SOME REMARKS ON THE PHYSIOLOGY, THE ANATOMY AND THE RADIOLOGY OF THE VESTIBULUM AND THE ISTHMUS NASI

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Assuming that the nose functions, among other things, as a conditioning system, i.e., that it purifies, heats and moistens the inspired air, one may expect that a dosage mechanism is placed before this conditioning mechanism. Otherwise, this system would work with a very high energy loss. It should also be realized that the oxygen requirement and thus the respiratory volume is subject to very strong variations, for example between sleep and exertion, and that a dosaging "air inlet" is therefore highly useful. The latter fact is a very fascinating physiological subject, but will not be discussed now. We wish to make only one remark: especially in conditions of limited

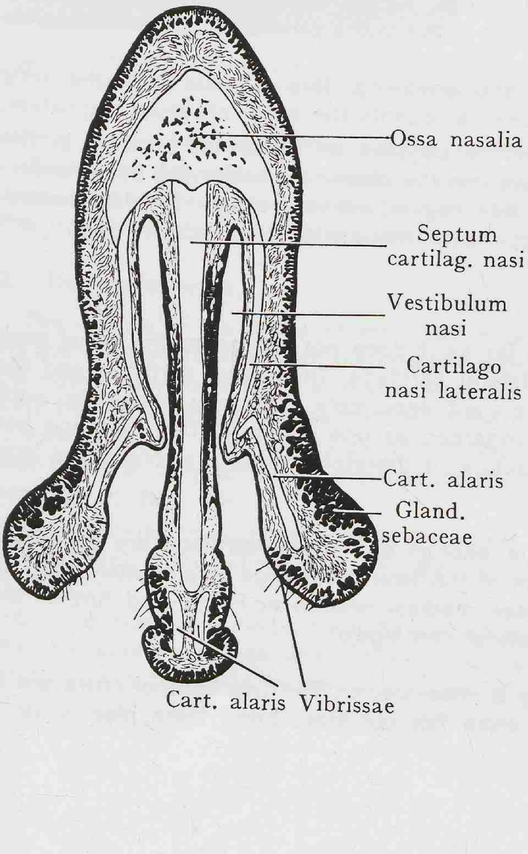

Fig. 1. Frontal section of the nose. The valve mechanism at the level of the vestibular limen is clearly visible (from Corning's "Lehrbuch der topographischen Anatomie").

oxygen requirements, for example during sleep, this dosage mechanism is of great importance for the maintenance of a regular respiration.

The most important dosage mechanisme of the nose is located in the soft part (the nasal apex) of the pyramidal process. Via the relatively wide and always open vestibulum, the air travels through the narrow isthmus, where a valve mechanism is situated, to arrive again in the wider nasal cavity. This configuration corresponds with the Venturi tube which is used in aviation. This is a tube that begins with a wide part, and then narrows to become wider again. Such a system is approximately governed by the law of Bernouilli, which says: the static pressure plus the dynamic pressure gives a constant expressed in a formula as follows: $P + \frac{1}{2}P\ v^2 = C$.
The law only holds good by a constant flow and when the stream is lamillar and not turbulent. It gives us nevertheless an insight in the processes in the nose.

In other words, if the velocity, i.e., the dynamic pressure, increases as is the case in the isthmus, the static pressure decreases. If the atmospheric pressure is P, then the pressure in the vestibulum is P — 5 mm. water and in the isthmus about P — 12 to — 20 mm. water.

The lower side of the lateral part of the septolateral cartilage forms a flaccid valve at the site of the isthmus due to the abovementioned differences in air pressure P — (P — 12 mm. water) = 12 mm. water. This valve is thus pushed inwards on inspiration. On inspiration breathing is therefore inhibited to a certain, i.e., desired degree. As far back as 1937 **Van Dishoeck** found that the isthmus was the main factor in the production of the resistance in the nose.
He also discovered that, properly speaking, this isthmus was the only determined factor in normal noses as regards the nasal pressure regulation.

Vestibulum and isthmus therefore possess an important function in the regulation of the respiration. If we use the dissecting knife with some understanding of the physiology of this region, we are struck by the unsatisfactory and incomplete descriptions of the anatomy in former days.

1. The cartilaginous skeleton.

a. The back of the nose, as far as it does not belong to the nasal root, is mainly formed by the septolateral cartilage. The septal cartilage and the lateral cartilage originally developed separately, but they constitute such a firm entity that they can be regarded as one cartilage. This cartilage has in its upper part a T-beam structure; it therefore forms a strong nasal dorsum (Fig. 2 upper level).

b. At the level of the isthmus, septum and lateral cartilage are separated from each other. This lower rim of the lateral cartilage is extremely thin, so that it can serve as a valve (see mediam section in Fig. 2 and further the separate sketch of the septolateral cartilage).

c. The alar cartilage is really a nose-opener. The two internal crura are in apposition; the firm external crura fan out from here. Here also again a

