The gagging problem in prosthodontic treatment. Part I: Description and causes

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Every dentist and most dental students and paradental personnel have had experience with the patient whose gag reflex is abnormally active. For all concerned, an episode of gagging can be regarded, at best, as an unpleasant experience. Gagging reactions range from mild choking when the palate is inadvertently touched with a mouth mirror to violent, uncontrolled retching during impression making. Some clinical descriptions are more graphic than others. Feintuch, for example, offers the following: "As the body trembles and the foot rest is stamped, large tears roll down from the eyes. The face of the victim takes on the hue of apoplectic purple and the patient gasps for breath, at the same time attempting to eject the intruders from his mouth and his insides with them."

DESCRIPTION AND IDENTIFICATION

Faigenblum's classification of patients with a gag reflex differentiates mild retching from severe retching. The patient who demonstrates mild retching may experience nausea with minimal reaction to a stimulus and generally is able to control the response. Fortunately, most dental patients with gagging problems fall into this category. The patient who demonstrates severe retching responds in an exaggerated manner to physical or psychologic stimuli. When this occurs, such patients may be unable to tolerate impressions, operative procedures, or insertion of new or old dentures.

It is obvious that patients in the "severe" category present problems for the dentist. If treated at all, the "severe gagger" often receives compromised dental care. If unmanaged, an abnormally active gag reflex precludes maintaining a dry field and precise instrumentation. While usually associated with prosthodontic treatment, severe gagging compromises all aspects of dental treatment such as the making of radiographs, the placement of restorations, and the scaling of teeth.

Another undesirable consequence is that many patients do not seek dental treatment because of severe gagging. It is estimated that fear of pain remains a barrier to dental treatment for 12 million Americans. Just how many people avoid dental treatment because of severe gagging is unknown. It is conceivable, however, that the number of such individuals is significant.

There is very little in the dental literature written on the subject of gagging. Most dental textbook indices do not even list the word. Further, little dental-oriented research is reported for gagging. As a result, our knowledge of the problem is limited to clinical impressions. With limited knowledge, the problem of patient management is often perplexing. All too frequently, the dentist regards the problem gagger as a neurotic individual who upsets the office routine. In spite of the paucity of systematic research on gagging, sufficient material is available to provide an understanding of the problem and permit the dentist to manage most of the difficult gagging situations.

Part I reviews dental literature that describes and identifies the gag reflex and its causes. Part II will review various approaches for the management of the gagging patient.

The nature of gagging

The gag reflex is a normal, healthy defense mechanism. It functions to prevent foreign bodies from entering the trachea. Gagging movements alter the shape of the pharynx and its various openings to ejet foreign bodies from the mouth and pharynx. Present from birth, the gag reflex may be compared to the swallowing reflex. Stimulation of the mouth, tongue, palate, or pharynx can set in motion muscular responses of the mouth, tongue, palate, pharynx, larynx, and respiratory system. Swallowing occurs if the muscle action is smooth and coordinated. When muscle action is spasmodic and uncoordinated, gagging occurs.
Table I. Sensory nerves for afferent pathways to reflex center in medulla oblongata

<table>
<thead>
<tr>
<th>Cranial nerve</th>
<th>Area supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (Trigeminal nerve)</td>
<td>Lips</td>
</tr>
<tr>
<td></td>
<td>Buccal surfaces of cheek</td>
</tr>
<tr>
<td></td>
<td>Anterior two thirds of tongue</td>
</tr>
<tr>
<td></td>
<td>Soft palate</td>
</tr>
<tr>
<td></td>
<td>Sublingual region</td>
</tr>
<tr>
<td>IX (Glossopharyngeal nerve)</td>
<td>Posterior one third of tongue</td>
</tr>
<tr>
<td></td>
<td>Part of the pharynx</td>
</tr>
<tr>
<td>X (Vagus nerve)</td>
<td>Epiglottis</td>
</tr>
<tr>
<td></td>
<td>Pharynx</td>
</tr>
<tr>
<td></td>
<td>Larynx above the vocal cords</td>
</tr>
</tbody>
</table>

Some clinicians suggest that not all regions of the mouth are equally sensitive to stimuli that produce the gag reflex. Yet, five regions of maximum sensitivity are identified as "trigger areas." They are the fauces, base of the tongue, palate, uvula, and posterior pharyngeal wall.

