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GRADUATE STUDIES

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ORTHODONTIC UTILIZATION AND TREATMENT OUTCOME IN CUYAHOGA COUNTY, OHIO

by

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Submitted in partial fulfillment of the requirements

for the Degree of Master of Science in Dentistry

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August 14, 1998

ORTHODONTIC UTILIZATION AND TREATMENT

OUTCOME IN CUYAHOGA COUNTY, OHIO

Abstract

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Previous studies have shown that orthodontic services have been provided to an increased proportion of the population. This study surveyed a sample of 1360 tenth grade students enrolled in eleven different Cuyahoga County public high schools between September and December 1997 to estimate orthodontic utilization rate and treatment outcome. A visual analog scale (VAS) was used to measure the students' perception of their own smile. Survey results showed that 32% of the sample (436/1360) were treated orthodontically by 104 different practitioners. The mean pre-treatment VAS score was 39 ± 25 and the mean post-treatment VAS score was 74 ± 20 (n = 436). Dental study casts were obtained for a sub-sample of 149 students and scored for outcome using the Peer Assessment Rating (PAR) Index. The mean post-treatment PAR score was 10.8 ± 5.1 (n = 149) and the extraction rate was 19.5% (n = 149). There was a weak relationship between the VAS score and the PAR score ($r = -0.1$, $p \leq 0.04$). These results suggest that the VAS scale and PAR Index measure different aspects of orthodontic treatment outcome. Further, the outcome of

orthodontic services provided in Cuyahoga County, as measured by the PAR Index and the VAS scale, was within the range considered by orthodontists to be satisfactory.

DEDICATION

To my family, thank you for your continuous support of my professional and personal endeavors.

To all my friends, thank you for all the fun times and the great memories here in Cleveland.

ACKNOWLEDGEMENTS

To my classmates, Vidya, Charissa, Randy, and Ryan, and colleagues of the classes of 1997 and 1999, thank you for all the great memories.

To my thesis committee members, Drs. Mark Hans, Suchitra Nelson, and Azzam Aljundi, thank you for your guidance in this project.

Special thanks to Roland L. Feghali for educating and calibrating me on the PAR Index.

I appreciate the assistance from Lowell Bernard, Leonor Hernandez, Yumi Abei, and all the dental students with the data collection.

I thank the faculty and staff in the Department of Orthodontics at CWRU for giving me the knowledge of orthodontics.

TABLE OF CONTENTS

Page

ABSTRACT ii

DEDICATION iv

ACKNOWLEDGEMENTS v

TABLE OF CONTENTS vi

LIST OF TABLES viii

INTRODUCTION 1

LITERATURE REVIEW 3

STATEMENT OF THE HYPOTHESIS 30

MATERIALS AND METHODS 31

RESULTS 40

DISCUSSION 50

SUMMARY AND CONCLUSIONS 59

APPENDICES

APPENDIX 1. Consent Form 61

APPENDIX 2. Dental Health Survey 63

APPENDIX 3. Schedule of School Visits 64

APPENDIX 4. The Par Ruler 65

APPENDIX 5. The PAR Scoring Sheet 66

APPENDIX 6. PAR Score and VAS Score Data 67

APPENDIX 7. Overall Data Sheet 72

LITERATURE CITED 85

LIST OF TABLES

Table Page

1. Sample Demographics 40
2. Age Distribution by School 41
3. Number and Percent of Treated Group 42
4. Number and Percent by Gender 42
5. Post-Treatment PAR Score (Weighted) 43
6. PAR Components (Weighted) and Extraction Status 44
7. Total PAR Score Between the Genders 44
8. VAS*before* Scores 45
9. VAS*now* Scores 46
10. Reliability of VAS Score 47
11. Reliability of PAR Score 48
12. PAR (Weighted Score) Compared to Previous Studies 49
13. Date of Survey and Impression 64
14. PAR Score and VAS Score Data 67
15. Overall Data Sheet 72

INTRODUCTION

In studying the orthodontic activity within a community, it is important to assess both utilization and outcome of such service. Apparent in a review of the current literature, the dynamics of dentistry and of orthodontics are changing. The importance placed on a healthy smile by the general public has increased the demand for orthodontic services. This demand could be due, in part, to an increase in the importance placed on health and fitness today. In turn, this might have led to an increase in utilization of orthodontic services.

Along with an increased popularity of orthodontic treatment among the public, there has also been an increase in the number of practitioners delivering such care. Survey studies indicate that, not only is there an increase in the number of orthodontists graduating from residency programs today, there is also an increase in the number of non-orthodontists rendering treatment, namely general dentists and pediatric dentists.

Part of the increase in the number of practitioners delivering orthodontic services is due to a recent shift in the focus of dentistry. Because of an emphasis placed on preventive care and the inception of fluoride and fluoridation of water, there has been a decline in need for restorative dental treatment. Therefore, general dentists and pediatric dentists, who traditionally focus their practices on restorative

dentistry, are now rendering orthodontic services to fill the gap in their workday. Because of this, the public has found easy access to orthodontic services.

The orthodontic profession has found it necessary to objectively evaluate finished results. There are numerous methods to quantify and qualify orthodontic results, such as, cephalometric analyses, facial and skeletal norms and standards (Broadbent et al. 1975), occlusal indices (Richmond et al. 1992), and visual perception of the "plaster on the table." Perhaps through a comparison of each orthodontic case to an accepted standard, the orthodontist can assess treatment outcome. The purpose of this study is to estimate the utilization of orthodontic services and to assess treatment outcome in a sample of tenth grade students in Cuyahoga County.

LITERATURE REVIEW

Utilization - - Who's Getting Braces?

Orthodontics is the oldest dental specialty. It is characterized by long-term treatment objectives related to dentofacial morphology and function, growth, facial balance and maturation. The utilization of orthodontic services has increased steadily in recent years. More and more people are aware of the many benefits of orthodontic treatment. The American Association of Orthodontists (AAO) periodically administers a practice survey. Questionnaires are mailed to members to characterize orthodontic practice. The 1996 census data was recently collected and analyzed. The AAO surveyed 8,593 orthodontists in the United States and Canada and received 1,440 responses, or about one in six. The data indicated that a growing number of orthodontists in the United States were delivering care to a greater number of patients than ever before. In fact, the average number of new patients seen per doctor had increased 23.8% since 1986, from 239 to 296. Likewise, the average number of new starts per orthodontist also increased 29.9%, from 154 to 200, as compared to 1986. Interestingly, of all new patients, 58% were attributed to dental referrals. This represented a slight decrease over the last ten years. Over half of the patients in each practice were female. A steady number of adult patients, forty per orthodontist per year, was found. Fifty-four percent of new patients were covered by orthodontic

health insurance, which is an increase of 6% from the 1986 figure of 48%. There was a decline in the number of patients per practice enrolled in a managed health-care program; from 16.4% in 1986 to 9% in 1996. Ironically, in 1994, 42% of orthodontists reported participation in at least one managed-care program (HMO, PPO, DMO, IPA) as compared to 10% in 1986. The trend seems to indicate that access and affordability of orthodontic services is due, in part, to insurance and managed health-care programs.

In 1990, Douglass and Furino reported on epidemiologic and demographic trends in balancing dental service requirements and supplies. They suggested that dental service requirements were determined by four demographic and epidemiologic factors. These included the population at risk, the incidence and prevalence of dental diseases, accepted standards of care, and the perceived need and expectations toward dental health by the public. Although their report dealt mainly with the trends seen in general dentistry, some comparisons and interpretations can be extrapolated to orthodontics. Due to preventive measures dental caries has decreased in the younger population. Older Americans are retaining their teeth longer and this should lead to an increased demand for dental care in the elderly. The demand for dental services, including orthodontic treatment, has steadily increased in the past decades due, in part, to an increased emphasis placed on health, fitness, and beauty. The U.S. Bureau of the Census has estimated the population will grow to 310 million in the year 2030. With this increase in population, and with the shift in dental health need from

restorative to prevention and esthetics, Douglass and Furino predicted the need for dental services, including orthodontics, will increase in the future.

In 1975, Jenny reported on social perspectives of the need and demand for orthodontic treatment. She said that many patients requested orthodontic treatment primarily for cosmetic considerations rather than for functional disability. The trend of the time was that orthodontics was only available to the economically privileged, mainly to the white upper-middle-class families. According to the AAO census data, this trend is changing and more patients from all economic backgrounds are seeking orthodontic services today. A variety of social factors relate to the perceived needs for acceptable dentofacial appearance and to the public's demand for orthodontic services. Socio-cultural factors define the norms for acceptable, normal and attractive physical appearance. Since early times, teeth have been the object of mutilations to satisfy socio-cultural expectations. Not every culture has the same concept of beauty but people in every culture will go to considerable expense, discomfort, and even physical trauma to achieve a culturally defined state of physical acceptability. The practice of piercing the ears, nose, or lips for the insertion of decorative objects is an example of this. And it is not surprising that straight, white teeth are perceived today as an important component of beauty. Today orthodontic appliances are practically a badge of honor, a symbol of beauty, endurance and wealth. Adult expectations are conditioned by socio-cultural expectations and peer pressure can influence both parents' and children's perception of need for orthodontic care. The strive for upward

mobility in society also appears to be related to this perceived need. From a sociological point of view, the need and desire of members of a society to achieve a culturally acceptable body image constitutes neither frivolity nor luxury. If children's teeth do not naturally meet the norm for esthetic dental appearance, the response of families to socio-cultural expectations and pressures produces a culturally valid need for orthodontic intervention. Along a similar line, Lindegard et al., in 1971, reported that the demand for treatment is higher among children whose parents have themselves had orthodontic treatment.

Sivertsen, in 1981, studied how different social classes benefit from the subsidized orthodontic services in Norway. A survey of nineteen hundred Norwegian children, aged 13-14 years, was mailed to two districts, A and B, in West Norway. In District A, the orthodontic fee was 90% subsidized, while in District B, there was less than a 50% subsidy for orthodontic services. There was a lower orthodontist to population ratio in District A than in District B. The actual need for orthodontic treatment was based on the referral frequency from the school dentist to the orthodontist. This actual need was found to be 40% in District A and 42% in District B and the greatest need was found in the highest social groups in both districts. The actual demand for orthodontic treatment was based on replies to two questions asking if the participant has ever had braces and whether or not they were undergoing treatment at the time. The actual demand was 27% for District A and 26% for District B. The two highest social groups in District A and the three highest social

groups in District B had the highest treatment frequency. The lowest treatment frequencies were found in the single parent families. The reasons why orthodontic treatment was not carried out related to social status. It was suggested that the two lowest social groups represented a considerable latent treatment potential for orthodontic services. That is, the need for treatment is present in these low social groups but the feasibility is not as great due to social status.

In 1995, D. J. Burden completed a study in the Salford District of Manchester to predict future demand for orthodontic treatment. He randomly sampled 540 school children who were in their final year of compulsory education, aged 15-16 years. He reported that certain factors influenced the use of orthodontic services. These factors included social class, gender, and peer pressure. The socioeconomic background of each subject was determined from the postal code of the home address using ACORN data, a classification of residential neighborhoods for the specific area. The results indicated that 165 subjects, or 30%, had orthodontic treatment. Of these, there were no statistical significance for differences in socioeconomic status and use of orthodontic services. Although seven percent more females than males had orthodontic treatment, this was not statistically significant. In contrast, the 1996 Census Data of the AAO and the 1989 survey by Roberts et al. showed a statistically significant difference; more females than males sought treatment. Of note in the Burden study was that peer influence had a statistically significant effect. That is, the subjects who received orthodontic treatment were more likely to have someone in

their peer group receiving orthodontic care. Seventy-five percent of the subjects who received orthodontic treatment had a friend who also wore an orthodontic appliance. Of the three variables assessed in this study, the influence of peer pressure was found to be the most important.

Utilization of health services is important to both providers and planners of health care delivery. Estimates of population need and utilization are required. Among the many influences on the utilization of orthodontic services are social and cultural setting. In 1980, Foster reported other influencing factors including the attitudes of the patients and parents, availability of the service, travel distance, cost of treatment, and the skill and cooperation of the patient in managing their own treatment.

In 1984, Tulloch and her associates compared attitudes toward orthodontic treatment in British and American communities. They assumed that the public's attitude about dental irregularity and their perception of the psychosocial implications of malocclusion were critical factors in the utilization of available services. Their hypothesis was that increased familiarity with orthodontic treatment would lead to more critical judgment of dental esthetics, treatment need, and increased valuation of straight teeth. They tested this by surveying two communities with historic differences in the availability and utilization of orthodontic services. They selected Lexington, Kentucky, and Cardiff, Wales because both cities had a population of approximately 200,000 to 250,000 and that most of the wage earners were employed

in administration and light industry. Their sample contained 385 children aged 11-12 years and 123 of their parents. Questions asked in the survey dealt with dental esthetics, treatment need, and knowledge about, attitudes toward, and value placed on orthodontic treatment. The Lexington group had greater knowledge about such services, but they did not have a better perception about treatment nor value straight teeth more. There was no significant difference between the two groups' judgment of dental esthetics or their assessment of treatment need. Tulloch et al. could not explain the difference in utilization of services in the two communities by differences in attitude toward malocclusion and orthodontic treatment. The null hypothesis was rejected. Of note, a difference in knowledge about, and experience with, orthodontic treatment appeared to lead to a difference in utilization of orthodontic services.

There has been research in Europe studying the utilization of orthodontic and dental services. Kenealy et al. (1989) studied the effects of social class on the uptake of orthodontic treatment. Previous studies had shown that working-class families made less use of dental services and receive inferior dental care than did middle-class families. Salzmann (1977) found that the most positive attitude towards orthodontic treatment was found in the higher social groups. The Kenealy et al. investigation examined the uptake of orthodontic treatment by families from different social classes. If a significant association were shown between uptake of orthodontic services and social class, then findings relating to the effectiveness of orthodontic treatment might be confounded by this social class factor. They utilized a

longitudinal cohort of 1,018 children aged 11-12 years living in South Glamorgan, Wales. The sample contained 51.7% middle-class families and 48.3% working-class families. Their study included an oral health examination, occlusal features assessment, and psychological and social assessment. They reported 31% of the children had received and completed orthodontic treatment. Significantly, more middle-class (36.6%) than working-class children (25%) had received and completed orthodontic treatment. They used treatment need to determine the extent of class difference in frequency of orthodontic treatment. The measure used for rating orthodontic need was determined by examination of the children's dental status compared to an "ideal" occlusion. On a 100-point scale, they judged the children's occlusion; a low score indicated a "high objective need" and a high score indicated a "low objective need" for orthodontic treatment. When a case was considered a "high objective need," there was no significant difference among the classes and the likelihood of families seeking orthodontic services was consistent among all social classes. But when the case was deemed a "low objective need," the higher social classes sought treatment more often than did the lower classes. This suggested that the uptake of orthodontic services among social classes was related to the extent of the orthodontic problem at initial evaluation.

