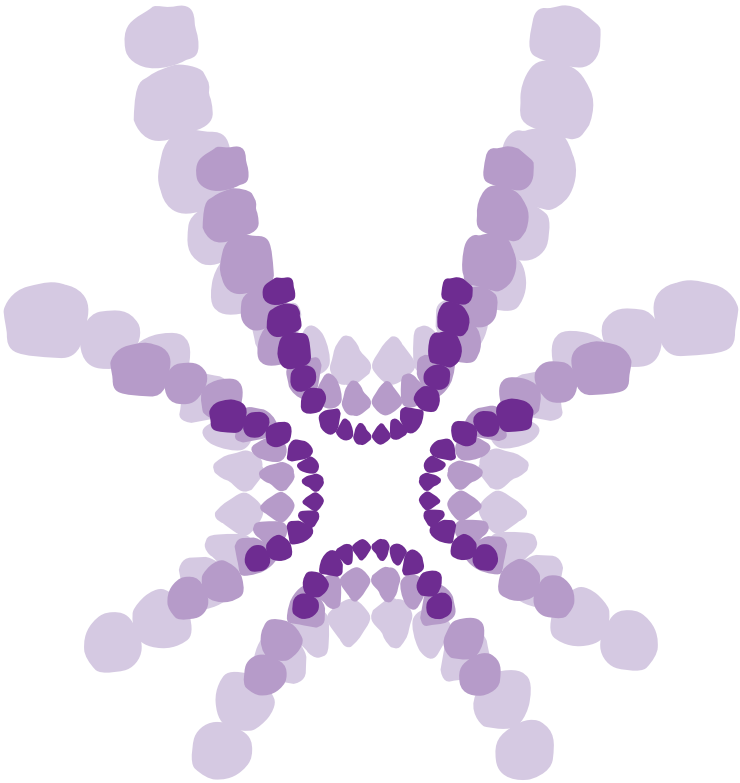
DOCTORAL DISSERTATION IN ODONTOLOGY

EVA-KARIN KORDUNER

THE SHORTENED DENTAL ARCH (SDA) CONCEPT AND SWEDISH GENERAL DENTAL PRACTITIONERS

Attitudes and prosthodontic decision-making



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To Mikael, Johan, Lars and Caroline

CONTENTS

PREFACE

This thesis is based on the following papers which are referred to in the text by their Roman numerals I-IV.

I. Korduner EK, Söderfeldt B, Kronström M, Nilner K. Attitudes toward the shortened dental arch concept among Swedish general dental practitioners. Int J Prosthodont. 2006; 19: 171-6.

II. Korduner EK, Söderfeldt B, Kronström M, Nilner K. Decision-making among Swedish general dental practitioners concerning prosthodontic treatment planning in a shortened dental arch. Eur J Prosthodont Restor Dent. 2010; 18: 43-7.

III. Korduner EK, Söderfeldt B, Collin-Bagewitz I, Vult von Steyern P, Wolf E. The Shortened Dental Arch concept from the perspective of Swedish General Dental Practitioners: a qualitative study. Swed Dent J 2016; 40: 1-11.

IV. Korduner EK, Collin-Bagewitz I, Vult von Steyern P, Wolf E. Prosthodontic decision-making related to dentitions with compromised molars; the perspective of Swedish general dental practitioners (accepted for publication in J of Oral Rehabil).

ABSTRACT

A Shortened Dental Arch (SDA) is defined as a dentition where most posterior teeth are missing. The SDA concept, described by Käyser and co-workers in the 1980s, was developed mainly for elderly and high risk-patients, those with poor general health and those with accumulation of dental problems. It was however, proposed as a treatment option based on individual preferences. The SDA concept suggested that a dentition comprising teeth in the anterior and premolar region might meet the requirements of a functional dentition.

The aim of this thesis was to study attitudes towards the Shortened Dental Arch (SDA) concept and to explore the factors affecting prosthodontic decision-making, with a focus on the SDA concept, among Swedish General Dental Practitioners (GDPs).

Two different research approaches (quantitative and qualitative) were used: a questionnaire study (Study I and II) and an interview study (Study III and IV).

The base in the questionnaire study was made up of 102 responses from a random sample of 189 Swedish GDPs. The sample was taken from the membership register of the Swedish Dental Association. Besides questions about gender, age, years in profession and place of dental education, the questionnaire contained questions about factors to be considered when planning for a prosthetic treatment in an SDA. There were also questions related to risks and benefits of an SDA and various statements concerning the SDA concept. For all items the dentists were asked to mark on a Visual Analogue

Scale ranging from 0 to 10 with different anchors for each section. The data was described and analyzed in contingency and frequency tables. The treatment planning statements were subjected to principal component analysis. A multiple linear regression analysis was used to study explanatory patterns regarding the assessment of importance for the variables influencing dentists' choice of treatment in an SDA.

Eleven Swedish GDPs were strategically selected for the interview study, the necessary inclusion criterion being that the participant had to have at least one year of practice to ensure experience of treating dentitions without molar support. The in-depth, semi-structured interviews dealt with treatment considerations relating to two patient cases and the participants' opinions on pre-formulated statements about the SDA concept. Two authentic patient cases were discussed; initially with complete dental arches, and later a final treatment plan based on an SDA. The cases involved patients with compromised teeth situated mainly in the molar regions. One patient suffered from extensive caries and the other from severe periodontal disease. Qualitative Content Analysis was used to analyze the data.

The participants of the questionnaire study received a short description of the SDA as an introduction and the participants of the interview study were given a brief explanation of the SDA concept after discussing the two patient cases.

Attitudes towards the SDA and the SDA concept, results and conclusions

The questionnaire study (I) showed that the Swedish GDPs had a positive attitude towards the SDA concept which they also considered carried few risks. There were small differences in attitudes between different groups of dentists (private practice dentists/dentists employed in the public dental health service and male/female dentists) but vast differences in attitudes among individual practitioners. Female practitioners envisaged a higher risk of impaired oral function, periodontitis and TMD in an SDA than male practitioners. Private practice dentists saw fewer advantages in using the SDA concept compared to Public Dental Health Service dentists in terms of reduced risk of overtreatment, better patient costs, and the patients' ability to keep their own natural teeth as they aged.

The results of the interview study (III) showed that none of the GDPs was familiar with the SDA concept of treatment although two dentists had heard the expression SDA before. Swedish GDPs showed little or no cognizance of the concept and they did not appear to apply it in their treatment planning.

Prosthodontic decision-making with a focus on SDA and compromised molars, results and conclusions

The study with a quantitative approach (II) showed that there were vast individual differences when Swedish GDPs ranked the importance of various patient-related items when planning a treatment in an SDA. The results of a factor analysis showed that dental care delivery system, place of dental education and also attitudinal factors influenced the decision-making process in relation to the SDA. The analysis also indicated that it was possible to capture common dimensions ("technical", "comfort" and "time") of decision-making in prosthodontics compared to other decision-making situations.

The study with a qualitative approach (IV) showed that preserving a dental arch which included molars appeared to be important to Swedish GDPs. The SDA concept did not seem to have any substantial impact on prosthodontic decision-making in relation to dentitions with compromised molars. The dentist's experience, as well as the advice of colleagues or specialists, together with etiological factors and the patient's individual situation, influenced decision-making more than the SDA concept. There was a contradictory relevance between the patient's age and the need for molar support when considering the SDA, mainly due to the individual patient's need. These conflicting results in the prosthetic decision-making process require further investigation.

POPULÄRVETENSKAPLIG SAMMANFATTNING

Ett av de mest använda måtten på tandhälsa är antalet tänder. Normalt har en vuxen person 28 tänder (32 inklusive visdomständerna). Det antal tänder som behövs för att kunna tugga bra och vara nöjd med sitt utseende är dock omdiskuterat och debatterat inom professionen och i den vetenskapliga litteraturen.

Det finns en behandlingsstrategi, den förkortade tandbågen, (eng: the shortened dental arch (SDA) concept), som bygger på principen att tänder skall ersättas när det är nödvändigt för att uppnå funktioner såsom acceptabel tuggförmåga och utseende. Enligt SDA-konceptet anses det vara tillräckligt med ett bett med tio tandpar som har kontakt i sammanbitning, i form av intakta framtandsområden men med ett reducerat antal tänder i sammanbitning i sidotandsområdena. Tänder som saknas längre bak i bettet anses inte ha en lika viktig funktion som de längre fram. SDA-konceptet utvecklades i början på 80-talet av Käyser och hans medarbetare i Nijmegen, Nederländerna och ansågs vara speciellt lämpat inom äldretandvården, eftersom många äldre inte orkar med en tidskrävande och omfattande behandling, som en behandling av de bakre tänderna kan innebära. I den äldre åldersgruppen, där patienterna ofta är muntorra, kan ett reducerat bett med egna tänder, vara mer komfortabelt än ett bett där förlorade tänder ersatts med t.ex avtagbar delprotes. SDA-konceptet har kritiserats av tandläkare och man har ansett det viktigt att ersätta alla förlorade tänder för att inte riskera till exempel ökat tandslitage och problem med käklederna. Kritiken har avtagit successivt genom

åren och konceptet har bland annat använts som motivering till begränsningar inom tandvårdsförsäkringen.

Målet med avhandlingen var att med enkät och intervju undersöka svenska allmäntandläkares attityder till SDA-konceptet samt vilka faktorer som påverkar dem i beslutsfattandet, i bett där kindtänderna behöver tas bort och därmed resulterar i en förkortad tandbåge.

En enkät med olika frågor och påståenden om SDA konceptet skickades till ett slumpmässigt urval av svenska allmäntandläkare. 102 av 189 (54%) besvarade enkäten. Enkätformuläret bestod av 64 olika frågor och påståenden samt en referens till SDA. Förutom frågor om kön, ålder, yrkeserfarenhet och utbildning innehöll enkäten frågor om faktorer av betydelse för behandlingsplanering i en förkortad tandbåge samt deras uppfattning om risker och fördelar i ett sådant bett. De fick också ange sina synpunkter på ett antal påståenden angående SDA-konceptet.

Resultaten från enkäten visade att svenska allmäntandläkare generellt hade en positiv attityd till SDA och ansåg att det fanns få risker med en förkortad tandbåge. Det var stora individuella skillnader men även skillnader mellan olika grupper av tandläkare. Kvinnliga tandläkare ansåg i högre grad än manliga tandläkare att det fanns en risk för sämre tuggförmåga, tandlossning och käkledsproblem med en förkortad tandbåge liksom att tidigare problem med käklederna var viktigt att ta hänsyn till vid protetisk planering.

Tandläkare i offentlig tjänst ansåg i högre grad än privatpraktiserande att SDA-konceptet innebar minskad risk för överbehandling, bättre ekonomi för patienten och större möjlighet för patienten att behålla sina egna naturliga tänder liksom att det vid terapiplanering i bett med en förkortad tandbåge var viktigt att ta hänsyn till patientens förmåga att anpassa sig till och känna sig bekväm med den nya konstruktionen.

För att få en djupare förståelse för innebörden av de individuella variationerna i enkätsvaren kring SDA-konceptet, genomfördes djupintervjuer med elva strategiskt utvalda allmäntandläkare,

med utgångspunkt från två patientfall och de *påståenden om* den förkortade tandbågen som uppvisade störst variation i enkätsvaren. Kvalitativ innehållsanalys användes för att analysera den insamlade datan.

