Provision of Orthodontic Care by Dentists in Canada and Certified Orthodontists' Perspectives

by

Marc Olivier Aucoin

A Thesis Submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfilment of the requirements of the degree of

MASTER OF SCIENCE

Department of Preventive Dental Science

Orthodontics

College of Dentistry

University of Manitoba

Winnipeg

ABSTRACT

Introduction

In order to obtain perspectives of Canadian dentists on the quality of the undergraduate education received in orthodontics and the extent of orthodontic services provided, a descriptive survey was constructed.

Methods

An anonymous, web-based survey was created using Survey Monkey® (Palo Alto, USA), and distributed to registered dentists in Canada via links in newsletters and mass emails.

Results

There were 427 respondents. Results showed that 71% of dentists provide some orthodontic treatment, and 33% of them only offered space maintainers. A total of 23% treated most of their patients requiring interceptive treatment, compared to 15% for those requiring comprehensive treatment. A driving time greater than 1 hour to the closest orthodontist resulted in a 16% increase in the provision of orthodontic treatment by the general dentists. The undergraduate orthodontic education was deemed above average by 21.4% to 50.5% of the respondents.

Conclusions

The percentage of dentists currently providing orthodontic services to their patients is similar to previous reports. A driving time of more than 1 hour is an influencing factor on the

provision of orthodontic treatment by Canadian general dentists. The quality of undergraduate orthodontic education provided has improved over the last 25 years, although some amelioration may be beneficial.

Key words: provision of orthodontic treatment, general dental practitioners, distance to the nearest orthodontist, undergraduate orthodontic education.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to the members of my thesis committee, Drs. W. Wiltshire, F. Hechter and M. Torchia, for their guidance, support and critique, which helped make this project a success. Drs. Wiltshire and Hechter, thank you for your help and mentoring over the last 3 years with this project and the residency program. I would also like to take this opportunity to thank all the clinical instructors for taking the time to share their wisdom and expertise; it is truly appreciated.

Drs. J. Noble and S. Lapointe for the years of mentoring and encouragement, which have lead me to be where I am today. This has been a long journey and has definitely shaped me to be the orthodontist that I hope to become.

Mrs. S. Dueck, Mr. B. Dufault and Ms. K. Grant for their assistance in the completion of this project. The dental companies for their donations as well as the University of Manitoba Endowment Fund for the funding. A special mention, to everyone who helped in the distribution of the surveys.

To all of the clinical and administrative staff at the Graduate Orthodontic Program as well as to all my co-residents for the help and guidance through this journey.

Lastly, I would like to thank my family and friends (particularly V. Chow, M. Paris and M. Senye) for their support, encouragement and presence in the difficult and good times.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Introduction

1.1. Background

Non-specialists providing orthodontic treatment have been mentioned as a concern multiple times in the scientific literature (Huang & del Aguila, 2003; Konchak & McDermott, 1990; Koroluk, Jones, & Avery, 1988; Moorrees, 1984; Williams, 1977; Wolsky & McNamara, 1996). This issue has been brought back to light recently in the Canadian media regarding the case of a young patient who had previously started treatment with a dentist, and then transferred to an orthodontist after relocating to a new city. Sadly, this patient's condition was worse than prior to the beginning of her treatment (Goomansingh & Logan, June 11, 2013 12:43pm).

1.2. Current demographic

Access to dental specialists is more restricted than access to general dentists due to the reduced number of specialists and their distribution, which is consistent with the specialized nature of their work. According to the Canadian Dental Association (CDA), there were 20,616 registered/practising dentists in Canada in 2013, compared to 790 orthodontists (N. de Savigny, Coordinator Communication CDA, personal communication, July 17, 2013). Is there adequate access to care by specialist orthodontists amongst the Canadian population?

1.3. Background

The National Dental Examining Board of Canada (NDEB), founded in 1952, is in charge of establishing the national standard of competencies for Canadian general

dentists, as well as examining the competencies of dentists prior to licensure (National Dental Examining Board of Canada, 2014a). It is important to mention that although the NDEB is providing a national standard, the process of licensure of dentists in Canada is under provincial jurisdiction. The only competencies related to the field of orthodontics are managing abnormalities of orofacial growth and development and treating minor orthodontic problems (National Dental Examining Board of Canada, 2014b). Could such a vague definition explain how patients are finding themselves in the situation described previously? Are general dentists properly trained in the field of orthodontics while in dental school?

A Canadian study in the early 1990s revealed that 58.3% of the respondents rated their dental schools as *fair* in providing the basic principles of orthodontic education, and 80.4% rated them as *poor* in providing training that leads to competency in providing orthodontic care to patients (Konchak & McDermott, 1990). An American study in 2002 reported that dental school education is not proficient in preparing dentists to accurately diagnose malocclusion and make the appropriate referral decision for their patients (Bentele, Vig, Shanker, & Beck, 2002). Has the situation changed in Canada over the last 20 years? Do graduates of Canadian universities perceive that they are receiving better training than their American counterparts?

A recent study examining the consistency amongst orthodontists to properly diagnose the etiology and evaluate treatment difficulty of patients with Class II malocclusions revealed that specialists had only 33% agreement in the assessment of the difficulty of a case (Dolce, Mansour, McGorray, & Wheeler, 2012). Brightman et al. (1999) investigated the diagnostic skills of dental students and reported that they were

only able to diagnose severe orthodontic problems and were unable to assess the complexity (Brightman, Hans, Wolf, & Bernard, 1999). In light of the above findings, the aim of this study will be to investigate the provision of orthodontic treatment in Canada, as well as the consistency of general dentists and orthodontists in determining the degree of difficulty for patients seeking orthodontic treatment.

2. Literature Review

2.1. Provision of orthodontic treatment by the general dentist

The question of who should provide orthodontic treatment has been discussed several times in the scientific literature. It is believed that this concern was brought to light by an orthodontist, Dr. Jack Donovan. Gottlieb (2002) eluded that Dr. Donovan's motive was to increase the number of patients under his care by having general dentists provide orthodontic treatment and supervising them on a periodic basis (Gottlieb, 2002). One of the earliest publications on this matter was in 1973, when the American Association of Orthodontists reported a 14% decline in business at orthodontic practices due to general dentists offering similar services (American Association of Orthodontists, 1973). In 1977, Williams reported an increase in treatment provided by non-specialists (Williams, 1977).

Additional articles on this subject were published in the 1980s and 1990s. Koroluk, Jones and Avery reported a continuation of the previous trend in Indiana, with general dentists and pediatric dentists providing more complex orthodontic treatment (Koroluk et al., 1988), as opposed to space maintainers as previously reported by Miranda (Miranda, 1980). Moyers reported that dentists having minimal formal training

in orthodontics treated more than 50% of all malocclusions (Moyers, 1990). A study in Iowa indicated that 66.1% of dentists were providing some orthodontic treatment, and 20.4% of these dentists stated that they were providing orthodontic treatment to more than 10% of their active patients (Jacobs, Bishara, & Jakobsen, 1991). The only study with a Canadian perspective was undertaken in the late 1980s by Konchak and McDermott, who reported that 95.2% of Canadian orthodontists believed that there was an increase in the number of dentists providing orthodontic services to their patients in the previous three years (Konchak & McDermott, 1990). These authors predicted that up to 40% of the services provided by dentists in the mid-1990s would be related to the discipline of orthodontics.

Wolsky and McNamara reported that 76.3% of general practitioners in Michigan were providing some orthodontic treatment. A study from the state of Washington investigated a major dental insurance provider's claims for orthodontic treatment, and reported that 7.0% of providers of these claims were general dentists, while 1.9% were pediatric dentists (Huang & del Aguila, 2003). The majority of the studies on this topic in North America reported statistics for one or a few states/provinces, however, studies carried out on a national level prior to 2006 have not been found. Galbreath, Hilgers, Silveira and Schertz's nationwide survey in the USA reported that the number of non-specialists providing comprehensive orthodontic treatment has not changed when compared to previous surveys, and significant changes were not expected in the five-year period following the survey (Galbreath, Hilgers, Silveira, & Scheetz, 2006).

The nature of the orthodontic treatment provided by general dentists is an important factor to consider. For example, are general dentists providing only limited

treatment and referring more complex treatments to specialists, or is the full spectrum of orthodontic treatment being offered by these general practioners? In terms of the provision of limited treatment, e.g., the correction of anterior and/or posterior crossbite, space maintenance (Wolsky & McNamara, 1996) and the use of removable appliances, 59.2% of dentists in Iowa are providing preventive and/or interceptive services (Jacobs et al., 1991), compared to 57% of the general dentists in Michigan providing limited orthodontic services (Wolsky & McNamara, 1996). Only 29% reported using functional appliances (Koroluk et al., 1988). When investigating the extent of comprehensive orthodontic treatment or fixed appliances, 20.2% of dentists in Iowa (Jacobs et al., 1991), 18% of dentists and 62% of pediatric dentists in Indiana (Koroluk et al., 1988), 19.3% of dentists in Michigan (Wolsky & McNamara, 1996) and 22.7% of Canadian dentists were providing various levels of full-fixed orthodontics (Konchak & McDermott, 1990).

Similar concerns have been reported in Australia (Allister, Spencer, & Brennan, 1996; Lawrence, Wright, & D'Adamo, 1995; Spencer & Lewis, 1989), New Zealand (Aldawood, Ampuan, Medara, & Thomson, 2011), England (Gravely, 1989; Richmond, Shaw, & Stephens, 1992) and South Africa (de Muelenaere & Wiltshire, 1990). While these studies reported similar findings, however, Richmond, Shaw and Stephens reported that 43% of the orthodontic services provided by general dentists were with fixed appliances (Richmond et al., 1992) and De Muelenaere and Wiltshire reported that of the dentists providing orthodontic treatment to their patients, 98% were using removable appliances and 54% were using fixed appliances (de Muelenaere & Wiltshire, 1990). More recent studies reported a decrease in general practitioners providing orthodontic

treatment, compared to previous studies that were carried out in New Zealand (Aldawood et al., 2011).

In summary, it would be fair to say that the issue of general dental practitioners providing orthodontic treatment has been a concern of orthodontists for more than 40 years, and is a matter of international interest. The majority of studies carried out on this topic were surveys administered in the late 1980s to early 1990s. Although it is impossible to verify, it would be interesting to know the rationale behind these publications. For example, were they done while thinking of the patients' best interests, or were they servicing a political agenda? This question is posed taking into consideration that general dentists have provided orthodontic services for many years, and in addition, a recent nationwide American survey demonstrated that the number of dentists providing comprehensive treatment remained similar to previous studies conducted over the past 16 – 26 years (Galbreath et al., 2006). However, a more recent study has shown a decline in the number of dentists in New Zealand providing orthodontic treatment (Aldawood et al., 2011). Does this apply to Canada, or has the situation remained the same since the publication of the results of the historic study of Konchak and McDermot?

2.2. Distance to the nearest orthodontist

Knowing that non-orthodontists have been providing orthodontic care, it would be interesting to explore whether there are common characteristics amongst these providers. Some studies have considered common factors, however, they are not always consistent. Galbreath et al, suggested that undergraduate orthodontic education, the number of

continued education credits per year dedicated to the field of orthodontics, as well as the distance between general practitioners and the nearest orthodontist were factors influencing the provision of orthodontic treatment by general dentists (Galbreath et al., 2006).

The distance between a patient and the nearest orthodontist has been a subject of controversy, with multiple studies providing conflicting data. The study by Huang, Marston and del Aguila (2004) reported that although not statistically proven, the number of claims by general dentists for orthodontic treatment tended to decrease in a region with a higher ratio of orthodontists per capita (Huang, Marston, & del Aguila, 2004). Lawrence, Wright and d'Adamo (1995) reported that a variable having a significant effect on the provision of orthodontic treatment was whether the dentist was located in the outer suburbs of Australian cities, rather than an inner suburb. It can be assumed that there is limited access to orthodontists in the outer suburbs, as substantiated in the study by Aldawood, Ampuan, Medara and Thomson (2011), who reported a higher incidence of dentists providing orthodontic treatment in rural regions of New Zealand. In contrast, Wolsky and McNamara, as well as Jacobs, Bishara and Jakobsen, found that the proximity to an orthodontist was not an influencing factor. Can this conflicting data in the scientific literature be explained by other factors, such as the knowledge of the general dentists in the rural setting, the social peer-pressure of the patients, or simply by economic factors? With no mention of these factors found in the Canadian scientific literature, is the proximity to an orthodontist influencing Canadian dentists with respect to the provision of orthodontic services to their patients in a comparable fashion to their

North American neighbours, or are they similar to their colleagues in Australia and New Zealand with respect to practice demographics?

2.3. Undergraduate education

Various theories have been put forth in the literature to explain the increase in non-orthodontists providing orthodontic treatment. These include a reduction in the incidence of dental caries (Gottlieb, 2002; Koroluk et al., 1988), an increase in the number of dentists (Williams, 1977) and a decline in birth rates (Williams, 1977). Interestingly, Konchak and McDermot theorized that the reduced incidence of dental caries would have an impact on dental education, and potentially encourage dentists to tackle fields previously reserved for specialists, such as orthodontics. The sophistication of dental materials, including metallurgy and orthodontic attachment designs, as well as the delegation to less-trained staff members and dental hygienists or assistants receiving orthodontic modules as a part of their curriculum, has dramatically changed the delivery of orthodontics. How will this impact the profession over time?

As early as 1967, concerns about the lack of orthodontic education provided in the dental school curriculum were raised by Graber (Graber, 1967). In 1980, it was reported that the year of graduation had a significant impact on the number of referrals to orthodontists, and that a greater number of referrals were made by more recent graduates (Manasse & Dooley, 1980). Dr. Richard J. Smith commented in 1987 that even with the new guidelines approved by the Commission on Dental Accreditation of the American Dental Association combined to an average of 110 hours of instruction of orthodontics in American dental schools, students were not trained to provide comprehensive orthodontic

treatment. Moyers (1990) reported that the number of teaching hours required to obtain a minimal level of clinical competence in the field of orthodontics is higher than for any other discipline in dentistry. With only 110 hours of teaching in orthodontics in the undergraduate curriculum, and the complexity of its treatments, recent graduates have less knowledge of and competence in orthodontics than in other clinical fields (Moyers, 1990).

According to Bentele, Vig, Shanker and Beck, the situation has not improved over time, as the authors believe that dental school education does not sufficiently prepare dentists in the diagnosis of malocclusion, and in making appropriate referrals for potential orthodontic patients (Bentele et al., 2002). The unarticulated but often underlying message of many undergraduate orthodontic programs is: "When in doubt, refer out!" (Dr. F.J. Hechter, Part-time Professor (Orthodontics) – University of Manitoba, personal communication, December 17, 2014). Galbreath et al. (2006) concluded that the orthodontic training is similar in most dental schools, and if the orthodontic training provided were more thorough, general practitioners would better appreciate the nuance of orthodontic treatments.

What are the perspectives of dentists on this topic? The results of Konchak and McDermott's Canadian survey showed that 58.3% of general practitioners rated their dental school education as *fair* in terms of providing basic orthodontic principles, and 80.4% rated their dental school education as *poor* in terms of acquiring competency in providing orthodontic care to patients. Ngan and Amini reported that 73.5% of respondents, i.e., dentists in the state of Ohio, perceived their dental education to have helped them recognize and diagnose malocclusion, 76.9% were confident in diagnosing

children, 95.3% were comfortable screening a patient for referrals, and only 19.5% felt that they received enough training to provide limited orthodontic treatment to their patients (Ngan & Amini, 1998). Interestingly, Jacobs et al. (1991) reported that the quality of undergraduate education provided at in-state or out-of-state dental schools was **not** a significant factor in the provision of orthodontic treatment.

If most dentists reported gaps in their undergraduate orthodontic education in terms of providing orthodontic treatment, and taking into consideration that 76.3% reported providing some orthodontic treatment to their patients (Wolsky & McNamara, 1996), where do dentists acquire their education? An increase in requests for weekend courses in the field of orthodontics has been reported since the late 1980s (de Muelenaere & Wiltshire, 1990). This phenomenon is still quite common, with many continuing education courses marketed to dentists in the field of orthodontics, and including orthodontic products/systems, such as Six Months Smiles®. This avenue seems to be quite popular for non-specialist orthodontic practitioners (Huang & del Aguila, 2003), with 47% of Canadian dentists reporting having attended continuing education courses in the field of orthodontics (Konchak & McDermott, 1990). Jacobs et al. noted that dentists providing orthodontic treatment took significantly more hours of continuing education in orthodontics than dentists who do not provide orthodontic treatment.

If dentists are participating in continuing education courses to improve their knowledge and skills, who is teaching these courses? With orthodontists being reluctant to provide continuing education courses in orthodontics to general dentists (Smith, 1987), courses have been offered by a variety of non-orthodontists, such as dentists, pediatric dentists, dental hygienists, chiropractors, physical therapists, financial planners, and child

psychologists (Moyers, 1990). The nature of these courses in the field of orthodontics, provided by an array of non-orthodontists, might be purely for financial gain, which is evident in the advertisements of these courses (Bio Research Associates Inc.,). Questioning the quality of the education provided in these courses, and taking into consideration the fact that continuing education courses allow the practitioner to start providing treatment as soon as they feel ready without any form of "safety net" for the public (Smith, 1987), this is concerning.

In conclusion, knowing that many aspects of clinical orthodontics are a difficult field in which to become proficient, and require many supervised clinical hours to achieve competency, most general dentists understandably identified deficiencies in their undergraduate orthodontic education. As State Boards do not require a clinical test or exam in the field of orthodontics for dentists to be eligible for licensure, it is a concern that general dentists have the right to provide any and all orthodontic treatment without question (Smith, 1987). The situation is slightly different in Canada. A small portion of the national licensing examination is related to the field of orthodontics, however, due to the inconsistent nature of the teaching and the undergraduate clinical experience across the country, this section is quite limited and does not adequately reflect the knowledge of students in providing orthodontic care to patients (Dr. F.J. Hechter, Part-time Professor (Orthodontic) – University of Manitoba, personal communication, April 6, 2015).

One method of addressing this complex problem would be to rely on the establishment of a very solid foundation in orthodontic education as part of undergraduate dental training, which would hopefully help general dentists to be more proficient in orthodontics. Knowing the success reported with respect to interceptive

treatment in an undergraduate orthodontic dental school clinic (Bernas, Banting, & Short, 2007), and taking into consideration the high need for interceptive orthodontic treatment in underserviced Canadian populations (Karaiskos, Wiltshire, Odlum, Brothwell, & Hassard, 2005), is the current undergraduate orthodontic curriculum targeting the needs of the Canadian population where patients might benefit most from intervention by general dentists? How, in fact, are Canadian general dentists perceiving the quality of the undergraduate orthodontic education delivered in Canadian dental schools in terms of enabling them to confidently diagnose and treat malocclusion? Should dental students be taught orthodontics to the degree and extent of enabling them to treat complicated orthodontic malocclusion with full fixed appliances?

2.4. Diagnosis and assessment of case difficulty

When a patient seeks orthodontic treatment, the clinician needs to assemble and interpret the diagnostic records, generate a problem list, refine the treatment objectives list, consider alternate treatment modalities and then present and discuss treatment alternatives with the patient and family before arriving at the definitive treatment plan and biomechanics (Ribarevski, Vig, Vig, Weyant, & O'Brien, 1996). The foundation of this process relies on correct diagnosis of the patient's malocclusion. Knowing the deficiencies of orthodontic education for general dentists as reported in the scientific literature (Konchak & McDermott, 1990; Moyers, 1990), are general dentists sufficiently skilled to make a correct diagnosis? Brightman et al. (1999) investigated the diagnostic skills of dental students and reported that they were only able to diagnose severe orthodontic problems, and were unable to assess their complexity. The 171

dental students investigated were not able to properly use orthodontic diagnostic records, and were unable to assess priorities and identify more critical aspects of the diagnosis (Brightman et al., 1999). In fairness, orthodontics has been described as the most complex discipline in dentistry regarding the decision-making process, as well as when and which treatment to provide (Luke, Atchison, & White, 1998).

It might be assumed that orthodontists would diagnose cases more consistently. Interestingly, Luke et al (1998) reported that orthodontists, while examining the same patients' records and using the same classification, derived different conclusions. The study of Keeling, McGorry, Wheeler and King (1996) investigated 7 orthodontists and their consistency on various diagnostic elements, such as the facial convexity, the Angle molar classification, the overbite and the overjet. A poor to moderate inter-examiner reliability was reported for most criteria investigated, with kappa values ranging from 0.22 to 0.72 (Keeling, McGorray, Wheeler, & King, 1996). In their study of 5 orthodontists examining 148 patients records, Baumrind et al. (1996) reported a disagreement in the Angle classification of 29% of the adults and 27% of the adolescents (Baumrind, Korn, Boyd, & Maxwell, 1996). In 1999, Lee et al. reported that the level of disagreement between orthodontists was greater in the presence of mild malocclusion (Lee, MacFarlane, & O'Brien, 1999). It can be assumed that there is some consensus on how to make a diagnosis, however, why clinicians cannot agree on what they see and how to provide treatment remains unclear (Luke et al., 1998). Thus, there appears to be a great amount of individual variation. Various hypotheses have been mentioned in the literature to explain these inconsistencies, including personal beliefs, unawareness of new scientific evidence and contradictions in the literature (Dolce et al.,

2012), as well as the assessment of risk factors, perception of the current conditions, the treatment options available and/or socioeconomic factors (Luke et al., 1998).

The lack of consistency in diagnosis is not unique to the field of orthodontics. Inconsistencies in clinical decision making are also common to other dental professions, and have been reported for dentists (Espelid, Tveit, & Fjelltveit, 1994), periodontists (Lanning et al., 2005) and Temporomandibular disorder (TMD) specialists (Tegelberg, Wenneberg, & List, 2007). Espelid, Tyeit and Fjelltveit (1994) reported substantial variation in the correct diagnosis of dentin caries amongst 10 dentists. In the diagnosis of 3 periodontal patients, 27 clinical instructors were tested and presented a range of 6 to 19 different treatment plans for each patient (Lanning et al., 2005). In Sweden, TMD specialists achieved a 75% or higher degree of agreement on various statements regarding TMD, except for those on the topic of diagnosis (Tegelberg et al., 2007). When assessing the classification and diagnosis of TMD, general dentists disclosed having insecurities with regards to diagnosing, although they admitted providing treatment to their patients (Tegelberg et al., 2007). If other specialists are having a divergence of opinion, and dentists are having difficulty with a skill they are using on a daily basis, such as diagnosing cavities, what can we expect for a discipline that general dentist engage in less frequently, such as orthodontics?

While studying the accuracy of classifying soft tissue profiles, Fields et al. (1982) reported that orthodontists, pediatric dentists and dental students were more precise if the children were 12 years of age versus 8 years of age (Fields, Vann, & Vig, 1982). A study conducted in England (Richmond, O'Brien, Roberts, & Andrews, 1994) investigated the difference of opinion between a group of orthodontists and general

practitioners regarding the need for orthodontic treatment based on study model analysis of 16 patients, using a 9-point scale. They reported wide variations of intra-examiner agreement within each group with regards to esthetic needs (kappa values ranged from 0.54 to 0.97) and dental needs requiring treatment (kappa values ranged from 0.12 to 0.89) (Richmond et al., 1994). With regards to the inter-examiner agreement, the study reported a substantial level of agreement for the orthodontists for the esthetic aspect (kappa of 0.61 to 0.80) and *moderate* agreement for the dental aspect (kappa of 0.41 to 0.60), compared to *fair* agreement for the general practitioners group for both the esthetics and dental aspects (kappa = 0.21 to 0.40) (Richmond et al., 1994). Berk et al. (2002) reported high agreement (kappa range 0.86 to 0.95) for the need for orthodontic treatment when dental casts were assessed by pediatric dentists, orthodontists and general practitioners. Interestingly, a Japanese study (Kuroda et al., 2010) concluded that the perception of the need for treatment when based on the occlusion is higher in the presence of practitioners with more experience in the field of dentistry or orthodontics.

When investigating the selection of various treatment modalities, such as orthodontic extractions, Ribarevski et al. (1996) studied extraction decisions of 10 orthodontists, after evaluating the initial records of 60 Class II div 1 patients 4 weeks apart. The intra-rater reliability reported with kappa values was moderate to almost total agreement (0.54 to 0.96). The inter-examiner reliability for one session only was of 0.38 (fair agreement) with a range of 0.11 to 0.73 (poor to substantial agreement), and in only 13 of the 60 cases was there a total agreement on the extraction/non-extraction decision (Ribarevski et al., 1996). When examining the need for orthodontic extractions,

Baumrind et al. (1996) reported agreement on 66% of the cases reviewed for the 5 orthodontists included in the study. In their study of 10 orthodontists, Lee et al. (1999) reported a 0.54 kappa agreement on the decision of providing treatment, as low as 0.07 for the selection of treatment modalities such as headgear and 0.13 for removable appliances (Lee et al., 1999). When investigating the etiology of class II malocclusions, in 2012, Dolce et al. reported that the 8 orthodontists involved in the study were in agreement 65% of the time with regards to determining the type of malocclusion, and an overall moderate agreement with a kappa of 0.48 (range 0.18 to 0.55).

Taking into consideration that multiple years of full-time dedication to the field of orthodontics is required to learn to distinguish the subtleties and difficulties of various malocclusions, are general dentists able to identify which malocclusions are more complex? Only a few studies tackled this aspect, such as Brightman et al. (1999) reporting that dental students were unable to assess the degree of difficulty of cases. A study in Finland (Pietilä, Pietilä, & Väätäjä, 1992) reported 69% agreement with regards to the need for orthodontic treatment for 132 children between the ages of 7 and 8, when comparing an orthodontist and 3 public heath dentists. The orthodontist indicated that 36 cases were more complex and 16 were simpler than perceived by the general dentists. The overall agreement kappa value between the orthodontists and the general dentists was 0.22 (Pietilä et al., 1992). In the evaluation of Class II patients, the 8 orthodontists in the Dolce et al. (2012) study agreed 33% of time with regards to case difficulty. In terms of the difficulty of the case, the kappa agreement was fair, with an overall value of 0.21 and a range of 0.02 to 0.31 (Dolce et al., 2012)

In conclusion, the scientific literature demonstrates that accurate diagnosis is the key component in determining the need for orthodontic treatment, and that inconsistencies exist between orthodontists when assessing the difficulty and the treatment modalities. The problem of inconsistent evaluation is common in other disciplines of dentistry. What are realistic expectations for general practioners? Is the educational objective established in 1999 for the discipline of orthodontics, "to provide sufficient instructions to the dental student to recognize and assess malocclusion and treat uncomplicated problems and refer appropriate patients to orthodontic specialists" (Brightman et al., 1999, page 444) a realistic expectation? Have these expectations been met? What are the perspectives of Canadian general dentists regarding their orthodontic education experiences?

3. Objectives and null hypotheses

The results of this study will be presented in two distinct surveys.

3.1. Survey 1

3.1.1. Objective

To gather information about the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada, including demographics, undergraduate orthodontic dental education and the nature of the orthodontic services provided.

3.1.2. Null Hypotheses

Null Hypothesis #1

The proportion of general dentists providing orthodontic treatment to their patients in Canada has not changed.

Null Hypothesis #2

Proximity to an orthodontist has no influence on the provision of orthodontic treatment by general dentists.

Null Hypothesis #3

General dentists are not adequately prepared to confidently diagnose, treatment plan and provide orthodontic treatment for patients in the mixed and permanent dentitions.

3.2. Survey 2

3.2.1. Objective

To gather information about the perspectives of general dentists and orthodontists practicing in Canada by evaluating orthodontic patient records with regards to the level of difficulty and the treatment modalities used.

3.2.2. Null Hypotheses

Null Hypothesis #4

There is no agreement between general dentists and specialist orthodontists regarding the assessment of case difficulty.

Null Hypothesis #5

There is no agreement between general dentists and specialist orthodontists on how orthodontic cases should be treated.

4. Materials and Methods

4.1. Ethics

Ethics approval for this study was obtained from the University of Manitoba Health Research Ethics Board (HREB), Winnipeg, Manitoba, Canada (see Appendix A), prior to the commencement of this study in August 2013. A decision was made to alter the approved research protocol in order to add strategies to increase the number of respondents of Survey 1. In February 2014, these amendments were approved by the University of Manitoba HREB (see Appendix B).

4.2. Survey 1

A web-based survey using Survey Monkey® (Palo Alto, California, USA), was created, and asked various questions on topics such as undergraduate orthodontic dental education and the nature of the orthodontic services provided (see Appendix C).

This survey was conducted on an anonymous basis, and targeted registered dentists in Canada. An introduction email was sent to the Deans of the 10 Canadian dental schools (see Appendix D) and to the provincial dental associations (see Appendix E) asking them for their assistance in the distribution of the survey by sending a link to their respective alumni associations or any available mailing list of dentists. The Canadian Dental Association agreed to post a link to the survey in the online blog, *Oasis discussions* (see Appendix F); the preamble was posted 3 times, at 2 to 4 week intervals. Other strategies included mentioning the survey in the electronic newsletter of 3M® product users (see Appendix G), sharing of the survey link by the Alpha Omega dental fraternity (see Appendix H) and the Société Dentaire de Québec et de Montréal (see Appendix I) with their members, and publishing the survey link by the Alberta Society of Dental specialists in its electronic newsletter (see Appendix J).

4.3. Survey 2

There were 2 versions of this survey: 2A for the orthodontists (see Appendix K) and 2B for the general dentists (see Appendix L). The respondents were anonymous, and answered demographic questions, as well as multiple choice questions relating to their understanding of the difficulty and the treatment modalities to be used on the 4 patients presented.

4.3.1. Selection of patients for case review

The principal investigator selected the cases with diverse characteristics to be presented in Survey 2. This selection was based on the quality of the records,

the skeletal and dental relationships, the amount of crowding and the age of the patients. All cases selected were patients of the Graduate Orthodontic Clinic at the University of Manitoba, Winnipeg, Manitoba, Canada, and all signed consent forms allowing the use of their records. The patients' gender was not taken into consideration in the case selection process. The goal was to find patients representing a variety of malocclusions, with the least ambiguity possible in their diagnosis. The following patients were selected:

- Skeletal Class I with Class I dental and moderate crowding
- Skeletal Class II with Class II dental, growing
- Skeletal Class II with Class II dental, non-growing
- Skeletal Class III mild with Class III dental mild, growing

The order of presentation of the cases was randomly determined, and represented by the letters A, B, C or D, as follows:

- **A** = Skeletal Class II with Class II dental, growing
- **B** = Skeletal Class III mild with Class III dental mild, growing
- **C** = Skeletal Class II with Class II dental, non-growing
- **D** = Skeletal Class I with Class I dental and moderate crowding

4.3.2. Data collection method

All survey questions were identical for the 4 cases, and were web-based on Survey Monkey® (Palo Alto, California, USA). The patients' complete records were provided, including the description of the patients (age, gender, chief

complaint and medical history), extra-oral and intra-oral photographs, panoramic radiographs, lateral cephalographs, cephalometric analyses and measurements (Steiner's), as well as 5 photographs of the plaster models (photographs were utilized for logistical purposes). The completeness of the patients' records is contrary to other studies, in which only limited diagnostic records were provided (Baumrind et al., 1996; Han, Vig, Weintraub, Vig, & Kowalski, 1991; Mandall, 2002) in order to allow the respondents to use records with which they were familiar. The records were in a paper-format, and placed in a binder for the survey respondent to consult. Survey completion was done online using a provided iPad® or computer. To maintain the privacy of the patients, eyes were blocked out on the photographs and any potential identifying information was deleted (see Appendix M). The surveys were conducted in person by the principal investigator at the Canadian Association of Orthodontists annual meeting in Banff, Alberta, Canada, in September 2013, as well as at the Canadian Dental Association annual meeting in Winnipeg, Manitoba, Canada in January 2014.

