X-RAY MEASUREMENT OF THE PERMANENT TEETH BEFORE ERUPTION TO PROVIDE FOR EARLY REGULATION OF THE DENTAL ARCH.*

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Imperfect development of the teeth is not only a disfigurement but renders proper mastication impossible and the proper action of the saliva unlikely. The effects are starchy indigestion and irritation from unmasticated meat with auto-intoxication from both.

In the young child, as Dr. Strang remarks, "the nasal passages are lined below, in front and on both sides by the germs of the teeth" and imperfect development of the teeth and of the maxillary bones supporting them occasions mal-development in the bony walls of the nasal passages and the accessory pneumatic sinuses of the face; and the effect of under-development may even extend to the cranial cavity and the brain.

Deviations of the septum and mouth-breathing unrelieved by the removal of adenoids and tonsils are among the results of mal-development of the teeth.

A patient referred to me, 13 years old, has a great gap where the two upper central incisors should be, and an x-ray examination shows that these teeth are present and in normal position but simply cannot come down for lack of space.

Another patient, a little older, has failed to erupt the right upper central incisor and the x-ray shows that while this tooth is present, it lies in a horizontal position in the maxilla, growing forward instead of downward. This has resulted from the presence of two unerupted supernumerary teeth lying above the persistent temporary upper central incisor and blocking the descent of the permanent tooth. Other patients as adults are still minus certain teeth and the x-ray shows that some are present but retarded for lack of space and others are absent altogether. My album passed around this evening shows hundreds of similar malformations.

The object of my most recent work has been to determine beforehand the presence and position, and especially the size of the permanent teeth before the loss of the temporary teeth. The latter may be quickly and easily trained to a curve of the proper radius and will then guide the permanent teeth into proper position.

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My work shows the size that the permanent teeth will have and the radius of the curve required to accommodate them.

My first work in this connection was undertaken in 1906, at the suggestion of my friend, Dr. Henry W. Gillet, and a series of radiographs of the unerupted permanent central incisors was shown

Figure 1.

Figure 2.

Figure 3.

at a meeting of the New York Institute of Stomatology, in that year, with a promise to complete my report when the permanent teeth should have erupted. A certain number of the children have now been traced and the actual measurements have been compared with those predicted by the x-ray.

The practicability of radiographing the teeth of children five or six years of age is shown by my own series of over thirty children with only a single refusal.

TABLE I.

ACTUAL WIDTH OF TEMPORARY AND PERMANENT CENTRAL INCISORS (THE LATTER MEASURED
SOME YEARS LATER) IN HUNDRETHS OF AN INCH.

Name	Age at First Measure- ment. (years)	Age at Second Measure- ment. (years)	Weight at 2nd Measure- ment. (pounds)	Right Upper Central TEMPORARY.	Right Upper Central PERMANENT.	Ratio 1 to	Left Lower Central TEMPORARY.	Left Lower Central PERMANENT.	Ratio 1 to
Matthew Sweeney	6	8	.....	25	38	1.52	15	24½	1.63
Clara Tucksmith	5	10	85	24	36	1.50	15½	22	1.42
Cecelia Leonard	7	9	.....	21	33	1.30	.....	21	.....
Gretchen Winter	5	10	73	25	29	1.16	14	19	1.36
Margaret Frutchy	5	10	72	25½	33	1.25	16½	21	1.28
Florence Fox	5	10	63	25	34	1.36	14	21	1.50
Sissie Rielly	5	10	60	23	36	1.57	11	23	2.09
Jeanette Stevens	6	8	.....	22½	31	1.38	.....	.....	.....
Nora Ferguson	6	6	.....	.....	35	.....	.....	.....	.....

Figures 1, 2, and 3 are radiographs of the upper and lower central incisors showing both the temporary and the permanent teeth. Figure 4 shows the caliper square graduated in hundredths of an inch and with a screw adjustment in actual use in measuring the width of an unerupted tooth in a radiograph. Figure 5 shows how easy it is to read the 1-100 inch graduations with a magnifying glass.

The desirability of this early measurement is shown by the number of children whose permanent teeth come in crowded and out of alignment or are delayed in eruption through mal-position or some of which are missing altogether. Actual measurement of the temporary teeth will give no information as to absence or mal-position of the unerupted permanent teeth and my cases show that actual measurements of the temporary do not correspond with the

Figure 4.

actual measurements of the permanent teeth made after their eruption.

From Table I it is evident that neither the weight of the child nor the width of the temporary central incisors affords a basis for calculating the width of the permanent incisors.

