SURGERY OF THE FAUCIAL TONSIL AS IT RELATES TO THE FUNCTIONS OF THE TONGUE AND SOFT PALATE IN THE PRODUCTION OF VOICE.*

DR. G. HUDSON-MAKUEN, Philadelphia.

The faucial tonsil differs from other tonsils chiefly in respect to the conditions attendant upon its location in the pharynx. The pharyngeal tonsil hangs pendant from the smooth, bony and aponeurotic surface of the vault, and the lingual tonsil is attached to the single muscle forming the base of the tongue, whereas the faucial tonsil has a more or less close relationship and in many instances actual attachments, not only to the intra-pharyngeal aponeurosis, which for convenience sake has been called the capsule of the tonsil, but also to the following important phonatory and articulatory muscles:—namely, the superior constrictor, the palatopharyngeus, the palatoglossus and the lingual muscles. So closely and intimately is the faucial tonsil related to these important organs that in its normal state it forms with them a beautiful and unique mechanical structure varying in outline and presenting the recesses and half arches or columns which give to the lateral wall of the pharynx its distinctive acoustic characteristics. The location of the faucial tonsil, however, in the very midst of this network of muscles renders it particularly liable to infectious diseases, and therefore its surgery has come to be a matter of considerable importance.

There are two kinds of tonsillar surgery and they may be broadly designated as radical and conservative or palliative. Radical tonsillar surgery, as its name indicates, aims to enucleate the gland, or failing in this to remove as much as possible of it including the capsule, while conservative or palliative surgery aims to remove only so much of the gland as is obstructive, and at the same time to so open up diseased crypts and deep retention-pockets that satisfactory drainage to the tonsillar region is established without interfering in any way with the characteristic structure of the pharyngeal walls.

The modern tendency is toward radical surgery of the tonsil, and this is probably due to a desire to be thorough and to be sure of removing all sources of infection.

*Read before the Division of Surgical Specialties of the Clinical Congress of Surgeons of North America, Chicago, November 12, 1913, and by invitation before the Philadelphia Laryngological Society, March 17, 1914.

Formerly the surgeon was satisfied with so-called tonsillotomy or the removal of the projecting portion of the gland, but this operation fell into disrepute largely because it resulted in the formation of adhesions between the cut portions of the gland and the faucial pillars, and a sealing of the crypts at their point of section; thus encouraging the formation of numerous retention-pockets which became hot-beds of infection and defeated the very purpose for which the operation was designed.

The tonsillotomy or section of the tonsil as it is usually made is in the wrong plane of the tonsil. If it were made more nearly in the horizontal instead of the vertical plane, thus removing the upper pole including the supra-tonsillar fossa and leaving the lower pole intact, it would be a much more satisfactory operation and it would meet nearly if not quite all the requirements of a radical tonsil operation.

Tonsillotomy, as it is usually performed however, is not worthy of being classed among the conservative tonsil operations, and like so-called surface cauterization its practice should not be generally recommended. But there are other conservative procedures which are worthy of consideration. I refer to those which may result in giving good drainage to the diseased tonsillar crypts and to the tonsillar fossa without removing the entire gland and without doing injury to the capsule or to the palatal muscles or the mucous membrane covering them.

During my early apprenticeship in surgery I devised a knife with the blade at an angle of about 120 degrees to the handle, for the purpose of conservative tonsillar surgery. Many similar knives have been devised from time to time by other surgeons and for a similar purpose, namely to open up diseased tonsillar crypts and other retention-pockets formed by various inflammatory adhesions. My custom has been, after freely opening the pockets with the sharp knife, to sear the edges with the actual cautery; thus preventing a union between the cut-surfaces and causing also a marked diminution in the size of the gland itself.

Someone has said that in doing a little good one should take heed lest he do a great harm, and this injunction is particularly applicable to the surgeon who operates in the region of the pharynx.

