A Classification of Class II, Division I Malocclusion

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Introduction

The numerous articles that have appeared in orthodontic literature in the last decade on the subject of Class II, Division 1 malocclusion are in themselves testimony to the fact that there is still much to be understood with regard to this subject. Angle[1] spoke only of one type of Class II, Division 1, simply, the mandible was distal and underdeveloped. It wasn't long, however, before other suggestions were voiced. Lourie[2] in 1903 speaks of mesial movement of the upper arch. Case[3] in 1921 listed six types.

Since the advent of cephalometry studies have been carried out to locate the area or areas at fault and attempts made to classify the various types of Class II, Division 1 malocclusions. It is becoming imperative that we have some further classification of this type of malocclusion than the simple one presented by Angle.

The confusion that exists seems partly due to insufficient material in the studies and the difficulty of correct deduction from the results obtained.

Herein is presented a further study of Class II, Division 1 in which an attempt has been made to correlate intraoral and extraoral observations of a large number of these cases.

Aim of the Survey

1. To study the angulation of the upper permanent canine to the occlusal plane in normal and in Class II, Division 1 malocclusion.

Strang[4] places great stress on the stability of the apical one third of this tooth: "It is located deeply in fairly dense bone, formed late in denture history, is a portion of the longest root in the entire root series, and finally because occlusal force is received on the lingually inclined surface of the canine and has practically no influence in stimulating the apex of the root to move mesially. If there is practically no mesial inclination of the canines, we may rest assured that the maxillary teeth are in normal relationship to the cranium. If it is found that the mesial axial inclination of the maxillary canines is at all exaggerated, it may be correctly assumed that the crowns of these teeth and also of the molars and premolars, if all are still in proximal contact, have been carried forward or lipward by abnormal environmental forces; such crowns are said to be in mesial axial perversion." Fischer,[5] Fisk, Culbert, Grainger, Hemrend and Moyers,[6] and others speak of maxillary protrusion. The efficacy of canine angulation to the occlusal plane as a diagnostic aid is to be discussed.

2. To study the position of the upper first permanent molar in normal dentition and in Class II, Division 1 malocclusion to cranial anatomy and especially to the maxillary bones.

If the maxillary teeth can be moved forward in the maxilla then the upper first molar should be found mesially to normal in these cases.

3. To compare the cranio-facial morphology of Class II, Division 1 malocclusion with normal.

4. To suggest a classification of Class II, Division 1 malocclusion.

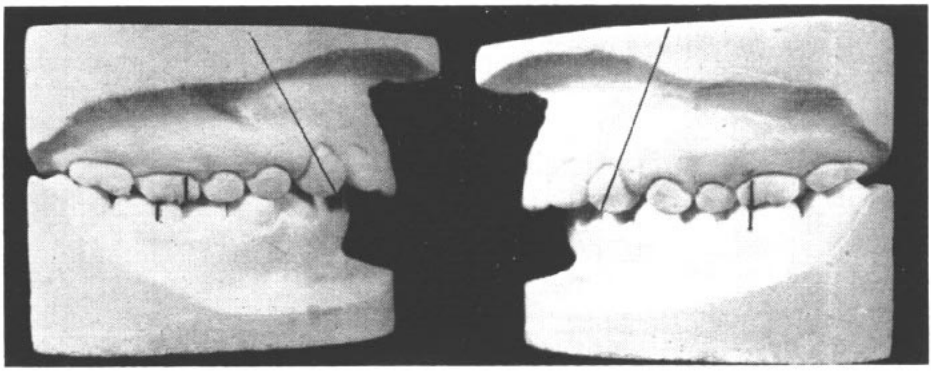

Fig. 1 Canine angulation.

Material

Our sample consisted of the following:

Lateral head roentgenograms and dental plaster casts of thirty-seven patients exhibiting excellent occlusion.

Dental plaster casts of twenty patients with Class II, Division 1 Subdivision (Angle) to study canine angulation.

Lateral head roentgenograms and dental plaster casts of one hundred three patients with Class II, Division 1 (Angle) malocclusion—comprising twenty-seven in the mixed dentition and seventy-six in the permanent dentition.