4.4. Incentive prizes

Incentive prizes donated from dental product suppliers (*inter alia:* 3M®, Dentsply GAC®, Orthodontic Essentials Opal® and American Orthodontics®) were provided to help solicit survey participation. Respondents of Survey 1 were asked to provide an email address at the end of the survey if they wished to participate in the prize draws, and the winners were randomly selected via the RAND function in Microsoft Excel®. After completion of the survey,

respondents of Survey 2 were asked to complete a ballot to provide contact information if they wished to participate in the draws (see Appendices N and O). The ballots were locked in black box until the draws took place. All winners were selected on June 1, 2014, in Winnipeg, Manitoba, Canada, in the presence of an external supervisor, and were contacted via email (see Appendix P). If the prizes were not claimed within 7 days, a substitute winner was selected. Once all prizes were claimed, the ballots were destroyed.

4.5. Validity

As Survey 1 was based on current opinions and had a limited utility, it was not specifically tested for validity. In order to assess the validity of Survey 2, a control group of 10 orthodontists and 10 general dentists was established. The participants in the control groups were asked to retake their respective survey at least 3 months after the first completion thereof. Selection of the control group participants was based on convenience, and included part-time orthodontic clinical instructors at the University of Manitoba, Winnipeg, Manitoba, Canada, and members of the Seattle Study Club – Winnipeg Progressive Dental Study Club, Winnipeg, Manitoba, Canada.

For the purpose of data blinding, a secretary of the Orthodontic Department at the University of Manitoba randomly assigned a unique number to each participant without the knowledge of the principal investigator (see Appendix Q). The date of their initial response were recorded by the same

individual, and 3 months later envelopes containing the unique number were given to the principal investigator for the second round of testing.

4.6. Statistical analysis

The data were exported from Survey Monkey® to Excel® version 14.4.5, then imported into SASS® software version 9.3. Descriptive statistics as well as non-parametric statistics were used to analyze the collected data. To assess the validity of Survey 2, intra-class correlations (ICC) were obtained for both control groups to assess intra-rater reliability with respect to case difficulty. Lastly, overall intra-class correlations were obtained to assess case difficulty within Survey 2. The INTRACC macro® was used to calculate ICC statistics.

5. Results

Taking into consideration the large amount of data collected, only interesting and relevant highlights will be reported. The results are organized by category and do not follow the chronological order of the questions presented in the survey. Further details appear in the attached appendices.

5.1. Survey 1

5.1.1. Demographics

Survey 1 was posted online for a period of 6 months. A total of 427 dentists responded to the questionnaire, with a 74% completion rate. Question #3

and Question #4 were omitted by11 respondents (4 females and 7 males). Table 1 illustrates the demographics of the respondents of this survey.

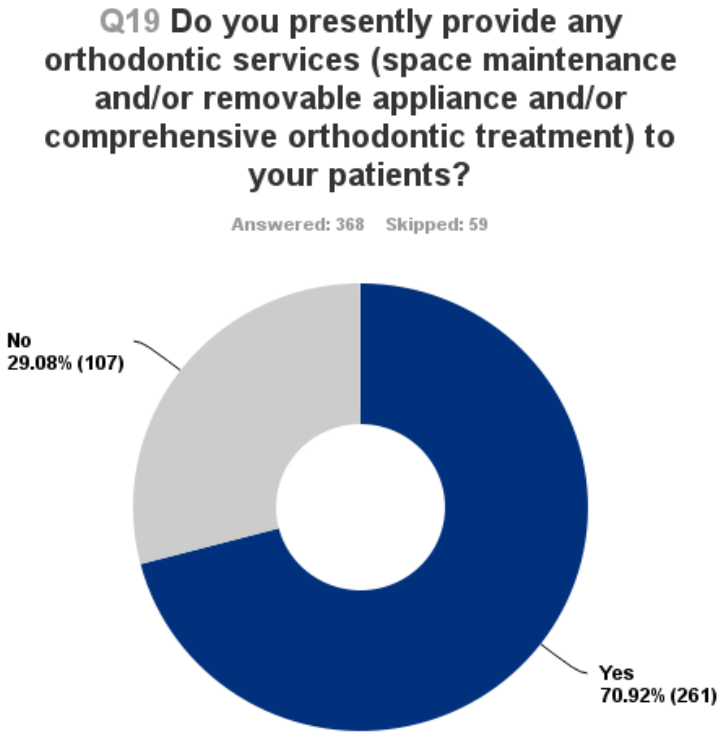
Table 1: Demographic information of the Canadian dentist respondents to Survey 1.

Question #1	**Number of respondents**	**Percentage**
My gender is?		
Male	253	**59.3%**
Female	174	**40.7%**
Question #3	**Number of respondents**	**Percentage**
How many years ago did you graduate from Dental School?		
25 years ago or more (before 1988)	140	**33.7%**
15 to 24 years ago (1989 to 1998)	75	**18.0%**
5 to 14 years ago (1999 to 2008)	126	**30.3%**
Less than 5 years ago (2009 to 2013)	75	**18.0%**
Question #4	**Number of respondents**	**Percentage**
At which of the following schools were you trained?		
Accredited Canadian Dental School	384	**92.3%**
Accredited American (USA) Dental School	14	**3.4%**
Other	18	**4.3%**

5.1.2. Provision of orthodontics

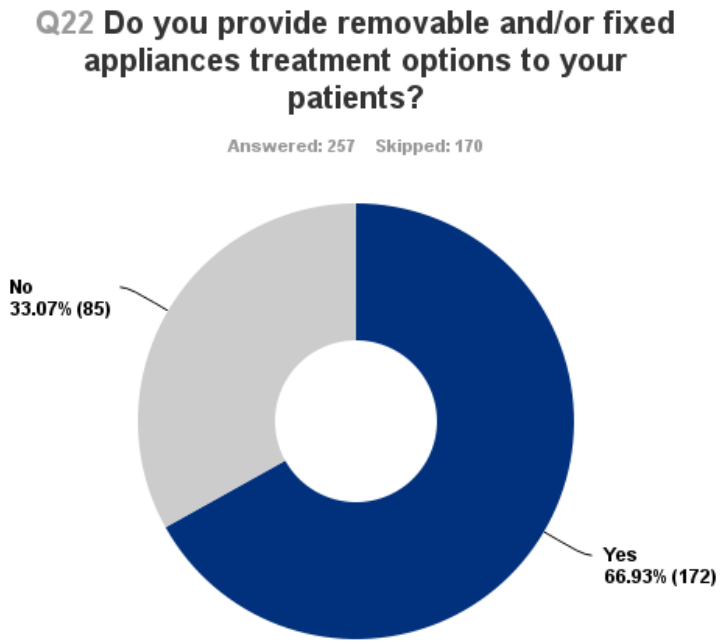
Regarding orthodontic services provided to Canadian patients, 59 of the initial 427 respondents neglected to answer questions in this section of the survey (see Figure 1).

Figure 1: Provision of orthodontic services by Canadian dentists.



The 261 dentists who answered positively to the previous question were invited to complete a more detailed section. An additional 4 respondents dropped out. Interestingly, it can be deduced that 33% of the general dentists providing orthodontic treatment offer only space maintenance (see Figure 2).

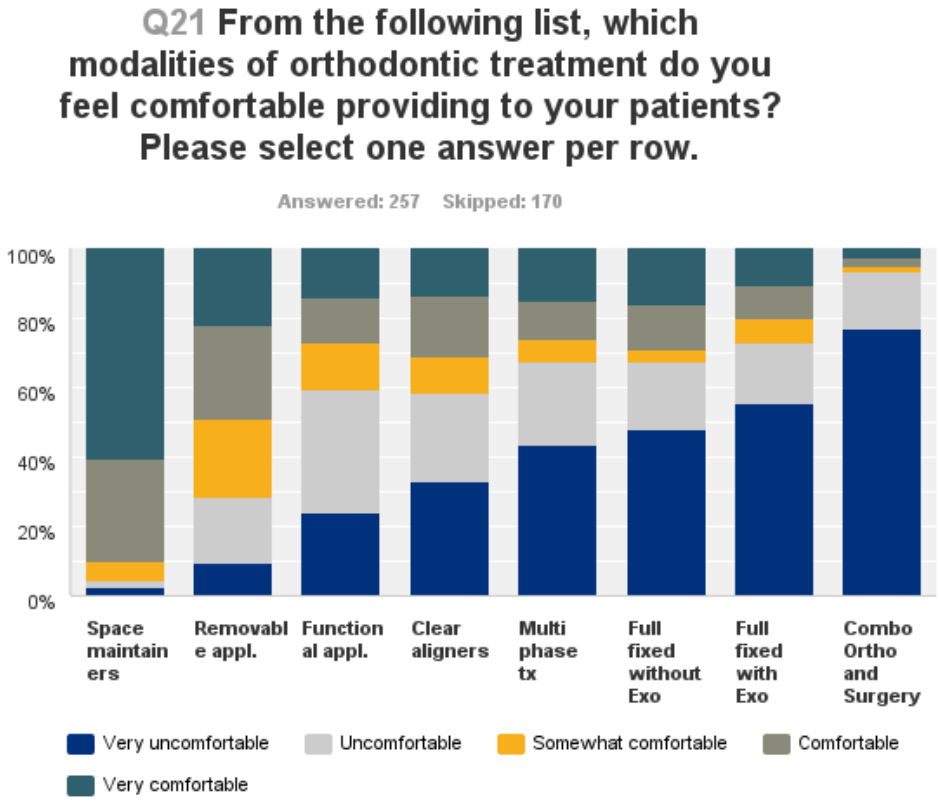
Figure 2: Nature of orthodontic treatment provided in Canada by general dentists.



The respondents were asked to rate their comfort level using commonly available orthodontic treatment modalities (see Figure 3).

Seventy-one percent (71%) of dentists provide some orthodontic services to their patients, with 33% of them providing only space maintenance services. The more complex the treatment modality, the less comfortable dentists were in providing treatment.

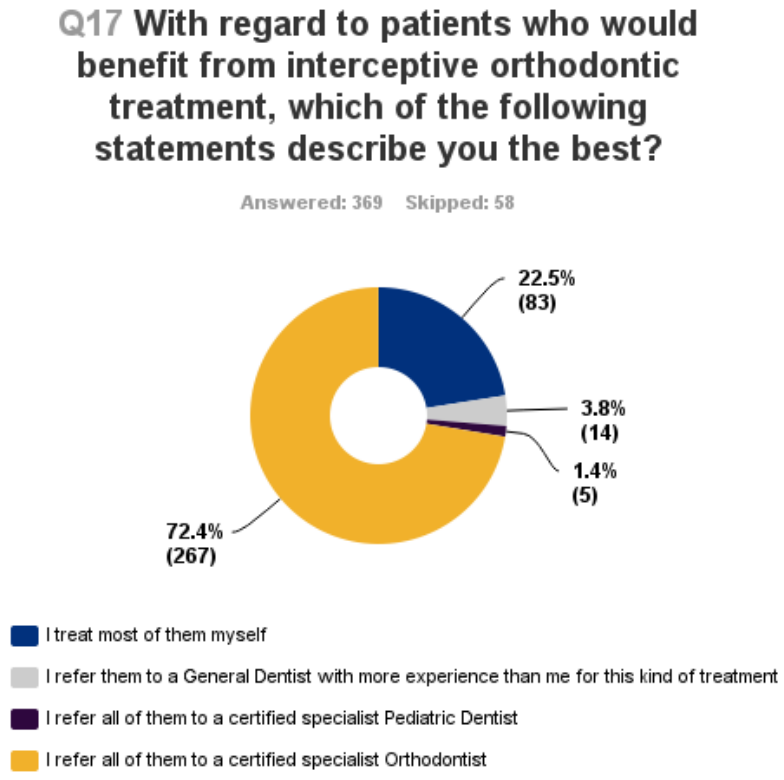
Figure 3: Comfort level of Canadian dentists on various orthodontic treatment modalities.



5.1.2.1. Interceptive treatment

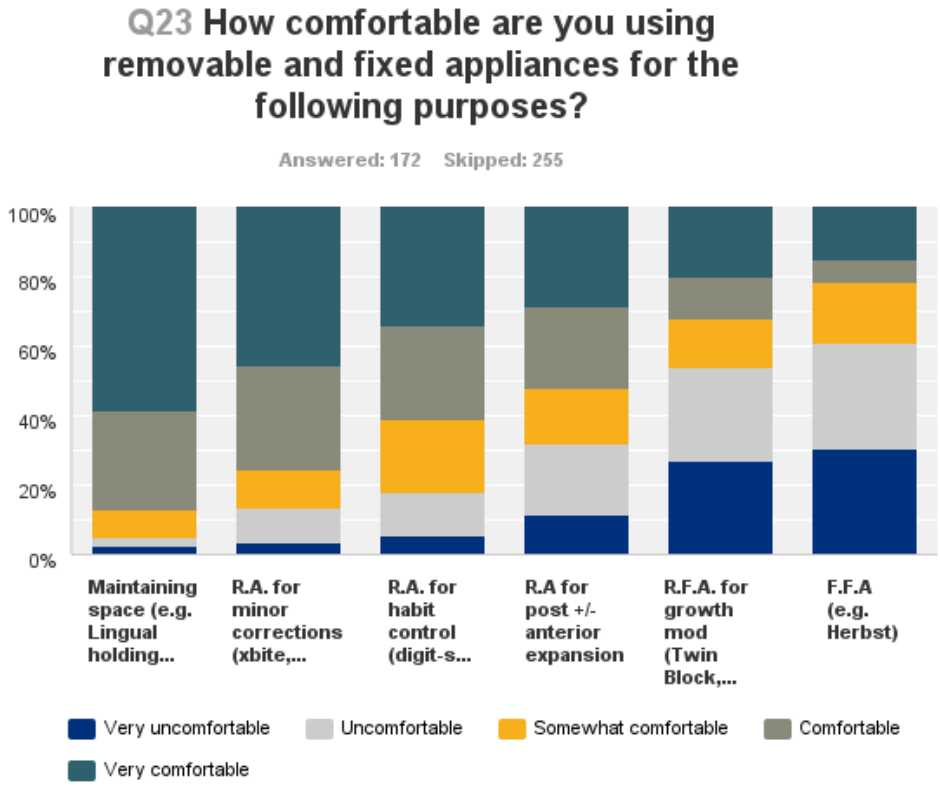
To distinguish between the types of orthodontic services currently being offered by Canadian general dentists, 369 respondents were asked to select the statements that best represented them (see Figure 4).

Figure 4: Provision of interceptive treatment by Canadian dentists.



The 172 general dentists who indicated offering orthodontic services to their patients were asked to rate their comfort level on the purpose of interceptive treatment. It can be noted that there is an inverse relationship between the complexity of the purpose/treatment modality and the level of comfort of the respondents (see Figure 5).

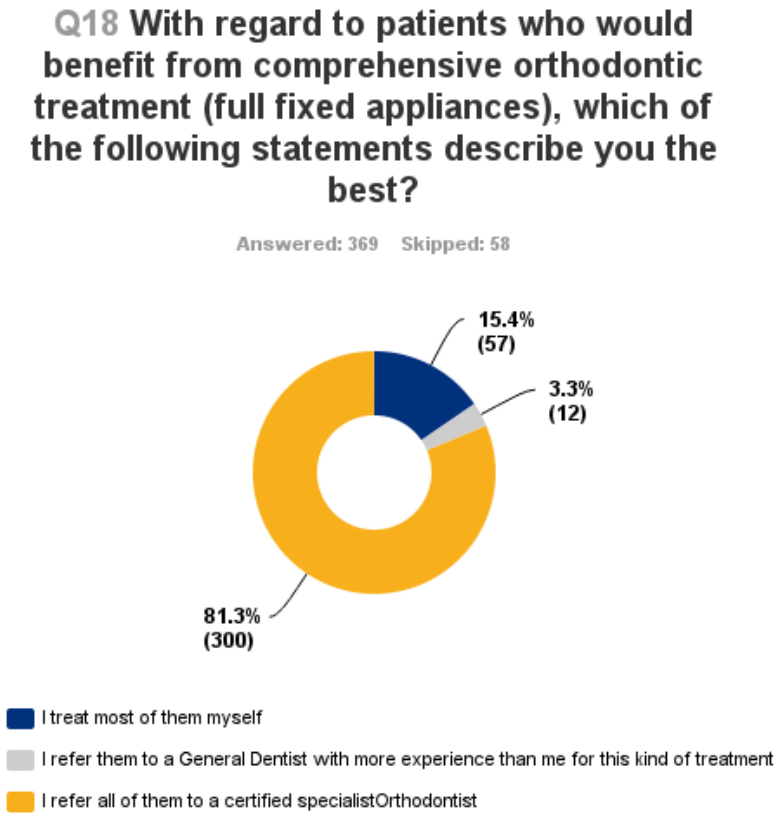
Figure 5: Comfort level of Canadian dentists when providing orthodontic treatment for various purposes.



5.1.2.2. Comprehensive treatment

Again, to differentiate the nature of orthodontic services being offered in Canada, a total of 369 general dentists were asked to select the statements that best represented them (see Figure 6)

Figure 6: Provision of comprehensive treatment by Canadian dentists.



5.1.3. Provision of orthodontics as related to the distance from the closest certified orthodontist

Table 2 shows the distribution of 416 general dentists with regards to their proximity to the closest orthodontist. Table 3 relates the distance to the provision and nature of orthodontic services provided. It is important to note that several of these dentists neglected to respond to the questions on the provision of

orthodontic treatment. The 3 groups (1 to 2 hours driving time, 2 to 4 hours driving time and more than 4 hours driving time) were merged into the 1 to 4+ hours of driving time group to prevent the sample size from being too small. Table 3 provides details on the distribution of the respondents' answers to Question #19 and Question #22.

Table 2: Proximity of Canadian dentists to the closest orthodontist.

Question #6	**Number of respondents**	**Percentage**
What is the proximity to the closest orthodontist from your private practice?		
0 to 19 minutes of driving	350	**84.1%**
20 to 59 minutes of driving	42	**10.1%**
1 to 2 hours of driving	11	**2.7%**
2 to 4 hours of driving	7	**1.7%**
More than 4 hours	6	**1.4%**

Table 3: Provision of orthodontic treatment in relation to the driving time to the closest orthodontist.

	Question #19		Question #22	
	Do you presently provide any orthodontic services (space maintenance and/or removable appliance and/or comprehensive orthodontic treatment) to your patients?		Do you provide removable and/or fixed appliances treatment options to your patients?	
Question #6	**Yes**	**No**	**Yes**	**No**
What is the proximity to the closest orthodontist from your private practice?				
0 to 19 minutes of driving	216/309 (69.9%)	93/309 (30.1%)	140/213 (65.7%)	73/213 (34.3%)
20 to 59 minutes of driving	27/38 (71.0%)	11/38 (29.0%)	18/27 (66.7%)	9/27 (33.3%)
1 to 4+ hours of driving	18/21 (85.7%)	3/21 (14.3%)	14/17 (82.3%)	3/17 (17.7%)

The prevalence of dentists offering orthodontic treatment to their patients is higher for the 1 to 4+ hours of driving time group (85.7%), compared to the 2 others groups (on average 70%). The results are similar with regards to offering removable and/or full fixed appliances to their patients, 82% compared to 66%. These results suggest that the distance from the closest orthodontist has an effect on the provision of orthodontic services provided by Canadian dentists, with fewer services being provided by dentists if the distance between their office and the orthodontist is less than 1 hour of driving time.

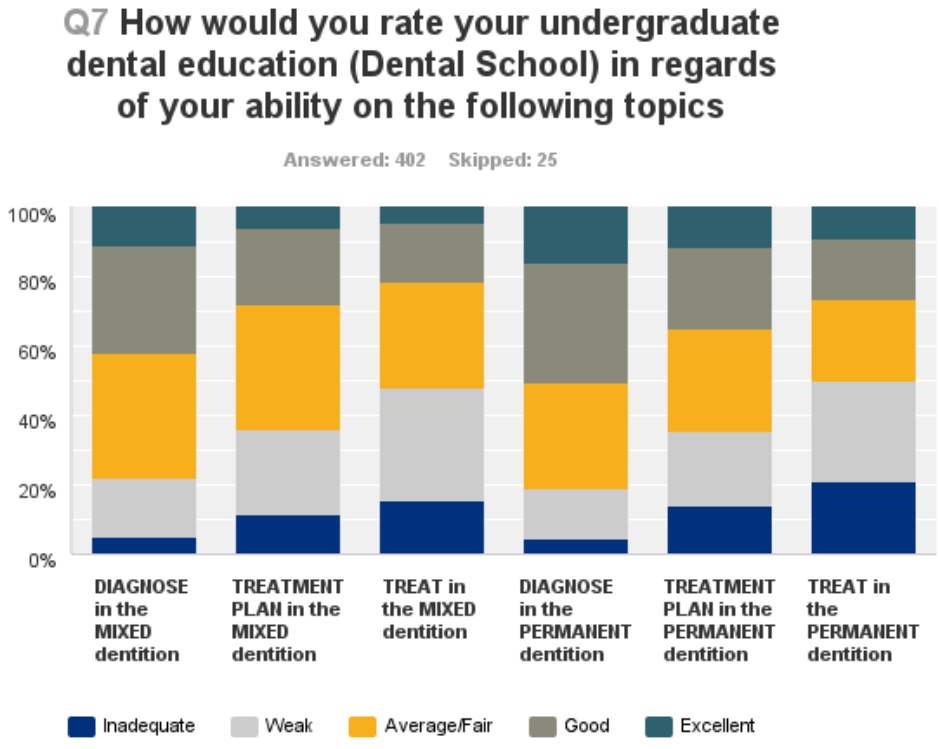
5.1.4. Opinions on the quality of the dental education

In order to inquire about the orthodontic training provided in their respective dental schools, respondents were asked to rank their perceived quality of the education in diagnosing, treatment planning and treating patients in the mixed and the permanent dentitions. Figure 7 illustrates the way Canadian dentists reported the quality of their dental education.

Respondents indicated that they were better prepared to diagnose, develop a treatment plan and provide treatment in the permanent dentition than in the mixed dentition. When asked about the quality of the education received, 21.4% to 50.5% of respondents indicated that they received above average education on the various statements. More specifically, 36.3% of dentists selected “Average/Fair” and 41.7% selected “Good” or “Excellent” for diagnosis in the mixed dentition compared respectively to 30.6% and 40.5% in the permanent dentition. Regarding the quality of their dental education for providing

orthodontic treatment in the mixed and permanent dentition, only 48% and 49.7%, respectively, rated it as “Inadequate” and “Weak”. The overall data suggest that general dentists feel their education was better with respect to the diagnosis aspects of orthodontics, as compared to treatment planning or providing treatment. Treating patients in the mixed and permanent dentitions received the lowest rating. Lastly, out of 393 respondents, only 50% attended short or weekend orthodontic courses since their graduation from dental school.

Figure 7: Perception of Canadian dentists on the quality of the orthodontic education received while in dental school.



5.2. Survey 2

5.2.1. Sample demographics

Survey 2A (orthodontists) and 2B (dentists) were administered at two Canadian dental conferences. Survey 2A included 70 orthodontist respondents, compared to Survey 2B with 83 dentist respondents. Demographic data were collected for each group, i.e., gender, years since graduation and country in which their training was obtained (see Table 4). Only one iteration of the surveys for members of the control group was included in the overall results. Of the 10 general dentists selected for Survey 2B, 2 failed to retake the Survey after 3 months, and were excluded from the control group.

Table 4: Demographic information of the Canadian orthodontists and dentists who responded to Survey 2.

	Survey 2A Orthodontists		**Survey 2B Dentists**	
Question #1	**Number of respondents**	**%**	**Number of respondents**	**%**
My gender is?				
Male	54	**77.1%**	49	**59.0%**
Female	16	**22.9%**	34	**41.0%**

Question #3	Number of respondents	%	Number of respondents	%
How many years ago did you graduate from dental school or orthodontic school?				
25 years ago or more (before 1988)	28	**40.0%**	31	**37.3%**
15 to 24 years ago (1989 to 1998)	17	**24.3%**	15	**18.1%**
5 to 14 years ago (1999 to 2008)	14	**20.0%**	17	**20.5%**
Less than 5 years ago (2009 to 2013)	11	**15.7%**	20	**24.1%**
Question #4	**Number of respondents**	**%**	**Number of respondents**	**%**
At which of the following schools were you trained?				
Accredited Canadian Dental School or Orthodontic program	58	**82.9%**	76	**91.6%**
Accredited American (USA) Dental School or Orthodontic program	12	**17.1%**	1	**1.2%**
Other, which country?	0	**0.0%**	6	**7.2%**

An additional question was added to Survey 2B to inquire about the general dentists' level of education in the field of orthodontics (see Table 5).

Table 5: Degree of education of the general dentist respondents to Survey 2B.

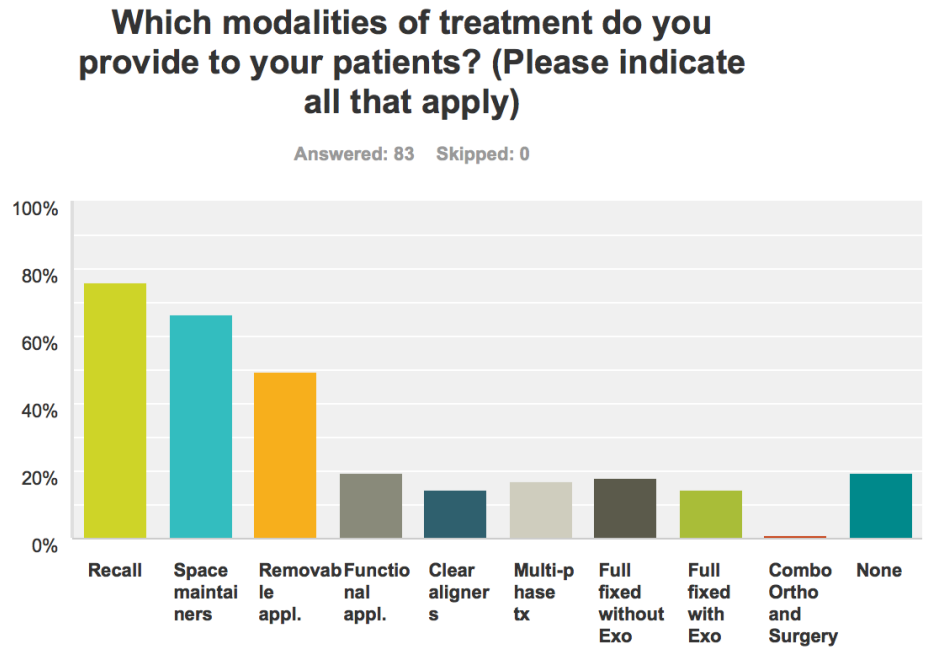
Question #7	**Number of respondents**	**%**
Which of the following statements describe you the best?		
General dentists without extra orthodontic training since graduation	49	**59.0%**
General dentists having completed **some weekend course(s)** in orthodontics since graduation	21	**25.3%**
General dentists having completed **extensive courses** in orthodontics since graduation	9	**10.9%**
General dentists full time non-practising academic	4	**4.8%**

The majority of the respondents of Survey 2A and Survey 2B were male (77% and 59% respectively), and the vast majority were trained in Canada (83% and 92% respectively). Most of the general dentists (59%) did not further their education in the field of orthodontics following their graduation from dental school.

5.2.2. Provision of orthodontic services by Survey 2B (Dentists) respondents

The respondents of Survey 2B (Dentists) were asked to indicate which orthodontic treatment modalities they offer to their patients. Figure 8 illustrates the responses.

Figure 8: Orthodontic treatment modalities offered by the respondents of Survey 2B.



Only 19.2% of the respondents indicated that they did not provide any orthodontic services to their patients. The range in the provision of modalities of an "interceptive" nature (space maintenance, removable appliance and functional appliance) is from 66.3% to 19.2%. A total of 18.1% to 14.5% indicated providing

comprehensive/full fixed orthodontic treatment without and with extraction respectively.

5.2.3. Degree of difficulty

The respondents of Survey 2A (Orthodontists) and Survey 2B (Dentists) were asked to rate the 4 cases presented on a 10-point Likert scale (1 being the easiest and 10 being the most difficult) on the level of difficulty foreseen in providing orthodontic treatment for each case. In order to have a better appreciation of the results, a review of the cases utilized in Survey 2A and Survey 2B (see Appendix M) would be beneficial. Table 6 (see Appendix R) shows the frequencies of each level of difficulty for the cases presented in Survey 2A and Survey 2B. Figures 9 through 12 represent the frequencies of each level of difficulty per case, comparing Canadian orthodontists and dentists.

Figure 9: Frequencies of the degree of difficulty for Case A (Skeletal Class II with Class II dental, growing).

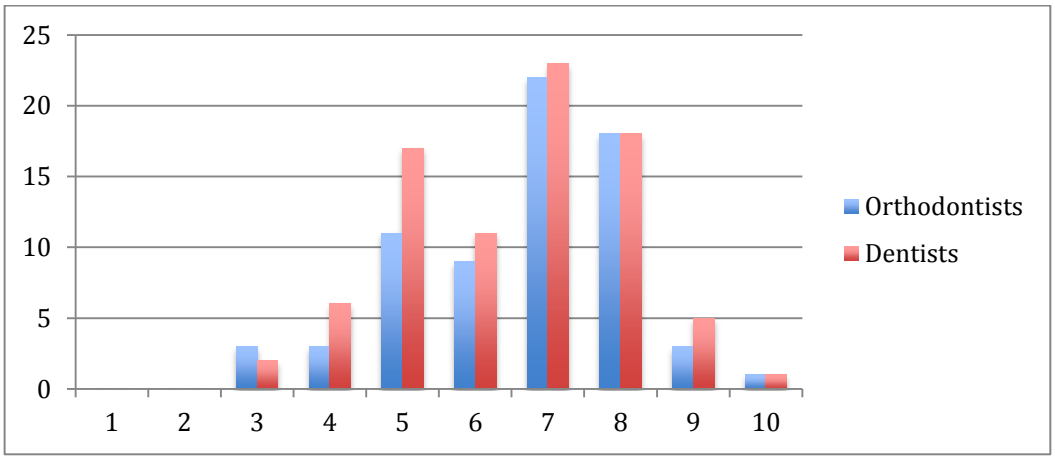


Figure 10: Frequencies of the degree of difficulty for Case B (Skeletal Class III mild with Class III dental mild, growing).

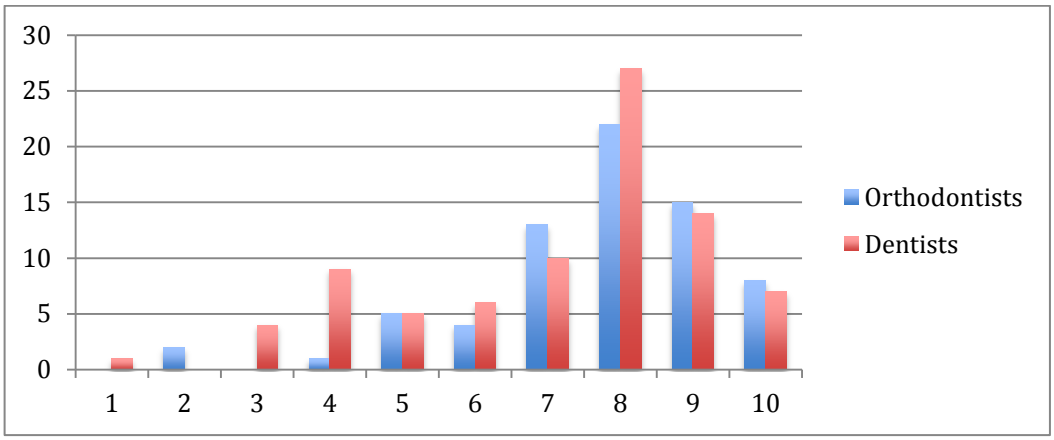


Figure 11: Frequencies of the degree of difficulty for Case C (Skeletal Class II with Class II dental, non-growing).