The two considerations which should actuate us in the performance of tonsillar surgery are: first, to improve the general health of the individual, and second, to improve his voice. While these two considerations are not strictly speaking antagonistic, yet it is unfortunately true that an operation upon the tonsils may im-

prove the general health of the individual and at the same time do a grave injury to his voice. The converse of this proposition, however, is not equally true because any operation that improves the voice must of necessity at the same time improve the general health, because good health is absolutely essential to good vocalization.

It goes without saying that no surgical operation is ever indicated in a normal pharynx because, forsooth, the faucial tonsils may have some slight and benignant function in the human economy, although only a few of the younger of us have reached absolutely definite conclusions in reference to this matter. I am one of those who take it for granted that the faucial tonsil has important bactericidal and protective systemic functions, and I am convinced beyond doubt that in its normal state at least it has some very important mechanical functions which are particularly operative in the production of voice and speech.

The lateral walls of the normal pharynx present, as I have said, certain distinctive structural characteristics, and in this respect they bear a close resemblance to the lateral walls of the larynx. These distinctive structural characteristics—and I refer particularly to the anterior and posterior half arches of the palate with the tonsils separating them and directing their muscular action—are not biological accidents or variants, but they are always present, and until attacked by disease and except in respect to their size they are always practically the same.

Moreover, the soft palate, the integrity of which is so essential to the distinctive structural characteristics of the pharynx, has important muscular connections not only with the tongue but also with the larynx itself. It will be observed, therefore, that the three most important peripheral organs of phonation and articulation—namely, the soft palate, the tongue and the larynx—are anatomically and physiologically inter-dependent, and they also have many points of similarity.

I have called attention elsewhere to the importance of the soft palate as an organ of phonation and articulation and I have especially emphasized its valvular action in the pharynx and its cord-stretching action in phonation through its connection with the larynx by means of the palato-pharyngeal muscles.

The soft palate, the tongue and the larynx are similar in that they are all freely movable organs, and their position at any particular instant during phonation and articulation varies not only as it relates to each one of them individually but also as it relates to the more or less fixed spinal column. These variations in posi-

tion take place with great rapidity and great precision, each particular tone or quality of voice in singing and each inflection in speaking requiring its own particular palatal, lingual and laryngeal position. The close anatomical relationship of these organs due to their muscular attachments makes the position of each one of them dependent largely upon that of the others. A low-hanging soft palate, for instance, which has become so, owing to a defective action of the levator muscles will result not only in a faulty position of the larynx, but also in a faulty action of the vocal cords.

Paresis of the palatal muscles, however slight, always brings about a corresponding disturbance of the laryngeal musculature. In other words, owing to the anatomical and physiological interdependence of these organs, palatal insufficiency always results in laryngeal insufficiency and the corresponding forms of vocal disability. The palatal muscles are virtually and practically extrinsic laryngeal muscles, the palato-pharyngei having direct connection with the larynx, while the palato-glossi have an indirect connection with it through the muscles of the tongue.

This brings us to a consideration of the faucial tonsil in its relation to these important organs of phonation and articulation. There are two kinds of faucial tonsils—the normal or physiological and the abnormal or pathological tonsil. Just as the normal tonsil is essential to the normal structure of the pharynx and helpful to the normal action of the palato-lingual and palato-laryngeal muscles in voice-production, so the abnormal tonsil may cause distortion of the pharyngeal structures and interfere with the action of the muscles.

The distinctive anatomical characteristics of the faucial tonsil are largely incidental to its location in the pharynx. The somewhat irregular folds found in the lymphoid tissue in the vault of the pharynx and the follicular character of the so-called lingual tonsil give way to the more highly developed lacunae and crypts of the faucial tonsil, these differences of structure following as a natural consequence of its more or less concealed or buried position between the palatal pillars.

The faucial tonsil is not a homogenous organ but is rather complex both in respect to its development and in respect to its structural arrangements. The rudiments of the gland are laid down in the dorsal prolongation of the second branchial cleft during embryonic life, and the sinus in which it develops is divided later by a fibrous fold into an upper and lower portion. This ingrowing or intra-tonsillar fold as it has been called soon disappears, but not

until after it has marked the boundary line between two distinct portions or lobes of lymphoid tissue, the upper one becoming the upper pole of the tonsil in which we have the supra-tonsillar fossa and the other one the lower pole of the tonsil or the gland proper.

