The relation of upper anterior teeth to lower anterior teeth as present on plaster models of a group of acceptable occlusions

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Overbites and overjets are but superficially considered in dental literature. Count von Spee studied the occlusal curves of the dentition; his thought was that the curve of the occlusal plane extended would be tangent to the anterior surfaces of the condyles; thus the Curve of Spee actually considers the anterior surfaces of the condyles. In none of the preceding studies, nor in this one, have the anterior surfaces of the condyles been considered, so the term "Curve of Spee" has been replaced with the term "occlusal curve", i.e., that curve along which the teeth occlude.

The first study by the present author resulted in a report in 1938 in which it was stated that the amount of overbite and the amount of overjet were the result of the manner in which the upper and lower occlusal curves came together. This fundamental principle was correct provided the widths of the upper teeth correlated with the widths of the lower teeth.

Some dentitions presented splendid Class I relationships of the buccal segments, had well aligned anterior teeth, and yet had an excessive overjet, excessive overbite, or even an end-to-end bite, of the anterior teeth. A second study resulted in a report in 1947 which showed that, if the buccal segments were in good Class I relationship from molars through cuspids, the amount of overjet was determined by the ratio of the sum of the mesio- distal diameters of the upper incisors plus the cuspid widths from the mesial contact point to the lingual cuspid eminence minus one half the labio-lingual thickness of the upper central incisor (all measured along the lingual surfaces at the level of the expected amount of overbite) to the sum of the mesio-distal widths of the lower incisors and cuspids plus one half the labio-lingual thickness of the lower central incisor at the incisal edge (measured along the labio-incisal edges). When this ratio was one (or equal) the overjet was a desirable one: when the relationship was less than one (the upper being less than the lower) an end-to-end bite resulted; when the relationship was greater than one (the upper being greater than the lower) an excessive overjet was produced.

The inclination of the upper incisors to the lower incisors as well as the lingual anatomy of the upper central incisors, were factors in determining the amount of overbite.

It was found also that where the ratio of the upper and lower anterior widths was correct, and the molars were in good Class I relationship, undesirable overbites and overjets were present in those cases in which there was an unfavorable ratio of upper and lower bicuspid and distal half of upper cuspid widths. These tended to produce Class II or Class III tendencies in the cuspid areas.

In the presence of so many variables and their resulting complications, Dr. Brodie suggested that a study of the

models of good occlusions might help clarify matters. He generously offered the use of such models, the respective head roentgenograms and the facilities of the Graduate Orthodontia Department of the University of Illinois. Encouragement, time, and the invaluable assistance of Dr. John McNutt, were enthusiastically given by Dean William Crawford of the Dental School of the University of Minnesota. The cost of materials and transportation were paid by grant from the Graduate School of the University of Minnesota through the thoughtful consideration of Dean Theodore Blegen. Dr. Isaac Shour was most gracious in letting us use x-ray equipment and the Graduate Department of Orthodontia at the University of Illinois was so cheerfully helpful and cooperative, that the project proved to be a most pleasant as well as productive undertaking.

The method of making the desired measurements had been carefully worked out and tested on models at the University of Minnesota before starting on the series of acceptable occlusion models at Illinois.

It had been found so difficult to reproduce accurately measurements of overbites and overjets made directly upon the plaster models that the models were x-rayed, and the measurements made on tracings of the x-ray films.

METHOD

Each model was given a number and this number as well as the name of the individual from whom it was made was recorded in a book. Metal numbers were used during the exposures to correlate the films with the models and book records.

A William Myer Portable x-ray machine No. P143, having a fixed exposure of 15 milliamperes and 75 kilovolts, was so set up that the central ray was parallel to the occlusal plane of the model, and perpendicular to the teeth to be measured; the target of the tube being always fourteen inches from the film. The film was placed in a plastic holder as close to the teeth as possible, perpendicular to both the path of the ray and the teeth to be rayed. Dupont regular dental film was used.