A very useful clinical description of gagging behaviors was offered by Khan more than 30 years ago. These behaviors are (1) puckering the lips or attempting to close the jaws, (2) elevating and furrowing the tongue, with rotation from back to front and with the hyoid bone at the center, (3) elevation of the soft palate and hyoid bone, (4) fixation of the hyoid bond, (5) closing of the nasopharynx by an approximation of the posterior pillars of the fauces that elevate the soft palate, (6) contraction of anterior and posterior pillars of the fauces, causing the tonsils to rotate in an anteromedial direction, (7) elevation, contraction, and retraction of the larynx and closure of the glottis, (8) retching or simultaneous and uncoordinated respiratory muscle spasm, and (9) vomiting.

When spasmodic contraction of respiratory muscles occurs during retching, air is forced through the closed glottis, producing the characteristic retching sound. In addition, during retching, chest muscles are in fixation and thoracic inlet muscles are contracting. This causes impediment of the venous return, dilating the veins of the head and neck, with flushing and congestion of the face.

Other reflex behaviors that are extraoral in nature also can be observed by the clinician. These include excessive salivation, lacrimation, coughing, and sweating. At times a full-body response may occur. The patient extends the head, arms, neck, and back in an attempt to completely withdraw from the offending stimuli. And if the stimulus sequence is repeated, collapse may occur for the extremely apprehensive or excited patient.

Table II. Sensory nerves for efferent pathways from reflex center in medulla oblongata

<table>
<thead>
<tr>
<th>Cranial nerve</th>
<th>Area supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (Trigeminal nerve)</td>
<td>Muscles of mastication</td>
</tr>
<tr>
<td></td>
<td>Mylohyoid muscle</td>
</tr>
<tr>
<td></td>
<td>Tensor palatini muscle</td>
</tr>
<tr>
<td>VII (Facial nerve)</td>
<td>Muscles of the lips</td>
</tr>
<tr>
<td>IX, X, and XI (Pharyngeal plexus)</td>
<td>Fauces</td>
</tr>
<tr>
<td></td>
<td>Palate</td>
</tr>
<tr>
<td>IX (Vagus nerve)</td>
<td>Larynx</td>
</tr>
<tr>
<td>XII (Hypoglossal nerve)</td>
<td>Tongue</td>
</tr>
<tr>
<td>Various sympathetic and parasympathetic nerves</td>
<td>Diaphragm</td>
</tr>
<tr>
<td></td>
<td>Abdominal muscles</td>
</tr>
<tr>
<td></td>
<td>Neck and shoulder muscles</td>
</tr>
<tr>
<td></td>
<td>Salivary glands</td>
</tr>
<tr>
<td></td>
<td>Lachrimal glands</td>
</tr>
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<td></td>
<td>Sweat glands</td>
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</table>

Neural involvement in gagging

When stimulation occurs on the soft palate and/or posterior third of the tongue, afferent impulses are transmitted to a center in the medulla oblongata. From this center, efferent impulses arise and are transmitted, resulting in the spasmodic and uncoordinated movements of gagging. The center in the medulla oblongata is very close to the vomiting, salivating, and cardiac center, explaining why gagging may be accompanied by additional reflex activity (e.g., drooling, tearing). Also, there are fibers that pass from the center in the medulla oblongata to the cerebral cortex, so the reflexes can be modified by the control of the cerebrum.

Table I presents the sensory nerves for the afferent pathway to the reflex center in the medulla oblongata.