The lymphoid tissue entering into the formation of the upper pole of the tonsil and its supra-tonsillar fossa is the first to appear in the early development of the gland, and it always remains somewhat rudimentary in character. This undeveloped or rudimentary condition of the upper pole of the tonsil and the concave or bowl-like shape of its fossa, combined with the fact that nearly, if not quite all, the crypts from the lower pole of the tonsil proper open into it, render this region extremely liable to disease.

In considering the relation of the tonsil to the pharyngeal structures the so-called capsule should not be overlooked. Authorities differ widely with reference to the anatomy of the capsule of the tonsil, and this seems to be due to the fact that the tonsil changes so much with the various stages of its development and also with the various pathological conditions which arise in this region.

Dr. D. R. Paterson, surgeon to the throat department of the King Edward Seventh Hospital, Cardiff, who has made many sections of the tonsil in its various stages of development, says that anatomically, in the first instance, the capsule is no essential part of the tonsil; it is nothing more nor less than a portion of the intra-pharyngeal aponeurosis or fascia attached above to the base of the skull and extending down between the superior constrictor and palatal muscles as far as the cellular portion of the esophagus, and as its development goes on, the tonsil becomes more and more closely adherent to this fascia until during the process of "physiological sclerosis" in more advanced life it actually becomes an integral part of it, building upon it and increasing its thickness by the addition of its own connective tissue. "Like the larva," says Dr. Paterson, "which spins its own cocoon, the tonsil may be said to weave, or, at least, to add to its own capsule," and thus a stronger wall of defense is formed against injury or systemic infection through the tonsillar region during advanced life.

Although this theory may not be in accordance with the more or less generally accepted views with reference to the anatomy of the capsule of the tonsil, yet those of us who have had a large clinical experience know that in many instances an extra-capsular enucleation of the tonsil necessarily involves a kind of window resection of the intra-pharyngeal aponeurotic sheath, and in some instances also, where fibers of the superior constrictor muscles are

lacking, a resection even of a portion of the extra-pharyngeal aponeurosis to which the gland has become firmly united. The tonsil that is easily removed from its bed and turned out of its capsule somewhat as a finger is removed from its stall in a glove is either a very young tonsil or not a pathological, but a normal one which in all probability should not be removed at all.

It appears, therefore, that we are dealing with a complex and a somewhat highly specialized organ, composed largely of lymphoid tissue, the systemic function of which is similar to that of the less highly organized lymphoid tissue found in other parts of the body, and this function is operative chiefly during childhood or up to the fifteenth year, after which time its function becomes more mechanical in character and is chiefly operative in phonation, articulation and deglutition.

Let us now consider just what happens during and after the operation for extra-capsular enucleation of the tonsil. In the first place, all that portion of the pharyngeal mucous membrane which covers the tonsil and extends into its deeper recesses and crypts is removed, and the tonsil itself together with that portion of the intra-pharyngeal aponeurotic sheath which may be attached to it is dissected out, including in many instances also fibers from the palato-pharyngeus, the palato-glossus and the superior constrictor muscles, and when, as occasionally happens, the superior constrictor muscle is thin or absent in the region of the tonsil, our resection may include also a portion of the peri-pharyngeal aponeurosis. This operation leaves a large, deep cavity with a surface of granulation extending from two to four square inches. Opening into this cavity we have the cut or torn edges of the pharyngeal mucous membrane, and in many instances the raw surfaces of the three important muscles to which I have referred—namely the palato-pharyngeus, the palato-glossus and the superior constrictor muscles, together with the cut or torn edges of the resected portion of the intra-pharyngeal aponeurosis, which it will be recalled is often muscular as well as fibrous in its construction. In those cases in which fibers of the superior constrictor muscles are wanting, we may have also a resected portion of the peri-pharyngeal aponeurotic sheath.

