The Significance of Adenoid Tissue in Orthodontia *

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Introduction

At one time the nasorespiratory area played an important role in orthodontic thinking. It was believed, and expressed, that obstructions in this area might influence the developing facial conformity. There are frequent references in the literature to the so-called "adenoid type face." In line with this thinking Todd[1] set forth the concept that adenoid growth, by constricting the nasopharyngeal passage and mechanically impeding breathing might complicate the facial pattern development in early childhood.

Nowadays, we are fully cognizant of the multi-deleterious effects of mouth-breathing on the developing denture. Inadequacy of proper nasorespiratory function, by inducing poor muscular function of the lips, may be directly responsible for a gradual increase in the procumbency of the maxillary denture.

Since excessive growth of adenoid tissue or excessive hypertrophy of this tissue may obstruct the nasopharyngeal cavity, it was deemed advisable to gather information pertaining to the adenoid tissue and its surrounding nasopharyngeal spaces. Investigation was undertaken in four general areas:

1. The location and configuration of adenoid tissue.
2. The growth of adenoid tissue and contiguous structures.
3. Changes resulting from removal of adenoid tissue.
4. The orthodontic implications of adenoid growth and removal.

Method of Investigation

The combined methods of cephalometric roentgenography (Broadbent)[2] and cephalometric laminagraphy (Brader)[3] were employed. These techniques permit the stabilization of the head within specially constructed head-holders; thereby, individuals may be similarly repositioned to obtain successive x-ray registrations. Such radiographic registrations are comparable from one period of time to another and may be subjected to qualitative as well as quantitative evaluations. Cephalometric laminagraphy, a body sectioning x-ray technique, permits a clear visualization of structures within a certain lamina; in this case the mid-saggital plane of the head. The image may be focused at any pre-determined depth; thus it is possible to alleviate the superimposition of calcified structures on either side of this depth or lamina.

I. Location and Configuration

Adenoid tissue cannot be radiographically visualized as a three dimensional object. Therefore, from x-rays, its location and configuration can only be expresed in relation to the mid-saggital plane. Numerous radiographs as well as cephalometric headplates and laminagraphs taken on 20 children, both prior and subsequent to adenoidectomies, were examined.

Adenoid tissue is located in the nasopharynx or that portion of the pharynx above the level of the soft palate. On

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the lateral headplate, developed so that soft tissue may be visualized, adenoid tissue appears as a somewhat convex prominence facing the superior surface of the soft palate. In the mid-saggital plane it is attached to the roof (inferior to the body of the sphenoid and basilar portion of the occipital bone) as well as to the posterior pharyngeal wall. (Fig. 1)

Fig. 1 Mid-saggital laminagraph depicting the presence of adenoid tissue within the nasopharyngeal cavity. An appreciation for its configuration, location and size may be attained.

The attachment to the roof of the nasopharynx may extend anteriorly as far forward as the posterior choanae. The anterior border extends downward from the roof of the nasopharynx, approaches the soft palate to varying degrees in individual cases, and then extends posteriorly as the inferior border. The inferior border faces the superior surface of the soft palate and posteriorly joins and blends into the posterior pharyngeal wall. On the average, the posterior attachment seems to extend inferiorly up to or slightly below the level of the anterior tubercle of the Atlas. In instances of excessively enlarged adenoid tissue, the greater portion of the nasopharyngeal cavity may be filled; in some cases the inferior border may actually touch the superior aspect of the soft palate.

II. Growth of Adenoid Tissue and Contiguous Structures

Fifteen subjects on whom longitudinal serial x-rays were available over varying periods of time were studied to evaluate the growth aspects of adenoid tissue. In each of these subjects there was no history of adenoid removal nor did the cephalometric roentgenograms indicate that an adenoidectomy had been performed. X-rays taken on the

same individuals indicate that the nasopharyngeal adenoid tissue follows a specific cycle of growth. The tissue seems to have a specific potential on which may be superimposed the hypertrophic reactions of nasorespiratory infections and allergies.

