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Thomas Weimert

Eugene L. Gottlieb

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AIRWAY OBSTRUCTION IN ORTHODONTIC PRACTICE

Dr. Thomas Weimert and Dr. Gottlieb

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Dr. Weimert is Clinical Instructor in Otolaryngology, University of Michigan, and in private practice of otolaryngology at Catherine McAuley Health Center, Ann Arbor, Michigan.

DR. GOTTLIEB: Tom, this is an opportunity for us orthodontists to get an ear, nose, and throat viewpoint about mutual patients and explore our common interests.

DR. WEIMERT: My involvement as an otolaryngologist in the treatment of orthodontic patients has been a particularly educational one for me. Having evaluated over 1100 patients referred by orthodontists over the past five years, I have been impressed with the incidence of significant upper airway obstruction in this patient population.

DR. GOTTLIEB: The classic picture from an orthodontic standpoint is a patient with the so-called "adenoid facies" appearance. It is a long, narrow face with a convex facial profile, narrow nose, and narrow nasal openings. There is sometimes a short upper lip and a mouth-open posture. These patients have been described as having a Class II malocclusion, but epidemiological studies have shown that about 75 percent of them are Class I and maybe 10 percent are Class III. Is there a typical patient that you see referred by an orthodontist?

DR. WEIMERT: The typical patient referred to

me is 7-12 years of age, with a history of intermittent or persistent mouthbreathing. Thirty-five percent have a history of snoring; 22 percent have symptoms of allergy--nasal congestion, rhinorrhea, and sneezing. Many of these patients have dark circles under their eyes and are mouth-breathers with some degree of nasal congestion.

DR. GOTTLIEB: Is this the classic adenoid facies?

DR. WEIMERT: Textbook descriptions of adenoid facies frequently include the mouth-open posture, short upper lip, narrow nasal openings, allergic shiners, and irritation around the nasal vestibule from rhinorrhea. The patient is constantly wiping the nose in an upward direction.

DR. GOTTLIEB: What exactly are allergic shiners?

DR. WEIMERT: Allergic shiners are darkened areas below the eyes that we frequently see in people with allergies or in any patient with significant nasal obstruction. They are caused by venous congestion poor venous outflow because of swelling in the nose.

DR. GOTTLIEB: While these things are typical, you do not have to see all of the classic symptoms in order to identify a patient with an airway problem.

DR. WEIMERT: That is correct. Patients

frequently have significant upper airway obstruction without many of these characteristics.

DR. GOTTLIEB: Do ENT texts include any reference to craniofacial morphology features that might be characteristic of this group?

DR. WEIMERT: Occasionally our literature refers to a patient with chronic mouthbreathing as having a long face or a high-arched palate. In general, however, the association between chronic airway obstruction and dentofacial development has not been well addressed--and certainly poorly investigated--in the otolaryngology community.

DR. GOTTLIEB: How do you examine the nasal airway?

DR. WEIMERT: For the most part, the nasal airway can be evaluated best by direct visualization with a nasal speculum. Topical decongestants may be used. The posterior aspect of the nasal chambers can be visualized indirectly with a mirror posterior to the uvula, many times even in a child. We also now have available pediatric fiberoptic scopes that can be inserted into the nose in selected individuals for more accurate assessment of posterior chamber abnormalities.

DR. GOTTLIEB: Is A-P x-ray valuable in evaluating the nose?

DR. WEIMERT: It can be helpful, but must be interpreted in light of the physical findings. It is particularly useful for evaluating the bony structures, but can be misleading in evaluation of soft tissues and cartilaginous structures. The majority of a person's nose is soft tissue and cartilage. There have been a number of studies correlating patients' symptoms with various diagnostic techniques, and the conclusion of most of these studies is that direct clinical examination of the nasal chambers correlates best with patient symptomatology. When the x-ray is abnormal it may be helpful, but a normal x-ray does not rule out the possibility of significant underlying nasal obstruction.

DR. GOTTLIEB: What is the function of the nose?

