A CLINICAL EVALUATION OF MOBILITY IN HUMAN INCISOR TEETH AS RELATED TO OVERBITE

A Thesis
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by

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ACKNOWLEDGEMENTS

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To my parents, my thanks for their love and guidance.

To Beverly, John, Jennifer, Kari, and future family members, my thanks for making life's endeavors worthwhile.
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INTRODUCTION

Trauma from occlusion and the possible resultant pathology affects dental patients almost universally. Mobility of teeth has been used as an indicator of trauma from occlusion for many years.

Shore¹ states that a deep anterior overbite in a patient with an occlusal prematurity usually results in maxillary anterior teeth which have mobility. A similar condition of mobility of the lower teeth may occur.

The purpose of this study was to determine if a correlation exists between the amount of overbite and mobility of the incisors of human subjects with clinically healthy mouths.
LITERATURE REVIEW

Tooth mobility has been a subject of great interest in dentistry for many years. *Mühlemann* states that mobility has become an important clinical diagnostic parameter for the integrity, functional state, and disease of the periodontium. He further states that mobility or loosening of the teeth is a cardinal sign of periodontal disease. *Goldman* considers loosening of a tooth or teeth an important clinical sign (of periodontal disease). *Pritchard* states that mobility usually indicates destruction of the periodontium by periodontal or occlusal trauma. *Glickman* stresses the importance of tooth mobility in the overall prognosis in the treatment of periodontal disease. Many others have related mobility to trauma from occlusion. As early as 1901, Karolyi suggested "that excessive occlusal forces lead to pyorrhea." Others have reputed this theory. The controversy of the relationship of occlusal trauma to periodontal disease has been going on ever since, *Stillman* in 1917 proclaimed: "The symptoms of traumatic occlusion should take precedence in diagnosis for periodontoclasia over all other factors."

Tooth mobility is commonly assessed clinically by holding the tooth firmly between the handles of two instruments and then an effort is made to move the tooth in all directions. An arbitrary value is placed on the amount
and direction the tooth moves.

Various investigators have attempted to use mechanical means to objectively measure tooth mobility. The development of various electronic devices for the measurement of tooth mobility has been reported, but these instruments have had limited clinical application. Joel suggested fastening small mirrors to teeth which would reflect a beam of light. The tooth was then moved and the movement greatly magnified by the light reflected on a large surface and the amount of mobility was calculated by trigonometry.

Mühlmann reported a method in 1951 for measuring tooth mobility using mechanical measuring gauges. The system is called periodontometry. Measurements are made to one-thousandth of a millimeter. Two other measuring devices have been developed. The macroperiodontometer which is used on incisors, cuspids, and first bicuspids and the microperiodontometer which may be used on any tooth. Facial and lingual deflections of the teeth are made by a known force using a force meter. Mobility is the sum of facial and lingual movements.

Values can be determined for mobility but there is agreement that physiologic mobility is expressed as a range of normal values. Physiologic mobility may be considered the amount of resiliency in the periodontium which allows a tooth to give slightly with functional forces and then quickly return to its original position.
Theories describing the mechanism of physiologic mobility have been proposed. O'Leary suggests that vertical forces are resisted in the periodontal ligament spaces by collagen fibers stretching and by fluid displacement, horizontal forces are initially met by stretching and compression of the fiber bundles and longer acting horizontal forces result in fluid outflow from the ligament spaces. He also suggests that greater forces cause elastic distortion of the walls of the alveolus and surrounding bone. If the force is within physiologic limits, the above components return to their former state.

Mühlemann reports initial and secondary tooth mobility. In a study using rhesus monkeys, he compared tooth mobility data with histologic sections of the measured teeth. Initial tooth mobility was found to be due to the orientation of the collagen fiber bundles of the periodontal ligament within the alveolus. This movement was made with forces less than 100 grams. Progression into secondary tooth mobility was effected with forces greater than 100 grams which were resisted by fiber bundles on the tension side. The larger crown displacements then lead to distortion and compression of the periodontium as a whole. The process is reversible under physiologic conditions.

