



Turun yliopisto
University of Turku

DENTAL FEAR IN ADOLESCENTS' TRANSITION TO EARLY ADULTHOOD

Sirkka Jaakkola

University of Turku

Faculty of Medicine
Department of Clinical Medicine, Public Health
Institute of Dentistry, Department of Community Dentistry
Doctoral Programme of Clinical Investigation

Faculty of Social Sciences
Department of Psychology
Welfare Division, Public Dental Health Care Clinic,
City of Turku, Turku, Finland

Supervised by

Päivi Rautava
MD, PhD, Professor of Preventive Health Care
University of Turku,
Department of Clinical Medicine, Public Health
Chief Physician of Research
Turku University Hospital
Turku, Finland

Satu Lahti
DOdont, Professor of Community Dentistry
University of Turku,
Institute of Dentistry,
Department of Community Dentistry
Turku, Finland

Hannele Räihä
PhD, Professor of Psychology
University of Turku,
Faculty of Social Sciences,
Department of Psychology
Turku, Finland

Reviewed by

Magnus Hakeberg
DDS, PhD, Professor of Dental Public Health
University of Gothenburg, Sahlgrenska Academy
Institute of Odontology, Department of Behavioral and
Community Dentistry
Gothenburg, Sweden

Jorma Virtanen
DDS, PhD, MSc, Professor of Community Dentistry
Institute of Dentistry
Department of Community Dentistry
University of Oulu
Oulu, Finland

Opponent

Heikki Murtomaa
DDS, PhD, MPH, Professor of Oral Public Health
University of Helsinki
Institute of Dentistry
Department of Oral Public Health
Helsinki, Finland

The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

ISBN 978-951-29-6038-5 (PRINT)

ISBN 978-951-29-6039-2 (PDF)

ISSN 0355-9483

Painosalama Oy - Turku, Finland 2015

To

*All those afraid of the dentist,
dental staff or dental treatment*

and

Aarne, Akseli and Saara

*"Pelko ei ole heikkoutta, se on
voimaa. Voimaa olla ihminen."*

*"Fear is not a weakness, it is a
strength. Strength to be a human
being."*

ABSTRACT

Sirkka Jaakkola

Dental fear in adolescents' transition to early adulthood

The aims of the study were to assess the validity of a clinical dental fear question (Short Dental Fear Question, SDFQ) and an instrument measuring interaction between adolescents and dental staff (Patient Dental Staff Interaction Questionnaire, PDSIQ). Also, adolescents' subjective perception of interaction with dental staff, the association with adolescents' dental fear and sense of coherence as well as a multi-professional small-group intervention model for decreasing high dental fear were assessed.

The study sample comprised Finnish adolescents in transition to early adulthood, aged 18–26 years ($n = 777$, $n = 773$, $n = 5$), except for a sample of 15-year-old adolescents ($n = 27$). Dental fear, sense of coherence (SOC) and the adolescents' perceived interaction with dental staff were assessed with questionnaires. The principles of fear treatment such as gradual exposure, relaxation, encouragement and cornerstones of the reteaming method based on a solution-focused framework to maintain motivation and peer support were used to decrease fear in the intervention study.

The SDFQ was found to be a valid dental fear instrument and the PDSIQ a valid interaction instrument with five factors of interaction retrieved: 'kind atmosphere and mutual communication', 'roughness', 'insecurity', 'trust and safety', and 'shame and guilt'. Highly fearful young adults more often perceived their interaction with dental staff as negative, more often felt insecure and had a weaker sense of coherence compared to their peers with no to moderate dental fear. The results of the intervention study showed that young adults' high dental fear decreased and their commitment to dental treatment increased.

The SDFQ is clinically feasible and informative instrument in measuring dental fear. Knowledge of the level of fear enables dental staff to better consider an adolescent's fear. Dental staff should be aware that a supportive interaction style, creating trust and safety, is especially beneficial for highly dentally fearful young adults. A weak SOC may affect young adults' high dental fear in that they would not have enough tools to manage their fear. A multi-professional small therapeutic group seems to increase fearful young adults' resources for confronting dental treatment.

Keywords: adolescent, dental anxiety, sense of coherence, professional-patient relations, interaction, questionnaires, treatment.

TIIVISTELMÄ

Sirkka Jaakkola

Aikuistuvan nuoren hammashoitopelko

Tutkimuksen tarkoituksena oli arvioida kliinisen hammashoitopelkomittarin (SDFQ) kuin myös nuoren ja suun terveydenhuollon henkilöstön välistä vuorovaikutusta mittaavan mittarin (PDSIQ) validiteettia, nuoren subjektiivista käsitystä suun terveydenhuollon henkilöstön kanssa käydystä vuorovaikutuksesta, nuoren hammashoitopelon ja koherenssintunteen välistä yhteyttä, ja moniammatillista pienryhmäinterventiomallia kovan hammashoitopelon vähentämisessä.

Tutkimuksen havaintoaineisto muodostui pääosin aikuistuvista suomalaisnuorista iältään 18-26 vuotta ($n = 777$, $n = 773$, $n = 5$) lukuun ottamatta 15-vuotiaiden nuorten otosta ($n = 27$). Hammashoitopelkoa, koherenssintunnetta ja nuoren kokemaa vuorovaikutusta suun terveydenhuollon henkilöstön kanssa arvioitiin kyselyin. Moniammatillisessa pienryhmäinterventiossa käytettiin hammashoitopelon hoidon peruseriaatteita kuten asteittaista altistamista, rentoutusta, kannustusta sekä lisäksi ratkaisukeskeiseen viitekehykseen perustuvan muutosvalmennusprosessin kulmakiviä: motivaation ylläpitämistä sekä vertaistukea.

SDFQ osoittautui validiksi hammashoitopelkomittariksi ja PDSIQ validiksi vuorovaikutusmittariksi, josta löytyi viisi eri vuorovaikutuksen osa-aluetta kuvaavaa faktoria: 'ystävällinen ilmapiiri ja vastavuoroinen viestintä', 'karskius', 'turvattomuus', 'luottamus ja turvallisuus' sekä 'häpeä ja syyllisyys'. Kovasti hammashoittoa pelkäävät nuoret kokivat vuorovaikutuksensa suun terveydenhuollon henkilöstön kanssa useammin kielteiseksi ja turvattomaksi verrattuna niihin nuoriin, joilla oli vähemmän tai ei lainkaan hammashoitopelkoa. Myös heikko koherenssintunne oli yleisempää kuin vahva kovasti pelkäävien nuorten keskuudessa. Interventiotutkimuksen tulosten mukaan nuorten aikuisten kova hammashoitopelko väheni ja heidän sitoutumisensa hammashoittoon lisääntyi.

SDFQ on kliinisesti toimiva ja informatiivinen mittari hammashoitopelon mittaamisessa. Tieto pelon voimakkuudesta auttaa suun terveydenhuollon henkilöstöä ottamaan paremmin huomioon nuoren pelkoineen. Suun terveydenhuollon henkilöstön tulee pitää mielessään, että erityisesti kovasti pelkäävä nuori hyötyy kannustavasta, luottamusta ja turvallisuutta herättävästä vuorovaikutustyylistä. Heikko koherenssintunne saattaa vaikuttaa nuoren aikuisen kovaan hammashoitopelkoon siten, ettei hänellä oli tarpeeksi keinoja, kuinka selviytyä pelkonsa kanssa. Moniammatillinen terapeuttilinen pienryhmä näyttää lisäävän nuoren aikuisen keinoja hänelle pelottavan hammashoidon kohtaamiseen.

Avainsanat: nuori, hammashoitopelko, koherenssintunne, asiantuntija-potilassuhteet, vuorovaikutus, kyselylomakkeet, hoito.

TABLE OF CONTENTS

ABSTRACT	4
TIIVISTELMÄ	5
TABLE OF CONTENTS	6
ABBREVIATIONS	8
LIST OF ORIGINAL PUBLICATIONS	9
1. INTRODUCTION	10
2. REVIEW OF LITERATURE	11
2.1 Background and definitions	11
2.2 Transition to adulthood and dental fear	13
2.3 Sense of coherence	15
2.4 Patient–dental staff interaction	17
2.5 Dental fear measurement and instruments	19
2.6 Treatment of dental fear	21
3. AIMS OF THE STUDY	26
4. MATERIALS AND METHODS	27
4.1 Study designs and subjects	27
4.1.1 The Finnish Family Competence Study designs and sample (Studies I, II, III)	28
4.1.2 The Finnish Student Health Service (FSHS) study desing and the sample of the intervention study (Study IV)	30
4.2 Data collection, instruments and methods	32
4.2.1 Instruments and methods in the Finnish Family Competence Study sample (Studies I, II, III)	32
4.2.2 Instruments and methods in the Finnish Student Health Service study sample (Study IV)	35
4.3 Statistical methods	38
4.3.1 Validation of Short Dental Fear Question (SDFQ) (Study I)	38
4.3.2 Association between dental fear and sense of coherence (Study II)	38
4.3.3 Validation of Patient Dental Staff Interaction Questionnaire (Study III)	38
4.3.4 Association between adolescents’ perceptions of their interaction with dental staff and dental fear (Study III)	38
4.3.5 Testing a group-therapeutic intervention model for the treatment of dental fear (Study IV)	39
4.4 Ethics	39

5. RESULTS.....	40
5.1 Validation of Short Dental Fear Question (Study I)	40
5.2 Association between dental fear and sense of coherence (Study II)	41
5.3 Validation of Patient Dental Staff Interaction Questionnaire (Study III).....	42
5.4 Association between adolescents' perceptions of their interaction with dental staff and dental fear (Study III)	42
5.5 Testing a group-therapeutic intervention model for the treatment of dental fear (Study IV)	43
6. DISCUSSION	45
6.1 Main results.....	45
6.2 Methodological considerations of study designs and participants	45
6.3 Methodological considerations of instruments	47
6.4 Discussion of the results.....	48
7. CONCLUSIONS.....	54
8. CLINICAL IMPLICATIONS AND FURTHER RESEARCH TOPICS.....	55
ACKNOWLEDGEMENTS	56
REFERENCES	60
APPENDICES.....	69
ORIGINAL PUBLICATIONS I-IV	73

ABBREVIATIONS

CBT	cognitive-behavioral therapy
CFA	confirmatory factor analysis
CFI	comparative fit index
DAS	Dental Anxiety Scale
DFS	Dental Fear Survey
EFA	exploratory factor analysis
FFCS	Finnish Family Competence Study
FSHS	Finnish Student Health Service
GRRs	generalized resistance resources
MDAS	Modified Dental Anxiety Scale
NFI	normed fit index
PDSIQ	Patient Dental Staff Interaction Questionnaire
RMSEA	root mean square error of approximation
SOC	sense of coherence
SOC-13	Sense of Coherence Questionnaire, a short version with 13 items

LIST OF ORIGINAL PUBLICATIONS

This thesis is founded on the following original publications referred to in the text by Roman numerals I-IV. The original publications have been reproduced with the permission of the copyright holders.

- I Jaakkola S, Rautava P, Alanen P, Aromaa M, Pienihäkkinen K, Räihä H, Vahlberg T, Mattila M-L, Sillanpää M. Dental Fear: One Single Clinical Question for Measurement. *Open Dent J* 2009, 3: 161-166.
- II Jaakkola S, Rautava P, Saarinen M, Lahti S, Mattila M-L, Suominen S, Räihä H, Aromaa M, Honkinen P-L, Sillanpää M. Dental fear and sense of coherence among 18-yr-old adolescents in Finland. *Eur J Oral Sci* 2013, 121(Suppl): 247-251.
- III Jaakkola S, Lahti S, Räihä H, Saarinen M, Tolvanen M, Suominen S, Aromaa M, Sillanpää M, Mattila M-L, Rautava P. Dental fear affects adolescent perception of interaction with dental staff. *Eur J Oral Sci* 2014; 122: 339-345.
- IV Jaakkola S, Miesvirta M, Räihä H, Vahlberg T, Myllymäki R, Luukkala-Wardi E, Saarni UM, Rautava P. Helpotusta hammashoitopelkoon pienryhmäinterventiolla. *Suom Hammaslääkäril* 2012, 14: 24-30.

1. INTRODUCTION

Feelings of fear, tension, and discomfort are common, natural and permissible concerning dental treatment. The ability to tolerate these challenging feelings is individual. These feelings may seize an individual's mind, causing a common and multidimensional phenomenon called dental fear. The objects and intensity of dental fear varies individually (Oosterink et al. 2008) and they can be assessed with special instruments. Dental fear contains emotional, cognitive, behavioral and physiological aspects (Milgrom et al. 2009), which can all be seen in the work of dentists. Dental fear may emerge in different stages of life, such as childhood, adolescence or adulthood (Milgrom et al. 1988). This thesis focuses on dental fear during the transition to adulthood, which is a special time with significant biological, psychological and social developmental changes during the course of one's life (Erikson 1959).

The inspiration for this doctoral thesis primary originated from clinical work; namely from how dental fear could be measured easily, what kind of elements may affect an adolescent's experience of dental fear, how fearful adolescents perceive their interaction with dental staff, how an adolescent's perceived interaction with dental staff could be measured, and whether a group intervention method could decrease fear among highly fearful dental patients. Thus, my interest has been to discover how dentists and dental staff could understand and alleviate adolescents' fear as well as better performing the required dental procedures by utilizing non-pharmacological, psychological methods.

Further, this thesis was inspired by the perspective of social interaction, which is an essential and important component of dental fear treatment (Milgrom et al. 2009). In fact, at its best, it may itself act as a treatment method by giving a person reconstructive experiences of social interaction and, further, of dental treatment. It is known that a good patient–dentist relationship is the foundation for a successful treatment outcome, producing content patients (Corah et al. 1988), decreasing fear (Corah et al. 1988, Kulich et al. 2000) and decreasing dental care avoidance (Liddel et al. 1990). Another point of view of social interaction is peer support, which may be used as a tool in treating high dental fear through a therapeutic group. To my knowledge, dentally fearful adolescents' perceived interaction with dental staff has not been investigated earlier and only a few studies have reported using a group to treat highly fearful dental patients.

This thesis was also inspired by Aron Antonovsky's (1979) concept of 'sense of coherence' (SOC), which is related to stress coping and thus also concerns the situation of a patient's dental treatment. A strong sense of coherence means that one has a sufficient repertoire of resources and is able to apply them efficiently in a stressful situation. Dental treatment may be considered as a stressful situation, at least for those afraid of dentistry. Regardless of the plethora of human features and factors studied in association with dental fear, the approach of sense of coherence seems to be new in the research field of dental fear.

2. REVIEW OF LITERATURE

2.1 Background and definitions

Background

Dental fear is a common problem, which has been ranked among the four most common general fears (Fiset et al. 1989, Oosterink et al. 2009). Although instruments and methods used in dentistry have been greatly developed over the last decades, studies indicate that the problem of dental fear still remains. The prevalence of dental fear has mainly varied from 4% to 37% depending on populations, different measures and cut-off points (Milgrom et al. 1988, Hakeberg et al. 1992, Moore et al. 1993, Locker et al. 1996, Armfield et al. 2006, Lahti et al. 2007, Nicolas et al. 2007, Humphris et al. 2013). The prevalence of high dental fear was reported in 10% of Finnish adults (Lahti et al. 2007). In addition, 30% of 10- to 14-year-old Finnish schoolchildren reported being quite or very afraid of the dentist (Alvesalo et al. 1993a-b) and 6% of 15-year-old adolescents reported being highly fearful of dental treatment (Rantavuori et al. 2004). The prevalence of high dental fear varied from 5% to 19% among 18-year-old adolescents (Skaret et al. 1998, Locker et al. 2001).

Dental fear seemed to arise during childhood in most cases, but also in adolescence, in young adulthood or later in adulthood (Berggren and Meynert 1984, Milgrom et al. 1988, Thomson et al. 1997, Locker et al. 2001a, Thomson et al. 2009). It was found that those whose dental fear originated from childhood had previous traumatic dental experiences as a dominating etiological component (Berggren and Meynert, 1984 Townend et al. 2000, Ten Berge et al. 2002). Berggren and Meynert (1984) found that the dentist's professional behavior was the most significant factor concerning a child's dental fear, whereas in the case of adults it was pain. Showing understanding towards the patient and trying to avoid pain seemed to be the most desired features in dentists by dentally fearful adults, whereas the most undesired features were heavy-handedness, criticizing patients and being remote and distant (Berggren and Meynert 1984).

Generally, a child's fears are connected to developmental changes in childhood and their quality depends on the child's age (Ferrari 1986) so that attachment and separation anxiety related fears are most actual in preschool age and bodily injury as well as social fears in school age and in adolescence. These childhood developmental fears and factors are also present in a dental clinic visit, perhaps also intermingling with dental issues. Most of these developmental fears diminish or disappear with age as a result of growing ego strength and increasing cognitive abilities, enabling children to better cope with different situations. However, there seemed to be a group of children whose fears last into adulthood, turning chronic (Ten Berge et al. 2002). Unfortunately, there is a lack of longitudinal studies providing more information of the development of dental fear from childhood to adulthood. However, the period from adolescence to

adulthood has indeed been investigated (Thomson et al. 2009). The results of the study by Thomson et al. (2009) show that there were different trajectories between the ages of 15 and 32 years: dental fear increased, decreased, arose or remained stable.

Different models of fear acquisition have been presented (e.g. Freud 1916, Rachman 1977, Weiner and Sheehan 1990, Rachman 1991, Freeman 1998 and 2007a, Armfield et al. 2008, Armfield 2010a) and they seem to consider both external and internal factors. The most important external factor reported to lead to dental fear is negative experiences during a dental visit (Öst 1987). Negative experiences may contain factors such as pain or an unpleasant interaction event between the patient and dental staff (Oosterink et al. 2008, Milgrom et al. 2009). Internal factors affecting the acquisition of fear are related to individual personality. For instance, psychodynamic theory suggests (Freud 1916, Freeman 1998 and 2007a) that one's unsolved internal conflicts and threats of the mind may be displaced onto the dental treatment situation (Freeman 2007a). Recently, Armfield et al. (2008) suggested, based on the cognitive viewpoint (e.g. Beck 1976, Beck and Emery 1985), that dental fear might originate from an individual's own perceptions of dental experiences, which are influenced by personality features and personal life experience. An individual's perceptions of uncontrollability, unpredictability, dangerousness and disgustingness related to dental treatment were found to be predominant factors predicting dental fear compared to negative dental care experiences (Armfield 2010a).

The prevention and treatment of dental fear is important as high dental fear often tends to result in avoidance behavior (Berggren 1984) leading to irregularity in using dental health-care services (Berggren and Meynert 1984, Pohjola et al. 2007, Nicolas et al. 2007, Thomson et al. 2009). This increases the risk for poor dental health (Berggren and Meynert 1984, Pohjola et al. 2007, Armfield et al 2009, Thomson et al. 2009) and when advanced it may also threaten a person's physical, mental and social wellbeing. From the fearful patient's, as well as the dental health-care organization's point of view, missed appointments, discontinuous dental care (Nicolas et al. 2007, Pohjola 2008) followed by acute dental treatment load both parties. Thus, supporting fearful dental patients in committing themselves to regular dental care is worth the effort.

Definitions

Fear, anxiety and phobia are defined as follows, according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), (American Psychiatric Association 2013):

Fear is: *“an emotional response to perceived imminent threat or danger associated with urges to flee or fight”*.

Anxiety is: “*the apprehensive anticipation of future danger or misfortune accompanied by a feeling of worry, distress, and/or somatic symptoms of tension. The focus of anticipated danger may be internal or external*”.

Phobia is: “*a persistent fear of a specific object, activity, or situation (i.e., the phobic stimulus) out of proportion to the actual danger posed by the specific object or situation that results in a compelling desire to avoid it. If it cannot be avoided, the phobic stimulus is endured with marked distress*”.

In this study, the term ‘dental fear’ is used to include dental fear, anxiety and phobia. ‘High dental fear’ is used to mean the most severe fear concerning dentistry.

In the literature, three periods of adolescence have been separated based on developmental stages: early (ages 11 to 14), middle (ages 14 to 17), and late (ages 17 to 20) (Kaplan et al. 1994). Late adolescence is followed by early adulthood, between the ages of 20 and 40 (Kaplan et al. 1994), but it has also been suggested to take place approximately between the ages of 16 and 25 years (Blos 1962, Mangs and Martell 1995).

This study focuses on investigating dental fear mainly during late adolescence or the beginning of early adulthood, using the study participants from the ages of 18 to 26, Studies II, III, IV. This stage of life is also called the transition to adulthood. The terms ‘adolescent’, ‘adolescence’, ‘stage of transition to early adulthood’, ‘early adulthood’, and ‘young adult’ are used in the thesis to denote this particular stage.

2.2 Transition to adulthood and dental fear

Adolescence is a significant period in the course of one’s life containing profound biological, psychological and social developmental changes (Kaplan et al. 1994), which all occur in an individual timetable varying from person to person. The stage of ‘transition to adulthood’ contains challenges in growth and identity, also including sexual and social development (Freud 1958, Erikson 1956). Although identity formation is considered a life-long process, its main crisis takes place during adolescence (Erikson 1959, Crain 1985). Then, an adolescent establishes a new sense of ego identity: that is, the feeling of who you are and where your place is in the larger social environment (Erikson 1956). This process generates feelings of confusion, originating from aspects such as rapid physical growth, developing sexuality and social matters (Erikson 1959, Crain 1985). Relationships with parents change and at the same time the meaning of peer relations is heightened (Erikson 1959). It has been found that peer relations have a major importance for adolescent and later adult personal adjustment (Parker and Asher 1987). Other people’s expectations and one’s appearance are also important adolescent concerns. For example, Darby et al. (2014) found that

young adults consider their teeth to be one of the most frequent shaming topics concerning a visit to a physician.

In addition to identity formation, cognitive development towards a more conceptual way of thinking (Inhelder and Piaget 1958) reaches an adult level. Increased cognitive abilities enable the control of impulses, and the understanding of the long-term consequences of actions (Steinberg and Morris 2001). Thus, cognitive development also increases adolescents' abilities in working with fears and in understanding the consequences of better dental health behavior.

