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Adult Orthodontics:

Internet information and a national survey

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Thesis submitted to National University of Ireland, Cork in partial fulfilment of the requirements of the Doctorate in Clinical Dentistry (Orthodontics)

JUNE 2015



ucc

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ABSTRACT

Aims

1. To investigate the quality, reliability and readability of information on the Internet on adult orthodontics.

2. To evaluate the profile, characteristics and treatment of adults by specialist orthodontists in the Republic of Ireland (ROI), including methods of information provision.

Materials and methods

1. An Internet search was conducted in May 2015. Three search engines (Google, Yahoo and Bing) were searched using the terms "adult orthodontics" and "adult braces". The first 50 websites from each search engine, and for each search term, were screened. Exclusion criteria were applied to the 300 websites. Included websites were then assessed using the JAMA benchmarks and the DISCERN and LIDA tools. Whether or not the websites displayed the Health on the Net (HON) seal was also recorded. Readability was assessed using the Flesch Reading Ease Score (FRES).

2. A pilot-tested questionnaire about adult orthodontics was distributed to 122 eligible specialist orthodontists in the ROI. Participants were identified by their inclusion on the Dental Council of Ireland specialist list and / or membership of the Orthodontic Society of Ireland. Questions addressed

general and treatment information about adult orthodontic patients, methods of information provision to adult patients and respondent demographics.

Results

1. Thirteen websites were included for further evaluation. Most were of US origin (61%). The authors of the websites were dentists (39%), professional organisations (15%), past patients (15%) and unspecified (31%). Three websites contained all JAMA benchmarks and only one displayed the HON Seal. The mean overall score (Q16) for DISCERN was 3.9/5 and the mean total LIDA score was 115/120. The average FRES score was 63.1.

2. The questionnaire yielded a response rate of 83%. The typical demographic profile of adult orthodontic patients in the ROI was professional females, between 25-35 years. The most common incisor relationship and skeletal base was Class II, division 1 (51%) and Class II (61%) respectively. Overbite and overjet reduction, anchorage management and “black triangles” were the most common challenges faced by orthodontists. Aesthetic upper brackets and metal lower brackets were the most frequently used appliances; lingual brackets and clear aligners were never used by 53% and 34% of orthodontists respectively. Seventy percent of orthodontists provide adult patients with information leaflets and only 30% advise them to find extra information Internet.

CONCLUSIONS

- The number of websites available on the Internet on adult orthodontics is low.
- Available websites exhibited moderate scores in terms of quality and the readability of the websites was found to be of a standard level.
- Most orthodontists in the ROI are treating adult patients.
- The demographic, malocclusion and treatment of adult patients varies between specialists.
- Most orthodontists provide information to their adult patients in a verbal or written form.

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DECLARATION

I hereby declare that the work described in this thesis, except where otherwise mentioned, is my own and has not been submitted previously as a requirement for a degree or a diploma at this or any other institution.

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Siobhán McMorrow

CHAPTER ONE

INTRODUCTION

INTRODUCTION

Orthodontics has traditionally been a specialty devoted to children and adolescents. Over the last few decades, there has been a steady rise in the number of adult patients seeking orthodontic treatment. This has been attributed to several factors including improved dental and orthodontic awareness, social acceptability of appliance therapy, availability of aesthetic appliances and accessibility of orthodontic services (Nattrass and Sandy, 1995). However, research in this subgroup of patients is limited and requires further consideration.

The global surge in the use of the Internet has meant that it is a popular source of information and patients, especially adults, often rely on it for healthcare information. It is imperative, therefore, that the information they attain is accurate, precise and comprehensible. To date, information available on the Internet on adult orthodontics has not been robustly assessed with regard to quality, reliability and readability.

Several surveys around the world have been carried out on various aspects of adult orthodontics. These have investigated demand, treatment need, demographic profiles, malocclusions, treatment types and outcomes of adult orthodontics. However, comprehensive profile data on adult orthodontics in the Republic of Ireland (ROI) has not been ascertained to date. Another facet which has not yet been explored is the methods by which orthodontists provide information to their adult patients.

This project addresses these two deficiencies in the literature: the quality of information on adult orthodontics on the Internet and a national survey of adult orthodontics in the ROI, with specific reference to methods of information provision.

CHAPTER TWO

LITERATURE REVIEW

LITERATURE REVIEW

This literature review was conducted using Pub Med, Medline, Science Direct, Web of Knowledge, Google Scholar, JSTOR and Academic Search. The following MeSH terms were used: 'adult orthodontics', 'adult braces', and 'orthodontic information on the internet'. Bibliographies of key papers were reviewed and screened for further publications, which were retrieved, if relevant.

This is a narrative, non-systematic review of the literature and is divided into three sections. The first section gives a brief general overview of adult orthodontics. The second and third sections review the literature pertaining to this project: information on the Internet about adult orthodontics and adult orthodontic surveys.

2.1 ADULT ORTHODONTICS OVERVIEW

Adult orthodontics is not new. It was practiced, although infrequently, as far back as a century ago. Kingsley (1880) was one of the first clinicians to show an awareness of the orthodontic potential for adult patients. A case report by Edward Angle documents his treatment of a thirty-eight year old female with four missing first molars (Angle, 1907). Currently adult orthodontic treatment is more prevalent than ever. Since 1992, the Republic of Ireland (ROI) has seen the number of orthodontists more than quadruple, highlighting the improved availability of orthodontic services in the country over the last twenty years (Moss, 1993; McGuinness and Collins, 2007). The intensive marketing campaigns by manufacturers of various clear aligner systems have also led to enormous interest in 'invisible orthodontics' which is especially appealing for the adult patient (Buckley, 2012).

2.1.1 Classification

Adult orthodontic treatment can broadly be classified as comprehensive or adjunctive (Tulloch, 2000). Comprehensive orthodontic treatment is aimed at achieving the best balance between dental and facial aesthetics, ideal occlusal relationships and long-term dentoalveolar stability (Buttke and Proffit, 1999). Adjunctive orthodontic treatment is the movement of teeth to facilitate other dental procedures necessary to control disease and restore function. The goals of adjunctive therapy are often limited. Appliances are typically only required in a portion of the dental arch and treatment takes a few months to complete (Buttke and Proffit, 1999).

Adult patients can be further classified according to their age (see **Figure 2.1**). A differentiation must be made between young adults, who have recently stopped growing and older adults who have experienced deterioration of their dentition and

changes in their occlusion over time (Melsen, 2012). Younger adults often desired, but did not receive, orthodontic treatment as youths and now seek it as they have become financially independent while older adults have other dental problems and need orthodontics as part of a larger treatment plan (Proffit, 2006). The former usually require comprehensive treatment while the latter require adjunctive orthodontic treatment. Older adults are more likely to require an interdisciplinary treatment approach, most commonly involving the periodontist, restorative dentist and implantologist.

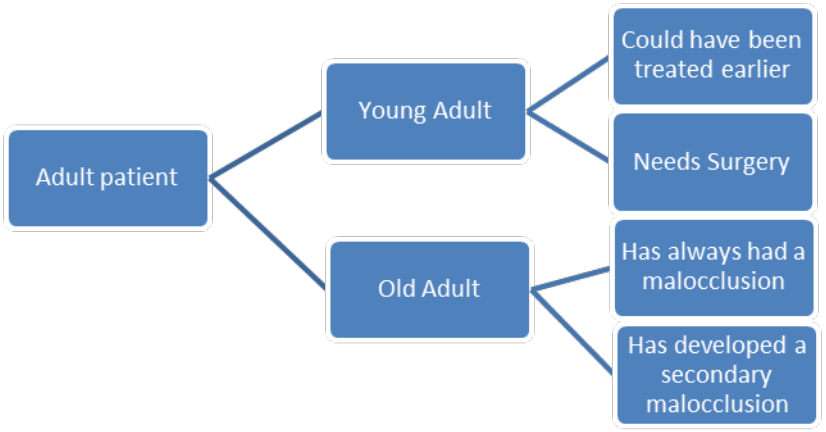


Figure 2.1- Classification of adult patients

2.1.2 Differences between child/adolescent and adult orthodontics

Orthodontic treatment of the child and adolescent or of the adult is similar in many respects, often with identical treatment aims and similar mechanics employed. However, adult orthodontics may demand additional skills, such as the ability to work with a compromised dentition and to accept less-than-ideal results as the best possible outcome (Melsen, 2012). There are some key differences in orthodontic treatment between the child/adolescent and the adult which can make management of the latter more challenging.

These differences can be broadly classified into three categories:

- Age-related
- Periodontal/restorative
- Psychosocial

2.1.2.1 Age-Related

Medical History

It is particularly important to take a thorough medical history in adult patients. The prevalence of patients with metabolic disease taking long-term medication increases with age which can influence the rate of tooth movements (Melsen, 2012). Nowadays more older adults are treated with bisphosphonates for osteoporosis. This can impact on the decision to proceed with orthodontic extractions, implants or orthognathic surgery. In patients with a high risk of osteoclastic inhibition (eg. patients on intravenous bisphosphonates), it has been recommended to avoid orthodontic treatment altogether (Zahrowski, 2007). Some conditions (eg. rhuematoid arthritis)

which are more common in older adults may affect dexterity and the ability to comply with oral hygiene which, again, may be a contraindication for orthodontic treatment.

Lack of Growth

One of the major disadvantages of treating adults is their lack of growth potential. This can make treatment of skeletal discrepancies quite taxing and preclude the use of growth modification appliances. Correction of anteroposterior skeletal anomalies, therefore, relies on orthodontic camouflage or orthognathic surgery. Vaden et al. (1995) compared adult with adolescent Class II correction in a sample of 22 and 23 females respectively. They confirmed that adult Class II molar correction was achieved completely by tooth movement whereas adolescent Class II molar correction was achieved with a combination of tooth movement and mandibular growth.

Deep overbite is one of the most common features of adult malocclusions (Nanda, 1997). Unlike adolescents, molar extrusion or eruption should be avoided in the correction of deep overbite in adult patients as it is unstable. Vertical condylar growth and alveolar bone changes are unlikely to occur to a significant degree in adults (Nattrass and Sandy, 1995). Incisor intrusion, incisor proclination or surgery is required instead. True incisor intrusion is mechanically difficult to achieve and excessive incisor proclination is prone to relapse making management of this anomaly quite challenging in an adult patient.

Temporomandibular Joint Dysfunction

Adults are more likely to suffer from temporomandibular joint dysfunction (TMD) (Christensen and Luther, 2015). Although no direct relationship has been proven

between orthodontic treatment and TMD, it should be borne in mind when treating the adult patient as any alternation in the occlusion may exacerbate symptoms. Signs and symptoms of TMD occur in healthy individuals and increase with age, particularly during late adolescence; thus, TMDs that originate during various types of dental treatment may not be related to the treatment but may develop naturally (McNamara et al., 1995). Adult patients require a thorough functional and TMJ assessment prior to orthodontic treatment. The risk of developing TMD (which may not necessarily be related to orthodontic treatment) and the limitations of orthodontic treatment in the management of TMD, should be explained to the patient before treatment starts (Bagga, 2010).

Reduced vascularity and cell turnover

The tooth supporting tissues are also influenced by age and as a consequence the initial tissue reaction to an orthodontic force system is delayed in adults (Melsen, 2012). The proliferative activities of fibroblast-like cells decrease with age (Kyomen and Tanne, 1997). It has also been suggested that reduced vascularity with increasing age causes an insufficient amount of progenitor cells for bone formation (Norton, 1988). However, although initial tooth movement is delayed in adult patients, overall treatment duration is similar to adolescent patients (Chiappone, 1976; Dyer et al., 1991; Harris et al., 1994). Nonetheless, the increased time for tissue reorganisation in adults means that long-term retention is necessary (Scott et al., 2007).

2.1.2.2 Periodontal/Restorative

Periodontal Factors

Periodontal disease increases with age, both in incidence and severity. Periodontal problems may even contribute to the development of malocclusion in adults (Melsen,

2012). Periodontal breakdown can lead to proclination of incisors, rotations, spacing and over-eruption of teeth. Although periodontal disease is not a contra-indication for orthodontics, it is imperative that all active disease is stabilized prior to commencement of treatment (Boyd et al., 1989). Measures to promote optimal oral hygiene in periodontal patients have been suggested, including the use of bonded tubes over bands, stainless steel ties over elastomeric ligatures and the removal of all flash from around brackets (Scott et al., 2007). The loss of clinical attachment makes periodontally affected teeth prone to tipping and hence the use of light forces is advocated (Scott et al., 2007). Anchorage reinforcement may also be required in periodontally involved dentitions due to reduced alveolar bone support (Johal and Ide, 1999).

Restorative Factors

Older adults are more likely to have multiple missing teeth and heavily restored dentitions. The presence of crowns and large amalgam restorations in adults may pose problems with bonding appliances. However, Zachrisson and Buyukyilmaz (1993) have described several methods to aid bonding to gold, amalgam and porcelain. The presence of heavily restored teeth may dictate the extraction pattern, which is often not ideal. Closure of old extraction sites may be difficult due to the reduced vertical and buccolingual bony dimensions (Nattrass and Sandy, 1995). Restoration of old extraction sites with prosthetic replacements can also be challenging due to over-eruption of the opposing dentition.

2.1.2.3 Psychosocial

Adult patients may have different motivations for seeking orthodontic treatment than adolescents. Adults generally initiate their own orthodontic treatment (McKiernan et al., 1991). They are usually internally motivated whereas adolescents may have some external parental pressure (Pabari et al., 2011). As a result, adult patients have higher expectations and can be more demanding. The advantage of this is that adults exhibit outstanding compliance and have been found to be excellent candidates for orthodontic treatment (Tayer and Burek, 1981). However, a minority of adult patients attending for orthodontic treatment may have unrealistic treatment expectations, possibly with underlying psychological problems. A survey of adults seeking orthodontic treatment in the UK estimated that the prevalence of Body Dysmorphic disorder was 7.5% (Hepburn and Cunningham, 2006). If a psychological condition is suspected, it should be identified early and referred appropriately for counselling (Scott et al., 2007).

Adults are often more concerned with the social acceptance of orthodontic appliances than adolescents. It has been shown that 74% of adult patients have initial fears concerning peer reaction to their treatment (Tayer and Burek, 1981) and almost half of adults cite embarrassment as a reason for not seeking orthodontic treatment (Breece and Nieberg, 1986). Despite improvements in the aesthetics of appliances, more recent qualitative research has revealed that social concerns are still a major factor in adults pursuing orthodontic treatment (Stanford et al., 2014).

One of the reported benefits of orthodontic treatment is improved quality of life. A retrospective survey of over 200 Asian adults who had completed orthodontic treatment identified improvement in career opportunities, social life and confidence in 71%, 86% and 93% of the sample respectively (Lew, 1993). However, the evidence-based relationship between orthodontic treatment and oral health-related quality of life in adults is equivocal (Chen et al., 2014; Clijmans et al., 2015; Johal et al., 2015).

2.2 ADULT ORTHODONTICS AND THE INTERNET

2.2.1 Evolution of the Internet

The concept of the Internet was first described in the US by Licklider and Clark (1962) at the Massachusetts Institute of Technology. They foresaw a globally interconnected set of computers through which everyone could access data and programs. With innovations and advances in computer technology these concepts gradually became a reality. Berners-Lee (1989) is credited with the invention of the World Wide Web. Since its invention, the use of the Internet has risen dramatically and in the last five years alone the Internet population has doubled to over 3 billion (http://www.internetlivestats.com/internet-users/). Recent Internet usage statistics reveal that there are over 3.6 million Internet users in Ireland (http://www.internetworldstats.com/stats.htm). The Internet has revolutionised how we communicate; with its improved speed and accessibility, it is now one of the main portals of information dissemination.

2.2.2 Healthcare Information on the Internet

Health information has many benefits for patients and health care professionals. It increases patient's knowledge of their disease and its treatment, can aid coping, reduce stress and anxiety, help individuals make informed decisions regarding their treatment and can increase an individual's adherence with medical advice (Ademiluyi et al., 2003). A well-informed patient is regarded as more likely to have greater treatment compliance and improved outcomes (Mullen, 1997).

As technology has advanced, the Internet has become a popular communication tool for health-related information. The Internet has the potential to educate and empower the health consumer, by providing information on health and health services, as well as supporting self-help and patient choice (Powell et al., 2003). Patients are increasingly using the Internet to research health matters or as a means of self-care as it provides quick, easy and vast amounts of information. The anonymity and convenience of the Internet adds to its appeal. In addition, it has been found that the information needs of patients are often incompletely met during clinic visits and hence they turn to other sources for medical information (Buck et al., 1996).

A World Health Organisation (WHO) survey in Europe in 2007 found that 71% of Internet users had used the Internet for health purposes (Andreassen et al., 2007). Two-thirds of those using the Internet to find health information claim it has some impact on their healthcare decisions (Fox and Rainie, 2002). In Ireland, a survey of health consumers revealed that 18% of respondents had used the Internet as a source of information on health matters (Gallagher et al., 2008). The most common reasons that patients utilize the Internet for health-related research has been investigated and the main reasons include: information about a condition, information about treatment, information about symptoms, advise about symptoms and advice about treatment (Shuyler and Knight, 2003).

The Internet is not used to replace health care professionals but to confirm information and to gather additional information (Nicholas et al., 2003). Almost 70% of patients searching for healthcare information do so before visiting a doctor's office (Brown, 1998). A cross-sectional study in the US of 285 healthcare professionals found that 80% of respondents experienced patients presenting printed internet-sourced information when they attended for consultations/treatment (Podichetty et al., 2006).

It is important, therefore, that the information patients attain does not conflict with professional opinion and is based on high quality evidence. Although patients rely heavily on the Internet, a cross-sectional telephone survey of over 14,000 people across seven European countries revealed that direct contact with health professionals was still regarded as the most important source of health information (Kummervold et al., 2008).

The search behaviour of Internet users varies depending on the type of information sought and experience levels. The profile of typical searchers of online health information has been explored. Educated females and those who are higher earners are more likely to search health information online (Kummervold et al., 2008; Wangberg et al., 2008). The most active health users have been found to be the 30-44 year old age group (Andreassen et al., 2007). A person's health status also influences the frequency of use of the Internet for health information (Houston and Allison, 2002; Fox, 2005). Unsurprisingly, those with poor health status, chronic conditions or suffering from long-term illness or disability are more likely to visit health sites. An observational study in the US revealed that low-literacy adults encounter more difficulties when searching for web health information due to content with high reading levels (Birru et al., 2004).

2.2.3 Tools to assess reliability of Information

The major disadvantage of health information online is the lack of regulation. The quality of health information on the Internet is critically important as it could potentially affect health outcomes for many users. Health information is not peer-reviewed and can be posted by any person or organisation at any time. Erroneous and

misleading information, caused by ignorance, bias or commercial interest may influence prospective patients and may contradict health care professionals. This has brought into question the quality, accuracy and completeness of information on the web (Stinson et al., 2009).

In order to combat this shortcoming of reliability of health information online, several tools have been developed. These tools provide patients with a means of systematically judging the quality of information online. The main tools available are:

- JAMA benchmarks
- DISCERN
- HON Seal
- LIDA
- Data Quality Scores

2.2.3.1 JAMA Benchmarks

The JAMA benchmarks were suggested by Silberg et al. (1997) as a basic means of assessing the quality of healthcare websites. Four key standards were highlighted as being indicative of high quality websites:

- Authorship: Proper identification of authors and contributors
- Attribution: All sources of information referenced
- Disclosure: Site ownership, financing, advertising and conflicts of interest disclosed

- Currency: Indication of the dates content is posted and updated

Any Internet-based sources of medical information that fail to meet these standards should be considered suspect.

2.2.3.2 DISCERN

The DISCERN instrument (Appendix 1) was developed in the UK in 1999 (Charnock et al., 1999). An expert panel generated criteria from a random sample of information for three medical conditions with varying degrees of evidence: myocardial infarction, endometriosis and chronic fatigue syndrome. Based on the panel's criteria, a draft instrument was tested by the same panel on a random sample of new material for the same three conditions. The performance of the draft instrument was then analysed by assessing the inter-rater agreement and by means of a panel debate. Based on these results, the instrument was re-drafted and a final pilot of the DISCERN instrument was conducted by a national sample of 13 self-help group members and 15 information providers on a random sample of leaflets from 19 major national self-help organisations. It was the first standardized index of quality of consumer health information. It consists of 15 key questions which each represent a separate quality criterion. Each question is rated on a 5-point scale according to the completeness of the information provided. Reliability is assessed in questions 1-8 (section 1) and treatment choices in questions 9-15 (section 2). Question sixteen is a summary question which gives an overall rating to the publication.

DISCERN possessed satisfactory internal consistency when assessing 89 websites on smoking cessation and showed satisfactory overall inter-rater reliability when assessed by two independent raters (Ademiluyi et al., 2003). Predictably, higher levels of

agreement were found for more objective questions and lower levels of agreement for more subjective questions. Substantial inter-rater agreement was also found when assessing 31 information leaflets on prostate cancer, indicating that the instrument could be used to discriminate reliably between low and high quality prostate cancer publications (Rees et al., 2002).

2.2.3.3 HON Seal

Health on the Net (HON) is a non-profit foundation established in 1995 (https://www.healthonnet.org/). The Health on the Net Foundation has elaborated a code of conduct to help standardise the reliability of medical and health information available on the World-Wide Web. The HON Seal is awarded to websites that comply with the HON code of conduct which aims at offering ethical, quality, objective and transparent health information. The identification of the seal (**Figure 2.2**) on a website is a quick way for users to delineate the quality of a site.



Figure 2.2 - HON Seal

2.2.3.4 LIDA Tool

This validated tool (Appendix 2) was developed in the UK in 2002 to assess the design and content of healthcare websites (http://www.minervation.com/lida-tool/). The

validity of this tool was measured by two assessors who used the LIDA tool to rank the quality of 40 major prostate cancer websites. Strong correlation between the rank orders of each assessor was found, confirming that the tool had good internal validity. Three distinct aspects are measured: accessibility, usability and reliability.

- *Accessibility*

This is the first tool to include accessibility in the assessment of health websites. It is now law in the UK and ROI that websites are accessible to all to prevent discrimination. Sites should also reflect best practice in coding and relevant meta-data. The accessibility score is calculated by inputting the given web address into a customized Web platform.

- *Usability*

This section looks at four key areas regarding the design and presentation of the websites; clarity, consistency, functionality and engagability. It is important for sites to be clear and easy to use to enable effective distribution of information. Poor usability of a website, even if it contains excellent content, will discourage users and reduce the overall quality score of the website.

- *Reliability*

Website content should be produced in a robust, unbiased and systematic way. Information should be updated regularly including the latest evidence. There should be no conflicts of interest and content production should be produced using rigorous methodology. Reliability of health websites is often rated as the poorest domain.

The total LIDA score achievable is 144, with the maximum scores for accessibility, usability and reliability being 63, 54, and 27 respectively. LIDA outcomes are

regarded as ‘high’ if the percentage score is >90%, ‘moderate’ between 50-90% and ‘low’ less than 50%.

The LIDA tool has been used in a number of studies which assess health information quality on the Internet. Three themes have emerged from these studies so far (http://www.minervation.com/lida-tool/):

- An observed correlation between LIDA scores and Flesch Reading Ease scores.
- No correlation between LIDA scores and conventional search engine rank.
- Reliability is often the lowest scoring domain.

2.2.3.5 Data Quality Score (DQS)

The DQS is a checklist-based evaluation instrument which awards points for inclusion of pertinent information on a specific topic. The given topic is evaluated under various

domains and for each domain a checklist with relevant items is created and points awarded for inclusion of each item. It was developed by Langille et al. (2010) to assess the quality of information on websites regarding effective treatment for Inflammatory Bowel Disease (IBD). It was created following a review of IBD treatment literature and through discussions with three gastroenterologists. Points were awarded (0-76) for mentioning well-known, proven IBD therapeutic regimens including their benefits and side effects. The DQS tool went through several revisions and was pre-tested three times before being finalized. It was designed as a non-biased, reproducible and objective form of measurement compared to more subjective tools like DISCERN and LIDA. A potential weakness of the DQS is the equal weighting given to the various points of information, which may not reflect that some pieces of information are more important than others (Langille et al., 2012). It has also been used to evaluate the content of obstructive sleep apnoea websites on the Internet (Langille et al., 2012). However, as it is a relatively new tool it has not yet gained widespread use.

2.2.4 Tools to assess readability of Information

The readability of a website is equally as important as reliability. The readability of a website must fit the demographic of the intended audience; for healthcare information websites, this equates to the general public. Websites containing healthcare

information should be readable by most adults, including those with low levels of literacy, to eliminate discrimination and empower patients to make informed decisions about their healthcare. A website which requires a very high reading level may compromise patient comprehension and render a potentially high quality website useless. It has been shown that websites which are easier to read score highly in the usability category of LIDA (Muthukumarasamy et al., 2012).

The most common tools used to assess readability of a text are:

- Flesch Reading Ease Score
- Flesch-Kincaid Grade Level
- Fog Scale Formula

2.2.4.1 Flesch Reading Ease Score (FRES)

The Flesch Reading Ease Score (FRES) is considered one of the oldest and most accurate readability formulae. It was developed in 1948 by Rudolph Flesch (Flesch, 1948). He devised a formula based on the average sentence length (number of words divided by number of sentences) and average syllables per word (number of syllables divided by number of words). The formula is as follows, where ASL is average sentence length and ASW is average syllables per word:

FRES = 206.835 – (1.015 X ASL) – (84.6 X ASW).

The final score ranges from 0-100 and high scores indicate texts which are easy to read. A score of 90-100 is considered easily understood by a 10-11 year old, while scores between 0-30 are best understood by college or university graduates. It has

been recommended that health information should be written at or below the reading age of 11-12 years.

2.2.4.2 Flesch-Kincaid Grade Level (FKGL)

The Flesh-Kincaid Grade Level is similar to the FRES test but the result is a number which corresponds with a US grade-school level. For example a score of 5.2 indicates that the text is understandable by an average student in the fifth grade. It was developed in the US in 1975 (Kincaid et al., 1975). The formula is as follows:

FKGL = (0.39 X ASL) + (11.8 X ASW) – 15.59

2.2.4.3 Fog Scale Formula

The Fog Index level 'translates' the number of years of education a reader needs to understand the material (Gunning, 1969). The "ideal" score is 7 or 8; a score above 12 is considered too hard for most people to read. This readability tool is not as widely used as FRES or FKGL. The formula for the index is as follows:

Fog Index = ((average number of words per sentence) + (number of words of 3 syllables or more)) X 0.4

Multiple online calculators exist which help in speedy assessment of the readability of a section of text, one of the most common being www.readabilityformulas.com.

2.2.5 Medical Information on the Internet

Table 2.1 lists some common medical topics which have been appraised to date. It is not the purpose of this literature review to summarize all topics assessed, but it is evident that there has been a steady rate of published literature analysing the quality of online medical information.

Table 2.1 - Studies assessing the quality of medical information on the Internet

Author/Year	Topic Assessed
Impicciatore et al. (1997)	Fever in Children
Biermann et al. (1999)	Cancer
Beredjiklian et al. (2000)	Carpal Tunnel Syndrome
Peroutka (2001)	Headache
Darmoni et al. (2001)	Depression
Meric et al. (2002)	Breast Cancer
Kisely (2002)	Chronic Fatigue Syndrome
Croft and Peterson (2002)	Asthma
Bichakjian et al. (2002)	Melanoma
Reed and Anderson (2002)	Menopause
Butler and Foster (2003)	Low Back Pain
Mathur et al. (2005)	Scoliosis
Maloney et al. (2005)	Osteoarthritis
Griffiths et al. (2005)	Depression
Bernard et al. (2007)	Inflammatory Bowel Disease
Ipser et al. (2007)	Anxiety Disorders
Roshan et al. (2008)	Tonsillectomy
Tan et al. (2009)	Mesothelioma
Morr et al. (2010)	Cervical Disc Herniation
Mallappa Saroja and Hanji Chandrashekar (2010)	Polycystic Ovaries
Kaicker et al. (2010)	Chronic Pain
Joshi et al. (2011)	Osteoporosis

San Norberto et al. (2011)	Aortic Aneurysm
Muthukumarasamy et al. (2012)	Thyroidectomy
Kirthi and Modi (2012)	Coronary Angioplasty
Ahmed et al. (2012)	Concussion
Tavare et al. (2012)	Uterine artery embolization
Alsafi et al. (2013)	Interventional radiology, vascular surgery and cardiology
Tirlapur et al. (2013)	Bladder Pain Syndrome
Bruce-Brand et al. (2013)	Anterior Cruciate Ligament reconstruction
Grewal and Alagaratnam (2013)	Colorectal Cancer
Kakos et al. (2014)	Pelvic Organ Prolapse
Garcia et al. (2014)	Shoulder Instability
Lutz et al. (2014)	Chronic Kidney Disease
Nicholson et al. (2014)	Ophthalmic Conditions

2.2.6 Dental Information on the Internet

Few studies have investigated the use of the Internet as an information source for dentistry. Ni Riordain and McCreary (2009a) assessed the use of the Internet for dental information by patients attending a range of dental clinics at Cork University Dental School and Hospital. They found that 34% of patients had either researched their presenting dental/oral condition or had a family member research it for them. A statistically significant association was found between the type of clinic attended and usage of the Internet. Forty-nine percent of patients attending oral medicine clinics, 20% of patients attending oral surgery clinics and 11.5% of patients attending restorative clinics reported researching their condition online. Harris and Chestnutt (2005) surveyed over 280 patients attending dental hygiene clinics and found that 43% of respondents would be interested in the Internet as a source of oral health information and 41% would appreciate being directed to appropriate sites by their dentist.

Seven non-orthodontic dental topics, mainly oral-medicine related, have been assessed to date. These are head and neck cancer (Ni Riordain and McCreary, 2009b; Lopez-Jornet and Camacho-Alonso, 2009), oral leukoplakia (Lopez-Jornet and Camacho-Alonso, 2010a), oral lichen planus (Lopez-Jornet and Camacho-Alonso, 2010b), temporomandibular disorders (Park et al., 2012), oral ulceration (Ni Riordain and Hodgson, 2014), dental implants (Leira-Feijoo et al., 2014) and xerostomia (Delli et al., 2015).

2.2.7 Orthodontic Information on the Internet

A key factor in an adult's decision to seek orthodontic treatment is the amount and quality of information available (Sergl and Zentner, 1997). Currently nine studies have assessed the quality of orthodontic information on the Internet. These have covered the following topics: cleft lip and palate, orthodontic extractions, orthognathic surgery, obstructive sleep apnoea, orthodontic pain and orthodontic practice websites. Details regarding these are summarized in **Table 2.2**. It is difficult to precisely compare these studies as they investigate various topics, use numerous tools for assessment and evaluate different numbers of search engines and sites. Google and Yahoo are the most used search engines in all studies. Some have included other search engines including Windows Live, Ask, AOL and Bing for completeness.

However, the following conclusions can be drawn from these studies:

- The quality of orthodontic information on the Internet is highly variable and is dependent on the topic.
- While the readability of orthodontic websites is of an acceptable level, the reliability of websites consistently scores as the lowest category.

