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PHOTO: LUO NILSSON

Patient with twin-block appliance (TBA).

contents

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Editorial

Swedish Dental Journal

Dear reader,

This is the first issue of Swedish Dental Journal volume 40, 2016. As previously informed, Swedish Dental Journal will be put on hold from 2016. The Journal does no longer accept new submissions. However, manuscripts submitted before 1 of July 2015, and accepted for publication, will be published in two issues during spring 2016. The first of these issues is the one you are reading right know. The next one will be published in May 2016. As the volume of 2015 only had two issues, the 2016 issues are included in the 2015 subscription. Right now there are no definite plans of whether the Journal will re-open for submissions or not. Hence, no new subscriptions are accepted.

Research is a prerequisite for subsequent development of high quality clinical treatment in all medical disciplines, odontology included. High quality research can improve treatment, and thereby lead to good health and wellbeing. The dental health care professionals agree with this idea. The reason why research does not attract more dentists or dental hygienist or dental technicians is not fully understood. Some would even suggest that more research is needed to explore, and better understand the reason for this situation. Possible explaining factors could be lack of finances, lack of time, or even lack of prosperous career opportunities. On the other hand, others may argue that every clinician is indeed involved in critical thinking and evaluation of treatment outcomes in her/his dental office. This is, of course, very much true. However, in order to improve treatment, treatment outcomes and cost-effectiveness, as well as more easily decide about treatment based on scientific knowledge, we all need to enhance the collaboration between clinicians and researchers. This is the vast biggest challenge for the future. Efforts to improve Swedish dental research has been the topic of several meetings and conferences since 2011. In April 2016, the Swedish Dental Society has taken the responsibility to keep this important mission alive by arranging the first Swedish Conference on Dental Research. This important meeting is held in Malmö, bringing together clinicians, researchers, politicians, industry, research funding agencies, representatives from county councils, and patients. The aim is to discuss how we can improve collaboration and dental research, aiming for a better oral health. An appeal for those dental health care professionals who are not able to attend – there are a variety of opportunities for you to support and participate in research activities. For example – donate money to dental research through the Swedish Dental Society (Svenska Tandläkare-Sällskapet accounts: bg 770-1451 or pg 501 49-4, when donating money write GÅVA and name of donor). Every krona or penny is important and will be used for stipends, stimulating and supporting foremost young colleagues involved in dental research. Your donation can actually make a difference! Other ways to promote dental research is to get involved in it yourself. There are numerous clinical research projects throughout the country that very much would like to incorporate more patients, and at the same time develop partnership in research with clinicians. Good dental research is a concern for all of us. We have to work together!

Gunilla Klingberg
Acting editor-in-chief

Andreas Cederlund & Sofia Tranaeus
Co-editors

The Shortened Dental Arch concept from the perspective of Swedish General Dental Practitioners: a qualitative study

Eva-Karin Korduner[1], Björn Söderfeldt[2], Ingrid Collin Bagewitz[3], Per Vult Von Steyern[1], Eva Wolf[4]

Abstract

◎ The aim was to study the cognizance of and attitudes towards the Shortened Dental Arch (SDA) concept among Swedish General Dental Practitioners (GDPs) and the application of the SDA concept in their treatment planning using Qualitative Content Analysis. Eleven Swedish GDPs were purposively selected and all agreed to participate. In-depth semi-structured interviews were conducted and covered treatment considerations concerning two patient cases and the participants' reflections regarding pre-formulated statements about the SDA concept. Qualitative content analysis was used to analyze this data. The emerging theme was "the SDA concept is irrelevant" in the sense of the GDPs disregarding treatments providing dentitions with loss of posterior teeth. There was a strong reluctance to extract teeth, without consideration of the SDA concept, and a firmly patient-focused attitude towards the needs, age and financial situation of the patients.

Within the limitations of this study, Swedish GDPs show little or no cognizance of the SDA concept and it does not seem to be applied in their treatment planning. The results show that the qualitative methodology can be beneficial for further understanding of cognizance and attitudes towards the SDA concept.

Key words

Keywords: Attitudes, molar support, preserving teeth, qualitative content analysis, SDA

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Den förkortade tandbågen (The Shortened Dental Arch Concept) ur svenska allmäntandläkares perspektiv – en kvalitativ studie

Eva-Karin Korduner, Björn Söderfeldt, Ingrid Collin Bagewitz, Per Vult Von Steyern, Eva Wolf

Sammanfattning

◎ Syftet med studien var att med en kvalitativ analysmetod undersöka svenska allmäntandläkares kännedom om och attityd till den förkortade tandbågen; ”The Shortened Dental Arch Concept”, samt om konceptet tillämpas i deras behandlingsplanering.

Ett strategiskt urval av elva svenska allmäntandläkare gjordes och samtliga tillfrågade accepterade deltagande. Semistrukturerade djupintervjuer genomfördes där allmäntandläkarna med utgångspunkt från två patientfall reflekterade över tänkbara behandlingsalternativ samt över tidigare formulerade påståenden om SDA-konceptet. Kvalitativ innehållsanalys användes för att analysera insamlad data. Det övergripande tema som identifierades var ”SDA-konceptet är irrelevant” i betydelsen att allmäntandläkarna inte använde sig av SDA-konceptet i sin behandlingsplanering. Deltagarna undvek extraktion i så stor utsträckning som möjligt för att försöka säkerställa molarstöd och hade en uttalad patientcentrerad inställning avseende patienternas individuella behov och ekonomiska situation.

Inom studiens begränsningar visade de svenska allmäntandläkarna liten eller ingen kännedom om SDA-konceptet. Konceptet tillämpades inte heller i behandlingsplaneringen. Resultaten visar att en kvalitativ metod kan bidra till en djupare förståelse av tandläkares attityd till och kännedom om SDA-konceptet.

Introduction

In the 1980s, Käyser and his co-workers introduced a dental treatment model to manage the individual requirements of patients with compromised teeth: the shortened dental arch (SDA) concept which means a dentition with loss of posterior teeth; in other words, an intact anterior region with a reduced number of occluding pairs of posterior teeth (22). After clinical studies, Käyser concluded that subjects with SDA show sufficient adaptive capacity when they retain at least four occluding units in a symmetrical position (one unit corresponds to a pair of occluding premolars, and two units correspond to a pair of occluding molars). The intention of the SDA concept was to make the planning of cost-effective treatment easy and efficient, while still providing acceptable oral comfort and function for the patient (19, 21, 22).

The core of the SDA concept is to distinguish different levels of functional need in relation to age and other individual factors. Käyser suggests dividing the dental arch into strategic and non-strategic regions for treatment which differ based on age and circumstances. In this system, the anterior and premolar regions always receive the best quality care. The molar regions also receive the same priority as anterior teeth and premolars, provided that there are no limiting factors such as poor health, declining income or accumulated dental problems. Such factors, which might emerge in high-risk groups like the elderly and those considered at risk of developing dental caries and periodontitis, could result in situations where adequate care for all teeth was neither financially nor practically possible (20, 23). The concept has been debated ever since Käyser concluded that SDA is sufficient for oral comfort and function (4, 6, 10, 11, 14, 18, 31, 32).

The attitudes of dentists have an impact on treatment behavior and decision-making in dentistry (26, 27, 28, 29). 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) (8). One publication defines attitudes 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" (7). 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 (12). Attitudes can change, but change in a person's attitude does not necessarily lead to change in behavior. Other stronger attitudes, predispositions, motives, emotions or habits may however affect behavior (7). Thus, attitudes only shape behavior when they are strong enough to do so (1).

Studies concerning dentists' opinions and use of the SDA concept are scarce. In one study it was found attitudes towards SDA to be less than positive (5). In 2006, a questionnaire study that found generally positive attitudes towards the SDA concept among Swedish General Dental Practitioners (GDPs) also found wide variations in individual opinions (25). Despite evident approval of the concept, it appears not to be widely practiced (2, 3, 24, 34, 36).

While questionnaires and studies based on quantitative scientific methods can provide valuable data, qualitative information on opinions is limited. Qualitative research methods are considered suitable to analyze people's thoughts, feelings, attitudes, perceptions and preferences (35). They can produce unique, detailed, personal accounts, which can be used to improve our knowledge and understanding on a variety of issues that are of interest and importance to dentistry (15). Therefore, qualitative research method was considered to be a valuable complement to the quantitative research approach, used in the previous questionnaire study. The qualitative method was supposed to be useful in order to explore the essence of the variations in the individual opinions (25).

The aim of this study was to study the cognizance of and attitudes towards the SDA concept among Swedish GDPs and the application of the SDA concept in their treatment planning using Qualitative Content Analysis.

Materials and methods

Qualitative Content Analysis – a definition

The study was conducted according to Qualitative Content Analysis with an inductive approach described by Graneheim & Lundman in 2004 (16).

Content analysis is an empirical scientific method used to extract and draw conclusions about the content of various types of communication. The method can be used to describe experiences, documents, written and/or unspoken rules and power structures. It can furthermore be used with either quantitative or qualitative data and in an inductive or deductive way (13). The inductive approach involves analyzing data with little or no predetermined theory, structure, or framework, and uses the actual data itself to derive the structure of analysis. This approach is most suitable where little or nothing is known about the study phenomenon (9).

Table 1. Participants' sex, duration of practice/employment, service affiliation, practice/employment characteristics and location of undergraduate dental education.

Sex	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	Göteborg
Female	5	PDHS	Urban/southern	Göteborg
Female	19	PP	Urban/southern	Stockholm

* Part-time research at a Faculty of Odontology

Qualitative content analysis shows conflicting opinions and unsolved issues regarding meaning and use of concepts, procedures and interpretation. One important characteristic is that the method focuses on the subjects *and* the context (16).

Subjects

Eleven Swedish GDPs (Table 1) were strategically selected to participate. Firstly, the strategy comprised the fulfillment of the necessary inclusion criterion of the participant to have at least 1 year of practice/employment to ensure experience of treating dentitions without molar support. Secondly, the strategy of selection aimed at obtaining a variation of experience among the participants, thus, they were selected according to the following variables:

- Location of undergraduate dental education (Umeå, Stockholm, Göteborg or Malmö)
- Location of practice/employment (rural or urban; southern, northern or central Sweden)
- Duration of practice/employment (years)
- Service affiliation [private practice (PP) or public dental health service (PDHS)]
- Sex

The participating GDPs were localized based on the telephone directory, colleague recommendations and personal acquaintance with the interviewer in order to find participants according to the different variables. All the dentists identified agreed to participate in the study. The interviewer (EK) contacted all participants to inform them about the study and to schedule an interview.

Development of the interview guide

For this study, a semi-structured interview was chosen from the three fundamental types of research interviews: structured, semi-structured and unstructured. The semi-structured interview provides the participants with some guidance on what to talk about and this approach also allows for the discovery or elaboration of information that is important to participants but may not have previously been thought of as pertinent by the research team (15).

From the results of two pilot interviews, it was decided to include patient cases in the interviews for the actual study, as this led to a more nuanced discussion about the SDA concept. The pilot interviews are not included in the present study.

Two authentic cases, initially with complete dental arches and a presumed final treatment plan resulting in an SDA, were selected. The cases comprised patients with compromised teeth, mainly in the molar regions. One patient suffered from extensive caries, and the other patient from severe periodontal disease. Participants received a short case history (Table 2), radiographs, and plaster study models for each case.

Data collection

The in-depth semi-structured interview covered:

1. Treatment considerations for the two patient cases.
2. Reactions to pre-formulated statements about the SDA concept.

The statements with substantial individual variation in response from the previous questionnaire

Table 2. 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.

(25) were selected. Those statements had been formulated by the author according to Käyser's principles.

- 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.
- Treatment planning for elderly people should concentrate on preserving the most strategic parts of the dental arches: the anterior and premolar regions.

Each GDP was interviewed for 45-90 minutes, eight at their own offices and three at the interviewer's office in Malmö, Sweden. All interviews were digitally recorded. The interview technique encouraged the participants to respond in their own words and from their own viewpoint. The task of the interviewer was to minimize interview bias by encouraging free-flowing narrative around the interview topics. During the interviews, the interviewer carefully checked that she understood the participant's answers by repeating and summarizing what the participant had said, and then asking if the participant had anything to add. A medical writing agency transcribed the interviews which the interviewer later checked, adding detail, including notations of non-verbal expressions such as silence and laughter. All participants read and approved the final transcripts of their own interviews.

Procedure

All the interview texts were read several times to get a sense of the whole. Then the text was divided into meaning units, i.e. divisions were placed at the point a change in meaning occurred in the text. After division, each meaning unit was condensed into more

Table 3. 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	The SDA concept is unknown	The patient's needs cannot be generalized	Age does not matter	The dental insurance system is not generous
	Extension of the dental arch	Totally unaware of the SDA	The patient's individual needs are in focus	Age can be of importance for acceptance of SDA	Compensation rules determine treatment
		Forced opinion			

succinct formulations while preserving the core of its content. For the purpose of this study, meaning units covering cognizance of and attitudes towards shortened dental arches were selected for analysis.

Data analysis

Two investigators (EK and EW) each separately evaluated the condensed meaning units based on their content, abstracting them and giving each meaning unit a code (Table 3). Then the various codes were discussed, compared and sorted into categories and subcategories. By means of questions, comparisons and discussion among all authors, a consensus was reached on coding and categorization of the manifest content, and a theme to cover the latent content was agreed. For the purpose of illustration, interview quotes have been translated into English from the transcripts of spoken Swedish.

Ethical aspects

The study was submitted to the Regional Ethical Review Board of Lund University, Lund, Sweden (daybook no. [Dnr] 326/2008), which judged it not to need ethical review due to negligible risk of negative impact on the subjects. The participants were verbally informed about the study, and their written, informed consent was obtained.

Results

An emerging overall theme was found in the latent content: "the SDA concept is irrelevant". The SDA concept was irrelevant in the sense that the GDPs were ignoring the possibility of dentitions with lack of posterior teeth as a treatment option. Throughout the interviews the GDPs expressed the importance of preserving teeth and they never spontaneously mentioned the SDA concept as a treatment option. However, the participants indicated that their most important treatment consideration was respect for their patient's needs. A uniform pattern was identified: the participants showed limited cognizance of the SDA concept and it did not seem to be applied in the dentists´ treatment planning.

Two main categories were identified in the analysis. One category was labeled the "Tooth preserving approach" with subcategories "Tooth extraction reluctance" and "Absence of SDA concept". The other was "Patient-focused attitude" with subcategories "Needs assessment", "Relevance of age" and "Economic incentives" (Table 3).

The interviews revealed that all participants had experience of treating dentitions without molar support, but none of the GDPs was familiar with the SDA treatment concept although two dentists had heard the expression SDA before.

> "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."

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?"

Tooth preserving approach

During the discussion of the two patient cases, it was obvious that the GDPs valued complete dental arches highly. They sought to preserve all teeth if possible, including those with dubious prognoses in the posterior regions, so that if necessary they might serve as support in future treatment. The participants stressed the importance of avoiding tooth loss and were reluctant to extract teeth.

Tooth extraction reluctance

The GDPs considered every tooth to be valuable and worthy of preservation. When discussing treatments for the two patient cases, the GDPs sought to save as many teeth as possible, including mobile, periodontally-involved and badly decayed teeth.

> "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."

Though extraction was never the first choice, it sometimes became necessary. In these cases, the GDPs seldom suggested a removable dental prosthesis as an option. Instead, they suggested replacement with fixed dental prostheses or dental implants to give the patient a complete dental arch.

Absence of SDA concept

No application of the SDA concept was mentioned by any GDP when discussing the two patient cases. The GDPs' treatment considerations were only to save as many teeth as possible, and none spontaneously considered treatments involving extraction according to the SDA concept.

The absence of the SDA concept also became evident when discussing the pre-formulated SDA statements, with which the GDPs generally disagreed. They explicitly expressed concern about the statement suggesting that SDA treatment reduces the technical difficulty of treatment. They stated that the simplest treatment is not always the best for the patient and, as such, is not appropriate or desirable. The GDPs said that they would never hesitate to offer treatment with potential technical difficulties if they considered that treatment was the most appropriate for the patient.

> "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."

When discussing the pre-formulated SDA statements, we also found implicit expressions of the GDPs' discomfort with the SDA concept; many participants hesitated to apply the concept and some even seemed embarrassed, as illustrated below.

> EK: A dentition with no molar support […] allows patients to retain their own natural teeth longer.
>
> Participant: … Ummm, do I answer yes or no to that? (laughter)
>
> EK: How do you see it? Do you think it's correct?
>
> Participant: No, I don't think so, I haven't seen that it does.

The general disagreement among the GDPs with the pre-formulated SDA statements occasionally developed into some kind of agreement. However, this never happened immediately, but only after hesitation and reflection, as in the response below to the statement that SDA simplifies oral hygiene for the patient.

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

No GDP spontaneously suggested any kind of treatment in accordance with the SDA concept. It was only after direct questions about SDA that they discussed it: then only hesitantly and, most often, with disagreement.

Patient-focused attitude

The GDPs took a patient-centered and emotional approach. They never suggested using the SDA concept as a treatment option to offer the patient a lower-cost treatment or one that is less complicated and time-consuming for the dentist or the patient.

Needs assessment

The participants claimed to make individual decisions for each patient, based on the patient's oral hygiene ability, treatment cost and the patient's specific needs concerning a potential loss of posterior teeth.

> "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 GDPs thought that SDA might reduce patients' chewing ability, but that would vary greatly from patient to patient.

> "Chewing ability might be impaired, but at the same time, you can be surprised by people who only have teeth from 3-3 and don't have any problems."

The more experienced GDPs stated that patients require much more from dental treatment today than they did 20 to 30 years ago. They considered this to be a result of greater knowledge of treatment possibilities among patients. The dentists stated that it is now less socially acceptable not to replace lost teeth and to have visible edentate spaces, even in the molar region.

> "Today, more want to replace lost teeth than before, because they have more information about what can be done. Patients are also more aware of how they look."

Relevance of age

The GDPs said that patients, both young and old, often experience the loss of molar support negatively. Some GDPs expressed that young people might have a better outcome for new prosthetic replacements than elderly people and that therefore it was important to consider carefully whether to remove teeth in elderly patients. The participants expressed ambivalence regarding how age changes the impact of tooth loss on quality of life. They stated that age was less of an issue in deciding treatment than the patients' medical needs and financial considerations.

> "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."

Life experience could also be important for the patient to understand the suggested treatment. Elderly people may be more conscious about their teeth than young people, perhaps because they have had time to reflect on how it is to live with tooth loss. Some of the participants said that elderly people who lose their molars miss them even more than young people do.

> ".. to my mind it is experience that makes the difference. Let's say because she has lived longer and she may have more knowledge of certain life situations. She knows what can cause different things and what the effect they have on the mouth … But I can't be sure … But maybe because she has more life experience … But that doesn't necessarily mean that she really understands her oral situation."

The participants highlighted many risks for young people due to loss of molar support, including future problems like loss of vertical dimension, overclosure, increased tooth wear on remaining teeth, and loss of self-esteem.

Economic incentives

The GDPs expressed that a patient's financial situation and the dental insurance system have too much impact on the choice of prostheses treatment in the molar region. They said it would be beneficial if the dental insurance system covered dental implants in position 6, as well as in position 7, when implant treatment is anatomically possible. The GDPs claimed that many of their patients declined such treatment because of its high costs. In many cases, implant-supported prostheses would have been the first choice for treatment. In these situations, it was not desirable for the patient to replace missing molars with removable dental prostheses or fixed dental prostheses. The GDPs reported that patients who have taken good care of their teeth do not get finan-

cial compensation from the dental insurance system when an implant-supported crown is the best treatment to replace their molars.

> "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."

One of the GDPs, however, suggested that sometimes dental insurance restrictions were perceived as a relief, allowing dentists to avoid discussions when treatment with dental implants was not advisable.

> "Rules for compensation for implants in the National Dental Insurance System allow you to avoid some problems. Sometimes the patients request implants in position 6 but then they have to pay the piper for themselves."

Another participant expressed the opinion that people should accept that there is a finite amount of money within social regulation systems. Dental insurance systems should not discriminate between elderly and young patients, but rather give everyone the best possible dental care for life.

Discussion

The results of this interview study showed that cognizance of the SDA concept was limited and the concept does not seem to be applied in the treatment planning. The most important consideration for the participants was to have a patient-centered and emotional approach towards treatment and to respond to the patient's individual needs. They also emphasized the importance of preserving teeth, regardless of the tooth position in the dental arch.

The purpose of selecting the two specific patient cases with seriously affected molars by caries or periodontal diseases was to expect the participants to suggest extractions of those molars and consequently the patient cases would result in an SDA. The intention was to discuss whether to leave the patient with an SDA or not and in that way capture the different variations in attitudes to an SDA and how well known the concept was to the participants. To include a patient case with already existing SDA most probably would have meant more collected information. However, in light of the results with the limited knowledge of the SDA concept among the participants, this potential shortcoming might be of limited significance.

The fact that the interviewer was a specialist in prosthodontics might have influenced the participants, who may have felt obliged to suggest a "prosthodontic approach" as much as possible. All but three interviews were conducted in an environment familiar to the participant (the participant's office). However, it seems unlikely that either the interviewer's professional position or the interview environment significantly biased the results. To reduce the risk of error and bias, the interviewer checked that she had understood what had been said by regularly repeating and summarizing the content.

To achieve credibility, a homogeneous group of participants – GDPs with experience of treating dentitions without molar support – were selected. However, 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 11 interviews, all of which were rich in information, allowing conclusions to be drawn about the study aims. To be credible, a qualitative study must also have categories that fit the data well, with both strong similarities within categories and well-defined differences between them (16). To address this, an agreement on categorization was sought among all researchers and representative quotations from the transcribed interview text were provided to support that categorization.

Transferability concerns the applicability of the findings in a different context (30). The participants were strategically selected with the purpose to ensure an experience of treating patients without molar support, a combination with a range of different perspectives to be included (Table 1). The overruling aim of the selection was to reflect the diversity within the Swedish GDP population. The results therefore might be valid for GDPs in Sweden although the number of participants seems to be few in relation to the number of subjects needed to be included in quantitative studies. However, the results are probably not applicable in other settings.

The attitudes expressed in the present study showed a uniform pattern; a distinct expressed patient centered attitude but little or no cognizance of the SDA concept. The participants had experience of treating patients without molar support but obviously lacked familiarity with the SDA as a concept, which was an interesting finding considering their

experience and diverse backgrounds.

The importance of patient interaction and the expressed interest in the patients' needs among the participants were obvious; a finding indicating that patient needs is superordinate in daily dental care. The GDPs stressed the importance of saving as many teeth as possible to provide molar support. A Japanese study evaluating five possible treatment options for missing molars found similar results, showing that both dentists and patients thought the SDA outcome (no replacement of missing molars) to be the least desirable option (17). A possible reason for this attitude could be that the SDA concept is not stressed in undergraduate training nor is it fully accepted among dentists.

In Sweden in 2003, the SDA concept was used as an incentive to introduce restrictions within the National Dental Insurance (NDI) system that created discontent among dentists and patients. Implant-supported prostheses were no longer subsidized for replacing molars in partially-edentulous jaws, except for anatomical reasons in certain situations. This might be considered in relation to the GDPs in the present study, who stated that a patient´s financial situation and the dental insurance system have too much impact on the choice of prosthodontic treatment in the molar region, and that the dental insurance system ought to give everyone the best dental care for life. The restrictions in the NDI, that recently have been removed, were based on the assumption that SDA is sufficient to provide the patient with acceptable oral function and comfort (33) which may be a misinterpretation of the concept (20). On the contrary, the intention with the SDA concept was to increase treatment planning options and patient decision-making on an individual basis, which is an attitude that the participants in the present study holds, although incognizant of the SDA concept.

By using a qualitative research approach it was possible to examine other aspects on the SDA concept than those examined in a previous questionnaire study (from which the formulated SDA statements were taken) (25). In the previous study, opinions seemed to vary widely for some of the statements, which are in contrast to the findings in the present study, where a uniform pattern was found. The discrepancy between the results of the present qualitative study and the previous quantitative study (25) is interesting and the reasons remain unsolved. However, the discrepancy still highlights an important issue; the choice of scientific method for addressing the research question. It is certainly possible to study distinctly qualitative constructs, like attitudes, using quantitative methods. However, the complimentary use of qualitative methods, might further contribute to knowledge, not least since the context is taken into consideration. When studying attitudes of complex clinical situations one might consider the value of using a combination of both quantitative and qualitative methods.

Although the SDA concept might be considered when planning treatment for patients with decreased molar support, there is a need for continuing research, evaluation and further discussion (18).

Conclusions

Within the limitations of this study, Swedish GDPs show little or no cognizance of the SDA concept and it does not seem to be applied in their treatment planning. The results show that the qualitative methodology can be beneficial for further understanding of cognizance and attitudes towards the SDA-concept.

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Aural symptoms in patients referred for temporomandibular pain/dysfunction

CHRISTINA MEJERSJÖ[1], INGRID NÄSLUND[2]

Abstract

◎ With the aim of studying frequency of aural symptoms and associations with symptoms of TMD, new patients referred to the Orofacial Pain Clinic, Odontologen, Göteborg, were asked, at their first appointment and before meeting a specialist, to report any symptoms regarding pain or fullness/swelling of the ear, impaired hearing, sensitivity to sound, and irritation/itching of the ear. They also answered a standardized questionnaire regarding temporomandibular pain and/or dysfunction, and classified their degree of TMD symptoms on a five-point verbal scale and a visual analogue scale. 108 consecutive patients were included in the study, they completed the questionnaires and were examined and diagnosed by different specialists at the clinic. Any ear symptoms were reported by 68% of the patients, fullness of ear by 44 % and impaired hearing by 37 %. 38 % of the patients had previously consulted a physician, and most of them had had pharmacological treatment due to their ear symptoms.

Females reported more pain in the ear (P=0.034) and more sensitivity to sound (P=0.046) than men. No significant association was found between age and aural symptoms. The degree of TMD- symptoms, as reported by the five grade scale, showed significant association with aural symptoms (P<0.001), as did the clinical dysfunction index of Helkimo (P=0.005). The diagnoses of myalgia, arthralgia, arthritis and headache showed significant association with aural symptoms, while no association with crepitus (osteoartrosis) and disc displacement. Itching in the ear was frequently reported (24 %) and was associated with myalgia (P=0.003) and tension headache (P=0.018). A medical examination by an ear-nose-throat specialist of 19 patients reporting a sensation of fullness of ear, did not reveal any objectifiable ear disease. To conclude, aural symptoms are common in patients with temporomandibular pain and/or dysfunction, are associated with TMD-symptoms and should be regarded as possible symptoms of TMD. A cooperation between physicians and dentists can give these patients a good treatment.

Key words

Temporomandibular disorders, diagnosis, aural symptoms, fullness of ears

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Öronsymptom hos patienter remitterade för smärta/ dysfunktion i käksystemet

CHRISTINA MEJERSJÖ, INGRID NÄSLUND

Sammanfattning

◎ Med avsikt att undersöka förekomst av öronsymptom bland patienter med smärta och dysfunktion i käksystemet fick nya patienter remitterade till Specialistkliniken för Bettfysiologi, Göteborg, vid sitt första besök på kliniken besvara ett frågeformulär om upplevda öronsymptom såsom värk i öron, känsla av lock/svullnad, försämrad hörsel, ljudkänslighet, och irritation eller klåda i öron. De fick även besvara ett standardiserat frågeformulär angående upplevd smärta och dysfunktion i käksystemet och fick ange svårighetsgraden av sina käkbesvär både på en fem-gradig skala (inga eller minimala besvär till mycket svåra besvär), och på en VAS-skala.

Studien omfattar 108 patienter, som besvarade frågeformulären och därefter undersöktes och diagnostiserades av olika tandläkare vid kliniken, ovetande om vilka öronsymptom patienten rapporterat. 68 % av patienterna uppgav något besvär från öronen, hälften hade mer än ett symptom. Lockkänsla rapporterades av 44% och försämrad hörsel av 37%. Kvinnor var mer ljudkänsliga (P=0.034) och hade mer smärta i öronen (P=0.046) än män. Åldern hade ingen betydelse. Patientens subjektiva svårighetsgrad av TMD symptom hade signifikant samband med öronsymptom (P<0.001), vilket även de kliniska symptomen enligt Helkimos dysfunktionsindex hade. Diagnoserna myalgi, arthralgia, arthritis och huvudvärk hade signifikant samband med öronsymptom, men inget sådant noterades för krepitationer och diskförskjutning. 24 % uppgav klåda i örat, vilket visade samband med myalgi (P=0.003) och spänningshuvudvärk (P=0.018). Medicinsk undersökning av ÖNH-läkare av 19 patienter med lockkänsla visade ingen öronsjukdom. 38 % av patienterna hade tidigare sökt läkare för sina symptom och de flesta hade då fått någon farmakologisk behandling. Sammanfattningsvis är öronsymptom vanligt hos patienter med smärta och dysfunktion i käksystemet, och bör beaktas som möjliga TMD symptom. Läkare och tandläkare behöver samarbeta avseende dessa patienter.

Introduction

Since long it has been reports and studies on aural symptoms in patients with diagnosis of temporomandibular disorders (TMD). Symptoms of otalgia, impaired hearing, hyperacusis, fullness of the ear, vertigo and tinnitus have frequently been found together with symptoms of pain and dysfunction of the masticatory muscles and temporomandibular joints (TMJ). 42-76% of patients with TMD reported aural symptoms (12, 17, 29). Among adult patients seeking medical treatment due to otalgia, a diagnosis of primary ear disease could be found in only half the cases (21). At an otolaryngology practice, 10% of all new patients had symptoms of TMD, and aural symptoms of loud noise sensitivity and cold wind sensitivity were 5 times more frequent in TMD subjects than in controls (5).

When screening a population regarding otalgia by a questionnaire, 9% reported otalgia in the previous six months. Of these, 100 persons were clinically examined and 91% were diagnosed with secondary otalgia (no pathology of the ear) (15). Kuttila followed 411 persons for two years and noticed secondary otalgia in 12-16 %, and fullness of the ear in 5-9 % (13). Individuals with secondary otalgia had significantly more TMD and cervical spine disorders (14, 15). Otalgia was also frequently associated with degenerative cervical spine disease (10). In an elderly population, fullness of ears was reported by 8.8 % of women and by 3.8% of men (7).

Many authors have noticed an association between aural symptoms and TMD, although the aetiology is not fully understood and the cause-effect relationship has been discussed. Pain in the aural region is likely explained by referred pain from the masticatory muscles and the temporomandibular joints, as well as from the cervical spine (15). Other explanations for simultaneous symptoms from the ears and the masticatory system are compression of the Eustachian tube, or pressure from the temporomandibular condyle (for a review see Bush et al (2). The partly common innervation of the ear, the TMJ and the masticatory muscles, have been suggested an explanations to the adverse aural symptoms appearing together with TMD (19, 23). The background of a sensation of fullness of the ear and/or impaired hearing in this context is still to be explained. Aural symptoms, however, cause great discomfort and many visits of the patients to both dentists and physicians. Patients with aural symptoms and simultaneous TMD were found to frequently seek medical care (16).

The aims of the study were, to investigate the frequency of some aural symptoms among patients referred for temporomandibular pain and/or dysfunction, find characteristics for patients with symptoms of TMD and aural symptoms, and to compare different sub-diagnoses in this respect.

Patients and methods

Patients

All new patients at their first visit to the Orofacial Pain Clinic after a referral were considered for the study. Patients with different kinds of orofacial pain/dysfunction are referred to the clinic, pulpal pain seldom emerge and only when the symptoms are atypical. Also patients with occlusal problems and sleep apnea syndrome are referred and treated at the clinic. The collection of the patients was performed during nine weeks in 2009. Ages 13 years and older were considered. Excluded were patients who recently had got a specialist treatment for the same symptoms and patients who had difficulties to answer the questionnaire. Non-Swedish speaking patients were included only when they could have the questions translated by an accompanying authorised interpreter. The inclusion criteria were fulfilled by 117 patients, 93% participated. The study comprises 108 patients, the female proportion was 65% and the average age was 46 years (13 -81 y).

Questionnaire and clinical examination

The patients first answered five questions regarding symptoms experienced from ear/ears during the last year. They only had to answer yes or no. The symptoms asked for were: pain in the ear, swelling or fullness of the ear, sensation of impairment of hearing, "sensitivity" to sound, and itching or irritation of the ear. They also had to report if they had sought medical care because of their symptoms from the ears and if any medication had been prescribed. The questions were asked in combination with the ordinary questionnaire used at the clinic regarding symptoms of pain and dysfunction from the temporomandibular system. The answers regarding symptoms from the ears were given before the patient met a specialist and before any information was given to the patients. The degree of pain and dysfunction was estimated by both marking on a VAS scale from 0-100 mm (9) and by rating the symptoms on a five-point scale from no or minimal to severe symptoms.

The patients were then taken care of according to the referrals by different specialists at the clinic, were unaware of the patient´s answers regarding ear

symptoms. A clinical examination was performed (3), signs of dysfunction and parafunction (tongue, lip or cheek pressure) were noted and the diagnosis stated (22). Information about the result of the clinical examination and diagnosis was later collected from the patient's journal, and the degree and severity of the dysfunction for every patient was estimated by the clinical dysfunction index of Helkimo (8).

Medical examination

During the inclusion period, all patients reporting swelling/fullness of the ear or impairment of hearing connected to the present ear problems, and offered an examination by an ear-nose-throat specialist, including a clinical examination of the ears, epipharynx, throat and eardrum/middle ear, and an evaluation of the hearing by acustic tympanometri and audiometri. The examination was performed with otomicroscopy and the result was clinically evaluated. For the medical examination, the patients had another appointment at a medical clinic some 20 minutes away, and it was performed to the normal fee for medical care. Nineteen patients participated in the examination, 4 men and 15 women, 51% of those invited. The age of these patients were ranging from 31–69 years.

