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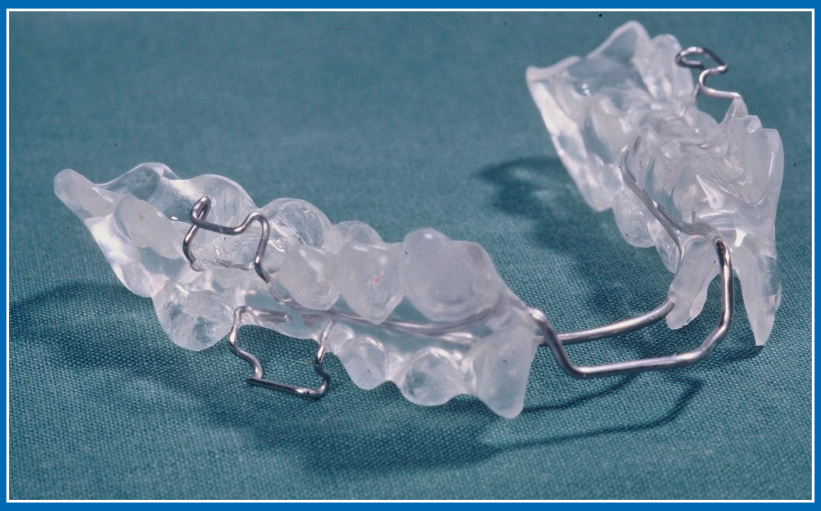

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Long-term dental implant success and survival – a clinical study after an observation period up to 6 years

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Abstract

◎ The aim of the present work was to evaluate the long-term results of dental implants and the risk factors associated with implant survival and success rates.

108 patients were examined and the control consisted of medical history taking, clinical and radiographic examinations.

The survival rate of dental implants was 96.0% and the success rate was 94.3%. Mucositis was found to be related to patients' age and the number of implant units placed. Peri-implantitis was often found in patients showing low standards of oral hygiene as well as in those who were not coming on regular dental visits.

Mucositis was in every 5th implant site and was mostly seen in patients with prosthetic constructions consisting of 3 or more units as well as in older patients. Oral hygiene and dental control visits are important to maintain good oral health.

Key words

Dental implants, success, survival, long-term

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Långsiktig överlevnad och lyckandefrekvens på dentala implantat - en studie med observationstid på upp till 6 år

Olga Charyeva, Kubeysin Altynbekov, Rahmed Zhartybaev , Asylbek Sabdanaliev

Sammanfattning

◎ Syftet med denna studie var att utvärdera långsiktig överlevnad och lyckandefrekvens på dentala implantat, samt att bedöma riskfaktorer som kan påverka implantatens resultat.

108 patienter undersöktes både kliniskt och röntgenologiskt, tillsammans med anamnesupptagning. Totalt har 324 endossösa implantat utvärderats. Kriterier från internationella kongressen för orala implantologer i Pisa, 2007, användes för att bedöma implantaten. Den statistiska analysen gjordes med hjälp av IBM SPSS version 18 och korrelation mellan olika variabler beräknades.

Överlevnaden för dentala implantat var 96.0% och lyckandefrekvensen var 94.3%. Mukosit visade sig vara relaterad till patientens ålder och antal inopererade implantat. Peri-implantit var relaterad till dålig munhygien och var oftast registrerad i patienter som inte kom på regelbundna tandläkarkontroller.

Protetiska konstruktioner som består av 3 eller fler led ökar risken för mukosit. God munhygien och regelbundna tandläkarkontroller är viktiga för att bibehålla en bra munhälsa för patienter med tandimplantat.

Introduction

The use of dental implants has become a wide spread treatment option in the last decades. The advance of dental implants into the dental practice can be explained by the high long-term success rates of over 95% (6), as well as functional and aesthetic satisfaction of many patients.

Despite a great success, the risk factors associated with dental implant success and failure have to be recognized in long-term studies with large implant samples in order to give a clinician a picture of implant results which can be expected in various patient groups. Some risk factors identified in the previous studies are smoking (1, 5), poor oral hygiene and history of periodontitis (5). Increased age of the patients does not appear to affect the clinical potential for osseointegration or the rate of crestal bone resorption observed around oral implants. In contrast, jaw site is related significantly to osseointegration potential; mandibular sites tend to be more successful than maxillary sites (4). The reason for this may be that jawbone quality and quantity are often more compromised in maxillary than in mandibular sites. However, evaluation of this relationship has been hampered by a lack of evidence to support the validity and reliability of methods used to assess jawbone condition preoperatively (4).

Peri-implant disease is a common reason for implant failure (9). It is the result of an imbalance between bacterias and host. In the Sixth European Workshop on Periodontology (13), the definitions of peri-implant diseases have been revised. Peri-implant mucositis is the presence of inflammation in the mucosa at an implant with no signs of loss of supporting bone. Peri-implantitis in addition to inflammation in the mucosa is characterized by loss of supporting bone (9). Correct diagnosis of peri-implant disease is critical for appropriate management of peri-implant disease. Bleeding on probing (BOP) is always present with peri-implant disease (13).

Other clinical signs of disease may include suppuration, increased probing depths relative to baseline, mucosal recession, a draining sinus (fistula) and peri-implant mucosal swelling (5). If undiagnosed, peri-implant disease may lead to complete loss of osseointegration and implant loss (5).

The main objective of the present cohort study was to evaluate i) the long-term results of dental implants after up to 6 years of function, ii) the risk factors associated with implant survival and success rates, and *iii*) the prevalence of peri-implant diseases in this patient sample.

Material and methods

In 2004–2006, 120 patients received dental implants at the Department of Oral Surgery at the Kazakh National Medical University. Antibiotics were not prescribed before implant placement and implants were placed under local anesthesia. A two-stage surgical protocol was utilised. During the first surgical procedure, a mucoperiosteal flap was reflected and bone was prepared for implant placement under thorough irrigation. The flaps were then closed after implant placement. The second surgical procedures were performed 4 and 6 months later for the mandibular and maxillary implants respectively.

Postoperative instructions for both surgeries included rinsing with chlorhexidine 0.2% twice daily, brushing carefully in the surgical area, and avoiding hot meals and drinks for the first week. Restorative procedures were initiated approximately 4-6 months post placement for mandibular and maxillary implants respectively. Patients were recalled for follow up after 1 month, 6 months, and 12 months, and then once a year after occlusal loading.

All patients were informed about the current investigation when they were recalled for examination 4 to 6 years after implant installation. Out of 120 patients, 108 agreed to participate in the current study and came for examination. Of these 108 patients, 32 people got implants in year 2004, 36 patients in 2005 and 40 in 2006. The examination consisted of:

i) Gender, age, general health and smoking habits registration,

ii) Probing around dental implants using the CPI probe with a 0.5-mm ball tip and a coloured band between 3.5 and 5.5 mm and registering bleeding and probing depth ≥ 4 mm at four sites – mesial, distal, buccal and lingual,

iii) Oral hygiene assessment by inspecting the mouth and giving the score 1-3, where 1 is not satisfactory (dental plaque seen generally in the whole oral cavity), 2 is satisfactory (dental plaque seen on some teeth) and 3 is excellent (dental plaque is not seen),

iv) Comparing panoramic radiograms which were taken after implant operation with the latest panoramic radiographs. If the bone loss was more than 2mm from initial surgery combined with BOP and periodontal pocket >4 mm, peri-implantitis was recorded,

v) Registering biological complications with the help of patient records to see what complications the patients had during the course of 4-6 years. Up-to-date observations were also recorded. Biological complications of interest were loss of sensitivity,

failure of implants to osseointegrate, mucositis and peri-implantitis. Mucositis was recorded when probing depth was ≥ 4 mm with bleeding on probing at one or more of the four sites,

vi) Studying patient records to see whether they were coming to the dental appointments regularly. Two or more visits that were skipped were recorded.

A total of 324 endosseous implants of Mis Seven dental implant system (MIS Implants Technologies Ltd, Israel) were examined. Implant dimensions were 4.2-5 mm in diameter and 8-13 mm in length. The implant location is presented in Table 1.

Criteria made by The International Congress of Oral Implantologists on Pisa Consensus Conference, 2007 (10), were used to assess the dental implants:

I. Success: a) No pain or tenderness upon function, b) No mobility, c) Less than 2 mm radiographic bone loss from initial surgery, d) No exudate history.

II. Satisfactory survival: a) No pain on function, b) No mobility, c) 2–4 mm radiographic bone loss, d) No exudate history.

III. Compromised survival: a) May have sensitivity on function, b) No mobility, c) Radiographic bone loss over 4 mm (less than1/2 of implant body), d) Probing depth over 7 mm, e) May have exudate history.

IV. Failure, any of following: a) Pain on function, b) Mobility, c) Radiographic bone loss over1/2 length of implant, d) Uncontrolled exudate.

Data were analysed using the Statistical Package for the Social Sciences (SPSS, v 18, SPSS Inc, Chicago, IL USA). The significance level was set at 5%. Correlations between different variables were calculated.

Results

Patients

Division of patients after gender and age is shown in Table 2. Patients ranged in age between 21 and 60 years. In total 104 patients were completely healthy, whereas the rest 4 patients had diabetes type 2 which was under control. No one was using medications. 12 male patients smoked 3-9 cigarettes per day; all women were non-smokers. No significant difference was found between implant failure and presence of diabetes (P = 0.632).

Oral Hygiene

Assessment of oral hygiene which was done by visual inspection of oral cavity showed that 11.1% patients (12) had no clinically noticeable plaque and were thus given the grade excellent. In 86.1% cases (93) the hygiene was satisfactory since clinically noticeable plaque was on a limited number of teeth. The rest 2.8% patients (3) had unsatisfactory oral hygiene. Hygiene was correlated with patients' age (younger patients having better standards, P = 0.014), gender (women having less plaque than men, P = 0.044), and number of implant units installed (fewer units were easier to keep clean, P = 0.042). Oral hygiene was significantly better in non-smokers than in smokers (P = 0.032). The presence of higher university education did not play a role in oral hygiene (P = 0.831).

Complications

The survival rate for dental implants in this study was 96.0%. A total of 4.0 % (13) of implants were removed due to increased mobility and considera-

Table 1. Location of dental implants places in this study

	Maxillary implants	Mandibular implants	Total implants
Single tooth	10	2	12
Partial arch	139	151	290
Full arch	18	4	22
Total	167	157	324

Table 2. Division of patients after gender and age

Gender	Age (years)				Total	
	21-30	31-40	41-50	51-60	Absolute number	Percentage (%)
Male	3 st (5.8%)	15 st (28.8%)	21 st (40.4%)	13 st (25.0%)	52	48.1
Female	2 st (3.6%)	17 st (30.4%)	23 st (41.1%)	14 st (25.0%)	56	51.9
Total	5 st (4.6%)	32 st (29.6%)	44 st (40.7%)	27 st (25.0%)	108	100.0

Table 3. Prevalence and location of peri-implantitis and mucositis in this study

	Peri-implantitis at maxillary sites	Peri-implantitis at mandibular sites	Mucositis at maxillary sites	Mucositis at mandibular sites
Single tooth	0	0	2	0
Partial arch	5	3	23	15
Full arch	2	2	7	9
Total complications	7	5	32	24

ble bone loss (1) and the rest due to inflammation around implants (12). One implant was removed after 4 years of function due to increased mobility and bone loss, 4 implants after 5 years of function and 8 after 6 years of function because of the peri-implant disease.

Peri-implantitis was significantly more prevalent in patients who were regularly skipping the dental appointments (P = 0.004) or had unsatisfactory oral hygiene (P = 0.003). The rest implants examined were immobile and the radiographic bone loss was <2 mm from initial surgery. Mucositis was found around 17.3% (56) implants and was a frequent finding in patients 41+, with prosthetic constructions consisting of more than 3 implants (P = 0.042). The success rate for dental implants which were not removed was 94.3%. Satisfactory survival with no bleeding on probing was noted in 1.8% (6) of implants. Loss of sensitivity was not reported.

It was seen that the maxilla was somewhat more often affected by mucositis and peri-implantitis compared to the mandible (Table 3).

Discussion

The present data show that unsatisfactory oral hygiene, ignoring dental appointments, implant prostheses consisting of more than 3 units and patients' age have significant affect on implant success and survival. Some of these factors were identified in earlier research (1,5). However increased age of the patients was not shown to affect the clinical potential for osseointegration in previous studies (4). The fact that the patients' age and the number of implants installed were related to higher risk of mucositis in this investigation can be explained by that the most patients with implant prosthesis consisting of 1-2 units were young, around 30 years of age, and were more concerned with oral hygiene measures. Their constructions were smaller and easier to keep free of plaque and inflammation. In contrast, patients with more extensive implant prosthesis were around 55 years and it was harder for them to keep the majority of units clean. In total, 17.3% implant sites had mucositis. Previous studies show that up to 50% of implant sites can be affected by this condition (13).

It was seen that the maxilla was somewhat more often affected by mucositis and peri-implantitis compared to the mandible. The reason for this may be that jawbone quality and quantity are often more compromised in maxillary than in mandibular sites. Previous studies also noted greater success and survival in mandible compared to the maxilla (4).

Patients with low standards of oral hygiene were significantly more prone to peri-implantitis. Peri-implantitis affected 4.0% of implants in this investigation; prevalence values for peri-implantitis vary from 12 to 43% of implant sites (13). The lower prevalence of peri-implantitis in this study can probably be explained by the fact that only panoramic images were available for evaluation of the horizontal bone loss. Panoramic images have a decreased resolution when compared to intra-oral films, resulting in a decreased ability to detect small changes in bone support along the implants (11).

It was not possible to judge the effect of smoking on the overall long-term complications due to few smokers ingoing in this study, and partially due to the fact that more than half of all smokers were in the group who were skipping dental visits and who got peri-implantitis. What comes first – smoking or ignorance of prophylactic measures, or perhaps a combination of both factors – is hard to say and requires a greater patient sample and randomized controlled trial design.

The survival rate for dental implants in this study is consistent with earlier researches (2,12). It is, however, hard to compare the success rate with previous investigations since many researchers use different criteria for the success rates (3,6). Thus, the common criteria for assessment of dental implant success and survival should be accepted for easier comparison of studies.

Table 4. Data comparison from this study and the international reviews (1,13)

Complication type	Current study (%)	International reviews (%)
Mucositis	17.3	50
Peri-implantitis	4.0	12-43

Conclusion

• Mucositis was in every 5th implant site and was mostly seen in patients with prosthetic constructions consisting of 3 or more units as well as in older patients.

• Peri-impantitis was seen in patients with unsatisfactory oral hygiene, and in those who were skipping dental appointments.

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Patient attitudes and expectations of dental implant treatment – a questionnaire study

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Abstract

◉ The aim of the present study was to evaluate patient attitudes and expectations relative to dental implant treatment.

A questionnaire was mailed to all 400 patients that had received dental implant treatment at a large multi-specialist clinic during 2008. The questionnaire included questions relative to the reasons for dental implant treatment, if the patient earlier had considered dental implants, expectations of the treatment, discomfort during and after surgery, and how the patient perceived the esthetic outcome.

The response rate was 61% (114 men/130 women). The stated reason for tooth loss was in 50% of the patients periodontitis, 19% caries, 8% accidents, 13% other reasons, and 10% no stated reason. Almost all patients (96%) were satisfied with the esthetic appearance and also regarding the information of the treatment (94%). Regarding the time between surgery and completion of prosthetic work, 79% (n= 192) found it to be reasonable. 71 % (n=170) thought the cost was what they had expected. 47% of the patients experienced the implant surgery better than expected and 48% as expected.

In conclusion, the present study revealed that almost all patients were satisfied with the function and esthetics of the dental implant reconstruction and most patients were also satisfied regarding the costs and treatment duration.

Key words

Dental implant, questionnaire, expectations, attitude

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Patientens attityder till och förväntningar på implantatbehandling – enkätstudie

ANNSOFI JOHANNSEN, ULF WIKESJÖ, GEORG TELLEFSEN, GUNNAR JOHANNSEN

Sammanfattning

◎ Syftet med denna studie var att utvärdera patientens attityder till och förväntningar på implantatbehandlingar.

En enkät skickades ut till 400 patienter som hade fått implantatbehandling på en specialistklinik i Stockholm under 2008. Enkäten innehöll frågor avseende; skäl till implantatbehandling, om patienten tidigare hade funderat över implantat, förväntningar på behandlingen, obehag under och efter operationen, kostnaden, tiden för den totala behandlingen och hur patienten uppfattade det estetiska resultatet.

Svarsfrekvensen var 61 % (114 män/130 kvinnor). Anledningen till tandförlusterna var följande: 50 % på grund av parodontit, 19 % karies, 8 % olyckor, 13 % andra skäl och 10 % av patienterna uppgav inget skäl. Anledningen till att man valde implantat var framförallt av funktionella skäl (81 %). Nästan alla patienter (96 %) var nöjda med det estetiska resultatet av behandlingen och även avseende informationen om behandlingen (94 %). 79 % av patienterna upplevde att behandlingstiden var rimlig och 71 % rapporterade att kostnaderna för behandling blev som de hade förväntat sig. 47 % av patienterna upplevde att det kirurgiska ingreppet gick bättre än förväntat och 48 % som de hade väntat sig. Sammanfattningsvis visade studien att nästan alla patienter var nöjda med funktion och estetik, och de flesta var även nöjda med kostnaden och behandlingstiden.

Introduction

Tooth loss has several etiologies, periodontitis and dental caries considered the most common (9,12). Various fixed and removable prosthetic devices have been developed and practiced to meet esthetic and functional demands following tooth loss. Tooth supported bridges have been common fixed prosthetic appliances. Removable partial or full dentures have also been used but may not satisfactorily meet functional demands (10). In consequence, bone-anchored dental implants have emerged as a preferred dental technology to replace single missing teeth, groups of teeth, and edentulated full arches. Longitudinal studies from Sweden have reported dental implant survival rates approximating 90-95% over 5- to 10-year periods (3,7).