Samtliga tandläkare i intervjustudien hade erfarenhet av att behandla bett utan kindtänder men de kände inte till SDA-konceptet. De intervjuade tandläkarna hade en uttalad patientcentrerad inställning med avseende på patienternas individuella behov och ekonomiska situation. Att fokusera på patientens tandsjukdom och dra nytta av den egna erfarenheten liksom kollegors och specialisters rådgivning hade större betydelse i beslutsprocessen än SDA-konceptet. Tandläkarna hade en motsägelsefull inställning till vilken betydelse patientens ålder hade med avseende på den förkortade tandbågen och betydelsen av att ha kvar sina kindtänder. Tandläkarna hävdade att det inte var patientens ålder som var avgörande vid behandlingsplaneringen utan den individuella patientens behov och livssituation. Samtidigt framkom att patientens ålder ändå kunde ha en omedveten inverkan på besluten. Erfarenhetsmässigt upplevde de att patienter med en förkortad tandbåge ofta inte hade några större problem. När de två patientfallen diskuterades uttryckte de dock vikten av att behålla kindtänderna och SDA-konceptet användes inte i behandlingsplaneringen.

Att studera attityder och beslutsfattande med information insamlat från enkät och intervjuer innebar en ökad förståelse för att ett protetiskt beslutsfattande med den förkortade tandbågen i fokus är en svår och komplex process och beroende av många olika faktorer.

ABBREVATIONS

EBD	Evidence-based dentistry
FDP	Fixed dental prosthesis
GDP	General dental practitioners
PCA	Principal component analysis
PP	Private practice
PDHS	Public dental health service
QCA	Qualitative content analysis
RDP	Removable dental prosthesis
SDA	Shortened dental arch
SD	Standard deviation
TMD	Temporomandibular disorders

INTRODUCTION

Since ancient times, people have been plagued by tooth problems and have sought a variety of means to alleviate them. The first dental healers were physicians but during the middle ages barber-surgeons specialized in dental care in Europe (1). One of the very few options for treating dental pain was extraction, leaving the patient partially or completely edentulous. However, over time, the role of a dental surgeon changed considerably and a multitude of different treatment options emerged that could be offered to patients (2).

With the exception of individuals with developmental disorders, most of us are provided with a complete dentition consisting of 28 teeth or 14 functional units. This occlusal system is not stable during life as changes occur due to physiological as well as pathological processes (3, 4). Examples of such changes might be tooth wear, loss of alveolar bone, caries, periodontal disease and traumatic injuries (3). Severe conditions such as periodontitis, labial and mesial tooth migration, impaired occlusal stability and temporomandibular disorders (TMD), including dislocation of the condyle and arthrosis, have been associated with lack of occlusal stability in the posterior regions (5). Traditionally, dentistry emphasized the need for total repair of the dentition in order to maintain complete dental arches where every absent tooth should be replaced.

The need to replace every lost tooth in order to maintain the health of the masticatory system was an opinion based more on belief than scientific evidence; one of the old dogmas in prosthodontics. That dogma has been revalued and questioned over the years (6, 7). The

term “The 28 tooth syndrome” was used when discussing the need for dentists to preserve a dental arch up to the second molar, or the need to replace lost molars in a complete dental arch using a removable dental prosthesis (RDP) (8). This, however, has been debated at length and today there is no scientific evidence of the need for such treatment (9, 10).

Today modern dentistry provides oral rehabilitation to restore oral function, both from an esthetic point of view and by restoring functions in a more traditional sense. Such treatment, however, requires financial means, raised either by the patient or with help from society through social insurance systems or a combination of both. In addition, extensive oral rehabilitation is often time-consuming. It is sometimes difficult and challenging for patients, especially elderly ones. It can also be difficult for the patient to maintain if the treatment results in a technically advanced prosthesis. At the same time, there has been a considerable increase in the ageing population in industrialized countries. The frail and elderly might not feel it necessary to have their dentition restored to its original state due to difficulties coping with demanding treatment or for financial reasons. The best solution might therefore be a treatment with limited goals but which still meets the requirements of what could be considered satisfactory oral function (11-15).

THE SHORTENED DENTAL ARCH CONCEPT

In 1981 Käyser introduced a concept, known as the Shortened Dental Arch (SDA) concept, comprising a dentition of ten occluding pairs of teeth with loss of the posterior teeth. It had been shown that patients with ten or fewer occluding pairs of teeth, preferably in a symmetrical position, had an acceptable level of oral function and oral comfort (16). Käyser meant that oral rehabilitation for the elderly should focus on keeping the most strategic parts of the dentition: the anterior and premolar regions (16). Although an occlusion with no missing units is usually preferable, sometimes it may not be attainable for general, dental or financial reasons (3) and the SDA concept was ‘problem-oriented’ in the sense of limited treatment goals based on individual oral requirements among patients (3, 17)

According to Käyser and co-workers (1996) (5), a functional classification of 28 teeth or 14 pairs of occluding pairs of teeth can be made as follows: the anterior region consists of six esthetic units, the premolar region and molar region of four occlusal units each (required primarily to provide a stable occlusion). The shortened dental arch, however, comprises an intact anterior region and a variation in arch length, expressed in occlusal units (OU), i.e. pairs of occluding posterior teeth; one molar unit is considered to be equal to two premolar units (4, 18) (Fig.1).

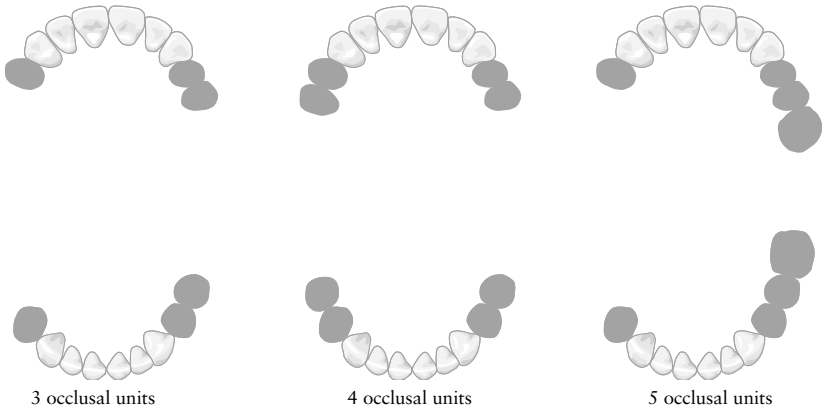

Fig.1 Illustration of shortened dental arches, comprising an intact anterior region and a variation of arch length, expressed in occlusal units (modified from Witter et al., 1999).

Clinical observations, confirmed by scientific findings, have led to the conclusion that the minimum number of teeth needed to satisfy functional and social demands varies individually. It depends on local and systemic factors such as the condition of the remaining teeth, occlusal activity, adaptive capacity and age (18, 19) where age seems to be the most important of the different factors (5).

Between the ages of 20 and 50 years, sufficient oral function is guaranteed (optimum functional level I) with a minimum of 12 occluding pairs of teeth. Between the ages of 40 and 80 years, ten occluding pairs of teeth meet the requirements of an oral function (suboptimal level of function II = SDA) and finally, between the ages

of 70 and 100 years, eight occluding pairs of teeth are considered sufficient (minimum functional level III, also referred to as an extremely shortened dental arch (ESDA) (3, 20).

An SDA can be distally extended with an RDP, a cantilever fixed dental prosthesis (FDP) or an implant-supported crown or bridge. A free-end RDP is an easy and non-invasive treatment for extending an SDA at a relatively low cost. Käyser and colleagues, however, argued that extending the dental arch with a free-end RDP might be considered as "overtreatment" (21) since this treatment has been shown to create more problems than extending the dental arch by means of a tooth-supported bridge (5). Furthermore, reports concerning patient groups with SDAs who were treated with free-end RDPs showed that these prostheses did not improve oral comfort or influence the prevention of TMDs. In fact, the reverse might be true and RDPs might create more problems (18, 19, 22, 23). It was therefore suggested that the treatment of partially edentulous elderly patients should focus on function-oriented treatment to be cost-effective, with an SDA meeting the requirements for satisfying oral function in some patients (24).

According to a literature review (9), there appears to be a trend favoring use of the SDA concept or implant-supported restorations rather than RDP. However, given the evidence that long-term use of RDP is associated with increased risk of caries and periodontitis, and low patient acceptance depending on construction, the opposite has also been reported (25, 26).

It has been suggested that the SDA concept was based on circumstantial evidence since it did not contradict current theories of occlusion and fitted well with a problem-solving approach; the concept offers some important advantages and may be considered a strategy for reducing the need for complex restorative treatment in the posterior regions of the mouth (27).

Although the anterior teeth and premolars were considered necessary for adequate oral function and comfort, Käyser and coworkers (1985) (20) expressed the opinion that molars should be given the same priority as the anterior teeth and premolars as long as there

were no limiting factors. These may occur in high risk groups (e.g. patients with poor dental status, especially in the molar regions, and/or financial constraints) where it is not possible to treat all teeth adequately (20, 28).

Allen et al. (1995) (29) also discussed the SDA concept and argued that the SDA might be indicated for patients in the following clinical situations:

- Progressive caries and periodontal diseases limited mainly to the molars
- Anterior teeth and premolars with good prognosis
- Financial and/or other constraints for dental care

Furthermore, Allen et al. (1995) (29) argued that the SDA may be contraindicated in patients less than 50 years old and in the following situations:

- Malocclusions such as Angle Class III or a pronounced Angle Class II (30) or anterior open bite
- Reduced alveolar bone support
- Parafunctions or extensive tooth wear in relation to age
- TMD

As also described by Witter et al. (1999), the anterior teeth in the SDA have more occlusal contacts in the intercuspal position compared to complete dental arches, whereas neither interdental spacing in the anterior region nor vertical overbite increases. This makes it plausible that the anterior teeth may be able to assist in absorbing occlusal forces. This is not possible in severe Angle Class II or Angle Class III relationships and makes it obvious that the SDA concept relates to normal occlusal relationships (4).

Allen et al. (1995) (29) concluded that, despite the limitations of knowledge at that time, a greater number of elderly patients with remaining teeth accorded the SDA increasing importance as a therapeutic strategy in the treatment of middle-aged and elderly with reduced dentitions.

The results of a literature study showed that the concept could be a useful tool in the planning of oral rehabilitation for the group between 21-63 years of age. However, there was no evidence that application of the SDA concept would be more preferable in any particular age group, such as middle-aged or elderly (31).

The SDA concept and its implications for oral rehabilitation in Sweden

The number of remaining teeth is one of the most widely used measures of oral health. The World Health Organization (WHO) stated in 1992 that retention, throughout life, of a functional, esthetic natural dentition of not less than 20 teeth and not requiring recourse to prosthesis should be the treatment goal for oral health (32). This is in line with a literature review since this proposed dentition will assure an acceptable level of oral function (33).

The SDA concept is currently of special interest in Sweden where the average life expectancy is increasing (34) and where there will be a greater number of elderly people who keep more of their natural teeth due to better dental health (35). It is believed that the need for dental care among people over 65 will probably increase due to a greater proportion of elderly people who have natural teeth and complicated prosthetic reconstructions (36, 37). Immigration also leads to the expectation that there will be patients with extensive dental care needs. In the future, dental care may therefore become more complex than before (37). Furthermore, the retention of natural teeth in the Swedish population increased by 7 % during the period 2009-2014. This could contribute to more caries and periodontitis since many of the elderly often suffer from dry mouth due to medication or chronic diseases (38).