Table 2.2 - Studies assessing the quality of orthodontic information on the Internet				
Study	**Topic**	**Methods/Search Engines**	**Methods/Tools Used**	**Results**
Antonarakis and Kiliaridis (2009)	• CL/P	• Google/Yahoo/Windows Live • Search Terms: "cleft palate", "cleft lip" and "family information" • Top 25 websites from each search engine	• Content Quality: Based on standard text books • Readability: - FRES - FKL - Fog Scale Level	• 49 websites evaluated (excluding repetitions) • CL/P information on the Internet is vast and highly variable • Readability: 8th - 9th Grade
Patel and Cobourne (2011)	• Orthodontic extractions	• Google/Yahoo • Search Term: "orthodontic extractions" • Top 50 websites from each search engine	• Reliability: LIDA Tool • Readability: FRES	• 21 websites evaluated (after exclusion criteria applied) • Overall mean LIDA score: 65% - Accessibility: 70% - Usability: 72% - Reliability: 41% • Readability: mean FRES 58.3

Aldairy et al. (2012)	• Orthognathic surgery	• Google/ YAHOO/ Ask Jeeves • Search Terms: "orthognathic surgery" and "jaw surgery" • Top 100 websites	• Reliability: DISCERN	• 25 websites evaluated (after exclusion criteria applied) • Mean Discern Score: 41/80 • Maximim Score: 64/80 (Wikipedia.org) • Minimum Score: 21/80 (qualitydentistry.com)
Langille et al. (2012)	• Treatment options for Obstructive Sleep Apnoea	• Google • Search Term: "obstructive sleep apnea" • Top 50 websites • 2 independent evaluators	• Content Quality: DQS • Website Quality: GQS • Reliability: DISCERN • Readability: FKS	• 34 websites evaluated (after exclusion criteria applied) • Average DQS : 36/67 • Average GQS: 2.9/5 • DISCERN: 3.3/5 • Readability: 11th Grade

Livas et al. (2012)	• Pain experienced by orthodontic patients	• Google/ Bing/ YAHOO/ Ask/ AOL • Search Terms: "orthodontic pain" and "braces pain" • Top 25 websites (from each search engine and using each search term)	• Accuracy: based on textbooks/evidence-based guidelines (quality rating devised) • Readability: FRES • Reliability: LIDA tool	• 25 websites evaluated (after exclusion criteria) • Accuracy: mean 26% (SD:21.39) • Readability: Mean FRES 68.1 • Overall mean LIDA Score: 61% - Accessibility: 86% - Usability: 58 % - Reliability: 16 %
Parekh and Gill (2014)	• Orthodontic practice websites	• Google/ YAHOO/ Ask • Search Term: "orthodontic practice" • Top 10 practice websites from each search engine	• Ethical advertising: GDC criteria • Reliability: LIDA tool	• GDC Criteria: Mean 63% • Overall Mean LIDA Score: 72% - Accessibility: 81% - Usability: 73% - Reliability: 43%

Pithon and Santos (2014)	• Pain after orthognathic surgery	• Google/Bing/Yahoo/Ask/ AOL • Search Terms: “pain” and “orthognathic surgery” • Top 30 websites from each search engine	• Content Quality: LIDA Tool/Modified DQS • Readability: FRES	• 29 websites evaluate (after exclusion criteria) • Accuracy: mean 30% (SD: 27) • Overall mean LIDA Score: 65% - Accessibility: 82% - Usability: 53% - Reliability: 37% • Readability: Mean FRES 53.96

Patel and Cobourne (2014)	• UK orthodontic practice websites	• Google • Search Term: "orthodontic braces" • Top 100 UK-based practice websites selected	• Ethical advertising: GDC Criteria • Reliability: LIDA and DISCERN tools	• GDC Criteria: 9% showed full compliance • Overall mean LIDA score: 76% - Accessibility: 82% - Usability: 76% - Reliability: 67% • DISCERN: 64%
Verhoef et al. (2015)	• Oral Hygiene Instructions for patients with orthodontic appliances	• Google/Yahoo/Bing • Search Terms: "Cleaning braces", "brushing braces" and "oral hygiene and braces" • Top 20 hits for each search	• Reliability: LIDA tool • Readability: FRES	• LIDA: - Accessibility: 85% - Usability: 63% - Reliability: 48% • Readability: Mean FRES 68.6
Keys: CL/P=Cleft Lip and Palate; FRES=Flesch Reading Ease Score; FKS=Flesch-Kincaid Score; DQS=Data Quality Score; GQS=Global Quality Score; GDC= General Dental Council				

2.3 ADULT ORTHODONTIC SURVEYS

2.3.1 Prevalence of Adult Orthodontics

Although the growth in adult orthodontics is quite conspicuous, only twelve surveys worldwide have documented the prevalence and trends of adult orthodontic treatment. To date, five European, six North American and one New Zealand study have been conducted to ascertain the frequency of adult orthodontic treatment (**Table 2.3**).

Thilander (1979) was the first to document the rise in adult orthodontic patients in Europe. She examined adult referrals to the University of Gothenburg orthodontic department over an eight year period. Six times as many adult patients were referred in 1978 compared to in 1970. Another early survey of 45 private orthodontists in New Zealand reported that 6% of their patients were adults (Muir et al., 1986).

More recent studies in Europe have revealed an even higher prevalence of adult orthodontics. A 2007 British Orthodontic Society survey found that, on average, adults consisted of 17% of an orthodontist's total caseload (BOS Members Survey 2007) . Another survey of UK orthodontists found the estimated mean number of adult cases started between April 2006 and April 2007 was 20.9 within the National Health Service (NHS) and 28.2 for private patients (Cedro et al., 2010). However, as these were mean figures reported, care should be taken with interpretation of the data; for a large proportion of orthodontists, adults represented only a fraction of their patients. There was also a relationship between place of work and number of adult cases. Unsurprisingly, those working in specialist orthodontist practice treated the highest number of adults privately and those in a hospital setting treated the highest number of adults within the NHS. This survey was conducted on over 1000 orthodontists with

a final response rate, after three postings, of 70%. This represents a good response rate, increasing the validity of the results and reducing sampling bias.

Table 2.3 – Studies assessing the prevalence of adult orthodontics			
Author/Year	**Country**	**Prevalence (%)**	**Comment**
Thilander (1979)	Sweden	1970: 26 adult pts 1978: 174 adult pts	Six times as many new adult referrals to University of Gothenburg from 1970-1978
Fastlight (1982)	US	15.3	
Gottlieb and Vogels (1984)	US	5	
Muir et al. (1986)	NZ	6	Survey of 45 private orthodontists
Gottlieb et al. (1991)	US	25	
Buttke and Proffit (1999)	US	15	
NHS Business Services (2004)	UK	4	% Adults undergoing orthodontic treatment within NHS
BOS Survey (2007)	UK	17	Methodology not provided
McGuinness and Collins (2007)	ROI	28 (in private practice) 11.8 (in hospital)	National Survey Response rate excellent at 86%
Cedro et al. (2010)	UK	Mean no. of NHS adult cases: 20.9 Mean no. of private adult cases: 28.2	>1000 UK orthodontists surveyed Response rate good at 70%
Keim et al. (2011)	US	20	>10,000 US orthodontists surveyed Response rate very poor at 3.5%
Keim et al. (2014)	US	24	>10,000 US orthodontists surveyed Response rate very poor at 1.9%

A 2007 report on the orthodontic workforce in Ireland surveyed over 100 orthodontists and revealed that the mean percentage of adults treated in private practice was 28% compared with 11.8% in a hospital setting (McGuinness and Collins, 2007). The response rate of this survey was excellent at 86%. The restrictions by the Health Service Executive (HSE) in the ROI of orthodontic treatment to children means that adult orthodontic treatment is predominantly undertaken in private practice, with the exception of orthognathic and hypodontia cases being treated by the HSE.

In the US, similar trends have been recognized. In 1970, adults made up only 5% of orthodontic patients (Gottlieb and Vogels, 1984) . Fastlight (1982) found that 15% of his orthodontic practice consisted of adult patients. This gradually increased and peaked at 25% in 1990 (Gottlieb et al., 1991). However, Norton (1988) noted regional variation in figures; with a predominance of adults in retirement communities, such as Florida, he speculated that adults there comprise between 60-70% of the practice. National data collected from 2000-2004 revealed that 1% of US adults had attended an orthodontic appointment in that period (Whitesides et al., 2008). According to an American Association of Orthodontists survey there was a 14% increase in the number of adult patients in the two year period from 2010 to 2012, with a record high of 1,225,850 patients (20%) aged 18 years and older (Brown and Nash, 2009). The most recent survey conducted in the US found that 24% of active orthodontic cases were adults (Keim et al., 2014). However, although large numbers were surveyed in this study (>10,000 orthodontists), there was a very poor response rate of only 1.9%. This signifies a high non-response error, introducing significant bias.

Clearly, it is difficult to compare data between countries and regions due to differing population demographics, health services and attitudes toward orthodontic treatment. Furthermore, some studies have reported actual numbers of adults treated per annum

while others report the prevalence of adult patients as a percentage of their caseload. It is apparent, nonetheless, that there has been an exponential rise in the number of adult patients seeking orthodontic treatment. One can surmise that in contemporary orthodontic practice, approximately one in five orthodontic patients is an adult.

2.3.2 Adult Demographics

2.3.2.1 Gender

Like children and adolescent orthodontics, females make up a high proportion of adult orthodontic patients. The ratio of female to male patients is even higher amongst adult patients (Khan and Horrocks, 1991). This observation has not changed much over the last few decades (see **Table 2.4**). Several studies in the UK, China and the US have confirmed that more than two thirds of adult orthodontic patients are female (Tayer and Burek, 1981; Khan and Horrocks, 1991; Lew, 1993; Cedro et al., 2012; Keim et al., 2011). These findings are not surprising, as it is well established that females are more discerning in their dental aesthetic judgements and are more frequent users of healthcare than males.

2.3.2.2 Age

The typical age range of adult orthodontic patients seems to be escalating; whereas in the past most adult patients were in their early twenties, nowadays they are more commonly in their late twenties to mid-thirties (see **Table 2.4**). A retrospective epidemiological study in 1991 at the Eastman Dental Hospital found that almost two-thirds of adult patients were less than 26 years, with 41% in the 18-21 age group (Khan and Horrocks, 1991). However, a more recent survey of all British orthodontists revealed that the most common age group treated was 26-35 years, followed by 36-45 years (Cedro et al., 2010). This slight rise in age may be due to increasing financial independence, with patients now being able to afford treatment which they could not in the past or due to patients returning as adults in their thirties with relapse of earlier treatment.

Table 2.4 - Studies assessing adult demographics (gender and age)

Study	Number of patients (P)/orthodontists	Female (%)	Mean age/ Range

	(O)/Hospital records (HR) surveyed		
Thilander (1979)	1186 (P)	63	31 years
Tayer and Burek (1981)	33 (P)	85	30.5 years
Breece and Nieberg (1986)	204 (P)	76	⅔rds between 18-27 years
Muir et al. (1986)	45 (O)	71	⅔rds between 18-25 years
Khan and Horrocks (1991)	676 (HR)	72	⅔rds between 18-25 years
Lew (1993)	203 (P)	70	23 years
Cedro et al. (2010)	1034 (O)	N/G	26-35 year olds most common age group followed by 36-45 years
Keim et al. (2011)	314 (O)	68.4	N/G
Cedro et al. (2012)	403 (HR)	76	31 years

There has also been a noticeable increase in older adults now seeking orthodontic treatment. In 1991, it was found that only 3.7% of adult patients were over the age of 42 years (Khan and Horrocks, 1991). However, a recent UK survey found that almost one fifth of orthodontists treat adults aged 55 years and older (Cedro et al., 2010). A US survey of orthodontists even found that the oldest patient under treatment was 71 years old (Keim et al., 2014). This trend in orthodontics amongst older adult patients is no doubt the product of adults keeping more teeth for longer and the rise in adjunctive orthodontic treatment.

2.3.2.3 Socioeconomic Status

Anecdotally, due to the high perceived cost of orthodontics, adult orthodontic patients are higher earning professionals. However, very little has been published about the socio-economic profile of adult patients to confirm this. A survey of 33 adult orthodontic patients found that 90% had college or postgraduate educational backgrounds (Tayer and Burek, 1981). Lew (1993) assessed 358 Chinese adults who had recently completed orthodontics in the University Hospital, Singapore and found that 78% were professionals, students or skilled workers, while 12% were unskilled workers and 10% were unemployed. In the US, Whitesides et al. (2008) assessed the demographic profile of adult users of orthodontic services. They found that single adults, women, and those from high-income families had significantly higher odds of reporting an orthodontic visit. However, they found no indication of racial or ethnic disparity between black/hispanic adults compared to white adults in the uptake of orthodontic services.

2.3.3 Motivations for Adult Orthodontics

There are multiple reasons which motivate adult patients to seek orthodontic treatment, including: improvement in dental and facial appearance, enhancement of speech and function, to raise self-esteem and confidence, to facilitate cleaning and enable other dental treatment to be carried out. To date, four studies of adult orthodontic patients and two surveys of adults in the general public have been conducted to explore their incentives for pursuing orthodontic treatment.

There is unanimous agreement that aesthetics is the main motivational factor in pursuing orthodontic treatment (Breece and Nieberg, 1986; McKiernan et al., 1991; Sergl and Zentner, 1997; Pabari et al., 2011). The earliest study which assessed adult motives was conducted on 204 adult orthodontic patients treated in the University of Nebraska-Lincoln and local private practices (Breece and Nieberg, 1986). The top three reasons cited were appearance, oral health and function. Pabari et al. (2011), in a qualitative study, found similar results, with a desire to straighten teeth (78%) and improve smile aesthetics (68%) being the main motives for adult patients.

Surveys of the general public in the UK (http://www.bos.org.uk/news/NOWYouGovSurvey) and Republic of Ireland (http://www.irishhealth.com/article.html?id=18951) revealed that 50% and 42% of people considering orthodontic treatment respectively would do so primarily to improve their appearance. Improvement in form and function was found to be the main motivating factor in 36% of Irish adults and 18% of UK adults. Furthermore, 21% of Irish adults and 25% of UK adults wanted treatment to improve their self-esteem. A small percentage of those surveyed in Ireland would even consider treatment to improve work and romantic prospects.

2.3.4 Adult Malocclusions

The aetiology of malocclusions in adult patients consists of the same genetic and environmental factors as in young patients. It has been shown that the prevalence of malocclusion in adults is quite similar to or greater than that observed in children and adolescents (McLain and Proffitt, 1985). Proffit et al. (1998) determined that almost two-thirds of adults have some form of malocclusion in the US. **Table 2.5** compiles studies which have assessed features of malocclusion in adult populations and below is a summary of the findings.

2.3.4.1 Skeletal & Incisor/Molar Relationships

Both UK studies, which assessed skeletal relationships, agreed that Class II was the most common and Class III the least common skeletal base in adult orthodontic patients (Khan and Horrocks, 1991; Cedro et al., 2012). However, there were still a relatively high percentage of Class III bases in both studies compared to adolescents; Cedro et al. (2012) found that 19% were Class III and Khan and Horrocks (1991) found 26%. This is not surprising given that growth can continue until late teens and it is often desirable to err on the side of caution and wait for completion of growth in Class III cases until starting treatment. The higher incidence of Class III skeletal bases seen in Khan and Horrocks (1991) study may be due to a higher percentage of males and the inclusion of orthognathic patients.

Incisor relationships closely matched their underlying skeletal bases with Class II division 1 being the most common, followed by Class I. The least common incisor relationship was Class II division 2. However, the incidence of Class II division 2 incisor relationships was still quite high (16.6%) in the Cedro et al. (2012) study. A premise for this may be the higher rate of relapse observed in Class II division 2 cases

(Mills, 1973; Canut and Arias, 1999). These patients may hence be more likely to re-attend for a second course of treatment.

Table 2.5 – Studies assessing the prevalence of adult malocclusions					
Study/Country	**Methodology**	**Skeletal Relationship (%)**	**Incisor/Molar Relationship (%)**	**Crowding/Spacing (%)**	**Overjet/Overbite (%)**
Khan and Horrocks (1991) * UK	• Retrospective epidemiological study • Case records of 676 UK adult orthodontic patients	S I: 27.8 S II: 46 S III: 26.2	*Incisor Classification:* Class I: 29.6 Class II div 1: 39 Class II div 2: 9.7 Class III: 21.6	N/S	N/S
Burgersdijk et al. (1991) Netherlands	• 3526 patients assessed • Statified cluster sampling	N/S	*Angles Classification:* Class I: 69 Class II: 28 Class III: 2	*Crowding: (>2mm)* ULS 30 (M:20-34yrs) 33 (F: 20-34yrs) LLS 53 (M:20-34yrs) 45 (F: 20-34yrs) *Spacing:* ULS 15 (M:20-34yrs) 10 (F: 20-34yrs) LLS 8 (M:20-34yrs) 7 (F: 20-34yrs)	*Overjet:* >5mm: 26 (F) 21 (M) Reverse: <1 *Overbite:* Deep OB: 16 AOB: 2

Salonen et al. (1992) Sweden	• Cross-sectional study of 669 adults	N/S	*Angles Classification:* Class I: 71.2 Class II: 23.2 Class III: 4.6	*Crowding:* 18.2 *Spacing:* 10.3	*Overjet:* N/S *Overbite:* Deep OB: 4.6 (gingival contact) AOB: 2.4
Tod and Taverne (1997) Australia	• Cross-sectional study of 216 adults	N/S	*Angles Classification*: Class I: 67.1 Class II: 28.7 Class III: 4.2	*Crowding*: ULS 25.9 LLS 45.4 *Spacing:* ULS 13 LLS 7	*Overjet:* ≥ 6mm: 16.2 Reverse: 2.3 *Overbite:* >5mm: 11.6 AOB: 4.2
Proffit et al. (1998) US	• Cross-sectional survey of 7000 adults, stratified by age and ethnicity	N/S	*Incisor Classification:* Class I: 43 Class II: 51.1 Class III: 5.8	*Crowding:* Upper: 56.9 Lower: 66.3 *Spacing:* N/S	*Overjet:* ≥5mm: 13.4 *Overbite:* ≥5mm: 15.2 AOB: 3.3

Whelton et al. (2007) Ireland	• 2556 patients assessed • Stratified random sample	N/S	N/S	N/S	*Overjet > 6mm*: 12 (16-24yrs) 7 (35-44yrs) 15 (65+ yrs)
Jonsson et al. (2007) Iceland	• Random sample of 829 adult population	N/S	*Molar Classification:* Class I: 65 Class II: 28 (half cusp or >) Class III: 7 (half cusp of >)	*Crowding:* ULS 7 LLS 13 *Spacing:* ULS 4.3 LLS 2	*Overjet:* ≥6mm: 5.3 Ant Xbite: 0.5 *Overbite:* ≥5mm: 11.6 AOB: 1.2

Cedro et al. (2012) * UK	• Retrospective observational study • Case records of 403 adult orthodontic patients at 2 hospitals	S I: 39.2 S II: 41.9 S III: 18.9	*Incisor Classification:* Class I: 30.8 Class II div 1: 35.2 Class II div 2: 16.6 Class III: 17.4	*Crowding*: ULS 48.6 LLS 49.4 *Spacing:* ULS 25.1 LLS 15.6	*Overbite:* AOB: 2
Claudino and Traebert (2013) Brazil	• Cross sectional study of 138 males	N/S	*Molar Relationship:* Normal 59.4 Half-cusp 14.5 Full-cusp 26.1	*Crowding:* One arch 33 Both arches 21.7 *Spacing:* One arch 15.9 Both arches 2.2	*Overjet:* 4-6mm: 19.5 *Overbite:* AOB: 7.1
Keys: N/S = Not specified; M=Males; F=Females; *=orthodontic population, S=Skeletal; ULS=Upper labial segment, LLS=Lower labial segment; AOB=Anterior open bite; Ant X-bite=Anterior crossbite; OB=Overbite					

The most common molar relationship was Angle's Class I. It is worth noting that the studies which assessed molar relationship were conducted on a random sample of adult patients, whereas the studies that assessed skeletal and incisor relationships used orthodontic-only populations. Therefore, Class II skeletal and incisor relationships may not be as common in the general adult population.

2.3.4.2 Overjet and Overbite

The 2002 Irish Oral Health Survey on over 2,500 adults revealed that just over 12% of randomly selected patients between 16-24 years had an overjet greater than 6mm (Whelton et al., 2007). This reduced to almost 6.5% in the 35-44 year age groups but rose to almost 15% in the over 65 year age group. This is most likely a consequence of labial drifting of incisors due to periodontal disease. According to a US survey of a randomly selected sample of adults approximately 50% of adults exhibit an excessive overjet (Proffit et al., 1998). Almost half of the sample had a deep overbite while 3% had an anterior open bite. This is similar to a study in the UK which revealed the incidence of anterior open bite in adults was 2% (Cedro et al., 2012).

2.3.4.3 Crowding and Spacing

Crowding has been cited as the predominant intra-arch problem in adults in the US and Western Europe, followed by spacing, crossbites and rotated teeth (Proffit et al., 1998; Buttke and Proffit, 1999). A US study revealed that crowding was more common in adult females (Proffit et al., 1998). In a UK orthodontic population, it was found that almost half of adults had crowded upper or lower labial segments; a quarter had spaced upper labial segments and 15% had spaced lower labial segments (Cedro et al., 2012).

2.3.5 Factors relating to Adult Treatment

2.3.5.1 Referral Pattern

The main source of adult patient referrals has been assessed and it has been noted that there is a difference in referral pattern between children and adults (Thilander, 1979; Musich, 1986; Lew, 1993). Traditionally, the General Dental Practitioner (GDP) was the main source of referral of adult patients, accounting for almost two-thirds of all referrals (Thilander, 1979; Musich, 1986; Khan and Horrocks, 1991; Lew, 1993). A study in 1991 found that GDPs provided 65% of all adult referrals to the Eastman Dental Hospital London, with only 3.1% being self-referrals and the remainder referred from other dental specialities within the hospital (Khan and Horrocks, 1991). This is comparable with a more recent UK study which revealed that 64% of adult referrals were from GDPs (Cedro et al., 2012). This is not surprising as both of these studies were conducted in a hospital-based setting, which is a secondary referral centre. However, the proportion of self-referrals has been found to be higher in private practice (Muir et al., 1986). Cedro et al. (2010) surveyed all UK orthodontists and revealed that a quarter of all adults were self-referred.

2.3.5.2 Re-Treatment

Re-treatment cases account for a significant proportion of adult orthodontics, ranging from 7.6% (Breece and Nieberg, 1986) to 50% (Sergl and Zentner, 1997). Relapse can occur for a variety of reasons, including; periodontal/gingival factors, occlusal factors, soft tissue factors or growth (Melrose and Millett, 1998). A study of Irish adults seeking orthodontic treatment revealed that 20% had received previous

treatment (McKiernan et al., 1991). Similar results were found in a UK study, with a quarter of active adult patients having already received a course of orthodontic treatment, particularly those with a Class II division 2 malocclusion (Khan and Horrocks, 1991). However, more recently, Cedro et al. (2012) found that only 15% of adult orthodontic patients were re-treatment cases. This reduction may be attributed to improved knowledge of stability and relapse among orthodontists.

2.3.5.3 Type of Adult Orthodontic Treatment

Table 2.6 outlines the studies which have assessed the type of treatment and appliances used in adult patients and below are a summary of the findings.

The use of removable appliances in adults has reduced in the last forty years from 30% in 1970 (Khan and Horrocks, 1991) to 4.7% in 2012 (Cedro et al.). This mirrors the general trend in orthodontics towards increased use of fixed appliances (O'Connor, 1993). A survey in the UK revealed that almost half of orthodontists used pre-adjusted edgewise brackets for treating their private adult patients and 27% used self-ligating brackets (Cedro et al., 2010).

Presently more adult patients are opting for aesthetic appliances, including ceramic/polycarbonate brackets, aesthetic wires, lingual appliances and clear aligners. The most popular aesthetic appliances used are aesthetic brackets, with almost 70% of UK orthodontists using them on their private adult patients. Orthodontists use clear aligners (30%) and lingual appliances (16%) less commonly (Cedro et al., 2010). This is not surprising as clear aligners are only appropriate for cases with mild crowding or spacing and lingual appliances are more technique sensitive and costly. Ultimately, the choice of appliance system comes down to multiple factors, including patient's and

orthodontist’s preference, degree of malocclusion, clinical setting and financial constraints.

Table 2.6 - Studies assessing types of adult orthodontic treatment			
Study/Country	**Setting/Population**	**Appliance Type (%)**	**Inter-disciplinary Treatment (%)**
Musich (1986)	• Private Practice	• N/S	*Orthodontics Only:* • 30.5 *Inter-disciplinary Tx:* • Dual Specialities: 45.2 • Multiple Depts: 24.3
Khan and Horrocks (1991) UK	• Hospital Setting • 676 adult cases records assessed	*Removable Appliances:* • 1970: 31.3 • 1985-88: 10.6 *Fixed Appliances:* • 1970: 68.7 • 1985-88: 89.4	*Orthodontics Only:* • 48.2 *Inter-disciplinary Tx:* • Orthognathic Surgery: 18.8 • Oral Surgery: 20.1 • Periodontal: 5.8 • Conservative: 12.6 • Prosthetics: 1
Cedro et al. (2010) UK	• All orthodontists on UK specialist registrar • Questionnaire to 1146 orthodontists with 70% response rate	*Removable Appliances:* (Invisalign) • NHS pts: 1.3 • Private pts: 30.5	*Orthodontics Only:* • 72.5

		Fixed Appliances: <u>Pre-adjusted edgewise</u> • NHS: 61.8 • Private: 6.8 <u>Tip-Edge</u> • NHS: 5.5 • Private: 3.2 <u>Self-Ligating</u> • NHS: 18.7 • Private: 27.6 <u>Aeshetic Brackets</u> • NHS: 3.6 • Private: 69.4 <u>Lingual</u> • NHS: 0.4 • Private: 16.1	*Inter-disciplinary Tx:* **(**22.8) • Restorative: 84.5 • Oral Surgery: 24.7 • Periodontal: 34
Cedro et al. (2012) UK	• Hospital Setting • 403 adult cases notes assessed	*Removable Appliances:* • Upper: 4.7 • Lower: 0.7	*Orthodontics only:* • 55.6

		Fixed Appliances: • SWA: 95.8 • Tip-Edge: 1.5 • Self-Ligating: 0 • Aesthetic: 0.5 • Lingual: 0.2	*Inter-disciplinary Tx:* • Oral Surgery: 13.4 • Periodontal: 12.9 • Restorative: 25.8 • Fixed Prosthodontics: 6.2
Keys: SWA=Straight Wire Appliance; Tx= Treatment; N/S=Not specified			

More interdisciplinary treatment is undertaken in adult patients compared to children. Studies reveal that the numbers of adults receiving orthodontics-only ranges from 30% to 72%. A UK survey found the most commonly involved disciplines were restorative (84%), followed by periodontology (34%) and oral surgery (24%) (Cedro et al., 2010). Patients are more likely to receive interdisciplinary treatment if they are treated in a hospital setting where almost one-fifth of adults comprise orthognathic cases (Khan and Horrocks, 1991).

A quarter of orthodontists in the UK have reported anchorage problems in their adult patients (Cedro et al., 2010). Transpalatal arches (TPA) have been found to be the most common source of additional anchorage for adults (Cedro et al., 2012). Despite the fact that temporary anchorage devices (TADs) are often endorsed as a valuable anchorage tool for adults, a retrospective study revealed that they were required in only 2% of adult cases (Cedro et al., 2012).

Extraction rates in adults have also been assessed by Cedro et al. (2012); they found that half of the adult sample already had missing teeth, mainly due to previous extractions (37%) and hypodontia (16%). Forty percent required upper arch extractions and 31.8% lower arch extractions as part of their orthodontic treatment. Even though extractions are often reported as enforced in adults, premolars were still the most frequent choice of extractions (Cedro et al., 2012). Lower incisor and molar extractions were carried out in 5% and 4.5% of the sample respectively.

Patient age and periodontal status have been shown to influence retainer choice by orthodontists in the Republic of Ireland (Meade and Millett, 2013). The use of bonded retainers has been advocated for adults with a history of periodontal disease (Johal and Ide, 1999). Only one study to date has evaluated the choice of retainers used for adult

patients and revealed that the majority received removable retainers, with a sizeable proportion having upper (23%) and lower (17.8%) fixed retainers (Cedro et al., 2012).

2.3.5.4 Treatment Experience

Multiple factors have been cited as problematic for adult patients including fear of pain, embarrassment, expense, duration of treatment, speech difficulties and lack of information. It has been stated that adult patients will tolerate orthodontics provided the treatment is less than nine months (Maini, 2013). This is probably true and the surge in adult patients availing of 'six month smile' treatment is testament to this.

Lew (1993) conducted a retrospective survey of 358 Chinese adults undergoing orthodontic treatment and assessed their opinions regarding the worst aspect of orthodontic treatment. In this Chinese sample the duration of treatment (45%), discomfort (24%), appearance of braces (22%) and maintenance of oral hygiene (9%) were regarded as the worst aspects of treatment. A more recent cross-sectional survey of 220 Indian adult orthodontic patients found slightly conflicting results with the most common problems being maintenance of oral hygiene (41%), duration of treatment (18.2%) and discomfort (15%) (Rajagopal, 2011). Perhaps the difference may be due to cultural variations in attitudes to oral hygiene regimes and pain thresholds. Brown and Moerenhout (1991) compared the pain experience of preadolescents, adolescents and adult patients to orthodontic treatment in a longitudinal study. Interestingly, the adolescent group experienced the highest level of pain during treatment. Another study showed that almost half of adult orthodontic patients found oral ulcers caused by the fixed appliance to be the most annoying part of the treatment (Kvam et al., 1989). The least common complicating factors reported by orthodontists in the UK regarding the treatment of adult patients has been assessed and includes pain, TMJ and speech problems (Cedro et al., 2010).

2.3.5.5 Treatment Outcome

There is a misconception that orthodontics takes longer in adults and with inferior outcomes to children. This is dependent upon the aims of treatment and whether comprehensive or compromise treatment is planned. Robb et al. (1998) found that there was no difference in overall duration of treatment between a sample of adults and adolescents undergoing fixed appliance therapy involving four premolar extractions. They also showed no significant difference between adults and adolescents in pre-treatment and post-treatment PAR (Peer Assessment Rating) scores. A retrospective study assessing the outcome of orthodontic treatment in adults found similar results with an average reduction of 73% in PAR scores for patients who were treatment planned with a goal of 'ideal treatment outcome' (Riedmann and Berg, 1999). However, in some older adults, limiting factors including dental, periodontal and medical status may call for a shorter treatment time with limited treatment goals.

2.4 SUMMARY OF LITERATURE REVIEW

Below is a summary of the key points from each section of this literature review.

2.1 Adult Orthodontics Overview

- Adult orthodontics can be classified as either comprehensive or adjunctive or according to age (young or old adults).
- Adult orthodontics is similar to child/adolescent orthodontics but differs due to specific age-related periodontal, restorative and psychosocial factors.

2.2 Adult Orthodontics and the Internet

- The Internet has become a valuable source of healthcare information, but reliability of the information is problematic.
- Four tools have been developed to overcome this.
- The profiles of typical searchers of online health information are educated females, aged 30-44 years.
- No study has yet assessed the quality of online information on adult orthodontics.

2.3 Adult Orthodontic Surveys

- Approximately one quarter to one fifth of all orthodontic patients are adults.
- Females, between 18-35 years, with third level education and professional backgrounds are the typical adult orthodontic patient.
- Class II division 1 incisor relationship and Class II skeletal base relationships are the most common malocclusions in adult orthodontic patients.

- Treatment with aesthetic appliances, including aesthetic brackets and wires, lingual appliances and clear aligner therapies are more common in adults.
- Compromised treatment plans may be required for adult patients due to multiple limiting factors.
- No comprehensive survey of adult orthodontics in the ROI has been conducted to date.

2.5 Aims and Null Hypotheses

AIMS

This project is divided into two parts with the following aims:

Aim 1

- To assess the quality, reliability and readability of information on the Internet on adult orthodontic treatment.

Aim 2

- To determine the profile and characteristics of adults undergoing orthodontic treatment by specialist orthodontists in the Republic of Ireland, including factors relating to their treatment and the methods by which they attain information.

NULL HYPTOTHESES

The following null hypotheses will be tested:

Null Hypothesis 1

- The quality, reliability and readability of information on the Internet on adult orthodontic treatment is of a high quality.

Null Hypothesis 2

- There is no variation in the profile, characteristics, treatment and methods of information provision to adults undergoing orthodontic treatment by specialist orthodontists in the Republic of Ireland.

CHAPTER THREE

MATERIALS AND METHODS

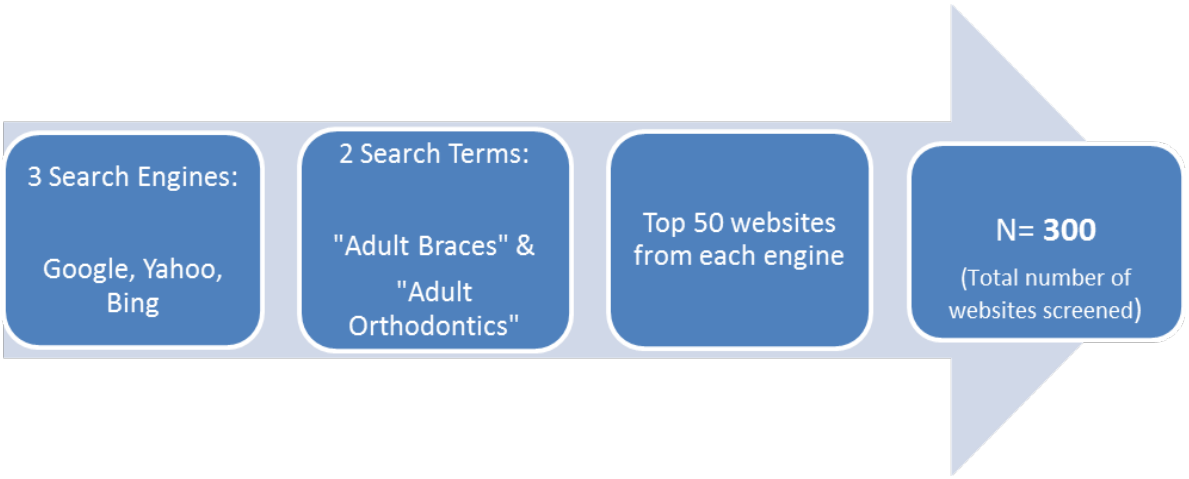
3.1 QUALITY OF INFORMATION ON THE INTERNET ON ADULT ORTHODONTICS

The first part of this project assessed the quality of information available on the Internet on the topic of adult orthodontics.

3.1.1 Search Strategy **(Fig 3.1)**

Three search engines were used in this study; Google, Yahoo and Bing. These were selected as they are the most commonly used search engines in Europe. The search was conducted in May 2015 by one operator. Default settings were not changed and the advanced search setting was not used. English language was used for the interface and operative system. The 'ncr' (no country re-direct) setting was used which prevents the searcher from automatically re-directing to their country-specific home page and, therefore, conducting a broader search. Two search terms were entered into each engine: "Adult Orthodontics" and "Adult Braces". The top fifty websites from each engine were selected. Paid advertisements were excluded. Fifty websites from three search engines, using two different search terms, brought the total number of websites screened to 300. The URL (unique resource locator) of these 300 websites was recorded and saved in an Excel spreadsheet.