The frontal view of the incisors was made with the film as close to the incisors as the model would allow, the rays coming from the back of the model, the exposure lasting for 4 seconds. The lateral exposure was made with the film as close to the model as possible yet perpendicular to the mesio-distal plane of the crowns of the upper central incisors and the path of the rays, the exposure being for 6 seconds. Pictures of the crowns of the buccal teeth were taken by placing Kodak Periapical radiatized, No. O size film in a plastic holder in the tongue space within the model. The film and path of rays were both perpendicular to the mesio-distal plane of the second bicuspids and the exposure was for 6 seconds. All films were developed in the customary manner.

Tracings of the films presenting the frontal and lateral views of the incisors were made on Kodapak. Measurements taken directly from the models were found to be the same as those on the frontal view tracings. The measurements of the overbites made on the lateral views of the incisors were somewhat greater because of the mechanical impossibility of getting the film for the lateral view as close to the incisor as in the frontal view. In the report, measurements of the overbites were recorded only on the frontal view tracings. It was necessary to use the lateral view tracings for overjet measurements. Since the error of elongation in the overjet measurements was consistent, it could be disregarded in this study, especially as it was of the magnitude of only 0.2 mm.

Plaster models presenting acceptable occlusions were offered generously by Dr. William B. Downs and Dr. Thomas D. Speidel to supplement those used in this group.

Dr. John McNutt, a graduate student in the Graduate Orthodontic Department of the University of Minnesota, made tracings of the lateral head roentgenograms of the patients of all models used. Frontal head roentgenogram tracings were made of a few. Each tracing showed the following landmarks: On closed lateral view: Bolton Point, porion, both condyles, both mandibular angles, both mandibular borders, sella turcica, pterygomaxillary fissure, both orbits, nasal bone and nasion, anterior nasal spine, hard palate, upper and lower third molars, upper and lower first molars, upper and lower central incisors, "A" and "B" points (subspinale and supramentale). On closed frontal view: outline of skull, mandible, and maxilla; both condyles and rami; anterior nasal spine; hard palate; upper and lower third molars; upper and lower central incisors; upper and lower first molars; upper and lower cuspids.

The following data were obtained from the models by direct measurement with sharply pointed dividers: Mesiodistal widths of the upper incisors on the lingual surface at the level where the lower incisors strike them in occlusion; widths of the upper cuspids from the lingual eminence to the mesial contact at this same level; measurement of the mesio-distal width of the lower incisors and cuspids individually near the labio-incisal edge or where they strike the lingual surfaces of the upper incisors; location and amount of any spacing of teeth; the actual mesiodistal width of any rotated teeth and the amount of space present for that tooth; the location of the lingual eminence of the upper cuspid as it fell in the lower bicuspid-cuspid embrasure or the amount it fell mesially or distally to this embrasure, buccal cusp height of upper and lower first bicuspids; crown height of upper and lower central incisors, cuspids, and first bicuspids; the approximate overbite; the relation of lower incisal labial surface to lingual surface of upper incisors; the approximate overjet; Class I, II, or III positions of molars; anomalies; the depth of interdigitation of the lingual cusps of the upper first molar and first bicuspids; other comments such as age, sex, restorations, and so forth.

The data were tabulated and placed in statistical form. The extreme values and the mean value of measurements studied are presented in Fig. 1.

Data and Conclusions

Measurements for studies D and F were made directly on the plaster models. Measurements for studies A, B, C, E were made on tracings of the roentgenograms of the plaster models (Fig. 1).

A. *Overbites*

The extreme values were found to be from 0.5 mm (low) to 4.3 mm (high). The mean or average was 3.1 mm with standard deviation of 1.9 mm; thus two thirds of the overbites lay between 1.2 mm and 5 mm statistically. The extremes, however, tended to the lower values, the high being only 4.3 mm. The variation of 3.8 mm between the low and high values indicated that there was no one value of overbite that was standard or necessary for all good occlusions.

B. *Overjets*

The extreme values were from 0 mm (low) to 3.7 mm (high). The mean was 1.6 mm with a S. D. of 1.6 mm; two thirds of the overjets lay between 0 mm and 3.2 mm. It was evident that there was no one value of overjet that was standard or necessary for all good occlusions. Actual values are tabulated at the end of the study.