It has been suggested that the transition from adolescence to adulthood as well as early adulthood contain some vulnerability for the onset of dental fear (Locker et al. 2001a). Additionally, the longitudinal study of a New Zealand birth cohort found dental fear to be instable during middle and late adolescence as well as early adulthood (Thomson et al. 1997). The prevalence of dental fear increased from 11% at the age of 15 years to 13% at 18 years and 21% at 26 years (Locker et al. 2001a).

It has been unclear whether the increasing tendency of dental fear is mainly due to exogenous factors (Weiner and Sheehan 1990) concerning dental treatment factors or endogenous factors (Weiner and Sheehan 1990) related to psychological development during transition from adolescence to early adulthood (Locker et al. 2001b). There are studies with findings that negative dental treatment experiences related to caries, tooth loss (Milgrom et al. 1988, Thomson et al. 2000, Poulton et al. 2001, Thomson et al. 2009) as well as symptomatic dental service use (Thomson et al. 2009) are associated with the onset of dental fear in adolescence and early adulthood (Milgrom et al. 1988, Poulton et al. 2001, Thomson et al. 2009).

On the other hand, endogenous factors have also been suggested to associate with adolescent dental fear. Locker et al. (1999) found in their cross-sectional data that a typical characteristic of dentally fearful study participants with adolescent onset (13–17 years) was a vulnerability to anxiety as well as perceived negative dental experiences, and those with adult onset (over 18 years) were characterized by multiple severe fears. Poulton et al. 2001 also found in a longitudinal New Zealand study that endogenous factors such as a vulnerable personality were more strongly related to increasing dental fear during adolescence before the age of 18 years than between 18 and 26 years. In their further study on dental fear during middle and late adolescence as well as early adulthood, Thomson et al. (2009) found different trajectories with dental fear indicating that the phenomenon is really multidimensional and varies between individuals depending on exogenous and endogenous factors. In addition to exogenous factors, differences were also found in the personality features concerning different emotional and behavioral styles containing aspects such as self-control, stress reaction, well-being and social closeness between the groups of dental fear trajectories (Thomson et al. 2009). For example, a group of impulsive adolescents whose dental fear was resolved during early adulthood was identified. Thus, an individual's innate,

biological and structural characteristics such as temperament (Klingberg and Broberg 2007, Stenebrand et al. 2013), as well as family members, may also affect the onset of dental fear. Rantavuori et al. (2009) found that a family member's dental fear was more strongly associated with a 15-year-old adolescent's dental fear than with the adolescent's own negative dental treatment experiences.

Dental fear researchers highlight the importance of preventive aspects of dental care in avoiding the onset of dental fear in all age groups (Milgrom et al. 1988, Locker et al. 1999, Poulton et al. 2001). They emphasized the importance of dental staff using appropriate communication techniques to increase the patient's feelings of trust and control, which may reduce the risk for dental anxiety in psychologically vulnerable individuals during childhood, adolescence and adulthood (Milgrom et al. 1988, Locker et al. 1999). Poulton et al. (2001) focused on the importance of preventive dental health-care practices to avoid the onset of dental fear in early adulthood. They recommended maintaining regular dental check-ups for young adults to diminish the need for acute dental services, which typically contain more traumatic treatment and increase dental fear. They also recommended that dental practitioners assess dental fear between routine check-ups during late adolescence and early adulthood, as dental fear seems to fluctuate more at this time than later in life (Thomson et al. 1997, Thomson et al. 2009).

2.3 Sense of coherence

Sense of coherence (SOC) is a concept that Aron Antonovsky created in the late 1970s (Antonovsky 1979). SOC is based on Antonovsky's salutogenetic theory (1979), which emphasizes factors maintaining health rather than illness. Antonovsky found that generalized resistance resources (GRRs) were not the only factor to explain health but there was an intervening variable, 'a way of looking the world' between resources and health. He named the concept a 'sense of coherence' (SOC) and defined (1987) it as follows:

The sense of coherence is a global orientation that expresses the extent to which one has a pervasive enduring though dynamic feeling of confidence that 1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable, 2) the resources are available to one to meet the demands posed by these stimuli, 3) these demands are challenges, worthy of investment and engagement.

Therefore, SOC contains three core components: comprehensibility, manageability and meaningfulness (Antonovsky 1987). A person with a high sense of 'comprehensibility' expects that encountering the coming stimuli will be predictable or at least understandable. For example, in the context of dental care, a dentist may increase a fearful patients' comprehensibility by agreeing on the next dental procedure with the

patients and giving them adequate information about it or by telling them about the potential sensations felt during the next step of the treatment. ‘Manageability’ contains a person’s own conception of their resources to confront the coming stressful situation, such as dental treatment. For example, these resources may contain relaxation techniques or the social support of family, peers or dental staff. ‘Meaningfulness’ refers to the motivation that the confronted challenges of life are worthy of engagement and investment. For example, in the context of a fearful patient’s dental care the dentist and dental staff might increase a patient’s motivation and commitment towards the treatment by rewarding the patient with positive feedback concerning the patient’s success during the treatment.

According to this theory (Antonovsky 1979), the strength of SOC is associated with coping so that strong SOC facilitates the toleration of stress. Further, the strength of SOC is dependent on an individual’s generalized resistance resources (GRRs); the larger or more functional the combination of GRRs is, the stronger the SOC and the better the ability to tolerate stress (Antonovsky 1979). However, the most important aspect concerning an individual’s well-being is considered to be their ability to choose and flexibly find the best suitable resource or combination of resources in the loading situation at hand (Antonovsky 1979, Honkinen 2009). Antonovsky (1979) defined GRR as follows:

(...) a characteristic of an individual, group, subculture or society that is effective in avoiding or combating a wide variety of stressors and thus preventing tension from being transformed into stress.

An individual’s resources partly originate from innate characteristics, but also a child’s living conditions in society, their social growth environment and the parents’ style of raising and supporting their children during development. According to Antonovsky (1987), building one’s sense of coherence begins in infancy, being based on early social relationships, the possibility to participate in decision making during social interaction as well as confronting life events. This progression of SOC continues further in childhood and adolescence so that by the end of adolescence a tentative SOC level has been gained (Antonovsky 1987). Honkinen et al. found (2008) that adolescents’ SOC at the age of 15 was already moderately stabilized compared with SOC at the age of 18. However, in the long run, Antonovsky (1987) saw that the important life stage for the development of SOC is early adulthood. Nevertheless, the possibility for a change of SOC is also retained in later life, as supported by a recent study (Feldt et al. 2011). Antonovsky highlighted commitment to long-lasting relationships, social roles and work during early adulthood, all of which could reinforce or reverse the tentative SOC level established during childhood and adolescence (Antonovsky 1987, Volanen 2011). The strength of SOC has been found to be associated with close and benevolent social relationships in childhood, adolescence and adulthood (Volanen 2011).

Antonovsky created the Sense of Coherence Questionnaire (also called “Orientation to Life Questionnaire”) to measure the level of sense of coherence (1987). The longer version of the questionnaire has 29 items and the shorter version 13 items with 7-point Likert-scale options. Both SOC versions are widely used and they have been found to be reliable and valid instruments (Eriksson and Lindström 2005, Feldt et al. 2007).

As SOC has been shown to be related to how people manage in stressful situations (Antonovsky 1979), SOC has also been investigated in the field of dental fear research. However, until now there seem to be few studies concerning SOC in patients with dental fear (Lindmark et al. 2011, Wennström et al. 2012, and Wide Boman et al. 2012). According to the results of these studies, SOC seems to be associated with dental fear so that the study participants with a weaker SOC tend to report suffering from dental fear more often than those with a stronger SOC (Lindmark et al. 2011, Wide Boman et al. 2012, Wennström et al. 2012).

2.4 Patient–dental staff interaction

Patient–dentist interaction has been considered as a multidimensional phenomenon containing emotional, cognitive, behavioral and communicative aspects (Kulich 2000). A patient’s fear or anxiety may be an element that considerably affects patient–dental staff interaction (dentist, dental nurse, dental hygienist and receptionist). High dental fear and anxiety are feelings found to influence a patient’s behavior and communication, in that patients with these strong feelings have momentarily weaker communication skills (Scott et al. 1984, Kulich et al. 2000). Additionally, strong fear or anxiety has been found to disturb cognitive capacity in general (Karila 1999) in the functions of memory (McLeod and McLaughlin 1995), attention (Karila 1999, Öhman et al. 2001), and thinking (Karila 1999, Fredrickson and Branigan 2005) so that the patient has fewer ideas for how to act in frightening situations. Thus, in the meanwhile, the probability of primitive action tendencies – attack or flee – may grow (Fredrickson and Branigan 2005). In addition, anxiety and fear seem to increase the need to be taken care of by others (Fredrickson and Branigan 2005). Therefore, fear and anxiety appear to affect and alter a patient’s abilities to receive and appreciate information as well as act during an appointment, in many different ways, thus requiring more from the dental staff’s skills of communication and interaction.

Kulich et al. (2000) have described the dynamics of the interaction between a dentist and a phobic patient. They found aspects of interaction as follows: the patient’s emotions (fear, shame, distrust, nervousness and tension), verbal and nonverbal cues of displaying or repressing emotions, as well as the dentist’s interpersonal skills concerning their professional and fellow-being roles during the encounter. The same study highlighted that good, honest contact with the patient, empathic understanding, warmth and respect can clearly reduce a patient’s fear (Kulich et al. 2000). Corah et al. (1988) also found that patients perceived a decrease in fear if the dentist’s behavior

was communicative, friendly, accepting, empathic, reassuring, supportive, pain preventing, and concerned for the patient's comfort. Rouse and Hamilton (1990) showed that a dentist's positive and supportive communication style relaxes the patient and significantly decreases patient fear, contrary to negative communication which increases fear. Therefore, they recommended that dentists minimize negative messages and maintain more positive communication during interaction with patients. Additionally, a good dentist-patient relationship founded on understanding and acceptance has been suggested to be a factor in contributing to a patient's commitment to dental treatment and decreased avoidance behavior (Liddell et al. 1990). This was confirmed by a recent study (Nanjappa et al. 2014) indicating that positive interaction between the patient and care provider increases the patient's commitment to health-care interventions. A good dentist-patient relationship has also been suggested to prevent dental fear, especially when a patient has previously experienced traumatic dental treatment (Abrahamsson 2002, Milgrom et al. 2009).

Recently, Bernson et al. (2011) studied how a fearful patient manages with regular dental treatment as a whole. They found the key element was a reciprocal relationship between dental staff and the patient where trust-filled interactions, striving for control, seeking and/or receiving social support, and mutual participation in mental efforts were related to a patient's ability to better cope with dental care. Mental efforts here denote matters that fearful patients must contend with in their minds before, during and after dental procedures in order to be able to co-operate with the dentist and continue treatment (Bernson et al. 2011). Such matters contain conflict between the feeling of fear and the need to visit a dentist, anticipatory fear before appointments, and accepting some inconvenience in order to tolerate the treatment procedure (Bernson et al. 2011).

Studies concerning the interaction between fearful dental patients and the entire dental staff are rare. Some studies have been published on interaction between dental staff and children (Zhou et al. 2011, Zhou et al. 2013, Humphris and Zhou 2013, Zhou and Humphris 2014) but no studies between dental staff and adolescents were found. Instead, a study was found concerning college students and dental staff (Bernstein et al. 1979). Its results show that a dentist's professional behavior and personal characteristics are the most important features for a patient in the dental clinic. Further, Bernstein's et al. (1979) study found that about half of fearful patients had some negative views about their dentist, whereas non-fearful patients reviewed their dentists more positively, even though they had experienced some pain. Lastly, the majority of the study participants considered the auxiliary staff to be positive, soothing and nonthreatening (Bernstein et al. 1979).

Receptionists, dental nurses and dental hygienists are important in creating the atmosphere in a dental clinic (Milgrom et al. 2009). Their positive and understanding early contact with fearful patients over the telephone and/or in the dental clinic may substantially help these patients to feel comfortable (Milgrom et al. 2009). In contrast, critical comments by dental staff, for example related to the state of the patient's mouth

or teeth, seem to raise patients' feelings of fear, and increase further avoidance behavior (Moore et al. 2004). In fact, Oosterink et al. (2008) found that sometimes the source of patients' fear may be related to previous perceived negative experiences of interaction in dentistry. "Being pushed about / rough / harsh treatment" was ranked almost as high as pain among most feared objects in dentistry by Dutch people (Oosterink et al. 2008). Milgrom et al. (2009) emphasize that all who provide dental treatment (dentists, dental hygienists, some dental nurses) also ought to remember that procedures dental staff consider to be simple may cause high fear in patients.

2.5 Dental fear measurement and instruments

A patient's dental fear can be assessed in different ways and with various instruments such as self-reported questionnaires (Milgrom et al. 2009), interviews (Friedman 1983, Vrana et al. 1986, Milgrom et al. 2009), observing behavior (Rousset et al. 1997) and performing physiological measures (Milgrom et al. 1990, Tuutti 1986, Lundgren et al. 2001). In a clinical context, using questionnaires is the most effective, quick and easy method for evaluating a patient's fear. Completed questionnaires provide information about the severity of the patient's fears, which is useful for treatment planning as well as making it possible to assess a patient's progress after an intervention (Milgrom et al. 2009). Naturally, dental staff should also observe the behavior of the patient during care (e.g. crying, deducting breathing) and take it into consideration (Milgrom et al. 2009).

From a patient's point of view, questionnaires may also be the easiest way to inform a dentist of their fears, as the patient's ability to communicate may be momentarily weakened due to high fear or anxiety (Scott et al. 1984, McLeod and McLaughlin 1995, Kulich et al. 2000, Öhman et al. 2001, Fredrickson and Branigan 2005). Additionally, shyness or reticence in social situations may itself restrict patients in giving enough necessary information *viva voce* to the dentist. Some may feel ashamed to talk about their fear to the dentist. Humphris and Hull (2007) found that completing a dental fear questionnaire in the dentist's waiting room actually decreases patients' anxiety before entering the dental surgery.

There are numerous dental fear instruments (Newton and Buck 2000, Buchanan 2012), both multi-item scales (Corah 1969, Kleinknecht et al. 1973, Schuurs and Hoogstraten 1993, Humphris et al. 1995, Stouthard et al. 1993, Armfield 2010b) and single questions (e.g. Milgrom et al. 1988, Neverlien 1990, Lahti et al. 2007, Viinikangas et al. 2007, Armfield 2011). However, they all have their own shortcomings in assessing the complete multidimensional phenomenon with emotional, cognitive, behavioral and physiological aspects of dental fear (Schuurs and Hoogstraten 1993, Stouthard et al. 1993, Humphris et al. 1995, Locker et al. 1996, Armfield 2010b). Indeed, none of the existing dental fear instruments have been regarded unambiguously as a 'golden standard'. However, following reliable and valid instruments, the Dental Anxiety Scale

(DAS) (Corah 1969, Corah et al. 1978), the Dental Fear Survey (DFS) (Kleinknecht et al. 1973, Kleinknecht et al. 1984, McGlynn et al. 1987), and the Modified Dental Anxiety Scale (MDAS) (Humphris et al. 1995, Humphris et al. 2000, Newton and Edwards 2005, Humphris et al. 2009) have been used as benchmarks when assessing the concordance (Locker et al. 1996) and validity of later developed and lesser used dental fear instruments, such as the Dental Anxiety Inventory (DAI) (Stouthard et al. 1995), the recent Index of Dental Anxiety and Fear (IDAF-4C⁺) (Armfield 2010b, Armfield 2011, Carillo-Diaz et al. 2012a) and instruments with only one question, such as the Seattle Survey Item (Moore et al. 1993), the Dental Anxiety Question (DAQ) (Neverlien 1990), a Finnish single dental anxiety question (Viinikangas et al. 2007) and a single-item dental anxiety and fear (SIDAF) question (Armfield 2011).

Corah's (1969) DAS is one of the longest used instruments to evaluate the level of dental fear. It has been used in numerous studies with adolescents and adults (Corah 1969, Corah et al. 1978, Berggren and Meynert 1984, Tuutti and Lahti 1987, Lahti et al. 1989, Hakeberg et al. 1990, Neverlien 1994, Moore et al. 1994, Liddell et al. 1994, De Jongh et al. 1994, Locker et al. 1996, Kaakko et al. 1998, Kaakko and Murtomaa 1999, Thomson et al. 2000, Kulich et al. 2000, Peretz and Mann 2000, Quteish Taani 2001, Locker et al. 2001a, Lundgren et al. 2001, Abrahamsson et al. 2002, Willumsen and Vassend 2003, Karjalainen et al. 2003, Majstorovic et al. 2003, Moore et al. 2004, Eli et al. 2004, Freeman et al. 2007, Haukebø et al. 2008, Oosterink et al. 2008, Thomson et al. 2009, Vika et al. 2009, Armfield 2010b, Bernson et al. 2011, Olak et al. 2012). The DAS provides a general overview of dental fear through four questions, measuring feelings about the forthcoming dental appointment, waiting in the dentist's office, and waiting for drilling as well as teeth scaling in the dentist's chair (Corah 1969). Each question has five response options, which are scored from 1 (the lowest level of dental fear) to 5 (the highest level of dental fear). Thus, the total score ranges from a minimum of 4 to a maximum of 20 points. The cut-off point of 13 or more has been suggested for dental fear and 15 or more for high dental fear (Corah et al. 1978).

Humphris et al. (1995) further modified the DAS, resulting in the MDAS. The response options were formulated consistently and a question regarding anesthetic injection was added in the MDAS. Thus, the MDAS measures dental fear with five questions, each having five response options from 1 = 'not anxious' to 5 = 'extremely anxious'. The total scores are ranged from 5 to 25: the higher the score, the higher the dental fear. A cut-off point for high dental fear has been suggested at 19 points, based on clinical relevance (Humphris et al. 1995, King and Humphris 2010). Freeman et al.'s (2007b) study resulted in conversion tables for the DAS and MDAS enabling researchers to convert scores and compare levels of dental fear between these two scales.

Kleinknecht et al. (1973) published the Dental Fear Survey, which is a measurement of 20 items concerning avoidance behavior, physiological fear reactions, different fear objects concerning dental appointments and treatment, and an overview of dental

fearfulness. This measurement also has five response options, giving the summed scores from a minimum of 20 to a maximum of 100. A cut-off point for high dental fear has been suggested at ≥ 60 (Milgrom et al. 1992, Skaret et al. 1998, Kaakko and Murtomaa 1999).

2.6 Treatment of dental fear

Dental fear can be treated in many different ways (e.g. Carlsson et al. 1980, Berggren and Carlsson 1984b, Berggren 1986, Kroeger 1986, Smith et al. 1987, De Jongh et al. 1995b, Hammarstrand et al. 1995, Aartman et al. 2000, Willumsen et al. 2001a, Moore et al. 2002, Mansell and Morris 2003, Kvale et al. 2004, Lahmann et al. 2008, Haukebø et al. 2008, Hägglin and Wide Boman 2012, Forbes et al. 2012, Carlsson et al. 2013, Armfield and Heaton 2013, Gordon et al. 2013, Wide Boman et al. 2013) depending on its intensity. The planning of dental fear treatment starts by measuring the patient's dental fear, which is recommended as part of the normal routine in dental clinics (Humphris and Hull 2007, Milgrom et al. 2009, Newton et al. 2012). The foundation of dental fear treatment lies in the dentist's interpersonal and mutual communication skills, enhancing the patient's feelings of trust and control (Friedman 1983, Friedman et al. 1989, Milgrom et al. 2009). Various treatment options may be needed during the different stages of individually planned care. These can include distinguished pharmacological methods, for example premedication, nitrous oxide, or general anesthesia, and nonpharmacological methods, including different psychological strategies such as behavioral (Smith et al. 1990, Liddell et al. 1994, Berggren et al. 2000, Aartman et al. 2000, Kvale et al. 2004) and cognitive strategies (De Jongh et al. 1995, Berggren et al. 2000, Kvale et al. 2004, Milgrom et al. 2009). Also, various forms of behavioral and cognitive therapies have been used in treating dental fear patients (Berggren et al. 2000, Willumsen et al. 2001a, Forbes et al. 2012). Recently, the combination of cognitive-behavioral therapy (CBT) has been reported as a worthy option in the management of high dental fear (Thom et al. 2000, Mansell and Morris 2003, Agdal et al. 2008, Haukebø et al. 2008, Vika et al. 2009, Davis et al. 2009, Hägglin and Wide Boman 2012, Öst and Skaret 2013, Carlsson et al. 2013) but also in managing intra-oral injection phobia (Vika et al. 2009, Boyle et al. 2010, Heaton et al. 2013). In general, the treatment of dental fear has been provided individually, but some studies using group methods were also found (Gatchel 1980, Jerremalm et al. 1986, Ning and Liddell 1991, Moore et al. 1996, Moore et al. 2002, Coulson and Buchanan 2008).

Behavioral strategies and therapy have their roots in behaviorism, also called 'learning theory'. 'Learning theory' explains how people learn and form their habits, thus also including the possibility to 'unlearn' them (Watson 1998). Behaviorism concentrates on contemplate observable behavior and actions as well as the laws and processes resulting from learned behavior (Eysenk 1959, Watson 1998). Therefore, behavioral

strategies and therapy aim to change impractical behavior in certain situations through learning (Eysenk 1959). As it has been found that relaxed patients feel less physiological or mental discomfort than tense patients (Wolpe 1954, Thompson 1977, Eli et al. 2003), the aim of some behavioral strategies is to relax the body, for example through relaxing breathing (Botto 2006, Milgrom et al. 2009, Martin et al. 2010) and/or muscle relaxation (Jacobson 1970, Lamb and Strand 1980, Botto 2006, Lahmann et al. 2008). Sometimes this is done with the help of physiological monitoring called biofeedback (Hirschman 1980, Carlsson et al. 1980, Milgrom et al. 2009). Exposure-based treatments, for example systematic desensitization (Wolpe 1954) and ‘tell-show-do’ (Addelston 1959, Milgrom et al. 2009), are also included in behavioral strategies (Milgrom et al. 2009).

