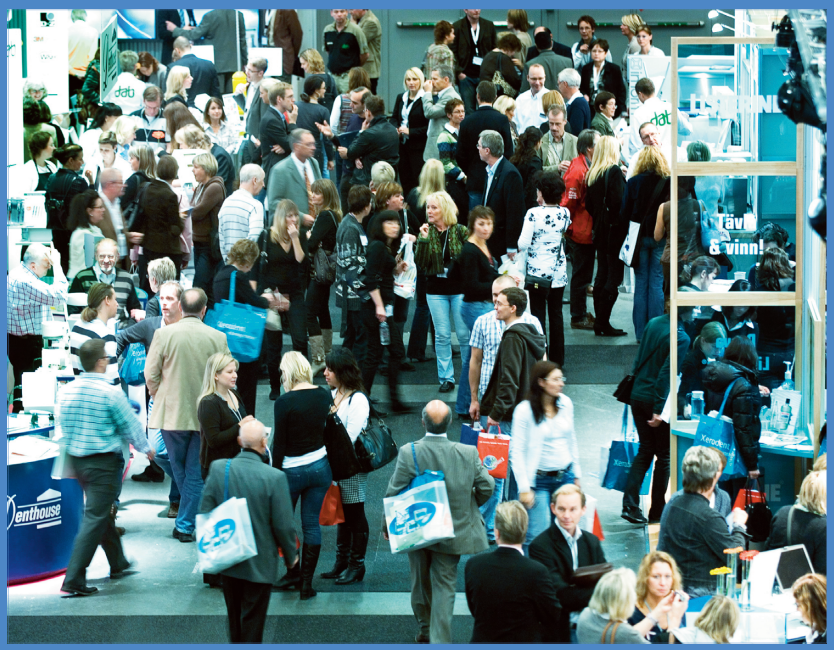
# Swedish Dental Journal

Scientific Journal of The Swedish Dental Association

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# Caries and associated factors in a group of Swedish children 2 – 3 years of age

MARIE BANKEL[1], ULLA-CARIN ERIKSSON[2], AGNETA ROBERTSON[3], BIRGITTA KÖHLER[4]

## Abstract

◎ The reported skew distribution of caries prevalence in preschool children, with a small group of children with very high caries prevalence, stresses the importance of early identification for prevention. The present study aimed to describe the caries prevalence in a group of Swedish preschool children and to identify caries risk factors in this population.

221 children, 2 to 3 years old, agreed to participate in the study (82%). A standardized questionnaire was used to describe socio-economic factors, dietary and oral hygiene habits and exposure to fluoride. Initial and manifest dental caries was diagnosed and the presence of plaque was visually observed without disclosing solution. Saliva and plaque samples were collected for identification of mutans streptococci (MS). For statistical analysis, the Student's *t*-test, the Chi-square test and Fisher's exact test were used.

The caries prevalence among the 2 to 3 year-olds was 7 and 18 percent respectively. An association between early childhood caries and a number of factors was found e.g. the presence of MS and visible plaque, nocturnal meals, frequent sugar consumption, mothers´ state of employment and immigrant background.

The Public Dental Health Service has been successful in decreasing the number of children with caries, but the challenge remains to be able to control caries in the high-risk group. The skew distribution, with many children without caries and a smaller group with very high caries prevalence, was confirmed. The study provided insight into various factors, useful for monitoring children at risk of developing early childhood caries.

## Key words

*Early childhood caries, mutans streptococci, dietary factors, socio-economic factors, immigrants.*

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# Kariesförekomst och kariesriskfaktorer hos 2-3 år gamla barn i Sverige

MARIE BANKEL, ULLA-CARIN ERIKSSON, AGNETA ROBERTSON, BIRGITTA KÖHLER

**Sammanfattning**

Tidigare studier visar att en förhållandevis liten grupp förskolebarn uppvisar en hög förekomst av karies. Detta poängterar vikten av tidig identifiering av denna grupp för förebyggande åtgärder. Syftet med föreliggande arbete var att beskriva kariesförekomsten i en grupp svenska förskolebarn samt att identifiera kariesriskfaktorer i denna population.

Tvåhundratjugoen 2- och 3-åriga barn i ett upptagningsområde i Göteborg accepterade att medverka i studien (82%). Föräldrarna visade sig ha sitt ursprung i 40 olika nationer i det undersökta området. Ett standardiserat frågeformulär användes för att beskriva socio- ekonomiska faktorer, kostvanor, tandborstningsfrekvens och fluortillförsel. Initial och manifest karies diagnostiserades samt förekomst av synligt plack. Saliv och plackprov togs för identifiering av mutans streptokocker (MS). För statistisk analys användes Student's t-test, Chi-square test samt Fishers's exakta test.

Sju procent av 2-åringarna och 18% av 3-åringarna uppvisade karies. Association mellan karies hos små barn och ett antal olika faktorer påvisades t.ex. förekomst av MS och synligt plack, nattmål, frekvent sockerintag, mammans socio- ekonomiska förhållanden samt invandrarbakgrund. 62 % av barnen till mammor med mindre än 10 års utbildning hade karies jämfört med 12 % av barnen till mammor med längre utbildning. Motsvarande samband förelåg ej mellan pappornas utbildningslängd och barnens kariesutveckling.

Folktandvården har lyckats minska antalet barn med karies men utmaningen att kunna kontrollera karies i högriskgrupperna kvarstår. Den sneda fördelningen med många kariesfria barn och ett mindre antal barn med hög kariesförekomst bekräftades. Studien visade också på ett flertal faktorer av betydelse vid kariesriskbedömning av små barn.

## Introduction

Epidemiological studies in the Nordic countries, on dental caries in the primary dentition, are frequently published. They all show that dental health among most Nordic preschool children is very good (4,7, 10,14,20,21,23). However, the decline in caries prevalence that has been reported in Sweden for several years seems to have levelled out among preschool children (27). In recent years, it has been claimed that caries in the primary teeth has increased again (10). The epidemiological evidence for this is, however, weak. An increase may have taken place in some sub-populations, but no conclusive documentation for a rise in caries in primary teeth can be found in larger regional or national data set. However, there has been a polarization towards many children without caries and a smaller group with very high caries prevalence and thus, caries still remains a public challenge (36). In order to influence this polarization in a positive sense, it is important that children, at high risk of developing caries, are identified early. For this reason, it is important to identify probable and potential risk factors.

Several studies have also shown an association between future risk of developing caries and a number of factors such as prior caries experience (8), immigrant background (7,35), dietary habits (7), quantity of dental plaque (37) and the presence of mutans streptococci (MS) (3,6,15-17). *Grindefjord* (5) found that the probability of developing caries increases significantly if many factors are involved. Thus, by monitoring the various factors in early childhood, children at risk might be identified for early preventive measures.

The purpose of this study was to describe the caries prevalence in a group of 2 to 3 year-olds in Göteborg and to identify factors associated with early caries development. Further, the results will form a

**Table 1.** Diet questionnarie.

| | <1 time per week | 1 time per week | 2-3 times per week | 1 time per day | 2 times per day | 3-5 times per day | >5 times per day |
|---|---|---|---|---|---|---|---|
| Lemonade | | | | | | | |
| Fruit juice | | | | | | | |
| Soft drinks | | | | | | | |
| Light drinks | | | | | | | |
| Rose-hip cream | | | | | | | |
| Chocolate drinks | | | | | | | |
| Formula in a bottle | | | | | | | |
| Other drinks in a bottle | | | | | | | |
| Tea with honey or sugar | | | | | | | |
| Chewing gum containing sugar | | | | | | | |
| Throat lozenge containing sugar | | | | | | | |
| Medication or health products containing sugar | | | | | | | |
| Candy | | | | | | | |
| Ice cream | | | | | | | |
| Raisins or other dried fruits | | | | | | | |
| Sweetened cereals | | | | | | | |
| Potato chips and other snacks | | | | | | | |
| Cookies and other pastries | | | | | | | |

basis for future caries risk assessment with subsequent preventive intervention.

## Material and Methods

*Subjects*

All 271 children, aged 2 to 3 years living in Majorna, Göteborg, were invited to participate. Those accepting the invitation were examined at the Public Dental Service Clinic in Majorna, Göteborg, by two experienced dentists (MB, UCE). The children were randomly distributed between the two, each examining one half of the group. The dentists were previously calibrated in cooperation with a paediatric dentist (AR), by examining 10 children and making joint decisions. During the study period, they regularly discussed the diagnostic criteria used.

The procedures, possible discomforts or risks, as well as possible benefits, were explained fully to the parents. An informed consent was obtained prior to the examination. The study was approved by the Ethical Committee of Göteborg University.

*Standardized questionnaire*

A standardized questionnaire was used at the baseline examination and contained questions about the child's general health, socio-economic conditions (e.g. the parent's education, employment status, immigrant background), dietary habits, oral hygiene and exposure to fluoride. The drinking water in the area has a low content of fluoride (<0.1mg/l). The parents were asked questions on whether they were employed or stayed at home with the child during daytime due to unemployment, studies, childcare or long-term illness. The child was considered to have an immigrant background if one parent was born outside of Sweden. A frequency questionnaire was used concerning the consumption of a selected number of snacks and other sugar-containing food and beverages considered as caries risk products (Table 1). 28 number of intakes per week was considered high. Questions were also asked on consumption at night. Water was not considered as an intake.

*Clinical examination*

The examination was made at the clinic with the help of a mirror, a probe and optimal light. All tooth surfaces were clinically examined for initial and manifest caries. General mineralization disturbances were excluded. A tooth was considered erupted if any part of the crown had penetrated the oral tissue. Initial caries was registered as a demineralized, rough surface with a chalky appearance and pits and fissures with white or dark discolorations. Manifest caries was registered according to the criteria stated by *Koch* (1967). Teeth that had been extracted or restored due to caries were registered and defs were calculated (d = decayed with manifest caries, e = extracted and f = filled surfaces.). Extracted molars were equivalent to five decayed surfaces and incisors and canines equivalent to four decayed surfaces. The presence of plaque was inspected visually and assessed dichotomous as plaque or no plaque without disclosing solution.