The statistical analysis were performed with the computer program SPSS. The chi-square test was used for comparison of the distribution of variables within the different groups of patients. The Spearman correlation test was used for evaluation of correlation between different variables. Statistical significance was considered at the 5 % level of probability.

Results

Frequencies of aural symptoms

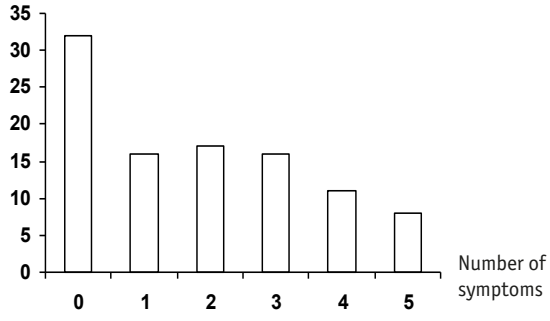
The referrals due to orofacial pain/dysfunction came from dentists in 67% and physicians in 33%, with the causes for referral as shown in Table 1. Any aural symptoms was reported by 68% of the patients (Table 2), half the patient group reported more than one symptom (Fig 1). Fullness of the ear was reported in 44% and impaired hearing in 37%, with a combination of these two symptoms in 29%, while either fullness of the ear and/or impaired hearing was reported by 51%.

◎ **Table 1.** Causes of referral to the Orofacial Pain Clinic, Göteborg (108 patients)

	%
Pain	53
Difficulties to open wide or locking	19
Attrition, sour teeth, occlusion	13
TMJ sound only	7
Headache only	6
Apnea	4
Posttrauma	1

◎ **Table 2.** Frequencies of reported aural symptoms by108 patients at the Orofacial Pain Clinic, Göteborg

	%
Pain in the ear	45
Swelling/fullness of ear	44
Impaired hearing	37
Sensitivity to sound or noise	34
Irritation, itching	24
Any aural symptom	68



◎ **Fig 1.** Number of reported aural symptoms in 108 patients (percentage distribution)

Females reported more pain in the ear (P=0.034) and more sensitivity to sound (P=0.046) compared to men. The females reported fullness of the ear in 48% and males in 38%, although no statistically significant difference. The age of the patients with TMD symptoms showed no association with any aural symptom. However, tinnitus wad reported by 39% in ages above 50 years, but only by 8% in ages 50 years and below.

Associations with TMD

The degree of TMD symptoms, as reported on the five grade verbal scale (Fig 2), showed significant association with reported fullness of the ear (P<0.001), sensitivity to sound (P<0.001) and to the number of reported aural symptoms (P=0.002). The evaluation

Table 3. Frequencies of some diagnoses of TMD and association with reported aural symptoms, and associations between aural symptoms and the clinical dysfunction index of Helkimo Di (108 patients). P-values for significant associations are given.

Diagnoses (n)		Aural symptoms: pain	fullness	impaired hearing	sensitive to sound	itching	number of
Myalgia	(95)	.001	.003		.051	.003	.008
Artralgi	(56)		.040				.008
Artrit	(7)	.029	.047				.048
Discdispl with reduction	(36)						
Discdispl without reduction	(5)						
Tension headache	(61)	.027				.018	.002
Sign of parafunction	(92)						
Crepitus	(31)						
Di		.025	.049			.015	.005

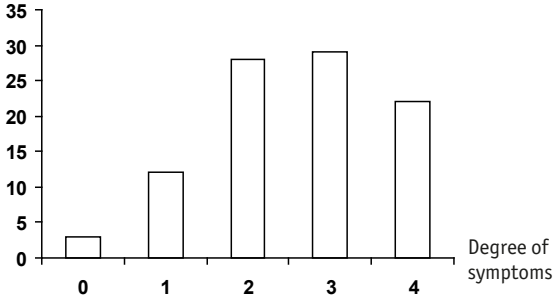


Fig 2. Degree of reported symptoms as classified by the verbal scale (0 = no or mild, 1 = mild, 2 = moderate, 3 = fairly severe, 4 = severe) by 94 TMD patient

of the degree of symptoms with the VAS, with mean 50, did not show any significant association with any of the aural symptoms, nor with the number of reported aural symptoms.

The frequencies of different diagnoses and associations with aural symptom are shown in Table 3. Any myalgia was recorded in 88% and myalgia of more than 3 sites in 69%, patients with myalgia reported significantly more aural symptom (P=0.008). Also arthralgia, arthritis and headache had significant association with aural symptoms. Itching in the ear was frequently reported (24%) and was associated with myalgia (P=0.003) and tension headache (P=0.018). The clinical dysfunction index of Helkimo was significantly associated with pain in the ear, fullness and itching of ear (Table 3). No association with maximal mouth opening was found.

Tinnitus was only association with the diagnosis of arthralgia (P=0.022). No patient with the diagnoses of neuralgia, sleep apnea, obscure pain, occlusal problems and malocclusion reported any aural symptoms, and they had few muscles tender to palpation. The proportion of patients not reporting any aural symptoms were for myalgia 16%, arthralgia/arthritis 28%, only headache 33%, disc displacement of any kind 35%, and other diagnosis 81%.

Of the patients reporting aural symptoms, half the group had had some pharmacological treatment due to their ear symptoms before the referral. Of the whole patient group 38% had previously consulted a physician due to their symptoms.

Medical examination

The medical examination by an ear-nose-throat specialist of 19 patients reporting fullness of the ear and/or impaired hearing did not reveal any ear disease. Measurements with acustic tympanometri showed a negative pressure in one out of the 19 patients. In pure-tone audiometry 7 persons had decreased hearing of different degrees. Four persons had a mild dip in the high frequencies, in two cases at the same side as the side of the symptoms. Three patients had a moderate symmetrical, high frequency, sensorineural hearing loss, which was known since earlier. Five of the seven patients with reduced hearing also had tinnitus.

Discussion

The high frequency of reported aural symptoms among our patients is in agreement with previous studies of patients with temporomandibular pain and/or dysfunction (17, 29). The clinical impression was that those symptoms are common but still not as common as noticed in the study. This could be a result of the questions not asked when taking the patients history, but also because the aural symptoms cannot be fully explained and there is no effective and generally acceptable treatment to offer.

The patients had diverse symptoms of pain and dysfunction and varying degree of symptoms. It is a heterogeneous group which could hide associations with aural symptoms, but which could also reveal differences in between diagnoses, and thereby give hints about the background of the aural symptoms in patients with TMD. The number of drop-outs of the study was low. The specialists who examined the patients did not know if the patient reported any aural symptoms or not, with exception for tinnitus that was reported in the standard questionnaire of the clinic and kept in the patient´s chart. The questionnaires regarding aural symptoms were answered, and than collected by a receptionist, before the patient met a specialist. The specialists did not know that their examinations and diagnoses later were going to be studied. However, the fact that different specialists examined the patients increases the variability of the examinations and diagnoses.

Women had more symptoms of pain in the ear and sensitivity to sound than men, but for the other symptoms or the total number of symptoms there was no significant difference in between men and women. Some epidemiologic studies showed more aural symptom among women (7, 13) and in a study of TMD patients females had significant more aural symptom (17). The aural symptoms were not age dependant in our study. Other studies have also failed to associate age with aural symptoms in TMD patients (4, 12). Tinnitus could be an exception, which could be explained by increased sensorineural hearing loss by age. Tinnitus have many different causes, but it has not been able to connect tinnitus and TMD (25).

Fullness of ears was reported by 44%. Previously, fullness of ear had been noticed in 30% and up to 90% in TMD patients (6) and epidemiologically in 5-9 % (15). Patients with sudden sensorineural hearing loss showed significant more symptoms and clinical signs of TMD compared to controls (1). Impaired hearing was reported by one-third of the patients of our study, which is in agreement with the findings by Tuz et al (29) of 21-36 % for different TMD diagnoses and 14 % among the controls. Tinnitus was neither associated with symptoms of TMD in that study. Still fullness of ears has been found a strong predictor for recurrent tinnitus (16).

A strong association between myalgia and aural symptoms was found, indicating that muscle hyperactivity and muscle tension play a part in the origin of aural symptoms. In our study patients with myalgia and arthralgia reported more fullness of ear and had more aural symptoms overall compared to patients with crepitus (osteoartrosis) and disc displacement. Previously, aural symptoms have been found to correlate to tenderness on palpation of the temporomandibular muscles and joints (6). In another study the severity of the TMJ arthropathy was significantly associated with ear symptoms and especially deafness (4). The greatest difference between different diagnoses was noticed for neuralgia, sleep apnea, obscure pain, occlusal problems and malocclusion. Those diagnoses had less myofascial pain and no aural symptoms which is further pointing to an association between muscular tension and aural symptoms. Itching of the ear and irritation of the meatus acusticus externa is frequent among patients with TMD symptoms, but the strong association with myalgia and tension headache, has to our knowledge, not been noticed before.

The group of patients reporting fullness of the ear and/or impaired hearing, and examined by an ear–nose-throat specialist, is small. Only half the number of these patients accepted the invitation to a medical examination, and it is not known whether those patients are representative for the group or not. The patient's rejection to the examination could be explained by the extra costs and inconveniences

of another appointment at another clinic. Of the 51% examined no primary ear diagnosis explaining the symptoms of fullness of ear was found. There has been report of minor alterations noticed by conventional tympanometry of TMD patients with aural symptoms (24) but which could not be found among the patients of this study.

It is important to consider other medical conditions and diagnosis presenting symptoms like fullness of the ear and sudden or fluctuating impairment of hearing. Beside the common otitis media there are several more serious and rare diagnosis (11, 18, 20, 28). In our study 38 % of the patients had first consulted a physician before the referral to a specialist. A close cooperation between dentists and physicians in these patients is eligible.

The patients rating of the degree of their temporomandibular pain and/or dysfunction was significantly associated with the number of reported aural symptoms, to sensitivity to sound and a sensation of fullness of ear. The ear symptoms are irritating experiences, and have measurable impact on the patient quality of life. The aural symptoms were also significantly associated with the clinical dysfunction index. Our findings that the frequency of aural symptoms increases with more symptoms and signs of temporomandibular pain and dysfunction is supported by the finding of Keersmaekers et al (12).

The cause and background of a sensation of fullness of the ear, and sudden or fluctuating impairment of hearing in TMD patients, is not fully understood (26). No cause-effect relationship has yet been demonstrated (17). Sakata et al (27) concluded that such symptoms may originate from some functional factor rather than an organic lesion. The muscles of the mandible, the external meatus acusticus, the incus and malleus bones of the ear, are all innervated by branches from n. mandibularis of the trigeminal nerve, and the ear muscles have a common embryological origin with the mandibular muscles. Pain of the ear in combination with symptoms of TMD could be explained by referred pain from mandibular muscles and prolonged contraction, or spreading of the tension of the masticatory muscles to the muscles of the ear. Could the sensation of fullness of ear, itching of the ear and changed hearing be some form of hyperalgesi, and depend on the common way of nerve impulses of the mandibular muscles and the ear muscles through the sensory n. mandibularis?

Conclusion

Aural symptoms, without organic lesion of the ear, are associated with TMD symptoms and should be included among symptoms of TMD. Aural symptoms are especially associated with diagnoses involving muscle tension, like myalgia and tension headache. Physicians and dentists in cooperation can give these patients a good treatment.

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Adult heavy and low users of dental services: treatment provided

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Abstract

◎ The aim of this study was to compare treatment provided to adult heavy and low users of dental services in the Finnish Public Dental Service (PDS) and to analyse changes in patients' oral health status.

We assigned all adults who attended the PDS in Espoo in 2004 to a group of heavy users (n=3,173) if they had made six or more dental visits and to a comparison group of low users (n=22,820), if they had made three or fewer dental visits. Data were obtained from the patient register of the PDS. A sample of 320 patients was randomly selected from each group. Baseline information (year 2004) on age, sex, number and types of visits, oral health status and treatment provided was collected from treatment records. Both groups were followed-up for five years.

Restorative treatment measures dominated the heavy and low users' treatments; 88.8 % of heavy users and 79.6% low users had received restorations during the five-year period. Fixed prosthetic treatments were provided to just 2% of the heavy users and 0.8% of the low users. Emergency visits were more common for heavy users (74.8%) than for low users (21.6%) ($p<0.001$). Fewer than half of the heavy (46.1%) or low (46.5%) users were examined twice.

Typical for heavy use of oral health services was a cycle of repetitive repair or replacement of restorations, often as emergency treatment, a lack of proper examinations and preventive care; crown therapy was seldom used. Immediately after the major dental care reform in Finland, the PDS in Espoo had problems providing good quality dental care for the new adult patients. Older patients with lower social class background were not accustomed to regular dental care and the PDS did not actively propose proper comprehensive regular care for adults.

Key words

Heavy use of oral health services; adult and elderly population; complicated treatment needs; treatment provided; quality of care, Public Dental Service.

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Vuxna storkonsumenter och lågkonsumenter av tandvården: utförda behandlingar

Annamari Nihtilä, Eeva Widström, Outi Elonheimo

Sammanfattning

◎ Avsikten med studien var att jämföra tandvårdsåtgärder utförda på vuxna storkonsumenter och lågkonsumenter av tandvården i den finska ”folktandvården” och analysera ändringar i gruppernas tandhälsostatus under en femårig uppföljningsperiod. Ur folktandvårdens patientregister i Esbo kommun utplockades alla de vuxna, som hade haft 6 eller fler besök (n=3173) och de som hade haft 3 eller färre besök (n=22820) år 2004. Ett slumpmässigt urval på 320 patienter selekterades från båda grupperna. För dessa samlades information om ålder, kön, antal och typ av vårdbesök, tandstatus och utförd behandling från patientjournalerna initialt år 2004 och under de fem följande åren 2005–2009.

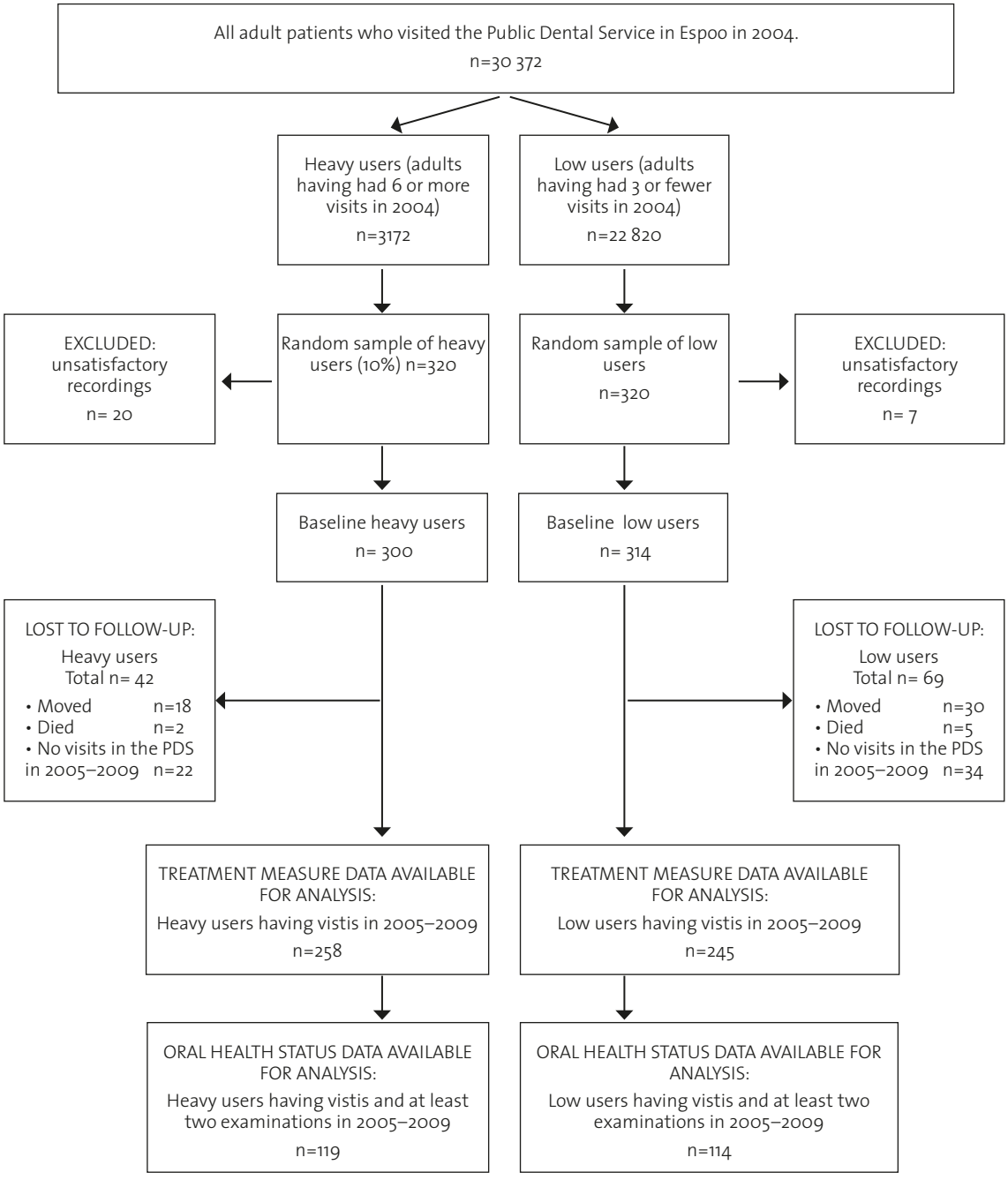
Fyllningsterapin dominerade vårdinnehållet för båda grupperna; 88.8 % av storkonsumenterna och 79.6 % av lågkonsumenterna hade fått restorationer under femårsperioden. Bara 2% av storkonsumenterna och 0.8 % av lågkonsumenterna hade fått fast protetik. Akutbesök var vanligare hos storkonsumenter (74.8 %) än hos lågkonsumenter (21.6 %) ($p<0.001$). Färre än hälften av patienterna hade under åren 2004– 2009 haft minst två undersökningar.

Typiskt för storkonsumenterna var upprepade reparationer och omgörningar av befintliga restorationer – ofta som akutbehandling och brist på ordentliga undersökningar, preventiva åtgärder och kronterapi. Det var uppenbart att folktandvården i Esbo tätt efter den stora tandvårdsreformen i Finland år 2002, som tog bort åldersrestriktionerna (som begränsat de vuxnas möjligheter att anlita folktandvården), inte kunde erbjuda vuxna patienter god vård. Antagligen var medelålderspatienter med lägre social bakgrund inte vana vid att kräva regelbunden tandvård och folktandvården erbjöd det inte.

Introduction

In Finland, dental services are provided by the Public Dental Service (PDS) and by private sector dentists. Local municipalities (n=320 in 2013) are responsible for arranging primary health care, including dental services for their inhabitants; these services are highly subsidised. Historically, the public sector catered mainly for children, young adults and some special needs groups and the adult population visited private dentists or clinical dental technicians. In 2001-

Figure 1 Selection of the study participants from the patient register in the Espoo PDS.



2002, the dental care provision system was reformed and the previous age limits restricting adults' use of the PDS were abolished. At the same time, all adults who used the private sector, irrespective of age, became entitled to partial reimbursement of the cost of dental care (except prosthetics) from the National Health Insurance. The Dental Reform aimed to increase equity by improving adults' access to care and reducing cost barriers (12). In 2005, Care Guarantee legislation was introduced stating that non-urgent treatment and examinations in primary health care clinics, hospitals and also in the PDS had to be provided within clear time frames.

Espoo, close to the capital, Helsinki, is the second largest city in Finland. The educational level of Espoo is the second highest in Finland and the income subject to state taxation per recipient is much higher than the national average (in 2011 €37 440 in Espoo compared with national average €26 555). Despite a good supply of private dental services for adults in the capital region, the increased demand for dental care by the adult population after the Dental Care Reform in 2002 put pressure on the PDS in Espoo. Before the reform, the PDS unit treated mainly patients up to the age of 30 years. To make the PDS more efficient, heavy use of dental services was analysed in 2004 (9, 11). These studies showed that 7% of the children and adolescents and about 11% of the adults who had visited the PDS in Espoo could be classified as heavy users. Their visits accounted for 26% of all visits by children and adolescents and 32% of all adult dental visits. High numbers of orthodontic treatments provided by general dentists and high numbers of decayed teeth in a small number of children were the main reasons for heavy use of services among children and adolescents (11). For a number of adult patients, a need for complicated treatment, dentists' and dental hygienists' lack of experience of adult dental care and a lack of specialists in the PDS resulted in high numbers of dental visits. The heavy users were older and had lower social status than low users and it was likely that the high cost of private dental care had created an accumulated need for complicated treatments in this group. The PDS of Espoo was unable to respond effectively to this need (9).

We also know from our longitudinal cohort study data that only 11% of the heavy consumers persisted as "chronic" frequent users during a five-year follow-up period. Most heavy users (62%) became low users (made 15 or fewer visits during 2005-2009) and 17% remained "intermediate users" who had made 6-29 visits. The "chronic" heavy users were even older (mean age 58.4 years) and to a greater extent retired (about 40%) than other heavy users (10).

The aim of this study was 1) to compare treatment provided to (the original) heavy and low users of dental services in the PDS of Espoo during the five years following the baseline year and 2) to analyse the changes in their oral health status using the following information: mean D, mean DMFT, highest CPI score, number of teeth present.

Methods

Initially all adults who had made six or more visits to dentists or dental hygienists in the PDS in 2004 were defined as heavy consumers of dental services. Low consumers were those who had made three or fewer visits during year 2004. The details of study participant selection have been published before (9,10) and are summarised in Figure 1. The city administration of Espoo, the legal owner of the patient register, granted research permission. From the 2004 patient records, we collected information on age, sex, occupation and self-reported general health status. Data on dental status were collected mainly from the 2004 records but also from the 2003 records when dental status had not been recorded in 2004. The occupational status was categorized into six classes: upper-level white-collar workers, lower-level white-collar workers, blue-collar workers, students, pensioners and others, using the classification recommended by Statistics Finland (16). From the 2004 records, we also collected information on the number of visits and on all treatment measures the patients were given during the visits.

In the follow-up study, we included all the heavy and low users of dental services identified in 2004 who had visited the PDS in Espoo during 2005-2009 (Figure 1). During the follow-up period, numbers and types of visits, treatment provided and oral health status (D, DMFT, highest CPI score, comprehensive periodontal status and the number of teeth present) were collected for each year as well as the number of treating dentists.

The D and DMFT indices were used to describe the caries status and the Community Periodontal Index (CPI) (1) to describe periodontal status. The sextant with the highest CPI score was noted from the patient records.

The PDS applies a specific coding system to record in the patient records the treatment measures provided and for charging patients as recommended by the Finnish Social Insurance Institution and these

Table 1. Demographic and service utilisation characteristics of the heavy and low users of the Espoo PDS during the follow-up period 2005-2009.

	Heavy users n=258	Low users n=245
Women% *	55.8	63.5
Mean age in 2004 (years) ***	49.7	42.0
65+ years %***	22.9	10.7
Mean number of all dental visits ***	14.8	7.7
Mean number of visits to a dentist ***	12.8	6.1
Mean number of visits to a dental hygienist*	1.8	1.0
Mean number of emergency visits***	2.8	0.3
Proportion who made emergency visits %***	74.8	21.6
Proportion examined % NS		
(Complete oral health status recorded)	67.0	66.9
Proportion having had at least one restorative treatment measure %*	88.8	79.6
Proportion having had at least one endodontic treatment measure %***	44.2	24.1
Proportion having had at least one periodontal treatment measure % NS	63.6	64.5
Proportion having had at least one extraction %***	45.3	28.6
Proportion having had at least on prosthetic treatment measure % *	26.0	14.3
Proportion having had at least one preventive treatment measure % NS	57.0	51.8
Proportion who visited a dental hygienist % NS	53.5	49.0

*** p<0.001¸* p<0.05, NS= p≥0.05

codes were used.

Data were analysed using SPSS version 18 (Statistical Package for the Social Sciences). Differences between the frequent and low attenders of dental services were evaluated by Chi-square and Mann-Whitney tests. Differences between the baseline and follow-up groups were evaluated by Chi-square and Wilcoxon tests. Determinants of emergency visits and preventive visits were analysed by binary logistic regression analysis at each step separately and they were adjusted for age and sex.

Results

Characteristics of the patients and use of services

During the follow-up, the heavy users were older and more often men and pensioners than the low users. Heavy users had also made significantly more visits to dentists (Table 1). Half of the patients in each group had visited a dental hygienist. Most patients in both groups had had fillings and prosthetic treatment was rare.

Emergency visits

Emergency care was an important feature of dental service use for heavy users. During 2005-2009, 74.8% of heavy users had sought emergency care compared with 21.6% of low users (p<0.001) (Table 1). The highest number of emergency visits per person during the 5-year follow-up period was 24 in the heavy user group.

Five or more treating dentists, restorative treatment, endodontic treatment, radiographs, and extractions were statistically highly significantly associated with emergency visits during 2005-2009 among heavy users (Table 2). Among low attenders, five or more dentists, endodontic treatment and extractions remained significant determinants for emergency visits. Oral health status was not a significant predictor for emergency visits in either of the groups (Table 2).

Examinations

At least one examination was provided to 67.0 % heavy users and to 66.9 % of low users and at least two examinations were provided to 46.1 % of heavy users and 46.5% of low users (p=ns) during 2004-2009 (Tables 1 and 3). During the five-year follow-up period, on average only one examination per patient had been provided and there were no significant differences by sex, age group or occupational status between heavy and low users (Table 3) who had had examinations. At least one radiograph was taken for 77.1% of the heavy users compared with 65.7% of the low users (p<0.05). Examinations including comprehensive periodontal charts were unusual; 11 heavy users (4.3% of all heavy users, 6.7 % of those

◎ **Table 2.** Determinants of making at least one emergency visit during 2005-2009. Odds ratios and 95% confidence limits based on logistic regression.

	Baseline heavy users n=258		Baseline low users n=245	
Independent variables	**OR (95% CI)**	**p-value**	**Odds ratio**	**p-value**
Sex				
Female	0.7 (0.4, 1.2)	0.202	0.8 (0.4, 1.5)	0.877
Male	Reference			
Age group (years)				
30-44	0.5 (0.2, 1.3)	0.160	0.9 (0.4, 2.0)	0.792
45-64	0.9 (0.4, 2.1)	0.918	0.7 (0.3, 1.8)	0.457
65+	2.1 (0.9, 4.9)	0.069	0.5 (0.2, 1.9)	0.342
18-29	Reference			
Variables adjusted for age and sex				
Oral health status in 2004				
3 or more D teeth	0.8 (0.3, 1.7)	0.612	1.2 (0.4, 3.5)	0.769
Periodontal pockets (CPI 3 or 4)	1.4 (0.5, 4.2)	0.564	2.3 (0.5, 10.0)	0.267
Number of teeth	1.9 (0.5, 7.0)	0.330	1.1 (0.9, 1.2)	0.292
Number of treating dentists				
5 or more	14.1 (6.6, 30.2)	0.000	3.3 (1.7, 6.3)	0.000
1-4	Reference			
Nagelkerke's R2 Heavy users=0.381 Low users=0.09				
Visits to dental hygienists				
At least one visit to dental hygienist	1.0 (0.5, 1.7)	0.937		
	0.6 (0.3, 1.2)	0.140		
No dental hygienist visits	Reference			
Examinations				
At least two examinations 2004-2009	1.5 (0.8, 2.7)	0.196	0.6 (0.3, 1.2)	0.183
0-1 examinations	Reference			
At least one treatment measure				
Radiographs	6.1 (3.1, 12.0)	0.000	1.7 (0.9, 3.6)	0.103
Nagelkerke's R2 Heavy users=0.227				
Restorative	6.3 (2.7, 14.6)	0.000	2.5 (1.0, 6.4)	0.054
Nagelkerke's R2 Heavy users=0.171				
Endodontic	6.2 (2.9, 13.1)	0.000	2.7 (1.4, 5.3)	0.003
Nagelkerke's R2 Heavy users=0.223 Low users=0.064				
Extractions	4.3 (2.2, 8.6)	0.000	2.4 (1.2, 4.6)	0.010
Nagelkerke's R2 Heavy users=0.179 Low users=0.053				
Prosthetic	2.0 (0.9, 4.3)	0.083	1.5 (0.6, 3.6)	0.333
Periodontal	1.8 (1.0, 3.4)	0.040	0.8 (0.4, 1.5)	0.475
Nagelkerke's R2 Heavy users=0.094				
Preventive	0.9 (0.5, 1.6)	0.908	0.6 (0.3, 1.1)	0.107
No such treatment measure	Reference			

examined and 15.6% of those whose highest CPI value was 3 or 4) and four low users (1.6 % of all low users, 2.4 % of those examined and 8.1% of those whose highest CPI value was 3 or 4) had had a proper periodontal examination.

Conservative treatments

Most patients, 88.8% of the heavy and 79.6% of the low users, had had restorative treatment (mainly composite fillings) during the follow-up period (Table 1). Heavy users had significantly more restorations in all groups when categorized by sex, age and socioeconomic status, than low users. The highest mean number of restorations was found in heavy users who were pensioners (Table 3). One chronic heavy user had received 66 fillings during the follow-up period.

Endodontic treatment remained more frequent for heavy users, 44.2% of the heavy users had had at least one endodontic treatment measure compared with 24.1% of the low users ($p<0.001$). To have one completed root filling, the heavy users had made an average 3.0 visits and low users 2.9 visits (p=ns). The highest number of endodontic treatment measures was 38 during 2005-2009, and this persistent frequent user had had 13 endodontic treatment measures already in 2004.

Prosthetic treatment measures had been provided for 26.0% of the heavy users compared with 14.3% of the low users (p=0.001). Fixed prosthetic treatments were rare: five (2%) heavy users and two (0.8%) low users had received fixed prosthetic treatment (p=ns). One porcelain crown was made; all the other fixed prosthetic treatments were fibre reinforced composite bridges. Denture repairs were more common: 15.5% of the heavy users and 5.3% of the low users ($p<0.05$) had received such care. The highest number of prosthetic treatment measures was 20 for one patient and the main reason for these visits was TMJ disorder.

More than half of the patients in each group, 63.6% of the heavy and 64.5% of the low users (p=ns), had had at least one periodontal treatment occasion. Dental hygienists usually provided the periodontal treatment; 52.2% of the heavy and 48.2% of the low users had been treated by dental hygienists compared with periodontal treatment by dentists (36.9% and 31.8% respectively). During the follow up period, 45 year old or older heavy users had received the highest number of periodontal treatment measures (Table 3). The highest number of periodontal treatment measures was 25 during

Table 3. Mean numbers of different treatment measures for heavy and low users by sex, age and socioeconomic status during the follow-up period 2005-2009

	Total		Men		Women		18-44yrs		+45yrs		Blue collar		White collar		Pensioners	
	Heavy users n=258	Low users n=245	Heavy users n=114	Low users n=90	Heavy users n=144	Low users n=155	Heavy users n=111	Low users n=165	Heavy users n=147	Low users n=79	Heavy users n=67	Low users n=45	Heavy users n=93	Low users n=132	Heavy users n=59	Low users n=23
Examination	1.1 NS	1.0	0.9 NS	1.0	1.3 NS	1.1	1.0 NS	1.1	1.2 NS	1.0	1.2 NS	1.0	1.0 NS	1.1	1.2	1.0
Restorative treatment	7.8***	3.9	7.0*	4.1	8.4***	3.8	5.4***	3.1	9.5*	5.6	8.4*	4.0	6.6*	4.1	11.0*	4.4
Endodontic treatment	1.9***	0.9	1.3*	0.7	2.3***	1.0	2.5***	0.8	1.4 *	1.1	2.5*	0.9	1.7 ***	1.1	1.1	0.5
Periodontal treatment	2.4*	1.5	2.7*	1.3	2.1 NS	1.5	1.2 NS	1.2	3.3*	2.0	2.2 NS	1.7	2.5 NS	1.4	3.2	1.8
Extractions	1.1***	0.5	1.3*	0.6	0.9*	0.5	0.6*	0.4	1.4 NS	0.8	0.9 NS	0.9	0.8 *	0.4	1.9*	0.5
Prosthetic treatment	1.3***	0.4	1.4*	0.5	1.2*	0.3	0.4 NS	0.2	1.9 NS	0.8	0.8 NS	0.5	0.7 NS	0.3	3.1	1.0
Preventive treatment	1.5*	1.1	1.6 NS	1.0	1.5 NS	1.1	0.9 NS	0.9	2.0 NS	1.5	1.6 NS	1.0	1.4 NS	1.1	2.1	1.6

Table 4. Determinants of having at least one preventive treatment measure during 2005-2009. Odds ratios and 95% confidence limits based on logistic regression.