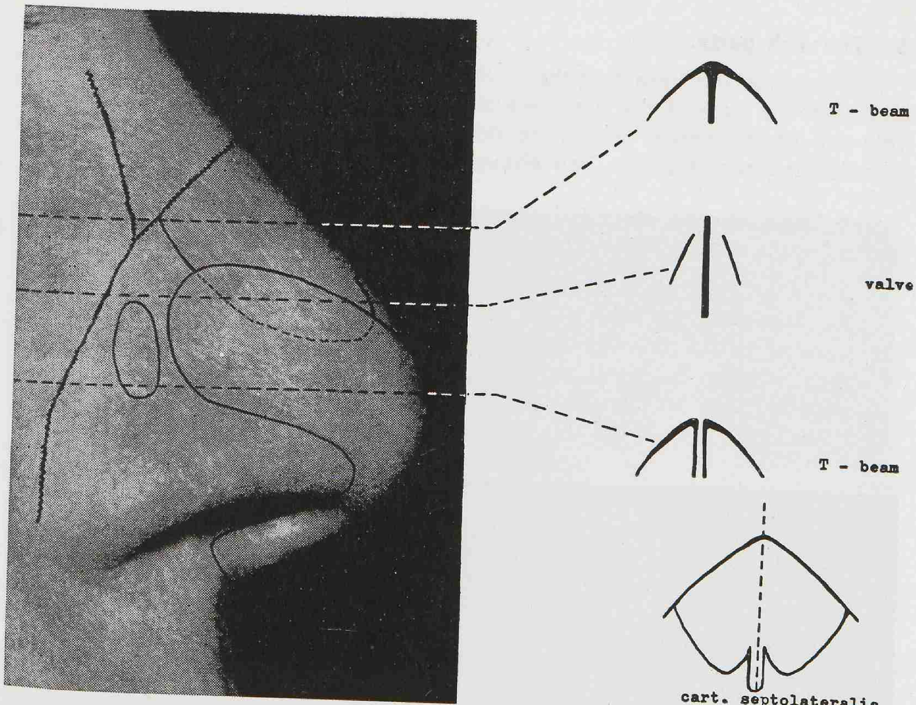

Fig. 2. The functions of the cartilaginous skeleton of the nose. Two T-beam structures, with the valve mechanism in between.

strong T-beam structure, this time to enforce the extreme tip of the nose.

Thanks to this entire cartilaginous structure, the vestibulum is always well open, a valve mechanism develops in the middle part, and the upper part of the nose is again wider and stronger.

2. The musculature

The course of the fibres of the nasal muscle is rather simple. Fibres run via the valve mechnism from the lateral border of the apertura to the back of the nose. They form there a tendon with the fibres at the other side. A second bundle of fibres runs to the rim of the nares, i.e., the nasal opening.

Van Dishoeck has already demonstrated by means of electromyography that there is only action in these muscles on forced respiration. For what happens in this case?

a. The muscles running towards the nasal dorsum contract and the valve is prevented from falling back, i.e., the isthmus remains wide open also on inspiration.

b. The musclus running towards the nares make these curl outward and the vestibulum becomes wider. On forced inspiration the air capacity of the vestibulum is therefore increased and the isthmus is not narrowed: in a way of speaking, the whole air passage becomes one size bigger.

3. The soft parts.

It is emphasized here that the crus lateralis of the alar cartilage does not approach the rims of the nares so closely as is indicated in most drawings. This rim of the nares, in a more limited sense the wings of the nose, are therefore mobile (function see above).

Van Bochove has recorded roentgenologically the above physiological and anatomical data. The projection is as follows:

> A conical tube as in current use for dental exposures, is placed against the forehead just above the root of the nose. The axis of the rays is parallel to the patient's body axis. The patient keeps a large-size dental film between his teeth, supported with one finger, so that the film is perpendicular to the axis of the rays. (N.B. the patient should be protected with a lead apron!).

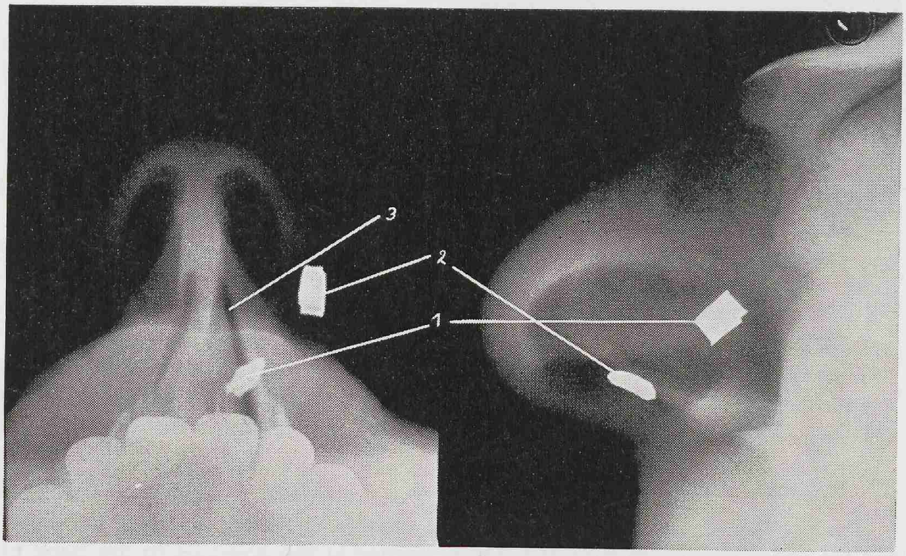

Fig. 3. The rim of the nares and the isthmus are marked by metal particles. It is seen how narrow the isthmus is, compared with the wide vestibulum.
1, 2 corresponding landmarks.
3. the isthmus (R. normal, L. somewhat narrowed isthmus).

