

The palatal rugæ in man / by Harrison Allen.

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SEPTEMBER 18.

Mr. CHARLES MORRIS in the chair.

Fourteen persons present.

A paper entitled "The Palatal Rugæ in Man," by Harrison Allen M. D., was presented for publication.

SEPTEMBER 25.

Dr. J. B. BRINTON in the chair.

Nine persons present.

The following was ordered to be printed:—

THE PALATAL RUGÆ IN MAN.

BY HARRISON ALLEN, M. D.

The structures of the body which are the most constant and those which are the most variable have alike an interest to the biologist and to the physician. When constant they present characters which may be employed in classification, and when variable they are accepted as delicate tests for the activity of the nutritive and developmental processes. I propose in the connections last named to study the folds or rugæ of the hard palate as they are seen in the human subject after the period of infancy, especially in subjects who have reported to me for the treatment of chronic nasal catarrh. A group of minor structures is here met with which can be presented in a systematic manner notwithstanding the wide range of variation they exhibit.

What variations from the type met with in the lower animals are seen in man? How do these variations in turn associate themselves with morbid states? With what structures do these variations correlate? What forces are at work to produce in man results so different from those seen in the animals related to him?

I will attempt to answer these questions. I will also give among related appearances those which may have a clinical significance.

In the main it may be said that the rugæ of the lower animals form a constant series. But instances of irregularity can be given. They are much broken up in the posterior part of the palate of the hog. A slight asymmetry often exists in the horse; and instead of being in opposite, may be in alternate series. For a full discussion of the subject with literature, especially for the description of the human rugæ in the embryo and infant, see Carl Gegenbaur, *Morpholog. Jahrbuch*, IV, 673.

The following embraces a brief description of the rugæ in man and a list of names which will be employed in this paper.

Two kinds of rugæ are recognized, the longitudinal and the transverse. The *longitudinal* lie in the median line and answer to the line of union between the right and left maxillæ and premaxillæ; the *transverse* lie across the palate and are composed of a right and left set.

The longitudinal kind is divided into two parts, viz.: the *raphé*, or the seam-like line which occupies the middle of the palate at the

maxillæ, and the *incisive pad* which is an elliptical or pear-shaped body which answers to the position of the incisive foramen.

The raphé is ordinarily composed of two parts, one of which represents the median line and the other is deflected from it to the left at the posterior free end. (See figs. 2, 4, 7.)

The rugæ extend back no farther than the first molar tooth. The region answers to an imaginary plane which bisect the infra-orbital foramina. The rugæ are composed of papules which are arranged in series, an arrangement which is most evident in the posterior folds. The folds are smallest where the membranes are the thinnest and are the largest where they are the thickest.

As a rule the incisive pad is in line with the raphé, but it may be deflected (see fig. 3) or continued forwards between the central incisors (see fig. 5). Occasionally the anterior end can be seen from the front lying in the interval between the teeth named. It may persist in the aged long after the loss of the incisors. When the deflection is decided it enters into the causation of *torus palatinus*.¹

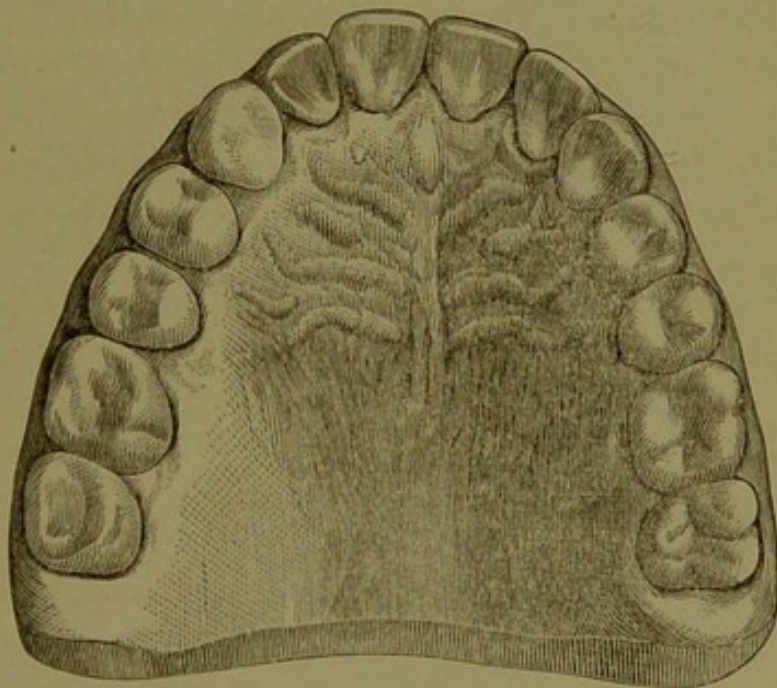


FIGURE 1.

The arch is wide and moderately arched. The rugæ as a rule are entire,—the exceptions being both first post-sutural rugæ—and the last post-sutural on the left side. The neck folds are conspicuous.

The largest transverse fold lies between the canine teeth or between them and the first bicuspid and answers to the suture between the maxilla and the premaxilla. It will receive here the name of

¹ For reference to *torus palatinus* see W. Sommer, Virchow's Archiv. 1883, vol. 94, 21.

the *sutural ruga*. The sutural ruga is the widest of any in the entire series. It is usually inclined somewhat backward, but never forward. A deep sulcus is often seen at the base of the sutural fold anteriorly.