Adenoid tissue is not radiographically evident until approximately 6 months to 1 year of postnatal life. Prior to this age the soft tissue forming the roof of the nasopharynx slopes smoothly downward and backward to blend into the posterior pharyngeal wall. The sloping nasopharyngeal roof appears to be straight or even slightly concave in configuration as it faces the superior surface of the soft palate. With growth, there is an apparent thickening or increase in mass of this soft tissue; concomitantly, its straight or slightly concave contour is replaced by a somewhat convex prominence facing the superior surface of the soft palate. At this stage of development the growth of adenoid tissue is rapid and by 2-3 years of age may occupy as much as one-half of the nasopharyngeal cavity. The growth of this lymphatic tissue is predominantly in a downward and forward direction, possibly influenced by the general path of growth of the upper face. Thereafter the adenoid tissue continues to grow, still predominantly in a downward direction, but at a somewhat retarded rate, until its peak of growth or greatest bulk is attained. (Fig. 2) This peak may be reached as early as

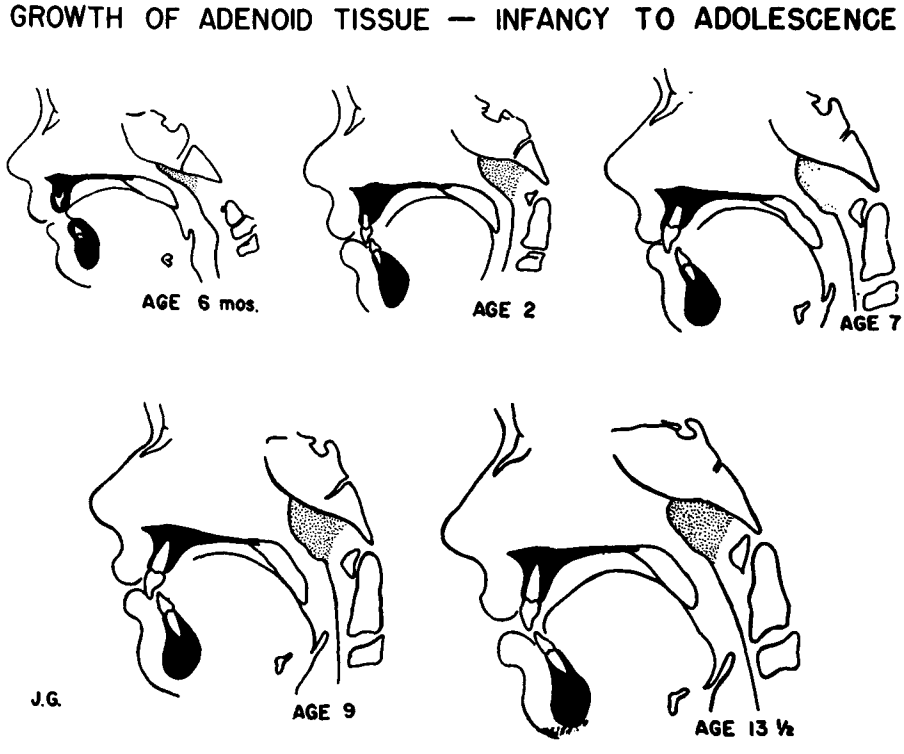


Fig. 2 Serial tracings of cephalometric headplates revealing changes in the adenoid tissue mass with age. The stippled area represents adenoid tissue as well as the soft tissue underlying the roof of the bony nasopharynx.

10-11 years of age and is sometimes evident as late as 14-15 years of age.

It is of utmost importance to remember that this tissue is growing within a constantly changing environment—a cavity that itself is continuously growing and changing in configuration. It has been demonstrated (Brodie,[4] King[5]) that the antero-posterior dimension of the bony nasopharynx stabilizes itself rather early in life. After two years of age, there exists a remarkably stable relationship between the posterior nasal spine of the hard palate and the anterior arch of the Atlas (first cervical vertebra). There is little known concerning the growth in width of the nasopharynx. However, there are indications (Hellman,[6] Subtelny[7]) that the width too stabilizes at an early age.