Howell and Morel (1993) studied orthodontic treatment need. They used the Westmead Hospital Dental Clinical School in Australia to select their subjects. One hundred fifty-four adolescents, consisting of seventy-six females and seventy-eight

males, took part in the survey. Their ages ranged from thirteen to seventeen years. The investigators examined and assessed dental esthetics, malocclusion, and TMJ signs. The patients were also questioned about their opinion of dental esthetics, their interest in having orthodontic treatment, and their TMJ symptoms. The patients who the examiners considered would benefit from orthodontic treatment were placed into groups of high, medium or low priority. They found that only 63% of the adolescents who needed orthodontic treatment actually wanted the service. Fifty-six percent of the total group, according to their assessment, needed orthodontic treatment, of which the majority was for esthetic reasons.

Many people seek orthodontic services for many different reasons. The utilization of these services may have changed over the years because of the growing knowledge of and interest in dentistry and health care in general. This change may be due, in part, to the emphasis placed on value and quality of service today.

Access To Orthodontic Services

The number of orthodontists has increased along with the number of non-orthodontists offering orthodontic service. The public has a number of available practitioners to choose from in seeking service. Many families shop for orthodontic services based on quality, finances, and convenience. Currently the consumer-driven market has families seeking the best value, the best treatment at the lowest price.

There are many different places that one could find orthodontic services. The American Dental Association reported the following in their 1995 publication on distribution of dentists in the United States:

Practitioners	United States	Ohio
General Dentists	122,001	4,760
Orthodontists	8,869	369
Pediatric Dentists	3,629	140

These practitioners are spread out among solo private orthodontic practices, group practices, commercial dental centers, and dental schools.

An article written by Gottlieb, in 1984, discussed the preservation of the referral-source orthodontic practice. In his article, Gottlieb mentioned that an orthodontic practice is dependent on referrals for new patients. Referrals usually come from satisfied patients and dentists knowledgeable of the competence of care, and from others who are aware of the orthodontist's reputation, or those who just have a favorable impression of the doctor. Without such referrals in the choice of an orthodontist, the public is prone to make their choice on the basis of advertising, price, convenience or some other factor unrelated to the competence of the orthodontist. There is a formula in the economic and marketing world; V = Q/P, or perceived *value* equals *quality* divided by *price*. It is interesting to note that if price were lowered then perceived value would increase. However, if price were lowered enough, quality might also be lowered and, thus, the perceived value need not be

lowered. In today's economic climate of relative abundance, however, the public equates perceived value with price and expects an equivalent quality. According to the price theory of value, competition lowers price and advertising promotes competition. Therefore, the end result tends to limit the increase in price in the long run, thus, making it more affordable to obtain health services. Gottlieb also discussed third-party activity as a means of making orthodontic care more accessible to the public. The 40% increase in third party activity from 1984 to 1996 was also reported in the AAO census data.

Which Practitioners Are Involved?

In 1996, Wolsky and McNamara reported on orthodontic services provided by general dentists. They surveyed a stratified random sample of general dentists in Michigan to determine the amount and nature of orthodontic treatment provided by general practitioners. There was a 75% response rate. Descriptive statistics, in the form of mean, standard deviation, range and total number of respondents were calculated for each question. To assess the nature of orthodontic services, they described three different categories:

1. *Comprehensive treatment* – for those practitioners using multi-banded or bonded orthodontic appliances to treat class I malocclusions and some limited class II and class III malocclusions.

2. *Limited treatment* – including those who perform non-comprehensive treatment such as correction of anterior or posterior crossbites, molar uprighting, correction of rotations, or space maintenance.

3. *No treatment* – for those practitioners who provide no orthodontic treatment of any kind.

The results indicated that the majority of general dentists, 76%, were engaged in some form of orthodontic treatment but only 19% provided complete comprehensive orthodontic services. Of the dentists providing comprehensive services, about 15% spent 26-50% of their time rendering orthodontic treatment. A very small percentage of these practitioners spent more than 50% of their time delivering orthodontic treatment. Limited orthodontic services were provided by 57% and about 24% did not offer any orthodontic treatment. Nearly one hundred percent of the sample reported spending a quarter or less of their total practice time providing orthodontic services. In the group that provided limited orthodontic services, more than half did not have any patients in either limited or comprehensive treatment at the time the survey was completed. Of the dentists in this category, 34% had one to ten patients under active orthodontic treatment. Of those dentists providing comprehensive treatment, about 17% had more than fifty patients, whereas about one third had ten or fewer patients in active treatment. Another goal of the study was to examine the relationship between the location of the office of the general dentist and the distance to the closest orthodontic specialist. There was no significant difference between urban or rural general dental practices with regard to the nature of the orthodontic services provided. In regards to referral patterns of these general practitioners, 85% made some referral to orthodontists and 25% made no referrals at all to orthodontists. In summary, they reported that 19% of all general practitioners were engaged in

comprehensive orthodontic treatment. Further, of all orthodontic patients, 27% were treated by general practitioners, 4% were treated by pediatric dentists, and the remainder by orthodontists. Slightly less than one-third of all orthodontic patients in the study received treatment from general practitioners. Similarly, a thesis completed at Saint Louis University by Foley (1988) reported that 38% of 434 dentists sampled nationwide performed orthodontic procedures and that 19% provided comprehensive orthodontic services. In addition, a survey of Canadian dentists by Konchak and McDermott (1990) found that 20-34% of comprehensive orthodontic patients in Canada were being treated by general practitioners.

It is of concern to orthodontic profession that orthodontic services delivered by non-orthodontists has increased. The question is whether or not the general dentist is capable in rendering quality comprehensive orthodontic care to patients. In a guest editorial in 1981, Dugoni and colleagues discussed the topic of undergraduate orthodontic education. They noted that non-orthodontists delivered 55% of the orthodontic treatment provided through pre-payment programs in California. They questioned whether, or not, the general dentist had sufficient knowledge to properly recognize occlusal problems needing orthodontic intervention. They were concerned about the lack of instruction on what orthodontics can accomplish with occlusal function, with profiles, for adult patients, with growth, with orthognathic surgery, and with early mixed-dentition treatment. Often, because there is only limited orthodontic exposure at the undergraduate level, students are often turned-off by the specialty and

end up shunning the orthodontist. They reasoned that to limit the orthodontic exposure of undergraduate dental students, in hope of preserving the specialty's knowledge is counterproductive. They reported evidence that dentists who graduated from a school that gave more orthodontic instruction later referred more patients to orthodontic specialists than did dentists not as adequately trained. Dentists who were well-trained in orthodontics were able to appreciate and to recognize occlusal problems and more often referred their cases to specialists. The position they took was that upgrading undergraduate orthodontic education was in the best interest of the profession, patients, and orthodontics as a dental specialty. The end result should be a better overall experience for the undergraduate dental student, a better understanding by the general dentist of orthodontic problems and their available treatment modalities, and an appreciation for the specialty itself by general dentists.

McComb et al. (1995) studied dentists' perception of orthodontic services in Manchester, England. In their investigation, they surveyed the orthodontic referral patterns of dentists working within two different areas in Northern England. A sample of 149 dentists was selected. These dentists were sent a questionnaire directed at their perceptions of the service provided and factors influencing their choice of orthodontist. A 90% response rate was obtained, or 121 surveys were returned. Sixty-seven percent of the practitioners did not provide orthodontic treatment. Of those who provided treatment, a mean of 10.43 cases per year, with a range of one to fifty, were completed. However, 88% of these dentists completed less than ten cases

per year. It was found that about 26% of the dentists did not refer an orthodontic patient and 51% referred to at least one provider. Interestingly, they concluded that the most important factors governing the choice of orthodontic treatment provider were the length of the treatment waiting list and the standard of treatment provided.

In Great Britain in 1982, Brown and his colleagues investigated factors influencing orthodontic treatment attempted by recent graduates of two dental schools. A questionnaire was sent to graduates of Bristol and Guy's dental schools. Although the study failed to mention how many graduates responded, they reported that 75% of those who were currently in general dental practice had treated six or more orthodontic patients since qualification. About 20% reported treating more than forty five patients. Between 33-50% of the respondents chose to refer 75-100% of their orthodontic patients to a specialist and about 33% referred less than 24% of their cases to a specialist. Slightly more than 50% of the respondents were prepared to treat 24% or less of their orthodontic patients. They looked at the factors that encouraged a practitioner to treat or refer to a specialist and found that practitioners who attended orthodontic refresher courses were more likely to treat a greater number of orthodontic patients. Those treating a greater number of patients were happier to activate a removable appliance and were able to recognize anchorage loss. They concluded that an important factor in determining orthodontic treatment or referral to a specialist was the confidence in the practitioner's own ability to adjust and monitor orthodontic appliances.

In 1995, Lawrence and associates (1995a) looked at the provision of orthodontic services by general dental practitioners. They surveyed a random sample of 307 dentists from the Victorian Dentists Register in Australia. Of these, they received replies from 218 dentists, or a 71% response rate. A two-week log was kept of the activities of these dentists. The dentists surveyed generally provided a wide range of preventive and interceptive orthodontic services for their patients. During the two-week time interval, 59% of the dentists saw at least one orthodontic patient, with one dentist seeing as many as 66 orthodontic patients. Removable orthodontic appliances were utilized more commonly by dentists, apparent by the report that 35% of the dentists used removable appliances as compared to only 18% using fixed orthodontic appliances. Twenty-six percent provided comprehensive orthodontic treatment, 22% aligned anterior teeth, and 21% corrected anterior crossbites. Only a small percentage used headgear in the treatment of their patients.

In a second study on the same subject, Lawrence and associates (1995b) attempted to identify practitioner characteristics that accounted for the variations seen in the level of orthodontic services provided and which of the characteristics distinguished providers of orthodontic services. Their null hypothesis was that selected characteristics of dentists providing orthodontic services were no different from those of dentists not providing orthodontic services. By using multiple regression analysis, they were able to identify four practitioner characteristics that explained the variance in the number of orthodontic patients treated. This was

accurate 41% of the time. Dentists who treated more orthodontic patients also treated more general practice patients. They frequently used multiple sources to keep up to date in orthodontics. They perceived their patient base to contain more children than adults. And they were likely to have attended a Truitt continuing education course. Based on their findings, Lawrence and associates rejected their null hypothesis and concluded that there was a difference in characteristics among dentists who provided orthodontic services.

In 1991, Jacobs and his colleagues in Iowa City, Iowa profiled providers of orthodontic service in general dental practice. Their study was designed to look at whether general practitioners, who provided some orthodontic treatment to a relatively large proportion of their patients, tended to limit themselves to treatment of simple cases and referral of more difficult cases. Also, the study looked at whether a high volume of orthodontic treatment was linked to an expanded scope of treatment and fewer referrals. Data was gathered by mailing 1,159 questionnaires to general practices in Iowa. Of these, 728 were returned, or a response rate of 62.8%. To test for statistical significance, the Chi-square test of independence was calculated. Their results indicated that the providers of a high volume of orthodontic treatment performed the same amount of limited orthodontic treatment as providers of a low volume of orthodontic treatment. Also, these providers performed significantly more major orthodontic treatment and used significantly more fixed appliances, functional appliances, and headgears, but not removable appliances, which is in contrast to the

thoughts of Moorrees (1984) and Lawrence and associates (1995a). These providers also took significantly more hours of continuing education in orthodontics and referred significantly fewer patients to orthodontic specialists. Their findings suggested that more major orthodontic treatment was likely to be rendered by general practitioners in the future.

In 1996, Brennan and associates reported service rates of dentists and distribution of practice styles over time. The aims of their study were to establish dentist practice styles and to assess the distribution of these styles of practice between 1983 and 1988. A total of 202 general practitioners who provided service rate data in both 1983 and 1988, were used in a cluster analysis to group dentists into practice styles. Three clusters of dentists were obtained, characterized by service rates as: 1) High restorative; 2) Low total rates; 3) High diagnostic and preventive. They added that the distribution of dentists within these practice styles may be related to aging of dentists, practice maturation, population demographics, need or demand changes, or involve subtle difference in cluster classification over time. Interestingly, the distribution of cluster membership changed over time. The percentage of dentists in the 'high restorative' cluster decreased from 27.9% in 1983 to 16.6% in 1988, the 'low total rates' cluster decreased from 60.7% in 1983 to 49.2% in 1988, while the "high diagnostic and preventive" cluster increased from 11.4% in 1983 to 34.2% in 1988. These figures suggest that from the period between 1983 and 1988 dentists' focus was on diagnostic and preventive measures. Although, there was only a

minimal amount of orthodontic services provided by these practitioners in each of the three clusters. They concluded that interests and desires of the providers stem from style of practice, along with other factors such as desire for income, personal characteristics of the provider and practice setting. This style of practice may be influenced by the providers' attitudes, values, or habits, and can result in the provider having preferences for particular treatments or services such as orthodontics.

In 1983, the Association of Pedodontic Diplomates surveyed pediatric dentists regarding the orthodontic services they provided. A twenty-three question, multiple choice survey was sent to members of the Association to determine educational background in orthodontics, trends in pediatric dental practice, and types of orthodontic services provided. A 73% response rate, or 287 of 383 members, was obtained. Ninety-nine percent of the pediatric dentists reported they provided some type of orthodontic service in their practice. The responses indicated that these practitioners provided a wide range of preventive and interceptive orthodontic services, ranging from lingual holding arch appliances to full arch expansion appliances. One-third of the respondents provided some comprehensive orthodontic treatment in their practice. Twenty-three percent used the edgewise technique, 28% used straight-wire, and 5% used the Begg technique. Eighty-seven percent of pediatric dentists reported that they referred patients to orthodontists, making them still an important source of patient referrals for orthodontists. Interestingly, 59% of

the pediatric dentists reported a decline in the need for traditional pediatric dental services in their practices.

In 1988, Koroluk and associates analyzed the treatment of orthodontics by pediatric dentists and general practitioners in Indiana. A two-page questionnaire was modeled after the one previously used by the Association of Pedodontic Diplomates (1983). The survey was randomly mailed to seventy one pediatric dentist and five hundred general dentists in private practice in the State of Indiana. None of the pediatric dentists surveyed were dual-trained in both orthodontics and pediatric dentistry. To ensure that the sample represented a cross-section of the practicing dentists in Indiana, dentists were selected from each of the fourteen state dental districts. They received 364 surveys back from the general dentists, or a response rate of 76.9%. The response rate from the pediatric dentists was 92.9%. Based on their data, they reported that orthodontic treatment by general practitioners and pediatric dentists was increased. They reported that 25-33% of their respondents provided some form of comprehensive service. They also found that 62% of pediatric dentists and 18% of general practitioners provided comprehensive orthodontic treatment. More than half of the general practitioners and nearly all of the pediatric dentists in the survey had attended some type of continuing education course in orthodontics. As expected, practitioners who had attended these continuing education courses spent significantly more time providing more complex orthodontic treatment than those who had not attended such courses. Both pediatric dentists and general practitioners

surveyed provided a greater amount of orthodontic treatment, of a more complex nature, than has been shown by previous surveys.