Among these nine children taken at random, one weighing eighty-five pounds and another weighing sixty pounds, both at the age of ten years, the permanent upper central incisors were the same width (0.36 inch) while in another child of the same age and weighing 73 pounds the width was 0.29 inch.

Among the same children three had temporary upper centrals 0.25 inch wide and had permanent upper centrals 0.38, 0.29, and 0.33 inch wide. It will be noted that 0.38 is the greatest and 0.29 the smallest width in this series.

The columns headed "ratio," show that there is no fixed relation between the width of the temporary and that of the permanent teeth.

The presence and position of every tooth may be determined by the x-ray, but the most important measurement, in hundredths of an inch is the greatest width of the unerupted permanent central incisors, the upper ones being of chief consequence.

These measurements show at once the practical width of the unerupted centrals. Mathematically exact measurements would require a geometrical calculation since the unerupted tooth is at a certain distance from the film and consequently its shadow image is very little enlarged.

Figure 5.

This calculation shows that about one-thirtieth of the width of the shadow of the unerupted tooth should be deducted to obtain the actual width of the unerupted tooth in a radiograph made upon a horizontal film according to the author's present technic.

Another detail which requires the closest attention is in the measurement of the width of the shadow, so as not to include the penumbra which is present even with the x-ray when the object is not in contact with the surface upon which its shadow is cast. The very small diaphragm in the author's present technic makes it possible to secure clear images of the unerupted teeth with very little uncertainty as to the width of the true shadow.

The direction of the tooth casting the shadow is of vital importance; a correct radiographic measurement being only possible when the tooth directly faces the x-ray tube. One of the central incisors will usually do so if the tube is placed in front of the patient without too great an effort to get it absolutely in the median line. The tooth whose occlusal edge is squarely at a right angle with its long axis in the radiograph is the one to be depended upon for a correct measurement. This is one of the particular advantages of the author's method of casting the shadow of the teeth

Figure 6.

Figure 7.

upon a film placed horizontally in the mouth. The curve of the dental arch is shown and it is easy to see whether a tooth directly faces the x-ray tube and at what angles the others are placed. The shadows vary like those of a visiting card held vertically to a sheet of paper and turned toward or somewhat away from a lamp which is at an elevation of forty-five degrees from the plane of the paper. In some cases the radiograph shows that both unerupted centrals are turned so far to the sides that an exact measurement requires another radiograph with the tube sufficiently to one side. This revelation of the sharp angle between the centrals is important as indicating narrowness of the dental arch.

It is the author's custom to make accurate measurements of the width of each temporary upper and lower central when making the radiographs of the unerupted permanent centrals. Knowing the actual measurement of the temporary teeth and applying our caliper square to the x-ray image of the same teeth one soon becomes able to measure the latter accurately.

Figure 8.

Figure 9.

The radiograph showed the entire absence of the germ of one of the lateral incisors in one of the cases where radiographic measurements were made. The author has made many hundreds of radiographs in older children and adults to determine the presence or absence and the position of unerupted teeth which have caused years of uncertainty. This would all be obviated by an x-ray examination at about the age of 6 years.

Having made measurements of the unerupted permanent central incisors the question naturally arises as to how nearly accurate

these measurements are likely to be. This is answered by Table 2. In all these cases the radiographic measurements have been made from films which were marked for identification at the time they were taken and which are still available for demonstration. The difference between the radiograph of the unerupted tooth and the actual width of the same tooth measured some years later after eruption in no case exceeds one one-hundredth inch. This variation is within the limits of possible error in making the actual measurement after eruption and is well within the limit of accuracy required for practical work in orthodontia. The children themselves are available as well as the original films if the accuracy of my figures needs corroboration.

TABLE II.

PERMANENT CENTRAL INCISORS MEASURED RADIOGRAPHICALLY
BEFORE ERUPTION AND ACTUALLY SOME YEARS
LATER AFTER ERUPTION.
(Numbers are hundredths of an inch).

Name	Tooth	Radiograph Unerrupted	Actually After Eruption.
Matthew Sweeney	Left Upper Central	39	38½
Clara Tucksmith	Right Upper Central	36	36
Clara Tucksmith	Right Lower Central	22	22
Cecelia Leonard	Right Upper Central	34 oblique	33
Gretchen Winter	Right Upper Central	29	29
Florence Fox	Right Upper Central	35	34
Sissie Reilly	Left Upper Central	36	36
Jeanette Stevens	Left Upper Central	32	32
Jeanette Stevens	Right Lower Central	21½	22

TABLE III.

WIDTH (in 1-100 inch) OF ERUPTED AND UNERUPTED PERMANENT
UPPER CENTRALS AT THE SAME DATE.