It should be noted that the glossopharyngeal nerve (IX) is peculiar in that its afferent fiber includes fibers that both elicit and inhibit the reflex. Clinically this is important since there is less likelihood of gagging if a region innervated by the glossopharyngeal nerve is stimulated than if a region supplied by one of the other cranial nerves is stimulated. Table II presents the motor nerves for the efferent pathways from the reflex center in the medulla oblongata.

Reflex characteristics of gagging

As a reflex, gagging behaviors share common characteristics with other reflex actions. Among these characteristics are grading of responses, summation of...
temporal and spatial stimuli, fatigue, and reinforcement. Table III presents the reflex characteristics of gagging and related actions.

CAUSES OF GAGGING

The initiation of the gag reflex may be the result of varied circumstances. Several authors propose a number of general classifications of causes including systemic disorders, psychologic factors, extraoral and intraoral physiologic factors, and iatrogenic factors. A discussion of the literature from each area is presented.

Systemic disorders

The patient's general health is often related to dental health, with some impact on the gagging reflex. Chronic conditions, such as a deviated septum, nasal polyps, or sinusitis, block nasal passages and increase the likelihood of the gag reflex. Chronic problems of the gastrointestinal tract may increase irritability, lower the threshold for excitation of the oral cavity, and contribute to nausea and gagging. Alcoholism, chronic gastritis, carcinoma of the stomach, peptic ulcer, and cholecystitis are related to chronic gastrointestinal irritability and gagging. Inflammation of the pharynx is a hypersensitive gag reflex. This condition is common in the person who drinks and smokes excessively. Medications that the patient may be taking are another consideration if they produce nausea as a side effect. Diaphragmatic hernia has also been implicated as a systemic cause for gagging.

Psychologic factors

In some patients, an abnormally active gag reflex may be due to experiences far removed in time from the current stimuli eliciting a gagging episode. Landau proposed that most problem gaggers have difficulty because of such stimuli. In the dental operatory, there may be a tendency to consider only the physiologic aspects of the patient's problem while ignoring the psychologic side of the situation.

In dentistry, as in other health professions, it is essential that the patient be evaluated as a total functioning unit. With such a view, it becomes possible to recognize some of the dynamic forces operating in the individual. These forces may modify the patient's interaction with his or her environment to a significant degree. Collett and Briggs evaluated three prosthodontic patients who were tentatively diagnosed as "psychologic gaggers" by means of projective techniques (Rorschach ink blot test and thematic apperception test). They attempted to identify psychologic factors that could explain prosthodontic difficulties experienced by the patients. Although no relationship was found between personal adjustment and gagging, the researchers suggested that general maladjustment might predict difficulty in adjusting to dentures.

Discussing the psychologic aspects of gagging, Bartlett states that such a psychosomatic reaction may be active or passive. An active reaction is due to factors that currently have some functional purpose in the patient's life situation. For various psychologic reasons, patients may gag to gain attention from the dentist, to avoid treatment, and/or to avoid the outcome of treatment. In contrast, a passive reaction is the result of conditioned reflexes established earlier in life for various reasons, the causes of which are no longer functionally important.