Independent variables	Baseline heavy users n=258 OR (95% CI)	p-value	Baseline low users n=245 OR (95% CI)	p-value
Sex				
Female	1.0 (0.6, 1.6)	0.961	1.1 (0.6, 1.8)	0.782
Male	Reference			
Age group (years)				
30-44	1.1 (0.5, 2.3)	0.836	1.0 (0.5, 1.9)	0.995
45-64	1.6 (0.8, 3.3)	0.222	2.1 (0.9, 4.7)	0.068
65+	1.0 (0.5, 2.2)	0.987	0.9 (0.4, 2.4)	0.885
18-29	Reference			
Variables adjusted for age and sex				
Oral health status in 2004				
3 or more D teeth	0.8 (0.8, 1.6)	0.527	0.8 (0.3, 2.0)	0.637
Periodontal pockets (CPI 3 or 4)	0.6 (0.2, 1.6)	0.286	6.2 (0.6, 64.6)	0.123
No of teeth	1.1 (1.0, 1.2)	0.024	1.0 (0.9, 1.1)	0.246
Number of treating dentists				
5 or more	1.3(0.8, 2.2)	0.300	1.3 (0.7, 2.3)	0.346
1-4	Reference			
Visits to dental hygienists				
At least one visit to dental hygienist	73.7 (31.6, 171.6)	0.000	74.7 (31.9, 174.7)	0.000
No dental hygienist visits	Reference			
Nagelkerke's R2 Heavy users=0.666 Low users=0.681				
Examinations				
At least two examinations 2004-2009	6.1 (3.4, 10.8)	0.000	5.1 (2.9, 9.0)	0.000
0-1 examinations	Reference			
Nagelkerke's R2 Heavy users=0.221 Low users=0.206				
At least one treatment measure in 2005-2009				
Emergency	0.9 (0.5, 1.6)	0.738	0.6 (0.3, 1.1)	0.109
Examination	5.5 (3.1, 9.9)	0.000	5.8 (3.1, 10.9)	0.000
Nagelkerke's R2 Heavy users=0.192 Low users=0.207				
Restorative	1.9 (0.9, 4.3)	0.100	0.6 (0.3, 1.2)	0.141
Endodontic	0.9 (0.6, 1.6)	0.817	0.7 (0.4, 1.2)	0.194
Extractions	1.5 (0.9, 2.6)	0.093	0.6 (0.4, 1.1)	0.642
Prosthetic	0.6 (0.3, 1.1)	0.118	0.7 (0.3, 1.6)	0.444
Periodontal	20.1 (10.2, 39.6)	0.000	30.7 (13.4, 70.1)	0.000
Nagelkerke's R2 Heavy users=0.444 Low users=0.492				
No such treatment measure	Reference			

the 5-year follow-up period for one patient, 14 of these visits were visits to a dental hygienist.

Preventive treatment measures

Dental hygienists had provided most preventive treatments (such as oral hygiene education instruction and fluoride varnishing); 49.6% of the heavy and 45.7% of the low users had such measures provided by a dental hygienist and 14.7% and 14.3% respectively by dentists. No significant differences could be found in the mean number of preventive treatment measures provided when comparing heavy and low users in different subgroups (Table 3). Regression analysis demonstrated that at least one

Table 5. Changes in oral health status between first examination in 2004 (2003) and the latest examination recorded during the follow-up period 2005-2009 in heavy and low users.

Dental status	Heavy users n=119			Low users n=114		
	First examination	Latest examination	Change	First examination	Latest examination	Change
Mean D	2.5	2.1	-0.4	1.0	1.1	0.1
Mean DMFT	21.0	22.4	1.4	15.0	15.9	0.9
% DT=0	21.8	31.1	9.3	50.9	43.9	-7.0
% DT=1-2	39.5	37.0	-2.5	35.1	39.5	4.4
% DT=3-5	28.6	23.5	-5.1	11.4	14.0	2.6
% DT=6-18	10.1	8.4	-1.7	2.6	2.6	0
% with healthy periodontal conditions (CPI=0)	9.8	4.9	-4.9	11.4	9.6	-1.8
% with gingival bleeding (CPI=1)	9.7	13.0	3.3	15.8	15.8	0
% with periodontal pockets (CPI=3 and 4)	30.1	33.3	3.2	11.4	14.9	3.5
Mean number of teeth	25.5	24.5	-1.0	27.4	27.0	-0.4
% with more than 20 functional teeth	90.9	85.1	-5.8	95.8	95.8	0

No statistically significant changes in dental status could be observed for heavy or low users during the follow-up period

visit to a dental hygienist, at least two examinations 2004-2009 and at least one periodontal treatment measure had a statistically significant relationship with provision of preventive treatment measures (Table 4). Oral health status was not a significant predictor for preventive treatments for heavy or low users.

Changes in oral health status

Changes in the dental status could be examined for those patients (about 46%) who had had an examination initially and during the follow-up period (Table 5). Only 1.2% of the heavy users and 0.6% of the low users were edentulous and none of these had had two examinations during 2004-2009.

Almost all heavy (96.0%) and most low users (82.5%), who had at least two examinations, had received restorative treatment measures. Despite the high number of fillings for the 119 heavy users (mean number of restorative treatment measures was 10.5 during 2005-2009), the changes in mean DMFT and the mean DT were minor and not statistically significant. The mean number of restorative treatment items for the 114 low users was 5.5 during 2005-2009.

The proportion of patients with healthy periodontium (CPI=0) was lower for both heavy and low users after the follow-up period and 3.2% of the heavy users and 3.5% of the low users had more shallow and deep periodontal pockets although the changes were not statistically significant (Table 5).

Data on numbers of endodontically treated teeth could not be assessed from the dental status recordings.

Discussion

In all municipal PDS units in Finland, the various treatment measures (including examinations) have the same codes to record interventions. These codes are used to pay dentists additional productivity bonuses in addition to their monthly salaries. This

should encourage precise recording and therefore we think that our data are reasonably valid and reliable. In addition, there was direct access to treatment measures in the PDS treatment statistics. Information on oral health status had to be extracted for each patient from the patient records. This was undertaken by one of the authors (AN).

Surprisingly, the study showed that two or more examinations with treatment planning were provided to fewer than half (46.1 %) of the heavy users of dental services, despite the high numbers of visits and treatment measures provided. This can be explained by high numbers of emergency visits among adult patients, partly due to the fact that the PDS was opened for adults older than 42 years as late as in 2001-2002. Older adults with limited means probably were accustomed to irregular and problem based dental care. Even today, many PDS units in Finland are under-staffed and have problems making appointments for adults. Studies have shown that problem-oriented users of dental services have poorer oral health and tend to make more emergency visits than regular users (7, 3). A recent Finnish study (19) showed that there is a great difference in adults' attendance patterns between the private and public sectors. In private practice, most adults attended regularly on an annual basis and, in the PDS, on a much more irregular basis. This is partly be explained by the major Dental Reform, which abolished age limits in the PDS, resulting in increased demand for care. Now, ten years after the Dental Reform, it seems to us that to manage adult dental health effectively, the PDS should offer adult populations´ oral health care including regular examinations, treatment plans and recall visits based on patients' oral health and risk factors.

This study indicates that fillings therapy dominated the treatment provided to heavy and low users both, in 2004 (9) and during the five-year follow-up period. It is known from other studies in Finland (2, 6, 13) that, after the 1994 recommendations to avoid amalgam for environmental reasons, amalgam fillings have been almost totally abandoned and composite fillings are used on broad indications, even in load bearing molars and in cases where prosthetic replacements would have been more suitable. Studies show that survival of composite fillings is not very long (6, 18). The high numbers of fillings provided and small changes in the dental status of the patients support this interpretation. Furthermore, in the past dentists in Espoo treated mostly patients under 30 years of age and probably had little experience of crown therapy. From the point of view of patients, fillings are cheaper compared with crowns. It was obvious from our study that prosthetic treatments were extremely uncommon in the Espoo PDS. Most edentulous people in Finland use the services of clinical dental technicians and have not visited the PDS.

Only small changes could be noted between status recordings of patients who had had at least two examinations. This may be partly because of the low number of examined patients. However, these results show that the methods used to measure oral diseases were not very sensitive and it was difficult to measure treatment success or failure. In practice, the number of teeth present was the clearest indicator of change. The irreversible DMF index cannot reveal improvements in an individual's oral health (15). Unexpectedly, from the dental status recordings, it was very difficult to collect information on root fillings or prosthetic devices.

For periodontal diseases, there were no records of bleeding on probing or on the numbers of shallow and deep pockets, so it was not easy to estimate periodontal treatment needs or success of treatment. The PDS units were advised to use the CPI-index in the mid-1980s (1) when the PDS mainly treated children and youngsters. Unfortunately, the CPI index, developed for screening purposes (1), seems to have become the standard way of recording periodontal status, although the PDS now treats all age groups. For patients with periodontal pockets with CPI codes 3 or 4, a more detailed periodontal examination, including circumferential probing assessments around all teeth, is recommended (17, 5). In our study, the dentists or dental hygienists had completed comprehensive periodontal charts for only 16% of heavy users and for 8 % of low users whose highest CPI values were 3 or 4; this is a matter of concern.

Dentists' reluctance to measure periodontal conditions in their patients may partly be due to the fact that the clinicians in Espoo tended to refer most periodontal patients to dental hygienists and consequently the periodontal skills of PDS dentists may have become rusty. A recent questionnaire study in Helsinki Metropolitan Area (14) showed that most of the PDS dentists (59%) evaluated their periodontal diagnostic and treatment skills as mediocre or poor.

Successful care of many chronic conditions, including caries and periodontal diseases, requires behaviour modification. Our study shows that during the five year period studied, only about 55% of the

heavy and low users had received any preventive care (including oral hygiene instructions) but almost 90% of the heavy users and 80% of the low users had received restorative treatment. This is alarming as the recently published Best Practice Guidelines on treatment and prevention of dental caries in Finland (2009) (4) and Sweden (2011) (8) stress that dental caries can be mastered by healthy dietary and oral hygiene habits. Furthermore, in our study preventive treatment was offered principally to patients who had received periodontal care from dental hygienists. Task sharing between the dentists and dental hygienist should be explicit, so that patients who do not visit a dental hygienist also may profit from preventive care.

Adult dental care in the PDS of Espoo seemed to focus on treating the consequences of oral diseases (mainly caries) and not their causes, in a rigid and old fashioned way, and prevention was not appreciated. To reduce the impact of dental caries, which is totally preventable, and to provide good care for their target population, the PDS should change focus to provide regular preventive and comprehensive oral health care for adult populations, just as has been offered to children and adolescents during the past 40 years. Our study showed that the recording routines used in examinations in the PDS were not suitable for adult patients and these procedures need to be improved.

This study highlights quality deficiencies in adult dental care in the PDS of Espoo. A first step towards improvement would be to offer proper examinations and treatment planning and systematic risk-based recall intervals. It is also important to revise the standing instructions about clinical dental recordings in the PDS. The methods in use were imprecise and not very practical. In particular, the inappropriate periodontal recordings probably led to underestimates of periodontal treatment need. According to our study, a critical problem that led to heavy use of oral health services was a cycle of repetitive repair or replacement of old restorations, often done as emergency treatment, a lack of proper examination and failure to use crown therapy. Recently, the supervisory authorities have been looking at waiting lists and some local municipalities have been penalised for exceeding the six months. In a situation where the workforce is inadequate and task sharing does not function well, patients are treated as emergencies or semi-emergencies, with no proper examinations. Offering new appointments may be a feasible solution for the care giver and it may keep within the time frames. The problem should be solved by focusing both on the primary causes of caries and on the causes of failed restorations with a view to improving the quality of restorative treatment. Solving the problem will also require adjustments to the patient payment system and the PDS dentists' productivity bonus system. It is obvious that consequences of the major Dental Care Reform require continuing staff education, better task sharing and rigorous clinical leadership by well qualified dentists.

Conclusions

This study shows that, immediately after the major Dental Care Reform Act, a large municipal PDS clinic in Finland failed to provide good quality dental care for the new adult patients. Patients of lower social background, unused to regular dental care, failed to request it and the dentists did not actively propose it. This has to change.

Contribution of each author

AN participated in the design of the study, collected the data, performed the statistical analyses and drafted the manuscript. EW tutored, participated in the design of the study and drafted the manuscript. OE tutored and helped draft the manuscript. All authors have read and approved the final manuscript.

Statement of conflict of interests

The authors have no financial or non-financial competing interests.

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Cephalometric analysis of adults with Turner syndrome

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Abstract

◉ Turner syndrome (TS) is a genetic disorder of females with a prevalence of 1/2000-3000 live female births. The aim of this study was to compare cephalometric variables from adult women diagnosed with TS to a standardized reference group of 31-year old healthy women, and to evaluate the possible effects of human growth hormone (hGH) therapy in women with TS. Registered TS subjects in the Southeast region of Sweden were invited to take part in the study. Twenty-one women aged 36±13(18-57) years accepted participation. Lateral radiographs of the head were analyzed using standard cephalometric methods (Hasund analysis) and with the commercially available soft-ware program FACAD®. Comparisons were made with roentgen-cephalometric standards from a reference group of nineteen 31-year old Swedish women.

Analysis of the cephalometric radiographs from the TS subjects showed a more retrognathic maxilla (SNA 80.3±5.4) (p=0.0460) and mandible (SNB 77.0±5.2) (p=0.0014), and a correspondingly backward position of the chin (SN/Pg 78.9±5.5) (p=0.0046) as compared to the reference values of 31-year old women (SNA 83.2±3.0, SNB 81.5±2.3 and SNPg 83.0±2.3, respectively). In addition there was an increased posterior inclination of the maxilla (SN/NL 8.6±4.1), as compared to the reference values (SN/NL 5,3±2.7) (p=0.0048).

There were no significant differences regarding sagittal or vertical jaw relations, mandibular inclination or cranial base angle between the TS-group and the 31-year olds with the reference values. No significant difference was seen in jaw relationship, as measured by the ANB value, however the $Wits_{index}$ (3.3±3.5) was higher (p=0.0001) than the reference values (-0.1±1.8).

Subjects with or without previous hGH administration did not show any significant differences in cephalometric values.

In conclusion, women with TS had a significantly more retrognathic maxilla (SNA) and mandible (SNB) and a correspondingly significantly posterior position of the chin (SN/Pg), a significantly increased posterior inclination of the maxilla (SN/NL) and a significantly increased $Wits_{index}$ as compared to the reference group of 31-year old women. No craniofacial variables differed significantly between previously hGH-treated and not hGH-treated women with TS.

Key words

Turner syndrome, cephalometric analysis, growth hormone

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Kefalometrisk analys av vuxna med Turners syndrom

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Sammanfattning

◉ Turners syndrom (TS) är en genetisk sjukdom med en prevalens på 1/2000–3000 levandefödda flickor. Det föds alltså 20–30 flickor med TS i Sverige varje år. Syndromet innebär att en X-kromosom saknas, eller att patienten har en mosaikism, vilket innebär en blandning av normala celler och celler med endast en X-kromosom, 46,XX/45,X, eller en strukturellt förändrad X-kromosom. Detta ger upphov till kortvuxenhet, tillbakabildande av äggstockar och utebliven pubertetsutveckling med vanligen följande infertilitet. Olika somatiska sjukdomstillstånd är vanligt förekommande som hjärtfel, högt blodtryck, diabetes mellitus, njurproblem, sjukdomar i sköldkörteln liksom nedsatt hörsel. Många av flickorna har också utmärkande drag i sitt utseende med t.ex. nack-halsveck, epikantusveck, hand- och fotödem samt lågt sittande, utstående öron. Till skillnad från skelettmognaden, som i regel är försenad mer än två år, är den dentala utvecklingen accelererad och tandframbrott kan ske tidigare än genomsnittligt. Tänderna kan även ha avvikande form. Vanligast är avvikelser i proportionerna mellan krona och rot med förhållandevis korta rötter. Olika bettavvikelser kan förekomma, men postnormalt bett och korsbett är mer frekvent förekommande. Behandling vid TS inkluderar behandling med tillväxthormon för att öka längdtillväxten samt könshormon för att efterlikna pubertetsutvecklingen, vilket gör att dessa flickor kan leva normala liv.

Syftet med denna studie var att jämföra kefalometriska mätvärden från vuxna kvinnor med TS med en referensgrupp av vuxna (medelålder 31 år) svenska kvinnor. Registrerade TS-patienter i den Sydöstra sjukvårdsregionen i Sverige tillfrågades angående medverkan i studien. Tjugoen kvinnor i åldrarna 36±13 (18–57) år accepterade deltagande. Profilröntgenbilder analyserades med hjälp av en standardiserad kefalometrisk metod (Hasunds analys) i ett kommersiellt dataprogram FACAD®. Jämförelser gjordes med röntgenkefalometriska standardvärden från en referensgrupp med nitton 31-åriga svenska kvinnor.

Analysen av profilröntgenbilderna för patienterna med TS visade en mer retrognat maxilla (SNA 80,3±5,4) (p=0,0460) och mandibel (SNB 77,0±5,2) (p=0,0014) och en haka, som på motsvarande sätt också är mer retrognat (SNPg 78,9±5,5) (p=0,0046) i jämförelse med referensvärden från de 31-åriga kvinnorna (SNA 83,2±3,0, SNB 81,5±2,3, SNPg 83,0±2,3). En ökad posterior lutning av maxillan kunde också ses (SN/NL 8,6±4,1) i jämförelse med referensmaterialet (SN/NL 5,3±2,7) (p=0,0048).

Det noterades ingen signifikant skillnad avseende den vertikala basala käkrelationen, mandibelns rotation eller kranialbasvinkeln mellan TS-gruppen och de 31-åriga, friska kvinnorna. Ingen signifikant skillnad kunde heller visas i den sagittala basala käkrelationen uttryckt som ANB, medan $Wits_{index}$ (3,3±3,5) var större (p=0,0001) än i referensmaterialet (-0,1±1,8).

Tillförsel av tillväxthormon under uppväxten visade sig inte ha någon betydelse för ansiktets tillväxt och utveckling baserat på de registrerade kefalometriska mätvärdena.

Sammanfattningsvis noterades statistiskt signifikanta skillnader för de kefalometriska mätvärdena mellan kvinnor med TS och den friska referensgruppen. Huruvida den studerade gruppen av kvinnor med TS tidigare hade behandlats med tillväxthormon eller ej medförde ingen påvisbar skillnad på de studerade kefalometriska variablerna.

Introduction

Turner syndrome (TS) is a genetic disorder caused by numerical and/or structural aberration of the X-chromosome. The X-chromosome monosomy (45X) constitutes the main karyotype, but isochromosom for the long arm of X and mosaics are also regularly observed. [11, 31]. TS affects females with a prevalence of 1/2000-3000 live female births [9, 24, 31. The timing of the diagnosis is divided among newborns, children and teenagers [9,13, 31, 36].

Females with TS are usually short in height. In addition to growth problems, the ovaries in TS atrophies prematurely, which affects their sexual maturation and the ability to give birth to children [12, 13, 34, 36].

A number of other health problems occur more frequently in subjects with TS. The literature reports about renal anomalies, cardiovascular malformations, diabetes mellitus, hypertension, thyroid conditions, and hearing difficulties, in subjects with TS [11, 13 23]. Some of the other physical features commonly seen in girls with TS are: a "webbed" neck (extra folds of skin extending from the tops of the shoulders to the sides of the neck), drooping of the eyelids, differently shaped and low set ears [11, 14] and edema (extra fluid in the hands and feet) [34]. Subjects with TS are all different having various features and symptoms. With early and appropriate medical care and ongoing support, most women with TS can live normal, healthy, and productive lives [23].

TS is a condition caused by a chromosomal abnormality, therefore there is no specific cure at present. Human somatotropic growth hormone (hGH) treatment is used to improve growth and influence the girls final adult height [25, 27]. Another treatment for TS is estrogen replacement, which enhance the development of pubertal physical changes, such as development of breast and menstrual cycle [12, 13, 23].

The effect of hGH therapy on craniofacial growth has previously been studied among children and adolescents [17, 29], but has only been compared to a (non- TS) reference group. In a 2-5 year longitudinal study of 28 children with TS aged 4-19 years of age at the start of the study, those treated with hGH had no or little effect on the growth of the jaws as compared to those (three TS subjects) who had not received any hGH treatment, especially when administration of hGH had started during late childhood [11]. The long term effect of hGH therapy on craniofacial growth in TS subjects has not previously been evaluated in adults.

The aim of this study was to compare cephalometric variables from adult women diagnosed with TS to a standardized reference group of 31-year old Swedish women [26, 32], and to evaluate possible effects on cephalometric variables of hGH therapy in the females with TS.

The hypotheses were:

1) It is possible to dectect craniofacial differences between women with TS and a reference group of 31-year old Swedish women.

2) It is possible to detect craniofacial differences between adult TS women with and without previous hGH treatment.

Material and Methods

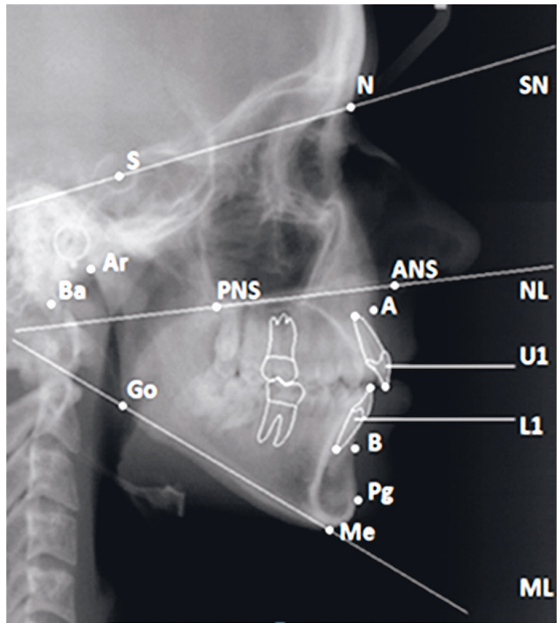
The study was performed in the South-East region of Sweden and included the three Swedish counties Östergötland, Kalmar and Jönköping.

All clinics of Gynaecology and Internal Medicine in the region were contacted. The local physicians first identified TS subjects and received oral informed consent before the subjects were contacted. The TS subjects were thereafter informed about the purpose of the study and gave their written informed consent. Twenty-one adult TS subjects accepted to participate and were included in the study.

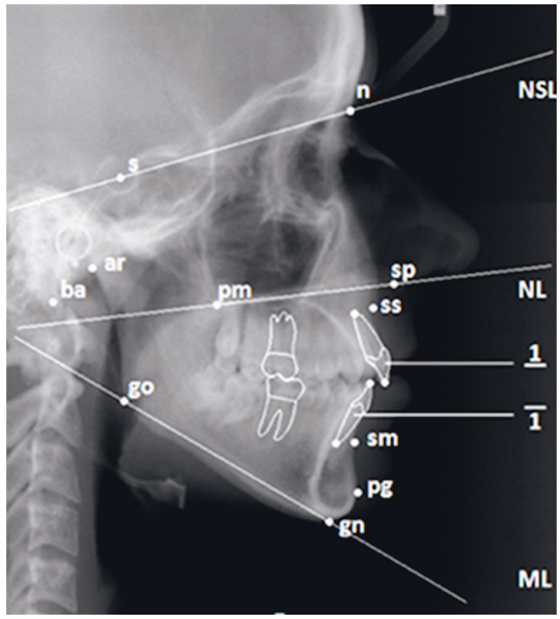
Ten TS subjects had a 45,X karyotype. Nine were mosaics 45,X/46,XX.Two had other karyotypes: 45X(12)46,X,i(X)(q10)[12]/47,X,i(X)(q10),i(X)(q10)[1] and 46iso(Xq), respectively. Seventeen had hormone replacement therapy (HRT), three had stopped HRT in expected menopausal age around 50 yrs and one had not reintroduced oestrogen (HRT) after egg donation. During childhood, eleven girls had been treated with hGH and ten had not been treated. The subjects ages varied between mean 18 and 57 years (mean±SD 36±13 years).

A medical examination was performed at the University Hospital in Linköping and the odontological examinations were made by an experienced specialist in paediatric dentistry (MB) at the Centre for Orthodontics and Paediatric dentistry in Linköping. The odontological examination included a clinical evaluation and lateral radiographs.

The lateral radiographs were exposed by a Siemens Heliodent (60 kV, 7mA) cephalostat (analogeous radiographs) from September 2003 to April 2004 (11 women) and by a Planmeca PM 2002 Proline imax (digitized radiographs) from May 2004 and forward (10 women). The radiographs were taken under standardized conditions with teeth in maximal occlusion. The enlargement of the radiographs



◎ **Figure 1.** Cephalometric reference points and planes used in the FACAD® Hasund analysis [30]:
Nasion (N), Sella (S), Basion (Ba), Artikulare (Ar), Menton (Me), points A and B, Anterior nasal spine (ANS), Posterior nasal spine, Pogonion (Pg), Upper incisor (U1), Lower incisor (L1), Sella nasion line (SN), Nasal line (NL), Mandibular line (ML).



◎ **Figure 2.** Cephalometric reference points and planes according to Björk [3, 4]:
Nasion (n), Sella (n), Basion (ba), Artikulare (ar), Gnathion (gn), Subspinale (ss), Submentale (sm), Anterior nasal spine (sp), Pterygomaxillary point (pm), Pogonion (Pg), Upper incisor (1), Lower incisor (1), Sella nasion line (SN), Nasal line (NSL), Mandibular line (ML)

was 1:1.1. A correction for the enlargement factor was made. Analogue radiographs were transferred into digital shape using the scanner Hp Scanjet 4890. The identity of the individuals and their possible hGH treatment history was unknown for the examinator. The radiographs from the TS-subjects were analyzed by one examinator (CS) using standard cephalometric methods (Hasund analysis[30]) with the commercially available soft-ware program FACAD® (Ilexis AB, Linköping, Sweden). The cephalometric analysis consisted of 13 angular and 3 linear measurements. The anatomical landmarks and the lines are depicted in Fig. 1 and Fig. 2. The definitions of the landmarks were according to Björk [3, 4].

The intraindividual error for the cephalometric measurements was calculated with the Dahlberg formula [5] after a repeated measurement by the same examinator (CS) on 10 randomly chosen radiographs, which was performed 14 days after the first measurement. The intraindividual mean±SD error for the angular measurements was 1.1°±0.6° and for the linear measurements 0.7±0.3mm.

The cephalometric values from the individuals diagnosed with TS were compared to published data from a standardized reference group of 19 Swedish women with a mean age of 31±0.46 years from Thilander et al. [26, 32]. Nineteen 31 year old women had originally been selected before adolescence based on the following inclusion criterias: Angle Class I molar/canine relationship, normal transversal occlusion, overjet and overbite 1-3 mm, dental arches without congenitally missing teeth or crowding, a "straight" profile without any obvious asymmetry, and no history of orthodontic treatment [32].

Since the $Wits_{index}$ had not been used in the study by Thilander et al., we used the reference material from Jacobsen [15] for comparison of this variable.

Following calculation of the cephalometric variables in the FACAD® program, the data was transferred to Statistica® software version 10 from StatSoft Inc., Tulsa, Oklahoma, USA) to perform the statistical analysis.

Two sample t-test equal variance was used for comparison between the TS group and the reference group. Two sample Wilcoxon rank sum test was used for comparison of TS individuals treated vs not treated with hGH. A p-value less than 0.05 was considered to be statistically significant.

The study was approved by the local Ethical Committee Linköping University (Dnr 03-093) and performed in accordance with the Declaration of Helsinki.

Table 1. Characteristics of the investigated subjects with Turner syndrome, divided in treated or not treated with human growth hormone (hGH).

	hGH (n=11)	Not hGH (n=10)	Total (n=21)
Mean±SD age (years)	27±9	47±9	36±13
Height (cm)	156±5	150±4	153±6
Weight (kg)	59±12	64±12	62±12
Body mass index (kg/m^2)	24±6	29±5	26±6
Karyotype 45,X (n)	5	5	10
Karyotype 45,X/46,XX (n)	5	4	9
Karyotype other (n)	1	1	2
Mean±SD[range] age at hGH-treatment start (years)	9±3.4[4-14]		
Mean±SD[range] duration of hGH-treatment (years)	7±3.1[3-13]		

Table 2. Comparison of cephalometric values between the study group diagnosed with Turner syndrome (TS) and the reference group using two sample t-test equal variance. The nomenclature for the cephalometric variables are presented both according to Björk [3, 4] (used for the reference material by Thilander et al. [27, 32]), and according to the Hasund analysis [30] (used in the FACAD® analysis). See also Figure 1 and Figure 2 for information about the nomenclature used in the first and second column.

Cephalometric variable according to Björk [3, 4]	FACAD® Hasund analysis [30]	TS n=21 (Mean±SD)	Reference n=19 (Mean±SD)	Difference (p-value)
s-n-ss	SNA	80.3±5.4	83.2±3.0	0.0460*
s-n-sm	SNB	77.0±5.2	81.5±2.3	0.0014*
ss-n-sm	ANB	3.3±3.3	1.7±2.1	0.0787
s-n-pg	SNPg	78.9±5.5	83.0±2.3	0.0046*
ML/NSL	SN/ML	30.8±8.7	26.4±4.8	0.0609
NL/NSL	SN/NL	8.6±4.1	5.3±2.7	0.0048*
ML/NL	ML/NL	22.1±6.9	21.1±4.8	0.5911
n-s-ba	NSBa	132.3±5.7	129.5±3.8	0.0731
RL/ML	Me-Go-Ar	121.0±8.8	117.3±5.6	0.1232
1/1	Interinc	130.9±12.4	134.6±6.1	0.2418
1/n-ss	U1/NA	22.1±11.1	18.5±4.3	0.1963
1/n-sm	L1/NB	23.8±6.4	24.2±4.9	0.8230
1- -(n-ss) mm	U1/NA (mm)	4.1±4.2	3.4±1.7	0.5306
1- -(n-sm) mm	Li/NB (mm)	3.4±2.6	4.5±2.0	0.1480
(n-sp')/(sp'-gn)	F_{index} = 100 x	80.1±7.0	79.0±6.0	0.5983
-	$Wits_{index}$ (mm)	3.3±3.5	-0.1±1.8¤	0.0001*

*) p<0.05
¤) Från Jacobsen [15]

Results

A description of the subjects from the study is presented in Table 1.

A comparison of the means of the craniofacial variables between the TS group and the reference group are presented in Table 2. Significant differences were found regarding the values SNA , SNB, SN/Pg, SN/NL, and $Wits_{index}$.

Jaw position in relation to the cranial base

Both the maxilla and the mandible had a more retrognathic position in the TS women, as shown by the significantly smaller SNA- and SNB-angle than in the reference group. The maxilla was also more posteriorly inclinated in the women with TS, as shown by the SN/NL angle, which was larger in the TS group as compared to the angle in the reference group. The inclination of the mandible was similar in the two groups, as there was no significant difference between the SN/ML-angles.

Sagittal jaw relations

The values for the basal sagittal jaw relationship ANB were similar in the TS group and the reference group. On the other hand a more postnormal relationship between the jaws was found in the TS group, as described by an increased value of the $Wits_{index}$ (Table 2).

Vertical jaw relations

The interbasal angle ML/NL were similar in the TS and reference group. The anterior facial height (F_{index}) expressed as (n-sp')/(sp'-gn) did not differ significantly from the reference group (Table 2).

Mandibular jaw angle

The jaw angle Me-Go-Ar did not differ significantly from the reference material. In addition a less prominent chin was found in the TS women, shown by a significantly reduced SN/Pg-angle.

Growth hormone

There were no significant differences regarding the cephalometric variables when comparing TS subjects with and without previous hGH administration (Table 3).

Discussion

This study was a part of an investigation among women with TS in the South East region of Sweden [35], which comprises one million inhabitants, around 10% of the Swedish population. Since the prevalence of TS has been set to approxiomatly 1/2000-3000 [12, 24, 31], we recognize that the studied group of individuals with TS represent a subset of the women with TS in the region. The drop-outs were not possible to register due to ethical considerations. A skewed distribution of the study group could therefore not be excluded. The standardized reference group of 19 adult healthy women is not representative of the entire female population in the age group, since harsh inclusion criteria were used for that material [32]. Due to the relatively small number of individuals included in the study and the selection of the reference group, the results should be judged with caution.

The growth in women is considered to be finished at about 18 years of age [4, 6, 10]. We therefore found the age range in the study group to be representative of adult women diagnosed with TS, since the youngest woman in the study was 18 years old.

The exposure of the lateral radiographs were performed during the technique-shift from analogue to digitized radiography. The transferral from analogue to digital radiographs was performed under standardized conditions and the scanning procedure was not considered to influence the final results.

Adult TS subjects exhibit some characteristic changes in craniofacial size and morphology [16, , 22, 28]. The calvarium, maxilla, and mandible has been found to be smaller and the cranial base shorter and more flattened in subjects with TS as compared to normal adult women. The maxilla and the mandible has been found to be retrognathic and posteriorly inclinated in relation to the cranial base [2, 8, 16, , 22, 28]. Midtbö *et al.* [18] also showed that the skeletal maturity was retarded on average 2-3 years while the dental maturity, on the other hand, was accelerated with a mean value of 1 year. Variations has also been found in tooth anatomy [7, 21] root length and root morphology [19, 33].

Jaw position in relation to the cranial base

Our findings that the maxilla and the mandible had a more retrognatic position (smaller SNA and SNB, respectively) and that the maxilla was more posteriorly inclinated (larger SN/NL) are in agreement with other studies [11, 16, 22, 28].

A less prominent chin (expressed as a smaller SN/Pg-angle) was found in the TS women. Also this finding is in agreement with previous studies [16, 28]. Midtbø et al. [22] found this difference only among TS women with 45X monosomy. Rizell [28] on the other hand, found this difference to be significant for all karyotypes. We did not separate the

Table 3. Comparison of cephalometric values between Turner syndrome subjects treated (n=11) vs not treated (n=10) with human growth hormone (hGH), using the two sample Wilcoxon rank sum test. See Figure 1, Figure 2 and the legend to Table 2 for further information about the nomenclature used in the first and second column.

