University of Alberta

Orthodontic Treatment in a First Nations Population of Alberta, Canada: A Comparative Study

by

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What lies behind us and what
lies before us are tiny matters
compared to what lies within us.

Oliver Wendell Holmes

Dedication

To my wife Laurel who provided never-ending love, support and encouragement over the past two and a half years.

Abstract

The primary objective of this paper was to determine if there was a significant difference in the degree of improvement due to orthodontic treatment between a sample of the First Nations orthodontic patients and a control sample of non-First Nations orthodontic patients. The secondary objectives were to determine if there was a difference in the severity of malocclusions being treated in a sample of the First Nations population compared to a control sample of the non-First Nations population and to determine if there are any significant differences in treatment outcome between these two samples. Several factors that may effect treatment outcome such as missed appointments, treatment duration, oral hygiene, extractions, dental classification and geographical location were studied.

A sample of sixty First Nations patients and a control group of sixty non-First Nations between who had treatment with full fixed orthodontic appliances and were between the age of 11 and 18 years were evaluated. The weighted Peer Assessment Rating (PAR) Index was applied to pre-treatment and post-treatment study models in order to address the studies main objectives.

The results showed higher pre-treatment and improvement in weighted PAR scores in the First Nations population. Post-treatment PAR scores were similar between the two groups. The study group had significantly more missed appointments and negative comments on poor oral hygiene than the control group.

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1.1- Introduction

Legislative History

The legal mandate regarding the provision of health care services to First Nations people has never been definitively established. Treaty number six (1876) was signed by Canada and the Cree of central Alberta and Saskatchewan. It contains the "medicine chest" which forms the basis of the claims to health care as a right. It states that: " a medicine chest shall be kept at the house of each 'First Nations' agent for the use and benefit of the 'First Nations people' by the direction of the agent." [1] Although no written mention of health services appears in any other treaties, 'First Nations' people claim that questions surrounding health coverage were discussed in the decisions leading to other treaties. It is the position of the 'First Nations' people that: 1) The federal government is responsible for 'First Nations' health services. 2) 'First Nations' people wish to only deal with the federal government. 3) 'First Nations' people regard Treaty no. 6 and following treaties as fundamental and binding. [1]

The current dental care system provides services to Medical Services Branch (Now known as the First Nations and Inuit Health Branch (FNIHB)) clients through private practitioners as well as dental therapists on selected reserves. According to Health Canada's most recent report (1999), [2] there are approximately 672,000 Indian and Inuit people in Canada who are eligible to receive dental and transportation services. The expense for providing dental services for native people in Canada was in excess of $ 106 million between 1998 and 1999 with the bulk of

this money going to private practice fee for service dentists. [2] The cost of such treatment has increased from $60 million in 1993.[1] In the 1998-1999 year, restorative services were the highest of all the dental sub-benefit categories at $31.7 million. The next highest dental sub-benefit was diagnostic services at $11.5 million followed by preventive services at $11.5 million and orthodontic services at $10.4 million.[2]

Dentists are paid through a computerized Nation Dental Claims Processing System operated for First Nations and Inuit Health Branch by First Canadian Health across Canada. To ensure access to needed care, it is becoming increasingly important to streamline the efficiency of delivery of dental care to First Nations people.

1.2- General Overview of the Problem

There is very little documentation describing the First Nations and Inuit Health Branch's responsibility in providing dental care to persons of First Nations descent.[1] The care program has therefore been able to evolve responding to patient needs and public demand. The goal of any dental or medical care system is to provide health services to those who need them. There is relatively little information on the prevalence of malocclusion and therefore the need for orthodontic treatment in North American First Nations children and adolescents is difficult to define. Several Studies have shown that North American First Nation's children have a high prevalence of dental disease.[3,4,5.] In addition to the high prevalence of dental caries there appears to be a greater degree of severe malocclusion in Aboriginal adolescents than that of the general population.[6,7] This combination leads to a question regarding where the dental health care dollars should be spent. The prevention and correction of dental disease may be considered an essential health service whereas some orthodontics may be considered elective in nature. This problem is intensified by the finding that the high dental disease prevalence tends to increase orthodontic service demands. As a result of a high level of dental caries which is a major contributor to a loss of arch length, a great number of First Nations children have malocclusions such as crowding and crossbite.[6,8] The problem of dental crowding in this population is exacerbated by the finding that the sum mesio-distal width of First Nations people's permanent teeth is larger than that of North American children with

European origin. [6] Although there appears to be a great need for orthodontic treatment among the First Nations group, a study done in British Columbia showed that while 13.7% of 13 year old Caucasian children received orthodontic treatment, only 1.9% of First Nations individuals received orthodontic treatment [6]. This information may suggest that the First Nations and Inuit are somewhat under-serviced with regard to orthodontic treatment but without up-to-date epidemiological data, the proportion of those who need orthodontics treatment to those who actually receive it will remain unknown.

The significant need for orthodontic treatment among First Nations people highlights the importance of effective and efficient delivery of care to these people.

1.3 – A Review of the NIHB Program

The vision statement of Health Canada is "*Our mission is to help the people of Canada maintain and improve their health*". [2] The Medical Services Branch (Now known as the First Nations and Inuit Health Branch) vision statement is as follows: "*First Nations and Inuit people will have autonomy and control of their health programs and resources within a time frame to be determined in consultation with the First Nations and Inuit*" .[2]

The Non- Insured Health Benefits Program is a program run through a division of Health Canada, the First Nations Inuit Health Branch. Its purpose is to provide non-insured health benefits to First Nations and Inuit people in a way that: is appropriate to their unique health needs, contributes to a health status that is comparable to the Canadian population as a whole, is sustainable from a fiscal and benefit perspective, and facilitates First Nations and Inuit control at a time and pace of their choosing. [2]

The program provides the health benefits not provided by provincially administered insured health care programs. The benefits include: pharmacy (Prescription and over the counter drugs and medical supplies); glasses and other vision care aids and services; transportation to medically required services; any provincial health care premiums; crisis intervention, mental health counseling and other related services; and dental services including orthodontics. [2]

The total number of NIHB clients has increased dramatically from 397,000 at the end of 1988 to over 672,000 in March 1999, an increase of over 65%. This

rapid growth may be attributed in part by the implementation of Bill C-31 in 1985, which resulted in changes to the Indian Act. These changes resulted in the eligibility of over 100,000 additional clients between 1985 and 1995. From 1991 to 1999, the Canadian population grew by 8.4% while the NIHB First Nations and Inuit population increased by 25.5%. The First Nations and Inuit population has grown at an average annual rate of 2.9% compared to 1.2% for the Canadian population. This population growth is expected to continue primarily because of the higher than average birth rate of the First Nations and Inuit population. The First Nations and Inuit population is relatively young with 41% of the 672,000 eligible NIHB recipients under the age of twenty.[2] Therefore, a significant number of the total population eligible for NIHB benefits are in the age group commonly associated with orthodontic services. [2]

The fundamental problem of ensuring that resources meet the population's need is apparent when deciding where money designated to health care should be spent. In the dental and any other health service, the resources are not able to provide unlimited health services. The competition for limited public resources between diverse needs means that government programs cannot afford to do everything medical science has to offer for everyone who might benefit from it [9]. Orthodontic services can only be provided at the expense of other dental expenditures. Dental expenditures can only be provided at the expense of other health care expenditures. It is therefore of utmost importance to ensure that

publicly funded dollars are spent in such a way that they will provide the most health benefit.

Complex tradeoffs are often required on the part of the NIHB in order to balance equity, freedom of choice, comprehensiveness and cost containment. [10] This responsibility requires difficult decisions to be made regarding who should or should not receive treatment. This decision becomes even more complex in orthodontics when evaluating need, risks and benefits of treatment. These factors are often difficult to define and therefor difficult to measure.

1.4 Strategies for Cost Containment

Health care systems around the world are struggling with the two common problems of cost and access. A question at the center of health care is: what are we buying with our health care dollars and what is the relationship between expenditures and health? Most often attempts are made to contain costs because cost is a major barrier to access.[9] Three main questions must be asked when planning expenditures: who is covered, what is covered and how is it financed and delivered.

One of the primary ways to limit cost is to limit those who are eligible for services. The NIHB program provides First Nations, Inuit and Innu individuals with a limited range of medically necessary health related goods and services not provided through other private or provincial health insurance programs.[2] For

orthodontic services, treatment is only provided to those individuals under the age of 18 at the time at which the benefits are applied.

Criteria concerning coverage must be established in order to ensure that only medically necessary treatments are being carried out. The question of what is covered is often the most difficult to answer, most controversial, and most important of the questions asked. The main criterion for the provision of orthodontic services are that the malocclusion be significant and be functionally handicapping.[11] The World Health Organization[12] defines a handicapping dentofacial anomaly as "one which causes disfigurement or impedes function." They also state that the patient requires treatment if "the disfigurement or functional defect is or is likely to be, an obstacle to the patients physical or emotional wellbeing." According to Salzmann[13] a handicapping malocclusion is one which constitutes a hazard to the maintenance of oral health and interferes with the wellbeing of the child by adversely affecting dentofacial esthetics, mandibular function, or speech. Grainger[14] outlined some features of a malocclusion that are prerequisites for the determination of a handicapping occlusal anomaly. These features are: unacceptable esthetics, significant reduction in masticatory function, a traumatic occlusion that predisposes tissue destruction, speech impairment and lack of stability of the occlusion. The remaining criteria can be seen in the Guidelines for orthodontic benefits.[11]

Orthodontic services for NIHB clients are financed publicly through tax revenues and payments are forwarded to the care providers from the NIHB

program. The NIHB recently introduced a standardized program that exists across Canada. The provider is now required to submit a completed orthodontic summary sheet to obtain approval. The provider receives 25% of the total fee at commencement, 50% between 14 and 17 months and 25% on submission of final records. The final records may differ based on regional provider customary practices. This structure was implemented to allow NIHB to better track orthodontic treatment.

The Non- Insured Health Branch's Dental Bulletin from Health Canada[11] explains why there has been placed a requirement for a treatment conference and a parental consent for orthodontic work as an important feature of the orthodontic summary sheet. They state that "parents must have a full knowledge of the work and the responsibility involved." "*This requirement has been put in place as a result of provider concerns regarding missed appointments and difficulties in completion of orthodontic treatment.*"[11]

The following two sections will discuss the literature related to missed appointments and premature discontinuation.

1.5 Patient Cooperation in Appointment Keeping

Nanda and Keiri [15] did pretreatment psychological evaluations of patients and parents to attempt to identify predictors for cooperation. No single factor was able to predict co-operation. Even when nine factors were combined they accounted for only 40 percent of the variability in co-operation. The most important characteristic was the perceived relationship of the clinician to the patient and parent. According to Shia[16], missed appointments are one of the top three reasons for increased treatment time. Beckwith et al.,[17] found that missed appointments were the most important variable when it comes to treatment time. The length of treatment may also be a factor in patient cooperation including missed appointments.

It is difficult to say whether the missed appointments lead to long treatment or long treatment leads to patient burn-out and increased missed appointments. Kottraba[18] found that once treatment exceeded 2 years, cooperation began to fail. Grew and Hermanson[19] found that with fixed appliances the length of treatment had no effect on co-operation. It has been suggested that patient cooperation and the discontinuation rate are related, but there has been little research to show a definite correlation. Murray[20] found that two or more missed appointments was one of the only factors related to premature discontinuation of orthodontic treatment.

1.6 Premature Discontinuation of Orthodontic Treatment

Difficulties with completion of orthodontic treatment not only concern orthodontic care providers for clients of the Non-Insured Health Benefits Plan, the level of discontinued orthodontic treatment has long been an issue in Britain as general dental and orthodontic treatment is a part of their National Health Service. Britain's National Health Service faces many of the same administrative constraints as the FNIHB faces in Canada. Researchers in Britain have done several studies to put the problem into perspective. In 1986 the Report of the Committee of Enquiry into Unnecessary Dental Treatment [21] stated that in twenty five percent of all orthodontic cases undertaken in the General Dental Service (42 percent of those 18 years of age and over and 20 per cent of those under 18 years of age) the patient failed to complete treatment satisfactorily. The criticism regarding discontinued orthodontic treatment has sparked several British reports detailing the percentage of orthodontic patients who failed to complete orthodontic treatment satisfactorily.

Haynes et al.[22] used data from the dental estimates board of England and Wales between 1964 and 1987 in order to do a long-term retrospective study on the level of discontinued orthodontic treatment in these countries. They found that the number of orthodontic treatments carried out in the general dental service increased from 60 000 per year in 1964 to 160 000 per year in 1987. The overall rate of discontinuation has been virtually constant but increased 4.9 percent over this period. The mean rate of discontinuation was 20 percent and never was less than 14.9 percent. The relatively high discontinuation rates in this study may be

attributed to communication failure, lack of patient or professional concern, and a lower level of expectation for the correction of malocclusions in a proportion of the patients being treated. [22]

Murray[20] studied the records of patients from the Eastman Dental Hospital in London who had been dismissed from current files in 1982 after either successful completion or termination of orthodontic treatment. This research showed that the discontinuation rate following active treatment was found to be 12.8 per cent in the population studied.