Method

The canine angulation to the occlusal plane was measured on the upper plaster models. Immediately certain difficulties arose. Infra or supraocclusion of the molars and/or canines, spacing distally to the canine, all affected the reading and so its diagnostic value. This reading, however, was important for this is the slope that is observed by the orthodontist in his observation and examination of the mouth of the patient and upon which his diagnosis may be made (Fig. 1).

The angulations of both left and right canines of the Class II, Division 1 Subdivision were noted and the Class II and Class I sides compared. A comparison was also made between normal and Class II, Division 1 canine angulations on the models. Using the lateral head roentgenograms these measurements were then related to the position of the upper first permanent molar within the maxilla and the slope of the upper central incisors to the sella turcica-nasion plane.

Cranial Morphology

Tracings were made of the lateral head roentgenograms of the normal and Class II, Division 1 groups. Eight angles and two linear dimensions were measured (Table 1 and Figure 2).

SNA: A measurement of the antero-posterior relationship of the maxilla to the cranium utilising Downs[7] point "A".

SNP: The facial plane angle.

A-B Difference: The antero-posterior base relationship as suggested by Graber.[8]

NSGn: Y Axis or axis of growth.

NSGoGn: The angle formed by the mandibular plane and the NS plane.

$\underline{1}$ to NS: The inclination of the upper left central incisor to the NS plane.

NS6: The cranial relationship of the upper left first permanent molar. The centre of the crown of the molar was chosen as a far easier discernible point than the buccal groove previously used by others.

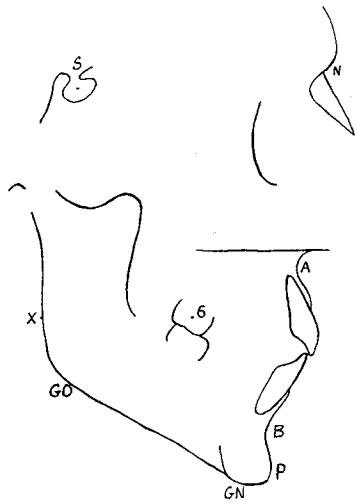

Fig. 2 Landmarks used.

$\overline{1}$ to GoGn: The inclination of the lower left central incisor to the mandibular plane.

$\underline{|1}$ to NA: The perpendicular distance of the incisal tip of the upper left central incisor to the NA plane. This measurement was chosen in preference to the $\underline{|i}$ to facial plane because it gives an indication of the relative forward position of the central incisor to its basal bone.

B-X: A measurement of mandibular length. Carrying further the idea of Nelson and Higley,[9] a line was drawn parallel to the mandibular plane from Down's point B to meet the ramus of the mandible at X.

NS6:NSA: In the more backward divergent face it is only natural to expect the upper first permanent molar to be further distal in cranial relationship and a consequently larger NS6 reading. Therefore as SNA decreases NS6 should increase. To test the constancy of the first molar within the maxilla the relationship NS6:SNA obtained by expressing NS6 as a percentage of the compliment of NSA, that is

$$\frac{NS6}{180\text{-}SNA} \times 100$$

The larger this reading the farther distal in the maxilla is the upper first permanent molar, or the farther anterior is point A. While it is realised that this measurement is in itself no more reliable than any of the other readings, it becomes useful within a group of readings and when correlated with the other data.

MEAN CEPHALOMETRIC READINGS

	Age Years	Canine Degrees	SNA Degrees	SNP Degrees	A-B diff Degrees	NSGn Degrees	NS6 Degrees	B-X Mms.	NS-GoGn Degrees	$\underline{\lvert 1}$-NS Degrees	$\underline{\lvert 1}$NA Mms.	$\overline{1}$-GoGn Degrees	NS6-SNA
Normal Occlusions	14.8	80.7	83	81.6	2.6	65.7	64.2	84.8	30.9	103.9	3.8	92.5	66.2
*		2.4	2.7	2.9	1.7	3.0	2.8	4.8	4.4	6.6	2.1	5.5	2.1
Cl. II, Div. 1 mixed dentitions	9	81.6	82.0	76.4	5.4	68.3	65.6	75.9	33.6	109.7	5.0	92.1	66.9
Cl. II, Div. 1 permanent dentitions		77.1	81.4	76.7	4.7	68.6	65.7	78.4	33.0	109.7	5.8	93.7	66.5
Combined Class II			81.6	76.6	5.1	68.5	65.6	77.7	33.2	109.7	5.6	93.3	66.5

* Standard deviation.