Many factors are reported to affect mobility in clinically healthy teeth. Parfit suggests that physiologic mobility varies with the time of day, exercise, and
systemic abnormalities. O'Leary, Rudd, and Nabors found that mobility was greater immediately after waking and after periods of no tooth contact. Mobility decreased during waking periods. He also found that chewing decreased mobility. Rateitschak has shown increases in physiologic mobility during pregnancy.

Pathologic mobility may be considered that which is in excess of physiologic mobility. O'Leary considers pathologic tooth mobility as that tooth movement which is discernible to the eye. The etiology of pathologic mobility is considered to be caused by multiple factors. Inflammatory changes in the periodontal ligament is considered a factor. Mobility from loss of alveolar bone can occur, but usually, the loss must be severe and the mobility is also dependent on root size. Parafunctrional habits such as bruxism, grinding, clamping, and "doodling", which is defined as grinding on one tooth are recognized by many clinicians as adding to the looseness of teeth. There is agreement that trauma from occlusion is, at least, a contributing factor to increased mobility. Mühlemann has concluded that occlusal trauma is the factor most responsible for increasing tooth mobility. He summarizes by stating that structural and physical properties of the periodontium are qualitative factors influencing the amount of mobility. These properties depend on the
metabolism of the local periodontal area which is, in turn, controlled by functional, local, and systemic physiological or pathological conditions.

Another factor noted in trauma from occlusion and increased mobility but not mentioned before is overbite and overjet of the anterior teeth.

Shore defines the vertical overbite as the vertical distance between the incisal edges of the upper and lower incisors when they overlap and defines horizontal overbite or overjet as the distance in the horizontal plane between the lingual surfaces of the upper teeth and the facial surfaces of the lower teeth.

Various investigators have stated their findings as to what is normal for overbite and overjet. Emelie's idea of an ideal occlusion includes the incisors and canines having contact in centric occlusion with a definite overbite. Neff considered the ideal overbite to be twenty percent of the length of the clinical crown. Anderson listed a one-third vertical overlap as being normal. Howitt stated that 0 to 3 mm. was the normal value for both overbite and overjet. Lundstrom in his research on Swedes found that the normal adult overbite varied from 3 to 3.5 mm. and the normal overjet from 3 to 4 mm. Steadman lists a range of values. He found the extreme values for overbites to be from 0.5 mm. to 4.3 mm., the mean or average being 3.1 mm.,
with a standard deviation of 1.0 mm.; thus, two-thirds fell between 1.2 and 5 mm. His extreme values for overjets were from 0 to 3.4 mm. with a mean of 1.6 mm. and a standard deviation of 1.6 mm. putting two-thirds of the overjets between 0 and 3.2 mm. There was no correlation between the amount of overbite and the amount of overjet. Collett\textsuperscript{38} in his study of 512 patients with variations in the natural dentition recorded overbites from 5 mm. open bite to 10 mm. overbite, the average being 2.49 mm. Overjet varied from 3 mm. prognathism to a 10 mm. overjet, the average being 1.97 mm.

Trauma from occlusion and increased tooth mobility have commonly been attributed to increased or deep overbite.\textsuperscript{9} McCall\textsuperscript{12} claimed that any malposition of teeth may cause traumatic occlusion and stated that prominent examples included excessive overbite of the anterior teeth. Ramfjord and Ash\textsuperscript{28} state that an inadequate overjet related to a deep overbite in a patient with bruxism is an example of a traumatic and unstable occlusion. Glickman\textsuperscript{6} states that in the presence of a deep overbite the anterior teeth "lock the occlusion" thereby interfering with eccentric mandibular movements and, as a result, the anterior teeth are continually being traumatized. Gould and Picton\textsuperscript{13} in their study of eighty subjects from 16 to 55 years of age found that increased overbite and overjet appeared related to increased
pocketing and tooth mobility. Shore\textsuperscript{1} cites Karolyi of Vienna who observed that there is usually no periodontal involvement in an abraded dentition with zero vertical overbite. Shore\textsuperscript{1} observed the following concerning overbite: "Deep vertical overbite tends to produce buckling of the arch, abnormal functional habits and directional stress which the teeth were not designed to bear. If any posterior occlusal contact is present, the mandible will slide forward and the labial surfaces of the lower anterior will be forced against the lingual surfaces of the upper anteriors with resultant wear and tooth movement. A similar condition of mobility and tooth movement of the lower tooth may occur."
MATERIALS AND METHODS

