Function And Growth

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The objective of moving teeth orthodontically is to establish a satisfactory esthetic and functional occlusion. We wish this occlusion to be associated with a pleasing facial contour and we wish it to be relatively stable but, more than this, we should desire that it be in functional harmony with the two temporomandibular joints and the musculature. The time relation of the therapy and facial growth dictates as to when the satisfactory occlusion is attained — presuming, of course, that the therapy is adequate. Recognizing the clinically demonstrated fact that facial growth and favorable growth increments of the facial components shortens the time of treatment and enhances the result attainable, the opposite is likewise so.

It is not a new opinion that orthodontic treatment does not promote growth of the mandible and maxilla, excluding the alveolar process. Again the opposite is so, that therapy does not inhibit growth. If the antitheses of these tenets were true and the orthodontist by therapy could promote or inhibit facial growth, the proportion of seemingly desirable results would be increased many fold. Individual cases are offered from time to time as evidence that growth had been influenced but these are countered by those in which the same therapy did not produce a similar "response". The response, or rather the association of growth and therapy, is entirely too variable for one to assume that therapy influences growth.

In further consideration of growth, the working hypothesis set forth in this paper is that, while favorable incremental and directional growth of the facial parts is our ally in treatment, continued growth subsequent to treatment is our functional foe. Specifically, continued mandibular growth at a greater rate than maxillary growth — desirable as it is in the correction of malocclusion — may be a functional detriment later on two counts, viz., abnormal temporomandibular joint function and traumatogenic relations of the teeth. This hypothesis is documented as fact, at least in part, by the following orthodontically-treated cases selected on the basis of disharmonious function of the parts of their respective stomatognathic systems.

This paper is a further extension of the functional concept set forth in two previous publications, *"Concepts Regarding Function of the Stomatognathic System"* [1] and *"Function — The Neglected Phase of Orthodontics"* [2]. The method of functional analysis and a more detailed description of the abnormal functional conditions of the stomatognathic system as outlined in these publications will not be repeated here but rather attention will be focused toward the conflict of favorable growth and abnormal function.

Case R.T. (Figure 1) was a Class II, Division 1 malocclusion. In the deciduous dentition the SNa (Sella turcica-Nasion - Point a) and SNb (Sella turcica-Nasion - Point b) difference was -11°, that is, SNb was 11° less than SNa. The evaluation of SNa at this age was not accurate as the anterior portion of the maxilla was contoured by the unerupted permanent incisors.

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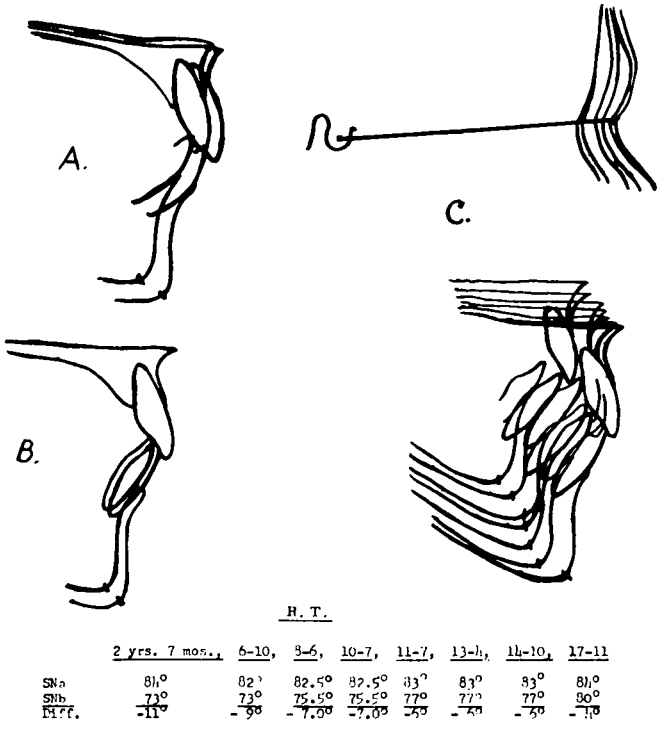

Fig. 1 A. Composite tracings of maxilla at ages fourteen years, ten months and seventeen years, eleven months superimposed on the SN line at point S.

B. Composite tracings of the maxilla and mandible at the same ages superimposed on the maxillary line to demonstrate the change in relation of mandible to maxilla.

C. Composite tracings of serial cephalometric radiographs for seven years. The two years, seven months age is not shown because of the inaccuracy of positioning the head at that age.