Much is known concerning the vertical growth of the nasopharynx (King[5]). The vertical dimension of the nasopharynx will normally continue to increase until approximately 17-18 years of age when the maxilla itself completes its growth. As the head grows the hard palate has been shown to move in a parallel manner further and further away from the base of the cranium. Both nasal and nasopharyngeal heights increase as a result of this descent of the palate. It is important to remember that the floor of the nasopharynx, the soft palate, by virtue of its attachment to the posterior border of the hard palate is also being spatially carried to lower and lower levels in relation to the cranial base. (Fig. 3)

Thus growth in the nasopharyngeal

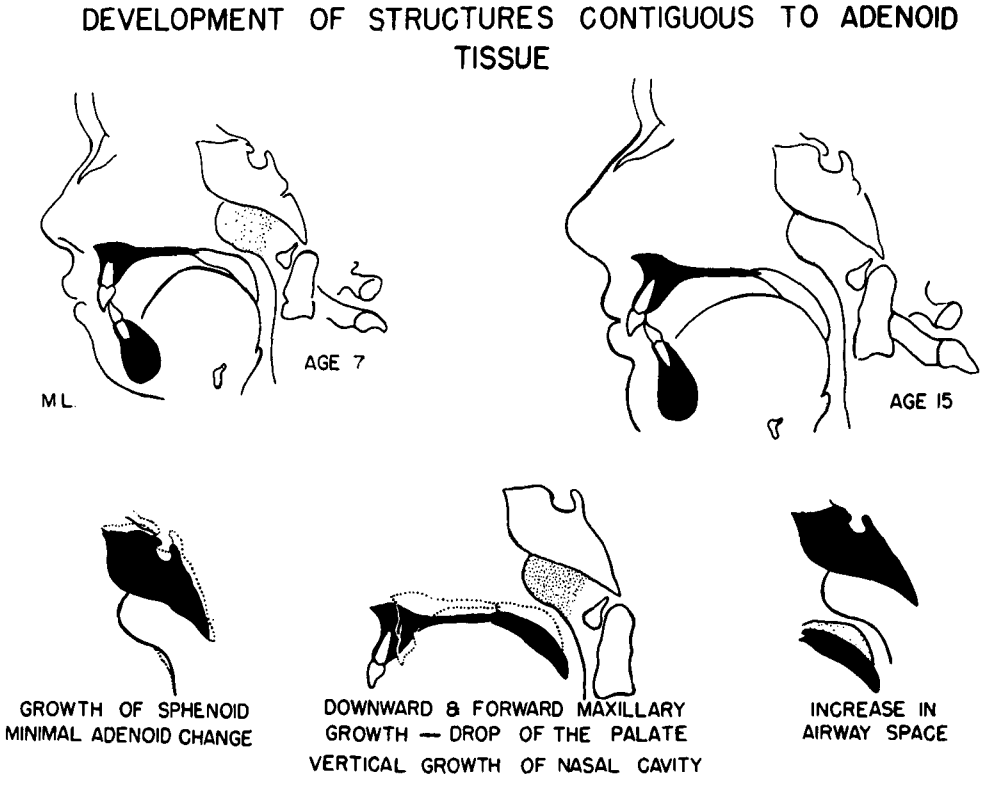


Fig. 3 Serial tracings of cephalometric headplates revealing changing relationships, with growth, between adenoid tissue and contiguous structures.

area seems to strike a fine state of equilibrium. During the early years the lymphatic adenoid tissue is growing rapidly, but the upper face too is growing at a rapid pace permitting a rapid descent of the palate. This fine balance usually allows the airway space, the distance between the superior surface of the soft palate at rest and the adenoid tissue, to remain adequate for nasorespiratory needs. Thereafter, both adenoid tissue and nasopharyngeal height continue to grow, but at a somewhat retarded rate. Although the rate of growth seems to decrease as the child grows this state of equilibrium normally seems to persist until the peak of adenoid growth is reached.

