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DEAFNESS AS INFLUENCED BY MALPOSITION OF THE JAWS.

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FOR the last few years the dental profession has held the attention of the combined branches of the healing art. Scientific study has led to amazing results in the form of discoveries, prevention and cures. How many more interesting and beneficial discoveries are to follow, must be decided by the future. It is true, however, that our daily routine presents many possibilities which are overlooked in the rush of pressing business.

The fact that some patients presenting for dental attention experienced more or less difficulty in hearing, has led the writer to spend some time trying to solve this phenomenon to his satisfaction. Since it is impossible to gather more than a fragment of the case history, a great

deal must be taken for granted in these cases and the lacking evidence be supplied by a definite knowledge of the anatomy involved, together with an understanding of the pathologic possibilities. Ample means have been at the writer's disposal in the form of patients in the public clinics of the dental school of the University of Pittsburgh, and anatomical material in the anatomical laboratory of the same institution.

Naturally, when anticipating results beneficial to the patient it is necessary to eliminate all those who present with cases that suggest destruction of the organ of hearing either by disease or accident and confine our treatment to patients who possess abnormal relationship of the mandible with the maxillae.

This consideration has permitted a classification of the various causes which may have a more or less profound influence upon the special sense of hearing. These causes are enumerated in the following proposition:

Proposition: That in some individuals deafness, to a greater or less extent, may exist due to abnormal relationship of the mandible with the maxillae producing habitual posterior displacement of the condyles of the mandible, this

other bone of the skull. It presents an excellent example of the protection that nature provides the organs of special sense.

This bone has for study three portions: The Tympanic, Squamous and Petro-Mastoid. It is necessary, however, to discuss only the Squamous and Petrous portions.

The Squamous portion is made up of two parts, the first vertical in position, shaped like a scale, forming the

Figure 1.

External view of temporal bone, showing eminentia articularis, glenoid fossa, post-glenoid tubercle, ext. auditory meatus, tympanic plate and mastoid process.

condition being the result of the following causes.

First: The loss of some or all of the teeth.

Second: Malposed teeth permitting malocclusion.

Third: Extensive abrasion producing a close bite.

Anatomy: In order to gain a more definite idea of the etiology in these cases, it is perhaps worth while to review some of the salient points of anatomical relationship.

The temporal bone (Figures 1 and 2), which is the structure in question, offers more points for study and more difficulties in studying its many parts than any

Figure 2.

Internal view of temporal bone, showing petrous and squamous portions.

thin lateral wall of the brain case. The second, horizontal, forming the roof of the external auditory meatus, the glenoid fossa and a small portion of the floor of the brain case. From the lower border of the Squamous portion a strong projection passes forward, the Zygomatic process, (Figure 3.) This process unites anteriorly with the malar bone, forming the Zygomatic arch which provides one of the strongest and most important connecting links between the cranium and face. Its upper border is tapered to an edge, to which is attached the temporal fascia, while the under surface is rounded, from which arises the masseter muscle. Three processes extend from the posterior extremity of the

Zygomatic arch, called the anterior, middle and posterior roots, which connect the arch to the temporal bone, (Figure

Figure 3.

Lateral view of skull showing relationship of zygomatic arch, condyle, tympanic plate and auditory meatus.

4.) The *anterior root* arises from the arch at nearly right angles and passes

Figure 4.

Enlarged view of skull in region of temporo-mandibular joint, showing zygomatic arch with anterior, middle and posterior roots; also condyle, ext. auditory canal, tympanic plate and glenoid fossa.

toward the median line with a slight posterior inclination. It is short and thick, having on its under surface, an

oval shaped concavo-convex eminence called the *Eminentia Articularis* (*tuberculum articulare*) which is covered with cartilage in the recent state. This eminence forms the anterior boundary of the glenoid fossa (*fossa mandibularis*.)

