THE INFLUENCE OF IMPERFECT NASAL RESPIRATION ON THE ORAL CAVITY.*

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The current of air which passes in and out of the lungs during twenty-four hours travels through the nose on an average of 20,000 times each way in normal respiration. Here it is relieved of particles of solid matter; its temperature is regulated to nearly that of the body, and the necessary moisture is supplied for its reception by the delicate lung tissues (¹). It has been calculated that during a day two quarts of fluid is supplied by the nasal structure to the inspired air.

These important physiologic functions of the nasal cavities attracted but little interest in this country until Bosworth (²), about twenty years ago, called attention to them. Soon after Aschenbrandt (³), Kayser (⁴) and Block (⁵) published exhaustive experiments which they had made. From that time to the present these functions have received more or less consideration.

It is as essential that the air be prepared by the nose before it enters the lungs as it is for the food to be prepared by the mouth before it enters the stomach.

During normal nasal respiration the lips are closed, the teeth of the opposing jaw are in contact, and the tongue completely fills the oral cavity with the exception of a small space between the dorsum of the tongue and hard and soft palate. This space, according to Metzger (⁶) and Donders (⁷) has a negative manometric pressure of from 2 to 4 m. m.

In this position the muscles are in a state of balance or tonicity which, in accordance with the generally accepted opinion, maintains the relative position of the jaws to each other. The muscles of the lips and cheeks on the one side

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and the tongue on the other exert equal pressure upon the alveolar arch.

If nasal respiration be obstructed, by faulty function or weakness of the alae, hypertrophy or hyperplasia of the mucous membrane and glandular structures of the nose and nasopharynx, atony of the turbinal bodies, abnormally placed structures, narrowly constructed bony frame-work, new growths, or any other cause interfering with the free passage of air, the nasal respiration is partly or completely abandoned; and, as a result, air must pass through the mouth, a cavity not intended for such use, and certainly unfit to properly prepare the air for the lungs.

In order to continue oral respiration the mandible is depressed, increasing the tension of the muscles and tissues of the cheeks, the lips are separated, the tongue instead of adhering to the roof of the mouth and pressing against the inner aspects of the upper teeth, lies free in the floor of the mouth, and the soft palate is drawn up instead of resting upon the base of the tongue. To maintain these abnormal positions without fatigue the muscles producing them must hypertrophy.

If nasal respiration be only partly obstructed, the voluntary muscles are often able to continue nasal respiration during the waking hours, but as soon as sleep abolishes the voluntary function then oral respiration begins. This explains the statement so often made by parents, that their child seems to breathe through the nose during the day, but when asleep breathes through its mouth, which constitutes a third or more of each twenty-four hours.

The constant passage of air, which is often dust-laden, over the mucous membrane of the mouth, fauces, and respiratory tract soon dries those tissues and lowers their resistance to pathogenic bacteria. The teeth also become carious, especially the upper ones, because these are more exposed, the lower teeth being partly protected by the tongue and saliva.

When nasal respiration is impossible, the mouth must perform two functions during the ingestion of food: that of preparing the food for the stomach, and supplying air to the lungs. This causes a peculiar and disgusting manner of eating.

The baby at the breast requires about fifteen or twenty minutes for the ingestion of a single meal. Under normal

conditions it does not remove its mouth from the breast during that time, but, if nasal breathing be impossible, oral respiration must be resorted to, and as a result the baby can suck the nipple only a short time before partial asphyxia forces it to stop nursing. This procedure is repeated many times until hunger is satisfied, or, more often, the baby is exhausted by its efforts to supply the stomach and lungs at the same time. Either a moderate amount of milk mixed with air is swallowed, or an insufficient amount of nourishment is taken. Both tend to produce indigestion and malnutrition.

When the child begins to ingest solid food a similar condition exists. Instead of being able to properly masticate its food, it must bolt it—with a continuation of indigestion and malnutrition.

It is an established fact that oral respiration is not so deep and long as nasal, and as a consequence the interchange of gases within the lungs is not so complete (*). This allows an excess of carbon dioxid to remain in the blood, and a deficiency of oxygen to be absorbed. Kyle (*), confirms this later statement by his findings in a series of examinations of the blood of persons with nasal obstructions. He found in every case, before removal of the obstruction, a reduction in the number of the red corpuscles which are the oxygen-carriers. In some instances as few as 1,500,000 were present, 5,000,000 being the normal. The hemoglobin was found to be only 50 to 60 per cent. of the normal, and in many cases there was a slight increase of the white corpuscles.