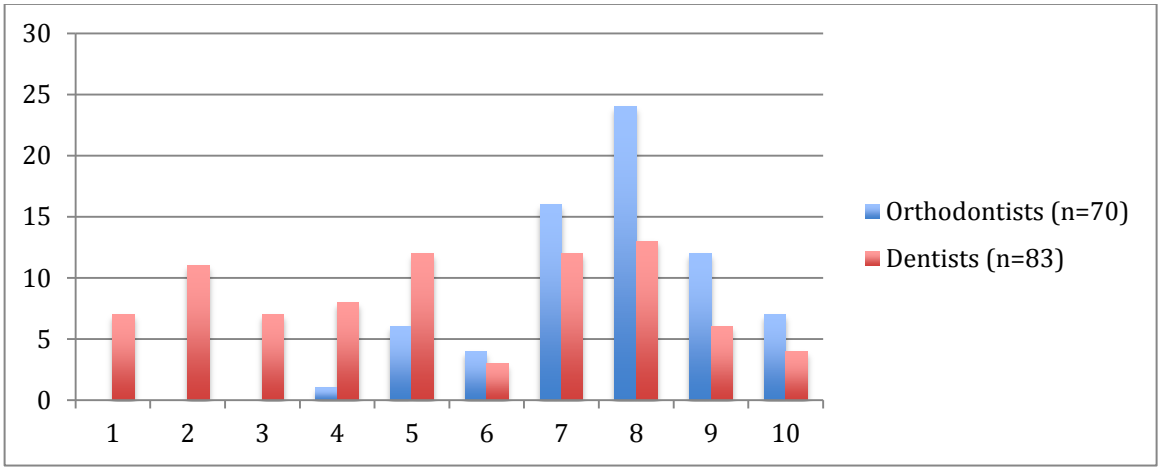
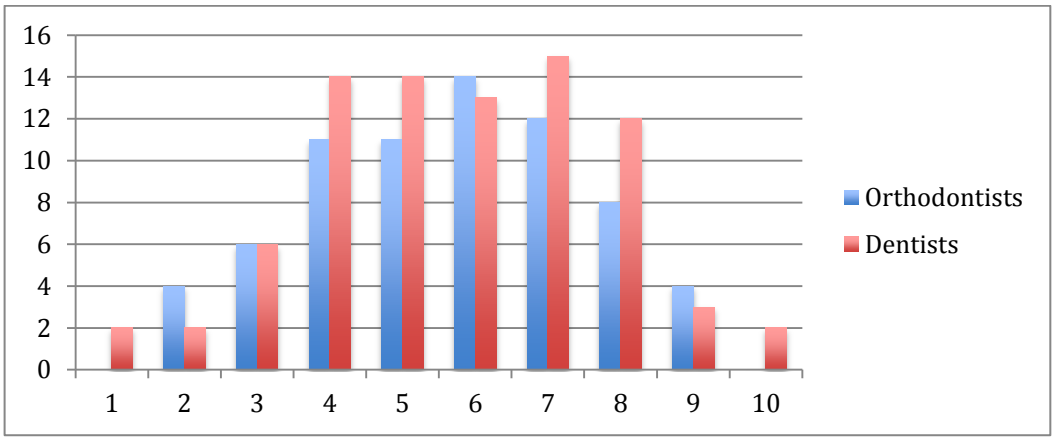


Figure 12: Frequencies of the degree of difficulty for Case D (Skeletal Class I with Class I dental, moderate crowding).



The graphic representation of the distribution of the orthodontists and the dentists are quite similar for Cases A, B and D. However, a different pattern can be seen for Case C, where the dentists' responses seem more evenly distributed when compared to the orthodontists, who tend toward a higher level of difficulty for this patient (skeletal Class II with Class II dental, non-growing).

Intra-Class correlation (ICC) was undertaken to investigate the overall consistency between the orthodontists and the dentists for the patients presented. The orthodontists obtained an ICC of 0.267, compared to the dentists with an ICC of 0.071. The same test was executed for both control groups. The 10 orthodontists in the control group of Survey 2A obtained an ICC of 0.147 for the consistency of agreement between their two iterations of the survey, as compared to the 8 control dentists in Survey 2B who obtained an ICC of 0.306. According

to the guidelines stated by Cicchetti (Cicchetti, 1994), the level of agreement within each group is poor. Lastly, taking into consideration an ICC result of 0, which indicates random agreement (Hallgren, 2012), and the very low value (ICC of 0.07) for respondents of Survey 2B, there appears to be very little, if any, consistency amongst the dentists in interpreting the degree of difficulty of a patient seeking orthodontic treatment. When the orthodontists and the dentists were combined an overall ICC of 0.141 was obtained, which indicates poor agreement between the two groups.

5.2.4. Treatment modalities

Orthodontists and dentists were asked to select, from a list of common treatment modalities, those they believed would be the most appropriate to use when treating these patients. The orthodontists in Survey 2A were allowed to select a maximum of 2 treatment modalities per case. For case A, the dentists were asked to chose only 1 option of treatment, and the "Recall" option was not available. For the remaining cases (B, C and D), the dentists were asked to select all treatment modalities that they believed could be used to treat the patients presented. Table 7 (see Appendix S) demonstrates the distribution of responses for orthodontists and dentists. Figures 13 to 16 illustrate the comparison of the most popular treatment modalities selected by the orthodontists and dentists for each case.

Figure 13: Frequencies of treatment modalities for Case A (Skeletal Class I with Class II dental, growing).

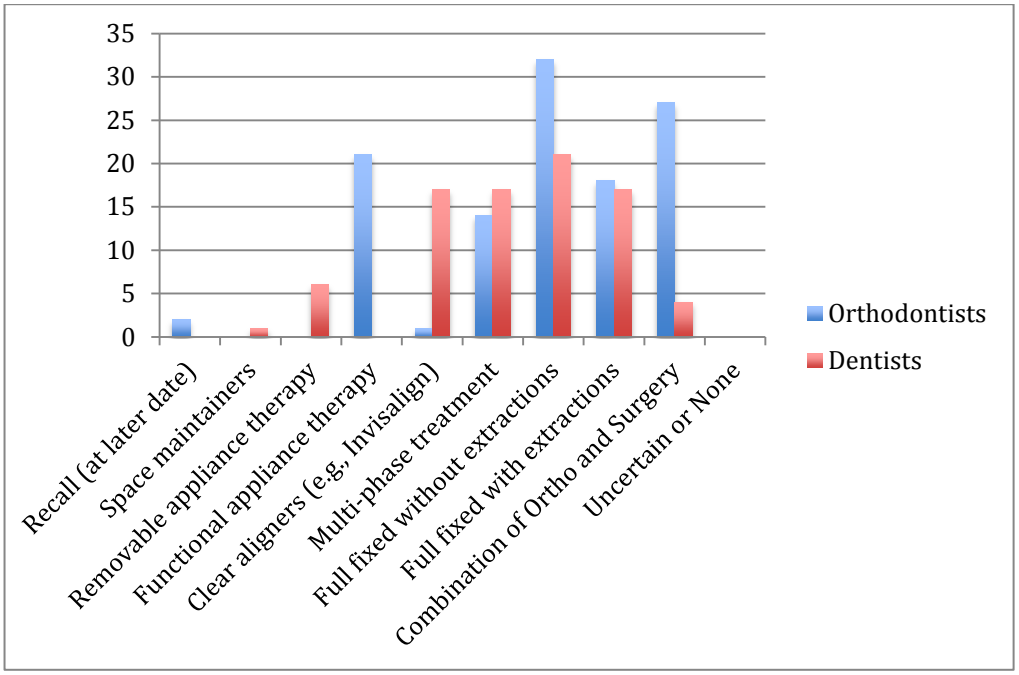
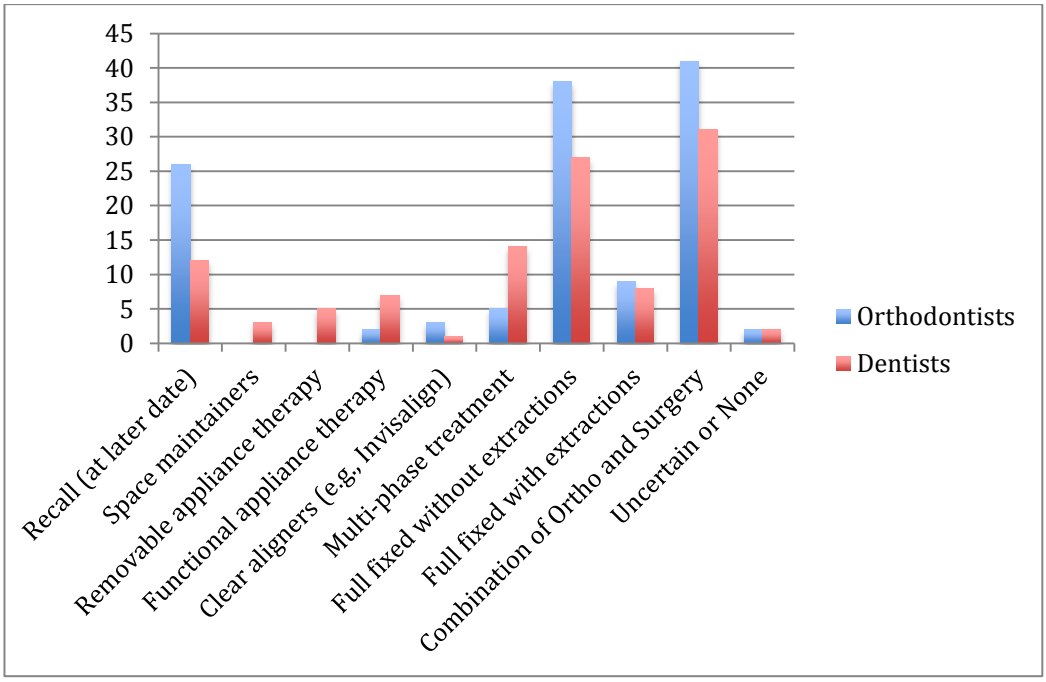
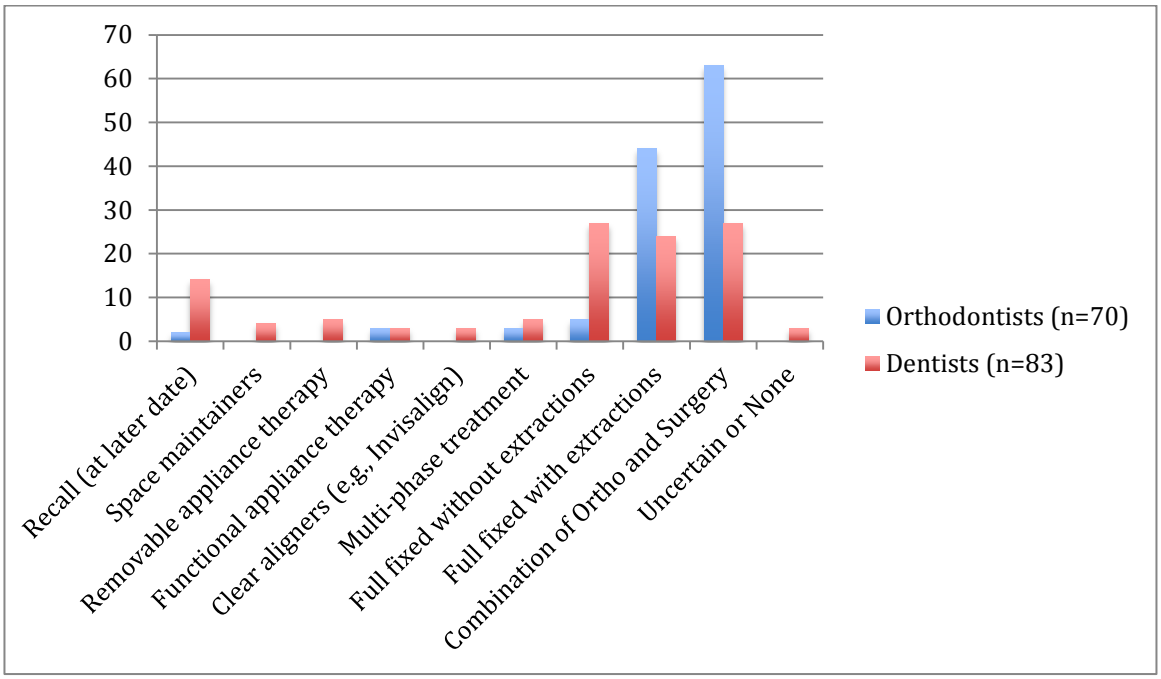


Figure 14: Frequencies of treatment modalities for Case B (Skeletal Class III mild with Class III dental mild, growing).



The most popular treatment modalities selected by the orthodontists for this patient (Case B) were comprehensive orthodontic treatment (full fixed appliances) without extractions, and a combination of orthodontic treatment with orthognathic surgery. The most popular options selected by the dentists were comprehensive (full fixed) orthodontic treatment with extractions, followed by equal responses for the multi-phase, full fixed without extraction and a combination of orthodontics and orthognathic surgery.

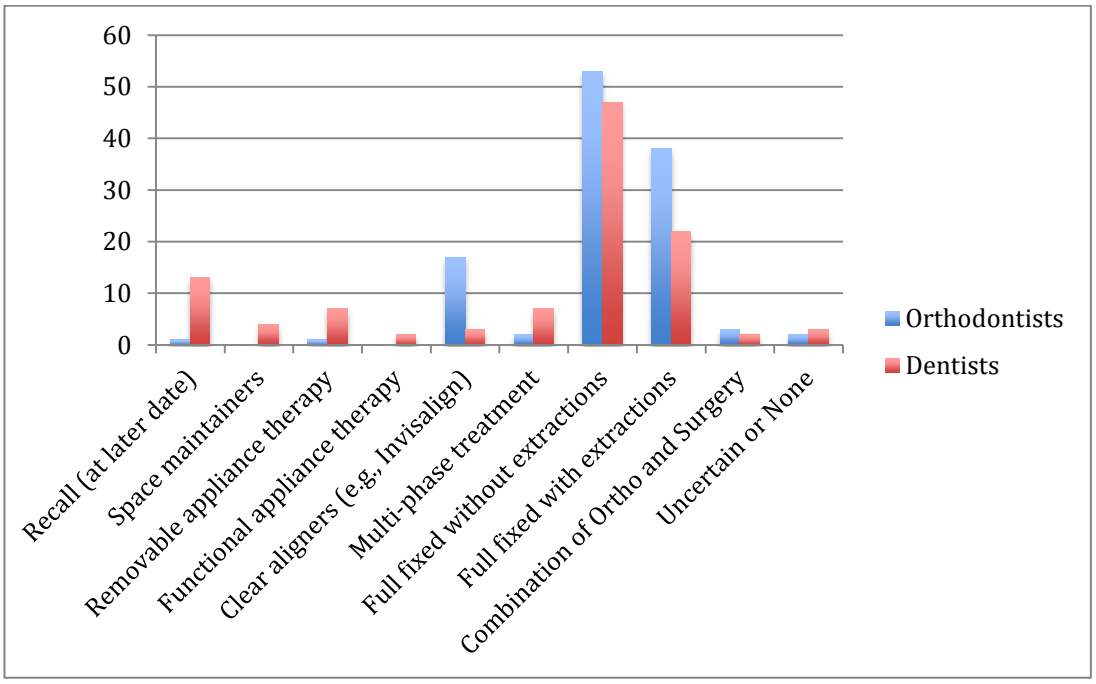
Figure 15: Frequencies of the degree of difficulty for Case C (Skeletal Class II with Class II dental, non-growing).



For Case C, most of the orthodontists selected a combination of orthodontic and surgical treatment, and comprehensive (full fixed) orthodontic

treatment with extractions, as compared to the dentists whose responses resulted in an equal response for a combination of orthodontics and surgery, and comprehensive (full fixed) orthodontics without extractions. Interestingly, the comprehensive (full fixed) orthodontics without extractions treatment option was selected only by a very small number of orthodontists.

Figure 16: Frequencies of the degree of difficulty for Case D (Skeletal Class I with Class I dental, moderate crowding).



The treatment modalities selected, for Case D, most often were the same for the orthodontists and the dentists. Both groups opted for comprehensive (full fixed) orthodontic treatment without extractions followed by comprehensive (full fixed) orthodontic treatment with extractions.

6. Discussion

6.1. Survey 1

6.1.1. Response rate and sample demographics

There were 427 respondents to Survey 1, representing 1.5% of Canadian dentists. The completion rate for the survey was 74%. Previous studies (Aldawood et al., 2011; de Muelenaere & Wiltshire, 1990; Galbreath et al., 2006; Konchak & McDermott, 1990; Koroluk et al., 1988; Lawrence et al., 1995) carried out on this topic used a mail-in format and reported a completion rate ranging from 61% to 76.9%. Larger studies, such as those conducted by Konchak and McDermott (1990) and de Muelenaere and Wiltshire (1990), targeted 1,976 and 3,127 respondents respectively, and obtained a much lower completion rate, in the range of 49.9% and 33%. Aldawood et al. (2011) used a web-based protocol, similar to the one used in this study, to target all registered dentists in New Zealand (1,174 potential respondents), and reported a 43.3% response rate.

The distribution of Survey 1 was mainly through links in an electronic newsletter, and sent via email by third parties (alumni associations, dental societies, et cetera). This makes it impossible to estimate the exact number of dentists who encountered the links. The results from Survey 1 provide an overview of the current Canadian dental demographics, as well as the opinion of dentists who have a keen interest in the field of orthodontics. The low number of respondents might be explained by respondent fatigue due to the length of the survey; 111 respondents did not complete the survey in its entirety. Another reason to account for the response rate is that practitioners receive multiple survey

requests on a weekly basis and are reluctant to respond to all of them, or simply might not have the time.

Survey 1 respondents consisted of 59% males and 41% females. The percentage of female respondents is disproportionate relative to the gender distribution of male (72%) and female (28%) dentists, as reported by the CDA in 2009 (N. de Savigny, Coordinator Communication CDA, personal communication, July 17, 2013). It is important to note that a tendency towards an increasing numbers of females entering the dental profession was noted in 2009. The CDA reported that in 2009, 34% of dentists were under the age of 40, and 18% were above the age of 60 (N. de Savigny, Coordinator Communication CDA, personal communication, July 17, 2013). The related item in Survey 1 focused on the number of years since graduation, as opposed to the age of the practitioners. Therefore, assuming that on average general dentists graduate from dental school in their mid to late 20s, dentists with less than 15 years experience could potentially be compared to the under 40 year age group. Applying the same logic, having more than 25 years of dental experience could correspond to the above 50 age group. Forty-eight percent (48%) of the respondents of Survey 1 graduated less than 15 years before answering the survey, and 34% completed the survey more than 25 years after graduation. This was not consistent with the CDA data indicating that the more experienced (> 25 years) and the less experienced (< 15 years) dentists were more highly represented.

The differences in demographics might be explained by work schedules of the respondents, for example, younger and older practicing dentists might have

lighter schedules, allowing them more time to complete surveys. Aldawood et al. (2011) reported a higher proportion of orthodontic providers amongst the more experienced practitioners, and Koroluk et al. (1998) reported that younger dentists were performing more orthodontic services. This difference in the results might bias the data. Lastly, 96% of the respondents were trained in North America. Overall, the respondents to Survey 1 reasonably represent the Canadian population of dentists. It is important to recognize that the demographics included a greater number of females, and a smaller group of practitioners with 16 to 24 years of experience practicing dentistry.

6.1.2. Provision of orthodontic services

The results of this study revealed that 71% of Canadian dentists provide some orthodontic treatment to their patients. This result is consistent with American studies conducted in the 1990s (Jacobs et al., 1991; Wolsky & McNamara, 1996), with results ranging from 66% to 76% of dentists providing orthodontic treatment. The recent decline in the provision of orthodontic treatment by general dentists reported in New Zealand, with 19.3% of the surveyed population providing some orthodontic treatment (Aldawood et al., 2011), has not happened in Canada. The nationwide American survey of 2006 reported that 43% to 50% of dentists who had achieved a Master's Level from the Academy of General Dentistry (Galbreath et al., 2006) indicated that they did not provide orthodontic treatment. These results suggest a trend to an eventual decline in the

provision of orthodontic treatment by general dentists in North America, however, this trend is not supported by the current study.

When closely examining the type of treatment, 33% of general dentists indicated that they provide only space maintenance appliances, while 23% indicated that they provide most of the interceptive treatment required by their patients. Previous studies have either included space maintenance as a part of interceptive treatment, or did not specify whether it was provided, which makes it quite difficult to compare these results to those previously published.

Although the percentage of providers of interceptive treatment in this research is smaller than the 65% previously reported by Konchak and McDermott (1990), this data is closer to the American data of 2006, which reported a decrease of 24% in the provision of interceptive orthodontic treatment, from 57% to 32% (Galbreath et al., 2006). Interestingly, the data also suggest a decrease in the percentage of dentists providing comprehensive/fixed orthodontic treatment when compared to the previous Canadian data, from 23% (Konchak & McDermott, 1990) to the current 15%. The American literature reported that 19.3% of dentists provided comprehensive/fixed orthodontic treatment in 1996 (Wolsky & McNamara, 1996), a rate that remained constant for 20 years, as reported by Galbreath et al. (2006). The data from this survey show only dentists providing most of these two categories of treatment. Presumably some dentists dabble in the field of orthodontics without necessarily treating most of their patients. The inconsistent definition of the terms “limited” and “comprehensive/full fixed” utilized in different studies, and various interpretations of these terms by

respondents, might also have affected the results. Another factor to consider is the increase in popularity of treatment modalities such as *clear aligners*, and the number of patients requesting them.

The results suggest that prior to starting orthodontic treatment, a case selection process is applied. This would explain the difference between the number of respondents indicating they provide orthodontic services (71%) and the number indicating that they "treat most of them myself" (23% interceptive treatment and 15% comprehensive orthodontic treatment). Regardless, respondents indicated that the more complex the orthodontic treatment modality, the less comfortable they were in providing treatment. Orthodontists commonly use all treatment modalities mentioned in the survey. It follows logically that the more complicated or advanced the modalities or objectives, the less comfortable general dentists would be using them. Sadly, this data did not identify whether general dentists offer treatment modalities with which they are not comfortable. It would be detrimental to the patient, the public and the dental profession if financial gain were the motivating factor for general dentists to provide orthodontic treatment.

6.1.3. Distance to the closest orthodontist in relation to the provision of orthodontic services

With regards to the distance to the closest orthodontist, the phrasing of the questions on this topic differed from those found in the literature. This survey focused on the driving time as a factor, compared to the linear distance, which has

been used in other studies. The concepts of traffic and accessibility motivated this decision. A driving time of 1 to 4+ hours to an orthodontist's office resulted in a 16% increase in the provision of interceptive and comprehensive orthodontic treatment by the general dentists. According to this study, when investigating the impact of the distance to the orthodontic specialist on their decision to offer orthodontic treatments, Canadian dentists seem to be closer to their counterparts in Australia and New Zealand, than to their American neighbors.

The descriptive statistics indicated that the sample size of general dentists located more than one hour from a certified orthodontist was limited, therefore, no inferences or conclusions could be drawn. That said, it is probable that a general dental practitioner in a suburban or rural region might take into consideration the real cost of orthodontics to their patients, including travel time, time away from work or school as well as all the travel expenses (gas, hotel, meals, et cetera) that might be encountered. The decision by general dentists to provide orthodontic treatment might be motivated by the knowledge or perception that the patients would not otherwise receive treatment, or succumbing to pressure from their patients wanting to save the cost necessary to see a specialist, possibly without a complete understanding of the potential negative consequences.

6.1.4. Opinions on the quality of the dental education received

When the respondents were asked their views on the quality of orthodontic education received, 21.4% to 50.5% indicated that they received above average education on the various statements. More specifically, 36.3% of dentists selected

"Average/Fair" and 41.7% "Good" or "Excellent" for diagnosis in mixed dentition, compared respectively to 30.6% and 40.5% in the permanent dentition. These results indicate greater satisfaction than previously reported, where 58.3% rated their education in providing basic orthodontic principles as *fair* (Konchak & McDermott, 1990). Although these numbers are encouraging, only 11% and 16.2% selected "Excellent" for diagnosis. These results are considerably more favourable than the overall 4% of "Excellent" reported in a 2006 American study (Galbreath et al., 2006), but still suggest there is room for improvement in the undergraduate orthodontic curriculum.

The overall data suggest that general dentists felt their education was better in terms of diagnosis in orthodontics, as compared to treatment planning or providing treatment. The highest incidences of "Inadequate" were for treating patients in the mixed dentition (15.7%) and permanent dentition (21.1%). Fewer than 50% of respondents selected "Inadequate" and "Weak" for the quality of their dental education related to providing orthodontic treatment in the mixed (48%) and permanent (49.7%) dentition. An issue not addressed by this study is the perceptions of respondents who did not complete the entire survey. However, since the respondents were given the opportunity to criticize with impunity, it is possible that these dentists had less stringent perceptions. This is a significant improvement when compared to the previous 80.4% rating for *poor*, as reported by Konchak and McDermott (1990). Even with a reduction of 30% of the negativity, almost 1 out of 2 dentists felt that their dental education was not sufficient for them to confidently provide treatment.

Interestingly, of 393 respondents, only 50% attended short or weekend orthodontic courses since their graduation from dental school. Sadly, this data did not identify if the general dentists taking these courses are the ones who were dissatisfied with their education, or if they have a keener interest in this particular field. As mentioned in the literature review, ideally, undergraduate orthodontic education should provide a solid foundation to help all graduates in determining the need for and objectives of orthodontic treatments, as well as to assist those having an interest in the field of orthodontics in selecting appropriate continuing education courses.

Karaiskos et al. (2005) reported a high incidence and needs for interceptive treatment in the underserviced Canadian population (Karaiskos et al., 2005), and Bernas et al. (2007) reported great success of interceptive treatment provided in an undergraduate orthodontic clinic (Bernas et al., 2007). Sadly, 48% of general dentists felt that their undergraduate education was “Inadequate” or “Weak” in terms of treating in the mixed dentition. Therefore, knowing that interceptive treatments are needed and can be successfully rendered by general dentists, it would be beneficial for the Canadian population if the undergraduate orthodontic curriculum focused on and provided better knowledge of this aspect of orthodontics.

An interesting side note is an increased scrutiny of the NDEB’s competency in the field of orthodontics, which refers to “managing abnormalities of orofacial growth and development and treat minor orthodontic problems” (National Dental Examining Board of Canada., 2014b). According to the results

of this study, this competency, written in the 1970s, is not being met. In this survey, 2 out of 5 dentists indicated that they received *good* or *excellent* dental education for diagnostics, and 1 out of 2 dentists felt that they received *inadequate* or *weak* education with regards to treating patients in the mixed and permanent dentition. That being said, it would be unrealistic to expect every graduating dentist to have a great interest in or affinity for the field of orthodontics. The non-specificity of the terms used in the definition of competency, coupled with not stating NDEB competency in the survey, limits the ability of the data to validate whether this competency has been met. Lastly, it would have been interesting to identify the basis by which general dentists evaluated the quality of their education. For example, whether they compared themselves to what they think they should know or to what they believe a specialist knows.

6.2. Survey 2

6.2.1. Respondents and sample demographics

In Survey 2A (Orthodontists), respondents included 70 orthodontists, 77% of whom were male and 23% female. According to the data provided by the CDA, there were 790 licensed orthodontists in Canada around the time the survey was administered (N. de Savigny, Coordinator Communication CDA, personal communication, July 17, 2013). The sample in Survey 2A represented 9% of the Canadian population of orthodontists. Information about the distribution of males and females obtained from the Canadian Association of Orthodontists (CAO) in the fall of 2013 indicated that 25% of the Canadian population of orthodontists

was female (A. Nash, Senior Account Executive/Operation Manager CAO, personal communication, November 18, 2013). Participants in Survey 2A closely represent the gender distribution of Canadian orthodontists. Lastly, the majority of the respondents received their orthodontic education in Canada (82.9%).

With regards to Survey 2B (Dentists), the 83 respondents consisted of 59% males and 41% females. This represents 0.4% of the Canadian general dentists. Similar to Survey 1, the percentage of females is higher than the data reported in 2009 by the CDA (72% males and 28% females) (N. de Savigny, Coordinator Communication CDA, personal communication, July 17, 2013). Again, it is important to note that a trend of more female dental school graduates was reported in 2009. The majority of the respondents of Survey 2B were trained in Canada (91.6%). Overall, the respondents of Survey 2B reasonably represent the Canadian population of dentists. It is important to recognize that the Survey 2 demographics included more females.

National data were not available for the number of years since graduation for the orthodontists. The "25 years ago or more (before 1998)" category was the most highly represented group in both surveys. Overall the data from Survey 2A and Survey 2B are similar to the Canadian population of general dentists and orthodontists in gender distribution, and represent the various years of experience. It is important to keep in mind that due to a larger number of dentists graduating from Canadian dental faculties, this sample size represents a very small portion of the total population of general dentists.

6.2.2. Provision of orthodontics services by the dentist respondents of Survey 2

Although the sample size of Survey 2B is almost one-fifth of the sample size of Survey 1, some comparisons can still be made. With 66% of the respondents of Survey 2B offering at least space maintainer services to their patients, this result is very similar to the 71% obtained in Survey 1. Comparing the provision of interceptive and comprehensive treatment is more complicated due to a discrepancy in the wording of the questionnaires. A total of 23% of the respondents of Survey 1 indicated that they treat most of their patients requiring interceptive orthodontic treatment themselves, compared to 49% and 19% of the respondents of Survey 2B who offer removable and functional appliances respectively. The results of Survey 2B with regards to the provision of comprehensive treatment are consistent with those reported in Survey 1. More specifically, 14% and 18% of the general dentist respondents of Survey 2 indicated offering comprehensive orthodontic treatment with or without extraction respectively, compared to the 15% of dentists who reported in Survey 1 that they, themselves, treat most of their patients requiring comprehensive orthodontic treatments. Overall, it can be assumed that the general dentists who responded to Survey 2B are consistent and representative of the general dentists who participated in Survey 1. Lastly, the data again support the concept of a patient selection process undertaken by the general dentists.

6.2.3. Degree of difficulty

The cases selected for use in Survey 2A and Survey 2B were relatively classic in order to minimize ambiguities in the diagnoses of the patients. As previously mentioned in the literature, orthodontists tend to disagree amongst themselves on the assessment of difficulty (Brightman et al., 1999; Dolce et al., 2012; Keeling et al., 1996; Lee et al., 1999). The results of this study are consistent with previous studies, and report a low level of the ICC (value of 0.267). Survey 2A ICCs indicated a poor level of congruence on diagnosing difficulty (Cicchetti, 1994), for example, various types of malocclusion in this study did not appear to have affected the results, which is consistent with those reported by Dolce et al. (2012) that used only Class II dental patients.