*Saliva and plaque sampling*

Saliva and plaque samples were collected for detection of mutans streptococci (MS). Dentocult SM Strip Mutans® (Orion, Finland) were used for both saliva and plaque sampling. The saliva sample was collected by rotating a plastic strip approximately ten times on the dorsum of the tongue and withdrawing it close to the lips to remove excessive saliva. Concerning plaque samples, specific surfaces of four different teeth; the occlusal surface of the mandibulary right primary first molar (84), the buccal surfaces of the maxillary right primary central incisor (51), the maxillary left primary first molar (64) and the mandibulary left primary central incisor (71) were sampled by using a wooden toothpick to collect plaque (39). The sample was transferred to a plastic strip for plaque, which was placed in tubes with a selective broth and were incubated for 48h at 37° C. The presence of salivary MS and MS in plaque was given a score from zero to three according to the manufacturer. Score 0= none or only a few colony-forming units (cfu) per ml saliva, score 1=<$10^5$ cfu per ml saliva, score 2=$10^5$-$10^6$ cfu per ml saliva and score 3=>$10^6$ cfu per ml saliva. The samples were also examined in a microscope to verify the estimated score in cooperation with the School of Dentistry's Cariology Department in Göteborg.

*Statistical analysis*

For statistical analysis, the Student's *t*-test, the Chi-square test and the Fisher's exact test were used. The Student's t-test was used analyzing the dietary habits. The level of statistical significance was set at five percent.

## Results

*Subjects*

A total of 221 children who accepted the invitation were examined. Fifty of the invited children did not

Table 2. Caries in relation to age and gender

| Age; sex | n* | Children with extracted or filled teeth | Children with initial or manifest caries | Children with initial caries (%) | Children with manifest caries (%) |
|---|---|---|---|---|---|
| 2 yrs; male | 49 | 0 | 4 | 6 | 2 |
| 2 yrs; female | 48 | 1 | 3 | 6 | 0 |
| 3 yrs; male | 62 | 0 | 12 | 18 | 15 |
| 3 yrs: female | 62 | 0 | 10 | 13 | 10 |
| Summary | 221 | 1 | 29 | | |

*=number

Table 3. Presence of visible plaque in relation to caries

| | Caries-free children* | Children with caries |
|---|---|---|
| No visible plaque | 108 | 7 |
| Visible plaque | 81 | 22 |
| Summary | 192 | 29 |

*Drop out=3

participate (18%). Eight children had moved, the parents of 41 children were not interested and one child was deceased. The non-participating children consisted of 26 boys and 24 girls, of whom 32 were 2 years old and 18 were 3 years old. Table 2 shows the distribution of the participating children according to age and gender.

*Erupted teeth*

At 2 years of age, the mean number of erupted teeth was 16.8 (range 10-20) and at 3 years of age 19.9 (range 18-20).

*Caries*

Initial and/ or manifest caries, restored or extracted teeth due to caries were diagnosed in 13 percent of the total group, in 7 percent of the 2 year-olds (7 children) and in 18 percent of the 3 year-olds (22 children). A child with a tooth diagnosed in any of the above mentioned diagnoses, was considered to have caries.

The mean number of defs in the 2 year-olds was 0.2 (range 0-16) and in the 3 year-olds 0.6 (range 0-14). Including initial caries, the mean number was 0.3 (range 0-18) in the 2 year-olds and 1.2 (range 0-27) in the 3 year-olds. Among the 2 year-olds, the majority of decayed surfaces (including initial caries) were located on the maxillary incisors (66%). Among the 3 year-olds, they were mainly distributed on the maxillary incisors (40%), the maxillary molars (23%) and the mandibulary molars (27%). Figure 1 shows the distribution of defs. One of the

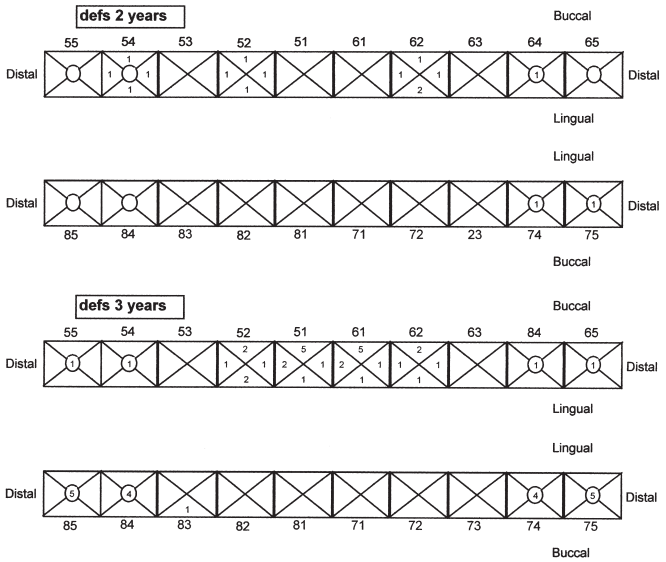


Figure 1. Distribution of caries lesions in the 2 to 3 year-old children. Each number indicates the number of children with presence or history of manifest caries on a specific surface.

2 year-olds had three teeth restored and three teeth missing due to caries. Manifest lesions were found in 15 out of 22 3 year-olds with caries (68%).

*Visible plaque and tooth-brushing habits*

Visible plaque was found in 47 percent of the total group of children and in 76 percent of the children with caries (Table 3). The mean frequency of tooth brushing with parental assistance, according to the parents, was 1.74 times a day (range=0-4, median=2) and 21 percent brushed their teeth less than twice a day. Toothpaste containing fluoride was used among 97 percent of the children but only 9 percent used tablets or chewing-gum containing fluoride. A statistical significant difference between the group of child-

Table 4. Presensce of number of children with MS in saliva and plaque

| | n | MS in saliva | MS in plaque | High levels of MS in saliva* | High levels of MS in plaque |
|---|---|---|---|---|---|
| Caries-free children | 192 | 23 | 22 | 14 | 13 |
| Children with caries | 29 | 20 | 20 | 17 | 15 |

*>$10^4$ cfu/ml salvia

Table 5. Caries in relation to the length of the parent´s education

| Length of education | Caries-free (%) | Children with caries (%) | P-value |
|---|---|---|---|
| Father >9 yrs | 86 | 14 | 0,42 |
| Father <10 yrs | 91 | 9 | |
| Mother >9 yrs | 88 | 12 | 0,01 |
| Mother <10 yrs | 37 | 63 | |

ren with or without caries was found concerning the presence of visible plaque in 3 year-olds (Chi-square test p<0.0001) but not concerning tooth-brushing habits (Chi-square test p=0.3, Fisher's exact test p=0.37) or the use of fluoride.

*Saliva and plaque sampling*

MS in saliva was found in 20 percent of the total group of children. 14 percent of the 2 year-olds and 23 percent of the 3 year-olds were colonized. A comparison between children with or without caries showed a significant difference (Chi square test p<0.0001). Significantly more children with caries than without had a high level of salivary MS (score 2+3) (Chi square p<0.0001). (Table 4).

*Consumption of sucrose-containing products*

The intake frequency of selected sugar-containing products was pooled and calculated on a weekly basis. Children with a frequent intake of these products showed a significantly higher caries prevalence (Student's *t*-test p<0.0001). 38 percent of the children with an intake of more than 28 times per week of the selected sugar-containing products had caries compared with 8 percent with an intake of less than 28 times. 33 percent of the children were taking nocturnal meals, of which 44 percent were 2 year-olds and 24 percent 3 year-olds. Caries was found in 42 percent among children being breast-fed at night (mostly 2 year-olds) and in 29 percent among children eating or drinking sugar-containing products at night (Figure 2).

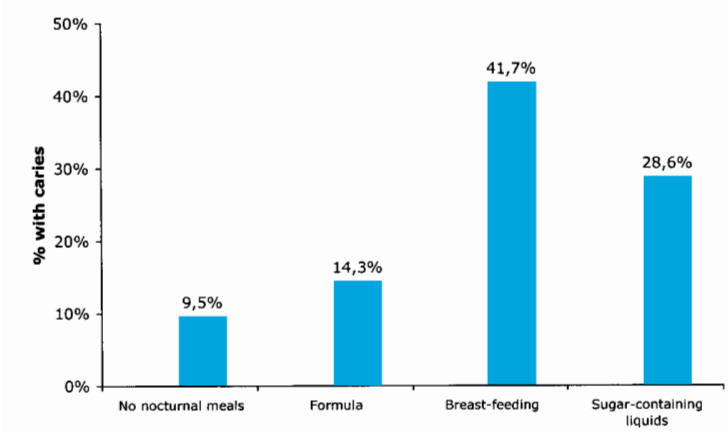


Figure 2. Presence of caries in relation to nocturnal meals

*Socio-economic factors*

16 percent of the children were living with one parent, the majority being their mother.

Where the mother had less than ten years of education, 63 percent of the children had caries compared to 12 percent where the mother had a longer education. The length of the father's education showed no association with the development of caries in the child (Table 5).

The group of children whose mother "stayed at home " during daytime had more caries than the children whose mother was working during the day. An association to caries in the child was not found regarding the father's employment status.

The parents came from 40 different nations and it was not uncommon with parents born in different countries within one family. 27 percent of the 2 year-olds and 39 percent of the 3 year-olds had an immigrant background. In the group of children with an immigrant background, caries was found in 31 percent compared to 8 percent in the non-immigrant group (Chi-square test p<0.0001).