Hayakawa and Jedrychowski (1994) studied practice characteristics of dual trained pediatric dentistry and orthodontic specialists. Surveys were mailed to 146 dentists who were trained in both orthodontics and pediatric dentistry. The survey consisted of thirty questions and asked information on demographics, integration of services in practice, practice characteristics, treatment time in various practice activities, teaching, membership in professional societies, board certification, meeting attendance and reasons for seeking dual specialty status. The response rate was 67% for the first mailing. The second mailing yielded a 79% response rate. The results indicated that most respondents were providing both pediatric dental and orthodontic services. About half of the practitioners reported that both specialties were fully integrated in their practices without separate times or days. Interestingly, patient treatment time was reported as 41% pediatric dental services and 59% orthodontic services. The respondent predicted their ten-year outlook to be 20% pediatric dentistry and 73% orthodontics. Also of note was that 79% of the respondents practiced, or taught full-time, and 21% practiced, or taught part-time.

Also, within the pediatric literature, in 1994, McKnight-Hanes and associates studied dentists' perceptions of the variety of dental services provided for children. A survey with questions pertaining to the practice of dentistry for children was mailed once to two thousand general dentists and one thousand pediatric dentists. There

were 1064 of 3000 (36%) usable responses, including 662 general dentists (33%) and 492 pediatric dentists (49%). The study mainly assessed the overall practice differences between the general dentists and pediatric dentists ranging from restorative procedures to consultation about proposed treatment plans. Of relevance was the fact that pediatric dentists reported more frequent orthodontic service for their patients. This suggested that their educational background had prepared them to recognize malocclusions in the developmental stages and to initiate corrective measures. The fact that over half of the general dentists provided only referral orthodontic services suggested that the general dentists were not as oriented to the treatment of developing malocclusions as were the pediatric dentists.

Moorrees summarized, in an American Journal of Orthodontics editorial in 1984, the topic of orthodontic specialty education, stating that specialty status implies having special skills and knowledge to deliver optimal patient care in a specific clinical discipline. He discussed that orthodontic services, traditionally provided by orthodontists, have become a much more attractive aspect of dental practice for the pediatric dentist, as well as, the general dentist. He found an increase in number of general dentists and pediatric dentists involved in orthodontic care. Because of a decrease in the prevalence of dental caries, some pediatric dentists have found that their restorative workload has diminished during the past ten years. Therefore, some pediatric dentists may begin to render orthodontic services due to the declining demand for their operative services. On the other hand, general dentists rely on

continuing education courses especially in the use of functional appliances. Orthodontics has become an increasingly more sophisticated specialty and, thus, Moorrees suggested a three year program format to encompass the vast amount of topics needed for the orthodontist to gain enough knowledge for competent practice. The question is whether the pediatric dentist and general dentist are competent enough to treat orthodontic cases after only limited courses during their respective curricular and continuing education courses. Similarly, in 1979, Haynes reported that the concern in Great Britain for services rendered by general practitioners and the quality of care delivered led to a recognition of orthodontics as a postgraduate subject combined with appropriate specialist registration. The main reason was that the provision of orthodontic treatment should be based on a greater depth of clinical experience than can be learned in general dental practice.

In 1986, Myrberg headed a group of Dutch professors at the Universities of Utrecht. Groningen, Nijmegen, and the Free University of Amsterdam to specify guidelines to be used in assessing which cases should be treated by an orthodontist and which cases could be treated by either an orthodontist or a general practitioner. The goal of these guidelines was to optimize service for the patient, whose welfare is of primary concern. The standpoint of orthodontic services in the Netherlands is based on the type and severity of the anomaly, the complexity of the treatment, the appliances to be used, and the knowledge and competence of the general practitioner

and that of the orthodontist. According to these guidelines, services a general practitioner could deliver included:

1. Diagnosis and assessment of treatment need;
2. Interceptive procedures and the supervision of development of the dentition without appliances;
3. Referral to a specialist for advice and treatment.

In 1987, Leif Linge of Norway commented on the role of the general practitioner and the orthodontist in the provision of orthodontic care. He advised that both must hold common treatment objectives for the individual patient. There is lack of significant data according to the FDI on orthodontics. Linge strongly recommended that an internationally accepted index for orthodontic purposes at the community level be developed to address problems of integration of orthodontic services within oral health care programs. Linge argued that, for the purpose of efficiency, qualified orthodontists should render orthodontic treatment, preferably, even if the case appears simple in the beginning. The more simple cases treated by specialists would demand less resources than would be needed for a system of effective communication and delegation to the general practitioner. Continuing education of all practitioners and other members of the dental team should be carried out for the respective categories and should communicate the importance of teamwork.

In 1973, the American Association of Orthodontists reported that there was a 14% decrease in overall orthodontic activity. Similarly, Gottlieb (1984) surveyed

orthodontic practices and found a decrease in number of comprehensive cases in the late 1970s and early 1980s suggesting that the decline was partly due to non-orthodontists providing orthodontic services, as well as, a decrease in birth rate and a softening economy associated with increased inflation rates.

The American Association of Orthodontists assembled a committee in 1974 to study the availability of orthodontic services. The committee was composed of one representative of each constituent society and a consultant from the Board of Trustees. Dr. Robert L. Williams of the Midwestern Society chaired the committee. Questionnaires were mailed to all of the active and associate members of the Association in 1974. They obtained a 72.1% response rate from the American members and a 60.2% response rate from the Canadian members. They predicted that, if the utilization rate (23%) and the number of patients treated by non-orthodontists (30%) remained the same in 1986 as in 1975, there would be a 38% reduction in the available number of patients per orthodontist. They attributed this to the increase in number of graduating orthodontists versus the minimal number of retiring orthodontists and the increase in non-orthodontist practitioners rendering orthodontic services. Also, the number of twelve year old adolescents decreased from the year 1974 to 1986.

Stewart and his colleagues, in 1990, studied specialist dental practice and dental education in Victoria, Australia. A survey of dentists registered with the Dental Board and resident in the State of Victoria included two sections; one for

specialist/restricted practitioners and the other for practitioners who had gained a postgraduate degree from the University of Melbourne between December 1982 and 1987. The responses suggested that demand for most specialist services appeared to be reasonably robust at the time. The majority of respondents indicated that they had been adequately trained for specialist practice. It was suggested that there were several market forces, such as financial independence, social stature, and practice lifestyles that could influence the number of applicants seeking specialty training in the future. The strongest demand was likely to be sustained for oral surgery and orthodontics. Despite the growing number of orthodontic graduates every year the demand for orthodontic service is still high.

In 1979, Calderone considered the geographic distribution of orthodontists versus general dentists. He hypothesized that general dentists practicing in rural areas would refer less orthodontic cases and would in fact have to deliver more orthodontic care because of the lack of an orthodontic specialist in the immediate vicinity. To the contrary, there was no correlation between the amount of orthodontics provided by a general practitioner and the availability of orthodontic specialty services, and therefore, geographic factors appeared to have no significant relationship to the amount of orthodontic services provided by general practitioners.

An interesting question is whether, or not, non-orthodontist practitioners deliver the same quality of care as the orthodontic specialist. Richmond et al. (1993)

reported that orthodontic treatment delivered by general dental services, in England and Wales, showed no improvement from start to finish of cases studied.

Utilization of health services encompasses a wide range of interesting topics. Many different questions can be addressed such as the percentage of the population that receives orthodontic services and the factors influencing their decision to seek service. Also, to whom these families are going and where they are going are of value. Lastly, the type of practitioner rendering the service is important. The results would have strong practical implications for the education of dentists and the economics of dentistry.

STATEMENT OF THE HYPOTHESIS

Using survey data and occlusal dental models from a sample of orthodontically treated tenth grade students in Cuyahoga County, Ohio, it was possible to answer valuable orthodontic research questions. The outcome of orthodontic treatment, the patients' perception of their own smile before and after treatment, the rate of extraction therapy, and the demographics of the treated group were all assessed from this sample. The specific goals of this study were to estimate the utilization of orthodontic services and to assess the outcome of treatment in this sample of tenth grade students. The PAR Index and the VAS scale, which is a personal perception scale, were used to determine post-treatment outcome in the treated group. The following hypotheses were derived to study this sample:

Hypothesis I:	The mean PAR score of the treated group is less than fifteen.
Hypothesis II:	If the patient feels good about their teeth now, then their PAR score is low.
Hypothesis III:	The percentage of treated cases using extractions is less than 25%.

MATERIALS AND METHODS

Study Sample

A cross-sectional sample was drawn from the tenth grade population in public high schools of Cuyahoga County. Eleven high schools were visited and a total of 1360 students surveyed. Of these 1360, thirty-two percent were orthodontically treated, leaving an available study sample of 438 students. Missing data reduced this number to 436. Impressions were taken on 162 of the 436 orthodontically treated subjects. Distortion of impression material and/or incomplete database information lowered the number of students in the impression sample to 149. Therefore, the final sample consisted of 436 orthodontically treated subjects. Dental study casts were obtained for a sub-sample of 149 of these 436 individuals.

Data Acquisition

Approval was given by the Review Committee for Human Studies in February 1997 to collect data for this study. Permission to enter each of the schools was arranged by the overall project coordinator Mr. Lowell Bernard. Table 13 shows a summary of the schedule for school visits during the data collection period.

Access to the schools was obtained by contacting the superintendent of each school district. A consent form (Appendix 1) was signed by both the participating students and their legal guardian before data was collected. The purpose of the study as well as the benefits and risks were explained.

Survey

The survey (Appendix 2) asked questions including biographical data (names, addresses, phone numbers), socioeconomic status (parents' education level and occupation), whether or not they ever had braces, how long their treatment lasted, the perception of their smiles before and after braces, and who their doctor was. Filling out the survey took about fifteen minutes, including time for instructions on how to fill out the surveys, completion of the surveys, and a question and answer session.

Each question on the survey was explained in detail to minimize the potential for ambiguous answers. Specifically, the questions dealing with occupation were explained with examples so that the students could get a better grasp on what was being asked. Also, the VAS scale was explained so that a single recorded mark crossed the 100 mm line leading to accurate data collection. The questions on whether or not the students ever had braces and who their doctors were also were explained at length with examples given. Overall, it was explained to the students that each question was important and that they needed to answer them to the "best of their knowledge."

To facilitate the data collection process, dental students manually prepared packages, which were specific for the collection of data. Each data collection package consisted of a ZipLoc™ bag (DowBrands, Indianapolis, IN) containing the following items:

1. A dental health survey
2. 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)
3. One Polybite™ Full Arch impression tray (Royal Industries, Industry, CA) labeled with the same identification number as the bag
4. One patient clinic napkin
5. Two paper towels

A five-digit identification number was placed on each bag. Two letters were used to indicate the school and three numbers to identify the subject.

Dental Impression Technique

All subjects were asked to take an impression of their own teeth using the President™ impression material. Specific instructions were given to the subjects as to the exact procedures for taking impressions of their own teeth. The entire class of students was "walked through" the impression procedure. Each class averaged about thirty students and two or three dentists monitored the impression procedures. This systematic approach allowed the impression procedures to be completed in the most efficient and timely manner with minimal risk of biohazardous contamination.

All subjects were seated at their desks in a classroom. Each subject was given a data collection package as described earlier. The subject was asked to transfer the identification number from the bag to the bottom of the survey form. Then the subjects were asked to check the contents of the bags. Next, each subject was asked to take the patient napkin out of the bag and place it on the desktop. The contents of

the bag were placed on the napkin and each student was asked to locate the impression tray. Each impression tray had an "up" side and a "down" side. Each subject was asked to verify the orientation of the tray. They were asked to place the tray into their mouths as a "practice" for when they took the actual impression. They were told to make sure they had the correct side facing up and the trays were fully seated inside their mouths and they could bite down all the way until their upper and lower teeth touched.

When the subjects were comfortable with this "practice session," it was time to take the actual impression. First, they were shown how to take the impression by a dentist or a dental student at the front of the classroom. A stepwise approach was used to ensure complete understanding by the subjects. Each subject was asked to take their two putties and mix them together completely with their hands until it turned one color (light tan). The mass of putty was divided in half and placed on each side of the tray. The trays were positioned in their mouths and the teeth closed down. The working time and the initial set of the material totaled about two minutes. This gave ample time for the students to manipulate the trays into their mouths.

The students were observed as a class by the dentists or dental students during the data collection visit. A member of the data collection team assisted those requiring help with taking the impression. Once the impression material was set, the students were advised to remove the impression tray from their mouth with one quick motion to minimize distortion. The impressions were checked for quality by the dental students or dentists or examination team. If the impression was adequate, it

was wrapped in the napkin and placed back into the bag. The corresponding survey was stapled to the bag. This procedure optimized infection control during transport back to the dental school. Obtaining these impressions took approximately one half-hour.

After the impressions were transported back to the laboratory, they were disinfected with Citrace™ Hospital Germicidal Deodorizer (Caltech Industries, Inc., Midland, MI). The impressions were sprayed liberally and left to disinfect for fifteen minutes.

The impressions were "poured up" by dental students using either dental buff stone or orthodontic white stone by a two-step method. The dental students were trained in this method by the primary investigator to ensure quality casts. One side of the impression was filled with dental stone and allowed to set before the same could be done for the other side. Dental vibrator units were used during the pour-up to ensure the most accurate reproduction of the cusps of the teeth. These models were allowed to set for thirty minutes before removal from the trays. The models were trimmed on a dental model trimmer to allow maximum intercuspation of the upper and lower teeth. Because of the time needed to allow the stone on both sides of the impression tray to completely set, each impression took about forty five minutes to pour up. To expedite the entire process about ten to fifteen impressions were poured with one mix of dental stone.

These labeled models were checked for maximum intercuspation and grouped by school. The Ortho Box Storage System™ (Raintree Essex, Inc., New Orleans,

LA), with a capacity of eighty models per box, was used to store models for each school.

Visual Analog Scale (VAS)

Part of the survey included a section for the subjects to rate how they felt about their smile. A visual analog scale (VAS) was used for this purpose. The subject was asked to place a mark on a 100 mm line. One end of the line was labeled "*I feel great*" and the other end "*I feel awful.*" Subjects were asked to rate their smile before and after treatment.

The VAS score was obtained by measuring the distance from the left margin of the line to the mark placed by the subjects. Scores ranged from "0" indicating the worst to "100" indicating the best assessment of the subject's smile.

Data Analysis

PAR Scoring

The technique for PAR scoring dental casts has been previously published (O'Brien et al. 1993). Before beginning this study the primary investigator was calibrated in the use of the PAR Index. To be calibrated, the primary investigator was asked to PAR score fifteen dental casts. Another investigator calibrated by O'Brien (Roland Feghali) scored the same fifteen casts and the resulting scores were compared for reliability. A reliability above 70% was considered satisfactory. The primary investigator had a total calibration score of 91%.