Cognitive strategies and therapy are based on cognitive theory, emphasizing thoughts, which form an individual’s attitudes, beliefs, and behaviors (Piaget 1929). The key idea of the theory is that to understand person’s behavior, it has to be recognized how the person thinks (Piaget 1929). It is known that individual’s thoughts including also expectations act as triggers for different feelings and further physiological reactions (Milgrom et al. 2009). Cognitive strategies aim to relax the mind of fearful patients (Milgrom et al. 2009), and aim to change the negative expectations and thoughts about themselves and dental care that maintain the feeling of fear (Berggren 2001, Willumsen et al. 2001a, Milgrom et al. 2009). The patient’s focus is directed away from his or her worries about the feared situation by using different cognitive techniques such as encouragement, altering expectations, distraction (Corah et al. 1979), guided imagery, focusing attention, and thought stopping (Milgrom et al. 2009).

CBT is a combination of behavior therapy (Eysenck 1959) and cognitive therapy (Beck 1976, Beck et al. 1985), which Clark (1986) tested successfully with panic disorders. It is generally considered a highly efficacious treatment method for anxiety and phobias (Norton and Price 2007, Davis et al. 2009) and recently CBT has also become a more used and investigated method in the treatment of high dental fear (Wide Boman et al. 2013, Gordon et al. 2013).

The objectives of CBT are to find efficient and adaptive modes with which individuals can respond to problematic situations and to eliminate inappropriate behaviors by using self-control skills and reflective problem solving (Petti 1996). CBT treatment generally contains psycho-education, graded exposure, cognitive restructuring and behavioral experiments, relaxation as well as self-assertiveness training (Thom et al. 2000, Hägglin and Wide Boman 2012). Self-assertiveness training aims to improve fearful patients’ communication skills concerning personal opinions, feelings and needs during dental treatment (Hägglin and Wide Boman 2012).

The CBT treatment of high dental fear patients has been performed by clinical psychologists (Ning and Liddell 1991, Thom et al. 2000, Hägglin and Wide Boman 2012) or by specially trained dentists in collaboration with them (Haukebo et al. 2008,

Vika et al. 2009). Recently, self-paced computerized applications of CBT interventions have also been developed and used in the field of dental fear research (Coldwell et al. 1998, Boyle et al. 2010, Heaton et al. 2013).

Four reviews concerning psychological interventions of managing dental fear could be found (Kvale et al. 2004, Armfield and Heaton 2013, Gordon et al. 2013, Wide Boman et al. 2013) and two of them were meta-analytic systematic reviews (Kvale et al. 2004, Wide Boman et al. 2013).

Armfield and Heaton's (2013) review offers practical advice and a thorough summary of behavioral and cognitive techniques used in different studies in helping fearful dental patients to receive care in the dental clinic or surgery. These techniques included building trustful interaction and rapport with patients by investing in mutual communication, providing control (tell-show-do, rest breaks, signaling, local anesthesia) and appropriate information about procedures, taking into account the patient's wishes concerning the nature and quantity of the knowledge they receive. Other behavioral and cognitive methods such as positive reinforcement, hypnosis and cognitive restructuring were also presented in the article (Armfield and Heaton 2013).

Wide Boman et al. (2013) evaluated studies, which used psychological treatment methods among adult patients with dental anxiety or phobia. They performed the only systematic review/meta-analysis of the treatment for dental anxiety or fear so far that adhered to a strict evaluation scheme with the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system (Atkins et al. 2004) in evidence-based medicine. The GRADE system follows the CONSORT checklist, which aims to improve the quality of reporting in randomized controlled trials (Begg et al. 1996) and is used world-wide by many Health Technology Assessment centers (e.g. Cochrane). Wide Boman and colleagues (2013) discovered that CBT/BT treatments decreased adults' dental anxiety and might facilitate study participants' acceptance of dental care better than general anesthesia. This result is supported by Gordon et al. (2013), who discovered that CBT is the most effective method of decreasing dental anxiety among these reviewed treatment methods: nitrous oxide sedation, premedication, music distraction, hypnotherapy, lavender oil scent, acupuncture, and relaxation training. They found that all different formats of the CBT, delivered individually, in a group, and from a duration of one to five sessions, generated effective fear reduction (Gordon et al. 2013). It is noteworthy that high dentally fearful patients seem to benefit clearly from even one session of CBT intervention (Haukebø et al. 2008, Gordon et al. 2013). The previous meta-analytic systematic review by Kvale et al. (2004) also found fear reduction after an intervention performed with psychological treatment methods and shows that it is commonly expected to be lasting.

Previous meta-analytic systematic review studies (Kvale et al. 2004, Wide Boman et al. 2013) and one review (Gordon et al. 2013) concluded that the heterogeneity between comparisons of different psychological interventions has been found to be

problematic. Heterogeneity originates from the sampling process, inclusion criteria, procedure of the intervention, control groups and outcome measures, for example (Kvale et al. 2004, Gordon et al. 2013, Wide Boman et al. 2013). Dental fear research has emphasized that more well-designed and consistent randomized controlled and clinical trials of psychological interventions of dental fear should be conducted in the future (Kvale et al. 2013, Gordon et al. 2013, Wide Boman et al. 2013, Heaton 2013).

When examining single studies, CBT resulted in positive effects for reducing high dental fear (e.g. Haukebø et al. 2008, Vika et al. 2009, Hägglin and Wide Boman 2012, Wide Boman et al. 2013), patient commitment (e.g. Haukebø et al. 2008, Hägglin and Wide Boman 2012) and acceptance of dental treatment for four patients out of five (Hägglin and Wide Boman 2012). These results were confirmed by earlier follow-ups of two (Berggren et al. 1986) and ten years (Hakeberg et al. 1990) with the results that behavioral intervention was clearly more effective than general anaesthesia. Thom et al. (2000) found a promising result; one session of CBT a week before oral surgery alleviated dental phobia significantly and decreased avoidance behavior. Similarly, Haukebø et al. (2008) found that dental phobic patients benefit from even one single prolonged session of CBT so that they were able to return to conventional dental care despite their longstanding dental avoidance.

Recently, CBT has also been used in self-paced computerized interventions in handling dental injection fear (Coldwell et al. 1998, Heaton et al. 2013). The Computer-Assisted Relaxation Learning (CARL) programme is self-paced, computer-based systematic desensitization containing video-based gradual exposure for dental injection and teaching cognitive and physical coping skills (relaxation breathing and muscle relaxation) for a patient with fear of dental injections (Coldwell et al. 1998, Heaton et al. 2013). CARL considers the patient's level of anxiety so that the steps of gradual exposure would be appropriate for each patient (Coldwell et al. 1998, Heaton et al. 2013). CARL was used in the first randomized control trial of computerized management of dental injection fear with encouraging results (Heaton et al. 2013). Study participants' in the CARL intervention group reported significantly less general and injection-specific fear than participants in the pamphlet control condition group (Heaton et al. 2013). Thus, a self-paced computerized intervention programme may be considered a practical treatment option in treating patients with dental injection fear; more high dentally fearful patients also with avoidance behavior could be reached and helped. Moreover, surplus dental health-care organization resources could be reserved for other procedures.

In summary, nonpharmacological psychological methods (Corah et al. 1988, Kulich et al. 2000, Kvale et al. 2004, Milgrom et al. 2009, Peltier 2009, Bernson et al. 2011, Hägglin and Wide Boman 2012, Armfield and Heaton 2013, Gordon et al. 2013, Wide Boman et al. 2013) have been shown to alleviate fear and increase a patient's commitment to dental treatment (Hakeberg et al. 1990, Berggren 2001, Kvale et al. 2004, Haukebø et al. 2008, Hägglin and Wide Boman 2012, Wide Boman et al. 2013)

more efficiently than pharmacological methods such as premedication (Hakeberg et al. 1990, Thom et al. 2000), anesthesia (Berggren and Linde 1984, Berggren et al. 1986, Berggren 2001, Hägglin and Wide Boman 2012, Wide Boman et al. 2013) or nitrous oxide sedation (Willumsen 1999). Aartman et al. (2000) also found a behavioral treatment method decreased dental fear more than nitrous oxide sedation, but unlike Willumsen's results the patients treated with nitrous oxide sedation sought dental treatment more often than patients in the behavioral treatment group.

There seems to be only a few studies concerning the use of group methods in the field of dental fear research but they have all been shown to reduce dental fear (Gatchel 1980, Jerremalm et al. 1986, Ning and Liddell 1991, Moore et al. 1996, Moore et al. 2002, Coulson and Buchanan 2008). Gatchel (1980) showed desensitization (with relaxation and imagery) decreases dental fear more than psychoeducation or group discussion. Jerremalm et al.'s (1986) study comprised two groups: the first using behavioral (relaxation) and the second using cognitive approaches (working with negative thoughts concerning dental contact). Both strategies significantly reduced dental fear (Jerremalm et al. 1986). Also, Ning and Liddell (1991) indicated that group CBT is effective in decreasing dental fear. Moore et al. (2002) found that adults with high dental fear attending group therapy maintained their regular dental care habits better than those treated with other methods. In addition to therapeutic groups, an online dental anxiety support group has been tested (Coulson and Buchanan 2008). According to the study results, three out of five participants believed that the online support group decreased their dental fear somewhat or greatly (Coulson and Buchanan 2008).

In conclusion, today there are effective psychological treatment methods concerning all four dimensions of dental fear: emotional, cognitive, behavioral, and physiological.

3. AIMS OF THE STUDY

The approaches of this research conform to the laws of social interaction and sense of coherence, which have been applied in the clinical situation when encountering an adolescent with high dental fear.

The main aims of this dissertation were firstly to test an instrument for quickly assessing adolescents' dental fear (Study I), to generally deepen dental staff's understanding of adolescents with high dental fear (Studies II, III), to clarify adolescents' perceptions of their interaction with dental staff (Study III), and to test a new clinical method for treating highly fearful young adults (Study IV).

The specific aims, hypotheses and research questions were:

- To validate a new clinical dental fear instrument, the SDFQ, against the DAS and DFS (Study I). The research question was: Does the SDFQ identify the same adolescents with dental fear as the DAS and DFS?
- To investigate the association of dental fear with SOC among 18-year-old adolescents (Study II). The hypothesis was that those with high dental fear have a weak SOC even when adjusted for gender and education.
- To validate a new instrument (PDSIQ) measuring adolescents' perceptions of their interaction with dental staff (Study III). The research question was: What kind of aspects concerning interaction does PDSIQ find by factor analyses?
- To investigate whether the subjective perception of interaction with dental staff is associated with dental fear among 18-year-old adolescents (Study III). The hypothesis was that highly dentally fearful adolescents perceive their interaction with dental staff more negatively than their peers. Further, the question was whether the difference of association with perceived interaction and dental fear remained significant even after adjusting for gender and SOC.
- To test a small-group intervention model for treating high dental fear. The research question was: Does a multi-professional, group therapeutic model decrease high dental fear and increase a patient's engagement in the finalized treatment (Study IV)?

4. MATERIALS AND METHODS

4.1 Study designs and subjects

The study designs were cross-sectional in Studies I, II, and III, and Study IV was an intervention study. The first study was conducted in dental clinics where adolescents filled out questionnaires in the waiting room before their dental examinations. Studies II and III were surveys based on mailed questionnaires. Study participants from two different sources were included in this dissertation study. In Studies I, II, and III, the study participants came from the Finnish Family Competence Study (FFCS) (*Figure 1.*) and in the group intervention study (Study IV) they were university students using the dental health-care services of the Finnish Student Health Services in Turku.

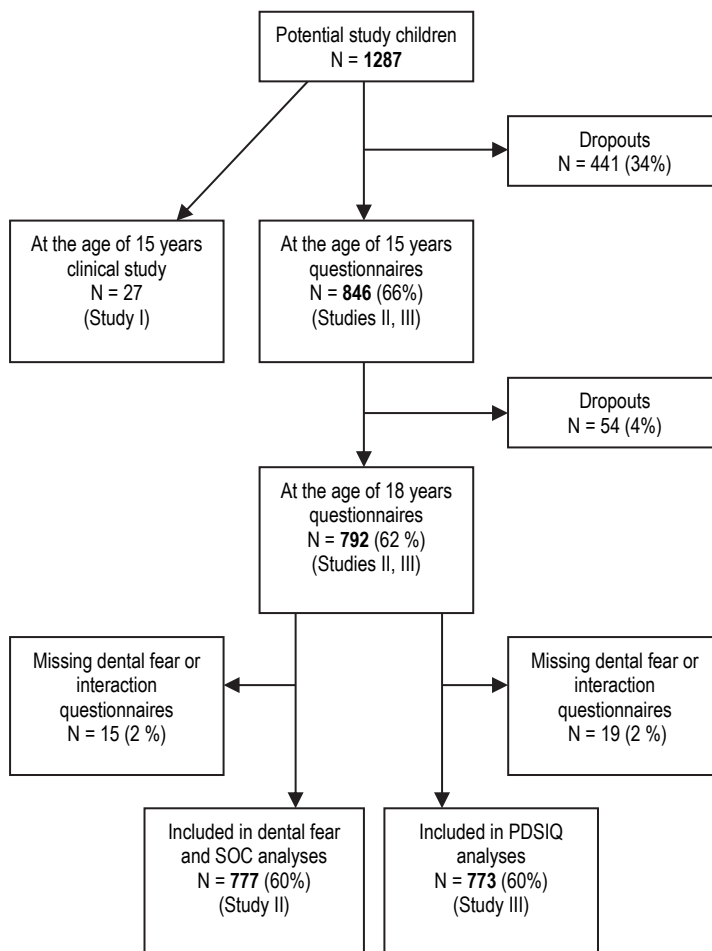


Figure 1. Participants of the dental fear study of the FFCS (Studies I, II, III).

4.1.1 *The Finnish Family Competence Study designs and sample (Studies I, II, III)*

The cross-sectional studies (I, II, III) are part of a prospective, follow-up study, the Finnish Family Competence Study (FFCS) (Rautava and Sillanpää, 1989), investigating preventive health care, including pediatric and adolescent care (somatic, dental, child psychiatric care), and public health-care services. The FFCS was initiated at the Department of Public Health in the Faculty of Medicine in Turku University in 1985. The study participants were gathered from the (then) province of Turku and Pori (total population 713,000) using a randomized stratified cluster sampling procedure (**Figure 2**). The clusters represented the populations of the different public health-care centers including maternity health-care, well-baby and public dental health-care clinics in the study area participating in the project.

The FFCS study cohort consisted of 1,582 potential participant mothers expecting their first child and visiting their maternity health-care clinic for the first time in about the 10th week of pregnancy during the year 1986. Of these mothers, 1,443 (91%) gave their informed consent and entered the study, while 139 (9%) mothers refused to participate in the study. The occupational distribution of those refusing was similar to that of the participants ($\chi^2 = 3.918$, $df = 3$, $p = 0.271$). The children were born between May 1986 and August 1987, and the number of the target population was 1,294. After the births, there were 1,287 potential study children who were followed up with their families from that time. Data on the study children and their families were mainly collected using frequent questionnaires during the time of pregnancy, delivery, preschool and school age until the age of 18 years (**Figure 3**). The original study design and population are described in detail elsewhere (Rautava and Sillanpää 1989, Aromaa 1999).

The target group of the clinical study (Study I) was 15- and 16-year-old adolescents ($n = 39$) of the FFCS, who were scheduled for their routine dental examination in two public dental health care clinics (Turku and Piikkiö) in the study area. The number of dropouts was 12 adolescents, whose reasons for not arriving included ‘summer job’, ‘fear’ and ‘problem to get a ride to the dental clinic’ or ‘the bus didn’t arrive’. Finally, there were 27 adolescents participating in the study (**Figure 1**).

The population of the cross-sectional studies II and III was the same sample of adolescents of the FFCS, who had filled out and returned self-reported, mailed questionnaires at the age of 18 years ($n = 792$) (**Figure 1**). The number of participants was 777 in Study II, and 773 adolescents in Study III (**Figure 1**).

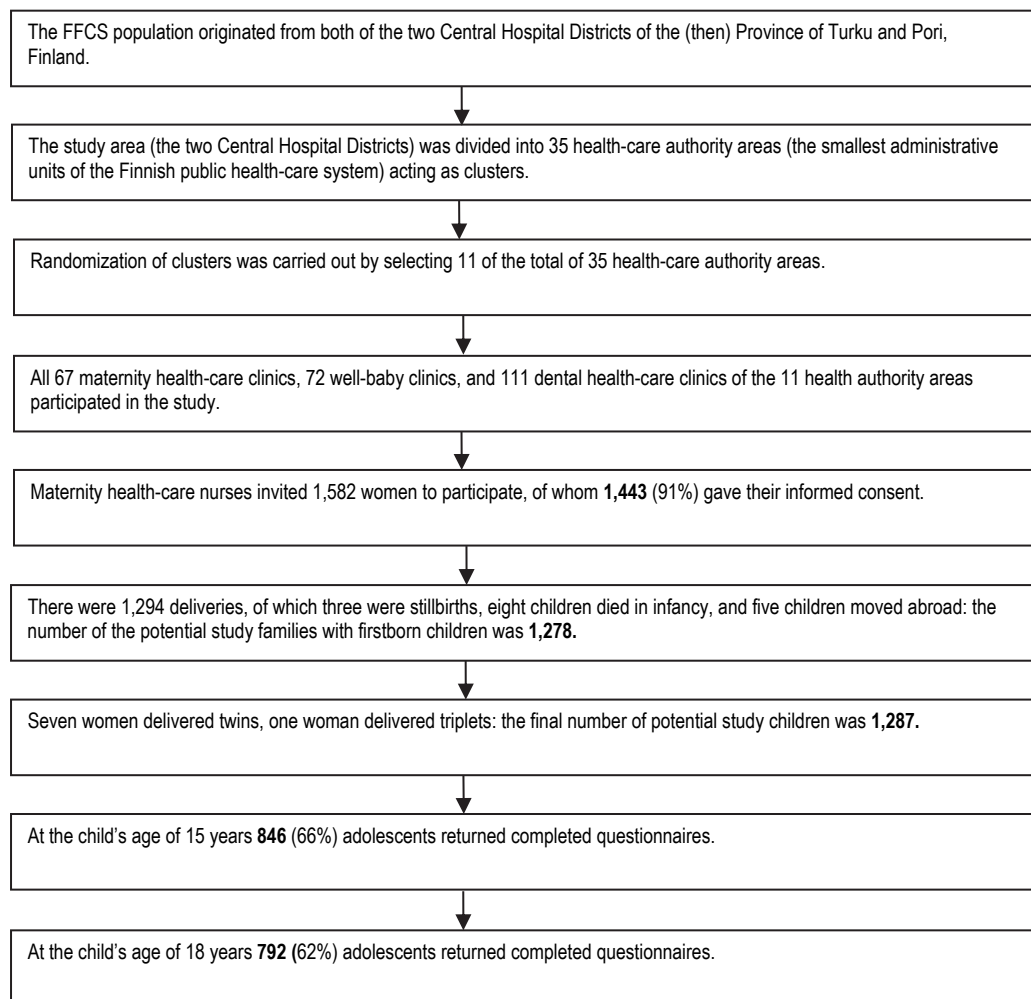


Figure 2. Flow chart of the study participants of the FFCS.

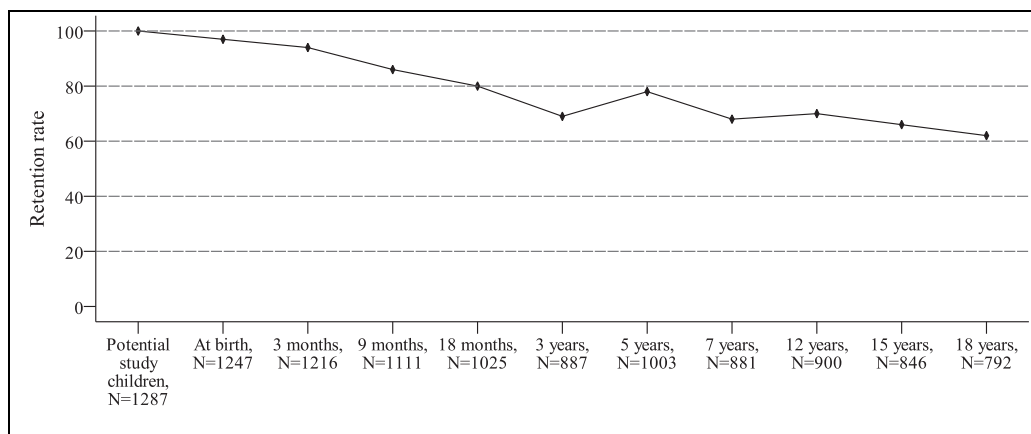


Figure 3. Retention rate of participants in the Finnish Family Competence Study (FFCS) (Study III).

4.1.2 The Finnish Student Health Service (FSHS) study design and the sample of the intervention study (Study IV)

The intervention study (Study IV) was organized on the initiative of the FSHS's dental services (Turku) in collaboration with the University of Turku and the private sector (**Figure 4**). The study design was a longitudinal before–after and the progress of the study can be seen in **Figure 5**. The group intervention meetings were organized during October and December 2008. After the intervention, the participants again filled out the same dental fear questionnaires in the same place as for the baseline. The study participants' situations with their dental treatment were checked in the patient registers in May 2009.

Generally, the prevalence of high dental fear was found to be over 5% among university students visiting FSHS's dental health care clinics (Pohjola et al. 2014). And the problem of high dental fear was shown to be more prevalent among female (7%) than male students (3%) (Pohjola et al. 2014).

As the result of actively advertising a group intervention for highly fearful students via the Internet, noticeboards, the student newspaper and contact with dental, mental as well as medical staff, six students were interested in participating in the intervention and the interview. The inclusion criteria for group membership were: high dental fear, desire to grow and develop mentally, realistic expectations in relation to the group process, and the ability to function with others. The exclusion criteria were: drug and alcohol misuse, difficult life situation, present acute event in the mental health domain (e.g. depression or psychosis) and risk of suicide. After the interviews one student felt that group work would not be suitable for him. He was offered an individual intervention comprising appointments with a dental hygienist and a cognitively oriented psychotherapist from the FSHS. Thus, the final number of group members was five: four female and one male. They all gave informed consent and filled out dental fear questionnaires during the individual interview session.