The sutural fold divides the hard palate into two parts, the pre-sutural and the post-sutural. The pre-sutural space thus answers to the premaxilla and has but one ruga¹ (see fig. 2). The post-sutural space has four to seven rugæ and are named in order from before backward the first, second, third, fourth, etc. Of these folds the third is the best developed. As a rule the first and the second are the least so and are represented usually by small nodules, or by groups of papules, at the outer portion of the vault. They are often aborted. The fifth, sixth, and seventh are also often aborted or represented by faintly expressed broken sinuate lines. The presutural portion of the vault is nearly flat and is of a special use in presenting a firm surface for the tip of the tongue to press against in mastication and in speech. The post-sutural space is concave with an abrupt declivity forwards. The alveolar processes of the molar range and the declivity named bound the true palatal vault. It presents extraordinary varieties, no two subjects being in all respects the same.

The pre-sutural rugæ were found in an examination of 90 examples of hard palates, present on the right side alone in 11, on the left side alone in 1, on both sides, 17, absent in 50, doubtful in 11. Occasionally a system of minute raised folds extends from the raphé outward in the spaces between the rugæ.

The roof of the mouth at the region of the incisors and the bicus-pids is distinguished from that of the molars by the presence of folds of gum-tissue placed at the necks of the teeth. These may receive the names of the *neck-folds*. They indicate a disposition of the mucous membrane to be in excess at the parts where the palate is the narrowest. They often entirely occupy the pre-sutural space. The rugæ as a whole, are the best developed in the regions where the neck-folds are found.

Each palatal ruga is divided into a median and a lateral part. The median part, as a rule, is crescentic in outline with the convexity directed forwards. The lateral is directed forwards. Taken together the last named folds are arranged in vertical series, (i. e. with the main axes of the crowns of the teeth) and are either separated by

¹ Some of the figures show neck-folds which must not be confounded with rugæ.

intervals of equal size or are clustered at the alveolar border opposite the bicuspid.

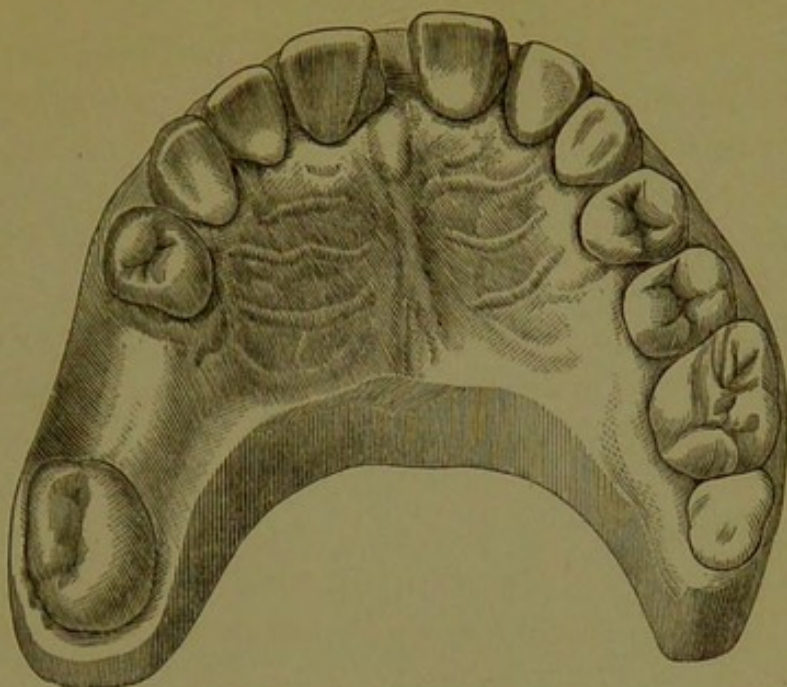


FIGURE 2.

The arch is flat and wide, the rugæ entire; no hyperostosis is present; moderate lateral concrescence is seen on the left side.

When the two parts, (the median and the lateral) are contiguous the rugæ may be said to be *entire*. But when they are separated by intervals more or less appreciable they may be said to be *broken*. In palates of a moderate curvature *i. e.* midway between the flat and the high vaults, the folds may be evenly disposed and be without break on one side while they are irregular and broken on the other. The left side is commonly the most developed, a feature which the rugæ exhibit in common with the mandible, the left ramus of which is commonly the larger.

An elliptical exostosis which is often met with on the roof of the mouth is almost always larger on the left side. The left sutural ruga (see fig. 3) is generally prolonged back farther than is the right. A similar disposition is seen in the first post-sutural ruga but to a less degree. The post-sutural rugæ especially on the right side (see fig. 9) may extend obliquely forward. The third is commonly so placed, but the fourth, fifth and even the second may illustrate this disposition (see fig. 8). As opposed to exostosis the term *hyperostosis* will be employed to denote the general excess of bone deposition along the line of the intermaxillary suture. It is a

common form of hypertrophy in the Anglo-American and one which has a distinct clinical significance (see fig. 5).

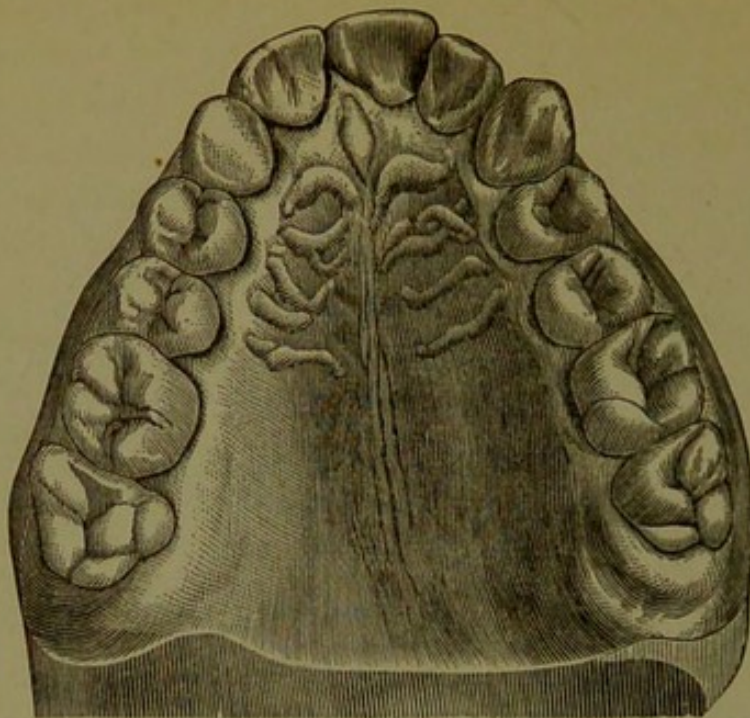


FIGURE 3.