Cephalometric variable according to FACAD® Björk [3, 4]	Hasund analysis [30]	hGH n=11 (Median [range])	No hGH n=10 (Median [range])	Difference (p-value)
s-n-ss	SNA	82.5 [68.3-85.7]	81.5 [76.9-90.3]	0.8602
s-n-sm	SNB	76.2 [64.9-84.9]	75.8 [73.1-83.0]	0.9439
ss-n-sm	ANB	1.8 [-2.0-8.6]	5.3 [-1.7-9.3]	0.1052
s-n-pg	SNPg	7.2 [66.0-87.5]	77.4[74.9-86.8]	0.8880
ML/NSL	SN/ML	28.3 [19.7-52.2]	30.9 [18.6-39.4]	1.0000
NL/NSL	SN/NL	6.7 [2.9-17.9]	9.3 [2.4-12.7]	0.4383
ML/NL	ML/NL	21.3 [15.0-36.6]	19.5 [12.3-30.4]	0.5732
n-s-ba	NSBa	131.4 [123.8-146.0]	132.3 [121.3-137.7]	0.9439
RL/ML	Me-Go-Ar	122.1 [109.6-138.9]	117.8 [105.1-133.8]	0.2908
1/1	Interinc	129.1 [121.1-145.6]	126.6 [114.0-163.4]	0.9439
1/n-ss	U1/NA	23.2 [15.8-39.8]	17.5 [-4.1-37.7]	0.1213
1/n-sm	L1/NB	20.4 [14.9-33.2]	27.0 [12.8-36.7]	0.0910
1- -(n-ss) mm	U1/NA (mm)	4.3 [2.5-10.9]	2.4 [-6.0-11.7]	0.1589
1- -(n-sm) mm	Li/NB (mm)	1.7 [-1.2-8.1]	3.8 [0.7-8.7]	0.1130
(n-sp')/(sp'-gn)	F_{index} = 100 x	80.4 [68.5-93.6]	78.7 [66.3-84.3]	0.2450
-	$Wits_{index}$ mm	2.3 [-3.1-11.1]	4.4 [-1.7-9.6] ¤	0.4386

¤) Från Jacobsen [15]

different karyotypes in our study due to the limited sample size.

The cranial base angle (NSBa) and the inclination of the mandible (SN/ML) did not differ significantly between the TS group and the reference group in our study. Although, the results showed a tendency (p=0.0713 and p= 0.0609, respectively) to support the findings from earlier studies where a flattening of the cranial base and a more posterior inclinated mandible has been reported [11, 16, 22, 28]. We find it reasonable to consider that the missing significances in the analysis of the cranial base angle and the inclination of the mandible in our study is due to the limited number of participants.

Sagittal jaw relations

The finding that the basal sagittal relationship (ANB) did not differ between the individuals with TS and the reference group is in agreement with the findings of Midtbø et al. [22] and Rizell et al. [28]. Midtbø et al. [22] could not find any significant difference regarding the sagittal relationship (ANB) between 7-16 year olds with TS and an age matched control group of healthy girls, and Rizell et al. [28] found no significant difference for the ANB-angle when 108 females aged 5-61 years were compared to the same referencegroup as we used in our study. The intermaxillary relationship between the jaws expressed with the $Wits_{index}$ showed a significantly more postnormal relationship between the jaws in the TS group as compared to the reference group (P<0.0000). No previous studies have been found where the $Wits_{index}$ has been used for the craniofacial analyses in women diagnosed with TS. The $Wits_{index}$ might add further information regarding sagittal interjaw relationships in case of vertical discrepancies such as in more pronounced deep or open basal relations.

Vertical jaw relations

The findings that our both measurements of vertical jaw relations, as expressed as- interbasal angle (ML/NL) and the anterior facial height (F_{index}) - were similar in the study group and the reference group are in agreement with previous studies from Denmark [16, 22] and Sweden [28].

Mandibular jaw angle

The similar mandibular jaw angle (Me-Go-Ar) found in the studied group of TS women and the reference group is also in agreement with the previous findings of Midtbø et al. [22].

The first hypothesis was confirmed, since several differences in craniofacial variables could be detected between the TS women and the reference group.

Growth hormone

The recommendations for treatment of subjects with TS has developed over time with new guidelines [27]. The introduction of hGH was therefore not available or started later among the older subjects in the study. The younger subjects had generally received hGH according to the new guidelines. Mean age for start of hGH treatment was 9 ± 3.4 yrs., (range 4-14 yrs.), and the treatment duration was 7 ± 3.1yrs (range 3-13 years) (Table 1). This should be noted when interpreting the results. The comparison of the subjects with and without hGH treatment is anyhow restricted to the comparison of subjects from different age groups since the new guidelines include hGH for all TS subjects. Two subjects were, anyhow, diagnosed with TS later in life, why they had not received any hGH treatment. The distribution of karyotypes was similar in the hGH treated and the not-hGH-treated groups, why the karyotypes is not expected to have influenced the results regarding differences between the hGH and non-hGH-treated groups.

Our finding that previous hGH administration had not influenced the evaluated cephalometric variables in the studied group of women with TS is in agreement with previous findings by Hass et al., who found that hGH -therapy had little or no effect on the growth of the jaws in a group of 4-19 year old TS girls as compared to healthy age matched girls [11]. Rongen-Westerlaken et al. [29] found that two years treatment with hGH in 8-16 year old girls with TS increased the mandibular ramus length, resulting in an anterior rotation of the mandible. No other effects from the hGH treatment were found by Rongen-Westerlaken et al. for the other cephalometric variables [29], which is in agreement with our findings.

Short stature is the most common finding in girls with TS affecting 95–99% of them [13]. One explanation of the reduced final height relates to the action of the *SHOX* gene located to the PAR1 region of the X and Y chromosome [13]. It has also been discussed wether girls with TS have a growth deficiency with reduced sensitivity to hGH rather than a growth hormone deficiency [13]. The effect of growth hormone in the synchondroses of the cranialbase and the epiphyseal plates of the limbs are probably the same but the timing may differ. Growth of the cranialbase is mostly completed at the age of 6 years while growth of the limbs proceed until late adolescence [11]. Since the deviating pattern of craniofacial size and morphology has been found to originate in the fetal period [1, 22], a possible reason why there was no difference among the hGH-treated and the non-hGH-treated women with TS in ur study could be that the hGH-therapy had been introduced too late. The second hypothesis was rejected, since we could not find any significant differences regarding the studied craniofacial variables between the hGH-treated group and the non-hGH-treated group of women with TS.

Conclusion

Women with TS had a more retrognathic maxilla (SNA) and mandible (SNB) and a correspondingly posterior position of the chin (SN/Pg), an increased posterior inclination of the maxilla (SN/NL) and an increased Witsindex as compared to the reference group of 31-year old women. No craniofacial variables differed between previously hGH-treated and not hGH-treated women with TS.

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Vital root resection with MTA: a pilot study

KAMRAN TAHMOORESSI[1], PETER JONASSON[2], LARS HEIJL[3]

Abstract

◎ Objectives. To investigate the outcome of vital root resection followed by immediate pulp capping with MTA in furcation involved maxillary molars.

Material and methods. This pilot clinical study of 12 months duration was designed to evaluate the outcome of vital root resection in maxillary molars with degree II furcation involvement combined with conservative endodontic treatment by means of pulp capping with mineral trioxide aggregate (MTA). Seven teeth in six adult patients suffering from adult chronic periodontitis were included in this study.

Results. At the final 12 month examination interval, one tooth had received root canal therapy subsequent to the 6-month evaluation. The remaining six teeth remained clinically vital for the duration of the study and required no further treatment at 12 months.

Conclusion. Results of this study provide limited data that can be used in a further investigation with similar methodology and a sufficient sample size in a randomized clinical trial model.

Key words

Periodontal surgery, Furcation Defects/surgery, Root resection, Dental Pulp Capping/methods*, Mineral Trioxide Aggregate.*

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Vital rotresektion med MTA: En pilotstudie

KAMRAN TAHMOORESSI, PETER JONASSON AND LARS HEIJL

Sammanfattning

◎ Syftet med denna pilotstudie var att undersöka behandlingsresultatet efter vitalseparation och extraktion av enstaka rot på överkäksmolarer med Grad II furkationsinvolvering följt av överkappning av pulpasåret med MTA (Mineral Trioxide Aggregate; ProRoot® MTA).

Sju vitala överkäksmolarer hos sex patienter inkluderades i studien och behandlingen följdes upp med kontroller under 12 månader postoperativt. Vid slutundersökningen 12 månader postoperativt hade en tand krävt traditionell rotbehandling (i samband med undersökningen 6 månader postoperativt), medan övriga tänder var fortsatt vitala, utan behov av traditionell rotbehandling samt parodontalt friska.

Studien visar, även om data är begränsade, att pulpaöverkappning med MTA kan vara en lovande behandlingsåtgärd vid rotseparation och extraktion av enstaka rot på vitala överkäksmolarer med Grad II furkationsinvolvering. Fler undersökningar krävs dock för att visa att vital rotresektion följt av överkappning med MTA kan användas som en rutinbehandling i parodontalvården. Fram till dess, bör man se på vital rotresektion som en interimistisk behandling som ska följas upp med traditionell rotbehandling.

Introduction

Root resection is accepted as a valid treatment with reasonable long-term effectiveness with proper long-term monitoring and maintenance (11, 17, 3, 5). Traditional endodontic therapy is completed prior to root resection procedures. Very little thought has previously been given to the possibility of preserving the vitality of the remaining pulp tissue (14).

In 1966, Haskell published a technique for vital root resection on maxillary multi-rooted molars with a radicular pulp capping procedure using calcium hydroxide (12). Later, the same author presented a large clinical series utilizing the same technique (13). However, the long-term prognosis for vital root resection in periodontics has been questioned (9, 24) and it has been concluded that vital root resection with radicular pulp capping was more acceptable as an interim treatment procedure between periodontal and endodontic therapy.

Vital root resection with mineral trioxide aggregate (MTA) instead of the traditional calcium hydroxide has not been tested yet and it may reduce subsequent complications and lead to more favorable outcomes. MTA is a relatively novel pulp sealing agent that has been originally reported to close communication between the pulp canal system and external surfaces of the teeth (18). The MTA has been studied in experiments demonstrating good sealing ability (26) and bio-compatibility (16). In vivo studies have shown that MTA has the capacity to induce bone, dentin and cementum formation in vivo (25, 27, 2). MTA-capped pulps showed complete bridge formation with no signs of inflammation (22, 29, 1, 8). The incidence of dentine bridge formation was higher with MTA than with calcium hydroxide (7, 20).

In addition, its ability to set in a moist environment without undergoing dimensional changes, together with beneficial tissue compatibility in a set stage, has given this material several clinical applications including capping of exposed pulps (22, 28). Due to the properties of the material, MTA or equivalent products could prove to be a material of choice for direct pulp capping procedures instead of hard setting calcium hydroxide cements (21). However, experimental studies in humans and clinical trials have yet to show the real clinical potential of this material (4).

The advantages of the MTA treatment modality might consist of:

1. Postpone (or eliminate the need for) traditional endodontic treatment
2. No need for extra prosthetic treatment
3. Maintaining a vital tooth
4. Less cost for the whole treatment
5. Less time involved for the treatment and in general an easier procedure with high success rate; the resection of a root may also help preserving an existing fixed prosthesis
6. Medically compromised patients may benefit from the maintenance of remaining roots, avoiding multiple reconstructive surgical procedures.

The potential disadvantages are:

1. Acute symptoms
2. Dystrophic calcification

The aim of the present study was to investigate the outcome of vital root resection followed by immediate pulp capping with MTA in furcation involved maxillary molars.

Material and methods

- Informed consent

Before recruitment and enrollment, each prospective subject candidate was given a full and adequate verbal and written information about the nature, purpose, possible risk and benefit of the study, and allowed to read the approved informed consent form. Once the investigator was ensured that an individual understands the implications of participating in the study, the patient was asked to give consent to participate in the study by signing the approved informed consent form. The investigator provided a copy of the signed informed consent form to the subject.

- Experimental design

The study was performed as a pilot study of 12 months duration. The study was designed to evaluate the outcome of vital root resection in maxillary molars with degree II furcation involvement combined with conservative endodontic treatment by means of pulp capping with MTA.

- Patients

Six adult patients aged 44-68 years and suffering from adult chronic periodontitis were included in this study. The study subjects were recruited from patients referred for periodontal treatment at the Specialist clinic in Periodontics, Odontologen, Göteborg.

- Inclusion criteria

• Subjects had to demonstrate at least one maxillary molar with degree II (11) furcation involvement as measured with a periodontal probe ad modum Nabers. A decision for root separation and resection should have been made and judged reasonable based on

- the length of the root trunk
- the divergence between the roots
- the length and the shape of roots
- remaining amount of inter-radicular bone (less than 3mm inter-radicular bone loss), i.e. remaining periodontal support around individual roots
- access to oral hygiene devices
- Teeth included in the study had to be vital (sensitive to electric pulp tester and cold on buccal or palatal aspects of the tooth) and without radiographic signs of endodontic pathology
- Teeth must not demonstrate any restorative complications
- Teeth must be freestanding, i.e. not anchoring a bridge
- Teeth must not demonstrate mobility
- Subjects must be in good general health

- Exclusion criteria

• Patients already included in other clinical trials involving therapeutic intervention (either medical or dental)

• Patients with systemic condition like diabetes mellitus, cancer, HIV, disorders that compromise wound healing, chronic high dose steroid therapy, bone metabolic diseases, radiation or immune-suppressive therapy

• Patients with acute infectious lesions in the area of intended therapy

• Patients smoking more than 10 cigarettes/day

- Study device

Pulp capping by means of grey MTA (Mineral Trioxide Aggregate; ProRoot MTA, Tulsa Dental Products, Tulsa, OK, USA) was used as test treatment.

- Screening examination

Probing data as well as intra-oral radiographs had to be obtained at the screening examination for identification of teeth meeting the inclusion criteria.

- Variables and registration

• Vitality test: Pulp vitality status with electric stimulation
- Buccal
- Palatinal

• Vitality cold: Pulp vitality status with temperature stimulation
- Non-senstitive (-)
- Sensitive (+)

Furcation involvement: Furcation involvement according to Hamp classification (11)
- Degree I
- Degree II
- Degree III

• Mobility: Tooth mobility status according to Miller classification (19)
- Grade 1
- Grade 2
- Grade 3

• PPD: Periodontal pocket depth in millimeters

• Subjective symptoms: Postoperative subjective experience
- Hot
- Cold

◎ **Table 1.** The baseline and final project status

Case	Tooth	Root	Furcation involvement	PPD	Evaluation (months)	Subjective Symptoms	Periapical lesion
1	16	MB	MII	M6,D4	6	H&C	Widened PDL
2	27	DB	BII	D5, P4	12	-	-
3	26	DB	DII	D6	12	-	-
4	16	DB	BII,DII	D4	12	-	-
5	26	MB	MII	M5,D5	12	-	-
6	16	DB	DII	M4,D5	12	-	-
7	17	DB	B,D II	D5,P4	12	-	-

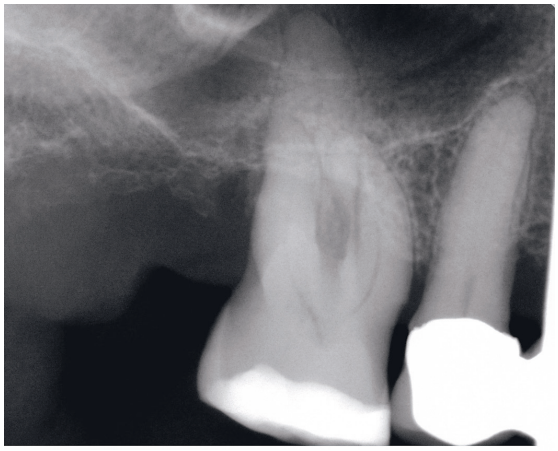


Figure 1. Tooth 16 presurgical radiographic view

Figure 2. Tooth 16 presurgical clinical view

• Periapical lesion: Inflammation status in periapical area such as widened PDL
• BoP: inflammation status in the periodontal compartment
  • Plus
  • Minus

- Basic therapy

Each individual patient was given a case presentation and detailed instructions in proper oral hygiene techniques. They also received series of treatment sessions with mechanical debridement. This professional therapy was performed under local anesthesia. Within three months after completion of the non-surgical instrumentation the patients were examined anew for definitive treatment planning and final decision about enrolment in the study.

- Baseline examination

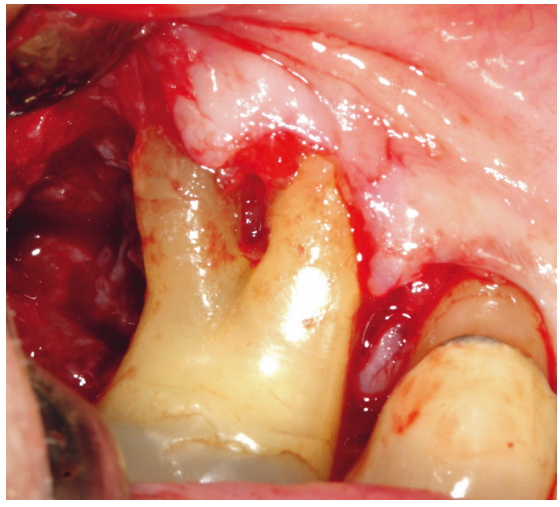
The patients were examined clinically and radiographically by one of the authors before the experimental treatment (Figures 1, 2). The clinical examinations involved assessments of oral hygiene status, gingival conditions, probing depths, furcation involvements (11) (Table 1).

The radiographic examination comprised intraoral periapical and bite-wing radiographs of the experimental molar regions, using a long-cone parallel technique (6). On the radiographs the amount of alveolar bone support was assessed at the mesial and distal aspects of the teeth. Radiographs and clinical examination (including periodontal probing) were used to assess the extent of the furcation involvement, the amount of attachment loss, the morphology and proximity of the roots, the ability to perform endodontic therapy, the proximity of anatomical structures, and the existence of caries or root resorption (Table 1).

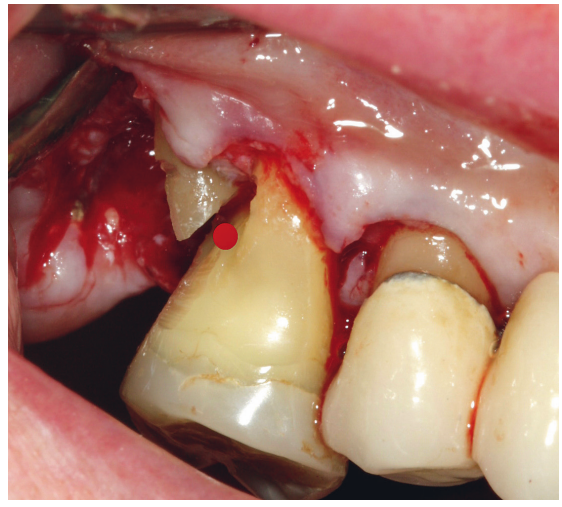
The vitality testing was performed using an electric pulp testing device SybronEndo Model 2006 (Sybron Dental Specialties) and cold testing by means of an "iced carpule" (an empty dental cartridge of 1.8 ml was filled with water and freezed) on a cotton roll. Testing was performed for at least 10 seconds on either the buccal or the palatal surface of the tooth (depending on the existing restorations etc.) and as close to the pulp as possible (Table 1). Vitality testing was done on the same surface for all subsequent examination intervals.

- Surgical treatment and technique for root resection and pulp capping

Following analgesia, access to the root surface was gained by elevating buccal and palatal full-thickness mucoperiosteal flaps (Figure 3). The extent of the flap had to be sufficient to provide access and visibility for instrumentation and to facilitate proper wound closure. All granulation tissue was removed with curettes, exposing the bone and root surfaces. A long fissure or tapered tungsten carbide or diamond bur was used to section the root by positioning it at the junction of the root and crown or at the most coronal portion of the root (the fornix of the furcation) and gently penetrating through the furcation (cutting with angle and avoiding to be too close to the floor of the pulp chamber). Complete root separation was verified by inserting a probe through the furcation and removing it through-and-through or by testing the mobility of each root individually (Figure 4). Once the root was cleanly separated from the remaining roots (Figure 5) and the crown of the tooth, it could be carefully elevated from its socket to avoid luxating or damaging the remaining roots. In



◎ **Figure 3.** Tooth 16 flap elevation



◎ **Figure 4.** Tooth 16 disto-buccal root separation (pulp exposure)

cases where root curvature posed a problem during elevation, it was necessary to progressively section and remove the coronal portion of the root as it was elevated until the root could be removed from the socket. The crown portion of the tooth was subsequently contoured with a long flamed diamond bur and then with a long shaft small flamed tip diamond bur for better accessibility to allow adequate oral hygiene maintenance. Subsequently, odontoplasty should be performed to ensure that no "lip" of tooth structure, which could act as a plaque-retentive ledge, was left in the dome of the furcation.

A small preparation (1mm in width and >2mm in depth) was then made at the amputation site (radicular pulp exposure) by using a contra angle EMS diamond tip (EMS Electro Medical Systems) with irrigation (sterile water) to remove the outer layer of the pulpal wound tissue, prepare a clean wound surface in the exposed pulp and create space for the pulp capping material. In those cases with an isthmus at the radicular pulp exposure, both entrances as well as the isthmus area in between were opened and connected. The wound was rinsed with sodium hypochlorite 0.5% (with 2ml syringe and a thin needle) 1mm into the pulp exposure to disinfect the wound surface and to dissolve soft tissue. The site was dried with a paper point (size 60). Then MTA was prepared in a thin line on a slab for easier application and applied 2-3 times with light pressure to be sure that the empty space is filled. The excess material was removed with hand instrument

◎ **Figure 5.** Disto-buccal root removed

(plastic instrument, carver and sharp probe) and the site was cleaned with moistened gauze and light air blasting was performed over the resected root surface. Subsequently, bonding resin was applied and light-cured on top of the MTA without etching to protect the material before setting. Subsequently, needed bone re-contouring and additional soft tissue trimming was performed and the remaining root surfaces planed to remove any remaining hard and soft deposits. The ostectomy and/or osteoplasty were performed to eliminate any remaining bony deformities, to optimize soft tissue coverage during healing and to provide for a biologic width of the dentogingival complex after healing (10). The flaps

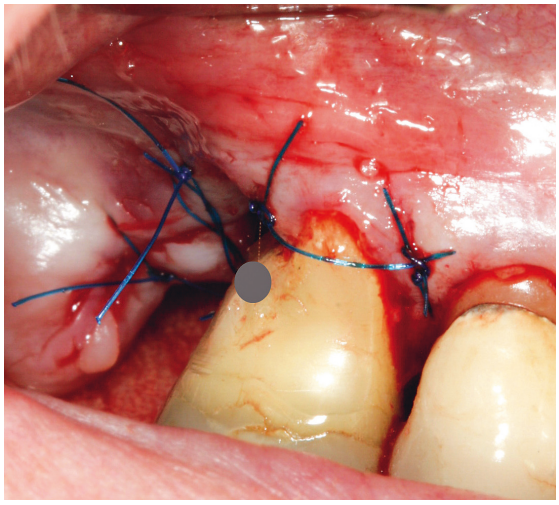


Figure 6. Tooth 16 disto-buccal root resection (MTA and composite material application)

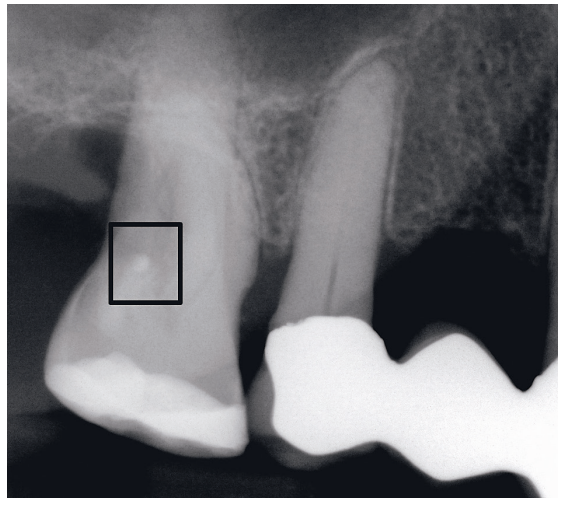


Figure 7. Tooth 16 postoperative radiographic view (MTA and composite material application)

Figure 8. Tooth 16 two-week postoperative clinical view

were then reapproximated and sutured (Figure 6). Postoperative intra-oral radiographs were taken the same day (Figure 7).

At 2-week post-surgery (suture removal) the resected root surface was etched (phosphoric acid 37%) and restored permanently with composite filling material (bonding and composite material) (Figure 8).

- Post-surgical instructions and maintenance

The patients were participating in a plaque control program including mouth rinse with chlorhexidine (0.2 %) twice daily for at least 2 weeks when further instructions for individualized oral hygiene measures, i.e. specific for the new dento-radicular morphology in the operated area, was given (Figure 8). The patients were instructed to report any problems they encountered with the root-resected tooth (postoperative symptoms).

Teeth that have had a root resected are in the clinical category of a reduced, but healthy periodontium and might benefit from splinting to the adjacent teeth, especially if the mobility is increasing (23). Thus, splinting and/or occlusal adjustment were performed as needed.

- Re-examinations

The subjects were recalled after one week for control of subjective symptoms. Subsequently, the subjects were recalled for clinical and radiographic re-examinations (assessments of oral hygiene status, gingival conditions, probing depths, furcation involvement and vitality testing) at 1, 3, 6 and 12 months post-surgery (Table 1).

When a tooth produced acute symptoms diagnosed as irreversible pulpitis or apical periodontitis, i.e. did not respond to vitality testing and having concomitant radiographic and clinical pathology, root canal therapy was immediately performed.

- Conduct of the study

The study was performed according to the declaration of Helsinki. The investigator conducted all aspects of this study in accordance with all national laws of the pertinent regulatory authorities.

Results

The seven teeth treated of six patients, three females and three males, are presented in Table 1. The ages ranged from 44 to 68 years. The treated teeth consisted of five maxillary first molars and two maxillary second molars, i.e. one patient presented with 2 teeth for inclusion in the study. The root resections consisted of five disto-buccal roots and two mesiobuccal roots. The follow-up examinations have been designed at one week, two weeks, one month, 3 months, six months and one year for all cases. Table 1 presents details about the treated teeth at the day of operation as well.

One tooth had to receive root canal therapy subsequent to the 6-month evaluation. The remaining six teeth maintained vitality for one year and required no further treatment. Nevertheless, some of these remaining healthy (asymptomatic) teeth presented at some point in time minimal sensitivity to cold/hot/electric, 4 mm PPD and minor mobility. This was considered maintainable with supportive periodontal therapy. In addition, the restoration over the resected root surface required repair in a few teeth. The patients have been under follow-up evaluation and supportive periodontal therapy one year after vital root resection operation. The final status and details about all the cases are presented in Table 1.

Discussion

In 1961, a technique utilizing a radicular calcium hydroxide pulp capping for the vital root resection of multi-rooted molars was developed (12). However, several problems became evident and indicated a greater degree of difficulty in achieving success in radicular pulp capping comparing to the intra-coronal pulp capping (15). The first and the most obvious difference are in obtaining asepsis. The use of a rubber dam has proved virtually impossible in vital root resection techniques. Conversely, with intracoronal exposures, the dam is most practical and recommended (15). Secondly, following the removal of a maxillary buccal root, there is a definite diminution of blood supply to the coronal pulp tissue. Subsequent pulp healing is probably affected to one degree or another, depending upon the health and size of the pulp (both radicular and coronal) (15). Thirdly, after the root resection dentin tubules are left open and the remaining thickness of the dentin covering the pulp is thin which means an obvious risk for pulp infection if not properly sealed.

In this study, all seven teeth included were asymptomatic, with pulp testing within normal limits prior to surgery and pulp capping. All teeth demonstrated moderate to severe periodontal disease. This was the basis for the vital root resection procedure and it is remarkable that, over the one year follow-up period, the majority of the treated teeth maintained their pulp vitality.

The decision to treat the only failed tooth endodontically was made based on the patient's complaints concerning symptoms when chewing and radiographic signs of the periapical periodontitis. In none of the present cases could the dystrophic calcification of the pulp space be seen in the performed radiographic examinations. The patients have demonstrated a high level of satisfaction following vital root resection treatment due to less cost and time demands.

Due to the limited number of treated teeth in this study, no statistical analysis could be performed on registered variables. Moreover utilizing variables such as general health, smoking and sex can be more appropriate in a more comprehensive continuing study. The variables such as PPD, BoP, furcation involvement, vitality test and pulp obliteration status have been registered to evaluate periodontal or endodontic status, even though they were not discussed in depth here.

Finally, vital root resection on maxillary multirooted molars with a radicular pulp capping procedure by preserving the remaining pulp tissue, is attempted because it is noted that the patients would frequently become discouraged when confronted with the combined expense of both endodontic treatment and restorative treatment. A pulpal failure can still be followed by traditional endodontic treatment. The method seems to be promising even though it requires further studies to confirm our results.

Acknowledgements

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Self-perceived oral health among 19-year-olds in a Swedish County – A comparative study between 2004 and 2011

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Abstract

◉ For decades, Swedish dental professionals have collected clinical epidemiological data from the dental records. To supplement the epidemiology, Östergötland County Council decided to examine patient perceptions of oral health: self-rated knowledge, self-perceived oral health, and opinions about oral health. The aim was to compare self-perceived oral health among 19-year-olds to determine differences between genders, various municipalities and between 2004 and 2011. This study analysed the responses from two cross-sectional surveys of the entire population of 19-year-olds in Östergötland County, Sweden, performed in 2004 and 2011. Of the 2,413 (53 %) (50 % men, 50 % women) 19-year-olds who responded to the questionnaire in 2004 and the 3,803 (67 %) (50 % men, 50 % women) in 2011, most 19-year-olds (88.1 % [2004] and 87.5 % [2011]) reported satisfaction with their oral health. Around half of the respondents rated their knowledge on periodontitis as low. Boys rated their knowledge about avoiding periodontitis higher than girls ($p<0.05$ in 2004 and $p<0.001$ in 2011). In 2004, 84.7 % reported shooting pain. In 2011 that figure was 83.7 %. The respondents expressed some uncertainty about the benefits of fluoride toothpaste (7.5 % in 2004 and 9.3 % in 2011), especially the boys (10.3 % in 2004 and 10.5 % in 2011). Girls reported both a higher social impact and greater concern about aesthetics related to their oral health. They also reported headache (27.5 %) nearly twice as often as boys (14.2 %) ($p>0.001$). Responses between the municipalities did not differ, with the exception of items regarding periodontitis. Thus, this study found indications that perceptions of oral health and knowledge in Östergötland County complied with Swedish Dental Act. The study also found patient perceptions of oral health among 19-year-olds to be good.

Key words

adolescents, dental care, health knowledge, Oral health, questionnaires

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Självupplevd oral hälsa hos 19-åringar i ett svenskt län

En jämförande studie mellan åren 2004 och 2011

ANNA AHLVIN, ELISABETH WÄRNBERG GERDIN, MATS BÅGESUND, SVEN ORDELL

Sammanfattning

◎ Enligt svensk tandvårdslag åligger det de 21 landstingen och regionerna att ansvara för tandvård till barn och ungdomar till och med det år de fyller 19. Sedan lång tid tillbaka har kliniska epidemiologiska data insamlats, och 2003 bestämdes i Östergötland att även inkludera ungdomarnas självupplevda uppfattning samt självskattade kunskap om oral hälsa i samband med 19-årsundersökningen. Detta samlades in med hjälp av en enkät. Studien är en analys över insamlade enkäter hos totalpopulationen 19-åringar i Östergötland under åren 2004 och 2011. Enkäten lämnas ut efter undersökningen och ifylles anonymt av respondenten och enkäten används hos både privat och offentlig tandvård. År 2004 var svarsfrekvensen 53 % (n=2413). Totalpopulationen 19-åringar i Östergötland år 2004 uppgick till 5332 personer, av dessa fanns epidemiologiska data från 4572. År 2011 var svarsfrekvensen 67 % (n=3803). Totalpopulationen 19-åringar i Östergötland år 2011 uppgick till 6481 personer och av dessa fanns epidemiologiska data från 5718 individer. Majoriteten (88.1 % år 2004 respektive 87.5 % år 2011) av respondenterna uppgav att de var nöjda med sin orala hälsa. Generellt sågs en låg kunskapsnivå om tandlossning. Pojkar skattar sin kunskap gällande hur man undviker tandlossning högre än flickorna gjorde ($p<0.05$ år 2004 respektive $p<0.001$ år 2011). År 2004 rapporterade 84.7% av 19-åringarna besvär med isningar, motsvarande siffra år 2011 var 83.7 %. Flickor rapporterade i större utsträckning huvudvärk (27.5m%) än pojkarna (14.2 %) ($p<0.001$) år 2011. En del av respondenterna (7.5 % år 2004 och 9.3 % år 2011) uttryckte osäkerhet angående nyttan av fluortandkräm. Inga större skillnader kunde ses mellan de olika kommunerna med undantag för frågor om parodontit. Att kommunerna inte skiljer sig nämnvärt åt indikerar jämlikhet avseende självupplevd oral hälsa samt självskattad kunskap om oral hälsa. Majoriteten av de responderande 19-åringarna var nöjda med sin orala hälsa, dock var flickorna överrepresenterade beträffande bekymmer över estetiska aspekter samt social påverkan på oral hälsa.

Introduction

Dolan's definition of oral health as "a comfortable and functional dentition which allows individuals to continue in their desired role" (2) indicates that oral health concerns not only the lack of oral disease but also includes social aspects. Oral health has a variety of effects on individuals – both physical and psychological – that influence how they grow, enjoy life, look, speak, chew, taste food, and socialize, as well as feelings of well-being (15).

According to Swedish Dental Act, the 21 county councils are responsible for providing dental care free of charge to children and adolescents up to the year they turn 20 years (21). Swedish children and adolescents are free to choose a dentist, public or private, and they visit their clinic for dental examination with a frequency based on their individual needs. All dental care for children and adolescents living in Sweden, including necessary specialist treatment and preventive dental care, is provided free of charge. To empower their patients, Swedish dental caregivers are obliged to provide them relevant information in order to build their knowledge on oral health (21).

