Dental Anxiety in Future and Current Orthodontic Patients

by

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A thesis submitted in conformity with the requirements for the degree of Master in Sciences
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University of Toronto

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2011

Abstract

Dental anxiety is not typically associated with orthodontic treatment because of the lack of evoking stimuli (i.e., drills, needles). Its prevalence in orthodontic patients is unknown but reported anecdotally. This study aimed to assess the prevalence of and factors contributing to dental anxiety in future and current orthodontic patients.

University dental clinics and private orthodontic office patients completed a questionnaire including the Modified Dental Anxiety Scale (MDAS), MDAS-Ortho (both scored 1-not anxious to 5-extremely anxious; sum score ≥15=dentally anxious), and list of concerns about orthodontic treatment. 675 patients participated (60.4% private practice; 64.3% female; 24.9% new patients; 85.5% aged 12-20 years). University clinic patients reported significantly higher MDAS and MDASO scores (p<0.05). 22.8% were dentally anxious and 18.7% anxious about orthodontic treatment, with concerns related to their relationship with the orthodontist, perceptions of orthodontic treatment and treatment factors. Results confirm dental anxiety in orthodontic patients and factors contributing to that anxiety.
Acknowledgments

First I would like to thank my parents for supporting me throughout all my studies, for encouraging me and believing in me. They are my inspiration. I could not have done this without their precious help, advice and encouragement.

I also offer my sincerest gratitude to my supervisor, Dr. Laura Dempster, who has supported me and helped me through this thesis. I attribute the level of my Master’s degree to her patience and her knowledge. I have further to thank the other members of my research committee: Dr. Vicki LeBlanc who helped me with the statistical analysis and provided me with valuable advice and Dr. Tompson who supported me with this research project and gave me the chance to accomplish my dream to become an orthodontist.

Finally, I would like to thank my classmates Mike and Matt, and all the other orthodontic residents who have made those three years so memorable…
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1 Introduction

Anxiety is an emotion experienced by most individuals at some time during their life. It can cause nervousness, fear, apprehension, and worrying. Its intensity and the reasoning behind it determine whether it is considered a normal or abnormal reaction (Barker, 2009). This emotion can occur with or without an identifiable triggering stimulus such as dental treatment (Ohman, 2000). Anxiety and its related conditions are one of the most prevalent psychological disorders in the general population (American Psychiatric Association [APA], 4th ed., 2000; Kessler, Chiu, Demler, & Walters, 2005; Toft et al., 2005).

Dental anxiety is the most common psychological condition seen in dentistry and affects a significant percentage of the population (Changpong, Haas & Locker, 2005; Hakeberg, Berggren, & Carlsson, 1992; Locker, 2003; Locker, Shapiro, & Liddell, 1996; Milgrom, Fiset, Melnick, & Weinstein, 1988; Ragnarsson, 1998; Schuller, Willumsen, & Holst, 2003; Stouthard & Hoogstraten, 1990; Thomson, Stewart, Carter, & Spencer, 1996; Vassend, 1993). As such, it is well documented that dentists deal with anxious patients in their daily practice (Chanpong et al., 2005; Corah, 1988; Locker, 2003; Locker et al., 1996; Milgrom et al., 1988). Anxiety in patients influences both the psychology (e.g., avoidance of dental care) and the physiology (e.g., palpitations, nausea) of the dental experience, which leads to a variety of behaviours that impact dental care, such as delay and avoidance of dental treatment. Despite improvements in dental technology, the prevalence of dental anxiety has remained relatively stable since the 1960s (Smith & Heaton, 2003).

Although studies have assessed several aspects of anxiety related to dental treatment, no research has investigated dental anxiety among patients receiving orthodontic treatment. This could be because dentists and orthodontists assume that their patients are not anxious because orthodontic treatment is not associated with the dental drill or injections for local anaesthesia, which are two of the most commonly cited stimuli associated with dental anxiety (Taani, 2002; Domoto et al., 1988). However, pain is often cited as a cause of dental anxiety (Maggirias & Locker, 2002; McNeil & Berryman, 1989), and pain experienced during orthodontic treatment has been reported as the worst aspect of treatment by some patients and a primary reason for wanting to discontinue orthodontic care (Brown and Moerenhout, 1991, Kluemper, Hiser, Rayens, & Jay, 2002; Oliver & Knapman, 1985).
Despite the unknown prevalence of patients anxious about orthodontic treatment, orthodontists anecdotally report many cases of dentally anxious orthodontic patients in their practice. It is important to establish if patients are anxious about having orthodontic treatment because dentally anxious patients tend to delay and/or avoid dental treatment, which can lead to poor oral health, self-esteem and general well-being. From the clinician’s standpoint, dealing with dentally anxious patients can be challenging and stressful. Determining the prevalence of dental anxiety in orthodontics and factors contributing to it will create an awareness of the problem, and help clinicians identify patients who are dentally anxious and facilitate appropriate treatment and management during orthodontic treatment.

1.1 Normal vs. clinically significant anxiety

Anxiety, including anxiety related to dental treatments, can be categorized as normal and expected or pathological and clinically significant. Normal anxiety is experienced as mild apprehension in reaction to threatening, dangerous, uncertain, or important situations whereas clinically significant anxiety is higher in intensity, of longer duration and experienced as overwhelming, distressing, and incapacitating. Pathological anxiety also involves physical and psychological symptoms. Pathological anxiety (moderate to severe levels of anxiety) may cause long term behavior changes and require specific management (APA, 2000). Such levels of anxiety have been experienced by individuals prior to and/or during dental treatments.

1.2 Defining dental anxiety

For the purpose of this study, dental anxiety is assessed in the context of orthodontic treatment and therefore defined as self-reported anxiety occurring in response to some aspect of orthodontic treatment. The anxiety might be initiated by orthodontic treatment, the anticipation of such treatment, or due to factors associated with orthodontic treatment such as fear of the unknown, fear of pain or dealing with the professional staff in the office. The current research is interested in those individuals with pathological levels of anxiety, identified as having moderate to high levels of anxiety.
1.3 Cognitive, behavioural and physiological dimensions of anxiety

Anxiety is a physiological and psychological state characterized by cognitive, physiological and behavioral components (Seligman, Walker & Rosenhan, 2001). These components are known to create an unpleasant feeling that is typically associated with apprehension, or worry, and can occur in combination or separately.

The cognitive component is represented by a series of mental processes whereby individuals evaluate the situation they are in. It includes anxious predictions, assumptions, beliefs and information processing biases.

The physiological component prepares the individual for action. It is characterized by an increase in muscular tension, tachycardia, hyperventilation and an increase in the person’s sensibility towards external agents, such as sensitivity to pain which is of significance in the field of dentistry (Caceres & Burns, 1997). Adrenaline levels (epinephrine) have been found to be higher among highly anxious patients than controls before and during dental treatment (Edmondson, Roscoe, & Vickers, 1972).

The behavioral component involves reacting to a situation and efforts to re-establish optimum conditions of wellbeing. The two extremes are: coping with the problem directly (i.e., endure it) or simply avoiding it. Avoidance is typically described as a flight or fight response. The behavioral response component includes avoidance behaviors, compulsions, distraction and multiple overprotective behaviors intended to reduce discomfort or prevent the danger anticipated by anxious individuals (Lang, 1971).

2 Clinical significance of dental anxiety

Despite an abundance of research, there exist gaps in our understanding of dental anxiety. General dentists report many cases of anxious patients in their practice. Although prevalence of dental anxiety is well-documented in the dental literature (Horst & De Wit, 1993; Locker et al., 1996; Moore, Birn, Kirkegaard, Brodsgaard & Scheutz, 1993), no information is available about the prevalence of dental anxiety among orthodontically treated patients likely because of the lack of commonly reported evoking stimuli (i.e, drill and needle) associated with dental anxiety. Indeed, drill and needle are used less frequently in orthodontic than dental treatment. Nonetheless, dental anxiety related to orthodontic treatment is anecdotally reported by
orthodontists and is worth to be investigated because it impacts both the clinicians and the patients.

2.1 Impact of anxiety on the patient

Patients with dental anxiety may avoid or delay seeking dental treatment and can be more difficult to manage once they are in the dental chair. Surveys indicate that a substantial proportion of the general population avoids making regular visits to the dentist because of their anxiety (Teo, Foong, Liu, Vignebsa, & Elliot, 1990; Todd & Walker, 1980; Todd, Walker & Dodd, 1982). That behavior can be detrimental for many reasons. Patients avoiding dental treatment may have untreated dental disease (e.g., periodontal disease, dental caries) leading to poorer oral health (Armfield, Slade & Spencer, 2009; Eitner, Wichmann, Paulsen & Holst, 2006; Schuller et al., 2003), reduced dental visits (Enkling, Marwinski & Johren, 2006; Pohjola, Lahti, Vehkalahti, Tolvanen & Hausen, 2007) and consequently poorer oral health-related quality of life (McGrath & Bedi, 2004; Mehrstedt, John, Tonnies & Micheelis, 2007).

2.1.1 Patient management and treatment

Dentally anxious patients are reported to be more challenging to treat for several reasons such as harsh attitudes towards dentists, dental specialists and their staff (Moore et al., 1993), more negative feelings about treatment (De Jongh, Muris, Schoenmakers & Ter Horst, 1995; Weinstein, Smith & Bartlett, 1973), less satisfaction with treatment (Kleinknecht & Bernstein, 1978; Liddell & Locker, 1992; Milgrom, Weinstein, Kleinknecht & Getz, 1985) and an increased sensitivity to pain (Lindsay, Wege & Yates, 1984; Locker et al., 1996; Maggirias & Locker, 2002;). This can be explained to some degree by different expectations between anxious and non-anxious patients (Liddell & Locker, 1992; Milgrom et al., 1985). Liddell, Ackerman & Locker (1990) reported that reduced satisfaction was not associated with the dentist’s level of technical competence or the diagnostic information provided, but related to the fact that the dentist did not understand the patient’s anxiety.

Some authors have suggested that dentally anxious patients are more likely to report pain during dental treatment (Davey, 1989; De Jongh, Muris, Ter Horst, & Duyx, 1995; Locker et al., 1996; Vassend, 1993), and more prone to undergo complications following invasive procedures (Liu, Barty & Weinman, 1994). De Jongh and Ter Horst (1995) showed a positive correlation between the degree of dental anxiety and reported negative outcomes of treatment, particularly
pain. This is in agreement with other studies associating negative, traumatic or painful
experiences more often with dentally anxious patients (Kent, 1997; Maggirias & Locker, 2002;
Vervoorn, Duinkerke, Luteijn, & Van de Poel, 1989). Some investigators have suggested that
anxiety lowers the pain threshold, resulting in normally non-painful stimuli as painful, and
proposed that the reported pain might be an attempt to translate the patients’ feelings (Brown &
studied patients’ anticipation of pain and their perception of pain as a result of orthodontic
treatment with fixed appliance. They found that patients who anticipated a greater effect of pain
on their daily activities and those who had a history of frequent headaches reported higher levels
of pain and more disturbance of their daily lives as a result of pain. A possible mechanism of the
pain increasing effects of anxiety may be that anxiety increases sympathetic activity and the
release of epinephrine at the sympathetic terminals, which may sensitize or directly activate
nociceptors (Chapman & Turner, 1986). Anxiety and other emotional traits (e.g., depression)
have been reported to predict approximately half of the variability between patients in
postoperative outcome measures such as pain (Taenzer, Melzack, & Jeans, 1986).

Dentally anxious patients are also inclined to complain more often that dentists do not
take their worries seriously (Johansson, Berggren, Hakeberg, & Hirsch, 1993) or make patients
feel guilty for being anxious (Kuzelmann & Dunninger, 1990), and to describe dentists as
making patronizing comments (Moore et al., 1993). Corah (1988) described six behaviours that
help to reduce patients’ anxiety, including the dentist’s dedication to prevent pain, and the dentist
being friendly, calm, taking adequate time, giving moral support and assuring relief from pain if
pain occurred.

2.1.2 Dental anxiety related to orthodontics

It is well documented in the dental literature that fear of pain is one of the possible
etiologies of dental anxiety (Bernstein, Kleinknecht & Alexander, 1979; Laucht, 1971; Maggirias
& Locker, 2002; McNeil & Berryman, 1989; Wardle, 1982). Although pain is subjective, a
certain discomfort is unavoidable during orthodontic treatment. Recent literature stated that some
orthodontic procedures such as separator placement, archwire placement and activations,
application of orthopaedic forces and debonding produce pain in patients (Krishnan, 2007). It has
also been suggested that patients treated with fixed appliances experience more pain than
removable or functional appliances (Krishnan, 2007). Patients describe discomfort associated
with orthodontic treatment as feelings of pressure, soreness of the teeth and tension causing pain (Ngan, Kess, & Wilson, 1989).

Approximately 70% to 95% of orthodontic patients are reported to experience pain during orthodontic treatment (Bergius, Berggren & Kiliaridis, 2002; Scheurer, Firestone & Burgin, 1996), although for most patients, pain is not a major problem (e.g., they endure it and continue their treatment). However, up to 8% of orthodontic patients interrupt their orthodontic treatment because of early pain experiences (Patel, 1989). Furthermore, the thought of having painful experiences discourages some patients from seeking orthodontic treatment, even when it is needed for functional rather than aesthetic reasons (Bartlett, Firestone, Vig, Beck & Marucha, 2005). A relationship also exists between reported pain and factors such as gender, age, cultural background and psychological state (e.g., anxiety), where females usually report more pain than males and adolescents express higher levels of pain than adults (Krishnan, 2007).

An individual’s physiological and psychological susceptibility can significantly influence the severity of pain caused by orthodontic appliances (Bergius, Kiliaridis, Berggren, 2000; Brown & Moerenhout, 1991; Sergl, Klages, & Zentner, 1998). Sergl et al. (1998) reported the correlation between pain felt after appliance placement and patient’s attitude towards treatment. Similarly, Litt (1996) reported that having a negative dental experience and/or dental anxiety increased the risk of reporting pain from general dental treatment. This is consistent with the findings of Bergius, Broberg, Hakeberg and Berggren (2008) who found that patients with prolonged pain reactions (compared with those who did not report pain one week after placement of elastics separators) were less motivated for orthodontic treatment and reported a higher level of dental anxiety. Therefore, psychological factors might play a critical role in determining a patient’s subjective response to orthodontic force and could explain the considerable variations in pain intensity reported in several studies (Erdinç & Dinçer, 2004; Fernandes, Ogaard & Skoglund, 1998; Firestone et al., 1999; Jones & Chan, 1992; Ngan et al., 1989; Pringle, Petrie, Cunningham, & McKnight, 2009; Scheurer et al., 1996).

It appears that dental anxiety related to orthodontic treatment may increase pain experienced during orthodontic treatment and consequently result in less compliance from the patient (Bergius et al., 2008). Pain also contributes to increase or maintain high dental anxiety levels, which leads to a vicious circle, where more pain can lead to more anxiety and more anxiety possibly leads to more pain. Strategies that reduce patient anxiety (e.g., improve
communication with the patient, show them the procedures before the treatment, reinforcement, parental involvement) could help to reduce patients’ discomfort following appliance placement.

It is important to establish the prevalence of anxiety among orthodontically treated patients, and to identify which factors contribute to anxiety regarding orthodontic treatment. Controlling those factors could reduce pain experienced during orthodontic treatment and make visits at the orthodontist’s office more enjoyable. Bergius and coworkers (2008) investigated prolonged pain experiences during orthodontic treatment and concluded that patients with higher level of dental anxiety might present higher pain sensitivity and poorer capacity to cope with treatment pain. Consequently, those patients were less motivated and less compliant during orthodontic treatment.

Data collected in this study will provide a better understanding of the nature of anxiety in orthodontic patients as it relates to their treatment. This will aid orthodontists in the treatment and management of their patients as well as furthering our knowledge regarding the factors that contribute to anxiety in this population. This study will allow participants to identify their concerns in a safe, non-judgmental process, which will then be translated back to the orthodontic community to enhance patient care. This will hopefully benefit both orthodontists and patients by providing a more enjoyable treatment experience.