The palate is moderately high arched. The lateral elements are elongated. The median elements are either two faint to be apparent or are absent.

The right lateral incisor is absent and the incisive pad shows an inclination to the side of defect. The left sutural fold is directed backward at the raphé.

The union of the right sutural and post-sutural rugæ so as to present a fork-like figure, the arms of the fork projecting outwards, is frequently seen.

The incisive pad, the raphé and the two sutural rugæ in rare instances may coalesce and give rise to a conspicuous cruciform figure.

The vertically placed lateral ends of the rugæ are by far the most constant of any parts of the series. They are especially well developed in high narrow vaults.¹

The course of the posterior palatine vessels and nerves serve as a guide to interesting conditions of the hard palate.

The mucous membrane is pale where it overlies tissues which are not in contact with the bone. The interval between the raphé and

¹ In the horse the roof of the mouth is very vascular. In *Mephitis* the pre-sutural portion appears to be in a similar condition. The exact limitation of this part of the roof is of interest and, so far as it goes, supports the position taken that the rugæ are naturally divided into a pre-sutural and a post sutural set.

the sides of the vault is marked by a whitish surface which yields to pressure. In some individuals this motion can be traced as far forward as the first post-sutural fold. The tract is best developed when the roof is normally formed. With a flat arch and a median exostosis present, the track is small. With rugæ well shown, but broken, the place of the interruption occurs across the track. The pale tracks appear to be entirely absent in high, acute arches. An association of the track and the color marking of the hard palate can also be detected. The high-arched palates are uniformly of a red color, while the flat arches are red only along the median line and at the region of the gum. A test exists here for the rate of blood vessel activity of the palatine structures and, by inference, of the rates of development of the maxilla.

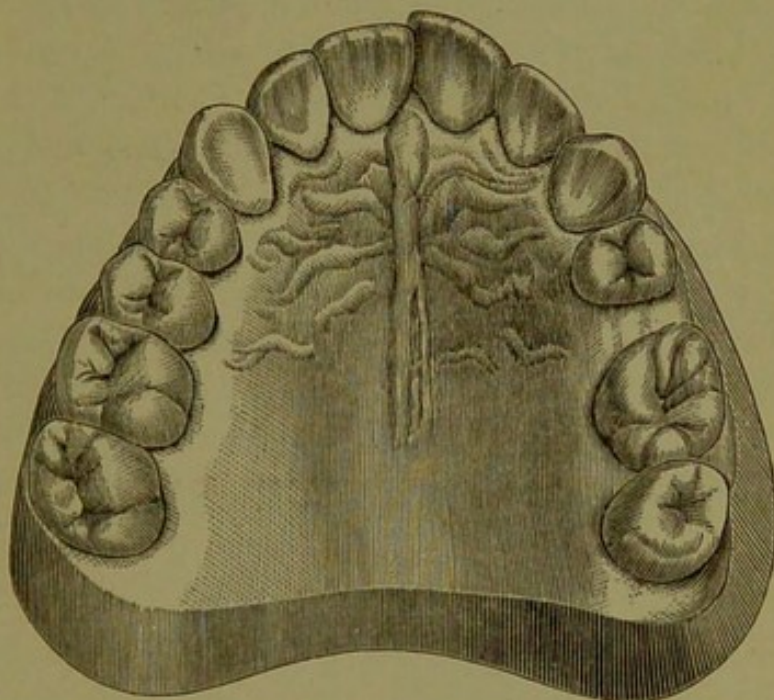


FIGURE 4.

The palate is normal in curvature. The incisive pad and raphé are continuous. The sutural folds are entire, the left fold extending farther up along the raphé than does the right. Median conresence is seen on the left side.

VARIATIONS OF THE RUGÆ.

At the risk of repeating some of the facts of the preceding description it is proposed to discuss under this head the principal variations of the rugæ. They will be included under the following propositions:

I. The rugæ of the left side tend to be the better developed (see figs. 3, 4, 5, 6, 7, 8,).

II. The rugæ of high laterally compressed as well as the wide, flat vaults are apt to be entire. (See fig. 8.)

III. The rugæ of vaults whose median suture has become the seat of general hyperostosis are always broken. (See. fig. 5.)

I. Not only is the group of rugæ on the left side more prominent than on the right, but the distance from the median line to the canine tooth is greater on the left than on the right side. The pre-sutural space is slightly the more prominent on the left. The left sutural rugæ is apt to be inclined backward as it approaches the median line to a point beyond that reached by the right. The right side exhibits a forked sutural ruga, and a larger first post-sutural fold than is seen on the left (see p. 261). The obliquely placed last post-sutural fold is as peculiar to the right side as the deflected sutural is to the left.

II. The rugæ of the high compressed vaults not only tend to remain unbroken but are well developed. The membranes are thick, cushiony and vascular. The incisors are thrown forward, since they cannot be accommodated in the narrow space between the canines, or the teeth last named remain out of the arch.

The skeleton is slight and the tonsils large if not hypertrophied.