The *middle root* is the smallest of the three, arising approximately three-fourths inch posterior to the anterior root and passes mesially only a short distance where it terminates at the glaserian fissure (*petro-tympanic*.) Since this root forms part of the posterior boundary of

Figure 5.

Inferior view of glenoid fossa, showing tympanic plate, glaserian fissure.

the glenoid fossa, it is called the *post glenoid process* or tubercle and helps to separate the glenoid fossa from the *external auditory meatus*.

The posterior root runs directly backward, passes above the external auditory meatus where it begins to curve upward above the mastoid portion; hence its name, *supramastoid* or *temporal crest*.

Between the anterior and posterior roots of the zygoma is the glenoid fossa, (Figure 5.) This depression is oval-shaped, extending inward and slightly backward. It is divided into two parts, the *articular*, *mandibular* or *anterior* part; covered in the recent state with cartilage and articulating with the condyle of the mandible. The *articular*

part is separated from the non-articular or posterior part by the post-glenoid process or middle root of zygoma and a long narrow slit, the glaserian or petro-tympanic fissure. This post-glenoid process, according to Humphry, is the representative of a prominent tubercle, which in some of the mammalia, descends behind the condyle of the jaw and prevents it being displaced backward during mastication, (Figure 6.)

The posterior part of the glenoid fossa is formed principally by the

Figure 6.

Lateral view of skull of man and animal, showing relative size of post glenoid tubercle and thickness of tympanic plate.

tympanic plate, which forms the anterior wall of the external auditory meatus and the tympanum, (Figure 7.)

The following structures pass near the glenoid fossa. The glaserian fissure lodges the processus gracilis of the malleus and transmits the tympanic branch of the internal maxillary artery.

The corda tympani nerve passes thru a separate canal parallel to the glaserian fissure, the canal of Hugier on the outer side of the eustachian tube. The canal for the eustachian tube passes internal to the glenoid fossa.

The tympanic portion of the temporal bone is lodged in front of the petrous portion and forms all but the roof of the external auditory meatus. The part

that forms the anterior wall of the auditory canal is called the tympanic plate. This plate is extremely thin and separates the external auditory canal from the glenoid fossa, (Figure 8.) As mentioned before, the tympanic plate is separated from the articular part of the fossa by the glaserian fissure, which

Figure 7.

Vertical cross section of skull, showing relationship of tympanic plate and auditory canal.

opens into the tympanic cavity. The inferior margin of the tympanic plate is jagged and rough, forming the vaginal process, which surrounds the base of the styloid process. The internal part is thinner than the external margin, to which the cartilage of the ear is attached. This plate is inclined inward and forward while the condyle is inclined inward and backward, forming a condition which places the inner end of the condyle in some normal cases as far back as the glaserian fissure or even across this dividing line.

CROSS SECTION.

In a horizontal cross section from before backward the following gross structures are seen: Condyle of mandible, interarticular fibrocartilage, parotid gland (part), tympanic plate, and auditory canal, (Figure 9.) The eustachian tube arises above and internal to the condyle, passing downward, inward and forward in a bony canal, the

conditions. When the posterior teeth of the mandible are lost, there is a tendency for the angle to become an obtuse angle which increases the distance from the condyles to the anterior teeth. If the anteriors remain in normal occlusion with the upper teeth, posterior displacement of the condyle must compensate for the additional length of the mandible. (Figure 12.) Similar results

Figure 8.

Views of lateral and horizontal cross sections of skulls, showing relationship of tympanic plate, external auditory canal and post glenoid tubercle.

thick walls of which afford it ample protection from the inner extremity of the condyle, (Figure 10.) The tympanic membrane or ear drum lies directly posterior to the inner end of the condyle and is separated from it by the thin wall of the tympanic plate and the soft tissues enumerated previously, (Figure 11.) Cases of fractured tympanic plate due to blows upon the mandible have been reported.

ETIOLOGY.