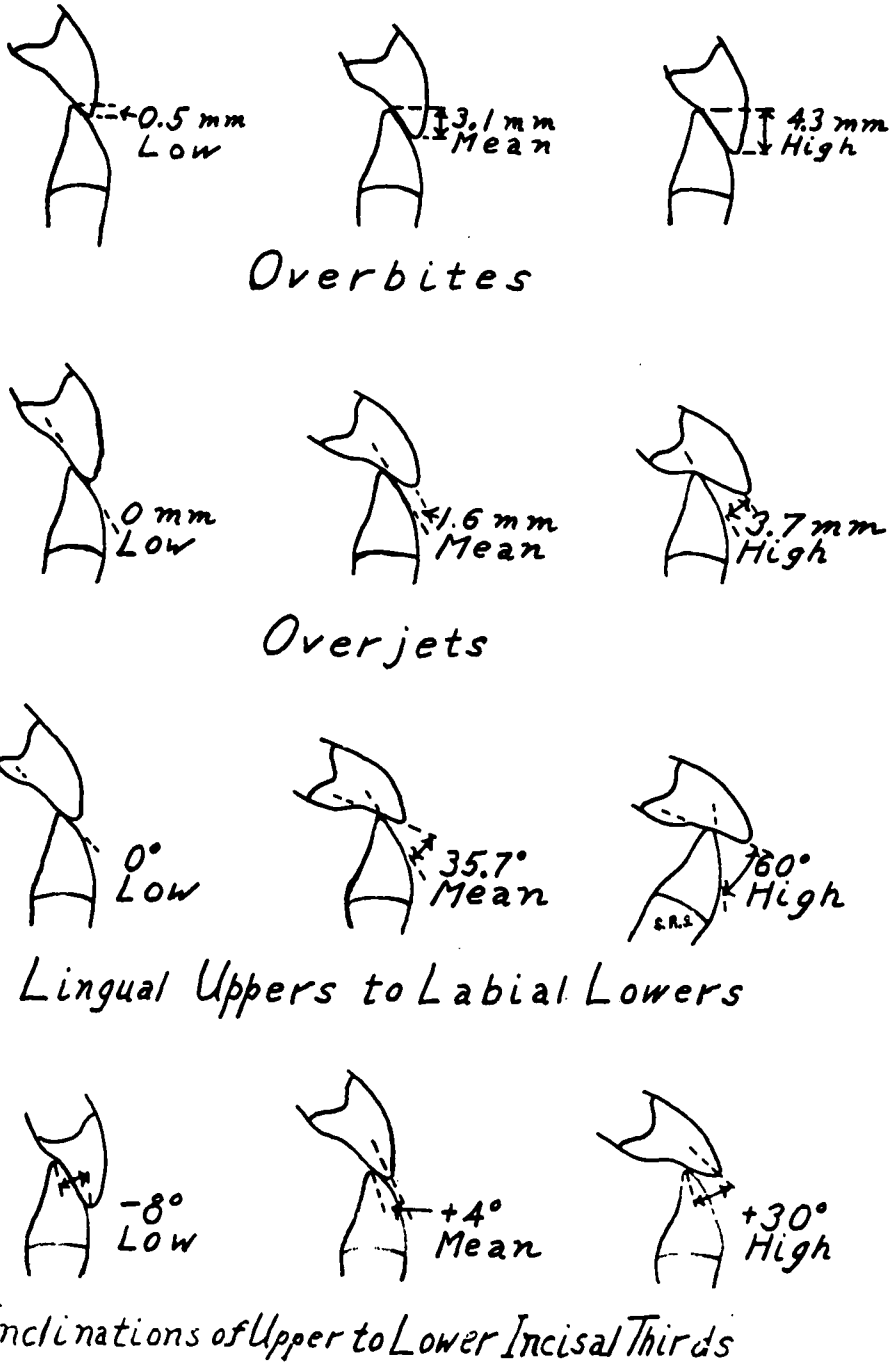


Figure 1

There are those who believe that there is some correlation between the amount of overbite and the amount of overjet. In the 47 cases measured, the coefficient of correlation between overbite and overjet was 0.3575 ± 0.125. This is suggestive of a slight correlation. The coefficient of correlation was tested in the individual cases with the following results: Those having 1.6 mm of overjet had overbites which varied from 1.2 mm to 4.1 mm; those having 3.1 mm of overbite had overjets varying from 0 mm to 2.7 mm. This seemed to indicate that there was no correlation between the amount of overbite and the amount of overjet.