Eaton et al. [23] requested all District Dental Officers in England and Wales to record orthodontic treatment for an eight-week period to determine the percentage of discontinued cases. During this time 2678 cases had treatment terminated either due to completion or early discontinuation. Of these cases, 336 were discontinued leaving an overall discontinuation rate of 12.5 percent.

Willmot et al.[24] asked all U.K. orthodontic consultants to carry out a prospective study of completed and discontinued treatments, and to record data about orthodontic treatments completed or discontinued during an eight-week period. There was an 88 percent response rate. During this 2-month window 2480 cases were completed in the practices of the one hundred and four respondents. Two hundred and thirty cases (9.2 percent) were discontinued during active treatment. For these discontinued cases, the average estimate by the operator of the proportion of the treatment objective achieved was 58 percent.

A similar pilot study was carried out to determine the rate of premature termination of orthodontic treatment among the First Nations people of Manitoba. Hector et al. at the University of Manitoba evaluated claims for orthodontic treatment for First Nations people submitted to the Medical Services Branch from April 1994 to December 1997 in order to determine the number of cases discontinued prematurely. It was found that of the 243 cases de-banded, 109 cases (44 percent) had claims that were not completed.

Information provided by the First Nations and Inuit Health Benefits in Alberta (1999) indicates that, for example, in the years 1997/1998 there were 462 full banding cases started and 423 completed cases. Assuming a relatively constant number of yearly case starts, this indicates roughly 9 percent discontinuation, a number which is similar to that found in Wilmots study done in the U.K.,[24] but significantly less than findings in Manitoba.

Having had several studies on the rate of discontinuation in the UK it becomes important to analyze the factors influencing this rate. [20]

1.6-1 *Factors Involved in Early Discontinuation of Treatment*

The main reasons given for discontinuation of treatment according to Eaton et al.[23] are as follows: at the request of the patient or parent due to burn-out, by the operator due to poor attendance and lack of co-operation; or poor oral hygiene.

High discontinuation rates may be due in part to a lack of communication, a lack of patient or professional concern or a lower level of expectation for treatment outcome.[22] Evidence for this appears when the patients start asking to have their braces off when their six maxillary anteriors area aligned because these are the only teeth the patient readily sees. According to Haynes [22] patient age is often directly proportional to the discontinuation rate, the older the patients, the higher the discontinuation rate.[22] According to Myrberg and Thilander,[25,26] in a Swedish population the gender distribution of orthodontic patients discontinuation appears to be roughly equal. As well, they found that the geographic distribution of patients tended to affect acceptance of treatment as opposed to the discontinuation rate. Those from the rural areas with a further distance to travel were less likely to start treatment than those from town. However, once treatment was started, the discontinuation rate was reported to be the same. Grewe and Hermanson,[19] in the United States, found that there was no significant differences in the discontinuation rate based on the severity of the malocclusion. The severity of the malocclusion was assessed by the use of three indices, The Handicapping Malocclusion Index (Salzman 1968),[13] the Occlusal Index (Summers 1971)[27] and the Treatment Priority Index (Grainger, 1967).[14] According to Eaton's review (1996) [23] of Grewe and Hermanson's study, those with more severe malocclusions are more likely to co-operate (and complete treatment) than those with milder conditions.

The type of appliance used may have an effect on treatment discontinuation. Myrberg and Thilander[25,26] found that the use of fixed appliances caused some

patients to discontinue treatment. Cousins et al.[28] found that the use of fixed appliances had no effect on discontinuation rate. According to Willmot, [24] a greater rate of discontinuation is seen in removable appliance cases when compared to fixed appliance cases. If this is the case it may explain part of the relatively high discontinuation rates seen in the U.K. as compared to North America.

In conclusion, Murray[20] states that none of the predicting factors at the start of treatment had a clear association with treatment discontinuation. The only factors found to be related were two or more failed appointments, an inexperienced operator and the use of removable appliances. [20]

It would be of great value to address the concerns of the orthodontic providers in Canada regarding missed appointments and difficulties in completion of orthodontic treatment. Considering the variations between the time practitioners spend finishing cases and the subjective nature of the determination of premature discontinuation, and the lack of consistency in record keeping within and between offices, using evaluation of written records for an indication of premature discontinuation would be highly inaccurate. It is difficult to determine at what point an orthodontic treatment outcome should be considered prematurely discontinued. For example, a case may be considered finished but at a lesser degree of completion than the case could have been finished ideally. It is difficult to determine the degree of deviation from "ideal" that should be acceptable. For this reason, an evaluation of patient's models may provide a more accurate assessment

of the status of each case at the time the braces are taken off. An occlusal index is a tool is often used to evaluate orthodontic treatment outcome.

1.7 Methods of Assessing and Grading Malocclusion Severity

Recently there has been an increased interest in the development of methods of reducing subjectivity in the assessment of the outcome of medical and dental treatment. [29] An attempt to accomplish this in orthodontics has led to the development of several different occlusal indices. These indices have been developed to provide a uniform method to assess and grade malocclusions. Occlusal indices record specific traits of malocclusion in numerical or categorical format, and have been developed to provide objectivity to the evaluation of a malocclusion. [29]

1.7-1 Development of a Malocclusion Index

The development of an objective index to detect the amount an occlusion deviates from normal poses several problems. The etiology of malocclusions are often multi-factorial as well as consisting of multiple interacting components. These problems underscore the complexity of developing an objective index for evaluating a malocclusion.[30] This situation is further complicated by the fact that malocclusions comprise deviations from accepted ideals, rather than specific diseases or abnormalities. Richmond et al.[31] state that an orthodontic anomaly is not a disease with a series of well defined symptoms. Certain characteristics must be evaluated to determine their variation from the norm. The objective evaluation

of a malocclusion therefore requires the assessment of occlusal, esthetic and functional components.

1.7-2 Occlusal Factors

Defining the ideal occlusion is difficult illustrated by the fact that numerous attempts have been made over the years with no general consensus. [32,33,34] Although occlusion is involved in determining malocclusion severity, it is not the only factor. Several attempts have been made to link malocclusion with temperomandibular disorders with, at best, weak correlations.[35,36,37,38] Therefore, occlusal factors alone should not be used to determine malocclusion severity.

1.7-3 Esthetic Factors

According to Shaw et al. [39] studies in social psychology indicate that unfavorable social responses may result from an unattractive physical appearance. From this it would appear that significant variations from normal facial and dental appearance would have a negative impact on social functioning. Many orthodontists involved in treating patients whose treatment is paid for by publicly funded programs have the belief that undesirable occlusal traits can have a negative effect in many facets of social interaction. [40] Attitudes towards social acceptability, ability and personality are often based on appearance whether the judges are adults or children. For example, teachers' academic expectations are less favorable for unattractive children. According to Cavoir and Dodecki,[41] children see those who are physically attractive to be more socially attractive. Shaw et al. [42] summarize

that the emotional handicap due to an unesthetic dentofacial appearance may have a negative impact on individual social well being, especially for those who are stigmatized or bullied by their peers and as a result view themselves as inadequate. For those with less severe afflictions, the esthetic benefits of orthodontic treatment remain questionable.

1.7-4 Functional Factors

Evaluation of occlusal function may be helpful in locating a deleterious interference resulting in occlusal trauma, but evaluation of mandibular function or centric relation prove to be too controversial to be included in an occlusal index.[43] The pathological significance of a discrepancy between centric relation and centric occlusion has not been conclusively found. Thus, the use of an objective system to evaluate mandibular function needs further substantiation before it becomes included in any index.

The assessment of a malocclusion may be facilitated by separately evaluating components of a patient's malocclusion and recording them as deviations from the ideal in an indexed approach. The World Health Organization endorsed this approach in 1966 and contributed to the development of specific guidelines. Subsequent concerns regarding lack of guideline specificity[13,27] resulted in the criteria for an ideal index of malocclusion.

The ideal malocclusion index should possess the following nine characteristics (Shaw *et al.*, 1991).[44]

1) Reliability

2) Validity

3) Sensitive to the needs of the patient

4) Acceptable to both the public and the profession

5) Administratively simple to operate

6) Sensitive throughout the scale

7) Amenable to statistical analysis

8) Require minimal judgement

9) Able to promptly detect shifts in group conditions

1.8- The Methods of Assessing and Grading a Malocclusion

Indices have been developed for grading dental disorders such as caries, periodontal disease and temperomandibular disorders. Although there are limitations involved in using any type of index, the indices of malocclusion pose several problems including the multi-factorial nature of malocclusion, the difficulty in standardizing criteria and the indication that malocclusion cannot be judged solely in physical terms. The social and psychological effects of malocclusion are difficult to detect, predict and quantify. Despite these problems, several indices of malocclusion have been developed and have been used for the following (Shaw *et al.*, 1991);[44]

- Diagnostic classification
- Epidemiological indices

- Treatment Need (treatment priority)
- Treatment success (outcome)

This section is intended to provide a brief overview of the different methods of assessing and grading malocclusions and provide some of their advantages and disadvantages.

1.8-1 Diagnostic Classifications

Diagnostic classifications are primarily descriptive and allow categorization of malocclusion. The classical index of this sort is the Angle's classification based on the antero-posterior positions of the first permanent molar teeth.[45] Although Angle's classification is relatively simple and it serves its descriptive purpose well, there are numerous deficiencies. Some of these deficiencies are as follows:

- Lack of meaning with respect to treatment needs and does not indicate disability relating to dental health function and esthetics [46]
- It is not sensitive to the dento-alveolar and skeletal aspects of malocclusion, it does not address arch length problems, it ignores transverse and vertical problems and does not examine the effect of tooth position on the facial profile [47]
- It has been shown to have poor intra- and inter-examiner reliability [48,49]

Despite many criticisms, Angle's classification has been the most widely used indicator of the prevalence of different types of malocclusion [50]

The incisor classification of Ballard and Wayman,[51] is a descriptive approach based on the positional relations of the incisor teeth rather than the first molars. This classification avoids the problems of drifted molars in a crowded arch. Although more reliable than Angle's classification,[50] it suffers many of the same drawbacks.

The Ackerman-Proffit group classification [47] proposed a classification system based on a minimum of five characteristics. This approach was designed to overcome the major weaknesses of Angle's classification. Characteristics evaluated include an evaluation of facial proportions and esthetics, alignment and symmetry within the dental arches and skeletal and dental relations in the transverse anteroposterior and vertical planes of space. The relative complexity of this classification has limited its application. [50]

1.8-2 Epidemiological indices

Many indices have been developed to establish the prevalence of malocclusion and specific aspects thereof in populations of interest. These epidemiological indices are also valuable in manpower planning and research.

The Dentofacial Index (DFI) was designed specifically for epidemiological study.[52] The facial orthometer was developed in order to measure dentofacial morphology using facial landmarks and specific features of malocclusion. This index proves to be more useful for anthropological studies than epidemiological research.

The Index of Tooth Position,[53] was designed as a quantitative method of epidemiologically evaluating a large group for malocclusion. Tooth displacement, rotation, infra-occlusion and supra-occlusion were scored and recorded to provide a score for a particular malocclusion. Unfortunately, this index was unreliable and gave no indication of relative severity since each tooth was recorded as either "maloccluded" or "aligned" giving a severely displaced tooth the same score as a mildly displaced one.

The Malalignment Index (MI),[54] evaluated each of the patients two arches separately. Each arch was divided into three segments and each tooth was evaluated for rotation and displacement. A summary score could be given to the entire mouth. The major drawback of this index is that it did not evaluate the occlusal relationships in any of the three planes of space.

The Occlusal Feature Index of Poulton and Aaronson,[55] was designed to evaluate malocclusion in population studies. This index was based on lower anterior crowding, cuspal interdigitation, overjet and overbite. Scores were given for varying degrees of deviation from normal.

Bjork et al.[56] developed another epidemiological tool for evaluation malocclusion. The system was based on three main components: anomalies in the dentition, crowding or spacing and occlusion. In addition, there was a subjective assessment of treatment need. Unfortunately, the system of registration is too complex for practical purposes.

The FDI Commission on Classification and Statistics for Oral Conditions (COSTOC) developed the FDI system for the examination of patients with a full compliment of permanent teeth excluding the wisdom teeth. [57] The system examined dental, intra-arch and inter-arch relations. Each malocclusion trait was recorded using coding for different aspects of malocclusion and the FDI system of tooth identification was used to localize specific tooth mal-relations.

Kinaan and Burke [58] proposed another occlusal assessment tool for epidemiological research. This index evaluated overjet, overbite, incisor alignment, posterior crossbite and buccal segment crowding. Each arch was divided into two posterior segments and one anterior segment and then evaluated for inter-arch relationships and alignment.

1.8-3 Indices of Treatment Need

Some indices have used the characteristics of urgency and need for treatment to categorize or grade malocclusions. The Handicapping Labio-lingual Deviation Index was devised by Drakar [59] and applied to determine orthodontic treatment need. This index evaluated the following criteria: cleft palate, trauma related malocclusions, overjet, overbite, mandibular protrusion, open-bite and labio-lingual spread (severe tooth displacement).

The following are some deficiencies of this index: [60]

- It does not account for missing or impacted teeth or dental spacing.
- It ignores transverse discrepancies such as midline deviation and crossbites.