DR. WEIMERT: The nose cleans inspired air

and filters out bacteria carried by the air. Hairs in the nose filter out a certain amount of dust particles. Smaller particles are swept to the front of the nose by a mucous blanket. The entire inside of the nose is lined by respiratory epithelium that secretes mucus. As that mucus flows over the nose, cilia on the cells of the mucosa beat the mucus back toward the nasopharynx so that you swallow it, or beat it forward to clean the nose and keep the sinuses clear. The respiratory control system is not well understood. We know that if you put nasal packs in the nose, as we do all the time for nasal surgery, it will drop the oxygen blood level about 15mm of mercury consistently; but we do not see the same phenomenon in people who have adenoid obstruction. So there are things about the function of the nose that we really don't understand.

DR. GOTTLIEB: What is the role of the nares?

DR. WEIMERT: The most critical area of the nose with regard to obstruction is the valve area, located just inside the nares anteriorly. This is the smallest cross-sectional area of the nose. Relatively minor changes in nasal architecture in this area can result in a significant increase in nasal airway resistance.

DR. GOTTLIEB: Where are the turbinates located?

DR. WEIMERT: There are three turbinates--inferior, middle, and superior--emanating from the lateral wall of the nose in each nasal chamber. Each turbinate has a thin bony core covered by erectile tissue abundant with blood vessels and mucus-secreting glands. The turbinate most readily seen when one looks in the nose is the inferior turbinate. This is also the turbinate responsible for airway obstruction when there is turbinate hypertrophy, because of the proximity of the inferior turbinate to the anterior and posterior nasal chambers. We rarely operate on the superior or middle turbinates.

DR. GOTTLIEB: What causes turbinate hypertrophy?

DR. WEIMERT: The most common cause of turbinate hypertrophy is allergy. There are other etiologies, however, and it is important to identify

the reason for turbinate enlargement before treatment is recommended. In some instances, especially in the allergic patient, medication is effective in reducing turbinate size and restoring the airway. In other patients, surgery becomes necessary.

It used to be thought that removing the turbinates would dry out the nose to such a degree that you would have trouble with encrusting and nasal obstruction, because the nose could no longer humidify the air being drawn in. I have not seen that happen. Most physicians are now treating the turbinates aggressively, but you may run across an ENT physician who still feels that turbinates should not be operated. The turbinates are critical in maintaining normal nasal physiology.

DR. GOTTLIEB: Do turbinates ever regenerate?

DR. WEIMERT: No, turbinates do not regenerate.

DR. GOTTLIEB: Isn't there some resistance among physicians to any nasal surgery in children?

DR. WEIMERT: Yes. Some otolaryngologists feel nasal surgery should be avoided at all costs in children, because of the risk of altering nasal growth. However, it has been demonstrated both experimentally and clinically that turbinate surgery and conservative nasal septal surgery do not interfere with nasal or facial growth. I don't alter the bony structure of the nose in children less than 12-14 years of age. Most otolaryngologists advocate conservative nasal surgery, even in young children, if the nasal airway is significantly structurally compromised.

DR. GOTTLIEB: Is nasal surgery painful?

DR. WEIMERT: Most of the discomfort from septal and turbinate surgery is related to nasal packing that is occasionally necessary. In children undergoing turbinate surgery or adenoidectomy, there is no significant nasal discomfort afterward.

DR. GOTTLIEB: When a septum is badly deviated, do you remove the septum or do you straighten it out?

DR. WEIMERT: It depends on the configuration of the septum, the age of the patient, and the surgeon's preference. In general, we use the most conservative method available to achieve a good

result. A cartilagenous framework is always preserved to maintain support of the external nose.

DR. GOTTLIEB: But you do not remove any of the vomer bone?

DR. WEIMERT: In children, we do not remove any of the vomer. In adults, we may if it is obstructive. Fortunately, the vomer rarely contributes to nasal obstruction in children.

DR. GOTTLIEB: Birth trauma is not a common cause of nasal obstruction?