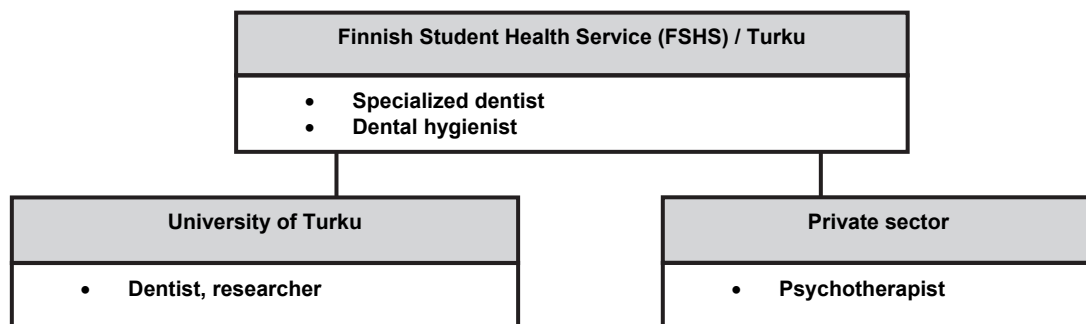


Figure 4. Quarters of collaboration and the multi-professional leader team of the intervention study (Study IV).

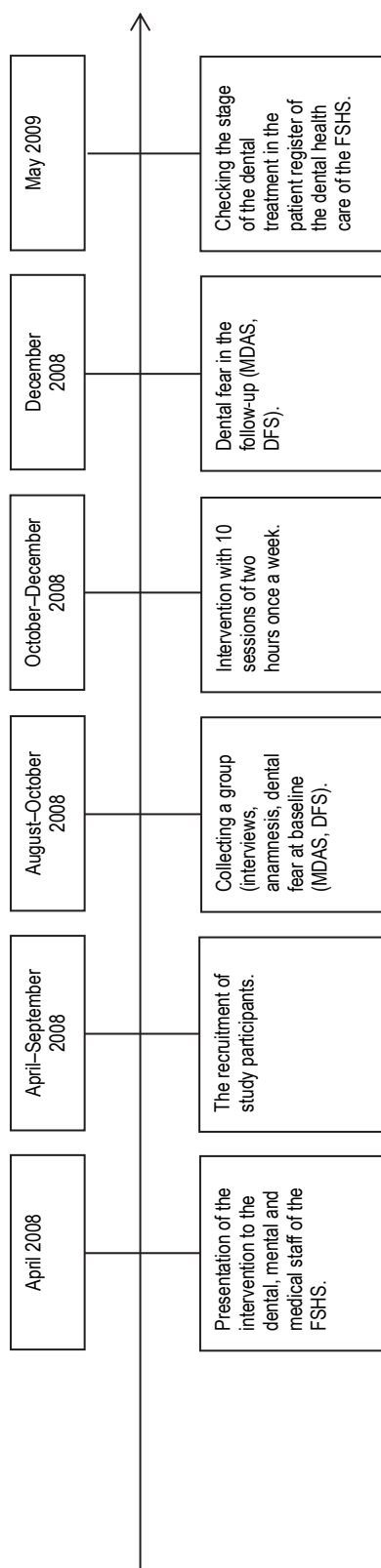


Figure 5. Study design of small-group intervention for students with high dental fear (Study IV).

4.2 Data collection, instruments and methods

Basic data were collected with questionnaires regarding dental fear (Studies I, II, III, IV), sense of coherence (Studies II, III), and patient perceptions of the interaction with dental staff (Study III). The study participants' stage of dental treatment was checked in the FSHS's patient register of dental health care (Study IV). Additionally, individually performed interviews were arranged to clarify the group applicability of the potential study participants and also to map their individual needs and wishes concerning the group work (Study IV). Feedback from each group session was gathered with questionnaires (*Appendix 1.*) (Study IV). Further background variables were gender (female vs. male) and the adolescents' education at the age of 18 categorized as 'other education' vs. 'general upper-secondary school', the former including both vocational training and no education after basic education (Study II).

In the dropout analysis (Studies II, III), the data originated from the questionnaires of dental fear and sense of coherence from when the study participants were aged 15.

4.2.1 Instruments and methods in the Finnish Family Competence Study sample (Studies I, II, III)

Dental fear was measured with the Short Dental Fear Question (SDFQ) (Study I) (*Table 1.*), DAS (Study I), DFS (Study I, IV) and MDAS (Studies II, III, IV) (*Appendix 2.*). SOC was measured with the shortened version of the Sense of Coherence Questionnaire (SOC-13) (Studies II, III), and the adolescents' perceptions of their interaction with dental staff using the Patient Dental Staff Interaction Questionnaire (PDSIQ) (Study III) (*Table 2.*). The DFS and MDAS were double translated.

Table 1. The Short Dental Fear Question (SDFQ).

Last time you visited your dentist, how did it go?

1. I was totally relaxed during the treatment.
2. I was nervous but, nevertheless, the treatment was carried out successfully.
3. I was nervous; the treatment could only just be carried out.
4. I was so frightened and nervous that:
 - a) treatment was difficult
 - b) the treatment didn't succeed
 - c) I totally missed my appointment

The SDFQ (Study I) is a new, short clinical instrument developed within the Finnish Family Competence Study group, and based on the dental fear literature (Frankl et al. 1962, Johnson and Baldwin 1968, Berggren and Meynert 1984) and on dentists' clinical experience. It contained one basic question with four response options. The options were based on a gradation so that in option 1 the patient is totally relaxed, but the degree of difficulty increases concerning the treatment situation gradually in options 2 and 3, until finally in option 4 there are great difficulties; in options 4a, 4b and 4c avoidance behavior emerges, revealing high dental fear (Berggren 1984, Skaret et al. 1998). The interpretation and classification of the SDFQ is based on patients' behavior observed by experienced dentist in treating fearful dental patients. The combination of "severely frightened" (options 4a, 4b, 4c), "moderately frightened" (option 3) and "slightly frightened" (option 2) formed the "dental fear group" as opposed to the "relaxed" group (option 1).

The DAS and DFS were used as continuous variables in Study I. Dental fear was measured with the MDAS in Studies II and III. The MDAS measures a patient's dental fear with five questions considering a forthcoming dental visit, the dentist's waiting room, tooth drilling, tooth scaling and local anesthetic injections. Each question has five response options from "not anxious" to "extremely anxious" yielding a range of 5–25 for the total score, with a higher score representing higher dental fear. A cut-off point of 19, as given in Humphris et al. (1995, 2000) and King and Humphris (2010) – and also having clinical relevance – was used for classifying study participants into two categories: those with high dental fear (MDAS scores 19–25) and those with no to moderate dental fear (MDAS scores 5–18).

SOC (Studies II, III) was measured with the shortened version of the Sense of Coherence Questionnaire with 13 items (SOC-13). Items one to three, seven and ten were reversed before analyses. Responses were summed to obtain the total score, which could be between 13 and 91; lower scores represented weak SOC. In the analyses, the SOC-13 scores were classified into two groups using a cut-off point of 64 (median value): scores of 13–63 illustrated a weak SOC; and scores of 64–91 illustrated a strong SOC. The SOC data was used from the ages of 18 and 15. The latter was used in the dropout analysis.

Adolescents' perceptions of their interaction with dental staff were measured with the PDSIQ (Study III) (**Table 2.**) created within the FFCS group by a dentist treating fearful dental patients (SJ) in collaboration with a psychologist (HR). The creation of the PDSIQ was also influenced by the literature (Milgrom et al. 1995) considering the target population, adolescents. The original Finnish instrument consisted of 22 items with five response alternatives, of which each item gathers scores from 1 (never) to 5 (almost every time).

Table 2. Patient Dental Staff Interaction Questionnaire (PDSIQ), original version.**Patient Dental Staff Interaction Questionnaire (PDSIQ)**

During the dental treatment dental staff make me feel:

1. secure
2. fearful
3. trustful
4. shameful
5. guilty
6. tense
7. insecure
8. something else, what? _____

How have you experienced dental staff during your treatment? The dental staff have been:

9. kind
10. reducing fear and tension
11. rude
12. too strict
13. increasing fear and tension
14. nervous
15. demanding
16. jovial
17. busy

18. I feel able to ask about things that are unclear for me.
19. I am listened to.
20. I am well informed about the course of events in treatment.
21. Dental staff take me into consideration.
22. Dental staff evoke trust.
23. The atmosphere created by dental staff is positive.

Response alternatives:

1= never, 2 = once or twice, 3 = a few times, 4 = often, 5 = almost every time.

In Study II, gender and education were selected as background factors. Finnish secondary education starts at the age of 16 and young adults graduate from general upper-secondary school at the age of 19. Hence, in this study of 18-year-old adolescents, education was categorized as ongoing ‘other education’ vs. ‘general upper-secondary school’, the latter containing both vocational training and no education after basic education.

4.2.2 Instruments and methods in the Finnish Student Health Service study sample (Study IV)

In Study IV, dental fear was measured using MDAS with a cut-off point of 19 of the maximum score of 25 (Humphris et al. 1995) and the cut-off point of DFS was 60 of the maximum score of 100 (Smith et al. 1987, Milgrom et al. 1990, Milgrom et al. 1992). Thus, MDAS score ≥ 19 or DFS score ≥ 60 represented high dental fear. Both the DFS and MDAS were double translated.

In Study IV, the method of the intervention was a multi-professional short-group therapeutic model. A main framework originated from the solution-focused therapy (De Shazer et al. 1986) within its limits of the reteaming method (Furman and Ahola 2007), which the psychotherapist of the leader team had previously successfully used with expectant mothers with a fear of childbirth (Miesvirta 2005). Additionally, behavioral and cognitive strategies typically applied in treating fearful dental patients were used in the implementation of the intervention (Milgrom et al. 2009).

Finnish psychiatrist Ben Furman and social psychologist Tapani Ahola (2007) developed the reteaming method, which can be used to solve problems and accomplish desired changes in individuals, teams and organizations. It is a step-by-step procedure for constructing motivation and steering change processes by utilizing the idea of co-operation. For example, the following steps of reteaming were used during the intervention: 'identify a goal', 'recruit supporters', 'highlight the benefits of the goal', 'recognize progress already made', 'make your promise', 'follow up your progress', 'prepare for possible setbacks', and 'celebrate success and acknowledge your supporters'. Participants were divided into permanent small groups of 'encouragement' (**Table 3.**) (one group with two and the other with three members) during the first session, reflecting the previously mentioned issues of motivation and social support. Participants were given a diary for notes to use during each 'encouragement' section (**Table 4.**), as well as being given homework. The participants reflected on questions like 'name your own project and identify your goals to achieve it', 'list those persons you could discuss your project with and recruit them as supporters', 'how have you concretely changed after having reached your goal?', 'how would you react if your project does not progress as you thought?', 'what kinds of ideas do you have for any setbacks?'. Homework given in each meeting was first discussed in the next meeting as a whole group, after which participants continues to work with further new items in small groups.

Besides the re-teaming method, behavioral (e.g. gradual exposure, 'tell-show-do', muscle and breathing relaxation) (Milgrom et al. 2009, Martin and Seppä 2010) as well as cognitive techniques (e.g. distraction, guided imagery, giving realistic information) (Milgrom et al. 2009), and peer support were exploited to decrease the participants' dental fear during the group work, comprising ten sessions of two hours once a week (**Table 3. and 4.**). Participants were exposed gradually to fearful objects in the dental

clinic in different ways, such as getting to know places and instruments, demonstrating treatment situations, providing the possibility to hold dental instruments, trying superficial anesthetic cream in their mucosa, assembling anesthetic syringes and injecting an anesthetic needle into oranges, holding and using a drill and drilling into a piece of plastic. The group members were also offered the opportunity to take home items such as saliva suction, a bitewing rack concerning x-rays and superficial anesthetic cream, as well as being given relaxation techniques, images and distraction exercises to test at home.

The study participants were informed before the beginning of the intervention about the importance to commit to the group meetings. However, participation during group meetings was voluntary, so that each member had the possibility to regulate their own involvement or activity in the program during sessions. The outline of the sessions with the timings and the leader's areas of responsibility are presented in **Table 3**. This outline was used in every session except for the seventh (when the psychotherapist was absent) and the tenth (a final celebration). The timetable tended to 'live' somewhat, depending on the study participants' actual activity and their needs concerning dental issues; for example, in the third session the relaxation/images section was bypassed as the study participants needed more time on dental issues.

The contents and locations of the sessions are presented in **Table 4**. Information about locations is provided, as the distance from fearful spaces concerning dental treatment was an essential part of the gradual exposure of the study participants. As they were highly fearful dental patients, most of them had a tendency for avoiding behavior. Attention should also be paid to the fact that the exercises for relaxation, images and distraction were arranged in different places according to the stage of exposure; for example starting in a meeting room and then moving into a dental clinic, in both the waiting room and the dentist surgery. The participants first gathered in the meeting room for every session except during the eighth session, when they arrived directly at the dental clinic on their own.

Table 3. The intervention outline with timings and areas of responsibility of the leaders during the sessions (Study IV).

- | | |
|----|---|
| 1. | “A warm-up”, 10 min (the dental hygienist) |
| 2. | Encouragement, working in small groups (reteaming), 30 min (the psychotherapist) |
| 3. | Information of dental fear and procedures, practical training (exposing), 30 min (the specialized dentist, dentist, dental hygienist) |
| 4. | Relaxation and images, 30 min (the psychotherapist) |
| 5. | Peer support, 20 min (the dental hygienist) |

Table 4. Themes and locations of 10 sessions during the intervention study (Study IV).

The locations in sessions 1, 2, 3: neutral meeting room on the first floor of FSHS's building, where the dental clinic is located on the fourth floor.

1. Becoming acquainted with each other and the rules of the group; facts of dental fear and one's own possibilities to manage it during dental treatment; dividing into groups of encouragement; being given the diary; muscle relaxation; peer support.
2. Becoming acquainted with instruments of dental treatment and getting to know real teeth; entitling of one's own project; encouragement; designing one's own support group outside this group; muscle relaxation; peer support.
3. Becoming acquainted with instruments and treatment procedures that assist patients during the appointments and help towards a favorable treatment outcome; a bag of presents and guiding of preventive dental treatment at home; encouragement, evidence of past personal success; peer support.

The location of session 4: firstly, X-ray space on the first floor and then proceeding to dental clinic area on the fourth floor.

4. Becoming acquainted with X-ray and the unoccupied dental clinic; encouragement; exploring the benefits of the goal; pain and relaxation with breathing; peer support.
5. A trial demonstration of dental examination; team group leaders playing dentist, dental nurse and patient; encouragement, preparing to face setbacks; images; peer support.
6. Taking X-rays of a voluntary group member and viewing X-rays together; encouragement; reflecting on one's own and another's progress in the project; relaxation / distraction in the dentist surgery; peer support.
7. Viewing a case treatment procedure of a fearful dental patient on video; follow-up of one's own progress and making it more concrete; peer support.
8. Becoming acquainted with anesthesia and anesthetic equipment using oranges, reservation of calmness in the waiting room of the dental clinic, where study participants arrived directly on their own for the first time during the intervention; relaxation exercise with sounds of drill and saliva suction; encouragement, sharing of joy when advancing in one's own project; expression of gratitude; peer support.
9. Becoming acquainted with a drill and drilling. Study participants got a chance to hold the drill and to drill into a piece of hard plastic; guiding of preventive dental treatment at home; individual plans for the future concerning their own projects; quick relaxation in the waiting room; peer support.

The location of session 10: group work space on the first floor of FSHS's building.

10. Celebration of success as a party.

4.3 Statistical methods

4.3.1 *Validation of Short Dental Fear Question (SDFQ) (Study I)*

The associations between the SDFQ, DAS and DFS were analysed with Spearman's correlation (r_s). The Mann-Whitney U-test was applied to test the difference in the DAS and DFS scores between the SDFQ fearful and relaxed groups. P-values less than 0.05 were considered statistically significant. The statistical analyses were performed using SAS/STAT® software version 9.1.3 SP4 of the SAS System for Windows.

4.3.2 *Association between dental fear and sense of coherence (Study II)*

Association between dental fear and SOC, gender and education were assessed using univariate and multivariate binary logistic regression models. Standardized Cronbach's alpha was applied to evaluate the reliability of summed MDAS and SOC scores. The final multivariate model was achieved by backward selection using exclusion criteria $p \geq 0.1$ for main effects and $p \geq 0.05$ for interactions. Fisher's exact tests were applied in the dropout analyses. A p -value of < 0.05 was judged statistically significant. Statistical analyses were performed using SAS ® version 9.2 (SAS Institute, Cary, NC, USA).

4.3.3 *Validation of Patient Dental Staff Interaction Questionnaire (Study III)*

Exploratory factor analyses (EFA) with maximum likelihood extraction and varimax rotation were performed to determine the factor structures of the PDSIQ. Additionally, confirmatory factor analyses (CFA) were performed by a statistician with expertise in running the analyses to assess whether the factor structure was an acceptable fit for these data, or whether it should be modified. Items were not permitted to load on more than one factor, and their error terms were not permitted to correlate. The fit indices used were model chi-square and its significance, normed chi-square (χ^2/df), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). For the model to fit, the χ^2 value should be non-significant and values $\chi^2/df < 5$. Values NFI > 0.90 , CFI > 0.90 , and RMSEA < 0.08 indicated a reasonably good fit (Byrne 2001, Kline 2005). Factors were investigated as mean scores of the items loading to the correspondent factors. Internal consistencies of PDSIQ were assessed by Cronbach's alphas.

4.3.4 *Association between adolescents' perceptions of their interaction with dental staff and dental fear (Study III)*

Association between adolescents' perceptions of their interaction with dental staff and dental fear, as well as the potential confounding variables of gender and SOC, were assessed using the univariate and multivariate binary logistic regression models for the categorized PDSIQ factor mean scores. PDSIQ factor mean scores originated from the

following response options: 1 = never, 2 = once or twice, 3 = a few times, 4 = often, 5 = almost every time. The factor mean score was dichotomized as 'high' if it exceeded the 75th percentile point and 'low' if under the 75th percentile point. A p -value of < 0.05 was judged statistically significant. Statistical analyses were performed using IBM SPSS Statistics 19 and IBM SPSS AMOS 20 software (IBM Corporation, Armonk, NY, USA) and SAS® version 9.3 (SAS Institute, Cary, NC, USA).

4.3.5 Testing a group-therapeutic intervention model for the treatment of dental fear (Study IV)

The statistical significance of the change in the scores of the MDAS and DFS was tested with the Wilcoxon rank sum test. Statistical analyses were conducted using SAS for Windows version 9.2 (SAS institute, Cary, NC, USA).

4.4 Ethics

The original FFCS design was approved by the Ethical Committee of the Faculty of Medicine, University of Turku (20th of January, 1986), and the dental fear study was separately approved by the Ethics Committee of the Hospital District of Southwest Finland in the year 2003 (Record number 6/2003). The intervention study (Study IV) was also approved by the Ethics Committee of the Hospital District of Southwest Finland (ETMK: 75/180/2008). Before entering the clinical study (Study I) and the small-group intervention study (Study IV) potential participants were informed (SJ) about the study and the voluntary nature of participation as well as the fact that the treatment offered was not conditional on involvement in the study. All participants gave their written consent for the study (Study I, IV). Additionally, the adolescents' parents gave their informed consent in Study I.

5. RESULTS

5.1 Validation of Short Dental Fear Question (Study I)

The study applied the new Short Dental Fear Question (SDFQ), which was shown to be valid as it found same adolescents to be fearful as the well-known, much used but longer DAS and DFS. The SDFQ correlated significantly with the DAS and DFS. However, more research into the SDFQ's validity with a larger study sample is needed. No significant difference was found between the distributions of percentages in adolescents' dental fear reports according to the order of SDFQ items presented; i.e. 'increasing fear' or 'decreasing fear' (**Table 5.**) (information not published earlier). From a gender perspective, no statistical difference was found between the self-reports of either females (Chi-square test, $p = 0.421$) or males (Chi-square test, $p = 0.722$) (information not published earlier).

Table 5. The Short Dental Fear Question (SDFQ) and its response options according to increasing and decreasing fear: Chi-square test, $p = 0.791$ (Study I).

Short Dental Fear Question (SDFQ) (according to increasing fear)	Options according to increasing fear n (%)	Options according to decreasing fear n (%)	Total
Last time you visited your dentist, how did it go?			
1. I was totally relaxed during the treatment.	46 (63%)	71 (62%)	117
2. I was nervous but, nevertheless, the treatment was carried out successfully.	21 (29%)	30 (26%)	51
3. I was nervous; the treatment could only just be carried out.	3 (4%)	9 (8%)	12
4. I was so frightened and nervous that a) Treatment was difficult b) The treatment didn't succeed c) I totally missed my appointment	3 (4%)	5 (4%)	8
Total	73 (100%)	115 (100%)	188

5.2 Association between dental fear and sense of coherence (Study II)

A weak SOC was found to be more than twice as prevalent as a strong SOC among highly dentally fearful adolescents (*Figure 6.*) even when adjusted for the potential confounding variables of gender and education. Adolescents with a weak SOC were more often females and with other than general upper secondary education. The prevalence of high dental fear was 8% among Finnish 18-year-old adolescents. The dropout analysis between the ages 15 and 18 indicated that dental fear or SOC did not differ significantly between those adolescents participating or not participating in the study at the age of 18. However, males dropped out from the study significantly more often than females. Cronbach's alpha coefficients for the Modified Dental Anxiety Scale (MDAS) and the short Sense of Coherence Questionnaire (SOC-13) were 0.87 and 0.86, respectively. These values indicated good reliability for the instruments in the study.