- Incisor deviation of position only accounts for the most deviated tooth per arch.
- The component weightings are based on the opinion of the originator and are subjective[61]

The Treatment Priority Index[14] was developed to determine whether orthodontic treatment reduced occlusion severity below the level considered significant for public health. The Treatment Priority Index is an epidemiological tool used to rank malocclusions and assess the need for orthodontic treatment. [62] This index was based on evaluation of casts or clinical evaluations of 375 12-year-olds from the Burlington study.

This index evaluated the following components:

- Overjet
- Overbite
- Openbite
- Tooth displacement
- Distocclusion
- Mesiocclusion
- Posterior crossbites
- Congential absence of incisors

These criteria were evaluated and the final TPI score could range between 1 and 10 being a reflection of the over-all malocclusion severity. According to Scivier et al. [63] and Popovich and Thompson,[64] the Treatment Priority Index is reliable and objective method of assessing the degree of malocclusion. Ghafari et al. [62] confirm the index's validity and show that TPI values decrease with orthodontic treatment. The following are some of the limitations of the index:

- The index excludes habits, soft tissue morphology, spacing, midline diastema and asymmetry [63]
- The index does not predict the severity of individual malocclusions in the permanent dentition [62]
- It fails to account account for several clinical conditions (mainly in the primary dentition) which may indicate treatment such as submerging deciduous molars, premature loss of deciduous canines and deciduous first molars with space loss [65]

The Handicapping Malocclusion Assessment Record of Salzmann,[13] was developed to priorize orthodontic treatment need and was endorsed and accepted by the American Association of Orthodontists (AAO) and the American Dental Association (ADA).

The components measured are:[60]

- Crowding
- Missing and rotated teeth
- Spacing
- Overbite
- Overjet
- Crossbite
- Anteroposterior discrepancy

The Handicapping Malocclusion Assessment Record has the following drawbacks:

- According to a study by Grewe and Hagen [66] that compared bias or systematic error between the HMAR, the Occlusal Index and the Treatment Priority Index, the HMAR had the highest bias. The HMAR therefor lacked validity.
- The weightings assigned to the components are subjective
- The index is only useful in the permanent dentition.
- The component scores or deviations from 'ideal' determined to be either present or absent with no evaluation of severity of the deviation.

The Summers Occlusal Index [27] was designed as a system for identifying and scoring occlusal disorders. It was based directly the Malocclusion Severity Estimate and the Treatment Priority Index as an attempt to refine them as an epidemiological tool. The nine components measured as a part of the Occlusal Index are as follows:

- Dental age
- Molar relation
- Overbite
- Overjet
- Posterior cross-bite
- Posterior open-bite
- Tooth displacement(actual and potential)
- Missing permanent maxillary incisors
- Midline relations

According to Grewe and Hagan,[66] when compared to other indices like the HMAR and the TPI, the Occlusal Index had the best validity and reproducibility.

The deficiencies evident with the Occlusal Index are as follows:

- It is complex and time consuming [67]
- Fails to score missing teeth other than upper incisors when pre-restorative orthodontics or orthodontic space closure is required. It therefore tends to underestimate treatment need [68]
- Summers only makes provision for scoring missing incisors if they are congenitally missing [46]
- The Occlusal Index penalizes cases that have a full unit disto-occlusion, which may be consistent with functional occlusion, such upper first bicuspid extraction cases [29]

The Swedish Medical Board Index, [69] concentrated on subjective health impairment and gave subjective guidelines for measuring esthetic impairment. The poorly defined criteria were used as indicators of orthodontic treatment priority. The index has been broadly accepted by providers and has been in use since 1966 but has not been thoroughly validated in a scientific way. [70]

The Index of Orthodontic Treatment Need (IOTN), developed by Brook and Shaw,[71] was developed to identify those who would most likely benefit from orthodontic treatment. It attempted to rank a malocclusion's occlusal traits based on their significance for oral health and esthetics. This index developed in the United Kingdom is comprised of two main components; the Dental Health

Component (DHC) and the Aesthetic Component (AC). The DHC was derived from the index of the Swedish Medical Board that is comprised of five grades. Grades one and two require no treatment; grade three is borderline; and grades four and five require treatment. The Aesthetic Component is based on ten intraoral photographs that represent a continuum of dental attractiveness. This scale is called the Standardized Continuum of Aesthetic Need (SCAN) Index.[72] Grades one through four require no treatment; grades five through seven indicate borderline need for treatment; and grades eight to ten represent need for treatment.[71]

The IOTN has a number of inherent flaws:

- Accumulations of plaque, associated gingival inflammation and poorly matched shade of anterior restorations may affect scoring although not related to those aspects of occlusion that are amenable to orthodontic treatment [73]
- The SCAN ratings use only front views of the occlusion thus limiting the effect of large overjets on esthetics [71]
- In the DHC, crowding represents a problem in recording when the patient is in the mixed dentition [71]
- Judgements of esthetics may vary between countries and different ethnic groups
- The SCAN index provides only a two-dimensional guide and an insufficiently extensive spectrum of dental esthetics [50]

The Dental Aesthetic Index is an orthodontic index based on a regression equation linking the relative social acceptability of the dental appearance and the objective, physical measurements of ten occlusal traits. [74] It allows the estimation of potential social handicaps if occlusal status deviates significantly from a societies aesthetic norms. [74]

This index was based on the opinion of the lay public in the United States. Sixteen hundred high school students and adults rated 200 photographs of teeth in occlusion. [75] The Dental Aesthetics Index involves the measurement of ten components of a malocclusion and the application of regression coefficients or weightings to the components. The components measured are as follows: [74]

- Missing Visible Teeth
- Crowding
- Spacing
- Diastema
- Largest Anterior Irregularity(Upper)
- Largest Anterior Irregularity (Lower)
- Anterior Maxillary Overjet
- Anterior Mandibular Overjet
- Vertical Openbite
- Antero-Posterior Molar Relation

Limitations of the DAI according to Oteyemi and Jones [50] include a failure to assess:

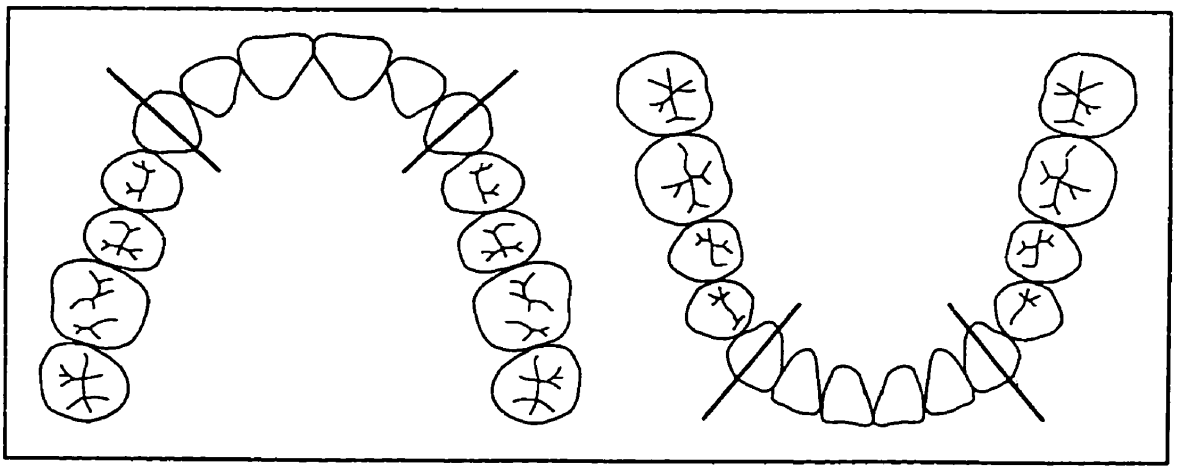
- Dental midline discrepancy
- Traumatic deep overbite
- Buccal crossbite
- Buccal open-bite
- Treatment need during the mixed dentition

18.4 Indices of Treatment Success

1.8-4a *The PAR Index.*

The PAR index according to Richmond et al.[76] was developed to provide a single summary score for all the occlusal anomalies that may be found in a patients malocclusion.

Shaw, Richmond and O'Brien[77] describe this index. The dental arches are divided into sextants. (Fig 1.1)



The components of the index are seen in Table 1.1

1	Upper right segment
2	Upper anterior segment
3	Upper left segment
4	Lower right segment
5	Lower anterior segment
6	Lower left segment
7	Right buccal occlusion
8	Overjet
9	Overbite
10	Centerline
11	Left buccal occlusion

Displacements of teeth are recorded as the distance between contact points of adjacent teeth. The greater the displacement the greater the PAR score. Buccal occlusion is recorded with regard to the three planes of space. Overjet is recorded, positive as well as negative, and overbite and centerline discrepancies are recorded. The individual scores are summed to obtain an overall total, representing the degree of deviation from normal alignment and occlusion. A score of 0 indicates good alignment, and higher scores indicate increased levels of irregularity. The components of the PAR index have been weighted to reflect current British opinion more closely. Subsequently DeGuzman et al. applied American weightings to the index[78]. The PAR index is expressed as a number rarely beyond 50. See Table 1.2. (Adapted from Richmond et al.)[76]

Table 1.2 Using the PAR Index (as per Richmond and Shaw-

Each arch is devided into three segments

Components of the PAR index:

Upper right segment	Right buccal occlusion
Upper anterior segment	Overjet
Upper left segment	Overbite
Lower right segment	Centerline
Lower anterior segment	Left buccal occlusion
Lower Left segment	

Normal occlusion is defined as all anatomical contact points being adjacent, with good intercuspal mesh between upper and lower buccal teeth, non-excessive overjet and overbite.

Occlusal features recorded Crowding, spacing and impacted teeth. These are determined by measuring displacements.Crowdingis determined by the amount contact points have slipped. Spacingis determined by the amount of space between the contact points. Posterior extends from mesial of first molar to the distal of the cuspid. Anterior extends from the mesial of the cuspid to the mesial of the cuspid. Impacted tooth is recorded when the space for this tooth is less than or equal to 4mm and the tooth is unerupted. Displacements are recorded as the shortest distance between the contact points of adjacent teeth parallel to the occlusal plane.

Conventions If the canine is missing, displacements between the premolar and the lateral incisor are recorded in the anterior segment. If an incisor is missing and the space is to be closed, the space is recorded. If an incisor is missing and the space is to be replaced with a prosthesis, the space is not recorded. Contact points between first , second and third molars are not recorded. Severe displacements in this area will produce a crossbite and be noted in the buccal occlusion. If the first molars have been extracted, the contact point between the second molar and second premolar is noted. If the contact point displacement is due to poor restorative, the displacement is not recorded. Mixed dentition crowding/spacing assessment uses average Mesio-distal widths:

Maxilla		Mandible:	
Canine -	8mm	Canine -	7mm
First pre-molar -	7mm	First pre-molar -	7mm
Second pre-molar -	7mm	Second pre-molar -	7mm
	22mm		21mm

Occlusal Features:Crowding, spacing and impacted teeth.

Score	Discrepancy
0	0-1mm
1	1.1-2mm
2	2.1-4mm
3	4.1-8mm
4	greater than 8mm
5	impacted teeth

(Scores for these are counted per arch and added)

Buccal Occlusion: Scored in three planes of space. The recording zone is from the canine to the last molar.

These measures are summed.

Score	Discrepancy
A-P	
0	Good interdigitation Cl I, II, or III
1	Less than Half-unit discrepancy
2	Half a unit discrepany (cusp to cusp)
Vertical	
0	No discrepancy in intercuspation
1	Lateral open-bite on at least two teeth greater than 2mm.
Transverse	
0	No cross-bite
1	Cross-bite tendancy
2	Single tooth in cross-bite
3	More than one tooth in cross-bite
4	More than one tooth in scissors-bite

Overjet: Recording zone is from the left to right lateral incisors (Ruler held parallel to the occlusal and radial to the arch). If the tooth falls on the line, the lower measure is recorded. Canine crossbites are measured in this section.

Score	Discrepancy
Overjet	
0	0-3 mm
1	3.1-5mm
2	5.1-7mm
3	7.1-9mm
4	greater than 9mm
Anterior cross bites	
0	No discrepancy
1	One or more teeth edge to edge
2	One single tooth in cross-bite
3	Two teeth in cross-bite
4	More than two teeth in crossbite

Overbite: tooth with greatest overlap is recorded.

Score	Discrepancy
Open-bite (dental Measurement)	
0	No open-bite
1	Open-bite less than or equal to 1mm
2	Open-bite 1.1-2mm
3	Open-bite 2.1-3mm
4	Open-bite greater or equal to 4,,
Overbite	
0	Less than or equal to one-third coverage of the lower incisor.
1	Greater than one-third, but less than two-thirds
2	Greater than two-thirds coverage
3	Greater or equal to full tooth coverage

Centerline: Recorded in relation to the lower central incisors (if a lower incisor is extracted or missing, then the measurement is not recorded).

Score	Discrepancy
0	Coincident and up to one-quarter width of the lower incisor.
1	One-quarter to one-half lower incisor width
2	Greater than one-half the lower incisor width

To develop this index, according to Richmond et al [76], a series of meetings with a group of 10 experienced orthodontists was convened (British Orthodontic Standards Working Party). Study casts of various treated and untreated cases were examined and discussed until agreement was reached about the individual features that should be assessed to obtain an estimate of alignment and occlusion. The scoring system, seen in Table I., was developed to analyze the study casts.