Figure 3.1- Search strategy of the Internet for websites on adult orthodontics



3.1.2 Exclusion Criteria

The 300 websites selected were then screened and considered for inclusion in the study. The study aimed to evaluate the quality of websites whose purpose was to provide unbiased information to prospective adult orthodontic patients. Therefore, the following exclusion criteria were applied:

- Links to scientific articles
- Video Links
- Social Media Links
- Forums/Blogs/Discussion Groups
- Orthodontic Promotional Product Sites
- Dental Services Promotional sites
- Irrelevant News/magazine articles
- Private practice sites
- Irrelevant sites

Sites were considered irrelevant if they were not relating specifically to adult orthodontics and merely happened to contain the search terms used.

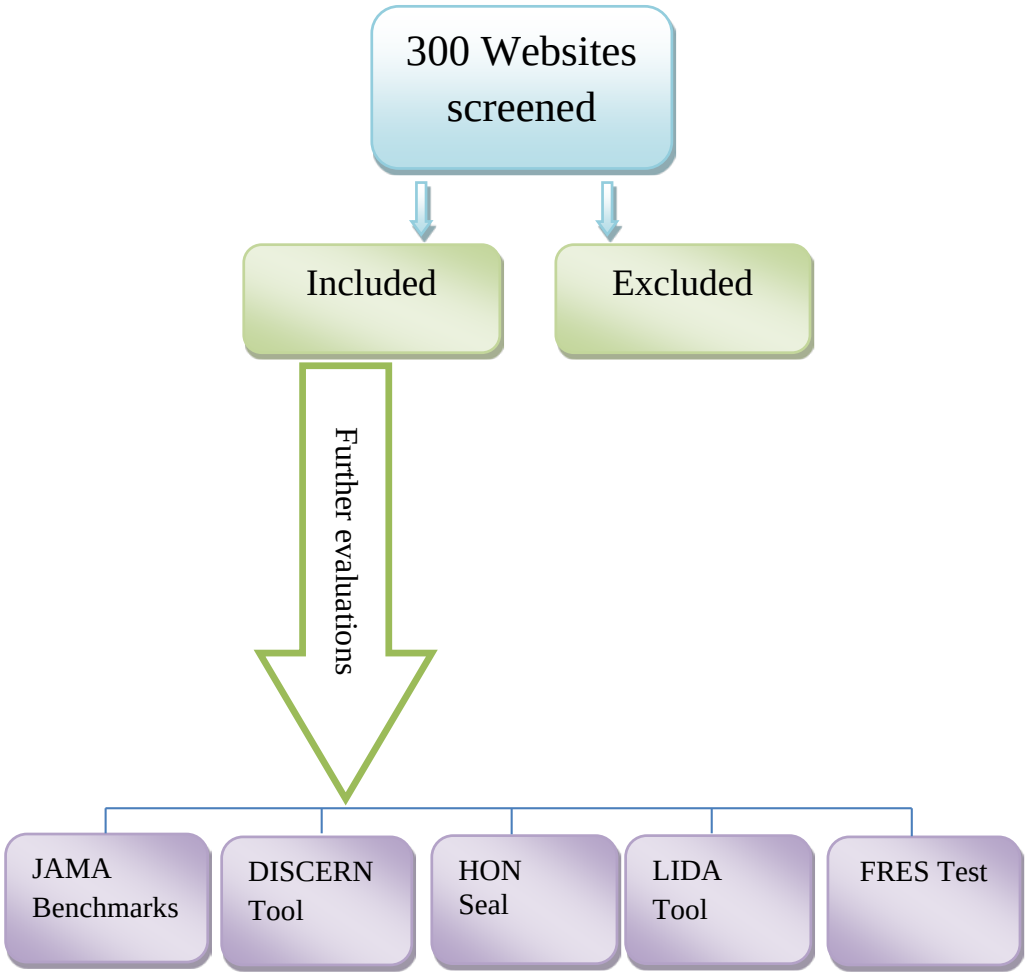
3.1.3 Quality Assessment

The included websites were then evaluated by one operator using three quality assessment tools: JAMA benchmarks, the DISCERN tool (Appendix 1) and the LIDA tool (Appendix 2). Whether or not the HON Seal was present on the websites was also recorded. The readability of included websites was assessed using the Flesh Reading Ease Score Test (FRES). This was done using an abstract of 200-500 words from each website copied and pasted into an online FRES calculator (www.readabilityformulas.com). **Figure 3.2** illustrates graphically the evaluation process. Final results were recorded on a data collection spreadsheet in Microsoft Excel.

3.1.4 Error Study

To test the intra-operator agreement for DISCERN and LIDA, all included websites were re-assessed by the same operator one month after the original assessment.

Figure 3.2 - Evaluation process for websites on adult orthodontics



3.2 SURVEY OF ADULT ORTHODONTICS AMONG SPECIALIST ORTHODONTISTS IN THE ROI

The second part of this project was a national survey about adult orthodontics in the ROI. Ethical approval was granted from University College Cork, Ireland (Appendix 3).

3.2.1 Questionnaire

A questionnaire was developed with reference to a previous shorter validated adult questionnaire by Cedro et al. (2010) and after several discussions with the project supervisor an outline of the questions to be included in the first draft was finalised. The questions were divided into four sections:

Section 1: General information about adult patients.

Section 2: Treatment information about adult patients.

Section 3: Information provision to adult patients.

Section 4: Participant demographics

The questions were designed in accordance with the guidance of Williams (2003), including the use of simple language, short and specific questions with no ambiguities. All questions were close-ended to prevent any questions going unanswered and facilitate coding for the final analyses.

The layout also followed Williams (2003) guidelines, with questions of appropriate font, a line separating each question, printed on good quality white paper with brightly

coloured front and back covers including a logo on the front cover. Clear instructions were given at the beginning of the questionnaire on how to navigate the questions.

Once the first draft of the questionnaire was developed pilot-testing was undertaken. This was to ensure its acceptability, identify any ambiguities and record the amount of time to complete it. Two cycles of pilot-testing were conducted by eight local orthodontists. Minor amendments to the questionnaire were made according to orthodontist's suggestions, including: adding more answer options for certain questions and broadening the percentage intervals in questions requiring a percentage answer. The average time to complete the questionnaire was ten minutes. Those orthodontists included in the piloting process were excluded from the final survey.

An e-version of the questionnaire, which was identical to the postal version, was developed using LimeSurvey® software. The e-questionnaire was piloted among departmental staff to ensure user-friendliness. The time to complete it was automatically recorded and was also under ten minutes.

The final questionnaire (Appendix 4) was then distributed to participants and two methods recommended to increase response rates were used:

- Contact of participants by telephone prior to distribution of the questionnaire and a monetary incentive (in this case entry into a €200 prize draw) (Dillman, 2000).
- The use of official-looking headed paper cover letters signed in blue ink, reminders and the inclusion of stamped addressed envelopes for return (Williams, 2003).

3.2.2 Participants

This survey was conducted using questionnaires distributed to specialist orthodontists within the ROI. The Dental Council of Ireland's Specialists Register of Orthodontists (as at August 2014) and the Orthodontic Society of Ireland members list (as at August 2014) were used as databases from which to obtain participant details. Orthodontists who were retired or not working within the ROI were excluded.

All orthodontists included were then contacted individually by telephone in September 2014. They were given a brief overview of the survey and the option of an e-mail or postal version if they wished to participate. Those orthodontists who were not contactable by telephone were automatically sent the questionnaire by post.

All participants were then sent a postal or e-questionnaire in October 2014 with an accompanying cover letter re-iterating the aims and anonymity of the survey. A deadline of four weeks, with a specified date was also included in the cover letter. Those who received the postal questionnaire were sent two stamped addressed envelopes to return the questionnaire and prize draw entry form separately. Those who received the e-questionnaire were also given the option to enter the prize draw via a separate link.

After the given deadline, any non-respondents were then sent a reminder with an accompanying second copy of the questionnaire. All questionnaires had a unique ID number. This ensured that respondents could be tracked and reminders were, therefore, only sent to non-respondents.

After the final deadline all returned questionnaires were gathered and sent to a data management company for analysis (SeefinDM, Listowel, Co.Kerry).

3.3 STATISTICAL METHODS

3.3.1 Quality of information on the Internet on adult orthodontics

Results are presented in graphical and tabular form with accompanying descriptive analyses. Spearman's rank correlation coefficents for LIDA and DISCERN were calculated for all included websites. Intraclass correlation coefficients were used to measure intra-operator agreement for the DISCERN and LIDA scores, which were re-evaluated one month after the initial assessment.

3.3.2 Survey of adult orthodontics among specialist orthodontists in the ROI

No formal statistical analysis was required for the survey of adult orthodontics by specialist orthodontists in the ROI. Results are presented in graphical and tabular form with accompanying descriptive analyses.

CHAPTER FOUR

RESULTS

4.1 QUALITY OF INFORMATION ON THE INTERNET ON ADULT ORTHODONTICS

4.1.1 Screening and Demographics of Included Websites

Following initial screening and application of exclusion criteria a total of 40 websites were included from all three search engines (see **Fig 4.1.1**). Twenty-seven of the 40 included websites were repeated in more than one search engine, bringing the final total of included websites to 13.

Table 4.1.1 lists the 13 websites included. Of these, 39% were developed by dentists, 15% by professional organisations, 15% by past patients and for 31% it was unclear (see **Fig 4.1.2**). The majority of websites were from the United States (see **Fig 4.1.3**).

Fig 4.1.1 – Screening Results from Internet search of adult orthodontics

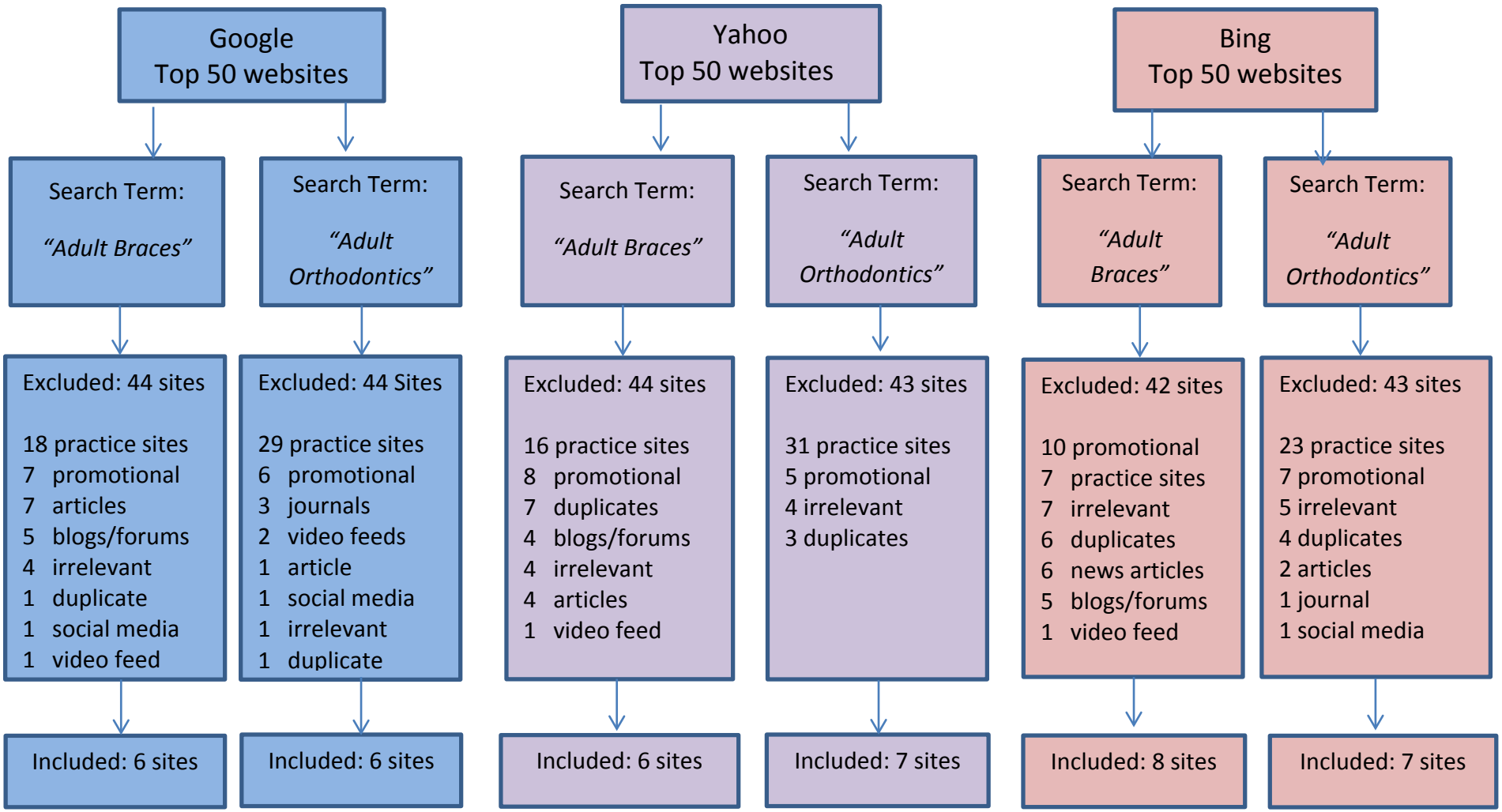


Table 4.1.1 – List of included websites from Internet search of adult orthodontics

1	www.knowyourteeth.com
2	www.oralb.com
3	www.deardoctor.com
4	www.archwired.com
5	www.bracesinfo.com
6	www.webmd.com
7	www.whybraces.com
8	www.orthodontics.org.uk
9	www.braces.org.uk
10	www.simplyteeth.com
11	www.ukadultbraces.co.uk
12	www.mynewsmile.com
13	www.bracesorthodontist.com

Figure 4.1.2 - Authors of websites on adult orthodontics

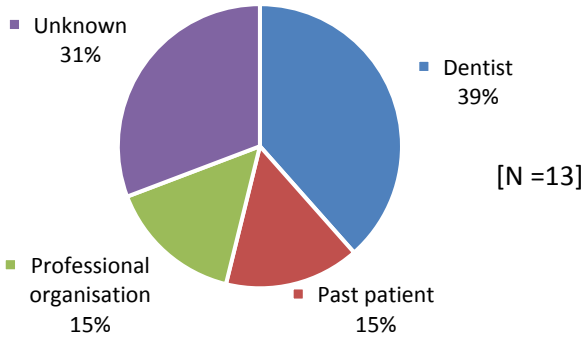
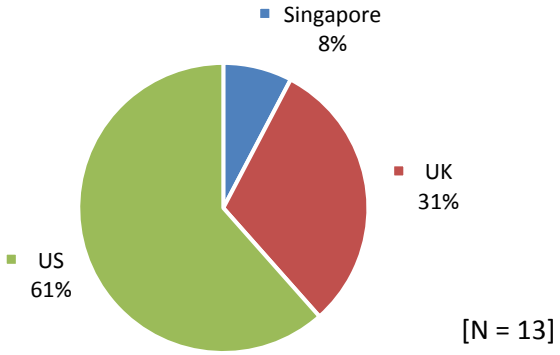


Figure 4.1.3 - Country of origin of websites on adult orthodontics

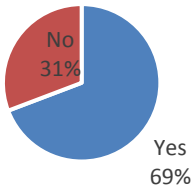


4.1.2 Reliability of Websites

JAMA Benchmarks

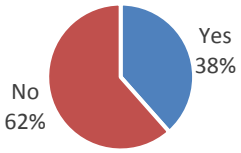
Results of the evaluation of websites for JAMA benchmarks are shown in **Figures 4.1.4.1 - 4.1.4.4.** Sixty-nine per cent of websites identified the author (**Fig 4.1.4.1**) and 85% indicated the date of content production, usually in the form of a copyright date (**Fig 4.1.4.4**). However, 62% of websites did not reference all sources of information (**Fig 4.1.4.2**) and 69% did not fully disclose information regarding site ownership, financing, advertising or conflicts of interest (**Fig 4.1.4.3**).

Figure 4.1.4.1 - JAMA Benchmarks for adult orthodontic websites : Authorship



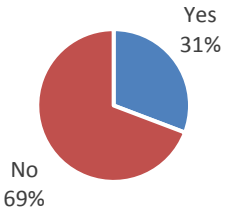
[N = 13]

Figure 4.1.4.2- JAMA Benchmarks for adult orthodontic websites: Attribution



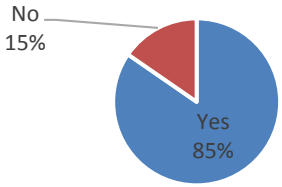
[N =13]

Figure 4.1.4.3 - JAMA Benchmarks for adult orthodontic websites: Disclosure



[N = 13]

Figure 4.1.4.4 - JAMA Benchmarks for adult orthodontic websites : Currency



[N = 13]

DISCERN

The DISCERN scores for each website are represented in **Figures 4.1.5.1 - 4.1.5.13.** The best websites according to the DISCERN tool were www.deardoctor.com (**Fig 4.1.5.3**), www.archwired.com (**Fig 4.1.5.4**) and www.webmd.com (**Fig 4.1.5.6**). The worst rated website was www.mynewsmile.com (**Fig 4.1.5.12**). Overall the questions which rated the best were question 2 (does it achieve its aims?), question 3 (is it relevant?) and question 9 (does it describe how each treatment works?) (**Fig 4.1.5.14**). The worst rated question was question 7 (does it provide details of additional sources of support and information?). The total scores for DISCERN (question 1-15), including domain 1 (1-8) and domain (9-15) are presented in Figure **4.1.5.15.**

Figure 4.1.5.1 - DISCERN scores for adult orthodontic websites: www.knowyourteeth.com

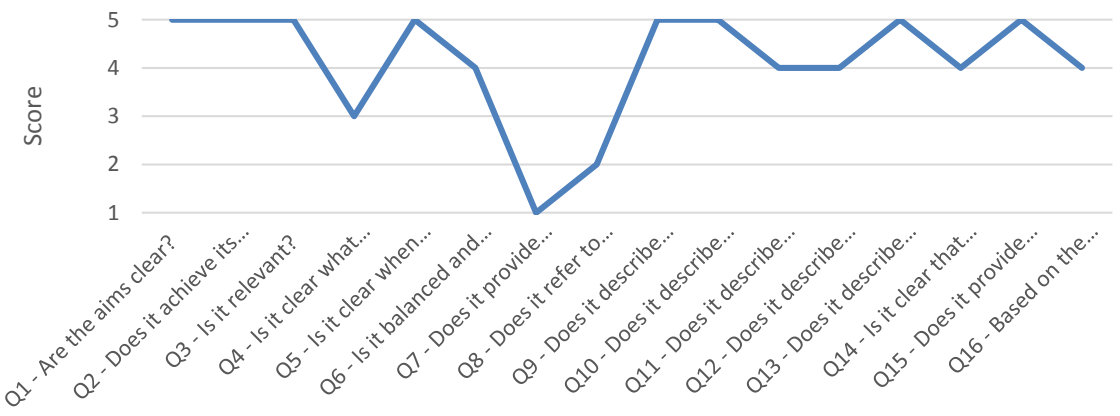


Figure 4.1.5.2 - DISCERN scores for adult orthodontic websites: www.oralb.com/embraceit

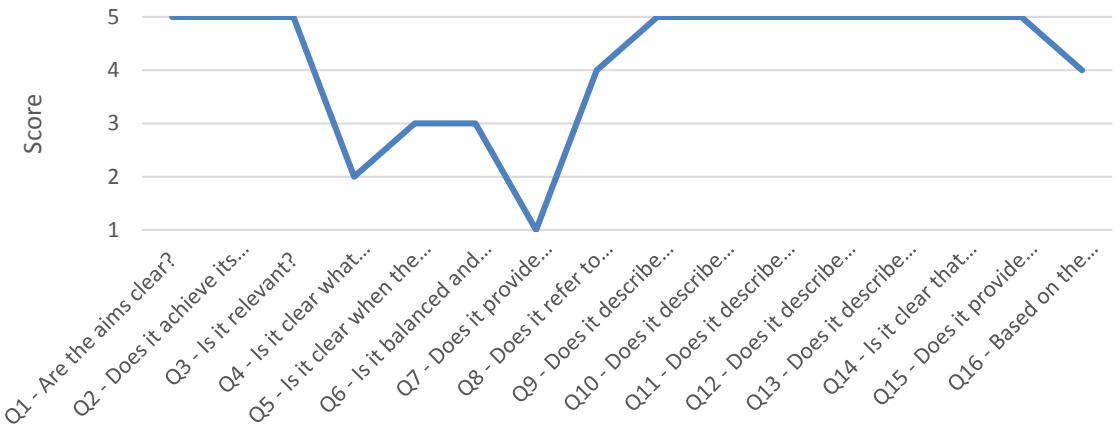


Figure 4.1.5.3 - DISCERN scores for adult orthodontic websites: www.deardoctor.com

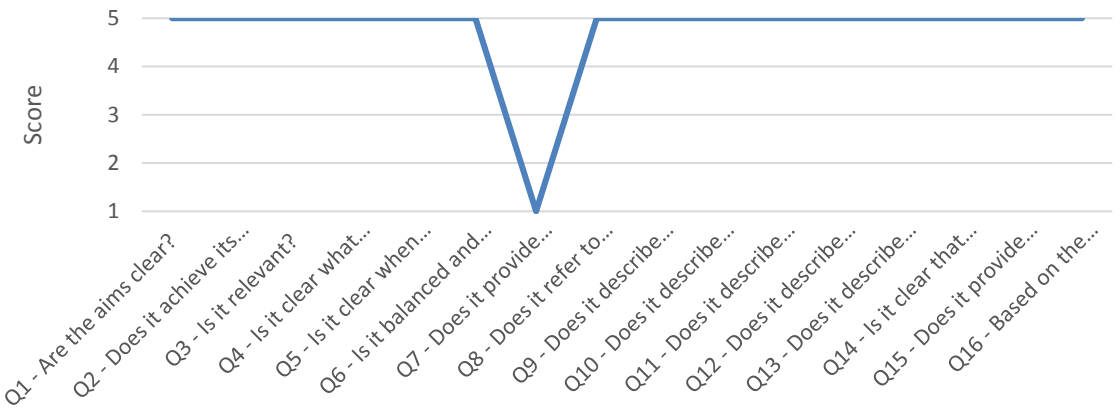


Figure 4.1.5.4 - DISCERN scores for adult orthodontic websites: www.archwired.com

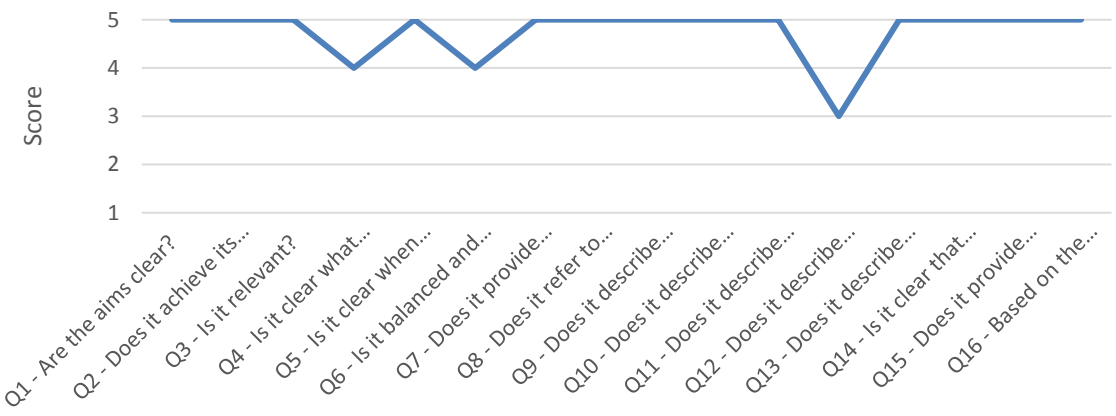


Figure 4.1.5.5 - DISCERN scores for adult orthodontic websites: www.bracesinfo.com

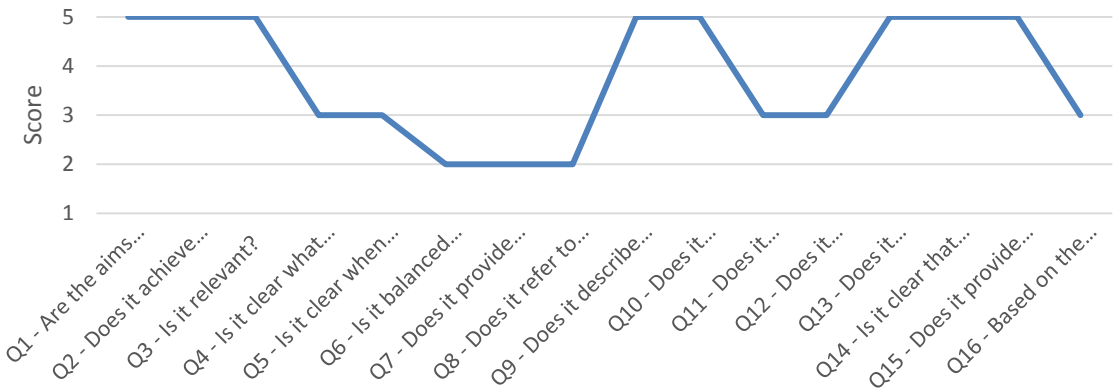


Figure 4.1.5.6 - DISCERN scores for adult orthodontic websites: www.webmd.com

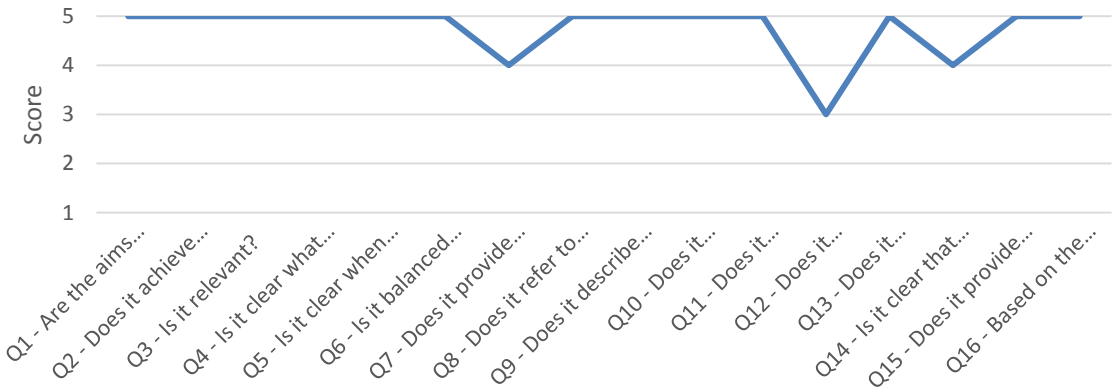


Figure 4.1.5.7 - DISCERN scores for adult orthodontic websites: www.whybraces.com

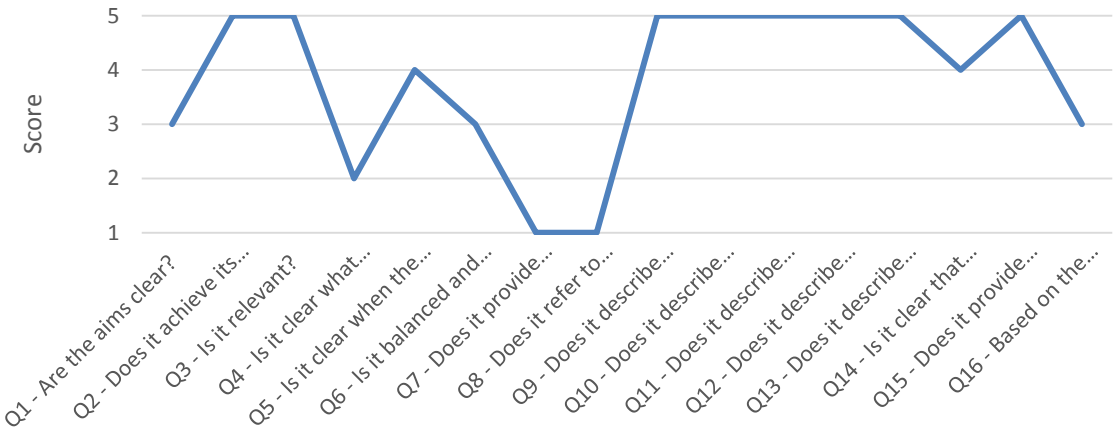


Figure 4.1.5.8 - DISCERN scores for adult orthodontic websites: www.orthodontics.org.uk

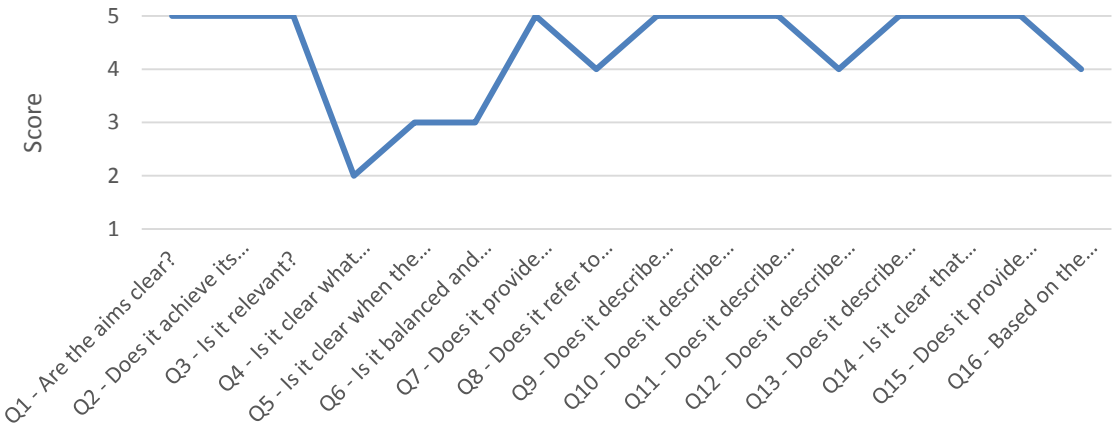


Figure 4.1.5.9 - DISCERN scores for adult orthodontic websites: www.braces.org.uk

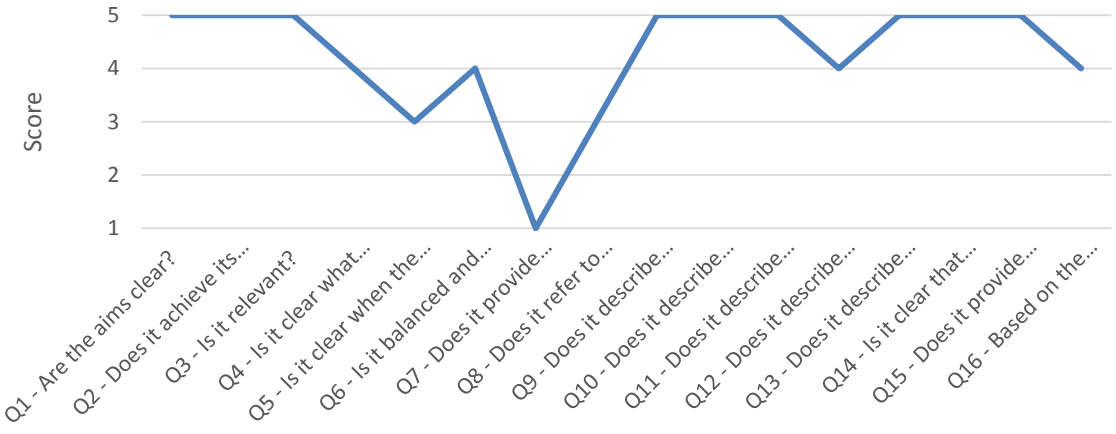


Figure 4.1.5.10 - DISCERN scores for adult orthodontic websites: www.simplyteeth.com

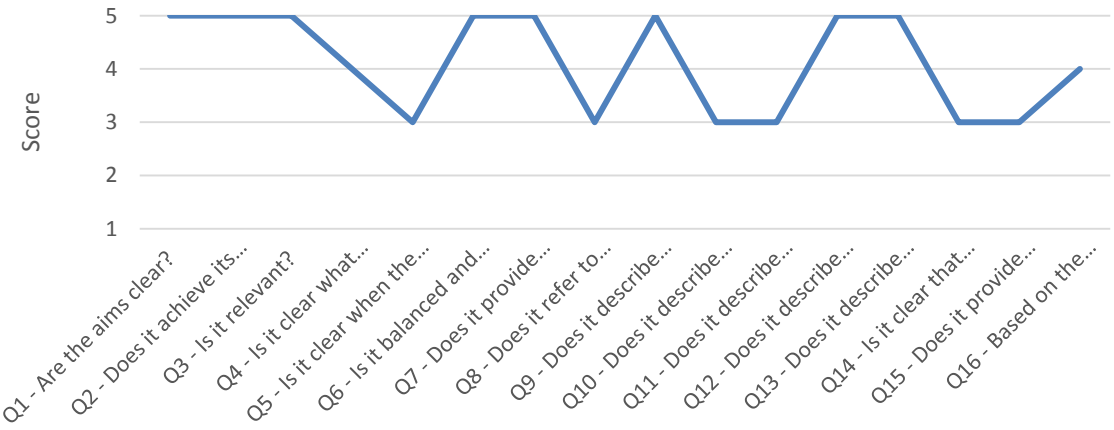


Figure 4.1.5.11 - DISCERN scores for adult orthodontic websites: www.ukadultbraces.co.uk

