Department of Orthodontics

CASE WESTERN RESERVE UNIVERSITY

SCHOOL OF DENTISTRY

GRADUATE STUDIES

We hereby approve the thesis of

VIDYA ARMOGAN

candidate for the degree Master of Science

in Dentistry.

Signed: _____ (Chairman)

_____

_____

_____

_____

Date: AUGUST 14th, 1998

ASSESSING TREATMENT NEED IN TENTH GRADE STUDENTS IN CUYAHOGA COUNTY, OHIIO

by

VIDYA ARMOGAN

Submitted in partial fulfillment of the requirements

for the Degree of Master of Science in Dentistry

Thesis Advisor: Dr. Mark G. Hans

Department of Orthodontics

School of Dentistry

CASE WESTERN RESERVE UNIVERSITY

August 14, 1998

ASSESSING TREATMENT NEED IN TENTH GRADE STUDENTS

IN CUYAHOGA COUNTY, OHIO

Abstract

by

VIDYA ARMOGAN

Previous studies have estimated unmet orthodontic treatment need to be in the range of sixteen to forty-six percent. The present study was based on a total sample of 1360 tenth grade students enrolled in eleven public high schools in Cuyahoga County, Ohio, between September and December 1997. Thirty-two percent of the sample had previously received orthodontic treatment. The primary purpose of this study was to estimate the unmet treatment need in Cuyahoga County, Ohio. Second to examine differences within the untreated sample, and between the treated and untreated subjects. All subjects completed a dental survey that included demographic and psychosocial information as well as a visual analog smile assessment scale (VAS). Dental study casts were obtained on a sub sample of 561 subjects. A Dental Aesthetic Index score was computed from dental casts and used to partition the untreated sample into groups based on treatment need. Analysis of the results revealed an unmet treatment need of twenty-nine percent (162/561). Within the untreated subject group there was a significant ($p < 0.05$) difference between those

with high and low DAI scores. Untreated subjects with high DAI scores were less likely to have visited a dentist in the past year, or to have been told that they needed braces. They also had lower smile assessment scores (VAS) and were more likely to be African American. Neither gender nor socio-economic status was significantly different. There was a weak resulting correlation between the VAS score and the DAI score ($r = -0.16$) which was not statistically significant. These results suggest that the VAS score and the DAI score measure different aspects of treatment need. Between the treated and untreated group, there were significant differences for race, socio-economic status and whether the subject had visited a dentist in the past year. However, gender and being told that they needed braces were not significant. The unmet treatment need, indicated by a DAI score of 31 or greater, in Cuyahoga County, Ohio, is comparable to other studies. However, untreated individuals have a lower self-perception of their smiles.

DEDICATION

To my mom, Edith, and dad, Edward, who provided me with the foundation on which everything is built, and the love to keep it healthy.

To my brothers, Davindra and Narendra, who have been my best friends and have unselfishly supported all of my endeavors.

To my uncle and aunt, Dr. Cheddi Jagan and Janet Jagan, who have been a source of wisdom and inspiration, and whose undying struggle for freedom from oppression has planted a seed in my heart.

ACKNOWLEDGEMENTS

To the most fantastic residency program on God's green earth, made so by the people I have had the fortune of meeting.

To my friends from the upper year who made life interesting, Clarence Red and Martin Palomo, without whom the environment to foster better education would not have been appropriate. To Virginia Luks, Hsin-Hsin Wu and Jamie Signorino who aided in my education.

To my classmates and friends, Nhat Le, Charissa Katzan, Randy Kulnis and Ryan Wenger, who have not only been supportive, but who have made the residency enjoyable and provided a balance in all things.

To my lower classmates, I thank you for all of your support and help, and wish you the best of luck in the future. To Manish Valiahtan, who was my brother in many ways and will one day be a King in his world. To my little brother Jon Eckhardt, who has had to endure with me over the past year and in the year ahead. To Soon-Jung Park whose intelligence will always impress me. To Roland Feghali and Bill Nguyen for their support.

To my advisory committee, Drs. Mark Hans, Suchitra Nelson and B Holly Broadbent, Jr., who have been extremely generous and kind throughout.

Special thanks to Lowell Bernard, Leonor Hernandez and Yumi Abei for the numerous hours and kindness they have shown to me. Also thanks to all of the dental students that assisted with the data collection and Jay Galati and Jed Gass.

To Dr. Alex Moullas for his friendship.

To Dr. Jolieann Joseph for her friendship and support over the years.

To Dr. Anca Bazile for her love, friendship and help.

No words can truly thank the Faculty and Staff who have made my education complete, with their unwavering dedication to excellence. I would especially like to thank the Admissions Committee, that not only gave me the gift of orthodontics, but the gift of orthodontics at Case Western Reserve University; Drs. Mark Hans, Arthur Phelps, Sanford Neuger, Douglas Amberman and Holly Broadbent, Jr.

TABLE OF CONTENTS

Page

ABSTRACT ii

DEDICATION iv

ACKNOWLEDGEMENTS v

TABLE OF CONTENTS vii

LIST OF FIGURES ix

LIST OF TABLES x

INTRODUCTION 1

LITERATURE REVIEW 4

STATEMENT OF THE HYPOTHESIS 67

MATERIALS AND METHODS 69

RESULTS 88

DISCUSSION 95

SUMMARY AND CONCLUSIONS 113

APPENDICES

APPENDIX 1. School Visits and Schedule 116

APPENDIX 2. Cover Letter 117

APPENDIX 3. Parental Permission Slip 118

APPENDIX 4. Survey Form 119

Page

APPENDIX 5. DAI Instructions 120

APPENDIX 6. DAI Score Sheet 129

APPENDIX 7. Overall Data Sheet 130

APPENDIX 8. Database Programming 162

LITERATURE CITED 176

LIST OF FIGURES

Figure Page

1. Experimental Design 70

LIST OF TABLES

Table Page

1. DAI - Preliminary Variables 35
2. DAI Components - Unstandardized 35
3. DAI Standard Components and their Rounded Weights 38
4. Summary of Sample Distribution 88
5. Demographics of Treated and Untreated groups 90
6. Demographics of Impression and Non-Impression groups 91
7. Frequency of subjects in DAI categories 92
8. Demographic data between the DAI categories 93
9. VAS score per DAI categories 94
10. Schedule of School Visits 116
11. DAI, Demographic and Psychosocial Data 130

INTRODUCTION

Using Angle's molar classification, the difference between a full class II and a full class III is about 6 mm. Despite this relatively small range of variation at the first molar, orthodontics has had significant impact on facial appearance and self-esteem. While orthodontists passionately argue on the merits of extraction vs. non-extraction therapy, or the success in attempts to modify growth, they usually unite in a belief that orthodontic treatment need can be placed in three general categories. Proffit (1986) stated that protruding, irregular or maloccluded teeth can cause three types of problems:

1) psychosocial
2) functional
3) susceptibility to damaging the teeth and supporting mechanisms.

The etiology of malocclusion is multifactorial and most orthodontic textbooks dedicate an entire chapter to the subject. However, while the "science of orthodontics" is thoroughly discussed in orthodontic circles, the "societal aspect of orthodontic treatment" is largely ignored. What motivates someone to wear metal braces on all of their teeth for a period of two years is questionable. The variety of cases treated by orthodontists varies from complex and handicapping malocclusions to slightly rotated central incisors or a small diastema. Regardless of the severity of

the case, the only common factor is that the people that received treatment have had braces. While the profession recognizes many of the factors that create a need for orthodontic treatment, the relative importance of each factor is not clear.

There is no doubt that in any society most individuals strive to achieve some sort of normalcy, and in our society, straight white teeth are considered to be desirable. Picking up a copy of the National Geographic and noticing the extremes that some cultures go to in order to establish what they perceive to be normal, can be shocking. In a tribe in South America it is desirable for the women to have large lips. In response, women try to enlarge their lips by placing progressively bigger wooden chips between their lower lips and the teeth. Similarly, the hill tribes of Thailand have women elongate their necks by progressively adding metal rings around the neck as they are growing. While these rituals may appear to be strange to us, the wearing of metal braces on all of the teeth for two years may appear equally strange.

In order to accurately assess unmet orthodontic treatment need, the study sample must be old enough to have had the opportunity to seek treatment, had they so desired. At the same time, the subjects should be young enough that confounding factors are minimized. Malocclusions resulting from trauma, neglect or periodontal degradation may not accurately reflect unmet treatment need.

Dividing a sample of untreated subjects into groups allows categorization of like treatment need. The Dental Aesthetic Index is an index that allows a score to be assigned to each subject based on a set of specific criteria. Decision points, or cutoff scores, allow easy grouping of the subjects into those who need, and those who do not

need, treatment. Comparison of factors believed to influence patients to seek treatment can also be tested.

As such, this study will examine what portion of the untreated population requires treatment, and what factors are responsible for them not receiving that treatment.

REVIEW OF THE LITERATURE

Psychosocial Reasons for Orthodontic Treatment

Correct alignment of teeth is a fundamental goal of orthodontic treatment. However, misaligned or crowded teeth can impact an individual's dentofacial esthetics. Amandeep and Battagel (1997) compared three methods of assessing dental crowding. Their results showed that while the reflex microscope and its customized computer program provided a valid and reproducible measure, visual examination showed positive bias towards over-recording the amount of crowding. Since dentofacial esthetics are visually perceived by the public, this study would suggest that there is a tendency to overestimate the severity of crowding in society.

Stereotyping, based on dental appearance, is all too familiar and evident in mass media. Jerry Lewis, with protruding teeth and big glasses, conjures up impressions of a mentally retarded person while a character with straight teeth and a brilliant smile creates a positive impression. Shaw (1981) showed that, with other features of appearance being held constant, normal occlusion is perceived as more attractive than malocclusion. In his study, Shaw presented black and white photographs of thirty young males and thirty young females to a group of sixty adult judges aged 20 to 65 years, and asked them to rank the children on facial attractiveness. Once ranked, the extremes were not used, but the runners-up were

selected. As such, one boy and girl were chosen from the attractive group and one boy and girl from the 'unattractive' group. Having selected the four basic test faces, Shaw modified only the smiles of each of the subjects and created a group of five pictures for each face. As such, the faces were standardized and each of four subjects was presented showing normal incisors; cleft lip, crowded incisors, missing lateral incisor and prominent incisors. Eight hundred and forty children and eight hundred and forty adults were shown one of the twenty photographs and asked to rate the child's suitability as a friend, likely aggressiveness, and attractiveness. The adults were also asked to rate intelligence. The hypothesis was that children with a normal dental appearance would be judged to be better looking, more desirable as friends, more intelligent, and less likely to behave aggressively. The results supported his hypotheses.

Out of a group of 297 adolescent patients screened at the University of North Carolina, 84% listed the appearance of their teeth as the reason for seeking treatment, while 52% claimed it was the advice of the dentist and 41% said that it was the appearance of their face. Those patients with an overjet of greater than 7 mm were more likely to report being teased about their facial appearance (Dann et al. 1995).

Shaw et al. (1980) found that after height, weight, and hair, the appearance of the teeth was the fourth most common target of teasing from peers. Teasing was defined as repeated comments made about one or more physical or social characteristics of a child in order to make fun of him. The results were obtained from interviews of 531 children, from six different schools, aged 9-13 years. They also

discovered that teasing about teeth resulted in strong feelings of unease and harassment, significantly more often than did other types of teasing.

In another part of the same study, where the salience of dental features among children was examined, a color cine film was presented to 82 children aged 11-13. Full face views of ten children demonstrated a variety of occlusal conditions, and two additional children wearing a removable and fixed appliance were shown. Each film sequence lasted for twenty five seconds and showed the subject in full frontal and right and left oblique views, both smiling and at rest. The children (judges) were given ten seconds to record their opinions. The judges were instructed to answer the questions, "If you had to describe this person's face to a friend, what would you say? Could you give this person a nickname?" The frequency with which the various facial features appeared in the response sheets placed hair first with 34.1% and teeth second with 17.8% (tied with eyes). For dental appearance, the orthodontic appliances attracted the most frequent comments while missing lateral incisors were next. Somewhat less noticed was incisal prominence and spacing. Interestingly enough, the authors reported that the condition of ideal alignment, when present, was referred to in a favorable way ('nice teeth').

Perception can be divided into self perception and peer perception. Kleck and Rubenstein (1975) found that attractive people elicit more smiles and are looked at longer by other individuals than less-attractive people. Adams (1977) showed a causality association between self-perception and peer-perception. He suggested that, while individuals differ in what is attractive and unattractive, the physically attractive

receive more positive social exchanges, which, in turn, manifests in differing social images, self-expectations and personality types. As a result of the greater degree of social interaction, the physically attractive are likely to maintain confident interpersonal behavior.

Adams and Cohen (1976) examined the physical attractiveness social stereotype, breaking it down into various categories. With regards to schools, teachers were found to rate attractive children more favorably, particularly when attractiveness was the most salient evaluative factor. The effects of physical attractiveness on teacher expectancy were attenuated when other equally salient variables (child's conduct, social class) were present.

With respect to the family, physical attractiveness did not appear to affect academic expectations, but it did influence parents prediction of the child's personal-social success (Adams and LaVoie 1975). They were predicted to be more popular, more likely to be elected as class representatives and assumed to have better personal attitudes. In fact, when behavioral transgressions occurred, adult females were more likely to judge it as an 'off' day for attractive children versus unattractive children. These women were then asked what they perceived the probability of future transgression to be. Unattractive children were seen as having significantly higher perceived probabilities of future transgressions. This was particularly true when the original infraction had been severe.

In the legal system, beautiful women are convicted less often for crimes they are accused of committing and are likely to be treated more generously when

punishment is assigned. Sigall and Ostrove (1975) also studied defendants who were trying to take advantage of their 'God-given' beauty by perpetrating crimes such as swindling (versus burglary). In these cases, the attractive defendants were punished more than unattractive people perpetrating the same crime.

In competence-performance settings, it was demonstrated that unattractive people were not discriminated against a great deal if their performance was impressive. However, if the performance was below par, attractiveness made a difference. In fact, you may be able to get away with inferior work if you are beautiful. Adams (1977) described one experiment in which students were instructed to read a story with a picture of an attractive or unattractive person attached to it. The story described a scenario where a female had taken a job knowing that in a few months the government would be making a decision on expansion, termination, or maintenance of the contracted position. As such, she would either be promoted, fired, or kept in the same position, in a few months. The students were asked to indicate the probability of the outcome for the employee. It was found that the attractive people were more likely to have positive outcomes.

Mathes (1975) identified an experiment using what was called the 'information availability model' of heterosexual attraction, which assumes that attractiveness will weaken in its effect as new information about an individual comes available. It was found that physical attractiveness maintained its influential effect over liking for another through at least five separate encounters, even though

additional competing information was present. This finding suggests that beauty has a strong and lasting grip on our appreciation for others.

Pitt and Korabik (1977) found that among a group of subjects that could not identify their own profiles, those with high self esteem judged their profiles to be closer to ideal, while those with low self esteem judged their profiles to be further from the ideal than they actually were. This suggested to them that perceptions of dentofacial attractiveness are determined by self-satisfaction rather than by objective appearance.

Albino and Tedesco (1981) conducted a study on grade eight and nine students, in which the potential effects of the objective degree of malocclusion were controlled statistically. They found that those who were not seeking orthodontic treatment had significantly more positive perceptions of their own occlusal attractiveness than did the group that was seeking treatment. They concluded that while this may seem to suggest that determining who needs orthodontic treatment is simply a matter of identifying those who perceive their teeth and occlusion as unattractive, there are difficulties with such an approach. Primarily, the reasons for initiating orthodontic treatment appear to be complex and utilizing only one component of that complex formula to initiate treatment will ignore many others that need treatment.

Kiyak et al. (1979) studied seventy-four patients who had orthognathic surgery as a part of orthodontic treatment. The patients reported an increase in psychological adaptation at one to two days, at three weeks and at four months. At

nine months, however, there was a decline in psychological adaptation. In fact, the facial self-image scores at nine months were even lower than the presurgical measures, suggesting that patients were transferring a generally negative self-evaluation from one focal point on the face to another.

Albino and Tedesco (1994) identified 94 children with mild-to-moderate malocclusions who were both between 11 and 14, and who were seeking orthodontic treatment. The control was a similar group of untreated individuals. A variety of psychosocial measures was used in an effort to measure self-image, self-esteem, self- and peer perceptions of appearance, and social behaviors and outcomes. Data analysis up to one year post-treatment demonstrated that not only did the treated subjects rate themselves as more attractive than did the untreated subjects, but they also received more positive peer ratings than did the untreated group.

Klima et al. (1979) designed a study to find out if there was any significant difference in body image and self-concept between orthodontically treated patients in retention and prospective new orthodontic patients, a general population, and mothers of the prospective new patients. They also examined whether males differed from females in their perception of body image and self-concept. To do this, they established four groups of subjects. The retention group was made up of 22 (7 males and 15 females) randomly selected patients aged 12-16 who had completed active full-banded orthodontic treatment at the Medical College of Virginia, and had retaining appliances. The new group was made up of 59 (16 males, 43 females) randomly selected patients who presented for treatment at the Medical College of

Virginia. The control group was made up of 92 (45 males, 47 females) randomly selected 12-16 year old schoolchildren. The mother's group was made up of 52 mothers of the prospective new orthodontic patients. Data was gathered by means of a questionnaire.

The authors concluded that there was no significant difference in body-image and self-concept satisfaction or importance between prospective orthodontic patients and the population sample. There was also no significant difference in body-image and self-concept satisfaction or importance between prospective orthodontic patients and orthodontic patients in retention. There was, however, a significant difference between prospective orthodontic patients' self-concept importance and their mothers' perception of self-concept importance. Therefore, in this sample, the teenagers placed more emphasis on their self-concept than did their mothers. Girls scored significantly lower in both body-image and self-concept satisfaction than did the boys at these ages and patients with class III malocclusion scored significantly lower than the other malocclusion groups in all categories of body-image and self-concept satisfaction and importance.

Rutzen (1973) studied 252 orthodontic patients post-treatment and compared them to a group of 67 subjects who did not receive treatment for diagnosed malocclusions. The treated cases were a representative sample from the files of completed cases in a state orthodontic program while the untreated cases were from an epidemiological study of malocclusions which identified those severe enough to enter into the state program. The study sought to examine whether a difference

existed between the two groups in measures of social rank, courtship, self-concept and personality. Social rank was assessed by data on education, occupation and income and scored by Hollingshead's Index of Social Position while courtship was assessed by frequency of dating, whether engaged or whether married. To evaluate self-concept, the subjects were assessed on how favorably they regarded themselves using Rosenberg's Self-Esteem Scale. Personality traits with a social bearing, such as introversion, anxiety and neuroticism, were measured with items selected from the High School Personality Quotient.

The treated subjects scored significantly more positive assessments of their appearance and more frequently mentioned oral features as their most attractive characteristic. While four of the nine comparisons (self-perception, occupational ranking, courtship status, and level of anxiety) proved to be statistically significant, only the difference in self-perception was reasonably large. Based on occupational rankings, the treated subjects also achieved a higher level of occupational status, even though the groups did not differ in social class or educational level. While this difference was statistically significant, it should be noted that the average (weekly) income was $95 for the treated subjects and $106 for the untreated. However, the treated group contained a number of students, who were scored as upper status workers because of the level they aspire to and are likely to become.

Whereas courtship status was deemed to be statistically significant for the treated versus untreated, it is interesting to note that, had the study been done one

year prior, the reverse would have been true, as many of the treated sample got married or engaged in the year of the study.

Macgregor (1979) has commented that severity of the dental condition is not directly related to the psychic distress experienced. Based on data from an interdisciplinary study of facially disfigured patients conducted at New York State University (1949-1952), she suggested that individuals with milder forms of facial disfigurement probably experienced more psychological distress because they were in a state of constant anxiety, never knowing when their condition would be ridiculed. Individuals with more severe deformities had acquired well-developed coping mechanisms, and therefore were not constantly stressed. These individuals with deformities that were distressing to look at or tended to elicit strong emotional reactions such as pity or revulsion, were not necessarily more well adjusted, but they appeared to complain less bitterly than the mildly disfigured. While it is true that there are many variables involved in determining adjustment to facial deformity, one important factor appears to be the consistency of the response expected from others.

Macgregor (1970) also points out that there are two other handicapping aspects associated with dentofacial deformities. First, the area in and around the mouth is emotionally charged and strongly connected to one's self image. Second, the face is the focus of attention in conversation and social interaction, thus deformities are often noticed. Macgregor goes on to quote Goffman as stating:

> "The closer the defect is to the communication equipment upon which the listener must focus his attention, the smaller the defect needs to be to throw the listener off balance. These defects tend to shut off the

> afflicted individual from the stream of daily contacts, transforming him into a faulty interactant, either in his eyes or in the eyes of others."

In a study by professionals and lay people, class I patients were judged to possess the most attractive faces. Class II nonsurgical (camouflage) patients were next and class II patients requiring surgical correction were judged to be the least attractive. The distribution of self-ranks among the groups was not significant, although the class II patients perceived themselves less attractive than did the class I patients (Phillips et al. 1993).

Cultural differences in perception of dental conditions that appear pleasing or displeasing have not been as significant as one might expect. Cons et al. (1983) utilized the social acceptability scale of occlusal conditions (SASOC) which was developed over a period of years in a series of steps. In 1963, there was a collection of 1137 orthodontic study models from a probability sample of 500,000 high school students aged 15-18. The models were analyzed for occlusal traits (using a different scale - COCSTOC) and 18 factors, combinations of occlusal traits or occlusal syndromes, and 5 unique traits not related to other occlusal conditions, were identified. One hundred models representing the occlusal traits were selected and photographed and the photographs were modified to show only those teeth normally visible in everyday social activities. Ten semantic differential adjectives (such as, good/bad, beautiful/ugly, attractive/unattractive) were selected to assess the public's perception of the social acceptability of the one hundred photographs. The photographs, accompanied by the set of ten adjectives, were printed and distributed to

a sample of 880 high school students, their parents (403), and 66 private practising orthodontists. After having calculated the mean scores and ranking the photos by social acceptability, a social acceptability scale of occlusal conditions (SASOC) was established.

In their study, Cons et al. utilized 100 students and 100 adults in the GDR, and 27 Australian adults, to rank only 25 of the 100 slides (#75-99). In addition, 145 Australian students ranked the entire set of 100 slides. By comparing the results, after analyzing the data in the same manner as the original study, researchers were able to determine which conditions were more pleasing and which were displeasing. A dental appearance pleasing to Americans was also pleasing in East Germany and Australia, while a dental appearance considered to carry with it some social handicap in the United States (midline diastemas; anterior spacing and crowding; large overjet; openbites), drew similar responses in these other cultural settings (Cons et al. 1983).

A more recent study by Stenvik et al. (1997) utilized a Norwegian sample of 137 children, 126 of their parents and 98 young adults. They were shown the ten photographs comprising the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need and asked to rank them on a four-category scale for dental attractiveness and orthodontic treatment need. In general, photographs with an increasing scale point were rated as increasingly more unattractive and the cut-off points for aesthetic treatment need did not differ from British professional opinion. Also of interest was their finding that the majority (80-100%) of the parents and

young adults rated the five photographs on the unattractive end of the scale to be in need of treatment, while the children were significantly less critical.

Holmes (1992) also utilized the Aesthetic Component of the IOTN in her study of 955 12-year-old Sheffield school children. She found that the children had difficulty in grasping the concept of the Aesthetic Component, trying to match their dentition to the photographs, looking for specific morphological traits. While the dentist rated 485 children at the attractive end of the 10-point scale, 676 children self-assessed themselves similarly.

Functional Reasons for Orthodontic Treatment

Problems with oral function have a great range with varied affects on individuals and include difficulties in jaw movement, tempromandibular joint disturbances and problems with mastication, swallowing or speech. The functional integration of dental and supporting structures, tempromandibular joints and neuromuscular systems are of interest to orthodontists. While genetics is a limiting factor in the determination of tooth size and cuspal morphology, and significantly influences craniofacial dimension and arch length, orthodontics has risen to the challenge to find ways to include overjet, overbite, mandibular excursions, condylar relationships and envelopes of jaw movements into a functional occlusion. Ostler and Kiyak (1991) reported that adult patients who had presented with severe malocclusion and difficulty in chewing later reported that those difficulties were largely corrected with treatment.

Malocclusion may make adaptive alterations in swallowing necessary. In the presence of certain malocclusions, it may be difficult or impossible to produce certain sounds, and orthodontics may be required prior to speech therapy. Even less severe malocclusions tend to affect mastication, swallowing, and speech, not so much by making the function impossible as by requiring physiologic compensation for the anatomic deformity (Proffit 1986).

In a review of the literature, Okeson demonstrated that pain was very prevalent in our society. While more than 81% of the general population reported at least one significant pain experience in their lifetime, 16% of the population surveyed had experienced pain in the past two weeks. Of 827 randomly selected individuals from a general population group, 66% reported pain/discomfort in different parts of their bodies, with 10% of these reporting that the pain was in their head, face or neck. In a survey of 45,711 households it was found that nearly 22% of the general population experienced at least one of five types of orofacial pain in the past six months. While the most common type of orofacial pain was toothache (12.2%), TMJ pain was also reported (5.3%).

Tucker and Proffit (1991) concluded that the relationship of malocclusion and adaptive function to tempromandibular disorders (TMD), manifested as pain in and around the TMJ, remains unclear and controversial. While TMD pain may result from pathologic changes within the TMJ, it is more often caused by muscle fatigue and spasm. Clenching or grinding the teeth or constantly posturing the mandible to an anterior or lateral position is almost always correlated with muscle pain.

Rugh and Sloberg (1985) showed that the number of people with moderate degrees of malocclusion make up 50-75% of the population, while the number of people suffering from TMD is 5-30%, depending on which symptoms are examined. Since the number of people suffering from TMD is less than those presenting with moderate degrees of malocclusion, it would appear unlikely that occlusal patterns alone are responsible for the hyperactivity of the oral musculature.

Certain types of malocclusion correlate positively with TMJ problems while others do not. However, even the strongest correlation coefficients are only $r = 0.3$ to $r = 0.4$. This further suggests that for the majority of patients, there is no association between malocclusion and TMD. A reaction to stress, however, is usually involved. While some individuals with poor occlusion have no problems with muscle pain when stressed, they may develop symptoms in other organ systems. It is uncommon to find an individual with both ulcerative colitis (a common stress-induced disease) and TMD. If a person does respond to stress by increased oral muscle activity, malocclusions may exacerbate the situation (Proffit 1986).

Reasons for Orthodontic Treatment based on Dental Injury and Disease

Ghafari (1997) identifies some of the controversies of early treatment with respect to timing of early treatment and effect of such treatment. While the profession remains divided on the issue of early treatment, it has been demonstrated that class II patients with a large overjet (upper incisors horizontally separated from the lower incisors) are susceptible to trauma of the upper central incisors (Tulloch et al. 1995, O'Mullane 1973).

O'Mullane (1973) conducted an investigation into some of the factors predisposing to injuries of permanent incisors in school children. The sample was taken from the school going population of Cork City (Irish Republic). In total, 2,792 students between the ages of six and nineteen were examined. Before evaluation of incisor injury, the subject was assessed for the predisposing factors of incisor protrusion, accident proneness, playing of contact sports and lip coverage. In addition to assessing the inclination of the upper incisors by having the subject bite in centric occlusion and evaluating the molar relationship and upper incisor proclination, the relationship between the upper and lower canines was also assessed. Subjects were classified as having protruding incisors if they were in a class II relationship with labially angulated incisors. A prototype 'protrusion gauge' was also used to apply a known force on a flat plane against the nose and chin, to evaluate if the incisors touched the plane. Three hundred and fifty seven (12.8%) of the 2,792 subjects examined had one or more injured upper or lower incisor. Only seven of 243 injuries, for which details could be obtained, were sustained during organized contact sports.

O'Mullane (1973) reported that 33% of children with untreated class II malocclusion will experience significant trauma to the upper incisors, resulting in a fracture of the tooth and/or devitalization of the pulp. Extreme overbite (vertical relationship of the incisors) can result in either damage of the palatal tissue (and may even cause loss of the upper central incisors) or extreme wear of the incisors.

While it was once thought that malocclusion was a primary etiologic factor in both dental decay and periodontal disease, it has been shown that malocclusion is secondary to plaque accumulation and proliferation.

Clearly there is a need for orthodontic treatment especially in a society in which appearance is held in such high regard. By being able to identify who needs treatment and the benefits of such treatment, we have a responsibility to find out why individuals are not receiving treatment.

Occlusal Indices

Edward Angle developed the first qualitative measure of dental malocclusion when he constructed the Angle's classification of malocclusion (Angle 1899). In recent years, quantitative measurement of dental malocclusion has gained popularity over qualitative measurement because of the inherent shortcoming of qualitative measurement to describe malocclusions in all three planes of space. Massler and Frankel (1951) were among the first to place a qualitative assessment of dental malocclusion by mathematical measurements in all three planes of space. However, conventional orthodontics recognized a need to reduce subjectivity in the assessment of malocclusions by quantifying the severity of the dental malocclusion, giving rise to occlusal indices.

Occlusal indices have proven useful in assessing treatment outcome by comparing pre-treatment and post-treatment scores. Indices have also been used to compare various treatment modalities; as a measure of treatment success; and as a

personal audit of orthodontic treatment results. Furthermore, indices that grade the severity of a case may be used as indicators for treatment.

Qualitative Methods of Evaluating Treatment Need

Although Angle (1899) was one of the first to describe a means of qualitatively assessing occlusal relationships, his method of classifying malocclusion has survived and, in fact, has been incorporated into many current quantitative indices. The qualitative methods have traditionally utilized morphologic criteria to classify malocclusions for epidemiologic studies of the prevalence of malocclusion. While the original methods of qualitatively assessing malocclusions were somewhat arbitrary in the choice of malocclusion traits selected, the later methods chose more logically grouped traits and assessed the severity of the malocclusion by the presence, or absence, of these morphologic traits. Qualitative indices were developed in the following chronological order:

Angle(1899)	Classification of molar relationship.
Stallard(1932)	General dental status; some malocclusion traits No definition of traits given.
Sclare(1945)	Recorded the presence of certain malocclusion traits: Molar relationship; arch constriction; protrusion of incisors; labial prominence of canines; lingually displaced incisors; rotated incisors; crossbite; open-bite and closed-bite. No definition of traits given.
Bjork et al. (1964)	Objective assessment of malocclusion based on defined traits - three areas of assessment:

1. Dental anomalies: tooth anomalies, abnormal eruption, alignment
2. Occlusal anomalies: saggital, vetical and transverse deviations of the dental arches
3. Spacing or crowding

Proffit et al. (1973) Assessed five characteristics:

1. Alignment: ideal, crowded, spaced, mutilated
2. Profile: mandibular prominence, mandibular recession, lip relative to nose and chin (convex, concave or straight)
3. Crossbite of posterior teeth (transverse plane)
4. Angle molar classification (saggital plane)
5. Deep bite, open bite (vertical plane)

Quantitative Methods of Measuring Malocclusion

Shaw et al. (1995) define an occlusal index as a rating or categorizing system that assigns a numeric score or alphanumeric value to an individual's occlusion. An index is a graduated scale that progresses from a lower limit to an upper limit, defining the progress of the disease from absence to terminal stages. The criteria of an ideal occlusal index have been described by various authors, but can be summarized as possessing the following features:

1. An index should be reliable and valid.
2. An index should be quick and easy to perform by a trained examiner, on patients or dental casts.

3. An index should be equally sensitive to all aspects of malocclusion.
4. An index should be objective and quantitative.
5. An index should be amenable to statistical analysis and modification.