### Table III. Gagging reflex characteristics and actions

<table>
<thead>
<tr>
<th>Reflex characteristics</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading of response</td>
<td>Variations of the strength of the stimulus result in corresponding gradations in the response of a reflex</td>
</tr>
<tr>
<td>Temporal grading of response</td>
<td>A single stimulus of a certain strength may be unable to initiate a reflex, and a series of subliminal stimulations applied in rapid succession produces a reflex</td>
</tr>
<tr>
<td>Spatial grading of response</td>
<td>When two subthreshold stimuli are applied simultaneously to two afferent nerves, summation occurs, resulting in a reflex response</td>
</tr>
<tr>
<td>Fatigue</td>
<td>When a stimulus lasts too long and is repeated too often, a reflex becomes inhibited and terminates</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>When normal excitation of a reflex is difficult, it can be facilitated by any stimulation that usually causes it to occur</td>
</tr>
<tr>
<td>Recruitment</td>
<td>Increased reflex action occurs from a prolonged stimulus of constant intensity</td>
</tr>
<tr>
<td>Absence of response</td>
<td>Depressed reflex action resulting from an altered physical state (e.g., shock, anesthesia, lack of oxygen)</td>
</tr>
</tbody>
</table>
Using the Eysenck Personality Inventory, Wright investigated personality variables associated with the gag reflex of denture wearers. Between groups identified as gaggers and nongaggers, no differences were found for neuroticism, extraversion, or psychoticism. In addition, no differences were found between these groups for medical history, social habits, and experiences. However, one third of the gagging group reported the problem as being most acute in the morning during oral hygiene and insertion of dentures. This might occur from lack of habituation to stimulation of the denture, since it was not worn at night. Or changes in metabolism from fasting may stimulate vomiting. Thus, Wright suggests that chronic gagging responses may be the result of several factors, including those of a neurologic and biochemical nature.

Kramer and Braham stated that "fear is almost always the underlying factor influencing the psychological gagger." This fear may be generalized and vague or quite specific. Often the fear is not merely that of pain. Some patients gag because of an abnormal fear of swallowing a foreign object. Thus, because there are no observable characteristics or signs, psychologic factors associated with gagging complicate clinical experiences. The complication exists in terms of problem recognition and management.

Physiologic factors

Visual, auditory, and olfactory stimuli are extraoral factors that can elicit the gag reflex, while dental prostheses and performance of dental procedures represent intraoral stimuli. Both classes are discussed in this section as physiologic stimuli.

Extraoral stimuli. The mere sight of a mouth mirror or impression tray is stimulus enough to cause some patients to gag. Landa observed a deaf patient suffer a spasm of gagging while viewing the gagging of another patient. He reported on another patient whose gagging difficulty was resolved by blindfolding during dental treatment.

An acoustic stimulus can initiate the gag reflex in some patients. Again, Landa described a husband and wife who were both severe gaggers. The sound of the wife gagging was sufficient to precipitate an attack of gagging in the husband, who was seated in another operatory. While the odors eliciting a response may or may not be obnoxious, certain smells may cause a patient to gag. The smell of various dental substances, cigarette smoke on the dentist's fingers, and even perfume have been reported as olfactory stimuli to the gag reflex.

Intraoral stimuli. The effect of tactile irritation on the gag reflex is well known. Patients show considerable variation in their ability to withstand various tactile stimuli. In most patients, certain regions of the oral mucosa remain almost immune to the tactile sense while other regions are extremely sensitive. The palate is roughly divided into two response regions for tactile irritation: hyposensitive and hypersensitive regions. A line drawn through the foveae palatinae demarcates the relatively hyposensitive anterior portion from the hypersensitive posterior portion. The tongue may be similarly divided into a hyposensitive anterior region and a hypersensitive posterior one third. Landa states that the upper surface of the posterior one third of the tongue is the most sensitive region in the entire oral cavity. Tactile stimulation of the oral tissues inevitably occurs when executing various dental procedures. Careful execution or modified techniques can minimize stimulation that causes gagging.

In the dental literature, various biomechanical aspects of dental prostheses are suggested as causing the gag reflex. Difficulties that arise range from occasional gagging episodes to complete intolerance of the prosthesis. However, gagging difficulties caused by crowns or fixed partial dentures are not reported in the dental literature. Because of their more obtrusive nature, complete dentures have drawn all the attention. Biomechanical aspects related to gagging are inadequate postdam, overextended posterior borders, disharmonious occlusion, poor retention, surface finish of acrylic resin, and inadequate freeway space.

