in adults, and when it is noted it is usually in an atrophic condition.

The cause of the involution of the Waldeyer's ring is still under investigation. The imbalance in the relationship between the enlargement of the nasopharynx/nasopharyngeal airway and the concomitant growth of adenoid tissue can result in reduced patent nasopharyngeal airway and increased nasopharyngeal obstruction. The growth of adenoidal tissue as demonstrated by a bell curve peaks at or near age six and also begins involution at or near this age as well (Fig. 6). Facial growth is coupled with adenoidal growth. As the cranial base forms the roof of the nasopharynx, a close examination of the growth and development of the craniofacial complex becomes significant for evaluation of the size and configuration of the nasopharyngeal airway. Any abnormal development regarding this craniofacial complex may affect the nasopharyngeal airway.

Abnormal adenoidal growth which occurs during childhood may consume the nasopharynx and interfere with the posterior choanae in the nose. This excessive adenoidal growth usually interferes with normal nasal growth and can result in abnormal breathing patterns, congestion, snoring, mouth breathing, sleep apnea, Eustachian tube dysfunction, otitis media, rhinosinusitis, facial growth abnormalities, swallowing problems, reduced ability to smell and taste, and speech problems. Theoretically, many clinicians believe the blockage should be removed as soon as possible through a surgical procedure called adenoidectomy. However, according to a study conducted by Havas and Lowner, one-third of child study patients with traditional adenoidectomies were ineffective with intranasal extensions of the adenoids obstructing the posterior choana. For this segment of the study population the "powed-dered-shaver adenoidectomy" was effective in the complete removal of the obstructive adenoidal tissue ensuring postural patency.

Upper Airway Obstruction & Mouth Breathing

During normal nasal respiration, the nose filters, warms and humidifies the air in preparation for its entry into the body's lungs and bronchi. This nasal airway also provides a degree of nasal resistance in order to assist the movements of the diaphragm and intercostal muscles by creating a negative intrathoracic pressure. This intrathoracic pressure generates airflow into the alveoli. Correct normal resistance is 2 to 5.5 cm H2O/L/Sec and results in high tracheobronchial airflow that enhances the oxygenation of the most peripheral pulmonary alveoli. In contrast, mouth breathing causes a lower velocity of incoming air and eliminates nasal resistance. Low pulmonary compliance results. According to blood gas studies, mouth breathers have 20% higher partial pressure of carbon dioxide and 20% lower partial pressures of oxygen in the blood, linked to their lower pulmonary compliance and reduced ventilation.

Contributing factors in the obstruction of upper airways include: anatomical airway constriction, developmental anomalies, macroglottis, enlarged tonsils and adenoids, nasal polyps and allergic rhinitis. However, for purposes of this paper the focus shall be on enlarged adenoids as the major contributing factor. There are numerous studies that link adenoid hypertrophy with nasopharyngeal airway obstruction to the development of skeletal and dental abnormalities.

Airway obstruction, resulting from nasal cavity or pharyngeal blockage, leads to mouth breathing, which results in postural modifications such as open lips, lowered tongue position, anterior and posterior inferior rotation of the mandible, and a change in head posture. These modifications take place in an effort to stimulate the airways. As previously discussed, facial structures are modified by postural alterations in soft tissue that produce changes in the equilibrium of pressure exerted on teeth and the facial bones (Fig. 7). Additionally, during mouth breathing, muscle alterations affect mastication, deglutition and phonation because other muscles are relied upon. Airway obstruction coupled with loss of lingual and palatal pressure of the tongue produces alterations in the maxilla. The positioning of the tongue also plays an important part in mandibular development. The tongue displaced downward can lead to a retrognathic mandible, and an interposed tongue can lead to anterior occlusal anomalies.

Additionally, maxillary changes can be viewed in the transverse direction, producing a narrow face and palate often linked with cross bite; in the anteroposterior direction, producing maxillary retraction; and in the vertical direction, causing an increase in palatal inclination as related to the cranial base and excessive increases of the lower anterior face height.

The most commonly found occlusal alterations are cross bite (posterior and/or anterior), open bite, increased overjet, and/or retroclination of the maxillary and mandibular incisors. Ma-hony and Lindner-Aronson's findings were in agreement with the significant correlation between changed mode of breathing and diminished mandibular/palatal plane angle (ML/NA) found in adenoidectomized children. Several authors have taken the position that adenoids are not consistently found to be associated with adenoids, mouth breathing, nor a particular type of malocclusion, and that there is no cause and effect relationship between adenoids, nasal obstruction/mouth breathing and malocclusion. Several of these authors have taken the position that adenoids are not consistently found to be associated with adenoids, mouth breathing, nor a particular type of malocclusion, and that there is no cause and effect relationship between adenoids, nasal obstruction/mouth breathing and malocclusion. Proposers of this position believe that the V-shaped palate was inherited and not acquired through mouth breathing. Hartsook (1946) on a review of literature related to mouth breathing concluded that mouth breathing is not a primary etiological factor in malocclusion. Additionally, Whitaker (1911) found that in a study of 800 children who under- went adenoidectomy or tonsillectomy, only 50% had dental anomalies that needed orthodontic intervention. There is some suggestion that adenoids and hypertrophic tonsils are a consequence of a thyroid hormone deficiency. This hormone deficiency acts as a catalyst for stimulating the organ-ism's defense mechanisms, which include hypertrophy of lymphoid tissue. Another orthodontic clinician, Vie, took the position that without documented tonsillectomy or adenoidectomy, or other treatment to improve nasal respiration is empirically difficult to justify from an orthodontic point of view.

Malocclusion: The Issue Still in Debate

Is there a cause and effect relationship between adenoids, nasal obstruction and malocclusion? Dentofacial changes associated with nasal airway blockage have been described by C.Y. Tones in 1872 as adenoid facies. Tones coined this term based on his belief that enlarged adenoids were the principle cause of airway obstruction and resulted in noticeable dentofacial changes. Tones reported that children who were mouth breathers often exhibited narrow V-shaped den tal arches (Fig. 8). This narrow jaw is a result of mouth breathers keeping their lips apart and their tongue position low. The imbalance between the tongue pressure and the muscles in the cheek results in cheek muscles compressing the alveolar process in the premolar region. Simultaneously, the lower jaw postures back. These simultaneous actions have been termed the compressor theory (Fig. 9).

Tones' views were supported in the 1950s by numerous leading orthodontists. These supporting clinicians reported airway obstruction as an important orthodontic malocclusion. Rub-avin advocated that in order for these patients to fully be assessed they must be thoroughly evalu- ated by both a rhinologist and an orthodontist. Malocclusion is the departure from the normal relation of the teeth in the same dental arch or to teeth in the op- posite arch. Airway obstruction coupled with loss of lingual and palatal pressure of the tongue produces alterations in the maxilla. The positioning of the tongue also plays an important part in mandibular development. The tongue displaced downward can lead to a retrognathic mandible, and an interposed tongue can lead to anterior occlusal anomalies.

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Nasal Respiratory Evaluation

The relationship of airway obstruction and dentofacial structures/malocclusion is still the subject of investigation and contro- versy among orthodontists. The correlation between functional problems and morphologic characteristics is yet to be solidified. Regardless of varied opinion in this area, practitioners should observe each patient carefully.

Suggested protocol:

1) As the patient enters the room, facial and head posture should be noted to see if the lips are held open and nasal respiration is present.
2) Signs of allergic rhinitis should be noted, as well as histories of sinusitis.
3) Assessment of family history for allergies is important.
4) Sleep history should be evaluated: sleep apnea, loud snoring, open mouth posture while asleep.