A larger population which includes groups of patients with an increased need for dental care could place dentists in a dilemma when deciding, for example, whether to repair or extract compromised molars if resources remain unchanged. Medication and mouth dryness can also cause fragile mucous membranes. Removable dentures might then be a poor alternative for patients with this problem since the prosthesis often gives rise to chafing and irritation (39). A reduced dentition with natural teeth can therefore be more

comfortable for a patient with a dry mouth than a 28-tooth dentition including an RDP (40).

The National Board of Health and Welfare in Sweden is forecasting a 19% decrease in the number of dentists in relation to the size of the population by 2025 if there is no net immigration of dentists from other countries (41). A reduced number of dentists could result in the need for a higher volume of less complicated, less time-consuming and yet cost-effective prosthetic treatments. The SDA concept may therefore be a useful treatment planning tool for elderly patients although obviously this varies individually for each patient (26).

DECISION-MAKING IN GENERAL AND IN DENTISTRY

In everyday clinical work, dentists have to make treatment decisions which include whether to replace missing teeth or to retain or extract periodontally or cariologically compromised teeth. When it comes to decision-making theory, two important distinctions are made: decisions are either normatively driven (how people ought to make decisions) or descriptively (describes how the decisions are actually made in reality) (42-44). According to the classic theory of rational decision-making, a decision is a fusion of information and values (our desires and beliefs). In a given decision situation, one should choose an alternative with maximum expected utility. However, it is suggested that this theory only functions under ideal circumstances when probabilities and utilities can be stated with absolute veracity. Since the ideal decision situation seldom exists, decisions frequently have to be made under uncertainty because we do not have enough information or knowledge to make exact probability assessments (44-46).

Studies have also shown that a decision might be influenced by the expected result of the decision, gains or losses, since people are generally more prone to avoid a loss than to obtain a profit. In addition, decisions are more often based on intuition and experience rather than logical thinking (47), scientific results and evidence-based knowledge (48).

In 2011, The National Board of Health and Welfare in Sweden provided recommendations and guidelines for adult dental care including complete and partial edentulousness. The recommendation was: "Primarily, only the edentulousness that leads to functional disturbance in the form of difficulties chewing, eating and speaking, or which has an adverse effect on the person – esthetically or psychosocially – should be treated." The aims of the recommendations and guidelines were to promote a range of dental treatments which should lead to effective treatment alternatives and be offered to patients on equal terms all over the country. The National Board of Health and Welfare also concluded, however, that there was a lack of knowledge since no scientific study could present sufficient evidence concerning the treatment of tooth loss (49). It is not known, however, whether Swedish dentists take the National Guidelines into account during decision-making in prosthodontics.

It has also been suggested that decision-making in oral rehabilitation has been regarded as more of an art than a science (50, 51) due to the variations in decision-making which are the result of a complex process when choosing the best treatment in a given situation (50).

Factors that have been reported to influence the complex decision-making process according to Kay and Nutall (1995, Part I) (50) are:

- Patient/dentist relationship: patient's involvement in treatment planning, personal/social similarities between patient and dentist
- Patient attendance
- Probability of treatment success
- Risk/benefit ratio: whether the benefits of treatment outweigh the risks, patient's and dentist's attitude to risk
- Dentist's and patient's value placed on dental health care: are preferences esthetic or health-based?
- Dentist's personal treatment threshold
- Patient's financial capabilities

Treatment variations are assumed to stem from two separate sources: perceptual variation and judgmental variation. Perceptual variation is when people see things differently; this might be due

to past experiences or environmental factors. Judgmental variation is when people value the same condition differently and decide on different treatment options. This might be due to patient and environmental factors or to treatment thresholds, attitudes to risk and past experiences (52).

Kay and Nutall (1995, Part II)(52) concluded that factors unique to *each individual dentist*, such as attitudes to risk, past experiences, patient and environmental factors, and treatment thresholds, may play a much greater role in dental treatment decision-making than general factors, such as the dentist's age, practice location and place of training. Those factors seem to have very little overall effect on dentists' decisions (52). Others have also shown large inter-individual discrepancies among dentists in clinical decision-making related to TMD (53). There is still a lack of knowledge as to which factors affect decision-making in prosthodontics and how decisions are actually made. It has been shown that dentists' attitudes can be significant in clinical behavior in dentistry and are important as background factors when analyzing prosthodontic decision-making among general dental practitioners (54).

ATTITUDES IN GENERAL AND TOWARDS THE SDA CONCEPT

According to Bohner et al. (2011) (55), an attitude is an evaluation of an object of thought. Attitude objects could be things, people, groups and ideas. Attitudes develop from the beliefs people hold about the object of the attitude (55). People form beliefs about an object by associating it with certain attributes, i.e. with other objects, characteristics, or events. An individual's behavior can be predicted based on attitudes, subjective norms, perceived behavioral control, and intentions (56).

According to social psychological theory, attitudes have at least two components: cognitive perceptions (the way facts are understood) and affective emotions (the way one feels about the facts) (57). Attitudes have also been defined as "a mixture of beliefs, thoughts and feelings that predispose a person to respond to objects, people, processes or institutions in a positive or negative way" (58). For a

person to have an attitude towards something, he or she must have some active knowledge and understanding about it and have made a judgment (59). Attitudes can change, but a change in a person's attitude does not necessarily lead to a change in behavior. Other, stronger attitudes, predispositions, motives, emotions or habits may affect behavior instead (58). Thus, attitudes only shape behavior when they are strong enough to do so (60).

The SDA concept has been debated over the years and studies have shown that a great majority of dentists have a positive attitude to the SDA concept although the concept is not widely practiced (61-64). The opposite has also been shown in other studies where dentists deem the outcome of an SDA to be of less value (65, 66). The reasons for having a generally positive attitude to a concept such as the SDA, and still not using it to a greater extent in the prosthodontic decision-making process, require a deeper understanding of this contradiction.

RESEARCH METHODS COMPRISING QUANTITATIVE AND QUALITATIVE DATA

Research methods for both quantitative and qualitative data include the systematic collection, organization and interpretation of data. Research using a quantitative and qualitative approach relates to different paradigms. The quantitative approach, based on a positivistic paradigm, is suggested as being experimental, deductive, numeric (includes figures) and realistic (67). The quantitative approach is used when observing and measuring information numerically or when testing objective theories by examining the relationship between variables (68). The qualitative approach, based on an interpretative paradigm, is suggested as being naturalistic, inductive, contextual, non-numerical and constructionist (67, 69). The qualitative approach is used when studying social phenomena as experienced by individuals themselves in their natural context (70, 71).

It has been suggested that quantitative and qualitative strategies in research should be seen as complementary rather than incompatible (71). When quantitative and qualitative approaches are combined, the methods are often applied in sequential order. Semi-structured interviews or observational data might be used, for example, to explore

hypotheses or variables when planning a large epidemiological study, resulting in enhanced sensitivity and accuracy of the survey questions and the statistical strategy. Studies with a qualitative approach can also be added to quantitative studies to gain a better understanding of the meaning and implications of the findings (71).

Quality criteria

In all research, quality is assessed by how trustworthy the study is. The criteria for assessing studies comprising quantitative data are reliability, objectivity, validity and generalizability. The suggested criteria for assessing studies comprising qualitative data are dependability, confirmability, credibility and transferability (72, 67).

According to Hamberg et al. (1994) (72) and Peters et al. (2002) (67), the following explanation of the criteria for studies with a qualitative approach (compared to the criteria used in studies with a quantitative approach) has been suggested:

Dependability refers to consistency (*reliability*) which focuses on the process of inquiry and the researchers' responsibility to ensure that the research process was consistent and well documented. It is enhanced by the clarity of questions, the researchers' role and status, and involvement of multiple researchers.

Confirmability refers to neutrality (*objectivity*) which establishes that the data and interpretations of the data do not distort the reality they set out to describe. This could be enhanced by involving multiple researchers in the study, questioning findings, rethinking and critically reviewing the data.

Credibility refers to the truth value (*validity*) which establishes whether truthful and credible findings and interpretations were produced. It depends on the researchers' skills during data collection and analysis. It can be ensured by triangulation which may involve the use of multiple investigators, multiple theoretical perspectives, and multiple methods.

Transferability refers to applicability (*generalizability*) where findings must be understandable to others and regarded as reasonable. It is enhanced by providing the reader with sufficient information to decide whether the findings are relevant to the situation and applicable to other contexts.

THE SDA CONCEPT AND SWEDISH GDPs

The SDA concept could be a useful treatment planning tool, particularly for simplifying oral rehabilitation for some elderly patients, especially given the prospect of an increase in numbers in this patient group which has a more complex dental care situation than earlier generations (37). It might be interesting, therefore, to study the attitudes of Swedish general dental practitioners and the application of the SDA concept in their treatment planning. In order to do this, two different research methods may be considered applicable: a quantitative and a qualitative approach.

AIMS

The overall aim of this thesis was to investigate attitudes towards the Shortened Dental Arch (SDA) concept and to explore which factors affect prosthodontic decision-making, with a focus on the SDA concept among Swedish General Dental Practitioners.

THE SPECIFIC AIMS WERE:

- To describe the attitudes towards the Shortened Dental Arch concept among Swedish General Dental Practitioners and to investigate differences between various groups of clinicians (Study I)
- To describe how dentists evaluate the importance of various patient-related items when planning a treatment in a Shortened Dental Arch, to analyze common dimensions of decision-making compared to other decision situations, and to find some explanatory factors for these dimensions (Study II)
- To study the cognizance of and attitudes towards the Shortened Dental Arch concept among Swedish General Dental Practitioners and application of the Shortened Dental Arch concept in their treatment planning using Qualitative Content Analysis (Study III)
- To study the clinical prosthodontic decision-making process relating to dentitions with compromised molars among Swedish General Dental Practitioners (Study IV)

MATERIAL

STUDY POPULATION STUDY I AND II

The subjects were 200 Swedish General Dental Practitioners (GDPs). The random sample was taken from the membership register of the Swedish Dental Association. Inclusion criteria were dentists currently working in Sweden as GDPs and not specialists. As it was not possible to identify the current work situation or dentists with a specialty degree in the sample frame, eleven dentists were later excluded from the study since they did not fulfill the inclusion criteria. Nine practitioners had a certificate in a specialty, issued by the Swedish National Board of Health and Welfare, one practitioner was working abroad and one was no longer working as a GDP. Data on employment – private or public – was obtained through the membership register of the Swedish Dental Association. The questionnaire was sent to 100 Private Practice (PP) dentists and 100 Public Dental Health Service (PDHS) dentists, thus 200 Swedish GDPs (about 2.74% of the dentists in Sweden), and the response rate was 54% (102/189) after one reminder. Among the respondents, 62% were men and 38% were women. Fifty-six percent were PP dentists and 44% were employed in the PDHS.

NON-RESPONSE

For the non-responders, information was available for gender, age and dental care system (PP and PDHS). A logistic regression model was applied with response/no response as the dependent variable and gender, age, and dental care delivery system as independent variables. No significant differences were seen between responders and non-responders regarding gender, age and dental care system. It was concluded that the non-response pattern was random. The internal non-response rate was low, not exceeding 2.9 % for any question.