The National Board of Health and Welfare has collected epidemiological data on dental disease in various forms since 1939, the present series since 1985. That has enabled quality control and allowed follow-up studies (20). To achieve holistic health, defined by the World Health Organization in 1946 as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (24), three Swedish county councils decided in 2003 to supplement these clinical epidemiological data with self-reported data on oral health at age 19, the last year that dental treatment is free of charge. The surveys had several long-term goals: (1) to identify regions with poorer self-rated and self-perceived oral health in order to implement targeted interventions, (2) to determine the quality of childhood and adolescent dental care in order to evaluate dental providers' success in their mandated task of health promotion, disease prevention, and disease treatment, and (3) to discover whether perceptions of dental care were equal across Östergötland County, in accordance with the Swedish Dental Act §3 The surveys provided an overview of the distribution of perceptions and knowledge about oral health throughout the County. Prevalence of dental caries was noticed since we wanted to have a measure of caries disease in individuals. The questionnaire was given to the patient in connection with the visit at the clinic and filled out after the check up.

An earlier Swedish study on oral health reported that boys generally were more satisfied with their teeth than girls, despite no evident differences between the genders in rates of caries according to epidemiological data (28). Another study found that girls show more interest in oral health and rate their knowledge higher than do boys (26). A study of 19-year-olds in Östergötland and Örebro Counties noted differences in self-rated knowledge both between boys and girls, and between the respondents from the two counties (3). Östergötland and Örebro counties are regarded to be typical for Sweden with both rural and urban populations.

A previous study conducted in three areas in Western Sweden found no statistically significant differences regarding oral health or dental care priorities between the different regions or between different socio-economic groups (30). On the other hand, a report from Östergötland County showed that prevalence of dental caries was socio-economically stratified throughout the County (23), why we wanted to investigate possible differences in self-perceived oral health between the municipalities.

The aim of this study was to compare self-perceived oral health among 19-year-olds in Östergötland County, Sweden, to determine differences between genders, municipalities, different years (2004 and 2011), and respondents with or without dentine caries.

Materials and methods

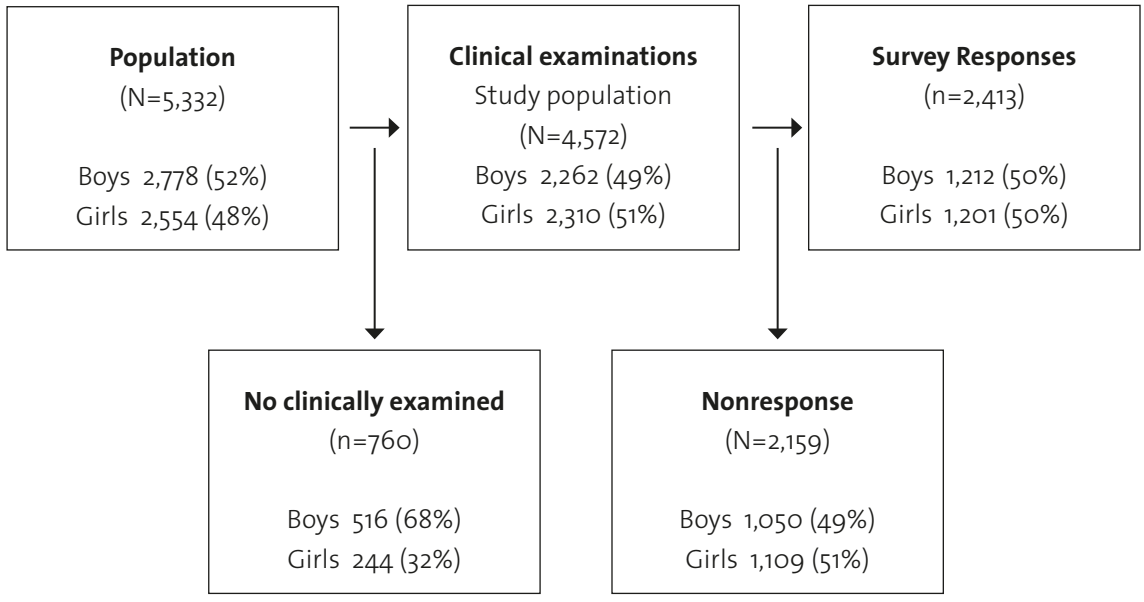
This study analysed survey responses from two cross-sectional studies of the population of all 19-year-olds who visited a dental clinic in Östergötland County, Sweden during the years 2004 and 2011. Östergötland County has a population of approximately 430,000 inhabitants living in both urban and rural areas. The 19-year-olds represent approximately 1.5% of this total population. This study was based on a questionnaire study that has been conducted annually in Östergötland County since 2004.

Study population

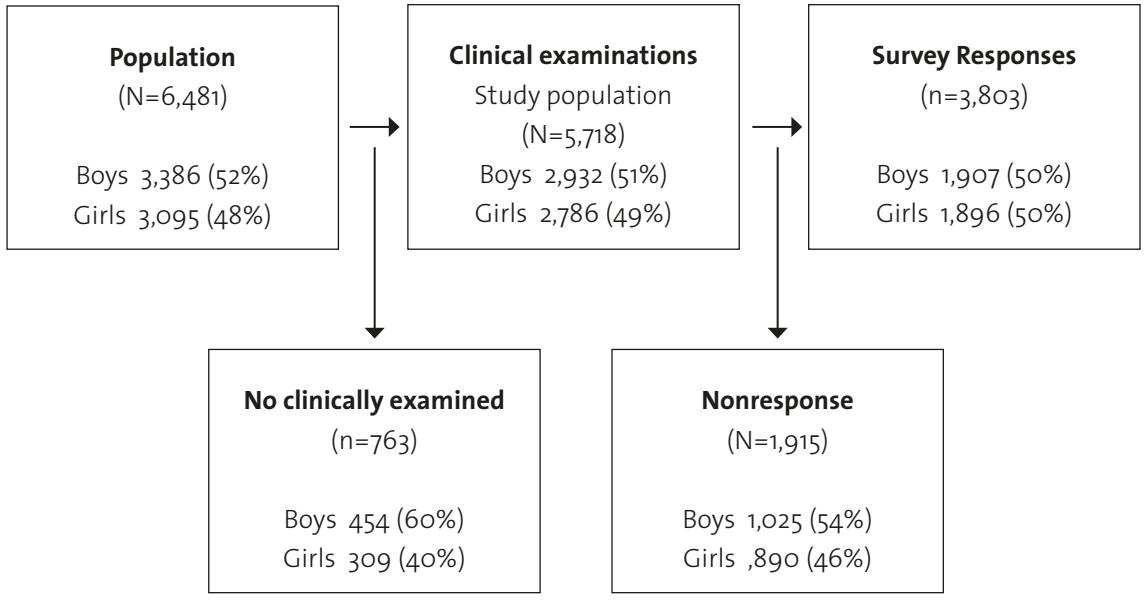
The study population was all 19-year-olds in the County of Östergötland who received a clinical dental examination in 2004 or 2011 and answered the questionnaire. Figure 1 presents the distribution of the total population and the study respondents.

◉ **Figure 1.** Total population, clinical examinations, and survey responses in 2004 and 2011 by gender.

2004



2011



The questionnaire

The survey of 19-year-olds measured the following patient characteristics: (1) municipality of residence (2011), (2) caries status, (3) self-rated knowledge of oral health, (4) self-perceived oral health, and (5) perceptions of the social impact of their oral health.

Data collection

The 2004 survey only reported the patient's county of residence, while the 2011 survey reported the municipality. The questionnaire contained 14 items (Table 1) with set alternatives on an ordinal scale, and one item on gender covering four aspects of health: knowledge, oral function, quality of life, and social impact. All private and public dental clinics in Östergötland administered the questionnaire. A cover letter detailed the procedure for handing out the questionnaires. The dentist recorded the numbers of decayed approximal surfaces and the patient's county (2004) or municipality (2011) of residence. The dentists worked according to written protocols when diagnosing caries, considering both clinical and x-ray examinations. After the regular oral health screening at age 19, the patients were asked whether they wished to fill in an anonymous, voluntary questionnaire. The patients usually filled out the questionnaire in the waiting room and then left it in a box or at the reception desk at the clinic. The completed questionnaires were scanned. If a response was missing in the file containing the scanned data, the authors then manually checked the questionnaires.

Dental caries

The 2004 survey used the Decayed or Filled Surfaces approximal (DFSa) index to describe previous or present approximal dentine caries. Due to changed routines for collection of epidemiological data in the County council, the survey used the Decayed Surfaces approximal (DSa) index to describe the presence of approximal dentine caries in 2011.

Statistical methods

The data analysis were made using the statistics software IBM SPSS (Statistical Package for the Social Sciences) version 20 with the level of statistical significance set at 5% ($P<0.05$). Before analysis items A-N were dichotomized (Table 1). The analysis made were bivariate chi-square test and calculated Pearson's correlation coefficient

Ethical aspects

This study complied with the principles of the Declarations of Helsinki. All respondents were informed that participation was voluntary, and that they could withdraw from the study without any impact on their future dental treatment. The Regional Ethical Review Board at Linköping University in Sweden approved the study (Dnr 2012/147-31, accepted 2012-05-23.

Results

Nonresponse

In total 2,413 (53%) of all 19-year-olds who visited a dentist in 2004 and 3,803 (67%) in 2011 (Fig 1) responded to the survey. In 0.3% of the 2004 surveys and 0.2% of the 2011 surveys, the participant responded to none of the items. Item L, "Have you had headache due to problems from your teeth or mouth?" (Table 1) had the highest nonresponse (1.8% in 2004 and 1.5% in 2011). The DFSa value was missing in 6.3% of the questionnaires in 2004, and DSa was missing in 11% of the questionnaires in 2011.

Gender

Table 2 provides the survey results by gender for each year.

Girls expressed significantly higher levels of concern on items about self-perceived oral health (F-J), and were more ashamed, embarrassed, and worried about their teeth than boys. Girls also reported headache more frequently (L).

Responses before dichotomization regarding the frequency of perceived problems of the mouth and teeth, however, reveal that 4.3% of the girls reported that they avoid laughing because of their mouth and teeth several times a week, while only 1.6% of the boys reported this frequency. Table 2 presents responses after dichotomization

The survey revealed a high prevalence of shooting pain in the teeth. Table 3 presents the proportions (before dichotomization) of responses for each year.

Correlation with caries

The proportion of patients without reported caries was 65.9% (DFSa=0) in 2004 and 78.4% (DSa=0) in 2011. To ensure representativity in the 2004 sample, we compared the prevalence of approximal caries in the study participants (34.1% had DFSa>0 in 2004) with that of the routinely collected clinical epidemiological data of 19-year-olds in Östergötland County for the same year (41.2% had DFSa>0).

In 2004 the two items on knowledge of periodon-

◎ **Table 1.** Questionnaire (translated into English). The columns indicate dichotomization.

KNOWLEDGE			
A.	**Do you know how caries occurs?**	Yes, sort of Yes	No
B.	**Do you know how to avoid caries?**	Yes, sort of Yes	No
C.	**Do you know how periodontitis occurs?**	Yes, sort of Yes	No
D.	**Do you know how to avoid periodontitis?**	Yes, sort of Yes	No
E.	**Do you know that it is important to use fluoride toothpaste?**	Yes, sort of Yes	No
SOCIAL IMPACT			
F.	**Have you avoided laughing because of your teeth or your mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
G.	**Have you felt embarrassed because of your teeth or your mouth?**	Yes, a little Yes, quite much Yes, very embarrassed	No, not at all
H.	**Have you been ashamed because of your teeth or your mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
I.	**Have you avoided your normal social life because of your teeth or your mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
J.	**Have you felt unhappy because of your teeth or your mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
FUNCTION			
K.	**Have you had problems chewing due to problems from your teeth or mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
L.	**Have you had headache due to problems from your teeth and your mouth?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
M.	**Have you had shooting pain from the teeth due to warm or cold food/drinks?**	Yes, occasionally Yes, once a month Yes, once a week Yes, several times a week	No, never
GLOBAL ITEM			
N.	**Overall, how satisfied are you with your teeth and your mouth?**	Completely satisfied Satisfied Satisfied in general	Somewhat dissatisfied Dissatisfied Extremely dissatisfied

Table 2. Survey responses by year and gender after dichotomizing the variables (percentages).

	2004 Boys	*p*	2004 Girls	2011 Boys	*p*	2011 Girls
A. **Do you know how caries occurs?** Some or good knowledge	96.2	*	98.1	95.4	NS	96.3
B. **Do you know how to avoid caries?** Some or good knowledge	99.4	NS	98.7	98.4	NS	98.5
C. **Do you know how periodontitis occurs?** Some or good knowledge	55.2	NS	56.3	50.7	*	46.6
D. **Do you know how to avoid periodontitis?** Some or good knowledge	57.5	*	52.3	54.5	***	45.1
E. **Do you know that it is important to use fluoride toothpaste?** Some or good knowledge	89.7	***	95.2	89.5	**	92
F. **Have you avoided laughing because of your teeth or your mouth?** No	78.7	*	74.6	79	***	67.3
G. **Have you felt embarrassed because of your teeth or your mouth?** No	79.9	***	72	8.3	***	64.9
H. **Have you been ashamed because of of your teeth or your mouth?** No	83.8	***	73.6	81	***	64.7
I. **Have you avoided your normal social life because of your teeth or your mouth?** No	98.4	NS	98.3	97.1	NS	96.7
J. **Have you felt unhappy because of your teeth or your mouth?** No	87.1	***	77.3	83.8	***	71.8
K. **Have you had problems chewing due to problems from your teeth or mouth?** No	61.6	*	56.6	58.4	NS	57.3
L. **Have you had headache due to problems from your teeth or mouth?** No	87.5	***	72.6	85.8	***	72.5
M. **Have you had shooting pain from the teeth due to warm or cold food/drinks?** No	15.4	NS	15.2	16.1	NS	6.4
N. **Overall, how satisfied are you with your teeth and your mouth?** Satisfied	88.9	NS	87.4	89.2	*	85.9

Data were analysed using the χ^2 test.
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
NS not significant

◎ **Table 3.** Undichotomized distribution of responses to the item "Have you had shooting pain from the teeth due to warm or cold food/drinks?"

	2004	2011
No, never	15.3%	16.3%
Yes, occasionally	55.2%	50.9%
Yes, once a month	21.1%	21.4%
Yes, once a week	6.3%	7.8%
Yes, several times a week	2.2%	3.6%

titis (C-D) correlated positively (r= -0.08, p< 0.01 and r= -0.08, p <0.01 respectively) with the presence of approximal dentine caries (p< 0.001 and p< 0.005) but the items on knowledge of caries (A-B) did not correlate with caries.

In 2011, presence of approximal dentine caries correlated less well with knowledge of how to avoid periodontitis (r= -0.03, p< 0.05) compared with 2004.

Table 4 presents the correlations between reported caries and oral symptoms for 2004 and Table 5, the correlations between reported caries and social impact for 2011. Reported social impact of having caries was greater in 2011 than in 2004.

Municipalities

The respondents in one municipality (a rural municipality with approximately 5,000 inhabitants) expressed higher knowledge of the reasons for periodontitis (p < 0.001) and how to avoid periodontitis (p < 0.001) than did respondents in the other municipalities. No other significant differences in responses occurred between the various municipalities of Östergötland County.

Changes between 2004 and 2011

Table 6 presents differences between the survey years.

The survey found an increase in 2011 over 2004 in self-reported problems related to the social impact of oral health and aesthetics. The most obvious change was in the reported experiences of embarrassment and unhappiness related to the condition of the teeth or mouth, which increased among girls. Analyses of the total population (both genders) showed that the social impact of oral health was greater in 2011 than in 2004.

The survey found no differences between 2004 and 2011 regarding mouth or tooth problems causing headache, or problems with chewing and shooting pain.

Discussion

Response rate

The survey's moderate response rate may hinder the generalizability of this material to all 19-year-olds in Sweden. Östergötland County administered the questionnaire for the first time in 2004, which could explain that year's low response rate (46%), since the questionnaire was new and had not yet become a routine for the dental clinics. In 2011, when the questionnaire had been used for a longer period of time, the response rate was higher (59%). We did

◎ **Table 4.** Correlation between reported caries (DFSa) and respondents experiencing any social or functional impact due to their mouth or teeth in 2004.

	No caries	Caries	*p*
F. Have you avoided laughing because of your teeth or your mouth?	22.5%	25.0%	NS
G. Have you felt embarrassed because of your teeth or your mouth?	23.2%	25.9%	NS
H. Have you been ashamed because of your teeth or your mouth?	19.6%	24.2%	*
I. Have you avoided your normal social life because of your teeth or your mouth?	1.4%	1.9%	NS
J. Have you felt unhappy because of your teeth or your mouth?	16.1%	19.0%	NS
K. Have you had problems chewing due to problems from your teeth or your mouth?	35.2%	51.5%	***
L. Have you had headache due to problems from your teeth and your mouth?	19.0%	23.6%	*
M. Have you had shooting pain from the teeth due to warm or cold food/drinks?	83.3%	87.3%	*

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

not evaluate why individuals declined to fill in the questionnaire. The survey was administered in direct connection with a dental check-up to facilitate administration of the questionnaire. The fact that the questionnaire was given to the patient in connection with the dental visit may have influenced the responses through social desirability bias – especially for the knowledge-based items (A-E, see Table 1). Reason for the relatively low response rate may be that the dental staff misses to hand out the questionnaire. Generally, the proportion of internal nonresponses was small, so we did not analyse the internal nonresponses further.

Gender

The survey found that overall self-perceived knowledge of periodontitis was poor among the 19-year-olds. This may be because periodontitis is an unusual condition among adolescents and thus such information may not be given to young patients routinely. Epidemiological data from 2011 (not included in this study) on 19-year-olds from Östergötland County show that 16% of girls and 21% of boys reported that they use tobacco. One reason for the higher self-rated knowledge about periodontitis found among boys could be that the proportion of tobacco users was higher among them than among girls, and that they therefore had received more thorough information from the dental personnel about periodontitis. Data from the municipalities may support this connection between tobacco use and periodontitis knowledge. The boys in one of the smaller municipalities expressed higher self-rated knowledge of periodontitis than in other municipalities. Epidemiological data from the Östergötland County Council (not shown in this study) showed that 34% of the boys in this municipality used tobacco, in comparison with the average prevalence of tobacco use among boys in Östergötland of 21%. Thus, tobacco use may correlate with increased knowledge about periodontitis.

Previous studies have also found that the prevalence of dental plaque is higher among boys (4, 1) and that girls have less self-assessed gingival bleeding during tooth brushing (29). Another study showed that, at the population level, plaque and calculus deposits and level of gingivitis and periodontitis were slightly higher in boys (9). We therefore find it reasonable to suggest that poorer periodontal health among boys has resulted in more information and thus better knowledge about periodontitis. Another reason could be that girls tend to underestimate their own knowledge, while boys overestimate their knowledge (13). A Japanese study, however, found that 18–19-year-old girls had greater self-rated knowledge about oral health behaviours (tooth brushing frequency, use of dental floss, frequency of dental visits in the past year) than boys of the same age (6). It is possible that differences between the Scandinavian and Japanese cultures may explain part of the difference found between these studies, but it is important to recognize the possibility that higher self-rated knowledge does not necessarily correlate with greater actual knowledge.

The findings that girls indicated they were more affected socially by their oral health and appeared to

Table 5. Correlation between approximal caries (DSa) and respondents experiencing any social or functional impact due to their mouth or teeth in 2011.

	No caries	Caries	*p*
F. Have you avoided laughing because of your teeth or your mouth?	25.5%	31.4%	***
G. Have you felt embarrassed because of your teeth or your mouth?	27.7%	30.4%	NS
H. Have you been ashamed because of your teeth or your mouth?	26.0%	30.1%	*
I. Have you avoided your normal social life because of your teeth or your mouth?	2.7%	4.7%	**
J. Have you felt unhappy because of your teeth or your mouth?	21.5%	23.7%	NS
K. Have you had problems chewing due to problems from your teeth or your mouth?	40.4%	47.8%	***
L. Have you had headache due to problems from your teeth and your mouth?	19.4%	24.2%	**
M. Have you had shooting pain from the teeth due to warm or cold food/drinks?	82.8%	86.2%	*

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

◎ **Table 6.** Survey responses for each year after dichotomizing the variables (percentages).

	2004	p	2011
A. **Do you know how caries occurs?** Some or good knowledge	97.1	*	95.8
B. **Do you know how to avoid caries?** Some or good knowledge	99.1	*	98.4
C. **Do you know how periodontitis occurs?** Some or good knowledge	55.7	***	48.6
D. **Do you know how to avoid periodontitis?** Some or good knowledge	54.9	***	49.8
E. **Do you know that it is important to use fluoride toothpaste?** Some or good knowledge	92.5	*	90.7
F. **Have you avoided laughing because of your teeth or your mouth?** No	76.7	**	73.2
G. **Have you felt embarrassed because of your teeth or your mouth?** No	75.9	***	71.6
H. **Have you been ashamed because of of your teeth or your mouth?** No	78.7	***	72.9
I. **Have you avoided your normal social life because of your teeth or your mouth?** No	98.4	***	96.8
J. **Have you felt unhappy because of your teeth or your mouth?** No	82.2	***	77.8
K. **Have you had problems chewing due to problems from your teeth or mouth?** No	59.1	NS	57.9
L. **Have you had headache due to problems from your teeth or mouth?** No	80.1	NS	79.2
M. **Have you had shooting pain from your teeth due to warm or cold food/drinks?** No	15.3	NS	16.3
N. **Overall. how satisfied are you with your teeth and your mouth?** Satisfied	88.1	NS	87.5

Data were analysed using the χ^2 test.
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
NS not significant

be more concerned about their aesthetic appearance than boys agrees with a previous study by McGrath et al. who found that the social impact of oral health was greater among girls (17). Another study found that girls, more often than boys, perceive their oral health to be good, except in their perception of the appearance of their teeth (27). Our finding that girls more often stated that they suffered from headache than boys did agrees with earlier studies in Sweden (14, 19) and in Norway (8). A study of Swedish adolescents showed that a large proportion of both girls and boys reported complaints and stress related to oral health, and that more girls than boys reported subjective health complaints such as headache and musculoskeletal pain (25). The results from this latter study support the findings in our study.

Correlations with caries

The present survey allows comparison between epidemiological data and self-rated knowledge regarding the 19-year-olds' oral health. The questionnaire has been used since 2004 with the only change being the caries index (DFSa in 2004, DSa in 2011). A previous study has shown good validity for the measurement of the DSa variable at the county level (5). Because of the different methods for measuring caries prevalence in 2004 and 2011, it is difficult to make any reliable analysis of possible changes in questionnaire responses based on caries prevalence between 2004 and 2011. It also appears that the epidemiological data and survey material did not fully agree concerning DFSa. Probable reasons for this include uncertainty when filling in the questionnaire or differences between the study population and general population.

Shooting pain

Shooting pain also seems to be a problem among the respondents in this study. About 80% reported experiencing shooting pain in the teeth due to warm or cold food or drinks, although only a small proportion of the respondents expressed frequent pain. A recent study in Norwegian 18-year-olds also found that a high proportion of adolescents had erosive wear, and that cuppings in the teeth were common (18). Research has found a high prevalence of dental erosion and consumption of soft drinks among Swedish children and adolescents (7). Our study did not further investigate the causes of the pain but, in accordance with other studies (7, 18), we find it likely that dental erosion – resulting in a higher dental sensitivity to temperature and irritating contents from food or beverages – likely explains the frequency of shooting pain among the 19-year-olds in our study.

Municipalities

Comparisons of different municipalities are based on the results from 2011 since municipality was not reported in 2004. In 2011 one municipality showed higher self-rated knowledge on periodontitis. A possible reason for this may be dedicated dental personnel on that specific clinic. There were no major differences between the groups responding in the various municipalities. The fact that the subjective experiences of the 19-year-olds did not differ between the municipalities suggests that their dental treatment met the requirements of dental law and the dental care objective established by the Swedish government (21).

Changes between 2004 and 2011

The item on knowledge of fluoridated toothpaste (E) showed that there is still uncertainty about its benefits, despite the item's intentional framing to lead patient responses (E, Table 1). Knowledge about the importance of fluoridated toothpaste was lower in 2011 than in 2004. An earlier study showed that Swedish adolescents seem to have low awareness of tooth brushing procedures and use of fluoride toothpaste, though they have received frequent dental care (10). It has also been shown that Swedish teenagers use whatever toothpaste is available at home, without reference to fluoride content (11) in spite of the strong evidence that daily use of fluoride toothpaste has a significant caries-preventive effect in children (22, 16). A study exploring oral health professionals' perspectives regarding their strategies for teaching their patients about tooth brushing found that they focus more on actual tooth brushing technique than on using fluoride toothpaste because they assume that patients are already familiar with the benefits of fluoride toothpaste (12). In Sweden, nearly all toothpaste is fluoridated, so it is possible that the 19-year-olds did not relate to the item in the way we expected.

Analysis of the items regarding knowledge (A-E) found that self-rated knowledge had decreased between the two time points, which we found rather surprising. A possible reason could be less vigilance on part of the dental staff as the disease prevalence has been stable for a long time. Comparisons of the items regarding self-perceived social impact (F-J) revealed an increase during the same time period. This may be caused by an increased focus on estheti-

cal aspects in society. The respondents in different waves of series of cross sectional surveys are subject to many influences that may have bearing to their answers.

Regarding the aspects of function (K-M), no differences were seen over time.

The global item (N) "Overall, how satisfied are you with your teeth and your mouth?" showed a small decrease between 2004 and 2011.

Conclusions

Almost 90% of the 19-year-olds in 2004 and 2011 had good self-perceived oral health. The finding that the responses were similar across the municipalities shows that self-perceived oral health is uniform throughout Östergötland County. Some of the respondents expressed uncertainty about the benefits of fluoride toothpaste. A high prevalence of shooting pain makes it important to carry out further studies to investigate the causes of this condition. Self-reported problems related to the social impact of oral health and aesthetics increased from 2004 to 2011, particularly among girls.

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Success rate, costs and long-term stability of treatment with activator/headgear combinations

CAMILLA HEDLUND, INGALILL FELDMANN

Abstract

◎ The aims of this study were to evaluate treatment outcome with activator-headgear combinations carried out by general dental practitioners, overall costs, long-term stability and patients' satisfaction with treatment outcome.

Patients who were recommended to start treatment in 2006 were included in this study (n=97). Inclusion criteria were: Class II Division 1 with at least half a cusp width distal molar relationship, overjet ≥ 6 mm and presence of dental records. Data were collected, pre-treatment, post-treatment and 3 years after treatment for those with favorable outcome. Patients at follow-up completed a questionnaire about satisfaction with treatment outcome, perceived pain and discomfort during treatment, and subjective need for additional treatment.

Eighty-five patients were analyzed, 52 boys and 33 girls (mean age 11.2 years SD 1.39). Thirty-five patients had successful treatment outcome, 15 partially successful and 35 had an unsuccessful outcome. Total costs for all 85 patients amounted to SEK 1 405 000 including both direct and indirect costs. Thirty-eight patients participated in the 3-year follow-up. Treatment outcomes were then categorized as successful in 28 patients, partially successful in 9 patients and 1 patient was judged as unsuccessful. Median values on VAS (0-100) for overall satisfaction with treatment and treatment outcome were high, 78 and 84 respectively. Median value for perceived pain and discomfort during treatment was 42.

Just over half of the patients had a favorable treatment outcome. Patients with favorable outcome were stable over time and satisfied with treatment.

Key words

class II treatment, headgear activator, success rate, costs

Orthodontic Clinic, Public Dental Service, Gävleborg County Council, Gävle, Sweden
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Aktivatorbehandlingar i allmäntandvården – långtidseffekt, patientnöjdhet och kostnader

Camilla Hedlund, Ingalill Feldmann

Sammanfattning

◎ Syftet med studien är att som ett led i kvalitetsuppföljning retrospektivt studera lyckandefrekvens av aktivatorbehandlingar utförda av distriktstandläkare inom allmäntandvården i Gävleborg samt att analysera kostnaderna av denna behandlingsform. I ett andra steg är syftet att göra en långtidsuppföljning av de patienter som bedömts ha ett lyckat resultat samt att utröna hur nöjda patienterna är med utförd behandling.

Studien inkluderar samtliga patienter som under 2006 rekommenderades att påbörja aktivatorbehandling inom allmäntandvården, Folktandvården Gävleborg AB (n=97). Inklussionskriterierna var Angle klass II:1 malocclusion med minst 1/2 kuspbredd postnormal molarrelation, horisontell överbitning ≥ 6mm och adekvat journalföring. Data samlades in från studiemodeller och journal före behandling och efter behandling samt 3 år efter avslutad aktiv behandling för de som bedömdes ha ett lyckat behandlingsresultat.

Resultatet bedömdes som lyckat, partiellt lyckat eller avbrutet/misslyckat. Kostnaderna mättes som direkta och indirekta kostnader. Vid 3-årsuppföljningen fyllde patienterna i en enkät om hur nöjda de var med behandlingen, behandlingsresultatet och upplevd smärta/obehag under behandlingen.

Åtta patienter avböjde behandling, 4 hade bristande journalföring. Således analyserades 85 patienter, 52 pojkar och 33 flickor (medelålder 11.2 år SD 1.39). 35 patienter bedömdes som lyckade, 15 som partiellt lyckade och 35 patienter hade avbrutit behandling eller hade ett misslyckat behandlingsresultat. Främsta orsaken till misslyckad behandling var bristande kooperation.

En kostnadsanalys för alla 85 patienter uppgick till SEK 1 405 000. Denna inkluderar de direkta kostnaderna (SEK 880 000) för behandlingstid och teknikerarvode samt indirekta kostnader (SEK 524 000) för föräldrars frånvaro från arbete (resekostnad exkluderad).

Av de 50 lyckade eller partiellt lyckade patienterna tackade 38 patienter ja till en uppföljande kontroll 3.6 år (SD±1.20) efter avslutad aktivatorbehandling. Av dessa bedömdes 28 patienter fortfarande vara lyckade behandlingar, 9 var partiellt lyckade och en bedömdes som misslyckad. Enkätsvaren visade på hög nöjdhet med behandling och behandlingsresultat, medianvärde 78 (interkvartilavstånd 45–100) respektive 84 (30–100) på en VAS-skala 0–100. Medianvärde för upplevd smärta och obehag under behandlingen var 42 med stora individuella skillnader (9–97).

Slutsatserna av studien är att 50 av 85 patienter hade ett lyckat eller partiellt lyckat behandlingsresultat och att de patienter som har ett gott behandlingsresultat är stabila över tid och nöjda med sina behandlingar.

Introduction

Correction of a Class II Division 1 malocclusion is a common orthodontic procedure in Scandinavia. Of all children and adolescents, 14-20% are diagnosed with this malocclusion (26) and the treatment panorama is broad, including many different approaches and appliance designs.

The reasons for treating Class II Division 1 malocclusion are mainly esthetic and/or trauma prophylactic. Earlier studies have shown that severe Class II malocclusions with prominent upper front teeth and incompetent lip closures are less esthetically appealing and a possible reason for children being teased at school (18, 24, 28). Traumatic injuries are also predisposed in Class II malocclusions with increased overjet and inadequate lip closure (4, 5, 13, 16, 20, 23).

One common strategy in patients with Class II Division 1 malocclusions has been early treatment in the mixed dentition with functional appliances, i.e., activator or activator-headgear combinations. These appliances can be effective in reducing overjet and improving the soft tissue facial profile and it has also been proven that they have some skeletal effect (7, 12, 15). However, the success rate is low (27-62%), mainly as a result of poor compliance (3, 6, 21). This is of course problematic, since many of these patients need additional treatment with fixed appliances. Over the past years there has been a lively debate on the benefits of early orthodontic treatment compared to one-stage treatment in the permanent dentition (8, 27, 29).

Besides the fact that early treatment with functional appliances often results in an increased number of appointments and longer treatment time (17), there are also higher costs to consider, for patients and their parents as well as for society. There are, however, few previous studies looking at the overall costs related to treatment with orthodontic appliances (11, 19).

The aim of the present study was to investigate the outcome and overall costs of Class II Division 1 malocclusion correction with activator-headgear combinations performed by general dental practitioners. Long-term stability and subjective need for further treatment for those patients with favorable outcome were also analyzed.

Material and Methods

All patients with a Class II Division 1 malocclusion who were recommended to start treatment with an activator or activator-headgear combination in the Public Dental Service, Gävleborg County Council, Sweden, in 2006, were included in the study. General practitioners performed all treatments under the guidance of an orthodontist.

The inclusion criteria were: Class II Division 1 with at least half a cusp width distal molar relationship, overjet ≥ 6 mm, incompetent lip-closure, and presence of dental records to verify treatment outcome. The Ethics Committee of Uppsala University, Uppsala, Sweden, approved the study with the registration number 2012/190.

Variables extracted from the dental records were: previous orthodontic treatment, sagittal molar relationship (cusp width), overjet, activator design, age at treatment start, number of visits, length of visits and treatment outcome. Stability after 3 years and remaining subjective treatment need were assessed in patients with a favorable outcome.

Data were collected from the patient's dental records, before treatment, after active treatment and 3 years after active treatment for patients who had a successful or partially successful treatment outcome.

Activator design

Two different types of activators (Figure 1) were used in the treatment of patients with Class II Division 1 malocclusion in Gävleborg County Council during that time period; modified activator-headgear combination according to Bass (2), and modified activator-headgear combination according to Teuscher (25).

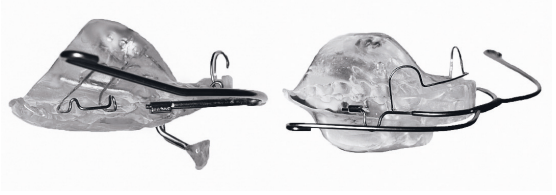


Figure 1. Activator-headgear combination (modified) according to Bass and activator headgear combination (modified) according to Teuscher

Treatment outcome

Treatment outcome was based on study casts and/or dental records and defined as follows (6):

- Successful outcome: Class I molar relationship with an overjet ≤ 4 mm
- Partially successful outcome: Substantially improvement in both molar relationship and overjet
- Unsuccessful outcome: Interrupted treatment and/or with no substantial improvement in molar relationship and overjet

Costs

Overall treatment costs were measured as direct and indirect costs. Direct costs were based on a generally accepted standard of SEK 1300/hour, including costs for materials, costs of the premises and personnel costs for the Public Dental Health Care, County Council of Gävleborg, Sweden, 2010. Treatment time was measured as the number of visits and their duration. Costs for manufacturing study casts and orthodontic appliances were also included in direct costs.

