Occlusal Relations in Children Born and Reared in an Optimally Fluoridated Community: I. Clinical Methods

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A clinical and social-psychological study was started in Chattanooga, Tennessee in January 1967 to describe the occlusal relations of children born and reared in an optimally fluoridated community and to determine if there are differences in occlusal relations between Caucasian and Negro children in such a community. This paper reports, in some detail, the clinical methods that were used to measure the occlusal relations. Subsequent papers in the series will present findings of the clinical examinations, the children's perception of various occlusal conditions, and the relation between clinical findings and perception of occlusal conditions.

Many studies have already been published reporting the prevalence of malocclusion.[1-19] Most reports have either attempted to classify children into the categories established by Angle,[20] to assess the need for orthodontic treatment by determining those with "severe" malocclusions, or to do both. Most age groups have been surveyed ranging from ages 2-6[2] to adults,[3] with most activity concentrated on teenage groups.[4-11] A few studies specifically have assessed the prevalence of malocclusion in Negroes.[1,10,12-14]

Five studies that were reviewed considered the occlusion of a population that had been born and reared on optimally fluoridated water. Although the designs of these studies differed from one another, the results of two[8,16] indicated that there is less malocclusion in fluoridated communities than in similar communities that have a fluoride-deficient water supply. The other three[14,17,19] showed no significant differences in the prevalence or severity of malocclusion between fluoridated and low-fluoride communities.

Estimates of percentages of children judged to have orthodontic conditions severe enough to require correction have varied from ten[4] to forty-eight per cent[15] of study populations. The prevalence of minor as well as severe malocclusion has been assessed by Ast and his co-workers[9] to be as great as ninety-five per cent of the population. Massler and Frankel[7] have summarized the reports of fifteen investigators that show the prevalence of malocclusion in the fourteen through twenty-two age group to vary from thirty to one hundred per cent. Part of the variation in reported findings is undoubtedly due to differences in the age, sex, racial and ethnic distributions of the study samples and, possibly, to some real differences among the study populations. However, one of the principal factors for the variation is probably the lack of an adequate definition of malocclusion.

Large differences also have been reported in the prevalence of malocclusions classified according to Angle's criteria which are based essentially on first molar relations. The following data from three representative studies illustrate this variation (Table I). The great variety of results would seem to

TABLE I

	Age	Number Examined	Normal Occlusion	Malocclusion		
				Class I	Class II	Class III
Mills[11]	8-18	1,337	17.5%	72.2%	6.6%	3.7%
Emrich, Brodie, and Blayney[10]	12-14	14,951	53.7	30.1	14.8	1.4
Ast, Carlos, and Cons[9]	15-18	1,413	4.7	69.9	23.8	1.6

indicate that either there is great regional variation in populations regarding malocclusion, that Angle's classification is not very precise for assessing malocclusion, or that the criteria for measuring malocclusion according to Angle are subjective and confusing.

Various investigators may not interpret in the same way the points of demarcation that separate Angle's classification of molar relations, which could lead to different reported findings. Some investigators[11] have stated that, in applying Angle's classification, they have modified the criteria for classifying molar relation. Other investigators may apply their own interpretations of Angle's classification or intentionally modify it, but they do not mention the alterations in their reports.

If the subdivisions of Angle's classification of molar relation are reported, it is possible to determine whether the observed Class II and Class III molar relations are bilateral or unilateral. However, not all reports contain data on the subdivisions and, in such papers, it is impossible to make this distinction.

The purposes of the present study were to (1) describe the occlusion of children born and reared in an optimally fluoridated community, and (2) determine if there are differences in the prevalence of certain occlusal relations of Caucasian and Negro children who had consumed optimally fluoridated water since birth.

The evaluation was done in conjunction with an ongoing study in Chattanooga to evaluate topical applications of stannous fluoride on teeth of children born and reared in an optimally fluoridated community.[21] At the time of the examination the city of Chattanooga had been optimally controlling the fluoride content of its water supply for more than fourteen years. The study population comprised all children participating in the topical fluoride study except for a few who were wearing orthodontic appliances or who had completed orthodontic treatment. Occlusal relations were measured for approximately 850 children, ages 9 through 13, in grades 5, 6 and 7. The group contained approximately equal numbers of Caucasian and Negro children.