The general dentists in this study were not congruent in their assessment of case difficulty, as indicated by an intra-rater class correlation of 0.071. Taking into consideration that an ICC value of 0 indicates random agreement (Hallgren, 2012), it is possible that a large number of general dentists randomly selected the level of difficulty for the cases presented. As the majority of the respondents (59%) did not further their education in orthodontics following dental school graduation, their orthodontic knowledge might be similar to an undergraduate dental student. The data are consistent with the results of the study by Brightman et al. (1999), which reported that dental students were not able to assess orthodontic cases complexity. In addition, the completeness of diagnostic orthodontic records provided with each case might have intimidated and overwhelmed the general dentists.

Interestingly, when closely examining the graphic representation of the frequency of difficulty level on a per case basis, the trends amongst dentists and orthodontists seem to be similar for Cases A, B and D. With such low levels of the ICC for both groups, the certified orthodontists might have had a more *educated* guess, which could explain their slightly higher value of ICC. The orthodontists might also have considered nuances by trying to evaluate the best and worst possible scenarios for each case. Case C represented a Skeletal Class II with Class II dental, non-growing patient. In this case, the responses from general dentists were somewhat evenly distributed amongst the rating from "1" to "10", with "10" being the most difficult, compared to the orthodontists, who tended towards a higher degree of difficulty. One possible explanation of the discrepancy for Case C is that the ideal treatment modality for this patient would be a combination of orthodontic and orthognathic surgery. In the reality of providing treatment, orthodontists often encounter patients refusing a surgical treatment option. Proffit, Jackson and Turvey (2013) reported a 50% refusal rate (Proffit, Jackson, & Turvey, 2013). If the orthodontists anticipated refusal of combined surgical treatment, the results of a camouflaged orthodontic treatment might explain the increase in the perception of complexity. The general dentists might have focused primarily on the dentition, assuming they were less familiar with recognizing skeletal diagnosis.

When combining both groups (2A and 2B), the ICC is 0.141, which indicates poor agreement. This result is somewhat consistent with the results of Pietilä et al. (1992), who obtained a kappa value of 0.22, indicating *fair*

agreement. The fact that the study by Pietilä et al. (1992) had more children who were only clinically examined, and a smaller number of examiners (1 orthodontist and 3 public health dentists) (Pietilä et al., 1992), might explain the difference between these studies. It is important to keep in mind that the validation of the level of difficulty can only be assessed after the completion of treatment and a critical analysis of the outcome (Baumrind et al., 1996).

Lastly, when examining the control groups for Survey 2A and Survey 2B, the ICC for both groups was below *poor* level of significance. A surprising fact is that the value obtained by the general dentists' control group (ICC = 0.306) was higher than the one for the orthodontists' control group (ICC = 0.147). The vast majority of Survey 2B's control group were members of a Seattle study club, which might have biased the results. The members of this specific Seattle study club included various dental specialists and focused on interdisciplinary treatment approaches (Seattle Study Club, 2015). Members of this group might have more orthodontic knowledge than the respondents of Survey 2B, which might explain the discrepancy of the ICC of this control group when compared to the population of Survey 2B. The discrepancy between the control groups and the fact that the general dentists were more consistent is difficult to explain. The fact that the general dentists of the control group were all members of the same study club might have biased their results, as these individuals have likely been exposed to the same courses and philosophies. Also, the orthodontists might have taken into consideration the best and worst case scenarios for each patient, or might have

been influenced by continuing education received in the time period between the surveys.

6.2.4. Treatment modalities

The scientific literature reports that orthodontists do not agree on which treatment modality to select for a patient (Lee et al., 1999; Luke et al., 1998). One the most discussed treatment modalities, and a subject of controversy for over 100 years, is the extraction/non-extraction debate (Baumrind et al., 1996; Ribarevski et al., 1996). When examining the selection of specific treatment modalities more specifically, Lee et al. (1999) reported a low level of agreement amongst orthodontists, with kappa values as low as 0.07 for headgear and 0.13 for removal appliances. The data from this study show variation in the selection of treatment modalities, which can be seen when examining the graphical representations. At no time was a specific modality selected by all orthodontists. The data show some trends and variations amongst orthodontists, which is consistent with results reported in the literature (Baumrind et al., 1996; Luke et al., 1998). The general dentists selected various treatment modalities as well, and again, at no time was one selected by all of them. Interestingly, some modalities that were selected by the general dentists were almost never selected by the orthodontists, for example, “space maintenance” and “removal appliance”.

It is important to keep in mind that the respondents were not asked about their experience and ability with a specific treatment modality, but rather which modalities they believed would allow them to obtain the *best* outcome. The

selection of treatment modalities is usually matched to the treatment objectives. Orthodontists are trained to evaluate the skeletal, dental and soft tissue, which influences their decision process. The general dentists, not having received similar in depth training, might have based their decisions for treatment objectives and treatment modalities primarily on dentition, with which they are most familiar. Orthodontists were allowed to select only the 2 best modalities, while general dentists had the option of selecting all modalities that applied. Due to lack of scientific literature on the consistency of orthodontic treatment modality selection by general dentists, it can be assumed that they would likely have a lower rate of agreement amongst themselves.

As a result of the mishap in the phrasing and construction of questions for Case A, any comparison of the frequency of selection of treatment modalities between the general dentists and the orthodontists for this particular case might be biased. Overall, the modalities selected for Cases B and D were similar for both groups, although some nuances can be seen. As the patients in Cases A and B were identified as growing, the notion for growth modification and timing in the treatment selection was introduced. Knowing that Class III patients and males tend to grow for a longer period of time (Proffit, Fields, & Sarver, 2007), the option of "recall (at a later date)" was selected twice as often by the orthodontists as compared to the general dentists, illustrating more intricate knowledge of growth and development by the orthodontists. As Case C had the greatest variation in the selection of the level of complexity between general dentists and orthodontists, it is interesting to look closely at the treatment modalities selected

by both groups. The vast majority of orthodontists selected the "Full fixed treatment with extractions" or the "Combination of Ortho and Surgery", while general dentists were evenly distributed for the "Full fixed without extractions" and "Combination of Ortho and Surgery" modalities of treatment. The "Full fixed without extractions" option was rarely selected by the orthodontists. This suggests that general dentists might focus their treatment decisions and diagnoses on the dentition rather than on an overall assessment of the patients.

The limitation on the number of treatment modalities selected by general dentists and orthodontists might have biased the data. This restricted the ability for the respondents to take into consideration the element of time and the way in which the case might respond to a specific treatment modality, and re-adjusting as required. The completeness of the records provided, as well as the various available treatment modalities, might have overwhelmed the general dentists. Close examination of the variation between the cases and the selection of treatment modalities by general dentists showed no obvious explanations that might account for the difference in treatment modalities selected, other than a different rationale on which they individually based their treatment objectives.

6.3. Overall critique

6.3.1. Overall results

It is somewhat concerning that almost 3 out of 4 dentists provided some sort of orthodontic services to their patients, and that 1 out of 2 dentists felt that their dental education was not adequate in preparing them to provide orthodontic

treatment. Half (50%) of the general dentists in Survey 1 and 59% of the general dentists respondents in Survey 2B indicated that they had not attended orthodontic related courses since their graduation from dental school. There is clearly a discrepancy between the provision of orthodontic services by general dentists (71% providing some orthodontic services, 33% offering only space maintenance and 22.5% treating most of their patients requiring interceptive treatment), and their perception of the quality of their undergraduate orthodontic education. Unfortunately, the surveys did not provide data indicating the extent to which these services were rendered. The results are not encouraging due to the need for interceptive treatment in mixed dentition, particularly in the underserviced Canadian population.

The respondents of Survey 2B, being similar in their provision of orthodontic treatment to those of Survey 1, suggest that some sort of case selection process is undertaken by the general dentists prior to "offering" orthodontic services to their patients. The results of Survey 2 suggest that the majority of general dentists randomly selected the degree of complexity of each case presented. The orthodontists were not consistent in their evaluation of case complexity, although when examining their distributions, most responded in a similar scale. It is extremely difficult to assess the absolute level of complexity and treatment modalities for a given patient, as these assessments cannot be completely appreciated until the treatment has been rendered. Case C (Skeletal Class II with Class II dental, non-growing) showed the greatest amount of discrepancy between the 2 groups in terms of level of complexity and selection of

treatment modalities. The data suggest that the patient selection process of general dentists does not rely on the same criteria as those of specialists. A plausible interpretation is that general dentists focused their diagnosis and treatment decisions on the dentition rather than on the overall assessment of the patient's skeletal pattern and soft tissue drape. As mentioned by Luke et al. (1998, page 518), "the diversity of treatment approaches … might reflect the amazing lack of agreement as to what the underlying problems are, even though the same patient records were used."

Knowing that general dentists were less consistent than orthodontists, but not by a large margin, makes it important to evaluate the results of treatment when comparing the two groups. Marques et al. (2012) carried out a blind study to compare the outcomes of 30 orthodontists and 30 general dentists. Providers were asked to submit their case with the *best* outcome, and were graded with the Objective Grading System established by the American Board of Orthodontics (ABO). Interestingly, 96.7% of orthodontists provided a case that was considered *satisfactory*, compared to 50% of general dentists (Marques, Freitas Junior, Pereira, & Ramos-Jorge, 2012). That being said, according to the ABO, most orthodontists are trained in and are aware of what is expected for an *excellent outcome*, while general dentists might not be aware of the criteria in detail.

Because orthodontics is considered one of the most challenging disciplines in dentistry with respect to the complexity in diagnosis and treatment sequencing (Luke et al., 1998), there is great variability in treatment planning amongst orthodontists, and even greater inconsistency amongst general dentists. General

dentists are most likely providing the best treatment they can, given the education they received. Taking into consideration the nature of a health profession, the practitioner is expected to provide treatment within the limits of his/her knowledge, while keeping the best interests of patients in mind. If the knowledge base is not adequate, what expectations are realistic? It goes without saying that orthodontics cannot be taught to the level of a specialist within a general dentist curriculum. Again, the key issue of this long-standing debate is who should provide orthodontic diagnosis, objectives and treatment, and in what capacity. From the perspective of the patients, is there enough information available to assist them in the selection of their orthodontic service providers (general dentists or orthodontists)?

6.3.2. Potential Bias

Overall, the respondents of the surveys likely have a keen interest in the field of orthdontics, which would create a source of bias. General dentists who are comfortable with their skills in orthodontics might have been more apt to participate in this study than others. The fact that Survey 2A and Survey 2B were administered in the presence of the primary investigator (an orthodontic resident) might have increased hesitancy in responses. The surveys did not collect any data on the location of the respondents' offices, which makes it impossible to confirm that each province and territory was represented. In addition, Survey 2A and Survey 2B were administered at a National Meeting, with attendees predominantly local practitioners. All surveys were conducted in English only,

which might have been a limiting factor for Francophones dentists. These factors should be considered in a future study, as well as an attempt to increase the number of respondents.

6.4. Analysis of the Null Hypotheses

6.4.1. Null Hypothesis #1

The first null hypothesis in this project stated: "The proportion of general dentists providing orthodontic treatment to their patients in Canada has not changed". A comparison of the data obtained through Survey 1 and the historical article by Konchak and McDermott (1990) shows a decline in the provision of orthodontic services by general dentists in Canada for "interceptive" and "comprehensive/full fixed" orthodontic services. However, it is important to consider the variation of semantics between investigations, specifically the ambiguity of the term "interceptive treatment". Furthermore, the questions in Survey 1 identified respondents who treat most of their patients needing interceptive/comprehensive treatment. All of these factors support the rejection of Null Hypothesis #1.

6.4.2. Null hypothesis #2

The second null hypothesis in this research stated: "Proximity to an orthodontist has no influence on the provision of orthodontic treatment by general dentists". The data obtained through Survey 1 supports rejecting the null hypothesis, as a driving time of more than one hour to an orthodontic office

resulted in a 16% increase in the provision of orthodontic treatment by the general dentists. Therefore, Null Hypothesis #2 is rejected.

6.4.3. Null hypothesis #3

The third null hypothesis stated: "General dentists are not adequately prepared to confidently diagnose, treatment plan and provide orthodontic treatment for patients in the mixed and permanent dentitions". The results associated with this issue are illustrated in Figure 7 of Chapter 5. Survey 1 results indicated an improvement in the perceptions of the quality of the undergraduate education received in the field of orthodontics, when compared to a previous Canadian study (Konchak & McDermott, 1990)

The ratings obtained vary greatly for diagnosing, treatment planning and treating in cases of the mixed and permanent dentitions. Encouragingly, general dentists are more comfortable in diagnosis than in the provision of orthodontic treatment. This trend is also noted for the permanent dentition, when compared to the mixed dentition. Almost 50% of dentists felt they received *inadequate* or *weak* education with regards to treating patients in the mixed and permanent dentitions. Therefore, Null Hypothesis #3 is supported. It is important to consider that results obtained in Survey 1 do not indicate the parameters that were considered by general dentists when evaluating the quality of their undergraduate education.

6.4.4. Null Hypothesis #4

The fourth null hypothesis stated: " There is no agreement between general dentists and specialist orthodontists regarding the assessment of case difficulty". The data obtained through Survey 2 suggested that the agreement between and within both groups was poor. Even though the ICC values obtained were below the level of statistical significance, the values obtained by the general dentist group suggested a random evaluation of case difficulty. Accordingly, Null Hypothesis #4 is accepted.

6.4.5. Null hypothesis #5

The final null hypothesis stated: "There is no agreement between general dentists and specialist orthodontists in terms of how orthodontic cases should be treated". The data obtained through Survey 2 suggested that selection of treatment modalities was case dependent. The treatment modalities selected for Case B and Case D were similar for both groups, although some nuances were evident. Case C suggested that general dentists might focus their diagnosis and treatment decisions on the dentition rather than on an assessment of the patients' diagnostic records (skeletal pattern, dental pattern and soft tissue drape). Because of the discrepancy between the cases, Null Hypothesis #5 is rejected, while acknowledging case specificity.

7. Conclusions

7.1. Survey 1

The respondents of Survey 1 were a reasonable representation of the demographics of dentists across Canada. It is important to note that the gender distribution was disproportionate, which might suggest a change in the current demographics with more females entering the profession. Also, there was a greater representation of more experienced (>25 years) and less experienced (<15 years) dentists in the Survey 1 respondents. The following conclusions can be drawn from the results of this survey:

- The number of dentists providing some orthodontic services to their patients is similar to the number reported in the American literature in the 1990s.
- The recent decline in the provision of orthodontic treatment noted in New Zealand, and hinted at in the United States of America, is not supported across Canada by the current study.
- More specifically, 33% of the general dentists providing orthodontic treatment provide only space maintenance appliances. A total of 23% indicated that they addressed the majority of the interceptive needs of their patients. This suggests a decline in the provision of interceptive treatment by Canadian dental practitioners, as compared to the 65% reported by Konchak and McDermott (1990) twenty-five years ago.
- A decline in the provision of comprehensive/fixed treatment is also noted, with only 15% of general dentists providing this type of treatment, as compared to the previously reported of 23% (Konchak & McDermott, 1990).

- It can be assumed that general dentists provide some orthodontic treatment without necessarily treating most of their patients. The data demonstrated a change in the treatment modalities offered by general dentists, which might be linked to the increasing availability and popularity of clear aligner therapy.
- The comfort level of dentists with common orthodontic treatment modalities is linked to the complexity of the modalities and/or objectives presented. The more complex/advanced the treatment modality, the less comfortable the dentists were in providing treatment.
- A driving time of more than one hour to the closest orthodontist showed a 16% increase in the provision of orthodontic treatment by the general dentists.
- The perception of the quality of undergraduate orthodontic education appears to have improved when compared to the previous Canadian data.
- General dentists felt that their undergraduate education was better in the diagnostic aspects of orthodontics, in comparison to treatment planning or providing treatment. Somewhat surprising was the fact that treating patients in the mixed dentition received the lowest rating.
- The undergraduate education offered in the field of orthodontics is not resolving the need for interceptive treatment reported in underserviced Canadian populations (Karaiskos et al., 2005).
- With less than 15% of dentists rating their undergraduate education in orthodontics as excellent, educators should consider revising the undergraduate orthodontic curriculum.

7.2. Survey 2

The orthodontists who completed Survey 2 closely represent the Canadian demographics for their profession. There is a disproportionate gender distribution of the dentists who answered Survey 2. This result might suggest a change in the current demographics with more females entering the profession. Lastly, the distribution of dentists responding to Survey 2 was fairly consistent with the respondents of Survey 1 in terms of their provision of orthodontic treatment to patients. The following conclusions were drawn for the results of this survey:

- The results are consistent with previous studies reporting that orthodontists tend to disagree amongst themselves when assessing the difficulty of cases. This is supported by the low ICC value obtained, indicating a poor level of agreement.
- General dentists did not agree amongst themselves when evaluating the degree of complexity of the patients' records provided.
- After a comparison of both groups, it can be concluded that the agreement between them is minimal, as reflected by the low ICC score. Case C (Skeletal Class II with Class II dental, non-growing patient) demonstrated the highest discrepancy between the groups.
- Interestingly, the control group of general dentists showed the highest value of intra-rater correlation, although this higher score did not achieve statistical significance.
- Agreement in the selection of treatment modalities might be case dependent, as reflected by Case B (Skeletal Class III mild with Class III dental mild,

growing) and Case D (Skeletal Class I with Class I dental, moderate growing), which had a greater consistency.

- Case C suggested that general dentists might focus their treatment decisions and diagnoses primarily on the evaluation of the dentition, rather than on an overall assessment of the patients' diagnostic records. Close examination of the case's orthodontic diagnostic records and the treatment modalities selected by the general dentists, revealed no obvious explanations for the discrepancy, other than differing rationales on which they based their treatment decisions.

7.3. Overall conclusions

Taking into consideration the data obtained through both surveys, the following umbrella conclusions are made:

- It is concerning that almost 3 out of 4 dentists provide some sort of orthodontic treatment to their patients, in light of the fact that 1 out of 2 dentists felt that their undergraduate education was not adequate in preparing them to provide orthodontic treatment. This is even more concerning when taking into consideration that 50% to 59% of the respondents indicated that they did not supplement their orthodontic education with orthodontic related continuing education courses following graduation from dental school.
- The data suggest the existence of a case selection process undertaken by the general dentists when deciding to provide orthodontic treatment. This explains the discrepancy between the percentage of respondents providing some sort of orthodontic treatment and those treating most of their patients requiring

interceptive or comprehensive/full fixed orthodontic treatment. Interestingly, the random selection of case difficulty when assessing the patients' orthodontic records suggests that the weighting system utilized by the general dentists is inconsistent with the criteria considered by certified orthodontic specialists.

- Consistent with the Code of Ethics of health care professionals, it is assumed that the general dentists are providing the best care possible when considering the education they received. Again, taking into consideration that the vast majority of respondents have not supplemented their undergraduate orthodontic education since graduation, and that more than 50% of them reported an inadequate undergraduate education, illustrates an ongoing challenge to the current undergraduate orthodontic curriculum. A common and standardized template to assess and diagnose patients, as well as gaining a clearer understanding of the advantages and limitations of available treatment modalities, could be a beneficial component of the current undergraduate orthodontic curricula across Canada.

8. Recommendations and future directions

The data collected from the questionnaires utilized in this research project produced a comprehensive overview of the current trends in the provision of orthodontic treatment by Canadian general dentists. This data brought to light the following points, which could be the focus of future research:

- A pan-Canadian evaluation of the objectives of the undergraduate orthodontic curriculum should be carried out in order to assess the strengths and weaknesses of the various dental schools' curricula, while attempting to standardize the quality, content and learning outcomes of orthodontic education provided in undergraduate dental programs.
- A deeper understanding of the case selection process undertaken by general dentists is required. A list of criteria or ranking of the importance placed on specific criteria used when assessing the difficulty of cases would clarify the general dentists' thought processes.
- Survey 1 should be implemented across Canada on a regular basis, possibly every 5 years, to evaluate the quality, content and teaching of undergraduate orthodontic education provided to Canadian dentists.
- Curricula should have a stronger focus on the limitations related to various treatment modalities (e.g., clear aligners therapy versus full fixed orthodontic appliances) undertaken by the general dentist.
- Data on specific treatment modalities requested by patients should be obtained to provide a more in depth analysis of current treatment trends.
- The way in which clinicians, regardless of either their field of expertise, will address requests by patients for compromised treatment, and to what extent they will modify the treatment objectives to satisfy those requests, should be evaluated.

REFERENCES

Aldawood, S., Ampuan, S. N., Medara, N., & Thomson, W. M. (2011). Orthodontic treatment provision and referral preferences among new zealand general dental practitioners. *Australian Orthodontic Journal, 27*(2), 145-154.

Allister, J. H., Spencer, A. J., & Brennan, D. S. (1996). Provision of orthodontic care to adolescents in south australia: The type, the provider, and the place of treatment. *Australian Dental Journal, 41*(6), 405-410.

American Association of Orthodontists. (1973). American association of orthodontists announces results of manpower survey. *American Journal of Orthodontics, 63*(1), 67-71.

Baumrind, S., Korn, E. L., Boyd, R. L., & Maxwell, R. (1996). The decision to extract: Part 1--interclinician agreement. *American Journal of Orthodontics and Dentofacial Orthopedics, 109*(3), 297-309.

Bentele, M. J., Vig, K. W., Shanker, S., & Beck, F. M. (2002). Efficacy of training dental students in the index of orthodontic treatment need. *American Journal of Orthodontics and Dentofacial Orthopedics, 122*(5), 456-462.

Bernas, A. J., Banting, D. W., & Short, L. L. (2007). Effectiveness of phase I orthodontic treatment in an undergraduate teaching clinic. *Journal of Dental Education, 71*(9), 1179-1186.

Bio Research Associates Inc.Brock rondeau, D.D.S., I.B.O., D.A.B.C.P. Retrieved December 13, 2014, from http://www.bioresearchinc.com/brock-rondeau-d-d-s-i-b-o-d-a-b-c-p/

Brightman, B. B., Hans, M. G., Wolf, G. R., & Bernard, H. (1999). Recognition of malocclusion: An education outcomes assessment. *American Journal of Orthodontics and Dentofacial Orthopedics, 116*(4), 444-451.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normal and standardized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284-290.

de Muelenaere, J. J., & Wiltshire, W. A. (1990). Orthodontic treatment in general dental practice in south africa. *The Journal of the Dental Association of South Africa = Die Tydskrif Van Die Tandheelkundige Vereniging Van Suid-Afrika, 45*(12), 529-533.

Dolce, C., Mansour, D. A., McGorray, S. P., & Wheeler, T. T. (2012). Intrarater agreement about the etiology of class II malocclusion and treatment approach. *American Journal of Orthodontics and Dentofacial Orthopedics, 141*(1), 17-23.

Espelid, I., Tveit, A. B., & Fjelltveit, A. (1994). Variations among dentists in radiographic detection of occlusal caries. *Caries Research, 28*(3), 169-175.

Fields, H. W., Vann, W. F., & Vig, K. W. (1982). Reliability of soft tissue profile analysis in children. *The Angle Orthodontist, 52*(2), 159-165.

Galbreath, R. N., Hilgers, K. K., Silveira, A. M., & Scheetz, J. P. (2006). Orthodontic treatment provided by general dentists who have achieved master's level in the academy of general dentistry. *American Journal of Orthodontics and Dentofacial Orthopedics, 129*(5), 678-686.

Goomansingh, C., & Logan, N. (June 11, 2013 12:43pm,). Buyer beware: Dentists can be trained in orthodontics, but they're not orthodontists. *Global News*, pp. July 5th 2013.

Gottlieb, E. L. (2002). The editor's corner : Donovan's dream. *Journal of Clinical Orthodontics, 36*(4), 185.

Graber, T. M. (1967). Count-down for dental student orthodontic education. *Journal of Dental Education, 31*(2), 128-137.

Gravely, J. F. (1989). Who should practise orthodontics? *British Journal of Orthodontics., 16*(4), 235-241.

Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: An overview and tutorial. *Tutorials in Quantitative Methods for Psychology, 8*(1), 23-34.

Han, U. K., Vig, K. W., Weintraub, J. A., Vig, P. S., & Kowalski, C. J. (1991). Consistency of orthodontic treatment decisions relative to diagnostic records. *American Journal of Orthodontics and Dentofacial Orthopedics, 100*(3), 212-219.

Huang, G. J., & del Aguila, M. A. (2003). Distribution of orthodontic services and fees in an insured population in washington. *American Journal of Orthodontics and Dentofacial Orthopedics, 124*(4), 366-372.

Huang, G. J., Marston, B. E., & del Aguila, M. A. (2004). Orthodontic care in an insured population in washington: Demographic factors. *American Journal of Orthodontics and Dentofacial Orthopedics, 125*(6), 741-746.

Jacobs, R. M., Bishara, S. E., & Jakobsen, J. R. (1991). Profiling providers of orthodontic services in general dental practice. *American Journal of Orthodontics and Dentofacial Orthopedics, 99*(3), 269-275.

Karaiskos, N., Wiltshire, W. A., Odlum, O., Brothwell, D., & Hassard, T. H. (2005). Preventive and interceptive orthodontic treatment needs of an inner-city group of 6- and 9-year-old canadian children. *Journal, 71*(9), 649-649.

Keeling, S. D., McGorray, S., Wheeler, T. T., & King, G. J. (1996). Imprecision in orthodontic diagnosis: Reliability of clinical measures of malocclusion. *The Angle Orthodontist, 66*(5), 381-391.

Konchak, P. A., & McDermott, R. E. (1990). Orthodontic education and practice in canada: Perceptions of the profession as shown in a recent survey. *Journal (Canadian Dental Association), 56*(6), 537-539.

Koroluk, L. D., Jones, J. E., & Avery, D. R. (1988). Analysis of orthodontic treatment by pediatric dentists and general practitioners in indiana. *ASDC Journal of Dentistry for Children, 55*(2), 97-101.

Kuroda, S., Fuji, A., Sugie, M., Uoi, S., Kondo, R., Ando, R., & Yamashiro, T. (2010). Relationship between orthodontic expertise and perception of treatment needs for maxillary protrusion: Comparison of dental students, residents, and orthodontists. *American Journal of Orthodontics and Dentofacial Orthopedics, 137*(3), 340-345.

Lanning, S. K., Pelok, S. D., Williams, B. C., Richards, P. S., Sarment, D. P., Oh, T. J., & McCauley, L. K. (2005). Variation in periodontal diagnosis and treatment planning among clinical instructors. *Journal of Dental Education, 69*(3), 325-337.

Lawrence, A. J., Wright, F. A., & D'Adamo, S. P. (1995). The provision of orthodontic services by general dental practitioners. 2. factors influencing variation in service provision. *Australian Dental Journal, 40*(6), 360-364.

Lee, R., MacFarlane, T., & O'Brien, K. (1999). Consistency of orthodontic treatment planning decisions. *Orthodontics & Craniofacial Research., 2*(2), 79-84.

Luke, L. S., Atchison, K. A., & White, S. C. (1998). Consistency of patient classification in orthodontic diagnosis and treatment planning. *The Angle Orthodontist, 68*(6), 513-520.

Manasse, R. J., & Dooley, R. J. (1980). Correlates of the orthodontic aspects of the general dentist's practice. *Journal of Dental Education, 44*(9), 543-546.

Mandall, N. A. (2002). Are photographic records reliable for orthodontic screening? *Journal of Orthodontics, 29*(2), 125-127.

Marques, L. S., Freitas Junior, N., Pereira, L. J., & Ramos-Jorge, M. L. (2012). Quality of orthodontic treatment performed by orthodontists and general dentists. *The Angle Orthodontist, 82*(1), 102-106.

Miranda, F. L. (1980). Orthodontics in pedodontic practice: A survey of the southwestern society of pedodontists. *Pediatric Dentistry, 2*(3), 217-220.

Moorrees, C. F. (1984). Orthodontic specialty education. *American Journal of Orthodontics, 86*(5), 435-436.

Moyers, R. E. (1990). Quality assurance in orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics, 97*(1), 3-9.

National Dental Examining Board of Canada. (2014a). About the NDEB. Retrieved August/25, 2014, from www.ndeb.ca/about

National Dental Examining Board of Canada. (2014b). Competencies for a beginning dental practionner in canada. Retrieved August/25, 2014, from www.ndeb.ca/accredited/competencies

Ngan, P., & Amini, H. (1998). Self-confidence of general dentists in diagnosing malocclusion and referring patients to orthodontists. *Journal of Clinical Orthodontics, 32*(4), 241-245.

Pietilä, T., Pietilä, I., & Väätäjä, P. (1992). Early screening for orthodontic treatment. differences in assessments made by a consultant orthodontist and three public health dentists. *Community Dentistry and Oral Epidemiology, 20*(4), 208-213.

Proffit, W. R., Fields, H. W., & Sarver, D. M. (2007). *Contemporary orthodontics* (4th edition ed.). St. Louis, Missouri: Mosby Elsevier.

Proffit, W. R., Jackson, T. H., & Turvey, T. A. (2013). Changes in the pattern of patients receiving surgical-orthodontic treatment. *American Journal of Orthodontics and Dentofacial Orthopedics, 143*(6), 793-798.

Ribarevski, R., Vig, P., Vig, K. D., Weyant, R., & O'Brien, K. (1996). Consistency of orthodontic extraction decisions. *European Journal of Orthodontics., 18*(1), 77-80.

Richmond, S., O'Brien,K.D., Roberts, C. T., & Andrews, M. (1994). Dentists variation in the determination of orthodontic treatment need. *British Journal of Orthodontics., 21*(1), 65-68.

Richmond, S., Shaw, W. C., & Stephens, C. D. (1992). Orthodontics in the general dental services of england and wales: The provision of treatment. *British Dental Journal, 172*(4), 150-152.

Seattle Study Club. (2015). Seattle study Club(r) *Cultivating excellence in comprehensive dentistry*. Retrieved January/8th, 2015, from http://www.seattlestudyclub.com/Default.aspx?PID=258

Smith, R. J. (1987). General practitioners and orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics, 92*(2), 169-172.

Spencer, A. J., & Lewis, J. M. (1989). Service-mix in general dental practice in australia. *Australian Dental Journal., 34*(1), 69-74.

Tegelberg, A., Wenneberg, B., & List, T. (2007). General practice dentists' knowledge of temporomandibular disorders in children and adolescents. *European Journal of Dental Education, 11*(4), 216-221.

Williams, R. L. (1977). Your future in orthodontics—Manpower. *American Journal of Orthodontics, 72*(3), 315-320.

Wolsky, S. L., & McNamara, J. A.,Jr. (1996). Orthodontic services provided by general dentists. *American Journal of Orthodontics and Dentofacial Orthopedics, 110*(2), 211-217.

APPENDICES

APPENDIX A
Health Research Ethics Board (HREB) Approval

UNIVERSITY OF MANITOBA | BANNATYNE CAMPUS
Research Ethics Boards

P126 - 770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Telephone 204-789-3255
Fax 204-789-3414

HEALTH RESEARCH ETHICS BOARD (HREB)
CERTIFICATE OF FINAL APPROVAL FOR NEW STUDIES
Delegated Review

PRINCIPAL INVESTIGATOR:	INSTITUTION/DEPARTMENT:	ETHICS #:
Dr. M. Aucoin	U of M/Preventive Dental Science	HS16583 (H2013:320)
APPROVAL DATE: August 26, 2013	**EXPIRY DATE:** August 26, 2014	
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable): Dr. W. Wiltshire		

PROTOCOL NUMBER:	PROJECT OR PROTOCOL TITLE;
NA	Provision of orthodontics care by dentists practicing in Canada and certified orthodontists perspectives
SPONSORING AGENCIES AND/OR COORDINATING GROUPS: NA	

Submission Date of Investigator Documents:	HREB Receipt Date of Documents:
August 6 and August 25, 2013	August 12 and August 26, 2013

THE FOLLOWING ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
Protocol: Proposal		August 25, 2013
Consent and Assent Form(s): AAO Informed Consent		August 6, 2013
Other:		
Consent Disclosure Survey 1, 2A and 2B		August 6, 2013
Survey 1 and 2B		August 6, 2013
Survey 2A		August 25, 2013
Introduction Email for Survey		August 6, 2013
Winner Congratulation Email for Incentive Draw		August 6, 2013
Binder (Used for Survey 2A and 2B)		August 6, 2013
Ballot for Draw Participant for Survey 2A and 2B		August 6, 2013

CERTIFICATION
The above named research study/project has been reviewed in a ***delegated manner*** by the University of Manitoba (UM) Health Research Board (HREB) and was found to be acceptable on ethical grounds for research involving human participants. The study/project and documents listed above was granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION
The University of Manitoba (UM) Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulations of Manitoba. In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

QUALITY ASSURANCE

The University of Manitoba Research Quality Management Office may request to review research documentation from this research study/project to demonstrate compliance with this approved protocol and the University of Manitoba Policy on the Ethics of Research Involving Humans.