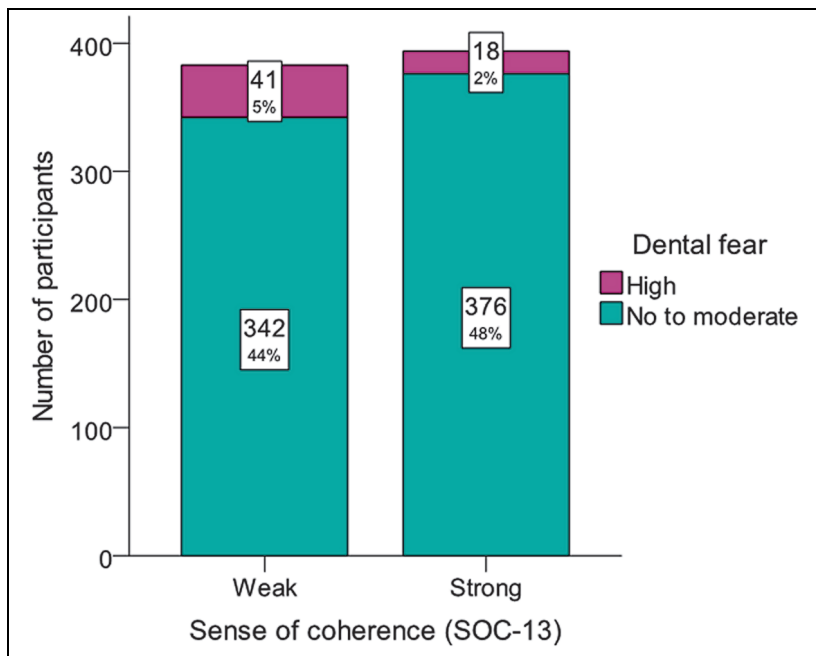


Figure 6. Proportions of high dental fear (Modified Dental Anxiety Scale (MDAS) scores 19–25) vs. no to moderate dental fear (MDAS scores 5–18) and a weak SOC (a 13-item version of Sense of Coherence Questionnaire (SOC-13) scores 13–63) vs. a strong SOC (SOC-13 scores 64–91) (Study II).

5.3 Validation of Patient Dental Staff Interaction Questionnaire (Study III)

Using explorative and confirmatory factor analyses, the Patient Dental Staff Interaction Questionnaire (PDSIQ) was found to contain five factors describing the different aspects of interaction. The factors were as follows: F1 = ‘kind atmosphere and mutual communication’, F2 = ‘roughness’, F3 = ‘insecurity’, F4 = ‘trust and safety’, and F5 = ‘shame and guilt’ (**Table 6.**). The PDSIQ was indicated to be a valid instrument with good convergent and average discriminant validity in measuring adolescents’ perceptions of interaction with dental staff. The Cronbach’s alpha coefficient of the PDSIQ (with 15 items) was 0.64, indicating acceptable reliability. The alpha coefficients for the five factors of the PDSIQ were: 0.86 (F1), 0.72 (F2), 0.60 (F3), 0.87 (F4), and 0.63 (F5). The values of F1, F2, F4 indicated good reliability and the values of F3, F5 acceptable reliability.

5.4 Association between adolescents’ perceptions of their interaction with dental staff and dental fear (Study III)

The study results indicated that adolescent’s subjective perception of interaction with dental staff was associated with dental fear. Although negative perceptions of interaction with dental staff were reported to be quite rare, when compared with adolescents with no to moderate dental fear, those with high dental fear more often perceived interaction with the dental staff as negative by experiencing less ‘trust and safety’, and less ‘kind atmosphere and mutual communication’ with dental staff (**Table 6.**). Highly dentally fearful adolescents more often experienced ‘roughness’, and ‘insecurity’, and more often felt ‘shame and guilt’. The differences remained significant even after adjusting for gender and SOC, except for perceived feelings of shame and guilt, for which the difference disappeared after adjustment.

Table 6. Median and mean (95% CI) scores (high dental fear, Modified Dental Anxiety Scale (MDAS) scores 19–25 vs. no to moderate dental fear, MDAS scores 5–18) for the five factors from the Patient Dental Staff Interaction Questionnaire (PDSIQ), p-values from Wilcoxon rank-sum tests (Study III).

	<i>High dental fear</i>			<i>No to moderate dental fear</i>			p
	Md	Mean	95% CI	Md	Mean	95% CI	
F1	3.4	3.3	3.0–3.5	4.00	3.9	3.9–4.0	<0.001
F2	1.5	1.8	1.6–2.0	1.3	1.4	1.3–1.4	<0.001
F3	2.0	2.5	2.2–2.8	1.0	1.4	1.4–1.5	<0.001
F4	2.0	2.2	1.9–2.4	3.5	3.2	3.1–3.3	<0.001
F5	1.0	1.5	1.2–1.7	1.0	1.2	1.2–1.3	0.25

5.5 Testing a group-therapeutic intervention model for the treatment of dental fear (Study IV)

The new multi-professional, group therapeutic treatment model seemed to decrease young adults' high dental fear, increasing their engagement in the finalized treatment. Before intervention (baseline) scores measured with the DFS ranged between 70 and 80 of a maximum of 100, and with the MDAS between 16 and 23 of a maximum of 25. The scores of all the students participating in the group intervention surpassed the cut-off point for high dental fear in the DFS (> 60 points) and also MDAS (> 19 points), apart from two students who had 16 and 18 points in the MDAS. Dental fear was alleviated in every participant, which presented itself in the fact that their DFS and MDAS scores had decreased after the intervention (follow-up) (**Figures 7. and 8.**). The mean of the baseline score in DFS was 74.4 (SD 4.4) and the mean of the follow-up score was 57.6 (SD 6.7) (statistically almost significant, $p = 0.063$). The mean of the baseline score in MDAS was 19.8 (SD 2.8) and the mean of the follow-up score was 12.6 (SD 2.7) (statistically almost significant, $p = 0.063$). All five participants attended dental care during or after the intervention and managed to complete their treatment within the subsequent months until May 2009. The participants' finalized dental procedures included removing dental calculus, local anesthesia, restorations, an extraction, and an operative extraction of a wisdom tooth. The participation rate of the students was as follows: two group members engaged in every session, one member in nine sessions, one member in eight sessions and one member in seven sessions (information not published earlier). There were a total of five sessions that included all of the study participants (information not published earlier). According to the group members' feedback about participation in the sessions, the attending group members missed those who were absent (information not published earlier). Unfortunately,

despite all efforts in recruiting study participants, the study design of the randomized control trial was not achieved due to the absence of a sufficient number of participants with high dental fear. There was only one potential member for the control group of individual dental fear treatment. Even though the intervention should be considered as a feasibility study, the presence of a control group would have increased the study's external validity.

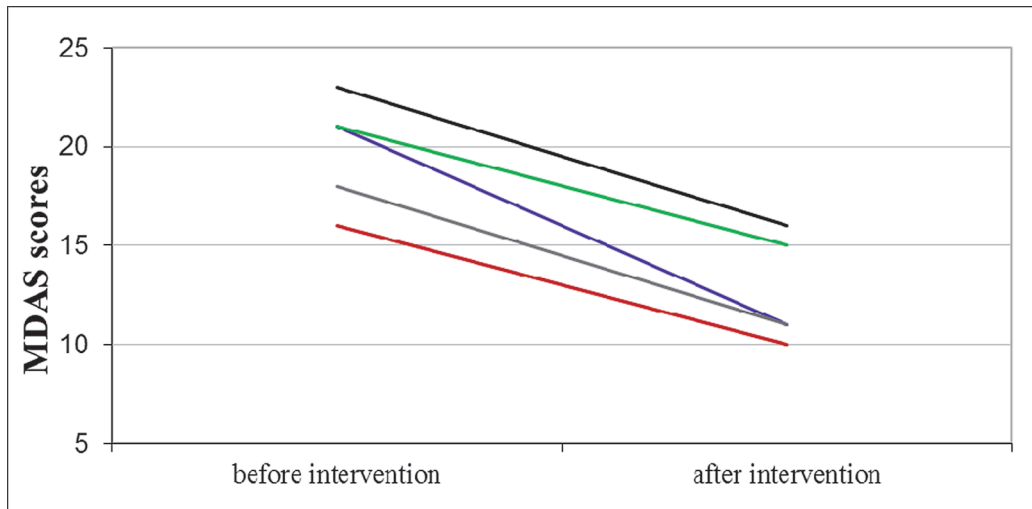


Figure 7. Changes of dental fear among students participating in small-group intervention as assessed with the Modified Dental Anxiety Scale (MDAS) (n = 5) (Study IV).

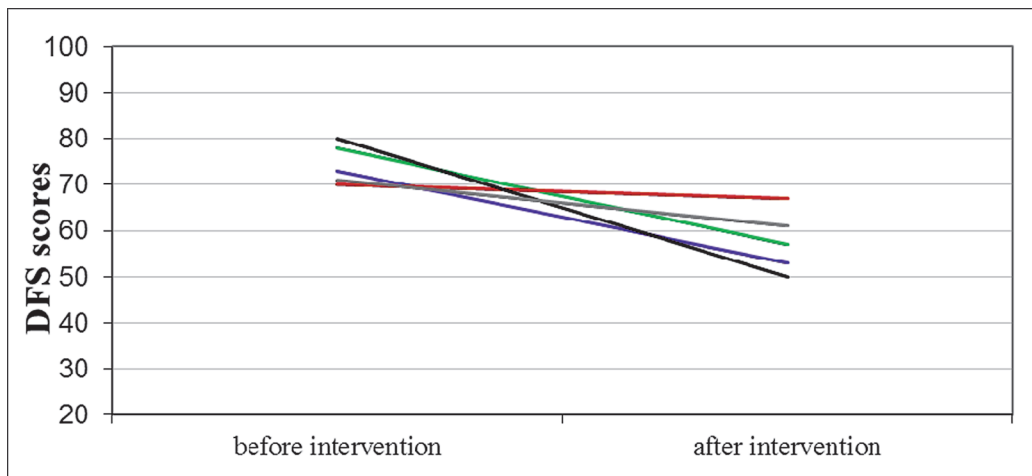


Figure 8. Changes of dental fear among students participating in small-group intervention as assessed with the Dental Fear Survey (DFS) (n = 5) (Study IV).

6. DISCUSSION

6.1 Main results

The results of this thesis show that the new Short Dental Fear Question (SDFQ) was a valid instrument in measuring adolescents' dental fear when compared to the well-known, much used but longer dental fear instruments the DAS and DFS. Further, it was found that a weak SOC was more than twice as prevalent as a strong SOC among highly fearful adolescents, who also more often perceived their interaction with dental staff negatively and felt more insecure than their peers with no to moderate dental fear. Adolescents' perception of their interaction with dental staff was measured with the new Patient Dental Staff Interaction Questionnaire (PDSIQ), which was a valid instrument with five factors of interaction: 'kind atmosphere and mutual communication', 'roughness', 'insecurity', 'trust and safety', and 'shame and guilt'. The results of the multi-professional, group therapeutic intervention study showed that the used treatment model decreased young adults' high dental fear, enabling all of the study participants to complete their dental treatment period.

6.2 Methodological considerations of study designs and participants

The Finnish Family Competence Study designs and participants

The main study population (Studies I, II, III) originated from a stratified randomized cluster sample of South-Western Finnish health authority areas with pregnant women expecting their first child. As a final result, a highly representative population-based, prospective follow-up study cohort of firstborn children and their families, FFCS, was formed. The occupational distribution of non-participants did not significantly differ from that of participants (Rautava and Sillanpää 1989) and attrition was reasonably low. Attrition in the follow-up of the FFCS's participants has been contemplated in different ways, such as drop out analyses as well as retention rates at different age points with questionnaires from birth until the age of 18 during the study. During the cross-sectional studies, Studies II and III, when the children were 18 years old, the participation rate was 62% (n = 792), which is good considering that the study participants had been followed, since their fetal period, for eighteen years and also taking into account that recent participation rates have tended to reduce notably in the earlier stages of follow-up studies. For instance, Langström et al. (2013) reported that only 19% of the recruited potential study participants entered their longitudinal study and the participation rate dropped from 100% at birth to 66% when the children were aged only 13 months.

Decreased participation rates might be a subsequent risk for selection bias and thus also the reliability of the data. However, considering the phenomenon of dental fear

and its extreme level, it has been found that despite avoiding dental appointments people with dental fear do not seem to be substantially under-represented in oral epidemiological studies (Armfield et al. 2009). The attrition analyses were performed between the ages of 15 and 18, as self-reported dental fear was first recorded at the age of 15. No significant differences in the dental fear or SOC scores were exposed between the study participants and non-participants. However, non-participants were significantly more likely to be males than females at the age of 18, which is a typical finding in the field of research.

The strengths of the study sample of the FFCS are that all of the study participants had experienced their childhood and adolescence as a first-born child. Thus, their parents had equally little experience of child rearing. Moreover, the study samples in Studies II and III were large based samples, enabling sufficient power for the analysis, whereas the cross-sectional design using data from a longitudinal study might be considered as a weakness. Furthermore, the inclusion of potential confounding variables in the analysis, such as gender and education, (Study II) and gender and sense of coherence (Study IV), may be considered a strength.

The Finnish Student Health Services study design and participants (Study IV)

Despite all efforts in recruiting study participants, the study design of the randomized control trial was not achieved due to the absence of a sufficient number of participants with high dental fear. There was only one potential member for the control group of individual dental fear treatment. Even though the intervention should be considered as a feasibility study, the presence of a control group would have increased the external validity of the study.

A total of six potentially highly fearful young adults were interested in participating in the intervention study. One male student dropped out due to his own feeling that the group method would not suit him. It is important to offer another option if the group method is not considered as suitable. In this study, individual dental-fear treatment with FSHS's cognitive oriented psychotherapist and a dental hygienist was provided as an alternative. Thus, the group intervention was performed with five participants, which is in fact the same size as samples (3–6 participants) in earlier studies with a group therapeutic approach (Ning and Liddell 1991, Moore et al. 2002). Surprisingly, despite a long recruitment time (half a year) and numerous advertising channels being used, a greater number of interested study participants were not reached, which is considered a weakness of the study. Thus, the initially planned study design with an intervention and control group was not realized.

Our difficulties in recruiting high dental fear research subjects are supported by Kaakko's et al. (2001) study, where great efforts were made and numerous types of different recruitment strategies (e.g. paid advertising, free publicity, and professional referral) used in gathering study samples for interventions of dental injection phobic

patients. Long established specialized clinics with research and treatment for highly fearful dental patients – as, for example, in Gothenburg, Sweden (Carlsson et al. 2013) or in Seattle, USA (Smith et al. 1987, Milgrom et al. 1995) – might also provide better opportunities, with a larger number of high dental fear patients, to compare and develop different treatment options in Finland.

A new adjunct for dental fear treatment, a psychological method called ‘reteaming’ to maintain motivation and social support, was implemented in the intervention group. ‘Reteaming’ has not been reported to have been used earlier in the field of dental fear research.

6.3 Methodological considerations of instruments

A strength of the study is the use of validated and reliable dental fear and sense of coherence instruments – the DAS (Corah 1969, Corah et al. 1978), DFS (Kleinknecht et al. 1973, Kleinknecht et al. 1984, McGlynn et al. 1987), MDAS (Humphris et al. 1995, Humphris et al. 2000, Newton and Edwards 2005, Humphris et al. 2009), and SOC-13 (Antonovsky 1987, Eriksson and Lindström 2005, Feldt et al. 2007) – which were used when possible, with the exception of the SDFQ and PDSIQ. The latter two were new instruments, and the targets of this research, and are discussed in the results section of the discussion. A further strength is the use of two dental fear instruments, the MDAS and the DFS, in the baseline and follow-up of the intervention study (Study IV). As all dental fear instruments have their shortcomings, more than one instrument has been suggested for use in assessing dental fear (Schuurs and Hoogstraten 1993, Locker et al. 1996, Armfield 2010b). Additionally, the DFS was utilized in mapping the study participants’ specific objects of fear, which were considered during the planning of the content of the group intervention (Study IV).

The MDAS was chosen to measure and to give an overview of dental fear in the rest of our studies (Studies II, III, and IV) instead of the DAS. The most important reason was that the MDAS is actually an advanced version of the DAS: the response options have been formulated consistently and a question regarding anesthetic injection has been added in the MDAS (Humphris et al. 1995). Additionally, Freeman et al. (2007) presented conversion tables for MDAS and DAS enabling investigators to convert scores and compare levels of dental fear between these scales. The question of anesthetic injection is a reasonable adjunct in the MDAS, as it is well known that anesthetic injections and needles are one of the most fear-stimulating objects for patients (Oosterink et al. 2008).

6.4 Discussion of the results

Validation of the SDFQ

The SDFQ is a new dental fear instrument with only a single question with four response alternatives created in the Finnish Family Competence Study group. Study I aimed to clarify whether the SDFQ could be a clinically feasible instrument; it contains emotional (e.g. nervousness) and behavioral (e.g. avoiding) aspects of dental fear. The SDFQ maps the level of dental fear and additionally highlights a patient's own perception of their previous dental visit. This is useful information for a dentist when starting a treatment period with a new patient. As fear should always be taken into account concerning a patient's treatment, clinicians have been recommended to routinely use a dental fear instrument in the waiting room to screen patients' fear (Humphris and Hull 2007). Completing the instrument has also been suggested to decrease a patient's anxiety before entering the dental office (Humphris and Hull 2007).

It has been suggested that more than one dental fear instrument should be used, as they all have their limitations (Schuurs and Hoogstraten 1993, Locker et al. 1996, Armfield 2010b). To test the validity of the SDFQ, two valid and reliable instruments, the DAS and DFS, were chosen as they were well known and the most frequently used in the field of dental fear research at that time (Corah 1969, Corah et al. 1978, Kleinknecht et al. 1973, Kleinknecht et al. 1984, McGlynn et al. 1987). There was a concordance between these three dental fear instruments: the DAS, the DFS, and the SDFQ. The strength of agreement between the DFS and the SDFQ was "excellent" and between the DAS and SDFQ "good" (Cicchetti 1984, Fleiss 1971). Thus, the SDFQ seems to be valid in identifying fearful adolescents. Additionally, further validation of the SDFQ was performed (information not published earlier). The potential effect on adolescents' self-reported dental fear due to the offered course of the SDFQ response alternatives, both according to increasing fear and decreasing fear, were also investigated. It was found that the course of options does not have an effect on adolescent self-reported dental fear with the SDFQ.

There are many different single questions used in measuring dental fear in this field (Milgrom et al. 1988, Gatchel 1989, Neverlien 1990, Viinikangas et al. 2007, Lahti et al. 2007, Armfield 2011) and some have been studied regarding their concordance with the DAS, DFS or MDAS (Neverlien 1990, Locker et al. 1996, Viinikangas et al. 2007, Armfield 2011). When comparing the results of the above mentioned studies with the results of the current study, it seems that the correlation between the SDFQ and the DFS is one of the highest found in studies investigating concordance between a single dental fear question and the DAS, DFS or MDAS (Neverlien 1990, Moore et al. 1993, Locker et al. 1996, Viinikangas et al. 2007, Armfield 2011). However, further research concerning the validity of the SDFQ is still needed, with a larger study sample, and in different age groups.

The strengths of the SDFQ are that, despite its brevity, it considers both the emotional and behavioral aspects of dental fear as well as patients' perceptions of their previous dental visit. These informative aspects support its clinical use, although on the other hand a weakness of the SDFQ can be considered that its question is limited only to the last previous dental visit. However, to my knowledge all these three viewpoints have not been included earlier in the same dental fear instrument with a one single question used among adolescents or adults. Instruments with one question generally seem to only measure the emotional aspects of dental fear (Milgrom et al. 1988, Neverlien 1990, Viinikangas et al. 2007, Lahti et al. 2007, Armfield 2011). Thus, the SDFQ is suggested to be a promising, feasible, and informative screening instrument of dental fear in clinical practice.

Association between dental fear and sense of coherence

Sense of coherence is a little investigated phenomenon in the field of dental fear research. To my knowledge, this population based study was the first investigation clarifying the association between adolescents' dental fear and SOC. It was hypothesized that those with high dental fear have a weak SOC, even when adjusted for gender and education. The results strengthened the hypothesis by showing that a weak SOC was more than twice as prevalent as a strong SOC among 18-year-old adolescents with high dental fear. This difference remained even when adjusted for gender and education. This result is in line with three other studies concerning dental fear and sense of coherence (Lindmark et al. 2011, Wide Boman et al. 2012, Wennström et al. 2012). The study results can be generalized to a population of this age as the study sample was large enough, and participants and non-participants did not differ concerning dental fear or SOC. The only difference was that more non-participants were male than female. Another strength of the study was the use of valid and reliable instruments of dental fear (MDAS) (Humphris et al. 1995, Humphris et al. 2000, Newton and Edwards 2005, Humphris et al. 2009) and SOC (SOC-13) (Antonovsky 1987, Eriksson and Lindström 2005, Feldt et al. 2007).

Fear and anxiety are emotions that seem to increase the need to connect with others (Fredrickson & Branigan 2005). In addition, highly fearful adolescents seem to have a tendency for weak SOC meaning that their ability to tolerate stressful situations is weaker than those with a strong SOC. Antonovsky (1979, 1987) found that those with a weak SOC have fewer resources, or tools, to manage in a stressful situation. As social relationships have also been considered as a resource (Antonovsky 1987, Volanen 2011), the significance of other people, including dental staff, and their social skills may be highlighted when encountering and treating highly fearful adolescents.

Individual characteristics such as sense of coherence seem to have an effect on perceived dental fear. It is important that dental staff maintain a preventive approach towards dental fear during interaction with all patients, including adolescents and

young adults who may be more vulnerable due to their psychologically sensitive developmental state compared with older adults (Locker et al. 1999).

The validation of the Patient Dental Staff Interaction Questionnaire

This study used a new instrument; the Patient Dental Staff Interaction Questionnaire (PDSIQ) to measure adolescent's perceived interaction with the dental staff. To my knowledge there is no other instrument for the interaction between adolescents and dental staff.