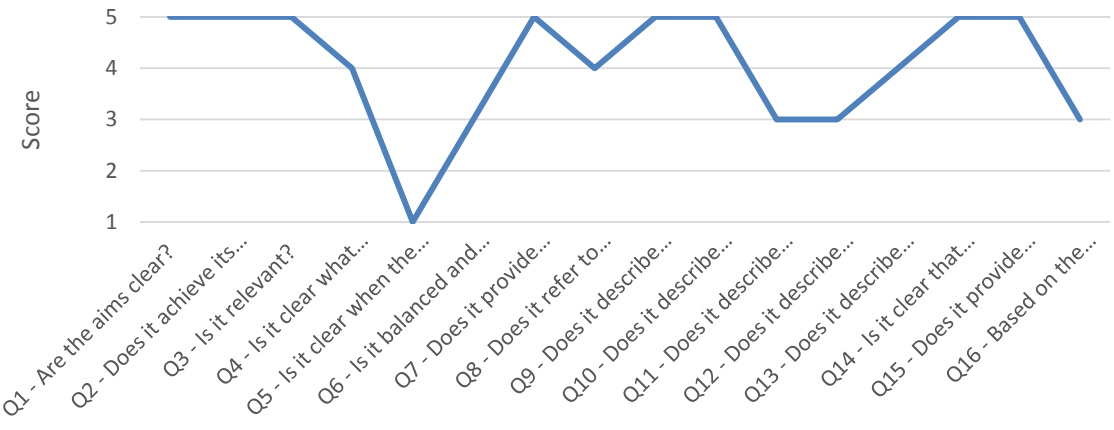


Figure 4.1.5.12 - DISCERN scores for adult orthodontic websites: www.mynewsmile.com

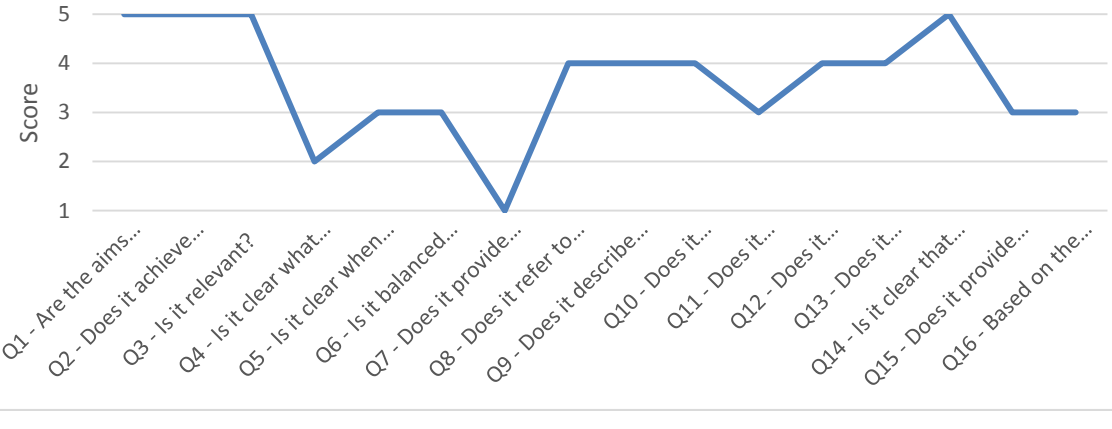


Figure 4.1.5.13 - DISCERN scores for adult orthodontic websites: www.bracesorthodontist.com

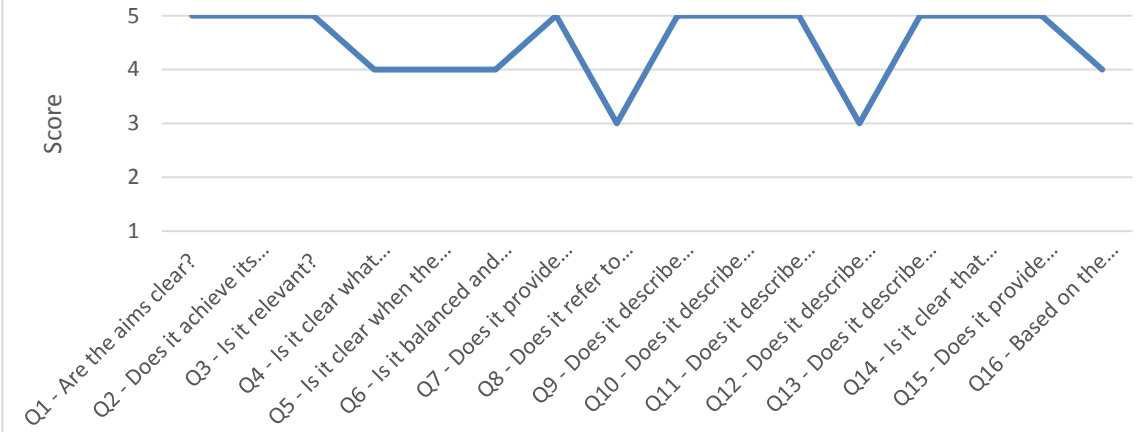


Figure 4.1.5.14 - DISCERN scores for adult orthodontic websites: Overall mean rating for each question

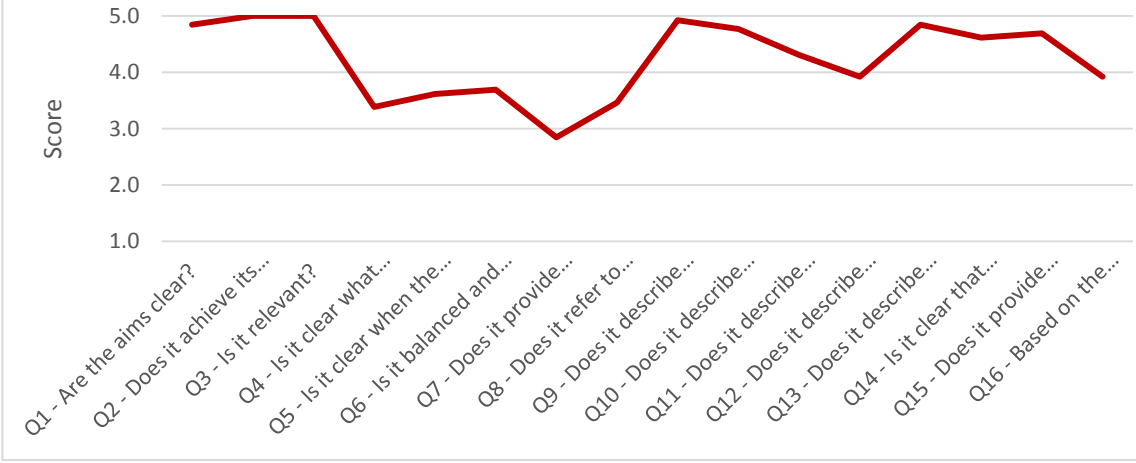
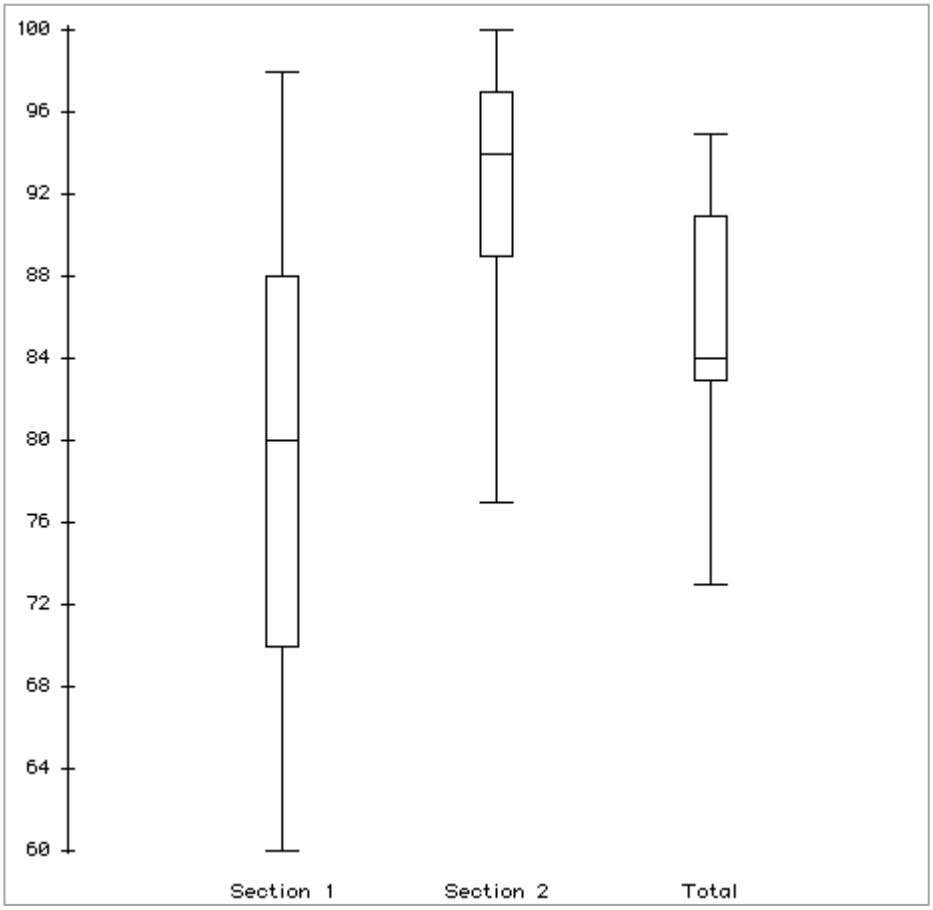


Figure 4.1.5.15 - DISCERN scores (%): section 1 (questions 1-8), section 2 (questions 9-15) and total (question 1-15)



LIDA Tool

Table 4.1.2 shows the LIDA scores for each website and **Figure 4.1.6.1** shows the percentage means and standard deviations according to accessibility, usability and reliability. **Figure 4.1.6.2** illustrates graphically the highest scoring websites in descending order. **Figure 4.1.6.3** shows the breakdown of LIDA scores according to accessibility, usability and reliability. Accessibility was the highest scoring domain and reliability was the lowest. Spearman's rank correlation coefficients were calculated for the 13 websites for DISCERN and LIDA (**Figure 4.1.6.4**). The correlation between DISCERN and LIDA (0.341) did not indicate a strong linear relationship between the two variables.

Table 4.1.2 - LIDA Scores for each website (n=13) on adult orthodontics

Website	Level 1 - Accessibility	Level 2 - Usability	Level 3 - Reliability	Total
www.knowyourteeth.com	57	44	18	119
www.oralb.com/embraceit	55	49	13	117
www.deardoctor.com	52	45	24	121
www.archwired.com	48	49	26	123
www.bracesinfo.com	59	42	6	107
www.webmd.com	59	42	24	125
www.whybraces.com	63	47	13	123
www.orthodontics.org.uk	60	41	9	110
www.braces.org.uk	60	44	16	120
www.simplyteeth.com	52	43	16	111
www.ukadultbraces.co.uk	55	43	9	107
www.mynewsmile.com	52	44	16	112
www.bracesorthodontist.com	56	40	9	105

Figure 4.1.6.1 - LIDA scores (%): accessibility, usability, reliability and total

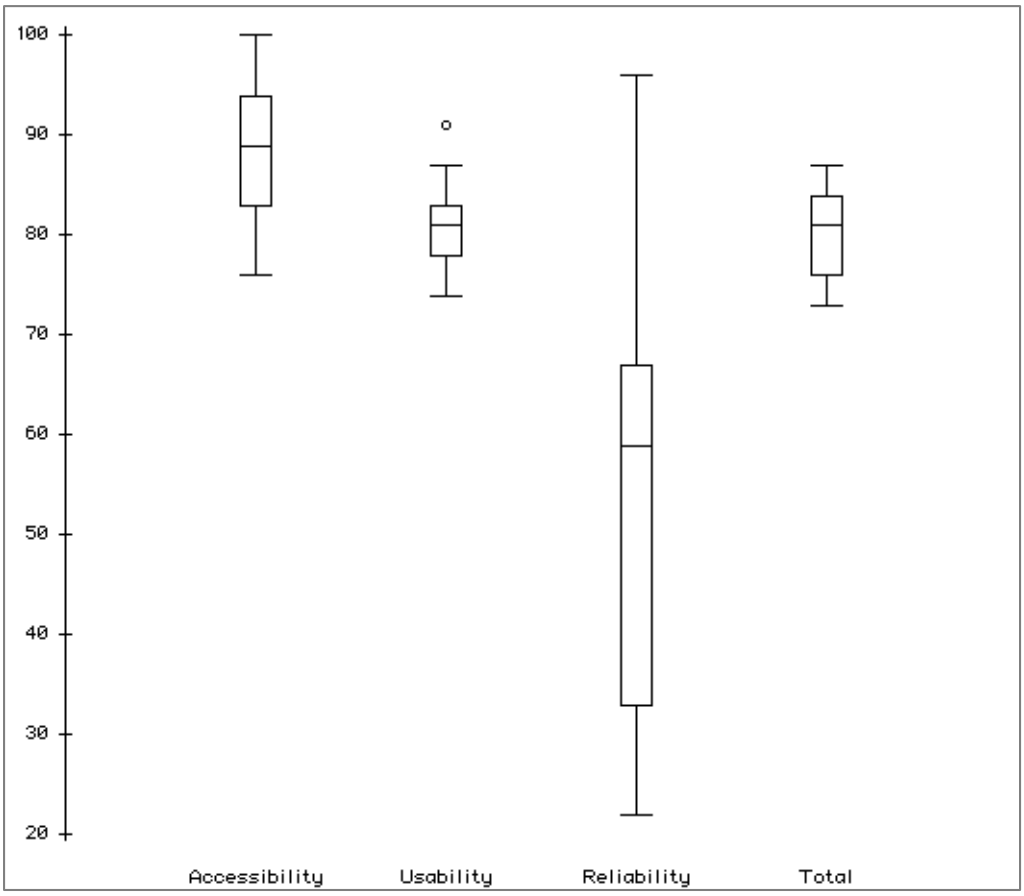


Figure 4.1.6.2 - Overall LIDA scores (%) for each website (n=13) on adult orthodontics

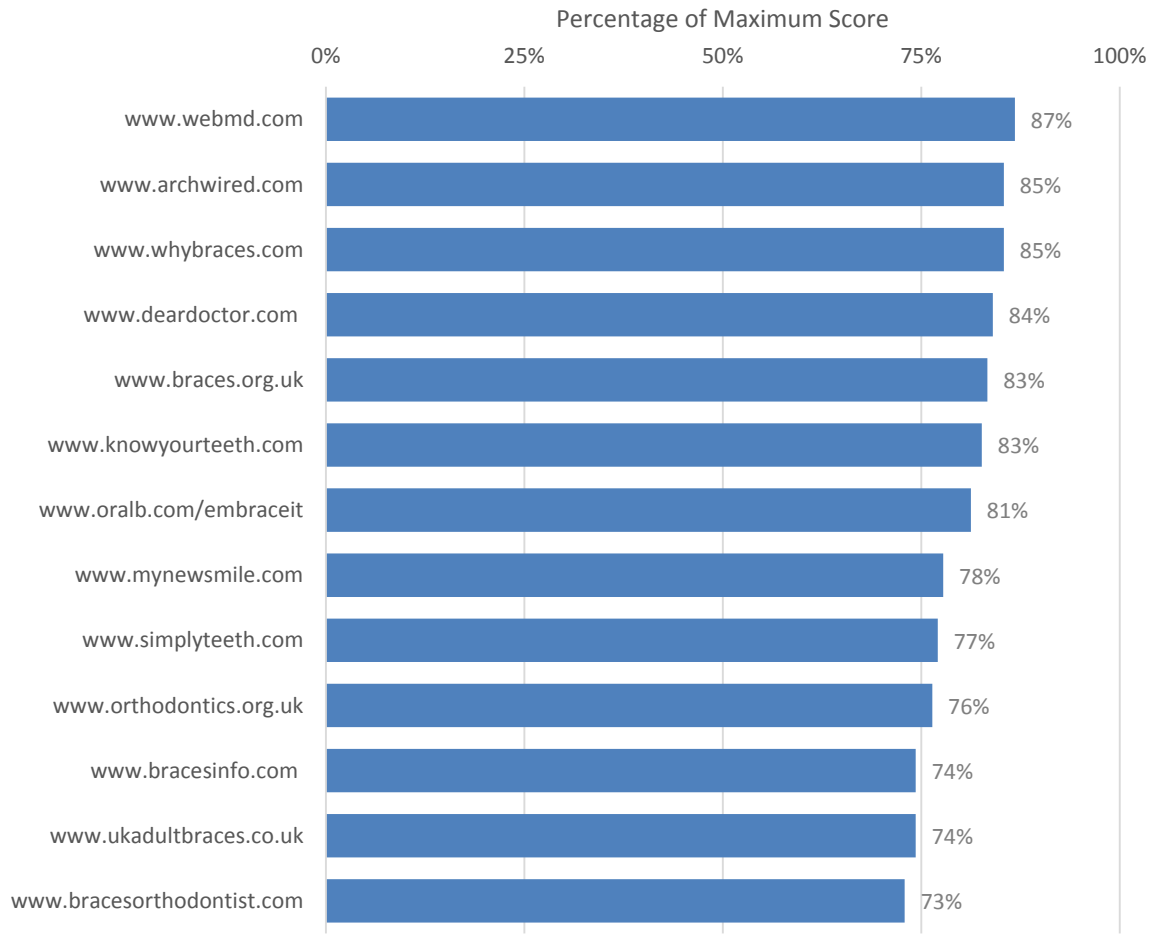


Figure 4.1.6.3 - LIDA scores (%) for each website (n=13) on adult orthodontics: accessibility, usability, reliability

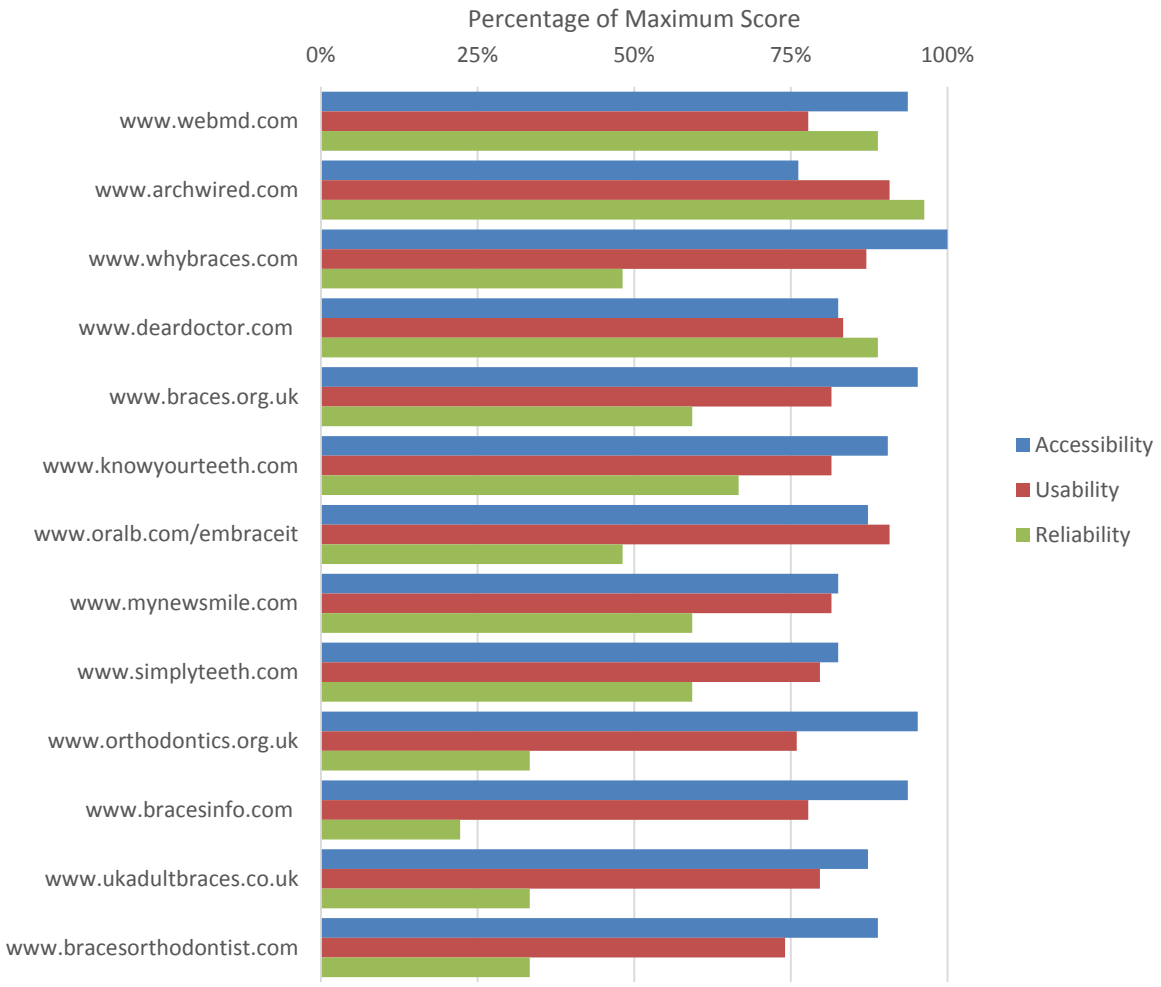
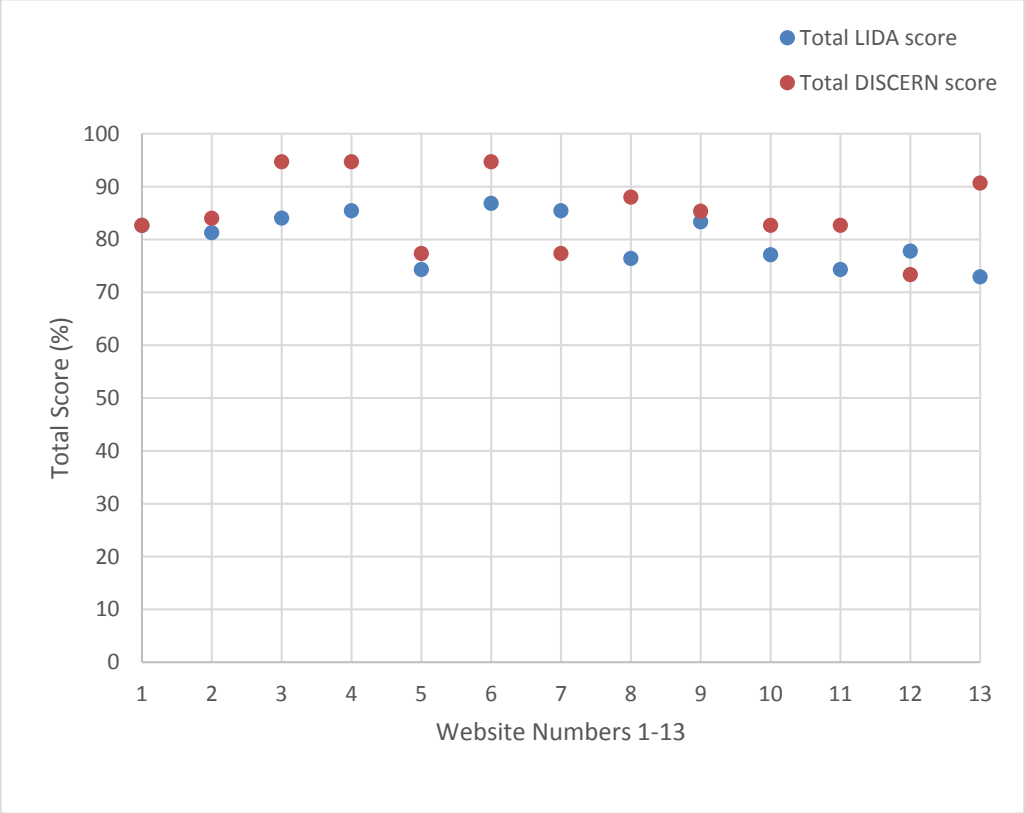


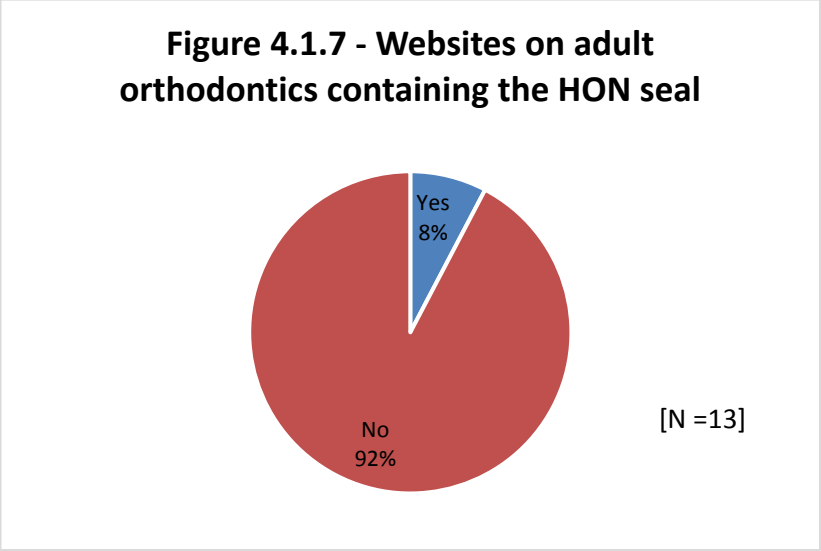
Figure 4.1.6.4 – Correlation between DISCERN and LIDA scores (%)



Keys: Websites numbers 1-13
1 = www.knowyourteeth.com
2= www.oralb.com/embraceit
3= www.deardoctor.com
4= www.archwired.com
5= www.bracesinfo.com
6= www.webmd.com
7= www.whybraces.com
8= www.orthodontics.org.uk
9= www.braces.org.uk
10=www.simplyteeth.com
11=www.ukadultbraces.co.uk
12=www.mynewsmile.com
13=www.bracesorthodontist.com

HON Seal

The HON Seal was identified on only 1 website (www.webmd.com) (**Fig 4.1.7**)



4.1.3 Readability of Websites

Flesch Reading Ease Score

The website which was the easiest to read was www.bracesinfo.com and the most difficult was www.knowyourteeth.com (**Fig 4.1.8.1**). The average FRES score was 63.1, with a standard deviation of 6.7 **(Fig 4.1.8.2)** which is considered a standard level of readability.

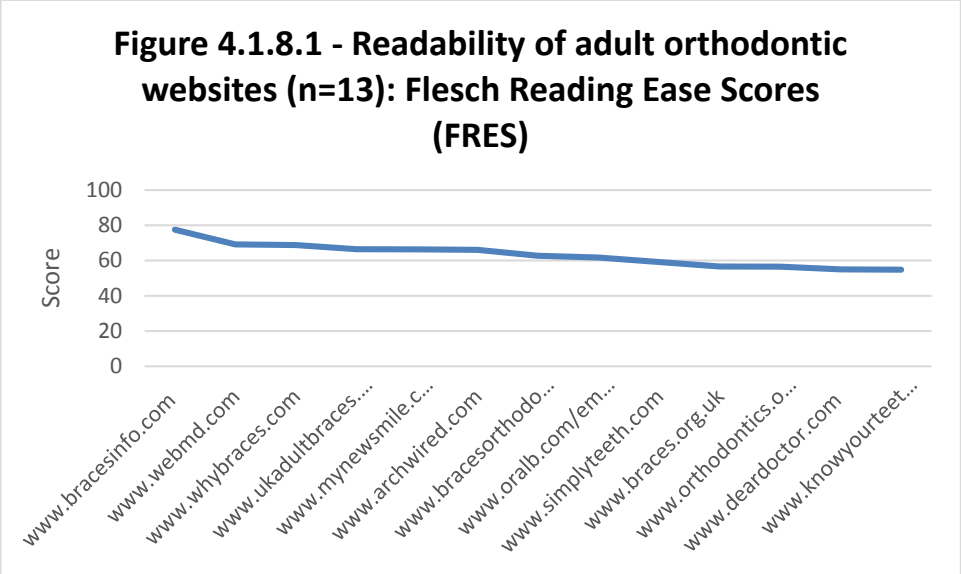
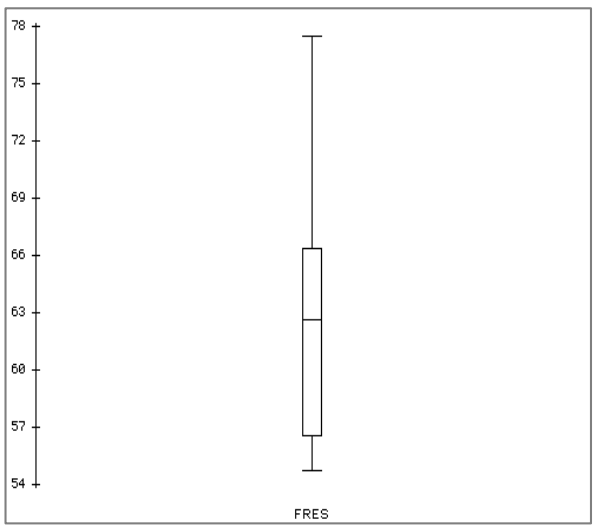


Figure 4.1.8.2 - Readability scores (%) for adult orthodontic websites



4.1.4 Error Study

The intraclass correlation coefficients (ICC) for DISCERN and LIDA are shown in **Tables 4.1.3 and 4.1.4**. The ICC for DISCERN was 0.825 and 0.965 for LIDA indicating strong intra-operator agreement.

Table 4.1.3 Intraclass Correlation Coefficient - DISCERN

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.825	.536	.943	10.438	12	13	.000
Average Measures	.904	.698	.970	10.438	12	13	.000

.

Table 4.1.4 Intraclass Correlation Coefficient - LIDA

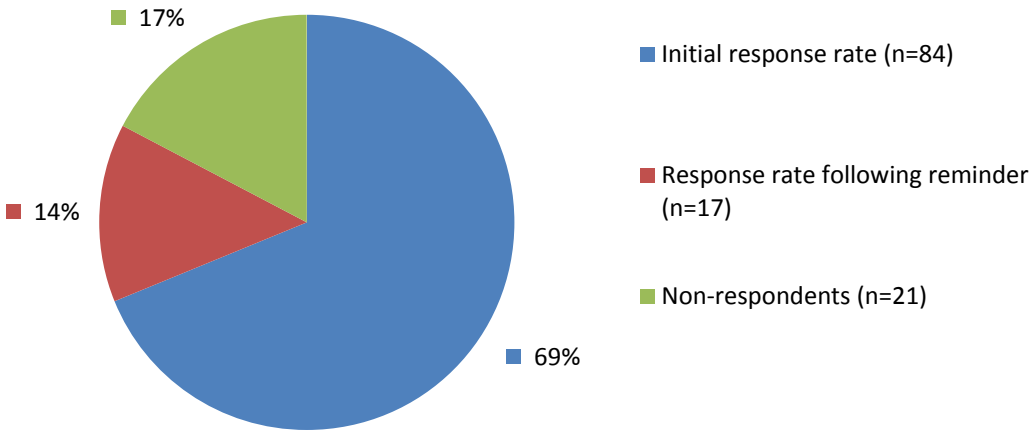
	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.965	.893	.989	55.883	12	13	.000
Average Measures	.982	.944	.994	55.883	12	13	.000

4.2 SURVEY OF ADULT ORTHODONTICS AMONG SPECIALIST ORTHODONTISTS IN THE ROI

4.2.1 Response Rate

A total of 122 questionnaires were sent to specialist orthodontists in the ROI after implementation of the exclusion criteria. This included 71 postal questionnaires and 51 e-questionnaires. The final overall response rate was 82.7%, with 60 and 41 postal and e-questionnaires returned respectively. **Figure 4.2.1** represents the overall response rate according to initial responses and subsequent responses following a reminder.

Figure 4.2.1 : Overall response (n ; %) for survey of adult orthodontics in the ROI



Figures 4.2.2 and 4.2.3 further breaks down response rates according to the mode of survey delivery (postal or electronic). After the first round of survey distribution, e-surveys generated more responses than postal surveys. Paradoxically, after the second round of survey distribution, following a reminder, postal surveys generated more responses. Overall, the response rate was slightly higher amongst those who received the postal questionnaire (84.5%) compared to the e-questionnaire (80.3%).