CONDITIONS OF APPROVAL:

1. The study is acceptable on scientific and ethical grounds for the ethics of human use only. ***For logistics of performing the study, approval must be sought from the relevant institution(s).***
2. This research study/project is to be conducted by the local principal investigator listed on this certificate of approval.
3. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to the research study/project, and for ensuring that the authorized research is carried out according to governing law.
4. **This approval is valid until the expiry date noted on this certificate of approval. A Bannatyne Campus Annual Study Status Report** must be submitted to the HREB within 15-30 days of this expiry date.
5. Any changes of the protocol (including recruitment procedures, etc.), informed consent form(s) or documents must be reported to the HREB for consideration in advance of implementation of such changes on the **Bannatyne Campus Research Amendment Form.**
6. Adverse events and unanticipated problems must be reported to the HREB as per Bannatyne Campus Research Boards Standard Operating procedures.
7. The UM HREB must be notified regarding discontinuation or study/project closure on the **Bannatyne Campus Final Study Status Report**.

Sincerely,

[redacted]

John Arnett, PhD. C. Psych.
Chair, Health Research Ethics Board
Bannatyne Campus

Please quote the above Human Ethics Number on all correspondence.
Inquiries should be directed to the REB Secretary **Telephone**: (204) 789-3255/ **Fax:** (204) 789-3414

APPENDIX B

Health Research Ethics Board (HREB) Amendments and Addendums

UNIVERSITY OF MANITOBA | BANNATYNE CAMPUS
Research Ethics Board

P126 - 770 Bannatyne Avenue
Winnipeg, Manitoba
Canada R3E 0W3
Telephone 204-789-3255
Fax 204-789-3414

HEALTH RESEARCH ETHICS BOARD (HREB)

CERTIFICATE OF FINAL APPROVAL FOR AMENDMENTS AND ADDENDUMS

PRINCIPAL INVESTIGATOR:	INSTITUTION/DEPARTMENT:	ETHICS #:
Dr. M. Aucoin	UofM / Preventive Dental Science	HS16583 (H2013:320)
HREB MEETING DATE (If applicable):	**APPROVAL DATE:** February 18, 2014	
STUDENT PRINCIPAL INVESTIGATOR SUPERVISOR (If applicable): Dr. W. Wiltshire		

PROTOCOL NUMBER:	PROJECT OR PROTOCOL TITLE:
NA	Provision of orthodontics care by dentists practicing in Canada and certified orthodontists perspectives
SPONSORING AGENCIES AND/OR COORDINATING GROUPS: NA	

REMINDER: THE CURRENT HREB APPROVAL FOR THIS STUDY EXPIRES: August 26, 2014

REVIEW CATEGORY OF AMENDMENT:	Full Board Review ☐	Delegated Review ☒
Submission Date of Investigator Documents: February 6, 2014	**HREB receipt date of Documents:** February 11, 2014	

THE FOLLOWING AMENDMENT(S) and DOCUMENTS ARE APPROVED FOR USE:

Document Name	Version(if applicable)	Date
Protocol:		
Revised Research Proposal		February 5, 2014
Consent and Assent Form(s):		
Other:		
Introduction email for newsletters received February 11, 2014	A,B,C and French	

CERTIFICATION

The University of Manitoba (UM) Health Research Board (HREB) has reviewed the amendment to the research study/project named on this ***Certificate of Approval*** as per the category of review listed above and was found to be acceptable on ethical grounds for research involving human participants. The amendment and documents listed above were granted final approval by the Chair or Acting Chair, UM HREB.

HREB ATTESTATION

The University of Manitoba (UM) Health Research Board (HREB) is organized and operates according to Health Canada/ICH Good Clinical Practices, Tri-Council Policy Statement 2, and the applicable laws and regulation of Manitoba. In respect to clinical trials, the HREB complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations of Canada and carries out its functions in a manner consistent with Good Clinical Practices.

APPENDIX C
Survey 1

Provision of orthodontic care by dentists practicing in Canada and certified

Consent Disclosure

University of Manitoba Bannatyne Campus Research Ethics Board
Consent Disclosure Statement

On –line Survey Consent Disclosure (Survey 1)

"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives" undertaken by the University of Manitoba

Thank-you for accessing the Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives on the internet. This survey will be part of the Masters' thesis of Dr Marc-Olivier Aucoin, 2nd year Orthodontic Resident at the University of Manitoba.

This survey is being conducted to gather information of the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada. This survey will be anonymous and will ask questions on the following topics: demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic services provided and referral to specialists.

Your feedback will be collected through an online survey which will ask you a series of questions and should take about 10 minutes to complete.

Your participation on this online survey is completely voluntary. You are not required to provide any personal information such as your name, address or telephone number, and you don't have to answer any questions you don't want to. The survey system will not record your e-mail address or IP (Internet protocol) address.

Incentive prizes will be drawn on June 1st 2014. The draw is on a voluntary basis and will not be linked in any shape or form to your answers on the survey. You will be asked to fill out a voluntary draw ticket by providing your contact information, the ballots will be kept in a locked box. Once all prizes have been claimed, the remaining ballots will be destroyed by a medical shredding company.

The risks of participating are low. All the data collected from this survey will be anonymous.

If you agree to participate in the survey, please note that you must complete the survey in one sitting (in other words, the system won't let you save your survey responses and return to complete them later.

Also, please note that when you have submitted your response, you will not be able to withdraw it as we are unable to link the survey responses back to you.

Your participation is important to us and will help us provide valuable data that will be part of a Masters' research thesis and eventually published. The idea is to help identify the strengths and weaknesses in the undergraduate orthodontic curriculum across Canada.

If you have any questions about this survey study, please do not hesitate to contact Dr Marc-Olivier Aucoin (researcher) at aucoinm@cc.umanitoba.ca or Dr William A. Wiltshire (supervisor) at wa_wiltshire@umanitoba.ca

This study has been approved by the University of Manitoba Health Research Ethics Board.

By continuing on and completing the on-line survey you are consenting to participate in the on-line survey.

Provision of orthodontic care by dentists practicing in Canada and certified

Demographic section

***1. My gender is?**

- ◯ Male
- ◯ Female

***2. Do you have a full, unrestricted license to practice dentistry in Canada?**

- ◯ Yes
- ◯ No

Provision of orthodontic care by dentists practicing in Canada and certified

***3. How many years ago did you graduate from Dental School?**

- ◯ 25 years or more (before 1988)
- ◯ 15 to 24 years (1989 to 1998)
- ◯ 5 to 14 years (1999 to 2008)
- ◯ Less than 5 years (2009 to 2013)

***4. At which of the following schools were you trained?**

- ◯ Accredited Canadian Dental School
- ◯ Accredited American (USA) Dental School
- ◯ Other, which country

***5. Which of the following represents the population of the town/city in which your primary practice is located?**

- ◯ 0 to 4 999
- ◯ 5 000 to 19 999
- ◯ 20 000 to 49 999
- ◯ 50 000 to 199 999
- ◯ More than 200 000

***6. What is the proximity to the closest orthodontist from your primary practice?**

- ◯ 0 to 19 minutes of driving
- ◯ 20 to 59 minutes of driving
- ◯ 1 to 2 hours of driving
- ◯ 2 to 4 hours of driving
- ◯ More than 4 hours

Provision of orthodontic care by dentists practicing in Canada and certified

Orthodontic Undergraduate Education section

***7. How would you rate your undergraduate dental education (Dental School) in regards of your ability on the following topics**

	Inadequate	Weak	Average/Fair	Good	Excellent
DIAGNOSE in the MIXED dentition	◯	◯	◯	◯	◯
TREATMENT PLAN in the MIXED dentition	◯	◯	◯	◯	◯
TREAT in the MIXED dentition	◯	◯	◯	◯	◯
DIAGNOSE in the PERMANENT dentition	◯	◯	◯	◯	◯
TREATMENT PLAN in the PERMANENT dentition	◯	◯	◯	◯	◯
TREAT in the PERMANENT dentition	◯	◯	◯	◯	◯

Provision of orthodontic care by dentists practicing in Canada and certified

Orthodontic Continuing Education section

***8. Have you ever taken short courses or weekend courses in orthodontics?**

- ◯ Yes
- ◯ No

***9. Have you ever taken an orthodontic program offered by an non-accredited institute taught by general dentists and/or orthodontists?**

- ◯ Yes
- ◯ No

10. Do you / would you prefer short courses offered by a general dentist(s) practicing orthodontics?

- ◯ Yes
- ◯ No

If Yes, why?

11. Do you / would you prefer attending orthodontic short courses offered by orthodontic specialists?

- ◯ Yes
- ◯ No

If Yes, why?

***12. How many hours of Continuing Education do you dedicate to orthodontics in a typical 3 years cycle?**

- ◯ 0 hours
- ◯ 1 to 9 hours
- ◯ 10 to 24 hours
- ◯ 25 to 49 hours
- ◯ 50 hours and more

Provision of orthodontic care by dentists practicing in Canada and certified

Orthodontic Referrals section

***13. On average what percentage of your patients, in the past 6 months, do you feel would benefit from orthodontic treatment?**

- ◯ 0 to 14%
- ◯ 15 to 29%
- ◯ 45 to 59%
- ◯ 60 to 74%
- ◯ 75 to 89%
- ◯ 90 to 100%

***14. What percentage of these patients did you refer to a registered certified specialist orthodontist?**

- ◯ 0 to 14%
- ◯ 15 to 29%
- ◯ 45 to 59%
- ◯ 60 to 74%
- ◯ 75 to 89%
- ◯ 90 to 100%

***15. On average how many of your patients, in the last 6 months, inquired about orthodontic treatment?**

- ◯ 0 to 9 patients
- ◯ 10 to 24 patients
- ◯ 25 to 49 patients
- ◯ 50 to 74 patients
- ◯ 75 to 99 patients
- ◯ 100 patients or more

Provision of orthodontic care by dentists practicing in Canada and certified

***16. How many of these patients did you refer to a registered certified specialist orthodontist?**

- ◯ 0 to 14%
- ◯ 15 to 29%
- ◯ 45 to 59%
- ◯ 60 to 74%
- ◯ 75 to 89%
- ◯ 90 to 100%

***17. With regard to patients who would benefit from interceptive orthodontic treatment, which of the following statements describe you the best?**

- ◯ I treat most of them myself
- ◯ I refer them to a General Dentist with more experience than me for this kind of treatment
- ◯ I refer all of them to a certified specialist Pediatric Dentist
- ◯ I refer all of them to a certified specialist Orthodontist

***18. With regard to patients who would benefit from comprehensive orthodontic treatment (full fixed appliances), which of the following statements describe you the best?**

- ◯ I treat most of them myself
- ◯ I refer them to a General Dentist with more experience than me for this kind of treatment
- ◯ I refer all of them to a certified specialist Pediatric Dentist
- ◯ I refer all of them to a certified specialist Orthodontist

19. Do you presently provide any orthodontic services (space maintenance and/or removable appliance and/or comprehensive orthodontic treatment) to your patients?

- ◯ Yes
- ◯ No

Provision of orthodontic care by dentists practicing in Canada and certified

Orthodontic Provider section

***20. How many days per month on average do you dedicate your practice to orthodontics?**

- ◯ 0 days per month (only on an emergency needs basis)
- ◯ 0 days per month (only when a minor case presents)
- ◯ Up to 1 day per month
- ◯ 2 to 4 days per month
- ◯ 5 to 7 days per month
- ◯ More than 8 days per month
- ◯ On a daily basis

***21. From the following list, which modalities of orthodontic treatment do you feel comfortable providing to your patients? Please select one answer per row.**

	Very uncomfortable	Uncomfortable	Somewhat comfortable	Comfortable	Very comfortable
Space maintainers	◯	◯	◯	◯	◯
Removable appliance therapy	◯	◯	◯	◯	◯
Functional appliance therapy	◯	◯	◯	◯	◯
Clear aligners (eg: Invisalign)	◯	◯	◯	◯	◯
Multi-phase treatment (Removable appliances followed by a full fixed appliance treatment)	◯	◯	◯	◯	◯
Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions	◯	◯	◯	◯	◯
Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions	◯	◯	◯	◯	◯
A combination of comprehensive orthodontic treatment and Orthognathic surgery	◯	◯	◯	◯	◯

Other (please specify)

Provision of orthodontic care by dentists practicing in Canada and certified

***22. Do you provide removable and/or fixed appliances treatment options to your patients?**

- ◯ Yes
- ◯ No

Provision of orthodontic care by dentists practicing in Canada and certified

***23. How comfortable are you using removable and fixed appliances for the following purposes?**

	Very uncomfortable	Uncomfortable	Somewhat comfortable	Comfortable	Very comfortable
Maintaining space (e.g. Lingual holding arch, Nance Button)	◯	◯	◯	◯	◯
Removable appliances for minor corrections (e.g. cross-bite, space closure, proclination of a few selected teeth)	◯	◯	◯	◯	◯
Removable appliances for habit control (e.g. digit-sucking crib, tongue crib, etc.)	◯	◯	◯	◯	◯
Removable appliances for posterior and / or anterior expansion	◯	◯	◯	◯	◯
Removable Functional appliances for growth modification (Twin Block, Bionator, etc)	◯	◯	◯	◯	◯
Fixed Functional appliances (e.g. Herbst)	◯	◯	◯	◯	◯

Provision of orthodontic care by dentists practicing in Canada and certified

***24. Which of the following are components of your orthodontic records? (Please select all that apply)**

- [ ] I do not take any specific orthodontic records
- [ ] Electronic models
- [ ] Cast (plaster) models
- [ ] Panoramic radiograph
- [ ] Cephalometric radiograph (Lateral Ceph)
- [ ] Antero-posterior Cephalometric radiograph (PA Ceph)
- [ ] Facial/Extra-oral photos
- [ ] Intra-oral photos
- [ ] CBCT (Cone Beam CT)
- [ ] Hand-wrist radiograph

***25. In terms of Cephalometric radiographs, please select all that apply**

- [ ] I do not take cephalometric radiographs routinely on orthodontic patients
- [ ] I only visually evaluate the radiographs
- [ ] I personally hand trace the radiographs
- [ ] My assistant(s) or hygienist (s) hand trace the radiographs
- [ ] I personally use a software program (Dolphin Imaging®, Quick Ceph®, etc) to trace the radiographs
- [ ] My assistant(s) or hygienist(s) use a software program (Dolphin Imaging®, Quick Ceph®, etc) to trace the radiographs

Provision of orthodontic care by dentists practicing in Canada and certified

***26. With regard of the use of software programs (Dolphin Imaging®, Quick Ceph®, etc) to trace radiograph (such as cephs), please select all that apply.**

- [ ] I do no use a software program
- [ ] I personally use a software program and select the landmarks myself
- [ ] I personally use a software program and let the software program select the location of the landmarks
- [ ] My assistant(s) or hygienist(s) select the landmarks
- [ ] My assistant(s) or hygienist(s) let the software program select the landmarks
- [ ] My assistant(s) or hygienist(s) do the initial tracing with the software but I review the landmark placement.

***27. Which of the following Cephalometric analyses do you routinely use? (please select all that apply)**

- [ ] I do not use any cephalometric analyses
- [ ] Steiner
- [ ] Downs
- [ ] Ricketts
- [ ] McNamara
- [ ] Tweed
- [ ] Wits
- [ ] Other (please specify)

Provision of orthodontic care by dentists practicing in Canada and certified

Incentive section

In order to thank you for taking the time to complete this survey, we will be drawing a few prizes. The draws will be held on June 1st 2014. The winners will be contacted by email and will be given 7 days to claim the prize. If prizes are not claimed within the allowed time, another winner will be draw until all prizes are claimed. Prizes are the following:

• Prize #1
o Prepaid Visa credit card, value of $250, provided by 3M

• Prize #2
o Best Buys' gift card, value of $150 provided by GAC

• Prize #3
o Best Buys' gift card, value of $50, provided by the American Orthodontics

• Prize #4
o iTunes gift card, value of $50, provided by the Researcher

***28. Do you wish to participate in draw?**

◯ Yes

◯ No

Thank you for completing this survey and have a great day!

Provision of orthodontic care by dentists practicing in Canada and certified

Contact information

*29. Please provide email address:

APPENDIX D

Introduction email to Survey 1 (Universities)

Dear Doctor,

Below you will find the link to complete the following survey:

"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives."

This survey will be used as a part of the Master of Science thesis of Dr Marc-Olivier Aucoin (University of Manitoba, Graduate Orthodontic Resident).

The survey should take about **10 minutes** of your time.

The purpose of this survey is to *gather information of the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada. This survey will be anonymous and will ask questions on following topics: demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic services provided and referral to specialists.*

In order to thank you for you participation, you will be asked at the end of the survey to participate in a draw by entering you email address. The prizes are the following:

- Prize #1
  - Prepaid Visa credit card, value of $250, provided by 3M®Canada
- Prize #2
  - Best Buy's® gift card, value of $150, provided by GAC®
- Prize #3
  - Best Buy's® gift card, value of $50, provided by American Orthodontics®
- Prize #4
  - iTunes® gift card, value of $50, provided by Researcher

Once you begin the survey, it must be completed without leaving the browser. You won't be able to go back to any previous question while taking the survey.

Please copy the following web address into your browser or click on the link to complete the survey.
https://www.surveymonkey.com/s/thesis-uofmanitoba2013

Respectfully,

Marc-Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba

APPENDIX E

Introduction email to Survey 1 (Dental Associations)

Dear Doctor,

Below you will find the link to complete the following survey:

"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives."

This survey will be used as a part of the Master of Science thesis of Dr Marc-Olivier Aucoin (University of Manitoba, Graduate Orthodontic Resident).

The survey should take about **10 minutes** of your time.

The purpose of this survey is to *gather information of the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada. This survey will be anonymous and will ask questions on following topics: demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic services provided and referral to specialists.*

In order to thank you for you participation, you will be asked at the end of the survey to participate in a draw by entering you email address. The prizes are the following:

- Prize #1
  - Prepaid Visa credit card, value of $250, provided by 3M®Canada
- Prize #2
  - Best Buy's® gift card, value of $150, provided by GAC®
- Prize #3
  - Best Buy's® gift card, value of $50, provided by American Orthodontics®
- Prize #4
  - iTunes® gift card, value of $50, provided by Researcher

Once you begin the survey, it must be completed without leaving the browser. You won't be able to go back to any previous question while taking the survey.

Please copy the following web address into your browser or click on the link to complete the survey.
https://www.surveymonkey.com/s/thesis-uofmanitoba-2013

Respectfully,

Marc-Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba

APPENDIX F
Introduction post for Survey 1 (CDA – Oasis Discussions)

Online Survey: the perspectives of Canadian dentists and certified orthodontists about the provision of orthodontic care

by JCDA Oasis | Nov 26, 2013 | Oral Health Research, Orthodontics | 0 comments

UNIVERSITY OF MANITOBA

Dr. Marc-Olivier Aucoin, a graduate Orthodontic Resident from the University of Manitoba, is seeking colleagues' support to complete an online survey for masters' thesis. Valuable prizes are available as a Thank You for your participation.

Dear Doctor,

I respectfully seek your assistance in completing an online survey for the completion of my Masters' thesis requirement.

Below you will find the link to **10-minute** survey titled: ***The perspectives of Canadian dentists and certified orthodontists about the provision of orthodontic care.***

The purpose of this survey is to collect information about the current state of aspects of orthodontics practice by Canadian dentists in Canada. The survey is anonymous and includes questions on the topics, such as demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic care services, and referral to specialists.

As a *Thank You* for you participation, you will be asked at the end of the survey to enter your email address for a draw. Valuable prizes await and they are:

- Prize #1
    - Prepaid Visa credit card, value of $250, provided by 3M®Canada
- Prize #2
    - Best Buy's® gift card, value of $150, provided by GAC®

- Prize #3
    - Best Buy's® gift card, value of $50, provided by American Orthodontics®
- Prize #4
    - iTunes® gift card, value of $50, provided by Researcher

Once you begin the survey, it must be completed without leaving the browser. You won't be able to go back to any previous question while taking the survey.

To take the survey, click here

Respectfully,

Marc-Olivier Aucoin, DMD

Graduate Orthodontic Resident

University of Manitoba

APPENDIX G

Introduction to Survey 1 in newsletter (3M®)

In order to support student research in the field of dentistry we would like to invite you to take part in the survey of a 2nd year resident at the University of Manitoba. This survey (part of his thesis) is targeting **Canadian general dentists**. The goal of this survey is to identify the practice of orthodontics, and particularly, if there are any deficiencies in the undergraduate training as well as the need for Continuing Education courses. The survey **takes about 10 minutes** to complete and **only aggregate results will be used**. **Participation prizes will be drawn** and the survey will be closed on April 22th 2014. Your help would be extremely beneficial in order to make this reflect the Canadian dental perspective. Please do not hesitate to contact the researcher so he can provide you the link to survey at: aucoinm@cc.umanitoba.ca

APPENDIX H

Introduction email to Survey 1 (Alpha Omega)

Dear Doctor,

Below you will find the link to complete the following survey:

"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives."

This survey will be used as a part of the Master of Science thesis of Dr Marc-Olivier Aucoin (University of Manitoba, Graduate Orthodontic Resident).

The survey should take about **10 minutes** of your time.

The purpose of this survey is to *gather information of the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada. This survey will be anonymous and will ask questions on following topics: demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic services provided and referral to specialists.*

In order to thank you for you participation, you will be asked at the end of the survey to participate in a draw by entering you email address. The prizes are the following:

- Prize #1
  - Prepaid Visa credit card, value of $250, provided by 3M®Canada
- Prize #2
  - Best Buy's® gift card, value of $150, provided by GAC®
- Prize #3
  - Best Buy's® gift card, value of $50, provided by American Orthodontics®
- Prize #4
  - iTunes® gift card, value of $50, provided by Researcher

Once you begin the survey, it must be completed without leaving the browser. You won't be able to go back to any previous question while taking the survey.

Please copy the following web address into your browser or click on the link to complete the survey.
https://www.surveymonkey.com/s/thesis-aucoin2014

Respectfully,

Marc-Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba

APPENDIX I

Introduction email to Survey 1 (Société Dentaire de Québec et de Montréal)

Cher (e) Docteur(e),

La présente est pour vous inviter à répondre à un sondage dont l'objectif est la récolte d'informations portant sur différents aspects de la pratique de l'orthodontie au Canada. Ce sondage s'intitule :

Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives."

Ce sondage est **anonyme** et aborde multiples sujets variés concernant l'orthodontie et la formation que vous avez reçue. Les données analysées incluent la démographie, l'éducation orthodontique reçue au cours de vos études en médecine dentaire, la formation continue orthodontique, les services orthodontiques que vous prodigués ainsi que les références aux spécialistes en orthodontie.

Ce sondage, rédigé en langue anglaise, et est relativement simple et facile à comprendre. En fait, ce dernier fait part intégral du projet de Maîtrise en Science du Dr Marc-Olivier Aucoin résident au 2e cycle en orthodontie à l'Université du Manitoba.

Ce sondage devrait prendre en moyenne **moins de 10 minutes** à compléter.
Votre participation est grandement appréciée.

Une fois le sondage débuté, celui-ci se doit d'être complété à la même séance. Fait à noter, il vous sera impossible de retourner à une page précédente en cours de complétion.

Afin de participer et compléter le sondage, **s'il vous plait copiez l'adresse électronique suivante dans votre navigateur d'internet, ou tout simplement cliquer sur ce lien suivant:**

https://www.surveymonkey.com/s/thesis-uofmanitoba2013

Dans le but de vous remercier pour votre participation, à la fin du sondage, vous aurez la possibilité d'inscrire votre adresse courriel afin de participer à un tirage. Les récipiendaires pourront recevoir l'un des prix suivants:

- Prix #1
  - Carte de crédit prépayée Visa®, d'une valeur de 250$ gracieuseté de 3M®Canada
- Prix #2
  - Carte cadeau Best Buy's®, d'une valeur de 150$, gracieuseté de GAC®
- Prix #3
  - Carte cadeau Best Buy's®, d'une valeur de 50$, gracieuseté American Orthodontics®
- Prix #4
  - Carte cadeau iTunes®, d'une valeur de 50$, gracieuseté du chercheur.

Mes plus sincères salutations, cordialement

Marc-Olivier Aucoin, DMD
Résident au 2e cycle en orthodontie, Université du Manitoba, Winnipeg

APPENDIX J

Introduction post to Survey 1 (Alberta Society of Dental Specialists)

<u>One of the primary objectives</u> of the ASDS executive this year is to foster and increase our communication and support for all specialists across this country. In that respect, we have received a request from Dr. Marc-Olivier Aucoin, an Orthodontic Graduate Student at the University of Manitoba. Dr. Aucoin has requested that our members take 10 minutes to fill out a survey titled "Provisions of Orthodontic Care by dentists practicing in Canada and certified orthodontists' perspectives. The ASDS executive would encourage all members to help this graduate student and complete his survey. There is a prize.

INTRODUCTION EMAIL FOR SURVEY

Dear Doctor,

Below you will find the link to complete the following survey:

<u>"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives."</u>

This survey will be used as a part of the Master of Science thesis of Dr Marc-Olivier Aucoin (University of Manitoba, Graduate Orthodontic Resident).

The survey should take about **10 minutes** of your time.

The purpose of this survey is to *<u>gather information of the current status of various aspects of the practice of orthodontics by general dentists practicing in Canada. This survey will be anonymous and will ask questions on following topics: demographics, undergraduate orthodontic dental education, orthodontic continuing education, orthodontic services provided and referral to specialists.</u>*

In order to thank you for you participation, you will be asked at the end of the survey to participate in a draw by entering you email address. The prizes are the following:

- Prize #1
  - Prepaid Visa credit card, value of $250, provided by 3M®Canada
- Prize #2
  - Best Buy's® gift card, value of $150, provided by GAC®
- Prize #3
  - Best Buy's® gift card, value of $50, provided by American Orthodontics®
- Prize #4
  - iTunes® gift card, value of $50, provided by Researcher

Once you begin the survey, it must be completed without leaving the browser. You won't be able to go back to any previous question while taking the survey.

Please copy the following web address into your browser or click on the link to complete the survey.

https://www.surveymonkey.com/s/thesis-uofmanitoba

Respectfully,

Marc-Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba

APPENDIX K
Survey 2A (orthodontists)

Provision of orthodontic care by dentists practicing in Canada and certified

Demographic Section

***1. My gender is?**

- ◯ Male
- ◯ Female

***2. Do you have a full, unrestricted license to practice as a certified specialist Orthodontist in Canada?**

- ◯ Yes
- ◯ No

***3. How many years ago did you graduate from an Orthodontic Specialty program?**

- ◯ 25 years or more (before 1998)
- ◯ 15 to 24 years (1989 to 1998)
- ◯ 5 to 14 years (1999 to 2008)
- ◯ Less than 5 years (2009 to 2013)

***4. At which of the following programs were you trained in Orthodontics?**

- ◯ Accredited Canadian Graduate program
- ◯ Accredited American (USA) Graduate program
- ◯ Other, which country

***5. Which of the following corresponds to the length of your Orthodontic specialty program?**

- ◯ Less than 24 months
- ◯ 24 months
- ◯ 25 to 30 months
- ◯ 31 to 36 months
- ◯ Greater than 36 months

Provision of orthodontic care by dentists practicing in Canada and certified

Case A

After examination of the provided records for CASE A, please answer the following questions.

***6. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***7. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***8. Who do you think should be able to treat this patient? (Please indicate all that apply)**

- ☐ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ☐ A General Dentist who has completed a weekend course(s) in Orthodontics
- ☐ A General Dentist who has completed extensive additional courses in Orthodontics
- ☐ A certified specialist Pediatric Dentist
- ☐ A certified specialist Orthodontist

***9. Which of the following would you prefer to be providing treatment for this patient? (Please indicate most appropriate)**

- ◯ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ◯ A General Dentist who has completed a weekend course(s) in Orthodontics
- ◯ A General Dentist who has completed extensive additional courses in Orthodontics
- ◯ A certified specialist Pediatric Dentist
- ◯ A certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case A

10. Which modalities of treatment do you think are indicated for this patient in the ideal situation? (Please indicate the 2 most appropriate choices)

- ☐ Recall (at a later date)
- ☐ Space maintainers
- ☐ Removable appliance therapy
- ☐ Functional appliance therapy
- ☐ Clear aligners (eg: Invisalign)
- ☐ Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ☐ Combination of orthodontic treatment and Orthognathic surgery
- ☐ Uncertain

***11. Which of the following modalities of treatment do you think SHOULD NOT BE UNDERTAKEN by a General dentist? (Please indicate all that apply)**

- ☐ Space maintainers
- ☐ Removable appliance therapy
- ☐ Functional appliance therapy
- ☐ Clear aligners (eg: Invisalign)
- ☐ Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ☐ Combination of orthodontic treatment and Orthognathic surgery

***12. How comfortable would you be with one of your referring dentists treating this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case B

After examination of the provided records for CASE B, please answer the following questions.

***13. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***14. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***15. Who do you think should be able to treat this patient? (Please indicate all that apply)**

- ☐ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ☐ A General Dentist who has completed a weekend course(s) in Orthodontics
- ☐ A General Dentist who has completed extensive additional courses in Orthodontics
- ☐ A certified specialist Pediatric Dentist
- ☐ A certified specialist Orthodontist

***16. Which of the following would you prefer to be providing treatment for this patient? (Please indicate most appropriate)**

- ◯ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ◯ A General Dentist who has completed a weekend course(s) in Orthodontics
- ◯ A General Dentist who has completed extensive additional courses in Orthodontics
- ◯ A certified specialist Pediatric Dentist
- ◯ A certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case B

17. Which modalities of treatment do you think are indicated for this patient in the ideal situation? (Please indicate the 2 most appropriate choices)

- ☐ Recall (at a later date)
- ☐ Space maintainers
- ☐ Removable appliance therapy
- ☐ Functional appliance therapy
- ☐ Clear aligners (eg: Invisalign)
- ☐ Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ☐ Combination of orthodontic treatment and Orthognathic surgery
- ☐ Uncertain

***18. Which of the following modalities of treatment do you think SHOULD NOT BE UNDERTAKEN by a General dentist? (Please indicate all that apply)**

- ☐ Space maintainers
- ☐ Removable appliance therapy
- ☐ Functional appliance therapy
- ☐ Clear aligners (eg: Invisalign)
- ☐ Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ☐ Combination of orthodontic treatment and Orthognathic surgery

***19. How comfortable would you be with one of your referring dentists treating this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case C

After examination of the provided records for CASE C, please answer the following questions.