Indirect costs were based on patients' and parents' time off from school and work, respectively, but with travel expenses excluded and defined as parents' loss of income, assuming that they were absent from work to accompany the patient to the dentist. Data sourced from the Swedish National Bureau of Statistics estimated the wages plus social security costs of an average Swedish worker to be SEK 240/hour. The parents' absence from work was estimated as duration of the appointment and 60 minutes of travel time.

Stability and treatment satisfaction

In order to study stability after active treatment with an activator-headgear combination, all patients who were judged to have a successful or partially successful treatment outcome were contacted for a 3-year follow-up. A new set of dental casts was obtained, and the patients completed a questionnaire about treatment satisfaction and subjective need for additional treatment. Self-report items from questionnaires previously found to be reliable and valid were used (9). The questionnaire included 11 questions and was graded on a Visual Analog Scale (VAS 1-100).

Statistics

Arithmetic means and standard deviations (SD) were calculated for age, overjet, treatment time and costs. Descriptive statistics including median value and interquartile range were calculated for treatment outcome satisfaction and subjective treatment need.

Between-group differences in treatment outcome were tested using the nonparametric Kruskal-Wallis, Mann-Whitney tests, Chi-square tests and t-tests. The level of significance was set to $P<0.05$.

Results

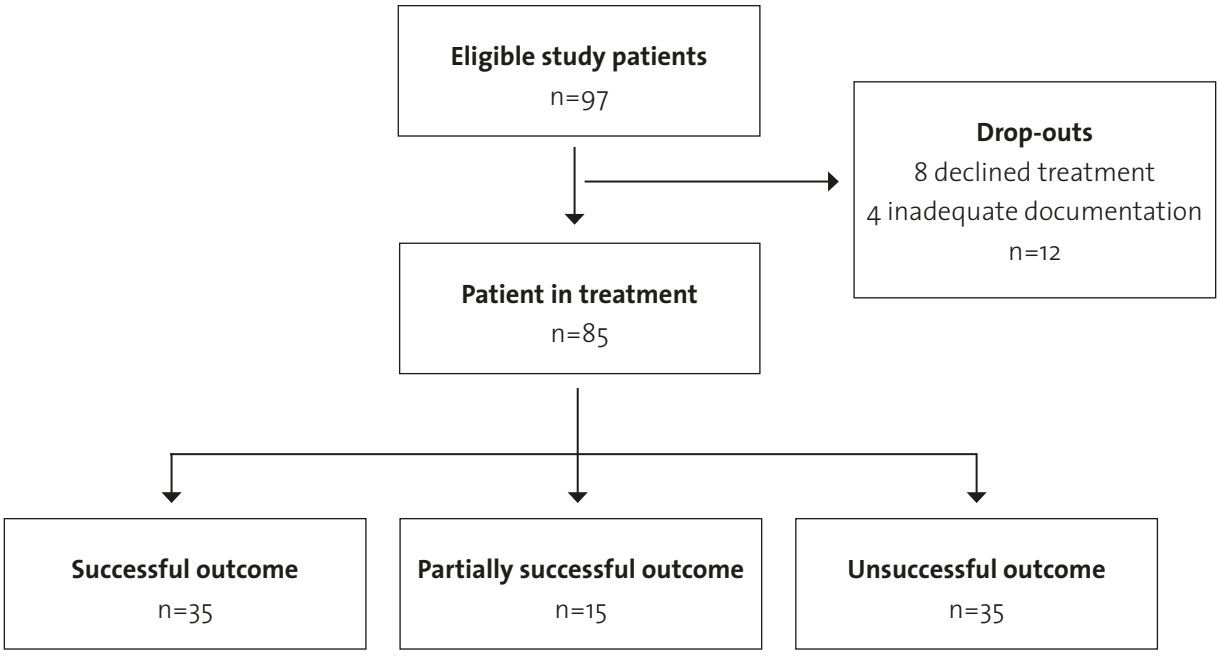
A complete file search resulted in 97 eligible patients, 60 boys and 37 girls. Twelve patients did not meet the inclusion criteria (8 patients declined treatment and 4 patients had missing records), and the final sample size therefore consisted of 85 patients: 52 boys and 33 girls. The dropouts were not significantly different from the remaining subjects with regard to age and gender. There was no significant difference in age between boys and girls at the time of treatment recommendation (mean age 10.9 years, SD 1.43). Fifteen patients had received previous orthodontic treatment: 4 removable plates, 4 Quad Helix, 5

◎ **Table 1.** Mean age and overjet at treatment start, number of patients with previous orthodontic treatment and recommended appliance design for the three groups of treatment outcome

	All patients N=85	(A) **Successful treatment outcome** N = 35	(B) **Partially successful treatment outcome** N = 15	(C) **Unsuccessful treatment outcome** N = 35	**Group differences P-values**
Number of patients with previous treatment (N=15)		6	1	8	NS
Number of patients with Teuscher-activators (N=66)		30	11	25	NS
Number of patients with Bass-activators (N=19)		5	4	10	NS
Mean age pretreatment (years, SD)	11.2 (SD 1.39)	11.1 (SD 1.34)	11.2 (SD 1.86)	11.3 (SD1.53)	NS
Mean overjet pretreatment (mm, SD)	8.8 (SD 1.87)	8.6 (SD 1.40)	9.0 (SD 2.17)	9.0 (SD 2.15)	NS

NS indicates not significant

Figure 2. Flow chart of all patients in the study.



activator-headgear combinations, 1 cross elastic and 1 fixed appliance in the upper jaw.

Activator design

Sixty-six patients were recommended a modified activator-headgear combination, according to Teuscher, and 19 were recommended a modified activator-headgear combination, according to Bass. The mean initial overjet was 8.8 mm (SD 1.87) for all patients in the study, but there was a significant difference (P=0.017) in mean overjet between patients who were recommended a Bass activator (9.8 mm, S.D. 1.88) and those who were recommended a Teuscher activator (8.5 mm S.D 1.78).

Treatment outcome

Thirty-five patients had a successful treatment outcome, i.e. Class I occlusion and an overjet not exceeding 4 mm, 15 had a partially successful outcome and 35 discontinued treatments and/or had a final outcome that was rated as unsuccessful (Table 1). One orthodontist and one resident in orthodontics performed the outcome assessments.

The main reason for unsuccessful treatment outcome was, according to the records, lack of compliance. There were no significant differences in age, initial overjet or activator design between patients who had a successful, partially successful or unsuccessful treatment outcome. However, eight patients with previous treatment belonged to the group with unsuccessful treatment outcome, and all five with previous activator treatment belonged to this group. No were lost or remade during treatment. A flowchart of all 85 patients is presented in Figure 2.

Treatment time

Mean treatment time for all patients in the present study was 25.8 months (SD 12.7), with a range between 3.9 and 54.4 months. This corresponded to a mean number of 16.8 appointments and 353 minutes of chair time per patient. Table 2 presents treatment time, chair time, number of scheduled visits, number of acute appointments and number of consulting appointments for the three different treatment outcome groups. There were significantly higher treatment times, chair times and number of appointments for patients with successful or partially successful treatment outcome compared to patients with unsuccessful treatment outcome. Number of acute appointments was also lower for patients with unsuccessful treatment outcome compared to patients with successful treatment outcome.

Costs

Costs for all patients in all three treatment outcome groups are presented in Table 3. A total cost analysis for all 85 patients, amounts to about SEK 880 000, including direct costs for treatment time, laboratory material and fees. Indirect costs for all patients are estimated about SEK 524 000, excluding travel expenses.

Stability

Thirty-eight of the eligible fifty patients with successful or partially successful treatment outcome were evaluated after a mean follow-up time of 3.6 years (SD 1.20). Three patients had moved from the area and nine declined participating. The patients who declined to participate did not differ in age or sex from those who agreed to participate. Three patients with previous successful outcome were rated as partially successful at the follow-up and three patients previously assessed as partially successful showed favorable progress to a successful treatment outcome. Only one patient was rated as unsuccessful at follow-up. A flowchart of all patients at follow-up is presented in Figure 3. At the time for follow-up 2 patients had just started continued treatment with fixed appliance and 5 patients were on the waiting list. These seven patients were still successful or partly successful regarding the activator/headgear treatment but had been recommended further treatment due to crowding. According to the records, none of the nine patients who declined to participate in the follow-up had continued treatment or were on the waiting-list for fixed appliance.

Treatment outcome satisfaction

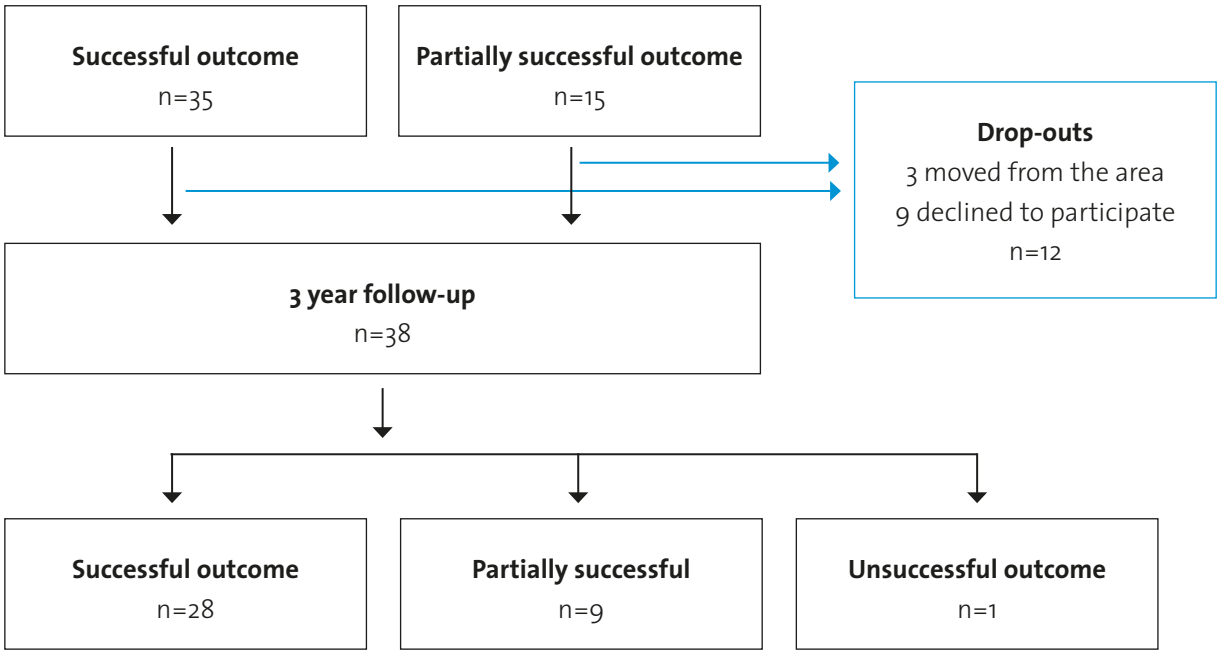
All patients who were part of the follow-up also answered a short questionnaire about how satisfied they were with their orthodontic treatment. Median values for overall satisfaction with treatment and outcome were high, but the spread was large. Some patients were aware of changes after treatment, but were mostly not concerned. Relatively high median values for perceived pain and discomfort, soreness and affected sleep were also observed. Median and interquartile range are presented in Table 4.

◎ **Table 2.** Mean values concerning treatment time, chair time and number of appointments for the different groups of treatment outcome

	(A) Successful treatment outcome N = 35		(B) Partially successful treatment outcome N = 15		(C) Unsuccessful treatment outcome N = 35		Group differences* P-values
	Mean	SD	Mean	SD	Mean	SD	
Treatment time (months)	30.6	11.89	28.2	11.29	20.6	13.09	A/B = NS A/C, P = 0.0013 B/C, P = 0.047
Chair-time (hours)	6.9	2.88	6.8	2.81	4.2	1.76	A/B = NS A/C, P < 0.001 B/C, P = 0.045
Total number of appointments	19.8	6.10	18.8	6.45	12.3	4.49	A/B = NS A/C, P < 0.001 B/C, P = 0.002
Number of acute appointments	0.7	0.78	0.9	1.03	0.2	0.41	A/B = NS A/C, P < 0.001 B/C, P < 0.001
Number of consultant appointments	2.2	1.18	1.9	0.88	1.9	0.89	NS
Number of missed appointments	0.9	1.36	0.7	1.33	0.8	1.56	NS

* NS indicates not significant

◎ **Figure 3.** Flow chart of all patients in the follow-up.



◎ **Table 3.** Mean costs (direct and indirect) for the different groups of treatment outcome

	(A) Successful treatment outcome N = 35		(B) Partially successful treatment outcome N = 15		(C) Unsuccessful treatment outcome N = 35		Group differences*
	Mean	SD	Mean	SD	Mean	SD	
Direct costs, chair time (SEK)	12 135	5 353	12 573	5 760	7 706	3 220	A/B = NS A/C, P < 0.001 B/C, P = 0.017
Direct costs, laboratory fees (SEK)	2 772	913	2 962	995	2 960	1000	NS
Indirect costs	3 878	1 265	3 834	1 623	2 410	883	A/B = NS A/C, P < 0.001 B/C, P = 0.002
Total costs	**18 785**	7 831	**19 368**	8 378	**13 076**	5 103	A/B = NS A/C, P < 0.001 B/C, P = 0.007

* NS indicates not significant

◎ **Table 4.** Questionnaire concerning satisfaction with treatment outcome and perceived pain and discomfort during treatment (VAS 0 -100)

	Median	Interquartile range
Do you think orthodontic treatment with an activator has been good for your teeth?	78	71–89
Considering everything, are you satisfied with your orthodontic treatment?	84	72–92
Are you satisfied with the changes made?	85	61–97
Are you satisfied with the appearance of your teeth after treatment?	72	54–86
Have you noticed any changes of your teeth after treatment?	20	10–79
If you have noticed any changes, how much do they bother you?	3	0–13
Did you experience pain and discomfort during treatment?	42	22–66
Did the treatment affect your sleep?	46	10–59
Did your orthodontic appliance cause soreness?	26	11–43
Did the orthodontic treatment affect your mood?	6	2–18
Have you ever been teased about the appearance of your teeth?	1	0–5

Discussion

The aim of the present study was to evaluate success rate and overall costs for patients with Class II, Division 1 malocclusion treated with a functional appliance in the context of general dental practice. Treatment of Class II malocclusion with proclined maxillary incisors with an activator-headgear combination is a common approach, and in Sweden also carried out by general dental practitioners, under the supervision of an orthodontist. The most important finding in the present study was that 59% of patients treated with an activator-headgear combination had a successful or partially successful treatment outcome. This is however comparable with results from other studies (3, 6, 21) reporting on outcomes of treatment performed by both general practitioners and orthodontists. There is a wide range in the literature of definitions of successful and unsuccessful treatment outcome and it is of course crucial that the definitions are the same when results are compared. The definitions in the present study are in accordance with the definitions of Casutt et al (6) but with the moderation that crowding and occlusal contacts were not considered. This is also the probable reason why favorable outcome were comparable (59% and 65% respectively) but outcome with ideal occlusion were not (41% and 27% respectively).

The main reason for unsuccessful treatment results in 35 of the 85 patients who started treatment was, according to the records, lack of compliance, which is a logical and known reason, given that the activator-headgear combination is a removable appliance (1,6). Compliance is difficult both to predict and to control, but because eight out of fifteen patients with previous treatment, including all five with previous activator treatment, belonged to the unsuccessful treatment outcome group, we can assume that previous treatment, particularly previous activator treatment, affects the prognosis negatively. The patients in this study were treated by general practitioners with varying degree of experience which together with variation in parental support probably also affected treatment result. There were, for example, a wide range in time intervals between appointments but the reason for this was not possible to further analyze. But, since we know that short intervals are important especially in the beginning of treatment this could have affected treatment results and it would have been interesting to know if the patients were scheduled differently or if the time intervals were changed by the patients and/or their parents.

Successful treatment outcome with an activator-headgear combination is also dependent on when treatment is performed. The optimal time for treatment with an activator–headgear combination is close to puberty, and previous research has shown that, at this point, we can expect the activator-com-

bination to be effective in treating Class II Division 1 malocclusions caused by maxillary prognathism, mandibular deficiency and facial convexity. Besides the dentoalveolar effects, skeletal effects in ANB are seen as a result of restrained maxillary growth, advancement of the mandibular structures and improvement of the soft tissue profile (2, 14, 15, 25, 27). Trauma prevention is, however, one of the most obvious reasons for treatment, and several studies and reviews have indicated the benefits of this early treatment approach. Nguyen et al (16) showed that risk of injury of anterior teeth increase with increasing overjet size. Borssén et al (4) reported that 35% of all children on one or more occasions had sustained injury to their primary or permanent dentition (64% of boys and 36% of girls) and that trauma was most frequent for boys at age 4 and between 8 and 11 and for girls between 4 and 9. If trauma prevention is the issue, treatment must start early, which in most cases leads to a second stage of treatment with fixed appliance in the permanent dentition. The mean age of patients in the present study at treatment start was 11.2 years (SD 1.39), which in most cases is too late for trauma prevention but is closer to the optimal period for treatment. Although the facts that boys experience their pubertal spurt significantly later than girls do, there was no significant difference between mean age for boys and girls at treatment start.

In the present study, the overall costs for all treatments with activator-headgear combinations in 2006 were SEK 1 405 000, including indirect costs. Because only 59% had a favorable outcome, the costs for each successful or partially successful treatment amount to about SEK 28 100. But, from this study we can easily conclude that the total costs are considerably higher including additional costs for 15 patients with pretreatment orthodontics, 35 patients with unsuccessful treatment outcome who are in need for retreatment, seven patients with favorable outcome who continued with a second phase of treatment with fixed appliances when all permanent teeth had erupted and one patient who needed retreatment after follow-up. The economic perspective, concerning both direct and indirect costs, is of vital interest in orthodontics, yet very few previous studies have looked at the overall costs and/or cost effectiveness (11, 19). Given that Class II, Division 1 treatments are common and often time-consuming; there is a need for further research on economic issues.

Long-term follow-up (after 3.6 years) of patients with successful or partially successful treatment outcome revealed that the treatment result was stable. Only one patient of those with a favorable outcome was judged as unsuccessful at the follow-up. But it is also interesting that three patients with partially successful outcome at the end of treatment were judged as successful at follow-up. It is difficult to predict final outcome even with a cooperative patient, but continuing treatment until all permanent teeth are erupted and in occlusion is probably important for long-term stability. Continued growth may also be an important factor affecting treatment outcome after retention. Favorable growth can even camouflage non-cooperative behavior and vice versa. Rudolph et al (22) observed 31 patients, diagnosed with Class II malocclusion, for 10 years in order to follow the normal growth pattern of these patients and found that 11 patients improved in terms of sagittal relation and 20 worsened.

Only 7 patients of all 50 with a successful or partially successful treatment outcome continued treatment with a second phase involving fixed appliances. This is compared to other studies a low number, which indicate that the patients besides the overjet had relatively straight teeth and therefore had little or no need for additional treatment. This is perhaps the most favorable situation when treating Class II Division 1 with an activator-headgear combination. Patients in the follow-up completed a short questionnaire about their perceptions of activator treatment, and the median values for satisfaction with treatment were generally high. Most patients were consequently satisfied with the outcome of the activator treatment. Patients had noticed changes in their teeth after treatment, mostly some crowding, but were generally not bothered by them (Median 3). Some other interesting and surprising findings from the questionnaire were how much pain and discomfort, soreness or disturbed sleep the activator had caused. Median values for pain and discomfort, disturbed sleep and soreness were 42, 46 and 26, respectively (with large individual variations), and therefore almost comparable with median values for the first week with fixed appliances (10). One possible shortcoming is of course that patients' perceptions of pain and discomfort, soreness and disturbed sleep were assessed retrospectively. However, the intention was to explore the patients' experiences of activator treatment, and this approach does provide information on how patients remember their treatment and, thus, how they would describe it to others.

The present study has some obvious weaknesses because it is retrospective in nature and therefore ranked relatively low on the hierarchy of evidence.

However, because all patients who were recommended treatment with an activator-headgear combination in Gävleborg County, in 2006, have been identified through a thorough search, missing data were few and the patients consequently representative of patients with a Class II Division 1 malocclusion treated with an activator-headgear combination. Drop-outs at the follow-up were however substantial and the conclusions from this part of the study must therefore be drawn with some caution.

Although it is effective in many cases, treatment with functional appliances has been a subject of debate. One of the reasons is that activator treatment must often be followed by a second phase of treatment with fixed appliances, which results in overall longer treatment time and consequently higher costs for patients, their parents and the orthodontic clinics. With prolonged treatment time there is also increased risk of lack of compliance. The general conclusion drawn from previous studies (17, 29) is, therefore, that one-stage treatment in the permanent dentition is preferable. The results from our study, both in terms of success rate and costs, indicate that activator treatments are unpredictable, mostly due to lack of compliance. However, in cooperative cases, with favorable growth and with no need for pretreatment or planned additional treatment later on, the activator can be recommended and from an economic perspective as well.

Conclusions

- Fifty out of 85 patients had a successful or partially successful treatment outcome with an activator-headgear combination.
- Patients with a favorable outcome had a stable treatment result 3 years post-retention and were satisfied with treatment.
- Patients with no need for pretreatment or planned additional treatment later on can be recommended treatment with an activator-headgear combination, also from an economic perspective.

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Treatment of adolescent patients with class II division 1 malocclusion using Eruption guidance appliance:

A comparative study with Twin-block and Activator-Headgear appliances

JENNY JIAYAN LUO NILSSON[1], XIAOCHEN SHU[2,3], BRITT HEDENBERG MAGNUSSON[4,5], IDIL ALATLI BURT[1,6]

Abstract

◎ The aim of this study was to evaluate the compliance and short term effects of eruption guidance appliance (EGA) in adolescents with class II division 1 malocclusion in comparison with twin-block appliance (TBA) and activator-headgear appliance (A-HG).

Dental records of 1886 patients were viewed in this retrospective study. 129 patients treated with one of these three functional appliances were identified. 123 fulfilled the inclusion criteria and data were extracted from the dental records. Gender, age, compliance, overjet change at every visit, number of appliance breakages and number of emergency visits apart from appliance breakage were studied. The data were analyzed with Chi-square test, General Linear Model and Fisher scoring test.

Results showed that 47 patients were treated with EGA, 38 patients with TBA and 38 patients with A-HG. Mean ages starting the treatment were slightly lower with EGA (11.5 years) than with TBA (12.3 years) and A-HG (11.8 years). Non-compliance was higher in the EGA group (31.9%) than TBA group (26.3%) and A-HG group (23.7%). Mean overjet reduction per month was 0.6 mm for EGA which was lower than TBA group (0.7 mm) and A-HG groups (0.7 mm). The number of emergency visits and appliance breakage were lower in EGA group. However, there was no statistically significant difference between the 3 groups regarding ages, compliance, mean overjet reduction, emergency visits and appliance breakage aspects.

In conclusion, this study indicates that EGA is an alternative choice in the treatment of adolescent patients with class II division 1 malocclusion. However, long-term follow-up and cephalometric prospective study should be performed to continue our understanding more about the mechanisms of EGA and more definite conclusions can be made.

Key words

Eruption guidance appliance, Adolescent patients, Class II, Twin-block appliance, Activator-Headgear appliance

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Behandling av postnormala bett med Eruption guidance-apparatur hos ungdomar

En jämförelsestudie med Twin-block och Aktivator-Headgear-apparatur

JENNY JIAYAN LUO NILSSON, XIAOCHEN SHU, BRITT HEDENBERG MAGNUSSON, IDIL ALATLI BURT

Sammanfattning

◉ Syftet med denna retrospektiva studie var att utvärdera korttids effekten av Eruption guidance-apparatur (EGA) hos ungdomar med postnormala bett i jämförelse med effekt av Twin-block apparatur (TBA) och Aktivator-Headgear-apparatur (A-HG).

Samtliga journaler från 1886 patienter behandlade av 4 ortodontister på två folktandvårdskliniker i Stockholm under 2010. 01 till 2011. 12, granskades i syfte att finna tidigare utförda EGA, TBA eller A-HG. 129 patienter hade behandlats med någon av dessa apparaturer och 123 av dessa inkluderades i studien. Uppgifter om patienternas kön, ålder, kooperation, horisontal överbett (höb) vid varje besök, antal akutbesök och fraktur av apparatur extraherades från journalerna och analyserades statistiskt med Chi-square test, General Linear Model och Fisher scoring test.

Resultat visade att 47 patienter var behandlade med EGA, 38 patienter med TBA och 38 patienter med A-HG. Den genomsnittliga åldern var något lägre hos de patienter som behandlats med EGA (11.5 år) jämfört med TWA (12.3 år) och A-HG-grupperna (11.8 år). Hos patienterna i EGA-gruppen var det 31.9% som inte koopererade vilket var något högre än i TBA (26.3%) och A-HG (23.7%). Den genomsnittliga minskningen av höb per 4 veckor var 0.6mm i EGA-gruppen vilket var lägre än i TBA-gruppen (0.7 mm) och A-HG-gruppen (0.7 mm). Antal akutbesök och frakturerad apparatur var lägre i EGA gruppen. Skillnaderna mellan de tre grupperna avseende ålder, kooperation, höb minskning, antal av akut besök och antal fall med trasig apparatur var ej statistiskt signifikanta.

Sammanfattningsvis antyder resultat från denna studie att EGA är ett alternativ vid val av apparatur för behandling av postnormala bett hos ungdomar på kort sikt. Prospektiva studier med längre uppföljningstid rekommenderas innan slutsatser kan dras.

Introduction

Most class II division 1 malocclusion patients have a deficiency in the anterioposterior position of the mandible and the maxillary anterior teeth are proclined. In addition, a large overjet, lip incompetence and convex profile are often present. A functional appliance engages both dental arches and acts principally by advancing the mandible, they have orthodontic and orthopedic effects in the treatment of a growing patient (23).

The eruption guidance appliance (EGA), developed by Bergersen (2, 3, 4), was designed to correct different malocclusions, specifically for treatment of children at their early mixed dentition stage. It was used as the sole treatment by guiding eruption of the teeth in preventive dentistry and interceptive abnormal oro-facial conditions. It was also aimed to simplify future orthodontic treatment. EGA is a prefabricated elastomeric appliance, consisting of a single elastic device with intercuspation for the upper and lower teeth in normal occlusion. It presents the combined characteristics of functional appliances and positioners. Characteristics attributed to functional appliances are mandibular advancement in order to correct class II sagittal discrepancies and as a positioner in minor tooth movement, as a result of the elastomeric material. Clark (5, 6) developed the twin block appliance (TBA) as a two part bite block designed for wearing full-time. It achieves functional correction of malocclusion by transmission of favorable occlusal forces to occlude inclined planes covering the posterior teeth. The forces of occlusion are used as the functional mechanism to correct malocclusion. Teuscher (24) was the first to combine the activator with high-pull headgear (A-HG) in the treatment of class II division 1 malocclusion. This appliance aims to advance the mandible forward and inhibit the anterior-posterior translation of maxillary development.

There have been few scientific reports about the effectiveness of EGA in the treatment of class II division 1 malocclusion and most of these reports showed the effects of EGA on deciduous dentition and early mixed dentition. Studies done by Bergersen (4) and Methenitou et al (20) showed that EGA could improve overbite and overjet in 3 to 8 year old patients. Keski-Nisula et al (15, 16) investigated dentofacial changes induced by the EGA in early mixed dentition and the mean age for starting treatment was 5.1 years. Reports by Janson et al (9, 10, 11) showed that EGA had good effects in the treatment of class II division 1 malocclusion in the mean chronological age of 9 years. In the same study, it was shown that in comparison with Fränkel appliance (11), EGA had the similar effect on occlusal changes, as evaluated by the PAR index. However, there have been no reports about the effects of EGA in the treatment of older children with mean age older than 10 years. Furthermore, no research has been done to compare EGA with other functional appliances, except for Fränkel appliance (11).

The aim of this study was to investigate the compliance and effects of EGA in older children with class II division 1 malocclusion and compare different aspects of EGA with the other two functional appliances: TBA and A-HG. The null hypotheses were that adolescents with class II malocclusion in their late mixed or permanent dentition could be treated effectively with EGA in the short term and there were no significant differences among EGA, TBA and A-HG in regard to compliance, overjet reduction, breakage and emergency visit apart from breakage.

Subjects and methods

Total dental records of 1886 patients treated by four orthodontists were collected from two orthodontic departments of the Public Dental Service (Stockholm, Sweden) from January 2010 to December 2011. These four orthodontists were selected because they had participated in the same education program in the use of functional appliances at the Eastman Institute (Stockholm, Sweden) and were well experienced in the use of functional appliances.

129 patients who had been treated with either the EGA, TBA or A-HG were identified, and of these123 satisfied the inclusion criteria, which was class II division 1 malocclusion without nasal obstruction and mouth breathing according to a health declaration in the records (Figure 1). Six patients were excluded 4 because of class I malocclusion and 2 with both mouth and nose breathing. 47 patients had been treated with EGA (Figure 2a, b); 38 patients with TBA (Figure 3a,b); 38 patients with A-HG (Figure 4a,b).

For EGA treatment, patients used a prefabricated EGA (LM-Instruments Oy Company, Finland). This type of EGA was divided into two models: low angle and high angle. Low angle model was used for mandibular low angle patients with a vertical opening in the posterior region to provide a greater vertical development of the posterior teeth. High angle model was used for mandibular high angle patients with a vertical contact posterior region to provide a greater

◎ **Figure 1.** Flow chart of dental record selection. EGA= eruption guidance appliance; TBA=twin-block appliance; A-HG=activator-headgear appliance.

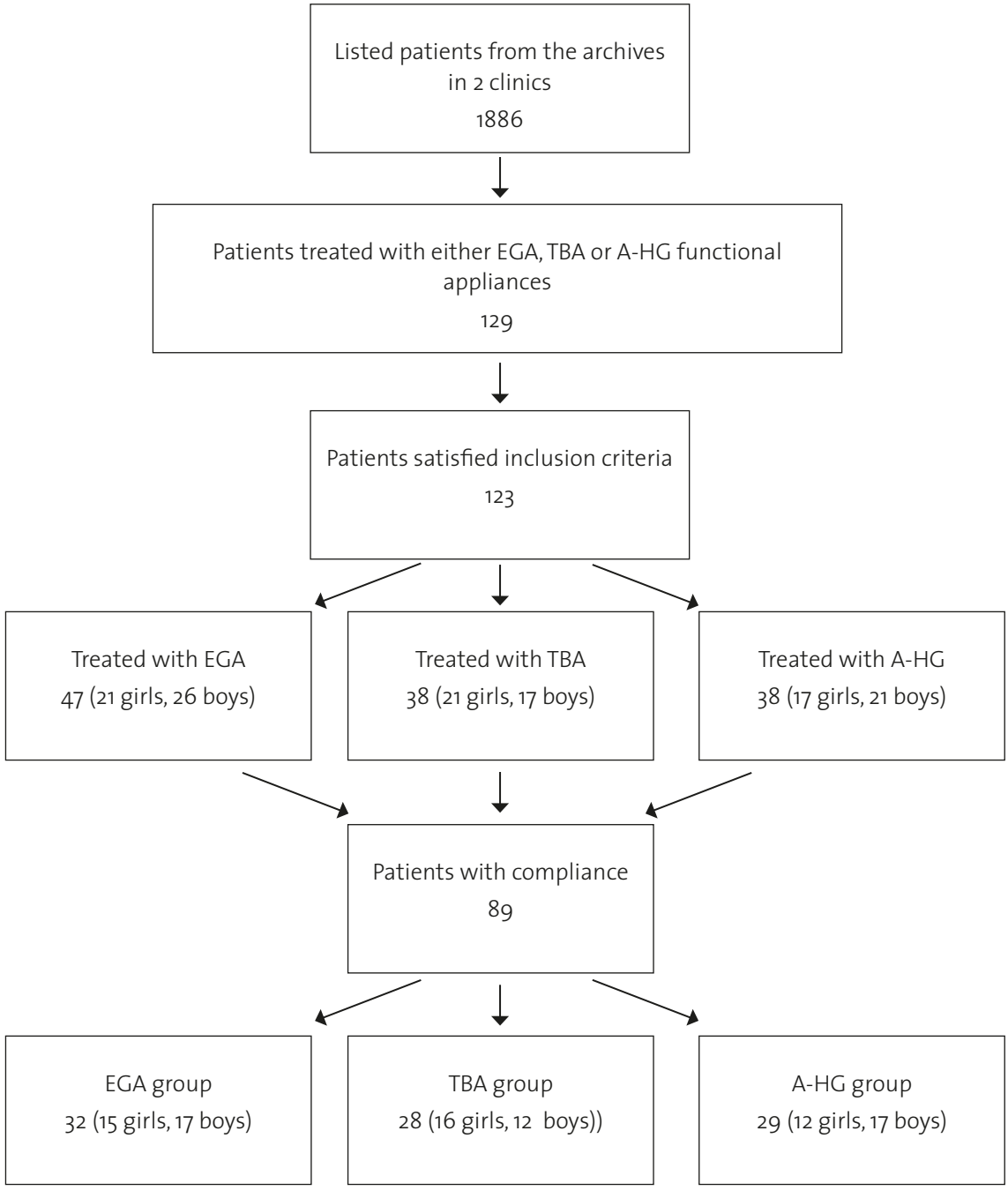


Figure 2a. EGA.