Table 1

The consistently greater slope of the Class II side and the mean difference of 4.6° (Table 2) clearly indicate a forward tipping of the canine on that side. There is also a forward position and a greater rotation of the upper first molar associated with these cases[10] which reveals the forward movement of the buccal segment as the chief cause of the malocclusion. The canine angulation in an individual case is therefore some indication of the mesial movement of the teeth distal to the canine. If, however, it is to be used in Class II, Division 1 as a diagnostic aid, it is of little use comparing its slope to normal. What may be normal for one is not of necessity normal for the next. The normal range was between 89° and 77°, and 37 cases of the Class II, Division 1 sample fell below these readings. To check the relative position of the upper first permanent molars in these two groups, 37 cases below 77° and 32 cases 77° and above, the angles NS6 and $\underline{1|}$ to NS were noted on their cephalometric tracings (Table 3).

CANINE ANGULATION

Class II Division 1 Subdivision

Patient	Canine Angulation Class II side	Class 1 side
1	75	78
2	73	78
3	71	73
4	58	67
5	77	81
6	75	79
7	74	78
8	64	75
9	68	75
10	78	83
11	77	81
12	73.5	78
13	71	71.5
14	66	74
15	75.5	79.5
16	78	81
17	74	75
18	73.5	78
19	82	86
20	75	80
Mean	72.9	77.9

Table 2

	Mean canine angulation	Mean NS6	Mean $\underline{1\|}$ to NS
37 below 77°	72.6°	65.7°	111.2°
32 above 77°	79.4°	65.4°	108.2°

Table 3

There was a definite correlation between the canine angulation and the angle $\underline{1|}$ to NS but absolutely none between the canine slope and the position of the first permanent molar. It would appear then that to claim that the slope of the canine is always a clear indication of mesial movement of the upper first molar is erroneous. While it is conceded that in certain cases it may be correct, the general use of this observation is clouded by the close relationship between the inclination of the mandibular and occlusal planes to the NS plane, see Table 9.

Baldridge,[11] Renfroe,[12] Elsasser and Wylie[13] studying the angle NS6 found the upper first permanent molar relationship to cranial anatomy when compared to normal to be the same, more posterior, and further forward respectively. When Baldridge[14] used the angle S6 to a perpendicular from the first molar to the Frankfort plane, he again showed its constancy of position in Class II, Division 1 malocclusions. While this present study showed the angle NS6 to be 1.5° greater (Table 4) for Class II, Division 1 cases, i.e. the molar is farther distal, when the angle NS6 was related to the angle SNA, there was only .3% difference which is of little statistical importance. Therefore, it must be concluded that the upper first permanent molar bears the same mean relationship to the maxilla and is slightly

Position of the upper First Permanent Molar

	NS6	SNA	NS6:SNA
Normal	64.2°	83°	66.2
Class II Division 1 Mixed Dentition	65.6°	81.6°	66.6
Class II Division 1 Permanent Dentition	65.7°	81.4°	66.5
Class II Division 1 Combined	65.7°	81.4°	66.5

Table 4

distal to cranial structures in Class II, Division 1 malocclusions when compared to normal.

Cranio-Facial Morphology

Class II, Division 1 was found to be associated with a slightly more backward divergent face, a mean difference in SNA of 1.4° to normal. Boys, 81.2°, had a slightly more backward divergence than girls, 82°, which contradicts the findings of Elsasser and Wylie.[13] The chin point as measured by SNP and NSGn showed definite evidence of distal positioning which fact is generally accepted. This posterior positioning results in a large A-B difference than normal (Table 5).

As Downs[7] pointed out, this backward divergence is associated with a slight increase in the angle formed by the mandibular plane. The large difference in the mandibular length between the two groups was partly due to the different age groups. Some extremely low readings in the Class II, Division 1 group which were due to mandibular underdevelopment also helped to keep the mean reading below normal (Fig. 3).