Fifty-one subjects were selected from 300 undergraduate dental students at the Ohio State University College of Dentistry. Each subject used in this study met the following criteria:

1. They ranged in age from 20 to 35 years.
2. They had had no orthodontic treatment.
3. They had no missing anterior teeth.
4. Any missing posterior teeth except third molars had been replaced with fixed restorations.
5. Periodontal health was evaluated clinically using Ramfjord's Periodontal Disease Index. The periodontium was scored at all incisor teeth as follows:

   0 = absence of signs of inflammation
   1 = mild to moderate inflammatory changes, not extending around the tooth
   2 = mild to moderately severe gingivitis extending all around the tooth
   3 = severe gingivitis characterized by marked redness, swelling, tendency to bleed, and ulceration

The depth of the gingival crevice (GC) in relation to the cemento-enamel junction (CEJ) was recorded using a University of Michigan, #0 periodontal probe. This was done by measuring the distance from the free gingival margin to the bottom of the GC at the facial
and mesial aspect of each tooth examined. The facial measurements were made at the middle of the facial surfaces. The mesial measurements were made at the facial aspect of the interproximal contact area with the probe touching both teeth if there is an adjacent tooth present and with the probe pointing in the direction of the long axis of the tooth to be scored. Measurements were rounded to the nearest millimeter; measurements including ½ millimeter were rounded to the lesser whole number.

The PDI was determined as follows:

A. Individual Tooth PDI
   1. If the gingival crevice did not extend further apically than the CEJ, the gingival status score was the PDI score.
   2. If the gingival crevice extended apically to the CEJ but not more than 3 millimeters, the PDI was 4. The score for gingivitis was then disregarded in the PDI score for the tooth.
   3. If the gingival crevice was apical to the CEJ from 3 to 6 mm. (including 6 mm.), the PDI was 5.
   4. If the gingival crevice was more than 6 mm. apical to the CEJ, the PDI was 6.

B. Total Area PDI
   1. All 8 incisors were scored.
   2. The individual tooth scores were totaled and divided by the number of teeth evaluated. The resultant number was the total area PDI.

Only subjects having a PDI of 3 or less were used in this study.
Subjects meeting the above criteria were examined clinically for mobility and overbite of the incisor teeth using the following methods:

1. Mobility of the incisor teeth was measured using the Macropendometer as outlined by Muhlemann.

2. Overbite was measured as follows: A alginate impression of the maxillary and mandibular incisors, including at least one-half of each maxillary cuspid, was made with the jaw of the subject in his centric (habitual) occlusion position. The impression was poured in Whip-mix stone. The resultant cast was then sectioned with a fine dental saw through the long axis of each maxillary incisor at its midline, perpendicular to the curve of the arch. The distance between the incisal edge of each maxillary incisor and its opposing mandibular tooth was measured to one-tenth of a millimeter with a Boley gauge and recorded. The midlines of the maxillary incisors did not coincide with the midlines of the corresponding mandibular incisors. Some sectioning went through mandibular cuspids. Therefore, there were fewer and varying numbers of samples for the mandibular incisors.

Other data was recorded to include:

1. open interdental contact points
2. rotated teeth
3. overlapping teeth
4. incisors which contacted opposing teeth in habitual occlusion as determined by a moist articulating paper

Data was statistically analyzed to determine if any correlation existed between the amount of overbite and the mobility of the incisor teeth.
RESULTS

Correlation co-efficients were determined between the amount of overbite and the amount of mobility for each of the eight incisor tooth groups (Appendix I). The data are graphically represented in Figures 1 through 8. There was no correlation between the amount of overbite and the amount of mobility for any of the eight incisor tooth groups (Table I).

