

MALFUNCTION OF THE TONGUE

PART I. THE ABNORMAL SWALLOWING HABIT: ITS CAUSE, EFFECTS, AND RESULTS IN RELATION TO ORTHODONTIC TREATMENT AND SPEECH THERAPY

WALTER J. STRAUB, D.D.S., M.S., F.I.C.D., SAN MATEO, CALIF.

INTRODUCTION

THIS report on abnormal swallowing habits will be divided into several parts, the first of which will take up the etiology of the abnormal swallowing habit.

The tongue is principally a muscular organ which normally has a great variety of possible movements. The fingers of the most efficient pianist cannot move as fast as the human tongue during conversation. Another property of the tongue is that only the lower part is fixed to bone, while the anterior part of the back, the blade, and the tip are free. All other striated muscles of the body are fixed at both ends. This double fixation ensures exactness of degree of contraction and provides double signals of the momentary position of the muscles to the central nervous system, since tension on both points of fixation is reported. As the anterior part of the tongue is not fixed, it is impossible for the central nervous system to get as many messages from this organ. This is the reason the tongue possesses a less accurate sense of position than other muscular organs.

The sensation of position is assisted by the sense of touch. For instance, if the tip of the tongue touches the incisors, consciousness of the tongue position is keener and more accurate. This factor changes the fundamental diminution of the sensation of place and position. The examiner can ascertain the state of mobility of the tongue if the patient is asked to protrude the tongue between the teeth, through the lips, and out of the mouth cavity, to move the tip gradually

Presented at the biennial meeting of the Pacific Coast Society of Orthodontists, Santa Barbara, California, Feb. 24, 1958; read before the Northern Section of the Pacific Coast Society of Orthodontists, Seattle, Washington, June 3, 1958; the Southern Section of the Pacific Coast Society of Orthodontists, Los Angeles, California, June 5, 1958; the Thirty-fourth Congress of the European Orthodontic Society, Copenhagen, Denmark, July, 1958; the San Mateo County Dental Society, San Mateo, California, Feb. 3, 1959; the Phoenix-Tucson Orthodontists Society, Phoenix, Arizona, Feb. 8, 1959; the Phoenix Central Section of the Dental Society, Phoenix, Arizona, Feb. 9, 1959; the Illi-Wash Study Club of Los Angeles, Beverly Hills, California, Aug. 19, 1959; the University of California, School of Dentistry, Postgraduate Education, San Francisco, California, Oct. 3, 1959 (as an all-day course); the University of California Alumni Association, Jan. 24, 1960; and the Mid-Peninsula Dental Society, Jan. 21, 1959. This paper has also been presented before the Sacramento Dental Society, Sacramento, California, Feb. 8, 1960; the Pacific Coast Society of Orthodontists, Palo Alto, California, Feb. 23, 1960; the Washington, D. C., Dental Study Club, Washington, D. C., Bethesda Naval Hospital, March 12, 1960; the Northeastern Society of Orthodontists, New York, New York, March 13, 1960; the Pedodontists Society of California, Carmel, California, April 4, 1960; the California State Dental Association, San Francisco, California, April 26, 1960; the California Speech and Hearing Association, Southern Section, and Orange County Society of Crippled Children and Adults, Inc., Newport Beach, California, May 21, 1960.

to the ridges of the upper and lower incisors, to the right and left corners of the mouth, respectively, and to the upper and lower molars, and finally to turn it backward permitting it to press on the soft palate.

Abnormal swallowing does not develop during orthodontic treatment, as many orthodontists have been prone to believe. It is not something that develops as the child grows older and has an orthodontic problem. Nor is it the result of thumb-sucking. These are some of the things that I have heard proposed as possible causes of abnormal swallowing. Many have thought that if a child was an abnormal swallower he was also a thumb-sucker. This is not true. Many children who swallow abnormally also suck their thumbs, but rarely, if ever, does one find a case in which the abnormal swallowing is due to thumb-sucking.

In an effort to determine the cause of perverted swallowing habits, I have kept a careful record of the abnormal swallowers seen in my office since 1943 (Table I).

TABLE I. PATIENTS WITH ABNORMAL SWALLOWING HABIT, 1943-1957

		MALE	FEMALE	BOTTLE-FED	BREAST-FED	BREAST FEEDING AND SUPPLEMENTAL FEEDING FOR TWO TO SIX WEEKS
Total number of patients	478	205	273	443	2	33
Age range: 2 to 40 years						
Under 14 years of age	399					
Over 14 years of age	66					
Over 21 years of age	13					
Abnormal swallowers with no contributing habits	223	97	126			14
Abnormal swallowers with thumb- and finger-sucking	171	76	95			10
Abnormal swallowers with other habits	84	32	52			9

It is interesting that only two of the 478 patients were breast-fed. Investigation revealed that the mothers of these two patients had a tremendous supply of milk and that merely touching the breast caused the milk to flow or ooze. In all our experience, we have had five patients who were breast-fed as babies and, with one exception, the history was much the same. In each case the mother had milk that flowed as soon as the breast was touched, and in order to keep from drowning the infant learned to swallow with the tongue forward, between the gum pads, in exactly the same manner as babies improperly fed from a bottle.

Only thirty-three babies were breast-fed in conjunction with supplemental bottle feeding of orange juice, milk, etc., and these were breast-fed for only two to six weeks. Of the 233 patients who had no other habits, fourteen were partially breast-fed for a short time. A total of 171 abnormal swallowers also sucked their thumbs, and eighty-four had other habits in addition to the abnormal swallowing habit.

It was found that in the normal act of deglutition the muscles of expression are never used. Any observed change in these muscles just prior to or during the act usually indicates a deviation from normal in the swallowing habit.

