AN EVALUATION OF OCCLUSION OF CEREBRAL PALSIED CHILDREN

By

Charles Herbert Rosenbaum

Submitted to the Faculty of the Graduate School of Indiana University School of Dentistry in partial fulfillment of the requirements for the degree of Master of Science in Dentistry, 1963.

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

The author desires to acknowledge and express his appreciation to Dr. Ralph E. McDonald for his guidance in Pedodontics and his direction in completion of this thesis.

The author wishes to express his gratitude to Dr. Robert R. Buckley for his advice and assistance which was so helpful in the completion of this project.

The author wishes to acknowledge United Cerebral Palsy Research and Educational Foundation for the fellowship grant which permitted both this study and the completion of the requirements for the Master of Science in Dentistry degree at Indiana University.

The author wishes to thank Dr. Eugene E. Levitt for his completion of a statistical analysis of the data recorded for this thesis.

The author wishes to thank Mr. Richard Scott and Mrs. Gloria Spray for their assistance in the preparation of the tables and illustrations included in this paper.

The author thanks Mrs. Margaret Smith for the excellent typing of this thesis.

The author appreciates the assistance of his wife, Gayle, and the sacrifices of his family during the past two years.

TABLE OF CONTENTS

Page

INTRODUCTION..... 1

REVIEW OF LITERATURE..... 3

Cerebral Palsy..... 3
Dental Occlusion in Cerebral Palsy..... 8

STATEMENT OF PROBLEM..... 20

EXPERIMENTAL PROCEDURE..... 21

RESULTS..... 28

FIGURES AND TABLES..... 33 - 47

DISCUSSION..... 48

SUMMARY AND CONCLUSIONS..... 53

REFERENCES..... 56

VITA

ABSTRACT

TABLE OF FIGURES AND TABLES

Figure		Page
1	Form used to record findings of clinical examination and review of the medical history	33
2	Severe bruxism in cerebral palsied child.	34
3	Severe bruxism in non-cerebral palsied child	34
4	Anterior open bite with tongue thrust in cerebral palsied child	35
5	Anterior open bite with unilateral buccal crossbite in cerebral palsied child	35
Table		
I	Sample size of cerebral palsy and control groups	36
II	Distribution of sample by age	36
III	Medical classification of the cerebral palsy group	36
IV	Intelligence quotient of the cerebral palsy group	37
V	Angle's classification of occlusion	38
VI	Classification of occlusion by type of cerebral palsy	38
VII	Right first permanent molar relationship.	39
VIII	Left first permanent molar relationship.	39
IX	Right cuspid relationship	40
X	Left cuspid relationship	40
XI	Overjet	41
XII	Overbite	41

Table of Tables (continued)

Table		Page
XIII	Open bite	42
XIV	Distribution of open bites by age	42
XV	Bruxism	42
XVI	Relation of bruxism to time of occurrence	43
XVII	Bruxism. Distribution by age	43
XVIII	Bruxism by classification of cerebral palsy	44
XIX	Maxillary midline deviation	45
XX	Mandibular midline deviation	45
XXI	Visceral swallowing	45
XXII	Distribution of visceral swallowing by age	46
XXIII	Distribution of visceral swallowing by classification of cerebral palsy	46
XXIV	Tongue thrusting	46
XXV	Distribution of tongue thrusting by age	47
XXVI	Distribution of tongue thrusting by classification of cerebral palsy	47
XXVII	Crossbite	47

INTRODUCTION

INTRODUCTION

Since 1861 when William Little gave the first medical description of cerebral palsy, then called spastic rigidity, clinical symptoms of this entity have been discussed in the literature pertaining to all related health fields[1]. The medical profession has done much to provide information on various aspects of this crippling problem. Only recently, however, has the dental profession taken an active interest in the particular dental problems of the cerebral palsied child. Very few articles appear concerning diagnosis, treatment, or management of the dental problems of the cerebral palsied patient. Most of the published information is concerned with the need of treatment, not with the specific treatment involved.

Some generalizations concerning the dental problems of cerebral palsied children have been made by various authors. Abnormal muscle force of the tongue and lip is a common conclusion for the etiology of frequently reported openbites and Class II malocclusions. Severe bruxism and abrasion of the deciduous and permanent dentition is a common finding of investigators. With clinical impressions as the only evidence, the presence of a generalized malocclusion problem in cerebral palsied children has often been reported. The assumption by various investigators that malocclusion frequently accompanies

cerebral palsy appeared very plausable to the author following six months of providing clinical dentistry for cerebral palsied patients.

A number of questions aroused the interest of the author and brought about an investigation related to the occlusion of cerebral palsied children. Is visceral swallowing and tongue thrusting more predominant in a cerebral palsied group than in a control group of non-handicapped children? If so, what effect do these habits have on the occlusion? Are both the anterior and posterior segments of the arches affected? Does the cerebral palsied group have a higher frequency of anterior openbite? Is bruxism present more frequently in the cerebral palsied group and if so, is it practiced during the day or during the night?

The answer to these questions will contribute to an understanding of the dental problems of the cerebral palsied individuals.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

In presenting a review of the literature, it seems desirable, because of the numerous different dental measurements to be made in this study, to record the review according to specific headings, keeping these headings in their respective chronological order. This will make specific areas of interest more readily available to the reader.

Specific information on the dental aspects of cerebral palsied children is quite sparse. It is felt that information pertaining to occlusion in normal children may provide some correlative background, so this is included when considered necessary.

Cerebral Palsy

Cerebral palsy is not a recently discovered problem. For the past 100 years, with changing medical concepts and improved diagnostic aids, the medical profession has reconsidered earlier beliefs in arriving at a more widely accepted general picture of cerebral palsy. Perlstein[2] considered cerebral palsy to be a condition characterized by paralysis, paresis, incoordination, dyskenesia or any aberration of motor function that is due to involvement of the motor control centers of the brain.

Incidence of Cerebral Palsy

Because of a lack of manditory reporting of cerebral palsy

and the problem of specific diagnosis at an early age, the incidence of cerebral palsy may be greater than is reported by various authors. There are an estimated 500,000 to 600,000 individuals with cerebral palsy in the United States today. Perlstein[3] estimated a rate of one per 200 births, or 7.5 per 100,000 total population per year; the American Public Health Association estimated there are 150 per 100,000 total population.

Classification of Cerebral Palsy

Much disagreement in the area of classification into specific types of cerebral palsy can be noted in the literature. Perlstein[2, 3] thoroughly reviewed classification methods and reported on the general methods in use.

Some diagnosticians classify the type of the cerebral palsy according to the anatomic site of the brain lesion. Pyramidal tract involvement results in a removal of the inhibitory effects within the pyramidal tract; this produces a true spastic. An involvement of the extra-pyramidal tract includes lesions of the basilar nuclear areas and/or their connections. Individuals with this involvement are either in the athetoid, rigidity or tremor classification. An involvement of the cerebellum and/or its connections results in the ataxic form of cerebral palsy.

Another very common classification of cerebral palsy is one related to the qualitative nature of the clinical symptom. A

lesion of the motor cortex with upper motor neurone involvement and exaggerated or hyperactive stretch reflexes of the involved muscle results in a spastic condition. Spasticity is present in 40 to 60 per cent of the patients. Dyskenesias, which is characterized by an abnormal amount and type of motion, can assume 3 forms, namely, athetosis, tremors and rigidity.

The athetoids, consisting of 20 to 45 per cent of the cases, exhibits purposeless involuntary movement. Tremors are characterized by regular and rhythmic involuntary vibrating movements. Two to five per cent of the individuals exhibit tremors. Rigidity, occurring in 4 to 5 per cent of the individuals, is a disturbance of agonist-antagonist muscle relationships and is a result of widespread brain damage. The final grouping by qualitative symptoms is ataxia, exhibiting a disturbance in the sense of balance and equilibrium. Eight to ten per cent of the patients exhibit ataxia.