Patients with deteriorated dental status state that they over several years before treatment with an implant-supported fixed prosthesis have made considerable economical and mental efforts to improve their dental status (22). They also reveal feelings of shame, guilt, and low self-esteem, because of their poor oral health. *Tavares et al.* (20) suggested, in a study from USA, that patient satisfaction with prosthodontic treatment interacted with the entire life situation of the patient, which could be related to personality factors. It is not difficult to realize that patients become more satisfied with implant supported prosthetic appliances relative to comfort, stability and esthetics compared with a conventional removable prosthesis (2,24). Patients state that the implant-supported prosthesis becomes part of their body and clearly enhances their daily quality of life (4).

Abu Hantash et al. (1), evaluating 50 partially edentulous individuals in Israel seeking dental implant therapy, showed that personality/psychological traits had an impact on patient satisfaction/quality of life following treatment. Patient expectations relative to cost of dental implant treatment have also been studied. High cost deters the patients more than implant therapy itself (16). A questionnaire study including 315 patients in Germany showed that expectations were high in terms of esthetics, function and performance (19). To meet patient demands and expectations about cost, esthetics and function of dental implant treatment it is important to investigate their opinions. Since until now there is limited information focusing on these questions and since patient opinion and comfort are essential to get the best outcome of treatment, it becomes important to expand the knowledge in this area. Our hypothesis in the present study is that the high expectations that the patients, who are treated with dental implants, have are fulfilled in terms of function costs, treatment time and esthetics.

The aim of the present study was to evaluate patient attitudes and expectations relative to dental implant treatment.

Material and methods

A questionnaire was mailed to 400 patients that had received dental implant treatment at a large multispecialist clinic (Danaclinic, Department of Periodontology, Stockholm, Sweden) during 2008. The patients had been referred to the clinic from 200 dentists and dental hygienists covering the area of Stockholm, Sweden and surroundings. The surveys were mailed between one and two years after completion of the prosthetic treatment.

The patients received the questionnaire together with a prepaid envelope and a letter explaining the purpose of the study and assuring that their answers would be kept confidential. No further reminder questionnaire was mailed to patients who did not respond. The questionnaires were coded and the responses were sent to a person who was not taking active part in the study. Thirty-nine patients had moved from Stockholm with address unknown, and their questionnaires were returned to the person responsible for the mailings. This study was approved by the Ethics Committee at Stockholm University, Sweden Dnr. 2009/172-31/4.

Treatment

The patients had all received dental implant treatment and the treatment protocol followed the manufacturer's (Straumann AG, Basel, Switzerland) recommendations: i.e., 7-8 weeks osseointegration in the maxilla and 5-6 weeks osseointegration in the mandible prior to initiating prosthetic reconstruction. The treatments included single-tooth replacements, partial arch replacements using 2-3 implants, or full arch replacements using 6 implants. Over denture protocols were not used.

Questionnaire

The questionnaire included 28 multiple-choice questions relative to the reason for dental implant treatment, if the patient earlier had been considering dental implants, expectations of the treatment, discomfort/pain and swelling during and after surgery, and how the patient perceived the esthetic outcome.

Response alternatives included "as expected", "better than expected" and "worse than expected" and "no/mild/moderate/severe" post-operative discomfort/pain and swelling as appropriate. The question about the treatment time was answered with the alternatives "reasonable" and "too long". Before study start, in order to disclose potential misinterpretation or ambiguities in the questions, a pilot study was undertaken in which a number of patients with implants completed the questionnaire.

Other questions asked whether the patient had received information on how to take care of the implants using the response alternatives "sufficient", "insufficient" and "don't know". A question relative to how they perceived the cost for the implant treatment used the response alternatives "as expected", "more than expected" and "less than expected".

Socio-demographic data such as age, gender, education, household income, occupation and marital status were collected as well as information relative to oral hygiene/dental care and tobacco use habits.

The questionnaire used was not formally validated, however, similar questions regarding patient's expectations about function, esthetics and cost aspects have been used in earlier studies (6,19).

Statistical analysis

Descriptive statistical methods were used and data are presented in numbers and percentages. Comparisons between genders were made using Student's t-test. Pearson's correlation was used to estimate household income and education level in patients who had earlier been treated for periodontitis; and the relation between education level and tooth loss. Statistical significance was set at $p< 0.05$ for each test. The data analysis was performed using SPSS 18.0 software (Chicago, IL, USA).

Results

The response rate was 61% (114 men/130 women). 75 % (n= 183) of the patients were recommended implant treatment by their dentist, 24% (n= 58) were self-referred and 1% (n= 2) by their dental hygienist. Table 1 shows patient demographic data such as age, marital status, education level, household yearly income, occupation and smoking habits.

The number of dental implants installed in each patient ranged between 1 and 11. Twenty-four percent (n= 58) of the patients received 1 implant, 38% (n= 93) 2-3 implants, 31% (n= 76) 4-6 implants, and 7% (n= 17) more than 6 implants. Since 6 implants in one jaw is sufficient for a full-arch treatment and since the Swedish insurance system does not cover anything of the costs for more than 6 implants in one jaw, all patients that received more than 6 implants were treated in both jaws.

The stated reason for tooth loss was in 50% (n= 121) of the patients periodontitis, 19% (n= 47) caries, 8% (n= 19) accidents, 13% (n= 32) other reasons (e.g. root fracture), and 10% (n= 25) no stated reason.

Sixty-six percent (n= 161) of the patients had not considered implant treatment earlier. 81% (n=131) of those had been satisfied with their situation as it was and 19% (n= 30) due to other reasons. 74% (n= 61) of the patients who earlier had considered implant treatment, stated that economy was the main reason as to why they had not pursued the treatment, followed by fear 14% (n= 12), and 12 % (n= 10) were not recommended. When listing the reasons for choosing dental implant therapy, 81% (n= 198) of the patients reported functional aspects as the most important reason followed by esthetics, 15% (n= 36), and social reasons, 4% (n= 10).

Table 1. Patient demographics; n= number of responders (%)

	n (%)	Men	Women	P
		114(47)	130(53)	ns
Age (n=244)				
< 59 years	43(18)	18(16)	25(19)	ns
60-69 years	107(44)	50(44)	57(44)	ns
>70 years	94(38)	46(40)	48(37)	ns
Marital status (n=243)				
Married/cohabitant	156(64)	89(79)	67(52)	0.001*
Single	87(36)	24(21)	63(48)	0.05*
Education (n=244)				
Primary/Secondary	143(59)	66(58)	77(59)	ns
University	101(41)	48(42)	53(41)	ns
Household yr income (n= 240)				
< 35 000 Euro	118(49)	41(36)	77(61)	0.05*
35100 - 50000 Euro	66(28)	35(31)	31(24)	ns
> 50000 Euro	56(23)	37(33)	19(15)	ns
Occupation (n= 243)				
Working	85(35)	42(37)	43(33)	ns
Non-Working	158(65)	72(63)	86 (67)	ns
Smoking habits (n=243)				
Present smokers	33(14)	8(7)	25 (19)	ns
Present no-smokers	210(86)	106(93)	104 (81)	ns
Former smokers	101(44)	38(37)	63 (59)	ns

* Significant differences between genders

Table 2 shows answers to questions about how the patients perceived dental implant therapy. 94 % (n= 227) were satisfied with the information about the treatment. Regarding the time between surgery and completion of the prosthetic work, 79 % (n= 192) found it to be reasonable. 73 % (n= 176) found the esthetic appearance to be what they had expected and 23% (n= 55) found it better than expected. 71 % (n=170) thought the cost were what they had expected. 47% of the patients experienced the implant surgery to be better than expected and 48% as expected. No statistical differences were found concerning patient attitudes and expectations regardless if the tooth loss was due to periodontitits, caries or by injury.

All patients brushed their teeth daily, and 74% (n= 178) used interproximal aids daily. 93% (n= 226) of the patients visited the dentist once or twice a year, and 50% (n= 120) visited the dental hygienist once or twice a year.

Table 2. Questions about the treatment; n= number of responders (%)

Information of treatment (n=242)	
Satisfactory	227 (94)
Wanted more information	12 (5)
Too much information	3 (1)
How was the implant surgery experienced (n=242)	
As expected	170 (48)
Better than expected	114 (47)
Worse than expected	13 (5)
Post-operative discomfort/pain and swelling (n=243)	
Mild discomfort/pain and swelling	89 (37)
Moderate discomfort/pain and swelling	34 (14)
Severe discomfort/pain and swelling	6 (2)
No post-operative discomfort/pain and swelling	114 (47)
Time elapsed between surgery and completion of prosthetic work (n=242)	
Reasonable	192 (79)
Too long	50 (21)
Esthetic appearance (n=242)	
As expected	176 (73)
Better than expected	55 (23)
Worse than expected	11 (4)
Costs of treatment (n=244)	
As expected	170 (71)
More than expected	66 (25)
Less than expected	10 (4)
Information about oral hygiene (n=243)	
Sufficient	191 (79)
Insufficient	40 (17)
Don't know	11 (4)

Pearson's correlation test showed a significant correlation ($r= 0.342$, $p< 0.05$) between patients who earlier had been treated for periodontitis and lower household income. There was a weak linear correlation ($r= 0.2$; $p< 0.05$) between education level and tooth loss. There were no significant correlations between the patients who earlier had been treated for periodontitis and the treatment time, the cost or the esthetic appearance.

Gender aspects

The demographic differences between the genders are also shown in Table 1. There were significantly ($p< 0.001$) more men who were married and significantly ($p< 0.05$) more women had lower income compared with men. No differences between men and women regarding the cost were found, however the patients with lower income more frequently reported the cost to be high.

Non-responders

An analysis of the non-responders through perusal of the records regarding age, sex and number of implants was made. The results were in line with those who had answered the questionnaire.

Discussion

The present study showed that almost all patients were positive to the implant treatment and treatment outcome as it pertains to function and esthetics. However, it must be considered that 25% (Table 2) of the patients thought that the total cost for their rehabilitation was higher than expected. Moreover, 25% of the patients stated that they earlier could not afford implant treatment, which might be regarded a high number. In comparison, an Austrian study found that as many as 76% of the patients considered cost to be the strongest deterrent to dental implant therapy (21). Others have also discussed that implant treatment is not accessible to all patients because of costs (17). In the present study 57% of the patients, who had lost their tooth/teeth due to periodontal disease, had an annual household income of less than 35,000 Euro, which may implicate that they also with difficulty could have afforded periodontal treatment. As patients clearly underestimate or cannot afford the costs for implant therapy, *Rustemeyer et al.* (19) concluded that finding individual solutions to financing also must be taken into consideration when presenting implant treatment to patients.

As shown previously (13,19) as many as 81% of the patients in the present study reported that function

was the most important reason for choosing implant treatment. A questionnaire study published in 1997 found a low expectation score relative to esthetics for the implant group suggesting that patients favored function over esthetics (10). Nevertheless, 23% (Table 2) of the patients in the present study perceived the esthetics better than expected, which is in line with *Pommer et al.* (18). These observations are noteworthy in perspective that the last decade developments in implant dentistry have focused on esthetics.

In terms of technique in the present study, the same procedure was used regardless of how many implants that was installed. Of course the number of implants needed may have had an impact on the expectations, in patients with full-arch rehabilitation the focus of expectations was primarily on regaining the chewing function while the single tooth implant patients were more concerned with the esthetic outcome, if treatment was conducted in the anterior region. Furthermore, patients undergoing full-arch rehabilitation may have higher cost expectations. This can be considered as limitations of the study. On the other hand, the patients were consecutively chosen and all patients were given the same pre-surgical and post-surgical information. To minimize the risk for "differences" in the pre-and post surgical information, all information about the treatment were given by the same specialist.

There were no gender-related differences regarding expectation of esthetics or cost despite that women reported significantly lower household income than men. Furthermore, only 12% of the men considered the treatment time too long compared to 20% of the women. In comparison, *Hakestam et al.* (10) showed that women had higher expectations than men relative to appearance as they also reported a weak correlation between education and expectations of improved health.

In the present study, treatment time was considered too long by almost 21% (Table 2) of the patients. Post-operative healing time, i.e. the time elapsed from implant placement to prosthetic reconstruction, has been a recent focus of research and debate, early/immediate prosthetic rehabilitation/loading potentially being a risk factor for early implant loss while desirable from a patient perspective offering shorter/immediate rehabilitation, including important facial esthetics. At present, immediate and early loading protocols appear successful provided primary stability has been sufficiently addressed (6,15,23). Thus the use of immediate/early loading protocols when possible may still increase patient interest and acceptance of treatment plans taking advantage of implant dentistry.

Nearly all patients (94%, Table 2) in the present study, found the pre-treatment information satisfactory, which also have been reported by others (10). It has indeed been suggested, evaluating patients following 3rd–molar surgery, that careful pre-treatment information enhance treatment outcome as it is important for patient well-being and comfort (5). One might argue that the patients that were recommended dental implant treatment by their referring dentist would have higher expectations on the outcome, however since all patients got the same thorough pretreatment information, the differences regarding expectations can be considered negligible.

The success and ultimately survival of dental implants appears considerably dependent upon personal oral hygiene routines and professional supportive treatment (14). It is of interest to note that in the present study 50% of the patients did not attend regular dental hygiene recall routines as might be expected especially for those earlier treated for periodontal disease. Possibly the referring dentists did not recommend or provide dental hygiene recall or the patients did not realize the importance of personal/professional specific attention and follow-up. Although, the significance of supportive therapy for implant patients appears irrefutable, evidence regarding preferred recall interval(s) remains lacking (11). In perspective, *Ferreira et al.* (8) suggested that the frequency of professional maintenance care did not influence peri-implant health.

A limitation of this study was that the questionnaire had not been formally validated, however some of the questions were similar to those used in other studies investigating this topic (6,19), also using not validated questionnaire. There is overall a lack of validated questionnaire concerning this topic. Moreover, the sample of this study was drawn from one multi specialist dental clinic; the patients referred from 200 dentists and dental hygienists throughout the Stockholm, Sweden area, which appears a limitation when drawing general conclusions from the results. On the other hand, there are a few advantages with this procedure, *e.g.*, all patients did get the same pre-operative information prior to the treatment, the same surgical routines were used and costs were the same depending only on the chosen treatment. Patient attitudes and expectations might be more comparable considering these aspects. Accordingly, future research should poll more and geographical-

ly disperse dental clinic samples and use validated questionnaires. Using interviews might provide still greater exacting knowledge about expectations and influence on patients self-esteem, to take into consideration in implant treatment.

Conclusion

In conclusion, the present study revealed that almost all patients were satisfied with the function and esthetics of the dental implant reconstruction and most patients were also satisfied regarding the costs and treatment duration.

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Clinical routines and management of suspected child abuse or neglect in Public Dental Service in Sweden

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Abstract

◎ Mandatory reporting to the social services is required by dental professionals when suspicion of child abuse or neglect occurs. The objective of this study was to analyze the recommendations previously made by the Ombudsman for Children in Sweden. The aim was to study the association between having guidelines and the inclination to report to the social services and also the association between management of multiple missed appointmens and reports to the social service. A web-based questionnaire was sent to the clinical department heads (CDH) of all PDS in Sweden, distributed and authorized by The Ombudsman for Children in Sweden. The response frequency was 95% and all county councils of Sweden were represented. The results showed regional differences regarding management of suspected child abuse, neglect and dental neglect. Clinical department heads that had reported to the social services more often had guidelines on child abuse and neglect ($p<0.000$). Management of repeated missed appointments varied between clinics. Those who never had made a report to the social services more often stated that the reason for missed appointments was parental negligence ($p=0.004$) and less often thought it was an actual maltreatment ($p=0.003$), and they more often rescheduled when a child repeatedly missed an appointment ($p=0.013$). Sixty-four percent of the clinical department heads requested additional support in this matter. In conclusion, public dental service clinics in Sweden are significantly more likely to report to the social services if guidelines regarding child abuse and neglect are available.

Key words

Child abuse, dental education, dental neglect, mandatory reporting, missed appointments.

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Tandvårdens rutiner för barn som far illa. En kartläggning av erfarenheter och kunskaper hos klinikchefer i Folktandvården i Sverige

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Sammanfattning

◉ Personal inom tandvården har liksom all övrig hälso- och sjukvård skyldighet att rapportera till socialtjänsten då de misstänker att barn far illa. Tandvården har hittills inte varit särdeles aktiv i att identifiera misstänkta fall av misshandel eller försummelse. Syftet med denna studie var att analysera de resultat och rekommendationer som Barnombudsmannen tidigare presenterade i sin rapport om ”Tandvård och barn som far illa”. De frågeställningar som analyserats är om riktlinjer kring barn som far illa leder till en ökad rapportering till socialtjänsten samt om rutinerna för upprepade uteblivanden och återbud avspeglas i rapportering till socialtjänst. En enkät sändes till samtliga klinikchefer i Folktandvården. Barnombudsmannen i Sverige ansvarade för den nätbaserade enkäten som innehöll elva frågor. Svarsfrekvensen var 95 % och svar erhölls från samtliga landsting i Sverige. Resultaten visar att det förekommer skillnader mellan landstingen avseende etablerade riktlinjer för misshandel, försummelse och dental försummelse. Kliniker som uppgav att de hade riktlinjer för hur misstankar om barn som far illa ska hanteras anmälde i större utsträckning till socialtjänsten ($p<0.000$). Handhavandet av barn som regelbundet uteblir skiljde sig mellan klinikerna, klinikchefer som inte hade anmält till socialtjänsten oftare uppgav att orsaken till uteblivanden berodde på slarv hos föräldrarna ($p=0.004$) och mer sällan att orsaken var en misshandel eller försummelse ($p=0.003$). Dessa kliniker sände oftare endast en ny kallelse ($p=0.01$) vid upprepade uteblivanden. Sammanfattningsvis visar resultaten att folktandvårdens kliniker i Sverige är mer benägna att anmäla misstanke om barn som far illa till socialtjänsten om de har riktlinjer för detta.