Denture pattern of Class II, Division 1 was very similar to normal except for the flaring of the upper incisors as shown by increased angle $\underline{\lfloor 1}$ - NS and 1.8 mms. increase in $\underline{\lfloor 1}$ - NA.

Considering Class II, Division 1 cases as a whole, it would appear that generally the fault lies in a posterior positioned and slightly underdeveloped mandible. When one considers individual cases, however, it soon becomes clear that it is quite ridiculous to treat all Class II, Division 1 cases as a whole.

Cranio-Facial Morphology.

Skeletal pattern.

	SNA	*SNP*	*A-B diff*	*NSGn*	*B-X*	*NS-GoGn*
Normal	83° SD. 2.7	81.6° SD. 2.9	2.6° SD. 1.7	65.7° SD. 3.0	84.8mms. SD. 4.8	30.9° SD. 4.4
Class II Division 1	81.6°	76.6°	5.1°	68.5°	77.7mms.	33.2°

Denture Pattern.

	NS6	$\underline{\lfloor 1}$ - *NS*	$\underline{\lfloor 1}$ - *NA*	$\lceil \overline{1}$ - *GoGn*
Normal	64.2° SD. 2.8	103.9° SD. 6.6	3.8mms. SD. 2.1	92.5° SD. 5.5
Class II Division 1	65.6°	109.7°	5.6mms.	93.3°

Table 5

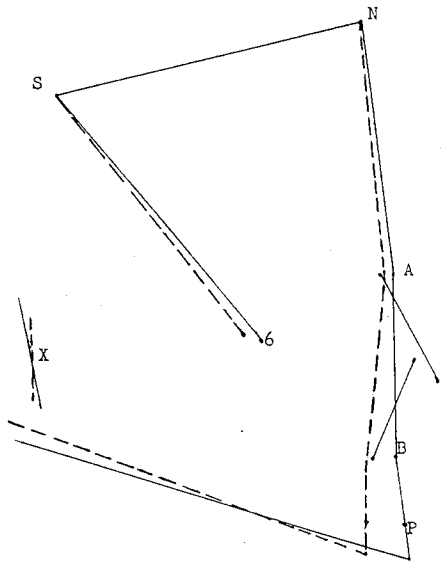

Fig. 3 Comparison of normal occlusion and Class II, Division 1 malocclusion.

Some cases are obviously maxillary dysplasias with an entirely normal lower. Indeed it is possible to classify the majority of Class II, Division 1 cases into four definite groups with the aid of models, cephalometric tracings and case histories.

Classification

The four types of Class II, Division 1 malocclusion into which most of the cases may be classified are:

1. Maxillary alveolar protrusion
2. Maxillary basal protrusion
3. Micro mandible
4. Mandibular retrusion.

There is obviously no sharp line of demarcation and, because of superimposition of environmental factors on hereditary influences, some cases may reveal characteristics of two of the types.

Again, discrepancy between tooth size and basal bone may be found in some of these cases but does not alter the classification.

Maxillary alveolar protrusion

This type is characterized by good skeletal proportions and the readings SNA, SNP, NSGn, A-B difference should all fall within the normal range. Because the malocclusion is limited to the maxillary teeth, the only readings expected to be abnormal should be $\underline{|1}$ to NA, $\underline{|1}$ to NS, and NS6. The forward movement of the upper first permanent molar should, consequently, affect the NS6: SNA ratio resulting in a decrease in this figure.

The cause of this type of malocclusion is entirely environmental, due to incorrect muscle pressure (Fig. 4). This may result from early habits such as thumb sucking, tongue thrusting, or faulty swallowing and breathing. Eleven cases clearly exhibited these traits and Table 6 gives the mean reading of these patients. Graphically it is shown in a polygonic interpretation in figure 5.