Sometimes there is a disturbance in this delicate balance—the adenoid tissue can be demonstrated to develop or increase in mass at a faster rate than the palate drops. (Fig. 4) Whether this is worthy to mention that most tonsillectomies and adenoidectomies have been performed by 9 years of age (Skolnik[8]) and that mouthbreathing is frequently manifested by this age.

After the peak of adenoid growth is reached, the growth process seems to reverse itself. The adenoid tissue commences to atrophy and progressively decreases in mass as it regresses from the area of the soft palate. (Fig. 5, 6) The anterior and inferior aspects seem to move in an upward and backward direction approaching the inferior aspect of the bony roof of the nasopharynx. By adulthood the adenoid tissue has completely atrophied and with maxillary growth at an end, the greatest dimension between the superior surface of the soft palate and the superior and/or posterior wall of the nasopharynx (airway space) is established.

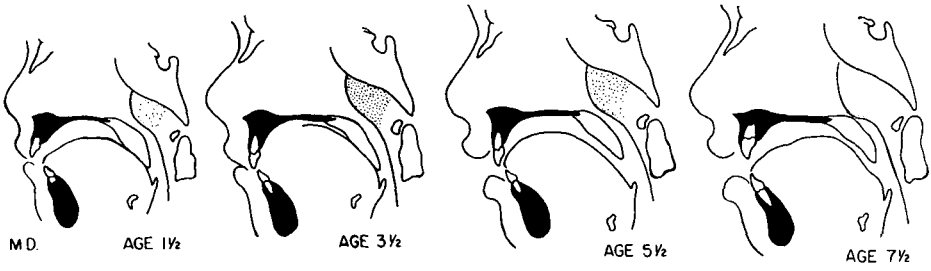
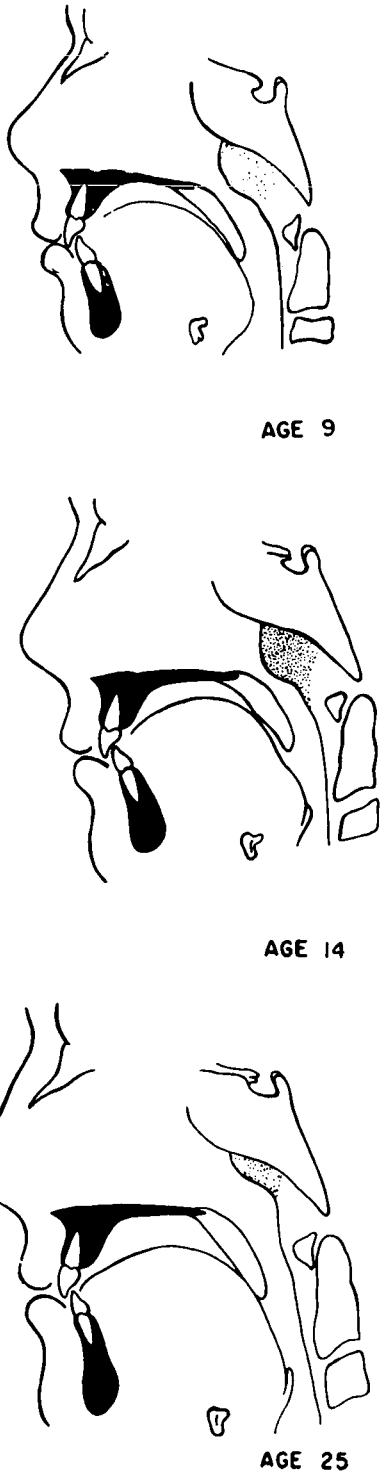


Fig. 4 Serial tracings of cephalometric headplates depicting an over-abundant development of adenoid tissue. Note the change in positional relationships between the tongue and soft palate.

a result of excessive adenoid growth or an allergic reaction or even a reaction to infectious agents resulting in hypertrophy of this tissue is difficult to determine. However, this may cause, by an approximation or near approximation of the adenoid tissue with the superior surface of the soft palate, a blockage of the nasopharyngeal cavity. It is noteworthy to mention that most tonsillectomies and adenoidectomies have been performed by 9 years of age (Skolnik[8]) and that mouthbreathing is frequently manifested by this age.