In the same study by Richmond et al.,[76] validation of the PAR index was attempted. This process involved comparison of a subjective measure against a more objective measure of the characteristic.

A panel of 74 examiners was selected representing the various groups carrying out orthodontic treatment in England and Wales. These examiners were asked to assess a representative sample of dental casts with respect to deviation from normal occlusion on a nine-point scale. A total of 272 cases were collected. Sixteen pairs of pre and post- treatment models were duplicated and added to the sample to assess for examiner reliability. 320 cases in total were examined. The dental casts were divided into four groups of 40 pre-treatment and 40 post-treatment pairs. Six validation study days were arranged.

Four trained and calibrated examiners each scored one group using the PAR index. The raw total for the PAR components had a correlation, r, of 0.74 with the panel of 74 examiners mean subjective scores for deviation from normal occlusion.

Direct summing of the sub-components might not provide the best index as the profession might place greater importance on certain aspects of a malocclusion. In order to determine weights that should be placed on each component to best predict average opinion, multiple regression of the sub-components was carried out. The Pearson's correlation coefficient, r ,was then 0.85 for the weighted PAR scores.

1.8-4b *Reliability of the weighted PAR score*

Richmond et al. [76] found that the inter-examiner, intra-class correlation coefficient of reliability for the total score of the 4 examiners was 0.93 with the lower 95% confidence limit 0.90. The weighted index shows a slight improvement over the un-weighted (un-weighted r= 0.91, lower 95% confidence limit 0.87)

In a related study, Richmond et al. [79] describe how the PAR index can be used in assessing improvement and the standard of orthodontic treatment. In orthodontics it is important to assess whether the treatment rendered has created a worthwhile improvement in terms of overall alignment and occlusion. The outcome of treatment is often dependent on many factors, e.g. complexity of the case, patient factors and expertise of the practitioner. There are two ways of assessing the degree of improvement using the PAR index. Using the reduction in weighted PAR score or using the percent reduction in weighted PAR score. A greater reduction of weighted PAR score is likely when the malocclusion is very severe and perhaps having a greater need for treatment. Percentage reduction reflects degree of improvement relative to the pre-treatment score. The following example illustrates the importance of looking at the reduction in PAR score and not only the percentage reduction in PAR score. A change in score from 40 to 10 and a change from 12 to 3 both indicate a 75% reduction in PAR score but a much greater improvement has been achieved in the first instance. According to Richmond et al., [79] at least a 30% reduction in the PAR score is required for a case

to be considered as improved and a change of 22 PAR points for great improvement.

Deficiencies of the PAR index include:

- The index relies entirely on the evaluation of study models to reflect the severity of a patient's dentofacial deformity
- There is no provision for skeletal relationship in the antero-posterior, vertical or transverse plane
- Growth potential is not factored in
- It fails to assess the axial inclinations of anterior teeth post treatment (mesio-distal or buccal-lingual)
- It fails to account for iatrogenic decalcification, root resorption and periodontal breakdown
- If fails to take dentofacial esthetics into account
- It fails to account for the etiology of the malocclusion

Most of these problems are common to occlusal indices in general. Acknowledging these problems Pae [80] stated that, "although this analysis is a relatively new index, the PAR index appears to be the gold standard for evaluating a malocclusion." This index appears to be the most accepted in the current literature.

1.9 Purpose

The goal of orthodontic treatment is to provide a functional, esthetic and stable correction of a presenting malocclusion. Termination of orthodontic treatment before these goals are met is undesirable.

The First Nations and Inuit Health Branch states that there is a continuing trend towards premature discontinuation among First Nations patients. It has also contended that all too often the precipitating factor to early discontinuation is the tendency towards an increased number of missed appointments. The Non-Insured Health Benefits Plan Bulletin [11] states that there is considerable concern among orthodontic providers regarding missed appointments and difficulties in completion of orthodontic treatment. This study will evaluate the number of missed appointments and the orthodontic treatment results of those First Nations patients who complete orthodontic treatment.

"First Nations" health service dentists have had a clinical impression that there is a greater frequency of severe dental mal-relations among First Nations people than in the general population.[81] As it is unrealistic to expect all malocclusions to be treated to an ideal occlusion, degree of improvement is often the gauge that is used to decide if a case's treatment was worthwhile. It is important to establish whether a worthwhile improvement has been achieved for an individual case and the proportion of cases that show improvement.[79] This study will use the PAR index to evaluate the pre-treatment and post-treatment

malocclusions as well as the degree of improvement in those patients who have been approved for coverage by the NIHB.

The provision of orthodontic treatment depends not only on the initial consultation and the fitting of the orthodontic appliance, but the ability of the orthodontist and patient to carry out the treatment to a successful conclusion.[21]

There has been no formal study done using records from private orthodontic practices to evaluate the orthodontic treatment outcome, the severity of malocclusion and the prevalence of missed appointments in First Nations people undergoing orthodontic treatment. In order to optimize the health benefit to the patient, the outcome of orthodontic treatment in these patients must be assessed and factors influencing it must be analyzed. This study will examine orthodontic treatment outcome in the First Nations populations as well as several factors that may affect the successful outcome of treatment.

1.10 Statement of Objectives

Objective 1. To compare the pre-treatment PAR scores of a sample of First Nations orthodontic patients to the pre-treatment PAR scores of a sample of non-First-Nations orthodontic patients.

Objective 2. To compare the post-treatment PAR scores of a sample of First Nations orthodontic patients to the post –treatment PAR scores of a sample of non-First Nations orthodontic patients.

Objective 3. To compare the reduction of PAR scores resulting from orthodontic treatment in a sample of First Nations patients to the reduction in PAR scores resulting from orthodontic treatment in a sample of non-First-Nations orthodontic patients.

Objective 4. To compare the reduction of PAR scores resulting from orthodontic treatment in a sample of First Nations class II dental orthodontic patients to the reduction in PAR scores resulting from orthodontic treatment in a sample of non-First Nations class II dental orthodontic patients.

Objective 5. To compare the reduction of PAR scores resulting from orthodontic treatment in a sample of First Nations orthodontic patients who had extractions to the reduction in PAR scores resulting from orthodontic treatment in a sample of non-First Nations orthodontic patients who had extractions.

Objective 6. To compare the number of missed appointments during the course of orthodontic treatment between a sample of First –Nations patients and a sample of non-First-Nations patients.

1.11 Hypotheses

Hypothesis #1

H_0: The pre-treatment PAR scores in First Nations patients commencing orthodontic treatment are not significantly different from the pre-treatment PAR scores of non-First Nations patients commencing orthodontic treatment.

H_a: The pre-treatment PAR scores in First Nations patients commencing orthodontic treatment are significantly greater than the pre-treatment PAR scores of non-First Nations patients commencing orthodontic treatment.

Hypothesis #2

H_0: The post-treatment PAR scores in First Nations patients are not significantly different from the post-treatment PAR scores in non-First Nations patients.

H_a: The post-treatment PAR scores in First Nations patients are significantly greater than the post-treatment PAR scores in non-First Nations patients.

Hypothesis #3

H_0: The reduction in PAR scores as a result of orthodontic treatment of First Nations patients is not significantly different from the reduction in PAR scores of the non-First Nations patients.

H_a: The reduction in PAR scores as a result of orthodontic treatment of First Nations patients is significantly less than the reduction in PAR scores of the non-First Nations patients.

Hypothesis #4

H_0: The reduction in PAR scores as a result of orthodontic treatment of First Nations class II dental patients is not significantly different from the reduction in PAR scores of non-First Nations class II dental patients.

H_0: The reduction in PAR scores as a result of orthodontic treatment of First Nations class II dental patients is significantly less than the reduction in PAR scores of non-First Nations class II dental patients.

Hypothesis #5

H_0: The reduction in PAR scores as a result of orthodontic treatment of First Nations extraction patients is not significantly different from the reduction in PAR scores of non-First Nations extraction patients.

H_0: The reduction in PAR scores as a result of orthodontic treatment of First Nations extraction patients is significantly less than the reduction in PAR scores of non-First Nations extraction patients.

Hypothesis #6

H_0: The percentage of missed orthodontic appointments among First Nations patients is not significantly different from the percentage of missed orthodontic appointments in non-First Nations patients.

H_a: The percentage of missed orthodontic appointments among First Nations patients is significantly greater than the percentage of missed orthodontic appointments in the non-First Nations patients.

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Chapter Two

Research Paper

Orthodontic Treatment in the First Nations Population

2.1- Introduction

Evaluation of treatment outcome in First Nations orthodontic patients is an important step in determining the effectiveness of the dental program of the Non-Insured Health Benefits program. The NIHB program provides supplementary health benefits, including dental treatment, for registered Indian, Inuit and Innu people throughout Canada. Orthodontic services for NIHB clients now comprise nearly 12 percent of total costs in the NIHB dental program and are surpassed only by general restorative services. [1] The expense of providing dental services to the First Nations people of Canada is in excess of $106 million per year. [2] This number has almost doubled since 1993 when total spending for the dental program was about $60 million.[3] In the 1998-1999 year, orthodontic services contributed $10.4 million to the total cost of dental services funded by the NIHB program. [2]

The Non-Insured Health Benefits (NIHB) program is a branch of the First Nations and Inuit Health Branch (FNIHB) of Health Canada. The program is publicly funded through tax dollars provided at the federal level to provide not only dental, but many other health care benefits to its clients. In any publicly funded health care program the competition for limited public resources between several areas of need means that there is a limit to what services may be provided, the volume of those services provided and to whom .[4] Dental expenditures must be

prioritized in the context of many other health care needs and access limited to those who would receive the greatest health benefit.

According to NIHB program policy, dental coverage is not comprehensive. It is intended that clients receive coverage for those services that are required to maintain an intact dentition.[5] Regarding orthodontics, the NIHB program's policy limits treatment to those individuals under the age of 18 years. As well, the overall cost of multiple phases of treatment should not exceed the total fee for a malocclusion of similar severity treated in one phase and the malocclusion must be significant and functionally handicapping. [1] (Appendix 2.1) According to Salzmann,[6] the definition of a handicapping malocclusion as developed by the Council on Orthodontic Health Services of the American Association of Orthodontists is as follows: "Handicapping malocclusion and handicapping dentofacial deformity are conditions that constitute a hazard to the maintenance of oral health and interfere with the well being of the child by adversely effecting dentofacial esthetics, mandibular function or speech." To apply this definition involves some degree of subjectivity.

The Regional Orthodontic Screening Committee conducts the predetermination of orthodontic benefits based on the NIHB nation wide guidelines for orthodontic benefits.[1](Appendix 2.1) Predetermination is a common administrative procedure used by most insurance programs. [7] According to Cooney et al.,[8] the main purpose of this system is to check client eligibility or consistency of request for prior services. The Regional Orthodontic Screening Committee

evaluates each patients diagnostic records and determines if the patient is eligible to receive benefits based on the guidelines to orthodontic benefits. The primary question that the orthodontic screening committee must answer is as follows: Is the presenting malocclusion handicapping?

Shaw stated that the assessment of orthodontic need is difficult to quantify because the dental, functional and psychological benefits are, for the most part, unknown. [9] Practitioner's and patient's perceptions of treatment need are effected by many different variables. [10] The variables affecting their assessment of orthodontic need may be very different when comparing between practitioners and patients, between practitioners themselves and between patients themselves. What these variables are and how they are used by orthodontists to determine treatment need is largely unknown. [11] Although the determination of treatment need is relatively subjective, orthodontists must make recommendations regarding treatment. Considering the nature of the determination of treatment need, it would be interesting to evaluate the severity of cases being accepted for treatment by the NIHB to those patients treated in the general population.

Kitzhaber stated that determining what is being bought with our health-care dollars and the relationship between health care expenditures and health is a primary concern. [4] The outcome of providing a health service such as orthodontics to the First Nations patients who receive coverage from the NIHB program is of interest to the First Nations people, the orthodontists providing them service and

the FNIHB. According to Shaw et al., the assessment of orthodontic treatment outcome can be a determined through the use of an occlusal index. [10]

Shaw and colleagues [10] indicated that there are four types of occlusal indexes in existence. First are the diagnostic indices, for example, the Angle classification. Second there are the epidemiological indices, such as the Malalignment Index [12] and the Occlusal Index [13]. Third there are the indices of treatment need, these include Grainger's Treatment Priority Index [14], Salzmann's Handicapping Malocclusion Assessment Record[15] and the Index of Orthodontic Treatment Need.[17] The fourth type of index measures treatment success, such as the Peer Assessment Rating (PAR) index. [17] According to DeGuzman et al., [18] the PAR Index evaluates treatment difficulty as well as malocclusion severity. Pae [19] states that the PAR Index appears to be the gold standard in evaluation a malocclusion.

The primary objective of this study was to determine if there was a significant difference in the degree of improvement due to orthodontic treatment between a sample of the First Nations orthodontic patients and a control sample of non-First Nations orthodontic patients. The secondary objectives were to determine if there was a difference between the severity of malocclusions being treated in a sample of the First Nations population and a control sample of the non-First Nations population and to determine if there are any significant differences in treatment outcome between these two samples. The PAR Index is the most suitable index for the purpose of this paper and will be applied to pre-treatment and

post-treatment study models. In addition, other factors that may influence treatment outcome such as missed appointments, treatment duration, oral hygiene, extractions, dental classification and geographic location will be evaluated.