It may also be noted that there was no mesial axial inclination of the first per-

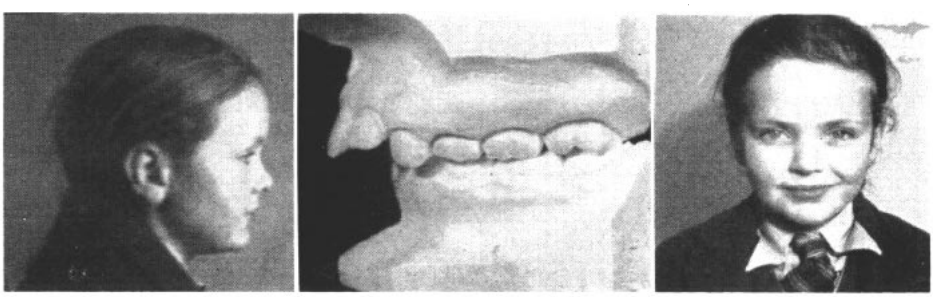

Fig. 4 Maxillary alveolar protrusion (Type 1).

Skeletal Pattern					
SNA	*SNP*	*A-B diff*	*NSGn*	*NSGoGn*	*B-X*
81.8°	80.9°	3.1°	63.5°	26.3°	80.7mms.
Denture Pattern					
Perm. Canine	*NS6*	$\underline{1}$ *to NS*	$\underline{1}$ *- NA*	$\overline{1}$ *- GoGn*	*NS6 - SNA*
77.4°	62.4°	116.5°	8.8	94.6°	63.4

Table 6

manent molars, and there was also a preponderance of No. 2 molar positions[10] (13 out of 22). No. 2 molar position exists when the palatal cusp of the upper molar lies in the groove between the marginal ridge and mesial inclines of the mesio-buccal mesio-lingual cusps of the lower first molar. The molars therefore had moved forward bodily, not tipped, this small amount and the greater rotation associated with this position resulted in the Class II position of the bicuspids etc.

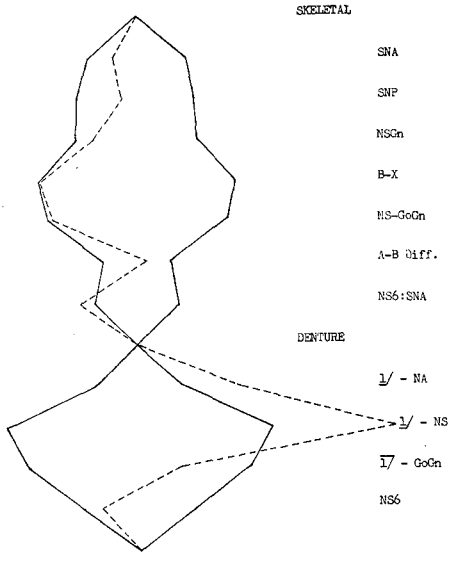

Fig. 5 Maxillary alveolar protrusion.

Maxillary basal protrusion

If the entire maxilla is forward, a large SNA reading would be expected with relatively normal SNP and NSGn figures, a large A-B difference, and mandibular measurements should be within normal range. It was simple to choose from the group, thirteen patients fulfilling these requirements (Fig. 6). Table 7 presents the mean readings and Figure 7 the polygonic interpretation. It is significant to note that every one of these thirteen patients was a severe thumb-sucker and the habit was still in evidence when presenting for treatment at the mean age of 8 years 1 month.

Micro mandible

In this group may be found the most

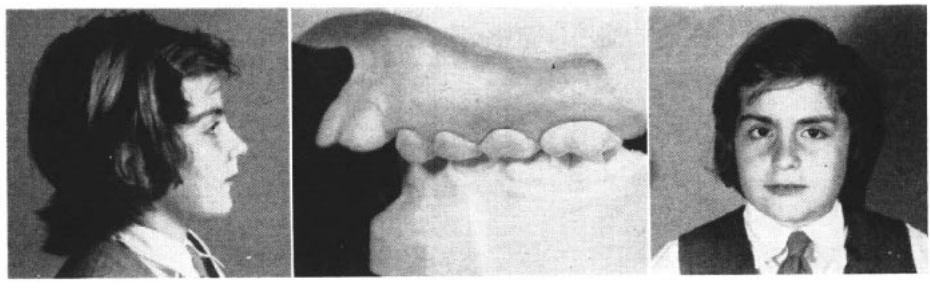

Fig. 6 Maxillary basal protrusion (Type 2).

SKELETAL PATTERN

SNA	*SNP*	*A-B diff*	*NSGn*	*NS-GoGn*	*B-X*
86.9°	79°	9.1°	66.5°	32.5°	79.8mms.

