

# Overbite and Vertical Facial Dimensions in Terms of Muscle Balance\*

WENDELL L. WYLIE, D.D.S., M.S.  
*San Francisco, California*

IN 1941 Brodie<sup>1</sup> demonstrated the striking constancy of pattern in the human cranio-facial complex, and showed particularly that the floor of the nose divided total face-height into two parts which maintained a constant ratio to one another throughout the life of an individual. He stated further that in all individuals nasal height and dental height were remarkably close to 43 per cent and 57 per cent respectively in their contribution to total face-height. This was found to be true in twenty-one males studied serially during the first eight years of life, in another group of forty adults, and in forty cases of Class III malocclusion.

Herzberg and Holic,<sup>2</sup> in 1943, measured 326 dry skulls in the Field Museum, and in this material from all parts of the world, presenting all degrees of attrition, confirmed with exactness the mean values previously published by Brodie. Attrition, however excessive it might be, had no effect upon the proportions in question.

Because mean values may be duplicated in different groups without demonstrating that each group in its entirety clusters about its mean value, Wylie<sup>3</sup> in 1944 used the coefficient of variation, a special measure of constancy within a group. He published not only mean values for dental height and nasal height which confirmed previous studies, but showed that variation was truly slight and not dependent upon the fact that the proportions were expressed in percentage of total face height. The mean for dental height in this family study was 56.6 per cent and the coefficient of variation was 4 per cent.

Clinical observation, coupled with an interest in the findings of Brodie and Thompson<sup>4</sup> on the physiologic rest position, suggested two additional avenues of investigation. Those workers showed in 1942 that the relation of the mandible to the rest of the face is established long before the eruption of the teeth, and that the relationship is a constant one throughout the life of the individual, being maintained after the loss of teeth. They showed also that when artificial restorations increase vertical dimension beyond limits of physiologic rest, closure is effected through resorption of underlying bone and depression of abutment teeth. These findings are significant enough that it is not unreasonable to suggest that the physiologic rest position of the jaws is of equal importance to the orthodontist as is the classical relationship of full occlusion of the teeth.

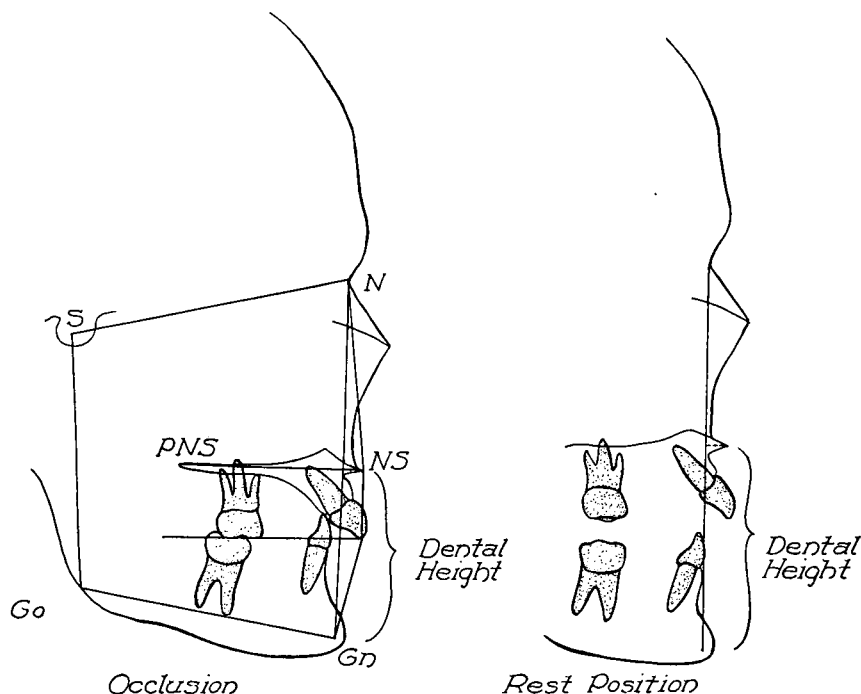
Even a very limited experience with orthodontic patients would lead

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\* From the Division of Orthodontics, College of Dentistry, University of California. Read before the International Association for Dental Research, Chicago, March 19, 1944.

one to suspect, since so many cases require bite-opening, that when orthodontic patients alone are considered, the average value for vertical dimension would be less than that for a group selected randomly from the general population. All previous groups reported above concerned the general population, and used measurements taken with the teeth in occlusion.