The hard palate with a wide, flat arch is associated with thin rugæ whose intervals are wide (see figs. 2 and 9). The sutural rugæ tend to be deflected less than in the other types. A hyperostosis is common.

III. The form of the wide arch which is modified by the hyperostosis of the median structures of the palate is an illustration of the disposition of the bones where they unite one to another by suture to exhibit excess of nutrition.¹

The raphé is exaggerated, a median bony ridge extends along its line, the pre-sutural region is occupied by thick membranes and prominent neck-folds. The left sutural ruga is apt to incline backward at the median line. The right sutural fold is united with the third near the raphé. This group is frequently met with in subjects of nasal catarrh.

THE RUGÆ OF MAN AS COMPARED WITH THOSE OF THE LOWER ANIMALS.

A generally accepted method of study embraces the variations of human structures and those of the lower animals in which these "variations" are constant.

¹ See a paper by the writer, *Am. Journ. of the American Sciences*, 1870, 405.

Most variations in human anatomy are said to be reversions. While this method is a most valuable one it has a limited use when applied to the study of the rugæ, excepting in the instance of the broken rugæ, and even here the comparison is not exact.

The human rugæ derive their peculiarity from two causes: *First*, the divergence from the median line of the dental arches as they are traced from before backward; this is much greater in man than it is in the lower animals. Out of 96 examples of dental arches examined by me 58 were found to be deflected more on the left than on the right (see figs. 3, 4, 5, 6, 9,), 21 deflected more on the right than the left, (see figs. 1, 2) while 17 only were symmetrical. If, as I have assumed, the folds in part at least are the result of compression it follows that abrupt and varying deviations of the boundaries of the palate must greatly disturb the harmonious development of its rugæ.

The deviations of the curves of the vault especially when interrupted by a disposition to hyperostosis must also be a disturbing influence. In 90 examples of palates the hyperostosis itself was found in 51. This is certainly a remarkably high proportion and when it is remembered that the specimens were from the mouths of patients who were suffering from chronic nasal catarrh, the association is suggestive of a relation between coincident causes.

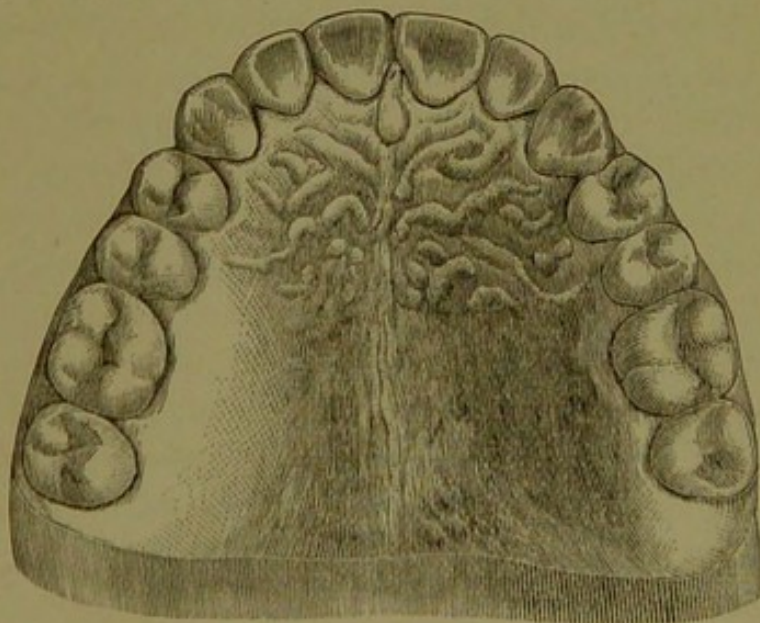


FIGURE 5.

The arch is wide. The raphé lies on a conspicuous ridge which forms a hyperostosis. The rugæ are irregular, while some in advance are long and entire, others are converted into clusters of coarse papillæ.

Again, in 90 examinations the sides of the vaults along the range of the bicuspid and molars was in 27 instances, both right and left,

nearly vertical, in 47 both sides inclined moderately outward, 3 had right side vertical and left inclined, 4 had the left side vertical and right inclined, and in 9 the inclination was undetermined.

Second, the extraordinary modifications in the proportions of the face. The face stunted as it is in its anteroposterior dimensions compensates for this defect in a great tendency to downward growth. The premaxilla is enormously thickened as it enters into the composition of the mouth; the sides of the vault including the alveolar processes are greatly elongated; and the sutural line of the maxillæ tends to become hyperostosed in the region of the rugæ or a separate exostosis forms back of it on the free surface of the palate. It has been seen how the presence of the hyperostosis modifies the shapes of the rugæ. The firm suture between the premaxilla and the maxilla determines the greater size of the ruga which answers to it. The sides of the vault drag the lateral part of the rugæ of the post-sutural set from a horizontal to a vertical and forward position. The median hyperostosis breaks the rugæ into parts,—a condition never seen so far as I know in any quadruped. The changes are in illustration of the well known law that peripheral structures are conformable to the deeper lying tissues with which they are in correlation.

One of the most conspicuous appearances in the human rugæ is the approach of two or three folds towards one another either at the median or lateral ends. It is most marked in children in the lateral ends (where they are clustered toward the deciduous canines and molars) and in the adults at the median ends anteriorly.

The third and fourth rugæ of the right side have marked special dispositions to incline forward and inward, often cutting off the first and second folds or causing them to disappear. The convergence may go so far as to effect union between the different folds. Especially is this the case between the sutural fold and the third on the right side, by means of which the forked appearance is seen (see fig. 8). In some examples the sutural fold is united with the third behind, and with the pre-sutural in front.

In 90 specimens examined I found the lateral ends of the left rugæ convergent in 19; the lateral ends of those of the right side in 10; and on both sides in 11.