2.2 Materials and Methods

2.2-1 Reliability

Five pre-treatment and five post-treatment models, were randomly selected from the pool of treated patients from the University of Alberta Graduate Orthodontic Clinic. Intra-examiner reliability was determined through a pilot study where the author used the PAR Index (as originally described by Richmond et al., 1992)[17] to score the ten sets of models at five separate occasions and then compare the scores. To determine inter-examiner reliability, the author, one orthodontist and one orthodontic resident each used the PAR Index once to score five sets of models from the same lot selected for the intra-examiner reliability project.

Data describing intra-examiner reliability suggests that there was excellent reliability between days with mean differences between 0 and 2 PAR points of a possible 50 points. The largest difference was between days three and five with a mean difference of 2.0 (S.D.=3.266). Pearson's correlation coefficients show a very high correlation with r-values greater than 0.957 (Appendix 2.2).

Inter-examiner reliability was excellent with mean differences of 1.65 (S.D.=1.45) and 2.65 (S.D.=1.66) PAR points between the two respective reliability volunteers and the examiner. Pearson's correlation coefficients show a very high correlation with r-values greater than 0.963. (Appendix 2.2)

2.2-2 Sample Size Estimation.

Twenty subjects were randomly selected by the author from active retention files of the private practice of an Edmonton area orthodontist. Ten subjects were from the First Nations group and ten were from the non-First Nations group. The examiner was blinded to the identity of the subjects through covering the patient's name on the models. The pre-treatment and post-treatment models were separated and the models were arranged in random order. The PAR Index was applied to both pre-treatment and post-treatment models and then weighted according to DeGuzmann et al. [18] The sample size was determined by examining the mean degree of case improvement as determined by reduction of weighted PAR score. The sample size calculation with an alpha of .05 and β of 0.02 determined that for a medium effect size, a minimum sample size of 60 per group would be required.

Formula for sample size calculation.

Effect Size calculation : $d = \frac{m_a - m_b}{\sigma}$

$= \frac{19.5-13.5}{8.02}$

$= 0.75$

(where m_a =mean improvement in PAR score for FN group
and m_b = mean improvement in PAR score for non-FN group
and σ = standard deviation for mean improvement for the FN group)

For a medium effect size where d =0.75, α= 0.05, β=0.02, and a power of 98%
A sample of size n= 60 would be required per group.

2.2-3 Sample

This study was conducted in three private orthodontic practices in Alberta, Canada. These practices were chosen because of the large number of First Nations patients treated in each practice. They were located Edmonton, St. Albert and Lethbridge. Each practice contributed twenty First Nations and twenty non-First Nations subjects to the study. A total of sixty First Nations and sixty non-First Nations subjects were randomly selected by the examiner from the active retention files of the volunteer orthodontists. The patients had been de-banded within the last five years. The criteria for case selection were as follows: (1) availability of written record indicating the patients address, dental classification, treatment plan including extractions required, when the treatment was started, the number of missed appointments (no- shows), the number of attended appointments and when the patient was de-banded. (2) The method of payment for the First Nations patients was through the Non-Insured Health Benefits plan (NIHB). This served to verify the patient's First Nations status. (3) The patient was between the ages of 11 and 18 at the beginning of treatment. (4) Pre-treatment and post-treatment models were available.

Table 2.1 Description of Sample

	First Nations Pts(n=60)	Non-First Nations(n=60)	Mean difference	p-value
Age (months/years)	161.10/ 13.4	163.57/ 13.6	2.47	0.506
Gender (M/F)	29/ 31	34/ 26	5./5.	0.469

2.2-4 Data Collection

To ensure examiner blinding, patient charts obtained from each practice were placed in random order and each chart was assigned a number. This number was then placed on the patient's pre-treatment and post-treatment models and the patient's name was obscured from view. The models were then placed in random order and the PAR Index was applied to the models according to the criteria of Richmond and Shaw. The PAR score was recorded on a score sheet as a single number (between 0-50) for each set of models. The scores were then weighted to reflect North American standards according to DeGuzman.[18] (Appendix 2.3)

Pre-treatment and post-treatment weighted PAR scores were tabulated by the examiner for each patient as well as the degree of improvement (pre-treatment minus post treatment weighted PAR scores). In addition to the model analysis, a review of each patient's chart was done in order to evaluate a number of variables. The variables included were: the number of missed appointments, the geographic location of the patient (50 km was used as the maximum distance the patient could live from the practice and be considered to have reasonable access to services as per the FNIHB. If the patient lived less than 50km from the center where the practice was located they were classified as local); the dental classification of I, II, III (the division of class II cases was not determined since it was not consistently entered in the patient's charts); whether permanent tooth extractions were done to facilitate orthodontic treatment; treatment duration and the number of entries in the progress notes regarding poor oral hygiene.

2.2-5 Statistical Analysis

Following the tabulation of data, the information was observed graphically in order to ensure a normal distribution for each comparison. Mean differences for pre- treatment, post-treatment and improvement in weighted PAR as well as for treatment duration and number of kept appointments between the First Nations and the non-First Nations groups were assessed and subjected to the Student's *t*-test. Due to non-normal distributions, the comparison of number of missed appointments and number of negative comments on poor oral hygiene between the First Nations and non-First Nations patients was done by means of the Mann-Whitney non-parametric test. In addition, a multiple linear regression was done comparing all variables excluding pre and post-treatment PAR to the primary outcome measure (improvement in weighted PAR score).

2.3 Results

The means, standard deviations and *p*-values for pre-treatment, post-treatment and improvement in weighted PAR, treatment duration and appointments attended can be found in table 2.2. Significance levels of $p<0.05$ were considered to be statistically significant.

Table 2.2 Statistics comparing First Nations and non-First Nations groups.

	First Nations Pts n=60		Non-First Nations Pts n=60			
	Mean	S.D.	Mean	S.D.	Mean difference	p-value
Pre tx PAR (weighted)	28.02	9.27	22.97	8.74	5.05	0.003
Post tx PAR (weighted)	9.57	6.99	8.07	6.15	1.50	0.215
Improvement in PAR (weighted)	18.45	9.86	14.9	9.07	3.55	0.049
Treatment Duration (Months)	21.88	6.02	22.33	5.65	-0.45	0.674
Appointments Attended	13.62	4.18	16.27	5.19	-2.65	0.003

Students *t*-tests indicated that there were significant differences found in pre-treatment weighted PAR scores, improvement in weighted PAR score and number of appointments attended. No significant differences were found in post-treatment weighted PAR scores and treatment duration between First Nations and non-First Nations patients. These results indicate larger pre-treatment PAR scores, greater reduction in PAR scores and fewer appointments attended in the First Nations population.

Medians for number of missed appointments and number of negative comments on poor oral hygiene can be seen in figures 2.1 and 2.2 and table 2.3.

Table 2.3 Median number of missed appointments and negative comments on poor oral hygiene.

	First Nations Pts median	Non-First Nations median	difference	p-value
Missed appts.	2	0	2	0.000
Neg. OH comments	2	1	1	0.021

Figure 2.1 Boxplot of number of missed appointments

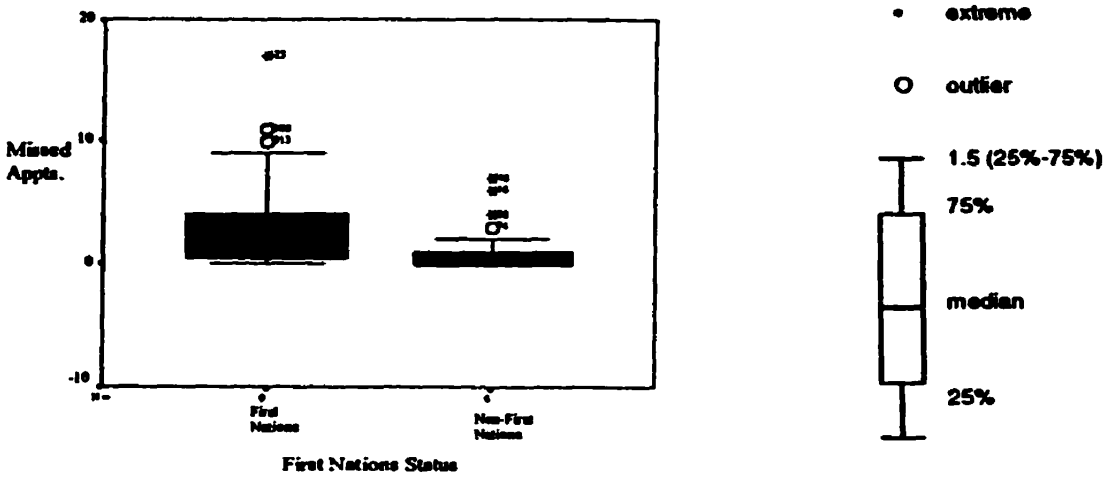
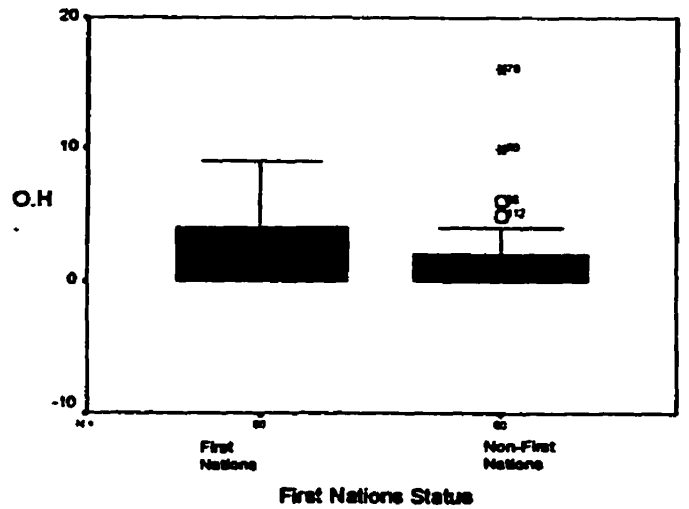


Figure 2.2 Boxplot of the number of negative comments on poor oral hygiene.



The Mann-Whitney non-parametric test indicated that there were statistically significant differences found in the number of missed appointments and

the number of comments on poor oral hygiene between the First Nations and non-First Nations patients.

Since pre, post and improvement in weighted PAR scores may be influenced by the difficulty of the presenting malocclusion it was of interest to evaluate the scores of Class II dental patients and extraction patients.

Descriptive statistics comparing First Nations and non-First Nations extraction patients and class II dental patients can be seen in tables 2.4 and 2.5.

Table 2.4 First Nations and non-First Nations extraction patient weighted PAR scores

	Extraction First Nations Pts n=41		Extraction Non-First Nations Pts n=22			
	Mean	S.D.	Mean	S.D.	Mean difference	p-value
Pre tx PAR (weighted)	29.20	8.61	24.00	10.47	5.20	0.039
Post tx PAR (weighted)	9.56	7.01	7.32	6.30	2.24	0.215
Improvement in PAR (weighted)	19.63	10.52	16.68	11.86	2.95	0.314

Table 2.5 First Nations and non-First Nations Class II dental weighted PAR scores

	Class II First Nations Pts n=32		Class II Non-First Nations Pts n=25			
	Mean	S.D.	Mean	S.D.	Mean difference	p-value
Pre tx PAR (weighted)	32.85	7.03	25.04	8.09	7.81	0.000
Post tx PAR (weighted)	12.12	8.28	9.15	7.01	2.97	0.165
Improvement in PAR (weighted)	20.73	10.62	15.89	9.98	4.84	0.093

There were significant differences found in pre-treatment weighted PAR scores between the First Nations and non-First Nations extraction patients and class II dental patients. The First Nations patients had higher pre-treatment weighted PAR scores in each case. Although a trend towards higher post-treatment and reduction in weighted PAR scores could be seen in the First Nations patients, these relationships were not statistically significant.

Table 2.6 Local vs. Non-local Patient weighted PAR scores

	Local n=74 (within 50 km)		Non-local n=46 (further than 50 km)			
	Mean	S.D.	Mean	S.D.	Mean difference	p-value
Pre-tx PAR (weighted)	26.77	9.07	23.43	9.45	3.34	0.560
Post-tx PAR (weighted)	8.57	6.16	9.22	7.31	-0.65	0.602
Improvement in PAR (weighted)	18.20	9.27	14.22	10.47	3.99	0.031

Table 2.6 illustrates the effect of geographic location of patients on pre-treatment, post-treatment and improvement in weighted PAR scores. Local patients had a statistically significant higher reduction in weighted PAR score than non-local patients.

As can be seen in Table 2.7, this study indicates that the geographic location of patients had no significant effect on the number of missed appointments.

Table 2.7 Missed appointments vs. geographic location

	Local n=74 (within 50 km)		Non-local n=46 (further than 50 km)			
	Mean	S.D.	Mean	S.D.	Mean difference	p-value
Missed Appointments	1.95	3.17	1.65	2.17	0.29	0.582

A multiple regression of all variables except pre and post-treatment PAR on improvement in weighted PAR score showed an r^2 value of 0.180 Table 2.8 shows that after removal of non-significant variables the r^2 value was 0.144.