Figure 2b. Patient with EGA.

Figure 3a. TBA.

Figure 3b. Patient with TBA.

vertical intrusion of the posterior teeth. The appropriate size of the appliance was determined following the recommendations by the manufacturer. Mild crowding or mild spacing was taken into account when we determined the correct size of EGA, thus a larger or smaller appliance was used to create (expansion) or close the space. Two hours day-wear in addition to night-wear, totaling 14 hours per day was recommended. If difficulties were encountered, daytime wear of an extra two hours was recommended until the problems with night-wear disappeared. The patients were advised to keep the lips in contact. EGA was modified sometimes with a scalpel or silicone bur, if the appliance caused discomfort to the patient because of excess pressure on soft tissues. Figures 5a, b shows some results of treatment with EGA, the overjet and overbite were reduced and the diastema mediale was closed.

The TBA and A-HG groups, required a single-step mandibular advancement, carried out with wax bite registration. An edge-to-edge incisal relationship with 4 to 8 mm bite opening between the central incisors was maintained. TBA and A-HG appliances were made at the Dental Health Laboratory (Stockholm). Patients were instructed to wear the appliance for 14 hours per day. Interocclusal acrylic trimming was performed to allow vertical development of the mandibular buccal segments if needed. Labial bow was activated when it was necessary to close the space during treatment.

The data were extracted from dental records, including gender, age in the start of treatment, compliance, overjet change every visit, number of patients with appliance breakage and emergency visits apart from appliance breakage. Data were analyzed for 9 months of the treatment period with respective appliances. Unfortunately, dental study models and cephalometric records at completion of treatment were not available as this was a retrospective study.

◎ **Figure 4a.** A-HG.

◎ **Figure 4b.** Patient with A-HG.

◎ **Figure 5a.** Before treatment with EGA.

◎ **Figure 5b.** After treatment with EGA.

Statistical method

Data was analyzed with Chi-square test, General Linea Model and Fisher scoring test using SAS ((Version 9.3) SAS Institute Inc., Cary. NC. USA). P values of 0.01 were considered as significant.

Results

Gender and age

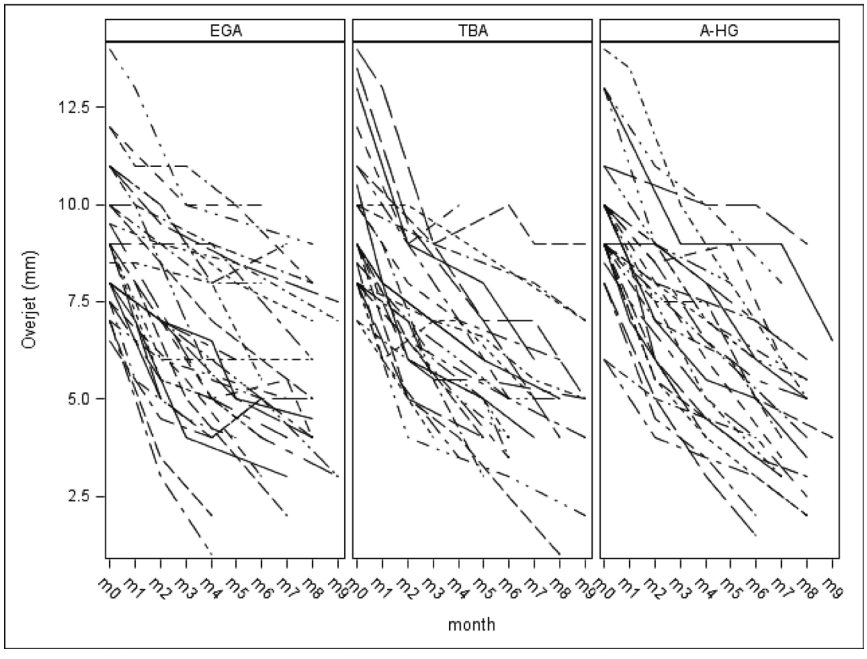
Dental records of 123 patients (59 girls, 64 boys) were collected in the study. 47 (21 girls, 26 boys) in the EGA group, 38 (21 girls, 17 boys) in the TBA group, and 38 (17 girls, 21 boys) in the A-HG group. The mean age at the start of treatment was 11.5 for EGA, 12.3 for TBA and 11.8 years for A-HG (Table 1).

Compliance

A patient was recorded as non-compliant in this study if the dental records noted that the patient did not use the appliance, or used the appliance not long enough during the day (less than 8 hours per day), or that the routine measurements indicated no clinical improvement after 9 months of appliance wear. 15 patients in the EGA group (31.9%), 10 patients in TBA (26.3%) and 9 in the A-HG group (23.7%) were recorded as non-compliant. Chi-square test showed no difference between EGA and A-HG (p=0.40), TBA and A-HG (p=0.79), and EGA and TBA (p=0.57) regarding compliance aspect (Table 1).

The 89 patients who were compliant (72.4%) continued with analysis, 32 patients (15 girls, 17 boys) in EGA, 28 patients (16 girls, 12 boys) in TBA, and 29 patients (12 girls, 17 boys) in the A-HG group. The mean age of these 89 patients was 11.4, 12.4 and 11.6 years for EGA, TBA and A-HG groups, respectively (Table 2).

The mean overjet at the start of treatment was 9.1 mm for EGA, 9.5 mm for TBA, and 9.7 mm for A-HG groups. Mean overjet after 9 months treatment was 3.6 mm for EGA, 3.2 mm for TBA, and 3.4 mm for A-HG group. The mean overjet reduc-



◎ **Figure 6.** Individual overjet values over time of 89 patients with respective appliances.

◎ **Table 1.** Mean age (years) of 123 patients at the start of treatment with respective appliances. EGA= eruption guidance appliance; TBA=twin-block appliance; A-HG=activator-headgear appliance; N=number; CI=confidence Interval.

group	N	Mean age(years)	95% CI age (years)	Non compliance (N) (%)
EGA	47	11.5	11.0-12.0	15 (31.9%)
TBA	38	12.3	11.9-12.7	10 (26.3%)
A-HG	38	11.8	11.4-12.2	9 (23.7%)
Total	123	11.8	11.6-12.1	34 (27.6%)

◎ **Table 2.** Mean age (years) and overjet (mm) of 89 patients with compliance at the start of treatment and after 9 months. Further, overjet reduction (mm) per month with respective appliances. N=number; CI=confidence Interval.

Group	N	Mean age(years)	95% CI age (years)	Mean overjet (mm) pre- (range),9month		Mean overjet reduction (mm)	95% CI overjet reduction
EGA	32	11.4	10.8-12.0	9.1 (6.5-14)	3.6	0.6	0.5-0.7
TBA	28	12.4	12.0-12.8	9.5 (7-14)	3.2	0.7	0.6-0.8
A-HG	29	11.6	11.2-12.1	9.7 (6-14)	3.4	0.7	0.6-0.8

◎ **Table 3.** Emergency visits and appliance breakage with respective appliances of 89 patients.

	EGA	TBA	A-HG	P	
				EGAvsTBA	EGAvsA-HG
Emergency(n)	3(9.4%)	7(24.1%)	8(27.6%)	0.13	0.12
Breakage(n)	3(9.4%)	5(17.9%)	1(3.5%)	0.26	0.37

tion per month was 0.6 mm for EGA group, 0.7 mm for TBA group, and 0.7 mm for A-HG group, (1 month=4 weeks) (Table 2). Analysis with General Linear Model showed no difference between EGA and A-HG (p=0.30), TBA and A-HG (p=0.55), EGA and TBA (p=0.70) regarding mean overjet reduction per month.

Individual changes in overjet of 89 patients with respective appliances are shown in Figure 6 (1 month=4 weeks). Some of the patients have no value in the 9th month due to that their next clinical check-up occurred later than 9 months and the visit was not a part of this study, which is a disadvantage of this retrospective study that data extracted from the records could not be controlled regarding clinical check-up intervals.

Emergency visit and appliance breakage

The 89 compliant patients were also analyzed for number of emergency visit and appliance breakage. A higher number of emergency visits were required for TBA and A-HG appliances than for EGA. The common reason to seek treatment was sore oral mucosa rather than appliance breakage or lost. Three patients in the EGA group (9.4%) had emergency visits during their treatment compared with seven patients in the TBA (24.1%) and eight patients in A-HG groups (27.6%). Fisher scoring test showed no statistically significant differences comparing EGA group with TBA (p=0.13) and A-HG (p=0.12) (Table 3).

More appliance breakages were reported for the TBA group than EGA and A-HG groups. Three patients in EGA group (9.4%) had breakage compared with five in TBA group (17.9%) and one breakage in A-HG group (3.5%). Fisher scoring test showed no statistically significant difference in comparing EGA group with TBA (p=0.26) and A-HG (p=0.37) (Table 3). Regarding laboratorial costs, EGA (about 70 Euro) was a cheaper appliance in comparison to TBA (about 260 Euro) and A-HG (about 180 Euro).

Discussion

This study showed that EGA could be used for adolescents. TBA and A-HG functional appliances have been extensively demonstrated to be effective methods for treating adolescents with class II division 1 malocclusion (5, 6, 7, 13, 22, 24). However, EGA, as the name defined often was used to guide erupting permanent teeth to correct positions in the dental arches. Therefore, EGA has been used for early mixed dentition (3, 4, 9, 10, 12, 15, 16). In the present study, the mean age at the start of treatment with EGA was 11.5 years. The oldest patient using EGA in

the present study was a 14.9 years old boy, his cervical vertebrae maturation was at stage 4 according to Lampaski (18) scoring method, his overjet reduced from 9 mm to 5 mm after six months of treatment. A 14.8 years old girl with cervical vertebrae maturation stage 4 also showing overjet reducted from 7 mm to 3 mm after 9 months of EGA. This study showed that using EGA could extend the treatment age from early mixed dentition to permanent dentition.

In this study, investigation of the total treatment time was planned, but some patients did not use the same functional appliance continuously because they were tired of the appliance, some changed their orthodontist, some transferred to complete their treatment with a fixed appliance. Therefore we could not calculate the optimal treatment time that functional appliance should be used. However, all compliance patients had worn their first appliance for at least 9 months, therefore data were analyzed for 9 months of the treatment period with respective appliances. Even though the study period was short, we carried out the data analysis for all patients with the primary outcome measure compliance, with secondary outcomes of overjet reduction, appliance breakages and emergency visit.

Usage time of TBA was recommended as 24 hours per day (5, 6). However, in our study, patients were recommended to use their appliances about 14 hours per day, since it was not convenient for them to use the appliance during school time as they felt embarrassed. O'Brein's study (22) confirmed the same compliant of embarrassment. We found 14 hours per day was sufficient and effective to treat patients. Furthermore, this shorter usage time was a considerable advantage for this comparative study as all the patients no matter which group they belonged to were recommended to use the appliances approximately 14 hours per day. Patient compliance is one of the most important factors influencing the results of orthodontic treatment. This study showed the ratio of unsuccessful usage of EGA (32%) was slightly higher than TBA (26%) and A-HG (24%), but there was not a statistically significant difference. The non-compliance ratio in the EGA group was quite similar to a Finnish study (16). Various psychosocial disturbances were reported as the main reasons for poor cooperation (22). Interestingly, family background seemed to be one of the important factors affecting compliance (16). In our study, it was found that patients attending the clinic, located in the central city had a much higher compliance rate than patients attending in the suburbs, where most had immigrant backgrounds. Some of the parents as well as the patients from the latter group had Swedish language deficiencies and the parents were unemployed. Unfortunately, scientific statistical analyses to assess socio-economic status was not possible in this research as the collected materials were not sufficient for use in this study if they were divided to two socio-economical groups and three appliances. Further prospective research will be needed with regards to this aspect. Another important reason for the non-compliance in the EGA group was that in some study patients the appliance did not fit so well in the mouth at the beginning of the treatment, since it was a prefabricated appliance. It was noticed that some patients had difficulties in using EGA during night. Therefore, it is very important to choose the right appliance size from the beginning. If loosening in the mouth whilst sleeping was encountered, daytime wear of extra two hours was recommended until the problems with night-wear disappeared. Awareness and support of parents was essential for compliance as mentioned above because they could remind their children to wear the appliance during the daytime and check appliance wear at the night.

Effect of functional appliance in treatment of class II division 1 malocclusion is usually measured by overjet change at every clinical visit. In this study, the clinical overjet measurement that was registered in the data was taken into account. Unfortunately, sagittal molar relationship and overbite were not available in every patient's dental record. This study showed that EGA was slightly less effective to reduce overjet than TBA and A-HG, but there was no statistically significant difference between the 3 groups. Factors contributing to overjet correction require cephalometric analysis. No cephalometric records were available at the completion of treatment in this retrospective study because of Swedish radiology law. Reviewing the literature, it has been shown that factors, which may have contributed to the correction of the overjet with EGA, proposed that treatment with EGA was significantly improved the maxilla-mandibular relationship (9,10), that mandibular growth was greater than maxillary forward growth during treatment and that condylar growth was enhanced, resulting in a clinically significant increase of mandibular length (15), lingual inclination and retrusion of the upper incisors, linear protrusion of the lower incisors(9,10). However, Keski-Nisula (15) reported using EGA for early mixed dentition did not cause a significant restriction of anterior

growth of the maxilla and no effects were observed in the maxillary position, maxillary size, inclination or retrusion of the maxillary incisors. No studies to date have investigated orthodontic and/or orthopedic effects of EGA in late mixed and early permanent dentition. Further prospective research with cephalometric analysis would help us to understand more about the mechanisms effected by EGA.

Emergency visits were more frequent in the TBA and A-HG groups compare to the EGA group, but there was no statistical significant difference between the 3 groups. Reasons included sore oral mucosa rather than appliance breakage or lost. The hard acrylic material of TBA and A-HG easily allowed excess pressure on the soft tissues compared to the silicon elastomeric material of EGA. The TBA appliance broke more than EGA and A-HG. However, this was lower than the study by Badri et al (1). Breakage in our study occurred most commonly in the lower front part of TBA due to of its narrow and thin acrylic structures.

Finnish researchers have shown that EGA could be offered to more patients without extra manpower or increased costs (17). In this study, EGA apparatus cost was less than the other functional appliances as it was prefabricated and the other appliances were made by technicians. EGA appliances were seldom breaking and required fewer visits to the clinic. However, it was difficult to calculate other costs as time consumption in this study since every visit time was booked the similar for all appliances although EGA checking and adjustment in fact required far less. This was the disadvantage of the retrospective study. Kerosuo et al showed that experienced general practitioners could be involved in the treatment of patients with EGA under the supervision of an orthodontist (14). Furthermore, retention could be carried out with the same appliance. All of these factors can reduce the total clinical costs. In Sweden, orthodontics treatment is included in the public dental health care system, so clinical costs often influence the choice of techniques used, thus the characteristics of EGA might be economically beneficial to our dental health care systems.

In conclusion, this study indicates that EGA is an alternative choice in the treatment of adolescent patients with class II division 1 malocclusion. However, long-term follow-up and cephalometric prospective study should be performed to continue our understanding more about the mechanisms of EGA and more definite conclusions can be made.

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Native-born versus foreign-born patients' perception of communication and care in Swedish dental service

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Abstract

◎ Like many other countries Sweden is becoming more multicultural and many residents do not fully master the national language and are not completely familiar with national norms and habits. The key to good interaction between dentists and patients is communication. Therefore this study aimed to examine whether there are differences in the experience of communication and care between native-born (NB) and foreign-born (FB) patients in the Swedish Public Dental Service (PDS). Consecutive patients at four PDS clinics in a major Swedish city (Gothenburg) were asked to complete the Dental Visit Satisfaction Scale (DVSS), eight additional items concerning communication and care, and a questionnaire eliciting background information. The questionnaires were available in English, Swedish, Arabic and Farsi. The response rate was 74% (204 patients, mean age: 42 years, range 18-86). Of the participants, 96 (47%) were NB and 108 (53%) were FB; 80 (40%) were men and 121 (60%) women. The NB group was significantly older, had higher education and more regular dental care habits, and reported higher dental fear than the FB group. Fewer FB than NB patients thought the dentist treated them in the same manner as he or she would treat other patients and this applied particularly to those who had lived in Sweden for more than 5 years. FB patients were as satisfied with the information and communication they received from the dentist as those born in Sweden, but they were more sceptical about the dentist's technical competence. The differences between the two groups were otherwise smaller than might have been expected in view of probable language difficulties and differences in dental care background.

Key words

Communication, culture, dental care, satisfaction.

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Skiljer sig upplevelsen av kommunikation och omhändertagande åt mellan svenskfödda och utlandsfödda i svensk tandvård?

Minh Olausson, Nadya Esfahani, Johanna Östlin, Catharina Hägglin

Sammanfattning

◎ Likt många andra länder blir Sverige alltmer mångkulturellt och många invånare behärskar inte fullt ut det svenska språket och är inte heller helt bekanta med svenska normer och vanor. Förutsättningen för ett bra samspel mellan tandläkare och patienter är kommunikation. Därför syftade denna studie till att undersöka om det finns skillnader i upplevelsen av kommunikation och omhändertagande mellan svenskfödda (SF) och utlandsfödda (UF) patienter i folktandvården (FTV). Patienter vid fyra FTV-kliniker i Göteborg tillfrågades konsekutivt om deltagande i studien. De patienter som valde att delta i studien fick fylla i Dental Visit Satisfaction Scale (DVSS) och ytterligare åtta frågor om kommunikation och omhändertagande, samt en enkät med bakgrundsinformation. Frågeformulären fanns tillgängliga på engelska, svenska, arabiska och persiska. Svarsfrekvensen var 74% (204 patienter, medelålder: 42 år, spridning: 18–86). Av deltagarna var 96 (47%) SF och 108 (53%) var UF; 80 (40%) män och 121 (60%) kvinnor. SF-gruppen var signifikant äldre, hade högre utbildning och mer regelbundna tandvårdsvanor, samt rapporterade högre grad av tandvårdsrädsla än UF-gruppen. Färre UF än SF patienter trodde tandläkaren behandlade dem på samma sätt som han eller hon skulle behandla andra patienter och detta gäller i synnerhet de som hade bott i Sverige i mer än 5 år. UF patienterna var minst lika nöjda som SF patienter vad gällde kommunikationen med tandläkaren och den information som gavs, men de var mer skeptiska till tandläkarens tekniska kompetens. Skillnaderna mellan de två grupperna var annars mindre än man kunnat vänta med tanke på troliga språksvårigheter och skillnader i tandvårdsbakgrund.

Introduction

As the public's expectations of access to medical information have increased, the dentist's role has changed from authoritarian to communicative and patient-centred, with the goal being to get the patient involved in the treatment (20). The key to good interaction between dentists and patients is communication (4, 15). Poor communication between a patient and health care professionals seems to be the cause of most patient complaints (9, 11, 16). Most discrepancies between patient expectations and the realization of these expectations are found in the field of communication (10). Effective communication is essential for a good working relationship and for a good quality of care. Communication between dentist and patient is promoted If they are reasonably conformant in language and culture. Deficiencies in communication due to cultural differences can lead to deterioration in the care of patients because communication between patient and caregiver is important to educate and motivate patients to make the necessary changes and be involved in decision making for better health outcomes (20).

The proportion of Swedish residents born abroad is steadily increasing. In 2014, close to 17% of the total population were immigrants (18). Like many other countries Sweden is becoming more and more multicultural, with a high proportion of residents who do not fully master the national language and are not completely familiar with national norms and habits. It is, therefore, important to examine how this part of the population experiences the treatment and care it encounters with dental services. According to a report from the Swedish National Board of Health and Welfare, people from Iran felt that in their contacts with the Swedish community they were generally treated worse than native Swedes, but this sense of discrimination seemed to be less pronounced when it came to health care (12). One of the difficulties health care professionals in Europe experience in serving immigrant patients is the language barrier (14). Caregivers commonly fail to use an interpreter. This may mean that patients get less access to health care (14).

To our knowledge has no study of foreign-born dental patients' perception of communication and care in comparison with native-born been presented. Therefore, the aim of this study was to examine whether there are differences in the experience of communication and care between native-born (NB) and foreign-born (FB) patients in the Swedish dental service and to assess the impact of background factors like sex, age, education, dental attendance and dental fear on their experience.

Materials and Method

Study samples and procedures

In 2008 patients at four public dental service clinics in Gothenburg, Sweden (metropolitan area: about one million inhabitants), were asked to participate in a questionnaire study. In order to reach as many people with foreign backgrounds as possible, the questionnaires and the information sheets were written in four languages: Swedish, English, Persian (Farsi) and Arabic. Two of the clinics were located in multicultural areas with a high proportion of foreign-born patients, while the other two clinics were in middle class areas, with patients mainly of Swedish origin (Table 1).

Formal ethical approval was not necessary according to information given by the Ethical Committee at Gothenburg University. However, the study followed the ethical considerations of the Helsinki Declaration. Participation in the study was voluntary. Information about the study, formulated according to the general outlines provided by the Ethics Committee

Table 1. Number and percentage of native-born (NB) and foreign-born (FB) participants from each National Dental Service clinic (n=204)

Dental Service clinic	NB		FB		Total	
	n	%	n	%	n	%
Multicultural 1	11	13	76	87	87	100
Multicultural 2	33	61	21	39	54	100
Homogeneous 1	25	76	8	24	33	100
Homogeneous 2	27	90	3	10	30	100
Total	96	47	108	53	204	100

◉ **Table 2.** The background factors sex, age, education, dental care, and dental fear in relation to native-born (NB)(0) or foreign-born (FB)(1) status.

	NB		FB		Logistic regression[1]		
	n	%	n	%	OR	95% CI	p
Sex							
Male	35	37.2	45	42.1	1.3	0.71–2.31	0.406
Female[2]	59	62.8	62	57.9			
Age							
18–35	41	42.7	50	47.2			
36–60	32	33.3	49	46.1	0.98	0.96–0.99	0.011
>60	23	24.0	7	6.6			
Education							
Academic[2]	39	41.1	28	26.7	2.0	1.08–3.69	0.027
Non-academic	56	58.9	77	73.3			
Dental Care							
Regular2	7125	74.0	57	46.7	2.8	1.55–5.21	0.001
Irregular		26.0	50	53.3			
Dental Fear							
Fear[2]	45	46.9	28	26.4	2.8	1.51–5.14	0.001
No fear	51	53.1	78	73.6			

[1]Bivariate logistic regression analyses, adjusted for age. The actual age of the participants (years) was used in all analyses (continuous scale).
[2]Reference

at the University of Gothenburg, was handed out together with the questionnaires.

At the clinics all patients aged 18 or older were asked to participate. Most completed the questionnaires in the waiting room prior to treatment, but five people answered the questionnaires at home and mailed them back.

In this study a foreign-born individual (FB) is defined as a person born in a country other than Sweden. A native-born individual (NB) is a person born in Sweden, regardless of where the person's parents were born.

The questionnaire

The questionnaire consisted of two parts. The first part addressed patients' background and the second part their experiences of communication and care in dentistry. The participants were asked about the following background factors: Gender; Age (years); Education (Non-academic='elementary school', 'secondary school' and 'vocational education' and Academic='college/graduate school'); Dental habits: 'How often do you visit the dentist?' (Regular='once a year', 'once every second year', and Irregular='even less' and 'only in an emergency'); Country of origin: 'Where were you born?'; Skills in Swedish language: 'Do you speak Swedish?' (Well='yes, perfectly', 'pretty well', and Poorly='not so well', 'a few words' and 'not at all'). In addition, a question about dental fear was included to investigate whether dental fear had an impact on the experience of dental care (No dental fear='Visiting the dentist doesn't bother me at all' and Dental fear=I don't like it, or 'I think the dentist doesn't bother me at all', 'I don't like it' or 'I think it's quite unpleasant', 'I'm very afraid' or 'I think it's very unpleasant' and 'I'm terrified').

The remaining items dealt with the experience of communication and care in dentistry and were answered on a Likert scale where the different response options were as follows: 5 'strongly agree', 4 'somewhat agree', 3 'not sure', 2 'somewhat disagree', 1 'strongly disagree'. Of the 18 items, 10 were from the psychometric instrument Dental Visit Satisfaction Scale (DVSS) (2), which was translated into Swedish and validated by Hakeberg et al. (5) in a sample of 204 individuals. The DVSS total score ranges from 10 to 50, with a higher score indicating a more positive outcome. The DVSS items represent three dimen-

sions: Information/Communication, Understanding/Acceptance and Technical Competence. All items except one are positively formulated, meaning that a positive attitude results in a high score. Five items regarding the experience of communication and care were selected from another instrument, the Dental Beliefs Survey – Revised (DBS-R), which consists of 28 items in the original version (1). Since many of the items from the DBS-R repeat items from DVSS, only items that were considered relevant to the study were selected. The final three items were constructed for this study (SC1–3). These items dealt with aspects not included in the DVSS or DBS-R, and concerned communication and understanding or acceptance. The DVSS items, the selected DBS-R items, and the three self-constructed items are listed in Table 4.

The DVSS and DBS-R items were translated into Swedish with a back-translation procedure to check the content. The translation of the DVSS and DBS-R into Persian and Arabic was performed by a Persian and Arabic-speaking co-author, with the help of other persons knowledgeable in these languages. When it came to the preparation of the English version of the questionnaire, the items from the DVSS and DBS-R were of course used in their original English version. The other questions and the information sheet were translated by the co-authors with the help of knowledgeable people with an English-speaking background.

The data collection procedure was evaluated by means of interviews with 25 participants. Of these, eight answered in a language other than Swedish (five in Persian and three in Arabic). The majority found the questionnaires easy to understand and to answer. One of interviewed subjects reported problems with two of the self-constructed items (SC1 and SC2; Table 4) and three others felt that there were too many items.

Statistical method

The number of participants may vary for the different items because of incomplete answers. If a response to a single item was missing in the DVSS, it was replaced by the median value for the participant's responses to other items in that particular dimension.

The results are shown using frequencies, percentage, mean and standard deviation (SD). Comparison between two groups was performed using bivariate logistic regression, adjusted for age. A multiple logistic regression (ENTER model) was used to analyse relationships. Odds ratio (OR) and 95% Confidence interval (CI) were used. For multiple inference, the significance level was adjusted using the Bonferroni correction. The specified level of significance was $p<0.05$. In all analyses the actual age (years) of the participant was used.

Results

Participants

Of the 275 consecutive patients approached, 58 (21 %) chose not to participate. The most common reasons for not participating were "lack of time", 25 (43%); "problem with the language", 13 (23%); "did not manage", 7 (12%); and "did not want to", 7 (12%). Among the 217 who filled in the questionnaires, 13 were excluded (5%) because they had missed one whole page of the questionnaire. This left us with 204 (74%) participants included in the study, of whom 40% were male and 60% female.

Of the respondents 96 (48%) were native-born (NB) and 106 (52%) foreign-born (FB). In the FB group, 63 (59%) were from Asia, 30 (28%) were from other European countries, 8 (8%) from Africa, 3 (3%) from South America and 2 (2%) from North America. Countries representing Asia in this study were Iraq (n=26), Iran (n=16), Afghanistan (n=8), and India, Japan, China, Palestine, Saudi Arabia and Turkey (≤4/country). European countries of origin were Former Yugoslavia (n=14), Nordic countries (n=6), and UK, Germany, France, Italy, Poland, Rumania, Hungary and Belarus (n≤2/country). The South American countries were Argentine, Chile and El Salvador. For 14 FB participants, information on specific country of origin was missing.

Table 1 shows the number of participants from the clinics, both in total and separated into NB and FB. Among the NB, 26% had at least one FB parent.

Among FB participants, 26% had lived in Sweden for five year or less, and 69% had lived in Sweden for more than 5 year (4% did not answer the question). In average they had lived in Sweden 13.4 years (SD=12.2). The majority (79%) of the participants responded to the questionnaire in Swedish, 10% responded in Arabic, 9% in Persian (Farsi) and 2% in English. Of the FB participants, 65% considered themselves to speak Swedish 'perfectly well' or 'fairly well' and the rest 'not so well (25%), 'a few words' (7%) or 'not at all' (4%).

The mean age of the participants was 42 years (SD=17.1, range 18 to 86). A significant difference was found for age between the NB (45.1 years, SD=9.9) and FB groups (39.1 years, SD=13.6) (Table 2). Therefore, age was adjusted for in all analy-

◎ **Table 3.** Mean and standard deviation (SD) of scores for the separate DVSS items, total DVSS and subscale scores for native-born (NB) and foreign-born (FB) patients and comparison to the result from the study by Hakeberg et al. (5)

DVSS	NB		FB		Total		Hakeberg	
Question	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	4.1	1.0	4.2	0.9	4.2	1.0	4.3	0.7
2	3.8	1.0	3.9	1.0	3.9	1.0	3.7	1.1
3	4.2	0.9	4.2	1.1	4.2	1.0	4.2	0.9
4	3.9	1.0	4.2	0.9	4.1	1.0	4.1	0.9
5	4.1	1.0	4.1	1.0	4.1	1.0	4.2	1.0
6	4.4	0.8	4.4	0.8	4.4	0.8	4.5	0.7
7	4.4	0.7	4.0	1.0	4.2	0.9	4.5	0.7
8	4.1	1.2	3.7	1.4	3.9	1.3	4.3	1.2
9	4.3	0.9	4.0	1.2	4.1	1.1	4.4	0.9
10	4.5	0.6	4.1	1.0	4.3	0.9	4.6	0.7
DVSS-SUM	41.8	6.0	40.8	6.7	41.3	6.3	42.8	5.9
Info.[1]	12.1	2.6	12.3	2.4	12.2	2.5	12.2	2.2
Accept.[2]	12.5	2.3	12.8	2.0	12.6	2.1	12.7	2.2
Techn.[3]	17.3	2.4	15.8	3.4	16.5	2.9	17.7	2.6

[1]Information/communication, [2]Understanding/acceptance, [3]Technical competence

ses. Significant differences were also found between the FB and the NB groups for education, dental care and dental fear, while no significant difference were found for sex (Table 2).

Communication and Care

The mean value of the total sum of the Dental Visit Satisfaction Scale (DVSS) was 41.3 (SD=6.34, range 24 to 50). Table 3 shows means and standard deviations (SD) for the separate DVSS items, the total DVSS, and the separate dimensions for NB and FB patients. In addition, the results of the study by Hakeberg *et al.* (5) are presented. The only significant difference found between NB and FB according to the total DVSS sum and the three DVSS dimensions was that the NB were more positive in the dimension Technical Competence compared to the FB (p=0.001). The results of the statistical analyses for the separate DVSS items are reported in Table 4.

Table 4 shows the proportions of NB and FB patients answering 'somewhat agree' or 'strongly agree' on the separate DVSS items, the self-constructed (SC) items and the DBS-R items. Significant differences were found for 6 items. After Bonferroni correction only one item comparison remained significant, "The dentist seems to know what he/she is doing during my visit" where NB patients agreed with the statement to a greater extent.

In the NB group 96% thought that the dentist treated them in the same manner as other patients compared to 82% in the FB group (Table 4). The FB group was also divided into two groups based on how long they had lived in Sweden (≤5 years, n=31; >5 years, n=72). Of the group who had lived in Sweden for more than 5 years, fewer believed that the dentist treated them in the same manner as he/she would treat any other patient compared to FB who had been in Sweden for 5 year or less (76% and 93% respectively, p=0.003).

Table 5 shows the result from a multiple logistic regression with NB/FB as dependent variable. Six of the independent variables reached significant levels. FB patients were younger, scored lower in dental fear, had more irregular dental care habits, perceived

Table 4. Percentage answering 'strongly agree' or 'somewhat agree' for the separate DVSS items, the self-constructed items (SC) and the DBS-R-items according to being native-born (NB) and foreign-born (FB). In the bivariate logistic regression analyses (age-adjusted) all five response alternatives were used.