Clinical Examination

The following occlusal relations were measured and recorded for each child: dental age, molar relation, buccal crossbite, lingual crossbite, overjet, overbite, maxillary midline diastema, midline deviation, frenum attachment, tooth displacement and anterior spacing. Two dentists who were familiar with the classification system examined the children, each dentist surveying about half the group. The examiners first standardized techniques by discussion and by doing several practice examinations. Measurements were dictated by the examiners and recorded by auxiliary personnel on a prepared form. The recorder was in full view of the examiner so that a continual check of the entries could be made.

Each child was examined and evaluated for occlusion while standing with

his back and head supported against a wall. The children were placed in a supported vertical position so that a natural head balance for assessing centric relation and a direct view of both sides of the mouth were afforded. A portable dental light provided illumination. A mouth mirror, Boley gauge, tongue depressor, special plastic rule and sharp pencil were used to make the examinations.

Dental Age

The dental age of each child, as described by Summers,[18] was assessed as follows:

Dental Age 0—begins at birth and ends with the eruption (appearance of any portion of the clinical crown) of any primary tooth. Chronologically, the usual age range of Dental Age 0 is from birth to six months.

Dental Age 1—begins with the eruption (as defined in Dental Age 0) of any primary tooth and ends when all primary teeth are in occlusion. The usual period of Dental Age 1 ranges from six months to three years.

Dental Age 2—begins when all primary teeth are in occlusion and ends with the eruption (as defined) of any permanent tooth. The usual period of Dental Age 2 ranges from ages three to six years.

Dental Age 3—begins with the eruption of any permanent tooth and ends when all permanent central and lateral incisors and first molars are in occlusion. The usual period of Dental Age 3 ranges from ages six to eight years.

Dental Age 4—begins when all permanent central and lateral incisors and first molars are in occlusion and ends with the eruption of any permanent cuspid or bicuspid. The usual period of Dental Age 4 ranges from ages eight to ten years.

Dental Age 5—begins with the eruption of any permanent cuspid or bicuspid and ends when all permanent cuspids and bicuspids are in occlusion. The usual period of Dental Age 5 ranges from ages ten to twelve years.

Dental Age 6—begins when all permanent cuspids and bicuspids are in occlusion and is characterized by the completed eruption of all permanent teeth (second molars may or may not have erupted). Dental Age 6 usually begins at age twelve years.

Second permanent molars are not considered in the assessment of dental age inasmuch as cuspids and bicuspids usually erupt before second molars and fix the anteroposterior position of the first permanent molars. Subsequent eruption of the second molars therefore usually has no effect on molar relation.

Because of the chronological age of children in this study (9-13), nearly all participants were expected to range from Dental Age 4 through 6.

Several of the described dental ages either begin or end when groups of teeth have completely erupted into occlusion. Occlusal contact, however, does not occur in children who have an open bite or in whom one or more teeth, for a variety of reasons, have failed to erupt to the occlusal plane. When extenuating circumstances such as sucking habits or tongue thrusting produced the lack of occlusal contact, the mere presence in the mouth of the required teeth for a specific dental age was used in making the assessment.

Molar Relation

A method described by Summers[18] was used to classify the anteroposterior occlusal relation of maxillary and mandibular first permanent molars. The classification assesses the nature of the interdigitation of the upper and lower first permanent molars in the following

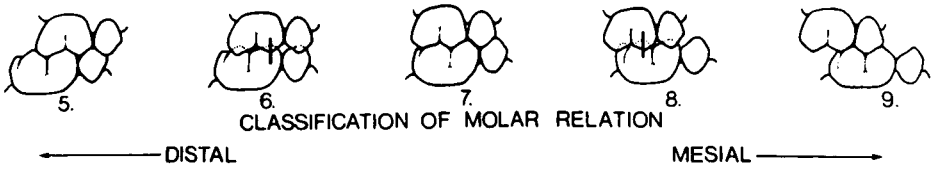


Fig. 1

manner: A cusp-and-groove relation in which the mesiobuccal cusp of the upper first permanent molar articulates with the buccal groove of the lower first permanent molar is given the numerical designation of "7". An end-to-end relation of the teeth in which the mesiobuccal cusp of the upper first permanent molar articulates with the mesiobuccal cusp of the lower first permanent molar is designated as a "6". A cusp-and-groove relation in which the distobuccal cusp of the upper first molar articulates with the buccal groove of the lower first molar is recorded as a "5". An end-to-end articulation in which the mesiobuccal cusp of the upper first molar occludes with the distobuccal cusp of the lower first molar is recorded as an "8". An articulation in which the mesiobuccal cusp of the upper first molar occludes with the distobuccal groove of the lower first molar or with the interproximal space between the lower first and lower second molars is recorded as a "9".