2.2 Impact of anxiety on the clinician

Dental anxiety is important to practitioners because anxious patients are more likely to delay or cancel their appointments (Moore & Brodsgaard, 2001), and treating anxious patients can be stressful and difficult to manage. In a study carried out by Hill, Hainsworth, Burke, and Fairbrother (2008), 91% of general dental practitioners reported feeling considerable levels of stress when dealing with anxious patients. Corah, O’Shea and Ayer (1985) reported similar findings with 80% of the surveyed dentists admitting that they were anxious when treating anxious patients. These two studies are in agreement with numerous studies highlighting the increased stress and anxiety associated with treating anxious individuals (Cooper, Watts, & Kelly, 1987; Moore & Brodsgaard, 2001; Weiner & Weinstein, 1995). O’Shea, Corah and Ayer (1984) also reported increased heart rates in practitioners executing routine procedures on anxious patients, whereas no such increase was noted when performing a technically demanding procedure on non-anxious patients. Practice efficiency is also affected when treating dentally anxious patients because it can take longer to provide the same care on a dentally anxious patient.
than on a non-dentally anxious patient (Kleinknecht & Bernstein, 1978). There has been a long standing assumption that a link exists between stress and treatment of anxious patients; however it is only more recently that the literature is reporting on research being done in relation to levels of stress in dental practitioners. Newton, Allen, Coates, Turner and Prior (2006) state that there is a need for the development of interventions to reduce the stress experienced by members of the dental team. They suggest that interventions to reduce level of stress should be customized to the individual needs of the practitioner in order to be effective.

Although dental anxiety is undoubtedly present in dental practice, some practitioners act as if dental anxiety does not exist. In one survey about perceptions of dentally anxious patients, about two-thirds of dentists thought that anxious patients were somewhat or always a problem, and about one-third of the practitioners believed dental anxiety was not an issue in dental practice (Weiner & Weinstein, 1995). A recent study also showed that very few dentists try to identify dentally anxious patients using dental anxiety measures (Dailey, Humphris, & Lennon, 2001). Dentists anecdotally report that they are afraid that questioning the patients about dental anxiety may increase the patients’ anxiety level but no scientific evidence supports this theory. Studies have shown that completing a dental anxiety survey did not increase nor decrease the patient’s dental anxiety (Humphris, Clarke, & Freeman, 2006; Humphris & Hull, 2007). Moreover, Dailey et al. (2002) report an important and statistically significant reduction in anxiety once the patients knew that their concerns were taken into consideration by the dentists. This could be because the dentists changed their behavior once they knew the patient was anxious or because the patients felt more secure knowing that their fears were taken seriously. Beck and Emery (1985) report that it may be easier for patients to control negative thoughts when they feel that the dentist understands their worries. A positive dentist/patient relationship and patients’ perception that the dentist comprehends their feelings have been reported to contribute to reduced patient anxiety (Lahti, Tuutti, Hausen, & Kaariainen, 1995; Liddel et al., 1990; Liddell, Di Fazio, Blackwood, & Ackerman, 1994; O’Shea, Mendola, & Corah, 1991; Rankin & Harris, 1984).

Dealing with dentally anxious patients can be challenging and stressful for the clinician. Treating anxious patients has been identified as one of the most common stressors of dentists along with causing pain, running behind schedule, late patients and heavy workload (Moore & Brodsgaard, 2001). By learning which aspects of orthodontic treatment might be a source of anxiety for patients, orthodontists will be able to understand their patients better, be empathetic
to their patient’s anxiety, and improve the quality of patient care. It is also easier to address patient anxiety if the source of the anxiety can be identified. Moreover, since anxiety is associated with pain experience, and pain is a factor in orthodontic treatment, efforts to reduce anxiety in orthodontic patients may also reduce pain associated with treatment. Efforts to reduce dental anxiety in patients can benefit both clinicians and patients.

3 Literature review

This section will review the four following areas:

1) An overview of anxiety disorders
2) Measuring dental anxiety and dental anxiety measures
3) The epidemiology of dental anxiety
4) Etiological hypotheses and factors contributing to dental anxiety

3.1 An overview of anxiety disorders

Anxiety is a normal reaction that individuals experience at one time or another. It can be normal or abnormal, which is often referred to as pathological or clinically significant. It is very common to experience normal anxiety, which may be feeling nervous before an interview or having ‘butterflies’ in the stomach before giving a speech (Hyman & Pedrick, 2006). Pathological anxiety involves various symptoms which are more intense, such as mental apprehension, physical tension and physical symptoms. When this translates into significant distress and some degree of functional impairment in daily living, then an individual may be diagnosed with a phobia (Hyman & Pedrick, 2006). Among the DSM-IV disorders (American Psychiatric Association [APA], 2000), anxiety disorders are the most prevalent class of disorders and affect 18.1% of the general population (Kessler et al., 2005).

Anxiety disorders include several categories of abnormal and pathological fear and anxiety (Berrios, 1999). The most recent version of the Diagnostic and Statistical Manual Of Mental Disorders (DSM-IV-Text Revision (TR)) defines anxiety as an `apprehensive anticipation of future danger or misfortune accompanied by a feeling of dysphoria or somatic symptoms of tension` (American Psychiatric Association [APA], 2000). The Diagnostic and
Statistical Manual Of Mental Disorders (DSM-IV-TR) classifies anxiety disorders in 12 different categories (Table 3.1).

3.1.1 Fear, anxiety and phobia

Although the basic emotion of fear is strongly related to anxiety, some authors identify these states as distinct from one another (Antony & Barlow, 1996; Barlow, 1988; Lang, 1971) whereas others consider them synonymous (Clark, 1986; Rapee, 1996). Anxiety is a future-oriented emotional state characterized by high negative effect, a sense that upcoming events are uncontrollable and unpredictable, difficulty concentrating, and a tendency to worry (Antony, Orsillo & Roemer, 2001). It is a generalized mood state that occurs without an identifiable triggering stimulus. As such, it is distinguished from fear, which occurs in the presence of an external threat. Additionally, fear is a focused, all-or-nothing, alarm reaction in which there is an intense motivation to escape from a potential danger, and in which the individual is ready (both physically and cognitively) for action. Fear is related to the specific behaviors of escape and avoidance, whereas anxiety is the result of threats that are perceived to be uncontrollable or unavoidable (Ohman, 2000).

Anxiety and fear are distinct from phobia, which is traditionally defined as an irrational severe, persistent and unreasonable fear associated with an anxiety response (APA, 2000). Phobias lead to avoidance of the feared situation, object or activity or endurance with significant distress and interfere with day-to-day functioning. Specific phobias are the most common psychiatric disorders in females and second most frequent in males (Barlow, 1988). According to the DSM-IV (APA, 2000), the criteria for a specific phobia are (i) marked and persistent fear that is excessive and unreasonable; (ii) exposure to the phobic stimuli almost invariably provokes an immediate anxiety response; and (iii) the person recognizes that the fear is excessive or unreasonable (but note that this third criteria might be absent in children); (iv) the phobic situation is avoided or else endured with intense anxiety or distress. Even though the DSM-IV classifies specific phobias in five subtypes (Table 3.2), not all phobias are categorized into one subtype and may be included in more than one category. Dental phobia is often included in the blood-injection-injury (BII) subtype because of the association between dental treatment and needles. In spite of this link, other aspects of dental treatment are related to dental phobia and therefore it may be more appropriate to recognize it as another type of phobia.
Table 3.1 Classification of anxiety disorders according to DSM-IV (APA, 2000)

<table>
<thead>
<tr>
<th>Anxiety disorders</th>
<th>Key features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panic disorder without agoraphobia</td>
<td>Recurrent, panic attacks, associated with persistent concern about the attacks</td>
</tr>
<tr>
<td>Panic disorder with agoraphobia</td>
<td>Panic disorder associated with agoraphobia (i.e., fear and avoidance of situations in which escape might be difficult or embarrassing, or in which help might not be available in the event of a panic attack or panic-like sensations)</td>
</tr>
<tr>
<td>Agoraphobia without history of panic disorder</td>
<td>The presence of agoraphobia in an individual who has never met full criteria for panic disorder</td>
</tr>
<tr>
<td>Specific phobia</td>
<td>Clinically significant anxiety, fear, and avoidance related to a specific object or situation (e.g., heights, animals, blood, injections, flying, enclose places)</td>
</tr>
<tr>
<td>Social phobia</td>
<td>Clinically significant anxiety, fear, and avoidance related to social and performance situations, associated with a fear of embarrassment or humiliation</td>
</tr>
<tr>
<td>Obsessive compulsive disorder</td>
<td>The presence of obsessions (thoughts, urges, or images that are distressing and intrusive) and compulsions (repetitive behavior meant to reduce anxiety and prevent perceived danger)</td>
</tr>
<tr>
<td>Posttraumatic stress disorder and acute stress disorder</td>
<td>Associated with previous exposure to extreme stress, accompanied by symptoms of increased arousal and avoidance of situations and thoughts that remind the individual of the event. In the case of acute stress disorder, a short-term extreme stress response which emphasizes dissociative symptoms</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>Persistent, excessive, and uncontrollable worry for at least 6 months, associated with other symptoms such as irritability, muscle tension, difficulties sleeping and concentrating</td>
</tr>
<tr>
<td>Anxiety disorder due to a general medical condition</td>
<td>Anxiety symptoms that are the direct consequence of a general medical condition (e.g., panic attacks caused by hyperthyroidism)</td>
</tr>
<tr>
<td>Substance-induced anxiety disorder</td>
<td>Anxiety symptoms that are the direct consequence of a substance (e.g., cocaine)</td>
</tr>
<tr>
<td>Anxiety disorder not otherwise specified</td>
<td>Disorder with prominent anxiety or phobic avoidance not meeting criteria for a specific anxiety disorder or for which there is inadequate or contradictory information</td>
</tr>
</tbody>
</table>
Table 3.2 Specific phobia types described by the DSM-IV (APA, 2000)

<table>
<thead>
<tr>
<th>Phobia Type</th>
<th>Key features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal</td>
<td>Fear is cued by animals or insects, and generally has a childhood onset</td>
</tr>
<tr>
<td>Natural Environment</td>
<td>Fear is cued by settings or events in the natural environment, such as storms, or heights, and generally has a childhood onset</td>
</tr>
<tr>
<td>Blood- Injection-Injury</td>
<td>Fear is cued by seeing or anticipating being exposed to blood, or an injury, or by receiving an injection or other invasive medical procedure. The BII subtype is highly familial and is often characterized by a strong vasovagal response</td>
</tr>
<tr>
<td>Situational</td>
<td>Fear is cued by a specific situation such as public transportation, tunnels, bridges, elevators, flying, driving, or enclosed places, and is similar to Panic Disorder with Agoraphobia in its characteristic sex ratios, familial aggregation pattern, and age of onset. The age of onset has a bimodal distribution, with one peak in childhood and another peak in the mid 20's</td>
</tr>
<tr>
<td>Other</td>
<td>Fear is cued by other stimuli, including situations that might lead to choking, vomiting, or contracting an illness; <code>space</code> phobia (e.g., the individual is afraid of falling down if away from walls or other means of physical support); or children’s fear of loud sounds or costumed characters</td>
</tr>
</tbody>
</table>

In the dental literature the term dental phobia may be used, but a description of criteria associated with a diagnosis of phobia is often lacking in those studies (De Jongh et al., 1995; Tunc, Fırat, Onur & Sar 2005). This results in patients with a high level of dental anxiety referred to as having dental phobia (Corah, Gale & Illig, 1978; Enkling et al., 2006; Stouthard & Hoogstraten, 1990; Vrana, McNeil & McGlynn, 1986). In a study by Locker, Poulton and Thomson (2001), results showed that amongst the 12.5% of patients identified as dentally anxious using the Dental Anxiety Scale (Corah, 1969) and the Diagnostic Interview Schedule (APA, 1987), only 1% of the total study sample met the DSM criteria for specific phobia. Accordingly, classification schemes of dental anxiety do not completely correspond with psychiatric diagnostic systems (Roy-Byrne, Milgrom, Khoon-Mei, Weinstein & Katon, 1994).

Despite the stated differences between fear, anxiety and phobia it is important to note that the terms are often used interchangeably in the dental literature. This thesis will focus on dental anxiety in the context of orthodontic treatment, rather than dental phobia.
3.2 Measuring dental anxiety and dental anxiety measures

3.2.1 Measuring dental anxiety

There are several possible approaches to measure anxiety. Classification systems such as DSM-IV or International Classification of Diseases (ICD-10; World Health Organization, 1992) classify anxiety disorder based on diagnostic criteria, identification of symptoms and key signs and history associated with the disorder (APA, 2000). Clinical interview such as the Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV; Brown, DiNardo & Barlow, 1994) and the Structured Clinical Interview for DSM-IV (SCID-IV; First, Spitzer, Gibbon & Williams, 1996) are other valuable methods to assess anxiety.

Self-reported questionnaires are the most commonly used measure of dental anxiety and will be outlined in the next section. These vary from single item indicators such as those used by Milgrom et al. (1988) and Gatchel (1989), to more complete multi-item questionnaires such as the Dental Fear Survey (Kleinknecht, Keplac & Alexander, 1973) and the Structured Interview for Assessing Dental Fear (Vrana et al., 1986). Since each questionnaire has its own limitations and assess different aspects of dental anxiety, Schuurs & Hoogstraten (1993) advocate the use of more than one questionnaire and/or other measurement instruments. There exist numerous differences in these measures with regards to study samples, anxiety components assessed and the availability of psychometric data to corroborate reliability and validity. This will be discussed in the next section.

3.2.2 Limitations of dental anxiety measures

There are certain limitations found in existing dental anxiety measures. First of all, the investigators often do not describe fear or dental anxiety and what they intend to measure in their study. It is therefore difficult to compare the different studies. This also explains why the prevalence of dental anxiety varies considerably among studies (Locker et al., 1996). A few researchers (Hakeberg et al., 1992; Moore, Birn et al., 1993; Vassend, 1993) have compared the level of agreement between different measures by using them in the same study. Although same subject analyses indicated a good correlation between the measures, these studies did not assess the level of agreement in terms of number of anxious patients which is important when estimating prevalence. To address this issue, Locker et al. (1996) conducted a study using the Dental Anxiety Scale, Gatchel’s Fear Question, and the single item from the Seattle study. Even
though 25.6% of subjects (n=679) were identified as dentally anxious by at least one dental anxiety measure, only 145 were so categorized by all three measures. This illustrates the possibility that each scale measures various aspects of dental anxiety.

Another limitation is that data from dental anxiety studies are often collected from population of convenience such as 1st year psychology students, military personnel, and dentally anxious patients seeking treatment. The most valuable studies to determine the prevalence of dental anxiety remains epidemiologically based samples from the general population, and therefore the findings from those specific population studies cannot be generalized.

The third limitation refers to the inconsistency in psychometric testing of dental anxiety measures. It is essential for a dental anxiety scale to be reliable and valid. In other words, a scale should measure what it is supposed to (validity) and to do so in a reproducible way (reliability). Those two properties are important to ensure scientific rigor in a study. Variability in reliability and validity testing makes it difficult to compare the different studies. Discussion of individual dental anxiety measures follow.

3.2.3 Dental anxiety measures

Self-report questionnaires are the most common method of assessing dental anxiety and their use is well-documented. In 2000, Newton & Buck (2000) published a review of the different measures of anxiety and pain in dentistry. It identified the reliability, validity and usefulness of the measures. The questionnaires were grouped into four categories: adult dental scales, scales for children and adolescents, general anxiety adult scales and measures of dental pain. The first category included the Dental Anxiety Scale, The Dental Fear Survey, The Dental Anxiety Question, The Gatchel’s 10-Point Fear Scale, The Photo Anxiety Question and The Dental Anxiety Inventory. The second category included the Children’s Fear Survey Schedule, the Venham Picture Scale, the Venham Anxiety and Behavior Rating Scales, the Adolescent’s Fear of Dental Treatment Cognitive Inventory and the Behavior Profile Rating Scale. In the third category, they investigated the Spielberger’s State-Trait Anxiety Inventory, the Fear Survey Schedule, and the Weiner Fear Questionnaire. Finally, the last category included the McGill Pain Questionnaire, The West Haven-Yale Multidimensional Pain Inventory and the Pain Anxiety Symptoms Scale.