Figure 4.2.2 - Postal response (n ; %) for survey of adult orthodontics in the ROI

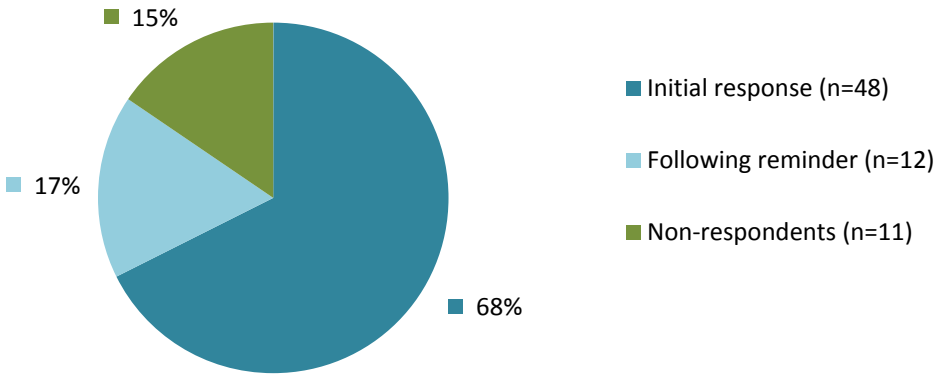
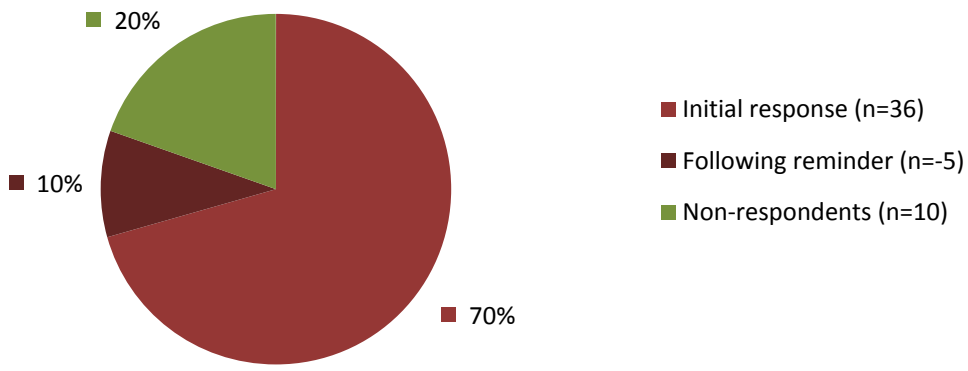


Figure 4.2.3 - Electronic response (n ; %) for survey of adult orthodontics in the ROI



4.2.2 Section 1 - General Information (Figures 4.2.4 to 4.2.14)

Ninety-five per cent of all specialists in the ROI treat adult patients (**Fig 4.2.4**). Adults mainly constituted 10-<20% of an orthodontists total caseload (**Fig 4.2.7**). The main sources of referral of adult patients were self-referral (40%), followed by GDP referrals (35%) (**Fig 4.2.5**).

Most adult patients were professional (**Fig 4.2.6**), female (**Fig 4.2.9.2**) and aged between 25-35 years (**Fig 4.2.8**). Most orthodontists (61%) saw a small proportion (0-<10%) of older adults, aged over 45 years (**Fig 4.2.10.1**).

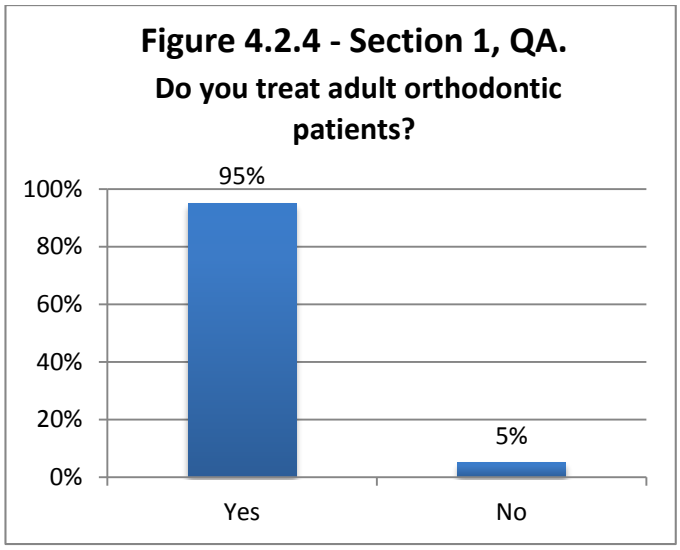
Sixty percent of orthodontists indicated that of their adult patients, between 0-<20% had previous orthodontic treatment (**Fig 4.2.10.2**) and 68% specified that between 0-<30% of adult patients had past non-orthodontic extractions carried out (**Fig 4.2.10.3**).

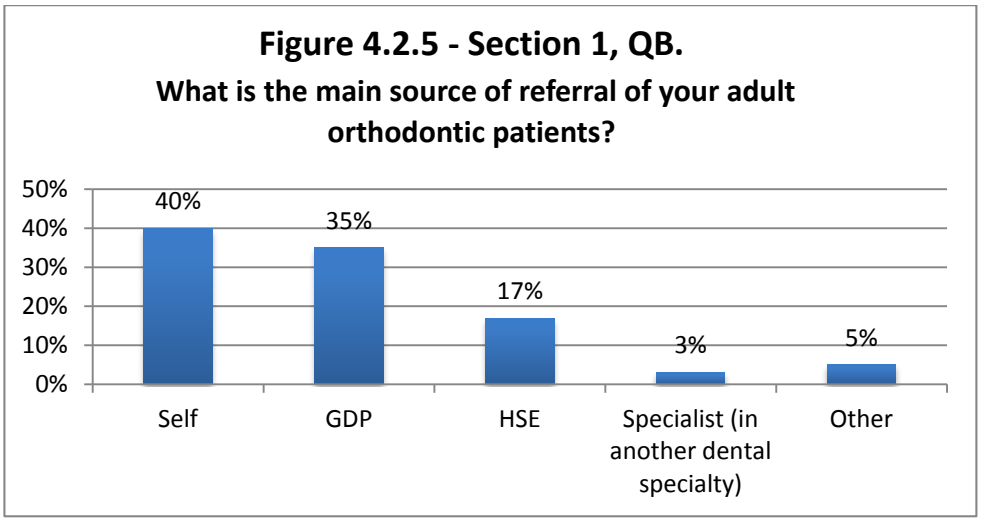
Over half of the orthodontists responded that less than 20% of their adult patients have/had periodontal problems (**Fig 4.2.10.4**). Most orthodontists (67%) experienced TMD in a small proportion (<10%) of their adult patients (**Fig 4.2.10.5**).

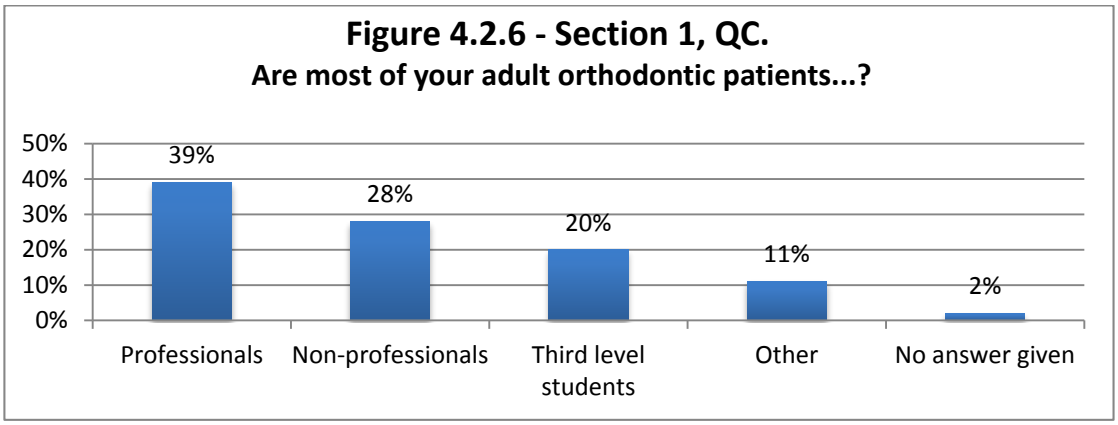
Improvements in dental and smile aesthetics were the most common reasons that orthodontists believed adults seek treatment (**Fig 4.2.11**) and improvement in function was the least common.

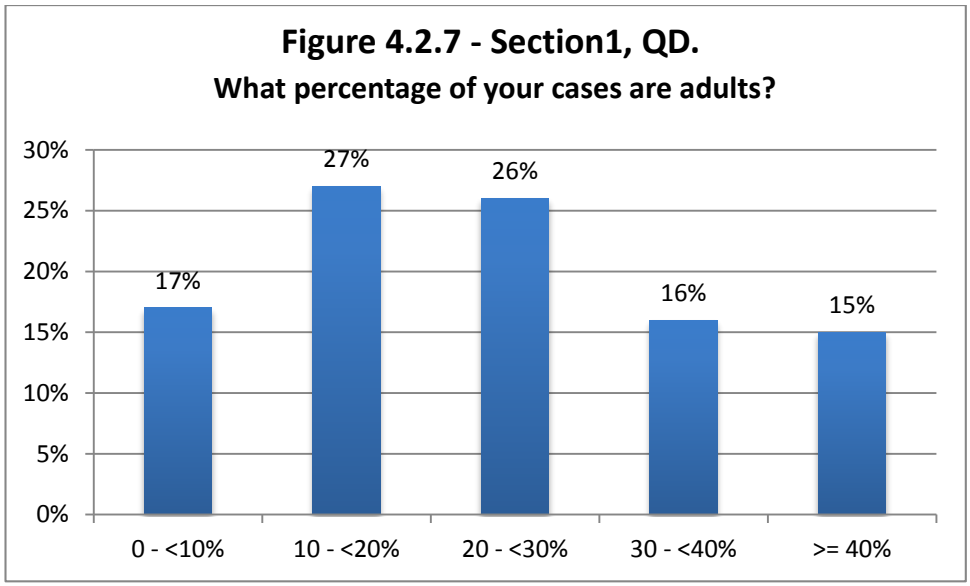
Class II Division 1 (51%) and Class II bases (61%) were the most prevalent incisor and skeletal relationships reported (**Fig 4.2.12** and **Fig 4.2.13**). Generalized crowding, late lower incisor crowding, increased overjet and deep overbite were the most common anomalies (**Fig 4.2.14**). Reverse overjet and anterior openbite were the least common.

Section 1 - General Information (Questions A-K)


Figure 4.2.4 - Section 1, QA.
Do you treat adult orthodontic patients?
100%
80%
60%
40%
20%
0%
95%
5%
Yes
No


Figure 4.2.5 - Section 1, QB.
What is the main source of referral of your adult orthodontic patients?
50%
40%
30%
20%
10%
0%
40%
35%
17%
3%
5%
Self
GDP
HSE
Specialist (in another dental specialty)
Other


Figure 4.2.6 - Section 1, QC.
Are most of your adult orthodontic patients...?
50%
40%
30%
20%
10%
0%
39%
28%
20%
11%
2%
Professionals
Non-professionals
Third level students
Other
No answer given


Figure 4.2.7 - Section1, QD.
What percentage of your cases are adults?
30%
25%
20%
15%
10%
5%
0%
17%
27%
26%
16%
15%
0 - <10%
10 - <20%
20 - <30%
30 - <40%
>= 40%

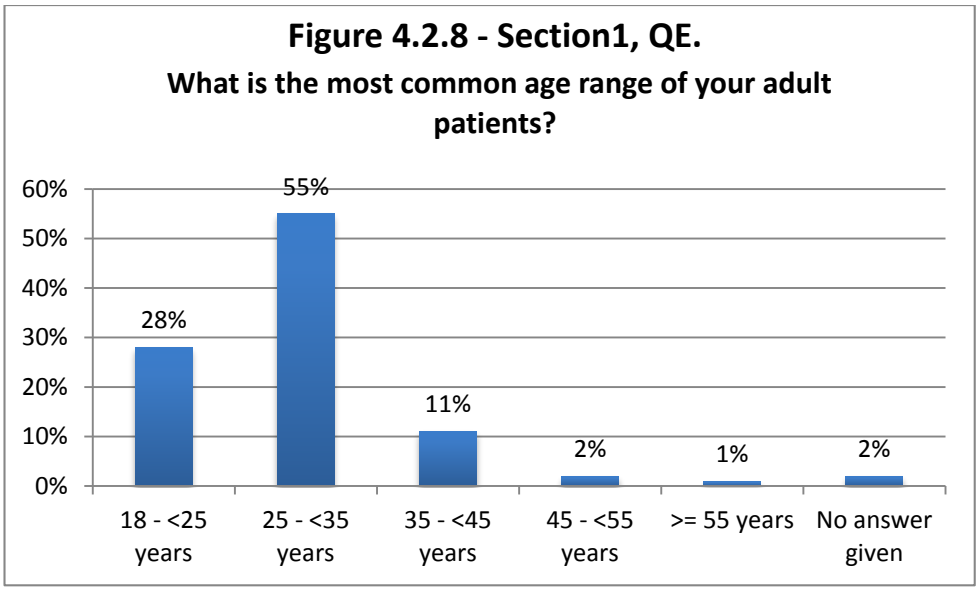

Figure 4.2.8 - Section1, QE.
What is the most common age range of your adult patients?
60%
50%
40%
30%
20%
10%
0%
28%
55%
11%
2%
1%
2%
18 - <25 years
25 - <35 years
35 - <45 years
45 - <55 years
>= 55 years
No answer given

Figure 4.2.9.1 - Section1, QF.
What percentage of your adult patients are male?

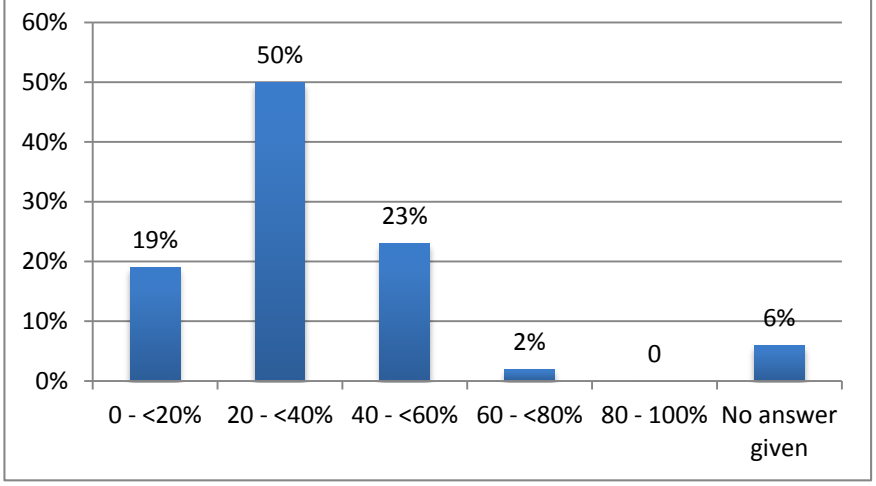


Figure 4.2.9.2 - Section1, QF.
What percentage of your adult patients are female?

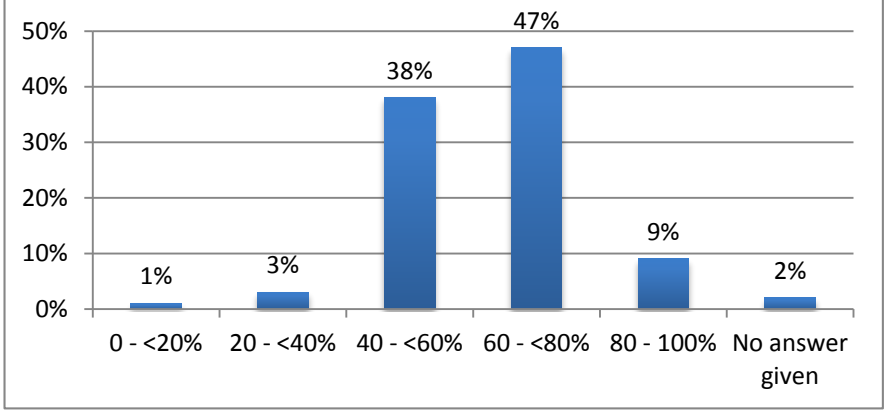


Figure 4.2.10.1 - Section 1,QG.

What percentage of your patients.....Are over 45 years?

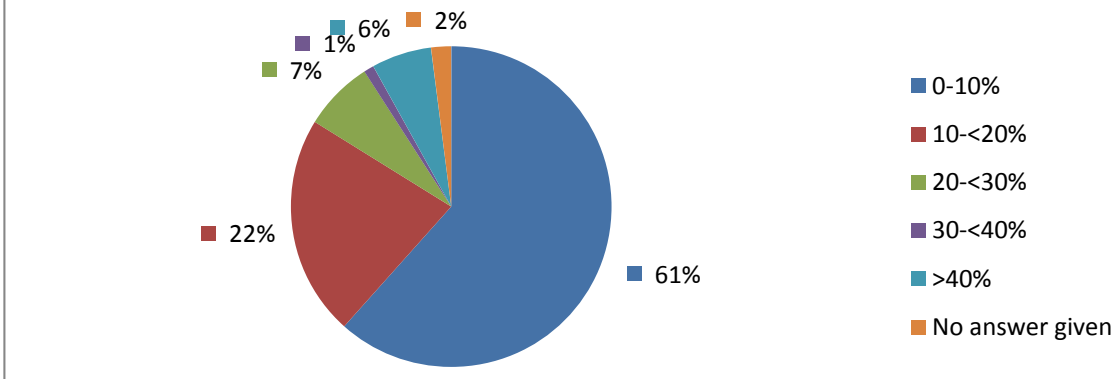


Figure 4.2.10.2 - Section 1,QG.

Have had previous orthodontic treatment?

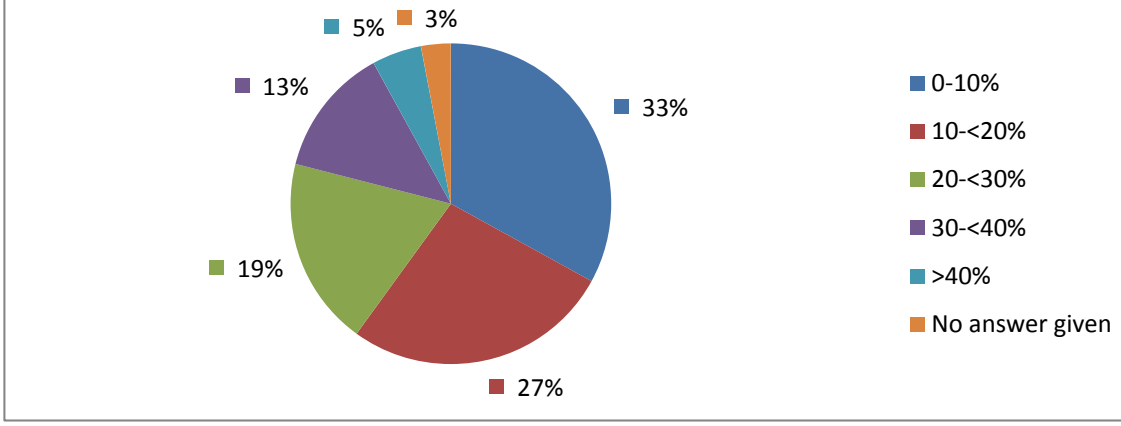


Figure 4.2.10.3 - Section 1,QG.

Had previous extractions for non-orthodontic tx?

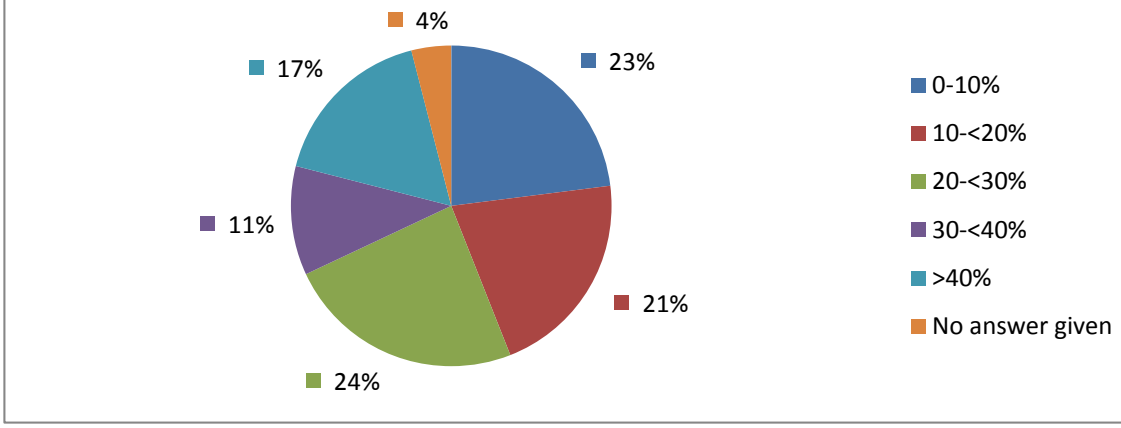


Figure 4.2.10.4 - Section 1,QG.
Have/had periodontal problems?

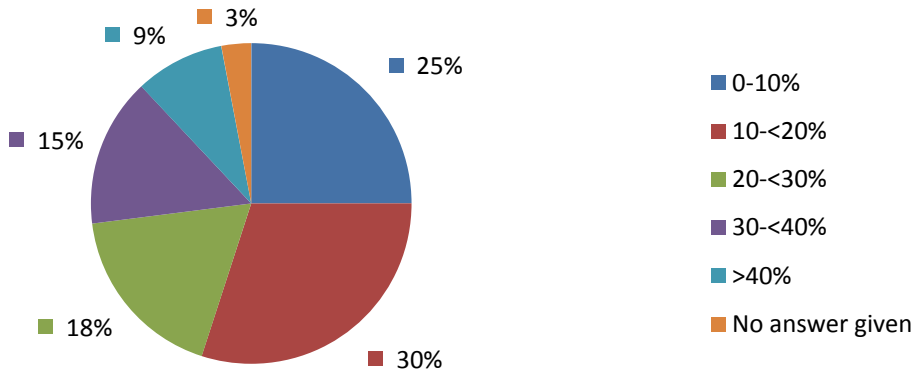


Figure 4.2.10.5 - Section 1,QG.
Have/had TMD problems?

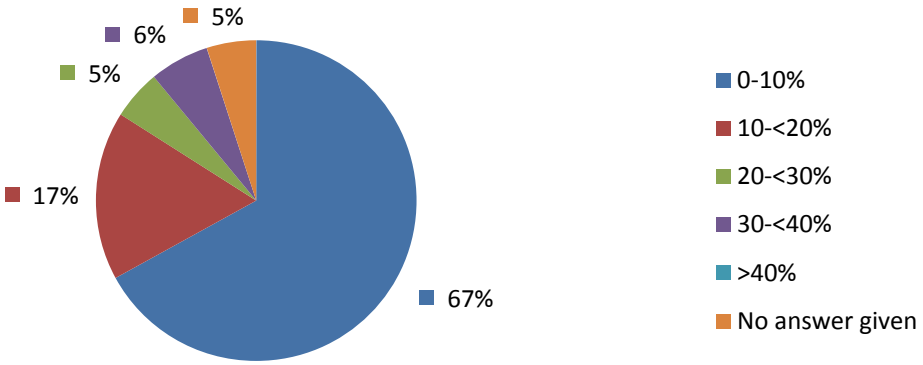


Figure 4.2.11 - Section 1, QH.
Why, in your opinion, do adult patients seek orthodontic treatment?

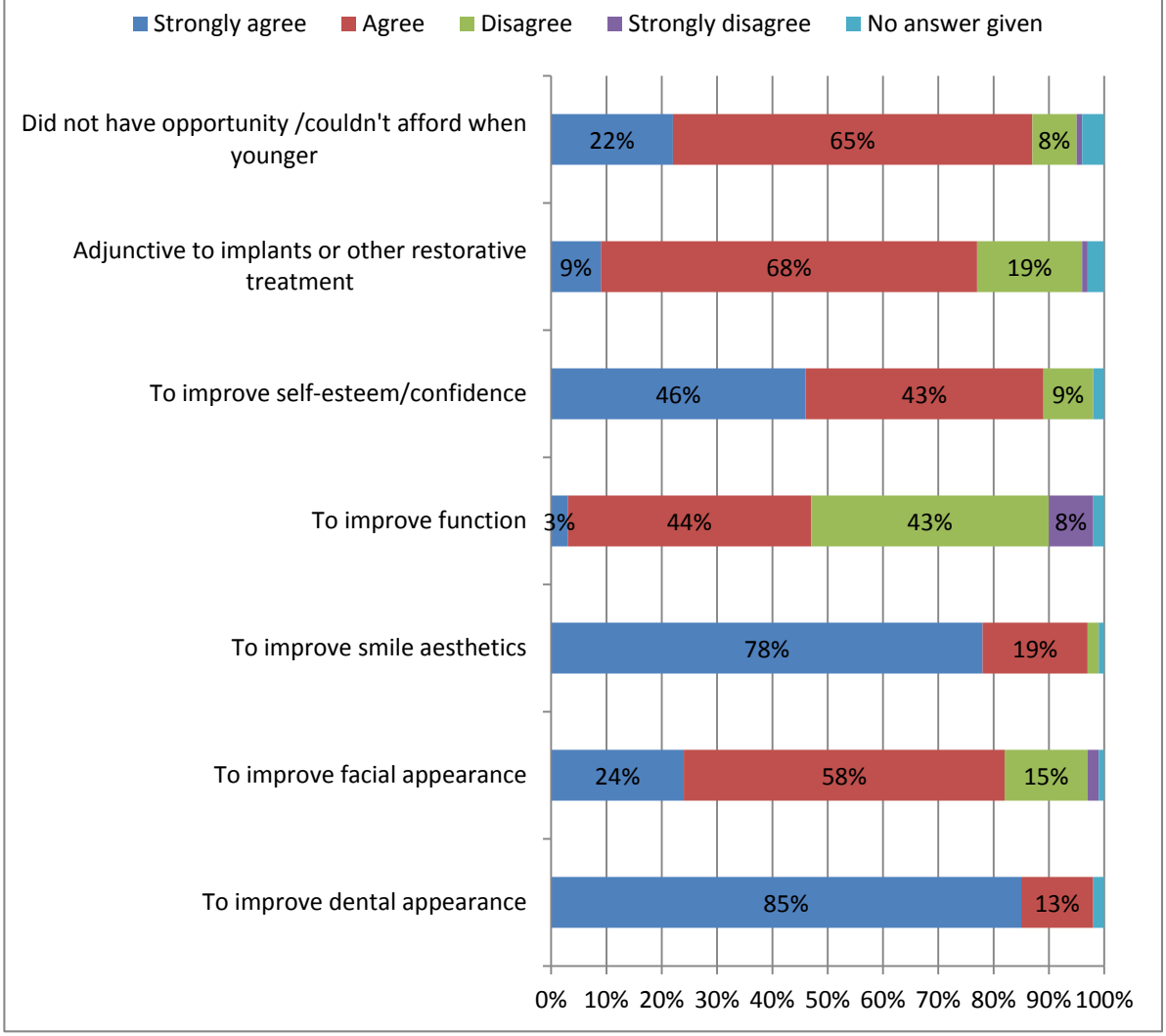


Figure 4.2.12 - Section 1, QI.

What is the most common INCISOR RELATIONSHIP of your adult patients?

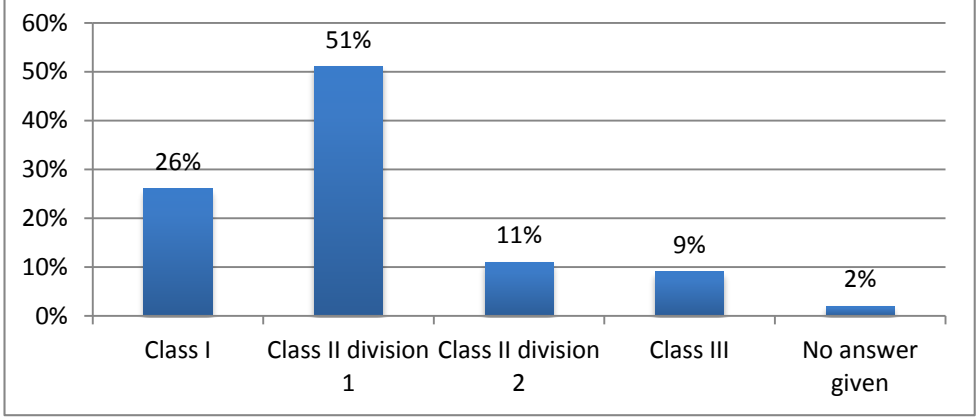


Figure 4.2.13 - Section 1, QJ.

What is the most common SKELETAL BASE RELATIONSHIP of your adult patients?

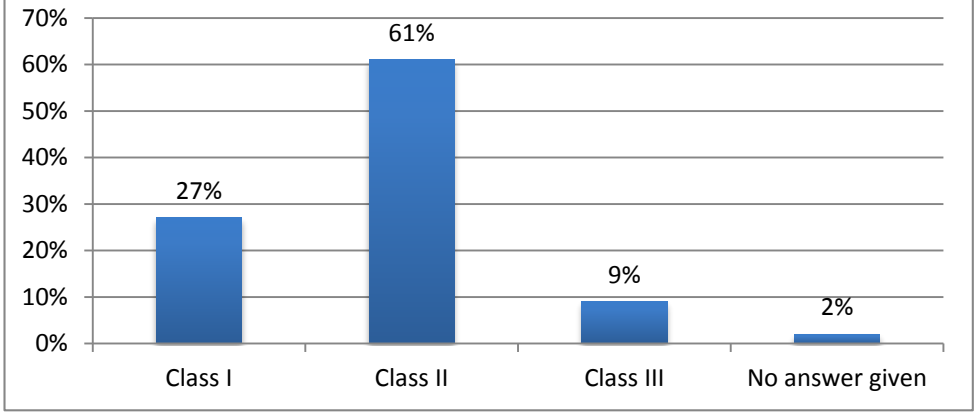
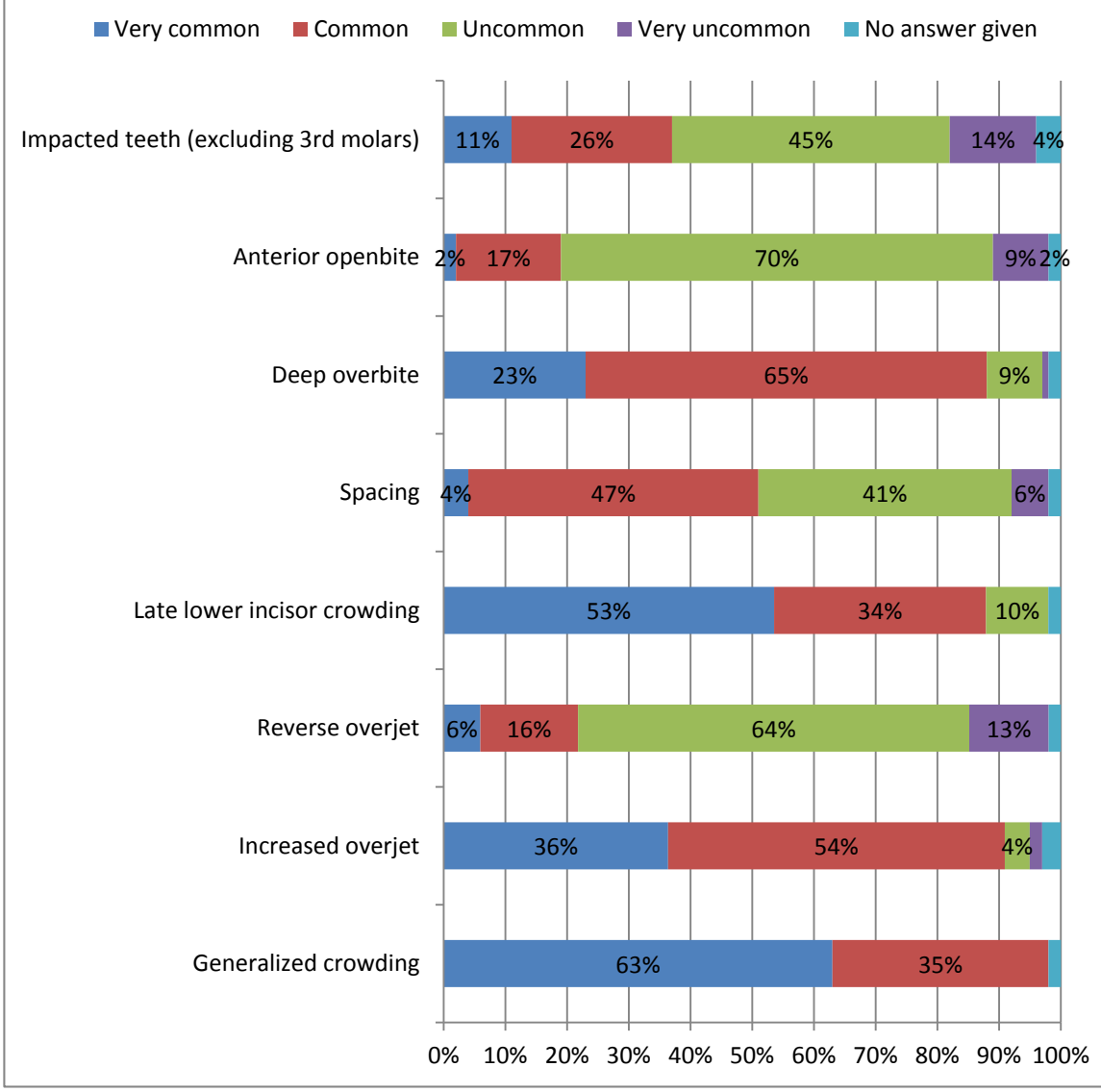


Figure 4.2.14 - Section 1, QK.
How common are these anomalies in your adult patients?



4.2.3 Section 2 - Treatment (Figures 4.2.15 to 4.2.22)

Most orthodontists responded that orthodontic treatment of their adult patients takes between 18 months to 2 years. Only 2% indicated that orthodontic treatment is undertaken in less than one year (**Fig 4.2.15**).

The most commonly reported challenges included: overbite reduction, anchorage management, overjet reduction, high aesthetic demands and "black triangles". Compliance was the rarest challenge (**Fig 4.2.16**).

The most frequently complained of difficulties when adapting to appliances were pain after appliance adjustment and eating. Speech and embarrassment were least reported (**Fig 4.2.17**).