STUDY POPULATION STUDY III AND IV

The subjects were 11 Swedish GDPs, strategically selected for participation. Firstly, the strategy included fulfillment by the participant of the necessary inclusion criterion which was to have been in practice for at least 1 year to ensure experience of treating dentitions without molar support. Secondly, the selection strategy aimed to obtain a variation of experience among the participants, so they were selected according to the following variables: gender, duration of practice, service affiliation (PP/PDHS), geographical location and characteristic (urban or rural) of current practice as well as location of previous undergraduate dental education (Table 1). Participating GDPs were identified based on the telephone directory using information from colleagues and other professionals to find participants according to the different variables. All eleven selected GDPs accepted the invitation to participate.

Table 1. Participants' gender, duration of practice/employment, service affiliation (PDHS=Public Dental Health Service, PP= Private Practice), practice/employment characteristics and location of undergraduate dental education.

Gender	Years in profession	Dental organization	Work site in Sweden	Place of dental education
Female	23	PDHS	Urban/northern	Umeå
Male	27	PP	Rural/northern	Stockholm
Male	35	PDHS	Rural/northern	Umeå
Male	32	PP	Rural/northern	Umeå
Male	1	PDHS*	Rural/southern	Malmö
Male	30	PDHS	Urban/southern	Malmö
Female	20	PP	Urban/southern	Malmö
Male	40	PP	Urban/southern	Malmö
Male	2	PDHS	Urban/middle	Gothenburg
Female	5	PDHS	Urban/southern	Gothenburg
Female	19	PP	Urban/southern	Stockholm

*Part-time research at a Faculty of Odontology

ETHICAL ISSUES

Studies I and II were approved by the Research Ethics Committee, Lund University, Lund, Sweden (Dnr 906-02). The research plans for studies III and IV were submitted to the Regional Ethical Review Board of Lund University, Lund, Sweden (Dnr 326/2008), which judged it not to need ethical review due to negligible risk of negative impact on the subjects. The participants in study III and IV were verbally informed about the study, and their written, informed consent was obtained.

METHODS

Study I and II were conducted as cross-sectional observational studies from a questionnaire data collection and Study III and IV were conducted as semi-structured in-depth interviews (Table 2).

Table 2. Aims, subjects and methods of analyses used in studies I-IV.

	Study I	Study II	Study III	Study IV
Aim of the study	Attitudes towards the SDA concept	Decision-making with focus on the SDA	Attitudes towards the SDA concept	Decision-making relating to compromised molars
Study design	Cross-sectional observational studies		Qualitative studies	
Data collection	Questionnaire		Semi-structured interviews	
Sample characteristics	Swedish General Dental Practitioners			
	Randomly sampled (n=102)		Strategically selected (n=11)	
Data analysis	Descriptive statistics Student´s t-test	Descriptive statistics Student´s t-test Varimax rotated principal component analysis Multiple linear regression analysis	Qualitative content analyses	

QUANTITATIVE APPROACH (study I and II)

Questionnaire

The questionnaire contained 64 questions. It was modified based on a questionnaire by Kronström et al. (1999) (73) and constructed in alignment with an analysis of the literature concerning the SDA concept (29). The questionnaire also included a reference to the SDA concept in the dental literature (16). The responses were reported on a Visual Analogue Scale (VAS), later divided into ten equal parts for data registration.

The following general information about the SDA concept was included in the questionnaire:

"Dear Colleague,
As you presumably know, there are many different factors to consider before selecting a prosthodontic treatment. One treatment concept which is discussed for patients who are lacking molar support is the so called 'shortened dental arch concept' (SDA concept). However, there are different opinions about such treatments. Some assert that a shortened dental arch will maintain good chewing ability and appearance, and also simplifies oral hygiene for older patients, while others claim that lack of molar support contributes to temporomandibular joint problems, tooth migration and increased occlusal tooth wear. [The definition of SDA is a dentition of 10 occluding pairs of teeth (pairs of teeth = own natural teeth, crowns and/or pontics)]."

The questionnaire was divided into four main sections:

A. Questions about factors to be considered when planning a prosthetic treatment in an SDA.
B. Attitudes related to risks and benefits of an SDA.
C. Attitudes related to various statements concerning the SDA concept.
D. Questions about gender, age, approximate years in profession and place of dental education.

In section A of the questionnaire, a series of 20 items were presented to mirror the assessed importance for dentists when planning a

prosthetic treatment in an SDA. Ten of the items (item 1-5, 15-16, 18-20) were taken from the items used in the questionnaire by Kronström, studying prosthodontic decision-making among Swedish GDPs in three different clinical situations (73). The remaining ten items were constructed from literature concerning the SDA.
For each situation in section A, a series of items was presented where the dentist was asked to mark on a VAS the importance of the different items, ranging from 0 for "unimportant" to 10 for "decisively important".

The items to be reported in section A when planning a prosthetic treatment in an SDA were:

1. Patient's wish
2. Patient's age
3. Patient's financial situation
4. Patient's general health
5. Expected patient comfort
6. Patient's adaptive capacity
7. Patient's experience of poor chewing ability
8. Periodontal condition of remaining teeth
9. Cariological status of remaining teeth
10. Good oral hygiene
11. Abrasion level of remaining teeth
12. Location of remaining teeth
13. Occlusion
14. Previous temporomandibular joint problems
15. Cost for patient
16. Prognosis for delivered treatment
17. Relatives' wish
18. Esthetic outcome
19. My own clinical experience
20. Treatment time required

Section B of the questionnaire comprised 16 different statements aimed at measuring attitudes to risks and advantages in a dentition without molar support. The statements were constructed by the authors based on the literature review concerning the SDA.

The items to be reported in section B related to risks in an SDA were:

1. SDA results in reduced chewing ability
2. SDA aggravates periodontitis in patients with low marginal bone level
3. SDA contributes to greater abrasion
4. SDA leads to loss of vertical dimension of occlusion
5. SDA contributes to tooth migration
6. SDA leads to development of TMD
7. There is a risk that the patient with an SDA will not be pleased with the esthetics
8. SDA can create speech problems

For the items related to risks, the dentist was asked to mark on a VAS ranging from 0 for "great risk" to 10 for "minimal risk".

The items in section B related to the advantages of an SDA were:

1. SDA simplifies oral hygiene for the patient
2. SDA allows the patient to keep their own natural teeth longer
3. SDA treatment focuses on replacing teeth that are necessary for oral function
4. SDA treatment reduces the technical difficulty of therapy
5. SDA reduces the risk of overtreatment
6. SDA allows for better patient costs
7. SDA makes it easier to predict the prognosis for delivered treatment
8. SDA enables easier treatment planning

For items related to advantages, the dentist was asked to mark on a VAS ranging from 0 for "small advantage" to 10 for "great advantage".

Section C of the questionnaire comprised 24 different statements aimed at measuring attitudes related to the SDA concept.

The statements were:

1. It is always important to replace a lost molar support
2. I often choose removable prosthetics in order to provide the patient with a dentition with molar support
3. It is important in my prosthetic treatment planning to provide the patient with a fixed prosthetic reconstruction
4. If a dentition has a dubious periodontal prognosis, I always choose removable dentures
5. If a dentition has a dubious cariological prognosis, I always choose removable dentures
6. If a dentition has a dubious prognosis, I always choose a removable prosthesis
7. My experience is that patients without molar support have sufficient chewing function
8. My experience is that patients without molar support are satisfied with their appearance
9. My experience is that patients without molar support often have temporomandibular joint problems
10. My experience is that patients without molar support have more occlusal tooth wear than patients with molar support
11. My experience is that patients without molar support get a reduced vertical bite over time
12. My experience is that in patients without molar support the vertical dimension increases over time
13. It is important to listen to the patient and not replace more teeth than the patient desires
14. The patient often has a firm opinion about whether or not a tooth should be replaced
15. The patient often leaves the decision regarding the prosthetic treatment to the dentist
16. Most patients are well adapted to a dentition without molar support
17. Patients who have received a prosthetic rehabilitation without molar support often demand more teeth
18. Patients younger than 50 years of age without molar support can acquire an acceptable chewing function
19. A dental arch to the second premolar is often sufficient to be esthetically acceptable to the patient

20. Patients over the age of 80 years have difficulty in adapting to removable dentures if they have no earlier experience of them
21. Between 20 and 50 years of age, adequate oral function is required with a minimum of 12 occluding pairs of teeth
22. Between 40 and 80 years of age, adequate oral function is required with 10 occluding pairs of teeth
23. Between 70 and 100 years of age, adequate oral function is required with 8 occluding pairs of teeth
24. Planning treatment for elderly people should concentrate on preserving the most strategic parts of the dental arches: the anterior and premolar regions

In section C, all statements had VAS response options ranging from 0 for "disagree completely" to 10 "agree completely".

All scales for sections A-C were coded ahead of analysis in 10 equidistant steps with the above-mentioned anchors for each VAS in turn.

In section D of the questionnaire, the demographic items covered the respondents' gender, age, years in profession and place of dental education.

For study I, the items in section B (all items) and C (items: 7-10, 18-24) were subjected to analysis in relation to gender and dental organization.

For study II, the items in section A were subjected to analysis in relation to gender, dental organization and place of dental education (multiple regression analysis).

Statistics

The responses were registered and all data analyses were made using SPSS (SPSS; Inc, Chicago, IL, USA) version 12.0. The data was described and analyzed in contingency and frequency tables, and means and standard deviations were calculated using Student's *t*-test for analyses of groups of dentists with respect to gender and dental organization.

The attitudinal statements "advantages" and "risks" of SDA were subjected to principal component analysis (PCA) in addition to 18 statements (section A) relevant for decision-making in SDA. The number of factors was determined by means of the Kaiser criterion (eigenvalue >1) and inspection of scree plots. The factor solution was varimax rotated (74). A multiple linear regression analysis was used to study explanatory patterns regarding the assessment of importance for the variables influencing dentists' choice of treatment in an SDA. The models were run with inspection of residual plots for determining heteroscedasticity (unequal distribution of residuals along the regression line). Statistical significance was set at α=0.05.

For the non-response analysis, a logistic regression model was applied with response/no response as the dependent variable, and gender, age and dental care system as independent variables.

QUALITATIVE APPROACH (Study III and IV)

In-depth interviews

The in-depth semi-structured interviews were performed in 2007 and covered treatment considerations for two patient cases and opinions on pre-formulated statements about the SDA concept. Each GDP was interviewed for 45-90 minutes. Two authentic patient cases, with complete dental arches and a presumed final treatment plan resulting in an SDA, were selected. Both cases comprised patients with compromised teeth, mainly in the molar regions. Case 1 was an 18-year-old patient with extensive caries. Case 2 was a 73-year-old patient with severe periodontal disease. Both patients had been treated by specialists (in pediatric dentistry and periodontology respectively) who had planned to extract most of their molars. This information was not given to the participants who received a short case history (Table 3), plaster study models, clinical photographs and radiographs for each case. In addition, for case 2, charting information regarding plaque, bleeding on probing, level of attachment and furcation involvement was provided.

Table 3. Short case history for the two patient cases used as a basis for the interviews.