The Dental Anxiety Scale (DAS) is the most commonly cited measure of anxiety in dentistry. The questionnaire can be used for adults or children (APA, 2000) and provides a useful
and short measure of dental anxiety (Table 3.3). This scale is extensively used for both surveys and clinical purposes. It consists of four multiple choice questions, each with five alternative responses ranging in value from 1 to 5, with 1 being the calmest choice and 5 being the most anxious choice. Corah considered anxious patients to score 13 or higher on the scale (Corah, 1969). Patients with a score of 15 and higher are considered extremely anxious. The internal consistency and test-retest reliability of the scale are high and the questionnaire is easy to administer. Studies have shown a reasonable validity and stability of this questionnaire over time (Schuurs & Hoogstraten, 1993). This questionnaire has been criticized as exhibiting a range scores that are too narrow to be used effectively in clinical studies (Newton & Buck, 2000) and for not covering all aspects of dental fear (Corah, 1988).

To overcome the shortcomings of the Dental Anxiety Scale, the original questionnaire has been modified by the addition of a fifth item that asks about responses to administration of local anesthetic and by a change in the response format (Newton & Buck, 2000). The Modified Dental Anxiety Scale (MDAS) was developed by Humphris, Morrison & Lindsay in 1995 (Table 3.4). This scale has a standardized answer scheme with scores ranging from 1 (not anxious) to 5 (extremely anxious) for each question. Subjects scoring 15 and higher are considered dentally anxious, and 19 and higher categorized as extremely anxious. The scale has shown advantageous psychometric properties in comparison with the original DAS. Its reliability and validity have also been proven to be adequate (Haugejorden & Klock, 2000; Schuurs & Hoogstraten, 1993). A study among Turkish patients reported a test-retest reliability of 0.96 and a Cronbach’s alpha of 0.88 indicating high reliability (Ilguy, Ilguy, Dinçer & Bayirli, 2005). One of the advantages of the MDAS is that it requires only 2-3 minutes to complete compared to other dental anxiety measures (Humphris et al., 1995). Additionally, the scale does not increase anxiety in respondents, regardless of the patient’s initial level of dental anxiety (Humphris et al., 2006; Humphris, & Hull, 2007). The first two items of the questionnaire focus on the anticipation of the dental visit whereas the final three items focus on various dental treatments (Yuan, Freeman, Lahti, Lloyd-Williams & Humphris, 2008).
Table 3.3 The Dental Anxiety Scale

1. If you had to go to the dentist tomorrow, how would you feel?
   (1) I would look forward to it as a reasonably enjoyable experience
   (2) I wouldn’t care one way or the other
   (3) I would be a little uneasy about it
   (4) I would be afraid that it would be unpleasant and painful
   (5) I would be frightened of what the dentist might do

2. When you are waiting in the dentist’s office for your turn in the chair, how do you feel?
   (1) Relaxed
   (2) A little uneasy
   (3) Tense
   (4) Anxious
   (5) So anxious that I sometimes break out in a sweat or almost feel physically sick

3. When you are in the dentist’s chair waiting while he gets the drill ready to begin working on your teeth, how do you feel?
   (1) Relaxed
   (2) A little uneasy
   (3) Tense
   (4) Anxious
   (5) So anxious that I sometimes break out in a sweat or almost feel physically sick

4. You are in the dentist’s chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments which he will use to examine your teeth around the gums, how do you feel?
   (1) Relaxed
   (2) A little uneasy
   (3) Tense
   (4) Anxious
   (5) So anxious that I sometimes break out in a sweat or almost feel physically sick

Schuurs and Hoogstraten (1993) reviewed six scales of dental anxiety (including the DAS) and concluded that the most sensitive, reliable and valid measure was the Dental Fear Survey (Kleinknecht et al., 1973). The original 27-item has been revised and reduced to a 20-item survey. This questionnaire focuses on different aspects of dental anxiety such as avoidance, self-perceived signs of physiological arousal, fear of specific dental situations and procedures, and dental fear in general. It offers a greater range of scores possible and may be a more sensitive tool for use in research (Schuurs & Hoogstraten, 1993). The Dental Anxiety Inventory has been described as another highly reliable scale but was found to be impractical in clinical settings because of the relatively long completion time (Ng, Stouthard & Leung, 2005).
Newton and Buck (2000) concluded that most of the questionnaires reviewed in their study exhibit adequate levels of internal consistency, and correlate with other measures of the same construct. They suggested that the choice of a particular measure depends on the purpose for which the measure is intended and on the particular aspects of dental fear that are being assessed. As already mentioned, anxiety includes three components and existing scales address different components of anxiety. For example, most scales for children are concerned with behavior and are written in a simpler language. They also recommended the use of the DAS to
measure dental anxiety in adults in clinical dental settings and the Dental Fear Survey to measure anxiety in adults as part of research. They consider the Dental Fear Survey a more sensitive tool for research given its greater range of scores. Because children may not have a fully developed ability to recognize and interpret the physiological and cognitive manifestations of anxiety, measures of dental fear in children have tended to concentrate on the behavioral component of fear or have used non-verbal tools such as picture (Newton & Buck, 2000). Another questionnaire used to measure dental anxiety is the Dental Belief Survey (DBS) (Milgrom et al., 1985). The DBS is a 20-item measure that is scored easily or simply scanned for areas of concern. The DBS was developed to evaluate the patient’s view about the dentist and dental treatment in three areas (subscales): professionalism, communication and lack of control (Milgrom et al., 1985). Heaton, Carlson, Smith, Baer & De Leeuw (2007) reported that the DBS accurately predicts patients’ anxiety during dental treatment. They found a significant relationship between self-reported and observed measures of dental anxiety. In this study, higher dental fear survey scores, younger age, more invasive treatment type and previous avoidance of dental care because of a bad experience have been found predictive of greater observed anxiety. Neither self-reported nor observed anxiety was affected by previous experience with a particular practitioner or treatment. Milgrom, Weinstein and Getz (1995) revised and expanded the DBS to a 28-item version known as the Revised Dental Belief Survey (R-DBS). In their study, Coolidge, Heima, Coldwell, Weinstein & Milgrom (2005) tested the internal reliability, test-retest reliability, and construct validity of the R-DBS. Their data provided strong evidence for the reliability and construct validity of the revised DBS. However, both the original DBS and the revised DBS perform nearly identically (Coolidge et al., 2005).

3.2.4 Validity and reliability of dental anxiety measures

The validity of a test refers to what it is intended to assess, (e.g. if it measures what is claimed), whereas the reliability of a test addresses the reproducibility of the test. For example, reliability implies that an individual answers’ to a test are the same on two different occasions. The most common statistic used to assess the reliability of a scale is the correlation coefficient, which falls into one of these categories: single-administration and multiple-administration. The former category includes split-half and internal consistency methods and the latter includes the test-retest and the alternate forms methods. The strength of the correlation between the items of
the scale and the measured outcome is represented by a coefficient ranging from 0 and 1. The more the coefficient is close to 1, the stronger the correlation.

Table 3.5 Summary of dental anxiety questionnaires

<table>
<thead>
<tr>
<th>Scale</th>
<th>Year of intro</th>
<th>No. of items</th>
<th>Target population</th>
<th>Reliability</th>
<th>Validity</th>
<th>Final assessment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Anxiety Scale</td>
<td>1969</td>
<td>4</td>
<td>Adults</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
<td>Most widely used scale to measure anxiety</td>
</tr>
<tr>
<td>Modified Dental Anxiety Scale</td>
<td>1995</td>
<td>5</td>
<td>Adults</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
<td>Increased range of score and clinical relevance</td>
</tr>
<tr>
<td>Dental Fear Survey</td>
<td>1973</td>
<td>27</td>
<td>Adults</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>Gives a score on three dimensions</td>
</tr>
<tr>
<td>Gale’s Ranking Questionnaire</td>
<td>1972</td>
<td>29</td>
<td>Adults</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>Do not give the absolute level of anxiety</td>
</tr>
<tr>
<td>Stouthard’s Dental Anxiety Inventory</td>
<td>1989</td>
<td>36</td>
<td>Adults</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>Might be used for categorization into anxiety levels</td>
</tr>
<tr>
<td>Weiner’s Fear Questionnaire</td>
<td>1990</td>
<td>16</td>
<td>Adults</td>
<td>+/-</td>
<td>-</td>
<td>?</td>
<td>Scale not widely used</td>
</tr>
<tr>
<td>Adolescents’ Fear of Dental Treatment Cognitive Inventory</td>
<td>1991</td>
<td>23</td>
<td>Adolescents</td>
<td>+</td>
<td>-</td>
<td>?</td>
<td>Not widely used</td>
</tr>
</tbody>
</table>

+ positive; +/- moderate, or insufficiently studied; - negative or (almost) not studied
? not sufficient empirical data available to justify final assessment

Split-halves reliability divides scale items in two-halves and the scores for each half is compared with one another. A high coefficient indicates that the scale is consistent and that the two halves most likely measure the same thing.

The fundamental principle behind internal consistency is that all the items of a scale measuring a specific outcome should be related. The most common type of internal consistency
reliability analysis is Cronbach’s alpha, also called coefficient alpha. The alpha coefficient tests how well items measure a single concept, in this case, the dental anxiety related to orthodontic treatment. This coefficient is an extension of Kuder-Richardson-20 (KR-20) which is appropriate for dichotomous variable (e.g., yes-no, male-female), whereas Cronbach’s alpha is used when there are more than two possible answers. An internal consistency of 0.8 or greater designates a high degree of variability. One limitation of internal consistency calculation is that it is measure on a single occasion and does not take into account possible variation between subjects completing the survey on different days. Inflated internal consistency should therefore be interpreted judiciously.

In the test-retest method, the same measure is administered on two or more different occasions and the Pearson Product Moment Correlation (Pearson Correlation), Spearman rank order, or a Chi Square based analysis are calculated depending on whether the data are interval, ordinal or nominal respectively. The appropriate time interval between tests administrations can be an issue since it is dependent on the nature of the measured outcome and the possible changes in outcome before the next test. A reliability coefficient of 0.7 is considered acceptable but should ideally be greater depending on the purpose of the test (i.e., 0.8 for basic research, 0.9 for clinical instrument (Streiner & Norman, 1989).

In the alternate forms method, reliability is estimated by the Pearson product-moment correlation coefficient of two different forms of the same measure, usually administered together.

3.2.5 Other dental anxiety measures

Salivary cortisol has also been studied as a biomarker in stress research. Cortisol levels in saliva have been shown to distinguish highly anxious from non-anxious patients in dental and non-dental studies (Benjamins, Asscheman, & Schuurs, 1992; Kirschbaum & Hellhammer, 1989; Kirschbaum & Hellhammer, 1994; Krueger et al., 2005). The process between the initiation of a hypothalamus-pituitary-adrenal axis (HPAA) response in the central nervous system and salivary cortisol variations as an outcome measure is modulated by numerous psychological and biological events (Chrousos & Kino, 2007). Hellhammer, Wüst and Kudielka (2009) investigated the validity and psychobiological significance of salivary cortisol as an HPAA biomarker of stress in general population. They concluded that salivary cortisol is a useful marker in stress research, as long as the researcher is aware of possible sources of variance, which may affect this measure. For example, variables such as adrenal sensitivity, capacity, cortisol binding, etc. affect
total and free cortisol levels in blood, and, finally, salivary cortisol levels. Whether these modulating factors are considered as confounders or as an important part of the information certainly depends on the research question. Furthermore, researchers who decide to assess salivary cortisol have to consider that variables such as estrogens (gender, menstrual cycle, oral contraceptives) or medical conditions could affect cortisol binding and HPAA responsivity. Several additional variables such as adrenal sensitivity, capacity, cortisol binding, etc. also affect total and free cortisol levels in blood and salivary cortisol levels. In sum, if the research focus is on free cortisol effects on target tissue, salivary cortisol can be considered as an appropriate measure. Measuring salivary cortisol concentrations is well accepted by patients and deserves further investigation (Benjamins et al., 1992; Krueger et al., 2005).

Caprara, Eleazer, Barfield, and Chavers (2003) tested another psychophysiological measurement, galvanic skin conductance (GSC), as a measure of dental anxiety. GSC measures electrical changes induced by minute amounts of fluid from epidermal sweat glands released secondary to anxiety. The purpose of their study was to determine if GSC in endodontic patients correlated with anxiety levels as measured by a standard dental-anxiety questionnaire. They also verified patient’s answers with polygraph responses. They found a statistically positive correlation between dental anxiety and skin conductance. They determined that scores of 0.5 Volts and higher seemed to be a good approximation for identification of an anxious patient. Finally, they concluded that the use of GSC is useful as a research tool for quantitation of anxiety.

### 3.3 Epidemiology

Anxiety disorders are the main class of disorder described by the DSM-IV and are encountered more often than mood disorders, impulse control disorders and substance disorders. Among the anxiety disorders, specific phobias are the most prevalent (Kessler et al., 2005).

Dental anxiety is ranked fifth among commonly feared objects or situations (Hägglin, Berggren, Hällström & Bengtsson, 1999). It is the most common psychological condition seen in clinical practice and affects a significant percentage of the population (Chanpong et al., 2005). There is a significant variability in the prevalence of dental anxiety reported in the literature. Epidemiological studies suggest that between 3% and 20% of the population are anxious or have levels of fear about dental treatment that require specific management (Eli, 1992; Locker et al.,
2001; Milgrom et al., 1988). The prevalence varies among the different studies depending on population sampled, definitions of anxiety and dental anxiety scales used.

Many studies have evaluated dental anxiety in specific groups of individuals such as psychology, dental and other students (Cohen, Snyder & LaBelle, 1982; Corah, 1969; Corah et al., 1978; Domoto et al., 1988; Gatchel, 1989; Teo et al., 1990; Weinstein et al., 1993); dental patients (Kunzelmann & Dunninger, 1990; Tunc et al., 2005); and male army recruits (Kaufman, Rand, Gordon, & Cohen, 1992; Teo et al., 1990). Due to the homogeneity of these groups, results cannot be extended to the general population. Studies that contribute the most to our understanding of dental anxiety are those that sample persons from the general population and many randomized general population studies have been conducted (Chanpong et al., 2005; Fredrikson, Annas, Fischer, & Wik, 1996; Gatchel, 1989; Gatchel, Ingersoll, Bowman, Robertson & Walker, 1983; Locker, 2003; Locker et al., 1996; Stouthard & Hoogstraten, 1990; Vassend, 1993).

Based on their broad clinical experience, Milgrom et al. (1985) developed the Seattle system. This system classifies dentally anxious patients according to the origins and the main sources of fear about dental treatment. It consists of four diagnostic types: 1) Fear of specific dental stimuli (Type I); 2) Fear of catastrophic medical reactions during dental treatment (Type II); 3) Generalized anxiety (Type III); 4) Distrust of dental staff (Type IV). In 1999, Locker et al. carried out a study to estimate the prevalence of the four diagnostic types in the general population. Among the 16.4% dentally anxious patients, 13.3% could not be categorized, 49.6% were Type I, 7.8% Type II, 19.4% Type III and 9.9% Type IV. Moreover, the authors found that younger individuals were associated with the Type I category whereas older individuals were associated with Type III category. Type I category (simple conditioned fear) is more related to the exogenous group described by Weiner and Sheehan (1990). This category is characterized by fear of dental procedures, most likely resulting from negative past experiences and not complicated by multiple phobias of general anxiety disorders. Subjects in the Type II to Type IV categories correspond to the exogenous group described by Weiner and Sheehan (1990). All subjects reported multiple fears and/or generalized anxiety. Although studies have used the Seattle system to classify dentally anxious patients (Locker et al., 1999; Moore, Brodsgaard & Birn, 1991; Roy-Byrne et al., 1994), there is no supporting evidence in the literature regarding its reliability and validity.
Most of the studies assessing the prevalence of dental anxiety have used a single dental anxiety measure. The most cited measure is the Corah Dental Anxiety Scale (Corah, 1969), with other. Single item measures being the Gatchel Dental Anxiety Scale (Gatchel et al., 1983), the Dental Anxiety Question (Weiner & Sheehan, 1986), and the Visual Analogue Scale for Dental Anxiety (Luyk, Beck, Weaver, 1988). Other measures include multiple item scales such as the Dental Belief Survey (Milgrom et al., 1988), the Dental Fear Survey (Kleinknecht et al., 1973), the Dental Anxiety Inventory (Stouthard, Mellenbergh, Hoogstraten, 1993), the Dental Anxiety Scale-Revised (Ronis, Hansen, Antonakos, 1995), the Modified Dental Anxiety Scale (Humphris et al., 1995), and the Dental Cognitions Questionnaire (De Jongh et al., 1995). Comparing results from studies using different dental anxiety measures as well as inconsistency in the use of cut points to define clinically significant anxiety lead to variation in the prevalence of anxiety. In addition, the reliability and the validity of the different measures are not always confirmed and this adds to the variability in the prevalence. The accuracy of the measures is questionable if the measures are not reliable and valid. Fiset, Milgrom, Weinstein and Melnick (1989) attribute a part of divergence in prevalence rates to variation in data collection methods, such as use of telephone and mail surveys.