DENTURE PATTERN

Perm. Canine	*NS6*	$\underline{1}$ *to NS*	$\underline{1}$ *- NA*	$\overline{1}$ *- GoGn*	*NS6-SNA*
76.3°	63.9°	112°	4.3mms.	92.9°	68.4

Table 7

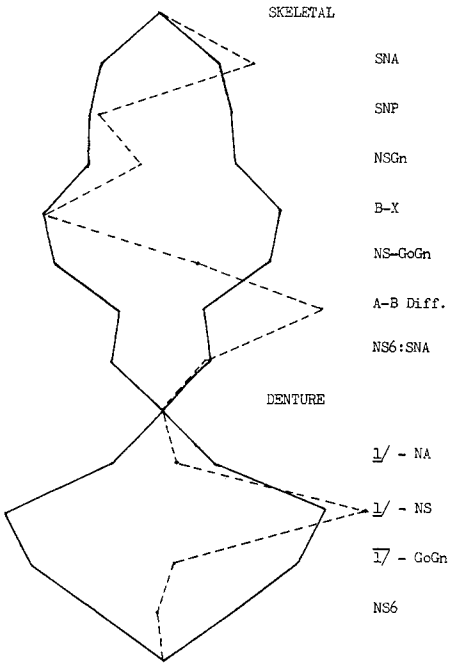

Fig. 7 Maxillary basal protrusion.

difficult of Class II cases, the chinless type face, the underdeveloped mandible of hereditary origin. Typical of this type are the steep mandibular and occlusal planes with crowding and apparent forward slope of the lower incisors. The upper may be relatively normal but there is usually a backward divergence of the whole face associated with the condition (Fig. 8).

The polygonic interpretation of the fourteen obvious cases (Figure 9) graphically reveals the skeletal dysplasia, while Table 8 presents the mean readings of the cases.

Mandibular Retrusion

Here there is a well developed mandible posteriorly placed to cranial anatomy. The fault is not in mandibular structure but in the posterior position of the glenoid fossa due to hereditary influences (Fig. 10). The readings influenced by this distal positioning are SNP, and A-B difference. Denture pattern remains very similar to normal, the only change being due to the accommodation of the posterior mandible, Figure 10 and Table 9.

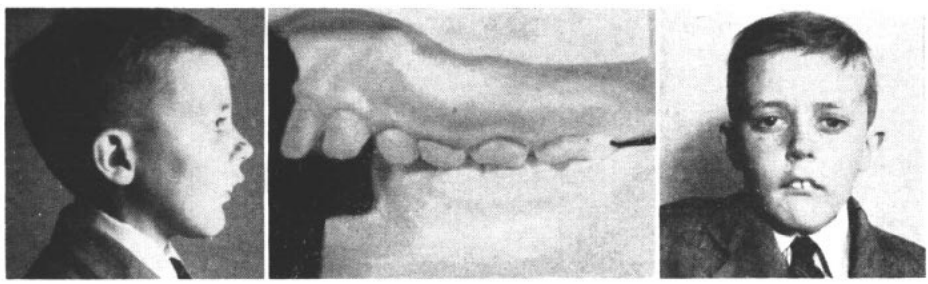

Fig. 8 Micro mandible (Type 3).

SKELETAL PATTERN

SNA	*SNP*	*A-B diff*	*NSGn*	*NSGoGn*	*B-X*
78.8°	72.3°	7.9°	72.8°	40.1°	71.6mms.

DENTURE PATTERN

Perm. Canine	*NS6*	$\underline{1}$| *to NS*	$\underline{1}$| - *NA*	$\underline{1}$| - *GoGn*	*NS6-SNA*
70.4°	68°	108.8°	5.9mms.	89°	67.1

Table 8

Of the one hundred three cases studied, fifty-seven fell distinctly into one of the four types. These, of course, tended to be the extreme cases and were easily categorized. With the aid of the measurements suggested it is possible, however, to classify the other cases into one or a combination of these four types. A clearer picture of the Class II, Division I malocclusion can thus be obtained by those who are interested in the case or the case report.

CONCLUSIONS

1. The angulation of the upper canine to the occlusal plane is some indication, in individual cases, of the mesial movement of the particular buccal segment. It cannot be claimed, however, that it is by itself a general indication of forward movement of the upper arch.