After nasal respiration had been established the cells and hemoglobin gradually returned to their proper number and percentage.

Oral respiration also interferes with sleep. Instead of a quiet, restful sleep it is often interrupted with sudden awakenings and exhausting dreams.

Thus we find, as a result of oral respiration, indigestion, due to improperly prepared and digested food; impoverished blood, resulting from an incomplete exchange of gases within the lungs; and insufficient sleep which so weakens a growing child that not only is dentition delayed and decay of the teeth started, but the bony frame-work of the head and body is retarded in growth, and the resistance of the whole body is lowered to the invasion of pathogenic bacteria, es-

pecially the oral cavity and respiratory tract, due both to the local and constitutional conditions.

In the earliest medical writings we find mention made of a peculiar facial expression and deformity of the superior maxilla associated with mouth-breathing.

Since the appearance of Wilhelm Meyer's (¹⁰) work on "Adenoid Vegetations," this facial expression has become known as the "adenoid facies." It may, however, be caused by other nasal obstructions. The face appears long, the point of the nose is pinched, the lower jaw hangs down, the mouth is open, the upper lip projects away from the teeth, the inner canthi of the eyes are drawn downward, the eyebrows raised, while the obliteration of the natural folds of the face gives to a person a stupid, vacant, semi-idiotic appearance. There is often a widening of the bridge of the nose, which is frequently crossed by a prominent vein.

The deformities of the superior maxilla, while not so constantly associated with mouth-breathing as the facial changes, are quite as characteristic. There is lateral narrowing of the alveolar arch, high palate, and prominence of the upper incisor teeth which tend to approach one another posteriorly. The occlusion of the teeth of the upper jaw, which are apt to be irregularly placed, is imperfect with those of the lower. As a rule the lower jaw is normal. The exception is generally when there are rachitic deformities in other parts of the body.

Although the association of these changes with oral respiration has been observed for centuries, still there appears to be a diversity of opinion as to the relation between cause and effect. Some consider the interference with nasal breathing as the cause of all variations from the normal, which the upper jaw may exhibit, while others regard these variations as the cause of the nasal obstruction.

In support of the former opinion we find several theories advanced to explain the way in which these deformities are produced. We will briefly consider only the most plausible ones.

(1) It is an acknowledged fact that the inactivity of an organ often prevents its development. In applying this to the nasal chambers through which air does not properly pass, there are two factors, which by some are considered of prime importance in preventing the perfect progress of the development of the upper jaw. One is the abeyance of the

natural functions, with the want of proper blood supply; the other is the absence of the mechanical force of the air upon the walls and sinuses of the nose. If these statements be true, the nasal chamber and the superior maxilla as a whole would be smaller in all dimensions, and the hard palate high and narrow.

(2) If we apply the same fact, that the inactivity of an organ prevents development, to the act of mastication which by mouth-breathers can only be imperfectly performed, we have another factor in preventing proper development of the upper jaw and perfect occlusion. Cryer (¹¹) is of the opinion that the loss, on account of oral respiration, of the developing and moulding influence, which directly results from the percussive force of occlusion exerted by the mandible upon the maxillary arch is of great etiologic importance in the irregularity in the upper dentures, and (¹²) that the lack of constant occlusion of the teeth is another important factor in not forcing the teeth and the alveolar processes outward.

(3) The continual downward and inward pressure against the lateral alveolar processes of the superior maxilla by the muscles of the cheek, which support the hanging mandible, and the absence of the backward pressure of the obicularis oris muscle upon the anterior teeth and their processes, have a detrimental influence upon the developing upper jaw teeth, especially during the early growing period and second dentition.

The existence of the lateral pressure of the cheek muscles can be demonstrated by placing a finger between the upper row of teeth and the oral surface of the cheek. When the jaws are opposed there is practically no pressure upon the finger, but if the jaws be separated there is then a decided pressure.

The question naturally occurs: why does not this force exert similar pressure upon the mandible? This has been answered by the constant lateral pressure of the tongue.