	Short case history
Patient case 1	General history: An 18-year-old man in his last year of high school. He spends a lot of his spare time on computers and is also very interested in music. Smokes about 10-20 cigarettes/day. Afraid of needles, wants nitrous oxide or general anesthetic for dental treatment. Asthma, medicate when necessary with Bricanyl and Clarityn. Allergic to nuts, kiwi, bananas, seafood, fur and pollen. Local history: He has drunk very sweet drinks but does not eat much candy. He has not brushed as he should. Currently, he brushes with a regular toothbrush, fluoride toothpaste and uses Colgate mouthwash or Listerine. He is now ready to deal with his caries situation. Local status: Neutral bite, missing 35 and 45, severe caries, plenty of plaque, gingivitis.
Patient case 2	General history: A 73-year-old woman. Medication for high blood pressure. Retired. Smoker. Local history: Sensitivity to cold in the anterior mandible caused by a previous trauma to this area 6 months ago. The patient is worried about mobile molar teeth and bleeding gums. She has some concern about losing her teeth and needing a prosthesis like her mother. Local status: Neutral bite. She has 17-28 and 38-48. Heavy deposits of plaque and calculus, excessive bleeding from the gums. Generally deep buccal recession, especially in the lower jaw. Deep periodontal pockets, especially in the molar regions.

Statements about SDA which showed substantial individual variation in response from the questionnaire study (Study I) were selected.

- SDA treatment reduces the technical difficulty of treatment (both for the dentist and the patient)
- SDA reduces the risk of overtreatment
- SDA simplifies oral hygiene for the patient
- SDA allows the patient to keep his/her own natural teeth longer
- SDA results in reduced chewing ability
- Planning treatment for elderly people should concentrate on preserving the most strategic parts of the dental arches: the anterior and premolar regions

Data collection

All interviews were performed by one interviewer (EK) who has a background as a senior consultant in prosthodontics. Eight interviews were performed at the GDPs' own clinics and three interviews at the interviewer's office. The interview was designed to be an interaction, with the interviewer acting as an instrument allowing the participant to tell the story. It was important at the interview to avoid the interviewer's personal notions and expectations from impacting on the interview itself. This was achieved by attentive listening, allowing a pause for the interviewee to continue an answer, probing for more information, attempting to verify the answers given and paying attention to aspects of the phenomenon under discussion described by the participant. Data collection continued until the point at which new interviews failed to provide any additional information. Saturation was considered reached after 11 interviews. All interviews were digitally recorded. A medical writing agency transcribed the interviews verbatim, and the interviewer later checked them, adding detail, including notations of non-verbal expressions. All participants read and approved the final transcripts of their own interviews.

Analysis of data

The qualitative content analysis that was used was based on Graneheim & Lundman (2004) (75). The analysis followed these steps:

1. All the interview texts were read several times to get a sense of the whole.
2. Division of the text into meaning units, i.e. divisions were placed at the point a change in meaning occurred in the text.
3. Condensation of meaning units into more succinct formulations while preserving the core of their content.
4. Abstraction of the condensed meaning units based on the content; the meaning units were given a code (Table 4).
5. The various codes were discussed, compared and sorted into categories and subcategories for illustration of the manifest content (the visible and surface content of the text).
6. Identification of a theme covering the latent content (the underlying meaning of the text).

For the purpose of Study III, meaning units covering cognizance of and attitudes towards shortened dental arches were selected for analysis. For Study IV meaning units covering the clinical decision-making process in dentitions with compromised molars were selected for analysis.

In Study III, a theme covering the latent content was achievable but in study IV the collected material was considered suitable to illustrate the manifest content but not substantial enough to identify the latent content, thus no covering theme was identified.

Two of the authors (EK and EW) performed steps 1-4 and all the authors contributed to steps 5-6.

Table 4. Example of a Meaning unit, a Condensed Meaning Unit and a Code (Study III).

Meaning unit	*Condensed meaning unit*	*Code*
I don´t extract teeth immediately. I have seen teeth.., I have had patients that I´ve told "we probably have to extract these teeth, they don´t look good". And they are left ……., ten years later, the teeth remain and not that much has happened really.	I don´t extract teeth immediately. I have seen teeth that I´ve told the patient we have to extract. After ten years the teeth remain. Not much has happened.	Dentition preserving approach

RESULTS

VARIOUS GROUPS OF SWEDISH GDPs; SIMILARITIES AND DIFFERENCES

In the studies where an approach for analysis of quantitative data was used (I, II), there were more men (62%) than women (38%) as well as more PP dentists (56%) than PDHS dentists (44%) among the respondents. In the studies where an approach for analysis of qualitative data was used (III, IV) the majority of the 11 participants were also men n=7 (64%) and a slight majority were employed in the PDHS n=6 (54%).

The average number of years in the profession for the participants in the studies of quantitative data was 23.6 (SD=8.9 years) and in the studies of qualitative data 21.3. Most of the participating dentists in the studies comprising quantitative data were educated in Gothenburg (30%) and Stockholm (29%), followed by Malmö (17%), Umeå (13%) and abroad (6%). The rest (5%) did not declare their place of dental education. In the studies comprising qualitative data, participants educated in Malmö were n=4 (36.5%), educated in Umeå n=3 (27.5%) and educated in Stockholm and Gothenburg n=2 (18%) respectively.

A summary of general results from study I-IV are shown in Table 5a and 5b.

Table 5a. Summary of general results Study I-IV.

Attitudes towards SDA and the concept		
	General results	***Differences between various groups of Swedish GDPs***
Study I	• Overall positive attitude to SDA • Few risks with an SDA	• Female dentists expressed higher risk for reduced chewing function, periodontitis and TMD than male dentists did • PP dentists expressed less advantages with the SDA concept than PDHS dentists with respect to the reduced risk for overtreatment, better patient economy and the ability for the patient to keep their natural teeth as they aged
Study III	• Little or no cognizance of the SDA concept • The SDA concept was irrelevant • The SDA concept seemed not to be applied in treatment planning	• Differences were not studied

Table 5b. Summary of general results Study I-IV.

Decision-making with focus on SDA and compromised molars		
	General results	***Differences between various groups of Swedish GDPs***
Study II	Of importance when planning for a SDA treatment: • Periodontal condition of remaining teeth • Prognosis for delivered treatment Identification of three factors of importance for the decision-making • Technical • Comfort • Time Largest variation in responses was seen for the patients´ age.	• Female dentists evaluated the statement "previous temporomandibular problems" as more important than male dentists did. • PDHS dentists reported a higher importance to the variables "patient´s adaptive capacity" and "expected patient comfort" than PP dentists did. • PP dentists expressed greater importance to the technical factor and less importance to the comfort factor than PDHS dentists did.
Study IV	Of importance when planning for a treatment in a dentition with compromised molars: • Keeping a dental arch with molars • Taking the individual patient needs and contextual factors into account • Taking advantage of own and colleagues´ clinical experience Conflicting results concerning the relevance of age and need for molar support.	• Differences were not studied

ATTITUDES TOWARDS THE SDA AND THE SDA CONCEPT

Study I

The results from the first study with a quantitative approach showed that Swedish GDPs generally had an positive attitude towards the SDA (section B: statements 11/16, section C: statements 9/11) since VAS ≥ 5 was registered for statements with the most positive attitude on the right hand anchor of the scales and VAS ≤ 5 on the reversed scales. Small differences were found in attitudes to the SDA concept between various categories of practitioners (gender and delivery system) but there were large individual variations (Table 6-7).

Great variation was seen for the clinicians' opinions towards the SDA concept regarding appearance, oral function, TMD, occlusal tooth wear and patient age (statements from section C: statements 7-10, 18-24). The largest variation in opinion (SD=2.9) was seen for the statement "Planning treatment for older patients should concentrate on preserving the most strategic parts of the dental arches: the anterior and premolar regions".

The general opinion among the GDPs was that there were few risks (statements from section B) associated with an SDA. The female practitioners deemed there were higher risks of reduced chewing ability, periodontitis, tooth wear, loss of vertical dimension of occlusion and TMD among patients with SDA than the male practitioners, although the differences were small. There were no significant differences in attitudes towards risks with respect to dental care delivery system (PP, PDHS) (Table 6).

Table 6. Frequency distribution of opinions of risks in a Shortened Dental Arch

Item	Overall population mean	SD	Mean for men	Mean for women	*P*	Mean for PP	Mean for PDHS	*P*
1. SDA results in a reduced chewing ability	5.2	2.4	5.7	4.5	.011	5.0	5.5	.349
2. SDA aggravates periodontitis in patients with low marginal bone levels	5.4	2.4	5.8	4.6	.019	5.5	5.2	.610
3. SDA contributes to greater abrasion	5.4	2.3	5.8	4.7	.023	5.4	5.4	1.000
4. SDA leads to loss of vertical dimension of occlusion	6.0	2.3	6.5	5.2	.005	6.0	6.1	.811
5. SDA contributes to tooth migration	6.1	2.0	6.3	5.7	.176	5.9	6.2	.408
6. SDA develops TMJ disorders	6.1	2.4	6.5	5.3	.016	5.7	6.6	.056
7. There is a risk that the patient with SDA will not be pleased with the esthetics	7.1	1.7	7.1	7.0	.688	7.1	7.1	.995
8. SDA can create speech problems	8.0	1.6	8.3	7.6	.052	8.0	8.1	.743

Responses were on a VAS ranging from 0 ("great risk") to 10 ("minimal risk"). $99 \leq n \leq 101$.

In the evaluation of advantages associated with SDA (statements from section B), the overall population gave a higher score for:" it simplifies oral hygiene", "it allows the patient to keep their own natural teeth longer" and "SDA treatment focuses on replacing teeth that are necessary for oral function" (Table 7). There were no differences observed between men and women in the evaluation of advantages with the SDA concept, but there were significant differences between PP dentists and PDHS dentists for three of the statements: "SDA allows the patient to keep their own natural teeth longer", "SDA reduces the risk of overtreatment" and "SDA allows for better patient costs". In these aspects, the PDHS dentists considered there were greater advantages with SDA than the PP dentists (Table 7).

Table 7. Frequency distribution of opinions of advantages in a Shortened Dental Arch

Item	Overall population mean	SD	Mean for men	Mean for women	*P*	Mean for PP	Mean for PDHS	*P*
1. SDA simplifies the oral hygiene for the patient	6.1	3.0	6.1	6.1	.969	6.0	6.2	.753
2. SDA allows the patient to keep his own natural teeth longer	5.7	2.7	5.6	5.9	.623	5.2	6.3	.035
3. The SDA treatment focuses on replacing teeth that are necessary for oral function	5.6	2.4	5.6	5.5	.721	5.4	5.8	.487
4. SDA treatment reduces the technical difficulty of therapy	4.7	2.6	4.9	4.5	.444	4.4	5.1	.192
5. SDA reduces the risk of overtreatment	4.7	2.7	4.7	4.5	.765	4.1	5.3	.033
6. SDA allows for better patient economy	4.4	2.5	4.3	4.5	.634	3.9	5.0	.034
7. SDA makes it easier to predict the prognosis for delivered treatment	4.3	2.7	4.7	3.9	.163	4.5	4.2	.629
8. SDA enables simpler treatment planning	4.3	2.5	4.6	3.8	.116	4.2	4.5	.523

Responses were on a VAS ranging from 0 ("small advantage") to 10 ("great advantage"). $96 \leq n \leq 100$.

Study III

The result of the interview study (III) identified an emerging overall theme covering the latent content: *"The SDA concept is irrelevant"*. The SDA concept was considered to be irrelevant in the sense that, although having experience of patients with dentitions without molar support, the GDPs were ignorant of the SDA concept per se, although two of the dentists had heard the expression.

> "No, I haven't heard of the concept, only diffusely that investigations have been made to determine whether ten teeth are enough, but I don't know what it's about."