Introduction

All health professionals, including dentists and dental hygienists, are required by law to report any signs or symptoms that could be associated with child abuse and neglect to the social services (32, 33). The Ombudsmen for Children in the Nordic countries has together stated that the dental profession, who meet children and adolescents on a regular basis, is an untapped resource for detection and prevention of child abuse and neglect. Internationally, few cases of suspected abuse and neglect are reported from dental health care (1, 37).

Sweden was in 1979 the first country in the world to prohibit corporal punishment. In a national survey of child abuse, parents were asked, about their attitudes towards corporal punishment and upbringing of children. Nearly 25% had shaken, pushed or grabbed their child and 3% stated they had slapped them. 0.2-0.4% used corporal punishment as a way to handle conflicts (19). Results from a population-based survey among 8 494 schoolchildren showed that 15% of the children had been hit by an adult. Only 7% of them had disclosed this to the authorities (4).

The oro- facial region is the most common site of injuries in documented cases of child abuse. Swedish statistics show that, 57% of abusive injuries in children, reported from 1999 to 2005, were located to the head (33). Oro-facial injuries include contusions, lacerations, bruises, avulsions and fracture of teeth and/or jaws (27). Extreme dental fear (38), dental behavior management problems (15) or repeatedly missed appointments (3) have been suggested as possible behaviors and situations indicative of sexual abuse, domestic violence or neglect.

Definitions

Physical violence is intentional harm towards a child such as inducing illness, pain or powerlessness. Psychological violence includes disrespectful behavior, harassment, isolation from social activities and also witnessing domestic violence. Sexual abuse is all forms of sexual actions that are forced on the child by an adult. Sexual assault involves that an adult make use of the child's position of dependence, that the action is based on the adults needs and that it violates the integrity of the child. In addition it occurs against the child's will or is an action that the child does not understand, is not mature for or cannot approve of. Neglect is when an adult damage or jeopardize a child's physical health or development, through the neglect of guarantying an acceptable standard in physical care or by not satisfying the child's essential needs of attention, belonging, upbringing, guidance, stimulation and education (31). Dental neglect is a willful failure of a parent or guardian to seek and follow through with treatment necessary to ensure a level of oral health essential for adequate function and freedom from pain and infection (3).

The aims of this study were to survey the experience and the state of readiness public dental service (PDS), Sweden, has when dealing with suspected child abuse and neglect. Furthermore, the aim was to study the correlation between having guidelines and the inclination to report to the social services.

Material and methods

Data collection and study sample

The data in this study was collected by the Ombudsman for Children in Sweden and has been presented as a descriptive government report (5) in Swedish. This article presents an extended an in-depth analysis of this data.

A web-based survey was conducted and authorized by the Ombudsman for Children in Sweden. Questionnaires were distributed from May 2010 to October 2010. Six hundred nineteen PDS clinics in Sweden were identified and an email was sent to all 619 clinics, with instructions and information clearly addressed to the clinical department heads (CDH). The addresses were collected from the official website of PDS (www.folktandvarden.se) in April 2010. Remainders were sent by email and if no responses were obtained, telephone calls to individual clinical department heads were made.

Exclusion and final sample

Questionnaires were returned from 463 clinical department heads, several CDH are responsible for more than one clinic and their answerers regard all clinics in charge. Three questionnaires were excluded since the CDH reported that they had no treatment responsibility for children in their clinics. One of the CDH did not specify their county and therefore is omitted in some analyses. Our exclusion criteria differ from those used in the report from Ombudsman for Children which results in a different total amount of responses. The final sample after exclusion in this article consisted of 460 clinical department heads with

a total of 590 clinics and an answering frequency of 95%.

Questionnaire

The questionnaire was compiled for this survey and had not been validated before use. It was based on questionnaires previously used (6, 21, 35) and expanded to include also questions on missed and cancelled appointments. It comprised 11 questions; two questions concerned the number of dentist employed and the number of children up to 19 years of age in their responsibility. Questions regarding clinical routines aimed to survey the existence of guidelines for managing suspected child physical or sexual abuse, general and/or dental neglect and also routines for repeated missed appointments. Further, questions concerned contacts to and the number of reports made to the social services during the last 12 months. In addition, CDH were asked to state their opinion of the need for further education and support on managing suspected child abuse and neglect.

Data analysis

All data were coded and analyzed in SPSS. Comparisons between groups were performed using the chi-square test and variables on a continuous scale were compared using Student's t-test with a level of significance at $p<0.05$.

Ethical considerations

The Ombudsman for Children is as a public authority entitled to perform surveys regarding children's best interests. Questions on child abuse and neglect can be sensitive to deal with. Suspicions and actual cases of child maltreatment and how it is managed may be uncomfortable to discuss for professionals in dental health care. Thoughts as; "Did I do right? Why did I not do something?" may arise. Questionnaires with questions that do not insult one's integrity are allowed without ethical permission. In this analysis all answers at an individual level are anonymous. Responses from the county councils are identified in the result; this may be revealing in both a positive

Table 1. Responses of clinical department heads regarding questions on contacts with and reports to the social services and guidelines on child abuse and neglect. Answers in percent

County Council	Number of clinical department heads	Contacts with social services	Reports to social services	Guidelines for abuse		Guidelines for neglect		Guidelines for dental neglect	
				Yes	Unknown	Yes	Unknown	Yes	Unknown
Municipality of Gotland	2	100	100	100	0	100	0	100	0
Jämtland County Council	12	33	33	58	25	58	25	100	0
Blekinge County Council	4	50	50	74	0	50	0	75	0
Dalarna County Council	24	13	8	66	4	63	4	96	0
Gävleborg County Council	15	27	6	66	13	67	13	87	0
Halland County Council	14	29	57	71	7	79	0	93	0
Jönköping County Council	26	50	35	84	8	65	0	93	4
Kalmar County Council	18	22	11	83	5	56	22	89	4
Östergötland County Council	20	55	45	45	10	45	10	95	5
Uppsala County Council	17	41	24	82	0	76	6	88	6
Värmland County Council	24	54	42	92	8	75	8	100	0
Kronoberg County Council	16	13	0	50	6	13	25	63	0
Sörmland County Council	15	40	20	73	0	67	0	93	0
Västernorrland County Council	10	40	30	60	0	70	0	100	0
Västmanland County Council	16	31	6	63	19	63	13	94	0
Norrbotten County Council	24	50	42	92	4	92	0	96	0
Örebro County Council	10	10	10	80	10	80	10	80	10
Region Skåne	47	28	23	81	2	56	17	91	0
Stockholm County Council	37	22	14	86	3	73	8	81	5
Västerbotten County Council	12	50	33	100	0	83	0	100	0
Region Västra Götaland	96	54	40	84	3	85	4	97	0
Total	(n=459)	40	28	78	5	70	8	92	2

and a negative perspective. Since this issue is constantly discussed, the results should be interpreted in the light of what is best from a child's perspective.

Results

Reports to and contacts with the social services

Responses were received from all county councils in Sweden. As can be seen in Table 1, CDH from all regions in Sweden had been in contact with the social services regarding suspicion of child abuse or neglect during the last 12 months. The inclination to contact or report to the social services varied among the CDH. For example in Kronoberg none of 16 CDH had filed a report to the social services whereas in Halland 8/14 (57%) of the CDH had filed a report from their clinic.

Totally, one hundred twenty-nine CDH (28%) had filed reports on suspicion of abuse or neglect to the social services. Of these 129 CDH, 75 (58%) had reported at one or two occasions, 26% had filed up to five reports, 12% between 6-10 reports and 3% of the CDH had filed more than eleven reports during the last year.

Clinical guidelines on child abuse or neglect

Three different types of guidelines were asked for. The majority of PDS clinics have clinical guidelines on child physical or sexual abuse, general neglect and dental neglect, but in some regions the CDH were not aware that such guidelines existed (Table 1).

Clinical department heads who reported that they had at least one guideline made reports to or contacted the social service significantly more often than clinics with no such guidelines (Table 2).

Management of children with multiple missed appointments

Eighty-seven percent of the CDH, reported that they have had patients who did not attend their scheduled appointments during the last 12 months, occasionally or repeatedly. For children with a single missed appointment, 91% reported that they contacted the child's caregiver and 82% rescheduled for a new appointment.

Regarding children with multiple missed appointments, seven different response options were available. Ninety-one percent of the clinics contacted the caregiver, 41% scheduled a new appointment whereas 10% of the CDH arranged for a new recall within 12-36 months. The latter had significantly more children with multiple missed appointments; 1.7% of the total child population compared to 0.7 % in clinics that reported other routines (p=0.001). Only reschedule for a new appointment was significantly correlated to not having filed a report to the social services during the last year (p=0.013). Contacts with the social services to informally discuss the child's situation were less frequent reported by clinics that had not filed a report during the last year (p<0.000).

Reasons for not attending scheduled appointments

The CDH were asked about their assumed reason regarding why children repeatedly fail to show up at scheduled appointments. Ten different response options were available. The most common assumption was that it was due to child or parental dental fear (74%), followed by parental negligence (68%) (Table 3). Those CDH who never had made a report to the social services more often stated that the reason was parental negligence (p=0.004) and less often thought it was because of actual abuse or neglect (p=0.003).

The caregivers were more often contacted if the assumed reason for missed appointments was negligence (p=0.004) or if there was a suspicion of abuse or neglect (p=0.021).

The decision to report to the social services was sig-

Table 2. Comparison between clinics with and without guidelines regarding the inclination to report to the social services on suspected child abuse and neglect

Guideline	Have guidelines and have filed a report to the social services (%)	No guideline and have filed a report to the social services (%)	p-value*
Physical or sexual abuse	30	21	ns
General neglect	34	14	<0.000
Dental neglect	30	6	0.008
One or more of the above	42	9	<0.000

* Chi-square test

Table 3. Clinical department heads assumed reasons for why children repeatedly fail to attend dental appointments.

Response options	%
Dental fear; parental or the child	74
Parental negligence	68
Lack of family dental tradition	52
Parental negligence of dental health for the child	29
Low priority due to lack of time	25
Parental avoidence of authorities or other public institutions	15
Parental fear of disclose an actual abuse or neglect	7
Parental lack of trust in health care	2
Economic reasons (e.g. expenses for travel)	2

nificantly associated with the assumption that the reason for the missed appointment was due to parental negligence (p=0.004), parental avoidance of authorities or other public institutions (p=0.034) and parental fear of disclosure of an actual abuse (p=0.003).

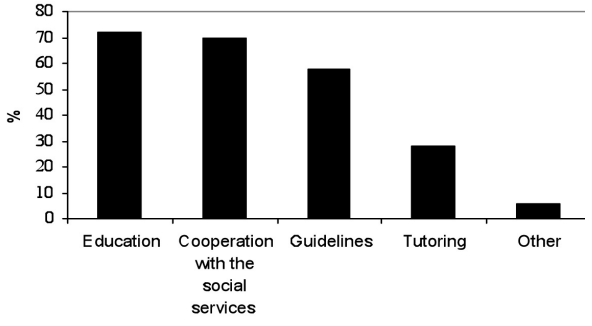
Additional support to dental health care professionals regarding child abuse and neglect

Two hundred ninety-six (64%) of the CDH were positive to more support to their staff. The different types of support asked for can be seen in Figure 1. Of these 296 respondents, 72%, requested educational support. Comments such as; more clear routines, cooperation/ discussions/tutoring with social services and educational days were suggested the respondents.

Discussion

Dentists in public dental service meet 85% of all children in Sweden on a regular basis during childhood and adolescence up to 19 years of age. In Sweden it is mandatory for all professionals in the health care system, working in private of public institutions, to report suspicion of child abuse or neglect to the social services. Both international and Swedish studies have concluded that health care professionals underreport cases of child abuse and neglect to the social services. *van Haeringen et al* (36) found that 43% of all doctors at some point had elected not to report cases of suspected child abuse.

Figure 1. Additional support requested by the clinical department heads



In an international perspective the tendency to report from dentistry to the social services was high in Sweden. In a study from Denmark (35), 38% of dentists and hygienists reported to have had suspicion of child abuse and neglect, but only 34% of them had filed a report to the social services during their whole professional career. In Australia and New Zealand only 10% of general dentists had filed a report during their entire career (21).

In a survey of 27 specialist pediatric dentistry clinics in Sweden (22), 74% had made at least one report to the social services with suspicion of child abuse or neglect. In Australia and New Zealand a higher reporting frequency was also seen among specialists in pediatric dentistry compared to general dentists (21). *Harris et al* (17) discuss if pediatric dentists neglect child dental neglect. Forty-eight percent of pediatric dentists in England reported that they meet children with neglected dentitions more than once a day and 81% stated that they saw this at least once a week. Of these respondents, 98-100% states that their responsibility is to treat pain and explain their concerns to parents. Only 4% referred to the social services, and approximately half of the respondents discussed the case with other health professionals. Dental neglect is a form of physical neglect and a potential indicator of inappropriate parenting or more serious problems. Retrospective self-report studies consistently show that maltreated children may be exposed to more than one type of maltreatment (11). Among children 0-19 years of age entering into foster care, 38% exhibited dental diseases including orthodontic problems, severe dental caries and missing teeth (7) which indicates previous dental neglect. Changes of foster homes are frequent and may lead to a disruption of regular health and medical care. It is important give these children health and dental care, no matter where they live, or it may be considered as social neglect (18). The correlation between abuse and dental disease have been discussed, *Schnitzer et al* (29) identified ICD codes that are suggestive or probable of maltreatment and they included documented failure to follow medical treatment and untreated caries. In a study of confirmed cases of child abuse or neglect, it was reported that abused children are five times

more likely to have untreated caries in primary teeth (13) and eight times more likely to have untreated caries in permanent teeth (14).

The results showed regional differences regarding the willingness to report between the county councils. Our analysis shows that CDH with knowledge of guidelines for neglect and dental neglect were significantly more likely to have filed reports to the social services than those with no guidelines. Regarding physical and sexual abuse there was no significant difference. A guideline is used to assist the clinician in a specific situation. The development of guidelines is based on scientific evidence and on cost conscious calculations and is therefore useful tools when facing clinical situations to give patients best care possible (10).

Reasons for not reporting to the social services are described among medical doctors and dentists as lack knowledge of the local child protection system, uncertainty of diagnosis, low confidence in dealing with these issues also concern and fear about the outcomes of reporting suspicions (1, 2, 12, 37). *Lykke et al* (24) found that personal previous experience of maltreatment cases and a sense of "this is not normal" made general medical physicians more inclined to report to the social services.

Clinical department heads were positive to invest in additional educational activities to further develop awareness of guidelines and cooperation with the social services. Education on child abuse and neglect is not mandatory in undergraduate dental education or in post-graduate education in pediatric dentistry. In medicine, only one in four residents in pediatrics had received training on child abuse and neglect (26). Dental professionals that have received training in recognizing domestic violence are more likely to report suspected cases (23, 25). To sustain this knowledge over time, intermittent and continuous education is required (9, 28, 30). Education on this subject needs to be mandatory for all health care professionals.

Children and adolescents often miss or cancel their scheduled appointments, 87% of the CDH report that they during the last 12 months had encountered children who failed to attend occasionally or repeatedly. Several clinics reschedule or change the recall interval to a new appointment in another 12 months or later. These clinics were also significantly more likely to have a higher frequency of missed appointments and to never have filed a report to the social services regarding suspicion of child abuse and neglect. This indicates that just arranging for a new appointment will result in another missed appointment.

The most common assumptions among CDH, why children repeatedly fail to show up at their scheduled appointments are child or parental dental fear and parental negligence. *Hallberg et al* (16) found that the major reason for failing to bring your child to the dental clinic was a feeling of overload in daily life. Due to these circumstances they gave regular dental recall examinations a low priority. This may explain why only re-scheduling a new recall appointment results in persistent failure to attend.

The social services was significantly more often contacted or received a report if the CDH thought that repeatedly missed appointments was due to parental negligence, parents refuse contacts with authorities, the parents are not concerned with the child's oral health or because of fear of disclose of an actual abuse or neglect. The inclination to report to the social services depends on the individual interpretation of the cause for multiple missed appointments. To be recognized as a child in a possible vulnerable situation has earlier been described as a lottery (36) and this view is supported by our results. The discrepancy between CDH assumptions on reasons for missing appointments and what parents report as major reasons for not taking their children to the dental clinic is not in favor for the children. Not attending regular dental appointments may lead to severe dental diseases and dental disabilities. If parents repeatedly fail to bring their children to dental check-ups it can be considered as a form of neglect and the social services should be alerted. Regarding child protection in Sweden, social workers often use the family as the only source of information in investigations of suspected child abuse and neglect (8). Repeatedly failure to follow treatment is registered in the dental journals and to use these register as a source for identification of children with risk of maltreatment could be valuable. Also, previous dental history can be indicative of unexplainable trauma, dental neglect and also on general neglect due to repeatedly missed appointments. The dental professionals may be helpful in documenting injuries as abusive or as a result of long-term neglect of oral health (27).

One limitation with this study is that it focuses on public dental service and not on private dental clinics. Our results are based on the survey made by Ombudsman for Children and in this report only public dental service was included. It is important to consider that about 15% of all children are mana-

ged in private clinics, but management of suspected child abuse and neglect should not differ since the mandatory reporting is equal for both private and public dental care.