DR. WEIMERT: In my experience, birth trauma is a very unusual cause of nasal obstruction. Occasionally the cartilagenous septum will dislocate from the maxillary crest at childbirth. If this is recognized in the newborn nursery it can be corrected quite easily.

DR. GOTTLIEB: Are accidents to the nose frequent in children beginning to walk? Is it an old wives' tale that they first hit the forehead, then the nose, then the mouth?

DR. WEIMERT: That may well be true, but nasal fractures in children are uncommon. The nasal cartilage is very resilient in a child. Also, the nasal bones are extremely small relative to the rest of the nasal architecture in the child. As a result, we don't see displaced nasal fractures nearly as frequently in children as in adults.

DR. GOTTLIEB: What is choanal atresia?

DR. WEIMERT: The posterior choanae are the openings of the posterior nares into the nasopharynx. Choanal atresia is a congenital abnormality in which one or both posterior choanae fail to develop completely. This results in unilateral or bilateral nasal obstruction in the newborn infant. Bilateral choanal atresia in the newborn is a medical emergency, because neonates are obligate nose breathers. Unilateral choanal atresia presents with unilateral rhinorrhea and nasal obstruction. Both conditions can be corrected surgically.

DR. GOTTLIEB: At what ages do you see it?

DR. WEIMERT: Unilateral choanal atresia may be diagnosed at any age, but is usually recognized and treated at a very young age.

DR. GOTTLIEB: What is vasomotor rhinitis?

DR. WEIMERT: Vasomotor rhinitis is a condition caused by an imbalance between the sympathetic and parasympathetic nervous systems. As a result, the turbinates become congested and hypersecrete mucus, frequently in response to changes in environment.

DR. GOTTLIEB: What kind of changes in environment? Temperature and humidity?

DR. WEIMERT: Yes. Typically, the patient goes into an air-conditioned room, and his nose becomes congested and runs. Or the patient wakes up in the morning congested, sneezes several times, and subsequently clears.

DR. GOTTLIEB: How does this compare to allergic rhinitis?

DR. WEIMERT: Vasomotor rhinitis can be difficult to differentiate from allergic rhinitis. Both cause nasal obstruction and rhinorrhea. More common in the allergic patient, however, are seasonal variation, conjunctival irritation, family history of allergy, nasal or ocular itching, and positive skin testing. The key to treating children with allergic rhinitis, particularly if there is some orthodontic consideration, is to monitor the airway. Frequently, many of the allergy symptoms subside in response to a vigorous allergy program (medications and/or hyposensitization shots), but the nasal obstruction persists. If the nasal obstruction has not improved in a reasonable period of time (one year), the surgical treatment of the turbinates is considered as an adjunctive measure.

DR. GOTTLIEB: Do you normally put them on a nasal decongestant?

DR. WEIMERT: After I make the initial diagnosis of allergic rhinitis, I generally give such patients a trial of antihistamines and intranasal steroid spray. Some patients improve dramatically on this program. If the medication is poorly tolerated or ineffective, then a more formal allergy evaluation is frequently recommended.

DR. GOTTLIEB: Would you consider indefinite use of antihistamines?

DR. WEIMERT: Yes. Studies have shown that long-term use of antihistamines and the new intranasal topical steroids are safe in children.

DR. GOTTLIEB: Do nasal sprays change the character of the cellular lining of the nose and possibly cause a chronic rhinitis?

DR. WEIMERT: Topical vasoconstrictors and decongestants such as neosynephrine have a number of adverse effects on the nasal lining. They can lead to excessive drying of the nasal mucosa, ulceration, and atrophy. Patients who chronically abuse nasal sprays of this type also develop a rebound phenomenon whereby the nasal obstruction worsens as a result of the medication. The new intranasal steroid sprays do not have these adverse effects.

DR. GOTTLIEB: How effective is nasal surgery on patients with allergies?