Since Massler and Frankel (1951) first quantified dental malocclusion, there have been many indices to assess treatment need and treatment outcome. The indices of treatment need include, but are not limited to, the following:

1957	Poulton and Aaronson	Occlusal Feature Index (OFI)
1959	Van Kirk and Pennell	Malalignment Index
1960	Draker	Handicapping Labio-Lingual Deviation
1966	Jamison and McMillan	(no name)
1967	Grainger	Treatment Priority Index (TPI)
1967	Howitt et al.	Eastman Esthetic Index (EEI)
1968	Salzmann	Handicapping Malocclusion Assessment Record (HMAR)
1971	Summers	Occlusal Index (OI)
1974	Linder-Aronson	Swedish National Board for Health and Welfare Index
1986	Cons et al.	Dental Aesthetic Index (DAI)
1989	Brook and Shaw	Index of Orthodontic Treatment Priority
1991	Shaw et al.	Index of Orthodontic Treatment Need (IOTN)

Official Position of AAO on Occlusal Indices to Assess Treatment Need

The first occlusal indices to assess treatment need were developed in the 1950's, and in 1967, the American Association of Orthodontists (AAO) endorsed the Handicapping Malocclusion Assessment Record (HMAR) of Salzman. In 1976, however, the AAO changed its policy to one that refused to recognize the ability of an occlusal index to measure treatment need. A 1985 resolution provides a good summary of current opinion:

> Resolved, that the following statement shall be adopted as American Association of Orthodontists policy: There has been no index which reliably or scientifically measures the degree of need or desirability for orthodontic treatment, and be it further resolved, that it is the policy of the American Association of Orthodontists that indices are not suitable as vehicles for qualifying an individual for orthodontic treatment. (Dental Insurance Resolution No. 17S-85 RC, May 8, 1985)

Due to a growing concern over the use of occlusal indices by some state dental programs for assessing orthodontic treatment need, the AAO held the Orthodontic Indices Consensus Conference in January, 1993. At that meeting, the following recommendations were adopted:

(i) That the AAO House of Delegates rescind Resolution 17S3-85

(ii) That the AAO House of Delegates adopt the following resolution:

> Resolved, that the use of an index by an educationally qualified orthodontist to evaluate the severity or degree of handicap associated with malocclusions and/or dentofacial irregularities may be an appropriate method for the preliminary identification of patients who should be considered for treatment in publicly funded dental care programs. Treatment decisions must be made and treatment carried out by an educationally qualified orthodontist using accepted diagnostic criteria and methods.

Furthermore, the participants discovered that the indices currently used by several states lacked the evidence needed to establish the reliability and validity of those indices. As such, the participants recommended:

> Resolved, that the Council of Scientific Affairs be requested to study the issue of the AAO funding research studies on the validity of the Index of Orthodontic Treatment Need (IOTN, Shaw, 1989) and the Handicapping Labio-Lingual Deviation (HLD, Draker, 1960) indices and the issue of developing methods for encouraging government agencies and foundations to fund such studies.

In response to these findings, Beglin (1997), in his unpublished Master's thesis, examined three occlusal indices of treatment need. He utilized the subjective opinion of fifteen orthodontists to rate a set of 170 study models for treatment need, and then used their subjective opinions to assess the validity of the Dental Aesthetic Index (DAI), Handicapping Labio-lingual Deviation (HLD California Modification) and the Index of Orthodontic Treatment Need (IOTN). While he did find that each of the three indices was both valid and reliable in assessing treatment need, he concluded that based on the properties of an ideal index, the three indices would be ranked (from highest to lowest) (1) DAI, (2) IOTN and (3) HLD (CalMod).

Beglin (1997) also used the same study casts to assess subjective opinion on treatment need in two different areas, western Pennsylvania and central Ohio. He found that while there was agreement of treatment need in both areas, the scores at which the orthodontists recommended treatment were lower than that suggested by the indices themselves. As such, even though the DAI recommends treatment at a

score level of 31 or greater, the orthodontists suggested that a score level of 28 was more appropriate in the United States.

Dental Aesthetic Index (DAI)

For an index to be useful in identifying the psychosocial impact of malocclusion, it must measure the impact of the deviations from social norms rather than from some clinical ideal. Specifically, it should seek to measure such deviations that are present in day to day relationships, placing greater emphasis on the anterior segments that are visible in normal interactions.

Methods for Assessment of Dental Aesthetics

Various techniques have been utilized over the years to identify social norms for occlusal states and to classify the acceptability of dental appearance. Some investigators utilized drawings or photographs and asked either the subjects, or the people evaluating the malocclusion, to rank the malocclusion present with one of the graphic representations. In so doing, it was thought that the most important characteristics would be noticed and ranked first and the less important characteristics would be ignored. Shaw et al. (1975) utilized one such method and found that representations of the ideal were most acceptable and other conditions, especially crowded teeth, were less acceptable. However, since only a small percentage of possible configurations are represented, and because occlusal conditions of people vary so much, it would be difficult to rank the aesthetics of a great many individuals' occlusal states adequately from the information derived using this method.

Shaw et al. (1986) also used techniques developed to rank individuals' dental appearance based on the perceptions of non-dentally trained raters. While it was found that non-dentally trained raters were competent in identifying morphological traits of malocclusion, the method utilized pictures of malocclusion that had to be matched with the subject's malocclusion and thus rated. Such methods of identifying malocclusions proved to be time consuming and did not provide a sufficient range of scores to correctly relate malocclusions with psychological factors.

Cons et al. (1986) stated that some investigators have employed objective measurements of morphological traits chosen specifically to measure those aspects of the teeth that might affect aesthetic judgements or psychosocial effects. Cons et al. went on to state that, even though associations may be found between some of the traits and measures of satisfaction with dental appearance, the arbitrary selection of single traits, biased towards anterior dental impairment, cannot be demonstrated to be the only traits involved in perceptions of nonaesthetic dental appearance. In any event, some of the traits utilized may be seen as more important by the orthodontist than by the public and vice versa.

Cons et al. (1986) made the statement that single traits not objectively weighted and combined cannot serve accurately as measures of dental aesthetics (the independent variable) in studies aimed at testing relationships between social and psychological variables and dental aesthetics.

Development

The development of the DAI employed an instrument that depicted the full range of occlusal conditions found in a natural population. The sample chosen was from a sampling frame of grades 10-12 (age 15-18) students in public senior high schools in upstate New York. The chosen age range avoided the mixed dentition period and insured little likelihood that further growth and development would materially change the occlusal pattern.

Using the census definitions of metropolitan and non-metropolitan areas, the schools selected for the study were divided into the appropriate group. Within each group, selection of schools and of pupils within schools was done entirely at random, employing sampling fractions of 1 out of 8 metropolitan and 1 out of 4 non-metropolitan children based on the 1963 enrollment figures. These sampling rates were determined to be adequate to permit inferences with a reasonable degree of precision about the overall population in these grades.

In total, 1,462 children in eleven metropolitan, and three non-metropolitan, schools were selected for the study, but parental consent for participation was secured for only 1,446 (98.9%) children. Cooperating dentists who practiced in the selected areas collected the preliminary data. They not only recorded identifying data for each subject, but also made notations regarding any history of orthodontic treatment and of the presence of cleft lip or palate. Alginate impressions of both arches and a wax bite registration were obtained. Stone casts were poured, identified by code number, and forwarded to the New York State Bureau of Dental Health. A commercial laboratory

completed the cast by adding a base and trimming the models in the correct occlusion.

For 139 children with a history of orthodontic treatment, attempts were made to obtain duplicates of their original pretreatment study models from the orthodontist of record. No pre-treatment models could be obtained for thirty-three of the students, and these were therefore eliminated from the study. As such, the final study group consisted of 1,413 (96.6%) students. These students were from a possible population of an estimated 500,000. In 1975, when the models were re-measured for the presence of occlusal traits, a further 76 models could not be assessed because they were either broken, missing, had a full denture, or still had primary teeth present. As such, the final archive of models used to develop the DAI consisted of 1337 (91.5%) study models.

In 1973, the Commission on Classification and Statistics for Oral Conditions (COCSTOC) of the Federation Dentaire Internationale (FDI) developed a method for measuring occlusal traits. Each trait was carefully defined and a method for recording each was suggested. Furthermore, there was no critical level below which no recording was to be made for any of the traits, thus allowing all levels for each trait to be recorded. As such, the index formulated by COCSTOC proved to be an objective method for collecting data about the prevalence of occlusal traits. Traits were measured as absent or present, or if measurable, to the nearest whole millimeter.

In 1979, a modified version of the COCSTOC method, called the Basic Method for Recording Occlusal Traits, was developed by the World Health

Organization (WHO) and the Federation Dentaire Internationale (FDI). The main modifications of the original COCSTOC method by the WHO-FDI included the assignment of critical severity levels, such that some traits were assigned values that indicated a certain level of severity rather than an absolute value. For example, whereas the original COCSTOC method measured maxillary overjet and recorded it to the nearest millimeter, the WHO-FDI method assigned a score of zero to an overjet from 0-5 mm; a score of one to an overjet from 6-9 mm and a score of two to an overjet greater than 9 mm.

In the development of the DAI, the original COCSTOC method was utilized since the criteria for severity was to be determined by the public's perceptions, rather than by professional opinion.

To properly develop the index, investigators needed to know the public's perception of the social acceptability of a wide range of occlusal conditions. In an effort to accomplish this, a subset of 100 models was chosen from the available 1337 models. The subset was selected using a factor analysis of the COCSTOC measures to identify 'strata' from which models were randomly drawn. The factor analysis identified 18 factors, combinations of traits, or syndromes, and 5 independent traits underlying the COCSTOC trait measures.

The eighteen factor scores and the five trait scores were computed for each model, resulting in 18 factors and 5 trait score distributions along which the various study models were arrayed. One model was randomly selected at each score point in the distribution, so that all magnitudes of the 18 factors, combinations of traits, and

the 5 independent traits were represented. Although this method allowed a collection of study models representing the wide range of occlusal morphologies, the various levels of severity were not represented in the same proportion as they occurred in the population since more severe deviations from the normal occur less frequently in a typical population than the less severe. The disproportionate stratified random sampling did, however, ensure that even the most extreme cases would be appropriately represented in the sample.

Once the one hundred models depicting the chosen occlusal conditions were selected, they were photographed in a frontal and right and left lateral view. The occlusal conditions, represented as photographs, became the stimuli to which subjects responded. Stylized masks in the shape of lips were placed around the teeth to eliminate viewing nonessential and possibly confusing parts of the plaster models. By so doing, the only stimulus seen was the occlusal condition itself, thus eliminating the potentially confounding effects of other facial features. It was decided to have a mask design that allowed the teeth visible after mask placement to include the incisors, the canines and the first and second premolars on the maxilla and mandible. Cons et al. (1976) cited Tjan et al. (1964) who showed that when smiling 41% of adults displayed the six anteriors and the first and second premolars; 49% displayed six anteriors and first premolars; 7% showed six anteriors only; and 4% had smiles that showed the first molar in addition to the premolars, canines and anterior teeth.

The manner in which the malocclusions were presented was determined by presenting three occlusal conditions (one good and two poor) to 538 children, grades

5 through 9, in four different formats and asking them to rate them as 'good' or 'bad'. The formats utilized were an artist's representation of mouths; a photographic representation of the full study models; a photographic representation of a simulated oral cavity with lips and other characteristics masked; and a photographic representation of the teeth framed in lips close to that of the artist's rendition. The children could easily distinguish between the various photographic representations of teeth, and furthermore, based on the responses, the mode in which the teeth were framed in stylized lips was adopted.

A ten-item scale of semantic differential polar adjectives was utilized to assess the public's perception of the social acceptability of the stimuli. Initially, a twelve-item scale of polar adjectives was utilized. These were: Good/bad, familiar/unfamiliar, desirable/undesirable, adequate/inadequate, satisfactory/unsatisfactory, dirty/clean, usual/unusual, happy/sad, nice/awful, valuable/worthless, attractive/unattractive and beautiful/ugly. Polar opposites were separated by a six-point scale and the direction of the items (positive/negative) was randomly alternated to guard against acquiescence response bias.

It was found that even though the twelve-item scale exhibited remarkably good internal consistency, it was possible to further improve the consistency by the elimination of familiar/unfamiliar and usual/unusual. As such, a ten-item scale was employed.

The photographs of the one hundred models were randomly divided into four groups, each consisting of twenty five photographs. A booklet was made up for each

group of 25 photographs with one black and white picture on each page and the semantic differential adjective directly under the picture. Each subject responded to only one booklet. In total, 880 adolescents in grades 7 through 11 and 403 of their parents from both urban and rural areas of two different states, New York and Minnesota, were utilized as subjects and data was collected.

Scale scores were obtained for each of the one hundred stimuli by a two-step computing procedure. First, an individual-level score was obtained by summing the semantic differential item scores assigned by each subject to each stimulus. The second step was to obtain group-level scores for each stimulus, which involved computing the mean of the individual-level scores for the parent and student subsets respectively. The array of group-level scores obtained was referred to as the Social Acceptability Scale of Occlusal Conditions (SASOC).

Since SASOC scale scores were derived from the means of several hundred individual level scores, each of which was derived from several semantic differential items, a fairly high degree of reliability was inherent in them. It was found that the Pearson correlation coefficient between parent and student subsamples was 0.95, so for regression analysis, only the parent subsample was used.

Regression analysis was performed on the SASOC mean scores and the COCSTOC measurements of the one hundred stimuli to derive an equation that predicted the SASOC score for any of the one hundred stimuli used, from a minimum number of COCSTOC measurements. Using the Statistical Package for the Social Sciences, factor analytic and stepwise regression procedures, a set of eleven summary

measures was derived from the COCSTOC measurements available for each model. The 11 preliminary variables and their regression coefficients are shown in Table I.

Although COCSTOC called for measurement of spacing and crowding in the incisal, right and left lateral segments of both arches, only the visible incisal segments of both arches were selected as variables for the preliminary regression equation. Inspection of the regression coefficients (weights) indicated that missing teeth on the mandible (coefficient = 0.14) contributed very little. All other variables except antero-posterior molar relation were visible aesthetic occlusal traits.

The regression equation was recalculated after missing teeth on the maxilla and mandible were combined into one variable and the extracted teeth counted were limited to those teeth visible in usual interpersonal relations, namely premolars, canines, and incisors. Even though the original COCSTOC description of the antero-posterior molar relationship differentiated between mesial and distal, it was found that the magnitude of the deviation, not the direction, was critical. As such, a new regression analysis was carried out and the results are shown in Table II.

The regression equation specified which physical traits must be measured and also specified how they should be weighed and combined to obtain a DAI score. From the data in Table II, an initial DAI was derived, but was not the final DAI used. However, the components listed in Table II were the components used in the formulation of the DAI.

The within-sample precision of the regression equation was assessed by mean of the hit rate, sensitivity and specificity. The hit rate, percentage of cases correctly

Table 1.--Preliminary Variables and their Regression Coefficients

Preliminary Variables	Preliminary Regression Coefficient
1. Missing Teeth on the Maxilla	5.91
2. Missing Teeth on the Mandible	0.14
3. Crowding in the Incisal Segments of Both Arches	0.51
4. Spacing in the Incisal Segments of Both Arches	1.06
5. Diastema	3.23
6. Largest Anterior Irregularity in the Upper Arch	0.83
7. Largest Anterior Irregularity in the Lower Arch	1.29
8. Anterior Maxillary Overjet	1.62
9. Anterior Mandibular Overjet	3.30
10. Vertical Anterior Openbite	4.15
11. Antero-Posterior Molar Relation	2.61
CONSTANT	13.76
R^2	0.64753

Table 2.--DAI Components and their Unstandardized Regression Coefficients

DAI Components	Regression Coefficients
1. Missing Visible Teeth	5.55
2. Crowding	0.35
3. Spacing	1.19
4. Diastema	3.29
5. Largest Anterior Irregularity (Upper)	0.81
6. Largest Anterior Irregularity (Lower)	1.38
7. Anterior Maxillary Overjet	1.61
8. Anterior Mandibular Overjet	3.32
9. Vertical Anterior Openbite	4.16
10. Antero-Posterior Molar Relation	2.57
CONSTANT	13.82
R^2	0.644

identified by a test as having or not having a given disease or condition, was over 90%. For the regression equation, the hit rate was the ability to predict the number of cases with a SASOC score above or below given percentiles (10^{th}, 80^{th}, 85^{th} or 90^{th}). Sensitivity is the percentage of cases that have a given disease or condition as indicated by the test. Sensitivity for the regression equation was the percent of SASOC scores that the equation correctly predicted as above a given percentile on the SASOC scale. At the 10^{th} percentile (most socially acceptable) the sensitivity was 50% while for the 80^{th}, 85^{th} and 90^{th} percentiles (least socially acceptable) the sensitivity was 77%, 71% and 64% respectively.

Specificity is the percentage of cases that did not have a given disease or condition as indicated by the test. Specificity for the regression equation was the percent of SASOC scores correctly predicted as below a given percentile on the SASOC scale. At the 10^{th} percentile level (most socially acceptable) it was 94%, while for the 80^{th}, 85^{th} and 90^{th} percentiles (least socially acceptable) it was 96%, 96% and 97% respectively.

The final criterion used to assess the within-sample precision of the regression equation was the ability to rank the one hundred stimuli after predicting the SASOC scores. The Spearman rank-order correlation coefficient (0.82) was highly significant ($p < 0.001$).

Having generated a regression equation that was reliable, the validity needed to be ascertained. To accomplish this, a double cross-validation procedure was utilized. In order to cross-validate a regression equation, it has to be tested on data

which was not previously used. While some researchers simply randomly divide the sample into two, generate a regression equation and then cross-validate it with the unused data, a completely new set of data was utilized for this study. To go one step further, the researchers decided on a double cross-validation by generating a separate regression equation from the second set of data and testing it with the first set of data, and vice versa.

A procedure replicating the one already described was carried out and a second regression equation was derived. Since two independent equations were generated, double cross-validation assessed the stability of individual regression coefficients, as well as, the stability of each equation's prediction. There was an additional advantage to the double cross-validation method. When both equations prove satisfactory in cross-validation and the weights from the two equations are similar, the final equation can be based on the combined data. As such, it was possible to combine the data and re-compute the regression equation on the larger sample, giving a more accurate estimate of population parameters.

In the final analysis, the Standard DAI was derived from the regression equation and the addition of a constant. Table III presents the DAI components and their actual and rounded weights.

Table 3.--Standard DAI Components and their Actual and Rounded Weights.

DAI Components	Regression Coefficients	
	Actual	Rounded
1. Missing Visible Teeth	5.76	6
2. Crowding	1.15	1
3. Spacing	1.31	1
4. Diastema	3.13	3
5. Largest Anterior Irregularity (Upper)	1.34	1
6. Largest Anterior Irregularity (Lower)	0.75	1
7. Anterior Maxillary Overjet (Upper)	1.62	2
8. Anterior Mandibular Overjet (Lower)	3.68	4
9. Vertical Anterior Openbite	3.69	4
10. Antero-Posterior Molar Relation	2.69	3
CONSTANT	13.36	13
R^2	0.654	
Standard Error	6.067	

As such, the DAI score = 6*(Missing Visible Teeth) + 1*(Crowding) + 1*(Spacing) + 3*(Diastema) + 1*(Largest Upper Anterior Irregularity) + 1*(Largest Lower Anterior Irregularity) + 2*(Anterior Maxillary Overjet) + 4*(Anterior Mandibular Overjet) + 4*(Vertical Anterior Openbite) + 3*(Antero-Posterior Molar Relation) + 13.

Inter- and Intra- Examiner Reliability of Dental Assistants in Scoring the DAI

For an index to be useful, it must be relatively easy to learn, and the reliability of examiners in assessing the malocclusion, must be high. In their study, Cons et al. (1986) tried to determine whether dental auxiliaries with varying experience could reliably measure the components of the DAI on study models and intraorally. They found that while the results were very reliable, the auxiliaries were more reliable in measuring the components of the DAI intraorally than on the study models. They

found that intraorally, only 2% of the variance was due to the raters, while with the models a full 8% of the variance was due to the raters (4% due to inter-rater variation and 4% due to model-by-rater variation).

It may be concluded that the lower the DAI score, the more socially acceptable the occlusion, and the higher the DAI, the more socially unacceptable. Jenny et al. (1996) categorized the data and identified 'decision points' on the DAI scale, defining case severity levels that approximated the judgement of orthodontists. DAI scores of 25 or less were judged to have normal or minor malocclusion with no, or slight, treatment need. Scores of 26-30 were judged to have definite malocclusion, with treatment being elective. Scores of 31-35 were judged to have severe malocclusions, with treatment being highly desirable. Scores of 36 or more were judged to indicate very severe (handicapping) malocclusion, and treatment is considered mandatory for these cases.

Katz (1978) compared eight different indices from the most simple Angle's classification to Salzman's handicapping malocclusion assessment. He used 162 volunteer patients, between ages 15 and 25, and compared the scores with results from a questionnaire developed from the Eastman Esthetic Index, obtaining the opinions of the subjects concerning satisfaction with their oral self-image. Both the greatest consistency in detecting differences and the greatest magnitude of significance were shown by Angle's classification. Katz concluded that Angle's classification had the strongest correlation with the psychosocial aspects of malocclusion, because it is a measure of anterior facial profile with no dilution of

assessment caused by consideration of details such as posterior crossbites or minor rotations.

Utilization of the PAR Index to assess treatment need is possible, especially when comparison of the categories of the PAR Index and the occlusal characteristics employed by the NHHESIII survey reveals that similar characteristics are being assessed. While the PAR Index does not differentiate between anterior spacing and anterior crowding, it does record irregularities in the anterior segment. A score assigned to indicate the severity of the anterior irregularity provides the information needed, especially since it would be highly unusual to find both spacing and crowding in the same anterior segment.

Bergstrom and Halling (1997) compared three indices in the evaluation of orthodontic treatment outcome. They used the PAR Index, the modified Indication Index and the modified Index of the Swedish Medical Health Board to obtain both pre- and post- treatment scores on 39 specialist treated individuals and 20 specialist treated individuals who had undergone surgery. They concluded that while the PAR Index was designed to measure deviations from ideal tooth arrangement, it was unsuitable for measuring treatment need.

Demand for Orthodontic Treatment

Jenny (1975) citing National Center for Health Statistics (1967) states that if mastication or speech functions are impaired, or if there are gross traumatic defects or injuries, the need for orthodontic intervention is felt to be fully justified and often mandatory. She goes further to point out that the main reason, however, why

treatment is sought, is for cosmetic purposes. In examining sociocultural factors, she uses the National Geographic Magazine to demonstrate how far people will go to achieve what is considered normal in their culture. She refers to tribes in Africa and South America that will endure great pain and discomfort to achieve what is considered pleasing in their respective societies. How different that sacrifice is to the orthodontic patient that has four teeth surgically removed and then endures two years of 'metal' in the mouth and a certain amount of discomfort, is questionable.

Jenny (1975) also examined the socioeconomic factors which influence the perceived need and demand for orthodontic treatment. She noted that in the United States, it is usually the rich and upper-middle-class that can afford orthodontic treatment, while the lower class and minority ethnic groups, regardless of their need, are rarely provided care. Her statement is supported by data from the 1973 National Center for Health Statistics.

Jenny also noted that public health and welfare programs rarely included orthodontic treatment. She went on to restate the study of Pruzansky et al. (1957) that called for publicly funded treatment for the indigent with severe malocclusion. Orthodontic therapy can produce psychological rehabilitation of an individual whose dentofacial handicap might otherwise lead to a life of antisocial behavior.

Jenny also identified a striving factor, in which a family striving for upward mobility appeared to be related to perceived need for orthodontic treatment. By citing a former study (Jenny and Proshek, 1973), she noted that dental appearance was found to be highly correlated with prestigious occupations such as, State

Governor, US Representative in Congress, physician, dentist and lawyer. Parents whose aspirations for their children included a prestigious job, or marriage to a person engaged in a prestigious occupation, might perceive a need to orthodontically improve a less than esthetic dental appearance. As such, there was a striving factor, whereby, they believe that an esthetic dental appearance might help their children in their pursuit of an improved locus in the social stratum.

Michaels et al. (1994) compared orthodontist and consumer expectations of orthodontic treatment by conducting structured telephone interviews with orthodontists and consumers (parents of children seeking orthodontic treatment). In their study, 44 items assessed respondents' estimates of the likelihood of a variety of positive and negative outcomes. The questionnaires were administered to 90 consumers prior to a screening appointment and to 173 Pennsylvania orthodontists. Michaels et al. (1994) found that while consumers and orthodontists group orthodontic outcome into similar categories, it was the orthodontists that expected greater esthetic benefits. It was also found that the orthodontists perceived more consumer inconvenience, such as appointment time and frequency, than the consumer themselves

Wheeler et al. (1994) assessed orthodontic need and demand in 3696 third and fourth grade students in Gainesville, Florida. With the aid of six orthodontists, the children were examined and data collected on age, sex, race, orthodontic status, socioeconomic status, availability of specialist training services and occlusal characteristics. Demand for treatment was defined as those students who currently

had appliances or who had already completed treatment, and need as those assessed as being in need of treatment and not having had, or in the process of having, orthodontic treatment. They found that while demand was significantly higher in girls the need was greater among boys. Among the demand, need and no need groups, there was no meaningful difference in age. However, both need and demand were greater in white children (compared to black children). Demand was greater in the urban schools than the rural schools, whereas need was similar. Need was similar among different socioeconomic groups, while demand in the higher socioeconomic groups was greater (11.7% vs. 1.8%).

Wheeler et al. felt that their study was more significant than many previous studies because others had not made distinctions between need and demand, thus inflating the number that needed treatment. By applying the definition of need used in their study, the authors determined orthodontic need was similar in several populations. Swedish schoolchildren were determined to have a need of 44% and 40% in two studies, while 9-year old Finnish children demonstrated a need of 44% and 14-year old Saudi Arabian boys had a need of 40%. Previous studies that did not clearly define need, determined need to be 24% in Finnish children, 18-28% in Argentine children, 50% in Dutch children and 52% in Israeli Arab children.

Gottlieb et al. (1991) published a study of orthodontic diagnosis and treatment procedures in which they surveyed 8,901 orthodontists in the United States. Although only 14% of the surveys were determined to be useable (1,253 responses), trends reflecting current opinion were apparent. An original survey in 1986 had

found that 10% of the cases were early treatment, while the 1990 survey found that 20% of the cases were two-phase treatments. The median age at which the respondents recommended starting treatment was ten years. In examining the provision of orthodontic care in the general dental services of England and Wales, Richmond et al. (1992) found that the greater proportion of patients commenced treatment between 11 and 14 years. In fact, 89.9% of the 1010 cases examined had initiated treatment by the age of 14 to 15. In a group of 765 Glasgow school children aged 9, 12, and 15, Hill (1992) found that the overall orthodontic treatment experience was 6.7%, 22.6% and 38.1% respectively. On a sample between the ages of 9 and 15 years, Hill utilized a Malocclusion Severity Index (MSI) to score what he thought were the best predictors for treatment need. He found that there was a 50% reduction in the proportion of children with an MSI score suggesting a need for treatment. This suggests that 50% of the children receiving treatment did not require it, using the MSI.

In designing a survey to assess need of treatment as one of its objectives, the definition used by Wheeler et al. (1994) should be utilized. However, to obtain a better indication of need, the sample should be old enough that those who demand treatment are minimized. Since Gottlieb et al. (1991) showed that the median age of treatment is 10 years, by surveying a sample of 15 year old (grade 10) students, the current study seeks to maximize those who have had treatment (or are in the process of having treatment), so as to obtain a more accurate representation of the unmet need for orthodontic treatment.

In assessing the prevalence of orthodontic treatment need, Holmes (1992) randomly selected 1107, 12-year old, Sheffield children from twenty-two different schools. Of the1107 children selected, 111 who were absent at the time of the examination and 41 who were undergoing orthodontic treatment, were excluded. Using the Index of Orthodontic Treatment Need (IOTN), Holmes found that the potential level of treatment need amongst the sample population was 36.3%. She also found that only 5.3% of children, having obtained a score of 1 on both the dental health and aesthetic component of the Index, had absolutely no need for treatment. A further 25.5% had little requirement for treatment.

In a follow up study, which used the same sample, Holmes (1992b) investigated the subjective need and demand for orthodontic treatment. She found that when the children were asked if they liked the look of their teeth, there were more females who disliked the appearance of their teeth (32.3%) than males (21.8%). When the children's response was compared to a score which measured the functional and dental health need for orthodontic treatment, it was found that as the need for treatment increased, so did the percentage of children dissatisfied with their dental appearance.

Having assessed the child's level of satisfaction with their dentition by asking how they liked the look of their teeth, Holmes went on to assess the child's perception of their need for orthodontic treatment by asking the children if they thought that their teeth needed straightening. Although only 110 (21.8%) of the males had responded that they disliked the appearance of their teeth, 221 (44%) thought that they 'probably'

or 'definitely' required orthodontic treatment. Similarly, 146 (32.3%) of the females actually disliked their appearance while 234 (51.7%) thought that they 'probably' or 'definitely' required orthodontic treatment. The perceived need for treatment was much higher than the proportion of children in each grade who disliked the appearance of their teeth.

In trying to determine which occlusal trait was perceived as the worst, Holmes (1992b) found that there was no statistically significant sex distribution and that 'crooked teeth' were disliked the most (18.4%), followed by 'sticking-out-teeth' (11.1%), and 'spaced teeth' (8.3%). A large percentage (31.7) of the children responded 'nothing', and a similar number (30.5%) either did not know what they disliked about their teeth or complained about tooth size or color. Not too surprisingly, 84.8% of the children who found nothing wrong with their teeth also rated themselves at the attractive end of the Aesthetic Component score scale. What was surprising, was that 64.3% of those who rated their teeth as being either 'too crooked', 'too spaced', 'stick out', or 'other reason/don't know', also rated themselves at the attractive end of the scale.

In order to assess demand for orthodontic treatment, the children were asked whether they were prepared to have orthodontic treatment if it were necessary. The overall level of potential demand was 85.7% of the children, with a higher proportion of females (98.1%) than males (80.1%). The demand for treatment was seen irrespective of the Dental Health or Aesthetic Component Indices scores. In the discussion of her study, Holmes (1992b) realized that there was a bias in her study in

that the interviews were conducted in a face to face fashion, perhaps inadvertently pressuring the child to choose the socially acceptable answer. However, she also noted that a discrepancy between those who thought something was wrong with their teeth, and those who thought that they needed treatment, had been noted by other authors.

Burden et al. (1994) investigated the unmet orthodontic need in a sample of 506 students from eight secondary schools. A single trained examiner, using the IOTN, examined the 15-16 year old subjects and found that 154 (30.4%) students were in need of treatment. Of the 154 in need of treatment, 82 had no recollection of orthodontic treatment ever being discussed with them. It was found that the 82 children who were in need of treatment, and had received no advice regarding orthodontic treatment, came from across the range of socio-economic groups, were more likely to be male, and were less likely to be happy with their appearance than their unaffected peers. The authors clearly demonstrated that even though the majority of adolescents requiring orthodontic treatment were being identified, there was still a fairly large group (30.4%) which was not being treated, and more than half of these were not even being advised that they required treatment. The lack of advice would perhaps be acceptable if these children had self-perceptions within normal, but they did not. Holdaway (1983) stated that:

> "Plastic surgical operations do not magically give new talents or personalities to people. Rather, they take away a liability so that the person's own natural talents and personality can develop normally."

Burden (1995) identifies some of the problems in the reported prevalence of orthodontic treatment need. He refers to data from the World Health Organization, in which ten industrialized countries were surveyed. The data demonstrated levels of orthodontic treatment need in 13 and 14 year old children ranging between 21% and 64%. While some range in the level of treatment need is to be expected, it is likely that such a large variation reflects the inherent subjectivity of the evaluation systems used. As such, he makes a case for the development of an internationally acceptable index of treatment need.

Burden (1995) extracted a study population from ten schools that were randomly picked from the two hundred and thirty three secondary schools in Northern Ireland. Of the 1107 children examined, 530 (48%) were males and 577 (52%) were females, all in their first year of secondary school. The mean age was 11.7yrs (range 10.9 - 12.6) and the population was predominantly Caucasian (5 subjects were not Caucasian). Burden utilized the IOTN and found 410 (37%) had no need for orthodontic treatment; 301 (27%) had a borderline need for treatment; and 396 (36%) had a definite need for treatment.

The Orthodontic Patient and Compliance

In a paper presented at the Midwestern Component of the Angle Society in 1974, Starnbach and Kaplan discussed the profile of an excellent orthodontic patient. A complete list of the patients treated by the orthodontist in the past seven years was compiled. Since the patients were subjectively evaluated by both the orthodontist, and his receptionist/assistant, any patient whom they could not recall was dismissed.