The children were divided into three groups according to the mother's native background; (i) born in Sweden, (ii) born in another European country or

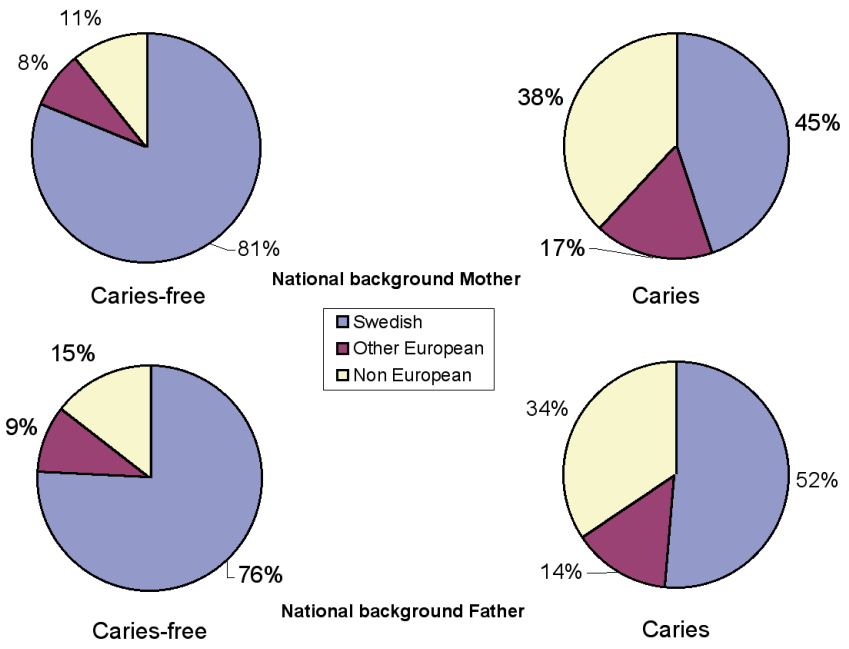


Figure 3. National background of mother and father in children with and without caries.

(iii) born outside of Europe. More than 50 percent of the children with caries had a mother born outside of Sweden compared to less than 20 percent of the caries-free children (Figure 3).

## Discussion

The present study describes the caries prevalence of 2 to 3 year-olds and some associated factors in a district with average socio-economic conditions, with approximately 12 percent of the population in the whole area having an immigrant background. However, in the present selected subgroup of families with small children, approximately 30 percent of the children had an immigrant background. 82 percent of the invited children participated, which is acceptable considering that all children in the age group were invited. 7 percent of the 2 year-olds showed caries, which is of the same magnitude as studies on other Swedish populations (24,34). 18 percent of the 3 year-olds had experienced caries, which is lower than what was found in the studies by *Wendt et al.* (35) and much lower than recently reported by *Wennhall et al.* (40). The latter study was performed in a low-socio-economic area with a dominance of non-European immigrants. Bitewing radiographs were not used in the present study examining the molars, which may explain a lower prevalence than in the study by *Wendt et al.* (35). The earlier demonstrated skew distribution, with many children at low risk and a smaller group at very high risk (13,22,26), was confirmed in the present study.

The presence of visible plaque was significantly associated to caries, which is in agreement with earlier studies (1,12,37). Visible plaque is also suggested as an indicator of caries risk (30). No association to caries was found regarding the frequency of tooth brushing or the use of fluoride as found in other studies (27,40). However, this was not to be expected since 97 percent of the children in the present study used fluoride-containing toothpaste and only a few families reported regular use of fluoride supplements. The presence of visible plaque might also be a result of an unsatisfactory tooth brushing technique apart from the frequency.

The quality of plaque, as measured by presence or absence of MS, is another approach of microbial screening to assess caries risk. In the present study, the presence of MS was significantly associated to caries in the children. Earlier studies have observed that the early colonization of MS is associated with future development of caries in the primary dentition (3,15,28,29), and *Mattos-Graner et al.* (18) have shown that an early heavy colonization of MS is related to an extremely high caries incidence in preschool children living in Brazil. Further, longitudinal studies are needed in the present population to

confirm the usefulness of microbiological tests as a caries predictive tool in preschool children.

A comparison between the results of salivary MS score and the plaque MS score showed a high agreement concerning the high and low scores. With a salivary MS score of 0, the four plaque scores for MS showed the same result in 95 percent of the samples and with a salivary MS score of 3, all four plaque scores had a positive MS result in 82 percent. The saliva samples though, were easier to collect and better accepted by the children than the plaque sampling. In future, follow-up studies regarding caries incidence of the present group of children, the predictive value of the two sampling techniques, will be evaluated. It is suggested that colonization of MS is likely to precede cavity formation, which makes it of special interest to evaluate the positive and negative predictive value respectively of MS at 2 years in relation to future caries. *Seki et al.* (25), using the Strip mutans dipslide, found that screening plaque MS score was more effective than salivary MS score in prediction of caries. However, the correlation at baseline was not reported. In the present study, the sampling sites were selected according to site-specific susceptibility to caries.

Dietary habits have been shown to be an important risk factor. A child's first acquaintance with foods and the gradual establishment of eating patterns during infancy and early childhood, form an important basis for the future development of both food habits and other health-related habits. The scientific evidence correlating sugar in the diet to caries in the primary diet is strong. Previous studies have suggested that a high sugar consumption often is established early in life (38). Children who consume sweets more than once a week at 3 years of age consume more sucrose than their counterparts, not only at 3 years of age but also three years later (14,32). In this study, in accordance with other studies, a high intake of risk products based on a frequency questionnaire significantly increased the risk of having caries (11,19). Caries prevention programs should thus focus on the total exposure to various sugar containing products rather than special sweets. Parents should be taught to pay attention to products with a high sucrose content for restriction of consumption by reduced availability. Such products might often be considered being nutritious as in e.g. fruit soups, cereals and sweet, dried fruit. The fact that high sugar consumption also often is established early in life (38), will also facilitate early colonization of MS (32). These observations together, stresses the importance of early dietary guidelines for caries prevention as suggested in the review by *Tinanoff & Palmer* (31).

Nocturnal meals have also been mentioned as a caries risk (21), which was confirmed in the present study regarding nocturnal breast-feeding and intake of sweet liquids. This can be explained by the observation that low salivary flow during sleep decreases oral clearance of the sugars and increases the length of contact time between plaque and substrates resulting in increased cariogenic potential of the substrate. Other studies, however, have reported no association between breast-feeding and caries (2,33). The frequent nocturnal breast-feeding in our study might indicate an eating pattern with frequent intakes of other sugar containing products, which might in fact be the etiological factor to the higher caries prevalence in this group, which is in agreement with the study by *Hallonsten et al.* (9).

Immigrant background was one factor, which was significantly associated with high caries prevalence. This has been reported earlier in several studies (7,27). In the present study, the mother's origin was of greater importance than the father's. A lower education of the mother and the fact that the mother was staying at home taking care of the child, instead of having day-care, was also associated to a higher caries prevalence in the child. The observation of the inverse relationship between mother's education and Early Childhood Caries (ECC) was not surprising and has been shown in earlier studies. However, that the children with "home-care" showed significantly higher caries prevalence was unexpected. One explanation might be an increased availability of snacks and sweet beverages and more irregular meals than at a day-care centre.

ECC is a serious socio-behavioural and dental problem. These children also tend to develop additional decay in their primary teeth during their preschool years and often require dental treatment under conscious sedation or general anaesthesia (34). This makes treatment costly and stressful for children, parents and dental personnel. These facts together make infants and toddlers an important target group of preventive dental care. This study provided insight into various factors associated with ECC, which is a prerequisite to be able to identify these children early. The importance of parental education based on a careful patient/family history is also evident.

## Conclusions

1. The study confirms that there is a skew distri-

bution with many children with a low caries prevalence and a small group with a high caries prevalence and thus caries still remains a public challenge in Sweden today.

2. Several factors associated to caries were identified in the preschool children, suggesting ways of monitoring children at risk of developing caries, for early preventive intervention. The results suggest the importance of collecting information about the dietary habits. This is especially important regarding immigrant families exposed to a new dietary culture.

**Acknowledgements**

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# Knowledge of and attitude to oral health and oral diseases among young adolescents in Sweden

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## Abstract

◎ The aim of this study was to investigate the knowledge of and attitudes to oral health among 12- and 15-year-old students in Sweden. The results are designed to act as a baseline survey to evaluate future interventions. From all 85 schools in the County of Uppsala, ten schools were randomly selected. In all, 993 students were offered the chance to participate in the study. 793 (80%) individuals answered a questionnaire consisted of fifteen structured questions about their knowledge and attitudes to oral health. The result showed that the level of knowledge by adolescents is relatively high. A large majority of the subjects felt that their teeth were important. Most of the adolescents had learned about oral health from the dental team. With the exception of the question about the meaning of the word "periodontitis", all the questions produced a distribution of correct answers in favour of the girls. Older students showed more knowledge compared with younger students. In none of the questions did the younger students display more knowledge than the older. The adolescents with an immigrant background showed less knowledge compared with natives of Sweden in several areas. Despite having less knowledge of oral health, more students with an immigrant background than natives of Sweden stated that their teeth were important. Several of the survey questions call for answers in the form of factual knowledge. Knowledge is therefore regarded as a quantitative measure of a reproduction, where the adolescents are expected to reproduce something that they have already learned. Increasing criticism has been levelled against this view of knowledge. Facts are not enough to induce young people to change their health behaviour. Facts are an important part of the message but must be complemented by reflection and consideration of how the receiver understands it.

## Key words

*Knowledge, oral health, young adolescents, prevention, primary prevention*

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# Svenska ungdomars kunskaper om och attityder till munhälsa och tandsjukdomar

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**Sammanfattning**

Syftet med denna studie var att undersöka svenska ungdomars kunskaper om och attityder till munhälsa på tio slumpmässigt utvalda grundskolor i Uppsala län. Studien baseras på en enkät med 15 strukturerade frågor rörande karies, gingivit munhygien, kost och fluor. Totalt tillfrågades 993 ungdomar och 793 (80 %) besvarade frågeformuläret. Resultatet visade att en majoritet av alla tillfrågade hade fått information om hur de ska sköta sina tänder. De allra flesta hade fått sina kunskaper från tandvårdspersonal. Svaren pekade på goda kunskaper överlag. En majoritet av de tillfrågade menade att tänderna är mycket viktiga. Vid flera av frågorna kunde skillnader mellan kön och ålder observeras. I alla frågor, utom den om parodontit, visade flickorna större kunskap än pojkarna. Ungdomarna i årskurs nio svarade i högre utsträckning korrekt jämfört med ungdomarna i årskurs sex. Beträffade frågorna som handlade om munhygien, gingivit och fluorens betydelse för tandhälsan uppvisade ungdomar med invandrarbakgrund sämre kunskaper än de som var födda i Sverige. Trots mindre kunskap om munhälsa hävdade ungdomarna med invandrarbakgrund i större utsträckning än de svenskfödda ungdomarna att deras tänder var viktiga. Många av frågorna i enkäten kräver svar i form av faktakunskap, vilket speglar en traditionell kunskapssyn där kunskapen ses som en kvantitet eller som en form av reproduktion där eleven återger vad läraren eller någon annan sagt. Kritiken mot denna undervisningsform har under senare tid växt sig allt starkare. Fakta räcker inte för att förmå unga människor att ändra sitt hälsobeteende. Fakta är en viktig del av budskapet men måste kompletteras med reflektion över hur den uppfattas av mottagaren.