***20. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***21. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***22. Who do you think should be able to treat this patient? (Please indicate all that apply)**

- ☐ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ☐ A General Dentist who has completed a weekend course(s) in Orthodontics
- ☐ A General Dentist who has completed extensive additional courses in Orthodontics
- ☐ A certified specialist Pediatric Dentist
- ☐ A certified specialist Orthodontist

***23. Which of the following would you prefer to be providing treatment for this patient? (Please indicate most appropriate)**

- ◯ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ◯ A General Dentist who has completed a weekend course(s) in Orthodontics
- ◯ A General Dentist who has completed extensive additional courses in Orthodontics
- ◯ A certified specialist Pediatric Dentist
- ◯ A certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case C

24. Which modalities of treatment do you think are indicated for this patient in the ideal situation? (Please indicate the 2 most appropriate choices)

- [ ] Recall (at a later date)
- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign)
- [ ] Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery
- [ ] Uncertain

***25. Which of the following modalities of treatment do you think SHOULD NOT BE UNDERTAKEN by a General dentist? (Please indicate all that apply)**

- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign)
- [ ] Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery

***26. How comfortable would you be with one of your referring dentists treating this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case D

After examination of the provided records for CASE D, please answer the following questions.

***27. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***28. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***29. Who do you think should be able to treat this patient? (Please indicate all that apply)**

- ☐ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ☐ A General Dentist who has completed a weekend course(s) in Orthodontics
- ☐ A General Dentist who has completed extensive additional courses in Orthodontics
- ☐ A certified specialist Pediatric Dentist
- ☐ A certified specialist Orthodontist

***30. Which of the following would you prefer to be providing treatment for this patient? (Please indicate most appropriate)**

- ◯ A General Dentist recently graduated from Dental School and without any extra Orthodontic training
- ◯ A General Dentist who has completed a weekend course(s) in Orthodontics
- ◯ A General Dentist who has completed extensive additional courses in Orthodontics
- ◯ A certified specialist Pediatric Dentist
- ◯ A certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case D

31. Which modalities of treatment do you think are indicated for this patient in the ideal situation? (Please indicate the 2 most appropriate choices)

- [ ] Recall (at a later date)
- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign)
- [ ] Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery
- [ ] Uncertain

***32. Which of the following modalities of treatment do you think SHOULD NOT BE UNDERTAKEN by a General dentist? (Please indicate all that apply)**

- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign)
- [ ] Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery

***33. How comfortable would you be with one of your referring dentists treating this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

Thank you for completing this survey and have a great day!

APPENDIX L
Survey 2B (dentists)

Provision of orthodontic care by dentists practicing in Canada and certified

Demographic Section

***1. My gender is?**

- ◯ Male
- ◯ Female

***2. Do you have a full, unrestricted license to practice dentistry in Canada?**

- ◯ Yes
- ◯ No

***3. How many years ago did you graduate from Dental School?**

- ◯ 25 years or more (before 1988)
- ◯ 15 to 24 years (1989 to 1998)
- ◯ 5 to 14 years (1999 to 2008)
- ◯ Less than 5 years (2009 to 2013)

Provision of orthodontic care by dentists practicing in Canada and certified

Demographic section

***4. At which of the following schools were you trained?**

- ◯ Accredited Canadian Dental School
- ◯ Accredited American (USA) Dental School
- ◯ Other, which country

***5. Which of the following represents the population of the town/city in which your primary practice is located?**

- ◯ 0 to 4 999
- ◯ 5 000 to 19 999
- ◯ 20 000 to 49 999
- ◯ 50 000 to 199 999
- ◯ More than 200 000

***6. What is the proximity to the closest orthodontist from your primary practice?**

- ◯ 0 to 19 minutes of driving
- ◯ 20 to 59 minutes of driving
- ◯ 1 to 2 hours of driving
- ◯ 2 to 4 hours of driving
- ◯ More than 4 hours

Provision of orthodontic care by dentists practicing in Canada and certified

Demographic section

7. Which of the following statements describe you the best?

- ◯ General Dentist without extra Orthodontic training since graduation
- ◯ General Dentist having completed some weekend course(s) in Orthodontics since graduation
- ◯ General Dentist having completed extensive courses in Orthodontics since graduation
- ◯ General Dentist full time non-practicing academic

***8. Which modalities of treatment do you provide to your patients? (Please indicate all that apply)**

- ☐ Recall
- ☐ Space maintainers
- ☐ Removable appliance therapy
- ☐ Functional appliance therapy
- ☐ Clear aligners (eg: Invisalign®)
- ☐ Multi-phase treatment (Removable appliance followed by full fixed appliance treatment)
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ☐ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ☐ Combination of orthodontic treatment and Orthognathic surgery
- ☐ None

Provision of orthodontic care by dentists practicing in Canada and certified

Case A

After examination of the provided records for CASE A, please answer the following questions.

***9. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***10. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***11. How comfortable are you diagnosing this orthodontic patient? (1=Very uncomfortable and concerned, 10=Really comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case A

***12. Which modalities of treatment do you think would be most appropriate for the treatment of this patient? (Please select one)**

- ◯ Space maintainers
- ◯ Removable appliance therapy
- ◯ Functional appliance therapy
- ◯ Clear aligners (eg: Invisalign)
- ◯ Multi-phase treatment (Removable appliance followed by full fixed appliance treatment)
- ◯ Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- ◯ Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- ◯ Combination of orthodontic treatment and Orthognathic surgery
- ◯ Uncertain

***13. In your hands, how comfortable would you be providing orthodontic treatment to this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***14. If you were planning to refer this patient, which of the following would you choose? (Please indicate all that apply)**

- ☐ I would not refer this patient – I would treat him/her myself
- ☐ To a Dentist providing orthodontic treatment or with more orthodontic experience than myself
- ☐ To a certified specialist Pediatric Dentist
- ☐ To a certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case B

After examination of the provided records for CASE B, please answer the following questions.

***15. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***16. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***17. How comfortable are you diagnosing this orthodontic patient? (1=Very uncomfortable and concerned, 10=Really comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case B

***18. Which modalities of treatment do you think would be most appropriate for the treatment of this patient? (Please select all that apply)**

- [ ] Recall
- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign®)
- [ ] Multi-phase treatment (Removable appliance followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery
- [ ] None

***19. In your hands, how comfortable would you be providing orthodontic treatment to this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

***20. If you were planning to refer this patient, which of the following would you choose? (Please indicate all that apply)**

- [ ] I would not refer this patient – I would treat him/her myself
- [ ] To a Dentist providing orthodontic treatment or with more orthodontic experience than myself
- [ ] To a certified specialist Pediatric Dentist
- [ ] To a certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case C

After examination of the provided records for CASE C, please answer the following questions.

***21. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***22. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***23. How comfortable are you diagnosing this orthodontic patient? (1=Very uncomfortable and concerned, 10=Really comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case C

***24. Which modalities of treatment do you think would be most appropriate for the treatment of this patient? (Please select all that apply)**

- [ ] Recall
- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign®)
- [ ] Multi-phase treatment (Removable appliance followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery
- [ ] None

***25. In your hands, how comfortable would you be providing orthodontic treatment to this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***26. If you were planning to refer this patient, which of the following would you choose? (Please indicate all that apply)**

- [ ] I would not refer this patient – I would treat him/her myself
- [ ] To a Dentist providing orthodontic treatment or with more orthodontic experience than myself
- [ ] To a certified specialist Pediatric Dentist
- [ ] To a certified specialist Orthodontist

Provision of orthodontic care by dentists practicing in Canada and certified

Case D

After examination of the provided records for CASE D, please answer the following questions.

***27. In your opinion, which of the following do you think will improve the most after completion of orthodontic treatment?**

- ◯ Functionality
- ◯ Esthetics
- ◯ Both (functionality and esthetics)
- ◯ I am not sure

***28. After review of the provided records, how difficult would you rate this case on a scale from 1 to 10 (1 being the easiest, 10 being the most difficult)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

***29. How comfortable are you diagnosing this orthodontic patient? (1=Very uncomfortable and concerned, 10=Really comfortable with no concerns)**

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

Provision of orthodontic care by dentists practicing in Canada and certified

Case D

***30. Which modalities of treatment do you think would be most appropriate for the treatment of this patient? (Please select all that apply)**

- [ ] Recall
- [ ] Space maintainers
- [ ] Removable appliance therapy
- [ ] Functional appliance therapy
- [ ] Clear aligners (eg: Invisalign®)
- [ ] Multi-phase treatment (Removable appliance followed by full fixed appliance treatment)
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) without Extractions
- [ ] Comprehensive orthodontic treatment (full fixed appliance treatment) with Extractions
- [ ] Combination of orthodontic treatment and Orthognathic surgery
- [ ] None

***31. In your hands, how comfortable would you be providing orthodontic treatment to this patient? (1=Very uncomfortable and concerned, 10=Very comfortable with no concerns)**

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

***32. If you were planning to refer this patient, which of the following would you choose? (Please indicate all that apply)**

- [ ] I would not refer this patient – I would treat him/her myself
- [ ] To a Dentist providing orthodontic treatment or with more orthodontic experience than myself
- [ ] To a certified specialist Pediatric Dentist
- [ ] To a certified specialist Orthodontist

APPENDIX M
Patients' records for Survey 2

University of Manitoba Bannatyne Campus Research Ethics Board
Consent Disclosure Statement

On –line Survey Consent Disclosure (Survey 2A and 2B)

"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives" undertaken by the ***University of Manitoba***

Thank-you for accessing the Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives on the internet. This survey will be part of the Masters' thesis of Dr Marc-Olivier Aucoin, 2nd year Orthodontic Resident at the University of Manitoba.

This survey is being conducted *to gather information about the perspective of general dentists and orthodontists practicing in Canada on 4 patient records (Case A, B, C and D). This survey will ask specific questions in regards to the degree of difficulty, diagnosis and treatment modalities*

Your feedback will be collected through an online survey which will ask you a series of questions and should take about **10 minutes** to complete.

Your participation on this online survey is **completely voluntary**. You are not required to provide any personal information such as your name, address or telephone number, and you don't have to answer any questions you don't want to. The survey system will not record your e-mail address or IP (Internet protocol) address.

Incentive prizes will be drawn on June 1st 2014. The draw is on a voluntary basis and will not be linked in any shape or form to your answers on the survey. You will be asked to fill out a voluntary draw ticket by providing your contact informations, the ballots will be kept in a locked box. Once all prizes have been claimed, the remaining ballots will be destroyed by a medical shredding company.

The risks of participating are low. All the **data collected from this survey will be anonymous**.

If you agree to participate in the survey, please note that you **must complete the survey in one sitting** (in other words, the system won't let you save your survey responses and return to complete them later.

Also, please note that when you have submitted your response, you will **not** be able to withdraw them as we are unable to link the survey responses back to you.

Your participation is important to us and will help us provide valuable data that will be part of a Masters' research thesis and eventually published. The idea is to help identify the strengths and weaknesses in the undergraduate orthodontic curriculum across Canada.

If you have any questions about this survey study, please do not hesitate to contact **Dr Marc-Olivier Aucoin** (researcher) at aucoinm@cc.umanitoba.ca or **Dr William W. Wiltshire** (supervisor) at wa_wiltshire@umanitoba.ca

This study has been approved by the University of Manitoba Health Research Ethics Board.

By continuing on and completing the on-line survey you are consenting to participate in the on-line survey.

Case A

Chief Complaint

- "My bottom teeth bite my palate causing bleeding."

Demographic

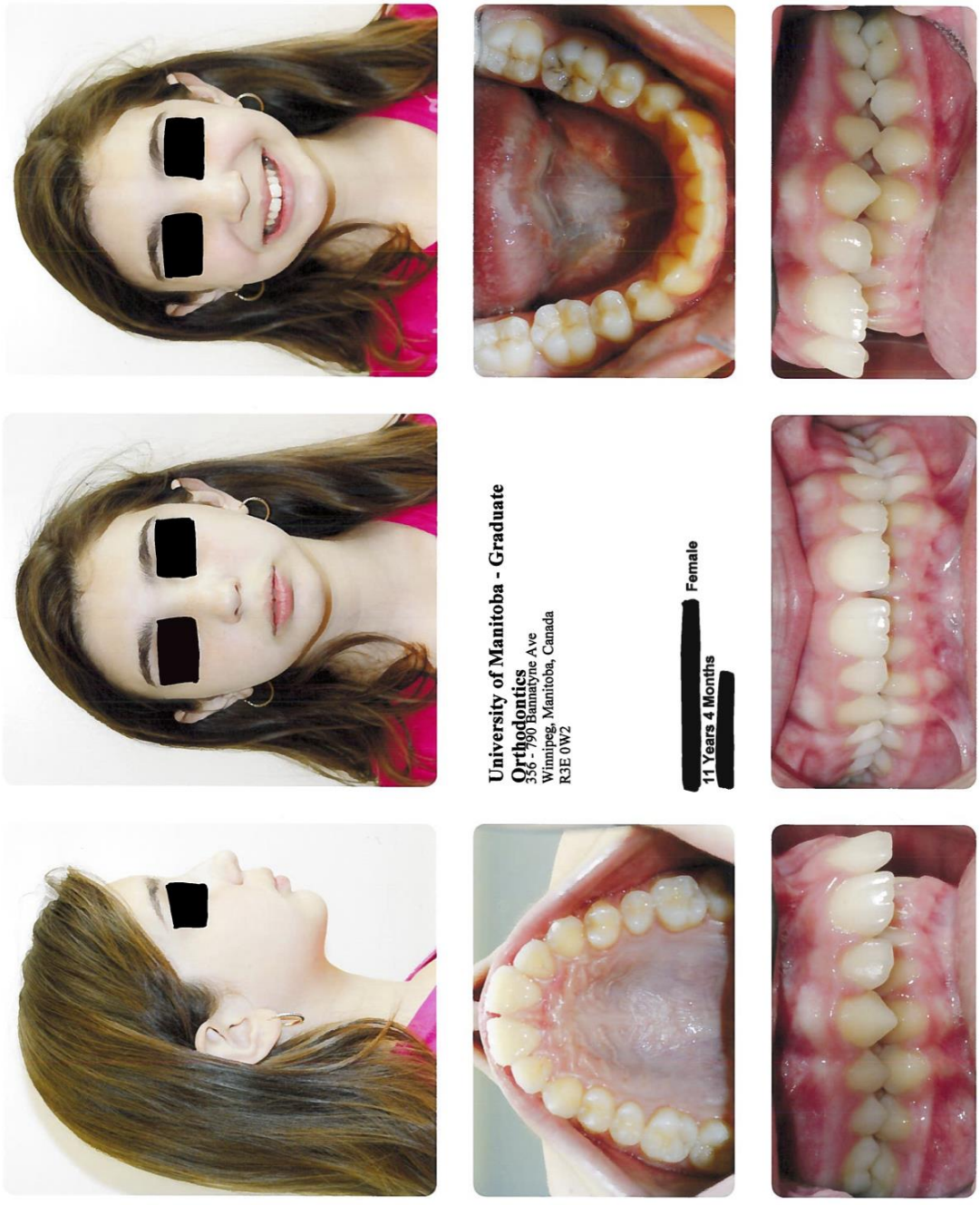
- Female
- 11y 4m at Initial Records

Medical History

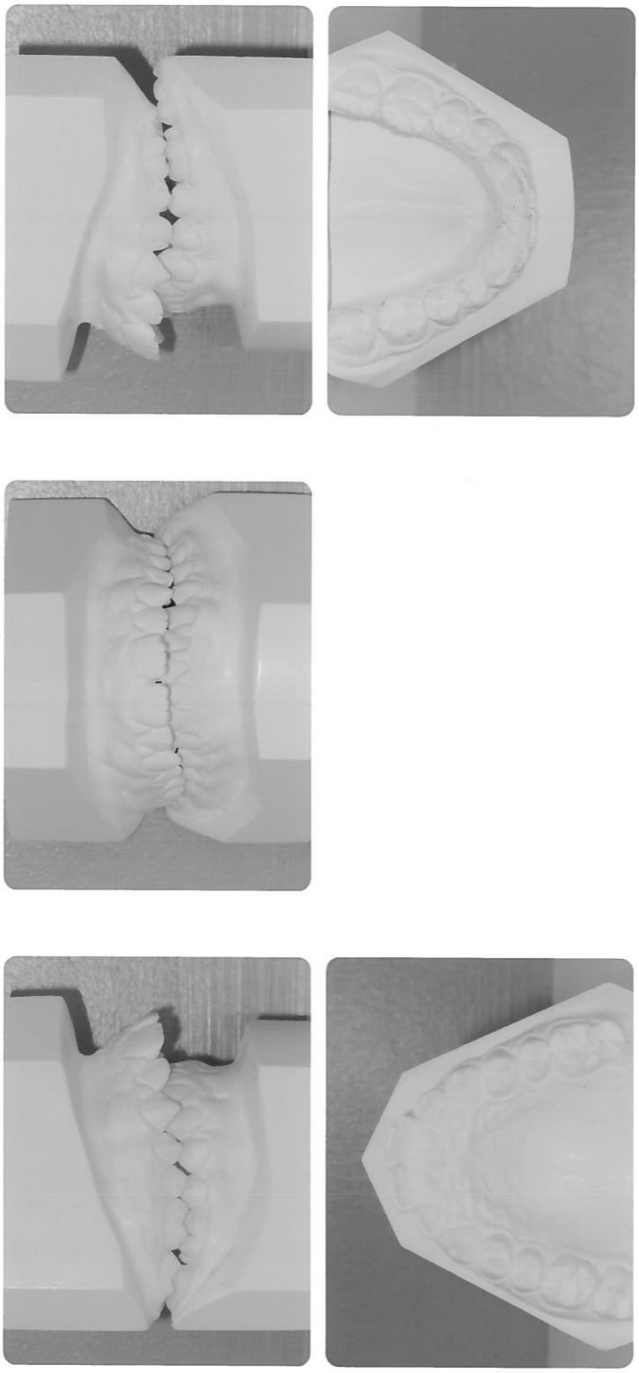
- No significant findings

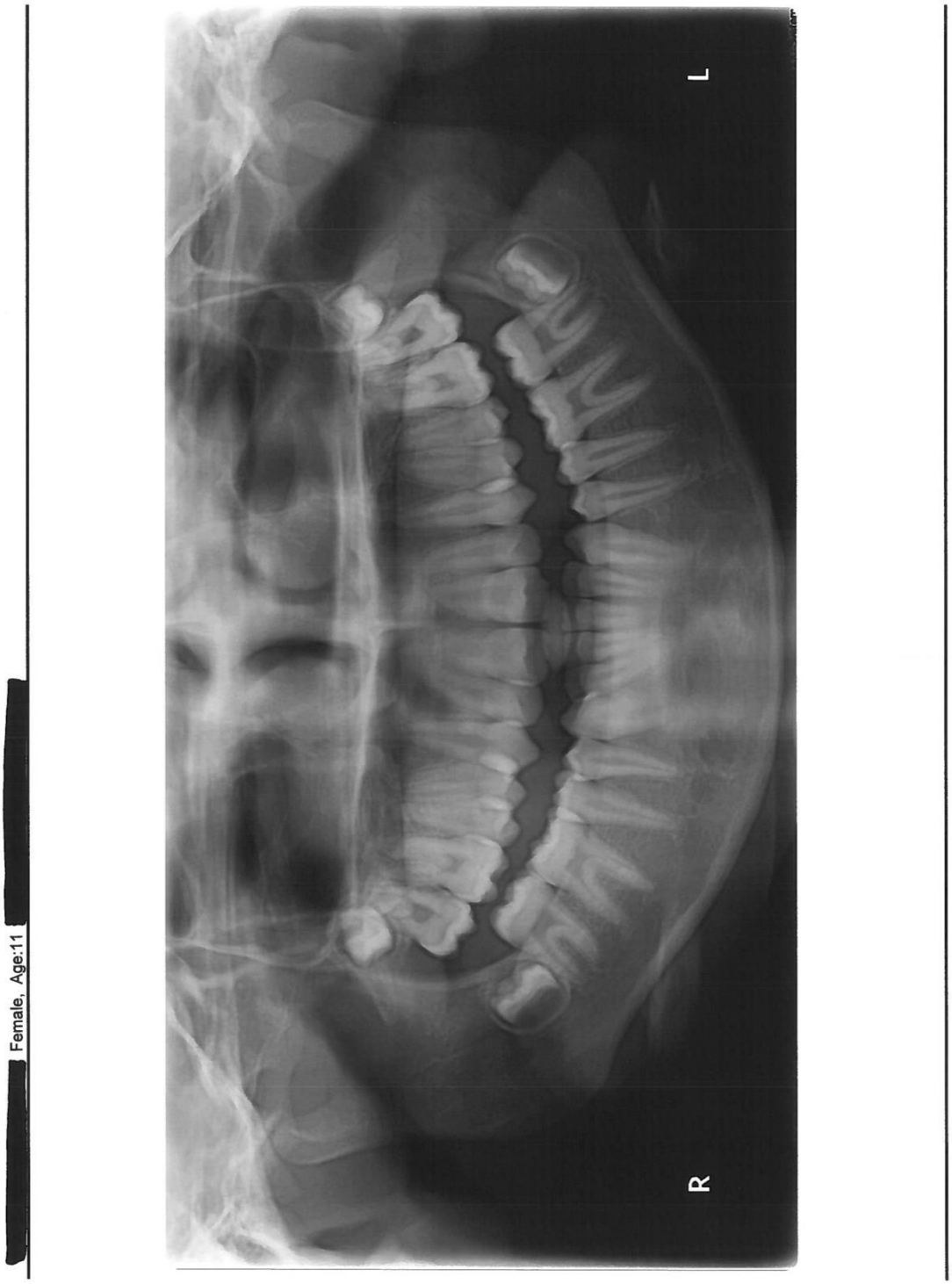
Dental History

- No significant findings


University of Manitoba - Graduate
Orthodontics
336 - 790 Bannatyne Ave
Winnipeg, Manitoba, Canada
R3E 0W2
Female
11 Years 4 Months

[redacted] Female, Age:11 [redacted]

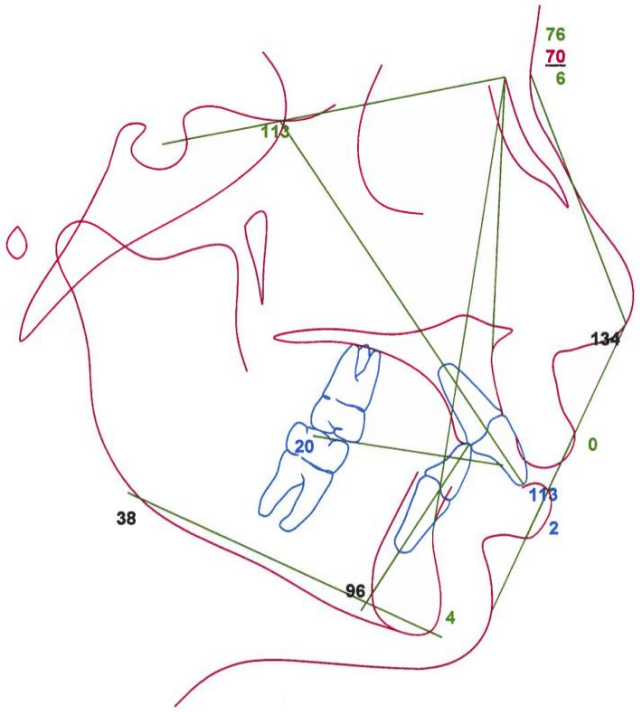



[redacted] Female, Age:11
L
R

[redacted] Female, Age:11 [redacted]

[redacted] Female, Age: 11y 4m [redacted]
[redacted] Analysis: Steiner Norm: N/A

	Value	Norm	Std Dev	Dev Nor	
Interincisal Angle (U1-L1) (°)	113.4	130.0	6.0	-2.8	**
IMPA (L1-MP) (°)	95.7	95.0	7.0	0.1	
ANB (°)	6.3	1.6	1.5	3.2	***
Lower Lip to E-Plane (mm)	2.0	-2.0	2.0	2.0	**
Upper Lip to E-Plane (mm)	0.1	-3.6	2.0	1.8	*
MP - SN (°)	38.1	33.0	6.0	0.8	
SNA (°)	76.4	82.0	3.5	-1.6	*
SNB (°)	70.1	80.9	3.4	-3.2	***
U1 - SN (°)	112.8	102.4	5.5	1.9	*
Occ Plane to SN (°)	19.8	14.4	2.5	2.1	**
L1 - NB (mm)	4.1	4.0	1.8	0.1	
U1 - NA (mm)	6.9	4.3	2.7	1.0	*
U1 - NA (°)	36.4	22.8	5.7	2.4	**
L1 - NB (°)	23.9	25.3	6.0	-0.2	
Pog - NB (mm)	3.5	1.7	1.7	1.1	*
Soft Tissue Convexity (°)	134.1	135.3	4.0	-0.3	
SN - GoGn (°)	35.8	32.0	5.0	0.8	



Case B

Chief Complaint

- "My teeth are crooked."

Demographic

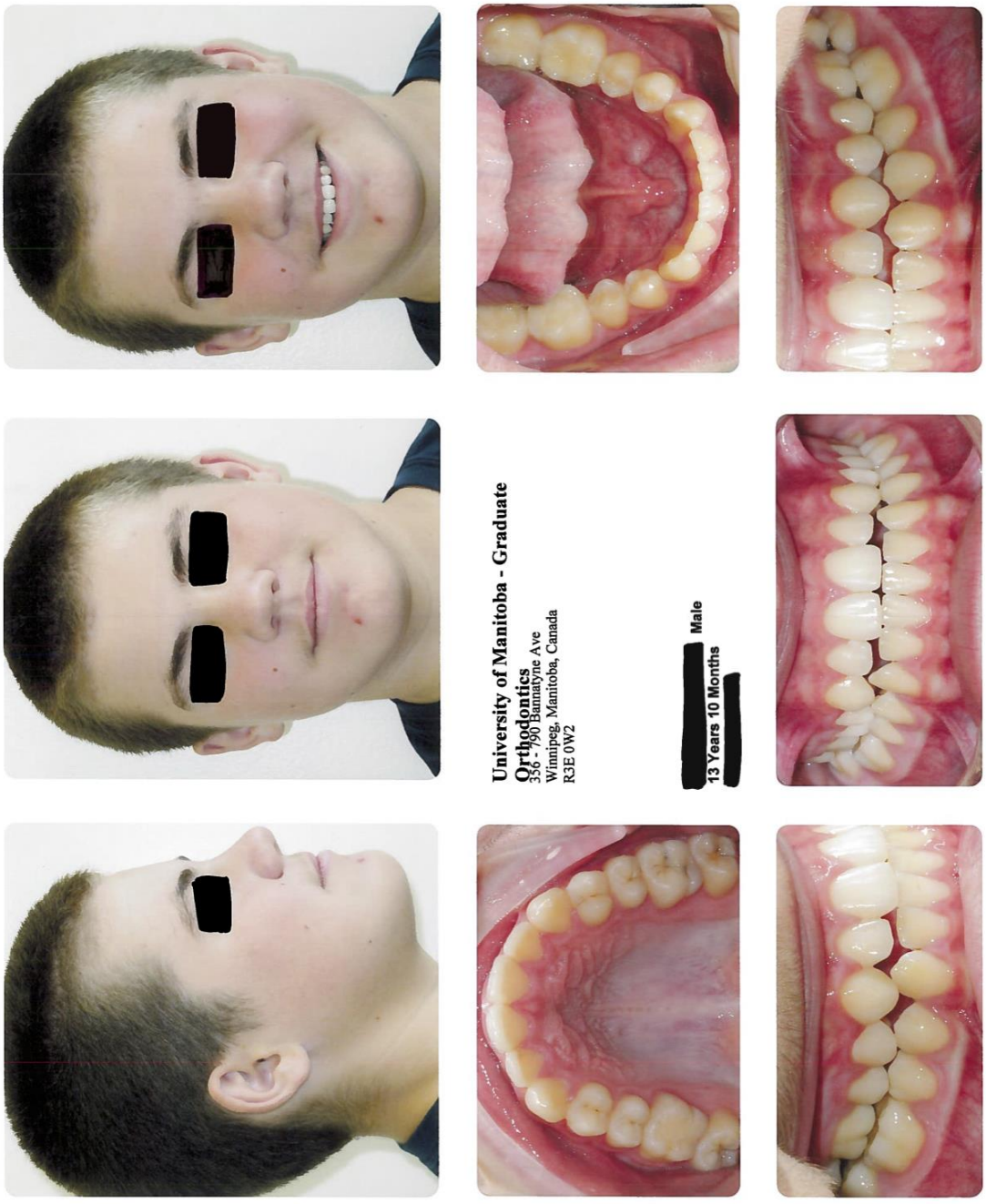
- Male
- 13y 10m at Initial Records

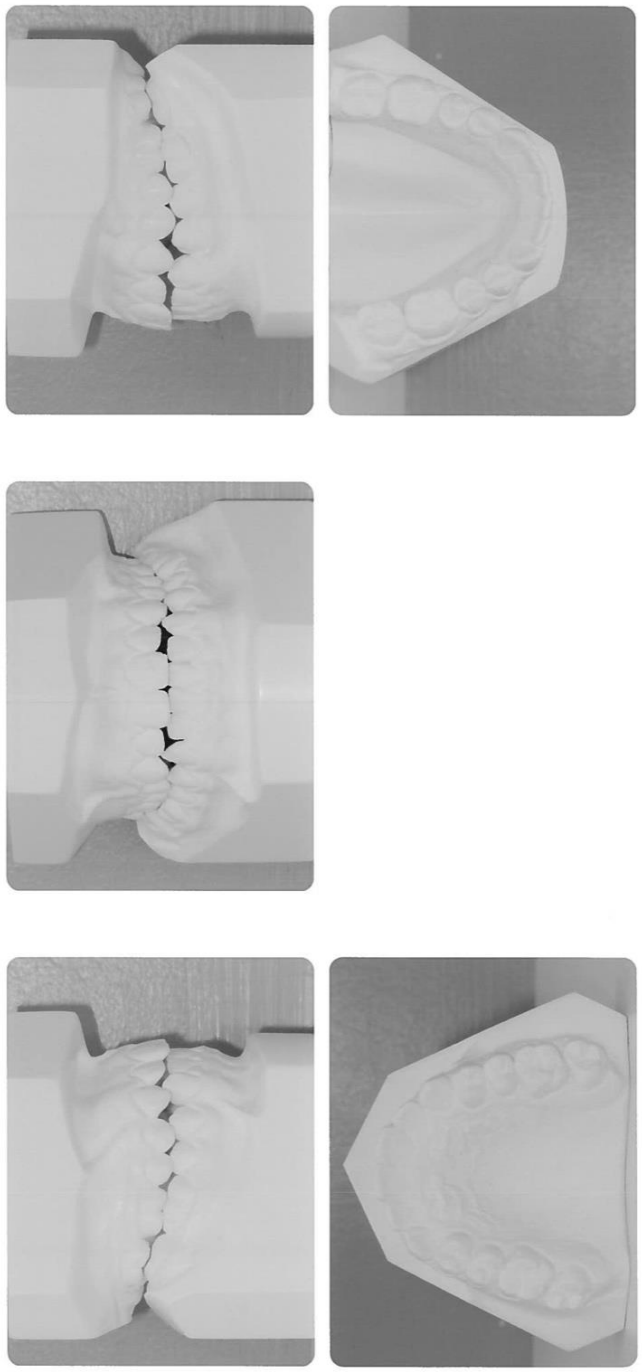
Medical History

- Allergy to Cats
- No significant findings

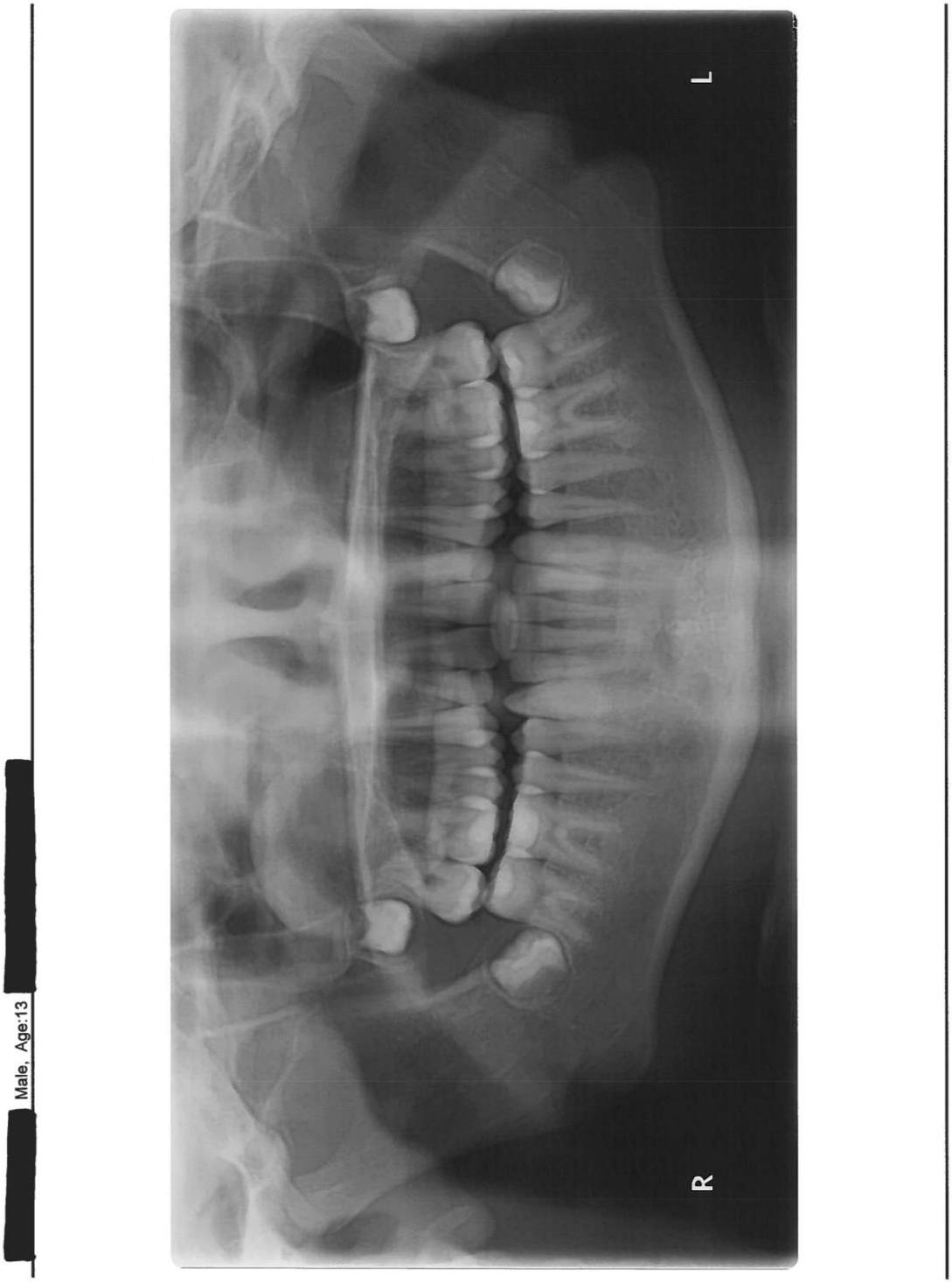
Dental History

- No significant findings


University of Manitoba - Graduate Orthodontics
336 -790 Bannatyne Ave
Winnipeg, Manitoba, Canada
R3E 0W2
[redacted]
Male
13 Years 10 Months