Each patient was evaluated for oral hygiene, appliance maintenance and care, and scheduling. A maximum value of five points was given to each criteria.

Of the 362 patients who were evaluated, 163 were categorized as excellent patients (having obtained a score of eleven or more out of a possible fifteen), 189 as average (score between six and ten) and 8 as poor (score less than six). A questionnaire was then printed on both blue and yellow paper and sent to the families. The blue questionnaire was sent to the families of excellent patients while the yellow questionnaire was sent to the families of the average patient. Due to the small sample size of the poor patient, it was decided not to investigate them further.

There was an 81% (132) return rate for the blue questionnaires and a 66% (126) return rate for the yellow questionnaires. By statistical analysis, the authors determined that the significant positive factors in producing excellent patients were: sex of the patient (female being better); occupation of the father (farm, benchwork, blue collar worker being better); religion (Protestant or Catholic being better); and the type of neighborhood (rural being better). Furthermore, the data suggests that the patients whose fathers are not self-employed are more compliant patients.

Several authors have investigated the reasons why patients do not complete orthodontic treatment. Murray (1989) devised a study to assess the discontinuation rate of orthodontic patients at the Eastman Dental Hospital. Murray included discontinuation factors related to the patient at the outset of treatment, and the treatment and patient behavior during treatment. In her review of the literature, she notes that the range of discontinuation has been reported to be between 10-20%.

With respect to patient factors, she noted that patient age was directly correlated with discontinuation rates. Thus, the older the patient, the higher the discontinuation rates (age 10-14 was 20.2%, while over 18 was 42.7%). Murray also made reference to a study done in Sweden where it was found that the discontinuation rates were equal for boys and girls, despite the observation that the girl to boy ratio in a practice is 3:2. Furthermore, the study showed that while distance from the practice was a factor in acceptance of treatment, it was not a factor in discontinuation of treatment.

With regards to socio-economic patterns, Murray (1989) reported on a study of Norwegian patients that demonstrated no significant pattern. However, there was a study on Danish school children that showed a small difference between socio-economic groups (slightly more patients from social classes IV and V tended to fail to complete treatment than from classes I, II, and III). Likewise, severity of the malocclusion appeared to have little effect on the co-operation of the patient during fixed appliance therapy.

In her study, Murray (1989) obtained full records on 522 patients who had been discharged from the clinic in 1982 following either successful completion or early termination. Early termination of treatment resulted from poor attendance, poor appliance maintenance, or poor oral hygiene. No distinction was made as to whether it was the patient or the operator who terminated the treatment. The failure rate was found to be 12.8%. Neither sex distribution, geographic distribution, nor severity of the presenting malocclusion, was found to significantly affect the discontinuation rate. While the termination group was, on average, older by one year, this difference

was not statistically significant. However, the factors found to be associated with treatment termination were inexperienced operators, the use of removable appliances and having two or more failed appointments.

Patel (1992) evaluated a sample of 193 hospital patients of which 139 (72%) had completed treatment and 54 (28%) had not completed treatment. Half of a group of 686 patients from a specialist practice were selected and, of these, 63 (18%) had failed to complete active treatment. Of the 280 patients who had completed treatment, 150 were randomly selected to match the sample from the hospital. Questionnaires were mailed to all participants and if no response was received in the first two weeks, a reminder was sent. After another four weeks, the questionnaire was again mailed (registered this time) to the non-respondents. The response rate was 75.6% with a further 12.6% of surveys not completed as the subjects had moved away (as indicated by the registered mail returns stamped 'Moved Away'). A higher percentage of patients who failed to complete treatment also failed to return the questionnaires. However, a higher percentage of non-completers had also moved away. Thus, whether some of the non-completers had really been 'transfer' cases could not be determined.

Patel found that the discontinuation rate for the hospital patients was significantly higher than that of the specialist practice. Furthermore, of those who successfully completed treatment, significantly more of the hospital patients had wanted to stop treatment. Within the private practice, age was a factor. In the under 18 group the discontinuation rate was 18% while the over 18 group demonstrated a

32% discontinuation rate. Within the hospital, the under 18 group and the over 18 group's discontinuation rate was similar (28% and 26% respectively).

While attitudes to orthodontic treatment were similar for both the completers and non-completers, there was a significant difference in operator status on the level of the discontinuation rate. It appears that the more experienced operators had better co-operation and fewer failed appointments. With regard to length of treatment, it was evident that both the non-completers and the specialist practice patients expected a shorter treatment time. As such, the author suggested that full discussion and realistic estimates of treatment times prior to commencement may help to reduce the problem of failure to complete treatment.

Roberts et al. (1994) also conducted a prospective longitudinal study to determine the factors relevant to non-completion of active orthodontic treatment. Over a one-year period, all patients attending a consultant orthodontist's new patient clinics in North Derbyshire, and whose treatment plans involved active appliance treatment were included in the study. Of the 294 patients in the study, 207 had completed treatment after a period of four years, and 50 had non-completed during active treatment. As such, the non-completion rate was19.5%. Of the fifty patients who had non-completed, 23 (46%) had done so in the first six months.

Cucalon and Smith (1990) devised a study to examine the relationship between compliance by adolescent orthodontic patients and performance on psychological tests. The patient sample of 252 adolescents between the age of eleven (11) and seventeen (17), was derived from the graduate orthodontic clinic at

Washington University School of Dental Medicine and from two private practices in Northern California. There were 116 (46%) males and 136 (54%) females with the majority being classified as Caucasian (71.1%); Black (9.5%); and Asian (2.0%). For 43 (17.4%) of the patients, no data was provided for race.

Utilizing criteria such as oral hygiene, appliance maintenance and care, elastic and/or headgear wear, and missing or being late for scheduled appointments allowed categorization into good, fair or poor compliance. In addition, three questionnaires were administered to evaluate different aspects of the adolescent's personality and environment, such as self-concept, socioeconomic status of the family and the extent of alienation of the adolescent from society. The questionnaires were the Comprehensive Personal Assessment System: Self-Report Inventory by Oliver H. Bown; The Adolescent Alienation Index by F.K. Heussenstamm; and The Home Index by Harrison Gough. These tests were selected because they were simple to obtain, administer and interpret.

In analysis of the data, the investigators found that there was no effect of age on compliance when the patients were split into an 11-14 years old and a 15-17 years old group. In fact, the single most predictive factor, even more so than any of the psychological tests, was the sex of the patient. The good complier group was 65% female, while the poor-complier group was 63% male. As stated earlier by Starnbach and Kaplan (1975) this is probably due to the observation that orthodontics is concerned with improving appearances and adolescent girls have shown greater interest in this than adolescent boys. In addition, they stated that females generally

mature quicker than males and thus are more capable of complying with treatment in an adult fashion.

Cucalon and Smith also found that females frequently scored higher than males within each level of compliance. The higher the scores on the tests that dealt with attitudes regarding an individual's basic self-concept, the greater the self-esteem. In general, it was found that patients with poor compliance lacked self-esteem, while good compliance was associated with a positive self-concept. It was also found that a patient with good compliance thought highly of themselves, took pride in their accomplishments and thought optimistically about future prospects.

The index used to measure the patient's socioeconomic background and status correlated a high score with academic performance and involvement in social activities. It also correlated high scores with better compliance. The authors cited literature that suggests that the socioeconomic relationship to compliance may be related to a variety of familial factors, such as, supportiveness, communication, and family involvement.

In summary, the psychological tests indicated that more compliant patients scored higher on self-esteem, derived greater personal achievement, were optimistic regarding the future, had higher socioeconomic status and had a low degree of alienation from society. The best predictors suggested that females from higher socioeconomic groups would tend to exhibit good compliance, while males with low socioeconomic status would be expected to comply poorly.

Gosney (1985) surveyed a sample of patients and their parents attending the Orthodontic Department at the Leeds Dental Hospital in order to investigate factors which may deter patients from undergoing orthodontic treatment. She distributed 240 surveys, of which 207 (86%) were returned on time to patients who were aged less than 18, attended school full time and were either undergoing active appliance therapy or in full-time retention. She found that there were economic and social factors operating on the family and stress-related factors operating on the patient. In general, the further a patient had to travel to receive treatment, the less likely they were to initiate treatment. There was also a loss of income suffered by the parents, with mothers suffering a greater frequency of loss of earnings although fathers missed work more frequently when accompanying the child. It was also found that fathers were more likely to accompany the child the greater the distance traveled. When analyzed for social class, a marked increase in loss of earnings occurred for an accompanying parent in the manually classified groups than occurred for the non-manual classes. This could conceivably result in a greater deterrent factor operating against treatment acceptance for children from the manually classified social groups who would, therefore, be placed in a more disadvantaged position.

Most of the patients indicated some level of anxiety towards treatment, girls more so than boys, especially when fixed appliances were utilized. Discomfort was cited as the main concern with fixed appliances, while speech difficulties was the reason for anxiety with removable appliances. Despite these problems, the author

reported that most of the patients would still have accepted treatment if advised by their dentist.

The Role of the General Dentist.

Undergraduate Orthodontic Education

To formulate an impression on how dentists are advising patients, several factors should be considered. Pender (1982) undertook a study to assess the views of recent graduates on the undergraduate orthodontic curriculum. Graduates of the Welsh National School of Medicine, University of Birmingham and University of London, comprised the sample. A questionnaire was posted and the response rate was fifty (50) percent. In total, four hundred and sixty four (464) responses were obtained. The number of orthodontic cases treated in each year using active appliance therapy was regarded as a practical expression of the use made of orthodontic undergraduate education. While there was no significant difference between the three groups, it was found that principals and partners tended to treat larger number of cases than did associates.

When queried on their opinions regarding their undergraduate orthodontic training, it was found that (1) less than adequate time was spent on the orthodontic course; (2) knowledge acquired, both of growth and malocclusion discernment, was less than adequate; (3) not enough time was spent on the more complex forms of treatment; (4) insufficient time was spent treating patients; and (5) the more cases that practitioners treated, the more inadequately they regarded the time spent on more complex forms of treatment.

Brin and Ben-Bassat (1990) selected dentists from the Hebrew University Hadassah School of Dental Medicine (HU-HSDM) who graduated between the years 1980-1987 and sent them a survey. There were 138 completed and returned questionnaires (57.5%) and since there was no statistical difference in the responses on the males and females, they were treated as one group. It was found that 19.5% referred all orthodontic patients for consultation or treatment; 58% gave general orthodontic consultation, but referred those in need of treatment; and 22.5% carried out limited and interceptive orthodontic treatment.

The more the graduate was involved in clinical orthodontics, the higher his perceived adequacy of the theoretical training. While the majority reported that they were generally satisfied with the time allocated to the theoretical and practical topics, the number of lectures on certain topics was judged to be inadequate. These topics included diagnostic aids, differential diagnosis, adult orthodontics, treatment timing and fixed appliances. Interestingly, more than 25% of the respondents reported that the time spent on laboratory procedures was excessive. The majority (67%) had not broadened their orthodontic knowledge since graduation, while 11% claimed that they had furthered their familiarity with orthodontics through self-education.

The authors claimed that comparison between findings of a survey of predoctoral orthodontic education in the United States and Canada and the scope of HU-HSDM's curriculum, revealed that their program at HU-HSDM corresponded with the 25% of surveyed schools that offered the more comprehensive orthodontic training.

Regarding treatment timing and diagnosis, the graduates felt that there was inadequate theoretical instruction. Whereas, practically the entire sample recognized the significance of the theoretical part of their orthodontic studies, a quarter of the respondents regarded the time allocated to laboratory sessions as excessive. This latter finding coincided with the instructors feeling that construction of an unsophisticated removable appliance was an oversimplification of the current state of the art. Overall, 58% of the respondents gave general consultations and about 22% carried out limited orthodontic treatment. The authors concluded that an orthodontically knowledgeable sample of general practitioners is more likely to provide comprehensive service to the public.

In a report of the undergraduate orthodontic education in two dental schools, (University of Toronto in Canada and University of Liverpool in England) Burton et al. (1994) compared the relative amounts of time spent on the theoretical, practical, and clinical components of the programs. They also evaluated the nature of appliance therapy undertaken by the students. The two programs were initially assessed by comparison of their curriculum. In terms of clinical experience, the outcome was assessed by means of a questionnaire to 288 students in Toronto and 110 students in Liverpool. A personal interview was also used to clarify details of the nature of appliance therapy. The overall response rate was 69.7% although it should be noted that the response rate of the senior students in Toronto was only 40% in comparison to the 84.1% from the Liverpool students. Both courses were comprised of more than 250 hours of teaching, of which over 100 hours involved clinical tuition. Also, both

courses provided instruction in removable and fixed appliance therapy. It was found that the undergraduates treated their own patients with both simple and complex appliances over a two-year period. While it was found that Liverpool students treat more patients per student than their counterparts in Toronto, they treated more cases in their third year with removable appliances and 'extraction only'. The treatment patterns employed in Toronto used more headgear and functional appliances.

The study found that both of the programs had above average course hours allocated to the instruction of orthodontics. Toronto had 258 hours while Liverpool had 273 hours allocated for undergraduate orthodontic instruction. The authors cited studies that estimated the British experience to be about 200 hours, while the mean for 45 US and Canadian schools, was 86 hours. The authors also cited literature that demonstrated both lack of confidence, and lack of expertise, as the primary reasons why general practitioners do not undertake orthodontic treatment. They concluded that even though the exposure to orthodontics was limited in the undergraduate programs, the wide ranging program may enhance the abilities of the practitioner to refer wisely and respond to continuing education programs.

Murtomma and Lehtinen (1984) sent questionnaires to 725 members of the Finnish dental society who had not attended continuing education courses. They also sent the same questionnaires to 713 dentists that had taken part in continuing education courses. Of the 725 sent to the non-attenders, 614 were returned but 19 were discarded owing to inadequate information. As such, there was an 82% response rate. However, a further 38% of these were eliminated as the respondents

were under 30 years and it was felt that they had only just recently graduated, and thus less inclined to go to continuing education courses. Of the 713 sent to attenders, 533 were returned, but 21 had to be rejected due to inadequate information, giving a 72% return rate. Of these, 2% were over 65 and were discarded.

The need for continuing education in orthodontics dominated among employed dentists, whereas the self-employed dentists most frequently needed education in prosthodontics. The main reason given for not taking part in continuing education was cost.

Factors Influencing Dental Visits

Assuming that all of the general dentists were comfortable in their knowledge of when to refer patients to the orthodontist, the other limiting factor would be the opportunity to see the patient and thus make such recommendations. As such, the factors influencing dental visits should be examined.

Craft and Croucher (1980) conducted a national sample survey amongst young adults 16-20 years old. Of the 791 young adults identified, 690 (90.7%) were interviewed. Analysis of the data indicated that the sex and social class distribution of the sample was nationally representative of the 16-20 year-olds, although there was a slight skew towards the younger age group.

With respect to dental visits, just less than 60% claimed to have visited a dentist within the past six months. Of the other 40%, nearly half said that it had been more than a year since their last visit. Even though 84% of the respondents claimed to have a regular dentist, only 45% claimed to visit a dentist for a regular check-up or

when having trouble. A sex and class gradient was evident when asked when they last visited a dentist, with males from the lowest social class being the least likely to have visited a dentist in the past six months. A similar sex and class gradient was evident when respondents were asked for the purpose of their dental visit, the visits being grouped into regular check-up, occasional check-up and only when having trouble. As expected, respondents from the non-manual group of both sexes were more likely to visit a dentist for regular check-ups.

When respondents were asked what they actually did to look after their teeth, the results being dichotomised between support for the conventional wisdom (brushing, diet, and dental visits) or self-care (brushing and diet), two important results were obtained. First, the females, in both manual and non-manual classes, were more likely to include dental visits in their reported behavior. Secondly, a class gradient was observed with the higher social groups being more likely to take up professional services.

Petersen and Pedersen (1984) conducted a study to develop structural socioeconomic demand models for dental visits. They chose the explanatory variables selectively from the various theories concerning health services utilization. The data utilized was from a socio-dental survey carried out among workers and staff members at a Danish shipyard. A sample of 988 employees was drawn, by stratified random sampling, and 841 people were interviewed regarding dental visits and attitudes towards teeth and dental health services.

They found that dental visits were influenced by dental health status, expectations about value of dental care, income, and price of dental care. The dental health of an individual was affected by both the number of dental visits, and age. Residence in rural areas during childhood, and age, had a negative effect on dental care early in life, while years of schooling had a positive effect. Years of schooling also had a positive effect on expectations about value of dental care.

Syrjala et al. (1992) conducted a study in Oulu, Finland in which the sample consisted of 390 randomly selected young and middle-aged patients visiting two occupational health centers. There were 207 women and 183 men with 9% of the sample under the age of 25; 29% between the age of 25-30; 20% between age 31-35; 25% between age 36-45; and 16% greater than age 45. The participants filled in a questionnaire under the supervision of one of the investigators, who provided additional information as needed.

The purpose of the study was to determine what reasons restrict people's daily cleaning of their teeth and yearly attendance for a dental check-up. The questions in the questionnaire were phrased so as to cover different reasons for rejecting innovations. Innovations were described as a new attitude to dental health, and it did not matter where the idea was 'objectively' new, but that it was perceived as new. As such, the reasons that prevent the change to the desired dental behavior can be viewed as various forms of rejection of the 'innovation'.

Five important factors identified were: (i) Reasons preventing daily brushing; (ii) practical reasons; (iii) unpleasant experiences of dental care; (iv) laziness; and (v) lack of appreciation.

The expense of dental care was found to be a reason restricting regular dental check-ups. While it is possible that the result was a pretext, it is unlikely since the more educated subjects found expense less restrictive than those with less education. Sex showed a significant correlation with reasons preventing daily brushing. In fact, the only factor on which women and men differed was that women had fewer barriers to brushing their teeth daily. In addition, there was slight evidence that 'unpleasant experiences' had the greatest effect on restricting regular dental visits for women. This study also identified laziness as a new feature in the restriction of regular dental care.

Grytten (1992) designed a study to examine the accessibility of dental services according to family income. She thought that Norway was ideal for such a study as almost all costs for dental care among adults are borne by the patient. The data used were collected in 1977 (n = 1382), 1983 (n = 1313), and 1989 (n = 1200). The three samples were independent and representative of the non-institutionalized Norwegian population aged 20 years and above. Data collection was conducted by a Marketing Research company, by means of a personal interview, using a precoded questionnaire.

The main finding of the study was that inequalities in use of dental services have decreased over time. The author suggested two possible explanations. First, an increase in the number of dentists from 1977-1989. As supply increased, it was

possible that proportionately more dentists worked in rural areas. Since average income is lower in rural areas, the increased supply of dentists in rural areas might have led to an increased demand for dental services among people with lower income. Secondly, the author found that there was a general increase in people's wealth, with mean income in 1986 being higher than in 1977 when adjusted for the Consumer Price Index.

The author discussed how a fall in the price of dental care would have two effects, an income effect and a substitution effect. With an income effect, assuming the price of dental care fell, and all other prices remained constant, the household would have more income to spend on more goods and services, including dental care. Interestingly enough, this would not benefit the person who does not currently go to the dentist. The other effect of reducing the cost of dental care would be the substitution effect. As the price of dental care fell, people would be able to purchase dental care rather than some other goods and services. Determining the effect of reducing dental cost will vary for each community, as demographics vary.

Grytten's study has shown that inequalities in use of dental services among different income groups in the Norwegian adult population have decreased between 1977 and 1989. However, it must be noted that inequalities still exist.

Downer et al. (1979) examined factors that influenced the local planning of dental services. Their sample was made up of 796 high school children; 411 first year (11-12 year-old) and 385 third year (13-14 year old). Information was obtained by means of a survey and personal interview.

The children were classified as regular attenders and irregular attenders. A regular attender was a child who reported at least one routine visit during the past year, could locate where they attended, and for whom the likelihood of routine care was confirmed on inspection of the mouth. The remainder, which included those who attended only in response to pain or sepsis, or for whom the condition of the mouth showed neglect, were classified as irregular attenders.

The children were chosen from four residential districts of varying makeups which were examined by the authors. It was found that in three of the four districts, over 60% of the children were regular attenders, enjoying the benefit of less active caries than irregular attenders. In the fourth district, much of which consisted of depressed, inner city areas undergoing re-development, only one third were regular attenders.

In general, the authors concluded that the uptake of dental services was subject to wide variation and that the proportion of high school children in receipt of regular dental care was dependent upon the level of service provision. Regular attendance was clearly desirable since it reduced the amount of active disease, though not, as regards caries at least, preventing its occurrence.

For the age groups investigated, it was apparent that not only was the number of dentists per capita important, but also the type of practice in which they were engaged and how conveniently sources of treatment were located. Certain trends were also apparent. One realization was that the general dentist dealt with all ages,

and had only limited time to devote to children. In an area where general dental services were scarce, the authors felt that children would not receive adequate care.

STATEMENT OF HYPOTHESES

The present study utilized surveys and occlusal dental models on a sample of tenth grade students from eleven high schools in the Cuyahoga County, Ohio, to provide comparative demographic information on orthodontically treated and untreated subjects, and to further investigate and answer research questions on the unmet orthodontic treatment need. Demographic and psychosocial differences between the orthodontically treated and untreated groups, the untreated group with impressions and without impressions, and within group differences of the untreated sample with impressions, were all assessed from this sample. Specifically, the goal of the present study was to estimate and evaluate the unmet treatment need in this sample of tenth grade students. Utilization of the Dental Aesthetic Index to identify unmet treatment need, the VAS score as a measure of personal perception, and various demographic and psychosocial variables made it possible to test the following hypotheses:

1. There is a difference, demographically, between the group which received treatment and the untreated group
2. In the untreated group, there is no difference, demographically, between the group that had impressions and the group which did not have impressions
3. Using the DAI Score, 35% of the untreated sample have a malocclusion that requires treatment

4. Using the DAI Score, there are more boys than girls in the group that requires treatment

5. Using the DAI Score, the group that requires treatment has a lower Socio-Economic Status as defined by Hollingshead's Two Factor Index of Social Position

6. Using the DAI Score, the group that requires treatment has not visited the dentist within the past year

7. Using the DAI Score, the group that requires treatment has not been told, by a dental professional, that they require orthodontic treatment

8. Using the DAI Score, the group that requires treatment has a lower VAS Score

9. A negative correlation exists between the DAI Score and the VAS Score.

MATERIALS AND METHODS

Study Sample

In the present study, all public high-schools in Cuyahoga County, Ohio, were approached with regards to participation in a Dental Health Survey of tenth grade students. Eleven schools participated. Data utilized in this study were obtained from eleven schools, these being the first to respond favorably and schedule an appointment prior to January 1, 1998 (Appendix 1). The schools utilized in the present study were representative of schools in Cuyahoga County. Additional schools that agreed to participate in the survey, were not included in the present study, but will be included in a later study.

In total, 1360 students were included in the survey. Impressions of the teeth were obtained from 799 (58.8%) and 561 (41.2%) had no impressions. The average age of the students in the sample was 15.3 years, with 89% between the ages of 15-16 years. The male/female distribution was 662 (48.7%) males to 698 (51.3%) females. Thirty two percent of the sample had been treated orthodontically. Figure 1 outlines the experimental design.

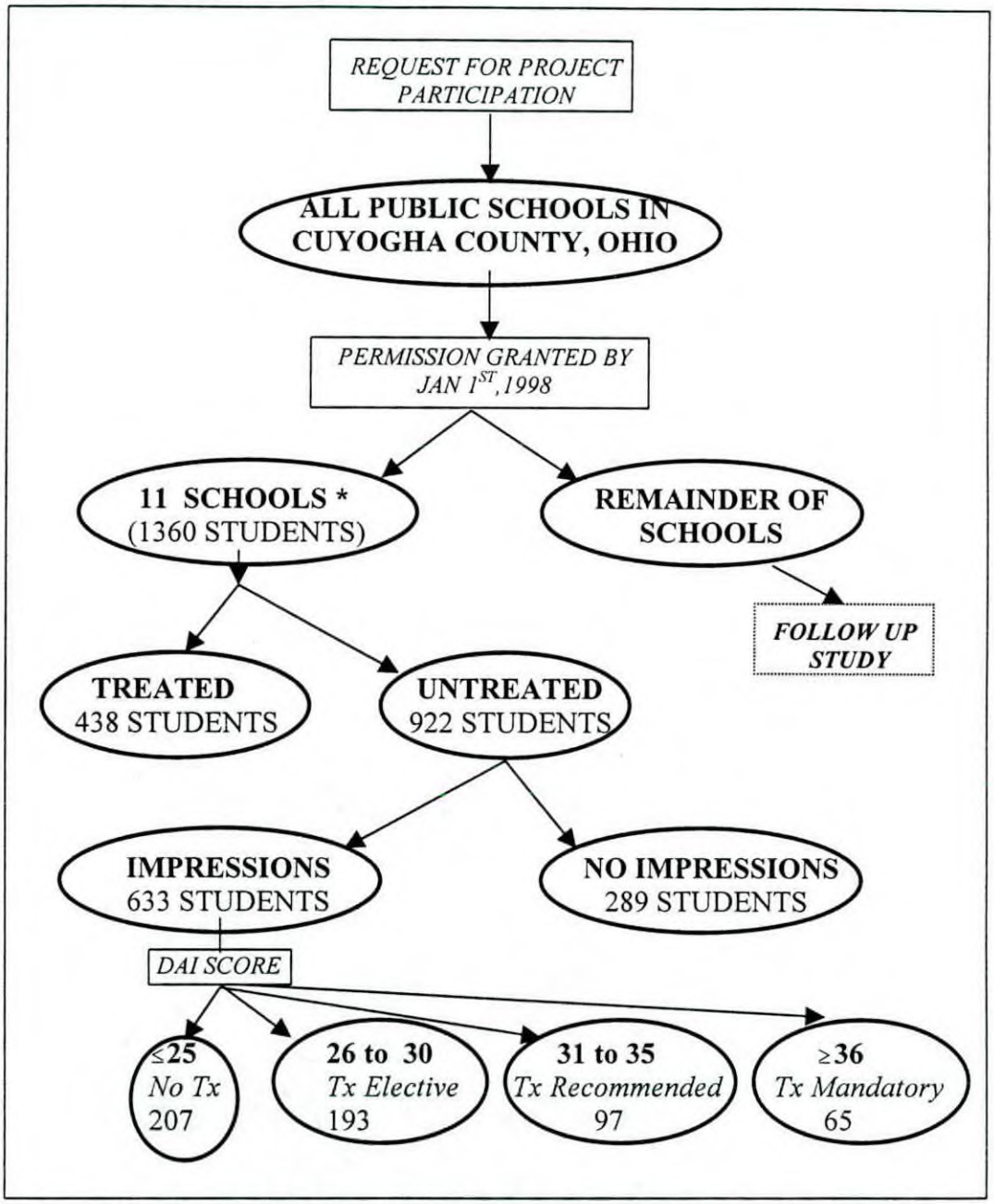


FIGURE 1. EXPERIMENTAL DESIGN

* see Appendix 1 for listing of the schools visited

Data Collection

Approval to conduct this study was granted by the Review Committee for Human Studies of Case Western Reserve University in February 1997. Although all of the schools in the county were contacted, approximately 50% turned down the possibility of surveying their schools in the Fall Semester. The reasons included, but were not limited to:

1. The school was already involved in too many surveys from other academic institutions.
2. There was no place for the survey in their curriculum.
3. Questions on the survey were too personal, and the school did not want to offend the parents.
4. There were problems with both parents and school boards - levies were turned down.
5. The procedure would take too much time (1 full class period), and it was difficult to fit into the busy workday of students and faculty.

In order to gain access to the schools, the Project Coordinator usually had to make numerous calls to each school's superintendent to gain their approval. Once this was accomplished, the superintendent took the request to the Board, and on their approval, the high school principal and faculty would discuss the possibility of doing the survey in their school. Discussions often focussed on logistics, as a suitable time period had to be found, when all tenth grade students were accessible.

Discussions with school administrators led to the creation of an information package for the parents. The package included a cover letter (Appendix 2) explaining the importance of the project, a Parental Permission slip (Appendix 3) to permit their

child to participated it the survey, and a copy of the survey to be jointly prepared by the student/guardian. In addition, the phone numbers of the project's Principal Investigator and Project Coordinator were included and the parents were encouraged to contact them in the event of any questions. This was done in an effort to increase the response rate and decrease the refusal rate through the Permission slips.

Unfortunately, most of the student's neglected to take home their information packages and thus an attempt was made by one school to mail all of the packages to the parents. Even in this instance the response rate was low. As such, it was decided to modify the implementation of the questionnaire, giving all students the choice to participate in class. This resulted in a 95% participation rate.

Initially the project was designed to focus on an orthodontic assessment of the students, but it was soon evident that the opportunity to examine dental health and related factors was too great to be missed. As such, additional faculty were added to the original advisory committee and a sample survey was designed. The sample survey was then field tested on an area high school and appropriate changes were made to facilitate easier data collection.

The survey utilized (Appendix 4) was divided into three sections, the first focussing on biographical data (name, address, phone number) and socioeconomic status (each parent's educational level and occupation). The second part of the survey focussed on factors related to dental health and included questions that provided information on frequency and nature of the student's dental visits; type of provider of dental care; and satisfaction of their dental appearance. While most questions forced

responses into categories (yes/no or choice from a list), the satisfaction of dental appearance was ranked by placing a mark along a line, with the far left being *'feel awful'* and the far right being *'feel great'*.

Only those individuals who had previously been orthodontically treated completed the third section. The survey included questions that tested whether the student had ever worn braces before; who placed the braces; when they finished treatment; whether they were still wearing retainers; and how they felt about their teeth/smile now. After some initial data collection, questions were added to the survey as seen fit. One of the questions added was whether a dental professional had ever recommended that the student get braces. It usually took the student fifteen minutes to complete the survey.

To facilitate data collection, the classes were divided into groups of twenty-five to thirty students, if they were not already that size. Each of these groups of students was then led by either a dentist or a dental student representing the University sponsoring the project (Case Western Reserve University, Cleveland, Ohio). On most occasions the Project Coordinator was also present. Before the class was assembled, a survey sheet with a unique number and a ZipLoc™ bag (DowBrands, Indianapolis,IN), with a separate unique number, was placed on each student's desk. Each ZipLoc™ bag contained:

1) President™ impression material (Coltene/Whaledent Inc., Mahwah, NJ) - both *putty A* and *putty B* wrapped individually in clear Reynolds Film 910™ wrap (Reynolds Metals Company, Richmond, VA).

2) One Polybite™ Full Arch impression tray (Royal Industries, Industry, CA) labeled with the same identification number as the ZipLoc™ bag.

3) One two-ply plastic base patient napkin.

4) Two paper towels.

The Ziploc™ bags with the materials for the impression were assembled by a group of dental students prior to the school visit. As such, each tray was numbered to correspond to each bag, utilizing a five-character identification number. The first two characters were letters used to identify the school, followed by three digits to identify the student. This format was decided on because not every student took an impression, and thus allowed the assembly of the bags to be independent of the number of students surveyed at each school.

Once the class was assembled, the teacher would introduce the supervisor who would then explain the aim of the survey and its importance. Each student was asked to verify that they had a survey sheet, and a ZipLoc™ bag containing the aforementioned items.

The supervisor would then explain how the survey was to be completed and gave specific instructions on marking the line to indicate how the students felt about their teeth/appearance. The supervisor explained each question in detail and gave examples to facilitate better understanding of the aim of each question. The importance of answering each question to the 'best of their knowledge' for accurate data collection, was stressed. The supervisor was available to clarify any questions raised by the students.

Dental Impression Technique

Once the surveys were completed, the supervisor explained the importance of having an impression taken for the study. He then demonstrated how the impression was to be taken by going through the procedure and taking an impression of him/her-self. It was stressed than no one with braces should be taking the impression on themselves.

With each student seated at their desk, they were asked to copy the identification number from the bottom of the ZipLoc™ bag to the space provided on the bottom of the survey form. To aid in the prevention of biohazardous contamination and, in an effort to produce a clean work environment, the students were instructed to place the patient bib on their desktops, with the plasticised surface touching the desk. The students were then shown the impression tray and asked to fit it into their mouth to get accustomed to the feeling. It was pointed out that there was a distinct upper and distinct lower side of the tray, and they were asked to identify these. They were then asked to practice placing the trays in their mouths to get an idea of how it should feel, remembering to bite down until their teeth just touched. Anyone having difficulties was shown how to do it.