In 2007, Klingberg and Broberg (2007) published a review about prevalence of dental fear/anxiety in children and adolescents. They used the terms dental fear and anxiety as referring to strong negative feelings associated with dental treatment among children and adolescents whether or not the criteria for a diagnosis of dental phobia was met. They reviewed 32 papers of acceptable quality (i.e. well-designed studies with sufficient number of subjects using measures shown to be valid and reliable for the age-groups studied) and found the mean prevalence of dental fear/anxiety was estimated to be 9% (ranging from 5.7% to 19.5% according to the different studies) among children and adolescents in general populations in Australia, Canada, Europe, and in the USA. Using childrens’ and adolescents’ self-reports of dental anxiety using the Dental Anxiety Scale (DAS) or Dental Fear Survey (DFS), the mean prevalence rate was 11.6%. They also found a decrease in prevalence with age in some studies they reviewed. They conclude that a decrease in dental anxiety with age may be due to normal psychological development. Another study of eight European countries (Bolin, 1997), including a total of 3200 children of 5- and 12- years old, found that 35% of 5 years old and 21% of 12 years old were fearful before visiting the dentist. However, Buchanan and Niven (2002) reported that although the majority of the children in their study (n=100) had low levels of fear, 7% of their sample
were very anxious, a finding which correlates well with the review published by Klingberg and Broberg (2007).

A review of self-reported dental fear suggests that the prevalence of dental anxiety has not changed significantly in general adult or college sample since the 1950s (Heaton et al., 2007). Table 3.6 reviews several randomized general population studies that have been conducted between 1983 and 2003.

Table 3.6 shows variable prevalence rates among the different studies using the same or different dental anxiety measures. However, six studies using the Dental Anxiety Scale reported prevalence between 10.2% and 16.2%. The Dental Belief Survey also indicated stability in prevalence rates in 3 studies with scores ranging from 20.4% and 23.4%. The studies were conducted in randomized general populations but the use of different dental anxiety scales and different cut-points makes comparison between the different studies difficult. Although the DAS and DBS (single item) have shown the most stability over time, increase or decrease in the prevalence of dental anxiety over the past decades remains challenging to establish mainly because of the methodological differences across studies. Conflicting results exist among studies investigating changes in prevalence rate over time. General improvement in dental health resulting in reduction of invasive dental treatment combined with improvements in technology to reduce pain related to treatment could explain a decrease in dental anxiety as reported by Locker and Liddell (1995). On the other hand, dental anxiety is now a well-known and common phenomenon and more patients could be inclined to report it which supports studies reporting increase in prevalence rates over time (Corah et al., 1978; Thomson et al., 2000).

3.3.1 Age of onset

Age of onset has been reported to vary among the different DSM-IV disorders according to the National Comorbidity Survey Replication (NCS-R) (Kessler et al., 2005). Anxiety disorders are associated with an earlier age of onset than substance or mood disorders, with a median age of onset of 11, 20 and 30 years respectively. Antony and Barlow (1996) also reported that the age of onset of specific phobias such as blood-injection-injury and animal phobias is in childhood, whereas other specific phobias begin in adolescence or adulthood.
Table 3.6 Prevalence estimates (%) in randomized general population studies reporting dental anxiety

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Dental anxiety measure used</th>
<th>Anxiety cut-point</th>
<th>Prevalence estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.J. Gatchel, B.D. Ingersoll, L. Bowman, M.C. Robertson, C. Walker</td>
<td>1983</td>
<td>Gatchel Fear Scale 1-10 scale</td>
<td>5-7= moderate fear 8-10= extreme fear</td>
<td>29.2%</td>
</tr>
<tr>
<td>P. Milgrom, L. Fiset, S. Melnick, P. Weinstein</td>
<td>1988</td>
<td>Dental Belief Survey (single item) 1-5 scale</td>
<td>1-2= low fear 3-5= high fear</td>
<td>20.4%</td>
</tr>
<tr>
<td>R.J. Gatchel</td>
<td>1989</td>
<td>Gatchel Fear Scale 1-10 scale</td>
<td>5-7= moderate fear 8-10= extreme fear</td>
<td>28.9%</td>
</tr>
<tr>
<td>M. Hakeberg, U. Berggren, S.G. Carlsson</td>
<td>1992</td>
<td>Dental Anxiety Scale 4-20 scale</td>
<td>5-8= low fear 9-14= moderate fear 15-20= high fear</td>
<td>16.2%</td>
</tr>
<tr>
<td>M. Hakeberg, U. Berggren, S.G. Carlsson</td>
<td>1992</td>
<td>Gatchel Fear Scale 1-10 scale</td>
<td>5-7= moderate fear 8-10= extreme fear</td>
<td>16.3%</td>
</tr>
<tr>
<td>R. Moore, H. Birn, E. Kirkegaard, I. Brodsgaard, F. Scheutz</td>
<td>1993</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥12= dentally anxious</td>
<td>10.2%</td>
</tr>
<tr>
<td>R. Moore, H. Birn, E. Kirkegaard, I. Brodsgaard, F. Scheutz</td>
<td>1993</td>
<td>Dental Belief Survey (single item) 1-5 scale</td>
<td>1-2= low fear 3-5= high fear</td>
<td>9.7%</td>
</tr>
<tr>
<td>R. Moore, H. Birn, E. Kirkegaard, I. Brodsgaard, F. Scheutz</td>
<td>1993</td>
<td>Dental Fear Survey (single item) 1-5 scale</td>
<td>1-2= low fear 3-5= high fear</td>
<td>10.3%</td>
</tr>
<tr>
<td>D. Locker, D. Shapiro, A. Liddell</td>
<td>1996</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥13= dentally anxious</td>
<td>10.9%</td>
</tr>
<tr>
<td>D. Locker, D. Shapiro, A. Liddell</td>
<td>1996</td>
<td>Gatchel Fear Scale 1-10 scale</td>
<td>8-10= dentally anxious</td>
<td>8.2%</td>
</tr>
<tr>
<td>D. Locker, D. Shapiro, A. Liddell</td>
<td>1996</td>
<td>Dental Belief Survey (single item) 1-5 scale</td>
<td>3-5= dentally anxious</td>
<td>23.4%</td>
</tr>
<tr>
<td>W.M. Thomson, J.E. Stewart, K.D. Carter, A.J. Spencer</td>
<td>1996</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥13= dentally anxious</td>
<td>14.9%</td>
</tr>
<tr>
<td>D. Locker, R. Poulton, W.M. Thomson</td>
<td>2001</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥13= dentally anxious</td>
<td>12.5%</td>
</tr>
<tr>
<td>J. Maggirias, D. Locker</td>
<td>2002</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥12= dentally anxious</td>
<td>13%</td>
</tr>
<tr>
<td>J. Maggirias, D. Locker</td>
<td>2002</td>
<td>Dental Belief Survey (single item) 1-5 scale</td>
<td>3-5= dentally anxious</td>
<td>21.1%</td>
</tr>
<tr>
<td>D. Locker</td>
<td>2003</td>
<td>Dental Anxiety Scale Score range: 4-20</td>
<td>≥12= dentally anxious</td>
<td>11.2%</td>
</tr>
</tbody>
</table>
Similar to prevalence studies, there is variability between age of onset studies. One of the reasons is the absence of distinction between anxiety, fear and phobia in the literature which results in the lack of distinction between the onset of fear and the onset of phobia. An average difference of nine years has been found between the reporting of the initial experience of fear and the point when that fear became significant enough to be diagnosed as a specific phobia (Antony, Brown, & Barlow, 1997). Another reason for the inconsistency among age of onset studies is due to how age of onset is measured. The majority of studies are based on recall from the subjects and this is a concern since the individuals may not be able to remember when they had their first episode of dental anxiety. Therefore, the validity of retrospective self-report information is questionable (Kheriaty, Kleinknecht, & Hyman, 1998; Merckelbach, Muris, & Schouten, 1996; Ost, 1987).

Locker, Liddell, Dempster and Shapiro (1999) investigated the age of onset of dental anxiety in a general population sample and identified differences by age of onset with respect to etiological factors (i.e. negative dental experiences, family history, and general psychological states). They found that regardless of age of onset, negative dental experiences were predictive of dental anxiety. Childhood onset individuals had a family member who was dentally anxious and were more anxious about invasive procedures. Adolescent onset subjects were characterized by high trait anxiety and showed more negative attitudes regarding dentists’ behavior. Adult onset subjects reported negative thoughts about dentists and more negative experiences as an adult. They also presented with multiple severe fears and symptoms potentially indicative of psychiatric problems. These results suggest that child-onset subjects were more likely to be part of the exogenous category (e.g., acquired dental fear that develops after negative experiences) described by Weiner and Sheehan (1990), and that adult-onset subjects were more likely to be part of the endogenous category (e.g., person’s vulnerability to depressive, anxiety or psychiatric disorders). Some authors (Locker, Liddell, & Shapiro, 1999; Ost, 1987) reported a relationship between age of onset of dental anxiety and first negative dental experience.

Specific procedure such as invasive dental treatments before 18 years of age, having one or more teeth extracted between 18 and 26 years and dental visiting pattern between 18 and 26 years have been identified as predictive of onset (Locker, Thomson, & Poulton, 2001; Thomson, Locker, & Poulton, 2000). These findings have been challenged by Poulton, Waldie, Thomson and Locker (2001) who found that age of onset between 18 and 26 years did not seem to be related to tooth loss or caries experience. They suggested that the role of adverse condition was
more important in late onset anxiety whereas high susceptibility to fear based on personality was more related to early onset anxiety (Poulton et al., 2001).

Two studies investigated age of onset of dental anxiety in large general population samples. Locker et al. (1999) found that 50.9% of their subjects developed dental anxiety in childhood, 22.0% reported becoming fearful in adolescence and 27.1% suffered onset as adults. Another study found similar results with 66% of onset in childhood, 17.9% in adolescence and 15.4% in adulthood (Milgrom et al., 1988). These results raise question about the hypothesis that dental anxiety develops predominantly in childhood.

The literature indicates a majority proportion of the population as becoming dentally anxious in their childhood but a significant number of patients also develop dental anxiety in adolescence or adulthood. This is important clinically since it points out that any individual who presents as non-anxious in a dental clinic is susceptible to become anxious. Every patient merits comparable care and monitoring to ensure that dental anxiety does not develop.

3.4 Etiology

There exist several theories attempting to explain the etiology of dental anxiety. Three main etiological hypotheses have been suggested to explain the cause of dental anxiety: 1) conditioning responses to aversive dental experiences, 2) heightened pain sensitivity and/or fear of dental pain, and 3) predisposing personality characteristics (Locker et al., 1996). In the same vein, it has also been suggested that dental anxiety encompasses an exogenous as well as an endogenous component (Weiner & Sheehan, 1990). The exogenous component relates to acquired dental fear which corresponds to dental fear developed after negative experiences (Rachman, 1991). The endogenous component refers to the person’s vulnerability to depressive, anxiety or psychiatric disorders (Armfield, 2006; Locker et al., 1999; Locker et al., 2001).

3.4.1 Negative experiences

Conditioning theory and theories on phobia onset suggest that disproportionate anxiety results from exposure to negative life events (Davey, 1987; Floor, Oosterick, De Jongh, Hoogstraten & Aartman, 2008; Locker et al., 1996; Ost & Hugdahl, 1985; Rachman 1977). That is, objects and situations which are irrationally feared should resemble previous distressing experiences. Numerous studies have shown evidence in support of the role of aversive conditioning dental experiences in the development of dental fear or anxiety (Locker et al., 1999;
Locker et al., 1996; Milgrom, Mancl, King & Weinstein, 1995; Oosterink, De Jongh & Aartman, 2008). According to a study published in the Journal of the American Dental Association (Smith & Heaton, 2003), dental anxiety can be initiated by a bad experience that unknowingly has become associated with dentistry. The study found that despite the advancement of modern techniques and the use of very effective anesthetics, patients still seem to maintain the same level of anxiety as they did years ago. The proportion was shown to be the same today as it was in the 1950's (Smith & Heaton, 2003). It is also believed that dental anxiety in some instances may result from model learning effects, i.e., fearful behavior communicated by relatives (Hägglin et al., 2001). However, aversive conditioning has not been identified as a contributing factor to adult onset of dental anxiety (Thomson et al., 2001).

3.4.2 Fear of pain

It is also known that painful or other traumatic experiences are one of the main factors contributing to dental anxiety (Maggirias & Locker, 2002). Fear of pain associated with dental treatment has been identified as a major component of dental anxiety (McNeil & Berryman, 1989) and the expectation of pain as a major barrier to the seeking of dental care (Dionne, Gordon, McCullagh & Phero, 1998). A study has suggested that prior to treatment, many patients expect that they will experience pain; even though post-treatment they often report less pain than they had anticipated (Arntz, Van Eck & Heijmans, 1990). Injection and the drill are the factors most commonly associated with the anxiety-provoking stimuli in the dental situation (Wardle, 1982). However, 37% of edentulous patients state that they delay dental visit because they are scared of the dentist. This suggests that negative past experiences, not necessarily the drilling and filling procedures, influence the patient’s attitude toward dental treatment (Todd et al., 1982). Udoye et al. (Udoye, Oginni & Oginni, 2005) have tried to evaluate which treatment corresponded to the highest anxiety level by the administration of a questionnaire based on the Corah Dental Anxiety Scale (DAS) prior to each dental procedure (root canal therapy, scaling and polishing, extraction and filling). They found that root canal treatment and tooth extractions are associated with the most anxiety level (Udoye et al., 2005). These results are in agreement with Wong and Lytle (1991) who also found that root canal therapy and oral surgery were the most anxiety provoking treatments.

Van Wijk and Makkes (2008) investigated the relationship between anxiety and pain comparing highly anxious dental patients and normal patients with respect to pain experience
(i.e., intensity and duration) while receiving and after receiving a dental injection. The short version of the Dental Anxiety Inventory was used to assess patient’s anxiety prior to the injection. The authors found that highly anxious dental patient feel significantly more pain, and for longer duration, than do normal patients. This finding supports the results of Weisenberg, Aviram, Wolf and Raphaeli (1984) that anxiety which is relevant to the pain-inducing stimulus will exacerbate pain, whereas anxiety that is irrelevant to the pain-inducing stimulus would reduce the experience of pain. The gate-control theory combines the sensory aspects of pain with cognitive, environmental and psychological factors. Of these contributors to a patient’s perception of pain, psychological factors, especially anxiety, show a stronger association than cognitive and environmental factors (Melzack & Wall, 1965). In addition, Sergl et al. (1996) investigated the relationship between pain sensations, attitudes toward orthodontic treatment, and effects on compliance during treatment in a prospective study. They concluded that individual stress-related factors and anxiety are likely to influence the intensity of discomfort caused by an appliance.

Orthodontic treatment remains associated with pain despite improvement in techniques or practitioners’ technical abilities. Discomfort related to orthodontic treatment has been reported as one of the most negative aspect of treatment and is ranked fourth among major concerns and worries prior to orthodontic treatment (O’Connor, 2000). Some patients even described orthodontic pain as more intense and more severe than pain experienced during extractions (Jones & Chan, 1992). Patel (1989) reported that 8% of the subjects in his study suffered pain during orthodontic treatment and terminated their treatment. Prospective studies of children and adults have shown that between 70% and 95% of the patients undergoing orthodontic treatment experience pain (Firestone et al., 1999; Kvam, Bondevik, & Gjerdet, 1989; Kvam, Gjerdet & Bondevik, 1987; Lew, 1993; Oliver and Knapman, 1985; Scheurer et al., 1996).