2. In the one hundred three cases of Class II, Division I malocclusions studied the mean position of the upper first permanent molar was distal in relation to cranial anatomy and in a similar mesio-distal position within the maxilla when compared to normal.

3. Class II, Division 1 malocclusions vary considerably and four types into which the malocclusions may be classified are readily discernible.

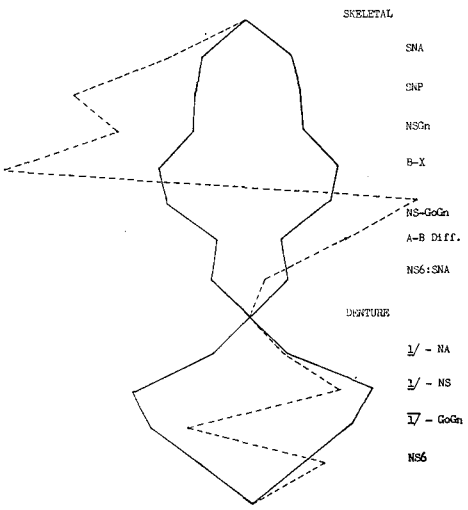

Fig. 9 Micro mandible.

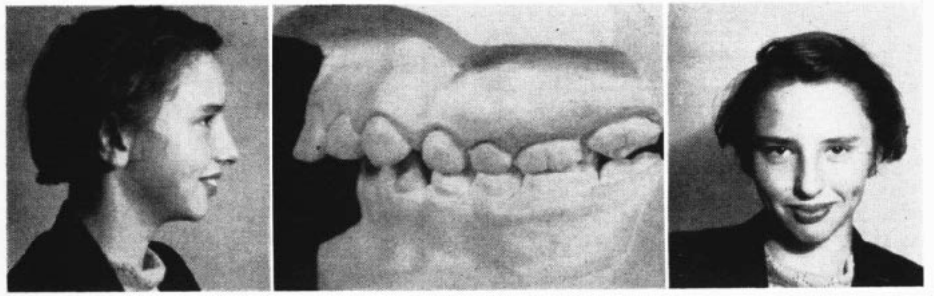

Fig. 10 Mandibular retrusion (Type 4).

SKELETAL PATTERN

SNA	*SNP*	*A-B diff*	*NSGn*	*NSGoGn*	*B-X*
81.2°	75.4°	7°	69.6°	35.0°	80mms.

DENTURE PATTERN

Perm. Canine	*NS6*	$\lfloor\underline{1}$ *to NS*	$\lfloor\underline{1}$ *- NA*	$\overline{1}$ *- GoGn*	*NS6-SNA*
77°	66.2°	104.9°	4.1mms.	94.1°	67

Table 9

Type 1. Maxillary alveolar protrusion.

Type 2. Maxillary basal protrusion

Type 3. Micro-mandible

Type 4. Mandibular retrusion.

4. The use of lateral head roentgenograms as an adjunct to dental plaster casts, case histories and patient examination in classification has been illustrated.

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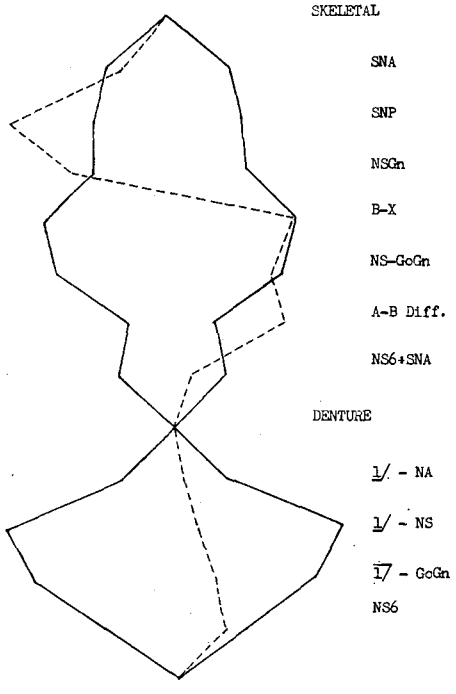

Fig. 11 Mandibular retrusion.

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