DVSS	NB %	FB %	OR	95% CI	p-value[a]
DVSS1. [1.] After talking with the dentist, I know what the condition of my teeth is.	78.1	83.0	1.1	0.84–1.54	0.402
DVSS2. [1.] After talking with my dentist, I have a good idea of what changes to expect in my dental health in the next few months.	72.9	74.5	1.1	0.84–1.48	0.468
DVSS3. [1.] The dentist tells me all I want to know about my dental problems.	82.3	82.1	0.99	0.75–1.31	0.933
DVSS4. [2.] I really feel that the dentist understands me.	67.8	82.0	1.4	1.06–1.98	0.019
DVSS5. [2.] I feel that the dentist really knows how upset I am about the possibility of pain.	80.0	82.1	1.1	0.80–1.46	0.608
DVSS6. [2.] I feel that the dentist accepts me as a person.	88.6	88.7	1.1	0.74–1,49	0.782
DVSS7. [3.] The dentist is thorough in doing the procedure.	87.5	73.5	0.6	0.45–0.88	0.007
DVSS8. [3.] The dentist is too rough when he/she works on me.	78.1	59.5	0.8	0.61–0.95	0.016
DVSS9. [3.] I am satisfied with what the dentist does.	87.5	76.4	0.8	0,60–1.04	0.089
DVSS10. [3.] The dentist seems to know what he/she is doing during my visit.	92.7	76.4	0.5	0.34–0.74	0.001
Self-Constructed Questions (SC) and the DBS-R questions					
SC1. I believe my dentist treats me in the same manner as he/she would treat any other patient.	95.9	81.8	0.6	0.39–0.85	0.006
SC2. I feel uncomfortable and do not wish to truthfully answer any of the dentist's questions.	1.0	7.5	1.4	0.90–2.08	0.135
SC3. More often than not I find myself not knowing all of the aspects of my treatment.	17.7	20.2	0.9	0.76–1.18	0.628
DBS-R14. I feel uncomfortable asking questions.	5.2	11.4	1.3	0.95–1.75	0.102
DBS-R15. Dental professionals say things to make me feel guilty about the way I care for my teeth.	9.3	14.3	1.3	1.03–1.76	0.033
DBS-R18. I am concerned that dentists do not like it when a patient makes requests.	7.3	11.3	1.1	0.84–1.42	0.499
DBS-R25. I have had dentists not believe me when I said I felt pain.	11.6	18.1	1.2	0.93–1.49	0.184
DBS-R27. I am concerned that the dentist will do what he/she wants and not really listen to me while I'm in the chair.	8.3	17.9	1.0	0.82–1.34	0.710

[1]Information/Communication dimension item, [2]Understanding/acceptance dimension item, [3]Technical competence dimension item
[a]Bonferroni correction with 18 comparisons gives a level of significance of $p<0.003$

◎ **Table 5.** A multiple logistic regression (ENTER model) with native-born (0) or foreign-born (1) as the dependent variable and all background factors, the three DVSS dimensions and one self-constructed question (SC1) included as independent variables

Independent variables	OR	95% CI	p
Age	**0.98**	**0.956–0.996**	**0.021**
Sex[1]	0.8	0.39–1.63	0.540
Dental attendance[2]	**3.0**	**1.43–6.23**	**0.004**
Education[3]	1.7	0.80–3.46	0.187
Dental fear[4]	**3.0**	**1.07–6.16**	**0.002**
DVSS inf[5]	1.1	0.94–1.40	0.187
DVSS accept[6]	**1.4**	**1.08–1.72**	**0.008**
DVSS tech[7]	**0.8**	**0.67–0.92**	**0.002**
SC1[8]	**0.5**	**0.26–0.81**	**0.008**

[1]Women (reference), [2]Irregular (reference), [3]Non-academic (reference), [4]Not afraid (reference) [5]Information/communication, [6]Understanding/acceptance and [7]Technical competence dimensions [8]Item shown in Table 4

the dentist as more accepting and understanding (DVVS understanding/acceptance dimension), had a more negative view of dentists' technical skills (DVVS technical competence dimension) and felt less confident that they were being treated equally with NB patients. The model explained 34% of the variance (Nagelkerke R^2=0.34).

Discussion

This study compares immigrants with native-born as patients in community dental care in terms of how they perceive their meeting with dental caregivers. We assessed patients' views on communication, information and caregivers' competence, as reflected in patients' recollection of their dental visits. Our main finding is that the differences between native-born and foreign-born patients are small, which is somewhat unexpected considering the differences in language, culture and previous experiences of dental care, and also in relation to the general integration problems reflected in immigrants' relations to other segments of the community.

Many studies show that good communication is the key to satisfactory care (8-11, 20, 21). This also applies to dentistry. With about 1.6 million foreign-born individuals in Sweden in a total population of close to 10 million (18), it is important to highlight their experience of dental care to enable improvements in any possible shortcomings. To our knowledge no study comparing native-born (NB) and foreign-born (FB) patients' perceptions of communication and care in dental situations has been presented.

In 2010–2011, 71% of women and 66% of men born in Sweden reported having visited the dentist in the past years (17), a number that is in line with the numbers for the NB group in this study. In this study, the majority of FB patients reported irregular dental care (50% women, 59% men). The fact that immigrant groups are more irregular in dental care agrees with the findings of other studies (6, 21). In Sweden, dental care is free and publicly funded between the ages of 3 to 19 years, and from 20 years of age on, a part or the entire cost is paid from publicly funded high-cost insurance (7). This might explain why the NB have been accustomed to regular dental visits since childhood, and thus differ from the FB. In many countries, people traditionally seek dental care only for acute problems.

When comparing the DVSS items and dimensions in this study with the study of Hakeberg *et al.* (5) in which the Swedish version of the DVSS was validated, few and very small differences were found in most items and dimensions. Only for item 8 ("The dentist is too rough when he/she works on me") and the Technical Competence dimension there were clear discrepancies between the scores of the FB in this study and the results from Hakeberg et al. (5).

In the present study NB patients were more positive than FB patients with regard to the dimension Technical Competence. Naturally it is difficult for patients to evaluate dentists' technical skills. In a review article discussing this issue, the conclusion was that patients base their quality judgments on the dentist's problem-solving skills, empathy, ability to remain on time, courtesy, etc. (13). In many countries, clinicians have a more authoritarian role, while Swedish dentists strive to promote patients' participation in treatment choices, in line with the ethical guidelines of the Swedish Dental Association (3, 19). This might be perceived as uncertainty by FB patients, and could be one reason why they appeared more negative about Swedish dentists' technical skills.

The multiple logistic regression analysis reflected in large part the results from the analyses performed at a group level. The DVSS understanding/acceptance dimension was, however, shown to have more influence. This probably reflects a more positive re-

sponse by the FB patients to the dentists' interpersonal efforts.

Although patients from four clinics participated in this study, the majority of the FB participants were patients in one of these clinics. This is a weakness in the study because special procedures, personnel, etc. at the clinic in question may have influenced its representativeness. However, it is important to note that almost one third of the FB patients did come from other clinics.

Another limitation is that all foreign-born, regardless of country of origin, were analysed as one group. Different countries mean cultural diversity. Thus, it would have been preferable to study different immigrant countries separately, but it was not possible in the present study due to small sample size. This is, however, something to consider for future studies.

The questionnaire was administered in Arabic and Persian because these are two of the most common langages of immigrants in Sweden (22). It was also administered in English because it is an international language, thus making participation possible for a large proportion of the FB patients who do not speak Swedish very well. However, the second most common reason for not participating in the study was language difficulties. Thus, since the questionnaires were accessible only in certain languages, some nationalities were not able to participate, which is also a limitation of the study. However, one of the multicultural clinics was situated in an area where 80 different countries are represented, making it difficult to offer translations in all languages.

The present study also revealed that fewer FB than NB patients thought the dentist treated them in the same manner as he or she would treat other patients. This applied particularly to FB patients who had lived in Sweden for more than five years. A possible interpretation of this finding is that FB patients who are newly arrived in Sweden do not perceive patterns of discrimination that those who have resided in Sweden longer have become sensitized too. It may be interesting to investigate this further in the future.

Foreign-born patients were more sceptical of the dentist's technical competence than native-born patients. However, there was no difference between these two groups when it came to their satisfaction with the information and communication they received from the dentist. It seems that FB patients respond favourably to the dentists' communicative style, but that some of them interpret the dentists' non-authoritarian attitude as evidence of professional indecisiveness. The differences between the two groups were otherwise smaller than might been expected, despite the probable difference in dental care experience.

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Patient-reported outcomes of caries prophylaxis among Swedish caries active adults in a long-term perspective

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Abstract

◉ The aim of this study was to measure patient-reported outcomes of caries prophylaxis and to compare them with previously documented efforts in dental offices. A questionnaire was mailed to 134 caries active (CA) and 40 caries inactive (CI) adult patients treated at a Swedish public dental service clinic. The overall response rate was 69%. The questionnaire included items regarding patient perceived caries prophylaxis in relation to: 1) treatment and recommendations given by the dental personnel, 2) performed self-care and 3) perceived and expected effects. The responses were studied for their association to clinical data, extracted retrospectively from the patients´ dental records. The mean follow up time was >16 years. Information about caries prophylaxis (p=0.01) and recommendations for self-care (p=0.04) were given more often to the CA group than to the CI group. Supplementary examinations and recommendations of self-care risk treatments were more frequent in the CA group (p<0.001). CA patients also made more frequent extra efforts at home to avoid caries by changing their eating habits (p<0.001), improving their oral hygiene (p=0.04) and using extra fluoride (p=0.001). In the CA group, 60% did not consider that the extra prophylaxis efforts had made them caries inactive, and 40% were not satisfied with the outcome. Most patients (>90%) hoped that the outcome of caries prophylactics would be a reduced number of cavities. The patient-perceived experiences of caries prophylaxis-were in concordance with dental records. Both the dentists and the caries active middle-aged Swedish adults were aware of the need for extra prophylaxis. The caries active patients perceived having made extra home care efforts, but had not experienced that they had become free from caries.

Key words

Caries prophylaxis, dental records, long-term evaluation, national guidelines, questionnaire

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Patientrapporterade utfallsmått för kariesprofylax hos kariesaktiva vuxna i ett longitudinellt perspektiv

Håkan Flink, Åke Tegelberg, Judy Arnetz, Dowen Birkhed

Sammanfattning

◉ Syftet med studien var att undersöka patientrapporterade utfallsmått för kariesprofylax och jämföra dem med tidigare dokumenterade journaldata. Ett frågeformulär skickades till 134 kariesaktiva (CA) och 40 kariesinaktiva (CI) vuxna patienter vid folktandvården i Sala, och besvarades av 69%. Frågorna gällde patientupplevelser relaterat till kariesprofylax avseende: 1) behandlingar och rekommendationer vid tandvårdsbesök, 2) genomförd egenvård, och 3) upplevd effekt och förhoppningar om önskat resultat. Svaren analyserades i förhållande till kliniska data, som hämtades retrospektivt ur patienternas tandvårdsjournaler. Medelvärdet för uppföljningstiden var > 16 år. Information angående karies och profylax ($p=0.01$) samt rekommendationer om egenvård ($p=0.04$) hade oftare givits till CA än till CI-gruppen. Kompletterande undersökningar och rekommendation av extra riskprofylax var mer vanligt förekommande hos CA-gruppen ($p<0.001$). CA-patienterna hade även mer ofta gjort extra ansträngningar för att undvika karies genom att ändra matvanor ($p<0.001$), förbättra munhygien ($p=0.04$) och använt extra fluor ($p=0.001$). I CA-gruppen upplevde 60% att de trots sina extra profylaxinsatser inte blivit kariesfria, och 40% var inte nöjda med resultatet. De flesta patienter (>90%) satte dock stort värde till kariesprofylax som förväntades att kunna minska antalet kariesangrepp. Patientrapporterade utfallsmått för kariesprofylax överensstämde med journaldata. Både tandläkare och de kariesaktiva patienterna i denna studie var medvetna om behovet av extra profylax. De kariesaktiva patienterna hade genomfört mer extra profylax, men många hade ej upplevt att de blev kariesfria.

Introduction

Despite the reduction of caries in industrialized countries during the last 50 years [15], especially in young people, approximately 30-40 % of the adult population still develop new manifest caries lesions every year [4, 26]. When treating caries active patients, there are two main clinical problems: one is to identify individuals with an increased risk to develop new caries, and the other is to choose effective preventive methods. Several of the caries preventive regimens that are used today are based on limited scientific evidence [1, 2].

Extensive literature reviews support that "previous caries experience" is the most reliable indicator for developing new caries lesions [1, 12, 16, 19, 25]. It has to some extent been used for "caries risk assessment" and to guide the need for preventive care [4, 5, 23]. Studies among children indicate that many of the methods used today do not decrease caries progression [13, 23]. Most studies regarding caries prophylaxis have been performed on children and teenagers. A majority of these studies has been conducted without any attention paid to their caries risk [1, 2]. Thus, there is a lack of evidence for caries preventive methods for adults with increased caries risk.

Prospective clinical prophylaxis studies should follow scientific protocols. This is, however, not done in general practise, where the prophylaxis actions tend to be occasional and more random rather than following structured programs or strategies [14, 23]. Furthermore, all recommendations are supposed to be in accordance with the patient's individual priorities and expectations [7, 17, 24]. Today, there is growing interest in the use of "patient-reported outcome measures" (PROMs) [8, 9] in health and medical care. To the best of our knowledge, there are to date no studies on subjective experiences of prophylaxis outcome among adult caries risk patients. The present study combined a patient questionnaire with a retrospective review of the dentists' recorded data. The first aim of this study was to measure patient reported outcomes of caries prophylaxis in regards to treatments, recommendations, self-care, perceived and expected results and compare responses between caries active and caries inactive individuals in the same clinic. The second aim was to compare patient reported outcome of caries prophylaxis from a questionnaire with documented efforts by dental staff as recorded in patients' dental records.

Material and methods

Setting and participants

The study was performed at the public dental service clinic in the municipality of Sala, Sweden, that treats approximately 7,500 adult patients by individual recall. A total of 134 caries active (CA) and 40 caries inactive (CI) individuals were recruited during 2007 and have been presented in an earlier study [10]. Among these, 40 CA and 40 CI patients were previously identified [11], and an additional 94 CA patients 25-50 years of age were consecutively recruited when receiving the questionnaire. The following definitions of the two groups were used: "*The CA group*" included individuals who had developed manifest primary or secondary caries lesions in 2 or more teeth in the last 3 years. "*The CI group*" was individuals who had been free from manifest dental caries for 3 years or more. Caries prevalence among the two groups has previously been described in detail [10]. There were statistically significant differences between the two groups for all caries-related variables, such as number of decayed teeth (DT), root filled teeth, extracted teeth, decayed, missing and filled tooth surfaces (DMFS) and "caries active time" during the follow-up period. *Caries active time* was defined as the time between two examinations where the patients showed development of manifest caries. *Caries inactive time* was defined as the time between two examinations where no manifest caries were recorded.

Questionnaire

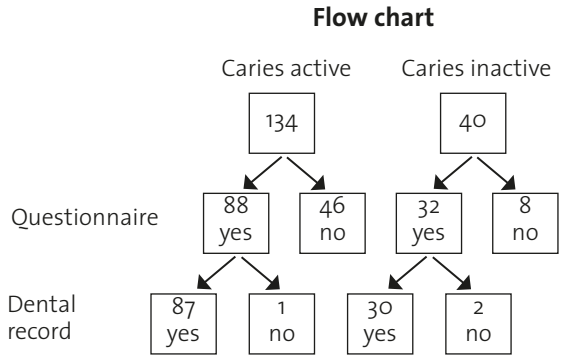
A questionnaire, along with detailed written information about the study, was mailed to all eligible individuals (n = 174) in April-May 2007. Two reminders were sent 3 and 6 weeks later to those who did not respond to the first invitation. All participants answering the questionnaire also returned a signed consent form. The regional ethical committee at Uppsala University, Sweden, approved the study (Dnr: 2006/310). The questionnaire was developed for this study and was piloted on several occaions among test groups of both caries active and inactive. The patient reported outcome of caries prophylaxis included questions or statements about the following three areas: 1) perceived caries prophylaxis treatment and recommendations given by the dental personnel, 2) performed self-care caries prophylaxis, and 3) evaluation of perceived and expected effect of the preventive treatment. The questions were constructed as Likert-type scales with 4 or 5 response alternatives. The questions have so far not been validated.

Dental records

Dental records were reviewed retrospectively to the patient age of 20 years or as far back as possible. Theoretically, this would provide a minimum of 5 years to follow up among the youngest participants. Caries prophylaxis measures taken were registered according to "*Basic prophylaxis*" and "*Risk prophylaxis*".

Basic prophylaxis involved four subcategories, defined as follows. *Information:* about causes of caries, diet and intake frequencies. *Recommendations:* Brushing with fluoride (F) toothpaste 2 times a day (after breakfast and before bedtime), rinse with minimal of water or no water at all after brushing, F tablets, F chewing gum or sodium fluoride (NaF) rinsing solution (0.05%). *Performed prophylaxis:* mechanical tooth cleaning, F varnish application, single dose NaF rinsing solution or fissure sealants. *Instructions:* tooth brushing, interdental cleaning devices (brush, dental floss/tape, toothpick).

Risk prophylaxis included supplementary investigations and recommendations of risk treatment, defined as follows. *Supplementary investigations:* microbiological tests (lactobacilli and mutans streptococci); determination of salivary secretion rate and dietary recall. *Recommendations of risk treatment:* Daily use of NaF rinse (0.2%), 1% NaF gel or chlorhexidine gel (1%) (in individual trays), chlorhexidine rinse (0.2%), brushing with chlorhexidine gel (1%) or NaF-chlorhexidine gel (0.2 %+0.5 %) or high F toothpaste (5000 ppm F, Duraphat).



◎ **Figure 1.** Flow chart showing number of eligible individuals receiving questionnaire, number of returned questionnaires and number of retrieved dental records.

Statistical methods

Differences between the two groups were tested by t-tests for continuous variables and by chi-square test for categorical variables. All tests were two-sided and p-values less than 0.05 were considered significant. All analyses were conducted using SPSS version 20.0, Chicago, IL, USA.

◎ **Table 1.** Background characteristics of the caries active (CA) and caries inactive (CI) patients participating in the present study.

	CA		CI		
	n	%	n	%	p
Gender					
Men	24	27	9	28	0.93
Women	64	73	23	72	
		Mean ± SD		Mean ± SD	
Age	88	39.5 ± 6.2	32	41.0 ± 6.3	0.27
Follow up time of dental records	87	16.5 ± 6.8	30	18.3 ± 6.4	0.22
Caries active time/ Follow up time	87	0.6 ± 0.2	30	0.1 ± 0.1	< 0.001
DT per year	87	1.0 ± 0.6	30	0.1 ± 0.1	< 0.001
Number of examinations	87	12.3 ± 5.7	30	10.8 ± 4.2	0.18
DT = 0 / examinations	87	0.4 ± 0.2	30	0.9 ± 0.1	< 0.001
Number of dentist performing the examinations	87	5.3 ± 2.5	30	5.1 ± 2.4	0.68

DT = number of decayed teeth
(DT = 0) = number of examinations with no manifest caries

Table 2. The patient reported outcome of caries prophylaxis administered in the dental office, based on the questions, **How often, as an adult, have you experienced that your dentist...?**
(CA=Caries active, n =88, CI=Caries inactive, n =32)

	Groups	Very often	Often	Sometimes	Seldom	Never	No answer	
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	p
Information								
Told you need extra prophylaxis	CA	7 (8)	27 (31)	33 (38)	15 (17)	4 (5)	2 (2)	< 0.001
	CI	0 (0)	0 (0)	2 (6)	10 (31)	20 (63)	0 (0)	
Informed about causes of caries	CA	5 (6)	21 (24)	40 (46)	17 (20)	4 (5)	1 (1)	< 0.001
	CI	0 (0)	1 (3)	10 (32)	11 (36)	9 (29)	1 (3)	
Recommendations								
Recommended less food intake between meals	CA	1 (1)	4 (5)	16 (18)	24 (28)	42 (44)	1 (1)	= 0.001
	CI	0 (0)	0 (0)	1 (3)	1 (3)	28 (93)	2 (3)	
Recommended reduced sugar intake	CA	2 (2)	4 (5)	16 (18)	26 (30)	39 (45)	1 (1)	< 0.001
	CI	0 (0)	0 (0)	1 (3)	1 (3)	29 (94)	1 (3)	
Recommended to use extra fluoride	CA	5 (6)	26(30)	35 (41)	7 (8)	13 (15)	2 (2)	< 0.001
	CI	0 (0)	1 (3)	4 (13)	8 (26)	18 (58)	1 (3)	
Performed prophylaxis								
Polished your teeth	CA	3 (3)	9(10)	40 (46)	21 (24)	14 (16)	1 (1)	= 1.000
	CI	1 (3)	3 (9)	15 (47)	8 (25)	5 (16)	0 (0)	
Applied fluoride varnish on your teeth	CA	5 (6)	7 (8)	36 (42)	25(29)	13 (15)	2 (2)	= 0.22
	CI	1 (3)	0 (0)	10 (31)	14 (44)	7 (22)	0 (0)	
Instructions								
Instructed how to brush your teeth	CA	1 (1)	8 (9)	30 (35)	28 (33)	19 (22)	2 (2)	= 0.34
	CI	0 (0)	1 (3)	6 (19)	16 (52)	7 (23)	1 (3)	
Instructed how to use dental floss or other devices to clean between your teeth	CA	3 (3)	15 (17)	41 (47)	18 (21)	10 (12)	1 (1)	= 0.62
	CI	1 (3)	4 (13)	11 (36)	10 (32)	5 (16)	1 (3)	

Results

The overall response rate to the postal questionnaire was 69% (120/174). Of these 120 patients, complete dental records could be obtained for 87 out of 88 in the CA and 30 out of 32 in the CI group (Fig. 1). A comparison of background characteristics between the two groups is summarized in Table 1. The groups did not differ significantly by gender, age, follow-up time, number of examinations or the number of dentists treating them. Most of the same dentists treated both the CA and CI patients. The CA patients had significantly more DT, longer caries active time and had been caries free fewer times at dental examinations than the CI patients ($p<0.001$).

The caries prophylaxis, administered in the dental office was experienced significantly more often in the CA than in the CI group for all questions except "polishing of teeth", "application of fluoride varnish", "instruction of tooth brushing or "inter dental cleaning" (Table 2).

There were no differences between the CA and CI groups with regards to dietary habits and home care

◉ **Table 3.** The patient reported outcome of home care prophylaxis with regard to diet and oral hygiene habits: **How often do you…?**
(CA=Caries active, *n* = 88, CI=Caries inactive, *n* = 32)

	Groups	More than two times per day	Two times per day	Once per day	Hardly ever/ rarely	Never	No answer	
		n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	p
Eat vegetables or fruits?	CA	26 (30)	26 (30)	32 (36)	4 (5)	0 (0)	0 (0)	0.95
	CI	9 (28)	11 (34)	11 (34)	1 (3)	0 (0)	0 (0)	
Eat sweets?	CA	3 (3)	10 (11)	33 (38)	42 (48)	0 (0)	0 (0)	0.18
	CI	0 (0)	3 (9)	7 (22)	22 (69)	0 (0)	0 (0)	
Drink soft drinks?	CA	1 (1)	1 (1)	4 (5)	70 (80)	12 (14)	0 (0)	0.10
	CI	0 (0)	0 (0)	0 (0)	32 (100)	0 (0)	0 (0)	
Brush your teeth?	CA	8 (9)	69 (78)	9 (10)	1 (1)	0 (0)	1 (1)	0.72
	CI	1 (3)	28 (88)	3 (9)	0 (0)	0 (0)	0 (0)	
Use dental floss?	CA	0 (0)	1 (1)	20 (23)	56 (64)	11 (13)	0 (0)	0.66
	CI	0 (0)	0 (0)	5 (16)	21 (66)	6 (19)	0 (0)	
Use toothpicks or proximal brushes?	CA	0 (0)	2 (2)	15 (17)	51 (58)	20 (23)	0 (0)	0.02
	CI	0 (0)	1 (3)	1 (3)	14 (44)	16 (50)	0 (0)	
Use fluoride toothpaste?	CA	8 (9)	63 (72)	7 (8)	7 (8)	3 (3)	0 (0)	0.81
	CI	2 (6)	25 (78)	3 (9)	2 (6)	0 (0)	0 (0)	
Use any kind of extra fluoride? (tablets, chewing gum or mouth rinses)	CA	5 (6)	4 (5)	24 (27)	41 (47)	14 (16)	0 (0)	0.08
	CI	0 (0)	2 (6)	3 (9)	17 (53)	10 (31)	0 (0)	

prophylaxis, with the exception of more frequent use of toothpicks or interdental brushes in the CA group (Table 3). Regarding extra efforts to avoid caries, the CA group had more often changed to better eating habits, performed better oral cleaning and used extra fluoride, compared to the CI group (Table 4). In the CA group, 83% agreed that they needed extra prophylaxis efforts, compared to 13% in the CI group ($p<0.001$). Among the CA group, 70% considered the extra prophylaxis efforts easy to perform, while 42% had difficulties remembering to perform them.

Approximately 60% of the CA group disagreed with the statement that the extra efforts "have made them free from caries (i.e. not needing fillings)" in contrast to 3% of the CI group ($p<0.001$). On the

Table 4. The patient reported outcome of caries prophylaxis efforts to avoid caries, based on the question: **How often, as an adult, have you made extra efforts to avoid caries, by the following actions?** (CA=Caries active, *n* = 88, CI=Caries inactive, *n* = 32)

	Groups	Very often	Often	Sometimes	Seldom	Never	No answer	
		n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	p
Changing to better eating habits	CA	15 (17)	23 (26)	42 (48)	7 (8)	1 (1)	0 (0)	< 0.001
	CI	4 (13)	8 (26)	4 (13)	8 (26)	7 (23)	1 (3)	
Performing better oral cleaning	CA	17 (19)	37 (42)	29 (33)	4 (5)	1 (1)	0 (0)	= 0.04
	CI	4 (13)	7 (23)	13 (42)	5 (16)	2 (6)	1 (3)	
Use of extra fluoride	CA	12 (14)	23 (26)	35 (40)	15 (17)	3 (3)	0 (0)	= 0.001
	CI	1 (3)	3 (10)	9 (29)	11 (36)	7 (23)	1 (3)	

Table 5. Caries prophylaxis recorded in patients' dental files.

	Caries active		Caries inactive		
	n	Mean ± SD	*n*	Mean ± SD	p
Basic prophylaxis					
Number of activities/year	87	1.2 ± 0.9	30	0.7 ± 0.5	< 0.001
Number of activities during follow up	88	19.7 ± 13.8	30	12.2 ± 7.9	0.006
Subcategories of basic prophylaxis activities					
Information	78	3.1 ± 1.9	13	1.7 ± 0.7	0.01
Recommendations	71	2.4 ± 1.4	9	1.4 ± 0.5	0.04
Performed prophylaxis	84	10.0 ± 8.4	28	7.9 ± 4.9	0.21
Instructions	80	6.0 ± 4.6	26	4.2 ± 3.0	0.06
Number of visits/year	87	0.6 ± 0.3	30	0.4 ± 0.2	0.002
Number of visits during follow up	88	9.8 ± 6.6	30	6.6 ± 4.1	0.01
Risk prophylaxis					
Supplementary investigations	88	1.4 ± 1.5	30	0.1 ± 0.3	< 0.001
Number of time home care risk prophylaxis treatments recommended	88	3.3 ± 2.5	30	0.1 ± 0.4	< 0.001

question if they were satisfied with the outcome of the extra prophylaxis, 41% and 3% of the CA and the CI groups (p<0.001), respectively did not agree.

The majority of patients, 79% of the CA and 90% of the CI group, agreed completely or fairly well with the statement, "By prophylaxis treatments, is it possible to make me caries free" (p=0.16). Responses to the statement, "I would spend more time with homecare if I knew it would reduce caries cavities in my teeth", did not differ between the two groups, with 84% in the CA group and 70% in the CI group agreeing completely or fairly well with the statement (p=0.13). There was also no significant difference between groups with regards to the desired effect of caries prophylaxis. On the statement, "I place great value on efforts that reduce caries cavities in my

teeth", 93% vs 90% of the CA and CI groups, respectively, agreed completely or fairly well (p=0.64).

Dental records

Table 5 summarizes the caries prophylaxis data retrieved from patients' dental records. "Basic prophylaxis" items were more frequent for the CA group compared to the CI group, except for the subcategories "Performed prophylaxis" and "Instruction". Performed prophylaxis, that includes mechanical tooth cleaning and varnish application, consisted of 50% (10/19.7) and 65% (7.9/12.2) of all the basic prophylaxis activities for the CA and the CI groups, respectively. "Risk prophylaxis", including supplementary investigations and recommendations of prophylaxis homecare treatments, differed between the two groups. Supplementary investigations were performed on 78 out of 88 (89%) CA patients compared to 3 out of 30 (10%) CI patients (p<0.001). Recommendations of high risk homecare prophylaxis treatments were made in 73 out of 88 (83%) in the CA group compared to 2 out of 30 (7%) in the CI group (p<0.001). A majority of these recommendations were carried out in the later part of the follow up period, 235 out of 290 (81%), during or after the year 2000. Among these recommendations given by dentists, 84 (36%) was daily use of 0.2% NaF rinse.

Discussion

This study examined patient-reported outcomes of caries prophylaxis in relation to patient expectations and compared them with documented clinical records. The results indicate that patient reported outcomes corresponded fairly well with data from dental records. The CA individuals had received more information and recommendations about caries and caries prophylaxis than the CI individuals, and had also made more extra caries prophylaxis efforts at home. However, 60% of the CA individuals had not experienced that they had become free from caries (i.e. not needing fillings) when evaluating the effect of the extra caries prophylaxis efforts that they had performed. This was confirmed by data from the dental records, indicating that the CA patients had significantly more DT than CI patients over the course of the study period. Moreover, four out of ten CA patients were not fully satisfied with the outcome of the extra caries prophylaxis efforts.

When evaluating effects of caries prophylactics, there are several difficulties. In a clinical setting, far from all factors can be completely controlled, especially during a long observation period, as in the present study. Caries studies need sufficient follow-up time to investigate caries activity and progress. A minimum time span for separating caries activity from inactivity seems to be approximately 3 years according to our earlier study [10]. This time span is probably also needed when evaluating outcomes of caries prophylaxis. Even if the follow-up times in the present study were sufficient, the numbers of different prophylaxis methods performed in the dental office and recommended for home care treatments varied, thus complicating the evaluation of the various treatment methods. Furthermore, the prophylaxis methods utilized, especially the homecare methods, were not specified in detail. It was not, for example, possible to know how long the recommended treatments were carried out, nor could patient adherence be controlled or evaluated during the follow-up time. Some of these problems are connected with the tendency that dentists' handwritten notes are brief, leaving out important details. In some instances information and recommendations may have also been given but not written down in the dental record. Several of these shortcomings are related to the retrospective study design. In order to better understand the specific prophylaxis methods, a prospective study design, investigating a more limited number of methods during a specified follow-up time would have been required.

During the follow-up period of this study, there were no national guidelines for caries prophylaxis in Sweden, but this was accomplished in 2011 [3]. In brief, these recommendations state that when a person has an increased risk of developing caries or shows signs of an active caries disease, the dental care givers should suggest that the patient rinse with a 0.2% NaF solution daily. Another alternative is to offer F varnish application in the clinic. The dental personnel should also advise the patients who have a high and frequent sugar intake, to change their dietary habits.

When comparing the methods used in the present study with the new Swedish national guidelines, it was apparent that the dentists had identified persons with an increased risk of developing caries or showing signs of active caries disease. Basic caries prophylaxis, such as information and recommendations of homecare prophylaxis treatments were significantly higher for the CA compared with the CI group. From the year 2000 and forward, there was a clear increase in recommendation of homecare prophylaxis treatment for high risk patients in this study, where daily rinsing with 0.2% NaF accounted for a

third of the recommendations. These developments are in agreement with shared treatment decision making between patients and clinicians [17] and the growing emphasis on patient self-care in chronic disease management [6]. Nevertheless, just four out of ten in the CA group reported using extra F daily or more often (Table 3). The alternative to offer F varnish application in the clinic was frequently used during the whole follow-up period, and consisted of about half of all basic caries prophylaxis activities in the dental office. However, it was offered equally to both groups, not just to the CA group. If the proposed high risk recommendations in the national guidelines were followed, there would be an annual increase of prophylaxis visits from 0.6 to 4 for each high risk patient (Table 5). This method could be seen as a more paternalistic approach, keeping the dentist as the decision maker with limited patient participation [17]. These kinds of "in office methods" seem to be more frequent among children and adolescents with high risk of developing caries [20, 21]. Caries active individuals had experienced recommendations of reduced sugar intake more often than the caries inactive group, even if more than half of the CA group never or seldom had heard the recommendation (Table 2). In general, the caries risk individuals in this study were identified by the treating dentists and given information and recommendations of caries prophylaxis treatments. However, not all in the CA group reported having received the recommendations nor was the frequency of the prophylaxis treatments completely in line with the national guidelines.

Due to incomplete information about prophylaxis methods used and recommended in the present study, as well as treatment and follow-up time, the outcome effect on caries progress was impossible to evaluate. The long follow up time makes it uncertain how well the participants will remenber different caries preventive measurements. Nevertheless, the participants seemed to be able to differentiate different groups of caries prophylaxis and these seemed to be in accordance to dental records. A long follow up time is also sensitive to changes in the participants' risk profile. However, in this sample changes in risk profile were rare, the CA group had manifest caries and continued to develop new caries while the CI group rarely developed any manifest caries during the follow up time. During a long retrospective follow up time there will be several changes into different preventive measurements making evaluations of specific preventive effects difficult or impossible. The only effect of caries prophylaxis that was possible to evaluate was the patients' perceived effect. The CA group was caries active for a very long period of time as shown earlier [10], and six out of ten of the individuals in this risk group reported that they did not become free from caries despite extra prophylaxis efforts. This indicates that the methods recommended were either not completely followed, and may need some kind of reminding system, or that the methods were not sufficient to stop progression of the disease – or a combination of these two reasons. Naturally, this negative result affected the satisfaction with the caries prophylaxis, but surprisingly not the expected future outcome. The outcome effect "to become free from caries by extra prophylaxis efforts" is just one possible factor to measure, but might be quite relevant as in this sample the individuals could perceive and judge caries activity over time very well [10]. In general health care, there are several validated PROM (Patient Reported Outcome Measurement) questionnaires available [9]. In dentistry, however, there are just a few, mainly Oral Health-Related Quality of Life (OHRQoL) questionnaires [22]. There is a need for more specific instruments for PROMs studies related to caries where there are important factors to consider in the developing process in relation to patients satisfaction [8], general health, what disease specific questions may be needed, follow ups of national guidelines and several other aspects [18]. In a previous study [10] respondents and non-respondents did not differ significantly in their perceptions of caries disease. It is not known if they differ in adherence to recommendations of caries prophylaxis. It is possible that the non-respondent caries active patients would be even less satisfied with the outcome of caries prophylactics than the responding CA group. We realise that the present study has limitations, such as a small sample size, wide variations in age and follow up time, and therefore the results must be interpreted with caution. However, it confirms the need for further studies of caries prophylaxis among caries active individuals, especially adults. Indeed, the patients in the present study were aware of their need of extra caries prophylaxis, and expressed a wish to reduce the caries disease and activity.

Conclusions

In the present study, caries active individuals reported receiving information and recommendations about caries and caries prophylaxis more often than caries inactive individuals, and these perceptions

were in concordance with dental records. The caries active individuals were aware of their need for extra caries prophylaxis and had performed extra home care efforts more frequently, but were not completely satisfied with the outcome and have not become free from caries.

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