In the context of orthodontic treatment, pain has been described as a highly variable and subjective response influenced by factors such as age, gender, individual pain threshold, the magnitude of the force applied, emotional anxiety and stress, cultural differences, and previous pain experiences (Bergius et al., 2000; Brown & Moerenhout, 1991; Firestone et al., 1999; Ngan et al., 1989; Scheurer et al., 1996). Females usually report more pain than males and adolescents express higher levels of pain than adults (Krishnan, 2007). It has also been suggested that some experiences of pain are culture specific since some ethnic groups promote social attitude and behavior such as openly expressing their feelings. These behaviors are transmitted from parents
to their child and influence perception of pain and its response (Bergius et al., 2000). As mentioned previously, dental anxiety is another factor known to increase pain experienced during orthodontic treatment (Bergius et al., 2000; Brown & Moerenhout, 1991; Sergl et al., 1998). Bartlett et al. (2005) found that a structured telephone call from a health-care provider reduced patients’ self-report anxiety and experience of pain which is in agreement with the theory that dental anxiety increases pain levels during orthodontic treatment.

### 3.4.3 Predisposing personality characteristics

The assumption that fear of pain is the main factor in avoidance of dental treatment has been questioned by several authors (Arntz et al., 1990; Keplac, Dowling & Hauge, 1982; Vassend, 1993). According to them, dental anxiety is related to personality types and the individual’s susceptibility to anxiety rather than being associated with past painful treatment. A study (Armfield, 2008) investigated the association between dental fear and other specific fears, general fearfulness, disgust sensitivity and harm sensitivity. The Fear Survey Schedule (Wolpe & Lang, 1964), the Harm Sensitivity Index (Gross, 1992; McCracken, Zayfert, & Gross, 1992) and the Disgust Sensitivity Index (Haidt, McCauley, & Rozin, 1994) was administered to 88 Australian adults. The author used the principle axis factor analysis to examine how dental fear related to other specific fears. The findings reveal that dental fear was grouped with fears such as fear of failure, fear of losing control and fear of heights rather than with fear of doctors or fear of receiving injections as has been previously reported. The author also found significant associations between dental fear and the personality dispositions of general fearfulness, harm sensitivity and disgust sensitivity. This is in agreement with Fiset et al. (1989) who found that 22.4% of the dentally anxious individuals they studied had two or more other severe fears. Another study found a link between fear of pain, closed spaces, mutilation and dental anxiety (McNeil & Berryman, 1989). Pohjola, Mattila, Joukamaa and Lahti (2011) looked at the association between dental fear and anxiety or depressive disorders using a standardized structured psychiatric interview. The results indicated that dental fear was associated with generalized anxiety disorder and with comorbidity of anxiety and depressive disorders when controlling for confounding factors. The authors concluded that individuals with anxiety and/or depressive disorders were more likely to be anxious about dental treatment than those without such problems. This study supports the endogenous component theory suggested by Armfield (2006), Locker et al. (1999), and Locker et al. (2001).
Other studies have demonstrated that dentally anxious patients are characterized by multiple other fears such as fear of pain and blood and body injury fears, agoraphobic symptoms, high trait anxiety and anxiety sensitivity (Fiset et al., 1989; Locker et al., 1999; McNeil & Berryman, 1989). However, the instruments in these studies did not provide enough information to identify individuals whose psychological problems are sufficiently severe to be diagnosed. To address this issue, Locker et al. (2001) conducted a comprehensive psychological assessment to compare the prevalence of psychological disorders among dentally and non-dentally anxious subjects from the general population. They found that highly dental anxious patients presented high rates of psychological disorder and that psychological disorder was associated with the maintenance of dental anxiety over time.

In a recent study, Vassend et al. (2011) studied 188 twins to estimate the heritability of anxiety traits and to investigate the genetic and environmental sources of covariance between dental anxiety, pain sensitivity and neuroticism trait. Neuroticism is described as an enduring tendency to experience negative emotional states. It has been shown that individuals who score high on neuroticism are more likely to experience such feelings as anxiety, anger, guilt, and depression (Matthews & Deary, 1998). The authors measured dental anxiety and personality using the Dental Anxiety Scale (Corah, 1969) and the NEO Personality Inventory Revised (NEO-PI-R; [Costa and McCrae, 1992]), respectively. Standard pain testing procedures (e.g. heat pain test and cold-pressor pain test) were used to assess pain sensitivity. The authors found moderate heritability for dental anxiety. A considerable part of the variance in dental anxiety was due to specific genetic and individual environmental influences unrelated to neuroticism. Thus, they concluded that even though neuroticism and dental anxiety share a substantial proportion of genetic (but not environmental) risk factors, their etiology is different and these two attributes are separate entities.

3.4.4 The Cognitive Vulnerability Model

Armfield (2006) has suggested a model of the etiology of fear which places cognitions as the central element in fear acquisition and expression. The Cognitive Vulnerability Model proposes the person’s perceptions of a stimulus or of certain characteristics of a situation as the main component in the etiology of fear. Perceptions of uncontrollability, unpredictability, dangerousness and disgustingness are thought to produce a strong feeling of vulnerability. Vulnerability-related perceptions are believed to be integrated in a schema that influences the
individual’s behaviours, emotions and experiences. Armfield (2008) also studied the Cognitive Vulnerability Model in relation to dental fear. The author found a strong correlation between dental anxiety and patients’ perceptions of uncontrollability, unpredictability and danger. In other words, highly anxious patients considered the dental environment as being very uncontrollable, very unpredictable or very dangerous.

3.5 Other factors contributing to dental anxiety

3.5.1 Gender

Gender is one of the most commonly reported factors in the extant literature that is associated with differences in dental fear (Liddell & Locker, 1997). Gender differences are also exhibited in the prevalence of most specific phobias (Fredrikson et al., 1996). Liddell and Locker (1997) concluded that gender difference in dental fear might be due to the complex factors involved in men’s and women’s attitudes toward pain and control. Heft, Meng, Bradley and Lang (2007) investigated gender differences in global dental fear, global fear of dental pain, and specific fear of dental pain. They found a higher prevalence of reported fear of pain for most of the specific dental treatment among females and a higher percentage of females in the high dental fear group. Interestingly, a study carried out by Pierce and Kirkpatrick (1992) showed that when men were asked to complete two similar questionnaires about their level of dental anxiety, a greater degree of fear was found in the second questionnaire in comparison with the first. This could be explained by the fact that they thought the honesty of their answers on the second test would be known. The authors report no difference in the women’s answers between the two tests.

Differences in pain thresholds between genders may explain the observed difference in the prevalence of dental anxiety between male and female. Another explanation is that male patients may be more reluctant to express their anxiety even if they are anxious about dental treatments (Ilguy et al., 2005). A study carried out by Doerr, Lang, Nyquist & Ronis (1998) support these findings. The purpose of their study was to assess the prevalence of dental anxiety in an adult American population and to investigate the factors that might be correlated with dental anxiety. They concluded that dentally anxious people were more likely to be female, have lower level of income, have poorer clinical and self-assessed oral health status and hold less favorable attitudes toward dental personnel. This is consistent with the review conducted by
Klingberg and Broberg (2007) that found that dental fear/anxiety seem to be more frequent in girls and to be related to general fear. Several other studies support the finding that women report more dental anxiety than men (Berggren & Carlsson, 1992; Bernstein & Kleinknecht, 1982; Brandon & Kleinknecht, 1982; Domoto et al., 1988; Locker et al., 1996; Locker et al., 2001; Locker, 2003; Mellor, 1982; Ragnarsson, 1998; Stouthard & Hoogstraten, 1990; Skaret, Kvale & Raadal, 2003; Weinstein et al., 1993) whereas only a few studies found no difference between males and females (Berggren & Carlsson, 1984; Fredrikson et al., 1996; Locker & Liddell, 1991; Schwarz & Birn, 1995). There exists no study in the literature that found higher prevalence of dental anxiety in men.

The high proportion of female participants in most studies may contribute to more reporting of dental anxiety in women. Therefore, since men seem less likely to participate in dental anxiety studies, dental anxiety in men may be underestimated due to inadequate representation.

3.5.2 Age

The prevalence of dental anxiety in specific age groups has been studied by numerous authors (Berggren, Carlsson, Gustafsson, & Hakeberg, 1995; Elter, Strauss, & Beck, 1997; Locker & Liddell, 1991; Schuller et al., 2003; Schwarz & Birn, 1995; Thomson, et al., 2000), while other studies used general population sample with a wide range of ages (Hakeberg et al., 1992; Locker et al., 1996; Milgrom et al., 1988; Neverlien, 1990; Ragnarsson, 1998; Schuurs & Hoogstraten, 1993; Stouthard & Hoogstraten, 1990). There exist a lot of controversies among those studies as discussed below.

Some studies (Hägglin et al., 1999; Locker & Liddell, 1995; Schwarz & Birn, 1995) have suggested that older people score lower on dental anxiety measures than younger individuals. However, epidemiological studies on adults using a cross-sectional design have not been able to establish if the lower prevalence of dental anxiety among older individuals is a cohort effect or an effect of fear declining with age (Hägglin et al., 1999). Locker and Liddell (1995) conducted the first longitudinal study among older adults and found that over a three-year follow-up, dental anxiety stayed virtually unchanged. Hägglin et al. (1999) conducted a longitudinal study among women aged 38 to 54 in Sweden over a 28 years period and reported reduced dental anxiety. They suggested that the decreases in dental anxiety found in the study were due to an age effect rather than to a cohort effect. This finding is in agreement with recent literature stating that older
adults (i.e., older than 60 years old) report lower dental anxiety levels than younger adults (Elter et al., 1997; Fredrikson et al., 1996; Hakeberg et al., 1992; Holtzman et al., 1997; Locker & Liddell, 1991; Milgrom et al., 1988; Neverlien, 1990; Ragnarsson, 1998; Schuller et al., 2003; Schwarz & Birn, 1995). Locker et al. (1996) have suggested lack of control over dental treatment as one reason to explain higher levels of dental anxiety in younger individuals.

Although a few studies have found no significant difference in dental anxiety level between different age group (Doerr et al., 1998; Fredrikson et al., 1996; Mellor, 1992; Moore et al., 1993; Teo et al., 1990; Thomson et al., 1996; Vassend, 1993; Weinstein et al., 1993), recent literature reports an association between age and dental anxiety with younger subjects being more dentally anxious than older individuals.

3.5.3 Family history

Family history has been recognized as a contributing factor in anxiety disorders (Antony & Swinson, 1996). However, the relationship between family history and dental anxiety is rarely mentioned in the dental literature. Locker et al. (1999) identified a correlation between childhood age of onset of dental anxiety and family history. They found that 55.9% of the subjects who became anxious in childhood had a mother, father, or sibling who was dentally anxious, in comparison with 35.6% of those with adult onset anxiety. Due to the lack of dental literature on this topic, the association between dental anxiety and family history remains unclear.

3.5.4 Evoking stimuli

Numerous stimuli have been identified as evoking dental anxiety. The Dental Fear Survey developed by Kleinknecht and coworkers (1973) evaluates the degree of fear associated with 14 stimuli. The sight, the sound and the sensation of the needle and drill are commonly cited as generating the most fear (Humphris, Freeman, Campbell, Tuuti, & D’Souza, 2000; Kaufman et al., 1992; Mellor, 1992; Rafique, Fiske, & Banerjee, 2003; Weinstein, Raadal, Naidu, Yoshida, Kvale, & Milgrom, 2003).
4 Measuring dental anxiety related to orthodontic treatment

4.1 Introduction

Dental anxiety is extremely common in clinical practice. Prevalence in the general population is reported to range between 10% and 16% (Chanpong et al., 2005; Dempster, 2007; Locker et al., 1996; Stouthard & Hoogstraten, 1990).

Although orthodontists anecdotally report dentally anxious patients in their practice, the prevalence of dental anxiety as it relates to orthodontic treatment has not been investigated. Prevalence data and information regarding causes of anxiety among these individuals would be helpful to orthodontists and their staff in improving patients’ experience during the orthodontic treatment. The focus of this current research is to investigate patients with moderate to severe level of dental anxiety in the orthodontic practice since orthodontists are likely to encounter those patients in their practice.

4.2 Purpose

The purpose of this study is to (1) determine the prevalence of dental anxiety in future and current orthodontic patients and (2) investigate factors contributing to dental anxiety in this population.

4.3 Methods

4.3.1 Study population

The target population included subjects seeking or receiving orthodontic treatment at two orthodontic treatment facilities. Those included a private orthodontist office in Quebec and the undergraduate and graduate clinics at the Faculty of Dentistry, University of Toronto. Inclusion criteria included individuals 12 years of age and older who could read and complete the study questionnaire, which was written to be understood by subjects with English or French reading skills at the Grade 6 level. Subjects less than 12 years of age and those who could not read and understand the questionnaire were excluded from the study.
4.3.2 Sampling procedures

Eligible subjects were asked to complete a questionnaire about going to the orthodontist. An information sheet (Appendix A) explaining the goals of the study were distributed to each subject prior to the study along with a consent form (Appendix B). For patients 12 to 15 years old, their parent or guardian was asked to sign a permission form (Appendix C) along with the consent form. The questionnaire was returned to the respective receptionists in a sealed envelope. This study received ethics approval from the University of Toronto Research Ethics Board.

4.3.3 Study questionnaire

Subjects completed the study questionnaire “Going to the Orthodontist….Your thoughts and feelings about Orthodontic treatment” (GTO) (Appendix D). The questionnaire included demographic questions asking about gender and age; questions about the reason for the visit; if they had seen an orthodontist before; who referred them for orthodontic treatment; and if currently a patient, how long they had been in orthodontic treatment. It also included the Modified Dental Anxiety scale (MDAS) (Humphris et al., 1995), which measures dental anxiety and assesses anxiety about specifics dental procedures; and a modified version of the Modified Dental Anxiety Scale (MDASO) (Figure 4.1) that is applicable to orthodontic treatment and specifically asks about anxiety related to orthodontic procedures. The last section of the questionnaire asks about potential concerns that may be contributing to anxiety among orthodontic patients.

The MDAS consists of 5 questions with a standardized answer scheme for each question ranging from 1 (not anxious) to 5 (extremely anxious), with a sum score ranging from 5 to 25. A score equal or higher than 15 identifies an individual who is dentally anxious. Patients will be considered as extremely anxious if their sum scores are equal or higher than 19. In addition, a score of 5 for any of the questions in the MDAS categorizes the individual as dentally anxious. The MDAS was chosen because research supports the MDAS as a reliable and valid scale to measure dental anxiety (Humphris et al., 1995) and the scale is a short measure of dental anxiety commonly used by practitioners to assess dental anxiety (Dailey et al., 2002). The scale was also easily adaptable for orthodontic treatment and easy to complete by adolescents and older patients.
The MDASO asks similar questions as the MDAS only related to orthodontic (versus dental) treatment. The same answer scheme and scoring is used for the MDASO, including a similar 1 to 5 scoring scheme, a sum score ranging from 5 – 25, and a similar interpretation with a score of 15 or greater as identifying the individual as dentally anxious. The intent of modifying the MDAS was to allow patients to clearly distinguish a visit to the dentist from a visit to the orthodontist. Existing questionnaires assessing dental anxiety contain questions about dental injection and drilling that do not necessarily apply in orthodontics, therefore, it was important to develop a questionnaire that was specific to the target population and related to orthodontic procedures.

The last section of the questionnaire includes a list of potential concerns that may be contributing to anxiety in orthodontic patients (Figure 4.2). The 14 items scale is based on the Dental Belief Survey (Milgrom et al., 1985) but a number of questions were adapted to the context of orthodontic treatment. The Dental Belief Survey (DBS) was chosen amongst other questionnaire because it has been showed to be a valid and reliable scale (Coolidge et al., 2005). Questions asked subjects how much they worried about specific issues related to orthodontic treatment and were scored based on a ranking of 1 (not at all) to 5 (very much). One final question asked about how the individuals worried about things in general in their life.

4.3.4 Pilot study

The questionnaire was translated in French since patients from the private orthodontic office (Quebec) were all French speaking. An English teacher translated the questionnaire in French and asked her colleagues to verify the translation.