The PAR Index is comprised of six components each weighted by a factor according to difficulty of correction:

1. Upper Anterior Segment (UAS) X 1
2. Right Buccal Occlusion (RBO) X 2
3. Left Buccal Occlusion (LBO) X 2
4. Overjet (OJ) X 5
5. Overbite (OB) X 3
6. Centerline (CENT) X 3

The components are scored and multiplied by their factor. Then the "weighted" scores from the six components are added to obtain a total PAR score. According to Proffit (1998), the total PAR score indicates the degree of "idealness" of the occlusion with

0 = IDEAL

≤5 = NEAR IDEAL

6-15 = GENERALLY ACCEPTABLE

≥50 = VERY SEVERE

Each set of study models was hand articulated in maximum intercuspation without the use of a wax bite for reference. The primary investigator was blinded to the identification of the provider. Appendix 5 shows the data collection sheet used for this project.

Extraction Rate

Data for the extraction rate was obtained using the dental models. Extraction versus non-extraction orthodontic treatment was assessed by looking at the teeth present on the specific models. When more than one premolar was missing, it was

assumed that they were extracted for orthodontic purposes and not congenitally absent or lost due to dental disease. Extraction of both premolars of only one arch was also counted as an extraction case. The extraction rate was computed by dividing the number of extraction cases by the total number of treated cases with an adequate impression (n = 149).

Statistics

All data was entered into a computer spreadsheet (Microsoft Excel®, Microsoft Inc., Seattle, WA) by the primary investigator. The Statistical Package for Social Science (SPSS) was used for statistical analysis. Means, standard deviations, medians, modes and percentages were calculated for all variables. A p-value of 0.05 was used to assign statistical significance. Pearson correlational coefficients were used to find relationships between the VAS score and PAR score. Using the t-test, the equality of the means of VAS scores and PAR scores between the genders, between the cases treated extraction versus non-extraction, and between the students who took impression versus no impression was analyzed. Also, reliability testing was completed for examiner reliability using PAR score data and for student reliability using VAS score data. The Intraclass correlation coefficient was used.

Limitations

The sample was obtained from a cross-sectional design and may be limited as to the accuracy of the representation of the entire target population. The target population itself was quite large, but was reduced with the specific sample of the treated group.

There were also limitations in assessing outcome. Although most impressions obtained were suitable for PAR scoring, there were a number of impressions that were distorted due to manipulation error by the students and/or the data collection team. Also, there was no wax bite registration taken with the impression and so the PAR scoring was completed using a hand articulating method for "best fit" of the two arches. This could potentially create erroneous scores.

The surveys presented some limitations as well. The accuracy of the survey answers could have been affected by recall bias, a type of information bias. The reliability of the subjects in answering the questions accurately was questionable due to the fact that they might not have known or remembered certain aspects of their orthodontic treatment history. In addition, because the survey was administered in a classroom environment, the answers could have been influenced by peer pressure.

RESULTS

Total Sample

The total sample (n = 1360) included a treated group consisting of 438 cases and an untreated group consisting of 922 cases. Missing data and/or incomplete data reduced the treated subsample to 436 and the untreated subsample to 915. Of interest to this study was the treated group of 436 and the overall sample of 1360.

Demographics

In the overall sample (n = 1360), 49% were male and 51% were female. In the treated group (n = 436), there were 48% male and 52% female. The average age of the overall sample was 15.3 years, which was coincident with the tenth grade level. The average age of the treated sub-sample was 15.8. Table 1 shows a summary of the demographic information for the different groups of interest within the overall sample.

TABLE 1. –Sample Demographics

SAMPLE	SIZE	AVG. AGE (YEARS)	% FEMALE	% MALE	# OF PROVIDERS
Total	1360	15.3	51	49	XXX
Treated	436	15.8	52	48	104
Treated + Imp	149	15.3	51	49	59

The distribution of ages is categorized by each of the eleven participating public schools and can be seen in Table 2.

TABLE 2. - - Age Distribution by School

	AGE (YEARS)								
SCHOOL	14	15	16	17	18	19	20	MISSING	TOTAL
Lakewood	7	168	40	9	5	0	1	3	233
Beachwood	1	86	25	5	0	1	0	1	119
Richmond	2	50	12	3	0	0	0	0	67
HealthCenter	2	53	19	3	0	0	0	0	77
Shaw	1	96	28	5	2	2	0	1	135
Solon	1	156	36	3	1	0	0	1	198
John Hay	2	79	45	16	7	1	0	1	151
Fairview	1	113	38	1	0	0	0	0	153
Cleveland Hts.	0	11	53	31	9	3	0	2	109
Brooklyn	0	52	14	4	0	0	0	0	70
Cuyahoga Hts.	0	33	14	1	0	0	0	0	48
TOTAL	17	897	324	81	24	7	1	9	1360
Percent	1.2	66.0	23.8	6.0	1.8	0.5	0.1	0.7	100

In Table 3, the number of treated and untreated subject is reported for each of the eleven different schools. Beachwood High had a utilization rate of about 71%, which was the highest seen among the eleven public schools. Solon High, Cuyahoga Heights High, Richmond High, and Fairview High all followed with about a fifty percent utilization rate. The overall utilization rate (n = 1360) for this sample was 32%. The eleven schools targeted were distributed randomly and represented Cuyahoga County. Note that some data is missing as mentioned earlier.

TABLE 3. - - Number and Percent of Treated Group

SCHOOL	TREATED		UNTREATED		UNKNOWN		TOTAL
	#	%	#	%	#	%	
Lakewood	62	26.6	165	70.8	6	2.6	233
Beachwood	84	70.6	33	27.7	2	1.7	119
Richmond	30	44.8	37	55.2	0	0	67
HealthCenter	2	2.6	75	97.4	0	0	77
Shaw	9	6.7	125	92.6	1	0.7	135
Solon	105	53	93	47	0	0	198
John Hay	11	7.3	140	92.7	0	0	151
Fairview	70	45.7	83	54.2	0	0	153
Cleveland	22	20.2	87	79.8	0	0	109
Brooklyn	17	24.3	53	75.7	0	0	70
Cuyahoga	24	50	24	50	0	0	48
TOTAL	436	32.1	915	67.3	9	0.7	1360

Table 4 shows the number of males and females who participated in the study for each of the eleven schools.

TABLE 4. - - Number and Percent By Gender

SCHOOL	TOTAL	MALE		FEMALE	
		#	%	#	%
Lakewood	233	108	46.35	125	53.65
Beachwood	119	59	49.58	60	50.42
Richmond	67	42	62.69	25	37.31
Health Center	77	22	28.57	55	71.43
Shaw	135	60	44.44	75	55.56
Solon	198	112	56.57	86	43.43
John Hay	151	60	39.74	91	60.26
Fairview	153	89	58.17	64	41.83
Cleveland Hts.	109	52	47.71	57	52.29
Brooklyn	70	34	48.57	36	51.43
Cuyahoga Hts.	48	24	50	24	50
TOTAL	1360	662	48.68	698	51.32

Extraction Rate

There were 162 treated cases with available impressions. Thirteen of these impressions were distorted and were not able to be used in the sample. Therefore, the number of usable dental casts was 149. Of these 149 cases, 29 were treated with extraction of premolars. The extraction rate in this sample was 19.5% (n = 149).

PAR Score

The PAR scores for the treated sample are given in Table 5. Each of the six components is listed along with their respective mean scores from a sample of 149.

TABLE 5. - - Post-Treatment PAR Score (Weighted)

n = 149	MEAN	STANDARD DEVIATION
TOTAL	10.8*	5.1
UAS	1.4	1.7
RBO	3.0	1.6
LBO	2.9	1.5
OJ	1.9	2.9
OB	1.3	1.7
CENT	0.5	1.1

*Indicates post-treatment total PAR score at satisfactory level.

As shown in Table 6 PAR scores between extraction cases and non-extraction cases were not statistically different.

TABLE 6. - - PAR Components (Weighted) and Extraction Status

PAR	EXT	NON-EXT	p-VALUE
UAS	1.8 ± 2.3	1.3 ± 1.5	0.143
RBO	3.0 ± 1.7	3.0 ± 1.5	0.796
LBO	2.8 ± 1.2	3.0 ± 1.6	0.476
OJ	2.4 ± 3.4	1.8 ± 2.7	0.266
OB	0.8 ± 1.4	1.4 ± 1.7	0.087
CENT	0.6 ± 1.2	0.5 ± 1.1	0.458
TOTAL	11.4 ± 6.5	10.8 ± 4.9	0.577

Table 7 shows that there was no significant difference seen between PAR score and gender.

TABLE 7. - - Total PAR Score Between the Genders

GENDER	SAMPLE SIZE	TOTAL PAR SCORE	p-VALUE
Male	74	11.5 ± 5.6	p = 0.201
Female	75	10.4 ± 4.8	

Visual Analog Scale

The VAS*before* score for the entire treated sample (n = 436) was 39 ± 25. This illustrates that the students recalled their smiles more on the "awful" side before treatment. There was a significant difference between the VAS*before* (*p = 0.049) scores for cases treated by extraction and cases treated by non-extraction with the VAS score being lower in the extraction cases.

There was no significant difference found in the VAS*before* scores (p = 0.074) between students with impressions and students with no impressions. Also,

there was no significant difference seen in VAS*before* (p = 0.265) scores between the genders. Table 8 summarizes these findings.

TABLE 8. - - VAS*before* Scores

	SAMPLE SIZE	VAS*before*	p-VALUE
Male	79	39 ± 23	p = 0.265
Female	80	34 ± 24	
Imp	159	36 ± 24	p = 0.074
No Imp	269	41 ± 26	
Ext	29	29 ± 20	*p = 0.049
No Ext	117	38 ± 24	

* Statistically significant from baseline (p ≤ 0.05)

The VAS*now* scores for the treated sample (n = 436) was 74 ± 20. It can be deduced that the students felt better about their smile after treatment than before treatment. Again, following logical progression one would hope that the students felt better about their smiles after treatment. There was no significant difference between the VAS*now* (p = 0.691) scores for cases treated by extraction and cases treated by non-extraction. Students who took impressions felt better about their smile now, VAS*now* = 78 (n = 161), than those who did not, VAS*now* = 71 (n = 273). This was a significant difference (*p = 0.001). This meant that the students who felt good about their smile *now* were more inclined to take impressions on the day of data collection. Table 9 summarizes these findings.

TABLE 9. - - VAS*now* Scores

	SAMPLE SIZE	VAS*now*	p-VALUE
Male	80	78 ± 16	p = 0.887
Female	81	78 ± 19	
Imp	161	78 ± 17	*p = 0.001
No Imp	273	71 ± 21	
Ext	29	79 ± 14	p = 0.691
No Ext	119	78 ± 17	

* Statistically significant from baseline ($p \leq 0.05$)

Since the PAR Index could only be used for the 146 cases that had impressions, it was necessary to test the equality of the means between VAS data from the treated sample with impressions (n = 146) and the VAS data of the treated sample without impressions (n = 271). In order to make valid inferences, the t-tests was used and no significant difference was found between the two groups of VAS*before* (p = 0.074). However, there was a significant difference between the two groups of VAS*now* (*p = 0.001) as seen in Table 9. Thus, inferences could only be made from just the sample of treated with impressions for VAS*before*. It is interesting to note that, from the data, students who felt good about their smile "now" were more inclined to go ahead with taking an impression on themselves.

Relationship of VAS score and PAR score

Correlational analysis was completed between VAS and PAR scores (n = 146). There was a negative association between these two variables but it was not strong (correlation coefficent r = -0.1). When the difference of VAS*before* and VAS*now* was correlated with the PAR score there was even less association (r = -0.09). As PAR score increased, the VASnow score decreased and vice versa. This

follows the logic that the better the student feels about their smile, the lower the PAR score.

Reliability of PAR and VAS scores

Reliability testing was completed using the Intraclass correlation coefficient *r*, where

$$r = \frac{(MSb - MSw)}{(MSb + MSw)}$$

MS*b* = Mean Square Between People
MS*w* = Mean Square Within People

To test reliability of the VAS, scores from the original survey completed at Beachwood high school (pilot study) was compared to the scores of a second survey completed four months later at the same high school. The students' names and dates of birth were matched from the two surveys (n = 40). The *r* values, seen in Table 10, for VAS*before* and VAS*now* were 0.3 and 0.4, respectively, which indicated poor reliability.

TABLE 10. - - Reliability of VAS Score

	n	MS*b*	MS*w*	r
VAS*before*	40	792.9	427.8	0.3
VAS*now*	40	689.1	279.7	0.4

MS*b* = Mean Square Between
MS*w* = Mean Square Within

Thus, the reliability of the VAS scores was not great indicating that the students were not consistent in assessing their smiles on two different dates.

Interestingly, the VAS*now* scores were slightly more reliable than the VAS*before*. This may be explained by the fact that the students were more able to tell how they felt "now" as opposed to recalling how they felt "before" treatment.

To test reliability of PAR, the primary investigator re-scored blindly about ten percent of the treated cases (n = 23). The *r* values for the PAR scores can be seen in Table 11. The values were all above 0.7 with a total PAR score value of 0.9. This indicated an overall satisfactory reliability of PAR scoring by the primary investigator.

TABLE 11. - - Reliability of PAR Score

PAR	n	MS*b*	MS*w*	r
UAS	23	7.6	0.9	0.8
RBO	23	5.6	0.7	0.8
LBO	23	3.7	0.6	0.7
OB	23	4.4	0.3	0.9
OJ	23	6.4	1.1	0.7
CENT	23	0.9	0.2	0.7
TOTAL	23	31.7	1.5	0.9

MS*b* = Mean Square Between
MS*w* = Mean Square Within

Comparison of PAR Results to Previous Studies

This project's PAR data can be compared to previous PAR studies. Table 12 lists the different PAR scores for this and previous studies.

TABLE 12. - - PAR (Weighted Score)
Compared to Previous Studies

PAR COMPONENT	LE (1998) n = 149	RED (1998) n = 300	HOLMAN (1995) n = 200
UAS	1.4 ± 1.7	0.4 ± 0.7	0.1 ± 0.4
RBO	3.0 ± 1.6	1.6 ± 0.7	1.6 ± 0.5
LBO	2.9 ± 1.5	1.6 ± 0.6	2.0 ± 0.5
OJ	1.9 ± 2.9	0.5 ± 0.4	0.5 ± 0.3
OB	1.3 ± 1.7	1.5 ± 0.6	1.2 ± 0.5
CENT	0.5 ± 1.1	0.3 ± 0.4	0.3 ± 0.3
TOTAL	10.8 ± 5.1	5.2 ± 3.5	5.9 ± 3.1

DISCUSSION

Change in the public awareness of health and fitness along with the increase in number of practitioners providing care has changed the dynamics of orthodontic care delivery. The purpose of this study was to estimate the utilization rate and evaluate orthodontic treatment outcome in tenth graders living in Cuyahoga County. Also, each student assessed his or her smile, which was used as a measure of orthodontic treatment outcome. Specifically, surveys and dental casts of high school students' teeth were obtained. The outcome of orthodontic treatment was quantified using the PAR Index and the VAS scale. The extraction rate was also reported and correlational analyses were completed to find the relationship between PAR and VAS scores. The overall quality of orthodontic treatment completed in Cuyahoga County was assessed.