However, the muscles of mastication are used in bringing the teeth and jaws tightly together and holding them during the entire act of deglutition, a process that normally involves the use of some twenty muscles. Figs. 1 and 2

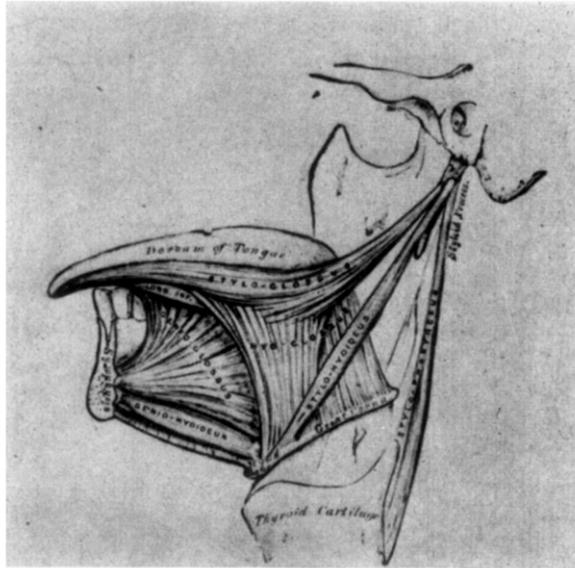


Fig. 1.—Extrinsic muscles of the tongue, left side. (From *Gray's Anatomy*, 27th edition, Lea & Febiger.)

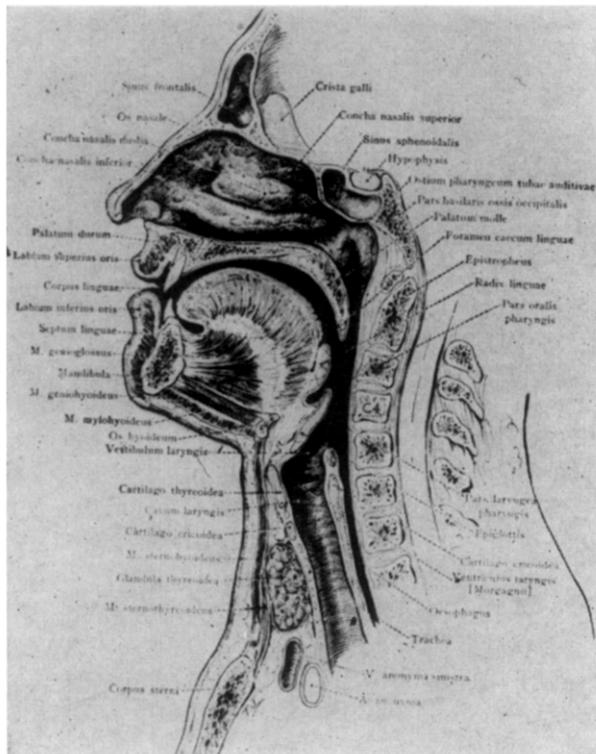


Fig. 2.—Muscles used in deglutition. (From *Gray's Anatomy*, 27th edition, Lea & Febiger.)

show the attachment of the muscles of the back of the tongue to the high hyoid bone and the styloid process.

The only time that the teeth are brought tightly together is during the act of deglutition. At all other times the teeth are apart and at rest. When we masticate our food, our teeth do not come into contact.

Let us now consider some of the different abnormal swallowing habits and the effects that they may have.

In persons who swallow abnormally there is a typical facial grimace, in which a line runs down from the wing of the nose to the orbicularis oris and the lips are protruded (Fig. 3).



Fig. 3.

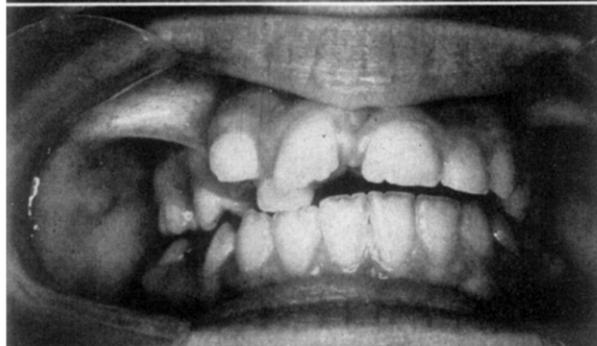


Fig. 4.



Fig. 5.

- Fig. 3.—The typical facial grimace seen in persons with abnormal swallowing habits.
Fig. 4.—Spaces created between the teeth by the positioning of the tongue.
Fig. 5.—Abnormal swallowing pattern in which the tongue is placed between the teeth in a forward position.

Figs. 4 and 5 show some of the results of abnormal positioning of the tongue during perverted swallowing. The spaces that exist between the teeth in Fig. 4 were caused by a positioning of the tongue which separated the teeth. Holding the tongue between the teeth in a forward position, as in Fig. 5, prevents normal deglutition.

Figs. 6 and 7 show a case in which the tongue is not only pushed up against the upper teeth but is also folded over the lower incisors. When the patient

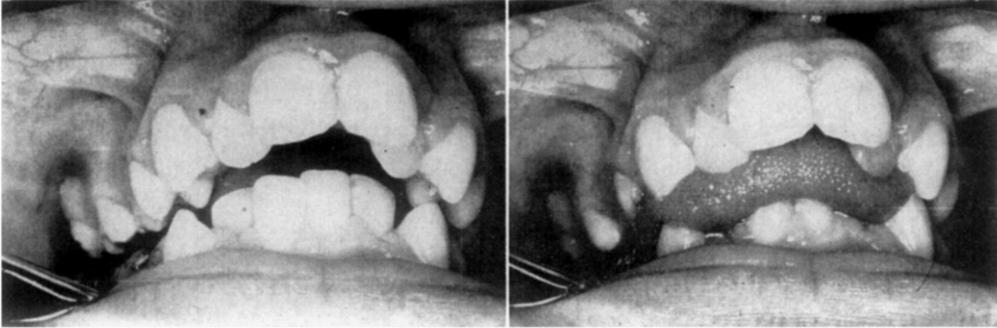


Fig. 6.

Fig. 7.

Figs. 6 and 7.—Abnormal swallowing pattern in which the tongue is pushed up against the upper teeth and folded over the lower incisors.

Fig. 8.