This study was undertaken to clarify two points: First, would a group



**Fig. 1.**—Illustrating the dimensions taken as total face-height (N-Gn), dental height (NS-Gn), and the difference between centric occlusion and physiologic rest position in an extreme case.

of orthodontic patients on the average have as much vertical height as a group from the general population? Secondly, does the physiologic rest position add any new information upon the problem of vertical dimension?

In order to explore these possibilities, head films taken on the Broadbent-Bolton cephalometer of twenty-nine different individuals were borrowed from the Department of Orthodontia, University of Illinois. Each set consisted of a frontal film, a lateral film in physiologic rest position and a lateral film with the teeth in occlusion. These films were traced and measurements were taken to determine the percentage contribution of nasal height and dental height to total face-height, both in occlusion and in physiologic rest. Figure 1 shows a typical tracing where the overbite is extreme and defines visually the distance from chin-point to nasal floor as dental height, with total face height taken as the distance from the chin-point to nasion.

Table I reviews the findings to date on this aspect of the vertical dimension; it can be seen that where malocclusion alone is considered, vertical

dimension is less than in the general population. This confirms suspicions based on clinical observation. Statistical analysis shows this difference is too large to be attributed to chance alone.

One may speculate at length as to what the deep-seated cause for the closed bite really is. If the anomaly involves only the teeth, the statement of Strang<sup>5</sup> is entirely adequate. It was he who pointed out that the closed bite involves infra-eruption of buccal teeth, supra-eruption of anterior teeth, or a combination of both. Let us suppose for the moment that only the

TABLE I.—DENTAL HEIGHT AS PERCENTAGE OF FACE HEIGHT

<i>Worker and Material</i>	<i>Sample</i>	<i>Dental Height</i>	<i>Year</i>
Brash <sup>6</sup> (skulls)	1. new born	58.7%	1924
	2. adult (occlusion)	56.2%	
Brodie (head films)	21 male children	57.0%	1941
	40 adults	57.0%	
	40 class III (occlusion)	57.0%	
Herzberg and Holic (skulls)	326 all ages (occlusion)	56.5%	1943
Thompson (head films)	24 Edentulous Rest position	55.4%	Unpublished data
Wylie (head films)	65 all ages and occlusions (occlusion)	56.6%	1944
Wylie (head films)	29 malocclusions (occlusion)	54.2%	This report
	In rest position	56.3%	

teeth are involved: in that case, the vertical dimension would be different for people with deep overbite and those with normal overbite only when the jaws are closed. In the physiologic rest position, which represents a dynamic equilibrium between the various muscles attached to the mandible, these differences should disappear, for the teeth no longer play a part in the picture.

The individuals with malocclusion which were just shown to be deficient in the vertical dimension when their jaws are closed may now be considered in the physiologic rest position. The last value in the table shows that in the physiologic rest position dental height for these individuals only *equals* and does not exceed the value for the general population when the latter group is measured with teeth in occlusion. As yet, no value for the general population in the physiologic rest position has been determined, but since that figure would certainly exceed the value for the same group with teeth in occlusion, we may justifiably conclude that closed bite cases are deficient in vertical height not only when the teeth are occluded, but in physiologic rest position as well.