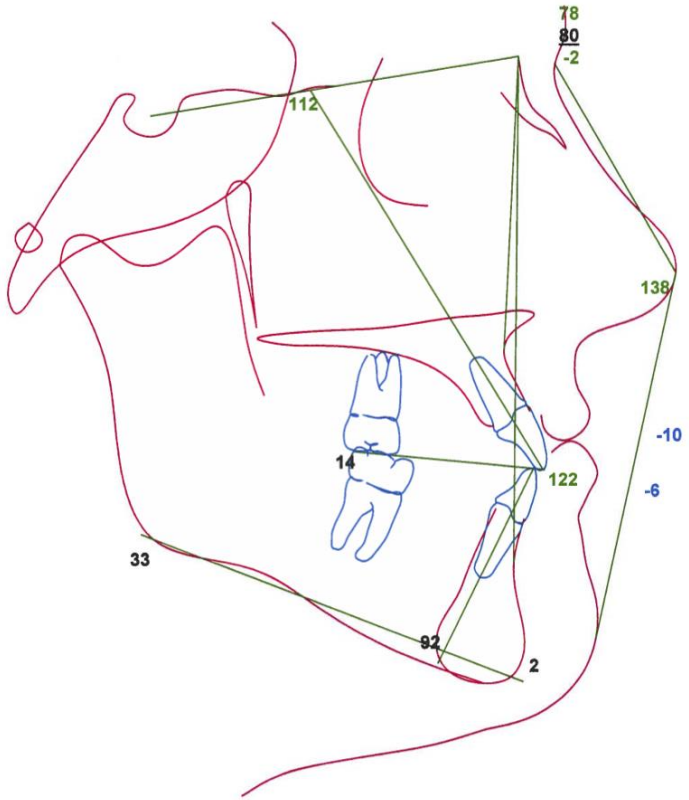
Male, Age:13


[redacted]
Male, Age:13
L
R

[redacted] Male, Age:13 [redacted]

[redacted] Male, Age: 13y 10m [redacted]
[redacted] Analysis: Steiner Norm: N/A

	Value	Norm	Std Dev	Dev Nor	
Interincisal Angle (U1-L1) (°)	122.4	130.0	6.0	-1.3	*
IMPA (L1-MP) (°)	92.3	95.0	7.0	-0.4	
ANB (°)	-2.3	1.6	1.5	-2.6	**
Lower Lip to E-Plane (mm)	-6.3	-2.0	2.0	-2.2	**
Upper Lip to E-Plane (mm)	-10.1	-5.3	2.0	-2.4	**
MP - SN (°)	32.8	33.0	6.0	0.0	
SNA (°)	78.2	82.0	3.5	-1.1	*
SNB (°)	80.4	80.9	3.4	-0.1	
U1 - SN (°)	112.5	102.7	5.5	1.8	*
Occ Plane to SN (°)	14.5	14.4	2.5	0.0	
L1 - NB (mm)	3.5	4.0	1.8	-0.3	
U1 - NA (mm)	8.4	4.3	2.7	1.5	*
U1 - NA (°)	34.3	22.8	5.7	2.0	**
L1 - NB (°)	25.5	25.3	6.0	0.0	
Pog - NB (mm)	2.0	2.2	1.7	-0.1	
Soft Tissue Convexity (°)	137.6	133.3	4.0	1.1	*
SN - GoGn (°)	30.3	32.0	5.0	-0.3	



Case C

Chief Complaint

- "My teeth are crooked (pointing at Upper Lateral incisors and Lower incisors)."

Demographic

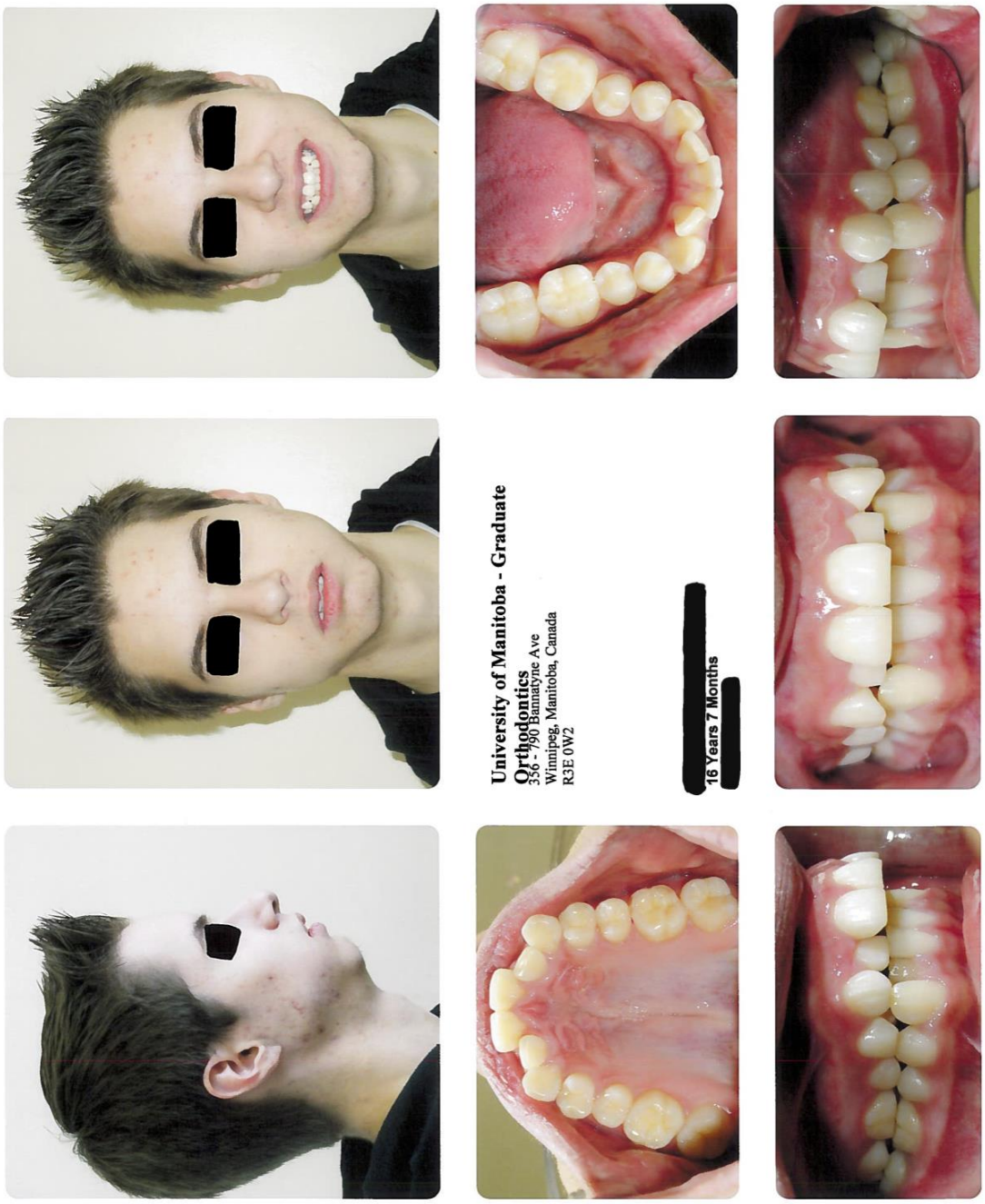
- Male
- 16y 07m at Initial Records

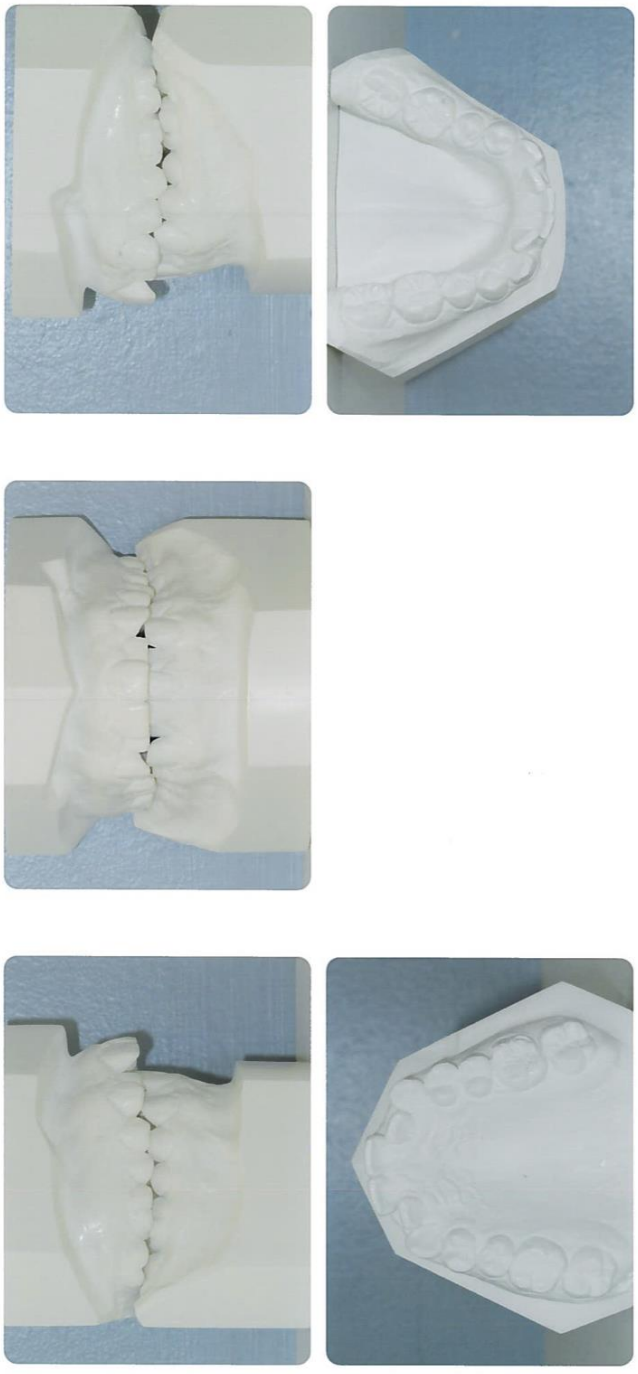
Medical History

- Congenital Heart Defect, medical clearance obtained by cardiologist
- None known drug allergy

Dental History

- No significant findings


University of Manitoba - Graduate
Orthodontics
336 - 790 Bannatyne Ave
Winnipeg, Manitoba, Canada
R3E 0W2
16 Years 7 Months



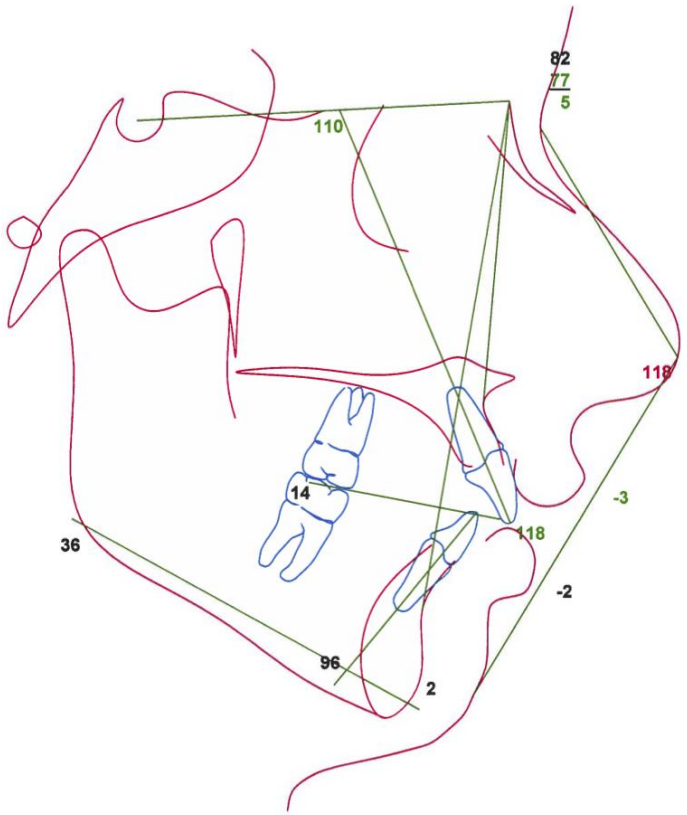
[redacted] Male, Age:16


Male, Age:16
L
R

[redacted] Male, Age:16 [redacted]

[redacted] Male, Age: 16y 7m [redacted]
Analysis: Steiner Norm: N/A

	Value	Norm	Std Dev	Dev Nor	
Interincisal Angle (U1-L1) (°)	118.2	130.0	6.0	-2.0	**
IMPA (L1-MP) (°)	96.5	95.0	7.0	0.2	
ANB (°)	4.8	1.6	1.5	2.1	**
Lower Lip to E-Plane (mm)	-2.1	-2.0	2.0	0.0	
Upper Lip to E-Plane (mm)	-3.2	-7.1	2.0	1.9	*
MP - SN (°)	35.8	33.0	6.0	0.5	
SNA (°)	82.2	82.0	3.5	0.1	
SNB (°)	77.5	80.9	3.4	-1.0	*
U1 - SN (°)	109.6	103.0	5.5	1.2	*
Occ Plane to SN (°)	13.8	14.4	2.5	-0.3	
L1 - NB (mm)	6.9	4.0	1.8	1.6	*
U1 - NA (mm)	6.9	4.3	2.7	1.0	*
U1 - NA (°)	27.3	22.8	5.7	0.8	
L1 - NB (°)	29.7	25.3	6.0	0.7	
Pog - NB (mm)	1.8	2.7	1.7	-0.5	
Soft Tissue Convexity (°)	118.0	131.1	4.0	-3.3	***
SN - GoGn (°)	31.9	32.0	5.0	0.0	



Case D

Chief Complaint

- "My teeth are uneven and crooked."

Demographic

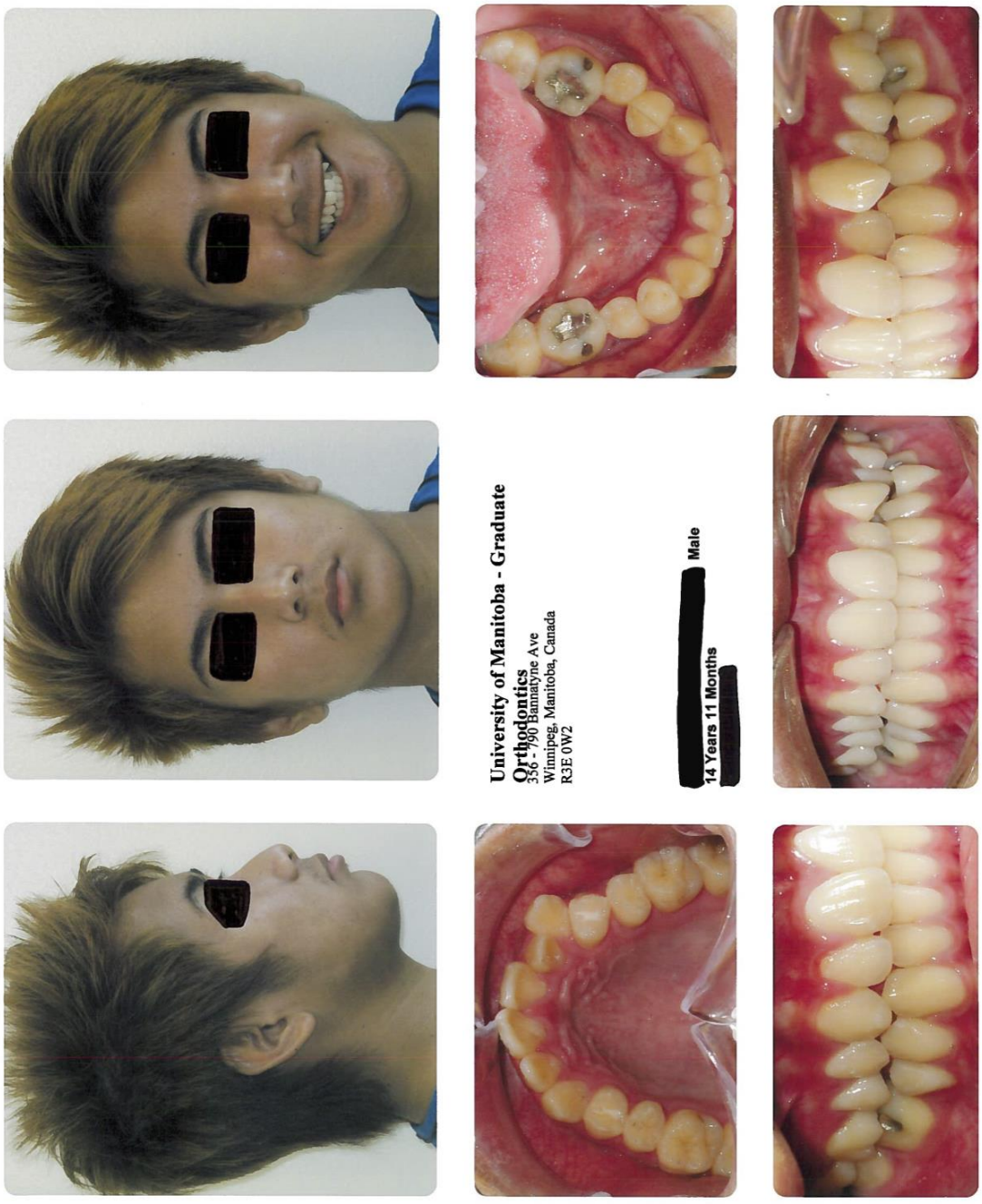
- Male
- 14y 11m at Initial Records

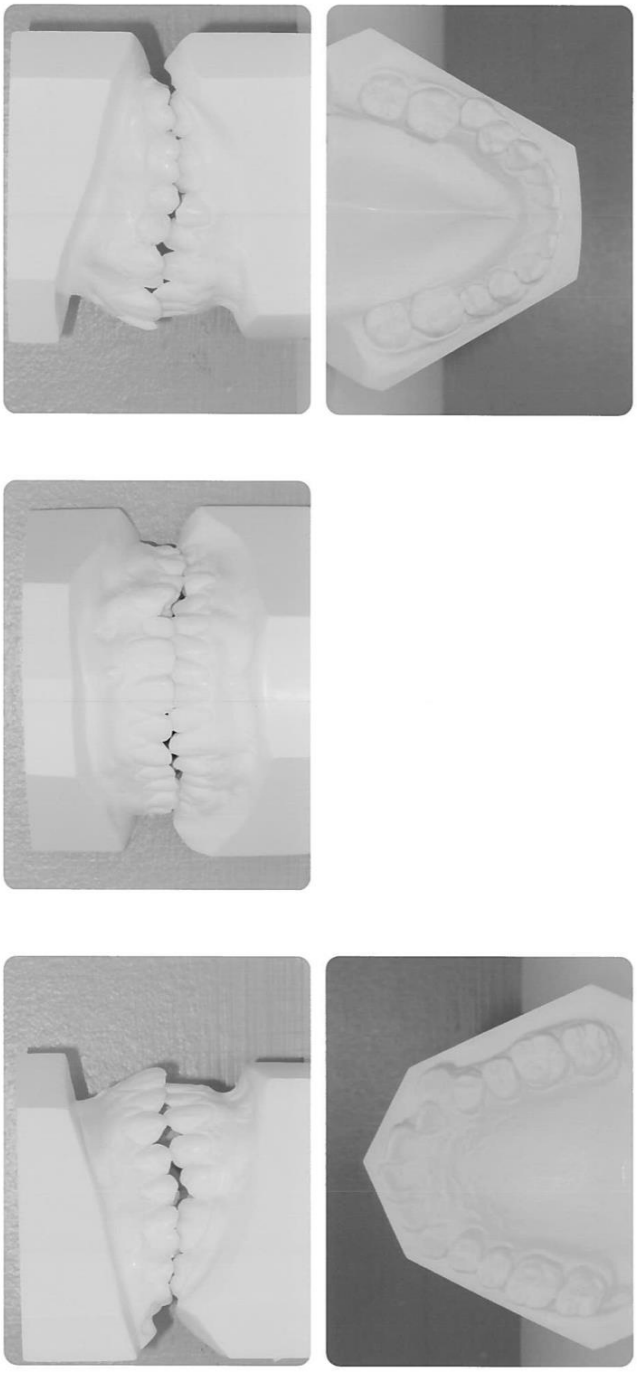
Medical History

- No significant findings

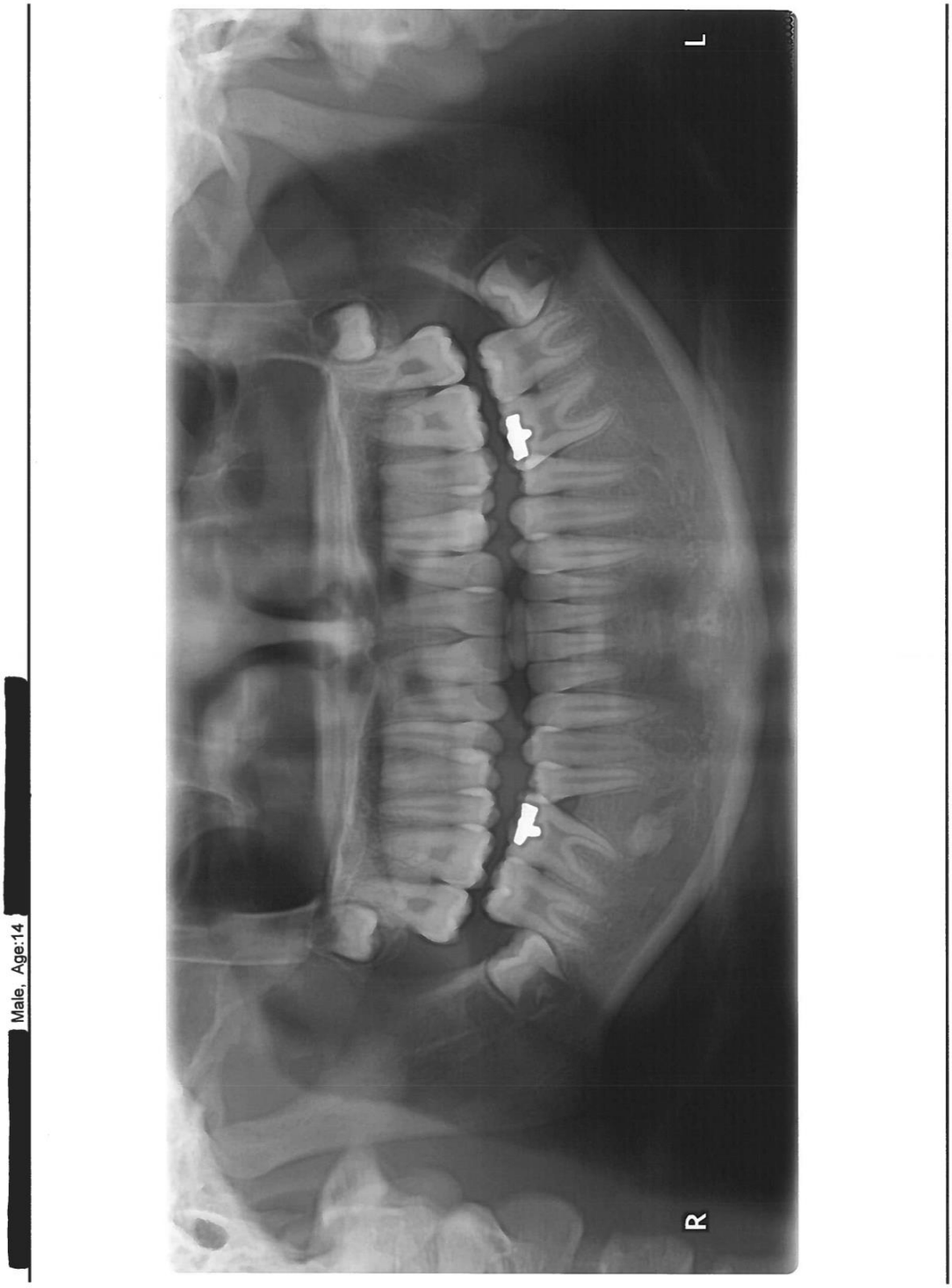
Dental History

- No significant findings


University of Manitoba - Graduate
Orthodontics
336 - 790 Bannatyne Ave
Winnipeg, Manitoba, Canada
R3E 0W2
Male
14 Years 11 Months



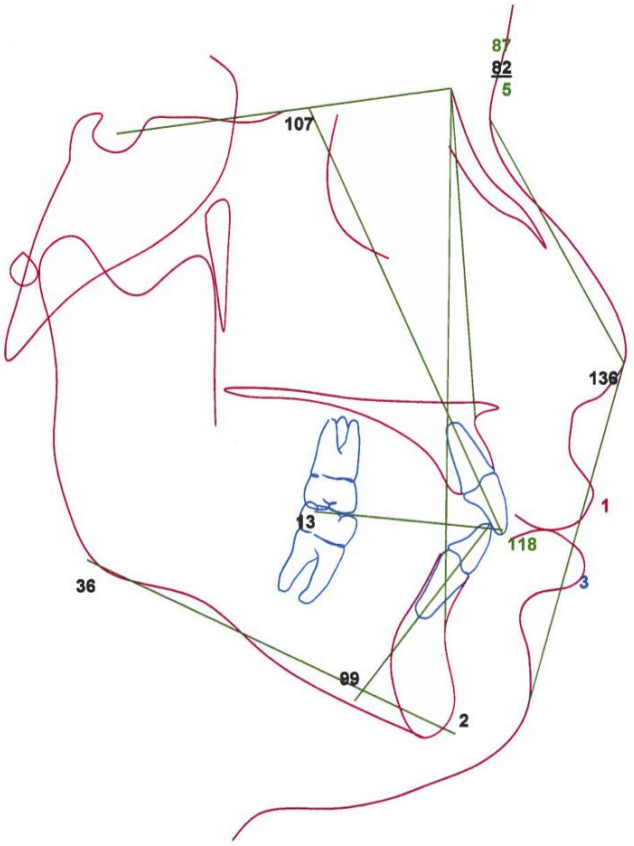
Male, Age:14


Male, Age:14
L
R

[redacted] Male, Age:14 [redacted]

[redacted] Male, Age: 14y 11m [redacted]
[redacted] Analysis: Steiner Norm: N/A

	Value	Norm	Std Dev	Dev Nor	
Interincisal Angle (U1-L1) (°)	118.2	130.0	6.0	-2.0	**
IMPA (L1-MP) (°)	99.3	95.0	7.0	0.6	
ANB (°)	4.8	1.6	1.5	2.2	**
Lower Lip to E-Plane (mm)	3.2	-2.0	2.0	2.6	**
Upper Lip to E-Plane (mm)	1.2	-6.0	2.0	3.6	***
MP - SN (°)	35.6	33.0	6.0	0.4	
SNA (°)	86.7	82.0	3.5	1.3	*
SNB (°)	81.9	80.9	3.4	0.3	
U1 - SN (°)	106.9	102.8	5.5	0.8	
Occ Plane to SN (°)	13.2	14.4	2.5	-0.5	
L1 - NB (mm)	8.2	4.0	1.8	2.3	**
U1 - NA (mm)	3.5	4.3	2.7	-0.3	
U1 - NA (°)	20.2	22.8	5.7	-0.5	
L1 - NB (°)	36.8	25.3	6.0	1.9	*
Pog - NB (mm)	1.8	2.4	1.7	-0.3	
Soft Tissue Convexity (°)	135.6	132.5	4.0	0.8	
SN - GoGn (°)	33.0	32.0	5.0	0.2	



APPENDIX N

Incentive prizes ballots Survey 2 (orthodontists)

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1: Valo Ortho curing light (retail value of $1695), provided by Orthodontic Essentials (OPAL)
- Prize #2: Best Buys' gift card (value of $150), provided by GAC

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ______________________

Address: ____________________

____

Phone: ______________________

Email: ______________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1: Valo Ortho curing light (retail value of $1695), provided by Orthodontic Essentials (OPAL)
- Prize #2: Best Buys' gift card (value of $150), provided by GAC

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ______________________

Address: ____________________

____

Phone: ______________________

Email: ______________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1: Valo Ortho curing light (retail value of $1695), provided by Orthodontic Essentials (OPAL)
- Prize #2: Best Buys' gift card (value of $150), provided by GAC

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ______________________

Address: ____________________

____

Phone: ______________________

Email: ______________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1: Valo Ortho curing light (retail value of $1695), provided by Orthodontic Essentials (OPAL)
- Prize #2: Best Buys' gift card (value of $150), provided by GAC

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ______________________

Address: ____________________

____

Phone: ______________________

Email: ______________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1: Valo Ortho curing light (retail value of $1695), provided by Orthodontic Essentials (OPAL)
- Prize #2: Best Buys' gift card (value of $150), provided by GAC

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ______________________

Address: ____________________

____

Phone: ______________________

Email:

APPENDIX O

Incentive Prizes ballots Survey 2 (dentists)

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1:Ortholux curing light (value of $1200), provided by 3M
- Prize #2: Best Buys' gift card (value of $150), provided by GAC
- Prize #3: Dental Products (retail value of $100), provided by Orthodontic Essentials (OPAL)

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ____________________

Address: ____________________

____

Phone: ____________________

Email: ____________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1:Ortholux curing light (value of $1200), provided by 3M
- Prize #2: Best Buys' gift card (value of $150), provided by GAC
- Prize #3: Dental Products (retail value of $100), provided by Orthodontic Essentials (OPAL)

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ____________________

Address: ____________________

____

Phone: ____________________

Email: ____________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1:Ortholux curing light (value of $1200), provided by 3M
- Prize #2: Best Buys' gift card (value of $150), provided by GAC
- Prize #3: Dental Products (retail value of $100), provided by Orthodontic Essentials (OPAL)

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ____________________

Address: ____________________

____

Phone: ____________________

Email: ____________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1:Ortholux curing light (value of $1200), provided by 3M
- Prize #2: Best Buys' gift card (value of $150), provided by GAC
- Prize #3: Dental Products (retail value of $100), provided by Orthodontic Essentials (OPAL)

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ____________________

Address: ____________________

____

Phone: ____________________

Email: ____________________

SURVEY FOR THESIS – (U OF MANITOBA)

Draw to be held on June 1st 2014. Prizes include:

- Prize #1:Ortholux curing light (value of $1200), provided by 3M
- Prize #2: Best Buys' gift card (value of $150), provided by GAC
- Prize #3: Dental Products (retail value of $100), provided by Orthodontic Essentials (OPAL)

Winners will be contacted via email

ENTER TO WIN!