From a study of the anatomy, it is evident that the condyle of the mandible is near the tympanic plate under normal

may attend the loss of the upper anteriors and the lower posteriors, (Figure 13.) (When the upper anteriors are lost the resorption is labio-lingually, which places the upper ridge posterior to the lower anterior teeth and the continual retrusive action of the mandible during mastication causes backward displacement of the condyles), the loss of all the upper and lower teeth, in fact any combination of losses which allows the jaws to approximate each other in what is termed a closed bite with continued effort on the part of the patient to retrude the mandible during mastication

should be regarded as a possible cause of existent deafness, (Figures 14, 15, 16, 17, 18.) Abrasion and malposition

the interarticular fibro-cartilage, but also of the structures surrounding the joint, which may include part of the tympanic

Figure 9.

View of horizontal cross section of specimen, showing condyle of mandible, inter articular fibro cartilage, part of parotid gland and auditory canal.

of the teeth, which permit abnormal relationship of mandible and maxillae, may be also listed in the group of causes, (Figure 19, 20.)

Figure 10.

Horizontal cross section of specimen, showing probe in eustachian canal on left, while canal has been opened on the right.

When the condyles of the mandible are habitually retruded, the pressure causes a gradual resorption, not only of

Figure 11.

Vertical and horizontal section to show relationship of inner extremity of condyle to tympanic membrane.

Figure 12.

Skull showing loss of upper anterior teeth and lower posterior teeth.

plate opposite the point of greatest pressure, (Figures 21, 22, 23, 24.) The condyle being in relationship with the

cartilaginous portion of the canal, causes a compression of the outer meatus which may almost amount to a complete closure. This constriction of the canal together with continued pressure and

As previously stated, it is impossible to obtain any evidence as to the condition of the tympanic plates of the patient afflicted. The lumen of the canal is usually diminished which condition pre-

Figure 13.

Skull showing loss of upper anterior teeth and lower posterior teeth.

irritation upon the tympanic plate, to which the ear drum is attached, and possibly upon tympanic artery and corda tympani nerve, seems to cause partial or

Figure 14.

Skull showing loss of upper and retention of lower anteriors, and lower left molar. The teeth have been lost since preparation of skull.

total loss of hearing which the writer terms traumatic deafness. The fact that many individuals allow the mandible to hang open when listening seems to indicate that hearing is improved when pressure about the joint is relieved.

Figure 15.

Skull showing approximation of jaws after loss of teeth.

vents proper examination, while the difficulties of X-ray examination may be easily recognized.

The examination of a number of

Figure 16.

Edentulous skull, showing fairly normal relationship of the jaws.

skulls has led the writer to believe that data obtained from this source cannot be relied upon, since the number of perforated tympanic plates appear to be greatly in excess of cases of traumatic

deafness occurring in life. The examined skulls were divided into three groups:

Figure 17.

Edentulous skull, showing abnormal relationship of jaws, greatly exaggerated to show posterior displacement.

Group 1. Normal or nearly normal relationship of the jaws.

Group 2. Abnormal relationship of the jaws.

Group 3. Edentulous skulls.

Figure 18.

Edentulous skull, showing elongation of mandible and abnormal form of condyle and glenoid fossa.

In group I, three skulls were found to contain perforated tympanic plates. One skull exhibited a rounded opening in either plate which indicated a normal, rather than a pathologic condition,

(Figure 25.) One with abraded teeth showed a slight perforation on the right. In group II, nearly 50 per cent were

Figure 19.

Skull showing abrasion where perforation of tympanic plate is present.

perforated on one or both sides. In group III, over 30 per cent were perfor-

Figure 20.

Same skull as in Figure 19, showing perforation of tympanic plate internal to inner end of condyle.

ated. This high percentage of perforations is due, no doubt, to the class of individuals which are turned over to the anatomical department, the disease

of which they died, the methods of preparing the skulls and other causes; but it shows that as a rule, skulls in groups

complete history as possible including, time when teeth were lost, soreness of temporo-mandibular joint, time when

Figure 21.