## Introduction

Oral health has improved in western countries during the last few decades (25). This improvement has been especially evident among children and adolescents. In Sweden, the number of 12-year-old individuals with no experience of dental caries increased from 22 % in 1985 to 57 % in 2002 (21). Oral hygiene (1), dietary habits (6, 10) and fluorides (24, 11) play a significant part in the aetiology of oral diseases. According to the The National Board of Health and Welfare (20), patients should participate in the planning and performance of their dental care. However, participation presupposes motivation and knowledge of oral health.

Lack of knowledge results in poorer oral health (4, 22, 17). An unequal level of knowledge among immigrant children has been reported (4). A low overall knowledge of oral health has been found, especially in the area of gingivitis and periodontitis (26, 8, 22). *Hugoson et al* (8) reported that 62 % of 15-year old students knew that bacteria and sugar where the main sources of acid formation, but only 6 % knew the meaning of the word "gingivitis". In addition the authors found that the knowledge of oral health had decreased compared with the measurements 10 years earlier. Despite the decreasing knowledge, the frequency of toothbrushing had increased and in 1993 88% of the students brushed their teeth at least once a day (8). In the Swedish study (8) children stated that the dental team were the main source of oral health information, but an American study register the family as main informant (26).

Oral health programme can increase oral health knowledge (3, 27, 5, 9, 2). Several studies report changes in behaviour as a result of the increase in knowledge (3,5,9) while other report a reduction in the prevalence of oral diseases (27, 2). *Hugoson et al* (9) reported that ten years after a programme was introduced, the benefit from the education was still undiminished, but the behavioural improvements had been reduced. On the other hand no or only small effects of education programmes have also been reported. *Melsen and Agerbaeck* (16) were only able to register a slightly improved cognitive level and no change in behaviour in Danish adolescents.

Learning is a phenomenon that is difficult to define as a result of its conceptual variation. While knowledge is the product of learning the way in which knowledge is viewed also varies. The traditional perspective of knowledge is that it is measurable with a characteristic of quantitative growth. Knowledge can also be described as an interior process, which determine the individual's view of, and way of dealing with reality (15). The process of learning is dynamic and based on the individual's previous knowledge and experiences. It can also be argued that learning is a social activity, something that takes place between people, in interaction, rather than something that is constructed solely in the individual mind. *Lave* (13) describes learning as "changing participation in the culturally designed settings of everyday life".

The aim of this study was to investigate the knowledge of and attitudes to oral health among 12- and 15-year-old students in Sweden. The results are designed to act as a baseline survey to evaluate future interventions.

## Material and Methods

The study was approved by the Ethics Committee, Faculty of Medicine, Uppsala University, Sweden. Informed consent was obtained from all participating adolescents and their parents before the study started. In the County of Uppsala, dental professionals give the children information about oral health every three years at school and during their annual visits to the dental clinic.

### *Subjects*

Children, 12 and 15 years of age and involved in compulsory schooling provided the sample framework for this study. From all 85 schools in the County of Uppsala, ten schools were randomly selected. At each school two sixth-grade (12- year-old pupils) and two ninth grade (15- years-old pupils) classes were selected at random. The children and their parents were informed of the study through a letter and could accept or refuse participation in the study. In all, 993 persons were offered the chance to participate in the study. 793 individuals answered questions about their knowledge and attitudes to oral health.

### *The questionnaire*

The questionnaire consisted of fifteen structured questions with fixed answers to choose from (Fig 1). The students answered the questionnaire during a lesson at their school in the presence of dental care professionals. The questionnaire had previously been used in a study in 1998 (7) in which 188 twelve-year–old subjects participated. As a result of the study in 1998 two of the questions were excluded and three were modified in the questionnaire used in the present study.

**Questionnaire:**

1. Are you a girl?
2. Are you born in Sweden?
3. During your time at school, have you learned anything about how to take care of your teeth?
4. If the answer to Question 3 was "Yes", who taught you how to take care of your teeth?
5. Are the teeth important?
6. How often should you brush your teeth?
7. What is wrong when the gum bleeds?
8. What does a good toothbrush look like?
9. Why should adults use dental floss?
10. What is caries?
11. Do you know another word for the soft bacteria that can cover the teeth?
12. What do the bacteria in the mouth produce when we eat?
13. What does the word "periodontitis" mean?
14. Why should you use toothpaste with fluoride?
15. Choose the alternatives below which you think reduces the risk of caries.

Figure 1. Questions in the questionnaire.

*Statistical analyses*

The survey has been analysed using the Monte-Carlo simulation of Fisher's F-test (involving the ratio of the between-groups mean square to the within-groups mean square). The reason for using Fisher's F-test was that a Chi square test could have resulted in an incorrect p-value since the expected value of certain cells was not sufficient for such an analysis. A level of 5 % significance was used.

## Results

An equal number of boys and girls answered the questionnaire. Of the 993 students who were asked to answer 200 (20 %) did not participate (Table.1). The reasons for not participating were illness and visiting a doctor or dentist, while some people gave no reason at all. The percentage of individuals with an immigrant background (individuals not born in Sweden) was 8 %. At two of the schools the percentage was higher (18-22 %).

The majority of the students stated that they had been given information about oral health during their time at school (Question 3). The dental team was the main source of information, followed by parents (Question 4, Table. 2). Almost 100 % of the participants said that the teeth were very or fairly important (Question 5). More girls than boys regarded their teeth as very important (p=0.037) and students with an immigrant background did so more often than natives of Sweden (p=0.031) (Table 3).

Of all adolescents, 91 % said that tooth brushing should be done twice a day (Question 6). More respondents with an immigrant background chose the alternatives with less frequent tooth brushing

Table 1. Number of participants, gender and dropouts.

| | Girls | (%) | Boys | (%) | Total | (%) | Dropouts | (%) |
|---|---|---|---|---|---|---|---|---|
| 12-year-old | 200 | (49) | 211 | (51) | 413 | (100) | 80 | (15) |
| 15-year-old | 186 | (49) | 194 | (51) | 380 | (100) | 120 | (25) |

Table 2. Distribution of answers to the question (4): Who taught you how to take care of your teeth? Number of individuals (%).

| | 12-year | (%) | 15-year | (%) | Girls | (%) | Boys | (%) |
|---|---|---|---|---|---|---|---|---|
| Parents | 62 | (17) | 36 | (12) | 9 | (3) | 51 | (15) |
| Teacher | 22 | (6) | 13 | (4) | 47 | (14) | 21 | (6) |
| Dental team | 271 | (75) | 252 | (81) | 271 | (80) | 251 | (77) |
| Other | 6 | (2) | 10 | (3) | 9 | (3) | 7 | (2) |

**Table 2.** Distribution of answers to the question (4): Who taught how to takr care of your teeth? Number of inidividuals (%).

| | 12-year | (%) | 15-year | (%) | Girls | (%) | Boys | (%) |
|---|---|---|---|---|---|---|---|---|
| Parents | 62 ( | 17) | 36 | (12) | 9 | (3) | 51 | (15) |
| Teacher | 22 | (6) | 13 | (4) | 47 | (14) | 21 | (6) |
| Dental team | 271 | (75) | 252 | (81) | 271 | (80) | 251 | (77) |
| Other | 6 | (2) | 10 | (3) | 9 | (3) | 7 | (2) |

**Table 3.** Distribution of answers to the question (5): Are the teeth important?

| | Immigrant | (%) | Swedes | (%) | Girls | (%) | Boys | (%) |
|---|---|---|---|---|---|---|---|---|
| Fairly important | 5 | (8) | 95 | (13) | 41 | (10) | 59 | (15) |
| Not important at all | 2 | (3) | 2 | (0) | 3 | (1) | 1 | (0) |
| Not esp. important | 1 | (2) | 6 | (1) | 1 | (0) | 6 | (2) |
| Very important | 56 | (88) | 626 | (86) | 348 | (89) | 332 | (83) |

Girls vs. boys: p= 0.037

Swedes vs. immigrants: p = 0.031

**Table 4.** Distribution of answers to the question (6): How often should you brush your teeth? Number of individuals (%).

| | Immigrant | (%) | Swedes | (%) | Girls | (%) | Boys | (%) |
|---|---|---|---|---|---|---|---|---|
| Once a day | 3 | (5) | 19 | (3) | 11 | (3) | 11 | (3) |
| Once a week | 3 | (5) | 1 | (0) | 2 | (1) | 2 | (1) |
| Twice a day | 54 | (84) | 670 | (92) | 354 | (90) | 368 | (92) |
| More than twice | 3 | (5) | 37 | (5) | 25 | (6) | 15 | (4) |
| Do not know | 1 | (2) | 2 | (0) | 1 | (0) | 2 | (1) |

Swedes vs. immigrant: p = 0.0017

**Table 5.** Distribution of answers to the question (10): What is caries? Number of individuals (%).

| | 12-year | (%) | 15-year | (%) | Girls | (%) | Boys | (%) |
|---|---|---|---|---|---|---|---|---|
| Bacteria on teeth | 224 | (55) | 228 | (60) | 226 | (58) | 226 | (57) |
| Bleeding gum | 8 | (2) | 2 | (1) | 4 | (1) | 6 | (2) |
| Cavity in a tooth | 66 | (16) | 68 | (18) | 87[1] | (22) | 47 | (12) |
| Calculus | 34 | (8) | 55 | (15) | 34 | (9) | 55 | (14) |
| Do not know | 79 | (19) | 25 | (7) | 41 | (10) | 63 | (16) |

[1] Boys vs. Girls: p<0.001

(p<0.001) (Table 4). More 15-year-old individuals knew why the gingiva bleeds compared with the 12-year-old (83 and 75 % respectively, p=0.035, Question 7). Seventy-nine per cent of the adolescents knew that a toothbrush should be soft and tight (Question 8). However, a difference between groups could be seen. Girls and persons native of Sweden more often chose the right alternative (p= 0.008 in both groups). The same results were found when the participants answered the question (Question 9): "Why should adults use dental floss?" Girls chose the correct alternative more often than boys (91 and 86 % respectively, p<0.001), and persons native of Sweden chose the correct alternative more often than those with an immigrant background (89 and 80 % respectively, p=0.010).