A consideration of the topographical distribution of the involvement by extremities is also used in classification:

a. A paraplegic exhibits involvement of the legs only.

b. A diplegic exhibits involvement of the legs primarily, with the arms only slightly involved.

c. A quadraplegic has involvement of all four extremities.

d. In hemiplegia the involvement is lateralized to one-half of the body.

e. A triplegic has three extremities involved.

f. A monoplegic has involvement of one limb.

g. A double hemiplegic is a spastic quadraplegic with more involvement of the arms than the legs.

Cerebral palsy can be further classified into three groups according to etiology. Thirty per cent of the cases are of prenatal origin; the prenatal period being defined as the period between conception and the onset of labor. Natal factors, occurring from the time of onset of labor to the time of delivery, constitute sixty per cent of the cases. Postnatal factors, which are those occurring after birth are responsible for a small percentage of the total cases.

Other methods of classification relate to the degree of tonicity of the involved muscles and to the severity of the involvement.

Intelligence Quotient of Cerebral Palsied Children

There is little agreement among researchers regarding the intelligence level of cerebral palsied individuals. Accurate testing is difficult with children who have led sheltered lives and have not had the experiences of an individual without a handicapping condition. Also, the motor involvement invalidates tests requiring extensive participation by the patient.

McIntire[5], in reviewing a study in which 146 cerebral palsied children were tested, reported that one in four was mentally defective to the extent of having borderline feeble-minded intelligence. In a later study involving 500 cerebral palsied residents of New Jersey, having a mean chronological age of 9.8 years, McIntire found feeblemindedness present in every third child examined, or approximately fourteen times as frequent as in the normal population. He found that tests requiring a verbal response, such as the Stanford Revision of the Binet, were most valuable when used along with written and oral reports of the patient's mental functioning.

Pohl[6] found 41 per cent of 144 cerebral palsied children to be below acceptable educational levels of intelligence.

Asher and Schonnell[7] found the mean I.Q. of 340 cerebral palsy children to be 67.9 for spastics, 67.6 for athetoids, 62.3 for ataxics, and 62.4 for the mixed group.

Levinson and Bigler[8] generalized that some degree of mental retardation is present in about 75 per cent of all cerebral palsied cases.

Henderson[9] reported on 111 female and 129 male cerebral palsied patients under the age of 21 which were examined in the Eastern Hospital Region of Scotland. He found that one in two cerebral palsied patients were mentally handicapped, as opposed to 3 in 100 in a normal population. It was also found that the intelligence level tended to decline as the physical handicap

became more serious. In a comparison of the I.Q. level of spastics and athetoids, the spastics were found to have a lower mean I.Q. than the athetoids.

Dental Occlusion in Cerebral Palsy

Cuspid Interdigitation

Baume[10] reported on the value of observing the cuspid relationship when diagnosing irregularities in the occlusion. He reported that in the normal relationship the distal surface of the lower cuspid was 2.5 mm. ± 0.5 mm. anterior to the distal surface of the upper cuspid. A larger figure represented a Class III relationship, and a smaller one represented a Class II relationship. This information was recorded using a non-handicapped sample.

The literature contains no specific reference to cuspid relationship in cerebral palsied children.

Molar Relationship

In 1907 Angle[11] presented his classification for malocclusion. Angle's classification may be defined as follows:

Class I. A normal mesio-distal relationship of the jaws and the dental arches; this was represented by locking of the mesio-buccal cusp of the maxillary first permanent molar in the buccal groove of the mandibular first permanent molar.

Class II. The mandibular dental arch is in a distal relation to the maxillary arch by one-half the width of the permanent first molar.

Class II, Division 1. Labioversion of the maxillary incisor teeth with a Class II occlusion of the first permanent molars.

Class II, Division 1, Subdivision.

A Class II, division 1 occlusion with the distal relationship present on one side only. The opposite side is in a normal relationship.

Class II, Division 2. Retruding maxillary incisors with a Class II occlusion.

Class II, Division 2, Subdivision.

A Class II, division 2 occlusion with the distal relationship present on one side only. The opposite side is in a normal relationship.

Class III. The mandibular dental arch is in a mesial relation to the maxillary arch by one-half the width of the permanent first molar.

Class III, Subdivision.

A Class III occlusion which is unilateral only.

In an examination of 1000 individuals, Angle found that 692 had a Class I occlusion, 266 had a Class II malocclusion, and 42 had a Class III malocclusion.

Jackson[12] examined 84 cerebral palsied children (45 male,

39 female) and recorded molar relationships. He reported 53.1 per cent Class I, 42.2 per cent Class II, and 4.7 per cent Class III malocclusions. He found little difference in comparison to the percentage within each orthodontic class of malocclusion between the cerebral palsied group and 380 normal children used as a control group.

Jackson[12] also reported on hypertonicity of the buccal and labial tissues of cerebral palsied children, which prevented forward and lateral growth of the maxilla and mandible. He reported perverted muscular action in swallowing and speech, both of which placed abnormal forces on the teeth. He concluded that the incidence of malocclusion and dental arch deformities is greater in cerebral palsied children than in normal children (76.2 per cent of 84, as compared to 52.5 per cent of 380) by Angle's classification. He further concluded that young cerebral palsied children in the deciduous dentition stage are more likely to have normal occlusions than older cerebral palsied children in the mixed or permanent dentition stage.

Watson[13] examined 119 cerebral palsied children in Australia. He recorded 52 cases of normal occlusion, 32 with Class I, 13 with Class II, and 6 with Class III malocclusions. He did not classify the occlusion of 16 of the children. Watson reported that the incidence of malocclusion was not much greater in cerebral palsied than in normal children. He wrote

that abnormal muscular movements did not cause malocclusions. He concluded that the incidence of malocclusion was not higher in cerebral palsy, but more difficult to treat.

Koster[14] reported that athetoids with malocclusions were predominately of the Class II, division 1 type with anterior open bites, while spastics with malocclusions were predominately Class II, division 2 with unilateral crossbites. He also reported that malocclusion was more predominate in athetoids than in spastics. Koster reported the high incidence of malocclusion in cerebral palsied patients to be due to facial and cervical musculature exhibiting abnormal tonic conditions and pernicious intra-oral functioning which is involuntary. Abnormal mastication and deglutition were also contributing factors.

Lyons[15] in an examination of 123 cerebral palsied children, ages 7 to 16 years, of both sexes and different races, found 104 (84 per cent) to have a definite malocclusion. Of the 104, 69 (66.3 per cent) had a Class II, division 1 malocclusion. In his control group of 157 children with other handicapping conditions, he found 10.2 per cent had Class II malocclusions.

Overjet

There was no information in the literature read by the author concerning overjet in cerebral palsied children. Some

information concerning overjet in non-handicapped populations is presented later.

Overbite

Strang[16] reported that both unbalanced muscle pressure and susceptible tissue must be present for the development of an overbite. He is of the opinion that perverted swallowing often produces excessive lingual and forward thrust against the posterior ends of the denture producing an exaggerated curve of Spee and excessive overbite.

Goldstein and Stanton[17] reported that overbite increases in normal occlusion of non-handicapped patients until it becomes predominant in the later years. Excess horizontal and vertical overbite were the predominant malocclusions with open bite disappearing after the seventh year. Since overbite increases with time in normal occlusion, and since malocclusion increases with age, an overbite disturbance in a normal occlusion might be an early sign of a malocclusion tendency. They also reported that the overjet and overbite were generally greater in the permanent dentition than in the deciduous dentition.

Bauerle[18] found the average overbite to be 1.25 mm. in the late deciduous dentition period, 3.17 mm. at age 9, and 3.81 mm. at age 12 years. He also reported no significant difference in the amount of overbite between acceptable occlu-

sions and Class I or Class II malocclusions.

Fleming[19], on examination of serial orthodontic casts and cephalometric radiographs, found that the mean overbite increased between the ages of 9 and 12, and then decreased until the age 17 years. He found no statistical difference between the overbite of males and females.

There are no studies reported on the literature reviewed concerning overbite in cerebral palsied children.

Open bite

Rogers[20] reported that open bites in a non-handicapped group occurs most frequently in the mixed dentition stage.

Nord[21] reported that the open bite which develops when the tongue does not allow the incisors to erupt into their normal position does not occur in the deciduous dentition. He also reported that a large thick tongue was frequently found to be a secondary cause of an open bite.