Conclusions

The results show that the CDH of public dental service clinics in Sweden are significantly more likely to file a report or contact the social services regarding suspicions of child abuse or neglect if they have guidelines to follow. Multiple missed appointments are significantly more prevalent if the routine is to only reschedule a new appointment. A report to the social services is more likely to be made if the CDH believe that missed appointments are due to parental negligence or parental avoidance from the clinic due to abuse or just avoiding authorities. These findings give support to the recommendations of national guidelines and educational programs previously made from the Ombudsman for Children. Dental professionals can be a valuable source in recognizing child maltreatment. Future research should focus on the correlation between oral health and maltreatment. Results can improve recognition of child maltreatment including dental neglect, give support in creating cost conscious national guidelines and the development of educational programs for undergraduate and postgraduate students as well as to public dental service and private dental clinics.

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Comparing patients with Apert and Crouzon syndromes – clinical features and cranio-maxillofacial surgical reconstruction

Dimitrios Stavropoulos[1], Peter Tarnow[2], Bengt Mohlin[3], Karl-Erik Kahnberg[4], Catharina Hagberg[5]

Abstract

◉ Cranio-maxillofacial malformations, as seen in Crouzon and Apert syndromes, may impose an immense distress on both function and aesthetics of the person affected. The aims of this study were to describe and compare the main facial and intraoral features of patients with Apert and Crouzon syndromes, the clinical manifestations that may be present, additionally to the main syndromic traits, as well as the cranio-maxillofacial surgical treatment protocols followed. Twenty-three patients with Apert syndrome (6 males, 17 females), and 28 patients with Crouzon syndrome (20 males, 8 females) were evaluated for general medical aspects, craniofacial characteristics, dentoalveolar traits before and after the final orthognathic surgery, and types and timing of cranio-maxillofacial operations. Mental retardation, associated additional malformations, cleft palate, and extensive lateral palatal soft tissue swellings were more common in children with Apert syndrome. In both syndromes, clinical findings included concave profile, negative overjet, posterior crossbites, anterior openbite, and dental midline deviation, which were corrected in almost all cases with the final orthognathic surgery, with the exception of the lateral crossbites, including more than one tooth pair, which were persisting in about half of the cases. Cranial vault decompression and/or reshaping, midfacial and orbital advancement procedures, often in conjunction with a mandibular setback, were the most frequent cranio-maxillofacial operations performed. In conclusion, Apert syndrome is more asymmetric in nature and a more severe clinical entity than Crouzon syndrome. The syndromic dentofacial features of both conditions could be significantly improved after a series of surgical procedures in almost all cases with the exception of the posterior crossbites, with half of them persisting post-surgically.

Key words

Apert syndrome, Crouzon syndrome, clinical features, cranio-maxillofacial surgery

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Jämförande undersökning av patienter med Apert och Crouzon syndrom – kliniska särdrag och kranio-maxillofaciala kirurgiska rekonstruktioner

DIMITRIOS STAVROPOULOS, PETER TARNOW, BENGT MOHLIN, KARL-ERIK KAHNBERG, CATHARINA HAGBERG

Sammanfattning

◎ Kraniella missbildningar av det slag som ses i Apert och Crouzon syndrom, kan medföra en påtagligt avvikande funktion och estetik hos de individer som drabbats. Målsättningen med den här studien var att beskriva och jämföra intra- och extraorala karakteristika hos patienten med Apert och Crouzon syndrom. Vidare att studera kliniska manifestationer som förekommer utöver de huvudsakliga syndrom-dragen samt beskriva de kirurgiska behandlingsprotokoll som följts. Tjugotre patienter med Apert syndrome (6 män, 17 kvinnor), och 28 patienter med Crouzon syndrome (20 män, 8 kvinnor) studerades med avseende på allmänna aspekter, kraniofaciala karakteristika och dentoalveolära särdrag före och efter den slutgiltiga käkkirurgin. Tidpunkt för och typ av kirurgi registrerades. Intellektuellt handikappade patienter, övriga till syndromen relaterade missbildningar, spalter och uttalade lateralt och palatinalt belägna mjukvävnadssvullnader förekom oftare i samband med Apert syndrom. I båda syndromen noterades ofta en konkav profil, mandibulär progeni, posteriora korsbett, anteriort öppna bett och mittlinjeförskjutning. Med undantag för korsbett, omfattande flera tandpar, hade nästan alla övriga avvikelser korrigerats i den slutgiltiga käkkirurgin. Dekompression och/eller omformning av kraniet, framflyttning av mellanansiktet och orbitae ofta i kombination med en tillbakaflyttning av mandibeln, var de oftast genomförda operationerna. Sammanfattningsvis är Apert syndrom mer asymmetriskt till sin natur och ett kliniskt svårare tillstånd än Crouzon syndrome. De i syndromen ingående käk-och bettavvikelserna kunde korrigeras genom en serie av kirurgiska ingrepp. Enda undantaget var posteriora korsbett där hälften var kvar efter kirurgi.

Introduction

Cranio-maxillofacial malformations, as seen in Crouzon and Apert syndromes, may impose an immense distress on both function and aesthetics of the person affected.

Apert syndrome, or acrocephalosyndactyly, is a congenital cranial and limb malformation syndrome characterized by craniosynostosis (premature fusion of cranial sutures), midface hypoplasia, and symmetric syndactyly (cutaneous and bony fusion) of the hands and feet, minimally involving the digits 2, 3, and 4. Associated clinical features of the syndrome may also include central nervous system abnormalities, hearing deficit, ocular pathology, cervical vertebral anomalies, visceral anomalies, and acneiform lesions (6). The French paediatrician, Eugene Charles Apert, is credited to have first described the syndrome in a publication from 1906 (2). The birth prevalence of the Apert syndrome has been estimated to 15.5 cases per million live births (3). The condition is inherited in an autosomal dominant mode of transmission, with no sex predilection (5). More than 98% of cases arise by new mutations of paternal origin (18), in the gene encoding the fibroblast growth factor receptor 2 (FGFR2) (25).

Crouzon syndrome, or craniofacial dysostosis, is an autosomal dominant congenital cranial malformation syndrome, characterized by craniosynostosis and midface hypoplasia (15). Associated clinical findings may include central nervous system abnormalities, hearing deficit, ocular pathology, cervical vertebral anomalies, calcification of the stylohyoid ligament, and solid cartilaginous trachea (6). The French neurologist, Octave Crouzon, is generally credited with the identification of the syndrome in 1912 (7). The birth prevalence of the syndrome has been estimated to 16.5 cases per million live births (4). Crouzon syndrome has no known sex predilection. Thirty to 60% of cases are sporadic, representing fresh mutations (1) of paternal origin (9), in the FGFR2 gene (23).

Although the two syndromes represent distinct clinical entities, it has been repeatedly stated that they exhibit the same craniofacial morphology. In fact, current literature sources that define Crouzon syndrome as Apert syndrome without syndactyly are not rare (8). The reasons for this confusion can be attributed to a number of common features that Apert and Crouzon syndromes share (6), most importantly the premature fusion of the cranial sutures and synchondroses. Secondary growth and/or developmental disturbances due to the aforementioned fusions, result in brachycephally, short cranial fossae, enlarged sella turcica, wide cribriform plate, shallow orbits, ocular proptosis, hypertelorism, short nose with deviated nasal septum, narrow nasal cavity, diminished nasopharyngeal space, maxillary hypoplasia, narrow and arched palate, relative mandibular protrusion, Angle's class III malocclusion, severe dental crowding, and posterior crossbite.

However, marked craniofacial differences do exist between the two syndromes (11-13). In particular, the Apert infant calvaria are characterized by prematurely fused coronal sutures only and by a wide midline calvarial defect extending from the glabella to the posterior fontanelle. In contrast, infants with Crouzon syndrome exhibit much more extensive synostosis of calvarial sutures with no midline defect. Thus, many patients with Crouzon syndrome have early radiographic signs of increased intracranial pressure, such as increased digital markings. Furthermore, the cranial vault assumes an oxycephalic (tower-like) shape in Apert syndrome, which is not encountered in Crouzon syndrome. In addition, asymmetry of the cranial base and platybasia (excessively obtuse cranial base angle) is much more frequent in Apert syndrome. These patients also relatively often show facial asymmetry. Moreover, cleft palate and bifid uvula are frequent findings in Apert syndrome, whereas rare in Crouzon syndrome. Lateral palatal soft tissue swellings, containing muccopolysacharides, are also much more frequent and more exaggerated in patients with Apert syndrome. In general, the abnormal craniofacial morphology is much more severe in Apert syndrome than in Crouzon syndrome. The craniofacial phenotypic differences are distinct at all ages, nevertheless, although they are more pronounced during infancy, they become less exaggerated with age (6).

Patients with Apert or Crouzon syndrome require a multidisciplinary treatment approach, involving many plastic surgery corrections to improve function and aesthetics. The goal is to adjust the reconstruction programme to coincide with facial growth patterns, visceral function, and psychological development (22).

Apert and Crouzon syndromes are rare, therefore, contemporary studies are scarce. Contrasting the clinical features of the two syndromes is of substantial interest, since their craniofacial traits, although similar, still exhibit distinct differences, which should be taken into account for diagnosis, treatment planning, and for treatment prognosis purposes. Pathologic manifestations, additionally to

the main syndromic clinical characteristics, should also be thoroughly considered for the full rehabilitation. Although many treatment protocols have been reported to date, the timing and type of each surgical reconstruction have not been adequately evaluated and remain as much an art as a science.

Therefore, the aims of this study were to describe and to compare:

-the main facial and intraoral features of patients with Apert and Crouzon syndromes,

-the clinical manifestations that may be present additionally to the main syndromic traits, and

-the cranio-maxillofacial surgical treatment protocols followed.

Material and methods

Data collection

Dental stone models, photographs and treatment charts were evaluated from a population of patients with Apert syndrome or Crouzon syndrome, born between 1970–1998. All of them were treated at the Craniofacial Centre at the Sahlgrenska University Hospital and registered and therapy planned at the section of Jaw Orthopaedics of the Gothenburg University Clinic in Sweden. The inclusion criteria were:

• A medically confirmed syndrome diagnosis.
• Caucasian ethnicity.
• Referral during the first year of life to the craniofacial centre in Gothenburg.

The study groups, then, comprised of 23 persons with Apert syndrome (6 males, 17 females) and of 28 persons with Crouzon syndrome (20 males, 8 females).

The assessment covered facial profile, lip relationships and posture, evaluated from photos. Furthermore, ocular pathology, associated additional malformations/deficits, and mental retardation were assessed from patients' charts. Palatal morphology (cleft palate, bifid uvula, and lateral palatal swellings) was evaluated from patients' charts and dental stone models.

The dental malocclusion was assessed on dental stone models before the final orthognathic surgery and immediately after it. Shortly before the final orthognathic surgery, stone model analysis was performed in 20 patients with Apert syndrome (median age: 15 years; range: 11–17 years) and 22 patients with Crouzon syndrome (median age: 15 years; range: 13–19 years). A damaged stone model did not make it possible to evaluate the dental midlines in one Apert syndrome case. Shortly after the final orthognathic surgery, cast analyses were performed in 11 patients with Apert syndrome and 19 patients with Crouzon syndrome. The traits evaluated (pre-surgically and post-surgically) were overjet, overbite, midline deviation, posterior crossbite, and apical base. The first three malocclusion variables were registered in millimetres (mm) to the closest integral digit. Intervals were set for each registration in order to avoid measurement errors. For the overjet, the negative intervals were: >10, 10 to >6, 6 to 1; the positive intervals were: 0 to 6, >6. For the overbite, the negative intervals were: >8, 8 to >4, 4 to1; the positive intervals were: 0 to 4, >4. For the midline deviation, the intervals were: 0 to 3, >3 to 6, >6.

The cranio-maxillofacial surgery was assessed in terms of types of surgical procedures and age when they were performed. Four age ranges were set: up to the first year of life (Apert: N=23, Crouzon: N=28), 1–12 years old (Apert: N=23, Crouzon: N=28), 12–16 years old (Apert: N=20, Crouzon: N=24), >16 years old (Apert: N=20, Crouzon: N=22). The reduced number of patients with age was mainly because some children were too young to be offered the next stage of surgical reconstruction. One patient with Apert syndrome continued treatment in Finland for the final orthognathic surgical operation (>16 years old).

All assessments were performed twice by two of the authors (DS, CH). When in doubt, a case was discussed before a consensus was reached. Due to the relatively small sample sizes, data for males and females were pooled.

The study was approved by the Regional Research Ethics Committee of Gothenburg (registration number 149-08).

Statistical analysis

Descriptive statistics in terms of median values with ranges and frequency as counts and percentages were used. Variables compared between patients with Apert syndrome and patients with Crouzon syndrome were tested as proportions and their differences, using the confidence interval analysis (CIA) (19). The confidence interval (CI) confirms a significant difference between proportions when the total interval is either positive or negative without spanning zero. The level chosen for the CI was 95%. The Wilson test was applied. The CIA for Windows software (version 2.2.0, University of Southampton, UK) was used for statistical testing.

Results

General medical aspects

Statistical comparison of prevalence rates between the studied groups in terms of gender, mental retardation, associated additional malformations/deficits and defined eye pathology that required regular ophthalmologic medical care, is presented in Table 1. The type and frequencies of the additional malformations observed are presented in Table 2.

Craniofacial aspects

Most of the patients with Apert syndrome had a concave profile (74%), while the remaining ones showed a straight profile (26%). In the Crouzon syndrome group, 71% exhibited a concave profile, 19% a straight, and 10% a slightly convex. In the Apert syndrome sample, the upper lip was short and/or thin in 43% and the mouth trapezoidal in shape in 48%. In the Crouzon syndrome study group, 71% were assessed as having the lower lip relatively protruded.

Out of the 23 patients with Apert syndrome, 6 (26%) exhibited an isolated cleft palate, with 2 of these being total and 4 being partial. In 5 cases a bifid uvula was identified (22%). A submucous palatal cleft was found in one individual. No cleft lip and/or palate was observed among the Crouzon syndrome group; nevertheless, a bifid uvula was found in one subject. The statistical comparison for the main palatal traits between the two groups is presented in Table 3.

Dentoalveolar traits before the final combined orthodontic and orthognathic surgery treatment

A negative overjet was observed in 96% of the cases with Apert syndrome and in all of the cases with Crouzon syndrome. Of the latter, a negative overjet greater than 10 mm was found in 45%.

Table 1. Prevalence of observed general characteristics compared as differences in proportions between the two study groups with Apert (N=23) and Crouzon (N=28) syndrome

Characteristics	n/N	Apert prevalence	n/N	Crouzon prevalence	CI	Statistical difference
Gender (females)	17/23	74%	8/28	29%	0.18 to 0.64	S
Mental retardation/disability	10/23	44%	1/28	4%	0.17 to 0.60	S
Associated additional malformations/deficits	13/23	57%	7/28	25%	0.05 to 0.53	S
Ophthalmologic pathology	15/23	65%	13/28	46%	-0.08 to 0.42	NS

N = sample size; n = number of characteristics; CI = 95% confidence interval; S = significant statistical difference; NS = non-significant statistical difference

Table 2. Associated additional malformations/deficits registered for 13 persons with Apert syndrome (out of the 23 examined) and 7 persons with Crouzon syndrome (out of the 28 examined)

Apert Syndrome Case. Malformation/deficit	Crouzon Syndrome Case. Malformation/deficit
1. Orthopaedic (back and body posture)	1. Hearing loss
2. Mental, urinary passage	2. Mental, hearing loss, hernia
3. Mental, hearing loss	3. Hearing loss
4. Mental, choanal atresia	4. Hearing loss
5. Mental	5. Hearing loss, TMD, spinal cord scoliosis
6. Hearing loss	6. Epilepsy, deformed vertebrae
7. Mental	7. Hearing loss
8. Hearing loss, aortal stenosis	
9. Mental, TMD	
10. Mental, malformed external ears	
11. Mental	
12. Mental, hearing loss, heart problems	
13. Mental	

Case = person with Apert or Crouzon syndrome; TMD = Temporomandibular Dysfunction

Table 3. Prevalence for the main palatal traits compared as differences in proportions between the two study groups with Apert and Crouzon syndrome

Characteristics	n/N	Apert prevalence	n/N	Crouzon prevalence	CI	Statistical difference
Isolated cleft palate	6/23	26%	0/28	0%	0.08 to 0.47	S
Lateral palatal swellings	18/23	78%	14/28	50%	0.02 to 0.49	S

n = number of palatal traits; N = sample size; CI = 95% confidence interval. S = significant statistical difference

Table 4. Prevalence for the main dentoalveolar traits before the final orthognathic surgery, compared as differences in proportions between the two study groups with Apert and Crouzon syndrome

Characteristics	n/N	Apert prevalence	n/N	Crouzon prevalence	CI	Statistical difference
Bilateral mesial occlusion	11/20	55%	20/22	96%	-0.62 to -0.15	S
Negative OJ > 6 mm	8/20	40%	15/22	68%	-0.52 to 0.02	NS
OB > 4mm	5/20	25%	4/22	18%	-0.18 to 0.31	NS
Lateral crossbite	17/20	85%	20/22	91%	-0.28 to 0.15	NS
Midline deviation > 3mm	9/19	53%	5/22	23%	0.01 to 0.54	S
Small upper apical base	17/20	85%	17/22	77%	-0.17 to 0.31	NS

n = number of dentoalveolar traits; N = sample size; CI = 95% confidence interval; OJ = overjet; OB = anterior openbite; S = significant statistical difference; NS = non-significant statistical difference

An anterior openbite was identified in 60% of the Apert syndrome sample. In 25%, this malocclusion was found to be greater than 4 mm. An openbite was registered in 18% of patients with Crouzon syndrome. A lateral crossbite was registered in 85% (all were bilateral) in the Apert syndrome study group and in 91% in the Crouzon syndrome study group. Of the 20 Crouzon syndrome crossbites identified, 14 were bilateral. Table 4 presents the statistical comparison for the main dentoalveolar traits before the final combined orthodontic and orthognathic surgery treatment between the two groups.