III. Changes Resulting from Removal of Adenoid Tissue

To determine, what changes if any, occurred as a result of adenoid and tonsil removal, twenty youngsters ranging from 4-12 years were radiographically examined. Both cephalometric headplates and laminagraphs were obtained shortly prior to, and shortly subsequent



to, the surgical removal of adenoid and tonsillar tissue. The radiographs were recorded, as much as possible, while patients were relaxed and in a rest position. Records were compared by superpositioning the before and after tracings on cranial structures. Growth changes were at a minimum because of the small time interval between radiographic recordings.

In some instances, removal of the adenoid tissue did not seem to be physiologically necessary. Radiographic examination revealed an apparently adequate distance, between the superior surface of the soft palate and the inferior surface of the adenoid tissue, to provide an ample airway channel. (Fig. 7) However, medical circumstances, such as infections, may have dictated removal of this tissue. It is called to the orthodontist's attention to point out that adenoidectomies are not routinely indicated. On the basis of nasorespiratory function, these cases would probably not have had any detrimental influence on the developing denture.

In many instances it was radiographically evident that there was an incomplete removal of the adenoid tissue. Excessive soft tissue remained in areas difficult to reach and extremely difficult to visualize properly. (Fig. 8) The residual tissue was usually located in the most anterior portions of the nasopharyngeal cavity; considerable retraction of the soft palate would be necessary to clearly visualize this area. If a sufficient airway space between the inferior aspect of the remaining adenoid tissue and the superior surface of the

Fig. 5 Serial tracings of cephalometric headplates revealing the upward and backward regression of adenoid tissue after its peak of growth is reached. Age 14 represents the peak of adenoid growth in this individual.