These photos give an excellent impression of the configuration of the nose. The nasal index figures can easily be read off from them and are recorded at once (see Fig. 4,1 and 4,2). A leptorhine and platyrhine nose are shown in this figure. It further gives a very good idea of the configuration of the isthmus and of the ratio between isthmus width and vestibular width.

Fig. 3 shows a nearly normal leptorhine nose. The rim of the nares and of the vestibular limen are marked by means of metal particles. The figure shows how narrow the isthmus is compared with the vestibulum.

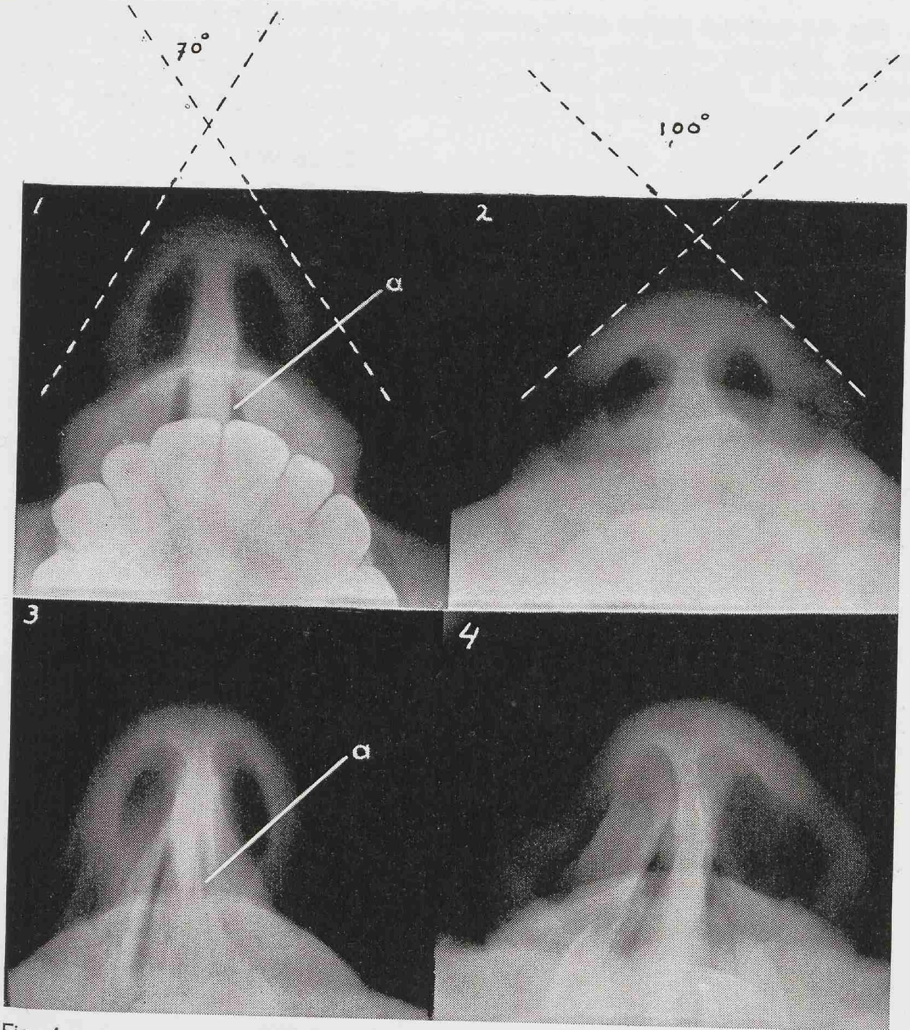

Fig. 4.

1. leptorhine (caucasian) nose, with normal patency of the isthmus.
   Triangle of the base view 70°.
   index $\frac{\text{hight}}{\text{width}} = \pm \frac{55}{65} \times 100 = \pm 85.$
   a = isthmus.
2. platyrhine nose
   Triangle of the base view 100°.
   index $\frac{\text{hight}}{\text{width}} = \pm \frac{30}{79} \times 100 = \pm 40.$
3. insufficiency of the right side.
   a = isthmus.
4. airpassage insufficient after too radical septum surgery.
   Dislocation of the crura lat.

Fig. 4,3 and 4,4 depict some noses with insufficient, or pathological passages. Although also this projection — like all other X-ray pictures — is only useful in combination with the clinical examination, we still are of the opinion that it is an asset for the functional diagnostics of the nose.

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