(4) The nursing baby exerts during each *meal at the breast* a negative pressure of about 75 c. m. of water upon the oral surface of the palate. This force is exerted many times a day during the most rapid growth of the bones of the body. Again, if we accept Metzger's and Donder's statement: that there is a vacuum between the upper surface of the

tongue and hard palate, when the mouth is closed, then these forces tending to pull the palate downward would be absent during oral-respiration.

(5) Hubbard (¹³) and Dawbarn (¹⁴) are of the opinion that there is a downward pull exerted upon the palate by adherence of enlarged faucial tonsils to the pillars of the fauces. If this force has any influence upon the shape of the palate, then the opposing muscles, the levator palati, which are on a constant tension by mouth-breathers, must also play a part.

As a proof of the theory that the interference of nasal breathing does have an influence in the abnormal development of the superior maxilla, the experiments of Ziem (¹⁵) and Collier (¹⁶) may be cited. Ziem found that by artificially occluding one-half of the nose in young animals there occurred an asymmetrical development of the two sides of the nose and adjacent bone tissues, the obstructed half being undeveloped. This arrest of development extended to all adjacent tissues on that side. Collier produced deformities of the upper jaw in young animals, chosen indiscriminately, by blocking their noses for a long time with cotton wool.

As additional evidence of the influence of oral-respiration upon the upper jaw, I will briefly report the condition of two of my patients. One was a girl seven years of age, whose brother and sister had normal arches and occlusion. The mother was a strong, broad-faced Swede. Father dead. This child fell from a chair when a baby, striking on its face. When I examined the child, December, 1905, I found the cartilaginous part of the septum bent in such a way as to obstruct both nasal passages. The child had breathed through its mouth since the accident.

The other patient was a boy seven years old. His parents were both large, with normal heads. His brother and sister both had normal arches and perfect occlusion. The mother knows of no accident to account for an irregularity of the external shape of the nose, but says the child has breathed through its mouth for a long time. On examination, January, 1907, I found an angular deviation of the cartilaginous septum, obstructing both nasal cavities. This irregularity is certainly the result of trauma, and of long standing.

Both parents had a high palatal arch, V-shaped alveolar arch, a moderate degree of malocclusion and decay of nearly all the upper teeth.

In opposition to the theory just considered there is the one that the deformity is primary and nasal obstruction secondary. Siebenmann (¹⁷) and his scholars, Fraenkel (¹⁸), Grosheintz (¹⁹) and Haag (²⁰), are the most ardent supporters of this theory. They devised an instrument (Palatometer) with which they measured the width of the alveolar arch and height of the palatal arch of different individuals with and without "adenoid vegetations," this being the principal cause of nasal obstruction which they considered. From these measurements they calculated an index, and by comparing these indices they arrived at the conclusion that individuals with "adenoid vegetations" had relatively the same height of palatal arch as normal, and are of the opinion that the high palatal and V-shaped alveolar arches depend upon the type of the skull. The normal type (Chamoprosope) being the broad face with the wide nasal cavities and dome-shaped palate. The abnormal type (Leptoprosope) the one with a high, narrow face, narrow nasal cavities (Leptorhine) high palatal arch and V-formed alveolar arch. They believe these types depend upon the congenital racial characteristics of the skull, and not upon the extrauterine influence of nasal occlusion.

Siebenmann says, in explanation of the common association of palatal deformity with mouth-breathing: "That the individual with a high palate, without exception, has narrow nasal cavities, and the swelling of the nasal mucous membrane, which is rarely absent with 'adenoid vegetations' becomes more obstructive when the palate is high and narrow than when low and broad; consequently oral respiration is seen more often in individuals with a narrow face."

Other theories of the cause of palatal deformity have been advanced from time to time, principal among which is rickets. Löwy (²¹) believes the changes of rickets is the cause of all irregularities of the superior maxilla and nasal septum.

Stone (²²), while studying the deformities of the spine in rickets, made some valuable observations regarding the cause of deformities of the superior maxillæ. He has no doubt that there is a relation between obstruction of nasal respiration and these deformities, but thinks the deformities depend much more definitely on the severity of the rickets than on any other single factor. He found that usually in rickets there is an hypertrophy of the faucial and pharyngeal tonsils; and believes this increase of lymphoid tissue is a part of the

disease, and that both the deformity and nasal obstruction are the result of the rachitic process rather than the result of the nasal obstruction.