The French version of the study questionnaire was pilot tested by a group of eighteen French speaking individuals (14 to 25 years of age) to confirm clarity and comprehension of the information being asked. Of those reviewing the questionnaire, some individuals were familiar with orthodontic procedures whereas others had never received orthodontic treatment. Individuals were asked to complete the questionnaire, and give their comments about the format of the questionnaire and the questions asked.
Figure 4.1 The Modified Dental Anxiety Scale adapted to orthodontics (MDASO)

1. **How do you feel or did you feel at your first visit to the orthodontist?**

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<td>Not anxious</td>
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<td>Slightly anxious</td>
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<td>Fairly anxious</td>
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<tr>
<td>Very anxious</td>
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<td>Extremely anxious</td>
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2. **If you were sitting in the waiting room of the orthodontist office (waiting for treatment), how would you feel?**

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<tr>
<td>Very anxious</td>
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<tr>
<td>Extremely anxious</td>
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3. **If you were about to have braces put on, how would you feel?**

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4. **If you were about to have your braces adjusted, how would you feel?**

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<tr>
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<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Fairly anxious</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Very anxious</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Extremely anxious</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

5. **If you were about to have impressions taken, how would you feel?**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not anxious</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Slightly anxious</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Fairly anxious</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Very anxious</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Extremely anxious</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 4.2 List of potential concerns about orthodontic treatment

1. **Do you worry about not knowing what is going to happen today?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

2. **Do you worry about not having enough information about your orthodontic treatment?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

3. **If you have been to the orthodontist before, are you worried today because you had a negative experience at your last appointment?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

4. **Are you worried because you feel uncomfortable asking questions about your orthodontic treatment?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

5. **Do you worry that the orthodontist will make you feel guilty or embarrassed about your teeth?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

6. **Do you worry that any fears you have about orthodontic treatment will not be taken seriously?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

7. **Do you worry about not being able to stop for a rest or take a break during treatment if you need to?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much

8. **Do you worry about feeling pain when the braces are put on your teeth?**
   - 1: Not at all
   - 2: A little
   - 3: Somewhat
   - 4: Much
   - 5: Very much
9. Do you worry about feeling pain at some point in the orthodontic treatment?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

10. Do you worry about having orthodontic treatment because of negative stories you have heard from other people?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

11. Do you worry about having impressions taken?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

12. Do you worry about needing extractions?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

13. Do you worry about having to receive an injection (needle)?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

14. Do you worry about the orthodontist having to use the drill on your teeth?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

15. Do you tend to worry about things in general?
   
   1  2  3  4  5
   Not at all  A little  Somewhat  Much  Very much

4.3.5 Procedure

The receptionists from the respective clinics distributed the questionnaire to the patients when they checked-in for their appointment. The patients completed the questionnaire in the waiting room of the private or university clinics prior to meeting the orthodontist. Once completed, the patients returned the questionnaire to the receptionists in a sealed envelope. The
envelopes were put in a closed box until collection. Questionnaires were collected over a period of twelve months.

4.3.6 Data analysis

Data analysis was performed using SPSS (version 19, SPSS, Chicago, Ill.). A p-value of 0.05 or less was considered statistically significant.

Descriptive statistics were calculated and included frequency distributions, percentages and sum scores calculated for the outcome variable of anxiety and other categorical covariates of interest. Chi-square test (categorical data) and multi-factor ANOVA (continuous data) were performed to identify which variables (private/university clinics, male/female, age, first visit, reasons of visits, referrals) had a statistically significant impact on the outcome variable (dental anxiety). Correlation analysis was carried out to assess the relationship between dental anxiety and anxiety related to orthodontic treatments. Factor analysis examined what factors could be identified from the list of 14 concerns about orthodontic treatment. Multiple linear regression was also performed to examine the contribution of each factor.

The multiple regression analysis takes the form of an equation that contains a coefficient \( b \) for each factor. The \( b \) values indicate the relationship between anxiety about going to see the orthodontist and each factor. A positive value indicates that there is a positive relationship between the predictor and the outcome whereas a negative coefficient indicates a negative relationship. The \( b \) values also specifies to what extent each factor affects the outcome if the effects of the other predictors are held constant. For each value, if the p-value is significant, then the contribution of the predictor to the model is significant. Additionally, the smaller the p-value and the larger the value of \( t \), the greater the contribution of that predictor to the model. The standardized versions of the \( b \) values are easier to interpret because they are not dependent on the units of measurement of the variables and so are directly comparable. The \( R^2 \) value is a measure of how much the variability in the outcome is accounted for by the predictors.

4.3.7 MDASO reliability testing

To test the reliability of the scale, internal consistency was calculated for the MDAS, the MDASO and the assessment of the list of potential concerns. Cronbach’s alpha score of 0.83 and 0.84 indicated high reliability for both the MDAS and the MDASO respectively. The concerns scale also showed a high reliability with a Cronbach’s alpha of 0.88.
5 Results

5.1 Study Sample

Six hundred seventy-five subjects volunteered to participate in the study and fully completed the questionnaire. Amongst the 675 responders, 408 (60.4%) were from a private orthodontist office in Quebec and 267 (39.6%) from the undergraduate and graduate orthodontic clinics of University of Toronto.

The study population included a total of 434 female subjects (64.3%), with females overrepresented in both private (71.1%) and university (53.9%) clinics (Table 5.1). This finding is consistent with other studies that reported greater participation by female subjects in dental anxiety studies (Chanpong et al., 2005; Heft et al., 2007; Liddell & Locker, 1997).

Surveyed patients were aged between 12 and 57 years, with a mean age of 17.63 years. Table 5.1 summarizes mean age, standard deviation and range for the overall sample and the private and university clinics. Figure 5.2 illustrates the age distribution, with 85.5% of the study sample being 20 years old and younger.

Table 5.1 Gender and age distribution for the total sample and private and university clinics

<table>
<thead>
<tr>
<th>Descriptive</th>
<th>Total</th>
<th>Private office (Quebec)</th>
<th>University clinics (Ontario)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n)</td>
<td>35.7% (241)</td>
<td>28.9% (118)</td>
<td>46.1% (123)</td>
</tr>
<tr>
<td>Female (n)</td>
<td>64.3% (434)</td>
<td>71.1% (290)</td>
<td>53.9% (144)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>17.63</td>
<td>18.43</td>
<td>16.40</td>
</tr>
<tr>
<td>Mean</td>
<td>6.90</td>
<td>6.18</td>
<td>7.73</td>
</tr>
<tr>
<td>SD</td>
<td>45(12-57)</td>
<td>41(12-53)</td>
<td>45(12-57)</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
New patients represented 24.9% (n=168) of the total population studied, with the remaining 75.1% (n=507) being patients who are currently undergoing orthodontic treatment. Table 5.1 also identifies the important difference that exists between private and university practice patients regarding the number of future and current patients. As many as 97.5% of the private practice patients that completed the questionnaire were current patients compared to 40.8% for the university clinics.

Table 5.2 Percentage of future and current patients in the total sample and private and university clinics

<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
<th>Private office (Quebec)</th>
<th>University clinics (Ontario)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>New patients (n)</td>
<td>24.9%</td>
<td>2.5%</td>
<td>59.2%</td>
</tr>
<tr>
<td></td>
<td>(168)</td>
<td>(10)</td>
<td>(158)</td>
</tr>
<tr>
<td>Current patients (n)</td>
<td>75.1%</td>
<td>97.5%</td>
<td>40.8%</td>
</tr>
<tr>
<td></td>
<td>(507)</td>
<td>(398)</td>
<td>(109)</td>
</tr>
</tbody>
</table>

The reason for the visit to the orthodontist by current patients was reported in Table 5.3. The majority of patients were at the office to have their braces or other appliances adjusted (35.1%). Other procedures included taking impressions and radiographs (4.9%), placement of orthodontic appliances (e.g., rapid palatal expander, functional appliance, space maintainer,
headgear - 1.7%), having braces put on (7.4%), removal of orthodontic appliances (e.g., rapid palatal expander, functional appliance, space maintainer, headgear - 0.7%) and removal of braces (3.1%). The remaining 22.2% of individuals visited the orthodontist for a second opinion, an emergency visit or a retention appointment, and 24.9% were new patients visiting the orthodontist for the first time.

The number of patients attending each procedure was different between the private practice and the university clinics as illustrated in Table 5.3.

In addition, patients undergoing orthodontic treatment were questioned about when they started their orthodontic treatment. Table 5.4 indicates that 10.2% were about to start, 2.2% started the same day they answered the questionnaire, 5.1% started their orthodontic treatment 3 months ago, 7.1% started 6 months ago, 12.6% started 12 months ago, and 37.9% more than 18 months ago. The average length of orthodontic treatment is approximately 24 months. Future patients (first visit) represented 24.9% of the sample.

Table 5.3 Current patients: Reasons for the visit at the orthodontic clinic

<table>
<thead>
<tr>
<th>Reason of visit</th>
<th>Total</th>
<th>Private office (Quebec)</th>
<th>University clinics (Ontario)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>Impressions/ x-rays (n)</td>
<td>4.9% (33)</td>
<td>3.7% (15)</td>
<td>6.7% (18)</td>
</tr>
<tr>
<td>Placement of orthodontic appliances (n)</td>
<td>1.7% (11)</td>
<td>1.2% (5)</td>
<td>2.2% (6)</td>
</tr>
<tr>
<td>Having braces put on (n)</td>
<td>7.4% (50)</td>
<td>5.1% (21)</td>
<td>10.9% (29)</td>
</tr>
<tr>
<td>Adjustment of braces or appliances (n)</td>
<td>35.1% (237)</td>
<td>51.1% (208)</td>
<td>10.9% (29)</td>
</tr>
<tr>
<td>Removal of orthodontic appliance (n)</td>
<td>0.7% (5)</td>
<td>1.2% (5)</td>
<td>0%</td>
</tr>
<tr>
<td>Removal of braces</td>
<td>3.1% (21)</td>
<td>4.9% (20)</td>
<td>0.4% (1)</td>
</tr>
<tr>
<td>Other</td>
<td>22.2% (150)</td>
<td>30.4% (124)</td>
<td>9.8% (26)</td>
</tr>
<tr>
<td>First visit</td>
<td>24.9% (168)</td>
<td>2.4% (10)</td>
<td>59.1% (158)</td>
</tr>
</tbody>
</table>
Table 5.4 Time elapsed since the beginning of the treatment of current patients

<table>
<thead>
<tr>
<th>Time</th>
<th>Total</th>
<th>Private office (Quebec)</th>
<th>University clinics (Ontario)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>First visit (n)</td>
<td>24.9% (168)</td>
<td>2.4% (10)</td>
<td>59.1% (158)</td>
</tr>
<tr>
<td>Have not started treatment yet (n)</td>
<td>10.2% (69)</td>
<td>1.0% (4)</td>
<td>24.4% (65)</td>
</tr>
<tr>
<td>Starting today (n)</td>
<td>2.2% (15)</td>
<td>3.4% (14)</td>
<td>0.4% (1)</td>
</tr>
<tr>
<td>Started 3 months ago (n)</td>
<td>5.1% (34)</td>
<td>6.6% (27)</td>
<td>2.6% (7)</td>
</tr>
<tr>
<td>Started 6 months ago (n)</td>
<td>7.1% (48)</td>
<td>10.9% (44)</td>
<td>1.5% (4)</td>
</tr>
<tr>
<td>Started 12 months ago (n)</td>
<td>12.6% (85)</td>
<td>17.4% (71)</td>
<td>5.2% (14)</td>
</tr>
<tr>
<td>Started 18 months ago or more (n)</td>
<td>37.9% (256)</td>
<td>58.3% (238)</td>
<td>6.8% (18)</td>
</tr>
</tbody>
</table>

With regard to referrals, more than half of the subjects were referred to the orthodontist’s office by their dentist (63.4%) with the rest of the patients referred by a family member (21.5%), friend (5.3%) or another orthodontist (1.6%). Some patients were referred by an oral and maxillofacial surgeon or simply decided to visit the orthodontist on their own and are represented in the ``Other`` category (8.2%).

Table 5.5 Referrals

<table>
<thead>
<tr>
<th>Time</th>
<th>Total</th>
<th>Private office (Quebec)</th>
<th>University clinics (Ontario)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>Dentist (n)</td>
<td>63.4% (428)</td>
<td>66.9% (273)</td>
<td>58.1% (155)</td>
</tr>
<tr>
<td>Friend (n)</td>
<td>5.3% (36)</td>
<td>2.9% (12)</td>
<td>9.0% (24)</td>
</tr>
<tr>
<td>Family member (n)</td>
<td>21.5% (145)</td>
<td>18.6% (76)</td>
<td>25.8% (69)</td>
</tr>
<tr>
<td>Another orthodontist (n)</td>
<td>1.6% (11)</td>
<td>1.0% (4)</td>
<td>2.6% (7)</td>
</tr>
<tr>
<td>Other (n)</td>
<td>8.2% (55)</td>
<td>10.5% (43)</td>
<td>4.5% (12)</td>
</tr>
</tbody>
</table>
5.2 Prevalence of dental anxiety in the studied population

Of the 675 patients that completed the questionnaire, a total of 22.8% were dentally anxious according to the MDAS. These subjects were further divided as, 18.7% being dentally anxious and 4.1% extremely anxious about going to see the dentist based on the MDAS cut-points of ≥15 and ≥19 respectively (Table 5.6). These results are higher than generally reported in the literature (Chanpong et al., 2005; Locker et al., 2001; Locker, 2003), and reported by Humphris et al. (1995), whose prevalence of dental anxiety ranged between 9.6% and 12.9% using the same dental anxiety measure. However, these authors studied older populations such as industrial dental service patients, general dental patients, general medical patients, and adult females.

Several authors have reported higher levels of dental anxiety in younger individuals (Hägglin et al., 1999; Locker & Liddell, 1995; Schwarz & Birn, 1995). Gatchel (1989) conducted studies among junior high school and high school students and reported prevalence rates of moderate fear of 22.5% and 22.3% and high fear of 9.0% and 10.5%. Weinstein and al. (1993) also carried out a study with the majority of his sample being adolescents (85.2%) and found out that 21.2% of the studied population was somewhat afraid of dental treatment and 20.9% very afraid. Since 85.5% of our sample was 20 years old and younger, this could explain in part why the prevalence of anxiety is greater than what was expected.

Table 5.6 Anxiety about going to see the dentist

<table>
<thead>
<tr>
<th>Anxiety category</th>
<th>Total subjects</th>
<th>Private Clinic</th>
<th>University Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>Not anxious (n) MDAS &lt;15</td>
<td>77.2% (521)</td>
<td>86.3% (352)</td>
<td>63.3% (169)</td>
</tr>
<tr>
<td>Dentally anxious (n) MDAS ≥15</td>
<td>18.7% (126)</td>
<td>12.5% (51)</td>
<td>28.1% (75)</td>
</tr>
<tr>
<td>Extremely anxious (n) MDAS ≥19</td>
<td>4.1% (28)</td>
<td>1.2% (5)</td>
<td>8.6% (23)</td>
</tr>
</tbody>
</table>
University clinic patients (Ontario) reported significantly higher MDAS scores ($p<0.01$) than private practice patients (Quebec). No significant difference was noted between MDAS score and age or gender (Table 5.7 and 5.8). Prevalence of dental anxiety in the private clinic falls within the range reported in the dental literature whereas the prevalence in the university clinics is considerably higher.

Table 5.7 MDAS scores for private and university clinics

<table>
<thead>
<tr>
<th>MDAS score</th>
<th>Overall sample</th>
<th>Private practice (Qc)</th>
<th>University clinics (On)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean :</td>
<td>10.39</td>
<td>9.04</td>
<td>12.45</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>SD :</td>
<td>4.13</td>
<td>3.26</td>
<td>4.46</td>
<td></td>
</tr>
<tr>
<td>Range :</td>
<td>20(5-25)</td>
<td>18(5-23)</td>
<td>20(2-25)</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05 = statistically significant

Table 5.8 summarizes the findings of the multiple linear regression model describing the association between MDAS scores and variables such as university/private clinics, gender and age. Private vs. university clinics was the only variable significantly ($p<0.01$) influencing dental anxiety as indicated by the positive beta coefficient ($b=3.46$), the standardized beta coefficient ($\beta=0.410$), and the t-value (11.36).