In the same number of specimens I found the median ends convergent in the left side in 6, on the right side in 4, and on both sides in 5.

The rugæ may be convergent on one side and transverse on the other. It is thus seen that the disposition of the rugæ to form little clusters is noticeable.

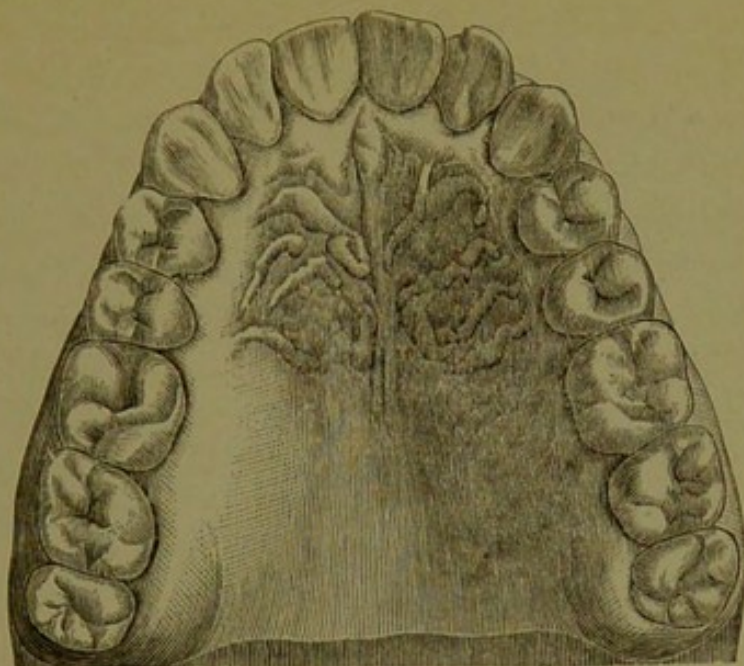


FIGURE 6.

The palate is wide but with deep recesses from a moderately high arch back of the sutural rugæ. The lateral elements on the left are regular and elongated; those on the right are unusually irregular, and first and second post-suturals very oblique. The median elements on both sides are strangely disturbed. Median concretion exists on both sides.

The inclination for the third, fourth and fifth rugæ on the right side to incline forward is especially marked.

In 90 specimens I found the right rugæ thus inclined in 33, the left only in 2 while in both right and left, 16. In the whole number the inclination of the third rugæ is the rule. The disposition is marked in palates with hyperostosis.

The median half of each ruga may incline independently of the lateral, but the inclined fold is, as a rule, entire. The degree of inclination is variable but it may be expected to be so great that the sutural and post-sutural folds may unite.

The approach of the rugæ one to another their entire length is much less frequently seen than the foregoing. The sutural, the third and the fourth post-suturals may be coalescent. In 90 examples this was noted on the right side 9 times, on the left 6 and on both 2.

The union of the sutural and pre-sutural I have seen but once. It was symmetrical.

The folds may be contiguous only. In 90 examples I found the arrangement on the right side 3 times, on the left 1, and for both 5.

It is probable that some forces create the variations above noted, which are distinct from those already named. They are evidently often out of harmony with one another,—the right side exhibiting their effects oftener than the left. Sometimes they are operating on the ends of the folds, sometimes in their entire length of the median halves. That they are correlative with morbid phenomena is undoubted (see p. 269). For the clumping of the rugæ their entire length is often found in atrophic foetid catarrh, and in the senile state. But it may be so by coincidence. No data exists which covers the entire range of appearances. Certainly nothing comparable to such dispositions are seen in the lower animals.

The term *concrecence* is an exact and convenient term to use in describing this class of modification of the rugæ.

The common abortion of the first and second post-sutural rugæ is not the least instructive of the changes affected by concrecence.

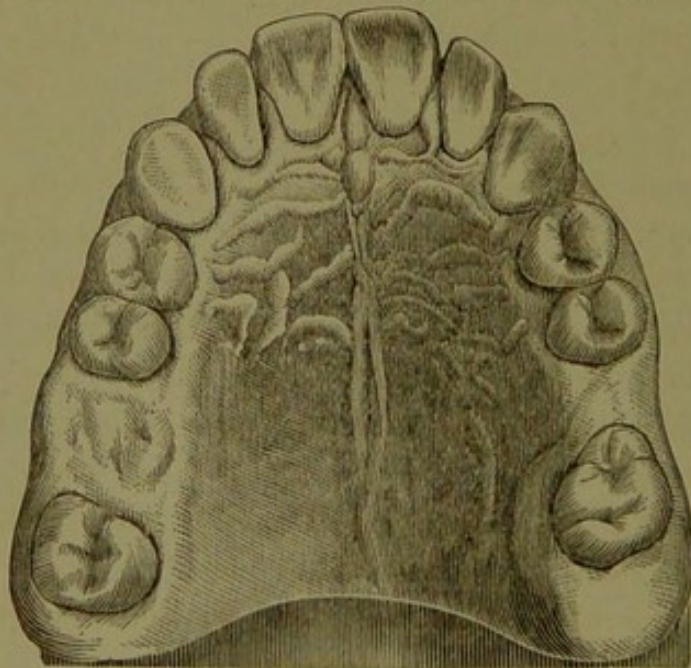


FIGURE 7.

The incisorial pad is divided by a transverse groove. The raphé shows a tendency to right and left subdivision. The left sutural ruga is deflected backward along the raphé. The post-sutural rugæ are irregular. A small pre-sutural ruga is evident. The right post-sutural rugæ tend to be oblique, especially in their displaced median elements. Median and lateral concrecence is shown on the right side.