Note that after the eruption of these teeth the SNa value was less by 2° but that the continual reduction of the measured difference was in the mandible. The reduction from a -9° to a -6° was a favorable trend for treatment but the continued reduction to -4° was a detriment to function (Figure 1B). Extraoral therapy exerting a posterior force on the maxillary teeth was applied intermittently and not too enthusiastically from eight to ten years of age and the Class II malocclusion became a Class I. No mandibular appliance therapy was used at any time. The enlarging facial pattern with favorable mandibular growth at the time of the treatment was responsible for the correction and, had the increments been small or unfavorable in direction, the unsatisfactory result achieved under those conditions would no doubt have been attributed to poor patient cooperation. In this enlarging facial pattern simple therapy with poor cooperation achieved a moderately good result. Useful as the mandibular growth was during treatment, it produced functional disharmony in the years after treatment, particularly since it was the major area of the face that was continuing to enlarge. As the SNb continued to increase and the SNa remained the same, a traumatogenic relation of the

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incisors was slowly introduced. Associated with this was the occurrence of functional crowding of the mandibular incisors. This in some measure was a protective mechanism. In addition, crepitus of both temporomandibular joints was noted. This is explained on the supposition that the incisal relation prevented the occlusal position of the mandible from assuming its full anterior position dictated by the condylar growth. This would not impede its anterior positioning at rest position; thus the condition of posterior superior mandibular displacement was initiated. The translatory movement between condyle and disc, not present normally, represents flaccidity in the joint structures that was recognized by the clinical symptoms of crepitus.

The traumatogenic relation of the incisors was recognized by the double tap heard as the teeth were occluded and by the detection of considerable incisal mobility noted by placing the fingers lightly on the maxillary incisors as the teeth were occluded and as the mandible was moved into the incision position. The patient complained of soreness (pulpitus) of these teeth. Treatment by equilibration on the lingual surfaces of the maxillary incisors and labial surfaces of the mandibular incisors relieved the acute symptoms but abnormal function is still present and restorative dentistry may be required to establish normal mandibular-maxillary functional relations of the structures.

The functional significance of greater mandibular prognathism is shown also in Case F.A. (Figures 2 and 3). Maxillary and mandibular prognathism (in relation to cranium) increased with growth but to a greater degree in the mandible. The angle SNa increased five degrees (78° to 83°) and the angle SNb increased eight degrees (75° to 83°). The mandibular change was due to

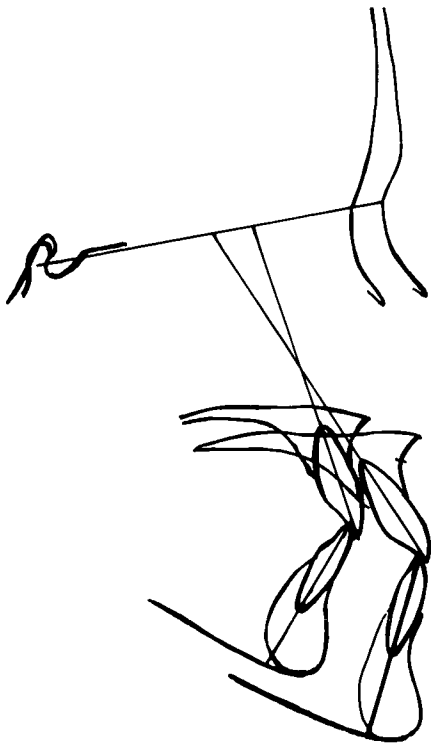

Fig. 2 Composite tracings of case F.A. at ages eight years, five months and fifteen years, four months superimposed on SN at S.

	8 yrs. 5 mo.	15 yrs. 4 mo.
SNa	78°	83°
SNb	75°	83°
Diff.	-3°	0°
1 to SN	99°	114°

growth and, possibly to some extent, repositioning during treatment. Initially the path of closure was upward and backward. As the maxillary incisors were moved labially in the first treatment period, the path changed to the normal upward and forward. The clicking and crepitus of the temporomandibular joints that was present before treatment was eliminated but, as the mandible continued to grow more rapidly than the maxilla, it returned. At the age of fifteen years and four

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months, even with a normal upward and forward path of closure exhibited, the abnormal joint function was again present. Other abnormal functional symptoms were the double tap heard when the teeth were tapped together, excessive mobility of the incisors and irregular mandibular movement on opening and closing.