Name	Tooth	Unerrupted Radiograph	Erupted Actual Measurement.
Nora Ferguson	Right Upper Central		35
Nora Ferguson	Left Upper Central	34 oblique	

Table 2 includes all the children of whom I have the original radiographs of the unerupted and the actual measurements of the

same teeth after eruption. It does not include a large number of radiographic measurements in children whom I have not been able to secure for measurement after eruption.

Table 3 relates to a child in whom one upper central was erupted and the other unerupted at the time the radiograph was made. The radiographic measurement of the unerupted tooth was the same as the actual measurement of the erupted one.

PRACTICAL APPLICATION OF THE METHOD.

The upper arch is the one which it seems most important to determine and it is practicable to measure the widths not only of the central incisors but also of the laterals and canines. The cases so far examined show that an arch calculated from the width of the upper permanent, unerupted central incisor is the correct one for the purpose in hand. This superior arch is based upon Bonwil's, Hawley's, Bogue's and McNaughton's work.

Figure 10.
Shows width of one permanent upper central incisor. The other is seen more or less in profile.

Figure 11.
Shows width of both permanent central incisors.

Double the greatest width of one permanent upper central: add .24 inch to it. The sum is the radius of the circle formed by the occlusal edges of the centrals and laterals and the cusps of the canines. Draw a small circle with this radius and with its center at *B*. Use the radius to measure the distance in a straight line from *A* the space between the centrals to *J* and *H* the distal points of the canines. Draw lines from *C* (diametrically opposite to *A*) through *J* and *H*, respectively, intersecting a line tangent to *A* at *E* and *D*. Use the line *ED* as the radius of a large circle with its center at *I*. Mark off this radius six times upon the circumference to determine the inscribed isosceles triangle *A, F, G*. The buccal cusps of the bicuspid and molars lie along the lines *J* to *H*, and *H* to *G*. Add 50 per cent to the radius of the small circle to get the distance from the anterior surface of the first upper permanent molar to the space between the upper centrals.

The curve of the temporary arch, whether right or wrong, is reproduced in the permanent arch in my cases. In the case of Sissie Reilly the temporary arch corresponded (Figure 6) to upper central incisors .30 inch in width. The temporary upper centrals measured .23 inch and the unerupted permanent upper centrals .36 inch. Five years later the permanent arch (Figure 7), is much too narrow and corresponds as did the temporary arch to upper centrals only .30 inch wide. This case is a striking example of the benefit which might have been secured by early regulation and of the fact that in such a case spontaneous expansion of the arch is not to be

Diagram
Preliminary work.

Diagram 2

Curve calculated by Tousey's method for permanent upper centrals 0.37 inch wide. E. D. is taken as the radius A. I. of the large circle. Of course, the teeth do not extend anywhere near as far back as F. and G.

depended upon. Figure 7 shows what the arch should be for permanent upper centrals .36 inch wide and how far Sissie Reilly's differs from the normal.

In the case of Clara Tucksmith the temporary arch (Figure 8), corresponded very well with the curve based upon a width of .36 inch shown by the radiograph of the unerupted permanent upper centrals. But the permanent arch (Figure 9) is deficient in that the centrals are placed at a re-entrant angle and one entire side needs lateral expansion. The radiograph of the unerupted upper centrals showed this indentation of the upper centrals. This was only slightly foreshadowed by that of the temporary centrals. This might have been corrected by moving the temporary teeth.

I am under obligation to Drs. Gillet, Young, Fairchild and Bogue for advice and assistance in this work.

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Complications After Adenectomies. DR. MAX LEWY, Charlottenburg. *Ztschr. f. Laryngol., Rhinol. u. ihre Grenzgeb.*, Bd. 5, Heft 2, 1912, p. 247.

In removing this chronically inflamed vascular organ, frequently containing encapsulated suppurating foci, we set a wound surface similar to that in infected abortus. We should, therefore, expect post-operative complications in nearly every case. The perfect drainage of the wound-secretions and the drying action of the respiratory air enhance healing.

The writer reports the following interesting complications following adenectomy: (1) Scar-formation, simulating syphilis; (2) torticollis, being practically an acute myositis of the pre-vertebral muscles; (3) fatal septic exanthem; (4) acute middle-ear suppuration with fatal meningitis, 7 days after the operation; (5) arthritic rheumatism; (6) septic letal diphtheria.

As prophylactic measures, the writer recommends postponing the operation when the patient suffers from an acute disease or when there is a case of sickness in the patient's family. GLOGAU.