The final results of this somewhat extensive dissection are what we should naturally expect, namely a contraction of the cavity and a more or less firm cicatricial union between these cut or lacerated surfaces, binding them all together at central points of cicatrization, and thus two or three months after the operation the old land-

marks that characterized the distinctive features of the walls of the pharynx are practically gone forever. Instead of the beautiful clean-cut, sharp edges of the palatal pillars during phonation and articulation, and the well-marked pharyngeal recesses both between and on either side of the pillars, we have plain oval pharyngeal walls with occasional bands of tense fibrous tissue coming into greater prominence when the mouth is open and the tongue depressed. Moreover, after the normal mucous membrane of the parts is destroyed its place is occupied by smooth, cicatricial tissue, having a glistening surface and no mucous secretion whatsoever.

The cicatricial bands, of which I have spoken, frequently give rise to painful tugging-sensations in the pharynx, and the absence of normal lubricating glands in this region often causes a dryness which in some instances becomes exceedingly annoying.

Now what effect must all this have upon phonation and articulation? In the first place it is not unusual to have the patient tell us in a proud way that he or she can sing one or two notes higher than before the operation, but surely this is not a "consummation devoutly to be wished," for the higher pitch is always reached at a sacrifice of other and more important or desirable qualities of the voice. It is accuracy of pitch and an indefinable something which we call timber or quality that is desirable and that should be sought after, but accuracy of pitch and that marvelous something that distinguishes the great voice from the ordinary voice cannot possibly exist or be acquired under the physical and neuro-muscular conditions which necessarily exist after a complete extra-capsular tonsillectomy. However carefully and skillfully the operation may be done, we must of necessity have a more or less crippled palate and tongue, and resultant inaccuracies in the action not only of the extrinsic but also of the intrinsic muscles in the larynx. The natural free movements of these three organs—the palate, the tongue and the larynx—during phonation and articulation are wanting because the smooth, well lubricated musculo-aponeurotic sheath with which they were in close relationship has been in part removed and the tonsil itself, which formerly served to keep the muscles in their normal relations and guide them in the direction of their activities, has been sacrificed and there have been substituted the resultant scar-tissue, fibrous adhesions and insufficient lubrication.

These results follow, be it understood, however well and adroitly the operation may be done, but when we consider how often it is

badly or mal-adroitly performed and how exceedingly more unfortunate are the results attendant upon such procedures, we have an additional reason for teaching conservatism in this operation.

At the last meeting of the American Medical Association, Dr. Sheedy, in discussing the tonsil question, said that in a careful study of the secondary results following 100 tonsillectomies in New York City, more than 80 per cent had deformed palates, and in only about 20 per cent did the palatal pillars even approximate the normal. This report is in entire accord with my own observations in the study of a far greater number of cases in Philadelphia. It is the exception rather than the rule to find the palatal pillars approaching the normal after the radical operation, and I have never seen anything like perfection in their action during phonation after an extra-capsular tonsillectomy in an adult patient.

But you will ask why I seek perfection in the action of these muscles, especially since perfection is found nowhere else in nature. My reply to this is that the human pharynx or throat, by a beautiful provision of nature, furnishes us with the most wonderful of all musical instruments. No two of them are exactly alike, and yet structurally they differ but little the one from the other. It is the slight, the almost imperceptible structural differences, however, that help to distinguish the great voice from the ordinary voice.

The mechanical instrument which most nearly approximates the vocal instrument in the human quality of its tones is the violin, and the two instruments are in some respects similar. For example, both may be very good and both may be very bad, and it is not always easy to tell why this is so. One violin, for instance, looks very much like another. You and I might not be able to tell them apart, and yet to purchase the one would cost you thousands of dollars, while you may have the other for \$1.50. The difference, we are told, is in the materials of which they are made and in the way they are put together. So I think we may look for the differences in vocal instruments. Who has ever heard of a truly great singer having ever undergone an extra-capsular tonsillectomy? The great voices are the product of the more nearly perfect instruments and these in turn are the products of nature and not of art.