DR. WEIMERT: The results are excellent when the surgery is performed in conjunction with good allergy management. If the patient has a structural obstruction as well as allergies, then increasing the nasal airway surgically is beneficial, whether this requires septal or turbinate surgery. In addition, patients with allergic nasal polyps sometimes require removal of the polyps along with allergy medication.

DR. GOTTLIEB: Do you generally see polyps in children?

DR. WEIMERT: Generally not. When we find nasal polyps in young children, we become suspicious of cystic fibrosis.

DR. GOTTLIEB: How are polyps treated?

DR. WEIMERT: Polyps are frequently allergic in etiology. They are nothing more than swollen mucous membrane of the sinus cavities projecting into the nasal chambers. Antihistamines, topical steroids, and sometimes desensitization are helpful in controlling the formation and size of polyps. When these measures are ineffective, then surgical removal is employed as a last resort.

DR. GOTTLIEB: Do polyps recur?

DR. WEIMERT: Polyps frequently recur, and patients are told this before they are removed. However, removal often provides the patient with several years of relief before another procedure is needed.

DR. GOTTLIEB: Can polyps be seen radiographically?

DR. WEIMERT: Polyps cannot be diagnosed radiographically, although complete opacification of the nasal airway on the PA head film in conjunction with radiographic evidence of sinus disease may be a tipoff that polyps are the source of the obstruction.

DR. GOTTLIEB: Is mouthbreathing a frequent accompaniment to all these nasal obstructions?

DR. WEIMERT: Every patient with nasal obstruction will mouthbreathe some of the time. In my experience, approximately 25 percent breathe with a mouth open posture persistently.

DR. GOTTLIEB: What's wrong with mouthbreathing from an ENT point of view?

DR. WEIMERT: Patients who mouthbreathe bypass the normal humidification and warming functions supplied by nasal respiration and may develop a number of symptoms including headache, dry mouth, sore throat, halitosis, poor sleep, chronic fatigue, and ear pressure and fullness. Moreover, mouthbreathing is an inefficient form of respiration. It can be demonstrated clinically, for example, that exercise tolerance is markedly diminished in the patient with nasal obstruction. Nasal respiration and pulmonary function are complexly related. We know, for instance, that when the human nose is occluded, the arterial oxygen tension drops 10-15 percent, even in the healthy adult. So, when we are discussing nasal obstruction, we must remember that we are not just referring to patient comfort. It affects other bodily functions as well.

DR. GOTTLIEB: We sometimes see obstructive techniques used in an attempt to overcome mouthbreathing--a positioner without airholes, for instance, or an oral shield. Can you make somebody who is a mouthbreather, either habitual or because of an obstruction, breathe through his nose rather

than just dump the appliance out because he can't do that?

DR. WEIMERT: If there is a significant mechanical nasal airway obstruction, the patient will not be able to overcome the mouthbreathing by conscious effort. On the other hand, the person who is mouthbreathing out of habit may well benefit by a concerted effort to keep the mouth closed.

DR. GOTTLIEB: It doesn't overcome obstruction?

DR. WEIMERT: No. In fact, the greater the effort to draw air in through the nose, the more turbulence is created in the airflow pattern, and a smaller volume of air is inspired. You cannot overcome an obstruction by forcibly breathing through the nose.

DR. GOTTLIEB: People have an idea that you measure the ability to breathe by intake, and actually it is measured by resistance. Is that correct?

DR. WEIMERT: The volume of air inspired is inversely proportional to the airway resistance. In an attempt to quantify degrees of nasal obstruction, some investigators measure nasal resistance using rhinomanometry. The nose normally accounts for over 50 percent of overall ventilatory resistance. As nasal resistance increases, pulmonary resistance increases.

DR. GOTTLIEB: What is the nasal cycle?

DR. WEIMERT: The nasal cycle is an important concept to understand in evaluating the nasal airway. The lining of the nose cyclically swells and shrinks. When one side of the nose congests, the other side will simultaneously decongest. In the normal individual, the overall nasal resistance remains constant. This cyclical variation in the nasal chambers is demonstrable in over 90 percent of adults and occurs every half-hour. When the architecture of the nose is abnormal (i.e., deviated septum), the nasal cycle may result in intermittent obstruction.