Other data considered were open interdental contact points, rotated teeth, overlapping teeth, and contact with opposing teeth. Chi square statistical analyses were done to determine relationships between the above entities and the amount of mobility (Table II and Appendix II). Nearly all samples of mobility were in the range of six to fifteen with mobility recorded in hundredths of millimeters. Ten or less was selected as lower mobility and greater than ten was selected as higher mobility because approximately two-thirds of the values found were 10 or less and one-third more than 10 as shown by the scatter diagrams (Figures 1 through 8). Mühlemann has stated that 10 is the lower end of the range of most frequent physiologic mobility for incisor teeth.

Correlations between higher mobility and open interdental contact points and higher mobility and rotated teeth were found. A correlation between lower mobility and
overlapping teeth was also evident. No correlation was found between higher mobility and lack of contact with opposing teeth.
<table>
<thead>
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<th>Tooth Group Number</th>
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<td>8-maxillary right central incisors</td>
<td>.18*</td>
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<td>9-maxillary left central incisors</td>
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<td>10-maxillary left lateral incisors</td>
<td>-.06*</td>
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<tr>
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<td>.23*</td>
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<td>24-mandibular left central incisors</td>
<td>-.007</td>
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<tr>
<td>25-mandibular right central incisors</td>
<td>-.04*</td>
</tr>
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<td>26-mandibular right lateral incisors</td>
<td>.15*</td>
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*Not significant (p .05)
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<tr>
<th>Factor</th>
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<td>Rotated Teeth</td>
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<td>Higher**</td>
<td>147</td>
<td>25.68</td>
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<td>Lower</td>
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<td>Lower</td>
<td>261</td>
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<tr>
<td>No Contact With Antagonist</td>
<td>135</td>
<td>Higher***</td>
<td>147</td>
<td>.66</td>
<td>.05</td>
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<tr>
<td>Contact With Antagonist</td>
<td>272</td>
<td>Lower</td>
<td>261</td>
<td></td>
<td></td>
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</table>

* greater than .010 millimeters
** .010 millimeters or less
*** not significant
N=sample size
$X^2$-Chi squared
DISCUSSION

In this study, no correlation was found between the amount of overbite and mobility in human incisor teeth. Several authors,\textsuperscript{1,6,9,12,13,28} have stated that deep overbite results in traumatic occlusion and increased tooth mobility. These statements appear to be based primarily on clinical impressions. Possible reasons for the above conflicting findings include:

1. Previous clinicians may have observed very deep overbites. Overbites as great as 9 millimeters were measured in this study. Wheeler\textsuperscript{40} lists the average length of human incisor crowns to range from 7 to 11 millimeters, so relatively deep overbites were found in this study but did not show abnormal mobility.

2. Subjects used in this study were young adult males with mouths that had reasonable clinical health. Previous findings of mobility could have been the result of having loss of supporting structures in subjects with periodontal disease.\textsuperscript{22}

A correlation was found between open interdental contact points and higher mobility. This is understandable since Mühlemann has demonstrated this finding on a rhesus monkey.\textsuperscript{41} He believed the differences were small and not of practical importance. In humans, King, Moore, and
Burch reported that facial movements were greater than lingual movements in my study regardless of open or closed interdental contact points.

A correlation was found between rotated teeth and higher mobility. Rudd, O'Leary, and Stumpf found that rotation of incisors with its accompanying improper interdental contact relationship was often associated with higher mobility. Rotated teeth may or may not be in premature contact in centric occlusion. It is, however, a clinical impression of this author that rotated teeth can have increased function in protrusive movement of the mandible. This could be one possible explanation for higher mobility in rotated teeth.

A correlation was found between overlap and lower mobility. Mention of overlap was not found in previous tooth mobility studies. A possible explanation would be a bracing effect by the tooth being overlapped reducing lingual movement. The overlapping teeth generally occupied a more facial position in the arch and could conceivably be protected in eccentric mandibular excursions.