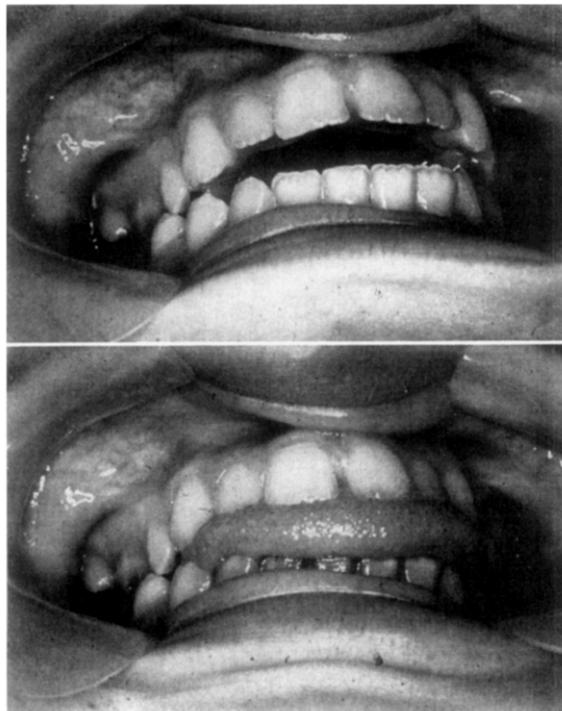


Fig. 9.

Figs. 8 and 9.—Severe open-bite in which the posterior teeth are closed tightly. Note typical diastema between the upper central incisors.

finishes the swallowing act, he retracts the lower anterior teeth and pushes the upper teeth outward with his tongue.

The severe open-bite case shown in Figs. 8 and 9 did not receive orthodontic treatment. The posterior teeth were closed tightly, and there was a typical diastema between the upper central incisors. This case could have been treated orthodontically in a very short time, but relapse would have followed removal of the bands, since the patient's swallowing pattern was such that the tongue demanded the space between the teeth. The tongue was between the teeth and was being thrust between the anterior teeth twice a minute while the child was awake and once a minute while he slept. It is easy to see why the teeth would be pushed apart and why the diastema would develop between the incisors. This case corrected itself at the completion of habit therapy, and the anterior teeth came together when the tongue habit was corrected.

Fig. 10.

Fig. 11.

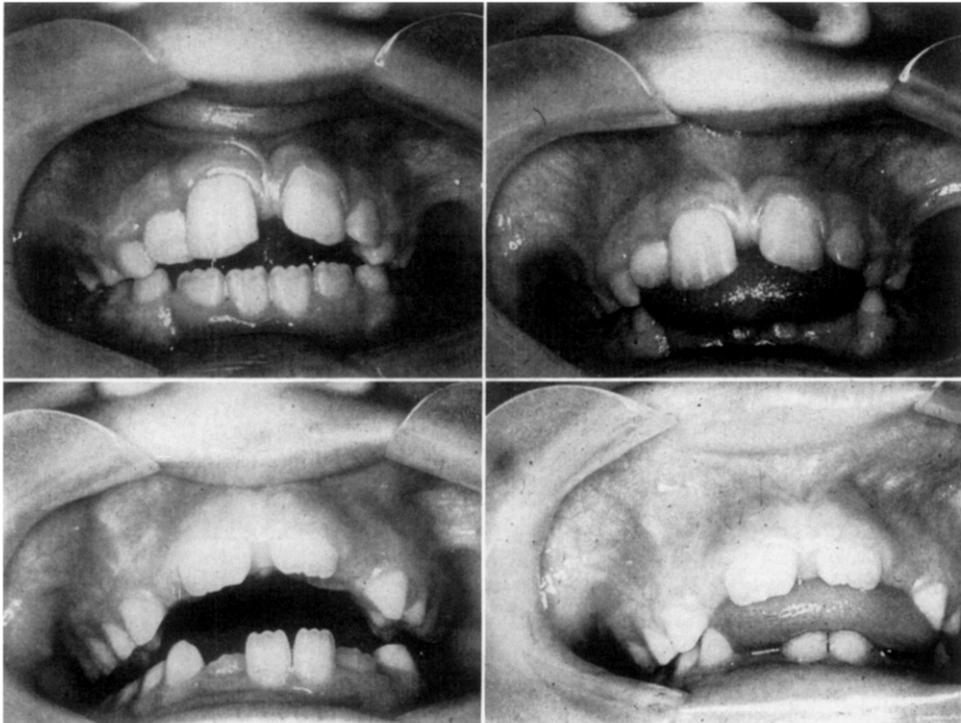


Fig. 12

Fig. 13.

Figs. 10 to 13.—Open-bite cases in which severe diastemas have been caused by tongue-thrusting.

Other open-bite cases in which tongue-thrusting has created severe diastemas are shown in Figs. 10 to 13. It will be noted that these children have different tongue positionings. There is an open-bite, the teeth are closed, and the tongue is between the anterior teeth with the posterior teeth closed.

Figs. 14 and 15 show a case in which the tongue is pushing the teeth forward, one incisor is partially through the process, and the gingiva is receding.

This is the beginning of the gingival recession seen in many cases of tongue-thrusting.

The habit does not improve with age. Figs. 16 and 17 show the mouth of a 42-year-old man who lisps and practically sprays saliva when he talks.

Fig. 14.

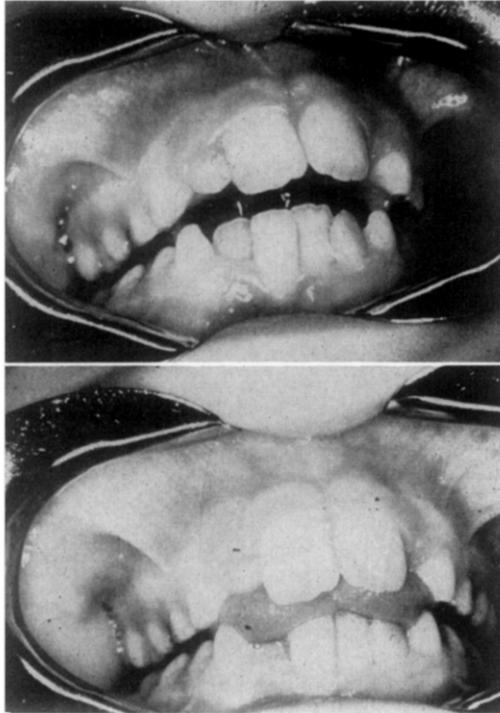


Fig. 15.