In this facial pattern the continued anterior movement of the mandible resulting from the continued condylar growth resulted in a traumatogenic incisal relation that was detrimental to the teeth and supporting tissues; also, the incisal function proprioceptively induced posterior displacement of the mandible with its attendant abnormal joint function. It is possible that even the true rest position as well as the harmonious occlusal position could not be exhibited because the positions occupied by the maxillary incisors, spatially and timewise, were not in harmony with the degree of mandibular growth or vice versa.

What can be done with regard to treatment? The initial labial movement of the maxillary incisors permitted the slight functional crowding of the mandibular incisors to improve and even become slightly spaced. With the later mandibular growth the mandibular incisors (without mandibular therapy) became more upright and the spacing was eliminated (Figure 3). This could not have occurred without spacing and it is probable that the present abnormal functional relation of the incisors will promote crowding once again. Equilibration on the labio-incisal area of the mandibular incisors and lingual marginal ridges of the maxillary incisors from time to time was bene-

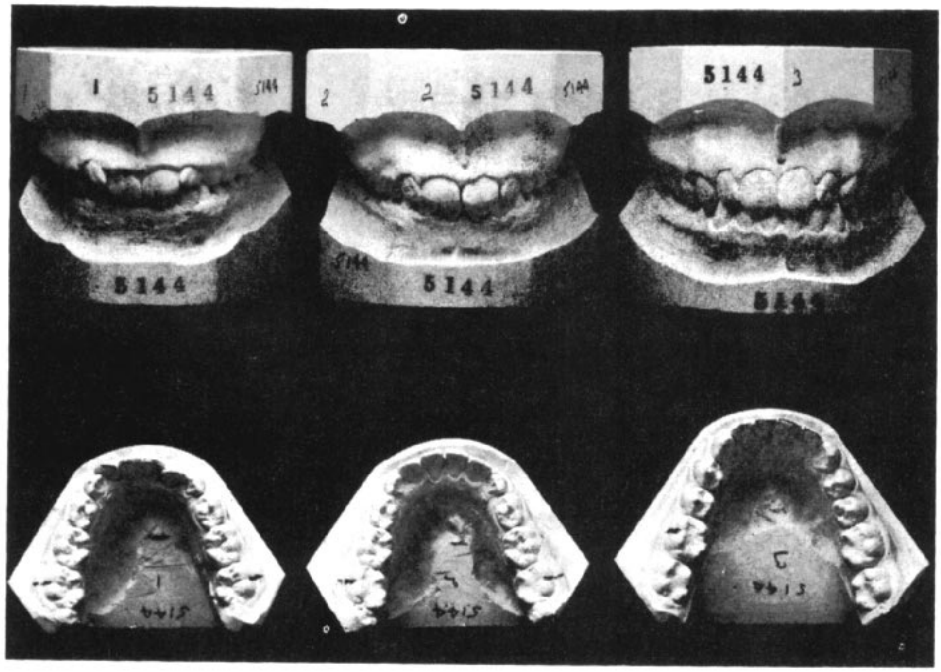

Fig. 3 Frontal views of casts and occlusal views of lower casts at ages eight years, five months; nine years, six months; and fifteen years, four months. Note the spacing that occurred between the mandibular incisors in the second cast and the reduction of the spacing in the third cast. No mandibular therapy was used.

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ficial in producing a single tap and lessening the incisor mobility but this improvement was only transient and, as the mandible grew or was repositioned anteriorly, the problem recurred. Now that growth is presumed to be almost completed, a static relation of the structures insofar as growth is concerned will be attained and attention can be focused on the dynamic problem of abnormal function. Additional equilibration has been done and a diagnostic treatment splint that positions the mandible slightly downward and forward has been placed. The clicking, earaches, and irregular mandibular movement have been eliminated. The splint is quite comfortable and it is presumed from evaluation of the improved functional condition that the splint occlusal position is the desired harmonious occlusal position. The splint will be replaced by restorative dentistry in the mandibular molars once it can be assumed that growth has been completed.

The spatial placement of the maxillary incisors in relation to the mandibular incisors determined by the concurrent or subsequent mandibular growth is important. Protruding maxillary incisors may be retracted in treatment. The extent of the retraction distancewise and timewise is determined by when an assumed normal relation of the incisor teeth is attained. This is influenced by the coincidental growth activity in the total face as teeth move more favorably in an enlarging facial pattern. With particular reference to the mandible, should the variance in growth rates produce mandibular growth activity expressed by a significant increase in the angle SNb, the desired incisal relation is attained sooner than if the growth is inactive. In the latter instance the maxillary incisors would need to be retracted farther and usually for a longer period of time.