Lyons[22], on examination of 50 white cerebral palsied children, ages 10 to 14 years, found that 7 (14 per cent) had an open bite. He also found that 36 (72 per cent) of the children had varying types of malocclusion.

Jackson[12] and Trausch[1] found 21 per cent of 84 cerebral palsied children to have an open bite. More than one-half of the group exhibited involuntary tongue thrusts.

Watson[13] found 17 cases (14.2 per cent) of open bite in

119 cases of cerebral palsied children.

Buckley[23], in an electromyographic study of 136 spastic hemiplegics, found an increased electrical activity in the orbicularis oris muscle corresponding to the side of the involvement during function of both right and left halves of the muscle. Thirteen of these patients were recorded as having open bites.

Bruxism

Album[24] reported on the problem of bruxism in athetoids. He linked the finding of bruxism to the periodic, but continuous inability of the patient to control his musculature.

Watson[13] reported severe attrition from bruxism in 28 of 119 cerebral palsied patients.

Koster[14] reported that bruxism is most common among the athetoid group of cerebral palsied patients and that they usually grind their teeth during the waking hours.

Massler and Perlstein[25] reported on 145 children, ages 2 to 10 years, with cerebral palsy. The incidence and severity of the malocclusions were not found to be significantly different from a control group of more than 4000 "normal" school children in the 6 to 12 year age group. They reported bruxism in 82 per cent of the cerebral palsied children examined. Bruxism was most common in athetoids and there was an apparent correlation with the type and severity of the injury.

Midline Shift

Koster[14] reported that there are facial asymmetries in spastic hemiplegics and quadriplegics with resulting displaced dental midlines. Other information on midline shifting in cerebral palsied patients was not found in the literature.

Visceral Swallowing and Tongue Thrust

In recent years much emphasis has been placed on abnormal swallowing and aberrant tongue motion in the production of dental malocclusions. Criteria used as standards have been quite varied, depending on the researcher involved. Little correlation is possible between statistics quoted in the literature.

Rix[26] presented a classic description of the normal swallowing mechanism. The sequence of events in the swallowing procedure are as follows:

1. Lips together
2. Soft palate raised
3. Nasal cavity closed posteriorly by approximation of the walls of the nasopharyngeal isthmus
4. Momentary cessation of respiration
5. Maxillary and mandibular teeth brought into occlusion
6. Tongue spread and raised
7. Front and sides of the tongue touch the lingual surfaces of the occluding teeth and supporting structures

8. The whole dorsum of the tongue lying in contact with the palate

9. In the posterior the dorsum forms a seal against the soft palate

10. Contraction of the mylo-hyoids which thrust the spread tongue hard against the teeth and palate, completing the swallowing act.

Rix reported a childhood pattern of swallowing in which the teeth are not in occlusion. The spread of the tongue takes its periphery through the separated teeth until it comes in contact with the cheeks and lips. The muscles of the lips and cheeks are put into action to create a firm walled cavity for the tongue to act in. He checked for the teeth-apart position by noting an increased lip activity which is necessary to seal off the oral cavity. He noted a high per cent of malocclusion when the infantile pattern persisted.

Jay[30] reported that the abnormal muscle activity of the face of cerebral palsied children can be an important factor in producing a malocclusion. He also reported that cerebral palsy may interfere with a child's growth and development and thereby become a controlling factor in the production of a malocclusion.

Jackson[12] reported there was perversion of muscular actions in association with swallowing in cerebral palsy. He concluded that the swallowing pattern exhibited a muscular imbalance which

placed abnormal pressure on the teeth, resulting in their displacement.

Trausch[1] reported on the presence of impaired and lacking voluntary tongue function in children with cerebral palsy. He found involuntary tongue thrusts were commonly present and prevailed most often in athetoids. He concluded there was a direct relationship between the involuntary tongue thrust and neuromuscular functions.

Watson[13] reported that 30 of 119 cerebral palsied children had tongue habits which included those with involuntary spastic or athetoid tongue movements, as well as tongue thrusting or sucking. Forty-three of 119 children in this group had chewing or swallowing habits.

Barton[31] reported that patients with some dysfunction of the facial musculature appeared more prone to develop malocclusions as a result of the lack of balance between tongue and cheek muscles.

Lyons[15] reported that an infantile type of swallowing pattern accounted for the occlusal change in individuals with cerebral palsy, with accompanying Class II, division 1 malocclusions. He found 69 (66.3 per cent) of 104 children between the ages of 7 to 12 years to have this classification of malocclusion.

Kastein[32] reported that malocclusion, combined with tongue thrust and drooling, was frequently found in cerebral palsied patients.

Lyons[33] reported that children with neuromuscular problems are handicapped in their masticatory ability as a result of abnormal muscle function.

Fletcher and associates[27] reported that a deviant swallowing pattern was characterized by the mouth enclosing musculature undergoing extreme tension, the absence of palpable contraction of the muscles of mastication during the act of swallowing, and forward thrust of the tongue between the incisors. Six hundred sixty-eight out of 1615 normal children between the ages of 6 to 18 years exhibited a tongue thrust swallow. They found the proportion of subjects having a tongue thrust swallow diminished rapidly in the higher age groups.

Rogers[28] reported 62.8 per cent of his orthodontic patients had a swallowing abnormality as compared to 56.9 per cent of elementary school pupils tested.

Ward[29] and associates reported on 358 children in grades 1 through 3. They found 74.3 per cent manifested visceral swallowing, with 47.5 per cent having malocclusion. Malocclusions and visceral swallowing were present coincidentally in 91 per cent of the cases.

Swallow[34] reported a higher incidence of malocclusion in cerebral palsied children than in the rest of the community.

Crossbite

Little information is reported concerning the incidence of

crossbites in cerebral palsy children. Koster[14] reported that in a spastic hemiplegic the crossbite is found on the affected side as a result of the lateral pull of the hypertonic muscles on the mandible.

Watson[13] reported on 119 cerebral palsied patients. Seven of these had posterior crossbites and three had inlocked upper incisors.

STATEMENT OF PROBLEM

STATEMENT OF PROBLEM

The purpose of this study was to provide information concerning occlusion and related problems in cerebral palsied children and to compare the results with those found in a similar group of non-handicapped school children. This was undertaken because of the author's interest in both cerebral palsy and occlusion and because of a lack of convincing evidence in the literature concerning the relationship.

EXPERIMENTAL PROCEDURE

EXPERIMENTAL PROCEDURE

An oral examination was conducted on 124 children between the ages of 6 and 12 years who were patients at the Indiana University Cerebral Palsy Dental Clinic (Tables 1, 2 and 3). The children were picked at random from those undergoing their routine medical and dental recall appointments. Some of the children had received dental care at the Cerebral Palsy Dental Clinic, some from local dentists and some had not had previous dental care. The examination was completed with the aid of a good light, a Dixon Boley gauge with beaks ground to provide a thin pair of points for measuring, an Arrow Ringhead Bow divider, dental floss and a sharp pencil. Complete medical records were available for all patients in the experimental group. The medical records were reviewed to determine the type of intelligence tests administered, the dates and results. The most recent classification as to type of cerebral palsy was recorded. The diagnosis that was used was that of the medical consultant, occupational and physical therapists and the author.

A control group of 141 children was selected at random from the patients coming to the Indiana University School of Dentistry, Pedodontic department. These children were also between the ages of 6 and 12 years. Some of the children in the control group had received no previous dental care, while others had been treated by their family dentist or by students

in the University clinic.

A data sheet was designed for the recording of numerous measurements which were considered important in an evaluation of the occlusion (Figure 1).

An Angle's classification of first permanent molar relationships was recorded. The designation was "normal" if the mesio-buccal cusp of the upper first permanent molar was directly in the buccal groove of the lower first permanent molar and there were no other tooth-arch discrepancies.

A designation of Class I malocclusion was recorded if the mesio-buccal cusp tip of the upper first permanent molar was one-half a cusp width or less either anterior or posterior from the buccal groove of the lower first permanent molar.