Figs. 14 and 15.—The beginning of the gingival recession seen in many cases as a result of tongue-thrusting.

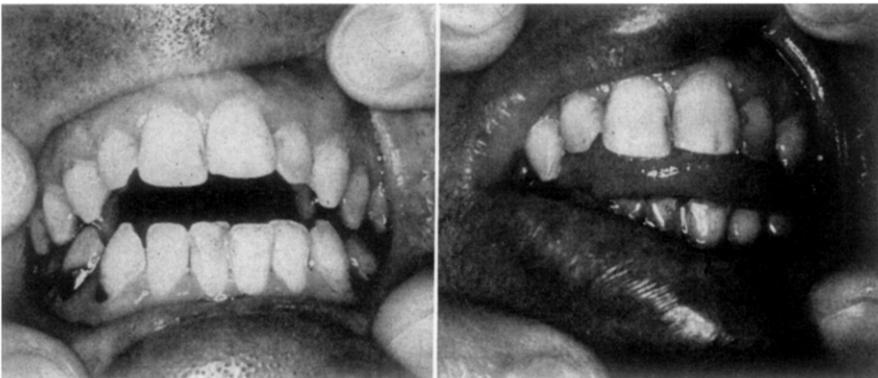


Fig. 16.

Fig. 17.

Figs. 16 and 17.—Complete anterior open-bite in a 42-year-old man with abnormal swallowing habit.

His tongue is between his teeth at all times during speech and also during swallowing; this has produced a complete anterior open-bite. The tongue is

forward a good $\frac{1}{2}$ inch when he speaks and when he swallows. The man is a ready gagger and a very difficult patient, from a dental standpoint. This has been a source of embarrassment to him all his life and has given him an inferiority complex.

The close-bite cases shown in Figs. 18 and 19 have fooled the orthodontists who believed that a child who had a close-bite would not put his tongue between his teeth and would not be an abnormal swallower. Actually, these children can be our worst abnormal swallowers, for they not only open their mouths to place their tongues between the teeth but will open as much as an inch in order to swallow abnormally. The photographs show the positioning of the tongue and the extent to which the child opens his mouth to accommodate the tongue.

Fig. 18.

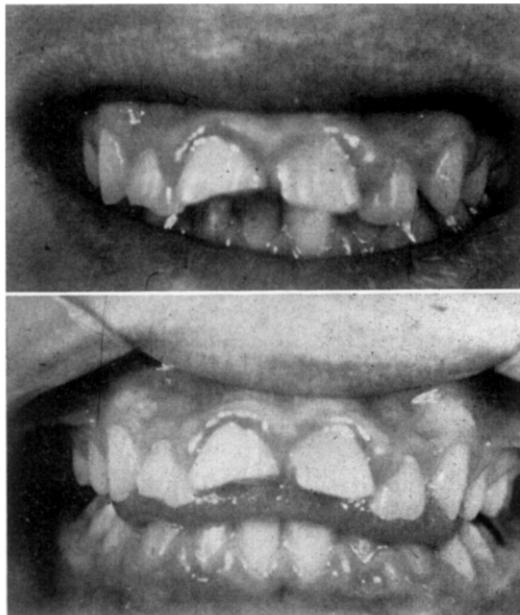


Fig. 19.

Figs. 18 and 19.—Close-bite resulting from swallowing habit in which the mouth is opened to accommodate the tongue, which is placed between the teeth.

In the close-bite case shown in Figs. 20 and 21, the lower incisors almost touch the palate. The child opens his mouth, thrusts his tongue forward, and puts it between his teeth.

Figs. 22 and 23 show another close-bite case in which there is a diastema. These photographs show how the patient slides his tongue over his anterior teeth.

In the severe close-bite case shown in Figs. 24 to 27, the lower anterior teeth touch the palate. Fig. 26 shows the facial grimace made in gathering the saliva, which is the first step in abnormal swallowing. The lips are pushed forward with no line on the first grimace from the wing of the nose to the corner of the mouth. Fig. 27 shows the same face at the completion of the

Fig. 20.



Fig. 21.



Fig. 22.

Fig. 23.

Figs. 20 and 21.—Close-bite case in which the lower incisors almost touch the palate.
Figs. 22 and 23.—Close-bite with a diastema.

Fig. 24.



Fig. 25.



Fig. 26.

Fig. 27.

Figs. 24 to 27.—A case of severe close-bite in which the lower anterior teeth touch the palate.
Note how much the child separates his teeth to place the tongue abnormally.

swallowing act. Here lines come down from the wing of the nose to the lips, the orbicularis oris is in a protruding position, and the tongue is in between the teeth. The child separates his teeth in order to place the tongue abnormally.

Some cases show a complete collapse of all the upper teeth, including the posterior teeth, and sometimes there is open-bite from the first or second molars

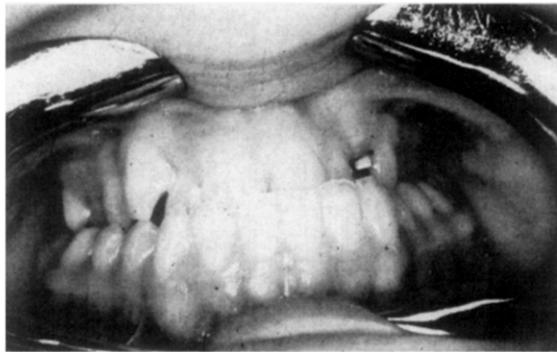


Fig. 28.

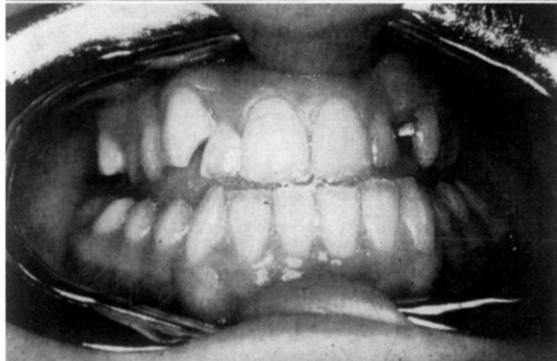


Fig. 29.