Thank You!

Name: ____________________

Address: ____________________

____

Phone: ____________________

Email:

APPENDIX P
Sample survey prize winner email

SAMPLE SURVEY PRIZEWINNER EMAIL

Congratulations!

First of all, thank you for taking the time to answer the ***"Provision of orthodontic care by dentists practicing in Canada and certified orthodontists' perspectives"*** survey.

Your email was randomly selected as one of the winners in Survey 1. You have won the following prize:

- $250 prepaid Visa credit card, donation of 3M® Canada.

Please reply to the following email address: aucoinm@cc.umanitoba.ca by June 8th 2014 at 8h00 am (Eastern Time) with your name and mailing address. Once your contact information is received, a conformation email will be sent to you. If your contact information is not received via email by the deadline date, an alternate winner will be drawn.

The prize will be sent via Canada Post to the mailing address provided.

Thanks again and congratulations!

Marc-Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba

APPENDIX Q

Answer key – Thesis survey –Validity testing

Answer key - Thesis survey - Validity testing

Orthodontist	I.D.	1st answer link	Date response #1	2nd answer link	Date response #2
_____	O1	www.surveymonkey.com/s/thesis_o1-1	_____	www.surveymonkey.com/s/thesis_o1-2	_____
_____	O2	www.surveymonkey.com/s/thesis_o2-1	_____	www.surveymonkey.com/s/thesis_o2-2	_____
_____	O3	www.surveymonkey.com/s/thesis_o3-1	_____	www.surveymonkey.com/s/thesis_o3-2	_____
_____	O4	www.surveymonkey.com/s/thesis_o4-1	_____	www.surveymonkey.com/s/thesis_o4-2	_____
_____	O5	www.surveymonkey.com/s/thesis_o5-1	_____	www.surveymonkey.com/s/thesis_o5-2	_____
_____	O6	www.surveymonkey.com/s/thesis_o6-1	_____	www.surveymonkey.com/s/thesis_o6-2	_____
_____	O7	www.surveymonkey.com/s/thesis_o7-1	_____	www.surveymonkey.com/s/thesis_o7-2	_____
_____	O8	www.surveymonkey.com/s/thesis_o8-1	_____	www.surveymonkey.com/s/thesis_o8-2	_____
_____	O9	www.surveymonkey.com/s/thesis_o9-1	_____	www.surveymonkey.com/s/thesis_o9-2	_____
_____	O10	www.surveymonkey.com/s/thesis_o10-1	_____	www.surveymonkey.com/s/thesis_o10-2	_____

General Dentist	I.D.	1st answer link	Date response #1	2nd answer link	Date response #2
_____	D1	www.surveymonkey.com/s/thesis_d1-1	_____	www.surveymonkey.com/s/thesis_d1-2	_____
_____	D2	www.surveymonkey.com/s/thesis_d2-1	_____	www.surveymonkey.com/s/thesis_d2-2	_____
_____	D3	www.surveymonkey.com/s/thesis_d3-1	_____	www.surveymonkey.com/s/thesis_d3-2	_____
_____	D4	www.surveymonkey.com/s/thesis_d4-1	_____	www.surveymonkey.com/s/thesis_d4-2	_____
_____	D5	www.surveymonkey.com/s/thesis_d5-1	_____	www.surveymonkey.com/s/thesis_d5-2	_____
_____	D6	www.surveymonkey.com/s/thesis_d6-1	_____	www.surveymonkey.com/s/thesis_d6-2	_____
_____	D7	www.surveymonkey.com/s/thesis_d7-1	_____	www.surveymonkey.com/s/thesis_d7-2	_____
_____	D8	www.surveymonkey.com/s/thesis_d8-1	_____	www.surveymonkey.com/s/thesis_d8-2	_____
_____	D9	www.surveymonkey.com/s/thesis_d9-1	_____	www.surveymonkey.com/s/thesis_d9-2	_____
_____	D10	www.surveymonkey.com/s/thesis_d10-1	_____	www.surveymonkey.com/s/thesis_d10-2	_____

APPENDIX R

Table 6: Frequencies of the level of difficulty for Case A, B, C and D

Table 5: Frequencies of the level of difficulty for each cases

	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey 2B Dentists
Case difficulty	Case A		Case B		Case C		Case D	
1 (easiest)	0	0	0	1	0	7	0	2
2	0	0	2	0	0	11	4	2
3	3	2	0	4	0	7	6	6
4	3	6	1	9	1	8	11	14
5	11	17	5	5	6	12	11	14
6	9	11	4	6	4	3	14	13
7	22	23	13	10	16	12	12	15
8	18	18	22	27	24	13	8	12
9	3	5	15	14	12	6	4	3
10 (hardest)	1	1	8	7	7	4	0	2

APPENDIX S

Table 7: Frequencies of treatment modalities for Case A, B, C and D

Table 6: Frequencies of the treatment modalities for Case A, B, C, D

	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey 2B Dentists	Survey 2A Orthodontists	Survey Dentis
Treatment modalities	**Case A***		**Case B**		**Case C**		**Case D**	
Recall (at later date)	2	N/A	26	12	2	14	1	13
Space maintainers	0	0	0	3	0	4	0	4
Removable appliance therapy	0	1	0	5	0	5	1	7
Functional appliance therapy	21	6	2	7	3	3	0	2
Clear aligners (eg: Invisalign)	1	0	3	1	0	3	17	3
Multi-phase treatment (Removable appliances followed by full fixed appliance treatment)	14	17	5	14	3	5	2	7
Comprehensive orthodontic treatment (full fixed appliance treatment) **without extractions**	32	17	38	27	5	27	53	47
Comprehensive orthodontic treatment (full fixed appliance treatment) **with extractions**	18	21	9	8	44	24	38	22
Combination of orthodontic treatment and Orthognathic surgery	27	17	41	31	63	27	3	2
Uncertain (Orthodontists) or None (Dentists)	0	4	2	2	0	3	2	3

*The "Recall" option was not available for dentists (2B) in Case A and the dentists were only allow to chose 1 treatment modality for Case A compared to all that apply for the remaining cases.

APPENDIX T
Manuscript (Provision of Orthodontic Care by General Dentists in Canada)

Provision of Orthodontic Care by General Dentists in Canada

Marc Olivier Aucoin, DMD[1]
William A. Wiltshire BChD (Hons), MDent, MChD, DSc, FACD, FRCD(C)[2]
Frank J. Hechter DMD, MSc, Med, PhD[3]
Mark G. Torchia, MSc, PhD[4]

1. Orthodontic Resident, Division of Orthodontics, Department of Preventive Dental Sciences, University of Manitoba, Winnipeg, Manitoba, Canada
2. Professor and Head of Orthodontics and Head of the Department of Preventive Dental Sciences, University of Manitoba, Winnipeg, Manitoba, Canada.
3. Part-time Professor, Division of Orthodontics, Department of Preventive Dental Sciences, University of Manitoba, Winnipeg, Manitoba, Canada
4. Associate Professor of Surgery, Faculty of Medicine; Director of the Centre for the Advancement of Teaching and Learning, University of Manitoba, Manitoba, Canada.

Word count:

- Content (background to end of discussion): 1 751 words
- Full manuscript: 3 096 words

Corresponding Address:
Marc Olivier Aucoin, DMD
C/O William A. Wiltshire
[redacted]

Dental supply companies' (3M®, Dentsply GAC® and American Orthodontics®) donations were used as incentives prizes for the survey respondents.

Abstract

Introduction: In order to obtain perspectives of Canadian dentists on the quality of undergraduate education in orthodontics, and the extent of orthodontic services provided, a descriptive survey was constructed.
Methods: An anonymous, web-based survey was created using Survey Monkey® (Palo Alto, USA), and was distributed to registered dentists in Canada via links in newsletters and mass emails.
Results: There were 427 respondents. Based on the results, 71% (n=261/368) of dentists provided some orthodontic treatment, and 33% of them offered only space maintainer services. A total of 23% treated most of their patients requiring interceptive treatment, compared to 15% of whom treated most of their patients requiring comprehensive treatment. A distance of 1 to 4+ hours from the closest orthodontist resulted in a 16% increase in the provision of orthodontic treatment by the general dentists. The quality of the undergraduate orthodontic education was deemed above average on various statements by 21.4% to 50.5% of the respondents. The lowest ratings obtained were for the provision of orthodontic treatment in the mixed and permanent dentitions.
Conclusions: The percentage of dentists providing orthodontic services to their patients was similar to the 76% reported in the USA. A driving time of more than 1 hour to a certified orthodontist seemed to be a determining factor in the provision of orthodontic treatment by Canadian general dentists. While the quality of orthodontic education provided has improved when compared to 25-year old Canadian data, some amelioration in the undergraduate orthodontic curriculum may be beneficial.

Introduction

Provision of orthodontic services
Historically, several scientific publications (1-5) discussed various aspects of the field of orthodontics, such as the type of treatment offered and the quality of the orthodontic education in dental schools. These studies reported that between 66% (4) to 76% (5) of general dentists provided some sort of orthodontic treatment to their patients. Similar studies have been reported from Australia (6-8), South Africa (9) and the United Kingdom (10, 11). A recent study (12) reported a decline in the provision of orthodontic treatment by dentists in New Zealand. This declining trend was not noted in a recent pan-USA study (13). In Canada, Konchak and McDermot (1990) (3) reported that 23% of Canadian dentists provided various levels of full fixed orthodontics, compared with 65% of whom provided interceptive treatment.

Distance to the nearest orthodontist
Galbreath et al. (13) suggested that the distance between the general practitioners and the nearest orthodontist, as well as the undergraduate orthodontic education received, were factors that had an impact on the provision of orthodontic treatment. Interestingly, the proximity to an orthodontist's office has been a subject of controversy in the scientific literature. Huang et al. (14) reported that, although not statistically significant, the number of orthodontic claims by general dentists were lower in areas where orthodontists

were present. Lawrence et al. (7) identified differences between suburban and urban neighborhoods. However, Wolsky and McNamara (5), as well as Jacobs et al. (4), stated that distance was not an influencing factor. To date, there are no Canadian data available on this topic.

Undergraduate Education

Over 35 years ago, Graber (15) reported concerns regarding the quality of the orthodontic education offered in dental schools. Moyers (1990) (16) stated that new graduates had less knowledge and competence in the field of orthodontics than in any other clinical field. Bentele et al. (2002) (17) reported that the situation had not improved over time, and that dental school education did not sufficiently prepare dentists to diagnose malocclusion. Galbreath et al. (13) reported that orthodontic training was similar in most dental schools, and that if the education provided were more thorough, general practitioners would have a better appreciation of the intricacies of orthodontic treatment.

In the late 1980s, more than half (58.3%) of Canadian dentists rated their dental school education as "Fair" in terms of providing basic orthodontic principles, and 80.4% rated it as "Poor" with regard to providing orthodontic care (3). Has the situation remained the same over the last 25 years, or has it improved? Taking into consideration the success of interceptive treatment in a Canadian undergraduate orthodontic dental school clinic (18), and the high need for interceptive orthodontic treatment in underserviced Canadian populations (19), is the current undergraduate orthodontic curriculum accurately targeting the needs of the Canadian population where many patients may derive benefit from the provision of interceptive orthodontic treatment by general dentists?

Materials and Methods

Ethics approval was obtained, in order to investigate the perceptions of Canadian dentists regarding the nature of orthodontic services offered to their patients, the proximity to orthodontic specialists and dentists' impressions on the quality of the orthodontic education received in dental school. An anonymous, web-based survey was created and hosted using Survey Monkey® (Palo Alto, USA). The questions were primarily of a descriptive nature, and required the respondents to select statements or to rank various orthodontic-related topics using a Likert scale. Respondents were required to have an active, unrestricted license to practise dentistry in Canada.

The survey was distributed online from October 21, 2013, to April 21, 2014, via links in newsletters and mass emails including: CDA *Oasis Discussions*, distribution lists of Canadian dental faculties and dental associations, dental societies (in the provinces of Québec, Manitoba, Ontario and Alberta) and via a dental supplier's electronic newsletter (3M®). To encourage responses, incentive prizes were offered, which included donations from three dental supply companies (3M®, Dentsply GAC® and AO®).

The data was compiled using Survey Monkey® software, and exported to Microsoft Excel® version 14.4.5 and SASS® software version 9.3. The results were analyzed using descriptive statistics and Chi-Square tests.

Results

Demographics

A total of 427 dentists responded to the questionnaire, with a 74% completion rate. Table 1 illustrates the demographics of the respondents. 60% were male and 40% female. With respect to the number of years of experience, the sample included a higher proportion in > 25 years group and the 5 to 14 years group. The vast majority (92%) of respondents were graduates from an accredited Canadian dental school.

Provision of orthodontic services

Orthodontic services were offered to patients by 71% (n=368) of dentists. Space maintenance was offered by 33% of respondents and 23% reported treating most of their patients requiring interceptive orthodontic treatment (Figure 1), compared to 15% who reported treating most of their patients requiring comprehensive/full fixed orthodontic treatments (Figure 2).

Distance from the nearest orthodontist

The vast majority of the respondents practised in close proximity to an orthodontist (Table 2). It is important to note that due to the small sample size, some groups were merged to form the 1 to 4+ hours of driving group. Table 3 illustrates the results, which included the provision of interceptive and/or comprehensive orthodontic treatment. Driving time of greater than 1 hour seemed to be a determining factor, and resulted in a 16% increase in the provision of orthodontic services by general dentists.

Opinions on the quality of the dental education

Dental school education was rated as "Inadequate" or "Weak" by 48% to 50% of the respondents, with regard to providing orthodontic treatment in the mixed and permanent dentitions. The respondents indicated that they were better prepared to diagnose than to treatment plan or provide treatment (Figure 3). 50% of the respondents indicated that they had attended short or weekend Continuing Education (CE) course relating to the field of orthodontics since graduation.

Discussion

Response rate

The 427 respondents represented 1.5% of Canadian dentists at the time of the survey. There was a total of 20,616 fully licensed dentists in Canada at the end of June 2013 (de Savigny, 2013) (20). The completion rate of 74% is similar to previous studies (2, 3, 7, 9, 12, 13) conducted through a mail-in format. Due to the mode of distribution selected, it is impossible to determine the specific number of dentists who encountered the survey links. The low number of respondents may be explained by the fact that practitioners receive multiple survey requests on a weekly basis, and are reluctant to respond or might simply not wish to invest the time to complete the survey.

Demographics

The percentage of female respondents was higher than the 28% of female dentists in Canada (Canadian Dental Association (CDA), 2009) (20). This is consistent with the trend noted in 2009, of an increasing number of females entering the dental profession. The higher proportion of dentists in the > 25 years and 5 to 14 years of experience groups, might be explained by work schedules of the respondents. For example, younger and older practising dentists might have a lighter schedule, allowing them more time to complete surveys. It is interesting to note that Aldawood et al. (12) reported a higher proportion of orthodontic providers amongst the more experienced practitioners, and Koroluk et al. (2) reported that younger dentists were performing more orthodontics services.

Provision of orthodontic services

The data obtained for the provision of orthodontic services by Canadian dentists (71%) is consistent with the 66% to 76% reported in American studies in the 1990s (4, 5). The recent decline reported in New Zealand (12) is not supported by the Canadian data. A total of 33% of respondents provide only space maintenance, which has often been included as part of interceptive treatment in other studies, making it difficult to definitely compare this result. The data indicate a potential decrease in the provision of interceptive treatment, with 23% compared to the 65% previously reported by Konchak and McDermot (1990). The same scenario is present for the provision of comprehensive/full fixed orthodontic treatment with a decrease from 23%(3) to 15%. It is important to note that this survey focused only on general dentists, who treat most of their patients requiring interceptive or comprehensive treatments; this was not common in other studies. It is likely that some dentists do not treat all patients with these treatment modalities, which would explain the variation in percentages over the last 25 years. Finally, the discrepancy in the results obtained when comparing the 71% of dentists offering some orthodontic treatments, versus the 23% and 15%, respectively, offering interceptive and comprehensive treatment suggests that general dentists undertake some sort of case selection process or utilized other treatment modalities, such as clear aligners.

Distance from the nearest orthodontist

Driving time of more than 1 hour to an orthodontist's office resulted in a 16% increase in the provision of interceptive and comprehensive orthodontic treatment by Canadian general dentists. This is in agreement with Australian and New Zealand studies. The decision by general dentists to provide orthodontic treatment may be motivated by the knowledge/perception that the patients may not otherwise receive treatment, or they may succumb to pressure from their patients/parents who want to save travel costs related to treatment by a specialist.

Opinions on the quality of undergraduate orthodontic education
The results indicated greater satisfaction with undergraduate orthodontic education in Canada than previously reported (3), with 21.4% to 50.5% of respondents indicating that the quality of the education received was above "Average". However, while these numbers are encouraging, only 11% and 16% selected "Excellent" for diagnosis.

Overall, the data suggested that general dentists felt their education was better in terms of diagnosis in orthodontics, as compared to treatment planning or providing treatment. The highest incidences of "Inadequate" were for treating patients in the mixed (16%) and permanent (21%) dentitions, which is an improvement when compared to the 80% "Poor" rating obtained by Konchak and McDermot (1990).With almost 50% of respondents feeling that their dental education was not sufficient for them to confidently provide treatment, it is interesting to note that 50% of the respondents did not attend any orthodontic-related CE courses since their graduation from dental school.

Being aware that 48% of the general dentists felt that their undergraduate education was "Inadequate" or "Weak" in terms of treating in the mixed dentition, and that interceptive treatment is greatly needed and highly beneficial in underserviced Canadian populations, it can be assumed that the undergraduate orthodontics curriculum should have an increased focus on and provide better knowledge in this aspect of orthodontics.

Conclusions

- The number of dentists providing orthodontic services to their patients has remained steady and the recent decline in New Zealand is not supported by the current study.
- 33% of the general dentists provide only space maintenance appliances, but 23% address the majority of the interceptive needs of their patients. This is a decline compared to 65% reported in Canada 25 years ago.
- A decrease in the provision of comprehensive/fixed treatment with only 15% of general dentists providing this type of treatment, as compared to 23% previously reported(3).
- A change in the treatment modalities offered by general dentists, which might be linked to the increasing availability and popularity of clear aligner therapy.
- A driving time of > 1 hour to the closest orthodontist showed a 16% increase in the provision of orthodontic treatment by the general dentists.
- The perception of the quality of undergraduate orthodontic education has improved.
- General dentists felt that their undergraduate education was better in the diagnostic aspects of orthodontics, in comparison to treatment planning or providing treatment.
- The undergraduate education offered in the field of orthodontics did not appear to resolve the need for interceptive treatment reported in underserviced Canadian populations.

References

1. Williams RL. Your future in orthodontics—Manpower. Am J Orthod. 1977 9;72(3):315-20.

2. Koroluk LD, Jones JE, Avery DR. Analysis of orthodontic treatment by pediatric dentists and general practitioners in Indiana. ASDC J Dent Child. 1988;55(2):97-101.

3. Konchak PA, McDermott RE. Orthodontic education and practice in Canada: Perceptions of the profession as shown in a recent survey. J Can Dent Assoc. 1990 Jun;56(6):537-9.

4. Jacobs RM, Bishara SE, Jakobsen JR. Profiling providers of orthodontic services in general dental practice. AJODO 1991;99(3):269-75.

5. Wolsky SL, McNamara, Jr. JA. Orthodontic services provided by general dentists. Am J Orthod Dentofacial Orthop 1996 Aug;110(2):211-7.

6. Spencer AJ, Lewis JM. Service-mix in general dental practice in Australia. Aust Dent J. 1989;34(1):69-74.

7. Lawrence AJ, Wright FA, D'Adamo SP. The provision of orthodontic services by general dental practitioners. 2. factors influencing variation in service provision. Aust Dent J. 1995 Dec;40(6):360-4.

8. Allister JH, Spencer AJ, Brennan DS. Provision of orthodontic care to adolescents in South Australia: The type, the provider, and the place of treatment. Aust Dent J. 1996;41(6):405-10.

9. de Muelenaere JJ, Wiltshire WA. Orthodontic treatment in general dental practice in South Africa. J Dent Assoc S Afr. 1990 Dec;45(12):529-33.

10. Gravely JF. Who should practise orthodontics? J Orthodontics. 1989;16(4):235-41.

11. Richmond S, Shaw WC, Stephens CD. Orthodontics in the general dental services of England and Wales: The provision of treatment. Br Dent J. 1992;172(4):150-2.

12. Aldawood S, Ampuan SN, Medara N, Thomson WM. Orthodontic treatment provision and referral preferences among New Zealand general dental practitioners. Aust Orthod J. 2011 Nov;27(2):145-54.

13. Galbreath RN, Hilgers KK, Silveira AM, Scheetz JP. Orthodontic treatment provided by general dentists who have achieved master's level in the academy of general dentistry. Am J Orthod Dentofacial Orthop. 2006;129(5):678-86.

14. Huang GJ, Marston BE, del Aguila MA. Orthodontic care in an insured population in Washington: Demographic factors. Am J Orthod Dentofacial Orthop. 2004;125(6):741-6.

15. Graber TM. Count-down for dental student orthodontic education. J Dent Ed. 1967;31(2):128-37.

16. Moyers RE. Quality assurance in orthodontics. Am J Orthod Dentofacial Orthop. 1990 1;97(1):3-9.

17. Bentele MJ, Vig KW, Shanker S, Beck FM. Efficacy of training dental students in the index of orthodontic treatment need. Am J Orthod Dentofacial Orthop. 2002;122(5):456-62.

18. Bernas AJ, Banting DW, Short LL. Effectiveness of phase I orthodontic treatment in an undergraduate teaching clinic. J Dent Ed. 2007;71(9):1179-86.

19. Karaiskos N, Wiltshire WA, Odlum O, Brothwell D, Hassard TH. Preventive and interceptive orthodontic treatment needs of an inner-city group of 6- and 9-year-old Canadian children. J Can Dent Assoc. 2005;71(9):649a-e.

20. de Savigny, N. Coordinator communication Canadian Dental Association, personal communication. July 17, 2013.

Tables

Table 1: Demographic information of the Canadian dentist respondents

My gender is?	Number of respondents	Percentage
Male	253	**59.3%**
Female	174	**40.7%**
How many years ago did you graduate from Dental School?	**Number of respondents**	**Percentage**
25 years ago or more (before 1988)	140	**33.7%**
15 to 24 years ago (1989 to 1998)	75	**18.0%**
5 to 14 years ago (1999 to 2008)	126	**30.3%**
Less than 5 years ago (2009 to 2013)	75	**18.0%**
At which of the following schools were you trained?	**Number of respondents**	**Percentage**
Accredited Canadian Dental School	384	**92.3%**
Accredited American (USA) Dental School	14	**3.4%**
Other	18	**4.3%**

Table 2: Proximity of Canadian dentists to the closest orthodontist.

	Number of respondents	Percentage
What is the proximity to the closest Orthodontist from your private practice?		
0 to 19 minutes of driving	350	**84.1%**
20 to 59 minutes of driving	42	**10.1%**
1 to 2 hours of driving	11	**2.7%**
2 to 4 hours of driving	7	**1.7%**
More than 4 hours	6	**1.4%**

Table 3: Provision of orthodontic treatment in relation to the driving time to the closest orthodontist.

	Do you presently provide any orthodontic services (space maintenance and/or removable appliance and/or comprehensive orthodontic treatment) to your patients?		Do you provide removable and/or fixed appliances treatment options to your patients?	
What is the proximity to the closest Orthodontist from your private practice?	**Yes**	**No**	**Yes**	**No**
0 to 19 minutes of driving	216/309 (69.9%)	93/309 (30.1%)	140/213 (65.7%)	73/213 (34.3%)
20 to 59 minutes of driving	27/38 (71.0%)	11/38 (29.0%)	18/27 (66.7%)	9/27 (33.3%)
1 to 4+ hours of driving	18/21 (85.7%)	3/21 (14.3%)	14/17 (82.3%)	3/17 (17.7%)

Figure 1: Provision of interceptive treatment by Canadian dentists.

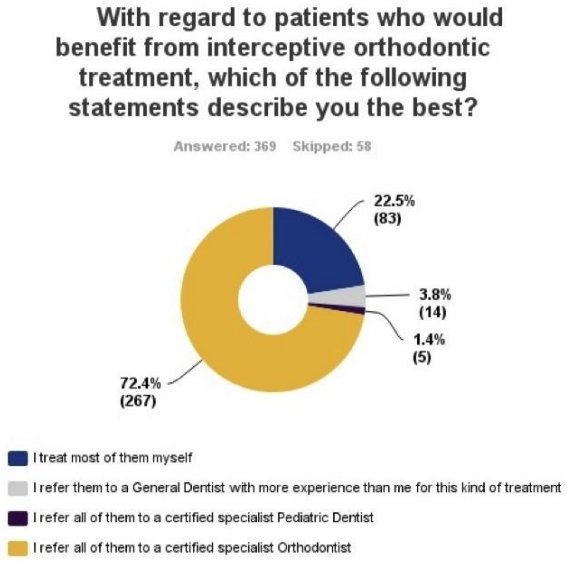


Figure 2: Provision of comprehensive treatment by Canadian dentists.

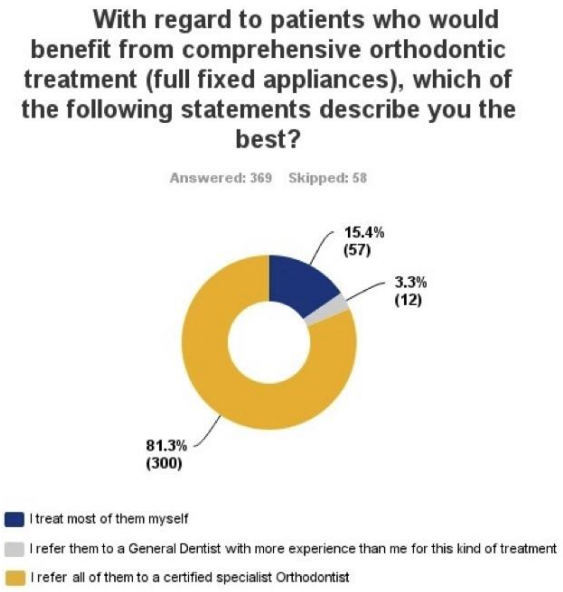
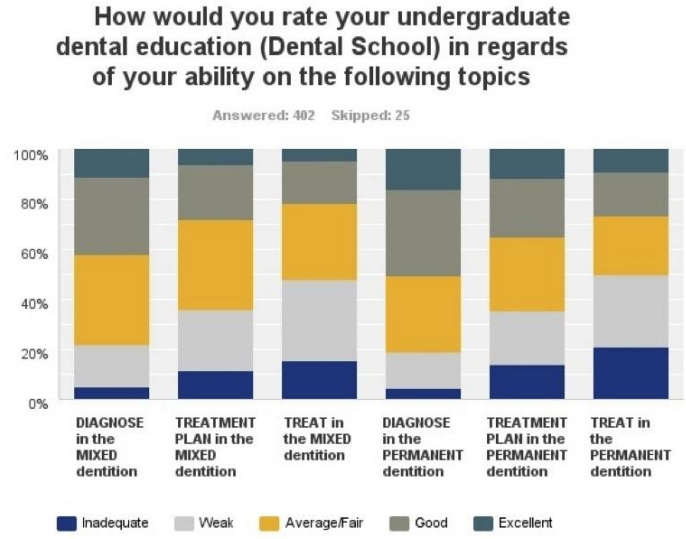


Figure 3: Perception of Canadian dentists on the quality of the orthodontic education received while in dental school.



APPENDIX U
Submission to Journal of Canadian Dental Association (JCDA)

From: Rachel Galipeau [redacted]
Subject: RE: Manuscript submission
Date: April 23, 2015 at 07:48
To: Marc-Olivier Aucoin [redacted]

RG

Thank you for submitting your manuscript (and photos) to the Journal of the Canadian Dental Association – now an online only publication available at www.JCDA.ca. A copy of your article will be passed on to the editor-in-chief for initial read to determine if it fits the scope of the JCDA. If your article fits the scope: a) your article may be sent for peer review; b) the editor may ask you to make modifications to your article prior to sending for peer review; or, c) if your article does not fits the scope of our publication the editor will contact you with his decision/comments. We will update you as to the status of your submission as soon as possible.

Please note that the new JCDA is now concentrating on original research and literature review articles that add to the dental literature, as well as reports of research meetings. It is positioned as a scholarly publication. Oasis Discussions is our clinical knowledge exchange platform.

Thank you for your interest in the JCDA.

Sincerely,

Ms. Rachel Galipeau
Coordinator, Publications | Coordonnatrice des publications
Canadian Dental Association | L'Association dentaire canadienne
[redacted]

-----Original Message-----
[redacted]
To: Rachel Galipeau
Subject: Manuscript submission

Hi!

I am sending/attaching an original manuscript. Could you please send me a confirmation of reception?

Have a great day

Marc Olivier Aucoin, DMD
Graduate Orthodontic Resident
University of Manitoba