Having completed the practice session, the attending dentist or dental student demonstrated the procedure, step by step, on him/her self. They stood at the front of the classroom and reiterated the important points, being sure to show the students how to do each step. The supervisor and remaining dental students ensured that everyone was paying attention and that no-one was following the procedure at this

point. Following the demonstration, the students were allowed to ask questions to further ensure that there was no ambiguity.

Each student was then asked to unwrap the two putties and start mixing them together in their hands until there was a uniform tan color. The supervisor monitored the time to ensure that no one mixed through the entire working time of the material. This was done in an effort to reduce the number of bad impressions by eliminating students biting into material that was almost set. Once the students had mixed the putties to a uniform color, they were told to roll the material in their hands so that they could have a long roll that they then placed on both the upper and lower sides of the tray. They were then instructed to press the upper and lower rolls together to flatten it out a bit and ensure the material flowed into the retention grooves of the tray. The students were then told to place the tray and material into their mouths, ensuring that the top of the tray was going in on the upper, and bite together until their teeth just touched. The working time and initial set of the material was two minutes, giving the students more than enough time to carry out the described procedure.

The dentist and dental students monitored the entire procedure and helped any students that were having difficulties. The students were told to keep biting down on the material for just over a minute, until the material was set. Once set, the students were advised to remove the tray by opening their mouths, and then quickly snapping the impression out of the remaining arch. The students who had any difficulties were asked to repeat the procedure, and the dental students tried to quickly assess the

quality of the remaining impressions. However, they were unable to check all of the impressions, allowing some distorted impressions to be included in the data collection.

Following the impression taking, the students were asked to ensure that the handle of the tray had a number that corresponded with the number of the bag that originally contained the putty materials. They were then told to wrap the impression in the patient napkin and place it back in the ZipLoc™ bag. The used paper towels were also placed back into the ZipLoc™ bag in an effort to reduce biohazardous contamination. The dental students then stapled the corresponding survey and ZipLoc™ bag together, allowing them to check that the number of the impression was correctly written on the bottom of the survey form. All of the bags with the surveys attached were placed in a box, sealed and transported back to the orthodontic clinic at Case Western Reserve University. The impression taking procedure required thirty minutes.

The students were thanked for their participation and a question and answer period ensued. Time permitting, the dental students were able to entertain questions on what was involved in becoming a dentist, and why they had chosen that profession. As such, the session also served to enlighten the students on career development.

At the orthodontic clinic, the survey forms were separated from the impressions after once again ensuring that the identification numbers corresponded. The paper towels and patient napkin were placed into biohazardous waste containers

and the impressions were sprayed liberally with Citrace™ Hospital Germicidal Deodorizer (Caltech Industries, Inc., Midland, MI) and left to disinfect for a period of fifteen minutes. The identification numbers on the tray handle were written with permanent ink, which proved to be a misnomer. As such, a modification was made in the procedure and care was taken not to spray the handle with disinfectant. A dental student then engraved the identification number on the tray handle using a slow speed handpiece and a #8 round bur. The trays were then again disinfected.

Once sterilized, the impressions were poured up with either buff stone or orthodontic white stone by a group of dental students who were employed by the Orthodontic Department. Since the tray simultaneously impressed the upper and lower dentition, the dental students had to pour up the impressions in a two-step procedure. An orthodontic resident (Nhat Le, DMD, Miami, FL) trained the dental students in this method to ensure accuracy and reproducibility of the quality of the casts. Dental stone was poured into one side of the impression, while placed on a vibrator, to reduce bubbling in the stone. The stone was allowed to set for a period of thirty minutes. Once set, the impression was turned over and the opposing arch was poured up. When this side had set, the stone models were removed and trimmed on a Whemer model trimmer to allow the teeth to intercuspate. The models were then placed back into the impression and the backs of the stone models were trimmed in a parallel fashion. The objective of trimming the backs of the models was to be able to articulate the models in maximum intercuspation in the absence of the impression. Each set of models required a total of forty-five to sixty minutes from initial pour up

to trimming, but the dental students were able to mix enough stone to enable pour up of fifteen impressions at a time.

After being trimmed and checked for accuracy, the stone models were placed in the impression and stored in a storage box (Ortho Box Storage System™, Raintree Essex Inc., New Orleans, LA). Each box had a capacity of eighty models, but the models were stored according to school groupings.

Visual Analogue Scale

A visual analogue scale (VAS) was utilized in the survey form to allow the students to rate how they currently felt about their teeth/smiles, and if they had braces, to recall how they felt about their smiles before the braces. The students were instructed to place a mark along the line to indicate how they felt about their teeth/smiles, with a mark to the far left indicating that they felt awful and a mark to the far right indicating that they felt great. To reduce errors in data collection, no incremental lines were placed on the VAS as this would have probably influenced where the students placed their marks. The line measured 100 mm in length, so a score of '0' to '100' was obtained by simply measuring the distance from the far left to the mark placed by the student. If the student failed to make a single mark that crossed the line, the data was recorded as 'missing', and was not scored.

DAI Scoring

Detailed instructions for scoring with the DAI was received from Dr. Cons and Dr. Jenny (Appendix 5), and reviewed by the principal investigator and the thesis

advisor. Calibration of the principal investigator in the PAR index two months prior was beneficial in that the DAI is an easier index to use, and thus to learn. The principal investigator scored thirty models and reviewed the scores with an advisor to determine if the instructions were being interpreted correctly.

The DAI is comprised of ten components, each weighted by a factor to reflect importance in determining treatment need. Factor weighting was previously determined by Jenny (1996). To obtain the DAI score, the components are scored and multiplied by their corresponding factor and added to a constant.

1. Missing teeth X 6
2. Incisal crowding X 1
3. Incisal spacing X 1
4. Midline diastema X 3
5. Largest Maxillary anterior irregularity X 1
6. Largest Mandibular anterior irregularity X 1
7. Anterior Maxillary overjet X 2
8. Anterior Mandibular overjet X 4
9. Vertical anterior openbite X 4
10. Antero-posterior molar relation X 3
11. Constant = 13

A DAI score sheet (Appendix 6) was utilized to score each model. This score sheet was modified from the original design to facilitate easier data entry by

magnifying the scoring areas and eliminating the "Cases Needing Referral for Further Evaluation" section from the original design sent by Dr. Jenny.

For purposes of data analysis, the untreated subjects were divided into four groups based on their DAI score. The decision points described by Jenny (1996) were utilized, and subjects were placed into one of four categories:

1) DAI Category 0	score of 25 or less	no treatment needed
2) DAI Category 1	score of 26 to 30	treatment elective
3) DAI Category 2	score of 31 to 35	treatment recommended
4) DAI Category 3	score of 35 or higher	treatment mandatory

Since dental models were used in the present study, and no wax bite was taken to record the subject's maximum intercuspation (MI), it was difficult to assess the student's true MI. Hand articulation of the models to a position of 'best fit' served as the MI, but it was not possible to test the validity of this method. The principal investigator was blinded to the demographic and psychosocial data of the subjects.

Data Storage and Analysis

Database: Purpose and Design

Having collected the data in the form of surveys, impressions, VAS scores and DAI scores, a method of data storage and retrieval, which allowed accurate analysis, was required. All of the data could have been entered into a database program, such as Microsoft® Excel, but it was decided that a relational database would be more efficient.

A relational database was designed by the Principal Investigator to store and retrieve data, according to relationships that the programmer had defined. As such, data can be organized according to a subject, making it easier to track and verify. In addition, data can be stored on how different subjects are related, so that it is easy to bring related subjects together.

An IBM compatible, P133 MHz computer running Windows® '95 and containing Microsoft® Office '97 (Professional Edition), was utilized. The principal investigator programmed the database in Microsoft® Access, which allowed data to be entered in several ways. In the present study, a form was created (which was similar to the survey questionnaire) for data entry.

While the form created was used to input and store data, accessory information was stored in tables in the database. Due to programming intricacies, it is essential to decide prior to program design exactly what types of information will be collected and how it will be utilized. As such, several tables suitable for the present study were created. Each table was similar to the more familiar Microsoft® Excel table format with a category title bar on the top and cell numbers on the side. A 'Survey table' was created to store the information entered into the survey form while an 'Occupation' table with a list of over four hundred occupations and their categorization according to the Hollingshead's Two Factor Index of Social Position was utilized to store related data. An 'Education' table contained a list of the various levels of education attained by the parents in the survey and categorized these levels as specified by the Hollingshead's Index. A 'Schools' table listed the various schools

and assigned a code to them while a 'Dentist' table containing a list of all the dentists in the area and categorization as to specialties was also created. Additionally, a 'DAI Score' table was created to store the DAI scores. A table for 'Ethnicity' defining the various Races and their categorization and a table defining the type of 'Providers', (whether solo practice, group practice etc.) were also included in the database.

Assumptions in Table Design

In designing the various tables, some assumptions had to be made. With the table on Providers, a list of all the dentists in the area was retrieved from the telephone directory and cross-referenced with the local dental society to ensure everyone was included. The yellow pages section of the local directory gave some indication as to which practices were group or solo or educationally/hospital based. However, after the data was input it was sorted by address and then resorted by telephone number. Any two dentists sharing exactly the same addresses or same phone numbers were placed into a group practice category.

Reduction in Data Entry Errors

In the present study, a relational database was used to make data storage more efficient and reduce the likelihood of inaccuracies. As such, a key element of each table was stored on the form. Since the relationship of each table to the form was defined, a relationship also existed between the various tables.

To minimize errors in data entry, a form closely resembling the survey-form used in the schools was created. Ideally, the person entering the data could go through the form from the school sequentially and enter the data into the computer.

Additionally, in an effort to reduce errors, rather than having the data entry personnel type in the information, pick lists were employed wherever possible. As such, rather than typing 'yes' or 'y' in response to a yes/no question, the data entry personnel was able to click a box that displayed 'YES' or a box that displayed 'NO' [similarly for gender (male/female) choices]. Other choices were provided to the data entry personnel to ensure that data entered corresponded with the actual survey questionnaire. As such, yes/no questions on the survey were given additional choices of 'missing' or 'not applicable' in the program, to indicate if the student did not choose either 'yes' or 'no'. In items where there were more elaborate choices, a more extensive pick list was employed. As such, for the occupation of the parent, a pick list of 432 different occupations was fabricated.

For items such as the date, data entry was forced into a specific format mm/dd/yy. If not entered into this format, the program would warn the data entry personnel that there was an error and would not proceed until corrected. Similarly, for items such as the identification number where it was decided that a five-digit number would be employed, the program forced a five-digit entry format and refused to accept a duplicate number, ensuring that each number was unique.

For items such as the scale used to assess how the subjects liked their smiles, where the values were between zero and one hundred, the program ensured that data entered was within the specified parameters. Once again, if the student failed to mark the line, a code for 'missing' was entered.

Data entry errors were also corrected by manually going through printouts of the data and checking for any apparent irregularities. These were then confirmed or denied by checking with the actual survey questionnaire.

Data Storage Format

Data was entered into the relational database in a survey form format that closely resembled the survey sheet used for data collection. Although data was entered in the original format, as it appeared on the survey the subjects filled-out, and remained retrievable in that format, it was stored numerically. This facilitated data analysis. As such, all categorical variables were coded as follows:

Yes/no	0/1
Male/female	0/1
Had impression/did not have impression	0/1

In addition, any missing data had to be recorded with a numerical code in the database, so the following system was used:

Missing data	999
Unknown data	888
Does not apply	444
Other	333

Hollingshead's Two Factor Index of Social Position was used to assign a score to the mother and father. Since the index was originally designed to evaluate the head of the household, it was decided to use the higher of the mother's score or the father's score for classification of socio-economic status. This method is not accurate in

assessing the income in a household, and does not recognize the difference between a family with two incomes, and one with one income. Neither is it capable of determining if the parents are divorced. Utilizing Hollingshead's methods, the subject was placed in one of five categories according to the socio-economic status. The lower the Social Class value, the more affluent the household. The categories were defined as follows:

1) Social Class I	11-17
2) Scoial Class II	18-27
3) Social Class III	28-43
4) Social Class IV	44-60
5) Social Class V	61-77

Statistics

Once the data was entered into Microsoft® Access, queries were run to provide the necessary information for data analysis. Due to the nature of a relational database, since the information required for an investigation necessary to answer a research question was stored in various compartments, a query was executed which identified the necessary information and placed it into a form. The data in the query form was then converted to Microsoft® Excel. Using the Statistical Package for the Social Sciences (SPSS), statistical analysis of the data was completed. Alpha was set at 0.05, and all analyses were two-tailed in nature. Statistical significance was assessed at $p < 0.05$. Chi-square analysis was used to test the difference between the proportions of the demographic and psychosocial categorical data, while the t-test

was utilized to evaluate the equality of the means of the VAS scores in the various DAI categories. An analysis was also employed to test for a correlation between the DAI score and the VAS scores.

RESULTS

Of the total sample of 1360 students who were surveyed in the present cross-sectional analytical study, impressions were taken on 799 students and no impressions were taken on the remaining 561 students. Of the 799 students who had impressions, 166 were previously treated and 633 were untreated. Of the sample of 633 models representing the previously untreated students, 72 (11.37%) models were not useful due to poor impressions, which resulted in a set of models which were not possible to accurately evaluate. The distribution of the sample is summarized in Table 4 below.

TABLE 4.-- Summary of Sample Distribution

GROUP	IMPRESSIONS	NO IMPRESSIONS	TOTAL
TREATED	166	272	438
UNTREATED	633	289	922
TOTAL	799	561	1360

The dental casts of the untreated sample were then evaluated by the principal investigator and assigned a DAI score. At a later date, fifty-eight models of the untreated sample were selected by a random number generator and re-scored by the

The first division of the sample data was by way of who had been treated and those who had remained untreated. In order to verify whether the two groups were similar, a two-tailed ($\alpha = 0.05$) Chi-square (χ^2) analysis was carried out on the categorical demographic data common to the two groups. The demographic data utilized was gender, socio-economic status, race, whether the subject had visited a dentist in the past year and whether a dental professional had ever told the subject that they needed braces. There was no significant difference between the two groups on the demographics of gender and whether they had been told, by a dental professional, that they needed braces. However, there was a significant difference ($p < 0.05$) between the groups with respect to race, socio-economic status and whether they had visited a dentist in the past year.

There was a greater percentage of Caucasians in the treated group (86.3%) versus the untreated group (57.4%), while the opposite was evident in the African-American group, (11.8% of the treated group and 35.2% of the untreated group). A similar trend was seen in the various socio-economic groups, in that the higher-class groups (I, II, III) showed a greater percentage of its subjects in the treated group, and the lower-class groups (IV, V) showed a greater percentage of its subjects in the untreated group. Similarly, if the subjects had visited a dentist in the past year they were more likely to have received orthodontic treatment (94.7%), and conversely, if they had not visited a dentist in the past year, they were more likely to have not received orthodontic treatment. The results are summarized in Table 5.

TABLE 5.--Demographics of the Treated and Untreated Groups

		PERCENT FREQUENCY *(NUMBER OF) (SUBJECTS)*		p-VALUE
		TREATED	UNTREATED	
MALE		48.3 *(211)*	49.0 *(452)*	0.813
CAUCASIAN AFRICAN-AM OTHER		86.3 *(44)* 11.8 *(6)* 1.9 *(1)*	57.4 *(62)* 35.2 *(38)* 7.4 *(8)*	<0.001*
SOCIO-ECONOMIC STATUS	I	14.1 *(55)*	7.4 *(50)*	<0.001*
	II	23.0 *(90)*	18.5 *(125)*	
	III	34.8 *(136)*	31.2 *(210)*	
	IV	21.5 *(84)*	28.0 *(189)*	
	V	6.6 *(26)*	14.8 *(100)*	
VISITED A DENTIST IN THE PAST YEAR		94.7 *(414)*	72.6 *(668)*	<.001*
TOLD THAT THEY NEED BRACES		100 *(1)*	24.7 *(102)*	0.082

* p-value is significant

Having separated the total sample into two groups, treated and untreated, the untreated sample was further divided into two groups, those that had an impression and those that did not have an impression. To test for a difference between the impression and no-impression groups, a two-tailed ($\alpha = 0.05$) Chi-square (χ^2) test was employed to detect any difference between the categorical demographic data. The demographic data utilized was gender, race, socio-economic status, whether the subject had visited a dentist in the past year, and whether a dental professional had told the subject that they needed braces. There was no detectable significant difference between these groups ($p < 0.05$) except in the group that had been asked if they had visited a dentist in the past year. More of the subjects who had visited a dentist in the past year did not have an impression taken. Conversely, more of the

students who had not visited a dentist in the past year had an impression taken. The results are summarized in Table 6.

TABLE 6.--Demographics of the Impression and Non-Impression Groups

		PERCENT *(Number of)* FREQUENCY *(Subjects)*		p-VALUE
		IMPRESSION	NO IMPRESSION	
MALE		47.4 *(300)*	52.2 *(151)*	0.139
WHITE BLACK OTHER		54.5 *(54)* 38.4 *(38)* *7.0 (7)*	88.9 *(8)* 0 *(0)* 11.1 *(1)*	0.203
SOCIO-ECONOMIC STATUS	I	7.3 *(33)*	7.6 *(17)*	0.928
	II	18.0 *(81)*	19.7 *(44)*	
	III	33.3 *(150)*	26.9 *(60)*	
	IV	25.7 *(116)*	32.7 (73)	
	V	15.7 *(71)*	13.0 *(29)*	
VISITED A DENTIST IN THE PAST YEAR		69.7 *(440)*	78.7 *(227)*	0.004*
TOLD THAT THEY NEED BRACES		23.7 *(88)*	34.1 *(14)*	0.140

* p-value is significant

The sample of untreated subjects who had an impression and were assigned a DAI score totaled 561. The data was then categorized according to the decision points as described by Jenny et al. (1996). It was found that 36.8% of the sample had no, or very slight, need for treatment, while 28.9% were in need of treatment. Of the 28.9% in need of treatment, it was determined that 40.1% of these (11.6% of the untreated sample) were in the group for which treatment was considered mandatory. The data is summarized in Table 7.

TABLE 7.--Frequency of subjects in DAI categories.

DESCRIPTION	CAT	FREQ	VALID %
DAI 25 OR LESS NO/SLIGHT Tx NEED	0	207	36.8
DAI 26 TO 30 Tx ELECTIVE	1	193	34.3
DAI 31 TO 35 Tx HIGHLY DESIRABLE	2	97	17.3
DAI 36 AND GREATER Tx MANDATORY	3	65	11.6

To test for a difference between the four groups, an analysis of variance was computed utilizing a two-tailed ($\alpha = 0.05$) Chi-square analysis for the categorical variables. The categorical variables tested were gender, race, socio-economic status, whether the subject had visited a dentist in the past year, and whether they had ever been told by a dental professional that they needed braces. It was found that there was a significant difference between the four groups (at a $p < 0.05$ level) for all of the demographic variables expect socio-economic status and gender.

In examining the data from a DAI category 0 (no need for treatment) to 3 (treatment mandatory), it was evident that the percentage of Caucasians decreased (70.0% to 11.1%), while the percentage of African-Americans increased (20.0% to 77.8%). Similarly, there was a decrease in the percentage of those who had visited a dentist in the past year (73.3% to 55.4%) and an increase in the percentage of those who had not visited a dentist in the past year (26.7% to 44.6%). Conversely, for those

who were told that they needed braces, there was a smaller percentage (11.5%) in the group which did not need treatment (DAI category 0) than in the group which needed treatment (61.8%), and vice-versa. All of these were significant. The results are summarized in Table 8.

TABLE 8.--Demographic data between the DAI groups

DESCRIPTION		PERCENT FREQUENCY IN DAI CATEGORIES				p-Value
		0	1	2	3	
VISITED A DENTIST IN THE PAST YEAR		73.3 *(151)*	68.9 *(133)*	74.2 *(72)*	55.4*(36)*	0.0465*
TOLD THAT THEY NEED BRACES		11.5 *(14)*	23.9 *(28)*	27.8 *(15)*	61.8 *(21)*	0.0001*
SOCIO-ECONOMIC STATUS	I	8.6 *(14)*	8.2 *(11)*	1.5 *(1)*	4.9 *(2)*	0.0988
	II	15.4 *(25)*	22.4 *(30)*	18.2 *(12)*	4.9 (2)	
	III	35.2 *(57)*	27.6 *(37)*	45.5 *(30)*	34.1 *(14)*	
	IV	26.5 *(43)*	26.1 *(35)*	22.7 *(15)*	34.1 *(14)*	
	V	14.2 *(23)*	15.7 *(21)*	12.1 *(8)*	22.0 *(9)*	
WHITE BLACK OTHER		70.0 *(21)* 20.0 *(6)* 10.0 *(3)*	63.6 *(21)* 30.3 *(10)* 6.1 *(2)*	50.0*(7)* 42.9 *(6)* 7.1 *(1)*	1.1 *(1)* 77.8 *(7)* 11.1 *(1)*	0.0166*
MALE		44.0 *(91)*	50.8 *(98)*	47.4 *(46)*	49.2 *(32)*	0.4233

* p-value significant

For the VAS score, a continuous variable, an analysis of variance utilizing a two-tailed ($\alpha = 0.05$) t-test was calculated to evaluate whether there was any significant difference between the VAS scores of the various DAI categories. There were 545 subjects who were assigned a DAI score and rated themselves on the VAS.

It was found that there was a significant ($p < 0.05$) difference between the VAS scores of the subjects who were categorized as not in need of treatment by the DAI, and both, those for whom treatment was highly recommended (DAI category 2), and those for whom treatment was mandatory (DAI category 3). These results are summarized in Table 9. When a correlation coefficient was calculated for the ungrouped DAI data with the VAS score, a weak negative correlation ($r = -0.1580$), which was not significant, was found.

TABLE 9.--VAS Score per DAI Category

DAI CATEGORY	Visual Analogue Scale (VAS) Score				
	Number	Mean	Std. Dev	C.I (95%)	Range
0	204	71.80	21.01	±2.90	68.90 - 74.70
1	187	68.17	22.79	±3.29	64.88 - 71.46
2	92	63.05	24.51	±5.08	57.98 - 68.13*
3	62	60.13	25.84	±6.56	53.57 - 66.69*

* significant ($p < 0.05$) to group 0

DISCUSSION

In order to accurately assess treatment need in tenth grade students in Cuyahoga County, Ohio, an experimental design described in the materials and methods, was utilized. To minimize bias and optimize accuracy in sample acquisition and thus references to the population group, it was necessary to test sampling uniformity at each level.

The first level of division of the group was into those who participated in the study and those who did not. For the data to be accurate, the two groups should have been the same. Within the present descriptive study it was not possible to test whether the children who participated were similar to those who chose not to participate, because no demographic data was obtained on the schools that chose not to participate. While this introduced selection bias, it would be difficult to surmise whether more affluent schools were more eager to participate, and conversely, whether the schools serving the less affluent communities might have been more likely to decline a survey of its students. The selection bias was probably minimized by the fact that all of the schools in the Cuyahoga County were approached, and only the first eleven that responded were chosen. A plot of the schools that participated in the study shows that they were not all in the same demographic area, and were, in fact, quite well distributed geographically.

Logistically, some schools simply were not equipped to place all of their tenth grade students into a common room at a common time, or were unable to find time in the children's schedule to allow data collection. Other schools cited a lack of funding within their school board system to accommodate the data collection, even though the process was not costly. One school (Beachwood High) did go to extraordinary lengths to ensure that the subjects and their parents were fully aware of the research design and data collection, by taking it upon themselves to mail out the approval form to all of the tenth grade students' parents. This however, was not a requirement of the procedure.

Furthermore, a more accurate assessment can be made in the future, in the follow-up study. Since many of the schools that initially declined to have the study conducted in their classrooms later agreed to participate, statistical analysis on demographic data between the two groups (schools that initially allowed data collection and those that did not) at a later date can confirm whether the sampling was uniform and representative.

In the present study, if there were a bias in the sample selection, one would surmise that the schools with more funding and greater organization would have been the first to respond favorably to the project coordinator. The resulting bias should have produced an increase in the demand for orthodontic treatment, and a correlated decrease in the need for orthodontic treatment.

At the second level of the experimental design, in which the sample (n = 1360) was divided into two groups, previously treated (n = 438) and untreated

subjects (n = 922), statistical analysis was utilized to compare demographic variables common to both groups. Information bias was introduced into the present study at this point, as students were divided into the two groups, treated and untreated, by means of them recalling whether they had previously received orthodontic treatment. The bias should have been minimal since the survey question was measuring an event that is usually significant in each child's life, versus a more trivial event, and thus less prone to memory loss. By utilizing a survey form, the study sought to reduce the bias introduced by means of a personal interview. In previous studies, the authors (Holmes, 1992b) have expressed concern that personal interviews place undue pressure on the subjects to choose the socially acceptable answer.

As expected, there was a difference between the two groups, measured by a difference in the demographic data. The demand for orthodontic treatment, defined as the percent of people that have had orthodontic treatment, was 32%. Brunelle et al. (1996) estimated a demand of 20%, but their sample was measuring demand for treatment in an aged population, thus reflecting demand approximately 35 years ago. Wheeler et al. (1994) defined demand as utilized in the present study, but in their sample of 3696 Grade 3 and 4 students, found a demand of 42% for orthodontic treatment, which was similar to that demonstrated in Swedish schoolchildren (40-44%), 9 year old Finnish schoolchildren (44%) and 14 year old Saudi Arabian boys (40%). The present study identifies a more accurate demand for orthodontic treatment by utilizing an older (Grade 10) population. Gottlieb et al. (1991) demonstrated that the percentage of early treatment cases in an orthodontic practice

had increased from 10% in 1986 to 20% in 1990. They also demonstrated that the median age of treatment was 10 years old, suggesting that the Wheeler et al. (1994) sample was too young to accurately reflect the demand for orthodontic treatment. Richmond et al. (1992) demonstrated that 89.9% of those who had started orthodontic treatment had done so by age 14 to 15. Hill (1992) went one step further to characterize those that had treatment at the different ages. At ages 9, 12 and 15, the overall orthodontic treatment experience was 6.7%, 22.6% and 38.1% respectively. As such, the investigators are confident that true demand (and need) for orthodontic treatment can only be estimated in a sample that is old enough to have received the stimulus (orthodontic treatment).

No difference was found between the treated and untreated subjects for the demographic variable gender. The result was not supported in the literature by some studies. Wheeler et al. (1994), found a greater demand in girls than boys. Similarly, Holmes (1992b) found that 12-year old girls (32.3%) disliked the appearance of their teeth more than boys (21.8%). Starnbach and Kaplan (1975) stated that orthodontics is concerned with improving appearances and adolescent girls have shown greater interest than boys. No difference in the treated and untreated group with respect to gender is, however, supported by Brunelle et al. (1996) who surmised that it was a reflection of current trends in that boys and girls have similar desire to have straight teeth. In studying an older population than Wheeler et al. (1994), it is possible that as boys get older their self-perception increases and thus, even though there is a disproportionate number of girls receiving treatment at age 9-10, by age 15 an equal

number of boys and girls have received treatment. If this were true, it is expected that studies examining patient gender at age intervals of one or two years would see an increase in the proportion of boys to girls in the older age groups, 12-15 years. No literature was found to support, or disprove, this hypothesis.

There was no difference between the treated and untreated groups when asked if they had ever been told that they needed treatment. This question was subjected to a great degree of recall bias. Furthermore, only one person who was treated responded to the question, and only 44.8% (413) of the untreated group responded to the question. As such, it was determined that measuring this variable was invalid.

Race was significantly different between the treated and untreated groups. A greater percentage of non-Hispanic whites (Caucasians) received treatment than any other race. In the untreated group, there was a greater percentage of African-Americans than any other race. The 1973 National Center for Health Statistics stated that lower class and minority groups, regardless of their need, were rarely provided care. Brunelle et al. (1996) reported similar findings in that there were significantly more non-Hispanic whites who reported that they had received orthodontic treatment than non-Hispanic blacks and other racial groups. Confounders probably included access to dental care and socio-economic status. Additionally, less than 10% of the total sample had responded to the question of race, suggesting that while the results identify an interesting trend, they are not reliable in the present study. The follow up study should have enough responses to the race question to either support this trend or disprove it.

Socio-economic status was also found to be significantly different between the treated and untreated groups. In general, the higher the socio-economic status, the greater the likelihood that the subject received treatment. Jenny (1975) had similar findings using data from the 1973 National Center for Health Statistics. She concluded that in the United States, it is usually the rich and upper-middle class that can afford orthodontic treatment. Wheeler et al. (1994) found that while need was similar in all of the socio-economic groups, the demand in the higher socio-economic group was greater. Murray (1989) reported that in a Danish study slightly more patients from social classes IV and V tended to fail to complete treatment than from classes I, II and III. Gosney (1985) found that there was a marked increase in loss of earnings for an accompanying parent in the manually classified groups than for the non-manually classified groups. This could thus result in a greater deterrent to initiate treatment, for the children in the lower socio-economic groups. Gosney (1985) also reported that the further a patient had to travel to receive treatment, the less likely they were to initiate treatment. While the present study did not investigate average distances from the schools to the nearest dentist and orthodontist, the follow-up study will do so. As a general rule, orthodontists are not located in lower socio-economic areas. However, larger dental clinics and groups such as Dental and Orthodontic Centers at Sears will probably be better positioned to provide service to the lower socio-economic groups both by more inventive fee scheduling and by practice location.

Socio-economic status was also found to be significantly different between the treated and untreated groups. In general, the higher the socio-economic status, the greater the likelihood that the subject received treatment. Jenny (1975) had similar findings using data from the 1973 National Center for Health Statistics. She concluded that in the United States, it is usually the rich and upper-middle class that can afford orthodontic treatment. Wheeler et al. (1994) found that while need was similar in all of the socio-economic groups, the demand in the higher socio-economic group was greater. Murray (1989) reported that in a Danish study slightly more patients from social classes IV and V tended to fail to complete treatment than from classes I, II and III. Gosney (1985) found that there was a marked increase in loss of earnings for an accompanying parent in the manually classified groups than for the non-manually classified groups. This could thus result in a greater deterrent to initiate treatment, for the children in the lower socio-economic groups. Gosney (1985) also reported that the further a patient had to travel to receive treatment, the less likely they were to initiate treatment. While the present study did not investigate average distances from the schools to the nearest dentist and orthodontist, the follow-up study will do so. As a general rule, orthodontists are not located in lower socio-economic areas. However, larger dental clinics and groups such as Dental and Orthodontic Centers at Sears will probably be better positioned to provide service to the lower socio-economic groups both by more inventive fee scheduling and by practice location.

Department of Orthodontics

Between the treated and untreated groups, there was a significant difference between those who had visited a dentist in the past year and those who had not. The question in the survey did introduce information bias into the study, but again, a dental visit is likely an event that would be remembered. In utilizing a survey format, there was less pressure on the subjects to err on the side of social acceptability, and thus introduce further bias in the study.

A dental visit in the past year is likely correlated with socio-economic status in that dental hygiene and maintenance are dependent on both education and availability of financial resources. Since socio-economic status was found to be significant between the treated and untreated group, it is not surprising that a dental visit in the past year is also significant. Craft and Croucher (1980) found that in their sample of 690, 84% claimed to have a regular dentist, but only 45% claimed to visit a dentist for a regular check-up or when having trouble. They identified a sex and class gradient, and found that a male from the lowest socio-economic class was the least likely to have visited a dentist in the past six months. They also found that respondents from the non-manual group of both sexes were more likely to visit a dentist for regular check-ups. Petersen and Pedersen (1984) found that the dental health of an individual was affected by both the number of dental visits, and age. They further found that the number of years of schooling had a positive effect on dental health. In Hollingshead's Two Factor Index of Social Position, however, the greater the number of years of schooling, the higher the level of education, and thus

the higher the social class. As such, a relationship exists between socio-economic position and dental visits.