Fig. 30.

Figs. 28 to 30.—A case typical of those in which abnormal swallowing results in complete collapse of all the upper teeth, including the posterior ones, and sometimes an open-bite from the first or second molars forward.

forward (Figs. 28 to 30). The girl whose mouth is shown in the accompanying photographs puts her tongue completely on the occlusal surface of all the lower teeth and never against the palate. Fig. 29 shows the tongue approaching its position for abnormal swallowing.

Figs. 31 to 33 demonstrate another type of swallowing. This child has a side-thrusting habit, in which the tongue is between the posterior teeth in the premolar and molar region (including the cuspid). Fig. 33 shows the position of the teeth when the jaws are closed tightly. The posterior teeth

Fig. 31.

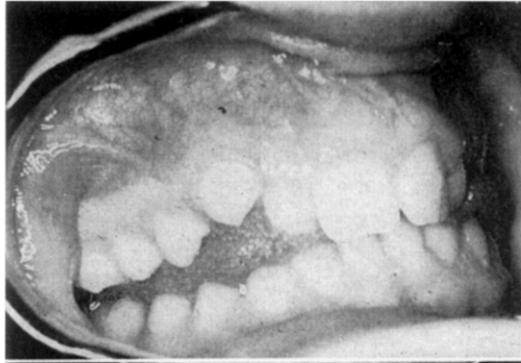


Fig. 32.



Fig. 33.



Figs. 31 to 33.—The results of side-thrusting, in which the tongue is between the posterior teeth in the premolar and molar region (including the cuspid).

do not come together. This condition is seen in many orthodontic cases in which, after the malocclusion has been corrected, side-thrusting causes the posterior teeth to open up until they are out of occlusion. Such cases can be treated successfully only by means of habit therapy to correct the abnormal swallowing pattern.

Abnormal swallowing habits may develop in bottle-fed babies who are given nursing bottles with the wrong kind of nipple. One villain responsible for many of the abnormal swallowing habits seen today is the long nipple that has several holes (Fig. 34). An infant's mouth is very small, and this long nipple, which fits halfway down his throat, will not let him put his tongue against the roof of his mouth, even if he wants to. He cannot suck and swallow properly for, as he sucks, the milk comes so freely that he will either regurgitate and choke or spill the milk out at the sides of his mouth. In self-defense, the child puts his tongue forward and grasps the nipple between the gum pads and tongue and swallows with his tongue in this position. Children who swallow this way from birth may go through life swallowing abnormally.

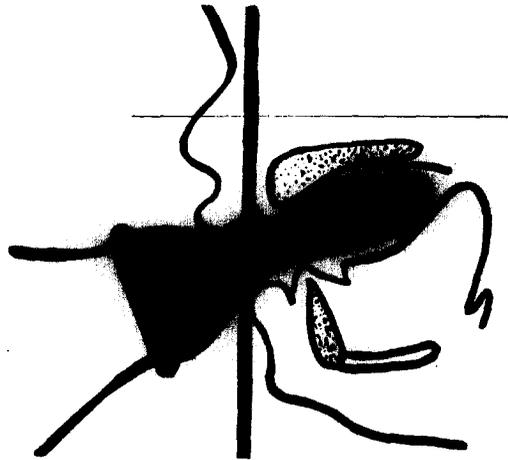


Fig. 34.—Diagram of a type of long nipple that has caused many children to develop abnormal swallowing habits.

This abnormal swallowing habit may be prevented by the use of a very short nipple, such as the one shown in Fig. 35. Since this nipple has only one small hole, the infant must suck for his milk. Also, his lips and face will press against a rubber padding which simulates the breast (Fig. 36). Fig. 37 shows an infant pressing and sucking in the nursing act. It has been found that with this type of nipple the child receives the same amount of milk as he would from the breast. Since children who nurse with these nipples receive less air, they seldom have an excess of milk, seldom regurgitate, have less colic, and seldom burp. A new bottle recently placed on the market has a valve in the bottom of the bottle, which helps to eliminate air colic and allows the milk to flow steadily without creating a vacuum. Thus, the infant gets a uniform amount of milk while sucking a nipple that has only one hole. This bottle is called the "No-Vac Nurser."

Abnormal swallowing does not eliminate itself as the child grows older. There are many variations of the habit, and it may go unsuspected all through life, since many patients who swallow abnormally never develop an open-bite.

It is strange that very little appears in the literature regarding a habit that occurs with such frequency and causes such severe malocclusions. In 1937 Truesdell and Truesdell¹ advanced several theories on the cause of the abnormal swallowing habit, but nothing has been published statistically to substantiate any theories as to the cause of abnormal swallowing.

Fig. 35.



Fig. 36.

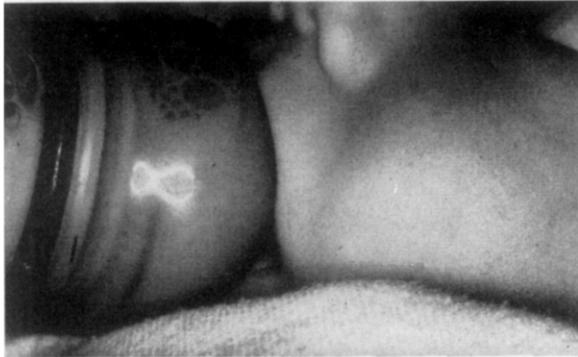
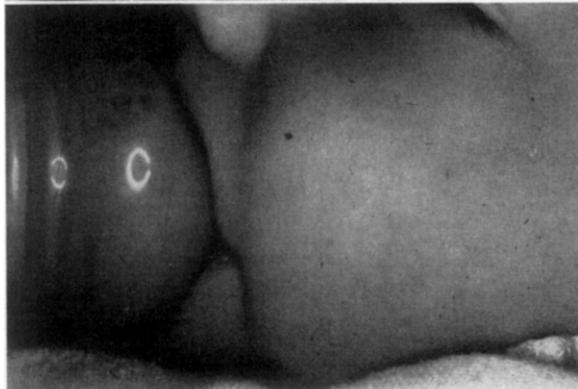


Fig. 37.