View of structures about temporo-mandibular joint.

II and III have much more resorption about the tympanic plates than those of group I.

Figure 22.

Same skull as Figure 14, showing perforation of antrum, possibly caused by pressure of lower molar.

EXAMINATION AND TESTS.

When a patient presents with defective hearing, it is advisable to observe the relationship of the jaws, obtain as

Figure 23.

Skull same as Figure 22, showing resorption of tympanic plates.

hearing began to fail, etc. (In cases of traumatic deafness, the joint usually be-

Figure 24.

Posterior aspect of condyle of mandible, showing groove to accommodate the post-glenoid tubercle.

comes painful shortly after the teeth are lost, and in the course of a few months is followed by a slight impairment of

hearing which gradually becomes worse, unless the abnormal relationship of the jaws is corrected by wearing properly constructed artificial dentures.) The patient should then be sent to an ear specialist for a thoro examination. The operator may make a series of simple tests which will enable him to determine progress, (Figure 26.)

Figure 25.

View of base of skull, showing perforated tympanic plates.

1. In a quiet room a whisper should be heard at a distance of 20 feet; to determine the relative hearing, the total distance should be used as the common denominator and the lesser distance the numerator—15/20.

2. A watch that has been tested on normal hearing may be used, altho it is not as satisfactory on account of the variation in loudness. A normal ear can detect the tick of a watch at about 40 inches and the hearing capacity is determined as in the whisper test.

3. A tuning fork of the middle register is the best instrument with which

to conduct such tests, because it enables the operator to not only determine the quantity of hearing, but also to localize, to some extent, the source of the lesion. By holding a vibrating fork one to two inches from the normal ear, the quantity of hearing may be determined in seconds. Abnormal hearing is computed as in the above tests.

These tests are called air conduction tests and are supplemented by the following bone conduction tests which help to localize the lesion.

Figure 26.

Paraphernalia used in tests—head mirror, aural speculum, tuning fork, watch, measuring rule.

Place the vibrating fork on the mastoid process. If hearing is normal, it should be heard one-half the time of air conduction. Set the fork in vibration in the mid-line of the skull; it will be heard alike on both sides if hearing is normal. If one or both ears are defective, it will be referred to the worst ear.

The loss of air conduction and the retention of normal bone conduction indicate interference with transmission of sound waves caused by obstruction of the auditory canal, disease of the tympanic membrane, the middle ear or ossicles.

The loss of bone conduction is the result of impaired perception of sound, caused by disease of the auditory nerve or internal ear.

Traumatic deafness is caused by defective transmission of sound.

CASES.

Mrs. A., age 28, having lost her posterior teeth several years ago, complained lately of severe pains in the region of the temporo-mandibular joint, accompanied by a gradual impairment of hearing. The lower anterior teeth touched the gingivae about the lingual of the upper teeth. A lingual bar denture was in-

Figure 27.

Casts of Mrs. A's case, before and after lower lingual bar denture was inserted.

serted below and a bridge made to replace the upper left bicuspid. Three days later the patient reported that the soreness had disappeared and the hearing returned to normal. A week later the patient's mouth became too inflamed to wear the denture and, upon the removal of the denture, soreness and deafness returned. Three days later the denture was again inserted and since that time the patient has not had a return of the trouble, (Figure 27.)

Mr. B., age 66, lost upper teeth, except third molars, fifteen years ago and three years ago lost third molars. The

upper process was restored, except at the tuberosities, which condition made it difficult to construct an artificial denture. Eighteen months ago the patient noticed that hearing on the left side was impaired, and gradually became worse, until at present he could not hear a watch tick unless it were held against his ear. An upper denture was constructed to open the bite. After fourteen days he could hear the same watch tick at a distance of thirteen inches. When last heard from, the condition was still improving, (Figure 28.)

Mr. C., age 59, lost upper molars 24

Figure 28.