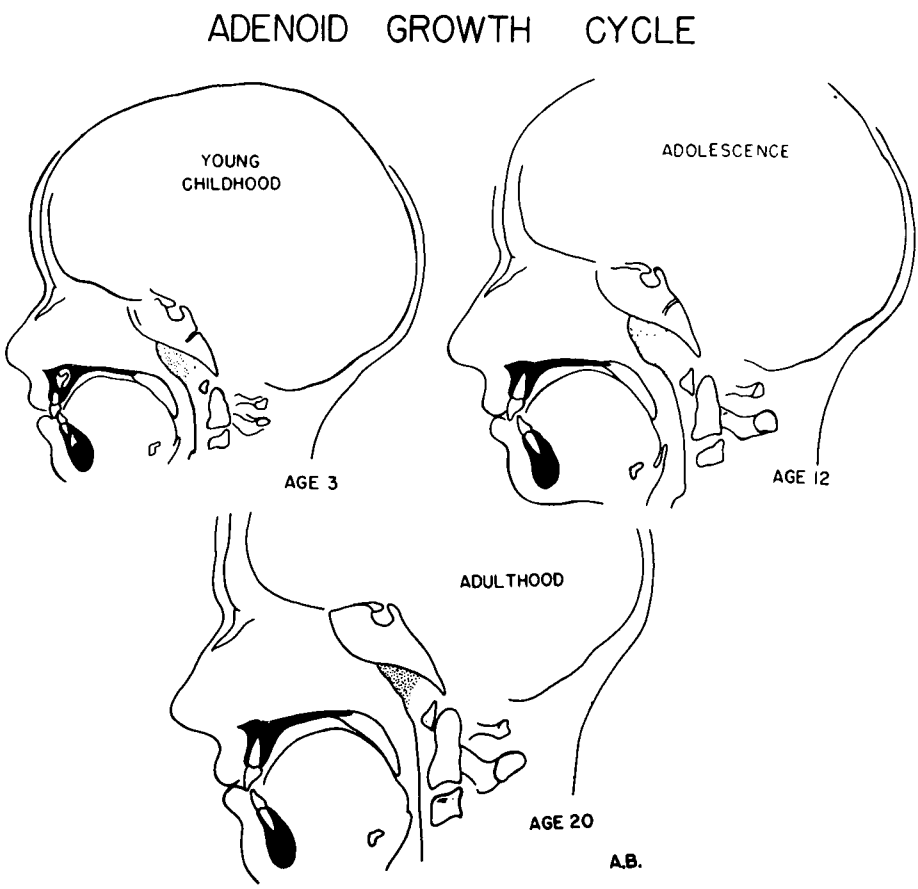


Fig. 6 Serial cephalometric headplate tracings depicting the full growth cycle of adenoid tissue. Growth to maximum bulk and subsequent atrophy is evident.

soft palate does not exist, a mouth-breathing problem may still exist in these cases. In such cases it would be physiologically impossible for the child to attempt to alleviate an already existing mouthbreathing habit.

Judicious removal of adenoid tissue resulted in a considerable improvement in the airway space in the nasopharyngeal region. Radiographically, the dimension, in the mid-saggital plane, from the superior surface of the resting soft palate to both the superior and posterior walls of the nasopharynx is increased appreciably. (Fig. 9) In these children the possibility of proper nasorespiratory function is markedly improved.

Of particular interest are those cases which exhibited excessive adenoid tissue and the usual nasorespiratory difficulties. The physiologic relationship of certain muscular structures seemed to deviate from normal. It has been noted that normally, in the rest position, the oral surface of the soft palate will rest against or approximate the posterior dorsal surface of the tongue. In cases of excessive adenoid tissue, that portion of the tongue usually approximating the soft palate, was found to be downward and forward away from

the soft palate. (Fig. 10A) Initially one gets the impression that the soft palate, at rest, has been raised away from the tongue; however, later evaluation reveals that the tongue has moved downward and forward away from the soft palate. This serves to establish a definite channel through which air may pass from the oral cavity into the oral pharynx. It may also be surmised that this could be a result of enlarged tonsils mechanically forcing the tongue downward and forward; however, this would be extremely difficult to evaluate. At any rate, the repositioning of the tongue will probably remove its influence from the lingual surface of the upper posterior teeth against which it normally rests. (Brodie[9]) In many of these children, subsequent to the removal of adenoid and tonsillar tissue, the soft palate may be seen to rest once again in contact with the posterior dorsum of the tongue. (Fig. 10B)