Consequently, the concept was not used in any case as a basis for treatment planning. In view of this, after discussing the patient cases, the participants were given a brief explanation of the SDA concept: "A shortened dental arch is a dentition with loss of posterior teeth" and "ten occluding pairs of teeth". All the GDPs were familiar with that type of dentition and had various degrees of experience with it. Then, to initiate discussion about the risks and benefits of a dentition without posterior teeth, the interviewer proposed scenarios in the patient cases that required molar extraction.

> "Let's imagine that you are in a situation where it's necessary to remove several teeth here in the lateral regions. What is your reasoning?"

Two categories covering the manifest content were developed. One was labeled the *"tooth-preserving approach"*, the other *"patient-focused attitude"* (Table 8).

Table 8. Theme, categories, subcategories and examples of codes from qualitative content analysis of Swedish GDPs' attitudes towards the SDA concept.

Theme	***The SDA concept is irrelevant***				
Category	**Tooth preservation approach**		**Patient-focused attitude**		
Sub-category	***Tooth extraction reluctance***	***Absence of SDA concept***	***Needs assessment***	***Relevance of age***	***Economic incentives***
Codes	Dentition-preserving approach Extension of the dental arch Important to have a stable occlusion	The SDA concept is unknown Unaware of the SDA Forced opinion Never thought of advantages with SDA	The patient's needs cannot be generalized The patient's individual needs are in focus	Age does not matter Age can be of importance for acceptance of SDA.	The dental insurance system is not generous. Compen-sation rules determine treatment

Tooth preserving approach: The GDPs' objective was to preserve a complete dental arch if possible. Every tooth was considered to be valuable and worthy of preservation including those with dubious prognosis in the posterior regions.

> "It's not bad to extract teeth, but it would be a shame not to keep the teeth for use as support if they are good enough."

Extraction was never the first choice and when it was suggested, a replacement, FDP or implant-supported prosthesis was the first priority with RDP second.

The disregard for the SDA concept also became evident when discussing the pre-formulated SDA statements (list of points, p. 40). The GDPs disbelieved and questioned the accuracy of the statements and showed no recognition for the content of the SDA concept.

> "Less technical…? Yes, ... yes, it would … Yes, of course it could be, it could be since molars, of course, are naturally more technically complicated if furcations occur and it's harder to save them. But this isn't something I think about at all when I'm there and providing treatment. I've never actually thought about it like that."

The disagreement among the GDPs was general except for the statement "SDA simplifies oral hygiene for the patient". This agreement, however, was not spontaneous and came only after hesitation and reflection.

> "… of course it would be easier with fewer teeth to keep clean … if you look at it like that."

Patient-focused attitude: The participants expressed a patient-centered approach based on the health status and specific needs of each individual patient.

> "It varies so much, what the patients think, and there are patients who say that this works just great for them and they don't want me to do anything. And then I have patients who call after two weeks and say that I have to put something in, I have to make a bridge or put in an implant. They'll pay for it."

The patient's age was significant and ambivalence became obvious with regard to how age might change the impact of tooth loss on quality of life. However, age was not an issue when deciding treatment; medical needs and financial considerations were more important.

> "It depends on what (laugh), whether the patient is sick or well. You always have some sort of aches or pains when you get older, but when it's a patient, then it's their state of health that determines the level of treatment you choose."

The restrictions imposed by dental insurance as well as the patient's own financial situation were deemed to have a high, and sometimes too high, impact on the treatment under discussion.

> "Some patients who otherwise have a nice dentition look very good, and then they break a 6. It's just sad for the patient who has taken care of their teeth because they don't get any compensation from their dental health insurance."

There was no association with the link between available research on the SDA concept and the restrictions within the dental insurance system.

PROSTHODONTIC DECISION-MAKING WITH FOCUS ON THE SDA AND COMPROMISED MOLARS

Study II

The results from the second study with a quantitative approach showed that there was a wide variation between answers to the statements (section A) which indicated major individual differences among the dentists. There were differences between groups of dentists (gender and delivery system) but the mean differences between the groups were small (Table 9).

The statements "periodontal condition of remaining teeth" and "prognosis for delivered treatment" were given the highest importance. Statements given the lowest importance were "relatives' wish" and "treatment time required". The statement "patient age" illustrated the greatest individual differences among the dentists (SD=2.8) (Table 9).

In a gender comparison, female dentists evaluated the statement "previous temporomandibular problems" as more important than male dentists did. Differences were also seen between PDHS dentists and PP dentists where PDHS dentists afforded greater importance to the variables "patient's adaptive capacity" and "expected patient comfort" than PP dentists did (Table 9).

Table 9. Frequency distribution of important factors to be considered when planning a prosthodontic treatment in a shortened dental arch. Responses were on the visual analogue scale ranging from "Unimportant"=0 to "Decisively important"=10. PP=private practice; PDHS=Public Dental Health Service†

	Item	Total population (mean)	SD	Men (mean)	Women (mean)	PP (mean)	PDHS (mean)
8	Periodontal condition of remaining teeth	8.2	1.3	8.1	8.4	8.4	8.0
16	Prognosis for delivered treatment	8.1	1.2	8.0	8.2	8.0	8.1
1	Patient´s wish	7.8	1.3	7.7	7.8	7.6	7.9
7	Patient´s experience of bad chewing ability	7.8	1.4	7.4	8.0*	7.6	7.7
6	Patient´s adaptive capacity	7.6	1.4	7.4	8.0*	7.2	8.1***
5	Expected patient comfort	7.7	1.4	7.5	7.9	7.3	8.1**
19	My own clinical experience	7.4	1.9	7.4	7.4	7.4	7.5
12	Localisation of remaining teeth	7.1	1.5	7.1	7.2	7.2	6.9
10	Good oral hygiene	7.0	1.6	6.9	7.1	7.0	7.0
3	Patient´s economy	6.9	2.3	6.8	7.1	6.6	7.3
9	Cariological status of remaining teeth	6.8	2.0	6.6	7.1	6.4	7.2*
4	Patient´s general health	6.7	1.8	6.5	7.0	6.8	6.6
14	Previous temporomandibular joint problems	6.7	1.7	6.2	7.4***	6.7	6.6
13	Occlusion	6.5	1.8	6.2	7.0*	6.9	6.1*
18	Esthetic outcome	6.5	1.8	6.5	6.4	6.4	6.6
15	Cost for patient	6.2	2.2	5.8	6.8*	5.9	6.6
11	Abrasion level of remaining teeth	5.6	1.8	5.3	6.1*	5.7	5.5
2	Patient´s age	4.7	2.8	4.4	5.1	4.4	5.0
17	Relatives wish	3.0	2.2	2.7	3.5(*)	3.0	3.0
20	Treatment time required	3.0	2.1	2.9	3.1	2.9	3.1

(*) = $P \leq .10$ * = $P \leq .05$ ** = $P \leq .01$ *** = $P \leq .001$
†99 ≤n≤102 sample size

The statements (section A) were subjected to a PCA where a 3-factor solution with a total variance explanation of 46% was obtained. Two of these twenty statements were excluded (statements 14 and 18) in the final run due to low communalities (<0.30). The three factors were interpreted to capture the dimensions "technical" (statements 7-13), "comfort" (statements 1, 3, 6, 15, 16, 19) and "time" (statements 2, 17, 20) (Table 10).

Table 10. Varimax-rotated Principal Components Analysis of items relevant for decision-making in an SDA.

Item	Factor 1 (technical)	Factor 2 (comfort)	Factor 3 (time)	Communality (h^2)
8 Periodontal condition of remaining teeth	0.73			0.46
11 Abrasion level of remaining teeth	0.72			0.60
10 Good oral hygiene	0.68			0.35
13 Occlusion	0.66			0.52
9 Cariological status of remaining teeth	0.55			0.49
12 Localisation of remaining teeth	0.54			0.49
7 Patient´s experience of bad chewing ability	0.49			0.40
6 Patient´s adaptive capacity		0.72		0.31
15 Cost for patient		0.63		0.45
16 Prognosis for delivered treatment		0.60		0.61
1 Patient´s wish		0.59		0.42
5 Expected patient comfort		0.57		0.55
3 Patient´s economy		0.54		0.34
19 My own clinical experience		0.52		0.33
4 Patient´s general health		0.46		0.52
20 Treatment time required			0.78	0.37
2 Patient´s age			0.64	0.60
17 Relatives´wish			0.59	0.40
Variance explanation (%)	17.1	16.7	11.9	

Factor loadings ≥ 0.30, n= 92

The attitudinal statements regarding “advantages” and “risks” with SDA (section B) were also subjected to a PCA, where a 2-factor solution with a total variance explanation of 32% was obtained for the factor “advantages” and 21% was obtained for the factor “risk”. The constituent variables were summarized into indices, indicating perception of “advantages” and “risks”.

Multiple regression analyses were run with the three factors, "technical", "comfort", and "time", as dependent variables. Variables from social and demographic attributes (section D) and the attitudinal variables "advantages" and "risks" found in the PCA were used as independent variables (Table 11).

The models showed that PDHS dentists awarded more negative importance to the "technical" factor than the PP dentists did, and more positive importance to the "comfort" factor than PP dentists did. Dentists educated in Stockholm and Umeå gave greater importance to the "technical" factor compared with dentists educated abroad.

The independent attitudinal variable "advantage" with an SDA showed significant associations with the factor "comfort", and the variable "risks" with an SDA showed significant associations with the factor "technical". All three models showed adjusted R^2 values (0.23, 0.24 and 0.07 respectively) indicating relatively good precision except for the third model ("time factor"), indicating a lack of model specification in that case (Table 11). This model was non-significant.

Table 11. Multiple regression model regarding assessment of importance for the variables influencing a dentist's choice of treatment in an SDA.

	Regression coefficient		
Independent variable (range or ref cat)	*Technical factor (32-66)*	*Comfort factor (29-77)*	*Time factor (0-26)*
Social and demographic attributes			
Gender (female, men ref.cat)	1.96	2.30	0.64
Delivery system (PDHS, PP ref cat)	-3.91**	3.08 (*)	1.19
Years in profession (2-42)	-0.02	0.07	0.04
Dental education (dummy variable)			
Umeå	-6.85 *	0.83	3.54
Stockholm	-7.58 **	1.28	4.90 *
Göteborg	-4.32	4.14	1.59
Malmö	-3.66	-0.36	3.61 (*)
Abroad (ref.cat)			
Risk (20-75)	0.15 *	0.06	0.07
Advantage (0-70)	0.03	0.10 (*)	0.04
Comfort (29-77)	0.29 **		0.08
Technical (32-66)		0.34 **	0.20 **
Time (0-26)	0.35 **	0.16	
Adjusted R square	0.23	0.24	0.07
Model significance	0.001	0.001	0.119

(*) =$P \leq .10$ *=$P \leq .05$ **=$P \leq .01$
***=$P \leq .001$

Study IV

The results of the final study showed the individualized patient-centered approach to be the basis for the decision-making process. Among the GDPs interviewed, a strong focus was placed on patients' needs, background history, motivation for treatment and the preservation of molar support. The GDPs emphasized the importance of having the patient physically present in the prosthodontic decision-making process since access to clinical photographs and radiographs, medical history and plaster models alone generated speculative, uncertain decisions. The GDPs had individually different approaches to the prosthodontic decision-making process but the treatment decisions were similar: retaining molar support. Two main categories covering the manifest content emerged and were labeled: "*holistic approach*" and "*functional approach*" (Table 12).

Table 12. Categories, subcategories and examples of codes from qualitative content analysis of Swedish GDPs' clinical decision-making in dentitions with compromised molars.