Demographics

The demographics of this sample were similar to previous studies (Holman 1995, Red 1998). The overall utilization rate (n=1360) was 32% with 104 different practitioners providing treatment. Females were treated slightly more often than males; 51% and 49%, respectively. This is in accordance to other studies that report an almost equal utilization between the genders with females slightly higher. The mean age of the sample was 15.3 years. The eleven schools were distributed randomly and represented an adequate sample of Cuyahoga County, Ohio.

Extraction versus Non-Extraction

In this study, the extraction rate was 19.5%, which was less than the 25% originally hypothesized. This reflects the current non-extraction trend. Is this due to market forces? Or is it due to better understanding of the biology of tooth movement and the stability of expansion or the benefits of early treatment? That is left up to the individual practitioner and his or her own experiences to judge.

Extraction of teeth to gain space for dental alignment is a sound treatment modality in orthodontics. Interestingly, the trend for extraction therapy has been cyclic historically. Non-extraction therapy was popular in the 1920s and 1930s with the influence of Dr. Edward Angle. There was a shift to extraction therapy for better stability as professed by Dr. Charles Tweed in the 1950s. Today, there is a shift back to non-extraction treatment. This may be due in part to the popularity of certain treatment options, i.e., more expansion and more early treatment. Since the public today is very health conscious, it is also probable that the shift back to non-extraction treatment may be market driven. For example, parents might rather save all teeth if possible and they will "shop around" until they find a practitioner who will treat their child with a non-extraction option. With an increase in the number of different practitioners delivering orthodontic care today, it is probable that someone will meet the parent's wishes.

Peer Assessment Rating

The total PAR score found in the sample of treated cases with impressions (n = 149) was 10.8 ± 5.1 with a range of 2-28. This was less than the hypothesized

fifteen and falls into the "Generally Acceptable" range. Breaking down the individual PAR score components (Table 5), it was apparent that the highest scores among the cases were seen in the buccal segments, RBO and LBO. The lowest scores were seen in the centerline component. In his study, Red (1998) found similar trends in PAR score components, although his total PAR score was about half that seen in this study. Also, this discrepancy was seen in the individual components as well. This might be due, in part, to the distortion caused by hand articulating the dental casts into maximum intercuspation as will be discussed in more detail later. Such distortion can cause the reliability of the buccal segment scores to be low. Nonetheless, the trends suggest that the practitioners treating these cases may have stressed anterior esthetics more than buccal occlusion in their finishing. Overall, the PAR score findings suggest that most cases treated in Cuyahoga County were treated to a satisfactory level.

The PAR scores for the extraction cases were not significantly ($p = 0.577$) different, 11.4 ± 6.5 ($n = 29$), than for the non-extraction cases, 10.8 ± 4.9 ($n = 120$). This suggests that there is no difference in outcome, as assessed by the PAR Index, between extraction and non-extraction treatment. This is in agreement with previous PAR studies (Holman 1995). There was no significant difference seen between PAR score and gender ($p = 0.201$).

Visual Analog Scale

The VAS*before* and VAS*now* scores for the treated sample ($n = 436$) were 39 $\pm$ 25 and 74 $\pm$ 20, respectively. The students felt better about their smiles after

treatment than before treatment. There was a significant difference between the VAS*before* (*p = 0.049) scores for cases treated by extraction and cases treated by non-extraction. Though, there was no significant difference with the VAS*now* scores (p = 0.691).

In looking at whether or not students took impressions, there was no significant difference found in the VAS*before* scores (p = 0.074). To the contrary, there was a significant difference in the VAS*now* scores between students who took impressions and students who did not (Table 9). Subjects who felt good about their smile *now* were more inclined to take impressions of their teeth. This was a selection bias in the study. If all subjects took impressions regardless of how they felt about their smiles, the total PAR score of the sample may be slightly higher even though PAR and VAS probably measure different aspects of treatment outcome. There was no significant difference seen in VAS*before* scores and VAS*now* scores between the genders.

Correlation between PAR and VAS

In assessing the correlation between PAR scores and VAS scores, it was found that there was a weak negative association. This finding suggests a reasonable assumption that when the PAR score is low, one can expect the VAS score to be high, meaning that the patient is satisfied with their smile. This follows logical reasoning. Although, because the association between these two entities is weak, it is probable that the VAS scale and PAR Index measure different aspects of treatment outcome. This may be explained by the fact that a good occlusion does not necessarily mean

that the teeth are straight. For example, a patient's treatment was finished with good interdigitation of the buccal segments, an ideal overjet and overbite, but poor alignment of the upper anterior teeth. In assessing this patient's treatment, it is probable that the PAR score would be low because the occlusion was good, whereas, the patient might rate his or her smile (VAS) with a low score because of the malaligned upper anterior segment. Thus, the VAS scale can be a subjective measure of the patient's assessment of their teeth while the PAR Index can be an objective measure of outcome from the practitioner standpoint.

Comparing PAR Results With Previous Studies

The PAR scores recorded in this study were higher than the other two reported in Table 12. The scores of the other two studies were comparable (Holman 1995, Red 1998). This may be due in part to the variation in sample sizes between this study and the other two studies. Also, as mentioned before, the fact that this study used hand articulated dental casts poured from President® impression material using the dual bite trays could have resulted in this discrepancy. Although the models were articulated into maximum intercuspation, it was sometimes difficult to find a "best fit." The other two studies utilized dental casts poured in stone from alginate impressions and hand articulated in maximum intercuspation. Due to the nature of the data collection process, there was no wax bite taken for the models in this study. Also, this study found that there were 59 different practitioners treating the 149 cases. These fifty-nine practitioners may have different experience levels and different philosophies in treatment modalities leading to variations in orthodontic results. The

other two studies assessed only one practitioner's results. This may also explain the differences seen in the PAR scores between this study and the other two studies.

Note the overall trend of the scores from the three studies. The anterior components of the occlusion (UAS, OB, OJ, CENT) all scored relatively lower than the posterior occlusion (RBO, LBO). This suggests that the practitioners treating these cases stressed the anterior occlusion more than the posterior. In addition, this may also suggests that it is more difficult to correct a class II malocclusion than to simply align teeth.

The total score in this study was almost twice as high as in the other two studies. Although the mean and standard deviation of all the components were relatively comparable among the three studies, the UAS, RBO, LBO, and OJ scores from this study were higher than the other two, leading to the total score being almost two times those found in the other studies. This discrepancy could be due to the lack of accuracy of hand articulating the dental casts into maximum intercuspation.

The centerline and overbite components showed similar scores among the three studies. This suggests that these two components were the least sensitive to distortion such as that which might have been caused by the technique of hand articulation of the dental casts.

The RBO and LBO components were about twice as high in this study than the other two studies. This suggests that the buccal segments are the most sensitive to the distortions mentioned earlier.

The overjet component showed a difference of about four times more in this study. Again, this may be due largely to the discrepancy caused by the hand articulation of the dental casts or the ability of the impression material to produce quality models.

Because all three investigators were calibrated to the same PAR standards, it is not possible that the discrepancy noted be attributed to individual interpretation. Instead, it can be reasoned that the discrepancy is possibly due to quality of dental casts used in the scoring process.

Limitations of Data Collection

The accuracy of the impressions and the subsequent poured models could affect the results of the PAR index. Distortion of the impression could be brought about by a number of reasons. First, the subjects might not have bitten down into a full occlusion. Second, the impression trays may not have been loaded properly. Third, the trays might not have been left in the mouth for an adequate length of time. All these reasons could have led to unusable impressions. Future studies should compare the quality of the President® impression material versus alginate or other impressions used for orthodontic purposes.

Also, some subjects took impressions while they still had braces on. This led to erroneous counts of usable impressions when in fact these impressions were not usable because treatment was not complete.

Obtaining permission from the schools to collect data was also difficult. Consent had to be given by the superintendent of the school district, the principal of

the school, the parents, and the participating student. This delayed the data collection process and sometimes eliminated certain schools that were originally chosen for the study due to one of the above parties declining participation.

Limitations of the PAR Index

The PAR Index is acceptable in determining orthodontic treatment outcome. There are a number of limitations to this index though. The PAR Index is a good measure of occlusal change, but does not factor in other targets of orthodontic treatment. For example, the index does not evaluate the change in soft tissue as it relates to treatment. Cephalometric radiographs are often used for orthodontic evaluation of hard tissue but the index does not take this into account.

The PAR Index does not measure other adverse dental conditions such as gingival recession, gingival hyperplasia, enamel decalcification, dental caries, dental anomalies, or TMD symptoms. Although the PAR Index is highly sensitive for overjet, overbite, and midline changes, it may not be sensitive enough to measure the fine detailing that occurs during finishing of orthodontic cases.

When scoring models in this study, it was necessary to hand articulate them to a "best fit" since there was no wax bite taken at the time of data collection. Therefore, the potential for erroneous results was increased. This is possibly the reason why the reliability (Table 11) of the PAR scoring for the primary investigator, although satisfactory, was slightly lower than obtained from standard methodologies.

Along the same lines, when PAR scoring a set of dental casts in centric occlusion, one would expect a relatively lower score than when scoring in centric

relation. This is due to the condyles seating distally and superiorly from centric occlusion to centric relation, shifting the mandible accordingly. Thus, the occlusion is altered in all dimensions, especially in the overjet component. This leads to a higher PAR score. With hand articulated models, it is hoped that the centric occlusion is achieved and, thus, if there is an error in the occlusion, it is in the direction of a lower PAR score.

Limitations of the VAS

The VAS score is a good indication of how one feels about his or her teeth before and after treatment. The problem with this type of score is that it has recall bias. Since the subjects were asked to recall how they felt about their teeth "after" their treatment had been completed, it was hard to get an accurate assessment. Also, the subjects were fifteen years old on average, and might not have taken the survey seriously or their responses could have been influenced by fellow classmates. This could lead to potential haphazard effort in completing the surveys accurately. There were no incremental marks on the VAS line to reduce the influence of the subject's response. Still, there were some subjects that circled "*I feel awful*" and "*I feel great*" giving them scores of "0" or "100." It would have been more accurate if they placed a mark on the line.

SUMMARY AND CONCLUSIONS

The utilization of orthodontic services and treatment outcomes were assessed in a sample of tenth grade students of Cuyahoga County, Ohio. Eleven high schools were randomly chosen and surveys were obtained from 1360 tenth graders. The sample of interest was the treated group, which consisted of 436 subjects. From these 436 subjects dental study casts were obtained on a sub-sample of 149.

Post-treatment PAR scoring was completed for the 149 cases with impressions. Descriptive statistics were reported for the 436 treated students. VAS scores were also calculated. The results of the study showed the following:

1. About one third (32%) of the population of tenth graders in Cuyahoga County is utilizing orthodontic services.

2. The demographics of this population is similar to other studies, indicating a reliable method of data collection.

3. The quality of orthodontic treatment rendered in Cuyahoga County, as rated by the PAR index, was satisfactory.

4. The buccal segments (RBO and LBO) showed the highest PAR scores.

5. Anterior segment, centerline, OJ, and OB all showed relatively low PAR scores.

6. The extraction rate was 19.5%, well below the hypothesized 25% for orthodontic treatment in this community.

7. Students in the extraction group felt worse (had low VAS scores) about their smiles before treatment.

8. Students felt better about their smiles after treatment than before treatment.

9. VAS score might not be reliable because the reproducibility of VAS scores by the same individual on two different dates was low ($r = 0.4$).

10. PAR Index and VAS scale probably measure different aspects of orthodontic treatment outcome.

There are conclusions that can be drawn from this study. First, there was a 32% utilization of orthodontic services in Cuyahoga County. Estimates of orthodontic need are around 40% indicating 75% of those in need of treatment are getting treatment. Second, orthodontic treatment in Cuyahoga County, as assessed by the PAR Index, was satisfactory.

APPENDIX 1. - - Consent Form

An Important Message for High School Parents. .

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 Dental School at Case Western Reserve University 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 Then have them return it to school for the classroom part 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 students can ask dental health questions that relate to their own health. Those of you who wish to send your dental health questions to class with your students may do so

We can all learn from this experience.

Parents and students gain an 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 gains by obtaining much needed information that can be used to improve the education of its future dental students,

The dental students/and participating dentists gain by becoming more aware of your community dental health needs and services

Please join us by signing the attached Parent Permission Slip and sending it back to school Now. Thank you for your participation!

APPENDIX 1. - - Consent Form (Continued)

Human Investigation Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

My child has been asked to participate in research study entitled: *Effect of Provider Education on Orthodontic Outcome*

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 School of Dentistry.

I understand that the purpose of this study is to determine the educational level of dentists providing braces and to find out how straight the teeth are after braces. This knowledge is important to children and parents considering having braces in the future.

I further understand that:

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

2. My child will have a trained dental student look in his/her mouth and measure the straightness of the teeth using a special ruler. No needles or sharp instruments will be used and there is no pain involved in the examination. The dental student will look at the teeth and measure how they fit together.

3. The information from the study is confidential and will be contained in a database for future study.

4. Dr. Mark Hans, Dr. Suchi Nelson and Mr. 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 the 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 the high school.

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

Study Subject Name:_____ Date: _____

Parent, Legal Guardian Name:_____

Relationship to Study Subject:_____

APPENDIX 2. - - Dental Health Survey

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

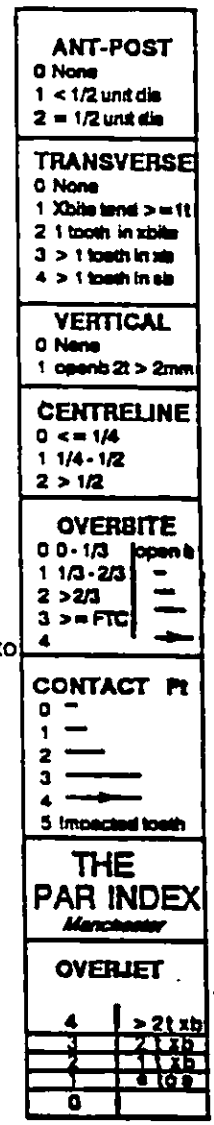
Impression ID Number _____

APPENDIX 3. - - Schedule of School Visits

TABLE 13. - - Date of Survey and Impression

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 4. - - The PAR Ruler



The first 3 sections provide a short hand summary of the buccal occlusion. Antero-posterior. transverse and vertical scores are summed for each buccal segment.

This section summarises centreline ratings. Centreline is recorded in relation to lower incisor width.

The overbite section allows recording of overlap in relation to the coverage of the lower incisors. Openbite is recorded by reference to the length of the lines on the right.

Contact point displacement. The length of the line is matched to the contact point displacements. If the distance between the contact points is greater than the line. the higher rating applies. Contact point displacements are summed for each anterior segment.