Figs. 35 to 37.—A short nipple that may prevent the development of abnormal swallowing habits.

The literature is quite comprehensive, however, regarding the act of deglutition. The word *deglutition* is derived from the Latin words *deglutitio* and *deglutire* ("to swallow down") and is defined as the act of swallowing.

Deglutition may occur during the ingestion of food, either solid or liquid, or at periodic intervals throughout the day. In order to understand the deviations from the normal, we should have a thorough knowledge of the act of deglutition. The descriptions that follow are generally accepted.

Persons whose teeth are in good or nearly normal occlusion close their teeth firmly in centric relation as the first step. Next the tip of the tongue is depressed and the tongue is placed in the palate, well back in the mouth, with the tip placed at the posterior part of the rugae. The tongue pressure is exerted backward and upward, the tip of the tongue in position and moving slightly distally. Naffziger and associates² state: "The soft palate closes off the nasopharynx, the larynx rises and the opening is covered by the epiglottis as the material passes into the upper portion of the esophagus."

Deglutition may conveniently be divided into three steps. In the first stage, which is both voluntary and conscious, the food is gathered into a bolus and carried into the isthmus of the fauces. During the second stage, which is involuntary but still conscious and may be considered a reflex mechanism, the bolus or saliva is carried through the oral and laryngeal portions of the pharynx. During the third stage, which is both involuntary and unconscious, the bolus or saliva is carried through the esophagus into the stomach.

The Truesdells gave a very good description of the act of deglutition: The muscles of mastication bring the jaws tightly together and hold them there during the entire process. Thus, the tongue is supplied with firm boxing against which it can press and gain mechanical advantage in forcing the bolus distally. The tongue raises the saliva or bolus of food, and in its proper position it has a complete boxing around it so that it obtains mechanical advantage with which to force the bolus, liquids, or saliva in the proper direction. From here the musculature used in swallowing is well described by the Truesdells and will not be repeated.

The four openings to be closed in the act of deglutition are the *nasopharynx*, the *two internal auditory tubes*, and the *glottis*. This also forms an additional aid in normal swallowing with a sucking action which, in addition to the pressure of the tongue, forces the liquids distally, although some persons swallow with or without the sucking pressure.

By the closure of the four openings and the sucking pressure, liquids can be swallowed upward (as sometimes demonstrated by contortionists in circuses and side shows) without the liquid running out the nose or escaping its distal pressure. Cannon,⁴ in describing human swallowing of a solid bolus, says that when food is sufficiently masticated it is gathered in a depression on the dorsum of the tongue. The tip and lateral aspects of the tongue press against the hard palate and teeth to prevent escape of the food particles forward and laterally to the mouth and cheeks.

Respiration is reflexly suspended. The tongue is pressed upward and backward by contractions of the mylohyoid and hyoglossus muscles, respectively. The tongue, thus acting as a piston, drives the bolus first against the downward wall, the sloping soft palate, and then on between this pharyngeal wall and

the posterior surface of the upright epiglottis, the tip of which lies in contact with the base of the tongue. During this phase the action of the palatopharyngeus muscles has thrown the pharynx into a narrow cleft, and the soft palate is pulled against this opening by contraction of the levator palatini, thus blocking entrance of the bolus into the nasal chambers.

Thus far the esophageal opening has remained closed, mainly by pressure of the larynx against it. With the rise of the hyoid and larynx, the esophagus opens. The epiglottis is pressed back until it shuts the laryngeal aperture. Then, presumably, the tip of the epiglottis slips downward along the posterior pharyngeal wall, pushing the bolus probably with a final impulse into the gullet. Whether or not the action of the epiglottis is a factor in pushing the bolus is a point that was disputed as far back as 1892.⁵

Mosher,⁶ in 1927, published studies from which he concluded that the epiglottis acts as a cover for the larynx during swallowing. Barelay⁷ stated that "time of swallowing is less than half a second with solids and probably less than one-fourth second with thin watery food." In swallowing we feel that the nasal cavity is suddenly automatically cut off, and we note the change of pressure in the eustachian tubes. The nasopharynx is completely emptied of air for a fraction of a second before we swallow, creating a suction that helps to slide the food down the esophagus after the tongue has thrown it into the pharynx and the upper part of the esophagus. "The act of swallowing must usually be accompanied by negative pressure." "In my own case, swallowing dry but masticated bread, it amounted to 18 cm. of water. The high negative pressure only lasted for about $\frac{1}{8}$ of a second, but even so it was sufficient to carry the bolus from the back of the tongue to the level of the clavicle."

Best and Taylor⁸ stated: "As a result of the muscular movement, chiefly on the mylohyoids, a pressure of 20 cm. of water is developed in the posterior part of the mouth pharynx and upper part of the esophagus. A negative pressure, however, exists in the anterior part of the mouth. A negative pressure also normally exists in the closed mouth at other times which aids in holding the lower jaw in the elevated position. When the food is in the esophagus a negative pressure amounting to 35 cm. H₂O or more is created in the pharynx and esophagus, thus aiding in the descent of the bolus."

At the University of Illinois, six miniature strain gauges were placed on the palate in such a position as to record the activity of the tongue antero-posteriorly and at different levels from the midline laterally. For demonstration purpose, water was sucked up through a straw from a glass and swallowed. In this one experiment, pressures of the tongue during sucking were shown to be on the lateral borders against the lingual side of the maxillary teeth, with pressures decreasing toward the midline of the tongue. No pressure was exerted in suction by the tip against the palate. In the act of swallowing the formation of a seal, beginning posteriorly on the lateral borders of the palate was seen. When that pressure reached maximum, there was a sharp rise of pressure anteriorly in the formation of the seal by the tip of the tongue,

thereby enclosing the water between the tongue and the palate and leaving only a posterior opening. The time taken to form the seal was about two-tenths of a second.