In considering the function of the tonsil much time has been given to the study of its systemic effect upon the individual and much more time and labor will have to be given before we arrive

at conclusions that may serve as a basis for intelligent work in this line. We do not know the systemic functions of the tonsil and we may never know them, because of the difficulties which arise in making the necessary investigations. Judging from the conflicting statements of those who have made a special study of the subject, we do not even know the minute anatomy of the faucial tonsils and of their setting in the pharynx, to say nothing of their physiology and general relation to the human economy. All this is a strong argument in favor of surgical conservatism.

The mechanical functions of the tonsil in phonation, articulation and deglutition, have received but little attention, and I am convinced that a greater knowledge in this direction would lead to greater conservatism in tonsillar surgery.

The normal tonsil, and by this I mean the healthy tonsil and the one of normal or approximately normal dimensions, is not only beneficial to voice-production, but it is absolutely essential to the attainment of the highest artistic results in singing and speaking.

The functions of the tonsil in phonation and articulation are three-fold: first, it serves to maintain the normal anatomical relations of the soft palate, the tongue and the larynx not only to one another, but to the comparatively fixed spinal column; second, it serves to keep the pillars of the palate apart and to direct them in their phonatory and articulatory activities; and third, it has in itself important acoustic properties in artistic vocalization.

The mechanical functions of the tonsil are somewhat analogous to those of the nasal and laryngeal cartilages. Just as these cartilages are essential to the structural integrity of the nose and larynx, so the tonsil serves to maintain the various parts of the walls of the pharynx in their normal structural relations, and its absence or its removal always results in a partial collapse of these structures. Moreover, like the cartilages of the larynx the tonsil has attachments to the various surrounding muscles and thus it influences and directs their activities.

As to the resonating function of the tonsil, we know that the tones of the violin are materially changed by the insertion of any foreign substance of varying density into the body of the instrument, and reasoning from analogy, therefore, tonsillar tissue being of a different density from the surrounding structures in the fauces must have some effect upon the resonance of the oral cavity. Just as the normal tonsil is helpful in voice-production, however, the abnormal tonsil may be altogether prejudicial, and

it may be prejudicial to such an extent as to make some kind of tonsillar surgery absolutely imperative.

There are three ways in which the abnormal tonsil may be injurious to the voice: first, it may obstruct the outgoing column of vibrating breath; second, it may interfere mechanically with the action of the muscles; and third, it may interfere with the neuromuscular activities of the pharynx by the local infection which it generates.

The three kinds of abnormal tonsils, therefore, which interfere with voice production are: first, the very large discreet tonsil that projects considerably beyond the edges of the palatal pillars and is more or less pedunculated; second, the large so-called submerged tonsil or the one held within the grasp of the palatal pillars and plica; and third, the smaller and chronically diseased tonsil which is undergoing degeneration. The first two types of hypertrophied tonsil may give no symptoms whatsoever except those of obstruction and pressure, while the third type is one presenting foci of infection and causing occasional attacks of peri-tonsillitis. These three types of tonsil belong chiefly to adult life, and they usually appear between the ages of 15 and 35. Moreover, this is the period also of artistic vocal development and the period during which the condition of the tonsils may make or mar the voice.

Before 15 years of age, the tonsils are exercising their bactericidal and protective functions and their very hyperemia and hyperplasia may be an evidence of their activities in the performance of these functions, but after 15 years of age, they are physiologically less active and they gradually undergo important physical changes. Their mechanical functions now come into greater prominence, and tonsillar surgery should aim not to destroy but to maintain their mechanical efficiency.

The surgery of the faucial tonsil may be considered under two headings: first, that of childhood, and second, that of adult life. The tonsillar surgery of childhood should be as conservative as possible, because then if ever the tonsils are exercising their systemic functional activities, and the tonsillar surgery of adult life should be conservative because of the mechanical functions of the tonsil in artistic vocalization.

The two conditions of the tonsil which require surgical interference are true hypertrophy or chronic hyperplasia and actual primary disease of the tonsil. A tonsil may be very large, while in other respects it is entirely healthy. Such a tonsil calls for conservative, rather than radical, surgical measures.