Seven-teen of the participants, were able correctly to answer the question (Question10): "What is caries?" More girls than boys answered correctly (Table. 5). When it came to questions relating to dental plaque, acid from bacteria, and periodontitis (Questions 11-13). 15-year-old students showed more knowledge compared with 12-year-olds. Sixty-eight per cent of the older participants knew that the name for bacteria on the surface of the teeth is plaque. Among the younger participants 42 % were able to answer correctly (p<0.001). Moreover the participants with an immigrant background showed less knowledge in this area. The question: half the participants answered "What do the bacteria in the

mouth produce when we eat" correctly. More participants native to Sweden compared with those with an immigrant background knew the correct answer (53 and 34% respectively, $p<0.001$).

The percentage of individuals who knew the meaning of the word "periodontitis" was low, 15 %. When it came to this question boys showed a tendency to have more knowledge than girls (18 and 12 % respectively).

Knowledge about the effect of fluoridated toothpaste was extensive (Question 14). Of all the participants, 85 % knew that fluoride strengthens the teeth. People with an immigrant background showed less knowledge compared with people native to Sweden (63 and 87 % respectively, $p<0.0001$). In Question 15 the participants were asked to choose the best alternative of four when it came to reducing the risk of caries. Several subjects gave multiple answers. Of the subjects, 53 %, stated that "not eating sweets at all" was the best alternatives, while 37 % of the students chose the alternative "eating sweets all at once", and 22 % of the students selected the alternative "eating sweets now and then" (Fig.2). The result showed that the majority of the subjects, 88 %, chose a caries- reducing alternative. However those with an immigrant background more frequently chose the alternative sweets "now and then" compared with people native to Sweden (Fig.2).

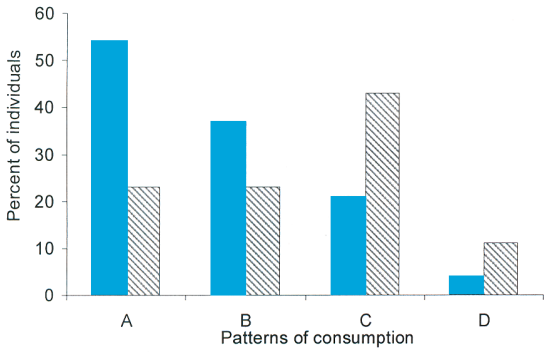


Figure 2. Proportions of choices in question 15:
A I never eat sweets
B When I buy sweets I eat all at once
C When I buy sweets I save and eat some sweets now and then
D I don't know

## Discussion

This study shows that the level of knowledge by adolescents is relatively high, especially when it comes to questions about oral hygiene. A large majority of the subjects felt that their teeth were important. The adolescents had learned about oral health from the dental team, but also from their parents. The improved dental health in western countries can probably be explained by a strong preventive approach towards dental care and especially the use of fluorides (18). Fore example, in the County of Uppsala dental professionals give children information about oral health every three years at school and during their annual visits to the dental clinic.

With the exception of the question about the meaning of the word "periodontitis", all the questions produced a distribution of correct answers in favour of the girls. This result is in line with the findings in other studies. *Marklund* (14) and *Östberg* (28) reported that girls have a better knowledge of factors that influence health compared with boys. Girls also had more healthy habits, as shown by the use of fluorides and dental floss. However, when it came to the appearance of their teeth girls were more displeased (28).

Older students showed more knowledge compered with younger students in several areas. More 15 -year-old individuals knew why gum bleeds and the name of the soft bacteria in the teeth. More of them also knew that bacteria produce acid and the meaning of the word "periodontitis". In none of the questions did the younger age group display more knowledge than the older. Similar results have been reported by other investigators (8, 28, 17).

Studies have found a poor knowledge of oral health among immigrants and stress the importance of increasing this knowledge in this group (4,12). In this study the adolescents with an immigrant background showed less knowledge compared with natives of Sweden in several areas. Fewer knew the recommended oral health routines and how oral hygiene aids should be shaped. In addition, more individuals with an immigrant background chose consumption patterns of sweets that increase the risk of caries. Despite having less knowledge of oral health, more students with an immigrant background than natives of Sweden stated that their teeth were important. In this study a strict definition of immigrant background was chosen. Other studies have chosen more extensive inclusive criteria, i.e. individuals whose parents were born outside Sweden or the individual him-/herself chose which ethnic group he/she belonged to (12). *Källestål et al*

(12) found that poor oral health behaviour are not only related to immigrant background, but also to which part of the world the person or family emigrated from. It cannot be excluded that a less strict definition of immigrant background in the present study would have resulted in even larger differences between natives of Sweden and persons with immigrant background.

Several of the survey questions call for answers in the form of factual knowledge. Knowledge is therefore regarded as a quantitative measure of a reproduction, where the adolescents are expected to reproduce something that they have already learned. Increasing criticism has been levelled against this view of knowledge. What use is it to know the meaning of the terms caries and periodontitis? Furthermore, is this knowledge pertinent to the personal dental care? A person's benefit from this kind of knowledge depends completely on his/her conceptualisation of the term (15).

Previous studies have revealed difficulties in bringing about sustained behavioural changes by mediating factual knowledge alone (23, 14). Facts are not enough to induce young people to change their health behaviour. Facts are an important part but they must be complemented by reflection and consideration (28,19). The increasing understanding of learning and behaviour has resulted in different types of pedagogic model. The application of these models can further improve young people's oral health. The view of learning is dynamic and complex in nature and is a process that is dependent on interaction between people and the world around them. To understand more about learning and identity construction in health promotion, we need to use qualitative analytical methods, not only as a complement to statistically oriented methods but also to obtain a deeper understanding of the phenomena.

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# An analysis of present dental professions in Sweden

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## Abstract

◎ Dentistry in Sweden is predicted to have a shortage of dentists in the future and the division of labour within dentistry will be a more debated question. In order to forecast the effects of such a shortage the professional status of the involved groups must be made clearer. The objective of this paper is to analyse the emergence and present professional status of clinical dental professions in Sweden.

The study was conducted on the basis of theories on professions, and their roles in organizations was analysed. The results were applied on the historical emergence, establishment and consolidation of clinical dental professions in Sweden.

The results show that a large sector of salaried dentists has not diminished the professional status of the Swedish dentists. Professional ambitions such as many clinical subspecialties and a strong element of research have not been restrained by the public health ambitions in the Public Dental Health Service (PDHS).

Presently, other dental professions are dental hygienists, dental technicians and dental nurses. Of these the only other licensed group, the dental hygienists, are an emerging profession. They have an uphill struggle to obtain a full professional status, mainly because their knowledge domains are neither specific nor exclusive to their group. Development of a common core curriculum on a clearly academic level would enhance their professional status. Dental technicians and nurses are lacking fundamental traits as professions. There appears to be little need for additional groups of clinical professions besides dentists and dental hygienists in Swedish dentistry.

In conclusion, this analysis provided better understanding of the present status of the Swedish dental professions, to prepare for future restructuring of the dental care system. Further work will be needed to understand the impact of professional traits on the management of groups of professionals.



## Key words

*Dental hygienists, dentistry, management, professions, Public Dental Health Service.*



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# En analys av de nuvarande professionerna i svensk tandvård

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**Sammanfattning**

Svensk tandvård står inför många utmaningar och frågetecken. Ett sådant område är den framtida arbetsfördelningen inom tandvården och den förändring i numerären av tandläkare och tandhygienister som prognostiseras. Effekterna av ändrade arbetsfördelningar är svåra at förutse, men det är angeläget att kartlägga hur den professionella strukturen ser ut hos de kliniskt verksamma grupperna inom svensk tandvård.

Studiens syfte var att analysera den historiska framväxten och den nuvarande statusen hos de dentala professionerna i Sverige.

Metoden baserades på analys av teorier om professioner och professionernas roller i organisationer. Resultaten av den analysen applicerades på framväxten, etableringen och konsolideringen av kliniska dentala professioner i Sverige. De grupper som analyserades var tandläkare, tandhygienister, tandtekniker och tandsköterskor.

Resultaten visar att tandläkarna utgör en väletablerad och utvecklad profession. Tandhygienisterna utgör en framväxande profession, medan grupperna tekniker och sköterskor idag saknar viktiga drag i en profession. Resultaten visar att en stor offentlig sektor inte minskat svenska tandläkares professionella status. Professionella strävanden som många kliniska specialiteter och ett stort element av vetenskaplig forskning har inte försvagats av den folkhälsoinriktning som finns i den offentliga tandvården. Det finns emellertid ännu ingen specialitet inom folkhälsovetenskap. Tandhygienisterna har svårigheter att nå status som fullvärdig profession, då deras kunskapsdomäner varken är uteslutande deras eller unika för gruppen. Deras utbildning är inte heller helt likartad. Utveckling av en kärna av unik kunskap med en bas i gemensam utbildning skulle främja deras professionella status. Det finns litet utrymme för ytterligare professionella grupper förutom tandläkarna och hygienisterna inom svensk tandvård.