The coefficients of variability were 60.436% ± 0.5531% for the overbites and 99.87% ± 13.89% for the overjets.

C.

The degree of inclination of the lingual surface of the upper central incisor to the labial surface of the lower central incisor at the incisal third of the crown gave extreme values of 0° for the low and 60° for the high. The mean value was about 35.7° with a S. D. of 2.5° which indicated that two thirds of the cases fell between 32.2° and 38.2°. This leads one to wonder if the few extremes presented unusual conditions, although this relationship of upper incisor to lower incisor was similar in many cases. It showed once again that there was no single angulation that could always be expected to be present.

D.

The ratio of the sum of the mesio-distal width of the upper incisors plus the cuspid widths from the mesial contact point to the lingual eminence (measured on the lingual surfaces along the line of contact with the lower incisors and cuspids)* to the sum of the mesio-distal widths of the lower incisors and cuspids (measured on the labial surfaces along the line of contact with the upper incisors)** presented extreme values of the upper width from 4 mm less to 3 mm greater than the lower widths. The mean showed the upper widths to be 2.8 mm greater than the lowers (S.D. 1.1 mm). The tendency was toward a ratio of one.

* Minus one half the labio-lingual thickness of the upper central incisor at the given level.

** Plus one half the labio-lingual thickness of the lower central incisor at the incisal edge.

The coefficient of correlation of the ratio of the upper and lower anterior widths to the angle of inclination of the upper central incisor was 0.03371 ± 0.1405 in the 48 cases considered. This indicated no correlation.

The coefficients of variability were 39.5% for the surface inclinations and 3.5% for the width ratios.

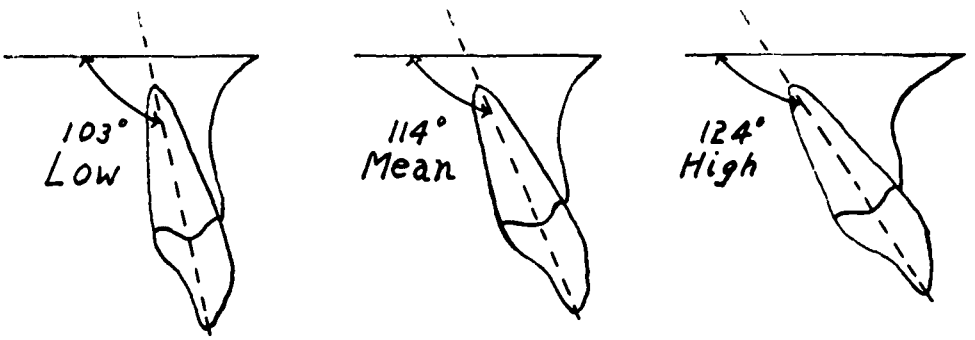
E.

The axial inclinations of the incisal thirds of the crowns of the upper and lower central incisors presented extreme values of —8° and 30°. The mean values was +4° (S. D. 2.5). Thus two thirds of the cases had incisal third axial inclinations within the range of 1.5° and 6.5°; the remaining third were widely scattered as shown by high and low extreme values.

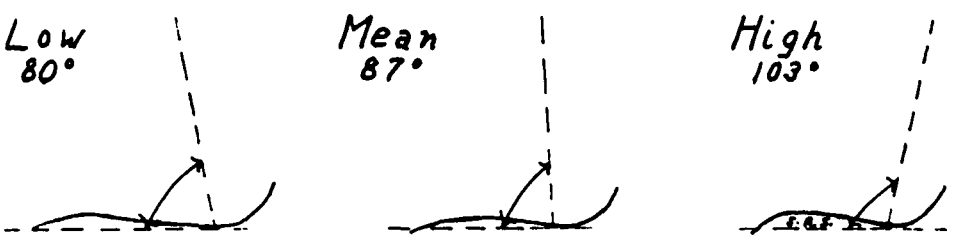
F.