ABBREVIATIONS

xbite, xb	-	crossbite.
sb	-	scissors bite.
open b	-	open bite.
FTC	-	full tooth coverage.
t	-	tooth/teeth.
e to e	-	edge to edge.
tend	-	tendency
1/2 unit dis	-	half unit discrepancy (cusp to cusp).

This section summarises overjet and anterior crossbite ratings. These ratings are summed if both are present.

APPENDIX 5. - - The PAR Scoring Sheet

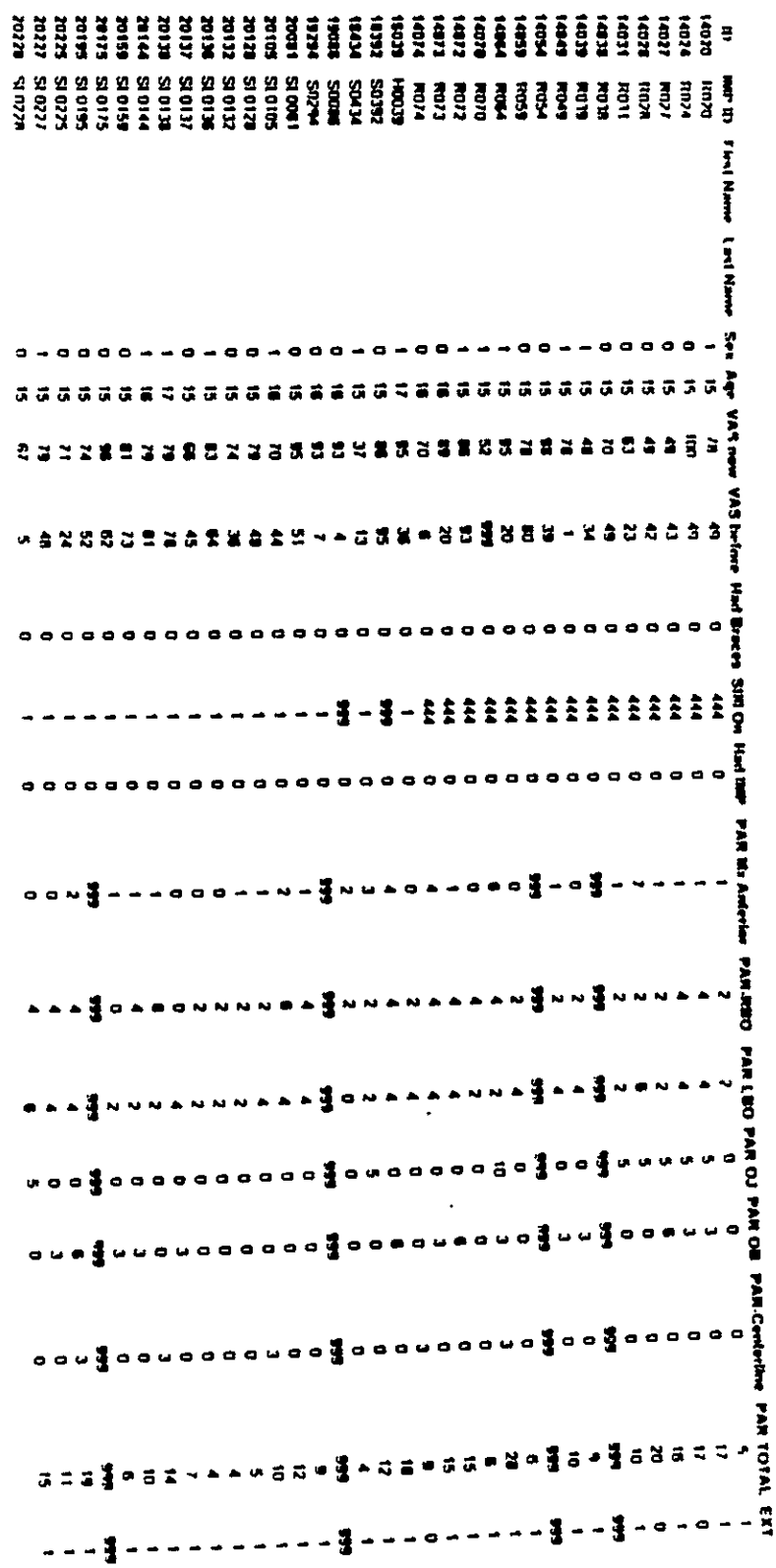
Patient_____ Rater_____ Date_____

PAR INDEX COMPONENT	SUB-COMPONENTS	RAW PAR SCORE	WEIGHTING	WEIGHTED PAR SCORE
Maxillary Anterior Alignment	Displacement			
	Impaction			
	Total		1	
Right Buccal Occlusion	Antero-posterior			
	Vertical			
	Transverse			
	Total		2	
Left Buccal Occlusion	Antero-posterior			
	Vertical			
	Transverse			
	Total		2	
Overjet	Overjet			
	Anterior Crossbites			
	Total		5	
Overbite	Overbite			
	Openbite			
	Total		3	
Centerline	Total		3	
TOTAL SCORE				

Extraction: ____Yes ____No

APPENDIX 6. - - PAR Score and VAS Score Data

TABLE 14. - - PAR Score and VAS Score Data



ID	PAR ID	First Name	Last Name	Sex	Age	VAS now	VAS before	Hard Braces	SIR On	Hard SIR	PAR Mx Anterior	PAR Mx	PAR LEO	PAR LO	PAR OJ	PAR OB	PAR Centerline	PAR TOTAL	EXT
14070	11070			1	15	78	49	0	444	0	1	1	2	2	5	3	0	5	1
14024	11024			0	15	100	49	0	444	0	4	4	4	4	5	3	0	17	0
14027	11027			0	15	48	43	0	444	0	2	2	2	2	5	3	0	16	0
14028	11028			0	15	49	42	0	444	0	2	2	2	2	5	3	0	20	0
14031	11031			0	15	63	23	0	444	0	2	2	2	2	5	3	0	10	0
14035	11035			0	15	70	49	0	444	0	2	2	2	2	5	3	0	10	0
14049	11049			0	15	78	34	0	444	0	2	2	2	2	5	3	0	10	0
14054	11054			0	15	48	49	0	444	0	2	2	2	2	5	3	0	10	0
14059	11059			0	15	78	20	0	444	0	2	2	2	2	5	3	0	10	0
14064	11064			0	15	55	20	0	444	0	2	2	2	2	5	3	0	10	0
14070	11070			0	15	55	33	0	444	0	2	2	2	2	5	3	0	10	0
14072	11072			0	16	88	53	0	444	0	2	2	2	2	5	3	0	10	0
14073	11073			0	15	88	53	0	444	0	2	2	2	2	5	3	0	10	0
14074	11074			0	17	70	20	0	444	0	2	2	2	2	5	3	0	10	0
18039	18039			0	15	55	36	0	444	0	2	2	2	2	5	3	0	10	0
18352	50352			0	15	88	55	0	444	0	2	2	2	2	5	3	0	10	0
18424	50424			0	15	37	13	0	444	0	2	2	2	2	5	3	0	10	0
19086	50086			0	16	63	7	0	444	0	2	2	2	2	5	3	0	10	0
19294	50294			0	15	55	51	0	444	0	2	2	2	2	5	3	0	10	0
20081	10081			0	15	70	44	0	444	0	2	2	2	2	5	3	0	10	0
20105	10105			1	18	78	69	0	444	0	2	2	2	2	5	3	0	10	0
20128	10128			0	15	74	36	0	444	0	2	2	2	2	5	3	0	10	0
20132	10132			0	15	74	34	0	444	0	2	2	2	2	5	3	0	10	0
20136	10136			0	15	63	45	0	444	0	2	2	2	2	5	3	0	10	0
20137	10137			0	15	68	34	0	444	0	2	2	2	2	5	3	0	10	0
20138	10138			0	17	74	31	0	444	0	2	2	2	2	5	3	0	10	0
20144	10144			0	16	74	31	0	444	0	2	2	2	2	5	3	0	10	0
20159	10159			0	15	88	72	0	444	0	2	2	2	2	5	3	0	10	0
20215	10215			0	15	88	72	0	444	0	2	2	2	2	5	3	0	10	0
20255	10255			0	15	74	52	0	444	0	2	2	2	2	5	3	0	10	0
20275	10275			0	15	74	52	0	444	0	2	2	2	2	5	3	0	10	0
20227	10227			0	15	74	49	0	444	0	2	2	2	2	5	3	0	10	0
20278	10278			0	15	67	5	0	444	0	0	0	4	4	5	3	0	15	0

TABLE 14. - - PAR Score and VAS Score Data (Continued)

ID	IMP ID	First Name	Last Name	Sex	Age	VAS now	VAS before	Had Braces	Still On	Had IMP	PAR Mx Anterior	PAR-RBO	PAR LBO	PAR-OJ	PAR OB	PAR-Centerline	PAR-TOTAL	EXT
20238	SI 0238			0	15	100	11	0	1	0	999	999	999	999	999	999	999	999
20240	SI 0240			1	15	55	33	0	1	0	1	2	6	5	0	0	14	1
20250	SI 0250			1	15	83	34	0	0	0	2	2	2	0	3	3	12	1
20252	SI 0252			0	15	74	22	0	0	0	1	2	2	5	3	3	16	1
20265	SL0265			0	15	90	33	0	1	0	0	4	2	0	0	0	6	1
20271	SL0271			1	15	68	51	0	1	0	2	4	4	5	0	0	15	1
20273	SL0273			0	15	100	47	0	1	0	3	2	2	0	0	0	7	1
20279	SL0279			1	15	80	16	0	999	0	999	999	999	999	999	999	999	999
20307	SL0307			1	15	46	46	0	999	0	2	2	4	5	3	3	19	1
20309	SL0309			0	15	69	50	0	1	0	0	4	2	0	0	3	9	1
20315	SL0315			1	15	61	22	0	1	0	1	4	2	0	0	3	10	1
20316	SL0316			1	16	61	28	0	1	0	2	0	2	0	0	0	4	1
20320	SL0320			1	16	92	5	0	1	0	4	2	2	0	0	0	6	1
20324	SL0324			1	15	65	36	0	1	0	1	6	2	0	0	0	9	1
20335	SL0335			0	15	76	44	0	1	0	2	2	2	10	0	0	16	1
20337	SL0337			0	15	90	45	0	0	0	10	2	2	5	0	3	22	0
20339	SL0339			0	15	84	44	0	1	0	1	4	4	0	0	0	9	1
20342	SL0342			0	15	67	46	0	1	0	0	4	4	0	3	0	11	1
20353	SL0353			0	15	78	34	0	1	0	1	4	2	0	0	0	7	1
20361	SL0361			1	15	95	39	0	1	0	1	4	4	0	0	0	9	1
20363	SL0363			1	15	80	28	0	1	0	0	4	4	0	3	0	11	1
20366	SL0366			1	15	82	15	0	1	0	2	4	4	0	0	3	13	1
20370	SL0370			1	16	59	39	0	0	0	2	0	2	0	3	0	7	1
20375	SL0375			1	15	83	51	0	1	0	0	2	2	0	0	0	4	1
20378	SL0378			0	15	85	47	0	999	0	2	4	4	0	3	0	13	1
20380	SL0380			1	15	89	39	0	1	0	0	2	2	0	0	0	4	1
20399	SL0399			0	15	70	23	0	1	0	0	2	4	0	0	0	6	0
20401	SI 0401			1	15	97	20	0	1	0	1	0	4	5	0	0	10	1
20405	SL0405			0	15	79	26	0	1	0	0	4	2	0	0	0	6	1
20410	SL0410			1	15	76	33	0	1	0	0	4	2	0	3	3	12	1
20417	SL0417			1	15	59	21	0	1	0	1	2	2	0	0	0	5	0
20418	SL0418			0	15	74	28	0	1	0	2	2	2	0	3	0	9	0
20419	SL0419			1	15	69	27	0	0	0	3	2	2	0	3	3	13	0
20435	SI 0435			0	15	78	14	0	1	0	1	4	2	0	0	0	7	1
20437	SL0437			0	15	85	27	0	1	0	0	4	2	5	6	0	17	1

TABLE 14. - - PAR Score and VAS Score Data (Continued)

ID	IMP ID	First Name	Last Name	Sex	Age	VAS now	VAS before	Had Braces	Still On	Had IMP	PAR Mx Anterior	PAR-RBO	PAR-LBO	PAR-OJ	PAR-OB	PAR-Centerline	PAR TOTAL	EXT
20439	SI 0439			0	15	100	34	0	1	0	0	0	2	0	0	0	2	0
20453	SI 0453			1	15	77	66	0	1	0	0	4	4	0	0	0	8	1
20458	SI 0458			0	16	81	50	0	1	0	1	4	4	5	0	0	14	1
20461	SI 0461			1	16	86	22	0	1	0	1	2	6	0	0	0	9	0
20478	SI 0478			1	15	40	29	0	1	0	0	2	2	0	3	3	10	1
20485	SL0485			1	15	93	15	0	1	0	0	4	4	0	3	0	11	1
20499	SI 0499			1	15	95	45	0	1	0	1	4	4	0	0	0	9	1
20500	SL0500			0	15	100	23	0	1	0	1	4	4	5	0	0	14	1
20502	SL0502			1	16	89	15	0	1	0	0	4	2	0	3	0	9	1
20504	SL0504			1	15	59	24	0	1	0	4	4	4	5	3	0	20	1
20507	SL0507			0	15	45	100	0	1	0	0	4	4	0	0	3	11	1
20525	SL0525			0	15	78	60	0	1	0	4	0	4	0	3	0	11	1
20526	SL0526			1	15	93	444	0	1	0	1	4	4	0	3	0	12	1
20527	SL0527			1	15	95	89	0	1	0	999	999	999	999	999	999	999	999
22187	J0187			1	15	40	49	0	1	0	6	4	2	5	0	0	17	1
22205	J0205			1	15	89	5	0	999	0	0	2	2	10	3	0	17	1
22215	J0215			0	15	59	23	0	0	0	999	999	999	999	999	999	999	999
22218	J0218			0	15	100	100	0	1	0	1	4	4	0	0	0	9	1
22224	J0224			0	16	100	444	0	444	0	6	6	0	0	3	0	15	1
22605	J0605			1	15	93	5	0	1	0	999	999	999	999	999	999	999	999
22624	J0624			0	15	83	17	0	999	0	8	2	2	0	0	0	12	1
22806	J0806			0	16	76	42	0	1	0	1	2	2	0	0	0	5	1
22823	J0823			1	15	100	48	0	1	0	0	2	2	0	3	0	7	1
24193	F0193			0	15	51	18	0	1	0	1	0	2	0	0	0	3	1
24276	F0276			0	15	89	45	0	1	0	0	2	2	0	0	0	4	0
24483	F0483			0	15	61	22	0	1	0	1	2	4	0	0	0	7	0
24544	F0544			1	16	85	26	0	1	0	0	2	2	0	0	0	4	0
24545	F0545			0	16	68	63	0	1	0	2	4	2	5	3	3	19	1
24547	F0547			1	15	92	8	0	1	0	2	2	2	0	0	0	6	1
24573	F0573			1	15	90	46	0	999	0	1	4	2	0	0	3	10	0
24581	F0581			1	15	90	4	0	1	0	0	2	4	0	0	0	6	1
24588	F0588			1	15	89	13	0	1	0	0	2	2	0	3	0	7	1
24595	F0595			1	16	83	15	0	1	0	2	4	2	5	0	0	13	0
24692	F0692			0	16	86	48	0	1	0	999	999	999	999	999	999	999	999
24697	F0697			0	15	93	36	0	1	0	1	4	2	0	0	0	7	0