One would have expected that a dental visit would identify malocclusions and thus led to the subjects being told that they needed braces. However, being told that they were in need of braces proved not to be significant. This could be due to the inherent recall bias of the survey in that if the subjects were told that they needed braces, and they acted on it, they would probably remember being told. Conversely, subjects who were told that they needed braces and did not think it was important, likely did not even remember ever being told. Another factor that may have contributed to this not being significant, is the dentist. Pender (1982) reported that dental students felt that their undergraduate orthodontic training was inadequate and their confidence with regards to orthodontics was low. Burton et al. (1994) reported similar findings, and noted that the wide ranging undergraduate programs probably enhanced the abilities of the practitioner to refer wisely. They noted that the average number of hours allocated for undergraduate orthodontic instruction was 258 in Toronto, Canada; 273 in Liverpool, England; but averaged only 86 hours for 45 US and Canadian schools. Murtomma and Lehtinen (1984) surveyed the Finnish dental society and found that the need for continuing education in orthodontics dominated among employed dentists, whereas the self-employed dentists most frequently needed education in prosthodontics.

In order to make comparisons on the group of untreated subjects who had impressions, it was first necessary to verify that the group which had impressions was

not significantly different from the group which did not have impressions. There was no difference between the impression and no impression group of the untreated subjects, except that a greater percentage of those who had visited a dentist in the past year did not opt to have impressions taken and vice-versa. It can probably be surmised that having an impression taken was a negative stimulus, and thus those who have had impression experience did not volunteer for it, while those that had not previously had exposure to the stimulus were not deterred by it. As such, selection bias was introduced into the study. From the results of the treated and untreated groups, if the subjects who had visited a dentist in the past year chose not to have impressions taken, it would be expected that in the non-impression group, there would be more people with lower DAI scores. As such, in a uniform sample of impression and non-impression groups, the percentage of subjects requiring treatment would be less.

The present study found that the unmet treatment need was 28.9%. Assuming that the impression and non-impression groups were uniform in their sampling, and assuming that none of the subjects who was treated had a need for treatment, the unmet treatment need for the population would be 22.3%. Burden et al. (1994) used the IOTN to evaluate unmet treatment need in a sample of 506 students aged 15-16 years. They found the unmet treatment need to be 30.4%. They further found that of those in need of treatment, more than half of them had never been told that they needed treatment, and most of these did not have self perceptions that were normal.

Burden (1995) extracted a study population of 1107 children from ten randomly picked schools, and found that 37% had no need for orthodontic treatment; 27% had a borderline need for treatment; and 37% had a definite need for treatment. In the present study, 37% had no need for treatment; 34% had a borderline need for treatment; and 29% had a definite need for treatment. Some of the difference in the two results may be accounted for by the age of the samples. Burden's (1995) sample had a mean age of 11.7 years, while the present study had a mean age of 15.2 years. Richmond et al. (1992) demonstrated that the greater proportion of patients commenced treatment between 11 and 14 years, with 89.9% of the cases having initiated treatment by age 14-15.

Having divided the untreated subjects into groups by their DAI scores, it was possible to test for differences between the groups. There was no significant gender difference between the groups. This was surprising because most of the literature suggests that girls are more aware of their facial esthetics than boys, and thus are more motivated to seek out orthodontic treatment. As such, it was expected that there would be more boys in the group that needed treatment. Wheeler et al. (1994) found that the need for orthodontic treatment was greater in boys than girls, but they utilized a sample that was approximately six years younger than the present study. Shaw (1981) showed that physical attractiveness was a more important factor in the evaluation of females than of males, and Holmes (1992b) found that 12 year old girls disliked the appearance of their teeth more than boys, even though they both had the same degree of malocclusion. The present study found no significant difference

between the gender and a need for treatment, which is supported by Birkeland et al.'s (1996) study, which found that the sex distribution of those in need of treatment was equal. Lewit and Virolainen (1968) related a positive attitude towards orthodontic treatment to one of the parents' wishes regarding treatment. They also reported that the importance of social factors in the decision to undergo orthodontic treatment was suggested by the common belief that braces are prestigious, probably because they imply affluence and responsibility on the part of the parents. Birkeland et al. (1996) reported that parents perceived dental esthetics to be equally important for girls and boys.

Socio-economic status also proved not to be significant among the groups of DAI categories. Due to the number of subjects in each of the categories, the results are not statistically reliable. Furthermore, in the assignment of the subject into a particular social class, and thus socio-economic group, the present study did not discriminate between a household with one income and a household with two incomes. However, in examining the trend that socio-economic status is not significant, several observations can be made. The general perception as to why people in need of orthodontic treatment do not receive it, is usually due to socio-economic reasons, with orthodontic treatment being a luxury. Jenny (1975) concluded that it is usually the rich and upper-middle class that can afford orthodontic treatment and Wheeler et al. (1994) found that even though there was a similar need in all of the socio-economic groups, more people in the higher socio-economic groups had received treatment. It is conceivable that socio-economic status itself is not

significant, but a correlated or associated factor of socio-economic status is significant. Gosney (1985) demonstrated that the further a patient had to travel to attain treatment, the less likely they were to initiate it. He also demonstrated that the further the patient had to travel, the more likely it was for the father to accompany the child. Furthermore, he demonstrated that people in the manually skilled labor groupings tended to lose more earnings due to time away from work. Petersen and Pedersen (1984) found that number of years of schooling had a positive effect on dental health. All of these studies identify factors associated with socio-economic status as being important. Some of the consequences of a lower socio-economic status include residing in an appropriate neighborhood and attending schools in the vicinity. It also usually means the parents are manually skilled workers and the level of education attained is not very high. In other words, there are many features of being poor and it sets up a cycle that is difficult to break. Perhaps the only real way out of it is through education. Lewit et al. (1968) stated that economic means, though important, are not singularly motivating because many clearly maloccluded cases offered free treatment nevertheless refuse it. Rather than actual gross annual income, the individual factors need to be examined. Education would probably be one of the factors that showed up as significant because clinical impression has led me to believe that the parents from lower socio-economic classes will do whatever they can to benefit their children. This is not to say that socio-economic status is not a factor, but perhaps we need to look at it from the other side. We need to evaluate the effect of cost of orthodontic services. It will be interesting to examine the impact of more

inventive marketing and the appearance of lower fees on the uptake of orthodontic services, and repeat this study in an area where these services are readily available.

Furthermore, it should be examined why socio-economic status was significant between the treated and untreated groups, but not significant among the untreated groups. Not only can higher income groups more easily afford orthodontic treatment, but factors described by Jenny (1975) such as social striving and avoidance of disfiguring dental conditions associated with more prestigious social positions and occupations, should be considered. The higher the aspirations for a child, the more likely the parent is to seek orthodontic treatment for them. Whether this is related only to income, or one of mental attitudes characteristic of income groups, has to be investigated. However, the chances afforded to children in lower socio-economic classes are probably different from those of children in higher socio-economic classes. As a result, the various groups probably also have different aspirations.

Race proved to be significant, but statistically unreliable, among the four DAI categories. The data does produce certain trends that can be supported, or disproved, in the follow-up study. There was a decrease in the percentage of Caucasians, and an increase in the percentage of African-Americans, as the need for treatment increased. Wheeler et al. (1994) reported similar findings, even though their study was conducted on a younger sample. When examining the treated group, it was found that there were more Caucasians that were treated, and less African-Americans. It would logically follow that in the untreated groups, the opposite would hold true unless African-Americans had a disproportionately smaller need for treatment. That is, the

prevalence of malocclusion in African-Americans would have to be significantly less than for Caucasians, or vice-versa, for there to be no difference in the untreated group.

The subjects who had not visited a dentist in the past year were more likely to be in need of treatment. This finding was expected since the literature illustrates that it is usually the more affluent and educated subjects that visit the dentist on a regular basis. Petersen and Pedersen (1984) showed that dental health was related to the number of visits, and age of the subject. Craft and Croucher (1980) found that females were more likely to visit a dentist regularly, whether they were from the manual or non-manual groups. They also found that there was a class gradient, in that the higher social groups were more likely to take up professional services. Syrjala et al. (1992) found that the expense of dental care was a reason restricting regular dental check-ups. They also found that the more educated subjects found expense less restrictive than those with less education. Grytten (1992) collected data in 1977, 1983 and 1989 from three independent samples and found that inequalities in use of dental services had decreased over time. Two reasons were cited for this, the first being an increase in the number of dentists from 1977 to 1989, and secondly, the author found that there had been a general increase in people's wealth. Downer et al. (1979) examined 796 schoolchildren from age 11 years to 14 years and found that when divided into groups based on residential districts, only the group that consisted of children from the inner city areas had lower regular dental attenders. The results of the present study have reinforced the need for dental education in the school systems.

Both boys and girls would benefit from some form of dental screening and referral for services, and could probably be done in combination with a local dental school to minimize costs and maximize benefits to both the school children and the dental students.

The subjects who were told they needed braces were more likely to be in need of treatment. This demonstrates that dental professionals are able to identify severe malocclusions and provide recommendations for treatment most of the time. The question was subjected to a great deal of recall bias, especially since these were the same subjects who were less likely to have visited a dentist in the past year. Whether the subjects were recording their personal desire to have orthodontic treatment, or an actual event in the dental office, is questionable.

The subjects demonstrating the greatest need for treatment by their DAI scores, were also the subjects that recalled being told that they needed braces, but did not receive orthodontic treatment. It can be argued that these subjects might have thought that there was nothing wrong with their appearance, and thus had high self esteem. However, these subjects also rated themselves significantly lower on the VAS, demonstrating that they were not as pleased with their appearance as the subjects in the groups that did not need treatment. Le (1998), in his master's thesis, showed that the VAS score, as utilized in this study, was not reliable. However, he tested reliability on the treated group, which was more prone to recall bias in that they were asked to score themselves on the VAS as to how they felt about their teeth before they had braces. The VAS score, as utilized in the present study,

should be a more accurate and reliable measure of how the subject perceives themselves, since it is a measurement of a current event, and not subject to recall bias. Even though the VAS score was significant in the DAI category 2 and 3 (the groups which needed treatment) when compared to DAI category 0, there was no significant correlation between the VAS score and the DAI score. This may suggest that the VAS score is measuring something other than how the subjects felt about their teeth, or it may be demonstrating what several authors have found, the degree of malocclusion is not necessarily related to the individual's self perception. Birkeland et al. (1996) concluded that the dental esthetic ratings of orthodontists were less favorable than those of the children. Children often rated themselves at the attractive end of the scale. Holmes (1992b) found that although only 21.8% of the males (32.3% of females) had responded that they disliked the appearance of their teeth, 44% (51.7% females) thought that they 'probably' or 'definitely' required orthodontic treatment. That is, the perceived need for treatment was much higher than the proportion of children in each grade who disliked the appearance of their teeth. Holmes concluded that there was a discrepancy between those who thought something was wrong with their teeth, and those who thought that they needed treatment.

The subjects in the groups identified as being in need of treatment also claimed that they had been told that they needed braces and rated themselves lower on the VAS than the groups not in need of treatment. However, socio-economic status did not prove to be significant between the groups of the untreated subjects, so

studies such as Lewit and Virolainen's (1968) which proposed that parental concern is the most powerful single factor in the motivation for treatment, become more applicable.

Even though some studies have shown that adults are more critical of dental malocclusions, Klima et al.(1979) found that there was a significant difference between prospective orthodontic patients' self-concept importance and their mothers' perception of self-concept importance. In fact, the teenagers placed more emphasis on their self-concept than did their mothers. Lewit and Virolainen (1968) may have discovered the correct model by which to understand why some adolescents opt for treatment, and why others do not. Their study demonstrated that there are a variety of factors acting on the individual, and it is the final equilibrium of these social forces that determines the treatment option. Some of these social forces which press the individual to make a decision are parental, peer or inter-personal in nature. The individual's dependency needs will then be the second factor that determines the outcome. In a middle-class individual with high dependency needs, parental pressures would tend to determine the motivation, blocking the peer and inter-personal forces. If dependency needs were low, then perceived peer standards become effective in those with strong needs for peer approval, and general orthodontic standards can become effective for relatively self-reliant adolescents.

A model such as this should provide invaluable information, while accounting for the results in the present study. There is probably an association or dependence of one factor with another throughout the study, making data analysis more complex.

The follow-up study will have 3-4 times the volume of data, and the increase in sample size should aid in the discovery of relationships and trends.

SUMMARY AND CONCLUSIONS

The unmet treatment need was assessed in a sample of tenth grade students from eleven public high schools in Cuyahoga County, Ohio. A total of 1360 students were surveyed. Sixty-eight percent of the sample was untreated, and of these nine hundred and twenty two students, sixty-nine percent (633) had impressions taken. Assessment of treatment need by a DAI score allowed categorization of the subjects into four groups ranging from no treatment need to treatment mandatory or handicapping.

Utilization of demographic and psychosocial variables allowed evaluation of the various groups, with the aid of descriptive statistics. The results of the present study showed the following:

1. There was a difference between the treated and untreated groups for the variables race, socio-economic status and whether the subject had visited a dentist in the past year. There was no difference between the groups for gender nor whether the student had been told that they needed braces.

2. In the untreated group, the group that had impressions was similar to the group that did not have impressions, except that the group which had impressions was more likely to have visited a dentist in the past year.

3. Using the DAI score as an indication of treatment need, 28.9% of the untreated sample was in need of treatment.

4. Using the DAI score as an indication of treatment need, there were equal numbers of boys and girls that needed treatment.

5. Using the DAI score as an indication of treatment need, the groups that needed treatment were significantly different from the groups that did not require treatment. The groups that required treatment were more likely to have not visited a dentist in the past year, to have been advised by a dental professionals that they needed braces, and be African-American. The socio-economic status for all of the untreated patients was statistically similar.

6. Using the DAI score as an indication of treatment need, the group that required treatment had a lower VAS score, indicating that their self-perception was lower.

7. A weak negative correlation exists between the DAI scores and the VAS score, but it was not significant.

Several conclusions can be drawn from this study. The unmet treatment need in Cuyahoga County was 29%. The general dentist plays an essential role in raising the dental IQ of the patient, and also in advising them that they need treatment. It is apparent that boys and girls have similar desire to have straight teeth, as there was no difference between the groups. Socio-economic status appears to be a significant factor in determining who receives treatment, but is not significantly different among the untreated students. As such, there probably is a striving factor involved, in that the more affluent receive treatment, whether they were in need of treatment (treatment highly recommended or mandatory) or not. Among the untreated students, socio-economic status alone was not the deterrent from treatment. There is no doubt that self-perception varies with individuals, as evidenced from a weak correlation between the DAI scores and the VAS scores. However, this study also demonstrates that the students in need of treatment have significantly lower self-perception than

their peers, who are not in need of treatment. A lower self-perception translates to more barriers to success in the future, indicating that the unmet treatment need must be addressed. Race was significantly different between both the treated and untreated groups, and among the untreated groups. There are probably numerous reasons for this, but access to health care and education is probably the largest contributor.

The present study has produced data that has answered some of the research questions and is supported in the current literature. Data analysis has eliminated gender bias in terms of need for treatment by age fifteen. It has also demonstrated that the unmet treatment need approximates that of other studies, but reinforces that children in need of treatment have lower self-perceptions. Perhaps the greatest contribution from analysis of the data is that further study is needed to isolate the dependent variables so that funding in the schools can be spent where it is most needed.

APPENDIX 1.-- High Schools Visited

TABLE 10.-- Schedule of School Visits

SCHOOL	DATE
Beachwood High	09-09-97
Lakewood High	09-26-97
Richmond Heights High	10-03-97
Health Careers Center	10-17-97
Solon High	10-31-97
Shaw High	11-05-97
John Hay High	11-07-97
Fairview Park High	11-12-97
Cleveland Heights/University Heights	11-14-97
Brooklyn High	12-05-97
Cuyahoga Heights High	12-12-97

APPENDIX 2.-- Cover Letter to Parents

An Important Message for High School Parents...We need your help!

Your children are the future of your community and this nation.

Your children's dental health provides a strong base in building a healthy body and mind.

Case Western Reserve University School of Dentistry wants to help you and your high school student towards this goal.

This academic year your school system is participating with the Case Western Reserve University School of Dentistry in a county-wide study of high school student's oral health and dental health services.

You can be a part of this study by helping your student fill in the attached questionnaire and Parental Permission Form. Then have your student return both to his/her school for the classroom portion of the study.

In their classroom, students will work with dentists and dental students from the University. They will make oral impressions of their teeth that will be examined back at the University.

A question/answer session will follow the oral impression-making exercise. During this time your student can ask dental health questions that relate to their own health. Those parents wishing to have their students ask questions on their behalf may send them with their student to class.

We can all learn from this experience...

Parents and students can gain insight into their own as well as their student's dental health. We will let you know the results of this study through the school.

The University School of Dentistry gains valuable information on dental health needs and services and can use this information to improve the preparation of future dentists.

The Dental students and participating dentists gain by becoming more aware and supportive of your community.

Please join us by signing the attached Parent Permission Slip and sending it back to school along with the completed Questionnaire <u>now!</u>

Thank you for your participation!
If you have questions please call..

Dr. Mark Hans
Principal Investigator
Phone: 368-4649

Lowell Bernard
Project Coordinator
Phone: 247-8370

APPENDIX 3.-- Parental Permission Slip

Parental Consent

Case Western Reserve University School of Dentistry
Dental Health Study

Human Investigation Consent Form

My child has been asked to participate in a research study on his/her Dental Health.

This study is being conducted by: Mark G. Hans, D.D.S., M.S.D., Suchitra Nelson, Ph.D., and Lowell Bernard, M.S.P.H. from Case Western Reserve University.

I understand that the purpose of this study is to determine the dental health of teenagers in Cuyahoga County Schools and the dental care they are receiving.

I further understand that:

1. My child and/or I will be asked to complete a survey about his/her dental health and dental health care.

2. My child will have trained dentists or dental students looking into his/her mouth to confirm their dental health condition. No needles or sharp instruments will be used and there is no pain involved in the examination.

3. The information from this study is confidential and will be contained in a database for future study. Parents may be informed as to their specific school results with no names revealed. A copy of the final report will be made through your school's principal.

4. Dr. Mark Hans, Dr. Suchi Nelson and Lowell Bernard are conducting this study and will be available to answer any questions about the study. They can be reached at 368-4649.

5. I have a right to refuse to participate in this study, in which case my refusal will not affect:

    A. Any care given at Case Western Reserve University.
    B. My child's grade in any course at their high school.

I have read and understood the above information and hereby give my consent for my child to participate in this study.

Parent, Legal Guardian Name _____ Date _____

Relationship to Child in study _____

APPENDIX 4.-- Survey Form

Name: _____. Male ____ Female _____ Date of Birth _____

Phone Number: _____ Age _____

Father's Occupation _____ Mother's Occupation _____

Last year of education completed by your father:

_____ 6th Grade
_____ Junior High
_____ at least one year of High School
_____ High School Diploma
_____ at least one year of College
_____ College Diploma
_____ (DDS. MD. JD. PhD. MBA)
_____ Other _____

Last year of education completed by your mother:

_____ 6th Grade
_____ Junior High
_____ at least one year of High School
_____ High School Diploma
_____ at least one year of College
_____ College Diploma
_____ (DDS. MD. JD. PhD. MBA)
_____ Other _____

Yes _____ No _____ 1. Have you visited a dentist in the last year?
If YES. why did you go to the dentist? _____

2. Where do you go for your dental care? _____

Yes _____ No _____ 3. Do you have a family dentist?
If YES. what is the name of your family dentist? _____

4. Place a mark on the line below that indicates how you feel about your teeth/smile now.

_____

I feel awful I feel great

Yes _____ No _____ 5. Have you ever worn braces before? If your answer to this question was NO do not answer the questions below. If your answer was YES then please answer the following questions.

6. Where did you go for your braces? _____

7. What was the name of the dentist who put the braces on your teeth? _____

Yes _____ No _____ 8. Was the dentist who put the braces on your teeth the same Dentist that cleaned your teeth and did your fillings?

9. When did you get your braces on? Month _____ Year _____

10. When did you get your braces off? Month _____ Year _____ Still On _____

Yes _____ No _____ 11. Are you wearing a retainer now? If No, when did you stop wearing your retainer? Month _____ Year _____

Place a mark in the line below that indicates how you felt about your teeth before braces.

_____

I felt awful I felt great

Impression ID Number _____

APPENDIX 5.-- DAI Protocol

DAI: The Dental Aesthetic Index Protocol

DENTAL ORTHODONTIC MEASUREMENTS NEEDED FOR THE DAI

1. Missing Visible Teeth: Incisors, Canines and Premolars

Count the number of missing permanent incisors, canine and premolar teeth on the upper and lower arches. This is done by counting the teeth present starting at the right second premolar and moving forward to the left second premolar. There should be 10 teeth present. If there are less than 10 the difference is the number missing. Record that number on line 1 of the recording form. A history of all missing anterior teeth should be obtained to determine whether extractions were performed to improve aesthetics.

If spaces are closed, do not count the teeth as missing. If a primary tooth is still in position and its successor has not yet erupted, do not count the teeth as missing. If a missing incisor, canine or premolar tooth is replaced by a fixed prosthesis do not count that tooth as missing.

When scoring a case in the mixed dentition the space from a recently exfoliated primary tooth should not be scored as missing if it appears that the permanent replacement will soon erupt.

2. Crowding in the Incisal Segments of the Arch

Examine both upper and lower incisal segments for crowding. Crowding in the incisal segment is the condition in which the available space between the right and left canine teeth is insufficient to accomodate

all four incisors in normal alignment. Teeth may be rotated or displaced out of alignment in the arch. The number of incisal segments (each incisal segment consists of four incisors in either the upper or lower arch) with crowding is recorded as 0, 1, or 2. 0 = no segments crowded; 1 = 1 segment crowded; 2 = 2 segments crowded. When in doubt assign the lower score.

Do not mark the incisal segment crowded if four incisors are in proper alignment but either or both canines are displaced.

3. Spacing in the Incisal Segment of the Arch

Examine both upper and lower incisal segments for spacing. When measured in the incisal segment spacing is the condition in which the amount of space available between the right and left canine teeth exceeds that required to accomodate all four incisors in normal alignment. If one or more incisor teeth have proximal surfaces without any interdental contact the segment is recorded as having space. The number of incisal segments in both arches with spacing is recorded as either 0, 1 or 2. 0 = no segments spaced; 1 = 1 segment spaced; 2 = 2 segments spaced. When in doubt assign the lower score.

4. Diastema

A midline diastema is defined as the space, in millimeters, between the two permanent maxillary incisors. This measurement can be made at any level between the mesial surfaces of the central incisors and should be recorded to the nearest whole millimeter.

5. Largest Anterior Irregularity on the Upper (Maxillary) Arch

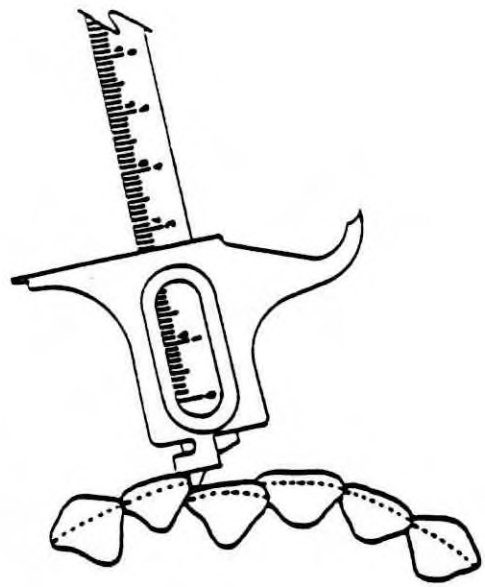
Irregularities may be either rotations out of, or displacements from, normal alignment (see Figure 3).



ROTATION DISPLACEMENT

Anterior Irregularities and Crowding

Visually scan the four incisors to locate the greatest irregularity between adjacent teeth. Measure the site of the greatest irregularity between adjacent teeth using the handle end of the Boley gauge or a tongue blade and sharp pencil (Figure 4). The edge of the tongue blade is placed into contact with the labial surface of the most lingually displaced or rotated incisor while it is held parallel to the occlusal plane and at right angles to the normal arch line. A sharp pencil is then placed on the labial surface of the adjoining tooth and slid along that labial surface to mark the amount of the displacement on the tongue blade. The irregularity in millimeters can then be read from the pencil mark on the tongue blade with a Boley gauge or a millimeter ruler. Record to the nearest whole millimeter. Irregularities may occur with or without crowding. If there is sufficient space for all four incisors in normal alignment but some are rotated or displaced do not mark that segment as crowded but record the largest irregularity. Irregularities at the distal of the lateral incisors should also be considered, if present.



MEASURNG IRREGULARITIES WITH A BOLEY GAUGE

6. Largest Anterior Irregularity on the Lower (Mandibular) Arch

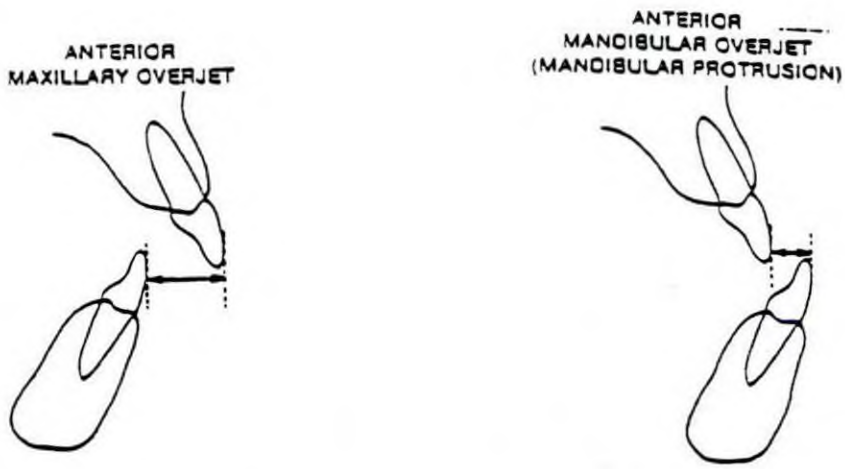
Measurement is the same as on the upper arch except that it is made on the lower (mandibular) arch. The greatest irregularity between adjacent teeth on the lower arch is located and measured as described above for the upper arch.

7. Anterior Maxillary Overjet

Measurement of the horizontal relation of the incisors is made with the teeth in centric occlusion. Record only the largest maxillary overjet with a Boley gauge or metric ruler to the nearest whole millimeter from the labio-incisal edge of the most prominent upper incisor to the labial surface of the corresponding lower incisor holding the instrument parallel to the occlusal plane. This trait is not recorded if all upper incisors are missing or in lingual crossbite (See Figure 5). This measurement also can be made by marking the amount of overjet on a tongue blade with a pencil and then measuring with a millimeter ruler or Boley gauge.

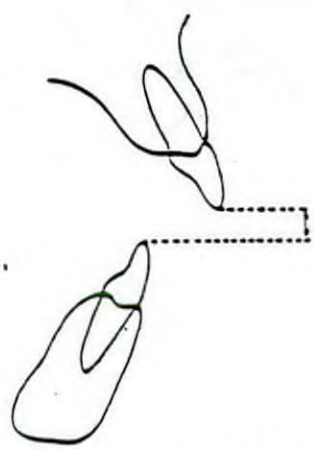
8. Anterior Mandibular Overjet (Mandibular Protrusion)

Record this trait when any lower incisor protrudes anteriorly, or labially, to the opposing upper incisor, i.e., it is in crossbite. Record the largest mandibular overjet (mandibular protrusion) or crossbite of any of the incisors in the lower arch to the nearest whole millimeter. Measure in the same manner as described for anterior maxillary overjet (See Figure 6). A tongue blade and pencil may also be used. Do not mark the tooth as a mandibular overjet if a lower incisor is rotated so that one part of the incisal edge is in cross bite (is labial to the upper incisor) but another part of the incisal edge is not in cross bite.



9. <u>Vertical Anterior Openbite</u>

If there is a lack of vertical overlap between any of the opposing pairs of incisors (openbite) the amount of openbite is measured directly with a Boley gauge or metric ruler. Record the <u>largest</u> openbite to the nearest whole millimeter (see Figure 7). A tongue blade may be used for this measurement.



Vertical Anterior Openbite

10. Antero-Posterior Molar Relation

This assessment most often is based on the relation of the permanent upper and lower first molars. If the assessment cannot be based on the first molars because one or both are absent, not fully erupted, or misshaped because of extensive decay or fillings, the relations of the permanent canines and premolars are assessed.

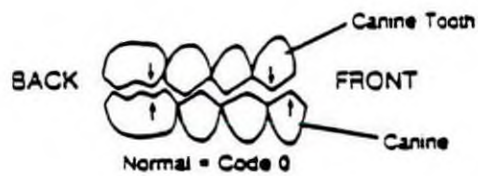
The right and left sides are assessed with the teeth in occlusion and only the largest deviation from normal molar relation is recorded. M or Mesial means the lower first molar is to the mesial (or anterior) to its normal (N) relation. D or Distal means the lower first molar is distal (or posterior) to its normal relation. Do not record D or M on the form; record only 0, 1 or 2. The schematic drawings in Figures 8 and 9 are used as a scoring guide. Note the position of the arrows on the first molars and the canines in these drawings to determine the scoring. Score as follows:

0 = Normal molar relation

1 = Lower first molar on either side is 1/2 cusp either mesial or distal to the upper first molar

2 = Lower first molar on either side is one full cusp or more either mesial or distal to the upper first molar. When in doubt assign the lower score.

VIEW OF THE TEETH FROM THE RIGHT SIDE



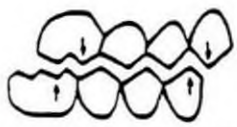
Normal = Code 0



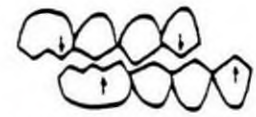
Lower molar is ½ cusp to the distal = Code D1



Lower molar is ½ cusp to the mesial = Code M1



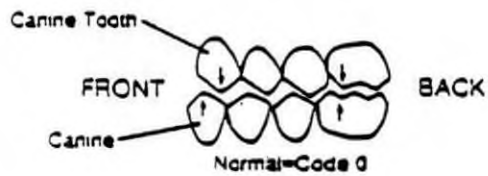
Lower molar is one cusp or more to the distal = Code D2

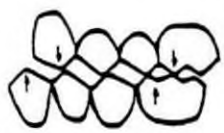


Lower molar is one cusp or more to the mesial = Code M2

Antero-Posterior Molar Relation

VIEW OF TEETH FROM THE LEFT SIDE





Lower molar is ½ cusp to the mesial=Code M1



Lower molar is ½ cusp to the distal=Code D1



Lower molar is one cusp or more to the mesial=Code M2



Lower molar is one cusp or more to the distal=Code D2

Antero-Posterior Molar Relation

APPENDIX 6.-- DAI Score Sheet

DENTAL AESTHETIC INDEX (DAI)
RECORDING FORM

ID # _____ Date _____

Name _____ Male ___ Female ___ Date of Birth _____

Geographic Location _____ Ethnic Group _____ Examiner _____

		A No. or Score	B Wt.	C
0	CONSTANT			13
1	Missing incisor, canine and premolar teeth-- Maxillary and Mandibular Enter total #		6	
2	Crowding in the incisal segments 0=no segment crowded 1= segment crowded 2=2 segments crowded		1	
3	Spacing in the incisal segments 0=no spacing 1=1 segment spaced 2=2 segments spaced		1	
4	Diastema in mm		3	
5	Largest anterior irregularity--Maxilla (upper) in mm		1	
6	Largest anterior irregularity--Mandible (lower) in mm		1	
7	Anterior Maxillary Overjet (upper) in mm		2	
8	Anterior Mandibular Overjet (lower) in mm		4	
9	Vertical anterior openbite in mm		4	
10	Antero-posterior molar relation Normal=0 ½ cusp=1 Full Cusp=2		3	
11	TOTAL (add lines 0 through 10)			

DIRECTIONS FOR CALCULATING A DAI SCORE

For lines 1-10, multiply Column A by Column B and enter the result in Column C.
Then: add Column C including Line 0 to obtain DAI score.