Table 2.8 Results from forward stepwise regression and correlation test

R Square for group= 0.144		
Variable	p-value	Correlation Coefficient
FN status	0.013	0.180
extractions	0.048	0.206
Geographic location	0.001	0.197

Another way of describing the degree of improvement is by using a nomogram as described by Richmond et. al.[20] It was developed using discriminant analysis in order to separate groups of treated patients into worse or no different, improved and greatly improved categories (Figure 2.3). The pre-treatment weighted PAR scores are entered on the horizontal axis and the post-treatment weighted PAR scores are entered on the vertical axis. The intercept between the two scores is used to indicate the degree of improvement. The line separating the

"worse or no different" from the improved section indicates approximately 30 percent improvement in weighted PAR score. The line separating the "improved" and "greatly improved" cases indicates a reduction of 22 weighted PAR points.

Figure 2.3- Nomogram Illustrating Improvement In the First Nations Group. (Each 1 illustrates a First Nations patient)

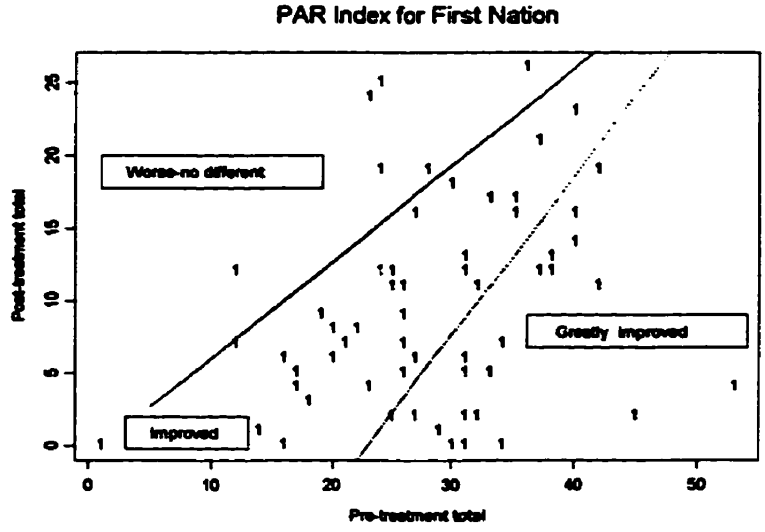
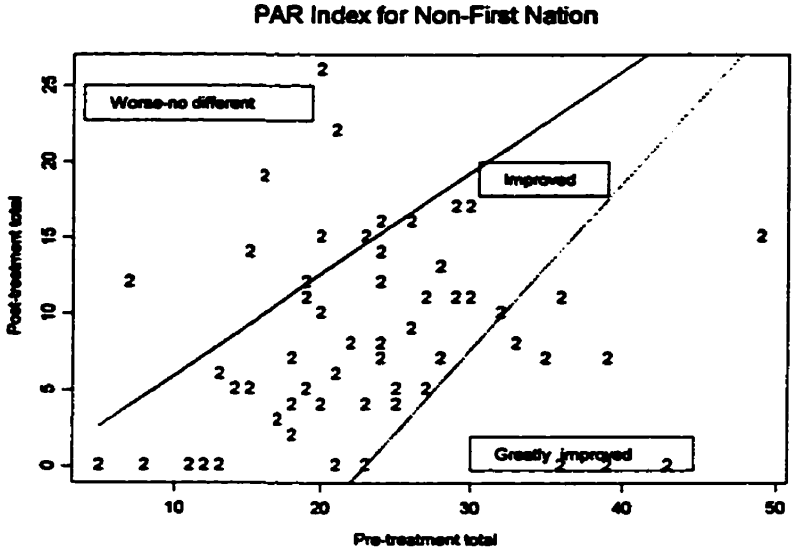


Figure 2.4 Nomogram Illustrating improvement in the Non-First Nations Group. (Each 2 illustrates one non-First Nations patient)



Figures 2.3 and 2.4 indicate that the majority of the cases in both the First-Nations and the non-First-Nations groups were in the "improved" category. More of the patients in the First-Nations group were in the "greatly improved" category than the non-First-Nations group.

2.4 Discussion

The pre-treatment PAR scores were found to be greater in the First Nations group than the non-First Nations group. There are a number of factors that may contribute to this finding. One factor is that the Regional Orthodontic Screening committee screened the First Nations patients included in this study in order for them to receive benefits. The screening committee determines that all cases accepted for treatment must be considered handicapping. The non-First Nations patients had no screening other than that done in the orthodontic office. This finding indicates that only the more severe cases in the First Nations group are being treated. In addition, there may be more "elective" orthodontic treatment (treatment of less severe or minor esthetic problems) being done in the general population. According to Richmond and Shaw,[20] the more severe malocclusions are the most likely to be greatly improved. It has been shown that the First Nations population has more severe malocclusions.[21,22]

There was no significant difference found between the post-treatment PAR scores of the First Nations and the non-First Nations patients. This indicates that the treatment standards for those cases being treated in the general population are the same as the treatment standards for those First Nations cases. The mean reduction of PAR score in the First Nations group was larger than the non-First Nations group. This is consistent with what you would expect based on the mean pre-treatment and post-treatment PAR scores. The difference in mean reduction of PAR scores is a reflection of the higher initial PAR scores in the First Nations

group. Those malocclusions most in need of improvement often achieve a greater degree of improvement than those with less need for treatment. [20]

The number of missed appointments in the First Nations group is statistically greater than that of the non-First Nations group. According to Fazzio and Boffa [23] who did a study into failed appointments, those who paid for their own appointments were good attenders. They found that when the dental care is free, the patients motivation to keep appointments is diminished. Failing to arrive, or arriving late results in staff frustration and may effect the time available for treating that patient or subsequent patients.[24] Richardson states, " It is unlikely the quality of treatment will be affected if one or two appointments are missed...but consideration of resources is relevant as time could be spent treating other patients." [25] There is a significant opportunity cost for the orthodontic office when patients miss their appointments. When missed appointments are common, fewer patients can be seen by the orthodontist. In addition, no shows and cancellations present the problem of rescheduling. Since orthodontic practices schedule on cycles of four to six weeks, there is little time available in the next several weeks to re-book the appointment.[26]

To ensure that the patients who missed their appointments did not simply re-book them shortly after their scheduled time, it was important to evaluate the total number of appointments attended. If First Nations patients had the same or greater number of appointments attended as the non-First Nations patients it would be an indication that the appointments were re-booked. If the First Nations patients

had fewer appointments attended than the non-First Nations patients it would indicate that they were not re-booking their appointments. This study found the latter to be the case.

The First Nations and non-First Nations patients had a similar mean treatment duration. The mean treatment times in this study were 21.9 months for the First Nations group and 22.3 months for the Non-First Nations group. This mean difference of 0.4 of a month equals approximately 10 days, which is not clinically significant considering the total treatment duration. The average treatment duration of the two groups is 22 months which is exactly the same as was found in Alger's study.[27] Fink and Smith found the average treatment duration of 118 cases from six offices to be slightly greater at 23.1 months.[28]

Negative comments on oral hygiene were found to be significantly greater in the First Nations group. This is a concern because as Shaw et al [29] state, when oral hygiene is poor orthodontic treatment predisposes gingival disease and dental caries.

According to the FNIHB guidelines, patients living within 50 km of the closest orthodontic practice are considered to have reasonable access to services. For the purpose of this study, those who lived over 50 km away from the practice were considered non-local. The results showed that local patients had a larger reduction in PAR scores than those whom where non-local even though this study indicated no relationship between geographic location and the number of missed appointments.

Because of the relative difficulty in treating Class II, Class III dental and extraction patients compared to Cl I non-extraction patients it was interesting to determine the difference in treatment outcome for these cases between the First Nations and the non-First Nations patients. Due to restrictions based on sample size, no evaluation of Class III cases was done and only Class II dental cases and extraction cases were evaluated. The only significant differences were found in the pre-treatment PAR score. These scores were greater for the First Nations patients in each category. Although there was a tendency towards increased post-treatment and reduction in PAR scores in the First Nations patients, this was not statistically significant. It appears that even in the more complex cases, the treatment results in the First Nations patients are similar to those in the non-First Nations patients.

The regression analysis indicates that when all factors are accounted for, the only ones having a significant effect on improvement in PAR score are First Nations status, extractions and geographic location. Determining the effect of all factors on the reduction in PAR resulted in low R- square values because of the requirement to leave pre-treatment PAR out of the regression . Although the pre-treatment PAR is strongly related to the primary outcome measure, it could not be used in the regression because it is part of the equation in determining improvement in PAR score due to treatment.

The nomogram as developed by Richmond et al.[20] is a convenient way to assess the outcome of treatment in terms of degree of improvement. A greater number of patients in the First Nations group were in the "greatly improved"

category. This may be explained by the more severe pre-treatment malocclusions in this group. Although there were more First Nations patients in the "greatly improved" category, the mean percentage reduction in PAR score is similar between the two groups.

2.5 Conclusions

Based on the results of this study of 60 First Nations patients and a control group of 60 non-First Nations patients, the following conclusions can be drawn:

1) Pre-treatment PAR scores were significantly greater for First Nations Patients than for non-First Nations patients.
2) There was no significant difference in post-treatment PAR scores between First Nations and non-First Nations patients.
3) The mean reduction in PAR score was larger in the First Nations group than the non-First Nations group.
4) There were a greater number of missed appointments among the First Nations patients than non-First Nations patients.
5) There were fewer appointments attended among the First Nations patients than the non-First Nations patients.
6) First Nations and non-First Nations patients had similar mean treatment duration as non-First Nations patients.
7) First Nations patients had more negative comments on oral hygiene than non-First Nations patients.

8) Patients who lived within 50 km of the orthodontic practice had a larger reduction in PAR score than those who lived further than 50 km from the practice.

9) First Nations Class II dental and extraction patients had higher pre-treatment and similar post-treatment PAR scores than non-First Nations patients.

Very little research has been done into the provision of dental services to the First Nations people. The intention of this paper was only as an introduction into this general area of research and therefore additional studies are required. This study reflects only the treatment results of those patients who have completed orthodontic treatment and does not reflect the results of those who have prematurely discontinued treatment. Future studies may include premature discontinuation of orthodontic treatment in the First Nations population and caries prevalence and decalcification after removal of orthodontic appliances in this population.

2.6-Appendices

Appendix 2.1
Guidelines for Orthodontic Benefits (adapted from the NIHB Dental Bulletin- Sept, 1999)

NIHB will consider supporting the cost of orthodontic treatment for eligible First Nations, Inuit and Innu clients when all nine of the following conditions apply:

1. The malocclusion is significant and functionally handicapping; providers will submit cases most in need of treatment and identify issues that will be addressed by treatment
2. All preliminary dental treatment (periodontal and restorative) has been completed.
3. The patient is caries free and has demonstrated consistently oral hygiene
4. This is the appropriate time for the proposed treatment to be provided.
5. The patient is less than 18 years of age at the time of the cases submission for assessment.
6. The patient and the parent/guardian must attend the treatment conference appointment and provide the consent and demonstrate a commitment to the plan.
7. If, in the provider's judgement, oral health is being or if there are non-compliance issues, the provider will discontinue treatment and advise the NIHB accordingly.
8. Records must be accompanied by a completed *orthodontic summary sheet.*
9. The overall cost of multiple phases of treatment will not exceed the total fee of what would be charged for a malocclusion of similar severity treated in one phase.

Appendix 2.2
Intra-examiner reliability.

Pearson's Correlation Coefficient

	Day 1	Day 2	Day 3	Day 4	Day 5
Day 1	1.000	.994**	.960**	.982**	.971**
Day 2		1.000	.957**	.989**	.974**
Day 3			1.000	.966**	.989**
Day 4			.	1.000	.974**
Day5					1.000

**Correlation is significant at the 0.01 level (2-tailed)

Inter-examiner Reliability.

Pearson's Correlation Coefficient.

	Average PAR score Researcher	Average PAR score Examiner One	Average PAR score Examiner Two
Average PAR score Researcher	1.000	0.987**	.988**
Average PAR score Examiner One		1.000	.963**
Average PAR score Examiner Two			1.000

** Correlation is significant at the 0.01 level (2-tailed).

Average PAR score is the mean PAR score for the group of 5 patients examined for inter-examiner reliability.

Appendix 2.3

Severity weightings for the PAR score components.

(DeGuzman et al., 1995)

Componenet of Malocclusion	Severity weighting
Overjet	5
Overbite	3
Midline discrepency	3
Buccal occlusion	2
Upper anterior alignment	1

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Chapter Three

Discussion

And

Recommendations

3.1 General Discussion

There is relatively little information on the prevalence of malocclusion in the First Nations population. According to Jenny et al.[1] those dentists involved in providing services to the First Nations people have the clinical impression that there is a greater frequency of severe malocclusions in the First Nations population than the general population. Harrison and Davies[2] found that there is a greater degree of severe malocclusion in Aboriginal adolescents than that of the general population. According to their study done of school children in British Columbia; 12% of First Nations 13 year olds had a mesial (Class III) molar relationship compared to 2.0% in the Caucasian group; 39.6% of First Nations 13 year olds had significant crowding (evidenced by a tooth being crowded or out of line by more than half of its crown width) compared to 16.2% in the Caucasian group; 6.0% of First Nations 13 year olds had negative overjet compared to 0.6% in the Caucasian group; 11.3% of First Nations 13 year-olds had an anterior open-bite compared to 0.9% in the Caucasian group. All of the above findings were significant at the $P < 0.05$ level. It can be seen that crowding, class III dental relationships and anterior open-bite are more common in the population studied. It is an interesting finding that 25.9% of First Nations 13 year-olds had an overjet > 4mm compared to 13.7% in the Caucasian group although this finding was not significant at the $P < 0.05$ level. Although these findings are valuable, the method used to measure crowding were coarse, information on skeletal relationships, esthetics and psychosocial aspects of malocclusion were not recorded.