The presumed normal incisal relation desired by the orthodontist is very often the adult relation of maxillary and mandibular incisors. Actually the norm for the eight or ten year old child exhibits considerable overjet thus anticipating further mandibular growth at puberty. The true norm for the age must be the orthodontic objective but, if it is not taken into account and a contact incisal relation is created at say the age of ten, function, while it may be satisfactory for the moment, may become abnormal as mandibular growth occurs and incisal interference may develop. If so, a double tap is heard as the teeth are tapped together and they can be felt to move excessively. The proprioceptive stimuli maintains the occlusal position but, as the mandible is enlarged and cannot be positioned forward, the upward and forward path of closure from rest to occlusion is changed to an upward and then to an upward and backward path. Clicking and crepitus of the joints is introduced and the mandibular movements may become irregular. One must not expect the maxillary incisors to be repositioned labially as their position is maintained by the constant lip pressure. They must be moved labially to conform functionally with the normal mandibular position.

Case J.E. is a Class II, Division 1 malocclusion (Figure 4). The serial cephalometric radiographic data is summarized in Table 1. It must be realized that the numbers do not tell the entire story of growth and treatment. One cannot be sure whether such differences in values as 82° and 83° represent actual changes or not, despite conscientious attempts at accuracy. Furthermore, if such a change is actual, one cannot be certain as to what it means, viz., whether it is a change in the dental area or a change in the line of orientation. The interpretations

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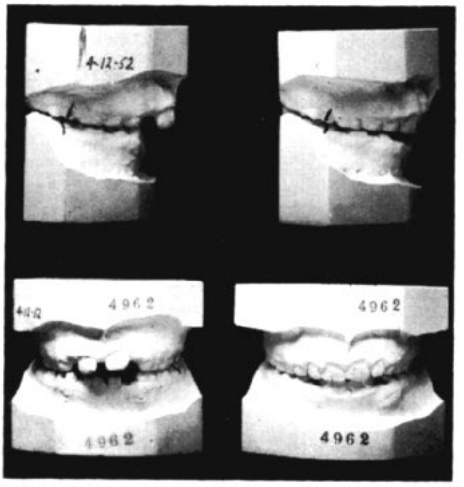

Fig. 4 Case J.E. Lateral and frontal views of casts before and after first period of treatment.

made here are with full awareness of the limitations of the technic and of the individual making its application and interpretation.

In contrast with R.T. who was treated similarly with extraoral therapy at a comparable age, no significant change occurred in the mandibular maxillary relation. In R.T. there was little maxillary incisor change but considerable mandibular change; the significant change for J.E. was in the maxillary incisor position.

In J.E. extraoral therapy applying a distal force on the maxillary second deciduous molars and a lingual force on the maxillary permanent incisors was started at eight years and three months (Table 1, column 1). A Class I tooth relation and reduction of most of the overjet was accomplished in one year. The maxillary incisor change is evident by comparing columns 1 and 2. The incisors are more upright and have been retracted. Some overjet was permitted to remain but during the next year, as spacing developed between the incisors as they inclined slightly to the labial (columns 2 and 3), a removable maxillary retainer was placed to close the spaces. This was accomplished but the overjet was eliminated. The question now arises as to the influence of the incisal interference on the position of the mandible. It was at this time that abnormal function, evidenced by clicking and crepitus of the joints, facial pain, irregular mandibular movement and jiggling and excessive mobility of the incisors, was noted. Steps were taken to correct the functional problem and a maxillary lingual arch appliance with auxiliary springs was placed to move the incisors labially since there was not sufficient self adjustment following elimination of the retaining appliance. The incisors were inclined labially to a 95° inclination to sella-nasion line (column 5). At thirteen years, nine months the abnormal functional condition was still present; therefore, maxillary incisor bands were

TABLE I

	1.	2.	3.	4.	5.	6.	7.	8.	9.
	8 yrs. - 3 mos.	9 - 3	10 - 2	11 - 1	11 - 10	13 - 4	13 - 9	14 - 4	15 - 8
SNa	83°	82°	83°	83°	82°	83°	83°	82°	83°
SNb	76°	75°	76°	77°	76.5°	77°	78°	77°	78°
Diff.	-7°	-7°	-7°	-6°	-5.5°	-6°	-5°	-5°	-5°
1 to SN	109°	90°	94°	91°	95°	92°	93°	99°	94°
1 to NP	9 mm.	4 mm.	6 mm.	5 mm.	5 mm.	5 mm.	5 mm.	5 mm.	5 mm.

Data compiled from serial cephalometric radiographs for case J. E.

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placed to move the incisors labially to the angulation of 99° (column 8).