TABLE 14. - - PAR Score and VAS Score Data (Continued)

ID	IMP ID	First Name	Last Name	Sex	Age	VAS now	VAS before	Had Braces	Still On	Had IMP	PAR Mx Anterior	PAR-RBO	PAR LBO	PAR OJ	PAR-OB	PAR Centerline	PAR TOTAL	EXT
24714	F0714			1	15	81	77	0	1	0	1	0	2	0	3	0	6	1
24717	F0717			0	15	90	5	0	1	0	2	4	4	5	3	0	18	0
24730	F0730			0	15	89	45	0	1	0	3	2	2	5	3	0	15	1
24745	F0745			0	16	84	37	0	1	0	0	0	2	0	0	0	2	1
24750	F0750			1	15	92	33	0	1	0	0	4	2	0	0	0	6	0
24798	F0798			0	17	71	38	0	999	0	1	0	2	5	0	0	8	1
24841	F0841			0	15	63	28	0	1	0	0	4	4	10	3	0	21	1
24842	F0842			1	15	84	26	0	1	0	1	2	2	0	0	0	5	1
24845	F0845			1	15	93	10	0	1	0	1	4	2	0	0	0	7	0
24846	F0846			0	15	95	7	0	1	0	0	6	2	10	0	0	18	0
24854	F0854			1	15	100	42	0	1	0	0	2	2	0	0	0	4	1
24882	F0882			1	15	94	5	0	1	0	1	4	4	0	0	0	9	1
24883	F0883			1	15	78	32	0	1	0	1	4	2	0	3	0	10	1
24884	F0884			0	15	89	42	0	1	0	1	2	2	5	3	3	16	1
26629	EC0629			1	15	89	45	0	1	0	0	4	6	5	3	0	18	1
26635	EC0635			0	16	89	53	0	1	0	1	2	2	0	0	0	5	1
26641	EC0641			0	17	37	18	0	1	0	2	4	0	0	3	0	9	1
26657	EC0657			1	17	60	30	0	1	0	0	0	2	5	3	3	13	1
26664	EC0664			1	16	89	57	0	1	0	0	2	4	5	0	0	11	1
26681	EC0681			0	15	82	70	0	1	0	1	4	2	5	3	3	18	0
26682	EC0682			1	15	93	13	0	1	0	0	2	4	0	0	0	6	0
26690	EC0690			0	17	91	21	0	1	0	1	2	2	5	3	0	13	1
26705	EC0705			0	19	47	50	0	1	0	4	0	0	0	0	0	4	1
26718	EC0718			1	16	97	17	0	1	0	0	4	4	0	3	0	11	1
26721	EC0721			0	16	69	68	0	1	0	1	4	4	0	0	0	9	1
26731	EC0731			1	999	34	34	0	1	0	3	4	2	5	3	0	17	1
26735	EC0735			1	16	86	32	0	1	0	0	4	2	5	3	0	14	1
26737	EC0737			0	15	79	43	0	1	0	0	2	10	0	0	0	12	1
26754	EC0754			0	17	50	48	0	1	0	3	2	4	0	0	0	9	1
26767	EC0767			1	17	81	40	0	1	0	0	4	4	0	0	0	8	1
28016	BR1016			1	15	49	52	0	1	0	999	999	999	999	999	999	999	999
28017	BR1017			0	15	81	3	0	1	0	1	0	2	0	3	0	6	0
28025	BR1025			1	15	60	100	0	1	0	1	2	2	0	3	0	8	1
28036	BR1036			1	15	93	5	0	1	0	2	4	2	5	3	0	16	1
28871	BR0871			1	16	73	24	0	1	0	1	6	2	5	0	3	17	0

TABLE 14. - - PAR Score and VAS Score Data (Continued)

ID	BMP ID	First Name	Last Name	Sex	Age	VAS now	VAS before	Had Braces	Still On	Had BMP	PAR-Mx Anterior	PAR-RBO	PAR LBO	PAR-OJ	PAR-OB	PAR-Centerline	PAR TOTAL	EXT
28923	BR0923			0	15	99	1	0	1	0	4	4	8	5	3	0	24	1
28929	BR0929			1	15	0	2	0	1	0	999	999	999	999	999	999	999	999
28948	BR0948			1	16	91	6	0	1	0	1	2	4	0	0	0	7	1
28959	BR0959			1	15	91	90	0	1	0	0	2	4	5	0	0	11	1
28960	BR0960			1	15	91	47	0	1	0	1	0	4	0	0	0	5	1
28978	BR0978			0	15	97	76	0	0	0	0	4	4	5	0	0	13	1
28980	BR0980			0	15	93	6	0	1	0	0	4	4	5	0	0	13	1
28992	BR0992			1	15	59	68	0	1	0	1	4	4	5	3	0	17	1
30201	UC0201			0	16	92	66	0	1	0	2	4	2	5	0	0	13	1
30208	UC0208			1	15	83	48	0	1	0	999	999	999	999	999	999	999	999
30223	UC0223			1	16	95	5	0	1	0	1	4	2	0	3	0	10	0
30549	UC0549			0	15	82	4	0	1	0	0	2	2	0	0	0	4	1
30558	UC0558			0	16	75	26	0	1	0	3	4	0	0	3	0	10	1
30592	UC0592			0	16	65	23	0	1	0	3	4	4	10	3	0	24	0
30649	UC0649			0	15	92	91	0	1	0	4	2	2	5	0	0	13	0
30653	UC0653			1	15	62	2	0	1	0	3	2	2	0	0	0	7	0
30659	UC0659			1	16	83	83	0	1	0	0	6	2	5	0	3	16	1
30668	UC0668			1	15	94	5	0	1	0	1	2	4	0	0	0	7	1
30670	UC0670			1	16	76	9	0	1	0	3	4	6	0	3	3	19	1
30702	UC0702			0	15	88	44	0	1	0	1	4	2	0	0	0	7	1
30740	UC0740			1	15	77	34	0	1	0	2	4	8	5	0	0	19	1
30743	UC0743			0	15	26	0	0	1	0	2	4	0	0	3	0	9	1
30830	UC0830			0	15	52	55	0	1	0	5	8	2	10	0	0	25	0

TABLE 15. - - Overall Data Sheet

ID	IMP ID	IMPcode	First Name	Last Name	Gender	Age	FamDDSname	BracesDRname	Had Braces	Still On	VAS before	** VAS now
10001		1	n/a	n/a	1	15			0	444	52	68
10004		1	n/a	n/a	1	15			0	444	96	98
10005		1	n/a	n/a	0	15			0	444	64	100
10018		1	n/a	n/a	0	15			0	444	38	38
10025		1	n/a	n/a	1	16			0	444	9	56
10026		1	n/a	n/a	1	16			0	444	58	83
10028		1	n/a	n/a	1	15	NOT APPLY		0	444	50	50
10029		1	n/a	n/a	0	15	NOT APPLY		0	444	0	80
10030		1	n/a	n/a	0	15		UNKNOWN	0	444	83	69
10031		1	n/a	n/a	0	15	MISSING		0	444	71	74
10036		1	n/a	n/a	0	15	UNKNOWN	UNKNOWN	0	444	67	79
10037		1	n/a	n/a	1	15			0	444	33	88
10045		1	n/a	n/a	1	15	UNKNOWN	UNKNOWN	0	444	50	97
10046		1	n/a	n/a	1	15			0	444	27	71
10047		1	n/a	n/a	1	16	NOT APPLY	MISSING	0	444	8	8
10059		1	n/a	n/a	0	15	MISSING	MISSING	0	444	80	100
10069		1	n/a	n/a	0	15			0	444	39	76
10071		1	n/a	n/a	0	15			0	444	50	80
10072		1	n/a	n/a	0	15			0	444	18	100
10087		1	n/a	n/a	0	15	UNKNOWN		0	444	72	89
10088		1	n/a	n/a	1	16	MISSING		0	444	0	50
10095		1	n/a	n/a	1	15	UNKNOWN		0	444	23	58
10102		1	n/a	n/a	1	15			0	444	68	85
10109		1	n/a	n/a	0	15			0	444	40	64
10116		1	n/a	n/a	0	15	UNKNOWN		0	444	25	54
10125		1	n/a	n/a	1	15			0	444	50	65
10127		1	n/a	n/a	0	16	MISSING		0	444	33	50
10128		1	n/a	n/a	0	16			0	444	33	50
10133		1	n/a	n/a	1	15	MISSING		0	444	23	73
10134		1	n/a	n/a	1	15	NOT APPLY	UNKNOWN	0	444	45	73
10140		1	n/a	n/a	0	15			0	444	51	97
10145		1	n/a	n/a	1	15			0	444	40	60
10146		1	n/a	n/a	1	15			0	444	33	97
10151		1	n/a	n/a	0	16			0	444	50	80

TABLE 15. - - Overall Data Sheet (Continued)

10154		1	n/a	n/a	0	15			0	444	71	73
10155		1	n/a	n/a	0	15			0	444	0	0
10157		1	n/a	n/a	1	15			0	444	0	80
10160		1	n/a	n/a	0	16			0	444	37	88
10162		1	n/a	n/a	0	18			0	444	33	65
10165		1	n/a	n/a	0	15			0	444	58	83
10166		1	n/a	n/a	1	15		MISSING	0	444	50	80
10168		1	n/a	n/a	1	16			0	444	999	59
10170		1	n/a	n/a	1	15			0	444	33	100
10173		1	n/a	n/a	0	15	UNKNOWN		0	444	33	50
10175		1	n/a	n/a	0	16			0	444	33	65
10177		1	n/a	n/a	0	17	UNKNOWN		0	444	8	37
10180		1	n/a	n/a	0	15			0	444	66	87
10181		1	n/a	n/a	0	15			0	444	77	79
10183		1	n/a	n/a	1	15			0	444	18	65
10188		1	n/a	n/a	1	15	MISSING	MISSING	0	444	999	65
10189		1	n/a	n/a	1	15	NOT APPLY		0	444	35	73
10191		1	n/a	n/a	1	14			0	444	18	100
10192		1	n/a	n/a	1	18			0	444	7	73
10201		1	n/a	n/a	1	15			0	444	50	56
10202		1	n/a	n/a	1	15			0	444	18	80
10205		1	n/a	n/a	1	15			0	444	45	89
10209		1	n/a	n/a	1	17	NOT APPLY	NOT APPLY	0	444	999	71
10213		1	n/a	n/a	1	15		MISSING	0	444	55	80
10215		1	n/a	n/a	0	15			0	444	95	64
10219		1	n/a	n/a	1	15	MISSING		0	444	73	68
10233		1	n/a	n/a	1	15			0	444	60	77
10234		1	n/a	n/a	1	15			0	444	0	73
12001		1			1	16			0	444	50	81
12008		1			0	15			0	444	25	57
12009		1			0	15			0	444	50	53
12011		1			0	15			0	444	71	75
12014		1			0	15			0	444	40	73
12015		1			0	15			0	444	25	45
12017		1			0	16	NOT APPLY		0	444	100	94

TABLE 15. - - Overall Data Sheet (Continued)

12018		1			0	15			0	444	34	78
12019		1			0	15		MISSING	0	444	98	98
12020		1			0	16			0	444	100	100
12022		1			0	15			0	444	81	100
12023		1			0	15			0	444	19	75
12025		1			0	15	NOT APPLY		0	444	81	96
12028		1			0	99			0	444	23	27
12030		1			0	15	UNKNOWN		0	444	50	50
12032		1			0	15	NOT APPLY		0	0	1	46
12033		1			0	15	NOT APPLY		0	444	0	0
12034		1			1	15			0	1	444	100
12035		1			1	16	NOT APPLY	UNKNOWN	0	444	64	100
12036		1			0	16			0	444	16	81
12037		1			0	16			0	444	50	50
12038		1			0	16	UNKNOWN		0	444	16	81
12039		1			1	15			0	444	19	88
12040		1			1	16	NOT APPLY		0	444	31	50
12041		1			1	15	NOT APPLY		0	0	78	72
12042		1			1	15	UNKNOWN		0	444	0	50
12043		1			1	15			0	444	81	100
12044		1			1	15	MISSING		0	444	50	999
12046		1			1	15			0	444	20	72
12047		1			1	15			0	444	98	93
12048		1	missing	missing	0	16			0	444	16	50
12049		1			1	17			0	444	22	82
12050		1			1	15			0	444	20	81
12051		1			1	15			0	444	0	74
12054		1			0	15			0	444	31	100
12057		1			1	15			0	444	50	50
12059		1			1	15	MISSING		0	444	24	81
12060		1			1	17	NOT APPLY		0	444	5	89
12061		1			1	15			0	444	22	78
12063		1			0	19	UNKNOWN	UNKNOWN	0	444	22	88
12064		1			0	15	NOT APPLY		0	444	50	72
12068		1			0	15			0	444	39	59

TABLE 15. - - Overall Data Sheet (Continued)

12067		1	0	15	0	444	57	72
12068		1	0	15	0	444	100	81
12069		1	0	15	0	444	19	86
12070		1	0	15	0	444	100	100
12071		1	1	15	0	444	35	90
12072		1	1	15	0	444	27	73
12073		1	1	15	0	444	22	84
12074		1	1	15	0	0	25	79
12075		1	1	15	0	444	81	99
12076		1	1	15	0	444	24	61
12077		1	1	15	0	444	8	58
12078		1	1	15	0	444	50	50
12080		1	1	15	0	444	56	68
12082		1	1	15	0	444	50	81
12083		1	1	15	0	444	16	81
12084		1	1	15	0	444	100	100
12085		1	1	15	0	444	0	100
12087		1	1	15	0	444	19	69
12088		1	1	15	0	444	31	80
12089		1	1	15	0	444	27	78
12090		1	1	15	0	444	24	84
12091		1	1	15	0	444	16	81
12092		1	1	15	0	444	16	100
12093		1	1	15	0	444	50	66
12094		1	1	15	0	444	20	83
12095		1	1	15	0	444	72	78
12096		1	1	15	0	444	27	88
12097		1	1	15	0	444	29	94
12098		1	1	15	0	444	94	96
12099		1	1	15	0	444	50	81
12100		1	1	15	0	444	60	70
12101		1	1	15	0	444	70	75
12102		1	1	15	0	444	19	89
12103		1	1	15	0	444	82	71
12104		1	1	15	0	444	31	100