Dentoalveolar traits after the final combined orthodontic and orthognathic surgery treatment

All but one of the patients with Apert syndrome (91%) ended up with a normal overjet (positive overjet less than 4 mm). All of them had a normal overbite. A posterior crossbite was observed in 6 cases (55%). A clear deviation of the dental midlines of more than 3 mm was registered for two cases only (18%).

Among the patients with Crouzon syndrome, 17 (89%) ended up with an overjet within normal range, while two individuals had an edge-to-edge anteroposterior incisor relationship. All but one had a normal overbite. In 42%, a lateral crossbite was recorded. A deviation of the dental midlines of more than 3 mm was recorded for two cases only (11%).

Cranio-maxillofacial surgery

A cranio-maxillofacial surgery was performed during the first year of life in 78% of children with Apert syndrome and in 71% of children with Crouzon syndrome. The most common procedure was a cranial vault decompression and/or reshaping (CVR). The patients that exhibited a cleft palate had additional reconstructive surgery for palatal closure. Between 1 to 12 years of age, surgery took place for 74% of children with Apert syndrome and for 82% of children with Crouzon syndrome. Midfacial advancement techniques and CVR were the most frequent types of operations. Between 12 to 16 years of age, 35% of individuals with Apert syndrome and 42% of individuals with Crouzon syndrome had at least an additional surgical procedure, mainly a midfacial advancement. A final orthognathic surgery was performed for half of the patients with Apert syndrome and almost all of the patients with Crouzon syndrome (91%). The most common surgical approach was a Le Fort I maxillary advancement osteotomy, often combined with a mandibular

Table 5. The number of cranio-maxillofacial surgical procedures for children with Apert or Crouzon syndrome up to 12 years old

		Apert	Crouzon
First year:		N=23	N=28
	CVR	16	11
	MOA		1
	CVR + MOA	1	4
	Shunt		2
	LCR + Shunt		2
	LF III	1	
	No surgery	5	8
1 - 12 years:		N=23	N=28
	LCR		1
	CVR	4	4
	MOA	2	1
	Shunt	1	2
	MOA + Shunt		1
	CVR + MOA	2	5
	CVR + MOA + FBipart		1
	LF I	1	
	LF II		
	LF III	7	3
	LF III + MOA		5
	No surgery	6	5

N = number of children evaluated; CVR = cranial vault reshaping; MOA = monoblock orbital advancement; LCR = linear craniectomy; LF = Le Fort osteotomy; FBipart = facial bipartition

Table 6. The number of cranio-maxillofacial surgical procedures for children with Apert or Crouzon syndrome from 12 years of age and later

		Apert	Crouzon
12 - 16 years:		N=20	N=24
	CVR	1	1
	MOA		4
	CVR + MOA	1	
	CVR + FBipart	2	
	LF I		1
	LF I + FBipart	1	
	LF II	1	
	LF III		3
	LF III + MOA		1
	LF I + G	1	
	No surgery	13	14
> 16 years:		N=20	N=22
	LF I	6	8
	LF I + Mand	3	8
	LF I + Mand + G	1	1
	LF I + G		2
	LF II + Mand + G		1
	No surgery	10	2

N = number of children evaluated; CVR = cranial vault reshaping; MOA = monoblock orbital advancement; LF = Le Fort osteotomy; FBipart = facial bipartition; G = genioplasty; Mand = mandibular set-back

set-back osteotomy. Tables 5 and 6 present the main cranio-maxillofacial surgical procedures applied to the two groups of children.

Discussion

The Craniofacial Centre at the Sahlgrenska University Hospital and the section of Jaw Orthopaedics Unit of the Gothenburg University Clinic, have been the national reference centre for treatment of craniofacial anomalies in Sweden. Therefore, the studied groups of patients can be regarded as total samples of patients with Apert and Crouzon syndromes in Sweden. To the knowledge of this study, this is the first report on clinical features and longitudinal surgical treatment strategies of patients with Apert and Crouzon syndromes from a Swedish population.

An unexpected finding of the study was that more females were found to have the Apert syndrome, whereas more males were observed to have the Crouzon syndrome. Although no sex predilection for Apert syndrome has been presented to population-based samples (5, 24), Tolarova (24), in a sub-sample drawn from a craniofacial centre, found a clear female dominance (male to female sex ratio: 0.7). In an attempt to explain this finding, Tolarova stated that published studies that are based on samples in which the index case was ascertained at the medical/surgical facility, the higher prevalence of females may be due to the parents of girls affected with Apert syndrome are more likely to bring their child for treatment. Kreiborg (15), in his monograph on Crouzon syndrome, found in the sample he studied a slight male dominance (54% of males). This trend can generally be regarded in line with the findings of this study. The higher proportion of males identified with Crouzon syndrome can be due to the relatively small sample size. On top of it all, the possibility that Sweden may constitute a geographic "pocket", where more females with Apert syndrome and more males with Crouzon syndrome are encountered, should also be considered.

Almost half of the patients examined with Apert syndrome had a registered mental retardation. This is in agreement with the study of Patton et al. (20), who investigated 29 cases with Apert syndrome and found that 52% had an IQ score of less than 70. One reason for this clinical observation might be the central nervous system abnormalities, such as megalencephaly, malformations of the corpus callosum and the septum pellucidum, which these patients quite often exhibit. On the other hand, the great majority of individuals with Crouzon syndrome seem to

have an intellectual capacity within normal range. Only 4% of our cases with Crouzon syndrome had a recorded mental retardation, which is in line with Kreiborg (15), who found that in 3.3% of the persons with Crouzon syndrome, a marked intellectual disability was noted.

Besides the main clinical characteristics, additional malformations/deficits were common for the two syndromes studied, with a much higher frequency for patients with Apert syndrome. Such findings have commonly been described (6) and indicate how truly pleiotropic the FGFR2 gene is. Therefore, early radiographic examination, such as magnetic resonance imaging and computed tomography scans, should be carried out for these patients in order to help define any abnormalities that may be present in addition to the main syndromic clinical features.

In the assessment of the lip posture, the Apert syndrome sample exhibited a short and/or thin upper lip in almost half of the cases, whereas the Crouzon syndrome sample showed mainly a protruded lower lip. The latter clinical expression is due to the relative mandibular protrusion the patients with Crouzon syndrome present because of the maxillary hypoplasia. On the other hand, the former clinical expression is attributed not only to the maxillary hypoplasia in the sagittal plane, but also to the severe restriction of vertical maxillary growth and/or displacement due to the hypoplastic anterior cranial base, postulated as the primary craniofacial abnormality in patients with Apert syndrome (13). These results in higher posture and strain of the upper lip are also in line with the observation that an anterior openbite was much more frequent in children with Apert syndrome than in children with Crouzon syndrome.

The palatal morphology is unique in these syndromes. Cleft palate, bifid uvula and extensive lateral palatal swellings were found to be much more common in the examined patients with Apert syndrome than in those with Crouzon syndrome, which is in agreement with observations in current literature sources (6). All clefts were limited to the soft palate. Cleft palate in children with Apert syndrome is of special concern, since it has been noted, in different studies, to occur in as many as 41% (12), 11% (21) and 4% (17). This variation in prevalence rates can be attributed to racial and ethnic differences. Therefore, sub-categorizing these patient groups according to their racial and/or ethnic background is of substantial interest for epidemiologic research purposes.

Maxillary dental crowding is a typical clinical characteristic of children with Apert or Crouzon syndrome (15, 12). However, this trait was not assessed in these study groups because of dental extractions and orthodontic interventions that had been carried out at various ages. Negative overjet, anterior openbite and posterior crossbites were common for both groups, due to lack of maxillary growth in all three planes of space (14). Bilateral mesial occlusion on first permanent molars was found to be more frequent in patients with Crouzon syndrome than in patients with Apert syndrome. The reason for this observation in the Apert group is the higher severity of crowding, also in the maxillary lateral segments, which may result in premature loss of maxillary primary molars and/or ectopic eruption of permanent premolars, with subsequent mesial migration of the permanent maxillary molars. This process may have also contributed to the higher registration of dental midline deviation in the patients with Apert syndrome, in this study. Most importantly, though, the frequently encountered asymmetric Apert cranial base (13) can be regarded as the main reason for the craniofacial and dental asymmetric clinical registrations in these patients.

After the final combined orthodontic and orthognathic surgery treatment, the syndromic dentoalveolar features were significantly improved in almost all of the Apert and Crouzon syndrome cases. The only exception was the posterior crossbites, which were found to be persisting in about half of the cases in both syndrome groups. This finding can be explained by the observation that maxillary hypoplasia in the sagittal plane could partly be improved by a mandibular set-back osteotomy in severe cases, adjunctive to a midfacial or maxillary advancement. However, the surgical improvement of a severely constricted maxilla in the transverse plane is not accompanied by an adjunctive mandibular operation. This restriction poses high surgical demands and/or skills in the improvement of the very hypoplastic maxilla in the transverse plane of space.

Apert and Crouzon syndromes constitute complex clinical presentations that have an inherent progressive craniofacial growth deficiency. In this perspective, cranio-maxillofacial surgery does not have any significant beneficial effect on the growth competence of the relevant anatomic structures; midfacial growth remains highly abnormal and cannot keep pace with mandibular growth. Therefore, surgical midface advancement is repeatedly required in many cases. Most of the children in this study had

midface advancement surgery during the first years of their lives to help improve the airway, protect the eyes and help self-image before the children started school. Repeated surgical procedures to address the midface retrusion were deemed necessary in severe cases. LF III and MOA were the most frequent cranio-maxillofacial operations. The application of implantable bone-anchored springs excerting low continuous forces to the site of the osteotomies to counteract the soft tissue forces, following midfacial repositioning, has been a major advancement for the craniofacial team at the Sahlgrenska University Hospital, eliminating the relapse previously seen (16). After growth completion, a final orthognathic surgery, most frequently LF I, often in combination with a mandibular set-back osteotomy (10), was offered to the majority of the children with the syndromes. However, not all of the children accepted the offer, especially the ones who suffered from a mental deficiency.

In conclusion, Apert and Crouzon syndromes are complex conditions affecting adversely craniofacial growth. Apert syndrome is more asymmetric in nature and a more severe clinical entity than Crouzon syndrome. The syndromic dentoalveolar features of both diseases could be significantly improved after a series of surgical procedures in almost all cases with the exception of the posterior crossbites, which were found to be persisting after the final orthognathic operation in about half of the cases in both syndromes.

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Bed partners' and patients' experiences after treatment of obstructive sleep apnoea with an oral appliance

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Abstract

◎ The purpose of the study was to evaluate bed-partners' and patients' self-reports of general well-being, physical strength and mental energy after treatment for obstructive sleep apnoea (OSA) with a mandibular advancement oral appliance (OA).

Patients (N=134) referred from medical physicians diagnosed with true OSA, i.e. an apnoea-hypopnoea index of >10, were treated with an OA for more than one year. The somnographic evaluations were undertaken in a patient's home before the start of, and six months after, treatment. An individually designed monobloc OA was manufactured by a dental technician for nightly use. After one year of treatment, a follow-up questionnaire was sent to patients whose sleep disorder was reduced > 50% from baseline values and to their bed partners. The questionnaire consisted of 15 questions or statements with multi-answer alternatives concerning well-being, physical strength, mental energy, sleep, day and night symptoms, and the Epworth Sleepiness Scale (ESS: eight questions).

The questionnaire was answered by 82% (110/134) of the patients and 85 bed partners. Both patients and bed partners reported improvement in general well-being, physical strength and mental energy, between 70-80% for patients and 55-68% for bed partners sharing the same bed-room. Similar results were found for concentration ability, joyfulness and strength of effort in social intercourse, as well as decreased daytime sleepiness, improvement in the feeling of getting enough sleep and reduced nocturia.

Conclusions: In all dimensions, the treatment effect had a great influence, not only on patients but on bed partners as well.

Key words

Follow-up, questionnaire, quality of life, self-report, treatment

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Sovkamratens och patientens erfarenheter efter behandling av obstruktiv sömnapné med mandibelframdragande oral apparatur

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Sammanfattning

◉ Syftet med studien var att utvärdera sovkamratens och patientens självbedömning av effekter med oral apparaturbehandling (OA) vid obstruktiv sömnapné (OSA) kring allmänt välbefinnande, fysisk ork och mental energi.

Behandling med OA vid diagnostiserad OSA utfördes på 134 patienter. Efter 1 års behandling sändes en uppföljningsenkät till de patienter vars sömnstörning minst halverats och till deras sovkamrater. Enkäten bestod av 15 frågor eller påståenden och en sömnighetsbedömning (ESS; 8 frågor).

110 av 134 patienter besvarade enkäten (82 %) och 85 sovkamrater. Båda grupperna rapporterade förbättringar avseende allmänt välbefinnande, fysisk ork och mental energi; för patienterna i 70-80% och för sovkamraterna i 55-68% som delade sovrum. Liknande nivåer i resultaten fanns när det gällde koncentrationsförmåga, glädje och sociala kontakter, liksom känslan av att få tillräcklig mängd sömn, minskning av dagtrötthet samt minskat behov av att gå upp och kasta vatten nattetid.

Behandlingseffekten med oral apparatur vid obstruktiv sömnapné hade, i alla de dimensioner som mättes, stor påverkan på patienterna men även på deras sovkamrater.

Introduction

Sleepiness is the most important daytime consequence of disturbed sleep in patients with obstructive sleep apnoea (OSA). Upper airway obstruction during sleep is usually associated with brief arousals which result in marked sleep fragmentation. Arousal-induced sleep fragmentation and nocturnal hypoxemia were found independently to contribute to an increased risk of daytime sleepiness (5). Moreover, snoring and apnoeas are shown to be significantly and independently associated with sleepiness (24).

Symptoms in OSA occur both during wakefulness and sleep and develop gradually. OSA has been shown to affect quality of life which improves after treatment with a mandibular advancement oral appliance (OA) (27).

Sleep fragmentation negatively affects cognitive functions, especially in severe OSA, with subjective symptoms such as reduced concentration ability and memory disturbance (14, 17). Depression and impaired mood are also symptoms in OSA patients, and sleep disturbances may cause both depression and OSA (10).

Patients with OSA complain of frequent awakenings to urinate (12). Several studies report higher urinary flow and higher sodium and chloride excretion in patients with sleep apnoea compared with normal subjects (11).

Patients with OSA not only experience dramatic fluctuations in blood pressure during apnoeas and hypopnoeas, but their risk of daytime hypertension also increases. About 30-50% of patients with OSA have hypertension due to their impaired nightly breathing (18, 20). During the last decade, there has been a steady increase in evidence linking OSA to long-term cardiovascular morbidity including hypertension, myocardial infarction, and stroke (2, 26).

Even if snoring seems harmless to the snorer, it is often very annoying for others who may be kept awake by loud and heavy snoring (4). It is undoubtedly the most frequent complaint from bed partners who witness these sleep disturbances, and this frequently precipitates a referral to a sleep laboratory (5). OSA is a highly prevalent sleep disorder. It affects 4% of males and 2% of females, even though they may not be aware of their condition (23).

Different methods have been used in treating OSA. The most frequent modalities are: continuous positive airway pressure (CPAP), an OA, and surgical treatment in the uvulopalatopharyngeal area (13, 19). However, there are few studies about treatment effects with an OA and its influence on bed-partner's physical and/or mental energy.

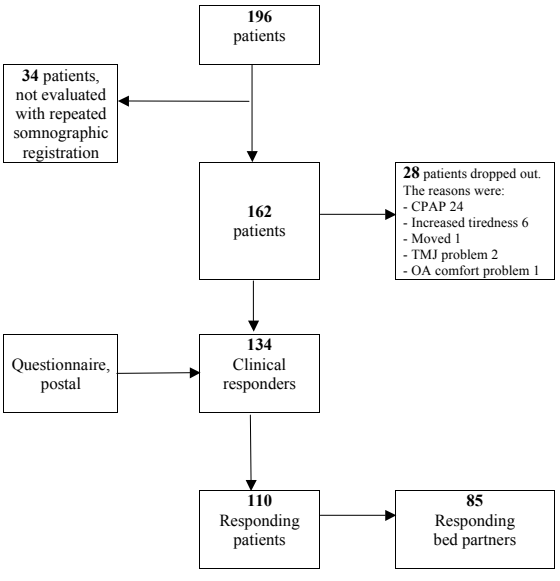
The aim of this study was to evaluate bed partners' and patients' reports of general well-being, physical strength and mental energy after treatment of OSA with an OA.

Material and methods

The study included a consecutive series of 196 patients referred from medical physicians with long experience in sleep apnoea. Patients were diagnosed with verified OSA after sleep recording, i.e. an apnoea-hypopnoea index (AHI) of >10 according to the international OSA criteria (1). They were treated with an OA at the Department of Stomatognathic Physiology, Central Hospital, Västerås, Sweden during one year. The patients followed a standard clinical procedure with regular check-ups of the treatment and any necessary adjustments to the OA being performed. After six months of treatment, the patients underwent a second sleep recording evaluation.

The flow chart of the study and the drop-outs at different stages are shown in Figure 1. After one year of treatment, a postal questionnaire was sent to patients with a successful treatment evaluated at the second sleep recording and to their bed partners. A

Figure 1. Flow-chart of the study



treatment response was defined as a reduction of the initial AHI by at least 50%.
The study finally consisted of a total of 134 patients and 85 bed partners.

Sleep recordings
The somnographic evaluations were undertaken in the patient's home with a portable digital recording unit (Embletta®), and with sensors for the registration of airflow, saturation, heartbeat frequency, respiratory movements of the chest, position of body, and snoring. The recordings were interpreted by an independent sleep technician.