After the formation of the seal, the entire tongue was pushed up by its extrinsic muscles acting instantaneously throughout the surface of the tongue. The time that elapsed from the beginning of elevation of the tongue to complete clearance of water from the oral cavity was about one-tenth of a second. Pressures decreased throughout the surface of the palate while water was kept in the oral pharynx. After about one and one-half tenths of a second, clearance of the pharynx was indicated through an elevation of the tongue and bracing against the palate; the pressure was relatively uniform throughout the surface of the palate. After clearance of the pharynx, the tongue retreated from the surface of the palate simultaneously throughout its surface.

In swallowing solid foods, after the seal was formed, the entire tongue was pushed upward to eject the food into the pharynx. The clearance of the pharynx was again a smooth process of bracing the tongue against the palate, and pressures again dropped immediately upon clearance of the pharynx.

The survey continued with the placement of the strain gauges on the buccal surface of the maxillary teeth and maxilla. For example, one strain gauge was placed on the labial surface of the central incisor in relation to the orbicularis oris while another strain gauge was placed superior to the cuspid just anterior to the quadratus labii superioris. The experiment, which involved grasping a straw, sucking, and swallowing water, demonstrated the instrument's ability to sense and record the activity of the lips in reaching for and tensing around the straw while sucking. Pressures were recorded throughout the labial and buccal surfaces in this activity, but (at least, in this single case) no pressure was demonstrated during swallowing.

In speech the records accumulated in this one survey case were in agreement with the general studies of speech. For example, the entire border of the tongue was in contact during pronunciation of the sounds "T" and "D," whereas only the buccal segments of the border of the tongue were in contact during pronunciation of the sounds "S" and "Z." One strain gauge was placed in the midline of the soft palate. This demonstrated that the contact of the tongue with the soft palate was made only in pronunciation of the sounds "K" and "G" and all allied exercises.

MATERIAL AND PROCEDURE

In discussing the abnormal swallowing habit in relation to one of her children, a mother expounded the theory that her own child's abnormal swallowing was the result of bottle feeding. Her reasons and descriptions sounded so plausible that we who had been gathering material on interference or pressure habits decided to survey and keep a record of all patients with the abnormal swallowing habit who came into the office.

From June, 1943, to January, 1957, 478 patients presented themselves with the abnormal swallowing habit. A careful case history was taken on every patient who came for orthodontic diagnosis. The general health, diseases to

date, and recurrent attacks of such conditions as colds and allergy were noted. Then the oral, orthodontic, or interference habits of the patient were recorded. In most of these cases it was not necessary to ask the patient to swallow, as either the position of the teeth indicated the positioning of the tongue or the patient would swallow involuntarily during the examination and reveal the presence of the abnormality.

In many cases, there were one or more habits in addition to the abnormal swallowing. For example, an abnormal swallowing habit would be accompanied by thumb-sucking or by any of the other habits with which orthodontists are familiar, such as leaning, lip-biting, tongue-thrusting, fingernail-biting, sleeping habits, and pencil-biting. The parents of children with abnormal swallowing habits were interrogated as to type of infant feeding, the length of time the child was on a liquid diet, the correlation between infected tonsils, respiratory infections, allergies, and duration of colds, and the correlation between endocrine disturbance and psychiatric problems.

THE ABNORMAL ACT OF SWALLOWING

It was pointed out earlier that in the normal act of deglutition the facial muscles of expression are not used, and any observed changes in these muscles just prior to or during the act usually indicates an abnormal swallowing habit. As stated, the masseter muscles or muscles of mastication are used in bringing the teeth and jaws tightly together and holding them during the entire process. In the abnormal swallowing habit, however, the muscles of mastication are not used in bringing the jaws tightly together. First, the tongue is thrust forward between the teeth, and then the muscles of mastication bring the jaws together until the upper and lower teeth contact the tongue. In most cases only the tip of the tongue is involved, with an open-bite in only the incisor and cuspid region. In others, the sides as well as the tip of the tongue are placed between the teeth, opening the premolars and molars as well as the anterior teeth. The orbicularis oris and other facial muscles of expression, especially the mentalis, enter the act by tensing as if to help the bolus back with the tongue. In many cases the patient blows air forward and builds up a positive pressure in the anterior part instead of a negative pressure. A wave of contraction starts with the facial muscles, the tongue being held between the teeth, with a contraction of the muscles of the throat, such as the palatoglossus, palatostyloglossus, and the mylohyoid.

In addition to the contraction of these muscles, the patient in some cases also has a tendency to move his head forward during the first stage of deglutition as if to help roll the bolus or saliva backward. The act of deglutition takes place approximately twice a minute during the waking hours and approximately once a minute or less, depending upon each individual's flow of saliva, during sleeping hours. Normal swallowing temporarily closes off the nasopharynx, the eustachian tubes, and the larynx from the pharynx while the bolus of food is passing it. As previously described, this causes a partial vacuum which helps to drain part of the nasopharynx and part of the eustachian tube and also relaxes the muscles after the act.

In abnormal swallowing the reverse occurs. The patient does not cause a complete vacuum but has a tendency to blow the remaining air against such openings as the lips, eustachian tubes, and nasopharynx. In the abnormal swallowing habit, the contraction is so intense that patients have a strained musculature about the face and throat (and in some older patients changes in facial expression and contour are seen), whereas the normal act of deglutition is a very relaxing episode.

RESULTS

Of the 478 patients with the abnormal swallowing habit, all but two had been bottle-fed babies. Thirty-three patients were breast-fed and given supplemental bottle feedings for a period of two to six weeks, after which they were left solely on the bottle. In a great many of these patients the anterior segments of both arches had been affected. Either there was a severe so-called "open-bite" to a protrusion of the upper anterior teeth or the anterior segments of both arches were in a protruded position with spaces between the incisors and cuspids. Many of the patients, in addition, sucked their thumbs and had an extreme protrusion of the upper anterior teeth; there was little room to accommodate the tongue in its proper position in the palate, and instead it was found resting on the lower teeth. In fact, in many of these cases the palate was so narrow and ill-formed that even if the patient wanted to put his tongue against the roof of his mouth he could not do so; the tongue was too wide to fit flat against the narrow palate.