The deflection of the left sutural fold backward along the raphé is probably also an example of concrecence. But for some reason it does not tend to unite with the post-sutural.

Of 90 examples I found the left sutural ruga thus deflected in 49 instances, the right, in 3 instances only, and on both right and left, 5 instances. In all the other examples the fold was transverse. In deflection it must be noted that the ruga after reaching the raphé is thence abruptly turned so as to be parallel with that structure. Both the right and the left fold may be inclined back before approaching the raphé or may not reach it at all.

The forms of the rugæ are never pathological as I venture to define that term. The question to what extent variations of structure may be said to be pathological is no longer a novel one. The fact that the forces operating in the economy often antagonize is generally accepted. Upon this antagonism the approach to symmetry as seen in the paired structures alone depends. In the plastron of a turtle (*Chrysemys picta*) in my possession, the plates exhibit a constant disposition for those of the right side to crowd and minimize those of the left. The same disposition for one side to gain ascendancy is seen in all paired structures which form by their growth inward a median suture or raphé. If such minor variations were to be called pathological every living creature would be an epitome of morbid anatomy. Anatomical variation I assume to be a better term for such deviations unless the structures are hurtful to the individual or at least tend to be so. A pathological condition is one in which the final effect is to create distress or to excite lesion. Prof. Alpheus Hyatt has described certain distorted shells found by him as constituting pathological species. Are not such species degraded, or reverted rather than pathological forms? The comparison sometimes made between the horn of the rhinoceros and the epidermic hypertrophies which appear upon the surface of man and some of the lower animals, is based upon the conception that the outgrowths are in both instances of the same nature,—that they are both pathological and differ only in the single feature that the rhinoceros by the law of selection has utilized a horn which happened to appear at a convenient locality. To my mind the structure is not pathological unless it expresses perverted function or interferes with a function; not only this but that it interferes in an abrupt, obstructive manner. If it does not so appear but in such guise as to encourage the animal to use it; the organ should be named an anatomical variation.

The word pathology is an anachronism in a system of biology. It originated at the hands of observers who had imperfect concep-

tions (if indeed they may be said to have any at all) on the general physiological laws operating in all the tissue changes of the body. What was once "morbid" is now natural. If the word is to be retained by naturalists, it should have a strictly medical application—the one originally designed for it by practical men.

THE CORRELATION BETWEEN THE RUGÆ AND THE INTERIOR
OF THE NOSE.

I have met with ten examples in which the left side of the nose was smaller than the right and in which the same side of the hard palate was also the smaller. Care must be taken to distinguish the common variety of narrowing of the nose by a deflection of the septum from the much rarer form or reduction of the chambers in all directions.

In six cases the right side of the nasal chamber was the larger and a corresponding increase in size of the right half of the palate was detected.

But the association between palatal and nasal conditions is by no means uniform and at the same time I cannot conclude that the cases brought forward in evidence were coincidences. I have studied individual cases in which not only was harmony present between the proportions of the nose and the hard palate but between these structures and the cranium as well.

It may be said that, in a manner, the law of symmetry is not without exemplifications in the harmonies of the arrangement of the sides of the hard palate, with the nasal chambers and with the corresponding side of the head but that this exemplification is subject to so many exceptions by the operation of minor disturbing factors as to be rarely present.

In examples of hyperostosis of the inter-maxillary suture the inferior turbinated bones are high and apparently compressed. This condition is often associated with imperfect development of the vomer at the choana. The same peculiarity is found in high V-shaped vaults.

A well defined group of subjects exhibit intumescent states of the membranes of the premaxillary portion of the nasal chamber, a rounded nodule projecting from the floor of the vestibule, a prominent anterior end of the inferior turbinated bone, and a tumid state of the membrane covering the septum. While such pronounced morbid appearances are seen in the front of the chamber the remainder of the nasal surface is perfectly healthy. Coincident with these

peculiarities of the nose the roof of the mouth is distinguished by a small incisive pad and coalescence of the sutural and the third post-sutural folds. The tonsils are moderately enlarged.

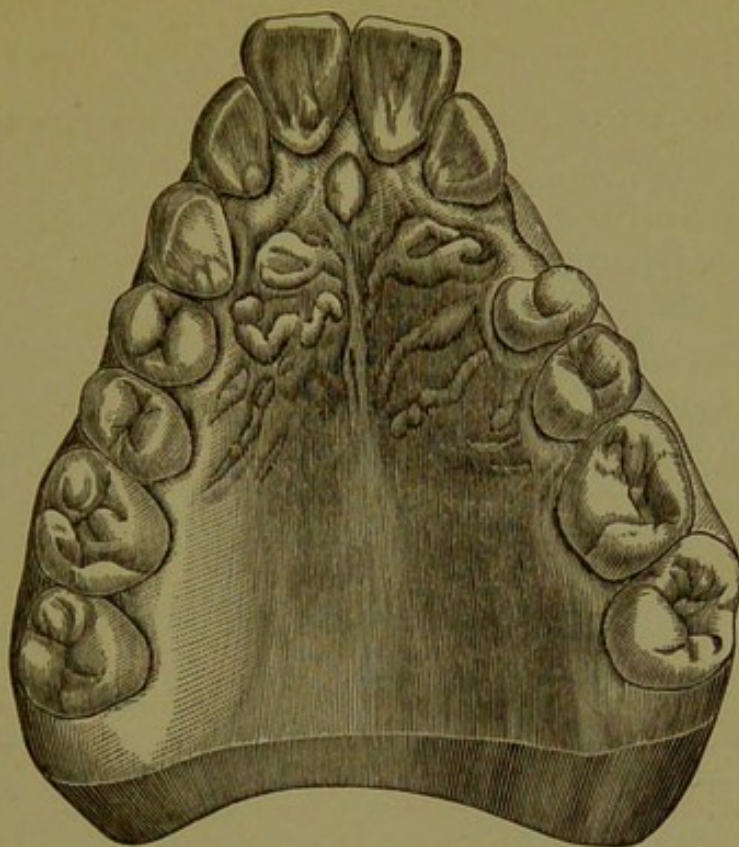


FIGURE 8.