Slutsatsen är att analysen gav en bättre förståelse av framväxten och nuvarande status hos den svenska tandvårdens professioner. För att kunna genomföra de förändringar som kommer att bli nödvändiga är sådana insikter grundläggande. Ytterligare forskning behövs för att förstå de professionella dragens inverkan på hur styrning och ledning av grupper av professionella kan ske på bästa sätt.

## Introduction

Demand for dental services is increasing and therefore a relative lack of dentists makes the issues of other Professions Complementary to Dentists (PCD) an interesting one. This is reported from the UK (21, 29) as well as from other countries (e.g. Canada) where power-based conflicts between professional groups are described (2).

Sweden has presently a very high ratio of dentists to population, but the average age of the dentists is high and a government report forecasts that the number of active dentists will decrease by 35 % up to the year 2020. The predicted shortage of dentists is planned to be met partially by other professional groups, primarily dental hygienists (34). This substitution, in effect, of dentists for dental hygienists may be questioned. To highlight some of the strengths and weaknesses of this substitution, it is therefore important to discuss the professional status of the various groups of clinical workers in Swedish dentistry. Our analysis of the professional status of the relevant PCDs in Sweden can bear on the situation in other countries, where a similar shortage of dentists can be forecasted. This necessitates first a discussion of the nature of professions.

Many organizations have departments that are called professional, such as research departments. However, when the core activity of the organization is based on the knowledge of the professionals (47), a *professional organization* emerges as one where the professional members define limits and formulate the objectives for the organization. Dental care in general fulfils this criterion, even if one can regard the professional nature of PCD:s as a matter of degree. To clarify this, we will define the concept of profession from the literature and then apply it to the Swedish dental professions. We will limit our efforts to clinical professionals, even though many others, such as behavioural scientists, researchers and administrators, make important contributions to the general mission of the dental professionals (22).

## What is a profession?

Traditional research on professionals has focused on categorizing, describing and analysing groups of professionals. One of these researchers is the sociologist *Thomas Brante* (8) who delineated two ideas about professional organizations: a *functionalist* and a *neoweberian* model. In the functionalist model, focus is on the necessity for division of labour to further the development of society. The neoweberian model has a power-oriented explanation, where the professionals take advantage of their skill monopoly to further their own influence in society.

These two main models do not, however, exhaust the concept of profession. Several authors (e.g. 1, 4, 20, 27, 28, 31, 47) have tried to define what constitutes the special traits of a profession, and they usually find several common attributes. A classical and still valid analysis is found in *Greenwood* (18), who identified five common attributes of a profession. He found that *systematic theory*, *professional authority*, *community sanction, ethical rules* and *an internal subculture* characterize professions. He also regarded all work as more or less possible to include in these criteria, which were seen as continuous and without endpoints. Some occupations have several or all of these traits, others only a few, and the difference between a professional and an ordinary worker was regarded as a matter of the quantity of these traits, not a matter of the quality (18). It has also been noted by other authors that the level of professionalisation for a group is not constant, but must be regarded as a process with periods of stronger and weaker tendencies, dependent on societal changes (16, 61).

*Greenwood's* definition has not been uncontested, and for example *Bluementhal* (7) has a different definition of professionals, where three important criteria must be fulfilled, 1. altruism, 2. a commitment to self-improvement and peer review, and 3. maintenance of the professional standards in co-operation with other professionals. The commitment to improvement also includes the necessity to contribute to the common body of knowledge of the profession.

Still, the criteria suggested by *Greenwood* (18) will be applied in our analyses of the Swedish dental professions and also used here for categorizing of other authors' findings on the special traits of professionals. In the analysis, we will group *Greenwood's* five categories into three parts. The first part will include "the systematic theory" and "sanction by the community". The second part of the analysis will detail "professional authority", and finally "ethical rules" and "internal subculture" will be addressed. The ambition is not to outline a history of the emergence of dental care in Sweden, which has been presented by others, among them *Lindblom* (25) and *Bäckman et al* (10). However, some historical data will be presented to underline and clarify specific points in the analysis, mainly in the analysis of the dentists.

The main aim here is to present an analysis of the degree of professionalism among dental professi-

ons in Sweden. We will analyse the dentists in some depth and then turn to other clinical workers, the PCD:s, assessing their degrees of professionalism.

## Special traits of professionals applied on Swedish dentists

*Systematic theory and sanction by the community*

A specific body of knowledge that is organized into an internally consistent system is a prerequisite for a profession, according to *Greenwood* (18). Other authors note that homogeneous standards of graduation from schools with a long formal education are important criteria for a profession (4, 6,13, 60). An important step in the emergence of a profession is therefore the formation of an accepted and universal standard for education and licensing.

The first effective professional standards for license to practice dentistry in Sweden were given in 1861, comprising both practical and theoretical tests. It was also from that time possible for women to apply for license to practice as a dentist (10, 59). The first State dental school with standards for acceptance, a curriculum and formal tests for licensing was opened in 1898 in Stockholm, thus constituting a platform for further education in dentistry (10, 52). The other schools that were started later all had the same curriculum as the Stockholm school up to the 1990's.

The right to conduct examinations for postgraduate studies is another important step in the shaping of a profession, also securing sanction by the community, and a 1920 government committee proposed this right for the dental school (52). The scientific basis for dentistry was described in great detail in the report, which suggests that the basis of dental science was not fully clear to the academic society in general. The same committee also declared that there was no need for further personnel categories in dentistry (52). The proposal for postgraduate examinations was not carried out, and this right was only granted the dental schools in 1949; scholars in dentistry could, before that, gain doctoral recognition in medicine (26). The slowness of this recognition indicates that the full professional status of dentists was relatively late in relation to that of physicians.

It has also been suggested that the formation of professional associations is an important step towards a stronger profession (6). The importance of this point can be illustrated by the growth in importance of the American Medical Association (AMA). The now powerful AMA was a weak and not very influential organization at the turn of the 19th century, as it accepted doctors with a wide variety of schooling, which led to a very heterogeneous background among its members. One of the events that led to an increase in prestige and influence was a study on the accreditation of medical schools. This study was conducted by an independent investigator and placed recommendations on strict curricula lasting defined periods of time, and on tests that the students actually had to pass to be accepted for further studies (12, 60). The AMA did not become influential until it had implemented strict criteria for inclusion in the association.

The first professional association for dentists in Sweden was formed in 1860 when eight dentists in Stockholm formed the Swedish Dental Society. At that time the total number of dentists in Sweden was about 20 in all, so the formation of an association was undertaken quite early (10).

*Greenwood* (18) suggests that the aggregate body of systematic knowledge that forms the profession will grow faster if a division of labour takes place. This is also the meaning of other authors (for example ( 64)), and the emergence of the subspecialties is important in this respect. A committee recognized the need for subspecialties in dentistry in 1935, proposing a need for surgeons and orthodontists as well as for radiologists (54). The first specialty, however, was the special care dentists, employed at the central hospital in each county that became an established part of the Public Dental Health Service (PDHS) in the 1940s, dealing mainly with surgical patients but also, at that time, being a general receiver of referrals and consultations. Later, in the 1950s, an orthodontic specialty emerged in the PDHS, usually with one clinic in each county and mainly occupied by orthodontic problems of children (56). Further specialties were added in the 1960s and 70s and reached the present number of eight in 1993 (48, 58). Sweden has more subspecialties in dentistry than most countries, and Swedish dental research has been successful on an international level for many years (30).

With licensing, formation of an association and development of a school with a formal curriculum, the first formative parts of a professional development of dentistry can be regarded as completed at the turn of the 19th century. The formation of the defined systematic theory can be regarded as complete by 1949 when the profession was granted the right to supervise its own postgraduate education and examination. The sanction by society was made clear earlier, from the 1860's, with the formal criteria for licensing by a national board. In conclusion, Swe-

dish dentists fulfil two of the criteria of a profession by having "a systematic theory" and "sanction from society", as put forward by *Greenwood* (18).

*Professional authority*

*Greenwood* (18) defines authority in a narrow meaning as the clients' inequality in information: i. e. that the client has difficulties in controlling the work of the professional. In the concept of professional authority also includes the professions' authority, or power, to resist or modify proposals for regulations that are considered to have negative consequences for the profession itself. This can be expanded to include the problems to control the professionals by the administrative management in a professional organization. The professionals have a high level of technical autonomy or independence in their work, both to define "the problem to be solved", as well as to the choice of methods to be used in solving it (13, 15, 19, 32).

Success for an administrative bureaucracy is classically characterized by full external control, equality for all clients, cost containment and decisions free from personal values, as prescribed by *Weber* and other researchers on organizations *(cf e.g.* (17)). Similarly, these objectives are also important in the Swedish Dental Act (42). Professional success could be described by little external control, those with most need have access, cost insensitiveness and that personal values are important (11). In a politically governed system, the political domain also demands effectiveness in the meaning equal access to care, equality in treatment and similar political issues (63). It has been found that from a managerial point of view, a professional attitude is not necessarily in accordance with a commercial attitude (5). It has furthermore been noted in studies on large group practices in health care that one important challenge is to make the administrative staff realize that the purpose of the organization is health care, not economic growth in itself (46). The professional authority is also seen in the formal education as professionals also maintain their special status in society by controlling the formal education that leads to professional status (13).

These problems may be illustrated by the actions and reactions of Swedish dentists on various governmental proposals, most typically the adoption of the PDHS in 1938 and the National Dental Insurance (NDI) in 1973.

Several committees proposed a PDHS in the period up to 1938 when the service finally was established (36). The various committees on PDHS were well received and supported by the dental profession, which in many cases were instrumental to their instigation. This is surprising in our opinion, as there was a clear shortage of dentists. In managerial terms, there was no need to seek new "customers" and a more commercial attitude from the dentists would probably show itself more as indifference in a market situation dominated by supplier shortage. The introduction of the PDHS was anyhow well supported by the dental profession, and the professional associations as well as the teachers in the dental school were positive to the proposals (10, 36).