The relatively high pre-treatment weighted PAR scores of the First Nations group found in the current study appear to confirm Harrison and Davies[2] findings of a high prevalence of severe malocclusion among the First Nations population. Although this finding may initially appear to show that the First Nations malocclusions are more severe, part of this effect can be explained by the sample chosen. This project was focused on studying those First Nations patients being treated under the Non- Insured Health Benefits plan (NIHB). In order to be included in the study, the First Nations patients must have gone through a screening process undertaken by the Regional Orthodontic screening committee of Alberta to be determined to have a "Handicapping Malocclusion". [3] (See the definition on page 8).

When the provision of health services is not comprehensive, and some treatment priority needs to be allocated, a screening system is justified. The funds allocated for orthodontic treatment of NIHB clients must be used to provide health services to those who are most in need. The primary challenge is to provide the maximum benefit to those patients who require them the most with the limited resources available for orthodontic services. It is evident from the current study that, relative to the general population, the NIHB is allocating its orthodontic budget to those patients having a high need for orthodontic services. This may provide an indication of the effectiveness of the Regional Orthodontic Screening Committee in determining those having a high need for orthodontic treatment.

A major goal of any public health system is to provide quality health services to its clients. The NIHB has an interest in that the orthodontic care interventions provided are effective. The similarity in post-treatment PAR scores between First Nations and non-First Nations patients indicates that the those patients treated under the Non-Insured Health Benefits plan are receiving the same quality of service as those having their orthodontic treatment funded by private dollars. Although this information is encouraging, it must be kept in mind that this study involved only patients who had post-treatment study models taken. This being the case, this study was insensitive to the post-treatment results of those patients who may have prematurely discontinued treatment and may not have had post-treatment study models taken. This is an important consideration as premature discontinuation of orthodontic treatment can adversely affect treatment results. Premature discontinuation is therefore undesirable and every step should be taken to reduce its incidence.[4]

The greater degree of improvement in PAR scores found in the First Nations population reflects the findings of Richmond et al.,[5] that those with more severe malocclusions often have the greatest reductions in PAR scores. This finding reinforces that those with more severe malocclusions benefit the most from orthodontic treatment. When one evaluates orthodontic treatment in terms of degree of improvement, the orthodontic treatment undertaken for NIHB clients who finish treatment appears to be more effective.

Missed appointments are a concern of many of the professionals providing orthodontic services to NIHB clients[3]. A 1994 survey done in the United States found that the dilemma with broken dental appointments by the First Nations population is common in most offices and excessive in others. According to the survey, as many as 60% of daily appointments in the First Nations population are not kept. [6] The current study validates these concerns by indicating that First Nations orthodontic patients miss more appointments than control subjects. Richardson states, "It is unlikely the quality of treatment will be affected if one or two appointments are missed...but consideration of resources is relevant as time could be spent treating other patients."[7] Failing to arrive, or arriving late results in staff frustration and may effect the time available for treating that patient or subsequent patients.[6] There is a significant opportunity cost for the orthodontic office when patients miss their appointments. When missed appointments are common, fewer patients can be seen by the orthodontist. In addition, no shows and cancellations present the problem of rescheduling. Since orthodontic practices schedule on cycles of four to six weeks, there is little time available in the next several weeks to re-book the appointment.[8]

The current study indicated that the majority of the First Nations patients who missed their appointments did not simply re-book their appointment shortly after the scheduled time since in addition to missing more appointments relative to the non-First Nations patients, they also attended fewer appointments.

Studies have shown that the number of missed appointments can effect treatment duration. [9,10] According to Gross et al.,[7] behaving irresponsibly regarding appointment keeping may result in less effective treatment or unnecessarily extended treatment periods. This assertion was not upheld by the current study that indicates that the treatment duration of the First Nations patients was similar to that of the control patients even though they missed more appointments. The First Nations patients took on average the same length of time for treatment and the treatment was of similar quality even though they missed more appointments This supports Richardson's statement that it is unlikely that the quality of treatment will be effected if one or two appointments are missed. [7]

Even though there was a high rate of missed appointments in the First Nations population, they obtained similar treatment results as the non-First Nations patients. There are many factors influencing appointment keeping. Obtaining dental care is a social process that includes the dentist, the patient and often family members and insurance providers. [8] Behavioral and cultural factors as well as the service delivery system may be related to reduced compliance with appointment keeping. Based on Brunick and Nelson's survey,[6] healthcare professionals speculated that access to vehicles, unreliable vehicles, treacherous roads and adverse weather were the primary factors leading to missed appointments. Brunick and Nelson [6] state, "other factors affecting appointments include irresponsibility, fear and lack of oral health education." Communication problems may interfere

fear and lack of oral health education." Communication problems may interfere when there is no telephone access or messages are not received. As evidenced by the present study a large number of the First Nations patients live more than 50 km away from the practice (57% in the First Nations group compared to 20% in the non-First Nations group), such a distance may act as a barrier to regular appointment attendance. Fazio and Boffa [9] found that those who paid for their own appointments were more likely to attend. The NIHB dental care delivery system provides the finances for orthodontic treatment of its clients. Fazzio and Boffa's findings may therefore be related to the high number of missed appointments in the First Nations group.

Oral hygiene was a common concern of the orthodontists and staff in the offices providing records in this study. Shaw et al. state that when oral hygiene is poor, orthodontic treatment predisposes gingival disease and dental caries.[14] Specific problems include gingivitis, gingival hyperplasia, periodontitis and enamel demineralization around orthodontic brackets. Many had the clinical impression that these problems were more of a concern in the First Nations patients. If this was the case, it would negatively effect the risk/benefit ratio for orthodontic treatment in these patients. Beckwith et al. found that there was a direct relationship between treatment duration and each progress note entry regarding less than "good" oral hygiene. Each negative comment on oral hygiene was associated with two thirds of a month increase in treatment time. [9] Patients who comply with the prescribed oral hygiene instructions may be more likely to co-

operate with other aspects of treatment.[15,16] This study found that there were significantly more negative comments regarding poor oral hygiene in the First Nations group than the non-First Nations group.

Often Class II and class III dental malocclusions are more complex to treat than class I skeletal and dental malocclusions. Fink et al. used the ANB angle, Salzmann index and mandibular plane angle to assess treatment complexity. [10] Their findings indicate that as the treatment complexity increases, the treatment duration increases as expected. As well, they found that extraction of premolars was an important variable in explaining the difference in treatment duration. More of interest in the current study is to compare the treatment outcome for the more complex cases between the First Nations and the non-First Nations patients. Due to the small number of class III patients in the sample, only Class II skeletal and/or dental cases and extraction cases were evaluated. The only significant differences were found in the pre-treatment PAR score. These scores were greater for the First Nations patients in each category. Although there was a trend towards increased post-treatment and reduction in PAR scores in the First Nations patients, this was not statistically significant. It appears that even in the more complex cases, the treatment results in the First Nations patients are similar to those in the non-First Nations patients.

According to Bergstrom et al., [17] individuals in rural areas have a greater degree of tolerance towards malocclusion than individuals in urban areas. It is their contention that individuals in urban centres who have small deviations and a

moderate treatment need may express a strong demand for treatment, whereas those in rural areas may be more accepting of a low to moderate severity of malocclusion. The current study does not reflect these assertions with higher mean pre-treatment PAR scores in the local (urban) patients than the non-local (rural) patients. According to Bergstrom et al.,[17] discontinuance of treatment may occur more with patients from rural areas. Their results indicate that individuals living in rural areas are more likely to accept small deviations and often want to discontinue prematurely. They also found a higher reduction of treatment need and a higher degree of success with patients from urban areas. The current study's results indicate a higher degree of improvement in the local (urban) patients even though they started with less severe malocclusions.

3.2- Limitations and Suggestions for Future Research

Although the sample size of 60 First Nations and 60 Non-first Nations was sufficient for answering the main research questions regarding the difference between pre-treatment and post- treatment PAR scores, and missed appointments, a larger sample size would have been preferred. This would have allowed the study to answer some of the additional questions regarding prevalence of class III skeletal and dental malocclusion in the population studied.

There are several variables that were not evaluated in the present study. Not included were, aesthetic factors, functional factors and psychosocial factors that may have a bearing on treatment results. The PAR tool used in this study evaluated

only static dental position and does not reflect skeletal relationships. According to Foster and Menezes,[18] the factors which have the greatest bearing on malocclusion severity are the form and functional relationships of the jaws and the form and function of the oral musculature.

Cephalometric films to assess the prevalence of the skeletal etiology of malocclusion would have been of value.

Information involving the motivation for seeking treatment in this patient group would be interesting. According to Jenny et al.[1] the First Nations patient's desire for improved dental esthetics parallels that of the general population. It is their contention that the provision of orthodontic care may be especially important in this group due to unusual problems in developing identity and have a higher rate of depression and anxiety than the general population.

This study failed to evaluate the occurrence of iatrogenic tissue damage. Since soft tissue and hard tissue damage negatively effects overall treatment results, it would be worthwhile evaluating this. Shaw et al. [14] state that where oral hygiene is poor, orthodontic treatment increases the predisposition to dental caries and gingival disease.

A crucial factor in attaining acceptable orthodontic treatment results is co-operation. Poor compliance with the use of elastics and headgear results in anchorage loss and compromised treatment objectives. The current study did not assess compliance as a factor in determining treatment results. It would be

valuable to study this factor and its effect on treatment results in the First Nations population.

Premature discontinuation can adversely effect orthodontic treatment. It was stated earlier that the difficulty in completing treatment for First Nations patients is a concern for those dentists providing orthodontic treatment for these patients.[3] The need to discontinue a patient's orthodontic treatment before it is complete is frustrating from the orthodontist's perspective because the treatment outcome may not achieve the functional, esthetic and stable result that was anticipated at the start of treatment. The patient suffers because the treatment may not be as successful as it could have been. The cost to benefit ratio for those cases that are not completed increases, raising concerns for the third party responsible for payment. Clearly, premature discontinuation of orthodontic treatment is a detriment to all those involved. Unfortunately, the sample was biased towards those patients who had finished orthodontic treatment since there was a requirement for post treatment models for inclusion in the sample. In addition, this study was retrospective and there was insufficient standardization of records indicating premature discontinuation.

An area of important future research would be to evaluate the premature discontinuation of orthodontic treatment as well as the iatrogenic effects of orthodontic treatment in the First Nations population. This would likely involve a prospective study with a design that would include a standardized definition of what constitutes premature discontinuation and a requirement for post-treatment

study models of those patients who prematurely discontinue. This approach could be facilitated by the institution of a treatment completion form or questionnaire by the First Nations and Inuit Health Branch that would be completed on submission of final records when the case is completed. Questions that could be included might be the number of missed appointments, whether the case was finished prematurely, compliance problems and the presence of caries or decalcification. Such research would provide information in addition to the current study that could be used to improve the orthodontic care delivery system to the First Nations people.

3.3 References

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Chapter Four

Appendix

4.1 Ethics Approval

Health Research Ethics Board | biomedical research | health research

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UNIVERSITY OF ALBERTA HEALTH SCIENCES FACULTIES, CAPITAL HEALTH AUTHORITY, AND CARITAS HEALTH GROUP

HEALTH RESEARCH ETHICS APPROVAL

Date:	July 2000
Name(s) of Principal Investigator(s):	Dr. Kirby Cadman
Organization(s):	University of Alberta
Department:	Graduate Studies; Dentistry
Project Title:	Orthodontic Treatment in the First Nations Population

The Health Research Ethics Board has reviewed the protocol for this project and found it to be acceptable within the limitations of human experimentation. The HREB has also reviewed and approved the patient information material and consent form.

The approval for the study as presented is valid for one year. It may be extended following completion of the yearly report form. Any proposed changes to the study must be submitted to the Health Research Ethics Board for approval.