COMMENTS _____

APPENDIX 7.-- DAI, DEMOGRAPHIC AND PSYCHOSOCIAL DATA

TABLE 11.-- DAI, Demographic and Psychosocial Data

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10001	1	0	1	0	444	444	68	13	37
10002	1	1	1	0	444	444	89	13	37
10003	1	1	1	1	444	444	50	13	65
10004	1	0	1	0	444	444	98	13	29
10005	1	0	0	0	444	444	100	13	61
10006	1	1	0	0	444	444	42	13	44
10007	1	1	0	1	444	444	18	13	999
10008	1	1	1	1	444	444	80	13	40
10009	1	1	0	0	444	444	80	13	888
10010	1	1	1	0	444	444	100	13	57
10011	1	1	1	0	444	444	65	13	58
10012	1	1	0	0	444	444	50	13	37
10013	1	1	1	0	444	444	50	13	25
10014	1	1	1	0	444	444	80	13	29
10015	1	1	0	0	444	444	50	13	50
10016	1	0	0	0	444	444	38	13	43
10017	1	1	1	1	444	444	65	13	73
10018	1	1	1	1	444	444	33	13	65
10019	1	1	1	0	444	444	0	13	51
10020	1	1	1	1	444	444	33	13	42
10021	1	1	0	0	444	444	80	13	22
10022	1	1	1	0	444	444	50	13	999
10023	1	1	0	0	444	444	69	13	40
10024	1	1	0	0	444	444	65	13	50
10025	1	0	1	0	444	444	56	13	59
10026	1	0	1	0	444	444	83	13	43
10027	1	1	1	0	444	444	42	13	58
10028	1	0	1	0	444	444	50	13	37
10029	1	0	0	0	444	444	80	13	37
10030	1	0	0	0	444	444	68	13	46
10031	1	0	0	0	444	444	74	13	43
10032	1	1	0	1	444	444	42	13	58
10033	1	1	1	0	444	444	50	13	22
10034	1	1	0	0	444	444	74	13	999
10035	1	1	0	0	444	444	80	13	999
10036	1	0	0	0	444	444	79	13	44

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10037	1	0	1	0	444	444	88	13	11
10038	1	1	1	0	444	444	80	13	65
10039	1	1	0	0	444	444	86	13	44
10040	1	1	1	1	444	444	100	13	30
10041	1	1	1	0	444	444	66	13	29
10042	1	1	0	1	444	444	63	13	51
10043	1	1	0	0	444	444	80	13	65
10044	1	1	0	0	444	444	80	13	15
10045	1	0	1	0	444	444	97	13	999
10046	1	0	1	0	444	444	71	13	22
10047	1	0	1	0	444	444	8	13	51
10048	1	1	1	0	444	444	80	13	43
10049	1	1	1	0	444	444	38	13	29
10050	1	1	1	0	444	444	80	13	25
10051	1	1	1	1	444	444	50	13	18
10052	1	1	0	0	444	444	999	13	18
10053	1	1	0	0	444	444	80	13	36
10054	1	1	1	0	444	444	40	13	65
10055	1	1	0	0	444	444	78	13	36
10056	1	1	1	0	444	444	999	13	999
10057	1	1	0	0	444	444	46	13	65
10058	1	1	0	0	444	444	50	13	29
10059	1	0	0	0	444	444	100	13	51
10060	1	1	0	0	444	444	100	13	58
10061	1	1	0	0	444	444	72	13	15
10062	1	1	1	1	444	444	50	13	44
10063	1	1	0	0	444	444	56	13	29
10064	1	1	1	0	444	444	92	13	51
10065	1	1	0	0	444	444	29	13	999
10066	1	1	0	0	444	444	36	13	58
10067	1	1	0	0	444	444	50	13	26
10068	1	1	1	0	444	444	80	13	999
10069	1	0	0	0	444	444	76	13	37
10070	1	1	0	0	444	444	58	13	51
10071	1	0	0	0	444	444	80	13	40
10072	1	0	0	0	444	444	100	13	59
10073	1	1	0	0	444	444	999	13	999
10074	1	1	1	1	444	444	50	13	999
10075	1	1	0	0	444	444	65	13	44
10076	1	1	1	0	444	444	65	13	65
10077	1	1	0	0	444	444	57	13	51
10078	1	1	1	0	444	444	100	13	999
10079	1	1	1	0	444	444	68	13	58

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10080	1	1	1	0	444	444	80	13	37
10081	1	1	1	0	444	444	65	13	43
10082	1	1	1	0	444	444	50	13	65
10083	1	1	1	0	444	444	58	13	11
10084	1	1	1	0	444	444	75	13	43
10085	1	1	0	1	444	444	66	13	37
10086	1	1	0	0	444	444	55	13	51
10087	1	0	0	0	444	444	89	13	29
10088	1	0	1	0	444	444	50	13	37
10089	1	1	1	0	444	444	50	13	999
10090	1	1	0	0	444	444	65	13	57
10091	1	1	1	1	444	444	50	13	999
10092	1	1	1	0	444	444	48	13	11
10093	1	1	0	1	444	444	65	13	61
10094	1	1	1	0	444	444	80	13	58
10095	1	0	1	0	444	444	58	13	22
10096	1	1	1	1	444	444	50	13	47
10097	1	1	0	0	444	444	52	13	53
10098	1	1	0	0	444	444	49	13	59
10099	1	1	1	0	444	444	50	13	47
10100	1	1	0	0	444	444	80	13	61
10101	1	1	0	1	444	444	36	13	36
10102	1	0	1	0	444	444	85	13	43
10103	1	1	1	0	444	444	86	13	40
10104	1	1	1	0	444	444	63	13	43
10105	1	1	1	1	444	444	71	13	51
10106	1	1	1	0	444	444	65	13	77
10107	1	1	0	0	444	444	65	13	43
10108	1	1	0	1	444	444	59	13	33
10109	1	0	0	0	444	444	64	13	65
10110	1	1	0	0	444	444	91	13	29
10111	1	1	0	0	444	444	62	13	22
10112	1	1	0	999	444	444	999	13	999
10113	1	1	0	0	444	444	100	13	58
10114	1	1	1	0	444	444	50	13	29
10115	1	1	0	0	444	444	50	13	22
10116	1	0	0	0	444	444	54	13	65
10117	1	1	1	1	444	444	100	13	999
10118	1	1	0	0	444	444	80	13	65
10119	1	1	1	0	444	444	18	13	57
10120	1	1	1	0	444	444	73	13	57
10121	1	1	1	0	444	444	58	13	15
10122	1	1	1	0	444	444	73	13	57

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10123	1	1	1	0	444	444	100	13	888
10124	1	1	1	0	444	444	73	13	65
10125	1	0	1	0	444	444	65	13	18
10126	1	1	0	0	444	444	60	13	888
10127	1	0	0	0	444	444	50	13	58
10128	1	0	0	0	444	444	50	13	999
10129	1	1	1	0	444	444	100	13	65
10130	1	1	0	0	444	444	65	13	999
10131	1	1	0	0	444	444	65	13	11
10132	1	1	1	1	444	444	53	13	58
10133	1	0	1	0	444	444	73	13	51
10134	1	0	1	0	444	444	73	13	999
10135	1	1	0	0	444	444	65	13	29
10136	1	1	1	0	444	444	50	13	30
10137	1	1	0	0	444	444	49	13	33
10138	1	1	0	1	444	444	58	13	54
10139	1	1	0	0	444	444	65	13	26
10140	1	0	0	0	444	444	97	13	61
10141	1	1	1	0	444	444	999	13	51
10142	1	1	0	0	444	444	72	13	51
10143	1	1	1	0	444	444	50	13	61
10144	1	1	0	0	444	444	999	13	999
10145	1	0	1	0	444	444	60	13	65
10146	1	0	1	0	444	444	97	13	999
10147	1	1	1	0	444	444	80	13	61
10148	1	1	1	1	444	444	58	13	22
10149	1	1	0	0	444	444	61	13	36
10150	1	1	1	1	444	444	100	13	999
10151	1	0	0	0	444	444	80	13	47
10152	1	1	0	1	444	444	58	13	50
10153	1	1	0	1	444	444	31	13	65
10154	1	0	0	0	444	444	73	13	37
10155	1	0	0	0	444	444	0	13	44
10156	1	1	0	0	444	444	68	13	51
10157	1	0	1	0	444	444	80	13	58
10158	1	1	0	1	444	444	50	13	999
10159	1	1	1	0	444	444	55	13	8
10160	1	0	0	0	444	444	68	13	999
10161	1	1	0	0	444	444	77	13	51
10162	1	0	0	0	444	444	65	13	444
10163	1	1	1	0	444	444	71	13	37
10164	1	1	0	1	444	444	50	13	65
10165	1	0	0	0	444	444	83	13	37

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10166	1	0	1	0	444	444	80	13	29
10167	1	1	0	1	444	444	65	13	51
10168	1	0	1	0	444	444	59	13	999
10169	1	1	1	0	444	444	50	13	57
10170	1	0	1	0	444	444	100	13	36
10171	1	1	1	0	444	444	58	13	999
10172	1	1	0	0	444	444	91	13	999
10173	1	0	0	0	444	444	50	13	22
10174	1	1	1	0	444	444	80	13	58
10175	1	0	0	0	444	444	65	13	29
10176	1	1	1	1	444	444	80	13	54
10177	1	0	0	0	444	444	37	13	37
10178	1	1	0	0	444	444	50	13	999
10179	1	1	1	0	444	444	50	13	37
10180	1	0	0	0	444	444	87	13	11
10181	1	0	0	0	444	444	79	13	65
10182	1	1	0	0	444	444	50	13	65
10183	1	0	1	0	444	444	65	13	36
10184	1	1	0	0	444	444	50	13	888
10185	1	1	1	0	444	444	100	13	57
10186	1	1	1	0	444	444	73	13	51
10187	1	1	1	0	444	444	95	13	22
10188	1	0	1	1	444	444	65	13	65
10189	1	0	1	0	444	444	73	13	44
10190	1	1	0	1	444	444	70	13	999
10191	1	0	1	0	444	444	100	13	36
10192	1	0	1	0	444	444	73	13	29
10193	1	1	1	0	444	444	42	13	999
10194	1	1	1	0	444	444	50	13	50
10195	1	1	0	1	444	444	80	13	44
10196	1	1	1	0	444	444	60	13	58
10197	1	1	1	0	444	444	27	13	36
10198	1	1	0	0	444	444	57	13	37
10199	1	1	0	0	444	444	50	13	29
10200	1	1	1	0	444	444	100	13	51
10201	1	0	1	0	444	444	56	13	51
10202	1	0	1	0	444	444	80	13	58
10203	1	1	1	1	444	444	71	13	999
10204	1	1	0	0	444	444	80	13	57
10205	1	0	1	0	444	444	89	13	51
10206	1	1	0	0	444	444	80	13	51
10207	1	1	0	0	444	444	65	13	43
10208	1	1	1	0	444	444	80	13	37

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
10209	1	0	1	0	444	444	71	13	37
10210	1	1	1	0	444	444	58	13	57
10211	1	1	0	1	444	444	33	13	999
10212	1	1	0	0	444	444	58	13	44
10213	1	0	1	0	444	444	80	13	999
10214	1	1	1	0	444	444	86	13	57
10215	1	0	0	0	444	444	64	13	29
10216	1	1	1	0	444	444	50	13	36
10217	1	1	1	0	444	444	58	13	65
10218	1	1	0	0	444	444	100	13	57
10219	1	0	1	0	444	444	58	13	29
10220	1	1	0	0	444	444	100	13	29
10221	1	1	1	0	444	444	42	13	58
10222	1	1	1	0	444	444	71	13	43
10223	1	1	1	1	444	444	73	13	47
10224	1	1	0	0	444	444	33	13	61
10225	1	1	1	1	444	444	65	13	444
10226	1	1	0	0	444	444	50	13	36
10227	1	1	1	0	444	444	48	13	999
10228	1	1	1	0	444	444	72	13	58
10229	1	1	1	0	444	444	100	13	51
10230	1	1	0	0	444	444	33	13	37
10231	1	1	1	0	444	444	95	13	888
10232	1	1	1	1	444	444	73	13	33
10233	1	0	1	0	444	444	77	13	33
10234	1	0	1	0	444	444	73	13	999
12001	1	0	1	0	444	444	81	13	43
12002	1	1	0	1	444	444	81	13	999
12003	1	1	0	0	444	444	81	13	22
12004	1	1	0	0	444	444	100	13	29
12005	1	1	0	0	444	444	100	13	4
12006	1	1	0	1	444	444	31	13	999
12007	1	1	0	0	444	444	87	13	36
12008	1	0	0	0	444	444	57	13	36
12009	1	0	0	0	444	444	53	13	15
12010	1	1	0	0	444	444	100	13	11
12011	1	0	0	0	444	444	75	13	15
12012	1	1	0	0	444	444	74	13	36
12013	1	1	0	0	444	444	90	13	888
12014	1	0	0	0	444	444	73	13	29
12015	1	0	0	0	444	444	45	13	29
12016	1	1	0	1	444	444	68	13	11
12017	1	0	0	0	444	444	94	13	37

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
12018	1	0	0	0	444	444	78	13	36
12019	1	0	0	0	444	444	98	13	11
12020	1	0	0	0	444	444	100	13	36
12021	1	1	0	0	444	444	78	13	11
12022	1	0	0	0	444	444	100	13	11
12023	1	0	0	0	444	444	75	13	11
12024	1	1	0	1	444	444	99	13	888
12025	1	0	0	0	444	444	96	13	25
12026	1	1	1	0	444	444	96	13	18
12027	1	1	1	0	444	444	80	13	11
12028	1	0	0	0	444	444	27	13	22
12029	1	1	0	0	444	444	99	13	46
12030	1	0	0	0	444	444	50	13	33
12031	1	1	1	0	444	444	89	13	999
12032	1	0	0	0	444	444	46	13	36
12033	1	0	0	0	444	444	0	13	40
12034	1	0	1	0	888	444	100	13	11
12035	1	0	1	1	444	444	100	13	25
12036	1	0	0	0	444	444	81	13	15
12037	1	0	0	0	444	444	50	13	29
12038	1	0	0	0	444	444	81	13	11
12039	1	0	1	0	444	444	88	13	47
12040	1	0	1	0	444	444	50	13	36
12041	1	0	1	1	444	444	72	13	33
12042	1	0	1	0	444	444	50	13	29
12043	1	0	1	0	444	444	100	13	36
12044	1	0	1	0	444	444	999	13	25
12045	1	1	0	0	444	444	89	13	29
12046	1	0	1	0	444	444	72	13	29
12047	1	0	1	0	444	444	93	13	29
12048	1	0	0	0	444	444	50	13	33
12049	1	0	1	0	444	444	82	13	33
12050	1	0	1	0	444	444	61	13	33
12051	1	0	1	0	444	444	74	13	18
12052	1	1	0	0	444	444	57	13	11
12053	1	1	1	0	444	444	89	13	73
12054	1	0	0	0	444	444	100	13	29
12055	1	1	0	0	444	444	90	13	999
12056	1	1	0	0	444	444	72	13	999
12057	1	0	1	0	444	444	50	13	58
12058	1	1	0	0	444	444	51	13	15
12059	1	0	1	0	444	444	81	13	22
12060	1	0	1	1	444	444	89	13	25

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
12061	1	0	1	0	444	444	78	13	43
12062	1	1	0	0	444	444	96	13	888
12063	1	0	0	0	444	444	88	13	999
12064	1	0	0	0	444	444	72	13	15
12065	1	1	0	0	444	444	66	13	22
12066	1	0	0	0	444	444	59	13	54
12067	1	0	0	0	444	444	72	13	36
12068	1	0	0	0	444	444	81	13	25
12069	1	0	0	0	444	444	86	13	29
12070	1	0	0	0	444	444	100	13	46
12071	1	0	1	0	444	444	90	13	11
12072	1	0	1	0	444	444	73	13	29
12073	1	0	1	0	444	444	84	13	40
12074	1	0	1	0	444	444	79	13	53
12075	1	0	1	0	444	444	99	13	36
12076	1	0	1	0	444	444	61	13	53
12077	1	0	1	0	444	444	58	13	25
12078	1	0	1	0	444	444	50	13	11
12079	1	1	1	1	444	444	66	13	58
12080	1	0	1	0	444	444	68	13	11
12081	1	1	1	0	444	444	81	13	29
12082	1	0	1	0	444	444	81	13	15
12083	1	0	1	0	444	444	81	13	25
12084	1	0	1	0	444	444	100	13	11
12085	1	0	1	0	444	444	100	13	57
12086	1	1	1	0	444	444	88	13	44
12087	1	0	1	0	444	444	69	13	29
12088	1	0	1	0	444	444	50	13	58
12089	1	0	1	0	444	444	78	13	29
12090	1	0	1	0	444	444	84	13	29
12091	1	0	1	0	444	444	81	13	15
12092	1	0	1	0	444	444	100	13	25
12093	1	0	1	0	444	444	66	13	33
12094	1	0	1	0	444	444	88	13	61
12095	1	0	1	0	444	444	78	13	29
12096	1	0	1	0	444	444	88	13	29
12097	1	0	1	0	444	444	94	13	15
12098	1	0	1	0	444	444	96	13	18
12099	1	0	1	0	444	444	81	13	36
12100	1	0	0	0	444	444	70	13	32
12101	1	0	0	0	444	444	75	13	11
12102	1	0	1	0	444	444	89	13	11
12103	1	0	0	0	444	444	71	13	61

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
12104	1	0	1	0	444	444	100	13	33
12105	1	1	0	1	444	444	50	13	36
12106	1	0	0	0	444	444	72	13	32
12107	1	1	0	0	444	444	81	13	36
12108	1	1	1	0	444	444	100	13	43
12109	1	0	1	0	444	444	81	13	11
12110	1	0	1	0	444	444	81	13	26
12111	1	1	0	0	444	444	59	13	53
12112	1	1	0	0	444	444	89	13	32
12113	1	0	0	0	444	444	100	13	15
12114	1	1	1	0	444	444	81	13	29
12115	1	1	0	1	444	444	8	13	57
12116	1	0	0	0	444	444	99	13	999
12118	1	0	1	0	444	444	81	13	999
12119	1	0	1	0	444	444	76	13	18
12120	1	0	1	0	444	444	50	13	11
14002	0	1	0	0	1	444	88	27	65
14005	0	1	0	0	1	444	76	26	57
14006	0	1	0	0	1	444	31	31	65
14007	0	1	0	0	1	444	999	22	22
14012	0	1	1	0	0	444	89	13	65
14013	0	1	0	0	1	444	42	25	36
14016	0	1	1	0	1	444	59	38	43
14018	0	1	1	1	1	444	78	26	15
14019	0	1	0	0	1	444	74	13	29
14020	0	0	1	0	444	444	78	13	53
14021	0	1	1	1	1	444	46	13	33
14024	0	0	0	0	444	444	100	13	53
14025	0	1	0	0	1	444	75	21	39
14027	0	0	0	0	444	444	49	13	11
14028	0	0	0	0	444	444	49	13	57
14029	0	1	0	1	1	444	6	32	40
14031	0	0	0	0	444	444	63	13	999
14034	0	1	1	0	1	444	93	13	999
14035	0	1	0	0	1	444	79	25	50
14038	0	0	0	0	444	444	70	13	51
14039	2	0	1	0	444	444	48	13	51
14040	0	1	1	0	1	444	45	33	51
14042	0	1	0	0	1	444	55	35	37
14043	0	1	1	1	1	444	89	41	36
14044	0	1	0	1	1	444	92	22	50
14047	0	1	1	0	1	444	90	13	33
14048	0	1	0	0	0	444	43	32	61

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
14049	0	0	1	0	444	444	78	13	37
14050	0	1	1	0	1	444	60	33	32
14052	0	1	0	0	0	444	90	25	888
14053	0	1	1	1	0	444	94	44	37
14054	0	0	0	0	444	444	98	13	57
14055	0	1	0	0	0	444	30	51	40
14056	0	1	0	1	1	444	61	35	22
14057	0	1	0	0	1	444	65	29	999
14058	0	1	0	0	1	444	80	13	999
14059	2	0	0	0	444	444	78	13	999
14060	0	1	1	0	0	444	23	36	65
14062	0	1	0	1	999	444	68	25	36
14063	0	1	0	1	1	444	46	25	33
14064	0	0	1	0	444	444	95	13	51
14066	0	1	0	0	1	444	68	27	11
14068	0	1	1	0	1	444	79	13	44
14069	0	1	0	0	1	444	74	19	37
14070	0	0	1	0	444	444	52	13	43
14071	0	1	1	0	1	444	82	23	29
14072	0	0	1	0	444	444	86	13	25
14073	0	0	0	0	444	444	89	13	36
14074	0	0	0	0	444	444	70	13	33
14075	0	1	1	0	0	444	85	31	65
14076	1	0	0	0	444	444	39	13	37
14077	1	0	0	0	444	444	58	13	40
14078	1	0	1	0	444	444	100	13	43
14079	1	0	0	0	444	444	27	13	65
14080	1	0	0	0	444	444	58	13	51
14081	1	0	0	0	444	444	53	13	22
14082	1	0	0	0	444	444	48	13	51
14083	1	0	0	0	444	444	64	13	29
14084	1	0	1	0	444	444	28	13	29
14085	1	0	1	0	444	444	34	13	11
14086	1	0	0	0	444	444	95	13	39
14087	1	0	1	0	444	444	61	13	29
14088	1	1	0	0	999	444	79	13	25
14089	1	0	0	0	444	444	50	13	22
14090	1	0	0	0	444	444	99	13	22
14091	1	0	0	0	444	444	56	13	22
14092	1	0	1	0	444	444	73	13	11
16001	0	1	1	0	444	444	88	30	48
16003	0	1	1	0	444	444	75	23	54
16004	0	1	1	0	444	444	92	26	444

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
16008	0	1	1	1	444	444	80	69	58
16009	0	1	1	1	444	444	69	27	33
16010	0	1	1	0	444	444	61	32	23
16011	0	1	0	0	444	444	84	32	999
16014	0	1	1	1	444	444	61	24	888
16015	0	1	1	1	444	444	96	24	30
16017	0	1	1	1	444	444	74	47	888
16021	0	1	0	1	444	444	36	23	999
16022	0	1	1	0	444	444	92	36	37
16023	0	1	1	0	444	444	57	26	999
16026	0	1	1	1	444	444	76	13	11
16030	0	1	1	0	444	444	75	22	20
16032	0	1	1	1	444	444	84	45	999
16033	0	1	1	0	444	444	50	34	43
16034	0	1	0	0	444	444	95	20	58
16037	0	1	1	0	444	444	50	25	61
16039	0	0	1	0	444	444	95	13	69
16045	0	1	1	0	444	444	53	24	58
16046	0	1	1	0	444	444	80	24	65
16051	0	1	1	1	444	444	80	37	888
16061	0	1	1	0	444	444	39	13	40
16064	0	1	1	1	444	444	83	20	34
16065	0	1	1	0	444	444	82	39	37
16067	0	1	1	0	444	444	73	38	54
16068	0	1	1	1	444	444	9	29	73
16076	0	1	1	1	444	444	43	34	444
16082	0	1	1	0	444	444	61	22	44
16085	0	1	1	1	444	444	96	30	33
16093	0	1	1	0	444	444	66	22	888
16098	0	1	1	0	444	444	92	24	61
16100	0	1	1	0	444	444	58	29	999
16106	0	1	1	0	444	444	52	39	69
16107	0	1	1	0	444	444	50	24	44
16108	0	1	1	0	444	444	53	18	65
16109	0	1	0	0	444	444	62	24	55
16111	0	1	1	1	444	444	40	29	73
16112	0	1	0	1	444	444	94	24	999
16113	0	1	0	0	444	444	41	29	62
16115	0	1	0	1	444	444	79	36	44
16116	0	1	1	1	444	444	91	19	40
16117	0	1	1	0	444	444	55	29	54
16118	0	1	0	0	444	444	79	28	444
16119	0	1	1	1	444	444	70	29	999

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
16125	0	1	1	1	444	444	46	30	55
16126	0	1	0	0	444	444	70	31	30
16127	0	1	0	0	444	444	92	30	999
16129	0	1	1	0	444	444	92	32	999
16130	0	1	1	1	444	444	58	33	444
16131	0	1	1	0	444	444	53	22	58
16134	0	1	1	1	444	444	41	27	999
16139	0	1	0	1	444	444	71	36	58
16142	0	1	1	1	444	444	78	29	444
16143	0	1	0	0	444	444	45	18	65
16146	0	1	1	0	444	444	92	32	58
16149	0	1	1	1	444	444	94	23	65
16151	0	1	0	0	444	444	89	22	69
16155	0	1	1	0	444	444	83	19	888
16156	0	1	0	0	444	444	93	26	26
16158	0	1	0	0	444	444	92	31	66
16160	0	1	0	0	444	444	9	25	999
16163	0	1	0	0	444	444	88	28	999
16173	0	1	0	0	444	444	90	19	61
16174	0	1	1	0	444	444	48	34	43
16176	0	1	0	0	444	444	20	25	444
16179	0	1	0	0	444	444	66	31	37
16180	0	1	0	0	444	444	79	21	65
16181	0	1	1	0	444	444	83	21	888
16182	0	1	1	1	444	444	46	23	65
16184	0	1	0	1	444	444	66	42	58
16186	0	1	1	1	444	444	47	29	16
16187	1	1	1	1	444	444	88	13	65
16188	1	1	1	1	444	444	17	13	69
16189	1	1	1	1	444	444	79	13	73
16190	1	0	1	0	444	444	47	13	50
18341	0	1	1	0	444	444	93	20	62
18343	0	1	1	0	444	444	92	13	61
18344	0	1	1	1	444	444	9	29	12
18345	0	1	0	0	444	444	95	21	58
18346	0	1	1	0	444	444	92	13	26
18347	0	1	1	0	444	444	64	23	888
18349	0	1	1	0	444	444	90	35	50
18350	0	1	1	0	444	444	8	18	999
18351	0	1	1	1	444	444	92	30	888
18352	0	1	0	0	444	444	57	13	444
18354	0	1	1	0	444	444	90	27	54
18355	0	1	0	1	444	444	54	23	51

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
18356	0	1	0	0	444	444	83	29	47
18357	0	1	0	1	444	444	39	33	44
18359	0	1	1	0	444	444	74	28	65
18384	0	1	1	0	444	444	64	33	444
18388	0	1	1	1	444	444	50	52	888
18389	0	1	1	0	444	444	61	33	26
18390	0	1	0	0	444	444	95	23	22
18392	0	0	0	0	444	444	86	13	22
18393	0	1	0	1	444	444	35	27	888
18395	0	1	0	1	444	444	53	27	61
18397	0	1	1	0	444	444	47	31	37
18398	0	1	0	0	444	444	93	31	999
18407	0	1	0	1	444	444	52	58	62
18411	0	1	0	0	444	444	93	29	22
18422	0	1	0	1	444	444	45	25	18
18423	0	1	1	1	444	444	54	20	888
18424	0	1	1	0	444	444	33	13	888
18425	0	1	1	0	444	444	52	29	33
18426	0	1	1	0	444	444	47	13	26
18427	0	1	0	0	444	444	100	27	888
18429	0	1	1	0	444	444	89	23	65
18430	0	1	0	1	444	444	94	26	36
18431	0	1	1	1	444	444	11	28	999
18434	0	0	1	0	444	444	37	13	65
18441	0	1	1	0	444	444	74	25	888
18442	0	1	1	0	444	444	95	25	888
18445	0	1	0	1	444	444	69	27	65
18446	0	1	0	1	444	444	94	34	888
18447	0	1	1	0	444	444	38	32	61
18448	0	1	0	1	444	444	59	21	22
18452	0	1	1	1	444	444	51	33	888
18455	0	1	1	1	444	444	18	13	69
18456	0	1	0	1	444	444	82	33	43
18459	0	1	1	0	444	444	38	32	888
18472	0	1	0	1	444	444	46	44	16
18496	0	1	1	0	444	444	49	13	54
18501	0	1	0	1	444	444	98	26	37
18503	0	1	0	1	444	444	46	27	51
18505	0	1	1	1	444	444	68	32	29
18506	0	1	1	0	444	444	78	22	22
18508	0	1	1	0	444	444	79	28	51
18509	0	1	0	1	444	444	50	47	30
18510	0	1	1	0	444	444	94	23	43

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
18511	0	1	1	0	444	444	92	27	44
18512	0	1	1	1	444	444	4	40	999
18514	0	1	1	0	444	444	79	26	19
18515	0	1	1	1	444	444	67	28	22
18517	0	1	1	1	444	444	90	19	26
18518	0	1	0	0	444	444	17	32	65
18520	0	1	0	1	444	444	96	35	999
18521	0	1	1	1	444	444	93	21	26
18522	0	1	0	1	444	444	90	24	40
18523	0	1	1	1	444	444	65	34	65
18524	0	1	0	1	444	444	88	25	999
18528	0	1	0	1	444	444	23	41	999
18529	0	1	1	0	444	444	41	40	65
18530	0	1	0	1	444	444	74	48	999
18533	0	1	0	0	444	444	91	30	40
18534	0	1	1	1	444	444	61	29	65
18535	0	1	0	0	444	444	100	21	65
18536	1	0	0	0	444	444	47	13	999
18537	1	0	1	1	444	444	49	13	54
18538	1	0	0	1	444	444	92	13	444
18539	1	0	1	0	444	444	93	13	33
18685	0	1	0	0	444	444	26	13	58
19080	0	1	1	0	1	444	73	30	33
19083	0	1	1	1	0	444	53	13	48
19086	0	0	0	0	444	444	93	13	65
19087	0	1	0	0	999	444	999	28	44
19088	0	1	1	1	999	444	44	22	65
19090	0	1	0	1	999	444	91	38	37
19092	0	1	1	0	999	444	86	13	15
19094	0	1	1	0	999	444	88	30	30
19095	0	1	1	0	1	444	95	27	65
19097	0	1	0	1	999	444	100	28	888
19099	0	1	1	0	1	444	83	23	999
19101	0	1	1	1	1	444	68	28	22
19110	0	1	0	0	1	444	999	32	999
19122	0	1	1	0	999	444	92	22	999
19140	0	1	1	1	999	444	90	27	999
19152	0	1	1	0	1	444	86	21	999
19157	0	1	0	1	1	444	92	26	19
19161	0	1	0	0	999	444	92	25	34
19165	0	1	0	1	1	444	70	28	22
19168	0	1	1	0	0	444	999	13	999
19170	0	1	0	0	1	444	81	27	999

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
19171	0	1	0	1	999	444	92	29	999
19172	0	1	1	0	999	444	95	22	999
19177	0	1	0	0	999	444	46	27	69
19183	0	1	0	0	999	444	90	24	999
19229	0	1	1	0	999	444	7	26	65
19230	0	1	1	0	999	444	95	24	33
19233	0	1	1	0	1	444	90	13	22
19234	0	1	1	1	1	444	48	20	33
19239	0	1	0	1	999	444	90	21	999
19244	0	1	1	0	1	444	92	33	999
19253	0	1	0	0	1	444	51	29	999
19255	0	1	1	0	1	444	92	28	999
19261	0	1	1	1	1	444	73	25	44
19272	0	1	1	0	999	444	48	36	888
19283	0	1	0	0	1	444	95	50	37
19294	2	0	0	0	444	444	93	13	65
19300	0	1	1	0	999	444	100	29	999
19312	0	1	0	0	1	444	999	29	999
19318	0	1	0	0	1	444	92	27	43
19321	0	1	0	0	999	444	88	24	999
19326	0	1	0	0	999	444	98	27	999
19367	0	1	1	0	1	444	999	29	57
19371	0	1	0	1	999	444	92	39	65
19377	0	1	1	0	999	444	96	22	61
19383	0	1	0	0	0	444	444	13	999
19402	0	1	0	1	1	444	73	20	999
19443	0	1	1	0	1	444	93	39	999
19444	0	1	1	0	1	444	77	28	444
19457	0	1	1	0	1	444	75	24	55
19476	0	1	1	1	1	444	17	25	61
19481	0	1	0	0	999	444	89	39	999
19482	0	1	0	0	999	444	100	21	999
19483	1	1	1	0	1	444	91	13	54
19484	1	0	1	0	444	444	90	13	888
19485	1	1	1	0	0	444	46	13	58
19486	1	1	1	0	1	444	53	13	999
20077	0	1	0	0	1	444	50	13	11
20081	0	0	0	0	444	444	95	13	44
20084	0	1	1	0	999	444	39	31	29
20091	0	1	0	1	1	444	80	36	36
20096	0	1	0	1	1	444	74	21	11
20097	0	1	0	0	1	444	78	13	30
20103	0	1	0	0	999	444	100	32	22