The arch is narrow and high, the pre-maxillary portions being thrown forward. Hence the space between the sutural rugæ and the incisorial pad and all the parts in advance of the sutural rugæ are exceptionally open. The third post rugæ is confluent with the sutural on both sides. The pre sutural rugæ are absent.

THE RELATION BETWEEN THE RUGÆ AND THE TEETH.

The relation existing between the rugæ and the teeth is not as important as would at first sight appear. For the pre-maxilla it may be said that no influence is exerted by the incisor teeth over the pre-sutural rugæ. The sutural ruga is directly opposite the canine teeth, the first post-sutural, directly between the canine and the first bicuspid, the second ruga opposite the bicuspid, etc. In the Proceedings of the Acad. of Nat. Sci. of Phila. p. 310, 1882, I proposed a system of naming of the parts in accordance with these facts. But it is less satisfactory than the one used in this paper.

Nevertheless the following statements would confirm the position assumed that some connection between the rugæ and the teeth must be accepted to exist.

The axis of the incisive pad when deflected from that of the median line is inclined toward the side which is minimized by the non-appearance or extraction of one of the incisor teeth of the permanent set, by the eruption of a tooth on the buccal or labial side of its arch, or by some third related cause (see fig. 3).

In one adult subject whose palatal vault exhibited straight, regular, unbroken rugæ on the right side retained on the left all the rugæ broken and parts of two entering into the composition of the pre-sutural and the sutural. The left side was narrower than the right. It is not likely that the irregularity of the rugæ on the left side was independent of the fact that the lateral incisor and the second bicuspid were absent from the upper jaw, and that the second bicuspid on the same side of the lower jaw was also absent, its place being taken by the second milk molar which had never been changed from the time of its eruption and was in all respects a normal, healthy tooth. The left side of the face was slightly smaller than the right.

In a girl of twelve years the rugæ were normal on the left but on the right the sutural fold was forked and the remaining folds broken. On the left side the left second bicuspid tooth was absent, while on the right both teeth were in position.

It is always of importance to remember that the mouths of children in whom the deciduous canines and molars are yet in position at a time when the permanent incisors and the first permanent molar have been erupted, that the rugæ exhibit a disposition to approach one another toward these teeth. Is it possible that the change from the infantile arrangement where the folds are entire, regular and symmetrical to that of the older child, where the acquired variations take place, is due either to the retention of the deciduous canines and molars, or to the retardation in development of the permanent bicuspid teeth?

The region of these teeth is an exceedingly active one within the maxilla since the germs of the permanent canine and of the bicuspids are well advanced to completion. At the same time the peripheral structures are not changing in correspondence. Hence an element of disturbance is created.

CLINICAL APPLICATIONS.

It is evident that if, as has been claimed, the rugæ are modified by nutritive and developmental processes they will have clinical significance also. The application will be especially evident in the

manner in which the rugæ are aborted by protusion of the premaxillary elements, and of the hyperostosis of the structures at the raphé. When the vault is flat—the rugæ tending to be symmetrical though feebly developed,—a condition is present which is often found associated with chronic nasal catarrh of the atrophic type. If the arch is wide the sides of the palate and the alveolar processes

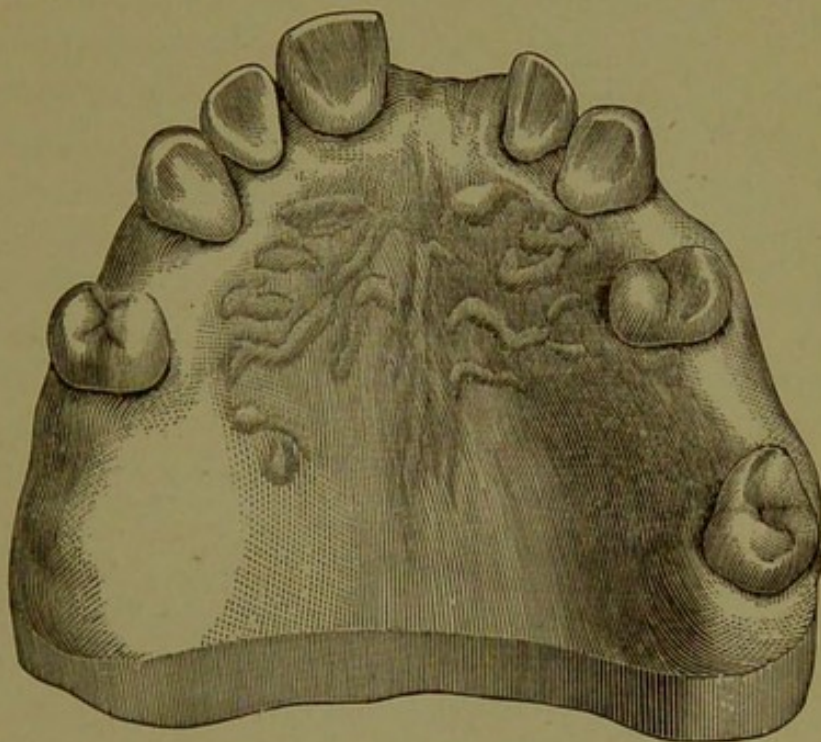


FIGURE 9.