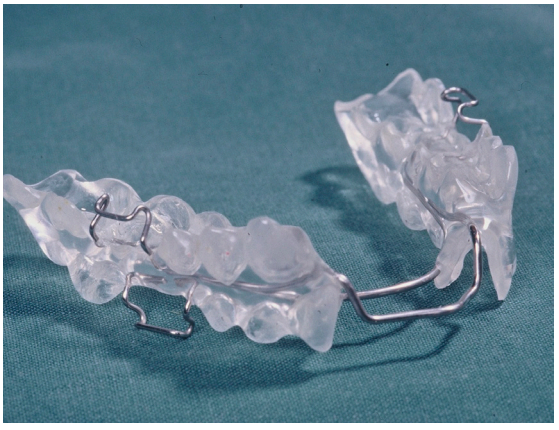
Treatment
All patients were treated by one dentist clinically experienced in this kind of treatment modality. The OA was an individually designed monobloc oral appliance that kept the maxilla and mandible together. The OA advanced the mandible by 50% to 75% of the patient's maximum protrusive capacity, and the mandibular advancement degree was related to the degree of OSA disease. The appliances required dental impressions, a bite registration, and fabrication in heat-cured acrylic polymer by a dental technician. The design of the appliance is shown in Figure 2 and described in detail in *Tegelberg et al.* 1999 (21). One dental technician was responsible for the manufacturing of all appliances.

Questionnaires
The follow-up questionnaire was mailed from, and analysed by, a dentist independent of the treatment procedure. All treatment-responding patients received two postal questionnaires, one for themselves and one for their presumptive bed-partner. They were asked to answer the questionnaires and return them within three weeks using a by postage-paid envelope. For non-responders, a reminder was mailed within two months after the initial letter.

The questionnaires, both for patients and their bed partners, consisted of 15 identical statements about general well-being, physical strength and mental energy. Answering alternatives ranged on a seven-point scale from very much better to very much worse, or how frequently problems occurred; very often to very seldom. The questionnaire also included an evaluation of daytime sleepiness measured with the validated Epworth Sleepiness Scale (ESS). Each question on the ESS was rated on a four-point scale (never dozing to a high chance of dozing) about the chances of responders dozing-off in eight specific situations. The ESS score ranges from 0-24, with lower scores indicating mild and higher scores excessive, daytime sleepiness (8, 9).

Statistical analysis
For comparison of the two groups, patients and bed partners, we used Student's t-test for age, the chi-square test and Fisher's exact test for categorical data, and the Mann-Whitney U-test for proportions. AHI was measured before and after treatment and the correlation was calculated with Pearson's correlation coefficient. Correlations between AHI changes before and after treatment versus well-being, physical strength and mental energy were calculated with Spearman's rho. A p-value of < 0.05 was considered statistically significant. The statistical analyses were performed using the Statistical Package for Social Sciences (SPSS, version 14.0).

Figure 2. The oral appliances used in this study were manufactured in a one piece heat-cured acrylic polymer



Results
The questionnaires were answered by 110 of 134 patients (82%) and 85 bed partners. Their mean age was 57.6 years (SD 10.1, range 21-78) for the patients and 55.8 years (SD 9.6, range 33–76) for the bed partners. The gender distribution in the patient group was 74% males and 26% females, and in the bed-partner group 18% and 82%, respectively.

The mean AHI before treatment was 19.4 (SD 13.9, range 5-68), and after six months of treatment 4.2 (SD 4.3, range 0–21), ($p<0.05$). Sleep normalisation rate, i.e. AHI of <10 was reached in 83% of all answering patients and in 89% of those patients who shared the same bedroom with their bed partner before and after treatment.

Table 1. Sleeping habits in patients and their bed partners, after treatment for obstructive sleep apnoea. Number (%)

	Patients N=110	Bed partners N=85
Sleeping in the same bedroom	66(60)	62(73)
Sleeping in separate bedrooms	22(20)	18(21)
Single or living apart relationship	22(20)	5(6)

Sleeping habits are presented in Table 1. About one-fifth of bed partners and patients slept in separate bedrooms after treatment. In the patient group 10 were single living and 94 of 100 remaining patients (94%) had the same partner as before treatment. The further analysis consisted of the 66 patients and the 62 bed partners who shared bedroom. A self-report of general well-being, as well as physical strength and mental energy in both groups after treatment is presented in Table 2.

Concentration ability, well-being/joyfulness, and strength of effort regarding social intercourse after treatment in patients with OSA and among their bed partners are shown in Table 3.

Table 2. Self-report of general well-being, physical strength and mental energy in patients and their bed partners sharing the same bedroom, after treatment for obstructive sleep apnoea. Number (%)

	General well-being		Physical strength		Mental energy	
	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=62
Very much/much better	25(38)	27(44)	15(23)	21(34)	16(24)	20(32)
Somewhat better	28(42)	15(24)	31(47)	14(23)	31(47)	14(23)
No difference	12(18)	20(32)	16(24)	27(44)	16(24)	27(44)
Somewhat worse	0	0	3(5)	0	2(3)	1(2)
Much/very much worse	1(2)	0	1(2)	0	1(2)	0

Mann-Whitney U-test: ns

Table 3. Self-report of concentration ability, well-being/joyfulness and social intercourse in patients and their bed partners sharing the same bedroom, after treatment for obstructive sleep apnoea. Number (%)

	Concentration ability		Well-being/ joyfulness		Social intercourse	
	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=60
Very much/ much better	12(18)	16(26)	28(42)	21(34)	14(21)	15(25)
Somewhat better	32(49)	16(26)	24(36)	17(27)	25(38)	13(22)
No difference	20(30)	30(48)	12(18)	23(37)	26(39)	32(53)
Somewhat worse	2(3)	0	2(3)	1(2)	1(2)	0
Much/very much worse	0	0	0	0	0	0

Mann-Whitney U-test: ns

Table 4. Self-report of daytime sleepiness, sleep quality and feeling of getting enough sleep in patients and their bed partners sharing the same bedroom, after treatment for obstructive sleep apnoea. Number (%)

	Daytime sleepiness		Sleep quality		Enough sleep	
	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=62
Very much/ much better	20(30)	12(19)	34(52)	40(65)	36(55)	29(47)
Somewhat better	20(30)	16(26)	25(38)	7(11)	21(32)	12(19)
No difference	15(23)	29(47)	7(11)	15(24)	7(11)	19(31)
Somewhat worse	11(17)	5(8)	0	0	2(3)	2(3)
Much/very much worse	0	0	0	0	0	0

Mann-Whitney U-test: ns

Table 5. Self-report of day-time symptoms in patients and their bed partners sharing the same bedroom, after treatment for obstructive sleep apnoea. Number (%)

	Feeling relieved		Awake difficulties when reading		Irritated/anxious	
	Patients N=66	Bed partners N=61	Patients N=66	Bed partners N=62	Patients N=65	Bed partners N=62
Very much/ much frequent	20(30)	21(34)	2(3)	0	0	0
Sometimes more often	27(41)	12(20)	7(11)	6(10)	3(5)	1(2)
No difference	8(12)	24(39)	23(35)	30(48)	32(49)	37(60)
Some less often	8(12)	4(7)	11(17)	6(10)	19(29)	12(19)
Often/very often infrequent	3(5)	0	23(35)	20(32)	11(17)	12(19)

Mann-Whitney U-test: ns

Table 6. Self-report of night-time symptoms in patients and their bed partners sharing the same bedroom, after treatment for obstructive sleep apnoea. Number (%)

	Disturbed sleep		Nightly sweating		Nocturia	
	Patients N=66	Bed partners N=61	Patients N=66	Bed partners N=62	Patients N=66	Bed partners N=61
Very much/ much frequent	0	0	1(2)	1(2)	2(3)	0
Sometimes more often	13(20)	5(8)	9(14)	2(3)	9(14)	9(15)
No difference	8(12)	20(33)	9(14)	25(40)	16(24)	28(46)
Some less often	24(36)	12(20)	19(29)	12(19)	18(27)	10(16)
Often/very often infrequent	21(32)	24(39)	28(42)	22(36)	21(32)	14(23)

Mann-Whitney U-test: ns

The daytime sleepiness and the feeling of getting enough sleep, as well as sleep quality after treatment between bed partners and patients are shown in Table 4. Tables 5 and 6 present self-report of day- and night-time symptoms after OSA treatment with an OA in patients, and among bed partners.

After treatment, the ESS mean value for the 66 patients was 6.9 (SD 4.1, range 1-18) and for the 62 bed partners 6.6 (SD 3.7, range 0-16). Fifty-five percent of the patients and 58% of the bed partners had values of ≤ 7, and 86% and 86%, respectively, had values of < 11.

Correlations between AHI changes versus well-being, physical strength and mental energy

There were no significant correlations between changes in AHI before and after treatment on one side and general well-being, physical activity and mental energy on the other side.

Discussion

This study examined the effects on different dimensions of daily life in patients with OSA and their bed partners after treatment with an oral appliance. The treatment had a positive influence on both patients and their bed partners, measured as improved general well-being, as well as physical strength and mental energy.

The main complaint of OSA patients is excessive daytime sleepiness. One symptom-based daytime sleepiness questionnaire is the Epworth Sleepiness Scale (ESS) (8, 9). Even if the index is actually under debate, it is frequently used worldwide. The ESS measures the general level of daytime sleepiness; it has been validated (8) and has high reliability and internal consistency (9). ESS score is positively correlated to AHI and falls significantly with effective OSA treatment. A score of 11 or higher is considered to represent an abnormal degree of daytime sleepiness. The majority of patients and bed partners

had values lower than 11, indicating no pronounced daytime sleepiness symptoms.

The overall response rate was good in this study, especially from patients. The lower rate from bed partners depends partly on the fact that some patients were singles, and partly that some couples slept in separate bedrooms, thus ensuring that their partners were not capable of responding adequately to the questions or statements. The patient group consisted mainly of males (74%), which is in line with the general prevalence of OSA and results from other clinical studies. Due to very few males among bed partners, it was impossible to make separate analyses for men and women. We did not ask patients about their sleeping habits regarding bed partners before treatment, and therefore we were not able to evaluate changes before and after treatment. In order to validate the answers from the patients and their bed partners we present the results from those who shared the same bedroom. However, the result figures from all patients and bed partners did not differ compared to those who shared bedroom.

In the early 1990s, OA treatment gained increased attention as a new treatment method in patients with OSA. Today, there are an increasing number of research reports in this area (7, 13), but the situation of bed-partners remains under-investigated (3).

The function of the OA is to enlarge the retroglossal space by anterior displacement of the tongue, to tense the tongue, the palatoglossal and palatopharyngeal muscles, and thus to reduce pharyngeal collapse during sleep (6). The commonly used mandibular advancement degree in clinical studies varies between 50 and 75% of the patient's maximum protrusive capacity. A more pronounced mandibular advancement is preferable for treatment effect in severe cases (22, 29). In this study we individualised the mandibular protrusion according to the degree of OSA severity.

After one year of OA treatment the normalisation rate was higher in this study than generally reported in a Cochrane report (13), but similar to earlier randomised studies (16, 22, 25). After treatment, the normalisation rate has been found to be higher in patients with mild to moderate OSA than in those with severe OSA (15, 29). When drawing a conclusion from treatment results, patients should be divided due to disease severity.

It is valuable to measure not only objective variables, but also a patient's self-estimated assessment of changes in different symptoms after an intervention to obtain knowledge of the health-related treatment effects. Many patients have, or have had, the sleep disturbed by frequent arousals and their well-being is often adversely affected by symptoms related to the central nervous system. Sleep disturbances in patients with symptoms such as, for example, snoring may interrupt the sleep of their bed partners. It is interesting, therefore, also to ask the bed partners about their well-being, physical strength (vitality), mental energy and quality of sleep. All these dimensions were improved in both groups after one year of treatment. Patients experienced more frequently improvement than bed partners regarding daytime sleepiness, receiving enough sleep and reduced nocturia.

The main part of the questionnaire used in this study, and several other studies before, has seven answer alternatives on a verbal scale. In another part of the questionnaire, the responders had to respond to a statement with four different answer alternatives. Finally, there were some open-format questions/areas where the responders had the opportunity to express their opinions and/or make additional comments which will be analysed in another paper.

The generally accepted practice is to use a general health- or disease-specific questionnaire in measuring general health and quality of life/well-being. In this study, we used a modification towards specific questions about physical strength, mental energy and nightly as well as daily disturbances. However, the participants responded to a question about general well-being.

A problem when comparing self-estimated quality of life (QoL) from different studies is that there are many other factors that cause sleepiness beside sleep fragmentation. There could be non-medical factors such as shift work and insufficient total sleep time, common illnesses such as insomnia, depression and chronic pain, as well as less common disorders such as narcolepsy and periodic limb movements. These factors were not evaluated in this study. Another limitation is the retrospective design, which may suffer from some participants experiencing memory difficulties. A prospective design will strengthen future studies in the measurements of changes, both before and after a treatment intervention for all included groups.

A drawback of this kind of study is that patients can stop using the OA at any time during the study period. The number of participants discontinuing treatment in this study was, however, similar to other studies (22).

As treatment of OSA is a lifetime process, long-

term follow-ups are imperative in evaluating treatment effects both in patients and their bed partners, further research efforts have to focus on these particular issues.

In conclusion, the treatment effect in all dimensions had a very positive influence not only on patients but also on their bed partners who did not receive active treatment.

Acknowledgements

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Tobacco cessation interventions by Swedish dental hygienists – a questionnaire study

ANNSOFI JOHANNSEN[1], SEPPO WICKHOLM[2], PIA ANDERSSON[3]

Abstract

◎ The aim of the study was to investigate tobacco cessation interventions by Swedish dental hygienists and their perception of the importance of tobacco cessation to oral health.

A questionnaire was mailed to 400 randomly selected dental hygienists (DH) in Sweden. The questions covered such topics as tobacco cessation interventions, perceived barriers, and their perception of the importance of tobacco cessation in relation to caries, gingivitis, periodontitis and dental implants.

The response rate was 57 %. Tobacco habits were routinely recorded by 94 % of the respondents. 52% of the dental hygienists reported time constraints, 50% reported insufficient competence and 43% answered that they had lack of experience to work with tobacco cessation. All respondents perceived tobacco cessation to be an important determinant of treatment outcomes in patients with dental implants and periodontitis. Bivariate analysis showed an association between training courses in tobacco cessation and tobacco cessation interventions (OR 3.25, CI 95% 1.80–5.85). A logistic multivariate regression model disclosed two other factors significantly correlated with tobacco cessation interventions: competence (OR 2.4, 95% CI 1.16–4.85), and experience (OR 2.1, 95% CI 1.06–4.28). The analyses were adjusted for age, length of undergraduate training course, and dental care organization.

The dental hygienists considered tobacco cessation to be very important in patients with periodontitis and in those with dental implants. Most of the DH in this study undertook some tobacco cessation interventions, though not extensive; the main barriers reported were lack of time, competence and experience.

Key words

Smoking, smokeless tobacco, tobacco cessation, periodontitis, dental implants

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Tobaksavvänjningsarbete hos svenska tandhygienister - enkätstudie

ANNSOFI JOHANNSEN, SEPPO WICKHOLM, PIA ANDERSSON

Sammanfattning

◎ Syftet med denna studie var att undersöka på vilket sätt och i vilken utsträckning svenska tandhygienister arbetar med tobaksavvänjning.
Ett frågeformulär skickades ut till 400 slumpmässigt utvalda tandhygienister av de 2865 som i april 2008 var medlemmar i svenska tandhygienistföreningen. Enkäten innehåll frågor avseende deras arbete med tobaksavvänjning; i vilken utsträckning, deras uppfattning om vikten av tobaksavvänjning i relation till karies, gingivit, parodontit, förekomst av tandimplantat, samt avseende eventuella skäl till att de inte arbetade med tobaksavvänjning.

Vid analysen användes beskrivande statistik och vid jämförelser mellan grupper användes χ^2 test. Vid analys av samband användes bi- multivariat logistisk regressionsanalys.

Svarsfrekvensen var 57 %. Resultaten visade att 94 % av tandhygienisterna registrerade tobaksanamnes rutinmässigt. 95 % av tandhygienisterna registrerade antalet cigaretter per dag medan 69 % av hygienisterna registrerade mängden snus per dag ($p<0,001$). 52 % av tandhygienisterna uppgav tidsbrist som skäl till att de inte arbetade med tobaksavvänjning, 50 % rapporterade bristfällig kompetens och 43 % svarade att de hade brist på erfarenhet.

Samtliga tandhygienister ansåg att det var viktigt att arbeta med rökavvänjning och att det utgör en del av behandlingen hos patienter som har parodontit och hos patienter som har tandimplantat, medan arbete med snusavvänjning sågs som viktigt av 91 % respektive 93 % av tandhygienisterna. Av de 64 % av tandhygienisterna som arbetade aktivt med tobaksavvänjning ägnade 50 % mindre än fem minuter och 49 % ägnade 5-10 minuter åt varje patient som röker. Motsvarande siffror för snusarna var 63 % respektive 36 %.

Den bivariata analysen visade ett samband mellan utbildning i tobaksavvänjning i relation till att arbeta med tobaksavvänjning (OR 3.25, 95 % CI 1.80–5.85). Dessutom visade en logistisk multivariat regressionsmodell att två andra faktorer var signifikant korrelerade till att arbeta med tobaksavvänjning: kompetens (OR 2.4, 95 % CI 1.16–4.85) och erfarenhet (OR 2.1, 95 % CI 1.06–4.28). Analyserna justerades för ålder, längd på utbildningen och tandvårdsorganisation.

Slutsatsen av denna studie var att tandhygienisterna ansåg att det var viktigt att bedriva tobaksavvänjning hos patienter med parodontit och hos patienter med tandimplantat. Flertalet av tandhygienisterna arbetade med tobaksavvänjning bland sina patienter, men inte på en för dom själva tillfredsställande nivå. De huvudsakliga skälen till att de inte arbetade med tobaksavvänjning var brist på tid, otillräcklig kompetens och bristande erfarenhet. Studien visade tydligt att utbildning är av största vikt för att tandhygienister i fortsättningen skall kunna öka sitt arbete med tobaksavvänjning.