Figure 1 is a diagrammatic representation of the various molar relations.

The molar relation on each side of the mouth was recorded and, thus, two numbers designated the bilateral molar relation, e.g., "5, 6". The first number represents the left side of the mouth, and the second, the right side relation.

The following rule determined the demarcation between designations, such as, between "5" and "6" or "6" and "7": Any articulation that was not precisely cusp tip-to-cusp tip (codes 6 or 8) was given the designation for the closest cusp-to-groove or cusp-to-interproximal space designation (codes 5, 7 or 9). For example, if the articulation was between a "5" and a "6", it was recorded as a "5", if between a "7" and an "8", it was recorded as a "7".

The molar relation for subjects with missing maxillary and/or mandibular first permanent molars was recorded as follows: A designation of zero ("0") was used to indicate that the maxillary first permanent molar was missing; a designation of "1" was used if the mandibular first permanent molar was missing; and a designation of "2" indicated that both maxillary and mandibular first permanent molars were missing.

There is a strong similarity between the present method of classifying molar relation and the system proposed by Angle.[20] Because they are similar, direct comparisons of findings from studies using Angle's and Summers' classification systems may be made. Summers' method has one advantage, however, in that it delineates in detail the points of demarcation between classifications, which should eliminate some of the confusion and subjectivity inherent in Angle's system and allow for greater standardization.

The specific method used by the examiners in this study to determine the subjects' molar relations was as follows: Each subject was requested to bite on his back teeth and the habitual or acquired molar relation was observed by retracting each cheek. The subject was then asked to open his mouth and to relax his jaw. The examiner grasped the child's chin and manipulated the lower jaw gently in order to achieve a hinge movement which was repeated

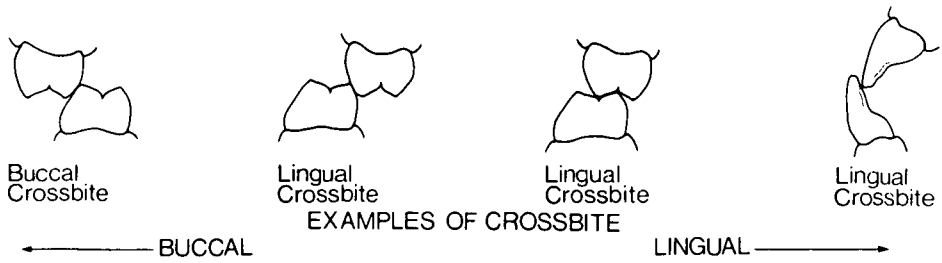


Fig. 2

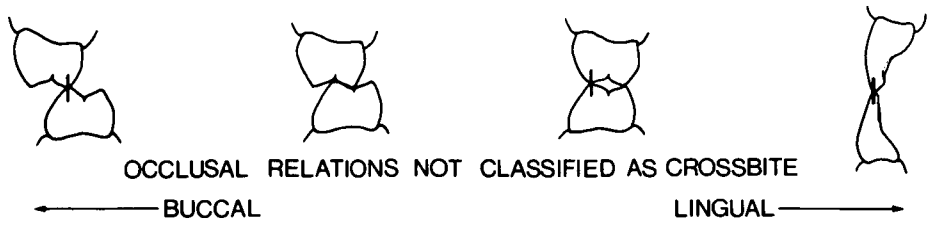


Fig. 3

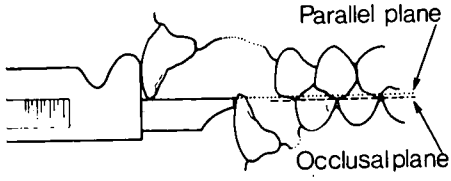
several times, allowing the opposing teeth to tap together lightly. Finally, the manipulation was stopped with the teeth in light contact. Then the subject was requested to "bite hard". If a mandibular shift occurred, it meant that the child had a deflective malocclusion (prematurity). The position of guided, light closure was the occlusion with the jaw in centric relation or in the terminal hinge position. This position was compared with the occlusion produced by the original closure without assistance. If the two positions were the same, it was assumed that the habitual centric occlusion was identical to the occlusion at true centric relation, or simply "centric occlusion". If they were not the same, the manipulated position was used to assess the molar relation provided a free hinge action had been attained.