A designation of Class II malocclusion was recorded if the buccal groove of the lower first permanent molar was greater than one-half a cusp width distal to the tip of the mesio-buccal cusp of the upper first permanent molar. A Division 1 classification was recorded if the lower first permanent molars were bilaterally distal with protruding upper incisors. A Division 2 classification was recorded if the lower first permanent molars were bilaterally distal with retruding upper incisors. A Subdivision classification was recorded for a unilaterally distal lower first permanent molar.

A designation of Class III malocclusion was recorded if the buccal groove of the lower first permanent molar was greater

than one-half a cusp width mesial to the tip of the mesio-buccal cusp of the upper first permanent molar. A unilateral relationship was recorded as Subdivision.

The molar relationship was recorded as not possible if either one or both of an upper and lower molar pair were unerupted or missing.

The relationship of the upper first permanent molars to the lower first permanent molars was determined. A vertical line was placed on the buccal surface of upper first molar originating at the tip of the mesio-buccal cusp. With the teeth in occlusion, a horizontal measurement was taken with the Boley gauge from the aforementioned line on the upper first molar to the buccal groove of the lower first molar and the millimeter measurement recorded. This was designated as (+) if the buccal groove was anterior to the mesio-buccal cusp tip, and (-) if the groove was posterior. This measurement was recorded for both right and left first permanent molar pairs, if present.

Cuspid interdigitation was determined by placing vertical lines on the labial surfaces of the cuspids, originating at the cusp tips. With the teeth in occlusion, the horizontal distance between the vertical lines was recorded in millimeters. This was recorded as (+) if the lower cuspid line was anterior to the upper cuspid line, and (-) if the lower line was posterior. This measurement was taken for both right and

left cuspid pairs, if present.

Overjet was determined by placement of the Boley gauge against the labial surface of the lower central incisor which best maintained the symmetric continuity of the arch. With the teeth in occlusion the movable portion of the gauge was placed against the labial surface of the corresponding upper anterior tooth. This measurement was recorded in millimeters. It was designated as (+) if upper anterior teeth were anterior to the lower anterior teeth; (-) if the upper anterior teeth were posterior to the lower anterior teeth and (0) if they appeared to be end-to-end.

Overbite was determined as the amount, in millimeters, of the lower anterior teeth which were lapped by the upper anterior teeth when the teeth were in occlusion. With the teeth in occlusion a line was drawn on the labial surface of a representative lower anterior tooth at the level of the incisal edge of the corresponding upper anterior tooth. Then, with the mouth open and using a Boley gauge, the distance from the line to the incisal edge of the lower anterior tooth was recorded. This was designated as (+) if the upper anterior teeth overlapped the lower anterior teeth, and (0) if there was no overlap.

Open bite was determined to be the presence of vertical spacing between the incisal or occlusal surfaces of erupted teeth in opposing arches when the patient was in occlusion.

The amount of spacing present was measured in millimeters by the Boley gauge. The amount and position were then recorded as anterior, right or left lateral.

Bruxism was determined to be the abnormal grinding of teeth with resultant clinically detectable facets. If present, this was recorded as moderate or severe, depending on the amount of occlusal or incisal destruction. Questioning of the parents revealed whether this grinding took place during the day and/or night.

Midline position of both upper and lower anterior teeth was determined by lining up dental floss along three midline points: the center of the forehead, the center of the nose, and the center of the chin. With the teeth in occlusion, the lips were parted and any deviation from the line formed by the floss was recorded in millimeters. If all central incisors were not present the designation was made as "cannot be determined".

Visceral swallowing was defined as swallowing without having the posterior teeth in occlusion. A number of methods were used to determine the presence or absence of this swallowing pattern:

1. Clinical observation of the patient during the examination.
2. Placement of finger tips in the area of the temporalis muscle to feel the contraction that

took place when the posterior teeth were brought into occlusion during swallowing.

3. Placement of finger tips on the masseter muscle to feel the contraction that took place when the posterior teeth were brought into occlusion during the swallowing pattern. At the same time the thumbs were used to retract the lower lip downward to allow a visual check of posterior tooth positioning.

4. The presence of abnormal mentalis muscle activity was observed during examination.

The presence or absence of a visceral swallowing pattern was then recorded on the data sheet.

Because of the wide variance of opinion between different investigators regarding the presence of a visceral swallowing habit, it was felt that a check on the author's evaluation would be helpful. After 40 cerebral palsied children had been examined, a double list was prepared containing the patients names. On one list the examiner marked the 10 patients he had diagnosed as visceral swallowers and/or tongue thrusters. The other list was given to the speech therapist who had worked with these children. On her list the names of 9 known visceral swallowers and/or tongue thrusters were marked. On comparison of the two lists, the 9 marked by the therapist were all included in the 10 marked by the author. The tenth name had not

been examined by the speech department for over three years.

Tongue thrust was defined as protrusion of the tongue beyond the incisal edges of the lower anterior teeth. This tongue protrusion necessarily provided the clinical impression of an anterior force on the lingual aspect of the upper anterior teeth if it was to be recorded as a tongue thrust. Tongue protrusion without a force on the anterior teeth (tongue seal) was not recorded as tongue thrust. This was determined during general observation of the patient, swallowing, and when the lower lip was retracted by the investigator's thumbs.

Crossbites were defined as teeth which did not occlude with their antagonist in the normal bucco-lingual or labio-lingual relationship. A normal relationship for the posterior teeth was determined to be when the lingual cusp of the upper posterior tooth occluded with the occlusal table of the lower posterior antagonist. A normal relationship for the anterior teeth was determined to be when the lingual surface of the upper anterior tooth was labial to the labial surface of the lower anterior antagonist.

RESULTS

RESULTS

All of the results in this study were recorded on a data sheet which was developed to facilitate easy recording and simple tabulation. The sum, average, sum of the squares and "t" test scores with probability percentages were figured on the measurements.

Tabulation of the I.Q. scores listed for 77 of the cerebral palsied group revealed that 75.3 per cent of the cerebral palsy group received scores of below 90, which places them in a below average range. The remaining 24.7 per cent were in the 90 to 120 range, which is normal and above. In a consideration of the I.Q. scores by cerebral palsy classifications, 64.2 per cent of the spastics, 85.7 per cent of the athetoids and 92.9 per cent of the mixed group were recorded as being below 90 (Table 4).

The variance in the sample size in the following measurements is a result of not being able to record a measurement for a certain individual because of the absence of teeth necessary for the recording of occlusion. Therefore, each specific measurement will have its own sample size.

An Angle's classification of molar relationships of the cerebral palsied group revealed that of 91 children examined, 4.4 per cent had ideal occlusion, 61.5 per cent had Class I malocclusions, 26.4 per cent had Class II malocclusions, and

7.7 per cent had Class III malocclusions. Of 119 children in the control group, 15.1 per cent had ideal occlusion, 52.1 per cent had Class I malocclusions, 22.7 per cent had Class II malocclusions, and 10.1 per cent had Class III malocclusions (Table 5).

When considering the Angle's classification of the cerebral palsied group by the specific type of cerebral palsy present, the spastics had the highest percentage of Class I malocclusions and the lowest percentage of Class II and Class III malocclusions. The athetoid and mixed groups were very similar in percentages of all three types of malocclusions (Table 6).

The right first permanent molar relationship measurements were recorded on 94 cerebral palsied children and 122 children in the control group. The average recording for the cerebral palsied group showed the buccal groove of the lower first permanent molar 1.2 mm. mesial to the mesio-buccal cusp tip of the upper first permanent molar. In the control group there was a 1.6 mm. mesial recording. There was no significant difference between these two figures (Table 7).

The left first permanent molar relationship measurements were recorded on 95 cerebral palsied children and 119 children in the control group. The average recording for the cerebral palsied group showed the buccal groove of the lower left first permanent molar 1.5 mm. mesial to the mesio-buccal cusp tip

of the upper left first permanent molar; there was a 1.2 mm. mesial recording of the control group. This difference was not statistically significant (Table 8).