Table 5.8 Summary of the multiple linear regression analysis regarding demographic characteristics* for MDAS scores

<table>
<thead>
<tr>
<th>Model</th>
<th>$b$</th>
<th>SE $b$</th>
<th>$\beta$</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.06</td>
<td>0.84</td>
<td>0.84</td>
<td>6.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Private vs. university clinics</td>
<td>3.46</td>
<td>0.30</td>
<td>0.41</td>
<td>11.36</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Gender</td>
<td>0.57</td>
<td>0.31</td>
<td>0.07</td>
<td>1.86</td>
<td>0.06</td>
</tr>
<tr>
<td>Age</td>
<td>-0.03</td>
<td>0.02</td>
<td>-0.04</td>
<td>-1.17</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Note: $R^2 = 0.17$

*1st visit, time in treatment, reason of visit and referral were not included in the multiple linear regression analysis for the MDAS since those demographics are related to orthodontic treatment only
5.3 Prevalence of dental anxiety related to orthodontics in the studied population

The percentages of patients dentally anxious and extremely anxious about going to see the orthodontist were 15.1% and 3.6% respectively based on the Modified Dental Anxiety Scale adapted for orthodontic treatment (MDASO) for a total of 18.7% (Table 5.9).

Table 5.9 Anxiety about going to see the orthodontist (private vs. university clinics)

<table>
<thead>
<tr>
<th>Anxiety category</th>
<th>Total subjects</th>
<th>Private Clinic</th>
<th>University Clinics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=408</td>
<td>n=267</td>
</tr>
<tr>
<td>Not anxious</td>
<td>81.3% (549)</td>
<td>91.7% (374)</td>
<td>65.5% (175)</td>
</tr>
<tr>
<td>Dentally anxious</td>
<td>15.1% (102)</td>
<td>7.8% (32)</td>
<td>26.2% (70)</td>
</tr>
<tr>
<td>Extremely anxious</td>
<td>3.6% (24)</td>
<td>0.5% (2)</td>
<td>8.2% (22)</td>
</tr>
</tbody>
</table>

University clinic patients (Ontario) reported significantly higher MDASO scores (p<0.05) than private practice patients (Quebec). Mean MDASO scores and p-value for private and university clinics are showed in Table 5.10.

Table 5.10 MDASO scores for private and university clinics

<table>
<thead>
<tr>
<th>MDASO score</th>
<th>Overall sample</th>
<th>Private practice (Qc)</th>
<th>University clinics (On)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean : 9.93</td>
<td>8.83</td>
<td>11.60</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td></td>
<td>SD : 4.05</td>
<td>3.12</td>
<td>4.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range : 20(5-25)</td>
<td>18(5-23)</td>
<td>20(5-25)</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05 = statistically significant

With regards to dental anxiety related to orthodontic treatment, the multiple linear regression model showed that variables such as gender, age of the subjects, reason of visit, time elapsed since the beginning of the treatment and who referred the patients did not have a significant impact on the model. In other words, no association was found between MDASO and these variables. Furthermore, patients’ experience with orthodontic treatment (future vs. current patients) did not significantly influence dental anxiety about going to see the orthodontist. The
difference in prevalence rate between future and current patients is represented in Table 5.11. The only variable having an effect on dental anxiety related to orthodontic treatment was the clinic the patient visited (private office vs. university clinics). These findings are summarized in Table 5.12.

Table 5.11 Anxiety about going to see the orthodontist (future vs. current patients)

<table>
<thead>
<tr>
<th>Anxiety category</th>
<th>Total subjects</th>
<th>Future patients</th>
<th>Current patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=675</td>
<td>n=168</td>
<td>n=507</td>
</tr>
<tr>
<td>Not anxious</td>
<td>81.3% (549)</td>
<td>64.9% (109)</td>
<td>86.8% (440)</td>
</tr>
<tr>
<td>Dentally anxious</td>
<td>15.1% (102)</td>
<td>26.8% (45)</td>
<td>11.3% (57)</td>
</tr>
<tr>
<td>Extremely anxious</td>
<td>3.6% (24)</td>
<td>8.3% (14)</td>
<td>1.9% (10)</td>
</tr>
</tbody>
</table>

Table 5.12 Summary of the multiple linear regression analysis regarding demographic characteristics for MDASO scores

<table>
<thead>
<tr>
<th>Model</th>
<th>b</th>
<th>SE b</th>
<th>β</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>6.27</td>
<td>0.49</td>
<td>.49</td>
<td>12.89</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Private vs. university clinics</td>
<td>2.60</td>
<td>0.38</td>
<td>.29</td>
<td>6.79</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excluded variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.01</td>
<td>0.30</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.01</td>
<td>0.13</td>
<td>0.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First visit</td>
<td>0.01</td>
<td>0.04</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason of visit</td>
<td>0.02</td>
<td>0.48</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time in tx</td>
<td>0.01</td>
<td>0.07</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referral</td>
<td>-0.04</td>
<td>-0.84</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $R^2 = .085$
A moderate correlation ($r=0.672; p<0.01$) was found between MDAS and MDASO scores indicating that dentally anxious patients are more likely to be anxious about going to see the orthodontist (Figure 5.2).

Figure 5.2 Correlation between MDAS and MDAS score

As represented in Table 5.13, a certain number of individuals (7.7%) were not anxious about going to the dentist but were anxious about going to the orthodontist, whereas 11.8% were dentally anxious but not anxious about orthodontic treatment. The majority of subjects were not dentally anxious at all (69.5%) and 11.0% were anxious about dental and orthodontic treatment.
Table 5.13 Percentage of patients that are both MDAS and MDASO anxious

<table>
<thead>
<tr>
<th>Anxiety regarding orthodontic treatment (MDASO)</th>
<th>Not anxious (n) MDASO&lt;15</th>
<th>Dentally anxious (n) MDASO≥15</th>
<th>Total (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety regarding dental treatment (MDAS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not anxious (n) MDAS&lt;15</td>
<td>69.5% (469)</td>
<td>7.7% (52)</td>
<td>77.2% (521)</td>
</tr>
<tr>
<td>Dentally anxious (n) MDAS≥15</td>
<td>11.8% (80)</td>
<td>11.0% (74)</td>
<td>22.8% (154)</td>
</tr>
<tr>
<td>Total (n)</td>
<td>81.3% (549)</td>
<td>18.7% (126)</td>
<td>100% (675)</td>
</tr>
</tbody>
</table>

5.4 Potential concerns about orthodontic treatment

An exploratory factor analysis was done for the 14 questions about concerns regarding orthodontic treatment in the ```Going to the Orthodontist``` questionnaire. The principal components were rotated orthogonally (Varimax) with Kaiser Normalization and results are presented in Table 5.14. Of the 14 concerns about orthodontic treatment, 11 items had high loadings greater than 0.50.

Factor 1 identified items associated with the patients’ perception of orthodontic treatment (i.e., not knowing what is going to happen, not having enough information about orthodontic treatment, negative experience from previous appointment); Factor 2 identified items related to the relationship between the patient and the orthodontist and the staff (i.e., uncomfortable asking questions about orthodontic treatment, feeling guilty or embarrassed about your teeth, fears about orthodontic treatment not taken seriously, not being able to stop for a rest or take a break during treatment); Factor 3 identified factors associated with the orthodontic treatment (i.e., feeling pain when the braces are put on the teeth, feeling pain at some point in the orthodontic treatment, heard negative stories about orthodontic treatment, having impressions taken, having to receive
an injection, orthodontist having to use the drill on your teeth). The three factors are described in Table 5.15.

Table 5.14 Exploratory factor analysis of concerns regarding orthodontic treatment with highest factor loadings

<table>
<thead>
<tr>
<th>Item content</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t know what is happening today</td>
<td>.554</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not enough information about treatment</td>
<td>.518</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worried because negative experiences</td>
<td>.792</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncomfortable asking questions</td>
<td></td>
<td>.769</td>
<td></td>
</tr>
<tr>
<td>Made feel guilty</td>
<td></td>
<td>.798</td>
<td></td>
</tr>
<tr>
<td>Fears not taken seriously</td>
<td></td>
<td>.699</td>
<td></td>
</tr>
<tr>
<td>Not being able to stop for rest</td>
<td></td>
<td>.489</td>
<td></td>
</tr>
<tr>
<td>Feel pain when braces put on</td>
<td></td>
<td></td>
<td>.538</td>
</tr>
<tr>
<td>Feel pain during treatment</td>
<td></td>
<td></td>
<td>.570</td>
</tr>
<tr>
<td>Heard negative stories</td>
<td></td>
<td></td>
<td>.390</td>
</tr>
<tr>
<td>Need impressions</td>
<td></td>
<td></td>
<td>.488</td>
</tr>
<tr>
<td>Need extractions</td>
<td></td>
<td></td>
<td>.794</td>
</tr>
<tr>
<td>Get needle</td>
<td></td>
<td></td>
<td>.854</td>
</tr>
<tr>
<td>Use drill on teeth</td>
<td></td>
<td></td>
<td>.683</td>
</tr>
</tbody>
</table>

Table 5.15 Factors related to anxiety about going to see the orthodontist

<table>
<thead>
<tr>
<th>Factors</th>
<th>Questions re: concerns related to orthodontic treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients’ Perception</td>
<td>- Not knowing what is going to happen</td>
</tr>
<tr>
<td></td>
<td>- Not having enough information about orthodontic treatment</td>
</tr>
<tr>
<td></td>
<td>- Negative experience from previous appointment</td>
</tr>
<tr>
<td>Relationship with Orthodontist/ Staff</td>
<td>- Uncomfortable asking questions about orthodontic treatment</td>
</tr>
<tr>
<td></td>
<td>- Feeling guilty or embarrassed about your teeth</td>
</tr>
<tr>
<td></td>
<td>- Fears about orthodontic treatment not taken seriously</td>
</tr>
<tr>
<td></td>
<td>- Not being able to stop for a rest or take a break during treatment</td>
</tr>
<tr>
<td>Treatment Factors</td>
<td>- Feeling pain when the braces are put on the teeth</td>
</tr>
<tr>
<td></td>
<td>- Feeling pain at some point in the orthodontic treatment</td>
</tr>
<tr>
<td></td>
<td>- Heard negative stories about orthodontic treatment</td>
</tr>
<tr>
<td></td>
<td>- Having impressions taken</td>
</tr>
<tr>
<td></td>
<td>- Having to receive an injection</td>
</tr>
<tr>
<td></td>
<td>- Orthodontist having to use the drill on your teeth</td>
</tr>
</tbody>
</table>

In order to evaluate which factor contributes the most to dental anxiety among orthodontically treated patients, correlations between the respective factor and MDASO score were done as well as a multiple linear regression.
The weakest correlation with the MDASO score was found for the patients’ perception of orthodontic treatment and the highest correlation was noted for the factors directly associated with the orthodontic treatment. Table 5.16 summarizes the correlation coefficient for each factor.

Table 5.16 Pearson correlation regarding the association between three factors and MDASO

<table>
<thead>
<tr>
<th></th>
<th>Patients’ perception of orthodontic treatment</th>
<th>Relationship with Orthodontist/Staff</th>
<th>Treatment factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson correlation</td>
<td>.410*</td>
<td>.501*</td>
<td>.586*</td>
</tr>
</tbody>
</table>

*Correlation statistically significant at p<0.01

These findings were confirmed by the multiple linear regression. Positive coefficients (b) indicate that there is a positive and significant (p<0.01) relationship between all three factors and anxiety about going to see the orthodontist. Concerns about orthodontic treatment was identified as the most important factor contributing to anxiety about orthodontic treatments as indicated by the beta coefficient (0.29), the highest t-value (11.01), and the standardized beta values (.42). The beta coefficient (b) and their standard errors as well as the standardized beta values (β) and the t values are summarized in table 5.17.

As mentioned previously, the R² value is a measure of how much the variability in the outcome is accounted for by the predictors. For the first model its value is 0.343, which means that concerns about orthodontic treatment accounts for 34.3% of the variation in anxiety about going to see the orthodontist. R² value for the second model increases to 0.381 or 38.1% of the variance in dental anxiety about orthodontic treatment. Therefore, the variable entering the second model (i.e., patients’ relationship with the orthodontist and the staff) accounts for an extra 3.7% of the variance in MDASO scores. Finally, the R² value for the third model is 0.396 (39.6% of the variance in MDASO scores) indicating that patients’ perception about orthodontic treatment accounts for another 1.5% of the variance in anxiety about orthodontic treatment. The adjusted R² value of the third model (0.393) is very close to the value of R² (0.396), which indicates that our model generalizes well to the general population. The Durbin-Watson statistic of 1.93 signifies that the assumption of independent errors is tenable since the closer the value is to 2, the better.
Table 5.1 Summary of the multiple linear regression analysis regarding factor analysis

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameter</th>
<th>$b$</th>
<th>SE $b$</th>
<th>$\beta$</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constant</td>
<td>3.39</td>
<td>0.40</td>
<td>0.37</td>
<td>9.16</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Treatment factors</td>
<td>0.40</td>
<td>0.02</td>
<td>0.59</td>
<td>18.76</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>2</td>
<td>Constant</td>
<td>2.80</td>
<td>0.31</td>
<td>0.36</td>
<td>7.52</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Treatment factors</td>
<td>0.31</td>
<td>0.03</td>
<td>0.45</td>
<td>11.86</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Patients’ relationship with the orthodontist/staff</td>
<td>0.36</td>
<td>0.06</td>
<td>0.24</td>
<td>6.35</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>3</td>
<td>Constant</td>
<td>2.70</td>
<td>0.29</td>
<td>0.28</td>
<td>7.32</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Treatment factors</td>
<td>0.29</td>
<td>0.03</td>
<td>0.42</td>
<td>11.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Patients’ relationship with orthodontist/staff</td>
<td>0.28</td>
<td>0.06</td>
<td>0.19</td>
<td>4.71</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Patients’ perception of orthodontic tx</td>
<td>0.15</td>
<td>0.04</td>
<td>0.14</td>
<td>4.09</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Note. $R^2 = .343$ for step 1: $\Delta R^2 = .037$ for step 2: $\Delta R^2 = .015$ for step 3

For this model, all three factors (i.e., concerns about orthodontic treatment, patients’ relationship with the orthodontist and the staff and patients’ perception of orthodontic treatment) are significant predictors of dental anxiety about going to see the orthodontist (with respective t value of 11.01, 4.71, 4.09; p<0.01). From the magnitude of the beta and the t values, it can be concluded that concerns about orthodontic treatment have more impact than patients’ perception of orthodontic treatment and patients’ relationship with the orthodontist and the staff.

The same regression analysis was also done separately to evaluate if the contribution of the three factors was similar in both samples. Tables 5.18 and 5.19 represent the regression analysis for the private practice and the university clinics respectively.

Table 5.18 indicates that concerns about orthodontic treatment (i.e., fear of pain, hearing negative stories, having to receive an injection, having impressions taken, having the orthodontist to use the drill) is the biggest contributor of dental anxiety related to orthodontics for the private office’s patients sample with a beta coefficient of 0.32 and a standardized beta coefficient of 0.51 ($t=11.43$; $p<0.01$). To a lesser extent, patients’ perception of orthodontic treatment was also found to contribute to dental anxiety in orthodontically treated patients.
(b=0.28; β= 0.15; t=3.09; p<0.01). Moreover, the patients’ relationship with the orthodontist and the staff was not found to be statistically significant in this model (b=0.08; β= 0.04; t=0.91; p=0.36).

Table 5.18 Summary of the multiple linear regression analysis regarding factor analysis for the private office (Quebec)

<table>
<thead>
<tr>
<th>Model</th>
<th>b</th>
<th>SE b</th>
<th>β</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.59</td>
<td>0.47</td>
<td>.51</td>
<td>5.52</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Treatment factors</td>
<td>0.32</td>
<td>0.03</td>
<td>.10</td>
<td>11.43</td>
</tr>
<tr>
<td></td>
<td>Patients’ relationship with the orthodontist/staff</td>
<td>0.08</td>
<td>0.08</td>
<td>.04</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>Patients’ perception of orthodontic tx</td>
<td>0.28</td>
<td>0.09</td>
<td>.15</td>
<td>3.09</td>
</tr>
</tbody>
</table>

Note. R² = .351

Table 5.19 shows that concerns about orthodontic treatment and patients’ relationship with the orthodontist and the staff have a similar impact on dental anxiety about orthodontic treatment in the university clinics sample. On the other hand, patients’ perception of orthodontic treatment was not found statistically significant in this model (t=1.64; p=0.10).