To view the contact relation properly during the outlined procedure, each side of the mouth was viewed as each cheek was retracted successively. While the contact position was held, a mouth mirror was used to visualize the molar relation at a right angle to the buccal surface. By using this method, the anteroposterior relation could be assessed even in the presence of a crossbite.

Crossbite

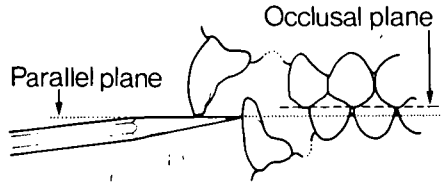
For the purposes of this investigation the illustrations in Figure 2 were considered crossbites, but those in Figure 3 were not. In other words, opposing teeth that had end-to-end incisal edge or cusp relations were considered as acceptable. This distinction was made to avoid the difficult task of assessing tip-to-tip contact of cusps in a transverse plane.

The method of determining crossbite was to have the subject occlude in centric relation and to observe, by retracting the lips and cheeks, how many maxillary teeth were either lingual to or entirely buccal to the mandibular teeth. The number of these situations on each side of the mouth was recorded. Buccal and lingual crossbites were recorded separately. For assessing crossbites, cuspids were considered posterior teeth.



MEASUREMENT OF OVERJET

Fig. 4



POSITION OF PENCIL IN RECORDING OVERBITE

Fig. 5

Overjet

A measurement of overjet was made with the subject in "centric occlusion" by using the end of the Boley gauge containing the depth gauge (after Moorrees[22]). The end of the fixed scale of the gauge was placed against the appropriate lower central incisor and the sliding scale was adjusted to touch the most labial part of the corresponding upper central incisor. The long axis of the fixed scale was placed parallel to the occlusal plane. The measurement was recorded to the nearest millimeter (Fig. 4).

When both maxillary central incisors were labial to the lower arch, the measurement of overjet was made on the incisor with the most labial position. If one of the maxillary central incisors was in crossbite, the overjet measurement was made on the incisor not in crossbite. If both maxillary central incisors were in crossbite, the measurement was made to the incisor that best approximated the general form of the arch, and the measurement was recorded in negative millimeters. When gross irregularities of the teeth produced a lingually or labially positioned mandibular incisor (but not an anterior crossbite), the overjet measurement was made to the mandibular central incisor that best approximated the general form of the arch.

Overbite

A measurement of overbite was made with the subject's teeth in "centric occlusion". The amount of vertical overlap of the upper central incisors on the lower incisors was marked with a sharp, soft-leaded pencil on the labial surface of the lower incisors, using the incisal edge of the upper central to guide the pencil (after Moorrees[22]). The upper conical plane of the sharpened part of the pencil and not the shaft of the pencil itself was placed parallel to the child's occlusal plane (Fig. 5).

After the lower incisor was marked, the child was asked to open his mouth and a measurement of overbite to the nearest millimeter was made with the beaks of a modified Boley gauge from the incisal edge of the lower central incisor to the pencil mark.

Where there was less overbite on one central incisor than on the other, or where the clinical crowns of the central incisors varied in length due to differences in eruption, soft tissue pathology or severe inclinations, the greatest overbite measurement was recorded.

An anterior openbite was said to exist when there was a lack of vertical contact or overlap between one or more opposing pairs of teeth if the full anatomic crowns of these teeth were visible. When a negative and positive overbite existed simultaneously, the negative overbite (anterior openbite) was the only condition recorded. The amount of anterior openbite was measured directly with the Boley gauge and was recorded

as a negative number of millimeters of overbite.

No recording of posterior openbite was made in this study because of the age range of the participants. Children of these ages are undergoing so much tooth eruption that making a determination of posterior openbite would be too subjective.