The original PDSIQ was created within the FFCS group by a dentist treating fearful patients (author), in collaboration with an experienced psychologist. The PDSIQ is based on clinical experience and literature (Milgrom et al. 1995), and was created considering the target population, adolescents. The original PDSIQ had 22 items with five response options from 1 (never) to 5 (almost every time). The goal was to explore, using factor analyses, what kind of aspects concerning interaction the PDSIQ reveals. The result was that five factors were found to describe interaction. They were named as 'kind atmosphere and mutual communication', 'roughness', 'insecurity', 'trust and safety', and 'shame and guilt'.

The PDSIQ seemed to detect different components of interaction in adolescents with high dental fear compared to those with no to moderate dental fear indicating sufficient discriminant validity. Reliability of the PDSIQ and its five factors separately assessed with the Cronbach's alpha indicated all to be acceptable (Nunnally and Bernstein 1994). As the factors of PDSIQ now measure both positive and negative aspects, the PDSIQ provides no overall score for adolescent's perception of the interaction with dental staff, which can be considered as a weakness of the instrument. Due to high variability in the distributions of the different factor scores, no common high/low cut-off point could be set. The PDSIQ has not been previously formalistically analysed and its reliability and validity needs to be studied further.

Association between dental fear and adolescent perceived interaction with dental staff

Adolescent's dental fear and their perceived interaction with dental staff were associated. Highly dentally fearful adolescents more often perceived their interaction with dental staff negatively and more often felt insecure than their peers with no to moderate dental fear. Treating highly fearful dental patients requires teamwork, which is influenced by all the staff: the receptionist, dental nurse, dental hygienist and the dentist. Every member of the treatment team affects the atmosphere of the dental clinic, which at the same time also affects a fearful adolescent visiting the dentist or dental hygienist. Empathic understanding, sensitivity to adolescents' emotional reactions and needs, constructive communication skills, attentiveness, support and a lack of condemnation are key elements that need to be considered by dental staff working with fearful patients (Kulich 2000, Bernson et al. 2011). This all builds

secure, confident, co-operative and control-inclusive interaction between dental staff and fearful dental patients, giving both parties the possibility of a successful treatment (Bernson et al. 2011).

When interacting with adolescents and young adults, dental staff should also keep in mind that adolescents develop individually: the appearance of being an adult does not guarantee that the adolescent's psychosocial and emotional skills are at the same level as adults, who have greater life experience. Many adolescents and young adults may also have personality traits such as shyness, and they may feel slightly socially anxious (Damon et al. 2006) during the dental visit. Young people may need special encouragement, discretion and understanding during their interaction with dental staff. Shyness and anxiety are normal reactions, and they often ease with increasing social abilities and life experience (Damon et al. 2006).

It is important that dentists and dental staff pay particular attention to their interpersonal skills (Kulich 2000) and appropriate communication as it increases trust (Corah et al. 1988) and adolescents' feelings of control (Kent 1987) during dental procedures, also helping them to commit to (Liddel et al. 1990) and better tolerate the treatment (Locker et al. 1999). Dental staff should also encourage fearful patients to bring a significant person, a trusted friend or relative, to their dental treatment appointments, as this will generate more feelings of trust and safety for the patient (Milgrom et al. 1995). Finally, the majority of an adolescent's identity development does not occur until late in adolescence, or maybe not until early adulthood (Steinberg and Morris 2001), and adolescents' psychosocial and emotional development proceeds individually. Therefore, it is important for dental staff to remember that a young patient's chronological age or the appearance of adulthood does not guarantee that the young adult can manage their fears or that they have the tools to meet fearful situations.

Testing the multi-professional, group therapeutic model for treating high dental fear

The study results show that the study participants' high dental fear decreased clearly and all study participants engaged in their planned dental procedures during or after the small group intervention. Even an operative extraction of a wisdom tooth was completed during the study time. These results are supported by the findings of other studies indicating psychological treatment methods (using behavioral and cognitive strategies) being helpful in alleviating dental fear and enabling convenient dental care for high dental fear patients. The study results were also supported by other group intervention studies, which all succeeded in reducing the participants' dental fear (Gatchel 1980, Jerremalm et al. 1986, Ning and Liddell 1991, Moore et al. 1996, Moore et al. 2002, Coulson and Buchanan 2008). Additionally, group interventions have been indicated to achieve positive effects for high dentally fearful patients' dental care habits, such as maintaining regularity concerning dental care (Jerremalm et al 1986, Ning and Liddel 1991, Liddel et al. 1994, Moore et al. 1996).

In the intervention study, the participants were given the possibility to work with their high dental fear in the target-oriented peer group, the meetings of which they were expected to commit to. Considering that there were 10 sessions, the participation rate was good. Group members perceived each other's involvement in the sessions as important and according to their feedback they missed those absent (information not published earlier). This may suggest that the participants had high levels of motivation and the group had good cohesion, which have both been considered to improve the target outcome of a group (Yalom 1986).

Ten sessions were reserved for the intervention, as study participants with high dental fear were thought to need this amount of time for support in working with their fear and gathering courage for their coming or ongoing dental treatments. However, the results indicates that perhaps fewer sessions – achieved by connecting, eliminating, and compressing the sessions – could also result in a decrease of high dental fear. This result then necessitates the investigation of this new model and its effect on high dental fear. According to the feedback, the second group session concerning real teeth and dental instruments resulted in anxiety in the participants. Thus, such exposure should be implemented more cautiously and more gradually than in the pilot study. Perhaps the content of dental issues in the second session could be replaced with the content of dental issues from the third session, which was perceived as interesting and rewarding by all group members. Moreover, the content of the seventh session, watching the video of the treatment of a fearful dental patient, could have been partly connected to another session. Pain was discussed during one session, but according to the feedback there would have been a need to return to this theme more often.

Fearful dental patients benefit from individual (Milgrom et al. 1995) but also from group treatment (Ning and Liddell 1991, Moore et al. 2002), where peer support is an essential element and valuable supplement to the treatment. Multi-professional group treatment enables psychologists or psychotherapists to use their professional skills for the entire group and a greater number of patients simultaneously (e.g. presenting different kinds of coping methods such as behavioral and cognitive strategies in stressful situations) as well as performing the reteaming process, as in this method through the intervention. Group leaders should have experience of group membership and motivation to treat fearful dental patients. They should also have experience of group working, as they are responsible for creating a secure atmosphere with feelings of trust and safety among the group members so that everyone is able to work with their own fear with the help of the group.

A psychological treatment method, a multi-professional group-therapeutic intervention model for the treatment of high dental fear, was developed and tested among young adults. Promising results were achieved in decreasing study participants' high dental fear as well as increasing their engagement in the finalized dental treatment. The study succeeded in producing encouraging and almost significant results regardless of the small sample of study participants. This study also presented a new adjunct for dental

fear treatment: a psychological method called 'reteaming', with which maintaining motivation and social support was implemented in the study group. Good cohesion between the study participants can be considered to have had an effect on the results and achieved aims of the group. It has been suggested that one of the best predictors of the outcome of a group is the group cohesion or how well the group is perceived to be functioning together (Dies 1993).

7. CONCLUSIONS

This study presented two new instruments: the Short Dental Fear Question (SDFQ) and the Patient Dental Staff Interaction Questionnaire (PDSIQ). They were both found to be valid; the PDSIQ in measuring adolescents' perceived interaction with dental staff and the SDFQ in screening dental fear. The SDFQ considers both the emotional and behavioral aspects of dental fear as well as patients' perceptions of their previous dental visit, even though it has only a single question. It gives clinicians beneficial information about a patient's perception of the fluency of their previous visit, fear intensity, and avoiding behavior. The PDSIQ involves the following aspects of interaction: kind atmosphere and mutual communication, roughness, insecurity, trust and safety, as well as shame and guilt. The PDSIQ was found to have acceptable reliability.

This study adds to dental staff's understanding of high dentally fearful adolescents and their experiences. Adolescents with high dental fear more often perceived their interaction with dental staff as negative, by experiencing less trust and safety, and less kind atmosphere and mutual communication with dental staff. On the other hand, they more often experienced roughness, and felt insecurity, shame and guilt. The difference remained significant even after adjusting for gender and SOC except for perceived feelings of shame and guilt. Also, a weak sense of coherence was shown to be more prevalent than a strong sense of coherence among highly dentally fearful adolescents. This difference seemed to remain, even when adjusted for gender and education.

The multi-professional, group therapeutic intervention model succeed in decreasing young adults' high dental fear as well as increasing their engagement in the finalized dental treatment. A new adjunct for dental fear treatment, a psychological method called 'reteaming', was also used. Its key elements, motivation and social support, were implemented in the intervention group.

8. CLINICAL IMPLICATIONS AND FURTHER RESEARCH TOPICS

The Short Dental Fear Question (SDFQ) could be used as a screening instrument in dental clinics by adding it into the questionnaire of the general anamnesis, which a new patient fills in before the first visit to the dentist or dental hygienist.

When treating fearful dental patients, clinicians should keep in mind that adolescents' abilities to cope with stressful situations are dependent on their individual character, varying from person to person, and that sense of coherence might be a factor affecting this ability. When encountering high dentally fearful adolescents, dental staff should invest particularly in creating a positive, trusting, approving and supportive atmosphere with kindness, calmness, and patience. Attention should be paid during basic dental and postgraduate education on dental staff's interpersonal and communication skills when encountering patients with high dental fear.

The group therapeutic intervention model was promising in that it gained good results in decreasing young adults' dental fear and increasing their commitment to dental treatment. As the current model with ten sessions was quite time consuming and expensive, the effectiveness of a shorter version of this model should be evaluated. In addition, further research concerning the validity of the SDFQ and the PDSIQ is still needed, for example concerning different age groups.

ACKNOWLEDGEMENTS

The present study was carried out in the Department of Clinical Medicine, Public Health mainly in the Finnish Family Competence Study (FFCS). I have followed this research path on and off over 12 years and during those years many kind people have helped me. Doctors Päivi Paunio and Marja-Leena Mattila as earlier defended dentists in the FFCS were encouraging and inspiring examples for me. I want to thank Päivi Paunio, specialist in pediatric dentistry, for initiating dental fear research and developing the first dental fear instruments used in the FFCS. I also wish to thank a member of my follow-up and co-author group, Marja-Leena Mattila, who has provided great help during the research process as a member of research group.

I owe my deepest gratitude to my supervisors, Professor Päivi Rautava, MD, PhD, Professor Hannele Räihä, PhD, Professor (Emer) Pentti Alanen, DDS, PhD, and Professor Satu Lahti, DODont, who have all participated in guiding my multidisciplinary research project. I am deeply grateful to Päivi, the first debater of FFCS, for giving me the possibility to be involved in the study group and in the interesting research work with Finnish families as well as for giving her expertise in the developing of the service system during the intervention study. You have committedly guided, taught and supported me throughout my research project including the phases of joys and sorrows in my life. I am thankful for you for your wise, empathic and patient guidance, positivity, encouragement, and helping me to see things more widely. Secondly, I want to warmly thank Hannele, whose psychological expertise and guidance I have appreciated highly throughout my study. I am grateful for your kind encouragement and help in exceeding my limitations as well as all those informative discussions containing so much wisdom about human life. I also wish to respectfully thank Pentti, an excellent teacher, for leading me to scientific thinking and guiding me from the beginning of my research project until the year 2011, when Satu came to continue in his place. I am sincerely grateful to you, Satu, for your skilled purposeful guidance with notable expertise in dental fear research and for your dynamic, committed support during these last challenging years of my study. I also want to warmly thank you for enriching my life with new acquaintances with researchers in Finland and abroad.

I am grateful to Docent Kaisu Pienihäkkinen, a member of my study group, for being a co-author and her practical scientific advice during my study. I am specially thankful for your words: ‘...this sounds just the same as you dreamed about when you started your research work’, said to me when I told you about the intervention study. It felt so good to hear this, as I already had forgotten my dream in the course of life.

I am thankful for Professor (Emer) Matti Sillanpää, the leader of the FFCS project, for paving my way into the world of research with instructive scientific discussions, insightful comments and vast experience. I sincerely want to thank Docent Minna Aromaa, the senior researcher of the FFCS, for her support as well as her clever and

inspirational comments as a member of my follow-up and co-author group. I wish to thank FFCS group for the creative atmosphere being built also by Professors Andre Sourander, Solja Niemelä as well as other researchers and Doctors including Päivi-Leena Honkinen (also warmly thanked as a co-author), Katri Louhi, Leena Pihlakoski and Professor Sakari Suominen, who is warmly thanked as a co-author and as an expert concerning sense of coherence.

I also wish to thank Professor Jussi Vahtera and other staff members of Public Health, including Professor Risto Tuominen, Carita Kemppi, and Raija Lietzen for belonging to the scientific community, their collaboration and for the educational and scientific discussions around the coffee table. I warmly thank Mrs Inger Vaihinen, Ms Sari Kuitunen and Ms Minna Ketola for collaboration and assistance during different phases of my research work.

I want to thank all the colleagues who have helped me in collecting research material. Special thanks go to their chiefs, Doctor Anna-Leena Eriksson, the former Leading Chief in the Oral Health Care Division of Turku, and Doctor Jouko Kallio, the former Chief in the Public Dental Health Care Clinic of Kaarina-Piikkiö, who kindly enabled me to arrange the clinical study in their public dental health care clinics and offered resources for it. Additionally, I am thankful to Doctor Minna Kinnarinen, the present Leading Chief in the Oral Health Care Division of Turku, for her positive, supportive attitude towards my study objectives and for giving me the possibility to concentrate on the research. I also want to warmly thank the Clinical Chiefs in the Oral Health Care Division of Turku, Doctors Varpuleena Kirstilä and Marina Merne-Grafström for their help, support and cognizance when I have searched for a way to apply clinically the research knowledge I have gained to help patients suffering from dental fear. My sincere thanks are also owed to my great clinical co-workers, dental nurses Mrs Taina Heinonen, Mrs Elise Tetri and Mrs Sari Raitio for their great collaboration with dentally fearful patients.

I am thankful to Anne Komulainen, the Medical Director in Dentistry of the Finnish Student Health Services (FFCS) for enabling the intervention study and to my co-author Doctor Ulla-Maija Saarni, the former Chief of Oral Health Services of FSHS in Turku for an initiative of the group intervention among dentally fearful students, asking for me to join the planning team and giving FSHS's resources for the study. My co-authors, physiotherapist and psychotherapist Merja Miesvirta, dental specialist Erja Luukkala-Wardi and dental hygienist Riitta Myllymäki are warmly thanked for all their collaboration as well as psychotherapist Kimmo Häärä. I also thank exercise therapist Maila Seppä and psychologist Minna Martin for their support and valued experience in leading groups, which started off the beginning of our study.

I owe my special thanks to the following biostatisticians, whose valuable expertise and patient statistical supervision in processing the statistical analyses has been essential

during the different stages of my study: Hans Helenius, MSc, Olli Kaleva BSc, Tero Vahlberg, MSc, Maiju Saarinen, MSSc and Docent Mimmi Tolvanen.

Many thanks go also to the staff members of the Libraries at the Medisiina as well as at the Educarium for their expertise and assistance.

I am grateful to Docent Ansa Ojanlatva, PhD, Heile Tofferi, MA, Jacqueline Välimäki, MA, Kari Schultz, MA, Simo Merne, MA and David Bergen, MA for checking the language or translating instruments during different phases of my study. Finally, I want to thank Suzanne Collins, MA for polishing my English in the final stages.

I want to thank all those adolescents participating to the Finnish Family Competence Study as well as those six brave, great students from the Finnish Student Health Services who involved themselves in our intervention study. You all have made this study possible and helped me to understand more about young people suffering from high dental fear.

I am grateful to my reviewers Professor Magnus Hakeberg DDS, PhD and Professor Jorma Virtanen DDS, PhD, MSc for revising the manuscript. Their expertise and constructive criticism were valuable in improving this thesis. My sincere thanks are also owed to Professor Heikki Murtomaa DDS, PhD, MPH, the opponent of my thesis.

I am thankful to all my fellow-researchers as well as Riitta Danielsson-Ojala, Virve Pekurinen, Christina Athanasopoulou, Sanna Koskinen, and Doctors Anna Axelin, and Heljä Lundgren-Laine, for inspiring discussions and sharing everyday life as a researcher during my recent research years.

I want to thank all my friends and particularly Titta Hassila, Seija Jalonen, and Kirsti Brunsberg as well as the members of the groups “November Party” and “Home-Evening” for friendship and support during my research years. I own my special thanks to Raija and Tarmo Kaiponen for friendship and being like the Turku-grandparents for our family. I am deeply thankful for you, Raija, for caring for and loving our children. I am also grateful to many families for mutual valuable collaboration with great children including families Jäppinen, Kilpi-Väisänen, Haukka, Heikkilä, Survonen, Ahtiala, Koivisto, Lundell, Huovinen, and Koivunen.

I am grateful to my mother-in-law, Maren Jaakkola, for her kindness, interest in my study and taking care of our children, when I was working with the intervention study. I also want to thank my father-in-law, Heikki Jaakkola, for the support he has given to our family during these years.

I will always gratefully remember my late parents – my dear mother Lyyli Flyktman and my dear father Reino Flyktman – for their love and support. I would have hoped to share the moment of completing my doctoral thesis also with them.

I owe my special thanks to my dear sister, Laura, for support, as well as her husband Marko and their three lovely children Oskari, Mandi and Elias with whom I and my family have spent much time together during holidays in the course of my research years. You have provided me with time completely away from science. I also want to especially thank Oskari, my godson, for helping me to get hundreds of articles in order.

Finally, I owe my most sincere and warmest gratitude to my family; my beloved husband Aarne for his love and patience, and in addition to his practical technical assistance for all the different kinds of support throughout all these years, and to our gorgeous children Akseli and Saara for the love, storms of growth and joy I have perceived with you. I am also thankful to Akseli for his technical help in computer working as well as cheering me on like Saara and Aarne during my final straight, the most intensive and demanding writing process of my study lasting about two months. You are absolutely the best thing I have been blessed with in my life – I love you all.

I also wish to thank the Doctoral Programme of Clinical Investigation, the PeGaSOS Postgraduate School of Turku University, and the DPPH Doctoral Programs in Public Health of Tampere University for their educational and financial support. I am also thankful for the economic support of the Research Fund of the Finnish Dental Organizations, the Finnish Dental Society Apollonia, the University of Turku, Turku University Foundation, the Finnish Student Health Services, Suomen Naishammaslääkärit r.y., Turun Hammaslääkärisseura r.y., and EVO funding of Turku University Hospital.

Turku, February 2015

A handwritten signature in black ink, reading "Sirkka Jaakkola". The script is cursive and fluid, with the first name "Sirkka" and last name "Jaakkola" clearly distinguishable.

REFERENCES

1. Aartman IHA, De Jongh A, Makkes PC, Hoogstraten J. Dental anxiety reduction and dental attendance after treatment in a dental fear clinic: a follow-up study. *Comm Dent Oral Epidemiol* 2000; 28: 435-442.
2. Abrahamsson KH, Berggren U, Hallberg R-M, Carlsson SG. Dental phobic patients' view of dental anxiety and experiences in dental care: a qualitative study. *Scand J Caring Sci* 2002; 16: 188-196.
3. Addelston H. Child patient training. *Fortn Rev Chicago Dent Soc* 1959; 38(17): 7-9, 27-9.
4. Agdal ML, Raadal M, Skaret E, Kavale G. Oral health and oral treatment needs in patients fulfilling the DSM-IV criteria for dental phobia: possible influence on the outcome of cognitive behavioral therapy. *Acta Odol Scand* 2008; 66: 1-6.
5. Agras S, Sylvester D, Oliveau D. The epidemiology of common fears and phobia. *Comprehensive Psychiatry* 1969; 10:151-156.
6. Alvesalo I, Honkanen A-M, Karjalainen M, Murtomaa H. Lasten ja varhaisnuorten hammashoito- ja muut pelkotilat. *Suom. Hammaslääkärilehti* 1993; 17: 968-975.
7. Alvesalo I, Murtomaa H, Milgrom P, Honkanen A, Karjalainen M, Tay KM. The dental fear survey schedule: a study with Finnish children. *Int J Paediatr Dent* 1993; 3: 193-198.
8. American Psychiatric Association. *Diagnostic and Statistical Manual of mental disorders*, 5th ed. Washington, DC, London, England, 2013.
9. Antonovsky A. *Health, stress and coping*. London, Jossey-Bass Publishers, 1979; 98-128, 182-197.
10. Antonovsky A. *Unraveling the mystery of health: how people manage stress and stay well*. London, Jossey-Bass Publishers, 1987; 15-32, 89-123, 189-194.
11. Armfield JM, Spencer AJ, Stewart JF. Dental fear in Australia: who's afraid of the dentist? *Aust Dent J* 2006; 51: 78-85.
12. Armfield JM, Slade GD, Spencer AJ. Cognitive vulnerability and dental fear. *BMC Oral Health* 2008; 8: 2.
13. Armfield JM, Slade GD, Spencer AJ. Dental fear and adult oral health in Australia. *Community Dent Oral Epidemiol* 2009; 37: 220-230.
14. Armfield JM, Slade GD, Spencer AJ. Are people with dental fear under-represented in oral epidemiological surveys? *Soc Psychiatry Psychiatr Epidemiol* 2009; 44: 495-500.
15. Armfield JM. Towards a better understanding of dental anxiety and fear: cognitions vs. experiences. *Eur J Oral Sci* 2010a; 118: 259-264.
16. Armfield JM. Development and psychometric evaluation of the Index of Dental Anxiety and Fear (IDAF-4C⁺). *Psychological Assessment* 2010b; 22: 279-287.
17. Armfield JM. A comparison of three continuous scales used to determine the prevalence of clinically significant dental fear. *Community Dent Oral Epidemiol* 2011; 39: 554-563.
18. Armfield JM, Heaton LJ. Management of dental fear and anxiety in the dental clinic: a review. *Aust Dent J* 2013; Dec; 58(4): 390-407; quiz 531. doi: 10.1111/adj.12118.
19. Aromaa M. *Headache in families*. Dissertation. Turku, Painsosalama Oy, 1999; 35-37.
20. Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, Guyatt GH, Harbour RT, Haugh MC, Henry D, Hill S, Jaeschke R, Leng G, Liberati A, Magrini N, Mason J, Middleton P, Mrukowicz J, O'Connell D, Oxman AD, Phillips B, Schunemann HJ, Edejer TT, Varonen H, Vist GE, Williams JW Jr, Zaza S. Grading quality of evidence and strength of recommendations. *BMJ* 2004; 328: 1490.
21. Beck AT. *Cognitive therapy and the emotional disorder*. New York: International Universities Press, 1976.
22. Beck AT, Emery G. *Anxiety disorders and phobias*. New York: Basic Books, 1985.
23. Begg C, Cho M, Eastwood S, Horton R, Moher D, Olkin I, Pitkin R, Rennie D, Schulz KF, Simel D, Stroup DF. Improving the quality of reporting of randomized controlled trials. The CONSORT statement. *JAMA* 1996; 276: 637-639.
24. Berggren U. *Dental fear and avoidance. A study of etiology, consequences and treatment*. Thesis. Göteborg: University of Göteborg, 1984.
25. Berggren U, Carlsson SG. Psychometric measures of dental fear. *Community Dent Oral Epidemiol* 1984a; 12: 1-6.
26. Berggren U, Carlsson SG. A psychophysiological therapy for dental fear. *Behav Res Ther* 1984b; 22: 487-492.
27. Berggren U, Linde A. Dental fear and avoidance: a comparison of two modes of treatment. *J Dent Res* 1984; 63: 1223-1227.
28. Berggren U, Meynert G. Dental fear and avoidance: causes, symptoms, and consequences. *JADA* 1984; 109: 247-51.
29. Berggren U. Long-term effects of two different treatments for dental fear and avoidance. *J Dent Res* 1986; 65: 874-876.