Measurements of right cuspid relationships were recorded on 98 cerebral palsied children and 110 children in the control group. The average measurement for both groups resulted in the lower cuspid cusp tip being 2.2 mm. anterior to the upper cuspid cusp tip (Table 9).

The left cuspid relationship measurements were recorded on 99 cerebral palsied children and 115 children in the control group. The average measurement for the cerebral palsied group resulted in the lower cusp tip being 2.4 mm. anterior to the upper cuspid cusp tip; the control group had an anterior recording of 2.8 mm. This was not a significant difference (Table 10).

The average overjet measurement of 119 cerebral palsied children was 4.8 mm. This was statistically different from the 4.0 mm. average of 135 control group children (Table 11).

The average overbite measurement of 109 cerebral palsied children was 2.6 mm. One hundred twenty-one control group children had an average overbite of 3.1 mm. The 0.5 mm. difference was statistically significant (Table 12).

There was no statistical difference between the percentage of open bites found in the cerebral palsied group (11.3) or in the control group (12.7). However, the cerebral palsied groups'

average open bite was 2.9 mm., more than twice the size of the average open bite in the control group (1.2 mm.). This measurement had a percentage score of $<.01$ (Table 13).

The distribution of open bites was found to decrease as the age increased, with the six-year-olds having the greatest number and the twelve-year-olds having none. This was found for both groups (Table 14).

Bruxism was found in 44 per cent of the cerebral palsied children examined. Twenty-two per cent of the children were recorded as having severe bruxism and twenty-two per cent as moderate bruxism. This was statistically different from the control group which had 21 per cent exhibiting bruxism - 5 per cent severe and 21 per cent moderate (Table 15).

Of the cerebral palsied children exhibiting bruxism, 57 per cent were day or day and night grinders. Of the control group, only 1 (3.4 per cent) was a daytime grinder (Table 16).

Twenty-seven cerebral palsied children (21.8 per cent) exhibited their grinding at night or day and night. In the control group 27 children (19.1 per cent) were night time grinders (Table 16).

The distribution of bruxism was found to decrease with age in both the cerebral palsied group and the control group (Table 17).

Bruxism, recorded by type of cerebral palsy classification, was most frequently found in the athetoid group (63.3

per cent), and least frequently in the spastic group (35.1 per cent) (Table 18).

The average maxillary midline deviation of the cerebral palsied group was not statistically different from the control group (1.9 mm. vs. 1.6 mm.) (Table 19).

The average mandibular midline deviation of the cerebral palsied group was not statistically different from that of the control group (1.8 mm. vs. 1.6 mm.) (Table 20).

Visceral swallowing was not statistically different between the cerebral palsied group (36.3 per cent) and the control group (24.1 per cent) (Table 21).

Thirty-five per cent of the cerebral palsied group exhibited tongue thrust compared with 26 per cent of the control group (Table 24).

The frequency of visceral swallowing decreased in both groups as the age of the child increased (Table 22). Fifty per cent of the athetoids and thirty per cent of the spastics examined exhibited visceral swallowing (Table 23).

The frequency of tongue thrusting decreased in both groups as the age of the child increased (Table 25).

Forty-seven per cent of the mixed group and 30 per cent of the spastics examined exhibited tongue thrusting (Table 26).

There was no statistical difference between the frequency of crossbites in either the cerebral palsied group or the control group (Table 27).

FIGURES AND TABLES

Figure 1. Form used to record findings of clinical examination and review of the medical history.

Name_____ Age_____ Birth_____

City_____ Sex_____ Date_____

Water fluoridation_____Yes_____No How long_____

Classification_____ MCIQ_____

D.T._____

First Permanent Molar Relationship

R L

____ ____ 0
____ ____ +
____ ____ -
____ ____ not possible

Cuspid Interdigitation

R L

____ ____ 0
____ ____ +
____ ____ -
____ ____ not possible

Occlusion

____Normal
____Class I
____Class II
____Division I
____Division II
____Subdivision
____ClassIII
____Subdivision
____Not Possible

Overjet - MM

____ 0
____ +
____ -
____ Not possible

Overbite - MM

____ 0
____ +
____ -
____ Not possible

Openbite, MM

_____Anterior
_____Right Lateral
_____Left Lateral
_____Not present

Bruxism

_____Not present
_____Moderate
_____Severe
_____Day
_____Night

Midline

_____Normal
_____Maxilla deviated to left
_____Maxilla deviated to right
_____Mandible deviated to left
_____Mandible deviated to right
_____Cannot be determined

Visceral Swallowing

_____present
_____Not present

Tongue Thrust

_____present
_____not present

Other Oral Habits

_____
_____
_____Not present

Ectopic Eruption

_____/_____
_____Not present

Crossbite

_____/_____
_____Not present

Amount of Space Closure due to premature loss of posterior deciduous teeth or from destruction of crown, MM (C,D,E)

_____/_____

Premature loss of deciduous teeth but no space loss

_____/_____
_____No premature loss of deciduous teeth

Loss of Permanent Teeth

_____/_____

Previous Treatment For Malocclusion

_____Yes
_____No

Type of Treatment

_____
_____

Ankylosis of Deciduous Teeth

_____/_____
_____Not present

Blocked out teeth

_____/_____
_____Not present

USD Pedo
-62

Figure 2. An example of severe bruxism in a cerebral palsied child. Note that the only teeth not exhibiting bruxism are the recently erupted lower incisors.

Figure 3. An example of severe bruxism in a non-cerebral palsied child.

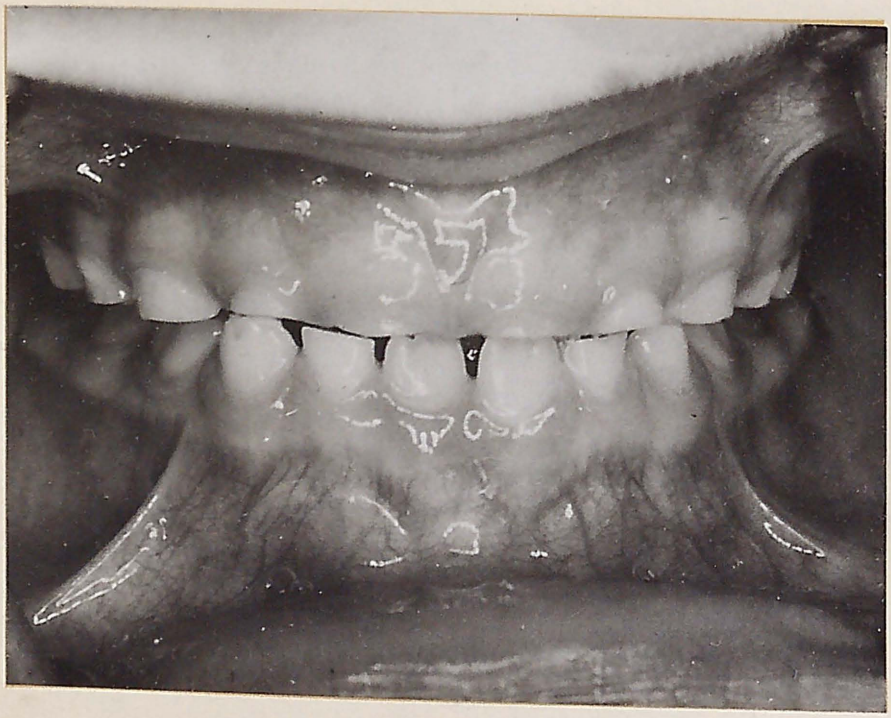

Figure 4. An example of anterior open bite with tongue thrust in cerebral palsied child. Note apparent normal interdigitation of the teeth in the posterior segment.

Figure 5. An example of anterior open bite with a unilateral buccal crossbite on the left side in a cerebral palsied child.

Table I. Sample size of cerebral palsy and control groups.

Table II. Distribution of sample by age.

Table III. Medical classification of the cerebral palsy group.