DR. GOTTLIEB: How much do you interfere with the nasal cycle when you remove the turbinates?

DR. WEIMERT: Two-thirds to three fourths of total nasal resistance is related to the inferior turbinates. Therefore, the inferior turbinates are never completely removed. As a result, the obstruction is relieved, but the nasal cycle is still operational.

DR. GOTTLIEB: Moving backward from the nose, I guess the next airway problem is with the adenoids and tonsils. When do the tonsils become obstructive?

DR. WEIMERT: In my experience, tonsils do not commonly cause true airway obstruction. Fewer than 1 percent of my patients undergo a tonsillectomy for reasons of airway obstruction. We grade tonsil enlargement on a 1 + to 4 + scale. The 1 + tonsils are barely visible; 2 + are small, but visible; 3 + are generous in size; and 4 + are truly obstructive and meet in the midline.

DR. GOTTLIEB: Do you use lateral x rays to diagnose tonsil obstruction?

DR. WEIMERT: I have not found radiographs to be particularly helpful in evaluating tonsil size. The lateral cephalogram is two-dimensional and only gives an overall impression of tonsil size. Direct visualization is far more useful.

DR. GOTTLIEB: Is there any more precise measurement than the 1 + to 4 + gradations?

DR. WEIMERT: Unfortunately, it is a very subjective evaluation. Tonsil size varies widely and fluctuates greatly. We do not have an objective way of measuring tonsil size relative to the volume of the pharynx and hypopharynx.

DR. GOTTLIEB: What is the function of the tonsils?

DR. WEIMERT: Tonsils and adenoids are composed of lymphoid tissue. We know that tonsils produce antibodies and that they have a role in the formation of lymphocytes, which are critical in the body's immune system.

DR. GOTTLIEB: Are the tonsils and adenoids indispensable to the body's immune system?

DR. WEIMERT: No. Removal of the tonsils and adenoids has not been shown to affect a person's

health adversely. Lymphoid tissue resides in other areas of the oropharynx. The lingual tonsils, for example, remain after a tonsillectomy and adenoidectomy.

DR. GOTTLIEB: Years ago, everyone had his tonsils removed. Then we went into a much more conservative phase. Why the change?

DR. WEIMERT: Many disease entities in the past were attributed to the tonsils and adenoids. Many years ago, tonsils and adenoids were removed almost prophylactically and--in retrospect--probably unnecessarily. Then, an anecdotal study published in one of our major medical journals suggested an association between tonsil removal and malignancy. The pendulum swung the other way, partly as a result of the article, and removal of tonsils and adenoids was discouraged. That study has since been disproven. Today, we are more selective in recommendations for tonsillectomy and adenoidectomy. We are better educated regarding conditions that are caused by the tonsils and adenoids. Refinement in surgical and anesthesia techniques have also diminished the morbidity and mortality of the procedure.

DR. GOTTLIEB: What is the indication for removing tonsils today?

DR. WEIMERT: The most common indication is recurrent infection. Rarely, marked tonsillar hypertrophy can lead to cor pulmonale or sleep apnea. These are absolute indications for removal. Tonsils do not commonly contribute to mouth-breathing in my experience.

DR. GOTTLIEB: Can tonsils grow back?

DR. WEIMERT: Tonsils do not grow back if they are removed properly. The palatine tonsils are encapsulated. There are other areas of lymphoid tissue in the pharynx, however, that can hypertrophy and become symptomatic (e.g., lingual tonsils) even after the palatine tonsils are removed.

DR. GOTTLIEB: How do you evaluate the adenoids?

DR. WEIMERT: There are two effective means of evaluating adenoid size. The first is indirect

visualization with the nasopharyngeal mirror. This is not always possible in the young child. The second is the lateral soft tissue x-ray. This is very helpful. The size of the adenoid pad on the x-ray correlates very well with what we ultimately find surgically. It is helpful to me when a referring orthodontist sends the lateral cephalogram along with the patient referred for an ENT evaluation.