Maxillary Midline Diastema

Any space between the maxillary central incisors was measured with the gauge and recorded to the nearest millimeter. The measurement was made at the points of greatest convexity on the mesial surfaces (usually the shortest distance between the central incisors). If there was no diastema or if an overlap existed, a "0" was placed in the appropriate box on the examination form. If the space was 2 mm or more, the condition was *also* recorded under "Anterior Spacing".

Midline Deviation

Midline deviation was measured with a gauge with the subject in "centric occlusion". The number of millimeters which the *upper* midline was to the left or right of the *lower* midline was recorded to the nearest millimeter. The metric value was placed in the left box provided on the examination form followed by "L" or "R" in the right box to designate a left or right deviation, respectively, of the upper to the lower arch. If no deviation existed, zeros were placed in both boxes.

Frenum Attachment

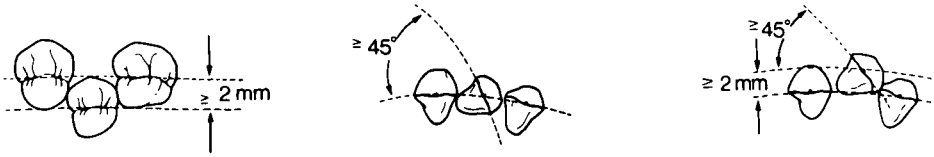
The distance from the most inferior point of attachment of the upper labial frenum to the tip of the gingival papilla between the central incisors was measured with the beaks of a Boley gauge and recorded to the nearest millimeter. The upper lip was drawn lightly forward and downward as an aid in establishing the point of attachment of the frenum on the alveolar ridge.

Tooth Displacement

Tooth displacement was assessed by inspecting each arch for the rotation and malposition of permanent teeth. A malposition was defined as a deviation in the position of a tooth which placed it outside the regular arch form. Malposed teeth could result either in an overlapping of adjacent teeth or, if the deviation occurred in a buccolingual plane, no overlapping. If the malposition was equal to or exceeded 2 mm, a "tooth displacement" was said to exist. An overlap always involves two adjacent teeth, but it may be caused by the malposition of only one of the two teeth. To determine if both adjacent teeth were involved or just one, the entire arch form was assessed and only those individual teeth deviating from the arch form were designated as tooth displacements. The arch form is an imaginary line through the contact points of the teeth of the arch that circumscribes a smooth arc.

Individual anterior teeth (centrals, laterals, cuspids) that were rotated 45° or greater, relative to the arch form, were also recorded as tooth displacements. Permanent posterior teeth were assessed for malposition only. This distinction was made because it was very difficult, without diagnostic casts, to determine accurately the rotation of posterior teeth. The number of displaced teeth in each arch according to segment was recorded on the examination form. Figure 6 shows a few examples of tooth deviations and rotations.

If a single tooth was rotated 45° or more and was also deviated by 2 mm or more, the tooth was recorded only once as a tooth displacement. Deciduous teeth were not assessed for tooth displacement.



CRITERIA FOR TOOTH DISPLACEMENT

Fig. 6

To aid in determining tooth displacements, a plastic rule scribed 2 mm from one end and also 2 mm along the sides and angled at 45° on the other end was used (after Van Kirk and Pennell[23]). Figure 7 depicts the instrument used for measuring tooth displacements.

Anterior Spacing

Spacing of the anterior teeth was assessed by recording the number of upper and lower anterior spaces that were 2 mm or greater. Measurement of anterior spacing was made with the beaks of a Boley gauge or with a 2 mm thick plastic strip. The maximum number of such spaces is five in each arch.

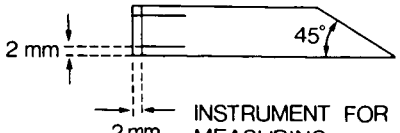
Space created by the loss of anterior deciduous teeth was ignored in measuring anterior spacing. Excess space due to loss of permanent teeth, however, was recorded. Distinguishing a missing permanent tooth from an unerupted tooth was done by questioning the patient and by comparing his chronological age with the usual age of eruption of the tooth under consideration.