SAMPLE SIZE

	CEREBRAL PALSY GROUP	CONTROL GROUP
MALES	64	73
FEMALES	60	68
TOTAL	124	141

TABLE 1

SAMPLE DISTRIBUTION BY AGE

	CEREBRAL PALSY GROUP		CONTROL GROUP	
AGE	MALE	FEMALE	MALE	FEMALE
6	11	10	12	10
7	10	9	12	10
8	9	10	10	10
9	8	10	14	10
10	10	7	10	11
11	10	6	10	11
12	6	8	5	6
TOTAL	64	60	73	68

TABLE 2

MEDICAL CLASSIFICATION OF THE CEREBRAL PALSY GROUP

CLASSIFICATION	NUMBER	PERCENTAGE
SPASTIC	74	59.7%
ATHETOID	30	24.2%
MIXED	19	15.3%
ATAXIC	1	0.8%

TABLE 3

Table IV. Intelligence quotient of the cerebral palsy group.

INTELLIGENCE QUOTIENT OF THE CEREBRAL PALSY GROUP

TOTAL RANGE	GROUP NUMBER	PERCENT	SPASTICS	PERCENT	ATHETOIDS	PERCENT	MIXED	PERCENT
0- 30	3	3.9	1	2.4	1	4.8	1	7.1
30- 50	8	10.4	3	7.1	3	14.3	2	14.3
50- 70	22	28.5	9	21.4	7	33.3	6	42.9
70- 90	25	32.5	14	33.3	7	33.3	4	28.6
90-110	17	22.1	15	35.8	1	4.8	1	7.1
110-120	2	2.6	—	—	2	9.5	—	—
TOTAL	77		42		21		14	

TABLE 4

Table V. Angle's classification of occlusion.

Table VI. Classification of occlusion by type of cerebral palsy.

ANGLES CLASSIFICATION OF OCCLUSION

	IDEAL		CLASS I		CLASS II		CLASS III		TOTAL
CEREBRAL PALSY GROUP	4	4.4%	56	61.5%	24	26.4%	7	7.7%	91
CONTROL GROUP	18	15.1%	62	52.1%	27	22.7%	12	10.1%	119
$p < .10 > .05$									

TABLE 5

CLASSIFICATION OF OCCLUSION BY TYPE OF CEREBRAL PALSY

	IDEAL		CLASS I		CLASS II		CLASS III		TOTAL
SPASTIC	3	5.3%	37	64.9%	13	22.8%	4	7.0%	57
ATHETOID	1	5.3%	9	47.4%	7	36.8%	2	10.5%	19
MIXED	—	——	8	50.0%	6	37.5%	2	12.5%	16
ATAXIC	—	——	1	100.0%	—	——	—	——	1

TABLE 6

Table VII. Right first permanent molar relationship.

Table VIII. Left first permanent molar relationship.

RIGHT FIRST PERMANENT
MOLAR RELATIONSHIP

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
-8	0	1
-6	1	0
-5	1	1
-4	5	7
-3	6	12
-2	14	16
-1	3	17
0	47	42
+1	8	6
+2	5	8
+3	1	8
+4	2	3
+6	1	1
TOTAL	94	122
AVERAGE	1.2mm	1.6mm
t test = 1.58		

TABLE 7

LEFT FIRST PERMANENT
MOLAR RELATIONSHIP

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
-6	2	1
-5	1	3
-4	3	2
-3	7	6
-2	18	12
-1	8	19
0	35	49
+1	5	11
+2	10	10
+3	2	3
+4	2	1
+5	1	1
+7	1	1
TOTAL	95	119
AVERAGE	1.5mm	1.2mm
t test = 1.44		

TABLE 8

Table IX. Right cuspid relationship.

Table X. Left cuspid relationship.

RIGHT CUSPID RELATIONSHIP

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
-3	1	0
-2	2	1
-1	4	10
0	14	16
+1	13	13
+2	22	24
+3	27	23
+4	10	15
+5	3	4
+6	2	3
+7	0	1
TOTAL	98	110
AVERAGE	2.2mm	2.2mm
t test = 0.21		

TABLE 9

LEFT CUSPID RELATIONSHIP

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
-4	1	0
-3	2	1
-2	6	0
-1	9	3
0	7	10
+1	14	14
+2	21	23
+3	22	31
+4	9	17
+5	6	9
+6	0	4
+7	1	2
+8	1	0
+9	0	1
TOTAL	99	115
AVERAGE	2.4mm	2.8mm
t test = 1.86		

TABLE 10

Table XI. Overjet.

Table XII. Overbite.

OVERJET

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
- 3	1	0
- 1	2	1
0	2	2
+ 1	2	5
+ 2	13	20
+ 3	21	31
+ 4	15	37
+ 5	21	16
+ 6	12	8
+ 7	14	4
+ 8	4	4
+ 9	9	1
+10	2	5
+11	0	1
+13	1	0
TOTAL	119	135
AVERAGE	4.8mm	4.0mm
$p < .01$		

TABLE 11

OVERBITE

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
0	10	7
+1	20	13
+2	26	22
+3	23	29
+4	14	27
+5	10	12
+6	5	10
+7	0	1
+8	1	0
TOTAL	109	121
AVERAGE	2.6mm	3.1mm
$p = .02$		

TABLE 12

Table XIII. Open bite.

Table XIV. Distribution of open bites by age.

Table XV. Bruxism.

OPENBITE

	PRESENT		ABSENT		TOTAL	AVERAGE
CEREBRAL PALSY GROUP	14	11.3%	110	88.7%	124	2.9mm
CONTROL GROUP	18	12.7%	123	87.3%	141	1.2mm
$p. < .01$						

TABLE 13

DISTRIBUTION OF OPENBITES BY AGE

AGE	CEREBRAL PALSY GROUP	CONTROL GROUP
6	6	6
7	2	3
8	1	2
9	1	3
10	3	1
11	1	3
12	0	0

TABLE 14

BRUXISM

	MODERATE		SEVERE		NOT PRESENT	
CEREBRAL PALSY GROUP	27	22%	27	22%	70	56%
CONTROL GROUP	22	16%	7	5%	112	79%
$p < .001$						

TABLE 15

Table XVI. Relation of bruxism to time of occurrence.

Table XVII. Bruxism. Distribution by age.

RELATION OF BRUXISM TO TIME OF OCCURANCE

	DAY		NIGHT		DAY & NIGHT		UNKNOWN	
CEREBRAL PALSY GROUP	22	40.7%	18	33.3%	9	16.7%	5	9.3%
CONTROL GROUP	1	3.4%	27	93.2%	-	——	1	3.4%
$p < .001$								

TABLE 16

BRUXISM - DISTRIBUTION BY AGE

AGE	CEREBRAL PALSY GROUP	CONTROL GROUP
6	14	6
7	14	5
8	7	6
9	7	3
10	6	3
11	4	3
12	2	3

TABLE 17

Table XVIII. Bruxism by classification of cerebral palsy.

BRUXISM — BY CLASSIFICATION OF CEREBRAL PALSY

	TOTAL	MODERATE		SEVERE	
SPASTIC	35.1%	18	66.7%	8	33.3%
ATHETOID	63.3%	7	36.8%	12	63.2%
MIXED	47.4%	2	22.3%	7	77.7%

	DAY		NIGHT		BOTH		UNKNOWN	
SPASTIC	5	19.2%	10	38.4%	7	26.9%	4	15.4%
ATHETOID	11	57.9%	6	31.6%	2	10.5%	—	——
MIXED	6	66.7%	2	22.2%	—	——	1	11.1%

TABLE 18

Table XIX. Maxillary midline deviation.

Table XX. Mandibular midline deviation.

Table XXI. Visceral swallowing.

MAXILLARY MIDLINE DEVIATION

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
0	104	118
1	5	8
2	6	7
3	2	2
4	1	0
TOTAL	118	135
AVERAGE	1.9mm	1.6mm
$p < .10$		

TABLE 19

MANDIBULAR MIDLINE DEVIATION

MM READING	NUMBER OF PATIENTS	
	CEREBRAL PALSY GROUP	CONTROL GROUP
0	79	89
1	17	21
2	17	22
3	2	3
4	1	0
5	2	0
TOTAL	118	135
AVERAGE	1.8mm	1.6mm
$p. < .10$		

TABLE 20

VISCERAL SWALLOWING

	PRESENT		ABSENT		TOTAL
CEREBRAL PALSY GROUP	45	36.3%	79	63.7%	124
CONTROL GROUP	34	24.1%	107	75.9%	141
$p < .10 > .05$					

TABLE 21

Table XXII. Distribution of visceral swallowing by age.