Category	*Holistic approach*		*Functional approach*	
Sub-category	**Patient concern**	**Aetiology focus**	**Mainten-ance of molar support**	**Informed decisions**
Codes	Patient motivation important. Freedom from symptoms prioritised first	Patient history important, preliminary therapy plan first. Treat the underlying illness	Treatment proposal includes replacing molar support No molar support means poor prognosis	Consulta-tion with specialists Patient´s opinion Own experience Patient´s economy

Holistic approach: The patients' individual needs were of great importance in the GDPs' decision-making process and the first priority was to address the patients' possible pain or other symptoms. They also took into account the patients' knowledge and motivation for different treatment options.

> "First it is important that you….talk with her to see what she thinks of the various alternatives for extracting teeth. That she really understands, is very important"

The etiology and pathogenesis of oral diseases and the patients' awareness of their situation were also important in the decision-making process.

> "It is important to reverse the caries situation before you initiate an extensive treatment so that you do not start at the wrong end"

This awareness was needed to promote a change in the patients' behavior if necessary. A long-term lasting result was important to the GDPs as was the possibility for follow-ups.

Functional approach: The GDPs found it necessary to maintain molar support even though some of the molars had severe periodontal disease or caries. Different types of treatments, including disease prevention measures and prosthetic constructions, were suggested in order to save the molar support including third molars. An SDA was not considered an option.

> "For the occlusal vertical dimension it is good to try to keep the molars and distribute the force. Have read that the molars are like support pillars, they maintain the occlusal vertical dimension better than the incisors."

An informed decision was considered to be important. Therefore, the participants first wanted to make a preliminary treatment plan and have a thinking period before deciding on a definitive treatment plan. Consulting colleagues, specialists, taking into account contextual factors concerning the patient's financial situation, the dental insurance system and the waiting time situation were important in prosthodontic decision-making.

> "If we did get a patient like this, the first thing I would do is to show him to our prosthodontist. That is what I would do first, to get an understanding of what you can and cannot do".

The conflicting results with regard to the patient's age and the need for molar support were interesting findings. The participants sometimes focused mainly on the patient's disease and the patient's age was less important. In other situations, they claimed that they decided differently depending on whether the patient was young or old; most often they were more reluctant to extract molars in young patients. Although claiming the need for molar support, the GDPs also said that there was seldom a clinical problem if the patient had had an SDA for a long time.

DISCUSSION

This study aimed at investigating the attitudes of Swedish General Dental Practitioners towards the SDA concept and the factors that influence prosthodontic decision-making with a focus on the SDA concept. A questionnaire study, followed by an interview study, was conducted to address these aims.

In summary, the results show a positive attitude overall to an SDA among the participating Swedish GDPs in the questionnaire study. There appeared to be few risks associated with a dentition that lacked molar support although the participants in the interview study showed a considerable belief in favor of molar support. SDA as a concept was unknown and seemed to have no influence on prosthodontic decision-making for the participants in the interview study instead focus was on the individual patient.

ASPECTS OF THE MATERIAL AND METHODS

Questionnaire study (study I-II)

Study group

At the time of the questionnaire study, there were only a few studies reporting attitudes towards the SDA concept among GDPs. In these earlier studies, a majority of the participating dentists, resident in Europe or Africa, were specialists or GDPs with a special interest in prosthodontics (76-79). It was therefore particularly interesting to investigate attitudes to and acceptance of the SDA concept solely among *GDPs* in *Sweden*.

Two hundred participants were considered to be an appropriate sample size for Study I and II as a basis for future studies. The results of the questionnaire studies did not constitute a basis for an extended questionnaire. It was more interesting to find out the underlying factors that gave rise to the individual variations in the participants' answers about attitudes and prosthodontic decision-making as shown by the substantial standard deviation (SD) for several of the statements.

Questionnaire

Using a questionnaire has several advantages: it is cheap, it can include many individuals, it can ask a lot of different questions, and the respondent can answer the questionnaire at any time. On the other hand, there is a problem of non-responders, there is no-one to support the responder if the questions are unclear, there may be a risk of misinterpretation, and there is no control over who actually answers the questions (80).

The composition of the questions was carefully discussed among the authors, and the questionnaire was designed to be similar to a questionnaire used previously (73). Results from a study seeking opinions among consultants in restorative dentistry regarding the value of the SDA concept (76) also influenced the construction of the questions. Using similar questionnaires was considered an advantage as it gives the ability to compare the results of this study with others.

Response and non-response

The response rate was comparably low. This could be due to the topic of the questionnaire being too difficult, too sensitive for the dentists or not being sufficiently interesting. Another reason could be that only one reminder was sent. Questionnaires with questions of a sensitive nature have been shown to decrease the response rate, while questionnaires with interesting topics increase it (81). A low response rate has also been reported for other studies concerning attitudes towards the SDA (61-63, 66, 82) with the exception of one study (79). Although the response rate was low in the present study, the analysis showed no significant difference between the responders and non-responders in relation to gender, age or dental care delivery

system. It is therefore probable that a larger population would have produced the same result.

The internal non-response rate was low, not exceeding 2.9% for any question. This might be due to the fact that the instructions to the participants indicated that there were no "right" or "wrong" answers and this may have minimized the feeling among responders of being controlled by the researchers. The low internal non-response rate also indicating that once interest had been stimulated, the total number of questions took up just about the amount of time that participants wanted to spend on answering the questionnaire.

Visual Ananlogue Scale coding
The formulation of anchor responses shape scale response distributions and affect the results in different ways. Firstly, the stronger the anchor, the less likely study participants are to use the extreme or outermost scale categories (83). The anchors used in the present study, exemplified by "decisively important" in section A, might have been too strong, not giving the respondents the option to mark the extreme. However, the anchors of the rating scales varied and the risk of uniform response distribution was therefore considered to be low. Secondly, in section B, "minimal risk" and "small advantage" assumes that there actually was a risk and an advantage with SDA and "no risk" and "no advantage" might have been a better anchor.

Positioning of the anchors on a VAS is another factor to consider. In section B, concerning opinions on the risks in an SDA, the response "great risk" was 0 and the response "minimal risk" was 10 on the VAS. In the same section, concerning the advantages of an SDA, "small advantage" was 0 and "great advantage" was 10 on the VAS. This reversed positioning might have gone unnoticed by the responders and may consequently have affected the results. The responses indicate, however, that the participants were aware of the differences in the VAS ranking since the responses in section B are comparable and together they indicate low risk and some advantages with SDA.

Principal Component Analysis and Multiple Regression Models
Decision-making in prosthodontics is traditionally considered to depend on a number of factors such as the patient's needs and demands, dental conditions, age, general health, financial situation, and the dentist's knowledge and skill (73, 84). The input of these different factors varies in each decision-making process. To understand the decision-making process among the GDPs, a method was needed for finding relationships between different variables and recognizing decisive underlying factors. Factor analysis is one such method. PCA was considered suitable in the present study since it is an explorative method in which the factors are not defined in advance, thus providing an option to condense the large amount of data obtained from the responses of the questionnaire in Study II (74).

A possible strength of study II, was the relatively high precision in two of the three multiple regression models, indicated by high R^2 values of 0.23 and 0.24, thus providing strong support to the findings.

Interview study (study III-IV)

Study group
There was some skewness with most of the participants exceeding 20 years of experience. This skewness though, ensured that there were participants with experience of dentitions with loss of posterior teeth. Data collection continued until saturation was reached and no additional information was gained. Saturation was considered reached after eleven interviews, all of which were rich in information, allowing conclusions to be drawn about the study aims.

Qualitative Content Analysis
Among the advantages with Qualitative Content Analysis (QCA) specifically are that it is well suited for studying attitudes and phenomena that are unknown (69). The method allows one to describe the meaning of the collected material, defined by a specific research question, and it takes the context into account (69, 85). The methods, however, are time-consuming and bias may arise during the interview situation due to the appearance and behavior of the interviewer, the way questions are asked, and the way responses are both recorded and interpreted (80, 86).

Interview and patient cases

Pilot interviews were conducted and the results of these revealed that including patient cases in the interview led to a more nuanced discussion about the SDA concept. Using patient cases as a basis in the interviews was considered a strength; the participating dentists were given the opportunity to relate to their clinical reality. The interviews were semi-structured which made it easier to focus on specific research questions.

Discussing the two patient cases was supposed to lead the dentists to suggest extraction of the compromised molars and exclusively discuss the risks and advantages of the SDA concept as a treatment option. Since the concept was especially developed for elderly, one young patient (18 years) and one older patient (73 years) was chosen to initiate the informants to discuss the risks of extracting molars related to age. The pattern that emerged, however, was uniform for both patient cases; all teeth should be saved and an SDA was not an option.

During the interviews, it was stated that the cases might not be sufficiently clear-cut, and the decision to retain the molars could also be a relevant option, despite the uncertainty of the prognosis. This illustrates that it is not possible to simplify prosthodontic decision-making; there are seldom any right or wrong answers but rather a variety of options. The actual patient cases were evaluated by specialists which might suggest that specialists are more likely to make definitive decisions and that expert opinion does not necessarily equal "truth".

To capture the attitudes of the Swedish GDPs and important factors in prosthodontic decision-making, the design of the interview study seemed to be appropriate to the research question. The finding that the participating dentists had little or no cognizance of SDA as a concept was unexpected since the result of the questionnaire studies indicated knowledge of the concept. The unexpected finding was also interesting in the sense of drawing attention to the importance of choosing an appropriate scientific method so that the research question can be answered. It might have been better to invite the participants to talk about some of their own patient cases resulting

in SDA. This was also confirmed during the interviews as the participants explicitly expressed the need for information about the specific patient's needs.

Being a specialist in prosthodontics, the interviewer may have had a greater influence on the participants, suggesting the importance of obtaining the advice of specialists during the decision-making process or suggesting treatments in a more "restorative way" than if the interviewer had been a GDP. However, the fact that the interviewer was a dentist was considered a strength since both parties shared knowledge about the clinical context under discussion during the interview.

Ethical considerations on studies with a qualitative approach

Brinkmann and Kvale (2005) (87) stated that being an ethically skilled qualitative researcher involves more than respecting the integrity of the research subjects. One also has to take into account the cultural context of the research. The idea of qualitative research being ethically good in itself or at least superior to "the uncaring quantitative approaches" has been critizised (87). When discussing the two patient cases in the interview situation, the participating dentists could have construed this as an "examination" where they might have suspected that the interviewer was seeking the "right answers". It was possible that the participants might be uncomfortable with the situation and feel judged. The risk of that being the case, however, was considered small as the interviewer stressed that there were no right or wrong answers. In addition, the participants were told that the interviews were anonymous and would be stored securely. Studies III and IV, however, were submitted to the Regional Ethical Review Board of Lund University, Lund, Sweden (Ref. no 326/2008), which judged it not to need ethical review due to the negligible risk of adverse impact on the subjects.

Trustworthiness of studies I-IV

The results of the questionnaire did not reveal that there was a lack of knowledge of the SDA as a concept, as was the case for the study with a qualitative approach. This might be due to the participants of the questionnaire study receiving a short description of the SDA

concept as an introduction, while the participants of the interview study were only given a brief explanation of the SDA concept after discussing the two patient cases.