As a result of the abnormal swallowing habit, we usually find a narrow upper arch and, in a great many cases, a severely contracted maxilla with upper teeth protruding in an open-bite relationship. The importance of the proper position of the tongue against the palate, with its boxing of teeth in the act of deglutition, cannot be overstressed, as this provides the balance of forces needed to maintain proper arch width in the maxilla. In the abnormal swallowing habit the opposite takes place, and the result is very difficult to correct.

The abnormal swallowing habit has been found to be definitely due to improper bottle feeding. In order to appreciate why bottle feeding can cause the abnormal swallowing habit, one should understand the differences in the mechanics of bottle feeding and breast feeding.

The breast-fed baby, in addition to sucking at the breast, presses against the breast with his nose, cheek, and lips. The teat is between his lips and gum pads, so that there is a combination of pressure against the breast, a squeeze, and a suck on the teat. The tongue is free in the mouth to place itself properly to take care of the normal act of deglutition, since the milk does not run freely but must be sucked out with pressure. When a mouthful is obtained, the source of supply is shut off and the baby uses the normal tongue action as described in the act of deglutition to throw the milk into the back of the pharynx.

In bottle feeding the nipple is very long and, because of the infant's small palate, the nipple reaches partially into the throat or soft tissue area.

Usually the parent wants to be sure that the child gets sufficient milk, or the entire formula, with no effort. To facilitate this procedure, several large holes are usually placed in the nipple. No pressure is used in sucking at the bottle and in order to keep from choking on excess milk the child thrusts his tongue forward with the tip between the gum pads. The nipple is allowed to rest between the tip of the tongue and the upper gum pads and lip since, with the large nipple, the palate is covered. The milk literally flows down the child's throat through the trough of the tongue. When the child attempts to suck vigorously, the milk comes so fast that he chokes before he can swallow properly, or the parent has to remove the bottle from the child's mouth until the excess is swallowed or flows out at the corners of his mouth.

The psychiatric problem of the baby nursing at the bottle should also be taken into consideration. Levy¹⁰ states: "Previous observation and clinical studies have demonstrated that the primary cause of thumb and finger sucking is insufficient sucking at the breast or bottle. In youngsters who suck after bottle feeding the nipple was replaced with one having one small hole increasing the sucking time to 25 minutes, which exhausts the sucking urge and the finger did not go to the mouth after feeding."

In addition to causing the abnormal swallowing habit, improper bottle feeding may help to produce finger- or thumb-sucking habits. When the child is fed from the bottle, the mother should hold him so that he gets a feeling of love and affection and senses the warmth and soft feeling of her body, and he should be made to suck and work for his food. The cold scientific way of feeding, in which the baby is placed in his crib and given a bottle that is supported in a chrome-plated holder or resting on a pillow, soon teaches the baby to shove his tongue forward, maintain the tip in that position, and swallow the back portion of the milk abnormally while the tip of the tongue is receiving a new supply of milk. The love, care, and affection shown by the mother in nursing the newborn child at the breast should be copied as much as possible in bottle feeding. Some mothers, whose children differ considerably in age, have had an opportunity to follow both the old and the new feeding methods. Their older children were fed every four hours from a bottle that was supported by a mechanical holder or a pillow. The younger children, on the other hand, were cuddled and fondled and were given a bottle (which had the proper nipple and hole) when they cried for it instead of according to a rigid schedule. It has been found that when the latter method is followed the mother is much happier and the child is better adjusted, with a better nervous system and a greater feeling of security and well-being. Time will tell whether or not the abnormal swallowing habit can be prevented by this newer method of bottle feeding.

COMMENT

Ways of detecting the perverted swallowing habit are described in the literature. Many methods are used in the correction of this habit. However, the orthodontist who is not familiar with the abnormal swallowing habit may

overlook it in making his diagnosis. Then, when treatment is nearing completion, he will imagine that the patient has developed an abnormal swallowing habit in response to the new position of the teeth and will instigate treatment to close up the anterior teeth when, in reality, the habit had always been present but, perhaps because of the existence of other habits (such as the leaning habit), had not produced an open-bite.

CONCLUSIONS

1. The abnormal swallowing habit seems to be the direct result of improper bottle feeding.

2. The so-called open-bite is not always an indication of the abnormal swallowing habit, as other habits (such as leaning) may affect the denture in such a way that the swallowing habit is disguised. The latter may, as a result, be present in a typical Class II, Division 1 malocclusion with quite an overbite and overjet.

3. The abnormal swallowing habit may be present in tongue-thrusters who have pushed both upper and lower anterior teeth labially, creating spaces and in some cases an edge-to-edge bite.

4. The abnormal swallowing habit may separate not only the anterior teeth but also most of the posterior teeth, including the premolars and in rare instances the first molars bilaterally.

5. In many cases of abnormal swallowing the palate is so high and narrow that, even if he wishes to, the child cannot place the tongue in its correct position until proper corrections have been made.

6. Abnormal swallowing may be present along with other interference habits, such as thumb- or finger-sucking, lip-biting, tongue-thrusting, nail-biting, and leaning.

7. The fact that abnormal swallowing seems to be more prevalent in females than in males should be discounted, since parents may be more concerned with slight irregularities in the teeth of their daughters than with those in the teeth of their sons.

8. Abnormal swallowing and tongue-thrusting may be aided by an unusually large tongue which causes severe open-bite.

9. The abnormal swallowing habit usually produces an open-bite. If not corrected, the habit will cause the anterior segments to relapse to their former position after the completion of orthodontic treatment.

10. It was found that the tongue habit plays an important part in interference with the normal growth of the dentition and is capable of causing many serious malocclusions.

11. The abnormal swallowing habit should be detected and corrected early to facilitate normal development of the palate and the dentitions. When detected early, it should be corrected by habit control or by lessons designed to teach the child to use the proper muscles of deglutition and to place the tongue in its proper position. It is a difficult habit to correct in older patients. There is some danger that patients who have swallowed incorrectly for fourteen

to sixteen years may return to the old habit of abnormal swallowing after all orthodontic appliances have been removed unless they are checked from time to time during treatment and referred back to the therapist until the abnormal habit is corrected.

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