30. Berggren U, Hakeberg M, Carlsson SG. Relaxation vs. cognitively oriented therapies for dental fear. *J Dent Res* 2000; 79: 1645-1651.
31. Berggren U. Long-term management of the fearful adult patient using behavior modification and other modalities. *J Dent Educ* 2001; 65: 1357-68.
32. Bernson JM, Hallberg LR-M, Elfström ML, Hakeberg M. Making dental care possible – a mutual affair. A grounded theory relating to adult patients with dental fear and regular dental treatment. *Eur J Oral Sci* 2011; 119: 373-380.
33. Bernstein DA, Kleinknecht RA, Alexander LD. Antecedents of dental fear. *J Public Health Dent* 1979; 39:113-124.
34. Blos P. Comments on the psychological consequences of cryptorchism: A clinical study. *PSC* 1960; 15: 395-429. On adolescence. New York, Free Press, 1962.
35. Blos P (1967). The second individuation process of adolescence. In: Esman AH. (ed) (1986). *The Psychology of adolescence*. International Universities Press Inc, fifth printing.
36. Botto RW. Chairside techniques for reducing dental fear. In: Mostofsky DI, Forgione AG, Giddon DB (eds). *Behavioral dentistry*. Oxford, Blackwell Munksgaard 2006, pp 115-126.
37. Boyle CA, Newton T, Milgrom P. Development of a UK version of CARL: a computer program for conducting exposure therapy for the treatment of dental injection fear. *SAAD Dig* 2010; 26: 8-11.
38. Broude GJ (2005). Adolescence. In: McNeil WH, Bentley JH, Christian D (eds). *Berkshire Encyclopedia of World History*. Berkshire Publishing Group, Great Barrington, pp 8-13.
39. Buchanan H. Acquisition and measurement of dental anxiety: a summary paper. *Soc Sci Dent* 2012; 2: 10-16.
40. Byrne BM. *Structural Equation Modeling With AMOS: Basic Concepts, Applications, and Programming*. London, Erlbaum, 2001.
41. Carlsson SG, Linde A, Öhman A. Reduction of tension in fearful dental patients. *JADA* 1980; 101: 638-641.
42. Carlsson SG, Wide Boman U, Lundgren J, Hakeberg M. Dental anxiety – a joint interest for dentists and psychologists. *Eur J Oral Sci* 2013; 121: 221-224.
43. Carillo-Diaz M, Crego A, Armfield JM, Romero M. Adaptation and psychometric properties of the Spanish version of the Index of Dental Anxiety and Fear (IDAF-4C⁺). *Oral Health Prev Dent* 2012a; 10: 327-337.
44. Carillo-Diaz M, Crego A, Armfield JM, Romero-Maroto M. Assessing the relative efficacy of cognitive and non-cognitive factors as predictors of dental anxiety. *Eur J Oral Sci* 2012b; 120: 82-88.
45. Cicchetti DV. On a model for assessing the security of infantile attachment: Issue of observer reliability and validity. *Behavioral and Brain Sciences* 1984; 7: 149-150.
46. Clark DM. A cognitive approach to panic. *Behav Res Ther* 1986; 24: 461-470.
47. Coldwell SE, Getz T, Milgrom P, Prall CW, Spadafora A, Ramsay DS. CARL: a LabVIEW 3 computer program for conducting exposure therapy for the treatment of dental injection fear. *Behav Res Ther* 1998; 36: 429-441.
48. Coulson NS, Buchanan H. Self-reported efficacy of an online dental anxiety support group: a pilot study. *Community Dent Oral* 2008; 36: 43-46.
49. Corah NL. Development of a Dental Anxiety Scale. *J Dent Res* 1969; 48: 596.
50. Corah NL, Gale EN, Illig SJ. Assessment of a dental anxiety scale. *JADA* 1978; 97: 816-819.
51. Corah NL, Gale EN, Illig SJ. The use of relaxation and distraction to reduce psychological stress during dental procedures. *JADA* 1979; 98: 390-394.
52. Corah NL, O'Shea RM, Pace LF, Seyrek SK. Development of a patient measure of satisfaction with the dentist: the Dental Visit Satisfaction Scale. *J Behav Med* 1984; 7: 367-373.
53. Corah NL, O'Shea RM, Bissell GD. The dentist-patient relationship: perceptions by patients of dentist behavior in relation to satisfaction and anxiety. *J Am Dent Assoc* 1985; Sep; 111: 443-446.
54. Corah NI, O'Shea RM, Bissell GD, Thines TJ, Mendola P. The dentist-patient relationship: perceived dentist behaviors that reduce patient anxiety and increase satisfaction. *JADA* 1988; 116: 73-76.
55. Crain WC. *Theories of development – concepts and applications*. New Jersey, Prentice-Hall Inc 2000; 281-284.
56. Damon W, Lerner RM, Eisenberg N (eds). *Child psychology, social, emotional, and personality development*. New York, John Wiley & Sons, sixth printing, 2006.
57. Darby RS, Henniger NE, Harris CR. Reactions to Physician-Inspired Shame and Guilt. *Basic and Applied Social Psychology* 2014; 36: 9-26.
58. Davis TE, Ollendick TH, Öst LG. Intensive treatment of specific phobias in children and adolescents. *Cong Behav Pract* 2009 August 1; 16: 294-303.
59. De Jongh A, ter Horst G. Dutch students' dental anxiety and occurrence of thoughts related to treatment. *Community Dent Oral Epidemiol* 1993; 23: 170-172.

60. De Jongh A, Muris P, ter Horst G, Van Zuuren FJ, De Wit CA. Cognitive correlates of dental anxiety. *J Dent Res* 1994; 73: 561-566.
61. De Jongh A, Muris P, Schoenmakers N, Ter Horst G. Negative cognitions of dental phobics: reliability and validity of the dental cognitions questionnaire. *Behav Res Ther* 1995a; 33: 507-515.
62. De Jongh A, Muris P, Ter Horst G, Van Zuuren F, Schoenmakers N, Makkes P. Case histories and shorter communications: one-session cognitive treatment of dental phobia: preparing dental phobics for treatment by restructuring negative cognitions. *Behav Res Ther* 1995b; 33: 947-954.
63. De Shazer S, Berg IK, Lipchik E, Nunnally F, Molnar A, Gingerich WJ, Weiner-Davis M. Brief therapy: focused solution development. *Family Process* 1986; 25: 207-221.
64. Dies RR. Research on group psychotherapy: overview and clinical applications. In: Alanso A and Swiller HI (eds). *Group therapy in clinical practice*. Washington, DC: American Psychiatric Press Inc, 1993, p 500.
65. Ekins R, Freeman R (eds). *Anna Freud selected writings*. London, Penguin Books, (1998).
66. Eli I, Schwartz-Arad D, Baht R, Ben-Tuvim H. Effect of anxiety on the experience of pain in implant insertion. *Clin Oral Implants Res* 2003; 14: 115-118.
67. Eli I, Baht R, Blacher S. Prediction of success and failure of behavior modification as treatment for dental anxiety. *Eur J Oral Sci* 2004; 112: 311-315.
68. Esman AH. (ed). *The Psychology of adolescence*. International Universities Press, Inc, fifth printing 1986.
69. Erikson EH (1956). The concept of ego identity. In: Esman AH (ed). *The Psychology of adolescence*. International Universities Press, Inc, fifth printing, 1986; 178-195.
70. Erikson EH. Identity and the life cycle. *Psychological issues*, 1: 1. New York, International University Press, 1959.
71. Eriksson M, Lindström B. Validity of Antonovsky's sense of coherence scale: a systematic review. *J Epidemiol Community Health* 2005; 59: 460-466.
72. Eysenck HJ. Learning theory and behavior therapy. *Journal of Mental Science* 1959; 105: 61-75.
73. Feldt T, Lintula H, Suominen S, Koskenvuo M. Structural validity and temporal stability of the 13-item sense of coherence scale: prospective evidence from the population-based HeSSup study. *Quality of Life Research* 2007; 16: 483-493.
74. Feldt T, Leskinen E, Koskenvuo M, Suominen S, Vahtera J, Kivimäki M. Development of sense of coherence in adulthood: a person-centered approach. The population-based HeSSup cohort study. *Qual Life Res* 2011; 20: 69-79.
75. Ferrari M. Fears and phobias in childhood: some clinical and developmental considerations. *Child Psychiatry Hum Dev* 1986; 17: 75-87.
76. Fiset L, Milgrom P, Weinstein P, Melnick S. Common fears and their relationship to dental fear and utilization of the dentist. *Anesth Prog* 1989; 36: 258-264.
77. Fleiss J. Measuring nominal scale agreement among many raters. *Psychological Bulletin* 1971; 76: 378-382.
78. Fountain G (1961). Adolescent into adult: an inquiry. In: Esman AH (ed) (1986). *The Psychology of adolescence*. International Universities Press Inc, fifth printing.
79. Forbes MDL, Boyle CA, Newton T. Acceptability of behavior therapy for dental phobia. *Community Dent Oral Epidemiol* 2012; 40: 1-7.
80. Frankl SN, Shiere FR, Fogels HR. Should the parent remain with the child in the operatory? *J Dent Child* 1962; 29: 150-63.
81. Fredrickson BL, Branigan C. Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion* 2005; 19: 313-332.
82. Freeman R. A psychodynamic theory for dental phobia. *Br Dent J* 1998; 4: 170-172.
83. Freeman R. A fearful child attends: a psychoanalytic explanation of children's responses to dental treatment. *Int J Paediatr Dent* 2007a; 17: 407-418.
84. Freeman R, Clarke HMM, Humphris GM. Conversion tables for the Corah and Modified Dental Anxiety Scales. *Community Dent Health* 2007b; 24: 49-54.
85. Freud S (1916-1917). Anxiety. In: *Introductory lectures on psychoanalysis*, Standard Edition SE 15 and 16. London, Hogarth Press.
86. Freud A. Adolescence. The psychoanalytic study of the child. 1958; 13: 255-278. New York, International Universities Press.
87. Friedman N. Iatrosedation: the treatment of fear in the dental patient. *Journal of Dental Education* 1983; 47: 91-95.
88. Friedman N, Cecchini JJ, Wexler M, Pitts WC. A dentist oriented fear reduction technique: the iatrosedative process. *Compendium* 1989; 10: 113-114, 116-118.
89. Furman B, Ahola T. Change through cooperation. *Handbook of reteaming. The art of motivating people to change what they want to change*. Helsinki, Helsinki Brief Therapy Institute, 2007.

90. Gatchel R. Effectiveness of two procedures for reducing dental fear: group-administered desensitization and group education and discussion. *JADA* 1980; 101: 634-637.
91. Gatchel R. The prevalence of dental fear and avoidance: expanded adult and recent adolescent surveys. *J Am Den Assoc* 1989; 118; 591-593.
92. Gordon D, Heimberg RG, Tellez M, Ismail AI. A critical review of approaches to the treatment of dental anxiety in adults. *Journal of Anxiety Disorders* 2013; 27: 365-378.
93. Hakeberg M, Berggren U, Carlsson SG. A 10-year follow-up of patients treated for dental fear. *Scand J Dent Res* 1990; 98: 53-59.
94. Hakeberg M, Berggren U, Carlsson SG. Prevalence of dental anxiety in an adult population in a major urban area in Sweden. *Community Dent Oral Epidemiol* 1992; 20: 97-101.
95. Hammarstrand G, Berggren U, Hakeberg M. Psychophysiological therapy vs. hypnotherapy in the treatment of patients with dental phobia. *Eur J Oral Sci* 1995; 103: 399-404.
96. Haukebø K, Skaret E, Öst LG, Raadal M, Berg E, Sundberg H, Kvale G. One- vs. five-session treatment of dental phobia: A randomized controlled study. *J Behav Ther & Exp Psychiat* 2008; 39: 381-390.
97. Harris CR, Darby RS. Shame in physician-patient interactions: patient perspective. *Basic and Applied Social Psychology* 2009, pages 325-334. DOI: 10.1080/01973530903316922.
98. Heaton LJ. Behavioral interventions may reduce dental anxiety and increase acceptance of dental treatment in dentally fearful adults. *J Evid Base Dent Pract* 2013; 13: 160-162.
99. Heaton LJ, Leroux BG, Ruff PA, Coldwell SE. Computerized dental injection fear treatment: a randomized clinical trial. *J Dent Res* 2013; 92: 37S-42S.
100. Hirschman R. Physiological feedback and stress reduction. In: Ingersoll B (chair), Behavioral approaches to dental fear, pain and stress. Symposium presented at the meeting of Society of Behavioral medicine, New York, 1980.
101. Honkinen P-L, Suominen S, Helenius H, Aromaa M, Rautava P, Sourander A, Sillanpää M. Stability of the sense of coherence in adolescence. *Int J Adolesc Med Health* 2008; 20: 85-91.
102. Honkinen PL, Aromaa M, Suominen S, Rautava P, Sourander A, Helenius H, Sillanpää M. Early childhood psychological problems predict a poor sense of coherence in adolescents. A 15-year follow-up study. *J Health Psychol.* 2009; 14: 581-594.
103. Humphris GM, Morrison T, Lindsay SJE. The Modified Dental Anxiety Scale: validation and United Kingdom norms. *Community Dent Health* 1995; 12: 143-150.
104. Humphris GM, Freeman R, Campbell J, Tuutti H, D'Souza V. Further evidence for the reliability and validity of the Modified Dental Anxiety Scale. *Int Dent J* 2000; 50: 367-370.
105. Humphris GM, Hull P. Do dental anxiety questionnaires raise anxiety in dentally anxious adult patient? A two-wave panel study. *Patient anxiety and Primary Dental Care* 2007; 14: 7-11.
106. Humphris GM, Dyer TA, Robinson PG. The modified dental anxiety scale: UK general public population norms in 2008 with further psychometrics and effects of age. *BMC Oral Health* 2009; 26; 9: 20.
107. Humphris GM, Zhou Y. Prediction of nursery school-aged children who refuse fluoride varnish administration in a community setting: a Childsmile investigation. *Int J Paediat Dent* 2013; DOI: 10.1111/ipd.12068.
108. Humphris G, Crawford JR, Hill K, Gilbert A, Freeman R. UK population norms for the Modified Dental Anxiety Scale with percentile calculator: adult dental health survey 2009 results. *BMC Oral Health* 2013; 13: 29.
109. Hägglin C, Wide-Boman U. A dental phobia treatment within the Swedish National Health Insurance. *Swedish Dental Journal* 2012; 36:71-78.
110. Inhelder B, Piaget J. The growth of logical thinking from childhood to adolescence. (Parsons A & Milgram S, trans.). New York, Basic Books, 1958.
111. Jacobson E. Progressive relaxation. Chicago, University of Chicago Press, 1938.
112. Jerremalm A, Jansson L, Öst L-G. Individual response patterns and the effects of different behavioral methods in the treatment of dental phobia. *Behav Res Ther* 1986; 24: 587-596.
113. Johnson R, Baldwin DC, Jr. Relationship of maternal anxiety to the behavior of young children undergoing dental extraction. *J Dent Res* 1968; 47: 801-5.
114. Jacobson E. Modern treatment of tense patients including the neurotic and depressed with case illustrations. Follow-up and EMG measures. Springfield, Illinois, USA: Charles C Thomas Publisher, 1970.
115. Kaakko T, Milgrom P, Coldwell SE, Gezt T, Weinstein P, Ramsay DS. Dental fear among university students: implications for pharmacological research. *Anest Prog* 1998; 45: 62-67.
116. Kaakko T, Murtomaa H. Factors predictive of anxiety before oral surgery: efficacy of various subject screening measures. *Anest Prog* 1999; 3: 3-9.

117. Kaakko T, Murtomaa H, Milgrom P, Getzt T, Ramsay DS, Goldwell SE. Recruiting phobic research subjects: effectiveness and cost. *Anest Prog* 2001; 48: 3-8.
118. Kaplan HI, Sadock BJ, Grebb JA. Synopsis of psychiatry – behavioral sciences, clinical psychiatry, seventh edition. Baltimore, USA, Williams & Williams, 1994, p 51.
119. Karila I. Hammashoitopelon vähentäminen sosiaalisena vuorovaikutusprosessina. In: Murtomaa H (ed). Dental fear – hammashoitopelko. Helsinki, Yliopistopaino, 1999.
120. Karjalainen S, Olak J, Söderling E, Pienihäkkinen K, Simell O. Frequent exposure to invasive medical care in early childhood and operative dental treatment associated with dental apprehension of children at 9 years of age. *Eur J Paediatric Dentistry* 2003; 4: 186-190.
121. Kent G. Self-efficacious control over reported physiological, cognitive and behavioral symptoms of dental anxiety. *Behav Res Ther* 1987; 25: 341-347.
122. King K, Humphris GM. Evidence to confirm the cut-off for screening dental phobia using the Modified Dental Anxiety Scale. *Social Science and Dentistry* 2010; 1: 21-28.
123. Kleinknecht RA, Klepac RK, Alexander LD. Origins and characteristics of fear of dentistry. *J Am Dent Assoc* 1973; 86: 842-848.
124. Kleinknecht RA, Thornlike RM, McGlynn FD, Harkavy J. Factor analysis of the dental fear survey with cross-validation. *JADA* 1984; 108: 59-61.
125. Klinberg G, Broberg AG. Dental fear/ anxiety and dental behavior management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *Int J Paediatr Dent* 2007; 17: 391-406.
126. Kline RB. Principles and Practice of Structural Equation Modeling. New York, Guilford, 2005.
127. Kroeger RF. Management of dental phobia: the use of fear-screening questionnaires. *International Journal of Psychosomatics* 1986; 33: 92-95.
128. Kruger E, Thomson WM, Poulton R, Davies S, Brown RH, Silva PA. Dental caries and changes in dental anxiety in late adolescence. *Community Dent Oral Epidemiol* 1998; 26: 355-359.
129. Kulich KR. Interpersonal skills in the dentist-patient relationship. The art of dentistry. Dissertation. Sweden: Vasastadens Bokbinderi AB, 2000; 17.
130. Kulich KR, Berggren UL, Hallberg LR-M. Model of the patient dentist consultation in a clinic specializing in the treatment of dental phobic patients: a qualitative study. *Acta Odontol Scand* 2000; 58: 63-71.
131. Kvale G, Berg E, Raadal M. The ability of Corah's Dental Anxiety Scale and Spielberger's State Anxiety Inventory to distinguish between fearful and regular Norwegian dental patients. *Acta Odontol Scand* 1998; 56: 105-109.
132. Kvale G, Berggren U, Milgrom P. Dental fear in adults: a meta-analysis of behavioral interventions. *Community Dent Oral Epidemiol* 2004; 32: 250-260.
133. Lahmann C, Schoen R, Henningsen P, Ronel J, Muehlbacher M, Loew T, Tritt K, Nickel M, Doering S. Brief relaxation versus music distraction in the treatment of dental anxiety. *JADA* 2008; 139: 317-324.
134. Lahti S, Tuutti H, Honkala E. The relationship of parental dental anxiety and child's caries status. *J Dent Child* 1989; May-June: 191-195.
135. Lahti S, Tuutti H, Hausen H, Kääriäinen R. Dentist and patient opinions about the ideal dentist and patient – developing a compact questionnaire. *Community Dent Oral Epidemiol* 1992; 20: 229-30.
136. Lahti S, Tuutti H, Hausen H, Kääriäinen R. Comparison of ideal and actual behavior of patients and dentists during dental treatment. *Community Dent Oral Epidemiol* 1995; 23: 374-378.
137. Lahti S, Vehkalahti MM, Nordblad A, Hausen H. Dental fear among population aged 30 years and older in Finland. *Acta Odontol Scand*, 2007; 65: 97-102.
138. Lamb DH, Strand KH. The effect of a brief relaxation treatment for dental anxiety on measures of state and trait anxiety. *Journal of Clinical Psychology* 1980; 36: 270-274.
139. Langström H, Rautava P, Kaljonen A, Räihä H, Pihlaja P, Korpilahti P, Peltola V, Rautakoski P, Österbacka E, Simell O, Niemi P. Cohort profile: Steps to the healthy development and well-being of children (the STEPS Study). *Int J Epidemiol* 2013; 42: 1273-1284.
140. Liddel A, Ackerman C, Locker D. What dental phobics say about their dental experiences? *J Can Dent Assoc* 1990; 56: 863-866.
141. Liddell A, Di Fazio L, Blackwood J, Ackerman C. Long-term follow-up of treated dental phobics. *Behav Res Ther* 1994; 32: 605-610.
142. Lindmark U, Hakeberg M, Hugoson A. Sense of coherence and its relationship with oral health-related behaviour and knowledge of and attitudes towards oral health. *Community Dent Oral Epidemiol* 2011; 39: 542-553.
143. Locker D, Shapiro D, Liddell A. Who is dentally anxious? Concordance between measures of dental anxiety. *Community Dent Oral Epidemiol* 1996; 24: 346-350.