Table XXIII. Distribution of visceral swallowing by classification of cerebral palsy.

Table XXIV. Tongue thrusting.

DISTRIBUTION OF VISCERAL SWALLOWING BY AGE

AGE	CEREBRAL PALSY GROUP	CONTROL GROUP
6	8	8
7	9	6
8	9	5
9	7	2
10	4	7
11	4	4
12	4	2

TABLE 22

DISTRIBUTION OF VISCERAL SWALLOWING BY CLASSIFICATION OF CEREBRAL PALSY

SPASTIC	22	29.7%
ATHETOID	15	50.0%
MIXED	8	42.1%

TABLE 23

TONGUE THRUSTING

	PRESENT		ABSENT		TOTAL
CEREBRAL PALSY GROUP	44	35.5%	80	64.5%	124
CONTROL GROUP	37	26.2%	104	73.8%	141
$p > .10$					

TABLE 24

Table XXV. Distribution of tongue thrusting by age.

Table XXVI. Distribution of tongue thrusting by classification of cerebral palsy.

Table XXVII. Crossbite.

DISTRIBUTION OF TONGUE THRUSTING BY AGE

AGE	CEREBRAL PALSY GROUP	CONTROL GROUP
6	8	8
7	7	6
8	8	6
9	6	4
10	5	6
11	6	5
12	4	2

TABLE 25

DISTRIBUTION OF TONGUE THRUSTING BY CLASSIFICATION OF CEREBRAL PALSY

SPASTIC	22	29.7%
ATHETOID	13	43.3%
MIXED	9	47.4%

TABLE 26

CROSSBITE

	PRESENT		ABSENT		TOTAL
CEREBRAL PALSY GROUP	26	21.0%	98	79.0%	124
CONTROL GROUP	20	14.2%	121	85.8%	141
$p > .10$					

TABLE 27

DISCUSSION

DISCUSSION

Because of the difficulty in obtaining an adequate sample and limited opportunities for dental personnel to obtain clinical information, few studies have been reported in the dental literature concerning the occlusion of cerebral palsied children. The articles that have been published fail to establish any occlusion standards for cerebral palsied children. Inadequate measurements have been made and the data has not been submitted to a statistical analysis.

Classification of cerebral palsied children is a difficult problem in many cases, as characteristics change with the age of the child. Each examiner relies on different criteria when determining a specific type of cerebral palsy. The sample of cerebral palsied children used in this study was similar to the percentage range of groups of cerebral palsied populations as quoted by Pohl[6] and Bawkin and Bawkin[35] for the spastic, athetoid and mixed types. No patients of the rare types, tremor and rigidity, were recorded in this sample.

Estimations as to the intelligence level of cerebral palsied children has varied with different examiners and different tests. Recent publications have raised the estimate of the percentage of retarded cerebral palsied children from one in four[5] to three in four[8]. The tabulation of the I.Q. scores of the 77 cerebral palsied children surveyed agreed with the more

recent publications with 75 per cent of the patients having a recorded I.Q. of less than 90. By specific classification, 93 per cent of the mixed group were below 90 in I.Q. which might be explained by the wide-spread brain damage characteristic of the group.

Molar and cuspid relationship measurements of the control and cerebral palsied groups were not significantly different. From this, it can be shown that the posterior teeth (cuspid to first permanent molar) of the cerebral palsied children are similar in positional relationship to those of the non-handicapped group.

Angle's classification is the only method of occlusion evaluation reviewed by the author in the literature concerning cerebral palsied children. The cerebral palsied group exhibited percentages of malocclusions similar to the control group and both were near the percentages reported by Angle[11]. This does not agree with Koster[14] or Lyons[15] who recorded a high percentage of Class II malocclusions for cerebral palsied groups. Watson[13] reported Class II malocclusion percentages similar to those recorded in this study.

Examination of the molar or cuspid relationships without further measurements can give a false impression of the over-all occlusion of the individuals being examined. Problems of occlusion can exist without being detected if one only considers the molar or cuspid teeth.

The cerebral palsied child exhibited a 0.8 mm. average increased overjet from that measured on the control group. Although the measurement itself is not large, it represents a trend of forward positioning of the upper anterior teeth in relation to the lower anterior teeth of the cerebral palsied child.

The cerebral palsied group differed statistically from the control group by recording an average of 0.5 mm. less overbite. Therefore, along with the outward position of the upper anterior teeth, there appears to be an upward positioning.

Open bite frequency, as recorded in this study, was similar to that recorded by Watson[13] and Lyons[22]. However, none of the articles read recorded the millimeter size of the measurement. This study found that although there was no difference in the frequency of open bites between the cerebral palsied and control group, the former had an average measurement of more than twice that found in the latter. This may be significant because whatever force is causing the open bite, when present in the cerebral palsied group, could be greater than the similar force found in the control group.

Bruxism is generally accepted to be a frequent finding in cerebral palsy, and this study is in agreement with the previous literature. The athetoid group exhibited the highest percentage of bruxism as also recorded by Koster[14] and Album[24].

Many of the parents reported that the movement of the extremities ceased when the child was sleeping, as did the bruxism. The percentage of night time grinding in both groups was similar. One can conclude that the cerebral palsied children who ground their teeth at night had the same grinding problem as the control group, but superimposed on their pre-existing condition. The remaining children with bruxism in the cerebral palsied group could be considered to be exhibiting bruxism as an integral part of their pathologic signs exhibited by the causative lesion.

Visceral swallowing and tongue thrusting were not significantly different in frequency between the two groups examined. This was contrary to the original thoughts of the author. However, when considering the results of the previous tabulations, this finding appears to fit into the developing pattern of occlusion of the cerebral palsied group. One would expect to find a large percentage of Class II malocclusions, anterior open bites, and severe flaring upward and outward of the upper anterior teeth if tongue thrust was a common finding. The cerebral palsied group had neither the Class II malocclusion nor open bite problem any more frequently than did the control group, and the difference found in the size of the open bite is not great enough to be of clinical significance. Thus, one might theorize that malocclusion and factors affecting occlusion are not found with greater frequency in cerebral

palsied children.

Further studies on the tongue and lips of cerebral palsied and non-handicapped children are necessary to provide more complete information.

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

A lack of evidence in the literature and an interest by the author led to the study reported herein on an evaluation of the occlusion of cerebral palsied children. One hundred twenty-four cerebral palsied children between the ages of 6 and 12 years were examined at the Cerebral Palsy Dental Clinic at the Indiana University Medical Center. There was close scrutiny of each patient's medical record. A data sheet was completed to record Angle's classification, first molar and cuspid relationships, overjet, overbite, open bite, bruxism, midline deviation, visceral swallowing, tongue thrusting and crossbite. Additional measurements were recorded but will not be included in the present study. A similar group of 141 non-cerebral palsied children of the same age group were examined at the Pedodontic Department of the Indiana University School of Dentistry. This group was used as a control.

Statistical analysis was done on the data tabulated and only probability scores of $< .05$ were accepted as representing differences of statistical significance.

The classifications of the cerebral palsy children as diagnosed in the medical history by the Cerebral Palsy Clinic personnel revealed that the group included 59.7 per cent spastics, 24.2 per cent athetoids, 15.3 per cent mixed and 0.8 per cent ataxics.

Tabulation of the I.Q. scores recorded in the medical records of 77 cerebral palsied children revealed that 75 per cent of the children examined had a below average I.Q.

Measurements related to the molar and cuspid teeth were similar in the cerebral palsied group and control group, which leads to the conclusion that there is no appreciable difference in the occlusion of the posterior segments between the two groups.

A statistically significant difference between the two groups was elicited in the increased overjet (0.8 mm.) and decreased overbite (0.5 mm.) of the cerebral palsied group. This represents an upward and outward relationship of the upper anterior teeth of the cerebral palsied children.