Likewise, the profession later welcomed the introduction of the Compulsory NDI scheme in 1973. Whether this should be seen as an altruistic action or a move in self-interest can be debated. At that time there was still a shortage of dentists, shown by the various regulations in the bills to ascertain that the needs of the PDHS was filled, and the number of private practitioners did not increase (40). Perhaps the dental profession followed the medical one and formed an alliance with the State in order to forward its own interests as described by *Garpenby* (16). The NDI was amended 64 times before a major revision in 1998 (40). One item that caused debate but little action from the profession was the fees for services, which were fixed in the NDI. However, when a committee in 1995 proposed a capitation fee for adults instead of fee for service, the professional opposition was successful in making the government withdraw the bill (57). One reason may be that on this issue, the publicly and privately employed dentists were in agreement on the action.

The organization and manpower of the PDHS are to be based on the need of the population, and the County Councils are responsible for the formulation and specification of these needs (42). However, the areas for specialists appear more to be defined from the teaching (or research) institutions in the dental schools, than from the demand for referrals or consultations by the general practitioners, or indeed from any analysis of the needs in the population. No changes in the present number of specialties were suggested in a report from a recent committee (58). Even though a special area of dental public health recently was recognized as important for the county councils, no formal recommendations for the introduction of a specialty in the field was made (58). A recent study described the attitude to new specialties from the established ones as favourable, as long as there was a clear demarcation between the old and

the proposed new areas (23). However, further specialties, such as in public health or in special care dentistry, appear also to have been strongly opposed by the established ones (58). We regard this as an indication that the authority of the present specialists in Swedish dentistry is firmly established; as the two proposed specialties are more cross-sectional and therefore not clearly demarcated from the established ones.

The professionals have power that may be used not only in their professional work but also in shaping society. The interests of the professionals may at times be in conflict with the interests of society in general (6). Within dentistry, the professional monopoly of the development of the organizations and of the division of work has had a major influence on the development of dentistry in Sweden. Political means, such as a NDI, have only somewhat decreased this professional influence (62).

The professional authority of Swedish dentists is thus firmly established and fulfils the criteria by *Greenwood* (18), even if the division of the dentists in the PDHS and those privately employed may weaken the profession's total influence on policymaking.

*Ethical rules and internal subculture*

Another cornerstone in the establishment of a profession is common and well-defined ethical values of the individuals within the professional subculture (18). These ethical rules can be manifested on several levels; on a personal level as in relations to patients or colleagues, or on an aggregate level where the profession acts for groups of populations.

The strong ethical internal culture, the personal dimension, can be seen in the internal control mechanisms and the subculture within the profession. This internal control occurs at two levels, first by discussion between professionals, and second by peer review before a group of colleagues. This internal control is not noticeable outside of the professional group and is also only effective if the "offender" values the respect of his or her colleagues. Such control mechanisms are usually based on some sort of regulation or rule connected to the membership in the professional association.

Ethical rules on the personal level for Swedish dentists were minuted in 1892 and finally adopted by the professional association in 1908 (3). They have naturally been adapted and modified since. These rules now regulate the dentist's behaviour towards patients and also towards other dentists.

The lack of public insight and control has lead to consumers' demand for formalized internal control e.g. in forms of quality assurance (64). Recent legislation has put greater importance on the reporting of mishaps and irregularities in treatment (50) as part of the compulsory quality assurance (51). Society has the ultimate power as regards patient protection against a dentist that is laid down in regulations and may lead to removal of the license to practice (45).

An ethical dimension on the second aggregate level of the emerging dental profession in Sweden can be seen in the epidemiological studies that were started in 1894 by a group of private members of the dental society (38, 39). They collected data during the years 1895-1901, and more than 16000 schoolchildren at selected locations were given clinical examinations (both dental and medical) and the parents filled out a questionnaire. Voluntary dentists carried out the data collection all over Sweden. All these data were compiled on an individual basis, and preliminary results formed the basis for the first proposal for a PDHS in 1904, which was turned down because of lack of dentists for the suggested service (10). However, the final results of the comprehensive study were not published until 1916 (37), due to personal conflicts among the responsible persons (10). Still, already the attempt to carry out such studies implies taking a societal ethical responsibility.

The two ethical dimensions based on *Greenwood's* (18) criteria ethical rules and internal culture, can be considered fulfilled for Swedish dentists.

We can conclude that the five criteria put forward by Greenwood (18) are present and that the dentists in Sweden represent a strong profession. However, the monopoly described by *Thurfjell* (62) is not unchallenged, and we will now turn to the problem of how a dominant profession handles the emergence of other professions on the arena.

## Special traits of professions applied on other dental professions in Sweden

Today, the division of labour in dentistry is a widely debated subject as exemplified by PCD in the UK (9, 21, 29), and by inter-professional conflicts in other countries (2).

Professional authority also includes the power to control other emerging professions within the same sphere of interest. *Freidson* (14) analysed the growth of new professions within medicine and what it takes for them to be accepted. He found that necessities were a clear division of tasks, functional autonomy and formal education or training for these tasks. Autonomy included freedom to accept outpatients, not

only patients that were referred. The AMA tackled the numerous new professions around medicine by demanding that the new professions had a physician as supervisor (60), and they were in that way contained and delimited by the physicians. Similarities and differences with the American situation can be found in the development of other dental professions in Sweden besides dentists.

Earlier proposals in the 1920s to introduce "lower cost dentists" with a shorter education were stifled (10, 25, 52, 53), as were the suggestions that technicians should be allowed to perform independently on patients (53). Presently, the other clinical professional groups besides dentists in Sweden are dental nurses, dental technicians, and dental hygienists. Some few specialist clinics may have other categories of clinical personnel, but they are very few in numbers. We will now apply the criteria cited by *Greenwood* (18) on these three other groups.

*Dental nurses*

One way to increase capacity in dentistry is to let other groups perform parts of the manual procedures under the direct supervision of a dentist. This has been the case for a long time; the 1928 committee (53) recognized the need for dental nurses to assist the dentist. Single-handed work on patients by nurses has been a practice in prophylactic care since the 1960's, but more complicated work, such as placing of fillings and injections for local anaesthesia, has been formalized in the 1990's, but only permitted by delegation by the dentist (49, 58). Training for dental nurses was initially connected to the education of dentists, but was taken over by the county councils in the 1970s. Recently, only local educational programs for dental nurses have been available. The future role of dental nurses in Sweden is currently debated and the government department responsible for health care published a report in 2004 (35). Therein it is proposed that the education for dental nurses should not be on an academic level, and that the dental nurses are to work under the supervision of a qualified professional. In that way dental nurses cannot be regarded as having the "sanction by community" and they lack a "systematic theory" in the meaning expressed by *Greenwood* (18). Likewise "professional authority" is lacking as they can only see patients under the supervision of other dental professionals. Consistent "ethical rules" or "internal subculture" cannot be identified even if ethical issues are on the curricula in nurses' training. Thus the dental nurses in Sweden do not fulfil the criteria put forward by *Greenwood* (18), and cannot be regarded as professionals in that sense.

*Dental technicians*

The dental technicians in Sweden work only under the direction of dentists and cannot accept patients directly. Much of the debates in the 1920s focused on the need for dental technicians to work independently of a dentist for the fabrication of dentures and removable appliances (53). Training for dental technicians was also originally in the dental schools as vocational studies. Later, within the NDI, technicians were required to register and get certified by the National Board of Health and Welfare (41), even if there was no requirement of formal education for this certification.

The formal education for dental technicians is now on a university level to a set program (44). The criteria of "systematic theory" in the form of formal education and "sanction by community" by can be considered to be met. However, the professional authority is not clear as they only work on the direct prescription from dentists. They are not allowed to see patients independently, even though their field of expertise is unique to their group and only in some parts overlapping that of other professions.

The curricula (44) as well as the association for dental technicians have ethical issues on their agendas. Still, the Swedish dental technicians cannot be considered as a profession in the current terms (18), due to their lacking autonomy. With the academisation of their training, this might however change in the future.

Following *Greenwood's* (18) and *Friedson's* (14) criteria, the technicians and dental nurses do not have functional autonomy and they also lack a formally clear division of tasks. In Sweden, only the dental hygienists have functional autonomy by a license to practice, and that was introduced as late as in 1991 (43).

*Dental hygienists*

Education for dental hygienists was suggested as early as in the 1940s (55), but that was not implemented, and it took another 20 years before a trial course was introduced in 1968 with 16 students (33). The first curriculum was finally adopted in the 1970's. Today, each university within a wide framework decides its own curriculum, and consequently they are not the same (44). Some universities have a two-year course with a voluntary third year while others have a compulsory three-year curriculum, and a student with

the shorter, formally sufficient education, is usually not qualified for further academic studies. This will impede their abilities and possibilities to engage in advancing the professional common body of knowledge as suggested by *Bluementahl* (7). The dental hygienists in Sweden today appear to be in similar situation as the AMA was at the beginning of the last century before the *Flexner* report advocated accreditation for universities (12, 60)

The hygienists' domain of interest has gradually increased and is now theoretically partly in conflict with that of dentists, as the reformed NDI now allows them to be independently associated to the insurance (57). A discussion to further increase their field of interest by allowing treatments on hard tissue has recently started. Therefore, the criterion of independent autonomy to accept patients directly as found by *Friedson* (14) is fulfilled. So, dental hygienists in Sweden have in part "systematic theory" and by licensing (43) they also have full "sanction by community".

In contrast to other countries (e.g. (2)), this has however not become an open conflict in practice, as the number of dentists is decreasing and the number of hygienists increases only slowly. Moreover, the dentists in Sweden are in most places too few to deliver the care that the population demands; there is consequently no competition for patients (58). Dentists in Sweden generally accepted hygienists and did not try to emulate the medical profession in the AMA by controlling other professions.

The number of hygienists has increased slowly, to an estimated 2770 in the year 2002. As a comparison, the number of dentists actively working in Sweden was some 7300 in the year 2002. The estimated numbers, however, will be 4500 hygienists and 4700 dentists in the year 2020 (34). In the future, these changes in numbers probably will have a great impact on the professional status of the dental hygienists.

Today the dental hygienists' "professional authority" suffers from a lack of clear division of labour, as also dentists can perform their tasks. Therefore, dental hygienists lack a knowledge monopoly. This monopoly is a prerequisite for an emerging profession to be accepted, and leads to a weaker professional status (14).