An inadequate postdam produces gagging as a result of too little pressure applied to the palatal tissue. When a postdam is too shallow, the light pressure that results can produce a tickling sensation, which elicits a gag. Overextended borders (especially the posterior part of maxillary dentures and the distolingual part of mandibular dentures) may impinge on one or more "trigger areas" and produce gagging. It is not uncommon for the extent of the posterior border of the maxillary denture to be implicated when in fact the postdam is inadequate. Gagging that persists after the posterior border is shortened points toward other causes.

Landa suggests that correct occlusion and balanced articulation are critical for minimizing the gagging reflex. A stable occlusion causes the denture to compress the underlying tissue. Conversely, unstable occlusion produces movement of the denture base, which in turn produces a tickling sensation and gagging.

An underextended prosthesis also may contribute to a gagging problem. Inadequately extended borders that
result in poor retention produce an unstable prosthesis. Movement of such a prosthesis may stimulate additional oral tissues sufficiently to elicit a gag.

A smooth, shiny surface has been reported to cause nausea and gagging in some patients. When such a surface is coated with saliva, a "slimy" sensation may result. For some patients this is highly objectionable.

Krol presented information suggesting that inadequate freeway space may be an additional cause of gagging related to complete dentures. In studying more than 100 patients who had serious difficulty wearing complete dentures because of gagging, he found that the gagging problem was eliminated or greatly relieved when the freeway space was increased. His explanation suggested that the elevator muscles do not relax normally if the occlusal vertical dimension exceeds the rest vertical dimension. This may cause a spasm that sets in action a chain of swallowing muscle responses. One possible sequence would involve a spasm of the tensor palatini muscle, which produces sensation when the maxillary denture seems to extend too far backward. The tensor palatini muscle slightly depresses the soft palate and presses it against the posterior border of the denture, producing a gag reflex. One might question this hypothesis when compared to gagging caused by an inadequate postdam.

In an attempt to identify possible anatomic features of persons with a problem gag reflex, Wright radio logically assessed the anatomic form of the mouth and pharynx. Denture patients, identified as having no gagging problems or chronic gagging problems, formed two groups matched for age, gender, and number and position of remaining teeth and removable partial dentures. No group differences were found for length or angle of the soft palate. Also, tongue enlargement restricting the pharyngeal airway was not found for patients who gagged. In addition, dentures caused less tissue modification for soft palate, tongue, and hyoid bone postures in the gagging group. Thus, with an obvious anatomic difference between the groups, Wright suggests that extensive vagus nerve distribution may be more closely related to problem gagging.

Iatrogenic factors

In the otherwise nongagging patient, poor execution of intraoral procedures may elicit the gag reflex. Sensitive tissues may be stimulated as a result of rough or careless technique and temperature extremes of instruments. This category is included for completeness and to remind the reader that the cause of a gagging episode may not be related to the patient.

SUMMARY AND CONCLUSIONS

The gag reflex is a complex physiologic phenomenon. The basic function of the reflex is protective in nature. When the reflex is abnormally active, the dentist may be presented with a bewildering and frustrating problem.

The gag reflex was described. The neural pathways involved and the reflex characteristics of gagging were described. Awareness of the basic physiology involved produces a clearer understanding of the events that occur during a gagging episode.

The causes of a gagging episode are varied and may be the result of a systemic disorder or psychologic, physiologic, or iatrogenic factors. The precise cause may be difficult to identify. The causes of gagging that have appeared in the dental literature are presented.

The quality of dental treatment for the problem gagger depends on effective management of the reflex. In order to prescribe a solution to severe gagging, the neurophysiology and causes of the reflex must be understood. Part II will present approaches to managing the overactive gag reflex.

REFERENCES

17. Kovats, J. J.: Clinical evaluation of the gagging denture 
on artificial dentures to be desired? J PROSTHET DENT 4:52, 
1954.
21. Wright, S. M.: The radiologic anatomy of patients who gag 

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