DR. GOTTLIEB: Do you ever use special x-ray techniques to evaluate the adenoids?

DR. WEIMERT: Usually not. The lateral soft tissue x-ray is usually adequate. Occasionally, a tomogram is helpful.

DR. GOTTLIEB: What is the difference between adenoid and tonsillar tissue?

DR. WEIMERT: The big difference is that the adenoids are not well encapsulated. They are an integral part of the mucosal lining of the nasopharynx, and really cannot be completely removed as the tonsils can.

DR. GOTTLIEB: Does that mean that the adenoids can grow back?

DR. WEIMERT: Yes, but significant regrowth occurs in fewer than 1 percent of our patients.

DR. GOTTLIEB: What are the complications of adenoidectomy?

DR. WEIMERT: Death is a potential complication as it is in any procedure requiring anesthesia. Bleeding is rare. Velopharyngeal incompetence occasionally develops postoperatively. This is usually transient in nature. Patients with submucosal cleft palate and bifid uvula are generally not candidates for adenoidectomy because of the greater risk of developing hypernasal speech postoperatively.

DR. GOTTLIEB: What do you think an orthodontist ought to include in an examination in relation to airway?

DR. WEIMERT: The orthodontist's evaluation should include such questions as whether the patient has allergies and which ones are under treatment; does the patient snore when sleeping, sound

Airway obstruction secondary to large adenoid pad.

stuffy during the day or night, have frequent sore throats, or mouthbreathe during the day or night?

DR. GOTTLIEB: What might be included in an orthodontist's physical examination?

DR. WEIMERT: An orthodontist can become reasonably comfortable with examination of the oropharynx and nose. Marked deviation of an anterior septum or gross turbinate enlargement can be identified without a great deal of experience. Just as I am becoming more attentive to occlusion and dental development in my patients, it behooves the orthodontist to maintain a high index of suspicion with regard to airway obstruction in his patients.

DR. GOTTLIEB: What percentage of orthodontic patients have nasal obstructions?

DR. WEIMERT: Among the patients we have evaluated who were referred by orthodontists, two-thirds had some degree of obstruction for which we recommended treatment.

DR. GOTTLIEB: Are airway problems in adults of the same significance as in children?

DR. WEIMERT: We don't have the concern about facial growth and development when evaluating the adult airway that we have for the child airway. Adult airway obstruction is more of a quality of life consideration than pediatric airway obstruction is. However, even in the adult, severe

**Table 1 Diagnosis after airway
evaluation**
(1360 patients)

Allergic rhinitis	34%
Vasomotor rhinitis	8%
Septal deviation	19%
Idiopathic turbinate hypertrophy	12%
Adenoid hypertrophy	39%
Tonsillar hypertrophy	1%
Habitual mouthbreather	21%
Normal examination	7%

Table 2 Treatment
(1360) patients)

No treatment necessary	28%
Medical treatment	24%
Surgical treatment	48%
Tonsillectomy	7%
Adenoidectomy	89%
Septal surgery	18%
Turbinate cautery or partial resection	71%

nasal obstruction can be a significant overall health problem. I believe we need to approach treatment of the pediatric airway more aggressively than we do in the adult.

DR. GOTTLIEB: Do you see more allergies in children than in adults?

DR. WEIMERT: We do in our practice, but then our patients may be a bit skewed. The greatest problem in treating allergic rhinitis in children is the tendency to place children into a treatment program for several years without consideration of the time factor involved. If

you accept a relationship between upper airway obstruction and dentofacial development, then waiting prolonged periods of time for allergic treatment response is no longer justified. If a child's nasal obstruction is secondary to allergic rhinitis, for instance, and he does not clear with allergy treatment over a 12-month period, adjunctive turbinate surgery should be considered.

DR. GOTTLIEB: Tom, I want to thank you for this in-depth look at an area that affects so many orthodontic patients.