Sharon Warren

Dr. Sharon Warren
Chair of the Health Research Ethics Board (B: Health Research)

File number: B-120600-DENT

University of Alberta | Capital Health | CARITAS HEALTH GROUP

4.2 PAR Index Score Sheet

Model No._____

PAR INDEX
Score Sheet

COMPONENT	SCORE
OCCLUSAL FEATURES	
Maxillary:	
Right _____	___
Anterior _____	___
Left _____	___
Mandibular	
Right _____	___
Anterior _____	___
Left _____	___
BUCCAL OCCLUSION	
A-P	
Vertical	___
Transverse	___
	___
OVERJET	
Overjet	
Anterior Crossbites	___
	___
OVERBITE	
Open-bite	
Overbite	___
	___
CENTERLINE	___
TOTAL PAR SCORE:	___

4.3 Data Collection Sheet

PT NO.	AGE	M/F	LOCAL Y/N	PHASE I TX	EXO'S	DENT CL	SKEL CL	PARi	PARf	PAR diff	MISSED APPTS	Mos in tx	OH	COMMENTS

4.4 First Nations Data

First Nations Group Demographics

Pt.	Age in Months	Gender	Pt resides <50 km fr. Practice Y/N	Dental class	Exo's Y/N	Number of Negative Comments	Treatment OH Duration (Months)	Kept Appts.	Missed Appts.	Weighted Pre-tx PAR Score	Weighted Post-tx PAR Score	Par Reduction
1	144	F	N	III	Y	0	19	8	3	32	11	21.00
3	173	M	N	I	Y	0	21	14	1	17	4	13.00
4	182	F	Y	I	Y	0	20	11	6	34	0	34.00
6	215	F	N	I	Y	4	23	12	5	30	18	12.00
8	160	M	Y	II	Y	0	20	12	2	35	17	18.00
11	141	M	N	I	N	4	17	14	4	18	3	15.00
12	153	F	N	I	Y	2	18	14	0	26	9	17.00
13	179	F	N	III	N	1	26	15	0	16	6	10.00
19	176	M	N	I	N	0	14	7	3	20	6	14.00
23	169	F	Y	I	Y	0	18	2	17	31	12	19.00
27	205	F	N	I	Y	0	18	15	0	19	9	10.00
29	191	F	N	I	Y	0	20	13	6	20	8	12.00
31	162	F	N	I	Y	0	19	12	2	31	2	29.00
32	170	F	N	II	N	0	20	16	0	29	1	28.00
35	144	M	N	I	N	0	8	9	0	28	19	9.00
38	146	F	Y	II	Y	2	19	13	1	40	23	17.00
40	139	F	Y	I	Y	2	14	10	1	45	2	43.00
42	156	M	N	II	Y	6	21	13	0	34	7	27.00
44	146	F	N	II	Y	0	45	31	0	36	26	10.00
45	133	F	N	II	Y	2	24	16	0	53	4	49.00
47	144	M	N	II	Y	4	20	12	1	24	19	5.00
50	139	M	Y	II	Y	1	25	16	3	40	16	24.00
51	143	M	N	II	Y	1	24	19	0	31	5	26.00
52	138	M	N	II	Y	1	31	14	2	33	17	16.00
55	146	M	N	I	Y	0	24	15	1	25	12	13.00
56	157	M	Y	II	Y	4	11	7	2	27	6	21.00
57	148	M	N	II	Y	6	22	17	1	24	25	-1.00
59	154	F	N	II	Y	1	30	12	9	26	11	15.00
61	133	F	N	II	Y	9	24	15	1	25	2	23.00

First Nations Group Demographics cont.

Pt.	Age in Months	Gender	Pt resides <50 km fr. Practice Y/N	Dental Class	Exo's Y/N	Number of Negative OH Comments	Treatment Duration (Months)	Attended Appts.	Missed Appts.	Weighted Pre-tx PAR Score	Weighted Post-tx PAR Score	Par Score Reduction
62	153	M	N	II	N	0	24	16	2	23	24	-1.00
64	138	F	Y	II	Y	4	25	17	3	33	5	28.00
67	149	F	N	I	Y	0	20	15	0	12	12	.00
68	173	M	N	I	Y	6	27	19	2	16	0	16.00
71	153	M	N	I	Y	3	17	12	3	19	9	10.00
73	148	M	Y	I	Y	7	18	12	5	27	2	25.00
75	146	F	N	I	N	1	11	9	2	22	8	14.00
77	163	M	N	II	Y	3	24	15	0	30	0	30.00
80	157	M	N	II	Y	0	13	7	3	31	6	25.00
81	149	F	N	II	Y	6	25	13	2	35	16	19.00
82	150	M	Y	II	N	4	25	13	8	31	13	18.00
84	155	M	Y	I	Y	7	20	16	3	27	16	11.00
86	179	M	N	I	Y	6	22	15	0	23	4	19.00
88	159	M	Y	I	N	7	18	13	0	17	5	12.00
89	152	F	Y	I	N	0	20	12	4	26	7	19.00
91	164	F	Y	II	Y	0	25	11	10	32	2	30.00
94	189	F	Y	III	N	0	26	20	0	38	12	26.00
96	192	F	Y	II	Y	1	24	11	3	25	11	14.00
99	154	F	Y	I	N	4	20	13	1	26	5	21.00
101	175	F	Y	III	Y	2	35	19	6	12	7	5.00
102	152	M	N	II	Y	4	22	13	1	31	0	31.00
103	161	M	Y	II	N	2	15	12	0	42	19	23.00
106	185	M	Y	I	N	1	23	15	11	14	1	13.00
110	147	F	N	I	N	6	23	11	7	37	12	25.00
111	215	M	Y	II	N	1	32	15	7	38	13	25.00
113	171	M	Y	I	Y	5	27	10	10	24	12	12.00
114	140	F	Y	II	Y	3	22	12	2	42	11	31.00
115	204	F	N	I	N	3	26	16	4	1	0	1.00
118	205	F	Y	II	N	6	31	23	2	37	21	16.00
119	154	F	Y	I	Y	1	23	13	1	40	14	26.00
120	140	M	Y	I	N	2	15	12	1	21	7	14.00
						3						
AVG	161.1	F-31 M-29	Y-26 N-34	I-29 II-27 III-4	Y-41 N-19	2.42	21.88	13.62	2.90	28.02	9.57	18.45

Non-First Nations Patient Group Demographics

Pt.	Age in Months	Gender	Pt resides <50 km fr. Practice Y/N	Dental Class	Exo's Y/N	Number of Negative OR Comments	Treatment Duration	Attended Appts.	Missed Appts.	Pre-tx PAR Score	Post-tx PAR Score	Par Score Reduction
2	144	F	Y	I	Y	0	21	14	0	24	8	16.00
5	187	F	Y	I	N	1	15	11	1	21	6	15.00
7	143	M	Y	II	N	3	29	27	0	24	16	8.00
9	174	M	Y	I	N	0	16	10	0	18	2	16.00
10	151	M	Y	I	Y	0	29	25	0	18	7	11.00
14	203	M	Y	I	N	0	23	15	6	30	11	19.00
15	184	M	N	I	Y	0	24	12	6	13	6	7.00
16	154	M	Y	I	Y	0	25	19	0	15	5	10.00
17	137	F	Y	I	N	0	25	17	1	14	5	9.00
18	151	M	Y	I	N	0	14	11	0	35	7	28.00
20	141	F	Y	I	N	1	31	17	0	23	15	8.00
21	198	M	Y	I	Y	1	33	24	0	28	13	15.00
22	166	F	Y	I	N	0	13	12	0	26	9	17.00
24	139	F	Y	II	Y	2	34	27	0	20	26	-6.00
25	157	M	Y	I	N	2	12	7	2	33	8	25.00
26	148	F	Y	I	N	0	21	20	0	24	12	12.00
28	173	M	Y	I	Y	0	25	19	0	49	15	34.00
30	158	F	Y	I	Y	0	25	18	0	43	0	43.00
33	166	M	Y	I	N	4	18	13	0	15	5	10.00
34	155	F	Y	II	Y	3	22	17	0	8	0	8.00
36	140	M	Y	III	N	0	28	23	1	20	4	16.00
37	148	F	N	I	Y	0	19	17	0	7	12	-5.00
39	187	M	Y	I	N	0	15	15	1	16	19	-3.00
41	148	F	Y	II	N	2	30	22	0	21	0	21.00
43	173	F	Y	II	N	1	27	24	1	39	7	32.00
46	175	M	Y	I	Y	2	29	16	7	19	5	14.00
48	190	M	N	I	N	0	22	16	0	20	15	5.00
49	140	F	N	II	N	0	27	20	0	5	0	5.00
53	172	M	N	I	N	0	22	15	2	11	0	11.00
54	158	F	Y	II	Y	0	26	15	2	26	16	10.00
58	194	M	Y	III	Y	0	22	18	4	23	4	19.00

Non-First Nations Patient Group Demographics Cont.

Pt.	Age in Months	Gender	Pt resides <50 km fr. Practice Y/N	Dental Class	Exo's Y/N	Number of Negative OH Comments	Treatment Duration	Attended Appts.	Missed Appts.	Pre-tx PAR Score	Post-tx PAR Score	Par Score Reduction
60	141	F	Y	II	Y	10	22	18	0	36	11	25.00
63	192	F	Y	I	Y	0	24	17	0	18	4	14.00
65	161	F	Y	II	N	1	18	16	1	30	17	13.00
66	149	M	Y	II	N	6	28	21	1	17	3	14.00
69	155	M	Y	II	Y	1	28	26	0	18	2	16.00
70	171	F	Y	II	Y	0	28	25	1	39	0	39.00
72	151	M	Y	II	N	0	23	16	0	22	8	14.00
76	126	M	Y	II	Y	4	24	15	1	28	7	21.00
78	182	F	Y	I	Y	1	22	16	0	23	0	23.00
79	143	M	N	I	Y	16	27	21	0	22	8	14.00
83	177	M	Y	II	N	1	15	9	0	25	5	20.00
85	144	M	Y	II	N	4	15	9	1	20	10	10.00
87	204	M	Y	II	N	1	28	25	1	36	0	36.00
90	173	M	N	I	N	2	15	9	0	15	14	1.00
92	166	M	Y	I	N	3	16	11	0	13	0	13.00
93	197	F	Y	II	N	0	22	13	1	29	11	18.00
95	147	F	Y	II	N	1	16	11	0	19	11	8.00
97	162	M	Y	II	N	0	15	10	0	32	10	22.00
98	183	M	N	II	N	3	19	12	0	21	22	-1.00
100	163	F	Y	I	N	1	30	21	0	24	14	10.00
104	172	M	Y	I	N	0	16	10	0	19	12	7.00
105	138	F	Y	I	N	2	16	11	0	12	0	12.00
107	148	F	Y	II	N	0	18	11	0	28	13	15.00
108	182	F	N	I	N	3	20	14	0	12	0	12.00
109	168	M	Y	I	Y	4	21	12	1	27	5	22.00
112	160	M	Y	II	N	5	16	11	1	25	4	21.00
116	186	M	N	II	Y	3	21	13	0	24	7	17.00
117	133	F	Y	II	N	0	22	15	0	27	11	16.00
74	186	M	N	II	N	0	33	22	3	29	17	12.00
AVG	163.57	F-26 M-34	N-11 Y-69	I-32 II-26 III-2	Y-22 N-38	1.57	22.33	16.27	0.77	22.96	8.07	14.90

4.6 NIHB, Medical Services Branch Orthodontic Summary Sheet

APPLICATION DATE	
Section 1 Provider Information	CONFIDENTIAL WHEN COMPLETED
Name & Mailing Address/Office Stamp	Prescriber's Telephone
	Prescriber's Fax
Patient's Name: Surname Given Name(s)	Date of birth

TO BE COMPLETED BY PROVIDER

1. ORAL HYGIENE
2. CHIEF COMPLAINT: (PATIENT) (PARENT/GUARDIAN)
3. SKELETAL AND SOFT TISSUE CHARACTERISTICS
4. DENTAL CHARACTERISTICS
5. SPECIAL FEATURES (RADIOGRAPHIC AND FUNCTIONAL ANALYSIS, PERIODONTAL TREATMENT)
6. TREATMENT OBJECTIVES
7. TREATMENT PLAN ACTIVE TREATMENT TIME: RETENTION TIME:

COST:	PROVIDER'S SIGNATURE:
I/we understand the nature and commitment to the orthodontic treatment to be provided	
PARENT/GUARDIAN	PATIENT

4.7 NIHB Guidelines for Completion of Orthodontic

GUIDELINES FOR COMPLETION OF ORTHODONTIC SUMMARY SHEET AND TO BE CONSIDERED IN THE DEVELOPMENT OF THE TREATMENT PLAN:

SKELETAL AND SOFT TISSUE ANALYSIS

1. Dysplasia
   - Class I
   - Class II
   - Class III
2. Symmetry
   - Transverse
   - AP Discrepancy
3. Face height
4. Profile
5. Lip competency

MODEL ANALYSIS

1. Buccal Occlusion Assessment

Right		Left	
-	AP	-	AP
-	Vertical	-	Vertical
-	Transverse	-	Tranverse

2. Overjet
3. Overbite/Openbite
4. Midline Relationships
5. Crossbites - anterior/posterior
6. Missing/impacted teeth (including dental morphology)
7. Tooth Size/Arch Size
   - Anterior
   - Posterior
8. Specific Dental Irregularities (e.g. displacements, rotations)
9. Diastemas

RADIOGRAPHIC ANALYSIS

1. Root configuration and anomalies
2. Impacted/supernumerary/ankylosed teeth
3. Pathology

FUNCTIONAL ANALYSIS

1. CR-CO relationship
2. Displacement (anterior/posterior/lateral)
3. TMD
4. Perioral Habits

PERIODONTAL ASSESSMENT

1. Oral Hygiene
2. Periodontal Structures
3. Attachments - Frenum