This fact may be more strikingly demonstrated by the data of this study. By examining in each individual dental height in occlusion and dental height in physiologic rest, we may readily see whether a large value in one accompanies a large value in the other, with small values likewise found with small values, or whether the two dimensions vary with no

predictable relationship. Such parallel behavior is measured by the coefficient of correlation, and perfect positive correlation is indicated by a coefficient of correlation of  $+1.0$ . It was found that millimeters of dental height in occlusion and millimeters of dental height in rest position gave a coefficient of correlation of  $+0.91$ , establishing definitely that where the vertical dimension is deficient with the teeth in occlusion, in most cases it will also be deficient in the rest position as well.\*

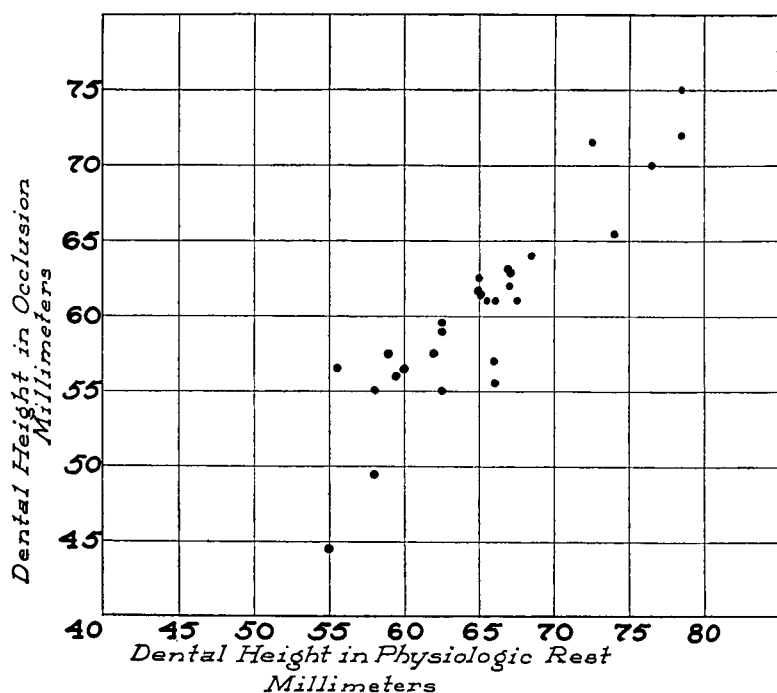


Fig. 2.—Scattergram showing the correlation between dental height in occlusion and dental height in physiologic rest position. Note that certain individuals fall well below the line established by the majority of individuals.

These facts suggest, when interpreted in the light of the findings of Brodie and Thompson, that in the great majority of humans the interval between the jaws is established early in life by a morphogenetic muscle pattern peculiar to the individual, and the buccal teeth erupt to a position compatible with that jaw relationship so as to permit a normal free-way space.

Figure 2 depicts in a graphic way the interdependence of vertical height in occlusion and rest position. The majority of the individuals fall about a straight line when one variable is plotted against the other. It should be noted, however, that about six of the group fall well below the line which might be drawn through the others, and none lies

\* When these dimensions are expressed in percentage of total face-height the coefficient of correlation =  $+0.88$ .

above. This indicates where a given individual fails to show the predictable relationship between dental height in occlusion and that for rest position, the discrepancy lies in an insufficient vertical dimension when jaws are closed—presumably then, for reasons not clearly understood, in about 20 per cent of these individuals (six out of twenty-nine), the molars have not erupted to the extent permitted by the jaw relationships. In these six, elevation of the buccal teeth by orthodontic means (or bite-opening by reconstructive methods) is clearly indicated; in the remaining eighty per cent, if the bite is closed, any therapeutic measures other than depression of incisors may be expected to be opposed by the musculature, with the prognosis therefore doubtful. These clinical implications are to be examined further with additional material actually receiving treatment.

#### SUMMARY AND CONCLUSIONS

1. The vertical dimension of orthodontic patients with the teeth in occlusion is, on the average, less than that of the general population.
2. This relative deficiency of vertical dimension in orthodontic patients obtains not only when the jaws are closed, but in the physiologic rest position as well.
3. Individual for individual, there is a high degree of correlation between vertical height in occlusion and vertical height at rest.
4. It is suggested that in the majority of individuals the amount of vertical development in the buccal segments is determined largely by the jaw relationships as dictated by the musculature, but that in some cases the full amount of vertical development permitted by the musculature is not attained. These latter cases offer the best prognosis for orthodontic or reconstructive procedures.

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The Medical Center

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