Schlauss (²³), admitting that rickets does cause deformities of the upper jaw in isolated cases, believes the principal cause is due to abnormal osseous union of the palatal bones (Synostosis).

Rickets being a disease due to malnutrition, it seems reasonable to believe it may, in a few cases at least, be secondary to the indigestion and impoverished blood which we have shown often results from oral respiration.

The theory that deformities of the superior maxilla are congenital, depending upon the racial characteristics of the skull and not upon extrauterine influences, has only clinical evidence for its support, while the theory that these deformities are acquired, principally from the influences produced by the obstruction of nasal respiration, has the support of animal experiments as well as that of my two cases, and I am sure that nearly every rhinologist has seen cases where the nasal obstruction was acquired and the palatal deformity resulted, without any question of a congenital narrow skull or the influence of rickets.

Parsons (²⁴) is of the opinion that the narrow skull formation, which is considered congenital, may be acquired, due to anterior nasal stenosis. He bases his belief upon the presence of a long continued external atmospheric pressure upon young and soft bones, caused by the negative pressure within the nasal fossae and sinuses which would occur at each inspiration.

Accepting Parsons' view, we would not expect to find so marked a deformity of the upper jaw when the cause of the nasal obstruction was located in the nasopharynx, such as an enlarged pharyngeal tonsil. This is partly true, but in a majority of mouth-breathers, from post-nasal obstruction, there also exists an anterior obstruction. Under such conditions the palate usually has its characteristic deformity.

There being no known single factor to account for the cause of all the deformities, and as each theory of the different causes is supported by careful observers, we must at present, at least, conclude that the deformities may occur in given cases, as stated.

I believe, however, that the greatest number of all de-

formed superior maxillæ are acquired and are undoubtedly a result of oral respiration, due principally to the loss of constant occlusion of the teeth and imperfect mastication, secondarily to the pressure of the cheek muscles and absence of the stimulating influence of nasal respiration upon the developing nasal fossæ and sinuses.

I do not believe the adhesion of enlarged faucial tonsils to the palatoglossus muscles, the absence of the suction-chamber between the tongue and palate and loss of the negative pressure during nursing has much, if any, influence upon the shape of the palate and teeth.

A lesser number of maxillary deformities are congenital, as those found in a narrow head.

The least number are due to rickets and other mentioned causes.

The logical treatment of the patients in whom interference with nasal respiration is the cause of palatal deformity, should be first to remove the nasal obstruction, and second, to correct the palatal deformity. This is supported by the fact that the characteristic facial expression and palatal deformity associated with oral respiration improve after nasal respiration has been established. The degree of the improvement, especially of the palatal deformity, depends upon the age of the individual and the length of time the deformity has existed. The earlier the nasal obstruction is removed the better the results, both in preventing oral deformities and in correcting it when it has occurred.

The treatment of the individual with a congenital narrow skull should be first to widen the palate, for this, we know, often widens the nasal cavities (²⁵), which in many instances is sufficient to produce nasal respiration. If, however, the widening of the palate does not allow respiration to take place through the nose during the day and night, then the rhinologist should correct any intranasal irregularity. The rachitic patients, I believe, can be helped by establishing normal nasal respiration.

As a result of a careful study of the uncivilized races, in whom mouth-breathing and irregularities of the teeth are

*This widening of the nasal cavity has been observed clinically for twenty years or more, but, so far as I can find, has not been confirmed by intranasal measurements. Since writing this article I have made intranasal measurements which prove that widening of the hard palate does widen the nasal cavity.

rarely found, Catlin says: "If I were to endeavor to bequeath to posterity the most important motto which human knowledge can convey, it should be in three words—Shut your mouth."

This, as we are well aware, is impossible for many members of our civilized society, and it is our duty as orthodontists and rhinologists to assist these unfortunates. We can, through our single or combined efforts, change the mouth-breather with a stupid, expressionless appearance and disfiguring irregular teeth to a nose-breather with an active, intelligent appearance and attractive, regular teeth.

CONCLUSIONS.

Imperfect nasal respiration causes partial or complete oral respiration which through its influences tends to produce the following:

1. Indigestion.
2. Impoverished blood.
3. Lowered resistance, especially of the upper teeth and respiratory tract.
4. Deformities of the superior maxilla, with imperfect dentition, both in quality and position.

The treatment of these conditions often require the combined efforts of the orthodontist and rhinologist.

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