Introduction

Cigarette smoking is a major threat to general health; it is implicated in coronary heart disease, stroke, chronic lung disease, and cancer [5-6]. Negative effects of tobacco on oral health have also been reported. Several studies have shown that cigarette smoking is a significant risk factor for periodontal disease [19], as well as peri-implantitis [23], resulting in tissue destruction and loss of teeth and dental implants. Cigarette smoking is also associated with impaired healing after scaling, root planing and periodontal surgery [9]. Therefore, tobacco cessation is an important determinant of successful treatment of periodontitis [20].

For smokeless tobacco (snuff), reported findings with respect to increased risk of cardiovascular disease and oral cancer are contradictory [8,12,13]. Although an association between snuff and periodontits has yet to be established [16], gingival recession tends to be more frequent in snuff-users [1].

In 2004–2005, 14% of Swedish men and 18% of women smoked daily and 21% and 3%, respectively, used snuff [27]. Approximately 70–85% of the smokers and 45% of the snuffers wanted to quit, and many of these reported that they would like support to do so [25]. Dental attendance in Sweden is high; almost 86% of the population visits the dentist or dental hygienist at least every two years [26]. Thus dental personnel could be a valuable resource in promoting tobacco prevention and tobacco cessation [21]. In this context, dental professionals have a potentially important role [3,18]; dental hygienists in particular should encourage and support patients in their efforts to quit smoking [22].

It has previously been reported that 75% of Swedish dental hygienists included patients' smoking habits in their history taking and gave smokers advice on how to stop smoking [28]. A recent study by Havlicek et al [10] reported that dental professionals rarely undertake tobacco cessation interventions. Other studies have shown that dental hygienists were insufficiently prepared [18], and lacked the confidence to provide tobacco cessation strategies [21]. Similar findings are reported from a study from USA, which also claimed that in dental undergraduate courses, theoretical and practical training in this area is inadequate [2].

In this context, it is important to determine the current level of involvement of Swedish dental hygienists in assisting their patients to quit using tobacco. It is also important to explore the dental hygienists own perception of the effects of tobacco use on oral health; to date there are no published studies on this topic.

The aim of the present study was to investigate, by means of a questionnaire, the involvement of dental hygienists in tobacco cessation interventions in the context of oral health care and their perceptions of the importance of tobacco cessation in relation to different oral diseases and in patients with dental implants.

Material and Methods

A questionnaire comprising twenty-five questions was mailed to a random sample of 400 dental hygienists (DH), who were members of the Swedish Dental Hygienist Association (SDHA). In April 2008 the SDHA had a total number of 2865 members; the SDHA approved the use of their register for sampling. The questionnaires were mailed out together with a prepaid envelope and a letter explaining the purpose of the study and giving an assurance that the answers would be kept confidential. Those who did not respond to the mailed questionnaire were reminded three weeks later by another letter including a prepaid envelope. All mailings of the survey were done by a secretary who was not involved in the study. This study was approved by the Ethics Committee Kristianstad (ER2008.11).

Questionnaire

Similar questions have been used in earlier studies [11,14]. However some questions were designed by the authors, e.g. the questions about the perceived importance of tobacco cessation for maintenance of oral health. Before study start, in order to disclose potential misinterpretation or ambiguities in the questions, a pilot study was undertaken in which a number of dental hygienists and dentists completed the questionnaire.

Data were obtained about the respondents' age, gender, year of graduation, length of education, dental care organization, years of practice and how much time they spent treating adults and young people. The questionnaire also included items about participation in undergraduate and continuing education courses on tobacco cessation. The DHs were asked about different patient groups with whom they undertook tobacco cessation interventions. The response alternatives were "yes" and "no".

Other questions included in the questionnaire disclosed the dental hygienists' routines with respect to tobacco habits, e.g. history of tobacco use, information about the deleterious health effects of

tobacco, different strategies for quitting and whether the interventions included nicotine replacement therapy (NRT) and comprehensive tobacco cessation programmes. The response choices were "always", "often" "seldom" and "never".

The questionnaire included items about perceived barriers to undertaking tobacco cessation interventions. The response alternatives were "yes" or "no". Finally, the questionnaire elicited the participants' perceptions of the importance of tobacco cessation in relation to treatment outcomes of different conditions – caries, gingivitis, periodontitis, and dental implants. The response choices were "very important", "important" or "not important".

Statistical analysis

Descriptive statistical methods were used and the results are presented as numbers and percentages. The χ^2 test was used for inter-group comparisons. Odds ratios (OR) with 95% confidence intervals were calculated with bi- and multivariate logistic regression analyses, exploring associations between the independent variable "training courses undergone in tobacco cessation" in relation to "undertaking tobacco cessation interventions" (bivariate analyses). Multivariate analyses included the independent variable" barriers (Table 4) to undertaking tobacco cessation interventions" in relation to the dependent variable "not undertaking tobacco cessation interventions". Adjustments were made for possible confounding variables: length of undergraduate education course, age and dental care organization. Statistical significance was set at $p<0.05$ for each test.

In the statistical analysis, the response alternatives "always", "often", "seldom" and "never" to the question about dental hygienists' routine engagement in tobacco cessation interventions were offered and the response choices were consolidated to the two categories "always/often" and "seldom/never". With respect to the question regarding dental hygienists' perceptions of the importance of tobacco cessation for treatment outcomes, the response choices "very important" and "important" were consolidated into one category. The data analysis was performed using SPSS 18.0 (Statistical Package for the Social Sciences).

Results

The response rate was 57 % (n=229), the characteristics of the DH are shown in Table 1. More than half of the respondents (59 %) had practised as a DH for 10 years or more. Fifty-five percent of the DH spent 80 % or more of their working time with adult patients, and 36 % worked 20 % or more with young patients. Forty-five percent had undergone training courses in tobacco cessation, 37 % of these during their dental hygiene undergraduate course, 37 % had attended continuing education courses after graduation, and 26 % had done both. The courses ranged from one to three days.

Tobacco habits were routinely recorded by 94 % of the DH. There were significantly ($p <0.001$, χ^2 test) more dental hygienists 95%, who recorded the number of cigarettes per day, whereas 69% of the hygienists recorded the amount of snuff used daily. Information about the deleterious effects of tobacco was given by 97 % (Table 2). An extensive programme about tobacco cessation was used by 6 % of the

Table 1. Characteristics of the respondent dental hygienists

	n (%)
Age groups (yr) (n=229)	
20–29	24 (11)
30–39	49 (21)
40–49	52 (23)
50–59	80 (35)
≥60	24 (10)
Dental hygienist basic undergraduate training (yr) (n=228)	
1	87 (38)
2	110 (48)
3	31 (14)
Years of practice (yr) (n=228)	
0–9	94 (41)
10–19	61 (27)
20–29	55 (24)
≥30	18 (8)
Dental care Organization (n= 229)1	
Public dental clinic	128 (56)
Private dental practice	77 (34)
Own practice	19 (8)
Specialist practice	16 (7)
Other	1 (1)
Proportion of clinical time spent with adult patients (n= 220)	
< 20 %	8 (4)
20-9 %	16 (7)
40-59 %	38 (17)
60-79 %	38 (17)
80–100 %	120 (55)
young patients (n= 220)	
< 20 %	142 (64)
20-39 %	72 (33)
40-59 %	5 (2)
60-79 %	0 (0)
80–100 %	1 (1)

1 11 DH worked in more than one organization

Table 2. Routine practice procedures for tobacco cessation interventions in adults and young patients

	Always/Often n (%)	Seldom/Never n (%)	n
Provide information on benefits of quitting smoke/snuff	205 (99)	2 (1)	207
Provide information on deleterious effects of tobacco	203 (97)	7 (3)	210
Discuss quitting date	159 (89)	20 (11)	179
Give brief advice	132 (76)	42 (24)	174
Information on the quit-smoking line	117 (61)	76 (39)	193
Follow up earlier advice	116 (69)	53 (31)	169
Recommend nicotine replacement treatment	109 (61)	69 (39)	178
Support during tobacco cessation	82 (51)	78 (49)	160
Refer to external cessation expert	60 (33)	121 (67)	181
Provide extensive tobacco cessation programme	9 (6)	145 (94)	154

Table 3. DH's perceptions of importance of tobacco cessation in relation to oral conditions

	Smoking			Snuff		
	n	Important n (%)	Not important n (%)	n	Important n (%)	Not important n (%)
Patients with:						
Caries	218	144 (66)	74 (34)	215	134 (62)	81(38)
Gingivitis	224	216 (96)	8 (4)	223	206 (92)	17 (8)
Periodontitis	228	228 (100)		225	204 (91)	21 (9)
Dental implants	227	227 (100)		222	206 (93)	16 (7)

Table 4. Barriers to implementing tobacco cessation interventions (n= 225)

	n (%)
Lack of time	117 (52)
Insufficient competence	113 (50)
Lack of experience	96 (43)
Lack of treatment codes	67 (30)
Resistance from patients	59 (26)
Low priority among DH	55 (24)
Lack of educational material	55 (24)
Low interest from colleagues	51 (23)
Lack of referral	46 (20)

Table 5. Different patient groups offered assistance with tobacco cessation by DH (n= 147)

	n (%)
All smokers	88 (60)
All snuff-takers	72 (49)
Patients with periodontitis	86 (58)
Patients with dental implants	45 (31)
Patients with gingivitis	22 (15)
Patients with dental caries	9 (6)

DH and other related routine practices are also presented in Table 2.

All the DH considered that it was important to encourage smoking cessation in patients who had periodontitis or dental implants (Table 3), while snuff cessation considered important by 91 % and 93 % of the DH.

52% of the DH reported time constraints, 50% reported insufficient competence and 43% answered that they had lack of experience to work with tobacco cessation (Table 4).

To improve tobacco cessation efforts, 53 % of the DH expressed the need for written guidelines and 37 % wanted more opportunities to participate in courses. Thirty-nine percent of the DH wanted tobacco cessation interventions to be given higher priority, not just by DH but by all members of the dental team. Five percent of the DH reported that they were satisfied with their tobacco cessation interventions.

The DH who had undergone courses in tobacco cessation were more active in intervention than those who had not ($p< 0.05$, χ^2 test), regardless of whether

the courses had been undertaken during the dental hygiene undergraduate course or as continuing education courses after graduation. The number of years as a practising DH or the length of the DH undergraduate education course had no significant influence.

Sixty-four percent of the DH reported that they were actively engaged in tobacco cessation interventions. Table 5 shows different patient groups given counselling on tobacco cessation. Written guidelines were used by 4 %. Of the 64% that were actively engaged in tobacco cessation interventions, 50 % spent less than five minutes on this activity with each smoking patient and 49 % spent 5–10 minutes. The corresponding values reported for patients who were snuff-users were 63 % (less than 5 minutes) and 36 % (5-10 minutes) respectively.

A bi-variate analyses showed an association with the independent variable "training courses in tobacco cessation" (OR 3.25, CI 95 % 1.80–5.85); and working with tobacco cessation. This association was unchanged when adjusted for the possible confounders age, length of education and dental care organization.

The reasons for not working with tobacco cessation intervention were analysed in a
logistic multivariate regression model and after correction for the confounding factors (age, length of undergraduate education, dental care organization), two significant factors were identified: level of competence (OR 2.4, 95 % CI 1.16–4.85), and experience (OR 2.1, 95 % CI 1.06–4.28).

Discussion

The present study demonstrated that competence and experience were prerequisites for dental hygienists to engage in tobacco cessation interventions. All the respondents reported that it was important to encourage tobacco cessation in patients with periodontitis and dental implants. The results showed that it was more common to ask the patients about their smoking habits than about their snuff use. However, among those (n = 147) who worked with tobacco cessation interventions, only 60 % offered this treatment to patients who smoked, and 49 % offered it for snuff-users (Table 5).

This might be explained by the fact that nearly all dental hygienists provided information of the benefits of quitting with tobacco, about the deleterious effects of tobacco use, and it is reasonable to believe that they offered this extensive tobacco cessation intervention only for those who needed it.

An interesting finding was that a majority of the DH considered that it was important to engage in tobacco cessation interventions in patients who used snuff, although there is no clear evidence that snuff has any adverse effect on periodontal disease [16]. On the other hand this could partly be explained by the fact that snuff has a negative influence on general health [12].

Approximately 55 % of all DH in the present study spent less than five minutes on tobacco cessation interventions with each patient. Although this was not considered satisfactory by the DH themselves, there is some evidence that this might be effective; *Carr & Ebbert* [3], reported that a brief intervention, including asking patients about their tobacco use, advising tobacco users to quit and introducing written material is effective in assisting patients to quit smoking. Furthermore, *Marlow & Stoller* [15] reported that two to five minutes' counselling increased the absolute rate of abstinence (OR 1.7, 95 % CI 1.45–1.98). The clinical relevance is that short interventions on repeated occasions seem to be sufficient to motivate the patients to quit using tobacco [15]. This confirms the fact that the DH is a valuable resource for working with this task, because most Swedish adults visit dental hygienists on a regular basis.

All the DH participating in the study were aware of the negative effects of tobacco on oral status and considered that quitting smoking is important for the successful outcome of treatment of periodontitis and in patients with dental implants. Despite this, nearly 40 % reported that they did not include any smoking cessation intervention in their treatment; these respondents stated that the major barriers were time constraints, lack of competence and lack of experience. Other studies have reported similar findings [7, 24].

However, the study respondents who engaged in tobacco cessation intervention also reported other barriers, e.g. patient resistance and lack of promotional material. A study by Needlemann et al [18] discussed other barriers such as low priority on the part of the dental care organization and/or the DH. In this context it should also be noted that in the present study, only 5 % of the DH were satisfied with their achievements in tobacco cessation, indicating a need to give greater priority to this topic and support to the DH in the clinical setting.

The need for training courses in tobacco cessation is in accordance with *Helgason et al* [11], who reported that DH who had participated in courses were more active in cessation interventions than

those who had not undergone any training. It has been suggested that there is lack of training in cessation techniques in the undergraduate dental hygienist curriculum [29]. Other studies have highlighted the need for pedagogical skills and clinical training in tobacco cessation interventions [4]. There is thus consensus that the dental hygiene undergraduate curriculum should increase the content on tobacco cessation. The World Health Organisation [30] has also advocated that this topic should be integrated into oral health programmes.

In the present study no definition of "tobacco cessation interventions" was given to the respondents. This could be a limitation because it allows the DH to interpret tobacco cessation intervention in different ways. On the other hand, by not providing a definition the DHs were able to disclose freely their own perspectives on tobacco cessation.

The response rate to the questionnaire in the present investigation of 57 % is comparable to the 61 % reported by *Lund et al* [14]. A possible reason for the relative low response rate could be lack of time or that the DH had no strategy in their work with tobacco cessation and therefore didn´t find it relevant to respond to the questionnaire.

In future research, qualitative interviews with DH who work with tobacco cessation interventions could yield in-depth information and broaden our current knowledge on this topic. As all the DH agreed that it was important to integrate tobacco cessation interventions into their clinical practice, especially in patients with periodontitis and in those with dental implants, it should be possible to eliminate any potential barriers.

Conclusion

The dental hygienists considered tobacco cessation to be very important in patients with periodontitis and in those with dental implants. Most of the DH engaged in some tobacco cessation intervention, but to a limited and unsatisfactory extent according to themselves. The main reasons for not working with more extensive interventions were time constraints, lack of competence and lack of experience.

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Use of different mouthrinses in an adult Swedish population

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Abstract

◎ The purpose of this study was to evaluate the use of mouthrinse products in a Swedish adult population and the factors that influence their use. A questionnaire, comprising semi-closed questions focusing on mouthrinses for oral health, was distributed to randomly selected 700 individuals aged 17-94 years (final response rate of 60%). The data revealed that 47% of the individuals use a mouthrinse product on a regular basis and that it does not differ significantly due to age. Women use such products to a greater extent than men. Individuals who brush their teeth and who use approximal cleaning aids frequently appear to use mouthrinse products to a greater degree. Rinsing is primarily performed once a day or more (45%), in the evening (57%) and after brushing (87%). Those individuals that have been recommended to use the products by dentists and dental hygienists use them to a greater degree (78%) than those who have not received any recommendations (27%). Apart from dental personnel, advertising also plays a significant role in product selection. Of the different products available on the market, pure fluoride products constitute 46%. To summarise, this study indicates that a Swedish adult population, especially women, uses mouthrinse products to a relatively large extent, mainly as a supplement to other oral hygiene procedures such as brushing with a fluoride toothpaste twice daily. To select the most suitable product, the dental personnell should play a more active role in recommendations to the patients who need or want to use mouthrinses.

Key words

Mouthrinse products, oral hygiene, questionnaire, self-care

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Användning av munsköljningsmedel i en svensk vuxenpopulation

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Sammanfattning

◎ Syftet med den här studien var att kartlägga användningen av munsköljningsmedel i en svensk vuxenpopulation samt vilka faktorer som påverkar valet av munsköljningsmedel. Ett frågeformulär skickades till ett slumpmässigt urval av 700 personer i åldern 17-94 år (slutgiltig svarsfrekvens var 60%). 47% svarade att de använder någon form av munsköljningsmedel, det var ingen skillnad mellan olika åldersgrupper. Kvinnor använder munsköljningsmedel i något högre utsträckning jämfört med män. Personer som har mer regelbundna munhygienvanor, både avseende tandborstning och approximal rengöring, använder munsköljningsprodukter i högre grad. De flesta individer sköljer en gång om dagen eller oftare (45%), på kvällen (57%) och efter tandborstning (87%). De som fått rekommendationer av tandläkare eller tandhygienist att använda munsköljningsmedel använder dessa i större utsträckning (78%) jämfört med de som inte fått rekommendationer (27%). Utöver tandvårdspersonal, har även reklam stor inverkan vid val av produkt. Av de produkter som används utgör 46% av rena fluorprodukter. Den här studien visar att en svensk vuxenpopulation, speciellt kvinnor, använder munsköljningsmedel i relativt hög utsträckning, framförallt som ett komplement till övrig oral hygien. För att den enskilda individen ska välja den mest lämpliga produkten bör tandvårdspersonal ta en mer aktiv roll i rekommendationen av munsköljningsmedel.