General Considerations

For all occlusal relations recorded in this study, if a measurement or assessment could not be made or was not applicable, an "X" was placed in the appropriate box of the examination form. Unusual conditions such as congenitally missing teeth, supernumerary teeth, cleft palate, etc., were noted in the "Remarks" section of the form. If a subject was undergoing or had completed orthodontic treatment, this information was also recorded under "Remarks" and no measurements were made for the subject.

This report contains the examination form used in this study of occlusal relations (Fig. 8). A code sheet is also included which outlines the scoring system for the examination form (Fig. 9). Generally, if multiple boxes are present for recording a characteristic on the examination form, the left boxes refer to the left side of the mouth and the right boxes to the right side of the mouth. The "(J)" group of boxes provides space for recording left posterior, anterior, and right posterior thirds of the arch. The upper boxes generally refer to the upper arch and the lower boxes to the lower arch.

An exception to this general format is utilized in the "(D)" group of boxes where the upper boxes refer to left and right maxillary anterior teeth and the lower boxes refer to left and right maxillary posterior teeth.

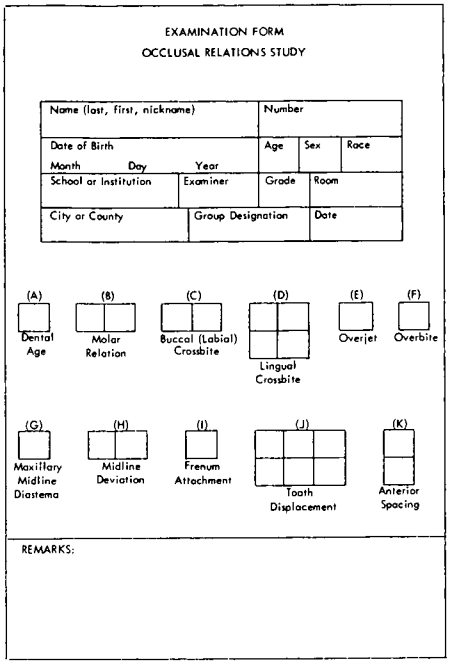


INSTRUMENT FOR MEASURING TOOTH DISPLACEMENT

Fig. 7

Summary

A method of measuring and recording several occlusal relations in a large population group has been reported. The techniques developed may help to eliminate confusion and keep subjective


EXAMINATION FORM
OCCLUSAL RELATIONS STUDY

Name (last, first, nickname)		Number		
Date of Birth Month Day Year		Age	Sex	Race
School or Institution	Examiner	Grade	Room	
City or County	Group Designation		Date	

(A) Dental Age
(B) Molar Relation
(C) Buccal (Labial) Crossbite
(D) Lingual Crossbite
(E) Overjet
(F) Overbite
(G) Maxillary Midline Diastema
(H) Midline Deviation
(I) Frenum Attachment
(J) Tooth Displacement
(K) Anterior Spacing

REMARKS:

Fig. 8

CODE SHEET
OCCLUSAL RELATIONS STUDY

Box	Characteristic	Score
A	Dental Age	1 through 6, as defined
B	Molar Relation	5, 6, 7, 8, 9 0 = Upper molar absent 1 = Lower molar absent 2 = Both molars absent
C	Buccal Crossbite (Posterior)	0 = No crossbite Enter the total number of maxillary teeth in crossbite
D	Lingual Crossbite (Anterior and Posterior)	0 = No crossbite Enter the total number of maxillary teeth in crossbite
E	Overjet	Record to nearest millimeter X = Cannot be measured
F	Overbite	Record to nearest millimeter X = Cannot be measured
G	Midline Diastema	Record to nearest millimeter 0 = No spacing or overlap X = Unrecordable
H	Midline Deviation	Left box -- record to nearest millimeter, upper to lower Right box -- right (R) or left (L) or 0 (if none)
I	Frenum Attachment	Record to nearest millimeter
J	Tooth Displacement	Enter the total number of deviated posterior teeth, or rotated and/or deviated anterior teeth
K	Tooth Spacing	Enter the total number of spaces in anterior region that are at least 2 millimeters in width

Fig. 9

judgments to a minimum in assessing dental age, molar relation, buccal and lingual crossbite, overjet, overbite, maxillary midline diastema, midline deviation, frenum attachment, tooth displacement and anterior spacing.

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