Table 5.19 Summary of the multiple linear regression analysis regarding factor analysis for the university clinics (Ontario)

<table>
<thead>
<tr>
<th>Model</th>
<th>b</th>
<th>SE b</th>
<th>β</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.66</td>
<td>0.81</td>
<td>.30</td>
<td>4.51</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>Treatment factors</td>
<td>0.22</td>
<td>0.05</td>
<td>.10</td>
<td>4.64</td>
</tr>
<tr>
<td></td>
<td>Patients’ relationship with the orthodontist/staff</td>
<td>0.40</td>
<td>0.10</td>
<td>.28</td>
<td>4.20</td>
</tr>
<tr>
<td></td>
<td>Patients’ perception of orthodontic tx</td>
<td>0.10</td>
<td>0.06</td>
<td>.09</td>
<td>1.64</td>
</tr>
</tbody>
</table>

Note. R² = .314
Table 5.1 and 5.19 reveal that patients from private office are worried about different aspects of orthodontic treatment than patients from university clinics. Both populations are concerned about treatment factors to a certain degree but university clinics’ patients show more concern about the relationship with the orthodontist and the staff than private office’s patients. In the same vein, patients’ perception of orthodontic treatment was found to contribute to dental anxiety about orthodontic treatment in patients treated in private office but was not statistically significant in the university clinics patients. Reasons to explain that difference are discussed in the following section.

6 Discussion

The purpose of this research was to assess the prevalence of dental anxiety in future and current orthodontic patients using a questionnaire, and further to investigate the factors contributing to dental anxiety in this population. This study is the first to measure dental anxiety in the context of orthodontic treatment. In order to complete this study, the Modified Dental Anxiety Scale was adapted to ask about anxiety related to orthodontic treatment. A 14 item scale was also developed based on The Dental Belief Survey to evaluate potential concerns about orthodontic treatment.

6.1 Prevalence data

The total sample size involved 675 subjects who completed the self-report questionnaire. Subjects were either patients in a private orthodontic practice (Rimouski, Quebec) or in university clinics (i.e. undergraduate and graduate clinics of the Faculty of Dentistry of University of Toronto). Study patients were predominantly female, especially in the private office patients’ sample. This could be because more females volunteered to complete the questionnaire, which is consistent with findings from previous studies. Another reason is that perhaps more females were seeking orthodontic treatment in the private office in comparison to the university clinics but this is unlikely since orthodontists anecdotally report treating the same number of male and female in their practice. Moreover, studies report no difference in prevalence of malocclusion between gender even though some occlusal characteristics such as deep overbite have been shown to be more frequent in males (Brito, Dias, & Gleiser, 2009; Ciuffalo et al.,
Overall, the majority of the subjects studied were current orthodontic patients; however, future patients comprised most of the university clinics sample. Prevalence rates for dental anxiety have been investigated in previous general population studies and wide ranges are reported. Studies using the DAS and other dental anxiety measures report prevalence rates between 8.2% and 39.2%, with the large variation attributed to the use of different measures and population studied. Studies using the MDAS report prevalence rates between 9.6% and 12.9% (Humphris et al., 1995). Using the MDAS, this study reported a significantly higher percentage of patients (22.8%) as dentally anxious than found in other studies.

A significant number of patients were also identified as being anxious about going to see the orthodontist. The prevalence of those anxious about orthodontic treatment was slightly lower than those anxious about dental treatment, with 18.7% anxious about going to see the orthodontist. A contributing factor may be that most of the subjects in the current study were aged between 12 and 20 years of age whereas prevalence studies using the MDAS were done in adult populations (Humphris et al., 1995). As mentioned in the results section, studies have showed that young subjects tend to be more anxious than older individuals, which could explain the higher prevalence rate (Gatchel; 1989; Hägglin et al., 1999; Locker & Liddell, 1995; Schwarz & Birn, 1995; Weinstein and al., 1993). Additionally, as mentioned in the literature review section, the variability (i.e., different population studied, different dental anxiety measures used, different definition of dental anxiety) in dental anxiety studies makes it hard to compare prevalence rate. Another factor that could have influenced the prevalence rate is the timing of completion of the questionnaire. In the present study, patients completed the questionnaire while waiting in the waiting room prior to their appointment with the orthodontist which could increase their level of anxiety at this particular moment. However, as mentioned in the literature review, a study published by Humphris et al. (2006) showed that completion of a short dental anxiety questionnaire by adult patients immediately before seeing their general dentist did not raise their level of anxiety. The authors conclude that completing dental anxiety questionnaires does not have a deleterious effect on patients and recommend their use routinely as part of a general assessment of patients.

It seems intuitive to expect that current patients who know what to anticipate from an orthodontic visit would be less anxious than future patients but no statistically significant difference was found regarding anxiety level between future and current orthodontic patients.
This is in agreement with the study carried out by Heaton et al. (2007) who did not find a difference in anxiety whether the patient had previous experience with the treatment scheduled for a specific day or not. Similarly, Peretz & Moshonov (1998) conducted a study to evaluate dental anxiety among patients undergoing endodontic treatment and found no difference between patients who had experienced endodontic treatment before and those who had not.

In our study, the prevalence of anxious patients from the university clinics (undergraduate and graduate clinics at the Faculty of Dentistry, University of Toronto) was significantly higher than the prevalence of anxious patients from private orthodontic practice. We might expect that patients receiving treatment from an undergraduate or graduate student would express more anxiety than patients visiting an orthodontist because they feel more confident about the experienced clinician. Patient’s trust towards the practitioner has been identified as a possible component of dental anxiety (Milgrom et al., 1995). Contrary to our results, Stewart, Marcus, Christenson and Lin (1994) reported that patients treated in dental schools have similar anxiety levels in comparison to those in the general population. The authors hypothesized that by the time the patients start their treatment with a student, they have had experience with many different clinicians in the dental school and therefore do not show higher anxiety levels.

Other factors to take into consideration are subject’s education level, income level and cultural background. In their study, Peretz & Moshonov (1998) found that patients with higher education level demonstrated lower dental anxiety. This is consistent with the findings of Hallstrom and Halling (1984) who reported a higher prevalence of dental anxiety among individuals of lower education level and social class. Lower income has also been associated with higher dental anxiety level. Having a low income level is a potential barrier to adequate access to dental services. Infrequent dental visits combined with worries about the cost of restoring or maintaining oral health certainly could contribute to one’s anxiety level. A study carried out in 2002 has showed that more children from public schools (i.e., lower to middle socioeconomic groups) (11.6%) had higher dental anxiety than those of private schools (i.e., higher socioeconomic groups) (6.9%). Furthermore, the study indicated that private school children visited the dentist more regularly than public school children (Taani, 2002). In the present study, it could be hypothesized that patients seeking treatment in educational clinics have lower income than those in private practice since treatment costs are significantly lower in educational institutions. A study (Al-Jewair, Suri, & Tompson, 2011) conducted in the graduate orthodontic clinic at the Faculty of Dentistry, University of Toronto, collected information about
the annual household income of the sample studied and found that 56.1% of the patients fell into the middle ($40,000 to $79,000) and 31.7% in the low (≤$39,000) income categories based on Statistics Canada’s low-income cut-off (Statistics Canada, 2008).

Finally, cultural differences between the two populations were anecdotally reported in the study. Participants from the Faculty of Dentistry of University of Toronto represented a multicultural population sample, whereas patients surveyed in the private practice where all French Caucasian patients. Patients and parents from both populations reported different experiences and knowledge regarding the dental experience. It would have been interesting to study the education level, the social class and the cultural background of the two populations studied to establish if these factors explained the difference in anxiety level between the two groups.

Even though the majority of studies report higher anxiety levels among females, no significant difference was found between males and females in this study. Pierce and Kirkpatrick (1992) suggested that men reported lower levels of fear than women in response to specific fear because they were not being truthful. This indicates a reporting bias in men. Similar prevalence rates between males and females in this study could also be explained by the predominant number of young patients, as younger individuals might be more inclined to express their fears and feelings because they are not aware of the social pressure and prejudices about being fearful and anxious.

In addition, factor such as the reason of the visit to the orthodontist office, time elapsed since the beginning of the treatment and who referred the patient did not influence the level of dental anxiety regarding orthodontic treatment. It seems reasonable to expect that the more time that passed since patients start treatment, the more familiar and comfortable they become, and therefore, the lower their level of dental anxiety about orthodontic treatment. However, this relationship was not found in our study, as future and current orthodontic patient did not present significant different levels of dental anxiety about going to see the orthodontist. Further investigations, for instance prospective studies measuring dental anxiety about orthodontic treatment at different time intervals, are needed to determine whether this is a coincidence or not. Indeed, the same questionnaire (Going to see the orthodontist) could be used prior to the beginning of orthodontic treatment and at the end of orthodontic treatment to assess changes in dental anxiety level in the same individual.
6.2 Potential concerns about orthodontic treatment

The factor analysis revealed three main factors responsible for dental anxiety in orthodontic patients, namely patients’ perception of orthodontic treatment, patients’ relationship with the orthodontist and the staff and concerns about orthodontic treatment. All were found to be positively correlated with dental anxiety about orthodontic treatment. The latter showed the greatest correlation with dental anxiety, which is in agreement with studies trying to explain the cause of dental anxiety. As with dental treatment, orthodontic tooth movement is often associated with pain and this seems to be a major component of dental anxiety in the orthodontically treated population. Furthermore, a positive correlation has been found between dental anxiety and patients’ reported pain. This leads to a vicious circle since pain increases anxiety levels and dental anxiety seems to increase pain. Something as simple as a telephone call has been showed to reduce patients’ self-reported pain and anxiety (Bartlett et al., 2005).

With regard to evoking stimuli, local anaesthesia is rarely used in orthodontics yet patients still reported it as being a source of anxiety. In the same vein, orthodontists never use the drill to remove caries or decay, but patients also cite it as a stressful stimuli. This suggests that the sight and the sound of the drill, even when no pain is present, provoke anxiety in certain patients or that patients think that drill and needle are commonly used in orthodontics.

It has also been suggested that individuals without experience with orthodontic treatment may have developed anxiety through a variety of observational and instructional experiences that communicate negative information (e.g., media) (Rachman, 1990). Negative stories communicated by family and friends may also contribute to increase the level of dental anxiety related to orthodontic treatment. Thus, even if patients themselves have never had orthodontic treatment or orthodontic pain, their attitudes and expectations may be influenced by the experiences of others.

The patients’ relationship with the orthodontist and the staff is another factor contributing to dental anxiety among orthodontic patients and one that possibly contributed to the higher level of anxiety in the university clinics sample. Patients might be more at ease to ask questions to an experienced orthodontist or simply insecure about being treated by students. As well, patients seeking orthodontic treatment in private practice usually choose the practitioner and therefore are more likely to trust and have confidence in their orthodontist. The relationship between the patient and the staff is also likely to be influenced by the time elapsed since the treatment started.
and it would have been interesting to investigate dental anxiety level at different time in the orthodontic treatment.

Finally, patients showed concerns about not knowing what is going to happen and not having enough information about their treatment. This illustrates the fact that patients are not well informed about orthodontic procedures and what is involved in orthodontic treatment. Communication between the orthodontist and the patient is the key to reduce dental anxiety related to this factor.

6.3 Questionnaire validity testing

The internal consistency of the MDAS was consistent with findings from previous studies (Humphris et al., 1995; Ilguy et al., 2005; Locker et al., 1996; Milgrom et al., 1988) and showed high reliability. Reliability testing of the MDAS and list of potential concerns was established by calculating the Cronbach’s alpha of the two scales. Analysis indicated that both scales presented high reliability. A test-retest would have been ideal to confirm the stability of the measure.

6.4 Limitations of the study

The use of two orthodontic populations provided enough data to establish a valuable prevalence rate of dental anxiety related to orthodontic treatment. However, both populations were not the same size and the sample of private practice patients was greater than for those seeking treatment in the university clinics. Differences between these two populations (e.g. socioeconomic status, size of urban setting, ethnicity) may have accounted for the different levels of anxiety rather than the geographic locations of Ontario and Quebec as reported by Hallstrom and Halling (1984). Further research is needed to identify why such a difference was found.

As with most studies, lack of generalizability is an issue and these results are only generalizable to communities presenting similar demographics (i.e., based on Statistics Canada data). Although a large scale national study would allow greater generalizability, the high cost associated with such a study make it difficult to complete.

In this study, dental anxiety was evaluated using a single self-report measure. The use of multiple measures is generally recommended since different measures assess different aspects of dental anxiety (Locker et al., 1996). The questionnaire developed for this study was not a comprehensive measure and did not address all dimension of anxiety. In order to assess other
aspects of anxiety, other scales such as the Hamilton Anxiety Scale (HAMA; Hamilton, 1959) and the Anxiety Disorders Interview Schedule-IV (ADIS-IV; Brown, Di Nardo & Barlow, 1994) could have been added to the questionnaire. The scales used in this study to assess dental anxiety about orthodontic treatment were adapted from validated questionnaires and showed high reliability; however, a test-retest analysis would have been an appropriate test to corroborate the findings of the internal consistency statistics. Limited time and confidentiality issues made it difficult to accomplish.

6.5 Implications

6.5.1 Future research

Future research should include an assessment of the socio-economic status, and education level of the population studied in an effort to understand the difference in anxiety levels between the two populations studied. It would also be interesting to investigate dental anxiety among the different ethnic populations since different background, life experiences and values could influence the experience of patients seeking dental and orthodontic treatment.

The questionnaire “Going to the Orthodontist” can be used to assess the level of dental anxiety orthodontic patients population in different clinics settings. Incorporating it as a screening tool in orthodontic clinics may raise clinicians’ and students’ awareness to dental anxiety. Consequently, practitioners could provide an appropriate management and treatment approach to patients with clinically significant levels of dental anxiety about orthodontic treatment.

6.5.2 Clinical relevance

This study confirms that concerns about orthodontic treatment such as fear of pain, negative stories, fear of needle, and fear of drill contribute significantly to dental anxiety about orthodontics. In the current study, patients often reported being anxious about having to receive an injection and about the orthodontist having to use the drill even though those procedures are not common during braces placement or braces adjustment. This tells us that patient might be misinformed about what is involved in orthodontic treatment, suggesting that improved communication between the orthodontist and the patient could reduce anxiety level.

Unfortunately, pain and discomfort are unavoidable during orthodontic treatment. They also contribute significantly to dental anxiety. Studies have shown that decreasing anxiety levels
can diminish the unpleasant feeling of pain, therefore reducing patients’ dental anxiety about orthodontic treatment could improve the experience at the orthodontist’s office. Strategies could include the orthodontist or orthodontic office calling the patient to ask how they are managing or discussing whether there are any issues related to anxiety.

Other factors such as patients’ relationship with the orthodontist and the staff and patients’ perception of orthodontic treatment have an impact on dental anxiety and effort should be made to improve communication with patients, answer their questions, and give them enough information about their orthodontic treatment.

7 Conclusion

The objective of this study was to assess the prevalence of dental anxiety in patients seeking orthodontic treatment and investigate which factors are associated with high dental anxiety levels. A self-report "Going to see the Orthodontist" questionnaire was developed, based on existing validated dental anxiety measures, and found to be a useful tool to identify dentally anxious subjects. It included the MDAS, a modified version of the MDAS adapted for orthodontics (MDASO) and a list of potential concerns about orthodontic treatment.

Dental anxiety is prevalent among patients seeking orthodontic treatment, based on the large percentage number of subjects studied reporting being dentally anxious (22.8%) and anxious about going to see the orthodontist (18.7%). Patients treated in university clinics (Faculty of Dentistry, University of Toronto) were significantly more dentally anxious (p<0.01) about dental and orthodontic treatments than patients treated in the private office (Rimouski, Quebec) (36.7% vs. 13.7% and 34.4% vs. 8.3% respectively). Future patients were not found to be significantly more anxious about going to see the orthodontist than current patients. Demographic characteristics such as gender, age, reason of visit, time elapsed since the beginning of the treatment, and who referred the patient had no significant influence on MDASO scores.

Patients’ perception of orthodontic treatment, patients’ relationship with the orthodontist and the staff, and treatment factors were important components in dental anxiety related to orthodontic treatment, with the latter reported to be the greatest contributor to dental anxiety in all study subjects seeking orthodontic treatment.
This study supports the understanding that dental anxiety is multifaceted and contributing factors extend beyond traditionally accepted stimuli of drills and needles, which are not commonly used in orthodontic practice.
8 References