Introduction

Different oral diseases, caries and periodontitis in particular, may occur throughout life. In addition to human defence mechanisms, many of them can be controlled by regular individual self-care practices. Basic preventive measures, such as toothbrushing alone with fluoridated toothpaste or in combination with other cleaning aids, such as toothpicks, dental floss and interdental brushes, can be used (24). Moreover, different mouthrinses can be used for the prevention of oral diseases in order to improve oral health (8). A wide variety of products for mouthrinsing are available on the Swedish market and are primarily designed to prevent dental caries, periodontal diseases and halitosis. They contain fluoride (28), chlorhexidine (12, 20), triclosan (1, 16), essential oils (7) or zinc (6).

Although the use of fluoridated toothpaste is regarded as the single factor that has contributed most to the worldwide decline in caries (3, 13, 27), the frequent use of fluoridated mouthrinses is also regarded as important (28). Regular fluoride mouthrinses have traditionally been a part of the preventive programmes in Swedish schools and have a significant effect on caries prevalence (14). They are also recommended to risk individuals of all ages.

When it comes to periodontal diseases, there are products that can prevent dental plaque, gingivitis and tartar. Antimicrobial mouthrinses have been found to reduce microbiota on the oral mucosal tissues and in saliva (2,10). The effective removal of dental plaque is essential for periodontal health. The biofilm that is found interdentally and in periodontal pockets is more protected and therefore more difficult to remove. A reduction in dental plaque by chlorhexidine is wellknown (10). Mouthrinses including zinc, alone or in combination with chlorhexidine in low concentrations, have an effect against halitosis (6, 26).

The choice of product may be difficult for the patient, due to the wide range of products available on the market. Little is known about the individual selection of mouthrinse products and their use. It is important that the recommendation is based on evidence. However, these data are often difficult for the individual to retrieve and other sources of information, such as advertisements, are more easily accessible. The hypothesis is that the usage of a mouthrinse varies in the population and that the choice of product is influenced by a large number of factors. The aim of this study was therefore to evaluate the extent to which Swedish adults use mouthrinse products and the various factors that may influence their choice.

Material and Methods

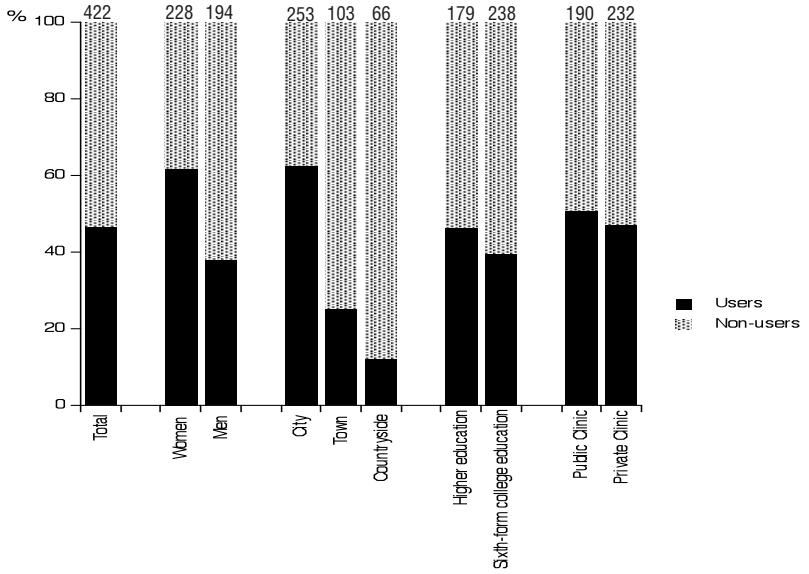
A cross-sectional study design focusing on mouthrinsing was used for this study. A total of 700 subjects (17-94 years), selected randomly from a population register belonging to the local area of Västra Götaland in the south-west of Sweden, were included. The total adult population in this area is 1.5 million inhabitants. The subjects were selected according to the following criteria: age (>16 years) and gender (50% men/50% women). They were subsequently divided into five age groups: ≤ 25 years, 26-45 years, 46-65 years, 66-80 years and ≥ 81 years. The number of participants were selected according to the results from a previous study (25). The study protocol was approved by the Ethics Committee at the University of Gothenburg.

A self-administered anonymous questionnaire comprising a total of 22 semi-closed questions was mailed to the subjects 2009, together with a coded envelope to be used to return the document. If no answer was received within two weeks after the first questionnaire was distributed, a reminder was sent. Of the 22 questions, 12 questions focused on mouthrinsing. One question distinguished users (frequent/non-frequent) of mouthrinse products from non-users and both groups were given appropriate follow-up questions. The remaining questions focused on behavioural factors, attitudes and socio-demographic variables such as gender, age, geographical location, education and information about habits related to visits to the dentist and dental hygienist. The questionnaire was in a pilot study tested against eight subjects representing different age groups.

The code was marked on the envelope and was used to identify the subjects who did not return the first questionnaire. The code list was destroyed as soon as this part of the study was completed. As a result, no name of any individual appeared at any time in the subsequent processing of the data and the confidentiality of the study population was respected throughout the study. A letter explaining the purpose of the study was sent to all subjects, together with both the first and second document.

Of the 700 questionnaires originally sent out, a total of 425 answers were returned after the reminder had been distributed. Three questionnaires had to be exluded as they contained too many incorrect answers (n=2) and one respondent had a full prosthesis (n=1). The final number analysed was there-

Figure 1. The distribution of users and non-users of mouthrinse products in the total population and in relation to gender, geographical location, education and where their their dental service was obtained. The n-values for the different categories are given above each bar



fore 422, giving a final response rate of 60% (65% women/55% men). The age distribution was 73 (≤ 25 years), 103 (26-45 years), 140 (46-65 years), 83 (66-80 years) and 23 (≥ 81 years) individuals, respectively.

Statistical analyses

The statistical analyses of the collected data were made in SPSS 14.0 (Statistical Package of Social Sciences); both a descriptive and an analytical approach were used. Bivariate analyses were performed using the chi-square test for the statistical evaluation of proportions. $p < 0.05$ was considered statistically significant.

For several questions, more than one answer could be given. For some of them, the subjects could also add alternatives other than those given in the questionnaire. The internal drop-out rate varied somewhat for the different questions.

Results

Of the 422 respondents, visits to the dentist once a year or more were made by 80% (n=388), while the figure for dental hygienists was 40% (n=169). The majority of the individuals (89%) brushed their teeth twice a day or more, while 10% brushed once a day. Approximal aids were used once a day or more by 45%.

Users vs non-users

Mouthrinse products were used by 47% of the subjects (Fig.1). It tended to vary in the five age groups between 41% and 51%, with the highest for those aged 26-45 years and the lowest for the two oldest age groups (ns). Women rinsed more often than men ($p<0.01$). Subjects living in the city used the products most frequently (62%, $p<0.05$). Visitors to public dental health clinics used products to a higher degree than patients at private dental clinics ($p<0.05$). Individuals with higher education (post-sixth-form college) used mouthrinse products to a higher degree than those with only sixth-form college education ($p>0.05$).

Individuals who brushed their teeth twice a day or more used mouthrinses more frequently (50%) than those brushing once a day or more seldom (27%, $p<0.01$). A similar tendency was found for the daily use of approximal cleaning aids; 50% for frequent users vs 43% for non-frequent users ($p=0.09$).

Mouthrinse products were regarded as important or very important in order to maintain good oral health by 37% of all individuals. Recommendations to use a mouthrinse product had been given to 163 of the subjects (39%). Of those 163 respondents, 75 subjects (46%) had been recommended by a dentist alone, 46 subjects (28%) by a dental hygienist alone,

Table 1. The reason for using a mouthrinse product (%). For those individuals using more than one product, separate answers could be given for each product. Information was totally given for 251 products used. n=196

Reason for using the product	% [1]
Avoiding tooth decay	51.8
Experiencing a fresh intraoral feeling	39.8
Avoiding bad breath	34.7
Killing intraoral bacteria	32.3
Avoiding gingivitis	27.5
Avoiding tartar	23.1
Avoiding periodontitis	12.7
Avoiding discoloration	9.7
Preventing tooth sensititity	9.6
Other reason	4.8
Do not know	2.0

[1] More than one answer per product could be given

Figure 2. The factors which have the greatest impact on the choice of specific products. More than one answer could be given. n = 197

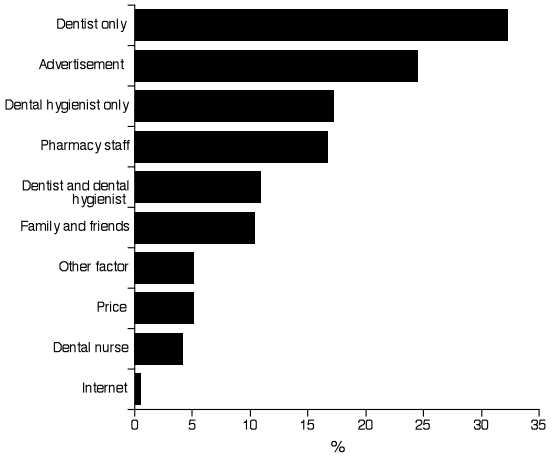


Figure 3. Use of different mouthrinse products. More than one answer could be given. n = 197

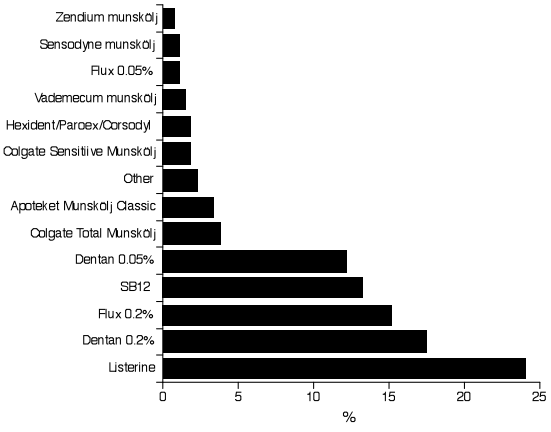


Table 2. Reason for not using any mouthrinse product as stated by the non-users (%). n = 225

Reason for not using any mouthrinse	% [1]
Not needed	41.3
Not received recommendation to us	35.4
Cannot be bothered	15.0
Expensive	12.1
Do not know what to use	8.3
Worried about chemical ingredients	7.8
Other reason	6.8
Unpleasant taste	6.3
Not considered	2.9
Use water rinse instead	1.5

[1] More than one answer could be given

25 subjects by either a dentist or a dental hygienist (15%) and 9 subjects by a dental nurse (6%). Among those who had received these recommendations, mouthrinse products were used by 80%, whereas only 27% of those who had not received any recommendations used these products ($p<0.001\%$). Other sources of recommendation were family and friends (12%) and pharmacy personnel (4%). A significantly larger number of individuals who had received information about use found it easy to decide which product to choose (46%) compared with those who had not received similar information (24%, $p<0.01$).

Factors related to users

Of all individuals who replied that they used mouthrinse products on a regular basis (n=197), 72% reported that they used one product, 21% two products, 6% three products and 1% four different products.

Rinsing was primarily performed once a day or more (45%), followed by once or a couple of times a week (34%) and more seldom than once a week (21%). Rinsing took place in the evening (56%), morning (21%), morning and/or evening (14%) and any time throughout the day (9%). It was

performed directly after brushing (87%), not in relation to toothbrushing (12%) and directly before brushing (1%).

The reasons for using the product are listed in Table 1, with avoiding tooth decay as the single most common factor (52%), followed by experiencing a fresh intraoral feeling (40%) and avoiding bad breath (35%). Choosing which product to use was considered "easy" or "very easy" by 38%, while 20% found it "difficult" or "very difficult". The factors which had the largest impact on the choice of specific product are shown in Fig. 2. Dental personnel were by far the most important source (65%). Figure 3 presents the use of different products of which Listerine is the single most commonly used product (24%). A total of 46% used the four pure fluoride products together (Dentan 0.05%/0.2% + Flux 0.05%/0.2%).

Factors related to non-users

Of all the respondents, mouthrinse products were considered to have a low impact on oral health by 17%. This figure was higher for the non-users (23%) compared to the users (10%) (ns). The reasons for not using a mouthrinse are presented in Table 2. The most common reason was that the respondents did not feel it was necessary (41%).

Discussion

This cross-over study produced information about different mouthrinses and their use in an adult Swedish population living in the south-west of Sweden. The total response rate was 60%, with a distribution from 17 to 94 years. The drop rate varied between the different age groups with the highest rate for the oldest individuals. Women had a somewhat higher response rate, which can be interpreted as meaning that women are more conscious of their health (5, 9, 18). Only a limited variation in response rate for the different questions was found.

Almost half the respondents used one or more mouthrinse products on a regular basis. No comparison can be made with previous data in order to see whether a change has occurred over time. Of these, 45% rinsed once a day or more. This figure can be compared with regular toothbrushing twice a day and daily approximal cleaning, which was performed by about 89% and 45% respectively; both figures are higher than recently reported data from a similar study (25). One question is whether oral mouthrinses are used as a supplement to or a substitute for other oral hygiene measures. Although not fully confirmed by the present study, there is an indication that mouthrinses are not used as a replacement for other oral hygiene measures. It appears that these products are used more frequently by individuals with a greater interest in their oral health status, as rinsing was performed more frequently by individuals who also performed regular oral hygiene habits, such as brushing and approximal cleaning. This corresponds well with studies in which products have been recommended as a supplement to toothbrushing and approximal cleaning in order to reduce plaque and gingivitis (4, 21).

Regardless of type of product, rinsing was most frequently performed directly after toothbrushing in the evening. There is a risk that this will reduce the fluoride effect produced by the previous brushing procedure (15). The recommendation today to rinse with just a little and preferably no water after brushing in order to retain as much fluoride as possible for a long time (22) will be seriously affected. This is of particular interest if an individual at high risk uses the toothpaste with 5,000 ppm F (Duraphat). In such cases, any of the mouthrinse products currently available on the market will produce a reduction in fluoride concentration, except if 0.2% NaF is used (15).

It is interesting to note that up to four products were used on a regular basis. Although some individuals reported the use of several products every day, there was a tendency for the product that was used "second, third or fourth" to be used less frequently. The fact that many individuals used multiple products can be related to either a real interest in oral hygiene or difficulty choosing product. Dental personnel were found to influence the use of mouthrinses to a large extent, as individuals who had received information at the dental clinic used mouthrinses to a greater degree, but they also reported that they found it easier to decide which product they should use. Such recommendations were possible to obtain for the majority of the respondents, as 80% said that they visited the dentist and 40% visited the dental hygienist once a year or more. These figures correspond well with other Swedish studies in which 90-95% seem to visit the dentist every year or every other year (11). According to this study, dentists give recommendations to a greater degree than dental hygienists. A very small percentage reported that they had received information from the dental nurse. However, this may be related to the fact that a higher frequency of individuals in the present study visit the dentist on a more regular basis. The difference

between the three groups should perhaps not be taken too seriously, as it may sometimes be difficult for a patient to remember afterwards who actually gave a specific recommendation. It is thought that all three dental categories play an important role in this respect. Apart from dental personnel, advertisements also emerged as an important source of information, while price appears to be a factor of little relevance.

The main reason for using a mouthrinse product was to avoid tooth decay. For many individuals, this is the most traditional way to use a mouthrinse as fluoride mouthrinses, particularly in the 1960s-1980s, played an important role in the caries decline in Scandinavian schoolchildren (14, 17). A large percentage in the present study reported that the rinsing product played an important part in experiencing a fresh intraoral feeling and avoiding bad breath, while a smaller number stressed periodontal diseases as the main reason. As some mouthrinse products may be closely associated with the concept of a cosmetic product, it is possible that this, at least partly, also explains the more frequent use of mouthrinse products by women than by men. The two most commonly given reasons by the subjects not using any mouthrinse was that it was not necessary and that they had not received recommendations to use any product. Once again, this indicates the importance of specific recommendations by dental personnel for products in relation to the individual oral condition.

When analysing the use of various products currently found on the market, a scattered picture emerged. When all products were taken together, traditional pure fluoride-containing products were in a majority, especially 0.2% NaF. The use of this high fluoride concentration has been given high priority in recommendations to invididuals running an increased risk of crown and root caries, as well as for initial caries risking progression, in the recently released Swedish National Guidelines for adults (23). Moreover, the product Listerine based on essential oils, which is recommended for plaque and gingivitis, as well as the product to prevent halitosis, were among the most frequently used. When used in addition to toothbrushing, mouthrinses containing chlorhexidine solution or essential solutions have been found to produce a greater reduction in gingivitis compared with toothbrushing alone (19). However, the composition of many current products is fairly complex, where fluoride is, for example, incorporated in several of the products. It has also to be underlined that several of the brands have released new versions of some products since this investigation was made.

The present data suggest that mouthrinses are not always used in the most optimal way. Not only the product itself but also behavioural factors are important in order to achieve the most optimal effect and prevent a specific oral condition. Increased knowledge is an important factor when it comes to making changes in lifestyle. Information not only about oral health products but also about factors related to different oral diseases are important. With the large number of mouthrinse products that can currently be found on the Swedish market, this is of greater importance than ever before.

To conclude, the present study indicates that a Swedish adult population, especially women, use mouthrinse products to a relatively large extent, mainly as a supplement to other oral hygiene procedures such as brushing with a fluoride toothpaste twice daily. To select the most suitable product, the dental personnel should play a more active role in recommendations to the patients who need or who want to use mouthrinses.

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