In all other aspects of treatment, the length of treatment and managing appointments around work were the most commonly reported problems. Wearing retainers and cost of treatment were the least reported (**Fig 4.2.18**).

For the majority of respondents: 60-<80% of their adult patients required orthodontic treatment only and less than 10% required minor oral surgery and maxillofacial surgery (**Fig 4.2.19, Fig 4.2.20.1, Fig 4.2.20.2**). Over half of the replies stated that less than one fifth of their adult patients required periodontal treatment (**Fig 4.2.20.3**). Most orthodontists indicated that restorative treatment was required in 10-<20% of patients (**Fig 4.2.20.4**).

Adults were treated for TMD by a quarter of orthodontists, while 19% provided tooth whitening, 14% provided anti-snoring devices; 8% treated adults for sleep apnoea and only 1% used Botox® (**Fig 4.2.21**).

Upper aesthetic brackets and lower metal brackets was the most commonly used combination of appliances **(Fig 4.2.22)**. Self-ligating stainless steel brackets and pre-adjusted edgewise stainless steel brackets were often used by 40% of respondents respectively **(Fig 4.2.22)**. Lingual appliances were never used by over half of those surveyed and 34% never used clear aligners **(Fig 4.2.22).**

Section 2 - Treatment (Questions A-F)

Figure 4.2.15 - Section 2, QA.
How long does treatment of your adult orthodontic cases usually take?

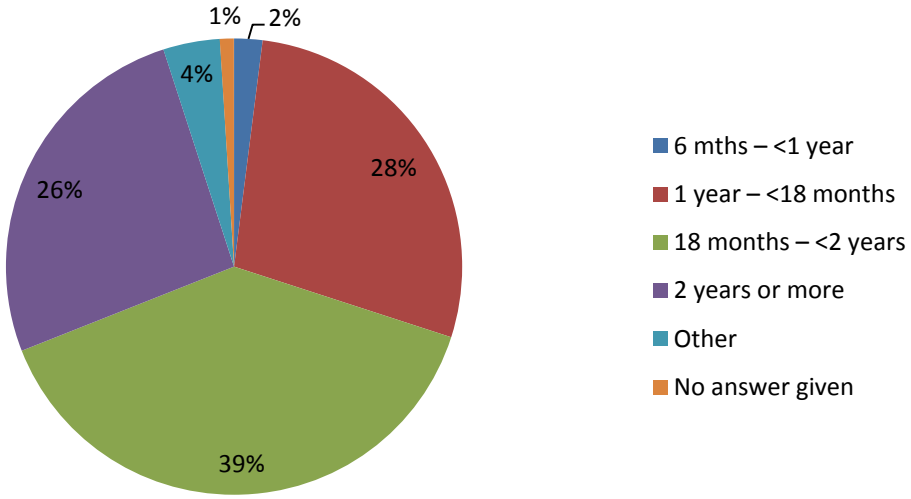


Figure 4.2.16 - Section 2, QB.

How frequently do you face the following challenges when treating your adult orthodontic patients?

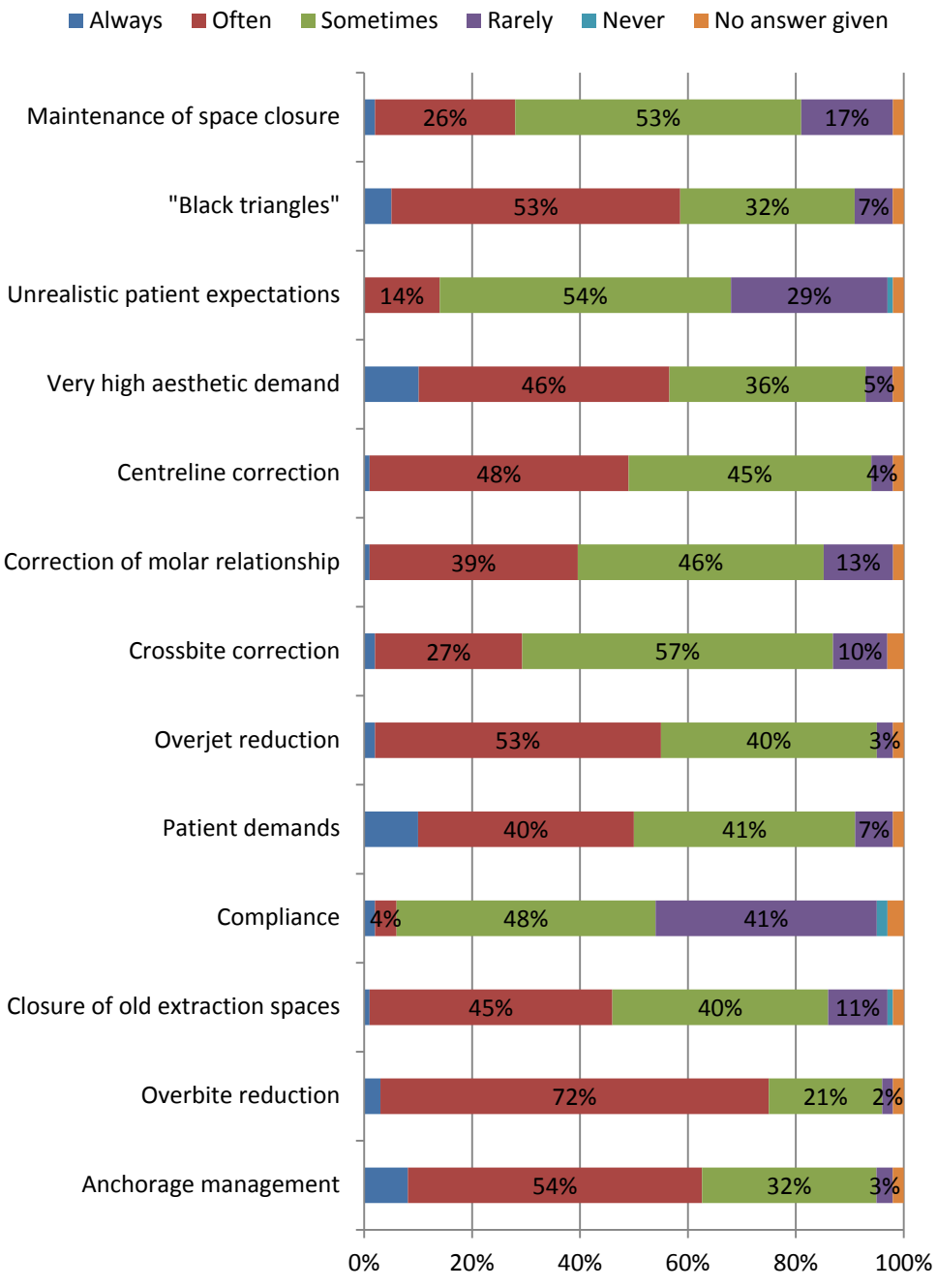


Figure 4.2.17 - Section 2, QC, i.

When adapting to appliances, how commonly do your adult patients report the following difficulties?

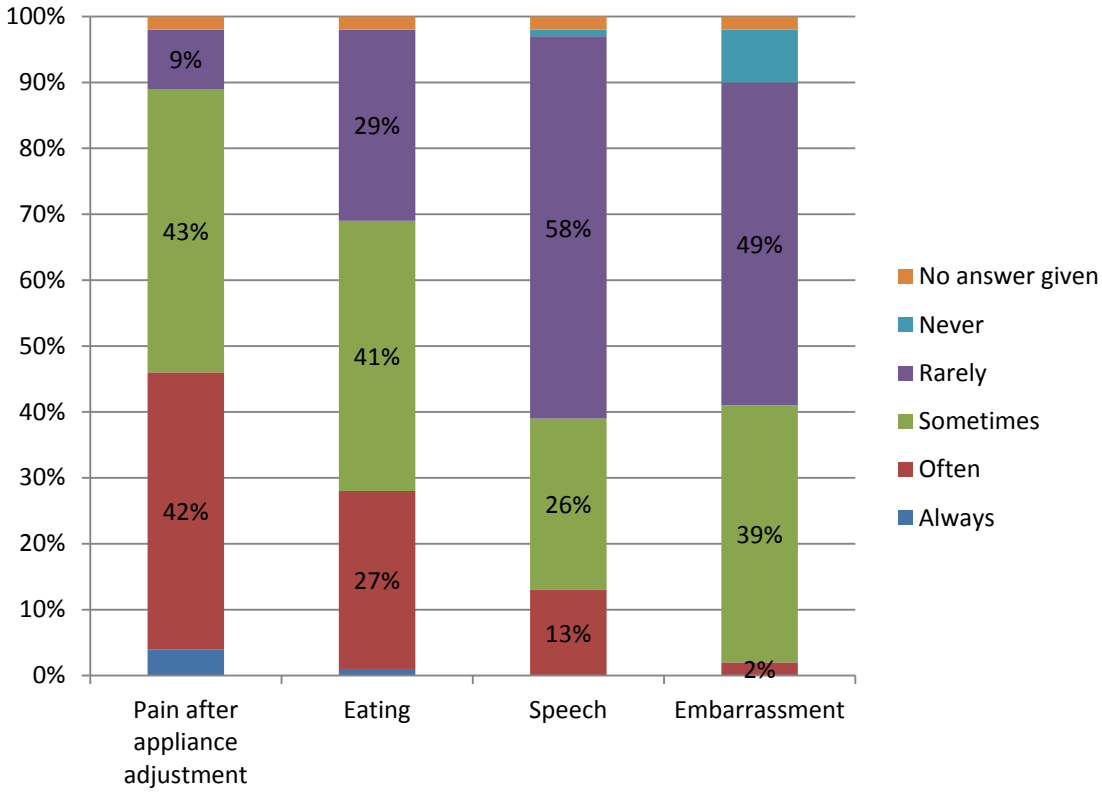


Figure 4.2.18 - Section 2, Q C, ii.

In all other aspects of treatment, how commonly do your adult patients report difficulty with the following?

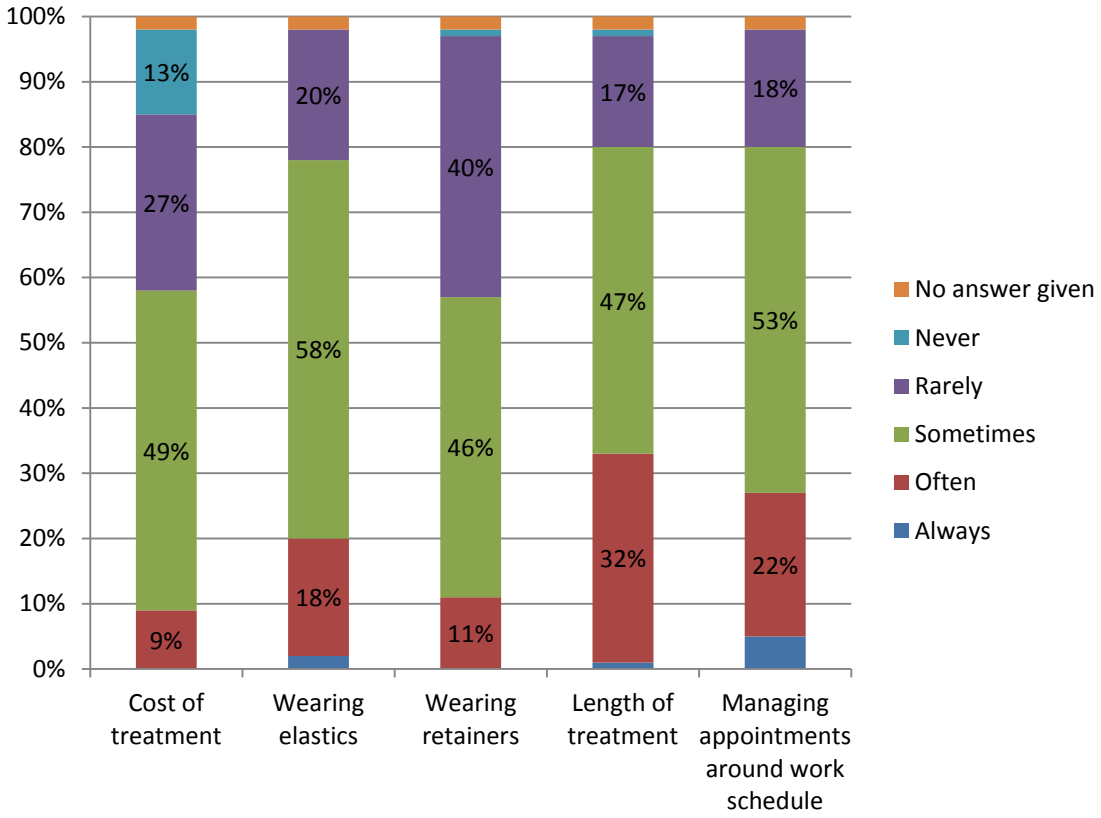


Figure 4.2.19 - Section 2, QD i.
What percentage of your adult cases require orthodontics ONLY?

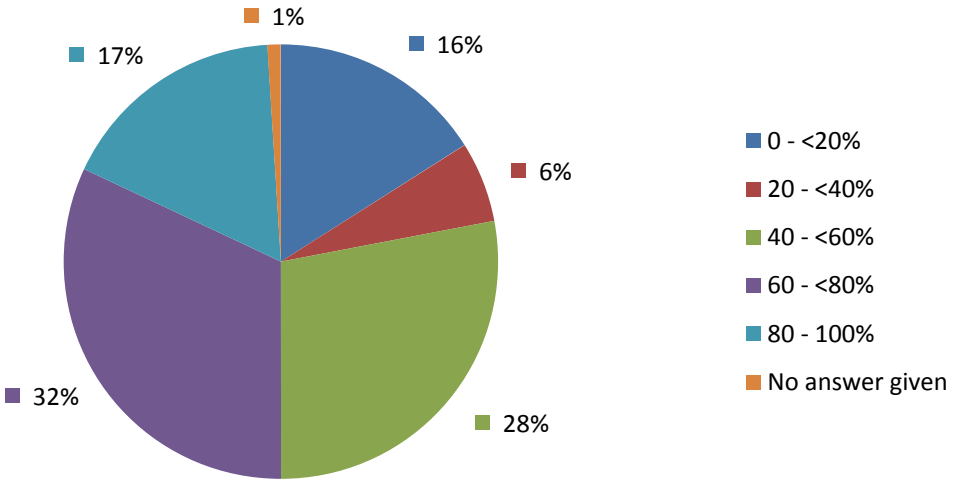


Figure 4.2.20.1 - Section 2, QD ii.
What percentage of your adult cases require orthodontics and MINOR ORAL SURGERY?

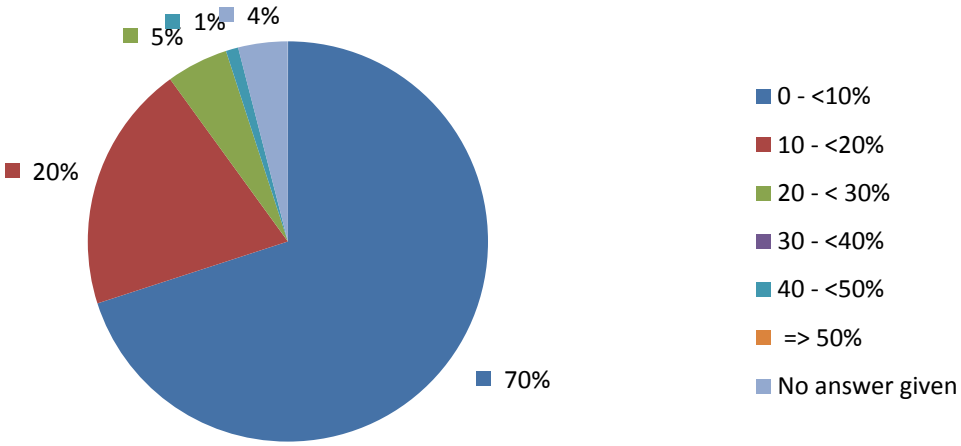


Figure 4.2.20.2 - Section 2, QD ii.
What percentage of your adult cases require orthodontics and MAXILLOFACIAL SURGERY?

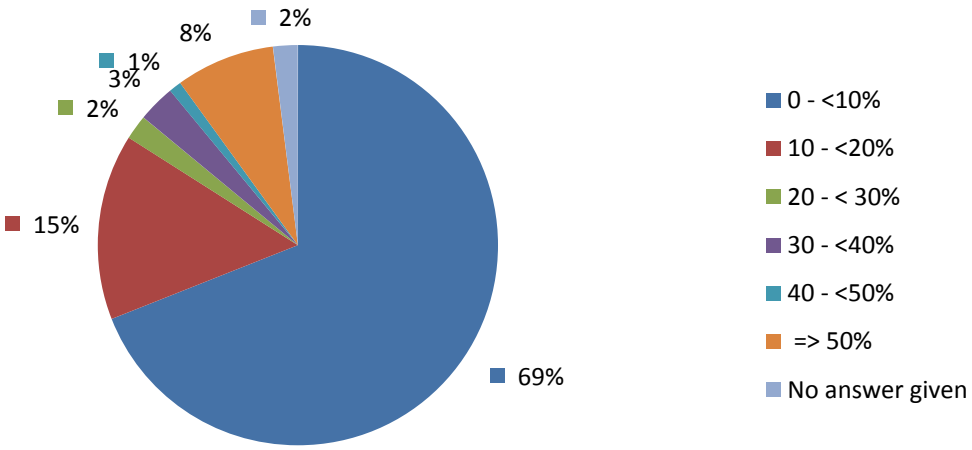


Figure 4.2.20.3 - Section 2, QD ii.
What percentage of your adult cases require orthodontics and PERIODONTAL TREATMENT?

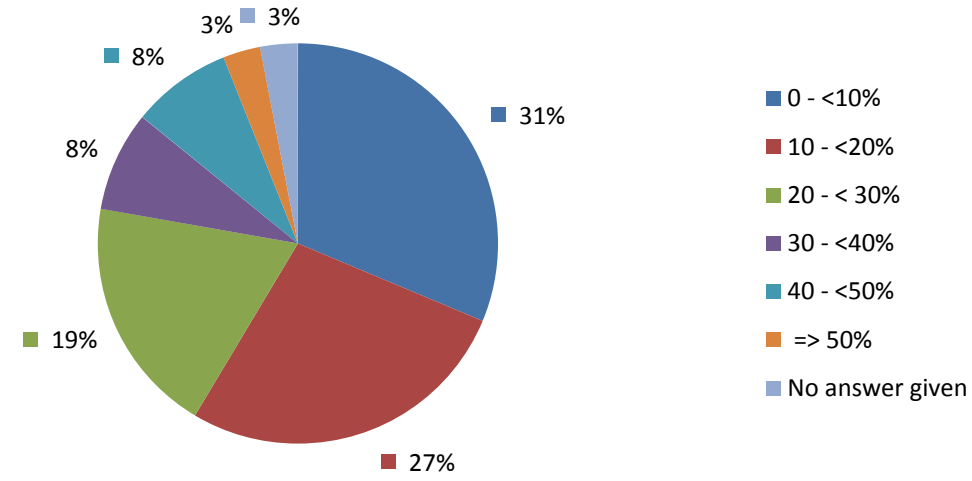


Figure 4.2.20.4 - Section 2, QD ii.

What percentage of your adult cases require orthodontics and RESTORATIVE TREATMENT?

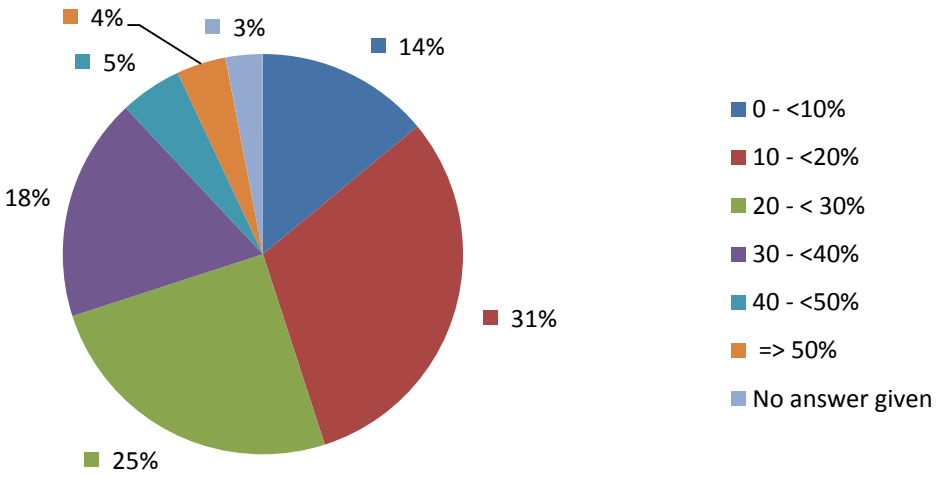


Figure 4.2.21 - Section 2, QE.

Do you treat adult patients for the following?

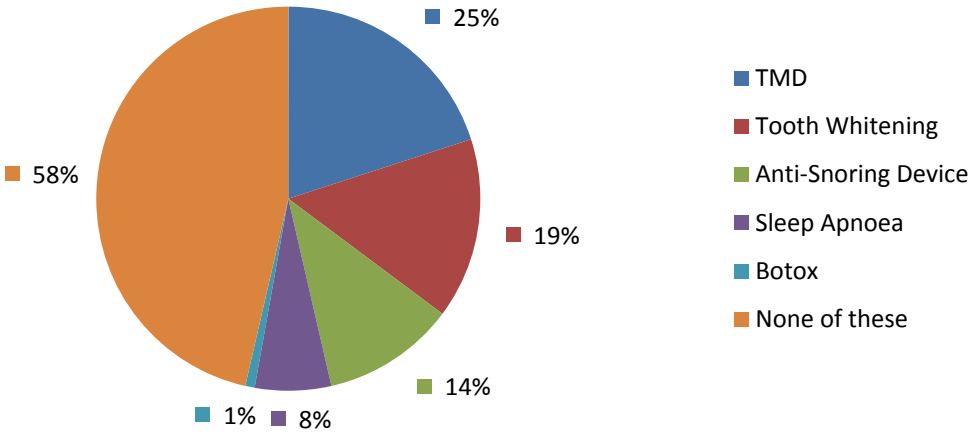
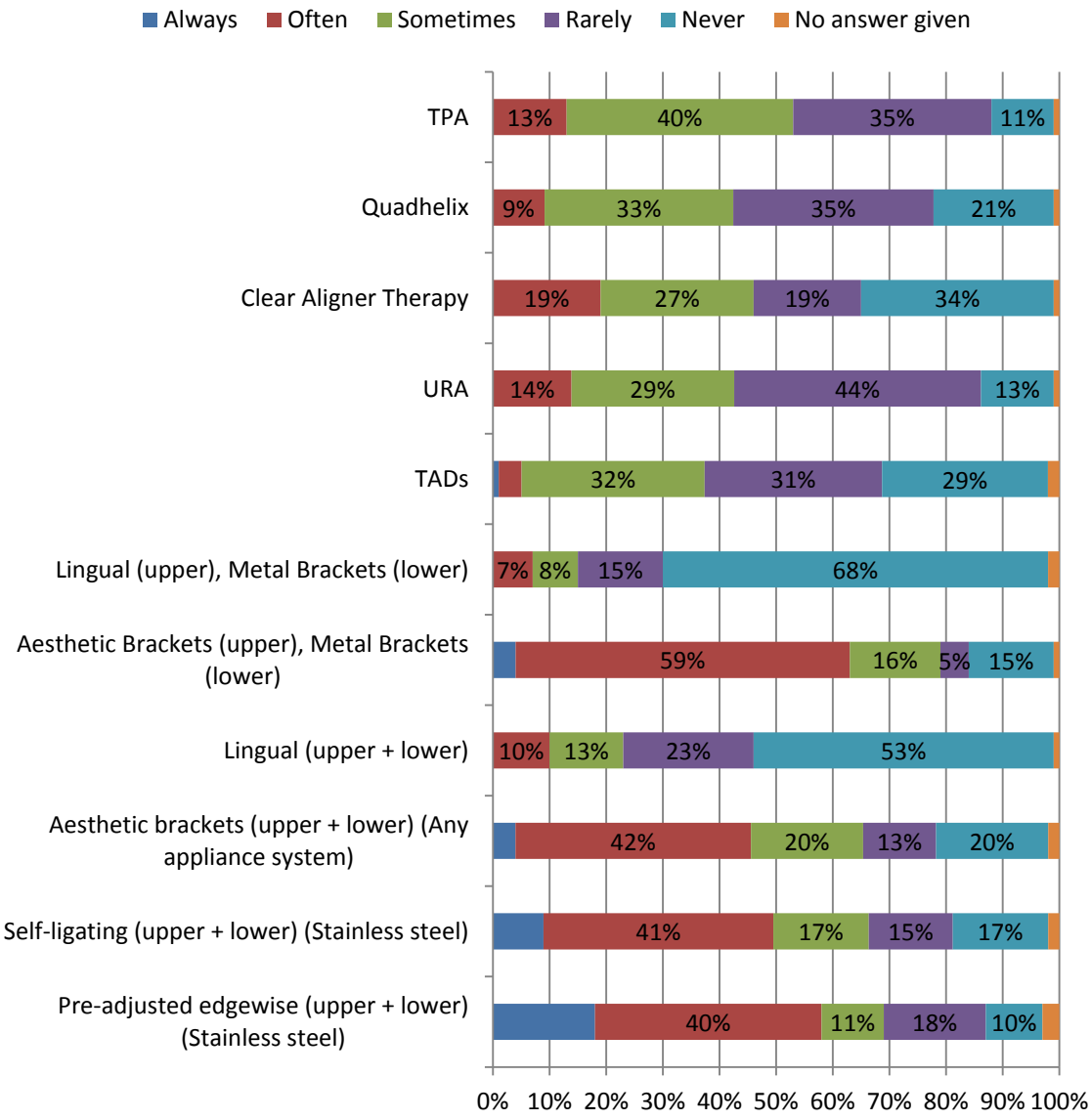


Figure 4.2.22 - Section 2, QF.

How FREQUENTLY do you use the following appliance types for your adult orthodontic patients?



4.2.4 Section 3 - Information (Figures 4.2.23 to 4.2.28)

Seventy per cent of orthodontists provide information leaflets to their adult patients and most of those are developed by the British Orthodontic Society (**Fig 4.2.23** and **Fig 4.2.24**). Seventy-one per cent of orthodontists have a practice website and of these only 31% have a specific section on their website dedicated to adult orthodontics (**Fig 4.2.25** and **Fig 4.2.26**). Only 30% of orthodontists advise their adult patients to find extra information on the Internet (**Fig 4.2.27**). The most common mode of information provision to adult patients about aspects of treatment was verbal and written (**Fig 4.2.28**).

Section 3 – Information (Questions A-F)

Fig 4.2.23 - Section 3, QA.
Do you provide information leaflets to your adult orthodontic patients about adult orthodontics?

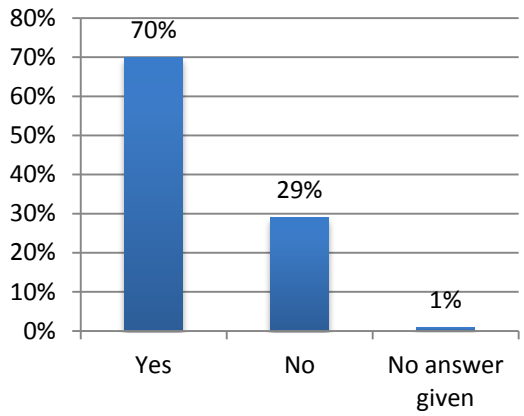


Fig 4.2.24 - Section 3, QB.
Are these leaflets developed by...?

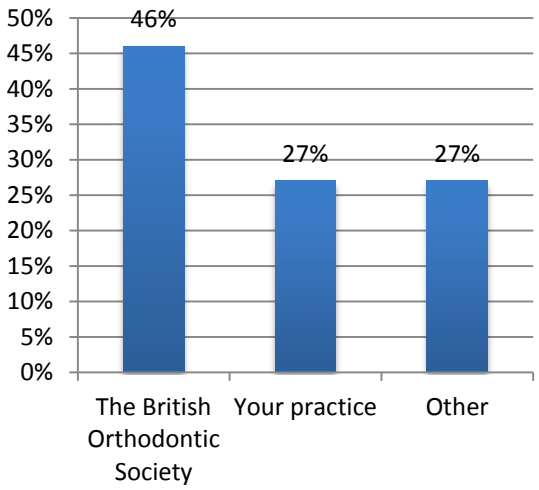


Fig 4.2.25 - Section 3, QC.
Does your practice have a website?

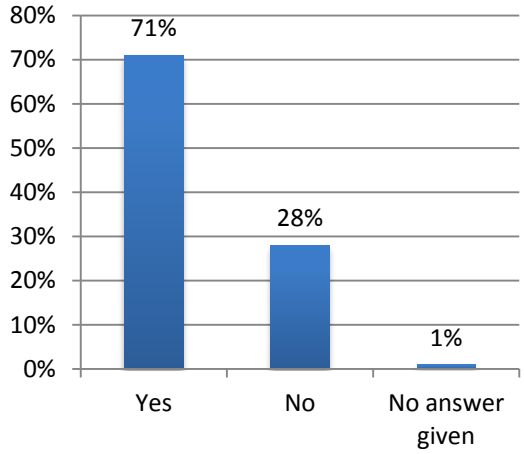


Fig 4.2.26 - Section 3, QD.
Does your practice have a section dedicated to adult orthodontics?

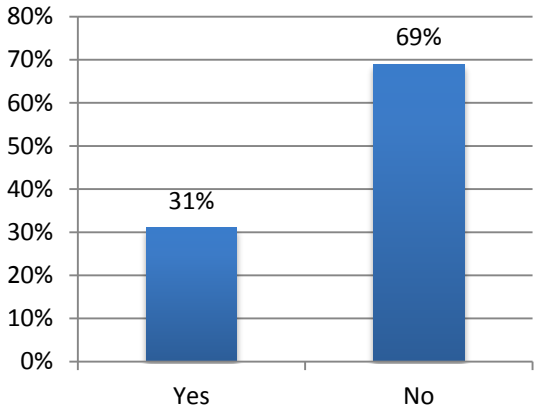


Fig 4.2.27 - Section 3, QE.
Do you advise your adult orthodontic patients to find extra information about adult orthodontics on the internet?

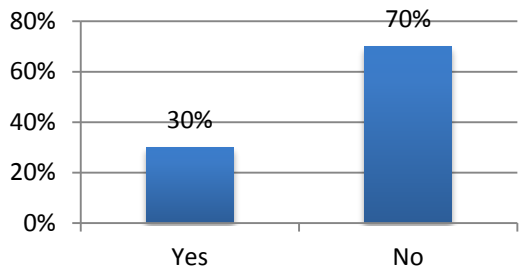
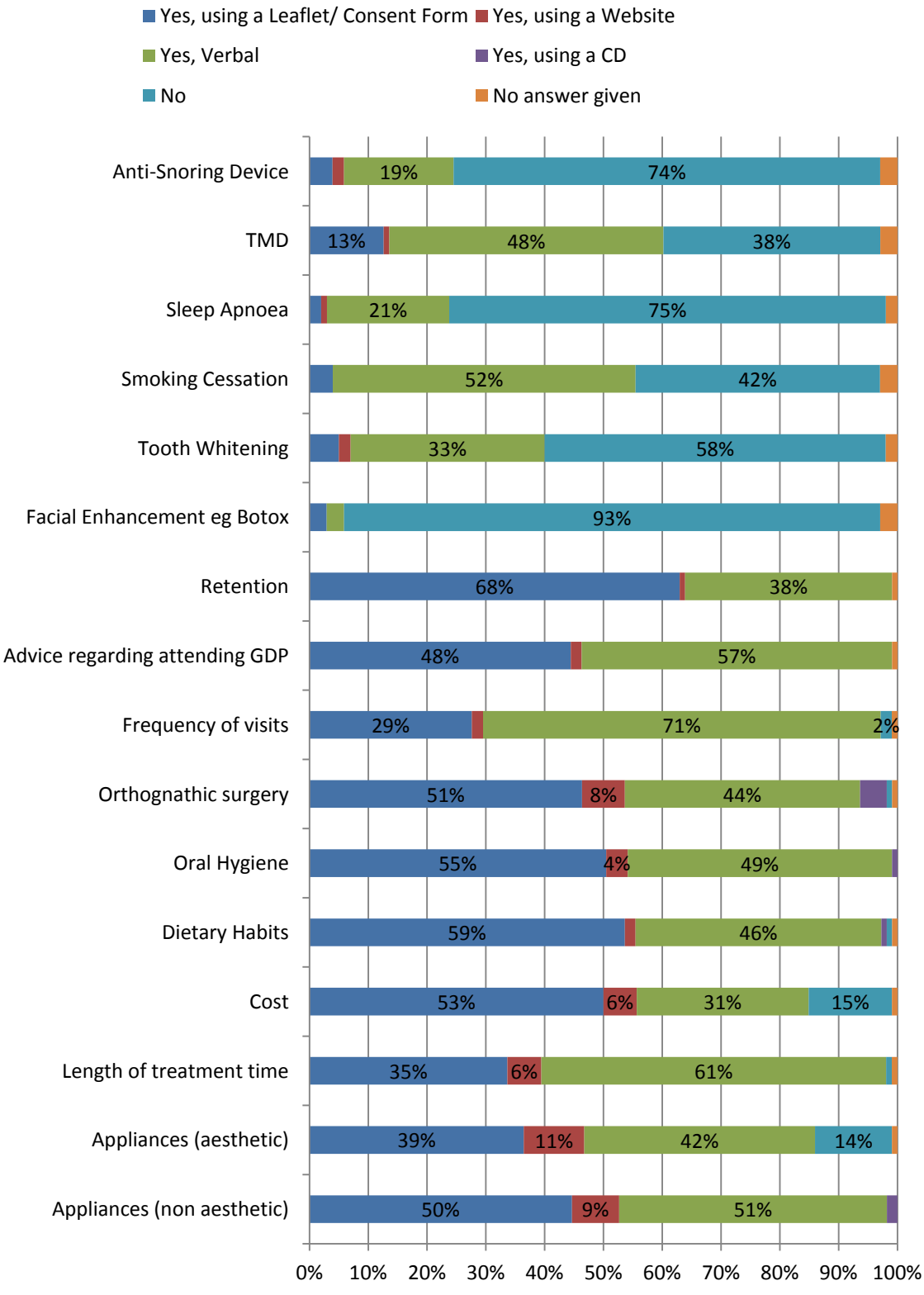


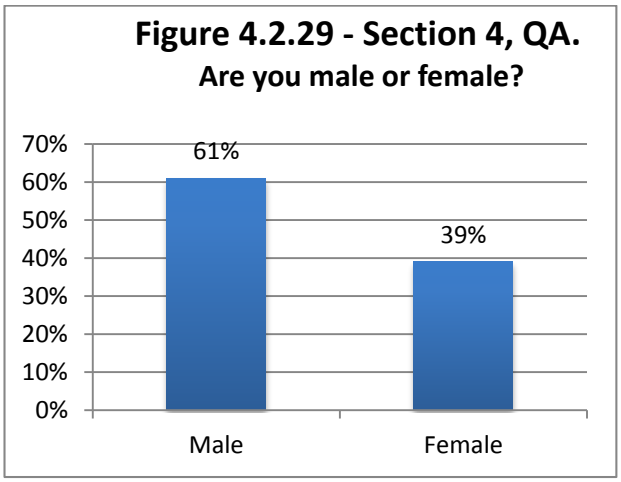
Figure 4.2.28 - Section 3, QF.
Do you provide information on the following?