Mühlemann, Herzog, and Rateitschak found that hypofunctional teeth are more mobile than hyperfunctional teeth. O'Leary, Rudd, and Nabor found that artificially induced lack of occlusal contacts resulted in increased mobility. No correlation was found in my study between higher mobility
and lack of occlusal contacts. Most lack of occlusal contact was related to anterior open bite. Anterior open bites are usually attributed to abnormal tongue posture or tongue thrusting during swallowing. Even though these teeth do not have occlusal contacts, they probably do function with the tongue.
CONCLUSIONS

1. This study shows no correlation between the amount of overbite and tooth mobility.
2. A correlation was found between open interdental contact points and higher mobility.
3. A correlation was evident between rotated teeth and higher mobility.
4. A correlation was found between overlapping teeth and lower mobility.
5. There was no correlation between lack of occlusal contact of opposing teeth in centric occlusion and higher mobility.
SUMMARY

Fifty-one young adult males were selected as subjects for this study. They were screened for relative periodontal health using Ramfjord's PDI. They were then examined clinically to determine if there was a correlation between the amount of overbite and mobility in their incisor teeth. Mobility was measured using the macroperiodontometer as outlined by Mühlemann. Overbite was measured by making an impression of the maxillary and mandibular teeth in centric occlusion. The resultant cast was sectioned through the central axis of each maxillary incisor at its midline, perpendicular to the curve of the arch. The distance between the incisal edge of each maxillary incisor and its opposing mandibular tooth was measured. Statistical analysis revealed no apparent correlation between the amount of overbite and mobility of the incisor teeth.

Other data was also statistically analyzed. A correlation was found between higher mobility and open interdental contact points and rotated teeth. A correlation was evident between lower mobility and overlapping teeth. There was no correlation between lack of occlusal contact and higher mobility.
Figure 1. Scatter diagram of tooth mobility vs. overbite for tooth group number 7.
Figure 2. Scatter diagram of tooth mobility vs. overbite for tooth group number 8.
Figure 3. Scatter diagram of tooth mobility vs. overbite for tooth group number 9.
Figure 4. Scatter diagram of tooth mobility vs. overbite for tooth group number 10.
Figure 5. Scatter diagram of tooth mobility vs. overbite for tooth group number 23.
Figure 6. Scatter diagram of tooth mobility vs. overbite for tooth group number 24.
Figure 7. Scatter diagram of tooth mobility vs. overbite for tooth group number 25.
Figure 8. Scatter diagram of tooth mobility vs. overbite for tooth group number 26.
APPENDIX I

CORRELATION COEFFICIENT FOR TOOTH NUMBER 7 WAS DONE AS FOLLOWS:

\[ r_{xy} = \frac{\bar{x}y - (\bar{x})(\bar{y})}{n} \]

\[ \sqrt{\frac{\sum x^2}{n} \left( \frac{\sum x}{n} \right)^2 \sum y^2 \left( \frac{\sum y}{n} \right)^2} \]

\[ r_{xy} = \frac{597.01 - 573.4}{\sqrt{(130.92)(188.39)}} \]

\[ r_{xy} = 0.15 \]
APPENDIX II

CHI SQUARE TEST FOR CONTACT WITH ANTAGONIST

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</tr>
<tr>
<td>No contact with Antagonist</td>
<td>C = 135</td>
<td></td>
</tr>
<tr>
<td>Low Mobility 10 of 10</td>
<td>B = 261</td>
<td></td>
</tr>
<tr>
<td>Contact with Antagonist</td>
<td>D = 273</td>
<td></td>
</tr>
</tbody>
</table>

Total Number = N = 816

\[
\text{Chi Square} = \frac{N \left( \frac{AD - BC}{(A+B)(C+D)(A+C)(B+D)} - \frac{N}{2} \right)^2}{(A+B)(C+D)(A+C)(B+D)}
\]

\[
\text{Chi Square} = \frac{816 \left( \frac{40131 - 35235 - 408}{408 \cdot 408 \cdot 282 \cdot 534} \right)^2}{408 \cdot 408 \cdot 282 \cdot 534}
\]

Chi Square = .66
BIBLIOGRAPHY