Cast of Mr. B's case.

years ago. Two years ago had remaining uppers extracted and denture inserted. Soon after this, all the lower teeth were extracted and for two years he masticated his food on the lower gums, priding himself that he could master an ear of corn without a lower denture. About 6 months after the lower teeth were lost, he noticed an aching about the temporo-mandibular joint together with an impairment of hearing. The better he became accustomed to masticating on the lower gums the worse his hearing was afflicted. Lately deafness of his left ear had caused great alarm since it meant the loss of his position. Tests were made and a lower denture inserted. After 6 weeks the deafness had not only failed to become

more severe, but showed a twenty-five per cent increase in air conduction, (Figure 29.)

In conclusion, the writer believes that nearly every community has some individuals whose hearing could be improved by the insertion of scientifically con-

Figure 29.

Cast of Mr. C's Case.

structed dentures and feels that one grateful patient is enough to repay for any diligence or labor required in recognizing and correcting this affliction.

DISCUSSION.

M. M. House: The men who have been carrying on work in this line are not commonly known to me. I have known Dr. Monson's work and I know that he has been doing a great deal of work along this line. He has been carrying it on with great scientific procedure and getting satisfactory results. I would like to hear from him.

Geo. H. Monson: I could only say that I appreciate Dr. Wright's work on this line. Dr. House said it was not a part of the work of the Geometry Committee. It has led up to the work of determining geometric forms. I don't know how much geometry is going to help us in determining osseous structure. In early life the meatus is more at right angles to the sagittal plane; as time goes on, it becomes more oblique; and, as abrasion of teeth is more marked and the anterior leg of the pyramid, which by the way, is a section of a

sphere, is shortened, it throws the muscular balance backward. This is true, as Dr. Wright pointed out, in dentures, and will continue while the anterior leg of the pyramid is shorter than the condyle dimensions.

I was much interested to see the results (which Dr. Wright has attained,) as if they were tabulated from my records, and I appreciate his work in this line.

M. M. House: I knew that Dr. Monson had been taking slides from the rear and knew that I could get him drawn out by starting him on circles and curves.

Alfred Gysi: I have to say that is a quite new subject to me and in Europe I have never heard of such things, and I am glad that I can bring back to Europe something that I have learned in your society.

Rupert E. Hall: I would like to ask Dr. Wright and Dr. Monson what per cent of deafness they associate with this condition; do they consider that all deafness is caused in part by condyle intrusion? In other words, would a person with the condyle unchanged go thru life without any impairment of hearing?

Geo. H. Monson: A simple method which I mentioned in my paper last year, by which you can determine condyle intrusion upon the auditory meatus, is to place the ends of the little fingers on the ends of the condyle and the thumbs on the forehead. Ask the patient to open, and when they open, you will feel a release, and when they close, you will feel that the condyle will go up to a certain point and then there is a backward thrust just like when in opening you throw the mandible forward. It is a total coordinative action of the muscles, when the mandible is off its balance and back. I mention this because it is so easy to make this diagnosis, and a further check is the photograph

and the relative dimensions, which are lost by abrasion (or lost by the absence of teeth) either in bridge-work or in natural abrasions. The canal becomes elliptical. As the doctor has shown here, there is a bending back of the anterior wall. In the extreme cases, when the fingers are placed in the ear, the patient will wince when the impingement comes. Now to locate the amount with the natural teeth that the mandible have to close with a normal balance position—if you take sheets of gutta-percha and add a sheet to each until reduction is completely made, you will about determine where the point of intrusion starts. I have had a number of cases, some 30 odd, and in all but one, there is a marked improvement, but they all showed evidence of condyle intrusion by the digital examination. I have one case, in fact, which has been in the hospital for some time where the auditory meatus is totally closed on both sides, and she has lost her hearing completely. When she opens her jaws you can see the condyles move forward.