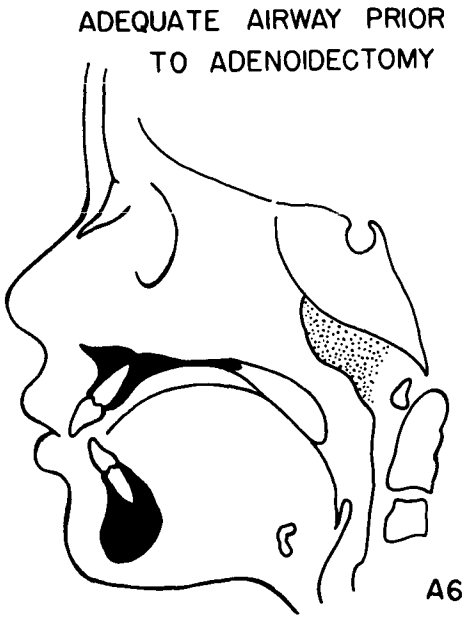


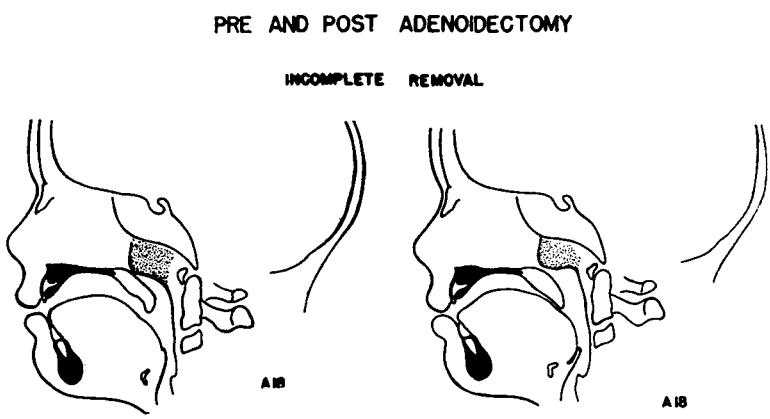
Fig. 7 The distance between the superior surface of the soft palate and the inferior surface of the adenoid tissue appears quite adequate for nasorespiratory needs.

IV. Orthodontic Implications

At this point we may, with some degree of assurance, theorize in what manner an immoderate amount of adenoid tissue may be a contributing factor to the development of a malocclusion. Once a tooth has erupted through the alveolar process, and has entered the oral cavity, it may be subjected to a variety of environmental influences. These environmental factors may directly, or indirectly, affect the position of teeth within the alveolar arch. Blockage of the normal respiratory passage with accompanying environmental modifications, may well have a detrimental influence on the developing denture. By necessity, breathing through the oral cavity requires numerous muscular changes. The lips, in repose, must part; the tongue, at least the posterior portion of the tongue, moves downward and forward away from the soft palate and there is usually an accompanying depression in the position of the mandible.

The damaging effects of a more than average parting of the lips have been emphasized elsewhere and do not require further elaboration here. Suffice it to say that the lip and associated musculature is envisioned as an elastic band of tissue exerting its influence on the denture in the direction of the tongue. A withdrawal of the restraining influence of the lip musculature permits the maxillary anteriors to become progressively more and more procumbent. It is also conjectured that the forward migration of the entire maxillary denture is subsequently possible leading to a class II divison I type of malocclusion.

In addition, it may now be inferred that with a drop of the mandible and of the tongue there is decreased muscular influence on the lingual surfaces of the maxillary posterior teeth. Thus the tongue is no longer capable of counteracting the lingual pressure of



Feg. 8. Residual adenoid tissue is evident in the anterior region of the nasopharynx. The airway passage is not markedly improved.

the buccal musculature. This may explain the narrow maxillary arch so frequently described in "adenoid faces" (Lederer[10]), mouthbreathers and many class II malocclusions. The so-called "high vault," also frequently referred to, is probably an optical illusion resulting from the constriction of the maxillary arch.

It must be carefully emphasized that not all children with tonsil and adenoid tissue will develop a mouthbreathing habit; the nasopharyngeal air passage must be obstructed. It is also true that most children who are mouthbreathers, as a result of enlarged adenoids, may be able to outgrow this habit. With growth the adenoid tissue will shrink in mass or atrophy; however, this transformation may occur too late to prevent any of the developing orthodontic problems. The majority of the permanent teeth will have erupted by the time this tissue commences to atrophy.

The child with a mouthbreathing problem should have the nasopharyngeal spaces examined for the presence of adenoid tissue and the quantity and