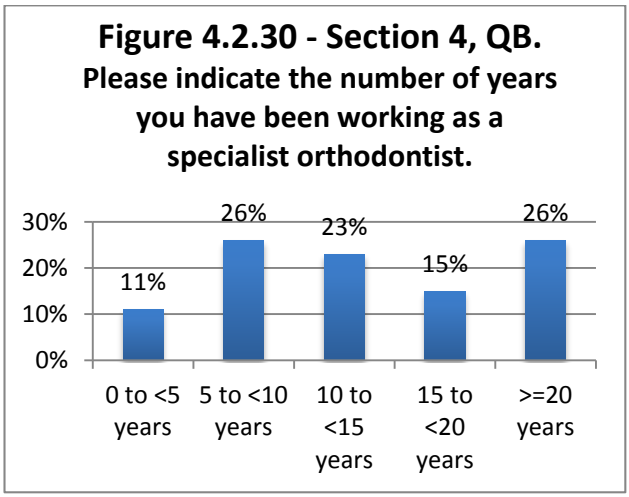


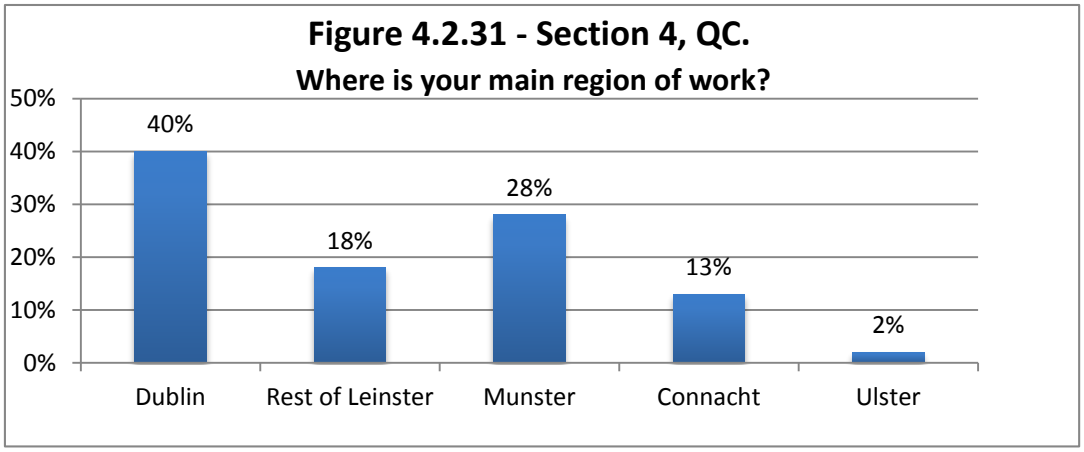
4.2.5 Section 4 - Demographics (Figures 4.2.29 to 4.2.32)

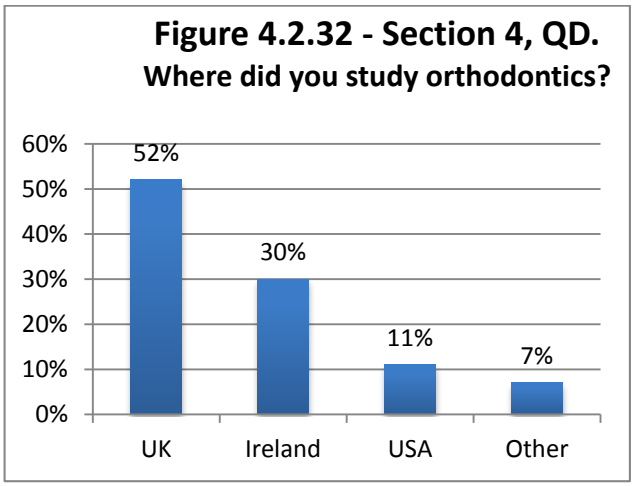
The majority of orthodontists were male (61%), worked in Dublin (40%) and worked in private practice (67%) (**Fig 4.2.29**, **Fig 4.2.31**, **Fig 4.2.33**). Most orthodontists had been working as a specialist for over five years and were UK-trained (52%), ROI-trained (30%) or US-trained (11%) (**Fig 4.2.30** and **Fig 4.2.32**).

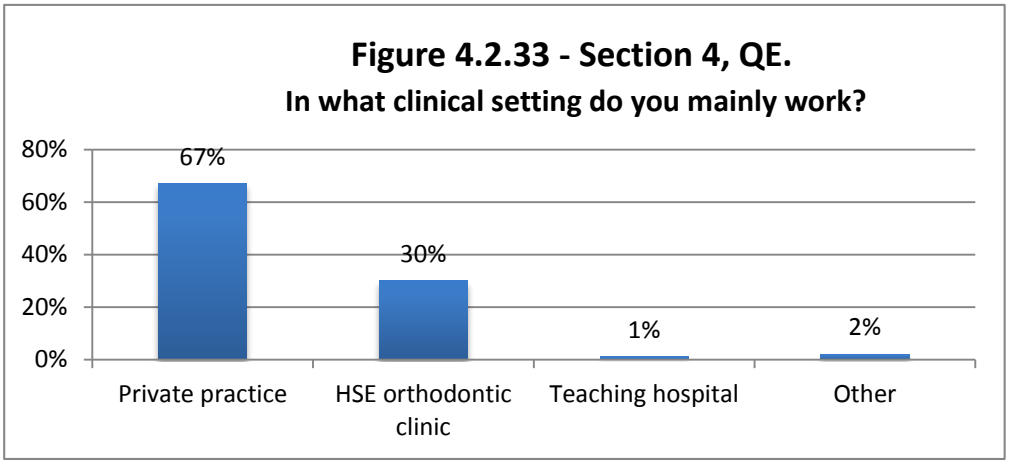
Section 4 – Demographics (Questions A-E)








Figure 4.2.32 - Section 4, QD.
Where did you study orthodontics?
60%
50%
40%
30%
20%
10%
0%
52%
30%
11%
7%
UK
Ireland
USA
Other


Figure 4.2.33 - Section 4, QE.
In what clinical setting do you mainly work?
80%
60%
40%
20%
0%
67%
30%
1%
2%
Private practice
HSE orthodontic clinic
Teaching hospital
Other

CHAPTER FIVE

DISCUSSION

5.1 Quality of Information on the Internet on Adult Orthodontics

To the best of the author's knowledge, this is the first study to date which has assessed the quality of online information on adult orthodontics. The level of healthcare information available on the Internet, together with the number of adult orthodontic patients has risen dramatically in the last decade prompting the timing of this research. Due to the elective, lengthy and costly process of having orthodontics, it is inevitable that some prospective adult patients will seek information on the Internet and clinicians should be able to guide them to the best quality websites.

A total of 300 websites were screened for inclusion in this study (50 websites from three search engines, with two search terms). Previous studies on the quality of online orthodontic information assessed between 30 to 300 websites (Parekh and Gill, 2014; Pithon and Santos, 2014). Fifty was chosen as the number of websites assessed in an attempt to be thorough; it is also very unlikely that an average user would go beyond this number of websites when searching information online.

The exclusion criteria used for the websites were similar to previous studies and all included websites were intended to be of a purely informative nature. The classification of some websites was ambiguous and hence some judgement as to the

applicability of the reliability tools was required for initial selection of the websites. On screening, most websites were private practice sites and it was decided to exclude these as the information was potentially biased. There was considerable overlap between search engines and after removal of all repetitions only 13 websites were included for further analyses, highlighting the scarcity of websites providing information on adult orthodontics. Other studies assessing online orthodontic topics have yielded between 21 to 49 websites which were suitable for further evaluation (Antonarakis and Kiliaridis, 2009; Patel and Cobourne, 2011).

Most websites (61%) assessed in the study reported here were of US origin; this is in agreement with studies assessing online information on cleft-lip and palate and orthodontic extractions (Antonarakis and Kiliaridis, 2009; Patel and Cobourne, 2011). This is not surprising as the US is a very technologically-advanced and informed country and the US, after China, has the greatest number of Internet users worldwide (http://www.internetlivestats.com/internet-users/).

The present study was comprehensive and used four methods to assess the quality of online health information; JAMA benchmarks, the presence of the HON Seal, the DISCERN tool and the LIDA tool. The JAMA benchmarks and the HON Seal are quick methods to assess quality. The DISCERN and LIDA tools provide a more extensive evaluation and are used more frequently in studies assessing the quality of online health information. LIDA is the only instrument which measures accessibility and is designed specifically for assessing websites.

The highest scoring JAMA benchmarks were authorship and currency; over two-thirds of websites identified the author and 85% specified a content date, usually a copyright date. This is higher than a study assessing oral ulceration websites which revealed that

27% provided authorship and 61% currency (Ni Riordain and Hodgson, 2014). The lowest scoring benchmark was disclosure and this was usually due to the omission of financing details and conflicts of interest. In contrast, another study on head and neck cancer websites found authorship to be the lowest scoring domain (Ni Riordain and McCreary, 2009b). Only three websites included in the current study achieved all four benchmarks.

Only one website displayed the HON Seal, which was www.webmd.com. A 2009 study assessing head and neck cancer websites found that 13 out of 33 websites contained the HON Seal and a more recent study on oral ulceration websites revealed its presence in only 4 out of 54 websites (Ni Riordain and McCreary, 2009b; Ni Riordain and Hodgson, 2014). Hence, it is evident that the HON seal has not gained widespread use and this may be for multiple reasons; healthcare website designers may not be aware of its existence, an application process is required to attain it, with a subsequent retention fee to maintain it and more comprehensive tools are now available.

The DISCERN tool was designed to assess written consumer health information; it is not explicitly designed for assessing websites, although it can be applied to them. It is suitable for health consumers, as a screening tool for health information providers, authors of written consumer health information and as a training tool for health professionals to improve communication and share decision-making skills. Although DISCERN can be used to judge the reliability of a publication as a source of information about treatment choices, it cannot be used to assess the scientific quality or accuracy of the evidence.

The average overall rating (question 16) for the included websites in this study using the DISCERN instrument was 3.9 out of 5. This is higher than that recorded for other studies assessing orthognathic surgery, oral ulcerations, dental implants and obstructive sleep apnoea websites where the mean overall ratings ranged from 2.5 to 3.3 (Aldairy et al., 2012; Langille et al., 2012; Ni Riordain and Hodgson, 2014; Leira-Feijoo et al., 2014). It is difficult to directly compare these studies as they assessed diverse topics; however, perhaps the higher score attained in this study is by virtue of adult orthodontics being a more commonly searched topic.

The lowest rated DISCERN question overall, with an average score of 2.8, was question 7, which assessed whether additional sources of support and information were provided on the website. Ideally, there should be a section with 'further reading' or 'useful addresses' but many of the websites did not provide this. Other questions which rated poorly were: disclosure and referencing of all sources of information (question 4), inclusion of dates of content production and updates (question 5), the provision of balanced and unbiased information (question 6) and referring to areas of uncertainty (question 8). It should be noted that the scoring of some questions is more subjective than others and depends on the assessor's judgement, for example question 3 which asks about the relevance of the publication and question 6 which rates the bias.

The mean LIDA score for all included websites was 115 out of 144 (80%), which represents moderate quality. All websites in this study were of moderate quality, with no website scoring as high quality (>90%). This is comparable to a recent study which assessed orthodontic practice websites where the author found that the mean LIDA score was 110 (76%) (Patel and Cobourne, 2014). Other studies, assessing the quality of online information on orthognathic surgery, orthodontic pain and oral hygiene

instructions for patients with fixed appliances, similarly concluded that websites were of moderate quality (Livas et al., 2012; Pithon and Santos, 2014; Verhoef et al., 2015).

The highest scoring LIDA domain overall was accessibility and the lowest was reliability. This is also in agreement with the literature which has consistently found reliability to be the lowest domain. Reliability is graded based on three components: currency of information, conflicts of interest and methods of content production. For websites to achieve higher scores for reliability they must be regularly updated, include a declaration of the objectives of the people who run the site as well as details of financing of the site. A robust method of content production should also be featured on websites; this should be user-driven and reviewed by independent experts.

To test the level of readability, an extract of 200-500 words from each website was inputted into a readability calculator. The overall readability of the websites was standard, with an average FRES score of 63.1; this is considered easily understood by 8th and 9th graders in the US (between 13-15 years). This is slightly higher than the recommended reading age of 10-11 years for health information (https://www.mlanet.org/sites/default/files/resources/pdf/low_hlth_literacy.pdf). The readability of text is a very important aspect of health information provision; it should be presented in simplified and comprehensible language so as to reach all sectors of society, including those with less educated backgrounds.

There are some limitations of this study which should be acknowledged. Firstly, the web-search was limited to English language only websites; hence, the results are not applicable to non-English language websites. Secondly, the assessment was carried out by one operator, possibly subjecting the study to systematic error. However, one month after the initial assessment, the same operator reassessed all websites and the

results revealed strong agreement between repeat measures. Furthermore, the assessor had extensive background information on orthodontics which the average health-consumer would not have and, thus, may have been subconsciously harsher when scoring certain questions. Finally, this study was conducted in May 2015 and, therefore, only gives a 'snap shot' of the websites at that time; given the dynamic nature of the Internet, websites are constantly being updated and can change drastically in a short period of time. So, the findings may be at variance with those reported here, if the same search is conducted at a future date.

With the rapid growth of the Internet, it has become an extremely popular source of information for prospective patients and this trend will likely continue. How we, as clinicians, provide information to patients will also evolve. The classic paper information leaflet will, with time, be surpassed by digital technology and we will be directing patients to Internet websites instead to seek information. It has been shown, after all, that computer-based visual information is a more effective method for patients to retain information (Patel et al., 2008). Currently, however, the number of websites providing information on adult orthodontics is low (as with other orthodontic topics) and of moderate quality. Dental educators and organisations should, therefore, endeavour to produce more accurate, high quality Internet information resources for patients in the future.

5.2 Survey of Adult Orthodontics among specialist orthodontists in the ROI

To date, this appears to be the first comprehensive survey investigating the characteristics and treatment of adult orthodontic patients by specialist orthodontists in the Republic of Ireland (ROI). It is also the first study which has assessed the methods of information provision by specialist orthodontists to adult patients.

The response rate for this survey was excellent at 82.7%. A response rate of 75% for a postal questionnaire is considered extremely good (Williams, 2003). Poor response rates reduce the validity of survey studies and introduce bias. Previous orthodontic surveys in the ROI have elicited similar response rates (McGuinness and Collins, 2007; Meade and Millett, 2013). This may be a reflection of the small orthodontic community in the ROI, therefore, generating a high response rate.

This survey adopted a 'mixed-mode' methodology, giving participants the option of an email or postal questionnaire. This approach was intended to produce the best possible response rate by participants choosing which was most convenient for them. The response rate was marginally higher (4.2%) for the postal questionnaire and this is in agreement with the literature which states that response rates are lower for Internet surveys (Hayslett and Wildemuth, 2005).

The design and layout of the questionnaire followed the recommendations of Williams (2003). All questions were closed-ended to facilitate data entry and coding. The questionnaire was piloted twice to ensure there were no ambiguities. All methods to increase response rates were utilized in this survey; contacting participants before sending the questionnaire, provision of a stamped address envelope for return, personalised cover letters, a monetary incentive (entry into a €200 prize draw) and reminders. A previous Cochrane review has confirmed that these are all effective methods for increasing response rates to postal and electronic questionnaires (Edwards et al., 2009).

This survey found that nearly all orthodontists (95%) in the ROI are treating adult patients. For most orthodontists, adults comprise between 10-30% of their caseload, which is similar to surveys from the UK (17%) and US (24%) (BOS, 2007; Keim et al., 2014). However, 17% of orthodontists indicated that adults consisted of less than 10% of their caseload while 15% of orthodontists indicated that more than 40% were adults, highlighting the variability between specialists. One reason for this variability may be that participants included orthodontists who worked in the HSE (30%), where a small percentage of patients are adults.

The most common sources of referral were self-referrals (40%), followed by GDP referrals (35%). A survey in the UK, however, found that GDPs were the most popular source of adult referrals (Cedro et al., 2010). The high level of self-referrals is probably a reflection of the ease of access to orthodontists in the ROI with many practices now advertising a 'no-referral needed' policy with free initial consultations.

The most common demographic profile of adult patients found in this study was professional, female and between 25-35 years of age. This is similar to research

findings in China (Lew, 1993), the UK (Cedro et al., 2010) and the US ((Keim et al., 2011). A quarter of orthodontists, however, stated that the most common age range of their adult patients was 18-25 years. For the majority of orthodontists (83%), adults over 45 years made up less than one fifth of their adult caseload, which was the least frequently treated age group. It is clear from this survey, nonetheless, that adults of all ages are now availing of orthodontic treatment.

For most orthodontists (60%), less than one-fifth of their adult patients had received previous orthodontic treatment. However, the answer to this question showed quite an amount of variability, with 25% and 17% of orthodontists stating that 20-<30% and >40% respectively of their adult patients had received previous orthodontic treatment. Inevitably, a significant proportion of adult patients will be re-treatment cases and this is for a multitude of reasons.

The majority of respondents indicated that between 20-30% of their adult patients had previous extractions for non-orthodontic purposes. A UK study found similar results with 37% of adult orthodontic patients having undergone previous extractions (Cedro et al., 2012). Periodontal disease was seen in less than 30% of Irish adult orthodontic patients according to most respondents. This is in line with results from the UK, where periodontal disease was reported in 12% of an adult orthodontic sample (Cedro et al., 2012). The incidence of periodontal disease is largely dependent on the age cohort of adults being treated; orthodontists who treat older adults will invariably observe higher levels of periodontal disease. Despite orthodontic treatment being often quoted as a contributor to TMD (Slade et al., 2008), most orthodontists in this study encountered TMD problems in less than 10% of their adult patients. This is comparable with the epidemiology of TMD in the general population, with 10% of over 18 year olds experiencing TMJ pain (LeResche, 1997).

Most respondents strongly agreed that the main motivations for orthodontic treatment amongst adults were to improve dental appearance and smile aesthetics, which is in agreement with the literature (Breece and Nieberg, 1986; McKiernan et al., 1991; Sergl and Zentner, 1997; Pabari et al., 2011). Almost half of respondents strongly agreed that improvement in self-esteem motivated adult patients and more than half disagreed that improvement in function was their incentive. This highlights the emerging role that orthodontics currently plays in psychosocial enhancement.

Class II division 1 malocclusion (51%) and a Class II skeletal base (61%) were the most commonly encountered incisor and skeletal relationships in adult orthodontic patients. This echoes findings from the UK (Khan and Horrocks, 1991; Cedro et al., 2012). Over half of the respondents indicated that crowding (generalised or late lower incisor crowding) was very common among adults, followed by deep overbite and increased overjet. Over a quarter of orthodontists found impacted teeth to be a common anomaly in their adult patients; this is quite high considering impacted teeth are usually a problem associated with children/adolescents. Perhaps this may be due to impactions being missed or overlooked by clinicians in the past or patients were unwilling to have treatment when they were younger.

Despite extensive advertising of 'six month smiles' aimed at adult patients (Maini, 2013), this survey found that only 2% of respondents completed adult treatment in under one year. Most respondents indicated that treatment usually takes between 18 months to 2 years. This is reassuring and highlights that specialists in the ROI are not succumbing to a 'quick fix' solution for their adult patients. However, this survey does not represent all the adult orthodontics being conducted in Ireland, only among specialists. It would be interesting to ascertain the treatment duration by General Dental Practitioners providing adult orthodontics in the ROI.

The most frequently encountered problem faced by orthodontists when treating adult patients was overbite reduction. This is not surprising given the lack of growth potential in adults. Other common problems were anchorage management, overjet reduction, the presence of "black triangles" and the high aesthetic demands of adults. A UK survey found appearance of appliances to be the main complicating factor reported by orthodontists (Cedro et al., 2010). Compliance from adults was the least reported challenge found in this survey. In the opinion of the orthodontists surveyed, the most common difficulties for the patients themselves were pain after appliance adjustment, length of treatment and scheduling of appointments. Speech, embarrassment, wearing retainers and cost of treatment were the least reported. This is interesting as embarrassment and cost of treatment are often seen by adults as deterrents to pursuing orthodontic treatment (Soh and Sandham, 2002).

Most adult patients received orthodontic treatment only. However, for those requiring multidisciplinary management, restorative and periodontal treatment were required more often than minor oral and maxillofacial surgery. Compared with a study in the UK in 1991, only 6% of adult orthodontic patients required periodontal treatment (Khan and Horrocks, 1991). This may have been a reflection of the lower age group of adult orthodontic patients treated at that time. Currently, however, older adults are now availing of orthodontics and with advances in restorative and surgical techniques, collaboration with other specialties has become a vital part of managing the adult patient.

Treatment with appliances for snoring and sleep apnoea was provided by 14% and 8% of orthodontists respectively. This is quite low, considering the teaching of sleep disorders is now part of the postgraduate orthodontic syllabus (Huggare et al., 2014). Perhaps most orthodontists are more confident with sleep disorders being treated in

designated sleep clinics and by their ENT colleagues as there may be underlying medical issues.

Just under one fifth (19%) of orthodontists carried out tooth whitening procedures in their adult patients. This is interesting considering orthodontics is a specialty where aesthetic outcome is of considerable importance. One, therefore, might expect more adjunctive bleaching procedures to be undertaken, especially in adults. Comparably, a survey of US orthodontists revealed that one third provide tooth whitening and two-thirds refer patients for tooth whitening to other dental professionals (Slack et al., 2013).

Only 1% of specialists in this survey provided Botox®. This is quite reassuring and possibly reflects the views of the Irish Dental Council that "the use of botulinum toxins is not the practice of dentistry" (http://www.dentalcouncil.ie/). However, Botox® has recently been described as an effective and safe solution to some difficult orthodontic anomalies, including vertical maxillary excess and "gummy smiles" so its use may become more popular among orthodontists with time and training (Singh et al., 2013; Suber et al., 2014).

The most commonly used combination of appliances for adults was aesthetic upper brackets and metal lower brackets, with 63% of orthodontists always or often opting for these. In the UK, very similar results have been found, with aesthetic brackets being used by 69.4% of orthodontists for their private patients (Cedro et al., 2010). The present study revealed that lingual appliances and clear aligners were never used by 53% and 34% of respondents respectively and sometimes used by 13% and 27%. This is surprising considering most orthodontists in this survey worked in private practice. Comparable results have been found in the UK where lingual appliances and

Invisalign® were commonly used by 16% and 30% of orthodontists respectively (Cedro et al., 2010). In the US, the use of lingual appliances and clear aligners appears to be more popular; in a survey reported in 2014, lingual appliances were occasionally or routinely used by 23% of orthodontists and 89% performed some form of clear aligner treatment (Keim et al., 2014). However, the conclusions of this US survey should be interpreted with caution as the response rate was very low, thereby, possibly reducing the validity of results.

The information-providing behaviour of orthodontists to adults, which seems not to have been assessed before, was investigated in this study. How clinicians provide information to their patients is vital and an essential part of the informed-consent process. Lack of information has been shown to be one of the main reasons for premature termination of orthodontic treatment (Brattström et al., 1991). However, this survey found that only 70% of specialists provide their adult patients with information leaflets about treatment. This is slightly disappointing as it has been recommended that verbal information should always be supported by written or visual information (Thomson et al., 2001). Research, regarding the quality of information provision in dentistry, is deficient. However, the medical literature has equally highlighted that inadequacies in information provision exist for diabetic and stroke patients (Rodgers et al., 2001; Peel et al., 2004).

The demographics of the respondents to this survey were mainly males (61%), working in Dublin (40%), in private practice (67%) and UK trained (52%). This corresponds similarly with previous surveys conducted on the orthodontic workforce and retention protocols in the ROI (McGuinness and Collins, 2007; Meade and Millett, 2013).

5.3 The links between the findings of Part 1 (Quality of information on the Internet on adult orthodontics) and Part 2 (Survey of adult orthodontics in the ROI).

To complement Part one of this project, a section dedicated to exploring the information-providing behaviour of specialist orthodontists to adult patients was included in Part two, the survey.

The scarcity of quality, reliable websites on adult orthodontics, as identified in Part one of this project, may be reflected in the relatively low number of orthodontists (30%), as identified in Part 2, who recommend the Internet as an extra source of information for their patients. If there were more, well known, high quality websites available clinicians may be more confident in directing their patients to them. It would also reduce their reliance on other methods of information provision, including paper forms.

Approximately 22% of orthodontists surveyed had practice websites with a specific section devoted to adult orthodontics. Given the growth of adult orthodontics, clinicians should tailor their websites to meet the information needs of adults instead of providing generic information.

Coincidentally, the demographics of the average adult orthodontic patient (female, professional, between 25-35 years), as identified in Part two, mirrors the typical

searchers of online information, as indicated in the literature review, thereby, further qualifying the relevance of this research.

5.4 Suggestions for future work

Further work, assessing the quality of other orthodontic topics online should be conducted. Qualitative research of adult patients, exploring their information needs, with regards to orthodontics, would also be useful. Additionally, there should be more investment in developing high quality, 'go to' orthodontic websites for patients.

It would be beneficial to perform a survey, in the ROI, on adult patients directly to establish their experience of orthodontic treatment. A survey of General Dental Practitioners, assessing their involvement with adult orthodontics, would also be an avenue for future research.

CHAPTER SIX

CONCLUSIONS

CONCLUSIONS

AIM 1

To assess the quality, reliability and readability of information on the Internet on adult orthodontic treatment.

CONCLUSIONS:

- The reliability of websites on adult orthodontics was of moderate quality.
- The readability of websites on adult orthodontics was of a standard level.

AIM 2

To determine the profile and characteristics of adults undergoing orthodontic treatment by specialist orthodontists in the ROI, including factors relating to their treatment and the methods by which they attain information.

CONCLUSIONS:

- Professional, females between 25-35 years were the typical adult orthodontic patient.
- Class II Division 1 incisor relationship and Class II skeletal bases were the most common malocclusion.
- Upper aesthetic brackets and lower metal brackets were the most common appliances used.

- The most common methods of information provision by orthodontists to their adult patients were verbal and written.
- Less than a third of orthodontists recommended the Internet as an information source for their adult orthodontic patients.

NULL HYPOTHESES

Null Hypothesis 1

The quality, reliability and readability of information on the Internet on adult orthodontic treatment is of a high quality.

This null hypothesis is rejected.

Null Hypothesis 2

There is no variation in the profile, characteristics, treatment and methods of information provision to adults undergoing orthodontic treatment by specialist orthodontists in the ROI.

This null hypothesis is rejected.

CHAPTER SEVEN

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CHAPTER EIGHT

APPENDICES

Appendix 1 – DISCERN Tool

Part 4

The DISCERN instrument

Organisations are authorized to reproduce The DISCERN Instrument without permission, provided (a) it is used in accordance with the instructions contained in this Handbook to ensure that its methodology is uniform and (b) that their experience in using it is summarized on the evaluation form provided at the end of the Handbook. A copy of this evaluation should then be sent to Radcliffe Medical Press Ltd, 18 Marcham Road, Abingdon, Oxon OX14 1AA (Fax: 01235 528830) for assessment by the NHS Research & Development Programme as part of The DISCERN Project's future development.

Section 1

IS THE PUBLICATION RELIABLE?

1 Are the aims clear?

No		Partially		Yes
1	2	3	4	5

HINT Look for a clear indication at the beginning of the publication of:

- what it is about
- what it is meant to cover (and what topics are meant to be excluded)
- who might find it useful.

If the answer to Question 1 is 'No', go directly to Question 3

2 Does it achieve its aims?

No		Partially		Yes
1	2	3	4	5

HINT Consider whether the publication provides the information it aimed to as outlined in Question 1.

3 Is it relevant?

No		Partially		Yes
1	2	3	4	5

HINT Consider whether:

- the publication addresses the questions that readers might ask
- recommendations and suggestions concerning treatment choices are realistic or appropriate.

4 Is it clear what sources of information were used to compile the publication (other than the author or producer)?

No		Partially		Yes
1	2	3	4	5

HINT

- Check whether the main claims or statements made about treatment choices are accompanied by a reference to the sources used as evidence, e.g. a research study or expert opinion.
- Look for a means of checking the sources used such as a bibliography/reference list or the addresses of the experts or organisations quoted.

Rating note: In order to score a full '5' the publication should fulfil both hints. Lists of *additional* sources of support and information (Q7) are not necessarily sources of *evidence* for the current publication.

5 Is it clear when the information used or reported in the publication was produced?

No		Partially		Yes
1	2	3	4	5

HINT Look for:

- dates of the main sources of information used to compile the publication
- date of any revisions of the publication (but not dates of reprinting)
- date of publication (copyright date).

Rating note: The hints are placed in order of importance – in order to score a full '5' the dates relating to the first hint should be found.

6 Is it balanced and unbiased?

No		Partially		Yes
1	2	3	4	5

HINT Look for:

- a clear indication of whether the publication is written from a personal or objective point of view
- evidence that a *range* of sources of information was used to compile the publication, e.g. more than one research study or expert
- evidence of an external assessment of the publication.

Be wary if:

- the publication focuses on the advantages or disadvantages of one particular treatment choice without reference to other possible choices
- the publication relies primarily on evidence from single cases (which may not be typical of people with this condition or of responses to a particular treatment)
- the information is presented in a sensational, emotive or alarmist way.

7 Does it provide details of additional sources of support and information?

No		Partially		Yes
1	2	3	4	5

HINT Look for suggestions for further reading or for details of other organisations providing advice and information about the condition and treatment choices.

8 Does it refer to areas of uncertainty?

No		Partially		Yes
1	2	3	4	5

HINT

- Look for discussion of the gaps in knowledge or differences in expert opinion concerning treatment choices.
- Be wary if the publication implies that a treatment choice affects everyone in the same way, e.g. 100% success rate with a particular treatment.

Section 2

HOW GOOD IS THE QUALITY OF INFORMATION ON TREATMENT CHOICES?

N.B. The questions apply to the treatment (or treatments) described *in the publication*. Self-care is considered a form of treatment throughout this section.

9 Does it describe how each treatment works?

No		Partially		Yes
1	2	3	4	5

HINT Look for a description of how a treatment acts on the body to achieve its effect.

10 Does it describe the benefits of each treatment?

No		Partially		Yes
1	2	3	4	5

HINT Benefits can include controlling or getting rid of symptoms, preventing recurrence of the condition and eliminating the condition, both short-term and long-term.

11 Does it describe the risks of each treatment?

No		Partially		Yes
1	2	3	4	5

HINT Risks can include side-effects, complications and adverse reactions to treatment, both short-term and long-term.

12 Does it describe what would happen if no treatment is used?

No		Partially		Yes
1	2	3	4	5

HINT Look for a description of the risks and benefits of postponing treatment, of watchful waiting (i.e. monitoring how the condition progresses without treatment) or of permanently forgoing treatment.

13 Does it describe how the treatment choices affect overall quality of life?

No		Partially		Yes
1	2	3	4	5

HINT Look for:

- description of the effects of the treatment choices on day-to-day activity
- description of the effects of the treatment choices on relationships with family, friends and carers.

14 Is it clear that there may be more than one possible treatment choice?

No		Partially		Yes
1	2	3	4	5

HINT Look for:

- a description of who is most likely to benefit from each treatment choice mentioned, and under what circumstances
- suggestions of alternatives to consider or investigate further (including choices not fully described in the publication) before deciding whether to select or reject a particular treatment choice.