R. R. Gillis: Since Dr. Monson called our attention to deafness as caused by intrusion of the condyle into the auditory meatus at New Orleans last year, I have been on the lookout for this condition among my patients. During the past 6 months, I have had two cases which may be interesting to report.

The first is an old lady of 82, whom I have treated for 17 years. We have probably built more dentures for her than for any other five patients for each time she visits us, I try out any new things that I may have learned in the meantime.

She has worn a full upper denture for over 50 years; she lost her last lower teeth about 4 years ago and has not worn a lower denture because of irritation over some infected areas that was not entirely relieved when that denture was made. The result you may

imagine; her mandible closes way too far; her condyles crowd into the auditory meatus; she has grown progressively deafer during these four years so that upon arriving for this last visit, she could not hear anything in her right ear and only loud noises in the left.

I explained this theory as to the cause of her deafness.

She was keen for relief. We built the dentures so as to re-establish central occlusion.

In three days, a happy surprise came when she informed us that she could hear every word of our conversation around the table and in 10 days she could hear a whisper in either ear.

The second case had gone without a lower denture for 12 years. This lady was showing some improvement after wearing the dentures over a month (when she went away on a visit) but she exhibited no such sensational recovery as the first patient.

I believe we should not expect like results in all cases. The age of the patient, the length of time this traumatic functioning has been existing, the general physical condition of the patient, any co-existing catarrhal tendencies, all have to be considered in our prognosis.

I wish to take this opportunity for thanking Dr. Monson for his having called my attention to this cause of deafness and its remedy; and I wish to thank Dr. Wright for his splendid exposition of the subject here.

Walter H. Wright (closing): It is really gratifying to hear Dr. Monson say the things he did about this work, because if there is anything in the world that makes one happy, it is to find somebody working on the same thing verifying a few things you have discovered. It helped me especially to know what he said about detecting this posterior dislocation. We know that a person will open the mouth when listening intently to loud sounds and a person who is hard

of hearing will do the same when listening to normal sounds. We know he does that to relieve the pressure.

I want to thank Dr. Gysi, but I hardly know what to say. If something new that had been worked out in this country could be taken to Europe and utilized there, I am sure that it would give Dr. Gysi the same pleasure that we, in this country, have felt in utilizing the contributions that Dr. Gysi has worked out over there. So I am glad that Dr. Gysi is here to hear this paper.

To Dr. Hall's question, What degree of deafness?—Will you state that again, Dr. Hall? (Dr. Hall: Do you attribute all deafness or what degree of deafness do you necessarily associate with condyle intrusion?) Answering: No, condyle intrusion does not accompany ordinary deafness. Ordinary deafness would not be accompanied by condyle intrusion and would be associated only with cases where we had reason to believe that malposition of the jaws might have something to do with the relationship of the condyles to the tympanic plate.

When I prepared the paper, I said in working out these cases that it was necessary before we began any work in constructing artificial dentures to discover whether our patient had an accident to or a disease of the ear in order to exclude the possibility of backward

displacement of the condyle, but in any case where we have backward displacement of the jaws, then I would suspect this as being the cause of the deafness.

It is better for us to suspect malposition of the jaws as being the cause of existing deafness and if possible to correct this condition than to allow the patient to become deaf thru our neglect.

Then Dr. Gillis in reporting his case has had the same experience as I have. In some cases the return of hearing is rapid, and in some cases it is so marked that they approach nearly normal hearing. In other cases the improvement is slight. It is gratifying to know that some one else has done work along this line.

In closing the discussion, I want to thank this organization for listening to this paper which I thought would be exceedingly dry and uninteresting, because in order to get a definite idea of the result you must go back to the anatomical construction and try to glean what knowledge we can from that source, and in view of the fact that so much interest has been shown, I am sure that the time I have spent in working it out has not been in vain.

Dr. M. M. House: On behalf of our society I wish to extend to Dr. Wright our hearty appreciation and our thanks for this masterpiece which is so well gotten up and well presented.