For J.E. the maxillary incisors had been moved too far to the lingual with elimination of overjet. The case had been overtreated and future mandibular growth had not been taken into account.

The congenital absence of one or both maxillary lateral incisors alters the position assumed by the central incisors from that which would have been attained by growth if all incisor teeth had been present. The central incisors are found to be more upright and lingually positioned. This is mutilation of a dental arch by nature with its attendant growth retardation. As the mandible continues to enlarge the maxillary incisor position invariably interferes proprioceptively with the forward positioning of the mandible in response to its growth. When this abnormal functional condition is introduced depends on the time relation of the incisor position and mandibular growth. The path of closure from rest to occlusion may be observed to change from an upward and forward to an abnormal vertical and then to an upward and backward path. Associated with this may be clicking and crepitus of the temporomandibular joints; pain may also be introduced. An abnormal pattern of incisal attrition on the lingual marginal ridges of the maxillary incisors and labial incisal areas of the mandibular incisors can be observed. The protrusive functional wax pattern will be perforated markedly and in the incisive movement the maxillary incisors can be felt to move more than normally.

At one time there were two choices as to treatment of these cases, viz., to close spaces or to open them and restore the missing teeth. Now that function of the entire stomatognathic system is taken into account in treatment planning, there is only one plan of treatment — to open spaces and place the maxillary incisors in positions that permit normal function.

In case B.L. (Figure 5) the maxillary lateral incisors were congenitally absent. The abnormal functional conditions of clicking and crepitus of the joints, jiggling and excessive mobility of the incisors was present in this instance before treatment. The angle of the maxillary incisor long axis to the SN line was 89° before treatment and 100° after treatment. This change was brought about by labial tipping of the

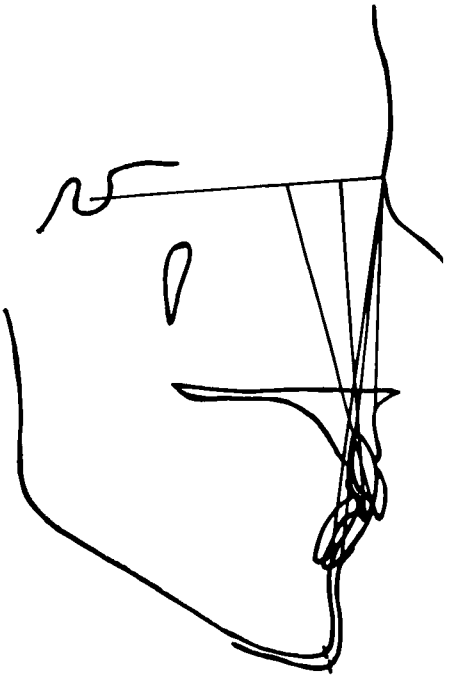

Fig. 5 Case B.L. Composite tracings of cephalometric radiographs at ages thirteen years, four months and sixteen years, seven months.

	13 yrs. 4 mos.	16 yrs. 7 mos.
SNa	83°	83°
SNb	77°	79°
Diff.	-6°	-4°
1 to SN	89°	100°

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incisors. With the creation of the overjet or horizontal overlap the mandible moved downward and forward without the use of elastics. As this occurred the abnormal functional symptoms of clicking and crepitus of the joints were eliminated. The path of closure from rest position to occlusal position changed from an upward to an upward and forward path. Since there was no significant cranial and maxillary growth in the treatment and retention periods, the forward and downward movement of the mandible can be assumed, at least in a large measure, to be repositioning on a proprioceptive rather than growth basis, particularly since it was accompanied by an improvement in joint function.

In such cases as B.L. function may be satisfactory at an early age but, as the mandible continues to enlarge and is not permitted to be repositioned forward in response to the condylar growth by the proprioceptive stimuli of lingually-positioned central incisors, a posterior displacement develops. When this occurs depends on the variables of the maxillary incisor position and mandibular growth. Naturally this is individualized for each subject. Going hand in hand with the developing posterior displacement is the occurrence of an abnormal incisal attrition pattern, increased incisal mobility, sensitivity of the incisors and abnormal joint and muscular function.

In the mind of the writer, considerations of function are modifying the time or age for treatment of malocclusion of the teeth. At present the general rule is to treat functional problems early and structural problems late. Furthermore, there is less desire to mutilate the dental arches by early removal of deciduous or permanent teeth. The predictions of future growth are far too general to apply specifically to an individual, and early attainment of assumed normal occlusion and assumed normal facial esthetics are not sufficient criteria for evaluation. Function must be foremost in our thinking.

55 E. Washington St.

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