For the studies with a quantitative approach, reliability, validity and generalization are to be considered. If the responses are validated, the credibility of a questionnaire's results increases. For such a test, true information must be available for comparison with the information given by the participants (a comparison of a measure of unknown validity to one of known validity) (88). In the present study, there was no information about prosthodontic activity or the kind of patients treated, young or elderly, which would have been useful. Self-reported data, however, usually have good validity (89). It was a random sample from all over Sweden and the responders represented a wide age range with about 50% from each delivery system and with only a slight overrepresentation of male dentists. It is most likely that the results are therefore generalized to GDPs in Sweden.

Dependability, confirmability, credibility and transferability are to be considered for the studies with a qualitative approach (71, 72).

By thoroughly describing the criteria for and selection of the participants as well as the different analysis steps, this would enable readers to evaluate the dependability and therefore make it possible to repeat the study if desired.

To achieve confirmability, two of the researchers discussed every step in the analysis process until they reached agreement about the interpretation. The analysis was double-coded, i.e. the coding was cross-checked by having two of the researchers' (EK, EW) agreement on the same passages in the text. There were small differences in vocabulary but not in essence. Agreement on categorization was achieved among all four researchers after reflecting on the findings. All four had different clinical and scientific experience, perspectives and backgrounds which was considered an advantage in the sense of seeing the same pattern despite the different backgrounds.

Credibility was achieved by respondent validation in letting all the participants read and approve the final transcripts of their own interviews. In an attempt to reduce the interviewers "dominance" on research subjects (in the sense of the interviewer having scientific competence and defining the interview situation), it has also been suggested to let participants validate the interpretation of the collected data (90). This approach, however, was also rejected (91). Although Giorgi's argument concerns research with a phenomenological approach we consider his argument to be relevant and also applicable in other qualitative research settings. The participants in the present study were not given the opportunity to evaluate the interpretation since the pattern identified was based on information from all of the interviews and was both a synthesis and an interpretation of the collected material. The participants did not have all information and were therefore considered unable to confirm the pattern identified on an adequate basis.

Although the dentists are a homogenous group in themselves, having participants with different backgrounds and experience may achieve transferability to some other given situation or context. Selection of the patient cases for the purpose of this investigation could be debated and instead include clinical cases resulting in SDA from the participants' own practice, thus enhancing transferability.

ASPECTS OF THE RESULTS

Attitudes towards the SDA and the SDA concept

According to the interview study (III), cognizance of the SDA concept was limited among the participating GDPs. They also thought it was irrelevant and did not appear to apply the concept in their treatment planning. These findings were unexpected considering the results of the questionnaire study (I) where the participants had a positive attitude overall and considered there were few risks with an SDA, and because other studies also show that there is a positive attitude to the SDA concept overall even though it seldom is practiced in dental treatments (61-63, 66, 82). The reason for the suggested lack of awareness of the SDA concept among Swedish GDPs could be that the concept was developed more than 35 years ago and prosthodontic treatment options have changed considerably. For example, treatment

with dental implants has increased in general (92) or it may be that the concept is not taught more widely in dental schools in Sweden.

Swedish GDPs in general reported few risks with a dentition lacking molar support (I), although some gender differences were found as in earlier studies (93, 94, 54). Thus, female practitioners expressed greater concern about impaired oral function, periodontitis and TMD in an SDA than male practitioners. One possible reason for this discrepancy could be that the female GDPs were less experienced in extensive prosthodontics than their male colleagues, correlating with a previous study (73). It might therefore have been valuable to include questions relating to experience of prosthodontic treatments.

Another difference found was that the PDHS dentists compared to PP dentists awarded greater importance to the advantages of SDA in terms of reduced risk of overtreatment, better patient economy, and the patient's ability to keep their natural teeth as they aged. It might be possible to explain this difference by different financial situations and different patient profiles in the two care delivery systems as reported earlier (73).

The vast individual variation among the dentists with regard to several of the statements was particularly striking. Limited knowledge of the SDA, however, might explain the significant variation in attitudes towards these statements, given that knowledge, understanding and judgment of the idea are required to form an opinion of it (59).

Prosthodontic decision-making with focus on the SDA and compromised molars

An obvious overall finding was that the prosthodontic decision-making process includes a large number of different factors, such as judgment of dental status, prognosis, attitudes towards risks and advantages of an SDA, as confirmed by the multiple regression analysis and in line with other studies (73, 84). Other factors involved in the decision-making process were the individual patient's needs and contextual aspects. One reason for the complexity of prosthodontic decision-making is that every individual is unique with regard to their needs, quality of life, social situation and attitudes. The dentists in the

present studies were obviously aware of the need for a holistic view and the involvement of patients´opinion when deciding on prosthetic treatments which would probably have an impact on oral-health-related quality of life. The patients' understanding of and motivation for the planned treatment was important, i.e. awareness of the causes of dental disease with the goal of changing the patients' behavior if necessary and subsequently being able to influence the outcome of the chosen treatment. These findings are in line with other studies (95, 84). The informants expressed a desire for further information on the patients, apart from the basic information and models provided by the survey, to make an informed treatment plan. This finding is important since there has been a reported discrepancy between professionally-assessed needs and patient-expressed needs (96, 97).

It was not unexpected to find that it was possible to capture the dimensions "technical", "comfort" and "time" from the important factors to be considered when planning a prosthetic treatment in an SDA (II). A previous study had shown rather similar dimensions - "time", "health" and "comfort" - when Swedish dentists were asked to evaluate clinical and patient-related factors when deciding on FDPs or RDPs (94), and FDP or single implants (54). These results suggest that it might be possible to capture common dimensions of decision-making in prosthodontics by reducing much of the data relating to decision-making into factors, and then being able to compare the factors in relation to gender, length of time in profession or delivery system to find out whether being a male or female dentist, for example, has any impact on decision-making.

The findings from the questionnaire study may be relevant today since there have been no major structural changes in terms of number of the dentists in Sweden during the period 2003-2013, except that the number of female dentists has increased during that period while the number of male dentists has decreased. Due to a rise in the number of people with dental training immigrating from outside the European Union and the European Economic Area, the proportion of qualified dentists with training from foreign countries will continue to increase (38). It is not known how, or whether, an increased number of female dentists and dentists educated abroad will have any impact on clinical decision-making.

Evidence-based dentistry (EBD), which is information derived from randomized controlled clinical trials, is considered to be the basis for clinical decision-making. As a result, dentists regularly should consult relevant and updated literature with a critical mind and apply the information when making clinical decisions (98). To some extent, it was expected that some of the participants in the interview study would mention EBD as an important factor during treatment planning of the two patient cases. Although the participants could have searched for relevant scientific evidence, they never mentioned this as a possible strategy for guiding decision-making (there were no questions or statements relating to the importance of EBD in the questionnaire). These findings are similar to other studies investigating the limitations on implementing EBD in restorative dentistry due mainly to time constraints (99-101). Besides decision-making based on their own clinical experience, the GDPs also suggested collecting information about the patient from others in the dental team, (dental hygienist, assistant or dental technician) and/or consulting a specialist, which could be considered an easier and more convenient alternative to obtaining evidence-based knowledge by the participants.

Molar support

Retaining dentitions with molar support was important to the participants in the interview study which might reflect the rational theory of decision-making (42), that one is prone to choose an alternative with maximum expected utility. The participants showed limited knowledge of the SDA concept, which might echo that lost molar support implies too high a degree of uncertainty regarding the outcome of the decision (102-104) and that people are generally more prone to avoid a loss rather than to obtain a profit (47). As there was limited cognizance of the SDA concept, the treatment gain was probably considered unpredictable even though the participants agreed there were few risks with dentitions lacking molar support and not a problem for the patient. This might also illustrate that dentists are taught during their training to conserve rather than extract teeth.

Extractions appear to create a difficult decision that requires a number of considerations and is influenced by contextual aspects, such as the individual patient's needs (50), availability, or whether

the patients have to travel a long way for the treatment. Thus, such considerations, rather than the SDA concept, might result in a radical treatment plan.

Patient Age

In both the questionnaire study and the interview study, the answers to the question of whether the need for molar support was or was not associated with patient's age showed an inconsistency. It was also interesting to note that a discrepancy was found in the interview study where, on the one hand, the participants claimed that the patient's age was not important but, on the other hand, they also illustrated an obvious difference in decision-making based on whether the patient was young or old. This contradiction may reflect the result that the largest individual variation in the questionnaire responses related to the patients'age. It may also indicate that Swedish GDPs do not find the SDA concept entirely applicable to oral rehabilitation for the elderly in Sweden and that patient factors other than age appear to be more important, as shown in a study by Ettinger (2015) (105). These findings are interesting since it has been shown that the minimum number of teeth needed to maintain oral function varies from individual to individual and cannot be defined solely by age (5, 18).

In summary, prosthodontic decision-making is a difficult and complex process in general, as well as in a shortened dental arch, and dependent on many different factors (106-111).

Clinical use and future perspectives

At the time of the interviews, dentists in Sweden had experienced changes in the national dental insurance system over the years where the SDA concept had an impact on limitations within the system. Restrictions concerning dental implants posterior to the second premolar were introduced in 2003 (112) and in 2007 the restrictions were expanded to include not only dental implants but also FDP posterior to the second premolar. These restrictions were removed in 2015. As some of the participants of the interview study stated, using guidelines or concepts, such as the SDA concept, to impose financial limitations in insurance systems can make it difficult for

dentists to suggest adequate treatment alternatives to the patient if they are only able to propose treatment that is based on financial rules and limitations. It has been shown that financial incentives have a significant impact on decision-making and on the choice of prosthetic treatment provided (92, 113-115).

Nevertheless, the use of the SDA concept may be justified in individual prosthodontic treatment planning for frail, elderly people (116).

Suggestions for further studies

Given the conflicting results in the prosthodontic decision-making process with regard to the relevance of age and the need for molar support, further studies are indicated. These further studies could be designed using a qualitative approach where decision-making in favor of an SDA already exists, based on authentic patient cases from the dentists'own practice. Bearing in mind the aging population, it would also be interesting to include use of the Swedish National Guidelines for Adult Dental Care in prosthetic decision-making when considering complete and partial edentulousness. Since this thesis only included dentists, it would be particularly interesting to conduct interviews canvassing the opinion of elderly patients whose recent treatment resulted in an SDA with a focus on their chewing function, esthetics and oral health related quality of life.

CONCLUSIONS

Within the limitations of this study, the following conclusions can be drawn:

Contradictory relevance exists between the patient's age and the need for molar support when considering the SDA, due mainly to the individual patient's need.

Qualitative methodology can be a beneficial complement to quantitative methodology for further understanding of prosthodontic decision-making and attitudes.

Attitudes:
Swedish GDPs who have been given an explanation of the SDA concept have a positive attitude towards the concept and they consider there to be few risks with an SDA. There are small differences in attitudes between different groups of dentists but vast individual differences. Swedish GDPs not receiving an explanation show little or no cognizance of the SDA concept.

Prosthodontic decision-making:
There are vast individual differences when Swedish GDPs evaluate the importance of various patient-related items when planning a treatment in an SDA. Delivery system, place of dental education and attitudinal factors are related to the decision-making process in an SDA.

It is possible to capture common dimensions of decision-making in prosthodontics compared to other decision-making situations.

The SDA concept does not seem to have any substantial impact on prosthodontic decision-making in relation to dentitions with compromised molars. Retaining a dental arch with molars seems to be important to Swedish GDPs.

The dentist's experience, as well as the advice of colleagues or specialists, together with etiological factors and the patient's individual situation, influence decision-making more than the SDA concept.

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