The length of the crowns of the upper central incisors varied from 6.6 mm to 13.1 mm (S.D. 0.9). Two thirds of the incisor lengths fell within a range of 1.8 mm, i.e. between 9.2 mm and 11 mm; the remaining third being widely scattered.

The coefficient of correlation of the axial inclination of the incisal thirds of the crowns of the upper and lower central incisors and the crown lengths of the upper central incisors was 0.0821 ± 0.0159, showing no correlation to exist.



Upper Incisor Axis Inclination to the Floor of the Nose



Lower Incisor Axis Inclination to the Mandibular Border

Figure 2

The coefficient of variability of the axial inclinations was 41.67% ± 0.282%; that of the crown lengths was 9.638% ± 0.738%.

It should be mentioned that the amount of wear which may have reduced the crown length was not taken into consideration in the measurements.

The following measurements were made upon tracings of the lateral head roentgenograms (Fig. 2).

G.

The angle of inclination of the long axis of the upper central incisor to the floor of the nose (delineated by a line joining the anterior nasal spine and the posterior third of the floor of the nose) presented extreme values of 103° (low), and 124° (high). The mean was 114° (S.D. 0.9). Thus two thirds of the long axis inclinations lay between 113.1° and 114.9°, a remarkably narrow range indicating unusual constancy of inclination.

H.

The angle of inclination of the long axis of the lower central incisor to the lower border of the mandible (delineated by a line joining the lowest point on the symphysis and the lowest point of the border in the region of the angle; if two borders appeared, the average of the two borders

was used) presented extreme values of 80° (low) and 103° (high). The mean was 87° (S.D. 1.6°). Two thirds of the long axis inclinations lay between 85.4° and 88.6°, which is a remarkably narrow range.

The coefficient of correlation between the angles in *G.* and *H.* was 0.00167 ± 0.1729; thus there was no correlation. From this it can be realized that the angle of inclination of the long axis of the upper central incisor to the floor of the nose bears no relation to the angle of inclination of the long axis of the lower central incisor to the lower border of the mandible.

The coefficient of variability was 9.81% ± 0.06% for the angle of inclination of the upper central incisor to the floor of the nose; that of the angle of inclination of the lower central incisor to the lower border of the mandible was 11.96% ± 5.77%.

The statistical values of the means and standard deviations were as follows:

Study	Means	Standard Deviations
A	3.136 mm ± 0.186 mm	1.895 ± 0.013
B	1.6224 mm ± 0.1594 mm	1.624 ± 0.113
C	35.79° ± 0.124°	1.273 ± 0.0878
D	2.775 mm ± 0.106 mm	1.093 ± 0.752
E	5.738° ± 0.1978°	2.391 ± 0.140
F	10.143 mm ± 0.102 mm	0.998 ± 0.072
G	114.60° ± 0.100°	0.922 ± 0.070
H	88.91° ± 0.115°	1.064 ± 0.813

This concludes the first report of the data obtained.

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References

Bach, E. N. 1947. Overbite cases. *American Journal of Orthodontics & Oral Surgery,* 33:308-312.

Brodie, Allan G. Unpublished lectures presented in the Graduate Department of Orthodontia, University of Illinois.

Goodhugh, Thomas 1924. Art of prosthetic dentistry. Bailliere, Tindall and Cox. London.

Pike, J. M. 1941. Deep overbites in children. *Minneapolis District Dental Society Journal,* 25:103-105.

——— 1941 Deep overbites in older patients. *Minneapolis District Dental Society Journal,* 25:105 106.

Steadman, Sherwood R. 1940 Six different kinds of overbites. *Journal of the American Dental Association,* 27:1060-1071.

——— 1940 Overbites. *The Angle Orthodontist,* 10:148-153.

——— 1949 Predetermining the overbite and overjet. *The Angle Orthodontist,* 19:101-105.

Turner, C. R. and L. P. Anthony 1932 American Textbook of Prosthetic Dentistry, Lea & Febiger, London.

von Spee, F. Graf 1890 Verschuebungsbahn des Unterkiefers am Schadel. Arch. f. Anat. und Physicl.

Washburn, H. B. 1925 History and evolution of the study of occlusion. *Dental Cosmos,* 67:223.