Actual disease of the tonsil is exceedingly difficult of diagnosis, and some one has well said that one must enucleate it before he can be sure that it is diseased. The so-called diseased tonsil is oftentimes not a diseased tonsil at all, but its condition is merely symptomatic of some general systemic affection. Moreover, a tonsil may be diseased only in part. A single crypt may become a focus of infection, while the other crypts and the remaining portion of the tonsil may be healthy or only secondarily disturbed. The total enucleation of the tonsil under these conditions would seem to be wholly uncalled for. One might almost as well think of amputating a hand because of an infection limited to a single finger.

Recurrent tonsillitis or even peri-tonsillitis may often be cured without resorting to radical surgery. Tonsillitis may be, and often is merely an expression of a systemic condition, and thus may be comparable to the rash of measles or typhoid fever, and peri-tonsillitis may result not from tonsillar infection at all but from extra-tonsillar infection.

The most puzzling cases of tonsillar disease are those in which the tonsillar region is suspected of being the portal for the entrance of infectious organisms into the general system. It is supposed that there comes a time when, on account of its diseased condition, the tonsil ceases to be a protective organ and actually becomes an infective organ, and thus a menace to the individual. The fact, however, that the tonsillar defense appears to be broken down, would seem to be an argument for its repair, rather than for its total annihilation. The removal of the tonsil, therefore, merely upon suspicion and without a thorough investigation of the conditions would scarcely seem to be a justifiable or scientific procedure.

Before doing a complete tonsillectomy, it would seem only reasonable to demand a thorough differential diagnosis. It is easier to enucleate than it is to investigate, and especially is this true with our improved technic, in the perfection of which we have spent so much valuable time. I predict that future years will find us trying not how best to enucleate but how to avoid enucleation.

In the great majority of instances there is really only one good reason for doing an extra-capsular tonsillectomy, and that is the difficulty of doing an intra-capsular tonsillectomy. I grant you that a tonsil may be more thoroughly removed by the former operation, but I deny the necessity for its thorough removal. Good drainage, as a rule, is better than tonsillectomy, although it may not be so easily accomplished.

And, finally, because of the mechanical functions of the faucial tonsil in phonation and articulation, if for no other reason I would protest not against tonsillar surgery, but against unnecessary tonsillar surgery and especially against extra-capsular tonsillectomy as a routine measure, and in its stead I would suggest the conservative measures to which I have referred, and in extreme cases what, in lieu of a better term, I would call intra-capsular tonsillectomy or a careful dissection of the gland from within its pocket in the intra-pharyngeal aponeurosis. This is a more difficult and more tedious procedure, but I have found it not to be an impossible one, and the fact that some tonsillar tissue may remain after the operation, is no great objection to it because when the operation is properly performed, good drainage, the *sine qua non* of every operation, is thoroughly established.

The extra-capsular tonsillectomized pharynx is always necessarily a damaged pharynx, and the radical operation should only be done when the damage to the pharynx and to the individual threatens to become greater by leaving it undone.

All the really great singers have tonsils, and they probably would not, and could not, be as great without them. Obviously the singers to whom I refer are not those who have pathological tonsils, for they also would damage the pharynx and preclude the possibility of their becoming great singers.

The whole question as to the final effects of tonsillar surgery upon phonation and articulation lacks clearness in our minds because we are not good judges or critics of the voice. We cannot always distinguish between artistic and mediocre singing tones, and we are, to a great extent, satisfied with merely intelligible articulation. The patient's own testimony is of little value because he is not a good judge of his own voice unless, perchance, he happens to be a trained singer who has learned to make fine distinctions as to tone and quality.

The voice specialist and the throat specialist are at odds in this matter because they do not understand each other's point of view. The singer is afraid of the surgeon and he will continue to be afraid of him and in many instances to dispense with his services until the surgeon begins to have regard for the singer's voice as well as for his health.

1627 Walnut Street.