TABLE 15. - - Overall Data Sheet (Continued)

12106		1	0	16	0	444	78	72
12109		1	1	16	0	444	0	81
12110		1	1	16	0	444	50	81
12113		1	0	15	0	444	16	100
12116		1	0	16	0	444	42	99
12118		1	1	15	0	444	50	81
12119		1	1	17	0	444	66	76
12120		1	1	15	0	444	50	50
14020	R020	0	1	15	0	444	49	78
14024	R024	0	0	15	0	444	49	100
14027	R027	0	0	15	0	444	43	49
14028	R028	0	0	15	0	444	42	49
14031	R031	0	0	15	0	444	23	63
14038	R038	0	0	15	0	444	49	70
14039	R039	0	1	15	0	444	34	48
14049	R049	0	1	15	0	444	1	78
14054	R054	0	0	15	0	444	38	98
14059	R059	0	0	15	0	444	80	78
14064	R064	0	1	15	0	444	20	95
14070	R070	0	1	15	0	444	999	52
14072	R072	0	1	15	0	444	93	86
14073	R073	0	0	16	0	444	20	69
14074	R074	0	0	16	0	444	6	70
14076		1	0	17	0	444	42	39
14077		1	0	16	0	444	60	58
14078		1	1	15	0	444	0	100
14079		1	0	15	0	444	54	27
14080		1	0	15	0	444	78	58
14081		1	0	16	0	444	52	53
14082		1	0	16	0	444	55	48
14083		1	0	15	0	444	25	64
14084		1	1	15	0	444	0	28
14085		1	1	15	0	444	18	34
14086		1	0	16	0	444	70	95
14087		1	1	15	0	444	22	61

TABLE 15. - - Overall Data Sheet (Continued)

14089		1	0	15	0	444	64	50
14090		1	0	15	0	444	27	99
14091		1	0	15	0	444	34	58
14092		1	1	15	0	444	0	73
16039	H0039	0	1	17	0	1	38	95
16150		1	1	15	0	1	27	47
18392	S0392	0	0	15	0	999	95	86
18434	S0434	0	1	15	0	1	13	37
18536		1	0	15	0	1	48	47
18537		1	1	15	0	0	49	49
18538		1	0	15	0	0	37	92
18539		1	1	15	0	0	15	93
19086	S0086	0	0	15	0	999	4	93
19294	S0294	0	1	16	0	1	7	93
19484		1	0	16	0	0	64	90
20081	SL0081	0	1	16	0	1	51	95
20105	SL0105	0	0	15	0	1	44	70
20128	SL0128	0	1	16	0	1	48	79
20132	SL0132	0	0	15	0	1	36	74
20136	SL0136	0	0	15	0	1	64	83
20137	SL0137	0	1	15	0	1	45	66
20138	SL0138	0	0	15	0	1	78	79
20144	SL0144	0	1	17	0	1	81	79
20159	SL0159	0	1	16	0	1	73	81
20175	SL0175	0	0	15	0	1	62	96
20195	SL0195	0	0	15	0	1	82	74
20225	SL0225	0	0	15	0	1	24	71
20227	SL0227	0	0	15	0	1	48	79
20228	SL0228	0	1	15	0	1	5	67
20238	SL0238	0	0	15	0	1	11	100
20240	SL0240	0	0	15	0	1	33	55
20250	SL0250	0	1	15	0	0	34	83
20252	SL0252	0	1	15	0	0	22	74
20265	SL0265	0	0	15	0	1	33	90
20271	SL0271	0	1	15	0	1	81	68

TABLE 15. - - Overall Data Sheet (Continued)

20273	SL0273	0	0	15	0	1	47	100
20279	SL0279	0	1	15	0	999	18	80
20307	SL0307	0	1	15	0	999	46	46
20309	SL0309	0	0	15	0	1	50	69
20315	SL0315	0	1	15	0	1	22	61
20316	SL0316	0	1	16	0	1	28	61
20320	SL0320	0	1	16	0	1	5	92
20324	SL0324	0	1	15	0	1	36	65
20335	SL0335	0	0	15	0	1	44	76
20337	SL0337	0	0	15	0	0	45	90
20339	SL0339	0	0	15	0	1	44	64
20342	SL0342	0	0	15	0	1	48	67
20353	SL0353	0	0	15	0	1	34	78
20361	SL0361	0	1	15	0	1	39	95
20363	SL0363	0	1	15	0	1	28	80
20366	SL0366	0	1	15	0	1	15	82
20370	SL0370	0	1	16	0	0	39	59
20375	SL0375	0	1	15	0	1	51	83
20378	SL0378	0	0	15	0	999	47	85
20380	SL0380	0	1	15	0	1	39	89
20399	SL0399	0	0	15	0	1	23	70
20401	SL0401	0	1	15	0	1	20	97
20405	SL0405	0	0	15	0	1	28	79
20410	SL0410	0	1	15	0	1	33	76
20417	SL0417	0	1	15	0	1	21	89
20418	SL0418	0	0	15	0	1	28	74
20419	SL0419	0	1	15	0	0	27	89
20435	SL0435	0	0	15	0	1	14	78
20437	SL0437	0	0	15	0	1	27	85
20439	SL0439	0	0	15	0	1	34	100
20453	SL0453	0	1	15	0	1	66	77
20458	SL0458	0	0	16	0	1	50	81
20461	SL0461	0	1	16	0	1	22	86
20478	SL0478	0	1	15	0	1	29	40
20485	SL0485	0	1	15	0	1	15	93

TABLE 15. - - Overall Data Sheet (Continued)

20499	SL0499	0		1	15		0	1	45	95
20500	SL0500	0		0	15		0	1	23	100
20502	SL0502	0		1	16		0	1	15	89
20504	SL0504	0		1	15		0	1	24	59
20507	SL0507	0		0	15		0	1	100	45
20525	SL0525	0		0	15		0	1	80	78
20526	SL0526	0		1	15		0	1	444	93
20527	SL0527	0		1	15		0	1	89	95
20531		1		1	16		0	0	43	14
20532		1		1	15		0	0	0	77
20533		1		0	15		0	1	52	83
20534		1		0	15		0	0	48	50
20537		1		1	15		0	1	0	88
20538		1		1	15		0	0	444	90
20539		1		0	15		0	0	48	92
20543		1		0	15		0	1	53	83
20544		1		1	15		0	0	68	93
20546		1		0	15		0	0	61	61
20547		1		0	15		0	0	59	27
20548		1		0	15		0	999	33	61
20549		1		1	15		0	999	48	74
20550		1		0	16		0	0	65	77
20552		1		1	15		0	999	18	41
20554		1		1	15		0	1	33	68
20555		1		0	15		0	1	53	28
20556		1		0	15		0	0	74	47
20557		1		0	15		0	0	73	83
20558		1		1	15		0	0	38	40
20559		1		1	15		0	1	36	91
20560		1		1	15		0	0	47	48
20561		1		1	15		0	1	11	100
20562		1		0	16		0	1	50	83
20563		1		1	15		0	1	48	54
20565		1		1	15		0	1	37	55
20567		1		1	15		0	1	51	70

TABLE 15. - - Overall Data Sheet (Continued)

20568		1	1	15		0	1	0	74
20570		1	0	16		0	1	88	73
20571		1	1	16		0	1	38	77
20573		1	0	15		0	1	43	79
20577		1	0	15		0	1	58	79
20579		1	0	15		0	0	0	23
20581		1	0	16		0	1	5	91
20584		1	1	15		0	999	45	92
20585		1	0	16		0	0	16	65
20586		1	1	15		0	0	21	89
20587		1	0	15		0	0	61	88
20588		1	0	15		0	0	46	47
20589		1	1	15		0	0	30	43
20590		1	1	15		0	0	27	39
20591		1	0	16		0	1	57	60
22187	J0187	0	1	15		0	1	49	40
22205	J0205	0	1	15		0	999	5	89
22215	J0215	0	0	15		0	0	23	59
22218	J0218	0	0	15		0	1	100	100
22224	J0224	0	0	16		0	444	444	100
22605	J0605	0	1	15		0	1	5	93
22624	J0624	0	0	15		0	999	17	83
22806	J0806	0	0	16		0	1	42	76
22823	J0823	0	1	15		0	1	48	100
22840		1	1	15		0	0	9	13
22842		1	0	15		0	0	5	999
22843		1	1	15		0	1	6	93
24193	F0193	0	0	15		0	1	18	51
24276	F0276	0	0	15		0	1	45	69
24483	F0483	0	0	15		0	1	22	61
24544	F0544	0	1	16		0	1	28	85
24545	F0545	0	0	16		0	1	63	68
24547	F0547	0	1	15		0	1	8	92
24573	F0573	0	1	15		0	999	45	90
24581	F0581	0	1	15		0	1	4	90

TABLE 15. - - Overall Data Sheet (Continued)

24586	F0586	0
24595	F0595	0
24692	F0692	0
24697	F0697	0
24714	F0714	0
24717	F0717	0
24730	F0730	0
24745	F0745	0
24750	F0750	0
24798	F0798	0
24841	F0841	0
24842	F0842	0
24845	F0845	0
24846	F0846	0
24854	F0854	0
24862	F0862	0
24863	F0863	0
24864	F0864	0
24870		1
24873		1
24874		1
24875		1
24876		1
24877		1
24880		1
24881		1
24882		1
24883		1
24884		1
24886		1
24887		1
24889		1
24892		1
24894		1
24896		1

1	15	0	1	13	89
1	16	0	1	16	83
0	16	0	1	48	86
0	15	0	1	36	93
1	15	0	1	77	81
0	15	0	1	5	90
0	15	0	1	45	89
0	16	0	1	37	84
1	15	0	1	33	92
0	17	0	999	38	71
0	15	0	1	28	63
1	15	0	1	26	64
1	15	0	1	10	93
0	15	0	1	7	95
1	15	0	1	42	100
1	15	0	1	5	94
1	15	0	1	32	76
0	15	0	1	42	89
1	15	0	1	35	94
1	15	0	0	8	49
1	15	0	1	69	58
1	15	0	1	38	91
0	15	0	1	0	67
0	16	0	0	66	66
1	15	0	999	999	85
0	16	0	1	80	89
1	15	0	1	19	77
0	16	0	0	99	100
0	15	0	0	35	67
0	15	0	0	66	70
0	15	0	0	67	47
1	15	0	0	48	95
0	15	0	0	20	6
0	16	0	0	82	92
0	16	0	999	47	79
0	15	0	0		

TABLE 15. - - Overall Data Sheet (Continued)

24898		1	0	16		0	0	51	46
24900		1	1	15		0	0	27	54
24901		1	0	15		0	0	28	30
24904		1	0	16		0	1	15	73
24905		1	1	15		0	0	15	47
24906		1	0	15		0	0	44	92
24908		1	0	15		0	1	17	96
24909		1	0	15		0	0	39	78
24910		1	1	15		0	0	56	35
24911		1	1	15		0	1	61	75
24914		1	0	15		0	1	48	80
24915		1	0	15		0	0	35	65
24916		1	0	15		0	1	20	83
24917		1	1	16		0	0	66	76
24918		1	1	15		0	1	9	86
24919		1	0	15		0	1	48	88
24922		1	0	15		0	0	50	100
24923		1	1	15		0	0	11	48
24924		1	0	16		0	0	61	73
24925		1	1	15		0	0	4	44
24927		1	1	15		0	0	21	77
24928		1	1	15		0	1	11	86
24929		1	0	15		0	0	100	77
24931		1	0	15		0	1	15	79
24932		1	0	16		0	1	44	49
24933		1	0	16		0	0	7	91
24934		1	0	16		0	1	11	93
26629	EC0629	0	1	15		0	1	45	89
26635	EC0635	0	0	16		0	1	53	89
26641	EC0641	0	0	17		0	1	18	37
26657	EC0657	0	1	17		0	1	30	60
26664	EC0664	0	1	16		0	1	57	89
26681	EC0681	0	0	15		0	1	70	82
26682	EC0682	0	1	15		0	1	13	93
26690	EC0690	0	0	17		0	1	21	91

TABLE 15. - - Overall Data Sheet (Continued)

26705	EC0705	0	0	19	0	1	50	47
26718	EC0718	0	1	16	0	1	17	97
26721	EC0721	0	0	16	0	1	68	69
26731	EC0731	0	1	99	0	1	34	34
26735	EC0735	0	1	16	0	1	32	86
26737	EC0737	0	0	15	0	1	43	79
26754	EC0754	0	0	17	0	1	48	50
26767	EC0767	0	1	17	0	1	40	81
26850		1	1	16	0	0	13	72
26852		1	1	17	0	0	44	64
26855		1	1	16	0	1	46	82
26856		1	0	99	0	1	95	95
26858		1	1	15	0	1	34	90
26859		1	0	17	0	999	41	33
28016	BR1016	0	1	15	0	1	52	49
28017	BR1017	0	0	15	0	1	3	81
28025	BR1025	0	1	15	0	1	100	999
28036	BR1036	0	1	15	0	1	5	93
28044		1	1	15	0	0	40	58
28046		1	1	15	0	0	0	15
28056		1	0	15	0	0	93	93
28082		1	0	17	0	999	100	100
28871	BR0871	0	1	16	0	1	24	73
28923	BR0923	0	0	15	0	1	1	99
28929	BR0929	0	1	15	0	1	2	0
28948	BR0948	0	1	16	0	1	6	91
28959	BR0959	0	1	15	0	1	90	91
28960	BR0960	0	1	15	0	1	47	91
28978	BR0978	0	0	15	0	0	76	97
28980	BR0980	0	0	15	0	1	6	93
28992	BR0992	0	1	15	0	1	68	89
30201	UC0201	0	0	16	0	1	66	92
30208	UC0208	0	1	15	0	1	48	83
30223	UC0223	0	1	16	0	1	5	95
30549	UC0549	0	0	15	0	1	4	82

TABLE 15. - - Overall Data Sheet (Continued)

30558	UC0558	0	0	15	0	1	26	75
30592	UC0592	0	0	16	0	1	23	65
30649	UC0649	0	0	15	0	1	91	92
30653	UC0653	0	1	15	0	1	2	62
30659	UC0659	0	1	16	0	1	83	83
30668	UC0668	0	1	15	0	1	5	94
30670	UC0670	0	1	16	0	1	9	76
30702	UC0702	0	0	15	0	1	44	88
30740	UC0740	0	1	15	0	1	34	77
30743	UC0743	0	0	15	0	1	0	26
30830	UC0830	0	0	15	0	1	55	52
30831		1	1	15	0	0	75	75
30832		1	1	15	0	0	43	63
30833		1	1	15	0	0	25	61
30834		1	1	16	0	0	8	93
30836		1	0	15	0	0	56	46
30837		1	0	15	0	1	28	63
30840		1	0	15	0	0	83	90

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