The hard palate is without neck-folds, is of low arch and is wide. The raphé is nearly obliterated. The rugæ are broken. The lateral half of the third post-sutural fold extends obliquely forward and is in line with one of the median elements (probably of the second). No similar disposition is seen on the left. Lateral conrescence is seen on the left side.

are not well developed, the rugæ are gathered in a clump upon an anterior declivity of low inclination, the turbinal scrolls are small, and the membranes nonerectile. The teeth in such individuals are large especially the incisors, the patient is predisposed to premature recession of the gums from about the necks of the teeth and to suppurative affections of their roots.¹

The Incisive Pad. The pad is often of a bluish red color when the palate elsewhere is of a pale hue. At other times the pad is of pink color and the base surrounded by a deep blue line. Thus the pad may be congested either in whole or in part while the rest of

¹ For the connection between atrophic catarrh and premature recession of the gum see a paper by the author in *Dental Cosmos*, 1885, xxvii, 329.

the hard palate be entirely free. In a man fifty six years of age from whom I had removed a number of polypi the pad was the seat of soreness and pain for a week after the operation. It constituted the only annoyance which followed upon an operation of exceptional extent. In children who have been operated upon for deflected septum the necks of the teeth are surrounded by a purplish red line as long as the plug is worn in the nose.

Absence of Rugæ. The rugæ may disappear by pressure from within, as from a nævus or a fibrous tumor, and from without, as from the pressure from a plate for artificial teeth. The absorption of the alveolar process after the extraction of teeth, as a rule, induce the absorption of the rugæ, but occasionally the rugæ persist and are found lying directly across the position of the former dental arch.

Medico-Legal Value of the Rugæ. The persistence of the rugæ after death leads to the conclusion that they may afford valuable signs by which the body can be identified, for during the processes of decomposition the mucous membrane of the hard palate is among the last to be lost. When the positions of the rugæ are recorded (as in the event of a patient having been recently under the care of a dentist and the impression of the rugæ having been taken in plaster,) it is certainly true that the folds could be used in connection with the teeth, or even in the absence of these organs, in identifying the subject.

Congenital Syphilis. In congenital syphilis I have often observed that while the roof of the mouth especially at the anterior part was of a deep red color from inflammation that the rugæ were milk white. The folds become swollen and painful in acute inflammation of the roof of the mouth and infiltrated in cases of prolonged suppuration from the alveolar processes.

In the diagnosis of syphilis this appearance is of importance. While the characters of the teeth as caused by scarlet fever may be much the same as those produced by syphilis yet in the sequelæ of the disease first named the hard palate yields no characters. In syphilis more or less congestion if not inflammation appears to be constantly present.

The study presented in the foregoing pages is based entirely upon examinations made upon living subjects. Forms of mouths which occurred to me as interesting were selected and casts of the rugæ

and teeth taken in plaster with great care.¹ The material therefore is not of the average. It is based upon the hard palate of individuals known to have some disease associated with disturbed states of secretion of the nasal chambers.

In order that the study should have a more extended application it was thought to be desirable before any exact clinical conclusion could be drawn that a study of similar extent be based on material known to be derived from entirely healthy individuals.

To make such examinations I visited the State Eastern Penitentiary in this city and by the courtesy of Dr. W. D. Robinson, the physician of the Institution, was enabled to study the mouths and nasal chambers of the inmates. In this way ninety examinations were recorded.

In no instance was hyperostosis present in the form spoken of in the foregoing pages. Nor was a single case of hyperostosis of the roof of the mouth back of the region of the rugæ seen. In a word no form of rugæ was detected which was broken by the descent of the median structures.

In twenty-two examples the raphé was sufficiently prominent to form a slight fullness which could be felt by the finger. The remaining fifty-eight examples were perfectly smooth.

The rugæ were very commonly of the form exhibited in Figs. 1 or 2 with a disposition for the folds to be con crescent at their outer ends. The examples of the left sutural rugæ deflected along the line of the raphé were but six in number; moderate degree of asymmetry of the sides of the roof in seven; concrescence of the right sutural and post-sutural as to form a fork-like figure in but three.

It is evident that the variations of the arrangement of the rugæ were within a much narrower range than in the ninety cases from subjects from other sources.

The roof of the mouth presented no narrowing of the vault with compression as seen in Fig. 8, and no flat wide palate as seen in Fig. 9. Thus the extremes of variation—viz., of the high narrow vault and the low, wide vault were absent. But one instance of a moderately compressed vault was seen and in this example the pre-maxillæ were not thrown forward.

¹ I desire in this connection to acknowledge my indebtedness to many of my friends especially to Dr. L. Ashley Faught, Dr. E. C. Kirk and Dr. J. M. McGrath. Dr. J. W. White and Dr. W. Storer How of the S. S. White Dental Mfg. Co., also greatly aided me in the investigation.

Respecting the presence of catarrhal affections in the cases it is necessary to say that not a single man among the entire number examined had complained to Dr. Robinson of any of the symptoms of these diseases. I detected small quantities of secretion in the nasal pharynx in fifteen instances. I cannot admit that this circumstance had any significance in the absence of any of the usual appearances of the membranes.

The teeth and nasal chambers were also examined but nothing found which is of special mention.

Conclusions. The following conclusions may be drawn from the statements made in the paper.

(1) That the range of variation in the roof of the mouth and its folds is greater in subjects of nasal catarrh than in those who are free from this disease.

(2) That the variations of the rugæ are different on the two sides of the roof.

(3) That excess of development of the pre-maxilla and the horizontal plate of the maxilla, especially at the anterior portion, constitutes a condition which is found in about fifty per cent. of cases of chronic nasal catarrh.

(4) That chronic nasal catarrh is found associated with so many phases of asymmetry of the rugæ of the hard palate and the dental arches that the disease should be studied as a morbid action which is based upon morphological elements and not alone upon climatic conditions.