left forehead and frontal headaches for nearly ten years.

Examination showed a marked bony swelling in the supra-orbital region on the left side, without any changes in the overlying soft tissue. Intranasal examination revealed a mild edema of the bulla ethmoidalis on the left side.

Radiographic pictures showed a well delineated border of the frontal sinus featured by a marked enlargement, which appeared to be filled with air. In the lateral view, a marked anterior prominence of the frontal sinus was evident.

The frontal sinus was explored and mild inflammatory changes of the mucous membrane were found — the nasofrontal duct appearing to be obstructed.

The second case concerns a 39 year-old male, who complained of having had a bulge on the right forehead for the last 4 years.

The external appearance, radiographic pictures and histopathological pictures were almost similar to the first case, except that the nasofrontal duct was unimpaired.

Reviewing the literature, it has been noticed that many authors showed profound concern on the etiology of the disease.

A variety of theories and hypotheses have been suggested, whereas so far no single cause of the disease has been accepted.

The proposed contributing factors are as follows:

1. increased intrasinus pressure due to an obstructed nasofrontal duct;
2. gas-forming organisms;
3. valvular obstruction of the nasofrontal duct;
4. evacuation of the contents of a mucocele;
5. trauma;
6. embryonic malformation.

In the first 3 hypotheses the cause is linked to an obstruction of the nasofrontal duct. These hypotheses are not conceivable for us on the ground that the air trapped in a tissue will rather be absorbed by the tissue than that it will expand the tissue. Moreover, we see many cases of chronic sinusitis with obstructed nasofrontal duct without a sinus dilatation.

We consider that an obstructed duct is not necessary, as was indicted by Harrison. Hypothesis no. 4 is again unlikely as most of the X-rays failed to

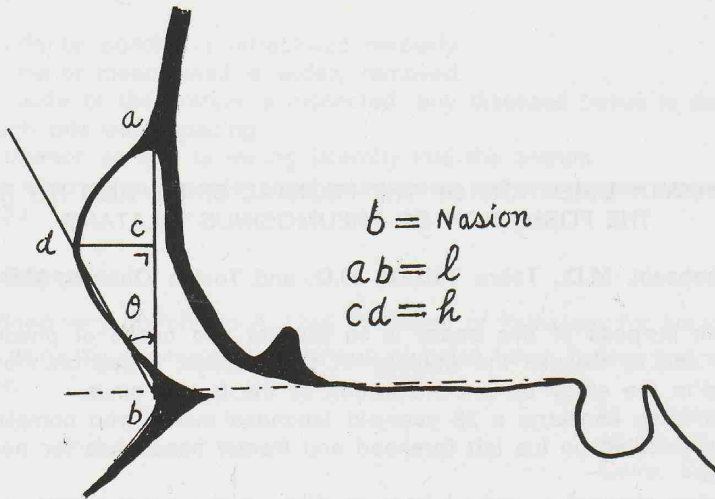


Figure 1.

- 1 = height of frontal sinus
- h = depth of the sinus, measured from the base line of the height
- d = most bulging point of anterior wall of the sinus
- a = top of the sinus

reveal evidences of mucocoele and histopathological supports are lacking. As a majority of the cases start during adolescence or in the adult, the factor embryonic malformation is difficult to accept.

In the course of serial study on the development and morphology of the frontal sinus, it was noticed that there are some well-pneumatized large frontal sinuses, which are characterized by unusual forward development. Thus attention was centered on this type of sinuses, for a possible connection with pneumosinus dilatans.

In the present study a total of 200 pairs frontal sinuses were examined as to their anterior development.

Straight and lateral radiographic pictures taken in a certain position have been utilized for this survey. The dimensions of the frontal sinuses were measured for superior, lateral and anterior development on different age groups.

It appeared that the anterior growth is proportional to the angle O in fig. 1. The following formular has been devised:

$$F = \frac{h}{1} = \frac{1}{2} \text{ tangent } O$$

In this formula F represents the anterior growth of the frontal sinus. 1 Represents the height of the frontal sinus in X-ray view and h also represents the depth of the sinus, measured from the base line of the height.

By examining a total of 400 frontal sinuses, the degree of anterior growth has been classified into four groups according to the F figures. It has been recognized that when F is greater than 0,25 it can be referred to as marked

anterior growth. In these two cases F was 0,3 and 0,25 respectively. In an attempt to make a comparison between the anterior growth and the overall growth of the sinus, further survey was carried out on the superior growth the lateral growth and on the maximum sagittal area of the sinus. Both superior and lateral growth of the frontal sinus exhibit their speedy growth in the 11—15 age group until they reach the usual size of adult sinus in the 16—20 age group.

In some cases, however, there still was evidence of sinus growth even in the 20—30 age group.

In all groups, it has been observed that the lateral growth always exceeds the superior growth.

On comparing the anterior growth of the frontal sinus in different age groups, a few cases of anterior growth were encountered before the age of 10, while only a small number of cases appeared in the 11—15 age group. After 15 years a number of cases showed a gradual increase. The maximum incidence is recorded in the 26—30 age group, as a marked anterior growth was observed in 14 % of them. After 30, the percentage showed a definite decline as age increased.

Studying reported cases of pneumosinus dilatans and ages of these patients, it may be reasonable to infer that there is a positive tendency for the disease to develop in the period between adolescence and about 30.

We would like to draw attention to the fact that this age coincides with the period of maximum anterior growth of the frontal sinus, as has been illustrated. Based on the above studies and observations, we consider the etiology of pneumosinus dilatans to lie in the abnormal proportional pneumatization of the frontal sinus.

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