15 Does it provide support for shared decision-making?

No		Partially		Yes
1	2	3	4	5

HINT Look for suggestions of things to discuss with family, friends, doctors or other health professionals concerning treatment choices.

Section 3

OVERALL RATING OF THE PUBLICATION

16 Based on the answers to all of the above questions, rate the overall quality of the publication as a source of information about treatment choices

Low		Moderate		High
Serious or extensive shortcomings		*Potentially important but not serious shortcomings*		*Minimal shortcomings*
1	2	3	4	5

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Appendix 2 – LIDA Tool



The LIDA Instrument

Minervation validation instrument for health care web sites

Full Version (1.2) containing instructions

Most internet users look for health information online,[1-3] but finding unreliable information can lead to harm.[4] There is no shortage of health information out there. The problem most people have is finding **good quality** information that's **relevant** to them.

These are the challenges to information providers:

1. How can you make sure that the information you are providing is accessible, relevant and high quality?
2. Could your site fall foul of legislation affecting visually impaired Internet users?
3. Does your site's poor usability waste your audience's time by making it hard for them to find what they need?
4. How can you be sure that the information you publish is up-to-date, accurate and reliable?

These difficulties have prompted Minervation to develop a set of free validation tools to help web site developers answer these questions.

How to use this document:

For Level 1 (Accessibility) go to www.minervation.com/validation and type in the URL of the site you wish to assess. This will generate answers to questions 1.1 to 1.4.

For questions 1.5, 1.6, Level 2 (Usability) and Level 3 (Reliability), view the web site as normal and enter your scores in the boxes provided. Score each question on a scale of zero to 3, where:

0 = Never
1 = Sometimes
2 = Mostly
3 = Always

The Minerva*lida*tion tool evaluates the design and content of health web sites.

The tool measures three areas:

1. **Accessibility**
   a. Can your audience access your web site?
   b. Does your site conform to legal accessibility standards?
   c. Are your competitors ahead of you?
   d. Does your site reflect "best practice" in coding and relevant metadata?

2. **Usability**
   a. Can your users find what they need to know?
   b. Can they use your web site effectively?
   c. What does it cost people to use your web site?
   d. Do your site visitors return to use the site again and again?

3. **Reliability**
   a. Does your site keep up to date with the latest research?
   b. Does your site reflect best current knowledge?
   c. Do your users trust you to provide them with unbiased information?
   d. Does your site conform to the highest information quality standards throughout?
   e. Is your site harmful or dangerous?

Why does validation matter?
These three areas are important for a number of reasons: some legal, some political, some financial:

Level 1 Accessibility
- Making sure that web sites are accessible to *all* is now law.[5-7]
- By conforming to accessibility standards, NHS and not-for-profit sites producing health information will be permitted to join the NHS Information Partners Programme[8], and will therefore be searchable via NHS Direct Online[9], leading to increased traffic.
- Research information which is available full-text online has a higher impact than information which has restricted access.[10]

Level 2 Usability
- If people cannot use your web site effectively, they'll go elsewhere.[11-13]
- Your web site may be costing your users time which they cannot afford.[14-16]
- Most health web sites present information in a way that is hard for users to understand.[17-19]
- If your site suffers from poor usability, your users may not come back.[13;20;20-22]

Level 3 Reliability
- Users will not trust your web site if it does not have a clear quality control policy.[23]
- Web health information often contains inaccuracies[22] and is usually incomplete.[24;25]
- In some cases web sites have actually been proven to be harmful or dangerous.[26-30] Can you be sure that your site is safe?
- Even "evidence-based" guidelines have been shown to be subject to bias.[31;32]

Aren't there other evaluation tools we can use?
- Yes, there are hundreds, but almost none have been tested for their reliability.[33]
- Those that have been tested are mostly unreliable.[34]
- The few that are reliable do not adequately address the issues of accessibility and usability.[35]
- Information which is validated according to well-known quality schemes still tends to be unusable.[36]

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Level 1 Accessibility
• *Does the web site meet W3C and Bobby standards?* • *Can users access the information in the web site?* • *Is the web site "future proof"?*
1.1 Page Setup *Characteristics which identify a web page so that web browsers can interpret it correctly.*
1.1.1 Document Type Definition
1.1.2 HTTP-Equiv Content-Type (in header)
1.1.3 HTML Language Definition
1.1.4 Page Title
1.1.5 Meta Tag Keywords
1.2 Access Restrictions *These factors can restrict users' access to the site, especially those with disabilities.*
1.2.1 Image Alt Tags
1.2.2 Specified Image Widths
1.2.3 Table Summaries
1.2.4 Frames *Web sites must not use frames because they confuse disabled users' screen readers and cause usability problems for other users.*[37]
1.3 Outdated Code *HTML elements which will not be used in future versions; should be done using style sheets to eliminate inefficient and inconsistent design practices.*
1.3.1 Body Tags
1.3.2 Table Tags
1.3.3 Font Tags
1.3.4 Alignment
1.4 Dublin Core Title Tags *Metadata which will ensure compatibility with NHS directives.*
1.5 Browser Test *The web site should work in all commonly used browsers and on Macintosh*
For a review of current web browsers, see: *http://www.minervation.com/news_archive.asp?t=10&nid=160&d=200503* ☐
1.6 Registration *Is the information available full text without registration, login or subscription?*[10]
3 = No login or registration essential for certain features (e.g. eCommunity) *1 = Free registration* *0 = Paid registration* ☐

Level 2 Usability

- *Can users find the information they need?*
- *Poor usability increases costs (for both you and your users)*
- *Good usability increases usage, stickability and revenues.*

2.1 Clarity

Total:

Clear design increases usability by promoting accessibility, signposting content and encouraging exploration.[37-40,40,41]

2.1.1 Is there a clear statement of who this web site is for?

- *Did it take you long to find this information (No=2, Yes=1, Couldn't=0)?*
- *Is this information on the home page (Yes = 3)?*

2.1.2 Is the level of detail appropriate to their level of knowledge?

When assessing this question, try to think of a typical user from the group specified in 2.1.1.

- *Does the site lead the user into the right level of detail in the right sequence?*
- *Is there a lot of jargon that they would not understand?*
- *Is the language of the right complexity?*
- *Does the site make good use of graphics to explain complex information?*

2.1.3 Is the layout of the main block of information clear and readable?

Look at the "block of content"

- *Is the font size appropriate?*
- *Scannability: use of subheadings?*
- *Use of bulleted lists and internal links within a long document (good)*
- *Text wrapping*
- *Length of the page (long = bad; may need "go back to the top" links)*

2.1.4 Is the navigation clear and well structured?

Look at the buttons, links and menus

- *Can you tell what is a link or button?*
- *Are they readable?*
- *Is it clear which menu you need to click to find what you need (e.g. mixing up subtopics with publication types would make this hard)?*

2.1.5 Can you always tell your current location in the site?

- *There may be breadcrumbs or changes in the menu system telling you which section you're in, though they can be confusing.*

2.1.6 Is the colour scheme appropriate and engaging?

- *Is it appropriate for the target audience?*
- *Is it tasteful?*
- *Is it readable?*
- *Print out a black and white page to see if there's enough contrast for colour blind people.*
- *Remember to check the colours of mouse-overs and previously-clicked links etc.*

Additional Comments on Clarity:

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2.2 Consistency

Total: ☐

Consistent design helps users to learn how a web site works and where to look for the information they need.[42;43]

2.2.1 Is the same page layout used throughout the site? ☐

Are the menus, text blocks, header, footer etc consistent throughout?
- *Sometimes it's a good thing to have a different layout, for example when moving from a text-heavy explanation page into a multiple choice question, or if it's a gateway site that links to other resources.*
- *Ask yourself, would this inconsistency be confusing to the user? Does it make sense to use a different layout for this page? Can the user still "retrace their steps" if they need to?*

2.2.2 Do navigational links have a consistent function? ☐

Think about what happens when you click the link, e.g.
- *Do external links always open in a new window?*
- *Does the home page or logo link always take you to the home page?*
- *Does the search or feedback button always work in the same way?*

Again, inconsistency may be appropriate depending on whether it would make sense to the user. If it doesn't make sense to you, it certainly won't make sense to everyday users.

2.2.3 Is the site structure (categories or organisation of pages) applied consistently? ☐

Think about whether the subsections used in different areas of the site are consistent.
- *If they are, users will find it easier to predict where to find what they need on the site.*
- *The site map should help to assess this question.*

Additional Comments on Consistency:

2.3 Functionality

Total: ☐

Web sites must provide users with the right tools to find what they need without overburdening them with unnecessary functions[40;44].

2.3.1 Does the site provide an effective search facility? ☐

Browse to a section and think of a typical term that might require that information and a synonymous term people might search for which isn't on that page (e.g. Fluoxetine and Prozac). Do a search for each.
- *Did you find the page in question?*
- *Does it work with synonyms?*
- *Is the ranking of results sensible?*
- *Does it display sufficient information on the hits for you to choose the right one?*
- *Can you refine your search?*
- *Is the complexity of the search engine appropriate for the site?*

2.3.2 Does the site provide effective browsing facilities? ☐

As above, find a page and think of a typical query that a user of this site might have which requires that page. Go to the site home page.
- *Can you find your page by browsing?*
- *Would it be obvious what to click on to get that page?*
- *How many clicks did it take (target ≤ 3)?*

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2.3.3 Does the design minimise the cognitive overhead of using the site?

Cognitive overhead means "the additional effort and concentration necessary to maintain several tasks or trails at one time".[45] So, it's a general term to describe whether a web site requires its users to learn, do, remember or read lot of unnecessary information before they get what they want.

- *If you very quickly get accustomed to a site and how it works, it probably has a low (i.e. good) cognitive overhead.*
- *The sorts of things that increase cognitive overhead are: having to go to lots of different areas to get the information you need; not being able to tell where to go to get what you want; or not getting what you expected when you click on a link; unusual design or layout that is inconsistent with user expectations, especially in search engine and results pages[46].*

2.3.4 Does the site support the normal browser navigational tools?

A usable web site shouldn't change what you'd expect to be able to do with your web browser:

- *e.g. mouse-over a link to get the target, page address displayed in the address bar, title in the window title, browser toolbar buttons present and consistent (back, forward, home, etc)*

2.3.5 Can you use the site without third party plug-ins?

Typical scores:

- *No plug-ins or PDF equivalent of text that's available elsewhere on the site = 3*
- *Appropriate use of freely available plug-in (such as PDF) **and** it adds value = 2*
- *As above but it could have been done in another way without a plug-in = 1*
- *Gratuitous = 0*

Additional Comments on Functionality:

2.4 Engagability — ***Total:***

Web sites which provide users with a satisfying experience are more effective and more popular[47;48].

2.4.1 Can the user make an effective judgment of whether the site applies to them?

- *Could they make this judgment within a few seconds of visiting the site?*
- *Can the user quickly find the subsection of the site that has been produced specifically for them?*

2.4.2 Is the web site interactive?

Newsletters, eCommunities, chat, enquiry and feedback forms, animations or illustrations:

- *Think about how the site compares with others in the same topic.*
- *For newsletters – look for the ability to specify topics of interest, rather than general updates.*
- *For eCommunities – look for active bulletin boards with lots of users.*
- *For feedback mechanisms – look for forms rather than simple email addresses; is it clear who you are sending feedback to?*

2.4.3 Can the user personalise their experience of using the site?

2.4.4 Does the web site integrate non-textual media?

This includes drawings, diagrams, graphs, photographs as well as audio, video and animation:

- *Do they look professional?*
- *Are they appropriate?*

Additional Comments on Engagability:

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Level 3 Reliability

Does the site provide comprehensive, relevant and unbiased information? If not, it is unreliable and may be harmful.[4]
In a systematic review of studies of the quality of health information on the web, 70% found that quality is a problem[17].

3.1 Currency

Total: ☐

If a site is not updated regularly, new evidence may emerge which conflicts with it and which renders the site redundant[49].

3.1.1 Does the site respond to recent events? ☐

Look for coverage of recent events, news items, etc.

3.1.2 Can users submit comments on specific content? ☐

Look for 'in page' comments (these often appear towards the bottom of the page), rather than simple feedback functionality which does not affect the actual site content.

3.1.3 Is site content updated at an appropriate interval? ☐

Is the clinical content updated frequently enough to be up to date? Look for a statement in site policy, the date on each page.
- *Can't tell = 0;*
- *For treatment, an ideal target would be 6 monthly updates; for diagnosis and background information it can be longer.*

Additional Comments on Currency:

3.2 Conflicts of interest

Total: ☐

Surveys show that disclosure of sponsorship is a key issue for users of health web sites.[17]

3.2.1 Is it clear who runs the site? ☐

3.2.2 Is it clear who pays for the site? ☐

Current practice is not good in this area. If you have to look for organisational reports, etc, which disclose funding sources, then that scores 1.

3.2.3 Is there a declaration of the objectives of the people who run the site? ☐

Are these consistent with the objective of providing you with unbiased and accurate information?

Additional Comments on Conflicts of Interest:

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3.3 Content production	***Total:***
Where information is not gathered using a rigorous methodology, the findings are likely to be biased[31,50-52].	
3.3.1 Does the site report a clear content production method? *Look for a statement that tells you how information on the site was produced and its quality checked. This might be in an About Us, About this Site or Editorial Policy section.*	
3.3.2 Is this a robust method? *Ideally, it should include:* o *User-driven identification of user needs and validation of site design* o *Comprehensive searching for relevant literature* o *Appraisal of the validity of sources using evidence-based guidelines* o *Review of the site content by independent experts* o *Review of the site by target audience*	
3.3.3 Can the information be checked from original sources? *Use your judgment to decide what statements require references. Background information may not need a reference, but clinical definitions of disease usually do; statements of the findings of research certainly do.*	

Additional Comments on Content Production:

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Questions 3.4 and 3.5 are supplemental questions which require a detailed examination of the web site production process. This may not be possible from looking at the site; you may have to find out more by contacting the host organisation.

3.4 Content production procedure - supplemental *Where the purpose is providing high quality answers to users' questions about health care.*	***Total:***
3.4.1 Are the audience needs identified in advance? *Determining needs in advance leads to more robust answers[53]; involving users in this process leads to more effective[20], satisfying (by as much as 40%) and cheaper[16] web solutions.*	☐
3.4.2 Is comprehensive literature searching conducted? *This is necessary to make sure all the relevant documents are found[54], and language[55] and publication[56] biases are eliminated.*	☐
3.4.3 Are retrieved documents critically appraised? *Critical appraisal should be conducted independently using validated appraisal tools.[57]*	☐
3.4.4 Is content authored by subject experts?	☐
3.4.5 Is content reviewed by an independent expert or panel?	☐

Additional Comments on Content Production – Supplemental:

3.5 Output of content - supplemental *Does the site provide accurate and reliable information?*	***Total:***
3.5.1 Has literature searching found the right information? *Are there any important data sources missing from the search?*	☐
3.5.2 Does the content check out? *Is the content consistent with current best practice in the topic area?*	☐
3.5.3 Is the content accurate? *Here we're checking for editorial mistakes such as the classification of information (e.g. information about metastatic cancer located in a section header about non-metastatic cancer), use of incorrect references and spelling mistakes.*	☐

Additional Comments on Output of Content – Supplemental:

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Summary Sheet

Calculate totals for each section and record them here

URL: _____

Site Owner: _____

1 Accessibility Total

Total (out of 63): ☐

Enter the totals from Level 1:

1.1-4. Automated test	☐	*out of 57*
1.5. Browser test	☐	*out of 3*
1.6 Full text availability	☐	*out of 3*

Key comments / priorities:

2 Usability Total

Total (out of 54): ☐

Enter the totals from Level 2:

2.1. Clarity	☐	*out of 18*
2.2. Consistency	☐	*out of 9*
2.3. Functionality	☐	*out of 15*
2.4. Engagability	☐	*out of 12*

Key comments / priorities:

3 Reliability Total

Total (out of 27): ☐

Supplementary Total (out of 24): ☐

Enter the totals from Level 3:

3.1. Currency	☐	*out of 9*
3.2. Conflicts of Interest	☐	*out of 9*
3.3. Content Production	☐	*out of 9*
3.4. Content Production - Supplemental	☐	*out of 15*
3.5. Output of Content - Supplemental	☐	*out of 9*

Key comments / priorities:

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Appendix 3 - Ethical Approval

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Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

COISTE EITICE UM THAIGHDE CLINICIÚIL
Clinical Research Ethics Committee

Lancaster Hall,
6 Little Hanover Street,
Cork,
Ireland.

19th August 2014

Our ref: ECM 4 (kk) 19/08/14

Professor Declan Millett
Professor of Orthodontics
Cork Dental School and Hospital
Wilton
Cork

Re: Adult orthodontics: internet information and a National Survey.

Dear Professor Millett

Expedited approval is granted to carry out the above study at:

- Cork University Dental School and Hospital.

The following documents have been approved:

- Application Form
- Study Protocol
- The LIDA Instrument Version 1.2
- Information Letter dated September 2014
- Study Survey
- CV for Chief Investigator.

The co-investigator involved in this study will be:

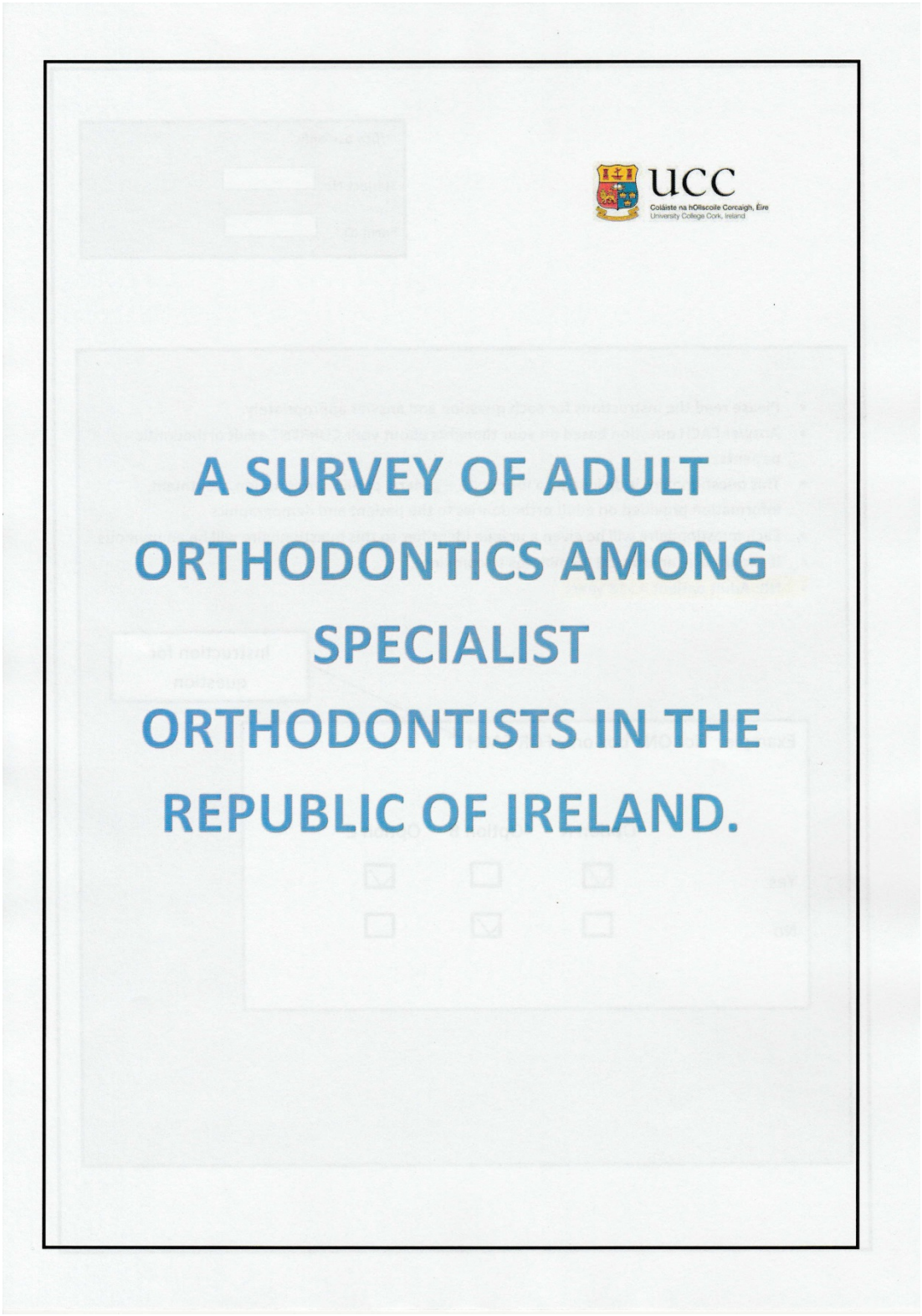
- Siobhan McMorrow.

Yours sincerely

Professor Michael G Molloy
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospitals

The Clinical Research Ethics Committee of the Cork Teaching Hospitals, UCC, is a recognised Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004, and is authorised by the Department of Health and Children to carry out the ethical review of clinical trials of investigational medicinal products. The Committee is fully compliant with the Regulations as they relate to Ethics Committees and the conditions and principles of Good Clinical Practice.

Appendix 4 - Adult orthodontic survey



Office use only.

Subject No. ☐

Form ID. ☐

- **Please read the instructions for each question and answer appropriately.**
- **Answer EACH question based on your thoughts about your CURRENT adult orthodontic patients.**
- **This questionnaire is divided into four parts – general patient information, treatment, information provided on adult orthodontics to the patient and demographics**
- **Each questionnaire will be given a unique identifier so this questionnaire will be anonymous.**
- **It should take approx. 10-15 minutes to complete.**
- **NB: Adult patient = >18 years.**

Instruction for question

Example: Tick ONE box only FOR EACH

	Option A	Option B	Option C
Yes	☑	☐	☑
No	☐	☑	☐

Please answer ALL questions in relation to your CURRENT adult orthodontic patients.

Section 1: General information

A. Do you treat adult orthodontic patients?

Tick ONE box only

1. Yes ☐
2. No ☐

If you answered 'No' to the above question please go to Section 4.

B. What is the main source of referral of your adult orthodontic patients?

Tick ONE box only

1. Self ☐
2. GDP ☐
3. HSE ☐
4. Specialist (in another dental specialty) ☐
5. Other ☐
   Please specify: _____

C. Are most of your adult orthodontic patients...?

Tick ONE box only

1. Third level students ☐
2. Professionals ☐
3. Non-professionals ☐
4. Other ☐
   Please specify: _____

D. What percentage of your cases are adults?

Tick ONE box only

1. 0 - < 10% ☐
2. 10 - <20% ☐
3. 20 - <30% ☐
4. 30 - <40% ☐
5. ≥ 40% ☐

E. What is the most common age range of your adult patients?

Tick ONE box only

1. 18 – < 25 years ☐
2. 25 – < 35 years ☐
3. 35 – < 45 years ☐
4. 45 – < 55 years ☐
5. ≥ 55 years ☐

F. What percentage of your adult patients are female/male?

Tick ONE box FOR EACH

	Female	Male
1. 0 - <20%	☐	☐
2. 20 - <40%	☐	☐
3. 40 - <60%	☐	☐
4. 60 - <80%	☐	☐
5. 80 – 100%	☐	☐

G. What percentage of your adult patients:

Tick ONE box FOR EACH

	Are over 45 years?	Have had previous orthodontic treatment?	Had previous extractions for non-orthodontic tx?	Have/had periodontal problems?	Have/had TMD problems?
1. 0 - <10%	☐	☐	☐	☐	☐
2. 10 - <20%	☐	☐	☐	☐	☐
3. 20 - <30%	☐	☐	☐	☐	☐
4. 30 - <40%	☐	☐	☐	☐	☐
5. ≥ 40 %	☐	☐	☐	☐	☐

H. Why, in your opinion, do adult patients seek orthodontic treatment?

Tick ONE box only PER ITEM

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. To improve dental appearance	☐	☐	☐	☐
2. To improve facial appearance	☐	☐	☐	☐
3. To improve smile aesthetics	☐	☐	☐	☐
4. To improve function	☐	☐	☐	☐
5. To improve self-esteem/confidence	☐	☐	☐	☐
6. Adjunctive to implants or other restorative treatment	☐	☐	☐	☐
7. Did not have opportunity /couldn't afford when Younger	☐	☐	☐	☐

I. What is the most common INCISOR RELATIONSHIP of your adult patients?

Tick ONE box only

1. Class I ☐
2. Class II division 1 ☐
3. Class II division 2 ☐
4. Class III ☐

J. What is the most common SKELETAL BASE RELATIONSHIP of your adult patients?

Tick ONE box only

1. Class I ☐
2. Class II ☐
3. Class III ☐

K. How common are these anomalies in your adult patients?

Tick ONE box only PER ITEM

	Very Common	Common	Uncommon	Very Uncommon
1. Generalized crowding	☐	☐	☐	☐
2. Increased overjet	☐	☐	☐	☐
3. Reverse overjet	☐	☐	☐	☐
4. Late lower incisor crowding	☐	☐	☐	☐
5. Spacing	☐	☐	☐	☐
6. Deep overbite	☐	☐	☐	☐
7. Anterior openbite	☐	☐	☐	☐
8. Impacted teeth (excluding 3rd molars)	☐	☐	☐	☐

Section 2: Treatment

A. How long does treatment of your adult orthodontic cases usually take?

Tick ONE box only

1. 6 mths – < 1 year ☐
2. 1 year – <18 months ☐
3. 18 months – <2 years ☐
4. 2 years or more ☐
5. Other ☐
   Please specify: _____

B. How frequently do you face the following challenges when treating your adult orthodontic patients?

Tick ONE box only PER ITEM

	Always	Often	Sometimes	Rarely	Never
1. Anchorage management	☐	☐	☐	☐	☐
2. Overbite reduction	☐	☐	☐	☐	☐
3. Closure of old extraction spaces	☐	☐	☐	☐	☐
4. Compliance	☐	☐	☐	☐	☐
5. Patient demands	☐	☐	☐	☐	☐
6. Overjet reduction	☐	☐	☐	☐	☐
7. Crossbite correction	☐	☐	☐	☐	☐
8. Correction of molar relationship	☐	☐	☐	☐	☐
9. Centreline correction	☐	☐	☐	☐	☐
10. Very high aesthetic demand	☐	☐	☐	☐	☐
11. Unrealistic patient expectations	☐	☐	☐	☐	☐
12. "Black triangles"	☐	☐	☐	☐	☐
13. Maintenance of space closure	☐	☐	☐	☐	☐

C. i) When adapting to appliances, how commonly do your adult patients report the following difficulties?

Tick ONE box only PER ITEM

	Always	Often	Sometimes	Rarely	Never
1. Pain after appliance adjustment	☐	☐	☐	☐	☐
2. Eating	☐	☐	☐	☐	☐
3. Speech	☐	☐	☐	☐	☐
4. Embarrassment	☐	☐	☐	☐	☐

C. ii) In all other aspects of treatment, how commonly do your adult patients report difficulty with the following?

Tick ONE box only PER ITEM

	Always	Often	Sometimes	Rarely	Never
1. Cost of treatment	☐	☐	☐	☐	☐
2. Wearing elastics	☐	☐	☐	☐	☐
3. Wearing retainers	☐	☐	☐	☐	☐
4. Length of treatment	☐	☐	☐	☐	☐
5. Managing appointments around work schedule	☐	☐	☐	☐	☐

D. i) What percentage of your adult cases require orthodontics ONLY:

Tick ONE box only

1. 0 - <20% ☐
2. 20 - <40% ☐
3. 40 - <60% ☐
4. 60 - <80% ☐
5. 80 – 100% ☐

D. ii) What percentage of your adult cases require:

Tick ONE box only FOR EACH SCENARIO

	Orthodontics & minor oral surgery?	Orthodontics & maxillofacial surgery?	Orthodontics & periodontal treatment?	Orthodontics & restorative treatment?
1. 0 - <10%	☐	☐	☐	☐
2. 10 - <20%	☐	☐	☐	☐
3. 20 - <30%	☐	☐	☐	☐
4. 30 - <40%	☐	☐	☐	☐
5. 40 - <50%	☐	☐	☐	☐
6. ≥ 50%	☐	☐	☐	☐

E. Do you treat adult patients for the following?

Tick ALL THAT APPLY

	Yes	No
1. TMD	☐	☐
2. Anti-Snoring Device	☐	☐
3. Sleep Apnoea	☐	☐
4. Botox	☐	☐
5. Tooth Whitening	☐	☐

F. How FREQUENTLY do you use the following appliance types for your adult orthodontic patients?

KEY: TADs, Temporary Anchorage Devices; ↑, Upper; ↓, Lower; URA, Upper Removable Appliance; TPA, Transpalatal Arch.

Tick ONE box only PER ITEM

	Always	Often	Sometimes	Rarely	Never
1. Pre-adjusted edgewise(↑ + ↓) (Stainless steel)	☐	☐	☐	☐	☐
2. Self-ligating(↑ + ↓) (Stainless steel)	☐	☐	☐	☐	☐
3. Aesthetic brackets (↑ + ↓) (Any appliance system)	☐	☐	☐	☐	☐
4. Lingual (↑ + ↓)	☐	☐	☐	☐	☐
5. Aesthetic Brackets ↑, Metal Brackets ↓	☐	☐	☐	☐	☐
6. Lingual ↑, Metal Brackets ↓	☐	☐	☐	☐	☐
7. TADs	☐	☐	☐	☐	☐
8. URA	☐	☐	☐	☐	☐
9. Clear Aligner Therapy (eg Invisalign©)	☐	☐	☐	☐	☐
10. Quadhelix	☐	☐	☐	☐	☐
11. TPA	☐	☐	☐	☐	☐

Section 3: Information

A. Do you provide information leaflets to your adult orthodontic patients about adult orthodontics?

Tick ONE box only

1. Yes ☐
2. No ☐

If you answered 'No' please go to Question C.

B. Are these leaflets developed by:

Tick ONE box only

1. The British Orthodontic Society ☐
2. Your practice ☐
3. Other ☐
   Please Specify:

_____

C. Does your practice have a website?

Tick ONE box only

1. Yes ☐
2. No ☐

If 'No' please go to question E.

D. Does your practice have a section dedicated to adult orthodontics?

Tick ONE box only

1. Yes ☐
2. No ☐

E. Do you advise your adult orthodontic patients to find extra information about adult orthodontics on the internet?

Tick ONE box only

1. Yes ☐
2. No ☐

If 'Yes', please specify which websites you recommend.

_____

_____

_____

F. Do you provide information on the following?

Tick MOST COMMON means used FOR EACH SCENARIO

	Yes, using a				No
	Leaflet/ Consent Form	Website	Verbal	CD	
1. Appliances (non aesthetic)	☐	☐	☐	☐	☐
2. Appliances (aesthetic)	☐	☐	☐	☐	☐
3. Length of treatment time	☐	☐	☐	☐	☐
4. Cost	☐	☐	☐	☐	☐
5. Dietary Habits	☐	☐	☐	☐	☐
6. Oral Hygiene	☐	☐	☐	☐	☐
7. Orthognathic surgery	☐	☐	☐	☐	☐
8. Frequency of visits	☐	☐	☐	☐	☐
9. Advice regarding attending GDP	☐	☐	☐	☐	☐
10. Retention	☐	☐	☐	☐	☐
11. Facial Enhancement eg Botox	☐	☐	☐	☐	☐
12. Tooth Whitening	☐	☐	☐	☐	☐
13. Smoking Cessation	☐	☐	☐	☐	☐
14. Sleep Apnoea	☐	☐	☐	☐	☐
15. TMD	☐	☐	☐	☐	☐
16. Anti-Snoring Device	☐	☐	☐	☐	☐

Section 4: Demographics

A. Are you male or female?

Tick ONE box only

1. Male ☐
2. Female ☐

B. Please indicate the number of years you have been working as a specialist orthodontist.

Tick ONE box only

1. 0 to <5 years ☐
2. 5 to <10 years ☐
3. 10 to <15 years ☐
4. 15 to <20 years ☐
5. ≥20 years ☐

C. Where is your main region of work?

Tick ONE box only

1. Dublin ☐
2. Rest of Leinster ☐
3. Munster ☐
4. Connacht ☐
5. Ulster ☐

D. Where did you study orthodontics?

Tick ONE box only

1. Ireland ☐
2. UK ☐
3. USA ☐
4. Other ☐
   Please specify: _____

E. In what clinical setting do you mainly work?

Tick ONE box only

1. HSE orthodontic clinic ☐
2. Private practice ☐
3. Teaching hospital ☐
4. Other ☐
   Please specify:

_____

Thank you for filling in this questionnaire.

You can return it to us by post using the pre-paid envelope to:

Dr. Siobhan McMorrow
Postgraduate Orthodontic Unit
Cork University Dental School and Hospital
Wilton
Cork
Ireland

Please ensure YOU HAVE FILLED IN YOUR PRIZE DRAW FORM and RETURN THAT TO US SEPARATELY in the allocated pre-paid envelope.

Appendix 5 – Permission to include LIDA document



Helen Smith <helen.smith@minervation.com> 30 Jun

to me

Dear Siobahn

Well done for completing your thesis and thank you for your permission request.

We give you permission to attached the LIDA document as long as the citation and link are included.

Hope that all sounds ok

Best wishes

Helen

Helen Smith | Office Manager (part-time)

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