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
20105	0	0	1	0	444	444	70	13	36
20114	0	1	1	0	999	444	85	27	29
20121	0	1	1	0	1	444	43	25	36
20128	0	0	0	0	444	444	79	13	30
20132	0	0	0	0	444	444	74	13	25
20136	0	0	1	0	444	444	83	13	11
20137	0	0	0	0	444	444	66	13	53
20138	0	0	1	0	444	444	79	13	15
20144	0	0	1	0	444	444	79	13	15
20150	0	1	1	0	1	444	51	25	65
20159	0	0	0	0	444	444	81	13	18
20162	0	1	1	0	1	444	86	31	65
20175	0	0	0	0	444	444	96	13	11
20178	0	1	1	0	1	444	77	29	57
20195	2	0	0	0	444	444	74	13	36
20225	0	0	0	0	444	444	71	13	36
20227	0	0	1	0	444	444	79	13	999
20228	2	0	0	0	444	444	67	13	57
20231	0	1	0	0	1	444	92	33	43
20235	0	1	0	0	1	444	70	34	57
20237	0	1	0	0	0	444	49	30	888
20238	0	0	0	0	444	444	100	13	30
20240	0	0	1	0	444	444	55	13	65
20250	0	0	1	0	444	444	83	13	15
20251	0	1	0	0	1	444	54	23	57
20252	0	0	0	0	444	444	74	13	25
20263	0	1	0	0	1	444	85	28	15
20265	0	0	0	0	444	444	90	13	36
20266	0	1	0	0	1	444	65	23	36
20269	0	1	1	0	0	444	47	25	22
20271	0	0	1	0	444	444	68	13	36
20273	0	0	0	0	444	444	100	13	11
20277	0	1	1	0	1	444	62	26	61
20278	0	1	0	0	1	444	46	28	37
20279	2	0	1	0	444	444	80	13	888
20280	0	1	0	0	888	444	50	33	33
20282	0	1	0	0	1	444	68	25	999
20294	0	1	0	0	1	444	100	20	11
20301	0	1	0	0	0	444	89	33	22
20302	0	1	1	0	1	444	49	23	15
20305	0	1	0	0	0	444	70	30	11
20307	0	0	1	1	444	444	46	13	29
20309	0	0	0	0	444	444	69	13	47

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
20311	0	1	1	0	1	444	43	22	999
20315	0	0	1	1	444	444	61	13	999
20316	0	0	1	0	444	444	61	13	36
20317	0	1	0	0	0	444	88	13	25
20319	0	1	0	0	1	444	45	25	36
20320	0	0	1	0	444	444	92	13	888
20322	0	1	0	0	1	444	28	26	999
20324	0	0	1	0	444	444	65	13	29
20328	0	1	0	0	1	444	48	19	888
20335	0	0	0	0	444	444	76	13	57
20337	0	0	0	0	444	444	90	13	29
20338	0	1	0	0	1	444	37	25	29
20339	0	0	0	0	444	444	64	13	61
20340	0	1	1	1	1	444	64	13	44
20342	0	0	0	0	444	444	67	13	36
20348	0	1	0	0	999	444	47	34	36
20352	0	1	0	0	0	444	65	25	29
20353	0	0	0	0	444	444	78	13	999
20360	0	1	0	0	999	444	69	23	43
20361	0	0	1	0	444	444	95	13	29
20362	0	1	1	0	999	444	76	13	30
20363	0	0	1	0	444	444	80	13	33
20364	0	1	0	0	999	444	78	26	19
20366	0	0	1	0	444	444	82	13	37
20368	0	1	0	0	1	444	47	27	33
20369	0	1	0	0	1	444	85	25	888
20370	0	0	1	0	444	444	59	13	29
20372	0	1	1	0	1	444	65	20	57
20373	0	1	0	1	1	444	35	27	44
20374	0	1	0	0	1	444	70	13	57
20375	0	0	1	0	444	444	83	13	40
20378	0	0	0	0	444	444	85	13	29
20380	0	0	1	0	444	444	89	13	36
20381	0	1	1	1	0	444	56	23	54
20386	0	1	0	0	0	444	74	25	999
20387	0	1	0	0	999	444	83	13	999
20399	0	0	0	0	444	444	70	13	61
20400	0	1	0	0	999	444	83	23	11
20401	0	0	1	0	444	444	97	13	11
20403	0	1	0	0	1	444	83	17	33
20405	0	0	0	0	444	444	79	13	29
20408	0	1	0	0	999	444	85	28	51
20409	0	1	1	0	999	444	48	30	8

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
20410	0	0	1	0	444	444	76	13	44
20414	0	1	0	0	1	444	84	15	15
20415	0	1	0	0	999	444	16	33	37
20417	0	0	1	0	444	444	59	13	40
20418	0	0	0	0	444	444	74	13	43
20419	0	0	1	0	444	444	69	13	51
20421	0	1	1	0	888	444	97	23	51
20432	0	1	0	0	1	444	12	23	44
20435	0	0	0	0	444	444	78	13	61
20436	0	1	1	0	1	444	93	24	22
20437	0	0	0	0	444	444	85	13	36
20439	0	0	0	0	444	444	100	13	36
20440	0	1	0	0	1	444	74	23	22
20449	0	1	0	0	1	444	100	17	37
20450	0	1	0	0	1	444	61	19	11
20451	0	1	0	1	1	444	82	28	33
20453	0	0	1	0	444	444	77	13	11
20454	0	1	1	0	999	444	100	28	11
20458	0	0	0	0	444	444	81	13	36
20460	0	1	0	0	0	444	60	28	26
20461	0	0	1	0	444	444	86	13	29
20462	0	1	1	0	999	444	22	26	999
20463	0	1	0	1	1	444	47	20	65
20464	0	1	0	0	1	444	65	24	50
20465	0	1	0	999	999	444	78	13	999
20471	0	1	0	1	1	444	49	13	65
20478	0	0	1	1	444	444	40	13	25
20479	0	1	0	0	1	444	92	27	15
20485	0	0	1	0	444	444	93	13	61
20487	0	1	0	0	888	444	44	13	44
20488	0	1	1	0	1	444	75	24	44
20494	0	1	1	0	1	444	73	22	51
20497	0	1	1	0	1	444	51	13	22
20498	0	1	0	0	1	444	48	13	999
20499	0	0	1	0	444	444	95	13	44
20500	0	0	0	0	444	444	100	13	999
20502	0	0	1	0	444	444	89	13	61
20504	0	0	1	0	444	444	59	13	999
20507	0	0	0	1	444	444	45	13	15
20513	0	1	0	0	1	444	63	13	29
20525	0	0	0	0	444	444	78	13	44
20526	0	0	1	0	444	444	93	13	37
20527	2	0	1	0	444	444	95	13	11

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
20530	1	1	1	0	999	444	70	13	33
20531	1	0	1	0	444	444	14	13	11
20532	1	0	1	0	444	444	77	13	29
20533	1	0	0	1	444	444	83	13	25
20534	1	0	0	1	444	444	50	13	25
20535	1	1	0	0	999	444	0	13	29
20536	1	1	1	0	999	444	40	13	18
20537	1	0	1	0	444	444	88	13	36
20538	1	0	1	0	444	444	90	13	11
20539	1	0	0	0	444	444	92	13	999
20540	1	1	0	0	1	444	74	13	51
20541	1	1	1	1	1	444	92	13	11
20542	1	1	1	0	0	444	65	13	29
20543	1	0	0	0	444	444	83	13	61
20544	1	0	1	0	444	444	93	13	44
20545	1	1	1	0	999	444	64	13	29
20546	1	0	0	0	444	444	61	13	11
20547	1	0	0	0	444	444	27	13	65
20548	1	0	0	0	444	444	61	13	22
20549	1	0	1	0	444	444	74	13	15
20550	1	0	0	0	444	444	77	13	22
20551	1	1	0	0	999	444	73	13	22
20552	1	0	1	1	444	444	41	13	61
20553	1	1	1	0	444	444	88	13	37
20554	1	0	1	0	444	444	68	13	15
20555	1	0	0	0	444	444	28	13	40
20556	1	0	0	0	444	444	47	13	65
20557	1	0	0	0	444	444	83	13	50
20558	1	0	1	0	444	444	40	13	36
20559	1	0	1	0	444	444	91	13	15
20560	1	0	1	0	444	444	46	13	22
20561	1	0	1	0	444	444	100	13	32
20562	1	0	0	0	444	444	83	13	999
20563	1	0	1	0	444	444	54	13	22
20564	1	1	1	0	1	444	60	13	44
20565	1	0	1	0	444	444	55	13	29
20566	1	1	1	0	1	444	73	13	999
20567	1	0	1	0	444	444	70	13	11
20568	1	0	1	0	444	444	74	13	40
20569	1	1	1	0	888	444	70	13	57
20570	1	0	0	0	444	444	73	13	15
20571	1	0	1	0	444	444	77	13	40
20572	0	1	0	0	1	444	96	13	53

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
20573	1	0	0	0	444	444	79	13	999
20574	1	1	0	0	1	444	48	13	15
20575	1	1	0	1	999	444	77	13	999
20576	1	1	1	0	999	444	53	13	29
20577	1	0	0	0	444	444	79	13	29
20578	1	1	0	0	999	444	89	13	57
20579	1	0	0	0	444	444	23	13	11
20580	1	1	0	0	0	444	58	13	11
20581	1	0	0	0	444	444	91	13	57
20582	1	1	0	1	1	444	51	13	4
20583	1	1	0	1	0	444	66	13	22
20584	1	0	1	1	444	444	92	13	22
20585	1	0	0	0	444	444	65	13	51
20586	1	0	1	0	444	444	89	13	40
20587	1	0	0	0	444	444	88	13	57
20588	1	0	0	0	444	444	47	13	61
20589	1	0	1	0	444	444	43	13	999
20590	1	0	1	0	444	444	39	13	57
20591	1	0	0	0	444	444	60	13	15
22187	0	0	1	1	444	444	40	13	43
22191	0	1	0	1	999	444	64	22	999
22192	0	1	1	1	999	444	84	29	999
22195	0	1	1	0	999	444	89	30	65
22196	0	1	1	1	1	444	85	28	33
22198	0	1	1	1	999	444	999	13	888
22202	0	1	0	1	999	444	92	30	999
22205	0	0	1	0	444	444	89	13	58
22207	0	1	1	0	999	444	74	35	47
22208	0	1	1	0	999	444	73	34	58
22209	0	1	0	1	1	444	92	28	999
22212	0	1	0	1	1	444	89	35	999
22214	0	1	0	1	444	444	999	39	999
22215	2	0	0	0	444	444	59	13	40
22217	0	1	1	0	1	444	83	23	65
22218	0	0	0	0	444	444	100	13	50
22219	0	1	1	0	999	444	999	13	999
22220	0	1	1	0	1	444	44	27	3
22222	0	1	1	1	999	444	44	21	29
22224	2	1	0	0	999	444	100	13	888
22226	0	1	1	1	1	444	55	25	37
22241	0	1	1	1	999	444	59	39	888
22242	0	1	1	0	0	444	999	36	40
22245	0	1	1	0	1	444	63	30	37

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
22247	0	1	1	0	1	444	96	21	61
22248	0	1	1	0	999	444	89	28	40
22257	0	1	1	0	999	444	73	21	999
22258	0	1	0	0	999	444	92	36	999
22259	0	1	0	0	999	444	71	24	29
22264	0	1	1	1	1	444	7	25	444
22267	0	1	1	1	999	444	78	31	58
22274	0	1	1	0	1	444	90	36	37
22275	0	1	1	0	999	444	94	13	50
22281	0	1	1	1	999	444	88	13	444
22287	0	1	1	1	0	444	56	26	33
22288	0	1	1	0	1	444	83	30	54
22290	0	1	1	0	1	444	82	24	888
22292	0	1	1	0	999	444	87	29	40
22293	0	1	1	0	999	444	53	23	73
22295	0	1	1	0	1	444	47	27	15
22298	0	1	1	0	1	444	84	32	37
22306	0	1	1	0	999	444	96	34	888
22308	0	1	1	1	1	444	59	13	65
22313	0	1	1	1	1	444	89	25	999
22314	0	1	0	0	0	444	999	33	40
22323	0	1	1	0	0	444	999	30	29
22327	0	1	1	1	999	444	92	13	58
22330	0	1	1	1	999	444	94	22	57
22382	0	1	1	0	0	444	15	47	888
22468	0	1	1	0	1	444	63	13	69
22480	0	1	0	1	999	444	75	19	888
22484	0	1	1	0	999	444	89	21	61
22489	0	1	0	0	1	444	7	26	65
22548	0	1	0	0	999	444	95	13	999
22566	0	1	0	0	0	444	93	30	888
22570	0	1	1	1	999	444	79	13	999
22571	0	1	1	1	0	444	93	34	999
22575	0	1	0	0	999	444	70	18	43
22578	0	1	1	0	999	444	92	29	999
22585	0	1	0	1	999	444	85	23	65
22588	0	1	1	1	0	444	67	30	20
22590	0	1	1	0	1	444	96	25	999
22591	0	1	0	0	1	444	92	27	999
22599	0	1	0	0	1	444	999	34	999
22601	0	1	1	1	1	444	95	27	62
22602	0	1	1	0	1	444	92	35	999
22603	0	1	1	0	1	444	94	31	50

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
22604	0	1	0	1	999	444	82	26	999
22605	2	0	1	1	444	444	93	13	58
22606	0	1	1	1	999	444	999	35	999
22607	0	1	1	1	0	444	58	28	999
22608	0	1	0	0	999	444	92	22	50
22609	0	1	1	1	1	444	7	27	999
22610	0	1	0	1	999	444	81	22	62
22611	0	1	0	0	1	444	90	31	999
22612	0	1	0	0	1	444	65	35	30
22613	0	1	1	0	0	444	100	22	47
22614	0	1	1	0	0	444	43	40	999
22615	0	1	0	1	999	444	50	30	999
22617	0	1	0	0	1	444	63	32	37
22618	0	1	1	0	1	444	46	30	65
22619	0	1	0	1	1	444	999	23	12
22620	0	1	0	1	999	444	92	13	888
22621	0	1	1	1	999	444	47	32	33
22622	0	1	1	0	1	444	78	24	36
22624	0	0	0	1	444	444	83	13	999
22625	0	1	0	1	999	444	51	40	65
22776	0	1	1	1	1	444	93	20	54
22777	0	1	0	0	999	444	45	31	999
22778	0	1	0	1	999	444	92	29	22
22779	0	1	1	0	0	444	50	42	15
22780	0	1	0	0	999	444	83	24	30
22781	0	1	0	0	0	444	72	39	999
22783	0	1	0	0	0	444	38	41	54
22784	0	1	1	0	1	444	89	25	999
22785	0	1	0	1	1	444	59	26	36
22786	0	1	0	0	1	444	77	26	999
22788	0	1	1	0	1	444	47	20	999
22789	0	1	0	0	444	444	44	27	999
22790	0	1	0	0	1	444	71	28	999
22791	0	1	0	0	1	444	91	28	999
22792	0	1	0	0	1	444	71	24	36
22795	0	1	0	0	1	444	72	25	26
22796	0	1	1	1	1	444	68	28	58
22797	0	1	0	1	1	444	96	26	47
22800	0	1	0	0	999	444	68	29	69
22801	0	1	1	1	1	444	85	31	47
22802	0	1	0	1	1	444	73	23	44
22803	0	1	1	0	1	444	82	25	51
22805	0	1	0	0	1	444	41	30	58

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
22806	0	0	0	0	444	444	76	13	58
22807	0	1	1	1	1	444	999	31	888
22808	0	1	1	1	1	444	66	28	30
22809	0	1	1	0	0	444	75	13	65
22810	0	1	1	0	999	444	50	28	999
22811	0	1	1	1	0	444	57	33	999
22812	0	1	0	0	1	444	92	27	58
22813	0	1	1	1	1	444	48	32	34
22814	0	1	1	0	999	444	36	23	37
22815	0	1	1	0	0	444	79	26	69
22816	0	1	0	0	999	444	83	27	888
22817	0	1	0	0	999	444	47	45	999
22818	0	1	1	0	999	444	90	35	50
22819	0	1	1	1	0	444	999	27	58
22820	0	1	1	0	0	444	81	25	65
22821	0	1	1	0	999	444	93	25	36
22822	0	1	0	0	0	444	45	13	999
22823	0	0	1	0	444	444	100	13	51
22824	0	1	1	0	1	444	70	23	999
22825	0	1	1	0	1	444	95	29	999
22828	0	1	0	1	1	444	89	13	999
22829	0	1	0	1	999	444	66	13	999
22830	0	1	1	1	1	444	94	13	999
22831	0	1	0	1	1	444	83	13	19
22832	0	1	0	0	999	444	92	13	999
22833	0	1	0	1	1	444	70	27	999
22834	0	1	1	999	1	444	89	23	444
22835	0	1	1	1	1	444	81	24	55
22840	1	0	1	0	444	444	13	13	55
22842	1	0	0	0	444	444	999	13	47
22843	1	0	1	0	444	444	93	13	73
22844	1	1	1	0	1	444	80	13	999
22845	1	1	1	0	0	444	92	13	43
22846	1	1	1	0	0	444	73	13	65
22847	1	1	1	0	0	444	66	13	999
22848	1	1	1	1	999	444	50	13	888
22849	1	1	0	0	999	444	68	13	999
22850	1	1	1	0	999	444	76	13	888
22851	1	1	0	0	1	444	999	13	999
22852	1	1	0	0	999	444	83	13	999
22853	1	1	1	1	1	444	57	13	999
24188	0	1	0	0	1	444	46	24	16
24193	0	0	0	0	444	444	51	13	61

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
24211	0	1	1	0	1	444	80	30	47
24221	0	1	0	0	1	444	4	39	50
24243	0	1	0	0	0	444	28	27	58
24256	0	1	0	0	0	444	66	23	57
24270	0	1	0	0	999	444	52	36	65
24276	0	0	0	0	444	444	69	13	51
24284	0	1	0	0	0	444	53	24	888
24286	0	1	0	1	999	444	74	35	58
24289	0	1	1	0	0	444	95	28	25
24303	0	1	1	0	999	444	73	21	33
24329	0	1	1	0	999	444	83	22	33
24331	0	1	1	0	1	444	44	23	29
24473	0	1	0	0	1	444	60	27	51
24477	0	1	0	1	999	444	93	13	65
24483	0	0	0	0	444	444	61	13	43
24486	0	1	0	0	1	444	90	23	33
24490	0	1	0	0	1	444	52	26	58
24493	0	1	0	0	888	444	61	33	34
24536	0	1	0	0	0	444	7	31	888
24537	0	1	1	0	1	444	77	19	44
24539	0	1	0	0	0	444	57	27	29
24542	0	1	0	0	999	444	92	21	40
24544	0	0	1	0	444	444	85	13	999
24545	0	0	0	0	444	444	68	13	36
24546	0	1	1	1	0	444	61	36	51
24547	0	0	1	0	444	444	92	13	47
24564	0	1	0	1	1	444	48	22	37
24573	0	0	1	0	444	444	90	13	888
24576	0	1	1	0	1	444	81	23	57
24581	0	0	1	0	444	444	90	13	36
24584	0	1	0	0	0	444	51	29	47
24586	0	0	1	0	444	444	89	13	33
24587	0	1	1	1	0	444	68	34	37
24589	0	1	1	1	1	444	39	28	69
24595	0	0	1	0	444	444	83	13	888
24634	0	1	1	0	1	444	61	24	65
24666	0	1	0	0	0	444	29	13	40
24680	0	1	1	0	0	444	73	26	22
24689	0	1	1	0	1	444	78	21	36
24692	2	0	0	0	444	444	86	13	29
24697	0	0	0	0	444	444	93	13	36
24709	0	1	0	0	0	444	52	30	26
24711	0	1	1	0	0	444	89	29	29

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
24713	0	1	1	0	1	444	29	32	65
24714	0	0	1	0	444	444	81	13	47
24716	0	1	0	0	1	444	43	26	22
24717	0	0	0	0	444	444	90	13	57
24719	0	1	0	1	1	444	45	16	65
24722	0	1	0	0	0	444	6	39	33
24725	0	1	0	0	1	444	90	21	65
24730	0	0	0	0	444	444	89	13	888
24745	2	0	0	0	444	444	84	13	61
24747	0	1	1	0	1	444	76	26	30
24748	0	1	0	0	1	444	77	27	33
24750	0	0	1	0	444	444	92	13	999
24751	0	1	1	0	1	444	100	25	40
24763	0	1	0	0	1	444	62	24	15
24794	0	1	0	0	1	444	64	13	65
24798	0	0	0	0	444	444	71	13	65
24831	0	1	0	1	0	444	48	40	999
24834	0	1	1	0	999	444	79	13	888
24837	0	1	1	0	999	444	93	26	999
24838	0	1	0	0	999	444	70	27	999
24839	0	1	0	0	1	444	75	24	40
24840	0	1	0	1	1	444	79	20	40
24841	0	0	0	0	444	444	63	13	57
24842	0	0	1	0	444	444	64	13	18
24843	0	1	1	0	0	444	74	21	40
24844	0	1	0	0	999	444	40	28	65
24845	0	0	1	0	999	444	93	13	58
24846	0	0	0	0	444	444	95	13	51
24847	0	1	0	0	0	444	44	32	61
24849	0	1	0	0	999	444	48	29	54
24850	0	1	1	0	1	444	70	31	999
24851	0	1	1	0	1	444	90	21	47
24852	0	1	1	1	444	444	60	20	37
24853	0	1	1	0	1	444	77	32	999
24854	0	0	1	0	444	444	100	13	40
24855	0	1	0	0	999	444	93	24	50
24859	0	1	1	0	999	444	60	28	61
24860	0	1	1	1	1	444	100	22	62
24861	0	1	0	0	1	444	72	26	29
24862	2	0	1	0	444	444	94	13	51
24863	0	0	1	0	444	444	76	13	15
24864	0	0	0	0	444	444	89	13	65
24870	1	0	1	0	444	444	94	13	44

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
24871	1	1	1	0	1	444	83	13	888
24872	1	1	1	0	0	444	64	13	58
24873	1	0	1	0	444	444	49	13	58
24874	1	0	1	0	444	444	58	13	888
24875	1	0	1	0	444	444	91	13	43
24876	1	0	1	0	444	444	67	13	30
24877	1	0	0	0	444	444	56	13	40
24878	1	1	0	0	0	444	40	13	61
24879	1	1	0	0	999	444	34	13	26
24880	1	0	0	0	444	444	95	13	43
24881	1	0	1	0	444	444	89	13	47
24882	1	0	0	0	444	444	77	13	30
24883	1	0	0	0	444	444	100	13	999
24884	1	0	0	0	444	444	67	13	29
24885	1	1	0	1	0	444	60	13	51
24886	1	0	0	0	444	444	70	13	29
24887	1	0	1	0	444	444	47	13	999
24888	1	1	0	0	999	444	74	13	999
24889	1	0	0	0	444	444	95	13	58
24890	1	1	1	0	999	444	48	13	65
24891	1	1	1	0	1	444	70	13	47
24892	1	0	0	0	444	444	6	13	29
24893	1	1	0	1	999	444	22	13	58
24894	1	0	0	1	444	444	92	13	43
24895	1	1	1	0	1	444	51	13	36
24896	1	0	0	0	444	444	79	13	33
24897	1	1	0	0	444	444	84	13	22
24898	1	0	0	0	444	444	46	13	26
24899	1	1	0	0	1	444	94	13	65
24900	1	0	1	0	444	444	54	13	37
24901	1	0	0	0	444	444	30	13	43
24902	1	1	1	0	0	444	48	13	22
24903	1	1	1	0	0	444	999	13	23
24904	1	0	0	0	444	444	73	13	51
24905	1	0	1	0	444	444	47	13	36
24906	1	0	0	0	444	444	92	13	47
24907	1	1	1	0	0	444	92	13	22
24908	1	0	0	0	444	444	96	13	65
24909	1	0	0	0	444	444	78	13	47
24910	1	0	1	0	444	444	35	13	65
24911	1	0	1	0	444	444	75	13	36
24912	1	1	0	0	888	444	60	13	58
24913	1	1	0	0	1	444	96	13	65

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
24914	0	0	0	0	444	444	80	13	15
24915	1	0	0	0	444	444	65	13	37
24916	0	0	0	0	444	444	83	13	57
24917	1	0	1	0	444	444	76	13	57
24918	1	0	1	0	444	444	86	13	33
24919	1	0	0	0	444	444	88	13	999
24920	1	1	0	0	999	444	51	13	15
24921	1	1	0	0	999	444	26	13	47
24922	1	0	0	0	444	444	100	13	33
24923	1	0	1	0	444	444	48	13	65
24924	1	0	0	0	444	444	73	13	58
24925	1	0	1	0	444	444	44	13	57
24926	1	1	0	0	1	444	50	13	36
24927	1	0	1	0	444	444	77	13	37
24928	1	0	1	0	444	444	86	13	888
24929	1	0	0	0	444	444	77	13	65
24930	1	1	0	1	1	444	47	13	11
24931	1	0	0	0	444	444	79	13	55
24932	0	0	0	0	444	444	49	13	22
24933	1	0	0	0	444	444	91	13	65
24934	0	0	0	0	444	444	93	13	22
24935	1	1	0	0	999	444	66	13	36
26197	0	1	1	1	0	5	47	24	11
26203	0	1	1	0	1	3	82	34	36
26204	0	1	0	0	1	3	63	13	43
26440	0	1	1	1	1	3	13	13	47
26572	0	1	1	1	1	3	68	43	54
26626	0	1	1	0	0	5	43	31	15
26627	0	1	0	1	0	3	88	26	29
26628	0	1	1	0	1	3	61	32	29
26629	0	0	1	0	444	5	89	13	58
26630	0	1	0	1	1	444	71	23	11
26631	0	1	1	0	1	444	94	30	40
26632	0	1	1	0	1	444	89	25	11
26635	0	0	0	0	444	5	89	13	57
26636	0	1	1	1	1	3	69	19	15
26637	0	1	0	1	1	5	60	27	33
26638	0	1	1	0	0	444	85	36	61
26639	0	1	1	0	1	444	999	27	54
26641	0	0	0	0	444	444	37	13	15
26642	0	1	0	0	0	444	51	40	999
26643	0	1	0	0	1	3	75	40	999
26648	0	1	0	0	1	3	81	30	33

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
26650	0	1	0	0	0	444	74	28	37
26655	0	1	1	1	0	3	6	28	51
26657	0	0	1	1	444	444	60	13	999
26658	0	1	0	0	1	444	45	24	999
26662	0	1	1	0	1	444	95	25	15
26663	0	1	1	0	1	444	79	23	30
26664	0	0	1	0	444	5	89	13	11
26669	0	1	1	0	1	444	91	45	999
26671	0	1	0	1	1	3	86	13	22
26672	0	1	0	1	1	444	92	37	999
26673	0	1	1	0	1	3	92	31	999
26674	0	1	1	1	1	444	52	30	65
26675	0	1	1	0	999	444	92	23	37
26678	0	1	0	0	1	444	92	34	22
26679	0	1	1	0	1	444	31	32	888
26681	0	0	0	0	444	444	82	13	999
26682	0	0	1	0	444	444	93	13	65
26683	0	1	1	0	1	444	78	26	29
26684	0	1	0	0	1	444	75	33	47
26685	0	1	0	1	1	3	6	32	37
26686	0	1	1	0	1	444	94	22	47
26687	0	1	1	0	1	444	48	27	888
26688	0	1	0	1	0	5	51	24	65
26690	0	0	0	0	444	5	91	13	33
26691	0	1	0	1	999	444	3	38	65
26694	0	1	0	0	999	444	77	33	29
26699	0	1	1	0	0	3	64	29	888
26700	0	1	0	0	0	444	44	13	15
26701	0	1	0	0	1	444	57	28	999
26704	0	1	1	1	1	3	86	13	999
26705	0	0	0	1	444	3	47	13	58
26706	0	1	0	1	0	3	38	13	33
26707	0	1	1	0	0	444	78	30	888
26708	0	1	0	1	1	444	80	30	999
26710	0	1	0	0	0	444	92	26	11
26712	0	1	1	0	1	3	56	13	11
26715	0	1	0	0	1	1	55	25	22
26718	0	0	1	0	444	5	97	13	18
26720	0	1	0	0	1	444	90	30	57
26721	0	0	0	0	444	5	69	13	11
26723	0	1	0	0	1	999	51	34	44
26724	0	1	0	0	1	3	84	30	888
26726	0	1	1	0	1	3	93	27	999

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
26727	0	1	0	0	0	1	48	46	25
26728	0	1	0	0	1	3	45	13	55
26729	0	1	1	0	1	444	99	22	40
26731	0	0	1	0	444	5	34	13	43
26732	0	1	0	0	999	444	57	35	65
26735	0	0	1	0	444	3	86	13	40
26736	0	1	1	0	1	3	79	22	65
26737	0	0	0	0	444	3	79	13	33
26739	0	1	0	0	1	3	66	29	29
26744	0	1	0	0	1	444	73	28	15
26746	0	1	0	0	1	3	69	19	999
26749	0	1	1	0	1	444	51	27	44
26752	0	1	1	0	1	3	76	29	37
26754	2	0	0	0	444	3	50	13	33
26755	0	1	1	0	1	3	76	13	40
26756	0	1	0	0	1	3	86	24	37
26757	0	1	1	1	0	3	38	33	888
26758	0	1	1	0	1	1	58	25	19
26759	0	1	1	1	1	3	72	25	40
26760	0	1	1	0	1	3	73	13	999
26761	0	1	1	0	1	3	73	25	999
26762	0	1	1	0	0	3	47	38	888
26764	0	1	0	0	0	3	49	42	65
26765	0	1	0	1	0	3	47	39	51
26766	0	1	0	0	1	999	999	37	54
26767	0	0	1	0	0	999	81	13	999
26768	0	1	1	1	1	3	44	43	65
26769	0	1	1	0	999	444	71	39	999
26771	0	1	1	0	0	3	79	45	51
26772	0	1	0	0	1	444	82	31	999
26773	0	1	0	0	1	3	79	31	40
26774	0	1	0	1	1	3	39	29	999
26775	0	1	1	1	1	999	58	31	58
26829	0	1	0	0	1	3	48	28	58
26848	0	1	0	1	1	5	79	29	36
26850	1	0	1	0	444	3	72	13	11
26851	1	1	0	0	444	1	49	13	999
26852	1	0	1	0	444	3	64	13	999
26853	1	1	1	0	999	444	95	13	999
26854	1	1	1	0	1	444	91	13	65
26855	1	0	1	0	444	444	62	13	11
26856	1	0	0	0	444	444	95	13	36
26857	1	1	1	0	999	444	0	13	888

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
26858	1	0	1	0	444	444	90	13	999
26859	1	0	0	0	444	444	33	13	11
28007	0	1	1	0	0	2	51	15	48
28009	0	1	1	0	1	5	80	25	61
28012	0	1	1	0	1	5	93	22	33
28016	2	0	1	0	444	5	49	22	44
28017	0	0	0	0	444	5	81	13	37
28019	0	1	1	1	999	5	53	16	22
28021	0	1	1	0	1	5	78	28	30
28025	0	0	1	0	444	5	999	13	33
28031	0	1	1	1	1	5	59	27	36
28036	0	0	1	0	444	5	93	13	40
28040	1	1	1	0	0	999	7	13	444
28041	1	1	0	1	1	999	0	13	51
28042	1	1	0	0	1	999	45	13	51
28043	1	1	0	1	999	999	40	13	32
28044	1	0	1	0	444	5	58	13	29
28045	1	1	1	0	999	999	999	13	999
28046	1	0	1	0	444	444	15	13	58
28048	1	1	0	0	1	5	80	13	37
28049	1	1	0	1	1	5	92	13	999
28050	1	1	0	0	999	999	0	13	37
28051	1	1	0	0	999	999	999	13	62
28052	1	1	1	0	999	999	92	13	61
28053	1	1	1	0	999	999	26	13	999
28054	1	1	0	0	999	999	88	13	58
28055	1	1	0	0	999	5	94	13	51
28056	1	0	0	0	444	5	93	13	44
28057	1	1	0	0	1	5	64	13	65
28058	1	1	0	0	1	5	89	13	65
28059	1	1	0	1	1	5	60	13	73
28060	1	1	0	0	1	5	88	13	44
28061	1	1	0	0	999	999	94	13	999
28062	1	0	0	0	444	5	100	13	999
28063	1	1	0	0	999	5	92	13	55
28200	0	1	0	0	1	5	58	28	40
28865	0	1	0	1	1	5	100	13	37
28870	0	1	1	0	1	5	95	13	44
28871	0	0	1	0	444	5	73	13	65
28873	0	1	1	0	1	5	50	30	37
28881	0	1	1	1	1	5	999	19	22
28916	0	1	0	0	999	5	61	29	65
28918	0	1	0	0	1	5	100	31	58