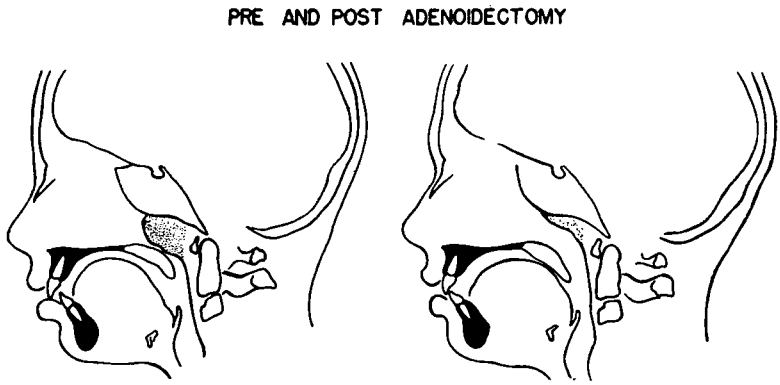


Fig. 9 Marked improvement in the nasorespiratory passage as a result of adequate removal of adenoid tissue. This tissue was removed, upon recommendation, during orthodontic treatment. Note the change in spatial relationship between the tongue and soft palate.

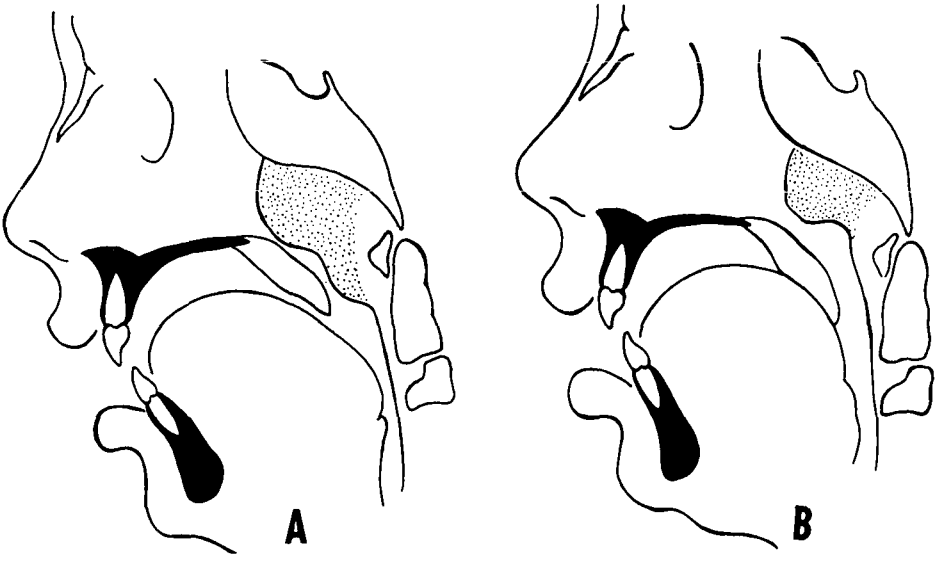


Fig. 10 A. Excessive adenoid tissue causing an aberrant tongue-soft palate relationship. The posterior dorsum of the tongue appears to be in a downward and forward position away from the soft palate.

B. Improved tongue position resulting from the provision of an adequate nasorespiratory channel. Note that some residual tissue still remains.

location of the tissue should be carefully evaluated. If the problem is coped with at an early age—that is, before the permanent teeth are positioned—the prevention of an orthodontic problem is possible. However, once the habit is established and the denture procumbent, then the improvement of breathing may be of little advantage since denture relationships may prevent closure of the lips. In these cases, the orthodontist must place the denture in a position where the lip musculature is able to normally drape over it.

If orthodontic treatment is undertaken and completed but a nasopharyngeal obstruction is still present, then the relapse potential will be very great. In spite of correct repositioning of the dentures the necessity for oral respiration will maintain poor muscular balance and function. In these cases it may be advisable to recommend adenoid removal or to anticipate long periods of retention if it is desired to await complete atrophy of the adenoid tissue.

In conclusion it might be advisable to interject a word of caution. Unless medical circumstances absolutely dictate it, adenoidectomies are contra-indicated in children with a repaired cleft palate (Subtelny and Koepp-Baker[11]). Frequently there is a sudden and dramatic appearance of an undesirable nasal quality in the speech of cleft palate patients subsequent to the surgical removal of tonsil and adenoid tissue.

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