144. Locker D, Liddell A, Dempster L, Shapiro D. Age of onset of dental anxiety. *J Dent Res* 1999; 78: 790-796.
145. Locker D, Thomson MW, Poulton R. Onset and patterns of change in dental anxiety in adolescence and early adulthood: a birth cohort study. *Community Dent Health* 2001a; 18: 99-104.
146. Locker D, Poulton R, Thomson WM. Psychological disorders and dental anxiety in a young adult population. *Community Dent Oral Epidemiol* 2001b; 29: 456-463.
147. Lundgren J, Berggren U, Carlsson SG. Psychophysiological reactions in dental phobic patient during video stimulation. *Eur J Oral Sci* 2001; 109: 172-177.
148. Majstorovic M, Veerkamp JSJ, Skrinjaric I. Reliability and validity of measures used in assessing dental anxiety in 5- to 15-year-old Croatian children. *Eur J Paediat Dent* 2003; 4: 197-202.
149. Mangs K, Martell B. 0-20 år i psykoanalytiska perspektiv. Lund, Sweden, Studentlitteratur, 1995, p 265.
150. Mansell W, Morris K. The dental cognitions questionnaire in CBT for dental phobia in an adolescent with multiple phobias. *Journal of Behavior Therapy and Experimental Psychiatry* 2003; 34: 65-71.
151. Martin M, Seppä M, Lehtinen P, Törö T, Lillrank B. Hengitys itsesäätelyn ja vuorovaikutuksen tukena. Tampere, Mediapinta; 2010.
152. McGlynn FD, McNeil DW, Gallagher SL, Vrana S. Factor structure, stability, and internal consistency of the Dental Fear Survey. *Behav Assessment* 1987; 9: 57-66.
153. McLeod C, McLaughlin K. Implicit and explicit memory bias in anxiety: a conceptual replication. *Behav Res Ther* 1995; 33: 1-14.
154. Miesvirta M. Rohkeutta synnytykseen – valmennusryhmä synnytyspelosta kärsiville odottajille. Lopputyö. Helsinki, Lyhytterapiainstituutti Oy, 2005.
155. Milgrom P, Fiset L, Melnick S, Weinstein P. The prevalence and practice management consequences of dental fear in a major US city. *J Am Dent Assoc* 1988; 116: 641-647.
156. Milgrom P, Kleinknecht RA, Elliot J, Hsing LH, Choo-Soo T. A cross-cultural cross validation of the dental fear survey in South East Asia. *Behav Res Ther* 1990; 28: 227-233.
157. Milgrom P, Vignehsa H, Weinstein P. Adolescent dental fear and control: prevalence and theoretical implications. *Behav Res Ther* 1992; 30: 367-373.
158. Milgrom P, Weinstein P, Getz T. Treating fearful dental patients: a patient management handbook (2nd ed.). Seattle, University of Washington, 1995.
159. Milgrom P, Weinstein P, Heaton LJ. Treating fearful dental patient: a patient management handbook (3rd ed.). Seattle, Washington; 2009: 28-31, 104-119, 134-141, 143-167, 169-209, 211.
160. Moore R, Birn H, Kirkegaard E, Brødsgaard I, Scheutz F. Prevalence and characteristics of dental anxiety in Danish adults. *Community Dent Oral Epidemiol* 1993; 21: 292-296.
161. Moore R, Brødsgaard I. Group therapy compared with individual desensitization for dental anxiety. *Community Dent Oral Epidemiol* 1994; 22: 258-262.
162. Moore R, Abrahamsen R, Brødsgaard I. Hypnosis compared with group therapy and individual desensitization for dental anxiety. *Eur J Oral Sci* 1996; 104: 612-618.
163. Moore R, Brødsgaard I, Abrahamsen R. A 3-year comparison of dental anxiety treatment outcomes: hypnosis, group therapy and individual desensitization vs. no specialist treatment. *Eur J Oral Sci* 2002; 110: 287-95.
164. Moore R, Brødsgaard I, Rosenberg N. The contribution of embarrassment to phobic dental anxiety: a qualitative research study. *BMC Psychiatry* 2004; 4: 10. <http://www.biomedcentral.com/1471-244X/4/10>.
165. Murtomaa H. Hoitosuhteen merkitys sun terveydenhuollossa. In: Murtomaa H (ed). Dental fear – hammashoitopelko. Yliopistopaino, Helsinki; 1999: pp 51-55.
166. Murtomaa H (ed). Fear, anxiety, pain in dentistry. Budapest, Dental Press Hungary Kft, 2002.
167. Nanjappa S, Chambers S, Marcenes W, Richards D, Freeman R. A theory led narrative review of one-to-one health interventions: the influence of attachment style and client-provider relationship on client adherence. *Health Education Research Advance Access* 2014; June 3. doi:10.1093/her/cyu029.
168. Neverlien PO. Assessment of a single-item dental anxiety question. *Acta Odontol Scand* 1990; 48: 365-369.
169. Neverlien PO. Dental anxiety, optimism-pessimism, and dental experience from childhood to adolescence. *Community Dent Oral Epidemiol* 1994; 22: 263-268.
170. Newton JT, Buck DJ. Anxiety and pain measures in dentistry: a guide to their quality and application. *JADA* 2000; 131: 1449-1457.
171. Newton JT, Naidu R, Sturmeyp P. The acceptability of the use of sedation in the management of dental anxiety in children: views of dental students. *Eur J Dent Educ* 2003; 7: 72-76.

172. Newton JT, Edwards JC. Psychometric properties of the Modified Dental Anxiety Scale: an independent replication. *Community Dent Health* 2005; 1: 40-42.
173. Newton T, Asimakopoulou K, Daly B, Scambler S, Scott S. The management of dental anxiety: time for a sense of proportion? *Br Dent J* 2012; 213: 271-274.
174. Nicolas E, Collado V, Faulks D, Bullier B, Henneguïn M. A national cross-sectional survey of dental anxiety. *BMC Oral Health* 2007; 10: 7:12.
175. Ning L, Liddell A. The effect of concordance in the treatment of clients with dental anxiety. *Behav Res Ther* 1991; 29(4): 315–22.
176. Norton PJ, Price EC. A meta-analytic review of adult cognitive-behavioral treatment outcome across the anxiety disorders. *J Nerv Ment Dis* 2007; 195: 521-531.
177. Nunnally JC, Bernstein IH. *Psychometric theory*. Third edition, New York, McGraw-Hill, 1994.
178. Olak J, Saag M, Vahlberg T, Söderling E, Karjalainen S. Caries prevention with xylitol lozenges in children related to maternal anxiety. A demonstration project. *European Archives of Paediatric Dentistry* 2012; 13: 83-88.
179. Oosterink FMD, De Jongh A, Aartman IHA. What are people afraid of during dental treatment? Anxiety-provoking capacity of 67 stimuli characteristic of the dental setting. *Eur J Oral Sci* 2008; 116(1): 44-51.
180. Oosterink FM, de Jongh A, Hoogstraten J. Prevalence of dental fear and phobia relative to other fear and phobia subtypes. *Eur J Oral Sci* 2009; 117(2): 135-143.
181. Parker JG, Asher SR. Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin* 1987; 102(3): 357-389. doi: 10.1037/0033-2909.102.3.357
182. Peltier B. Psychological treatment of fearful and phobic special needs patient. *Spec Care Dentist* 2009; 29: 51-57.
183. Peretz B, Efrat J. Dental anxiety among young adolescent patient in Israel. *Int J Paediat Dent* 2000; 10: 126-132.
184. Peretz B, Mann J. Dental anxiety among Israeli dental students: a 4-year longitudinal study. *Eur J Dent Educ* 2000; 4: 133-137.
185. Petti TA. Cognitive therapies. In: Lewis M (ed). *Child and adolescent psychiatry – a comprehensive textbook*. Williams & Wilkins, Baltimore, USA, 1996.
186. Piaget J. *The child's conception of the world* (Tomlinson J & Tomlinson A, trans.). New York, Harcourt, Brace and Company, 1929.
187. Pohjola V, Lahti S, Vehkalahti M, Tolvanen M, Hausen H. Association between dental fear and dental attendance among adults in Finland. *Acta Odontol Scand* 2007; 65: 224-230.
188. Pohjola V, Lahti S, Tolvanen M, Hausen H. Dental fear and oral health habits among adults in Finland. *Acta Odontol Scand* 2008; 66: 148-153.
189. Pohjola V, Rannanautio L, Kunttu K, Virtanen JI. Dental fear, tobacco use, and alcohol use among university students in Finland: a national survey. *BMC Oral Health* 2014; Jul 11; 14: 86.
190. Poulton R, Waldie KE, Thomson WM, Locker D. Determinants of early- vs. late-onset dental fear in a longitudinal-epidemiological study. *Behaviour Res Ther* 2001; 39: 777-785.
191. Quteish Taani DS. Dental fear among a young adult Saudian population. *Int Dent J* 2001; 51: 62-66.
192. Rachman S. The conditioning theory of fear-acquisition: a critical examination. *Behav Res Ther* 1977; 15: 375-387.
193. Rachman S. Neo-conditioning and the classical theory of fear acquisition. *Clin Psychol Rev* 1991; 11: 155-173.
194. Rantavuori K, Lahti S, Hausen H, Seppä L, Kärkkäinen S. Dental fear and oral health and family characteristics of Finnish children. *Acta Odontol Scand* 2004; 62: 207-213.
195. Rantavuori K. *Aspects and determinants of children's dental fear*. Dissertation. Oulu, Oulu university press 2008;25-31.
196. Rantavuori K, Hausen H, Tolvanen M, Lahti S, Seppä L. Factors associated with different measures of dental fear among children at different ages. *J Dent Child* 2009; 76: 13-19.
197. Rautava P, Sillanpää M. The Finnish Family Competence Study: knowledge of childbirth of nulliparous women seen at maternity healthcare clinics. *J Epidemiol Community Health* 1989; 43: 253-260.
198. Rouse RA, Hamilton MA. Dentist' technical competence, communication, and personality as predictors of dental patient anxiety. *J Behav Med* 1990; 13: 307-319.
199. Rousset C, Lambin M, Manas F. The ethological method as a means for evaluating stress in children two to three years of age during a dental examination. *J Dent Child* 1997; March-April: 99-106.
200. Schuur AHB, Hoogstraten J. Appraisal of dental anxiety and fear questionnaires: a review. *Community Dent Oral Epidemiol* 1993; 21: 329-39.
201. Scott DS, Hirschman R, Schroder K. Historical antecedants of dental anxiety. *J Am Dent Assoc* 1984; 108: 42-45.

202. Skaret E, Raadal M, Berg E, Kvale G. Dental anxiety among 18-yr-olds in Norway. Prevalence and related factors. *Eur J Oral Sci* 1998; **106**: 835-843.
203. Smith T, Getz T, Milgrom P, Weinstein P. Evaluation of treatment at a dental fears research clinic. *Special Care in Dentistry* 1987; May-June: 130-134.
204. Smith TA, Kroeger RF, Lyon HE, Mullins MR. Evaluating a behavioral method to manage dental fear: a 2-year study of dental practices. *JADA* 1990; **121**: 525-530.
205. Steinberg L, Morris AS. Adolescent development. *Annu Rev Psychol* 2001; **52**: 91.
206. Stenebrand A, Wide Boman U, Hakeberg M. Dental anxiety and temperament in 15-year olds. *Acta Odontol Scand* 2013; **71**: 15-21.
207. Stouthard MEA, Mellenbergh GJ, Hoogstraten J. Assessment of dental anxiety: a facet approach. *Anxiety, Stress, and Coping* 1993; **6**: 89-105.
208. Stouthard MEA, Hoogstraten J, Mellenbergh GJ. A study on the convergent and discriminant validity of the Dental Anxiety Inventory. *Behav Res Ther* 1995; **33**: 589-595.
209. Ten Berge M, Veerkamp JSJ, Hoogstraten J. The etiology of childhood dental fear: the role of dental and conditioning experiences. *Anxiety Disorders* 2002; **16**: 321-329.
210. Thom A, Sartory G, Jöhren P. Comparison between one-session psychological treatment and benzodiazepine in dental phobia. *J Consult Clin Psychol* 2000; **68**(3): 378-87.
211. Thompson KF. Hypnosis in dental practice: clinical views. In: Weisenberg M (ed). *The control of pain*. New York, Psychological Dimensions, 1977.
212. Thomson WM, Poulton RG, Kruger E, Davies S, Brown RH, Silva PA. Changes in self-reported dental anxiety in New Zealand adolescents from ages 15 to 18 years. *J Dent Res* 1997; **76**: 1287-1291.
213. Thomson WM, Locker D, Poulton R. Incidence of dental anxiety in young adults in relation to dental treatment experience. *Community Dent Oral Epidemiol* 2000; **28**: 289-94.
214. Thomson WM, Broadbent JM, Locker D, Poulton R. Trajectories of dental anxiety in a birth cohort. *Community Dent Oral Epidemiol* 2009; **37**: 209-219.
215. Townsend E, Dimigen G, Fung D. A clinical study of child dental anxiety. *Behav Res Ther* 2000; **38**: 31-46.
216. Tuutti H. Hammashoitopelko lapsilla ja nuorilla (Dental anxiety in children and adolescents). Dissertation. Kuopio, Kuopion yliopisto, 1986.
217. Tuutti H, Lahti S. Oral health status of children in relation to the dental anxiety of their parents. *Journal of Pedodontics* 1987; **11**: 146-150.
218. Viinikangas A, Lahti S, Yuan S, Pietilä I, Freeman R, Humphris G. Evaluating a single dental anxiety question in Finnish adults. *Acta Odontol Scand* 2007; **65**: 236-240.
219. Vika M, Skaret E, Raadal M, Öst L-G, Kvale G. One vs. five-session treatment of intra-oral injection phobia: a randomized clinical study. *Eur J Oral Sci* 2009; **117**: 279-285.
220. Volanen SM. Sense of coherence - determinants and consequences. Dissertation. Helsinki: Unigrafia, 2011.
221. Vrana S, Mc Neil DW, McGlynn FD. A structured interview for assessing dental fear. *J Behav Ther & Exp Psychiat* 1986; **17**: 175-178.
222. Yalom ID: *The theory and practice of group psychotherapy*, 3rd Edition. New York, Basic Books, 1985.
223. Watson JB. *Behaviorism*. New Brunswick NJ: Transaction, 1998 (Original work published 1924).
224. Weiner AA, Sheehan DJ. Etiology of dental anxiety: psychological trauma or CNS chemical imbalance? *Gen Dent* 1990; **22**: 39-43.
225. Wennström A, Wide Boman U, Stenman U, Ahlqvist M, Hakeberg M. Oral health, sense of coherence and dental anxiety among middle-aged women. *Acta Odontol Scand* 2013; **71**: 256-262.
226. Wide Boman, Wennström A, Stenman U, Hakeberg M. Oral health-related quality of life, sense of coherence and dental anxiety: an epidemiological cross-sectional study of middle-aged women. *BMC Oral Health* 2012; **12**: 14. <http://www.biomedcentral.com/1472-6831/12/14>.
227. Wide Boman U, Carlsson V, Westin M, Hakeberg M. Psychological treatment of dental anxiety among adults: a systematic review. *Eur J Oral Sci* 2013; **121**: 225-234.
228. Willumsen T. Treatment of dental phobia: short-time and lon-time effects of nitrous oxide sedatio, cognitive therapy and applied relaxations. Dissertation. Oslo, University of Oslo; 1999, p 134-136.
229. Willumsen T, Vassend O, Hoffart A. A comparison of cognitive therapy, applied relaxation, and nitrous oxide sedation in the treatment of dental fear. *Acta Odontol Scand* 2001a; **59**: 290-296.
230. Willumsen T, Vassend O, Hoffart A. One-year follow-up of patients treated for dental fear: effects of cognitive therapy, applied relaxation, and nitrous oxide sedation. *Acta Odontol Scand* 2001b; **59**: 335-340.
231. Willumsen T, Vassend O. Effects of cognitive therapy, applied relaxation and nitrous oxide

- sedation. A five-year follow-up study of patients treated for dental fear. *Acta Odontol Scand* 2003; 61: 93-99.
232. Wilson KI and Davies JG. A joint approach to treating dental phobics between community dental services and specialist psychotherapy services – a single case report. *Br Dent J* 2001; 190: 431-432.
233. Wisløff TF, Vassend O, Øyvind Asmyhr. Dental anxiety, utilization of dental services, and DMFS status in Norwegian military recruits. *Community Dental Health* 1995; 12: 100-103.
234. Wolpe J. Reciprocal inhibition as the main basis of psychotherapeutic effects. *AMA Arch Neurol Psychiatry* 1954; 72(2): 205–26.
235. Yalom ID. Interpersonal learning. In: *American Psychiatric Association Annual Review, Vol 5*. Edited by Frances AJ, Hales RE. Washington DC, American Psychiatric Press, 1986.
236. Zhou Y, Cameron E, Forbes G, Humphris G. Systematic review of the effect of dental staff behavior on child dental patient anxiety and behaviour. *Patient Education and Counseling* 2011; 85: 4-13.
237. Zhou Y, Forbes GM, Humphris GM. The behavior of preschool children receiving fluoride varnish application in a community setting. *British Dent J* 2013; 215: E11. DOI: 10.1038/sj.bdj.2013.990
238. Zhou Y, Humphris MG. Reassurance and distress behavior in preschool children undergoing dental preventive care procedures in a community setting: a multilevel observational study. *Ann Behav Med* 2014; 48: 100-111.
239. Öhman A, Flykt A, Esteves F. Emotion drives attention: detecting the snake in the grass. *J Exp Psychol Gen* 2001; 130: 446-78.
240. Öst LG. Age of onset in different phobias. *J Abnorm Psychol* 1987; 96: 223-229.
241. Öst LG, Clark DM. In: Öst LG, Skaret E (eds). *Cognitive behaviour therapy for dental phobia and anxiety*. John Wiley & Sons, Ltd, West Sussex, UK, 2013, pp 91-94.
242. Öst LG, Skaret E (eds). *Cognitive Behaviour Therapy for dental phobia and anxiety*. West Sussex, UK, John Wiley & Sons, Ltd, 2013.

APPENDICES

1/2

Appendix 1. Participant's feedback questionnaire of intervention study (Study IV).
Questionnaire in Finnish. For translation and validation in English, please contact the author.

HOPE/ palautekysely ryhmäläisille

Ryhmän kokoontumiskerta: _____

Pvm: _____

Nimi: _____

1) Miltä ryhmä tänään sinusta vaikutti? Valitse sopiva / sopivat vaihtoehdot.

- a) motivoitunut
- b) ei-motivoitunut
- c) hyvä me-henki
- d) väsähtänyt
- e) varautunut
- f) avoin
- g) luottavainen
- h) pelokas
- i) muuta, mitä: _____

Arvioi tämänkertaista ryhmätoimintaa merkitsemällä pystyviiva janalle 0-100 sopivaan kohtaan: 0 = en lainkaan tyytyväinen, 100 = erittäin tyytyväinen.

2 a) VIRITTÄYTYMINEN

0 ————— 100

2 b) Mihin olit tyytyväinen? Mihin et ollut tyytyväinen?

3 a) KANNUSTUS

0 ————— 100

3 b) Mihin olit tyytyväinen? Mihin et ollut tyytyväinen?

4 a) TEORIA

0 ————— 100

4 b) Mihin olit tyytyväinen? Mihin et ollut tyytyväinen?

5 a) RENTOUTUS

0 ————— 100

5 b) Mihin olit tyytyväinen? Mihin et ollut tyytyväinen?

6 a) VERTAISTUKI

0 ————— 100

6 b) Mihin olit tyytyväinen? Mihin et ollut tyytyväinen?

7 a) Hyödyttikö tämänkertainen ryhmätapaaminen sinua? Merkitse pystyviiva janalle parhaiten tilannettasi kuvaavaan kohtaan.

0 ————— 100

7 b) Mihin asiaan sait hyötyä? Millaista hyötyä?

8) Tuleeko mieleesi jotain, joka olisi syytä tehdä toisin seuraavan ryhmän kohdalla?

Lämmin kiitos palautteestasi!

Appendix 2. The Modified Dental Anxiety Scale (MDAS). Studies II, III, IV.**1. If you went to your Dentist for TREATMENT TOMORROW, how would you feel?**

Not *Slightly* *Fairly* *Very* *Extremely*
Anxious *Anxious* *Anxious* *Anxious* *Anxious*

2. If you were sitting in the WAITING ROOM (waiting for treatment), how would you feel?

Not *Slightly* *Fairly* *Very* *Extremely*
Anxious *Anxious* *Anxious* *Anxious* *Anxious*

3. If you were about to have a TOOTH DRILLED, how would you feel?

Not *Slightly* *Fairly* *Very* *Extremely*
Anxious *Anxious* *Anxious* *Anxious* *Anxious*

4. If you were about to have your TEETH SCALED AND POLISHED, how would you feel?

Not *Slightly* *Fairly* *Very* *Extremely*
Anxious *Anxious* *Anxious* *Anxious* *Anxious*

5. If you were about to have a LOCAL ANAESTHETIC INJECTION in your gum, above an upper back tooth, how would you feel?

Not *Slightly* *Fairly* *Very* *Extremely*
Anxious *Anxious* *Anxious* *Anxious* *Anxious*