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
28919	0	1	1	0	0	5	32	21	58
28921	0	1	1	0	0	5	70	28	22
28923	0	0	0	0	444	5	99	13	61
28927	0	1	1	0	0	5	19	32	36
28929	2	0	1	0	444	5	0	13	37
28932	0	1	0	0	1	4	82	29	51
28936	0	1	1	0	999	5	90	30	66
28937	0	1	0	0	1	5	75	19	41
28938	0	1	1	0	1	5	69	24	58
28940	0	1	0	1	1	5	100	27	58
28942	0	1	0	1	999	5	46	29	888
28943	0	1	1	1	1	999	74	17	61
28945	0	1	0	1	1	4	89	30	51
28948	0	0	1	0	444	5	91	13	65
28949	0	1	1	0	1	5	79	13	65
28956	0	1	1	0	0	999	79	43	47
28957	0	1	1	1	1	5	92	25	54
28959	0	0	1	0	444	2	91	13	54
28960	0	0	1	0	444	5	91	13	47
28963	0	1	1	0	0	5	78	30	65
28966	0	1	1	0	1	5	34	29	51
28978	0	0	0	0	444	5	97	13	22
28980	0	0	0	1	444	5	93	13	30
28982	0	1	0	0	1	5	93	19	50
28988	0	1	0	0	1	999	100	25	43
28992	0	0	1	0	444	5	59	13	22
28997	0	1	1	0	0	4	31	32	34
28998	0	1	0	0	0	999	48	28	51
28999	0	1	0	0	0	5	20	33	999
30199	0	1	0	0	1	5	50	35	58
30201	0	0	0	0	444	5	92	13	36
30208	2	0	1	1	444	5	83	13	22
30210	0	1	0	0	1	5	10	28	51
30223	0	0	1	0	444	999	95	13	37
30299	0	1	1	0	1	5	66	23	37
30540	0	1	1	0	0	5	50	26	999
30548	0	1	1	0	1	5	93	26	23
30549	0	0	0	0	444	5	82	13	51
30554	0	1	0	0	1	5	61	13	65
30558	0	0	0	0	444	5	75	13	36
30559	0	1	0	0	1	5	84	25	33
30560	0	1	0	0	1	5	70	32	33
30562	0	1	1	0	0	5	28	32	999

TABLE 11.--DAI, Demographic and Psychosocial Data (continued)

ID	imp	braces	gender	visitdds	needbraces	race	VAS	DAI	soc class
30563	0	1	1	0	1	5	68	25	65
30569	0	1	0	0	1	5	61	26	65
30592	0	0	0	0	444	5	65	13	58
30645	0	1	0	0	1	5	46	24	51
30649	0	0	0	1	444	5	92	13	51
30652	0	1	1	0	1	5	82	13	29
30653	0	0	1	0	444	5	62	13	47
30654	0	1	0	0	1	5	1	21	999
30659	0	0	1	0	444	5	83	13	51
30667	0	1	0	0	1	5	91	23	51
30668	0	0	1	0	444	5	94	13	61
30670	0	0	1	0	444	5	76	13	26
30693	0	1	0	1	1	5	46	27	54
30696	0	1	0	0	1	5	54	27	37
30702	0	0	0	0	444	5	88	13	22
30733	0	1	1	0	1	5	88	22	44
30734	0	1	1	0	1	5	78	20	65
30740	0	0	1	0	444	5	77	13	11
30741	0	1	1	0	1	5	68	26	33
30742	0	1	1	0	0	5	15	38	51
30743	0	0	0	0	444	5	26	13	58
30753	0	1	1	0	1	5	53	23	40
30826	0	1	1	0	0	5	30	30	29
30830	0	0	0	0	444	5	52	13	44
30831	1	0	1	0	444	5	75	13	888
30832	1	0	1	0	444	5	63	13	33
30833	1	0	1	0	444	5	61	13	37
30834	1	0	1	0	444	5	93	13	36
30835	1	1	0	1	999	999	73	13	999
30836	1	0	0	0	444	5	46	13	61
30837	1	0	0	0	444	5	63	13	65
30838	1	0	0	0	444	5	97	13	65
30839	1	1	0	0	999	999	444	13	999
30840	1	0	0	0	444	5	90		51

APPENDIX 8.--DATABASE PROGRAMMING

MICROSOFT® ACCESS DATABASE

Design

Perhaps the most difficult feature of using a relational database is the actual design of the program. Before data can be entered into the database, a schematic must be created to work backwards. Keeping in mind what questions or relationships will be examined, the various tables or containers of data must be created and the key element included in the master form. A form is the most convenient way for entering, changing and viewing records in the database.

It cannot be stressed how important it is to define, before turning on the computer, what information is to be stored in the form and in each table. Failure to do so will create much unnecessary work in the programming and debugging process, and could lead to wasted time in data entry.

Once the format of the form has been decided, creation of the program can proceed. However, before creating the program, it would be a good idea to identify which computer will be used to do the data entry, since Microsoft Access is designed to be on one machine. Duplication of the database is difficult and can create problems with data entry and/or changes in data entry. As such, identify the

computer that will be used to do the data entry and create the program in that computer.

In order to create the form, open the Microsoft® Access database program and click on the ***File*** menu and choose New Database. Microsoft® Access (MA) opens the New Database dialogue box and assigns a name to the new database. Change the name as desired. Note that a different directory may also be chosen. It is also important to note that while the database may be stored on a drive other than the 'C' drive, it is probably best to save it on 'C' as the program may get bigger than expected. Once again, transferring the program from diskette to hard drive can create a multitude of problems.

The Database Window will open at this point and allow creation of various aspects of the database. Experience has shown that the best way to create the database is to start with the ***Table*** tab and then clicking on the ***New*** tab. The reason for designing the database in the table is simply that a form can be generated from the table by utilizing the Access Wizards. Once all of the parameters of each column of the form have been well defined in the table format, the Wizard will automatically create the appropriate type of forced input format in the form. For this reason, it is suggested to create a table, generate a form from the table and run a sample of test data through the form to ensure that the form is laid out in the correct manner and that all of the information necessary is being input. If it is not, it is advisable to go back to the table, make the modifications, and then regenerate a new form.

By clicking on the ***New*** button, a Table Window will open and give several options. If the table is being created in Access with no data previously stored in programs like Excel or Paradox, the best way to create the new table is to click on ***Design View***. If the data were stored in a program like Excel or Paradox, the ***Import Table*** selection would be more appropriate. Having clicked on ***Design View***, MA will open the Table design window with three columns - Field Name, Data Type and Description. The bottom right corner of the window has a box that gives instructions and tells how to get help.

A 'Field' is equivalent to a column. As such, a 'Field Name' is the equivalent of a column heading. Information such as name, phone number, address, or supplier's name, are all fields since they contain unique but categorized data.

Once the 'Field Name' has been entered, press the ***Tab*** key on the keyboard and move to the next column, 'Data Type'. Immediately upon entering this column, the folders at the bottom left-hand corner of the screen (Properties box) will be activated and the word 'Text' will appear highlighted within the column, with a down arrow to its right. By pressing on the down arrow, a drop down list will appear and give choices such as: Text; Memo; Number; Date/Time; or Lookup Wizard.

Assuming that the first column on the form will be for the name of the student in the survey, "Name of Student" could have been entered into the 'Field Name' column and then the appropriate selection in the 'Data Type' column would be text. Having chosen 'text', information appears in the Properties box on the bottom left of the screen.

The first line of the Properties box is used to define the Field Size. By entering a number (from 1-250) on this line, a maximum is selected for the number of characters in that field. As such, if it is not expected that the name of any individual will be more than 30 characters, '30' could be entered thus limiting the input to 30 characters. By limiting the input to 30 characters, when the wizard is employed to design the form later on, the space made available for input will be proportional. As such, there will not be a five inch input area for a name, or for a 'yes' or 'no' response.

The 'Format' box is used to force the format of the data being entered into a specific design. It is a display only feature and does not affect the way in which the data is stored. The 'Format' feature will take precedence over the 'Input Mask' feature, the next line in the Properties box. An 'Input Mask' is used to force data entry into a specified format. If, for example, a telephone number is being input, the input mask can force the input into a predefined format of area code-3digits-4digits. The data is stored in this format and input masks supposedly are ignored when data is imported.

'Caption' in the Properties box is used to give the label in the form when it is created. By leaving this blank, the wizard will automatically use the 'Field Name' as the caption. It is probably better to use the 'Caption' box to enter the label and use the 'Field Name' box strictly as a way to identify data. The Microsoft manual suggests that it is best not to have spaces in the 'Field Name' box. There are other limitations to the type of characters used in the 'Field Name' box that are defined by pressing ***F1*** when the cursor is in the 'Field Name' box. Since the 'Caption' box is used to create

the label in the form, more descriptive text can be placed here. For example, in the 'Field Name' the text may read 'fname' while in the 'Caption' box it would read 'First Name'.

Assigning a 'Default Value' is more useful in situations where a certain type of answer to the question being asked, is expected. By leaving this blank, no value will be assigned automatically. If, however, data were entered for a yes/no response where a value of zero/one (0/1) were assigned respectively, then a 'Default Value' of '0' could be entered into this box. As such, when the data is being entered, the display will automatically read 'yes' (if '0' is chosen as the default) and the data entry personnel only has to press the ***Enter*** key for the value to be stored. It is pointless to assign a 'Default Value' for data that will be largely unique on each entry.

'Validation Rule' and 'Validation Text' are used when trying to force data entry within certain parameters. In the present study, students were asked to rate how they felt about their teeth before braces by placing a mark on a line. The position of the mark was converted to a score between 0 and 100. As such, when data was entered for this field, it had to be forced within 0 and 100. While the data entry personnel might know this, a validation rule was set up so that the value was forced within this parameter.

In creating the validation rule to force the number entered to be between '0' and '100', it is important to remember that a null value may also be acceptable depending on what the input is. If, for example, the student did not place a mark on the line, a null value has to be recorded. While there are several ways to handle this,

provision has to be in the 'Validation Rule' box. The commands in the box are very specific and will do exactly what it is programmed to do. As such, the obvious has to be defined. In the event that the data input is not as prescribed, the 'Validation Text' box is used to display an error message. If nothing is entered into the 'Validation Text' box, a standard error message will be displayed.

Display of the 'Validation Text' error message can prove quite useful in the debugging of the program. Sometimes as an attempt is made to exit the data entry portion of the form an error message may appear. By customizing the 'Validation Text' messages to either give a code or identify the 'Field Name' can prove invaluable. As such, the 'Validation Text' may read, "Enter a value between '0' and '100'. Error in 'howfeelaboutteethbeforebraces' (Field Name)." Such a message will tell the data entry personnel to ensure that a value is entered within the specified parameters, but should the error persist for some unknown reason, it will identify which field is causing the problem.

The 'Required' box is a 'yes/no' box in which it is specified whether data must be input into that field. In some cases it is essential to have information, such as an identification number or an impression code. In these cases, the 'Required' box should read 'yes' as this will force a value to be entered and the data entry will not proceed until a value is entered.

The 'Allow Zero Length' box is self-explanatory while the 'Indexed' box allows the input data to be indexed so that searches can be carried out faster. This would be similar to putting a red tab on your charts in a filing cabinet in that it allows

the program to quickly identify these records. Additionally, this box may be utilized to further limit the data being entered in that it dictates whether duplicates are allowed. Consider, for example, entering data on the impression code. Since it is likely that a repot will be produced later on in the data analysis, that would require identifying the impression code, the 'Indexed' box would be 'Yes'. However, since each impression code should be unique, the 'Yes (No Duplicates)' would be selected.

In the 'Data Type' box, there is a ***Lookup Wizard*** option. This option has been critical in the development of pick lists and drop down boxes that were utilized to reduce errors in data entry. In the present study, there was an area on the survey where the name of the school was to be input. Rather than having the data entry personnel enter the name of the school each time, making it both tedious and prone to errors in spelling (thus creating a new school), a pick list was employed. By clicking the arrow to the right of the input box, the data entry personnel were able to pick the applicable school from a list of all the schools surveyed.

To create such a list, the ***Lookup Wizard*** was utilized. On starting the wizard, there will be two immediate choices - allowing the table to lookup the values in another table, or typing in the values. For the information as to the school attended, it is more prudent to simply type in the values. By selecting this choice and pressing ***Next*** the wizard asks as to number of columns needed. In the case of the school, only one column with the name of the school may be necessary. However, in the present study there was also a place where the student was asked to indicate the highest level of education attained by their parents. While there were seven choices, it had been

predetermined that the level of education would be used in a calculation to estimate salary. As such, each level was assigned a category number. In this scenario, the wizard was used to create a list with two columns, one for the category number and one for the level of education. Even though the 'level of education' was displayed when the data entry personnel selected the appropriate choice, the value of the category was stored in the table. This is possible be defining which values are stored when creating the pick list by the ***Lookup Wizard***.

Date/Time

In programming to set up a field for a date, the data type selection will be 'Date/Time'. In the present study, the date of the survey was assigned a field name of 'surveydate' and the data type was defined as date/time. In the Properties box the Format was selected as Short Date which forces the display as "mm/dd/yy". Additionally, an Input Mask of "99/99/00;0;" was selected forcing data storage as literal data. The '9' allowed a digit or space entry while disallowing plus and minus signs while the '0' in the "99/99/00" allowed a digit entry where plus and minus signs were still disallowed. The '0' in the input mask of "99/99/00;***0***;" (as highlighted) allowed for literal data storage. Literal data storage allows the data to be stored in the format as defined by the input mask with the forward slashes (/). If the input mask were present without the '0' after the first semicolon, the data would be stored as a number.

Phone Number

In programming Access to accept a telephone number, the present study assigned a 'Field Name' of 'phone' and chose a 'Data Type' of 'Text'. The 'Field Size' in the Properties box was limited to 15 characters and an Input Mask was defined as "!\(999")"000\-0000;0". The initial character, an exclamation mark was used to force the data to display from right to left. This character could have been placed anywhere in the input mask for the same effect.

The backslash (\) causes the character that follows it to be displayed as the literal character while the '9' allows digit or space entry. The hyphen (-) is used as a time separator while the '0' after the semicolon is used to store the data as literal data. Neither was zero length allowed nor was the field required to have a value. It was decided that this particular field would not be indeed either.

Occupation Table

To minimize errors in data entry, an Occupation table was utilized. Similar tables were also utilized for the Providers of the dental care. In these tables, multiple columns were utilized to define the occupation, classify the occupation and categorize the occupation. Since it had been determined that these would be large tables, they were created separately by utilizing the table wizard and choosing the number of columns. Once they were created and data entered into them, the ***Lookup Wizard*** was utilized to create a Lookup value. As such, when the data entry personnel were entering data, they had simply to pick from a list of the know occupations.

To do this effectively, in the 'Data Type' column ***Lookup Wizard*** was selected and the first option of choosing to lookup the value in a table was selected. The wizard will give a list of possible tables and ask if the value being looked up is included in this list. Highlight the appropriate table and then the wizard will ask which fields should be included in the lookup table. That is to say, what information should be displayed for the data entry personnel to view. Sometimes it is necessary for the data entry personnel to see more than one column to make the appropriate selection, so this has to be taken into account. For example, if the data entry personnel were entering the name of the Orthodontist that provided care to the patient, and only the surname of the Orthodontists were displayed, what would happen if there were several orthodontists with the same surname? As such, it is important that the data entry personnel have access to enough data to make the correct choice.

Define the relationship between the lookup table and the main survey table. Usually many records in the form will relate to one record in the lookup table so a many-to-one relationship will have to be defined. Once this is accomplished, the wizard will ask for a name for the table. Assign a name to the table and click ***Finish*** to complete the task.

Accessing the Data

Once the raw data has been input, it has to be checked for errors and then utilized to produce reports to answer questions. In order to access the data, simply start the Microsoft Access program through the Program selection in the Start menu.

Once the Microsoft® Access program initiates, a Dialogue Box pops up to allow the user to choose whether they will create a new database or open an existing database. Click on the open circle next to 'Open an Existing Database' and a list of the current databases will be displayed. The current database has been stored under "C:\WINDOWS\PROFILES\BBGUEST\DESKTOP\db2". Double click on this choice and the program will open the database. If this choice does not appear in the window, simply click on 'More Files' and locate it directly off the C drive.

When the database is opened, the Database box is displayed with the title "db2:Database". Several folders will be evident, and include, Tables, Queries, Forms, Reports, Macros and Modules.

Data Entry

To enter data into the database, go to the 'Form' tab and then double click on the 'SURVEYFORM' label. The database will open to the form to allow viewing or entering of data. To view data in a record, simply use the scroll bar to the right of the form. To view a particular record, note the display on the bottom left of the screen. This display indicates which record is being viewed, and gives the total number of records to the right. To get to a particular record, simply enter the number of the record in the space and press ***Enter***. The particulars of that record will then be displayed in the form.

To enter data on a new individual, go to the bottom right of the screen to the Record display and press the ➤✱ (forward arrow with a star). Note that the total record count number is now greater by one. Also note that all of the fields of the

form are blank. Start entering data, using the ***Tab*** or ***Enter*** keys to move from one field to the next. In the event of any problems with data entry, there are two fields for notes at the end of the form.

Note that opposite to the blue fields asking for 'Father's Occupation' and 'Mother's Occupation' there is a push button which allows additional occupations to be entered. Due to the large number of occupations, this push button was added to facilitate ease of use. Other fields with tables do not have this allocation because there was not as much variation in their data.

Additional records for any of the tables has to be added in the table itself. If a new school is visited, the information must first be entered in the table for it to show up in the pick list. In order to do this, go back to the database dialogue box titled, "db2:Database" and click on the ***Tables*** tab. Highlight the appropriate table and either double click on it or click on the ***Open*** button to the right.

Once in the correct table, changes can be made. Note that changes in the table will affect all of the records related to that particular row. If a correction has to be made, highlight the desired cell and enter the new information. In order to add a new record to the table, go to the bottom left corner of the screen to the Record display and press the ➤✱ (arrow with a star). This will put the cursor into a new cell. All of the ID (or first) cells are on an autonumber program, so it will automatically assign a number to that cell. ***Tab*** over to the next column and enter the data. When the data for an individual row has been entered, press ***Enter*** and continue to add more data or click on the ***Save*** option (picture of a diskette). Alternately, close the window by

pressing the ***X*** at the far upper right corner of the Table and the program will ask if the changes should be saved.

Generating Queries

Now that the data has been input and any necessary corrections made, the next step is to put the data to work. The easiest way to do this is to generate 'Queries' about specific fields. The easiest way to learn about Queries after reading the Help section, is to try creating one. To access help, click on the ***Queries*** tab and then press ***F1***. Choose the fourth option "Create, modify, or view the results of a query" and read about queries. Once a basic appreciation has been gained, close the help and click on the ***Queries*** tab. Click on the ***New*** button and then choose ***Design View***. A 'Select Query' box will open with a 'Show Table' box in front of it. The show table box contains all of the tables in the database and allows the queries to be within a table or between the tables.

What if you wanted to find how many boys and how many girls had impressions? All of the data needed is in the surveytable, so highlight Surveytable and press ***Add***. Close the Show Table box. Place the cursor in the Select Query box in the first column in the 'Field' row. Click the mouse. Go to the arrow on the right and choose the desired field, 'gender' in this case. Access automatically fills in the Table designation. Click on the 'sort' row to determine how to sort the data. Choose 'Ascending'. In the Criteria row, place the criteria of the search. For gender, we know that we stored the data as '0' for 'males' and '1' for 'females'. These are the two criteria by which we can search. Since we want to know information about both of

them, put '0' (the number zero only) in the first row and '1' (the number one only) in the second row.

In the second field column, repeat the steps above to choose 'impcode' which was the field that stored data on whether an impression was taken or not. Once 'impcode' has been selected, choose how it should be sorted. Click 'Descending' for this example. Since this query may be used to do other queries, it would be a good idea to include the unique identifier, namely the 'ID'. Thus, in the third field column, choose 'ID'.

To execute a query, press the red exclamation mark on the toolbar. At a glance, it is evident that all of the records have been included and that the data has been sorted by gender and whether an impression was taken. To go back to the design view, right mouse click and choose ***Query Design***. Go to the third column and choose 'Ascending' in the 'Sort' field for the ID number. Execute the command and see the difference. Save the query by closing the window or by pressing the save command (diskette on the toolbar).

LITERATURE CITED

Adams, GR. 1977. Physical attractiveness research: Toward a developmental psychology of beauty. Hum Dev 20:217-239.

Adams, GR and AS Cohen. 1976. An examination of cumulative folder information used by teachers in making differential judgements of children's abilities. Alberta J Educ Res. 22:216-225.

Adams, GR and JC LaVoie. 1975. Parental expectations of educational and personal-social performance and childrearing patterns as a function of attractiveness, sex, and conduct of the child. Child Study J 5:125-142.

Albino, JE and Tedesco, L. 1994. Esthetic need for orthodontic treatment. In Melsen B. editor: Current Controversies in Orthodontics. Chicago. Quintessence Publishing, pp. 11-24.

Amandeep, SJ and JM Battagel. 1997. Dental crowding: A comparison of three methods of assessment. Eur J Orthod 19:543-551.

Angle, EH. 1899. Classification of malocclusion. Dent Cosmos 41:248-264.

Beglin, F. 1997. Validation of three occlusal indices of orthodontic treatment need. Thesis. Columbus. Ohio State University.

Bergstrom, K and A Halling. 1997. Comparison of three indices in evaluation of orthodontic treatment outcome. Acta Odontol Scand 55:36-43.

Birkeland, K, OE Boe,and PJ Wisth. 1996. Orthodontic concern among 11-year-old children and their parents compared with orthodontic treatment need assessed by Index of Orthodontic Treatment Need. Am J Orthod Dentofacial Orthop 110:197-205.

Bjork, A, AA Krebs, B Solow. 1964. A method for epidemiological registration of malocclusion. Acta Odontol Scand 22:27-41.

Brunelle, JA, M Bhat and JA Lipton. 1996. Prevalence and distribution of selected occlusal characteristics in the US population, 1988-1991. J Dent Res 75(Spec Iss):706-713

Buchanan, IB, WC Shaw, S Richmond, KD O'Brien and M Andrews. 1993. A comparison between the PAR and the Summers' occlusal indices. Eur J Orthod 15:27-37.

Burden, DJ. 1995. Need for orthodontic treatment in Northern Ireland. Community Dent Oral Epidemiol 23:62-63.

Burden, DJ, CM Mitropoulos and WC Shaw. 1994. Residual orthodontic treatment in a sample of 15- and 16-year-olds. Br Dent J 176:220-224.

Cons, NC, J Jenny, FJ Kohout. 1983. Perception of occlusal conditions in Australia, the German Democratic Republic, and the United States. Int Dent J 33:200-206.

Cucalon, A and RJ Smith. 1990. Relationship between compliance by adolescent orthodontic patients and performance on psychological tests. Angle Orthod 60(2):107-114.

Dann, C, C Phillips, HL Border, JF Tulloch. 1995. Self-concept, class II malocclusion, and early treatment. Angle Orthod 65(6):411-416.

Draker, HL. 1960. Handicapping labio-lingual deviations: A proposed index for public health purposes. Am J Orthod Dentofacial Orthop 46:295-305.

Fleiss, JL, MJ Slakter, SL Fischman, MH Park and NW Chilton. 1979. Interexaminer reliability in caries trials. J Dent Res 58(2):604-609.

Ghafari, JG. 1997. Emerging paradigms in orthodontics - An essay. Am J Orthod Dentofacial Orthop 111(5):573-580.

Gosney, MBE. 1985. An investigation into factors which may deter patients from undergoing orthodontic treatment. Br J Orthod 12:133-138.

Grainger, RM. 1967. Orthodontic treatment priority index. Washington. U.S. Government Printing Office. PHS publication No. 1000(Series 2):No. 25.

Hill, PA. 1993. The prevalence and severity of malocclusion and the need for orthodontic treatment in 9-, 12-, and 15-year-old Glasgow schoolchildren. Br J Orthod 19(2):87-96.

Holdaway, RA. 1983. A soft tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. Am J Orthod 84(6):1-28.

Holmes, A. 1992a. The prevalence of orthodontic treatment need. Br J Orthod 19(3):177-182.

Holmes, A. 1992b. The subjective need and demand for orthodontic treatment. Br J Orthod 19(4):287-297.

Jenny, J. 1975. A social perspective on need and demand for orthodontic treatment. Int Dent J 25(4):248-56.

Jenny, J and NC Cons. 1996. Establishing malocclusion severity levels on the Dental Aesthetic Index (DAI) scale. Aust Dent J 41:43-46.

Katz, RV. 1978. Relationships between eight orthodontic indices and an oral self-image satisfaction scale. Am J Orthod 73:328-334.

Kiyak, HA, RA West, T Hohl and RW McNeill. 1979. The psychological impact of orthognathic surgery: A 9-month follow-up. Am J Orthod 75:507-516.

Kleck, RE and C Rubenstein. 1975. Physical attractiveness, perceived attitude similarity, and interpersonal attraction in opposite-sex encounter. J Pers Soc Psychol 31:107-114.

Le, N. 1998. Orthodontic utilization and treatement outcome in Cuyahoga county, Ohio. Thesis. Cleveland. Department of Orthodontics. Case Western Reserve University.

Lewit, DW and K Virolainen. 1968. Conformity and independence in adolescents' motivation for orthodontic treatment. Child Dev 39:1189-1200.

Macgregor, FC. 1979. Social and psychological implications of dentofacial disfigurement. Angle Orthod 40:231-233.

Massler, M and DM Frankel. 1951. Prevalence of malocclusion in children aged 14 to 18 years. Am J Orthod Dentofacial Orthop 1951;37:751-768.

Mathes, EW. 1975. The effects of physical attractiveness and anxiety on heterosexual attraction over a series of five encounters. J Marriage Family 37:769-774.

Michaels, C, M. Bennett, R Weyant, K O'Brien and K Vig. 1994. Comparing orthodontist and consumer expectations of orthodontic treatment. J Dent Res 73:443 (Abstract).

Murray, AM. 1989. Discontinuation of orthodontic treatment: A study of the contributing factors. Br J Orthod 16(1):1-7.

O'Mullane, DM. 1973. Some factors predisposing to injuries of permanent incisors in school children. Brit Dent J 134:328-332.

Ostler, S and HA Kiyak. 1991. Treatment expectations vs. outcomes in orthognathic surgery patients. Int J Adult Orthodon Orthognath Surg 6:247-256.

Patel, V. 1992. Non-completion of active orthodontic treatment. Br J Orthod 19(1): 47-54.

Phillips, C, T Griffin and E Bennett. 1993. Perception of facial attractiveness by patients, peers, and professionals. Int J Adult Orthodon Orthognath Surg 10(2):127-135.

Pitt, EJ, and Korabik, K. 1977. The relationship between self-concept and profile self perception. Am J Orthod 72:459-460 (Abstract).

Proffit WR, JL Ackerman. 1973. Rating the characteristics of malocclusion: A systematic approach for planning treatment. Am J Orthod 64:258-269.

Proffitt, WR. 1986. Malocclusion and dentofacial deformity in contemporary society. In: Contemporary Orthodontics. St. Louis. C.V Mosby. pp.2-13.

Richmond, S. 1990. A critical evaluation of orthodontic treatment standards in the general dental service in England and Wales. PhD Thesis, University of Manchester.

Richmond, S, WC Shaw, KD O'Brien, IB Buchanan, R Jones, CD Stephens, CT Roberts and M Andrews. 1992a. The development of the PAR Index (Peer Assessment Rating): Reliability and validity. Eur J Orthod 14:125-139.

Richmond, S, WC Shaw, CT Roberts and M Andrews. 1992b. The PAR Index (Peer Assessment Rating): Methods to determine outcome of orthodontic treatment in terms of improvement and standards. Eur J Orthod 14:180-197.

Richmond, S, M Andrews and CT Roberts. 1993a. The provision of orthodontic care in the general dental services of England and Wales: Extraction patterns, treatment duration, appliance types and standards. Br J Orthod 20(4):345-350.

Richmond, S, WC Shaw, CD Stephens, WG Webb, CT Roberts and M Andrews. 1993b. Orthodontics in the general dental service of England and Wales: A critical assessment of standards. Br Dent J 174:315-329.

Roberts, EE, JY Kassab, JS Sandham, DR Willmot. 1994. Non-completion of active orthodontic treatment. Br J Orthod 21(3):275-278.

Rugh, JI and WK Solberg. 1985. Oral health status in the United States: Temporomandibular disorders. J Dent Educ 49:398-405.

Rutzen, SR. 1973. The social importance of orthodontic rehabilitation: Report of a five year follow-up study. J Health Soc Behav 14:233-240.

Saltzman, JA. 1968. Handicapping malocclusion assessment to establish treatment priority. Am J Orthod Dentofacial Orthop 1968;54:749-765.

Sclare R. 1945. Orthodontics and the school children: A survey of 680 children. Brit Dent J 79:278-280.

Shaw WC, HG Lewis and NRE Robertson. 1975. Perceptions of malocclusion. Brit Dent J 138:211-216.

Shaw, WC. 1981. The influence of children's dentofacial appearance on their social attractiveness as judged by peers and lay adults. Am J Orthod 79:399-415.

Shaw, WC, SC Meek and DS Jones. 1980. Nicknames, teasing, harassment and the salience of dental features among school children. Br J Orthod 7:75-80.

Shaw WC, M Addy, PMH Dummer, C Ray and N Frude. 1986. Dental and social effects of malocclusion and effectiveness of orthodontic treatment: A strategy for investigation. Community Dent Oral Epidemiol 14:60-64.

Sigall, H and N Ostrove. 1975. Beautiful but dangerous. Effects of offender attractiveness and nature of the crime on juridic judgement. J Pers Soc Psychol 31:410-414.

Stallard, H. 1932. The general prevalence of gross symptoms of malocclusion. Dent Cosmos 74:29-37.

Starnbach, HK and A Kaplan. 1975. Profile of an excellent orthodontic patient. Angle Orthod 45(2):141-145.

Stenvik, A, L Esperland, BO Linge and L Linge. 1997. Lay attitudes to dental appearance and need for orthodontic treatment. Eur J Orthod 19:271-277.

Stephens, CD, KJ Drage, S Richmond, WC Shaw, CT Roberts and M Andrews. 1993. Consultant opinion on orthodontic treatment plans used by dental practioners: A pilot study. J Dent 21:355-359.

Summers, CJ. 1971. A system for identifying and scoring occlusal disorders. Am J Orthod Dentofacial Orthop 59(6):552-567.

Tjan, AH, GD Miller and JG The. 1984. Some esthetic factors in a smile. J Prosthet Dent 51:24-28.

Tucker, MR and WR Proffit. 1991. Temporomandibular dysfunction: considerations in the surgical-orthodontic patient. In Proffit WR, RP White Jr. Surgical-Orthodontic Treatment. St Louis. Mosby-Year Book, Inc. pp 660-707.

Tulloch, JFC, C Philliphs and WR Proffit. 1995. Early vs. late treatment of Class II malocclusion: Preliminary results from the UNC clinical trial. In: McNamara JA Jr, editor. Orthodontic Treatment: Outcome and Effectiveness. Craniofacial Growth Series. Ann Arbor: Center for Growth and Development. University of Michigan. pp 81-112.

Wheeler, TT, SP Mc Gorray, L Yurklewicz, SD Keeling and GJ King. 1994. Orthodontic treatment demand and need in third and fourth grade schoolchildren. Am J Orthod Dentofacial Orthop 106(1):22-33.

978 308CS TH 9335
08/98 99-104-07

Department of Undergraduate