Although anterior open bites were not found more frequently in the cerebral palsied group, the severity of the open bite when present was more than twice as great (2.9 mm. vs. 1.2 mm.).

Bruxism was twice as prevalent in the cerebral palsied group and was recorded as being severe more frequently than in the control group. Of the cerebral palsied children exhibiting bruxism, 57 per cent were day or day and night grinders, while only 3.4 per cent of the control group were daytime grinders. The daytime grinders represent a group by themselves as a similar percentage of night time grinders are present in both the cerebral palsied group (21.8 per cent)

and the control group (19.1 per cent). Bruxism was most frequently found in the athetoid group, and least frequently in the spastic group.

Visceral swallowing and tongue thrusting were not found to be statistically different in the control and cerebral palsied groups.

Other measurements recorded were not significantly different.

Further studies on the tongue and lip will be necessary to provide background information for a more complete evaluation of occlusion.

REFERENCES

REFERENCES

1. Trausch, G.S.: A study of morphologic changes in the oral cavity induced by eccentric muscular activity in cerebral palsy children. Thesis, Northwestern Univ. School of Dentistry, Graduate Program, 1954.

2. Perlstein, M.A.: Infantile cerebral palsy. Classification and clinical correlations. J.A.M.A., 149:30, 1952.

3. Perlstein, M.A.: Medical aspects of cerebral palsy. Nerv. Child., 8:128, 1949.

4. American Public Health Association. Services for Children with Cerebral Palsy. 1955.

5. McIntire, J.T.: The incidence of feeble-mindedness in the cerebral palsied. Amer. J. Ment. Defic., 50:491, 1946.

6. Pohl, J.F.: Cerebral Palsy. St. Paul, Bruce Publishing Co., 1950.

7. Asher, P. and Schonell, F.E.: A survey of 400 cases of cerebral palsy in childhood. Arch. Dis. Child., 25:360, 1950.

8. Levinson, A. and Bigler, J.A.: Mental Retardation in Infants and Children. Chicago, The Year Book Publishers, Inc., 1960.

9. Henderson, J.L.: Cerebral Palsy in Childhood and Adolescence. London, E. and S. Livingstone, Ltd., 1961.

10. Baume, L.J.: Characteristics of the occlusion in the deciduous dentition. D. Abs., 4:29, 1959, Abstract.

11. Angle, E.H.: Treatment of Malocclusion of the Teeth. Philadelphia, S. S. White Dental Manufacturing Co., 1907.

12. Jackson, G.E.: A systematic analysis and classification of the dento-facial abnormalities shown in cerebral palsy. Thesis, Northwestern Univ. School of Dentistry, Graduate Program, 1954.

13. Watson, A.O.: Infantile cerebral palsy. A survey of dental conditions and treatment emphasizing the effect of parental Rh incompatibility on the deciduous teeth. D. J. Australia, 27:6, 27, 72; 27:92, 1955.

14. Koster, S.: The diagnosis of disorders of occlusion in children with cerebral palsy. J. Den. Children, 23:81, 1956.

15. Lyons, D.C.: An evaluation of the effects of cerebral palsy on dentofacial development, especially occlusion of the teeth. J. Pediat., 49:432, 1956.

16. Strang, R.H.W.: An analysis of the overbite problem in malocclusion. Angle Orthodont., 4:65, 1934.

17. Goldstein, M.S. and Stanton, F.L.: Various types of occlusion and amounts of overbite in normal and abnormal occlusion between two and twelve years. Ortho. and Oral Surg. Int. J., 22:549, 1936.

18. Bauerle, J.R.: A longitudinal study of incisor overbite from the deciduous dentition to age fifteen. Thesis, Univ. of Iowa School of Dentistry, Graduate Program, 1959.

19. Fleming, H.B.: An investigation of the vertical overbite during the eruption of the permanent dentition. Angle Orthodont., 31:53, 1961.

20. Rogers, A.P.: Open bite cases involving tongue habits. Ortho. and Oral Surg. Int. J., 13:837, 1927.

21. Nord, C.F.L.: The aetiology of the open bite. D. Record, 57:585, 1937.

22. Lyons, D.C.: The dental problem of the spastic or the athetoid child. Am. J. Orthodont., 37:129, 1951.

23. Buckley, R.R.: An electromyographic study of the orbicularis oris muscle of cerebral palsied spastic hemiplegics. Thesis, Indiana Univ. School of Dentistry, Graduate Program, 1961.

24. Album, M.M.: Dentistry for the handicapped child. D. Radiog. and Photog., 27:57, 1954.

25. Massler, M.M. and Perlstein, M.A.: Neonatal and prenatal enamel hypoplasia in children with cerebral palsy. Proceedings of the Workshop on Dentistry for the Handicapped. Philadelphia, Univ. Pennsylvania Press, 1958.

26. Rix, R.E.: Deglutition and the teeth. D. Record, 66:103, 1946.

27. Fletcher, S.G., Casteel, R.L. and Bradley, D.P.: Tongue-thrust swallow, speech articulation, and age. J. Speech Hearing Dis., 26:201, 1961.

28. Roger, J.H.: Swallowing patterns of a normal population sample compared to those patients from an orthodontic practice. Am. J. Orthodont., 47:674, 1961.

29. Ward, M.M., Malone, H.D., Jann, G.R. and Jann, H.W.: Articulation variations associated with visceral swallowing and malocclusion. J. Speech Hearing Dis., 26:334, 1961.

30. Jay, J.: Dentistry for the forgotten child. S. Carolina D. J., 10:7, 1952.

31. Barton, E.J.: Dental care for the cerebral palsied. J. New Jersey D. Soc., 27:27, 1955.

32. Kastein, S.: Oral, dental and orthodontic problems of speech in cerebral palsy. J. Den. Children, 24:243, 1957.

33. Lyons, D.C.: The dental problems of handicapped children. Children, 8:14, 1961.

34. Swallow, J.N.: Dental care of children with cerebral palsy. D. Abs., 7:394, 1962, Abstract.

35. Bawkin, H. and Bawkin, R.M.: Clinical Management of Behavior Disorders in Children. 2nd Ed., Philadelphia, W. B. Saunders Co., 1960.

VITA

VITA

Charles Herbert Rosenbaum

April 13, 1935	Born, Des Moines, Iowa
1953	Roosevelt High School, Des Moines, Iowa
Aug. 12, 1956	Married Gayle Blumenthal
1957	B.A., University of Iowa
1961	D.D.S., University of Iowa
1963	Indiana University School of Dentistry, Graduate School, and Fellow of United Cerebral Palsy

Professional Organizations

American Dental Association

American Society of Dentistry for Children

Delta Sigma Delta Fraternity

ABSTRACT

ABSTRACT

The purpose of this study was to provide information concerning occlusion and related problems in cerebral palsied children.

A group of 124 cerebral palsied children between the ages of 6 and 12 years were examined at the Cerebral Palsy Dental Clinic, Indiana University. The occlusion was evaluated according to Angle's classification. In addition, a recording was made of overjet, overbite, open bite, cuspid relationships, crossbite and midline discrepancies. The examination included a clinical evaluation of the swallowing pattern of each child. The cerebral palsy classification and I.Q. scores were recorded for each cerebral palsied child after a comprehensive review of his medical record. These findings were compared with a control group of 141 similar aged non-cerebral palsied children examined at Indiana University, Pedodontic department.

The cerebral palsied group had an average increased overjet of 0.8 mm. and an average decreased overbite of 0.5 mm., representing an upward and outward positioning of the maxillary anterior segment.

Anterior open bite was present in a similar percentage of both groups, but in the cerebral palsied group the measurement recorded was more than twice as great as that recorded in the control group.

Forty-four per cent of the cerebral palsied children exhibited bruxism, more than twice the percentage of cases recorded in the control group. The cerebral palsied children exhibited bruxism most frequently in the day time, and was most common in the athetoid group.

Other measurements recorded were not significantly different between the two groups.

From this study one can conclude that malocclusion and factors affecting occlusion are not found with greater frequency in cerebral palsied children.