It may also be argued that the functional autonomy and the formal training do not presently lead to a status as a strong profession for dental hygienists in Sweden. The criterion of formal education for hygienists is not quite fulfilled as Swedish hygienists presently have different educational backgrounds. Similar struggles for professional status, with similar problems have been reported elsewhere (2, 24). *Greenwood's* (18) criteria "ethical values" and "internal subculture" are fulfilled also for dental hygienists. The professional association for Swedish hygienists has sets of ethical rules in their constitution (www.tandhygienistforening.a.se), and the curricula also comprise ethical issues (44) Dental hygienists in Sweden is an emerging profession primarily lacking in a common systematic theory; still, many individual dental hygienists have pursued a postgraduate training.

### *Dental hygienists and ways to increase their degree of professionalism*

Perhaps one way to further distinguish the dental hygienists from the dentists would be to clarify their arena, either population based health promotion or clinical work on patients or groups of patients in the clinics, perhaps with focus on "dental nursing", in analogy with nurses in the medical field. The development in the UK with community based hygienists and clinical hygienists points to the possibility of a development along these two venues.

Another possibility is the development of the dental hygienists into the primary dental health care worker in line with developments reported elsewhere (2). In that way the population would meet the hygienist as the first line dental health care professional similar to primary health care as defined by WHO already in 1978. In such a service, the dental hygienist would become the primary contact for regular check-ups, which perhaps would help the Swedish population to maintain the advantages in oral health brought by the NDI since 1973, in spite of a much smaller number of dentists in the future.

## Conclusion

In Sweden, dentists constitute a strong professional body, while dental hygienists constitute an emerging profession that needs a clearer delineation and definition. The other clinical groups in Swedish dentistry, technicians and nurses are presently lacking traits necessary for them to be called professionals. It is unlikely that there is room for additional dental professions in Sweden besides dentists and dental hygienists.

The professional status of the Swedish dentists is ranked high, and the international impact of Swedish dental research has been great over the years. Professional ambitions such as a large number of clinical subspecialties have not been restricted by the

strong element of public health in the PDHS, but there is not yet any recognized specialty in dental public health.

In Sweden, the only other licensed clinical dental profession, the dental hygienists, have a somewhat uphill struggle to obtain a full professional recognition mainly for two reasons; their formal education is not homogenous, and their fields of knowledge are neither specific nor exclusive to their group. Perhaps more specific and well-defined areas of expertise, based on a common curriculum of formal education, would enhance their professional status more rapidly than the future prognosticated increase in numbers of hygienists compared to dentists.

Further understanding of the special traits of professionals will be needed to increase our understanding of management and governance of professional organizations. This will be the object of further research.

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# Quality of digital panoramic radiography in a newly established dental School

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## Abstract

Panoramic radiographs are known to be difficult to expose without errors. The aim of this pilot study was to determine the degree of success in taking error free digital panoramic radiographs. An experienced Oral and Maxillofacial Radiologist assessed the subjective image quality of 199 panoramic radiographs exposed in a newly established dental school in Kuwait. The number of errors according to an international "quality standard" in a panoramic radiograph was assessed. All radiographs were exposed by a dentist with minimal experience in taking panoramic radiographs. It was found that the number of errors in each radiograph ranged from 1 to 9 and no radiograph was completely free from errors. The average number of errors in the radiographs was 3.7.

Hence, these results confirm that panoramic radiography is a difficult radiographic technique, which needs an experienced operator in order to get high quality radiographs. Both theoretical and practical training is recommended for radiology staff, as in Sweden, where dental staff should be properly trained to make exposures.

## Key words

*Panoramic radiography, quality, error in radiographs*

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# Kvalitén hos digitala panoramabilder i en nystartad tandläkarhögskola i Kuwait

LEIF KULLMAN, BOBBY JOSEPH

**Sammanfattning**

Det är svårt att ta högkvalitativa panoramaröntgenbilder utan tekniska fel och syftet med föreliggande pilotstudie var att avgöra antalet tekniska fel i digitala panoramabilder på en nystartad tandläkarhögskola, som ett led i startandet av ett kvalitetsäkringsprogram.

En erfaren oral radiolog bedömde den subjektiva bildkvaliten i 199 digitala panoramabilder som alla tagits strax efter att kliniken startats. Antalet fel i bilden bedömdes i relation till en tidigare beskriven internationell kvalitetsstandard. Alla panoramabilderna var tagna av en tandläkare med ringa erfarenhet av panoramabildtagning.

Antalet fel i bilderna varierade mellan 1 och 9, ingen panoramabild var helt felfri. Genomsnittsbilden hade 3.7 fel av varierande ursprung.

Resultaten visar att det är mycket svårt att ta helt felfria panoramabilder för vanlig tandvårdspersonal. Panoramabildtagning är komplicerat och kräver stor noggrannnhet att utföra och en teoretisk och praktisk utbildning typ den svenska rekommenderas innan tandläkarpersonal utför denna typ av undersökning.

## Introduction

Dental panoramic radiography is a widely used radiographic technique giving a non-detailed image of the teeth or developing teeth, tooth position and gross bone pathology (1, 5 , 9). The examination is simple for the patient and it gives an image (Figur. 1) of high diagnostic value during some circumstances, even if it is less detailed than an intraoral x-ray.

The Faculty of Dentistry in Kuwait University is a newly established dental school where clinical facilities for patient treatment was started recently and a panoramic unit was among the purchased equipment.

It is a well-known fact that it is difficult to take good quality panoramics (11, 12).

One main problem is positioning of the patient before the exposure. If the positioning is not correct there is a risk that the patient's dental arch is positioned outside the "narrow zone of sharp focus", known as the "image layer" or "focal trough" and the final image of the dental arch will not be clear. *Schiff et al.* (10) reported in 1986 that about 80 percent out of 1000 panoramic radiograph had one or more errors.

According to the ALARA principle it is always important to keep the radiation dose low to the patients. ALARA is an abbreviation of the first letters in "As Low As Reasonable Achievable" and is a principle agreed upon by the International Commission of Radiological Protection.

One way to achieve this goal is to take high quality radiographs at the first attempt without a need for retakes. Therefore, every clinic with a panoramic unit needs to carry out regular clinical audit of the quality of its panoramic radiographs and strive for an optimal image quality (2, 7).

The main objective of this study was to establish the number of error free films when taking panoramic radiographs as one step in the quality assurance program in the Oral & Maxillofacial Radiology clinic. A standard described by *Langland et al.* (6) was used to define an error free film.

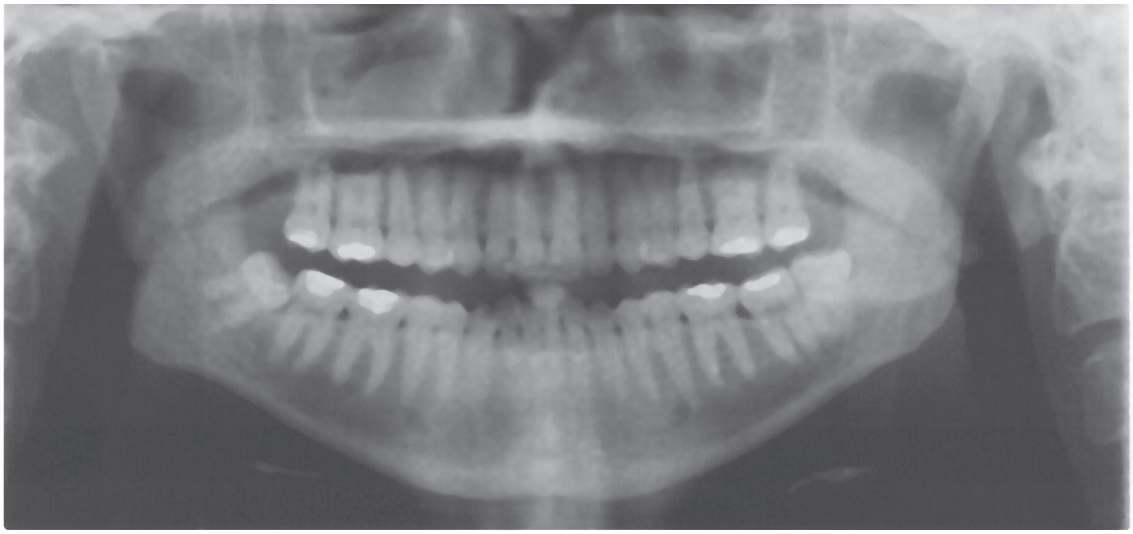
## Materials and methods

A digital radiographic system with a LAN network (Dimaxis Pro Version 3.1.0 Planmeca, Finland) was installed along with a panoramic machine when the school started. The panoramic machine is a direct digital panoramic unit, Planmeca 2002 EC Proline.

The first 199 panoramic radiographs that had been taken since the clinic started were used as the material for this study. After exposure, the images were saved in the Dimaxis database in a tif-format, using 8 bits per pixel and a resolution of 2424 x 1032 pixels.

All panoramic radiographs in this study had been exposed by a dentist with minimal experience in taking panoramic radiograph. The instruction manual was followed during exposures and the machine's bite-block was used to get the patient in a correct position. The focal positioning lights were also used every time in order to get the patient in correct po-

Figure 1. A panoramic radiograpg with an acceptable quality, showing two errors described in the quality standard criteria (Langland et al.) All theeth (crowns) are not separated from each other and the tongue is not in contact with the hard plate.



sition. The exposures were made without any knowledge that the radiographs would be eventually used in this study. The dentist made own observation whether the image was diagnostic and hence there was no retake of the radiographs.

The radiographs were evaluated in a random order for their subjective image quality by one experienced radiologist several months after the exposures were made. The radiographs were manipulated to get a good subjective contrast by using the inherent facilities of the software. The observer used a 15 inches screen and a resolution of 2424 x 1032 pixels.

The radiographs were classified according to the number of fulfilled successful criteria ('a quality standard') according to an assessment suggested by *Langland et al.* (6) for an optimum panoramic radiograph. One hundred of the used radiographs had earlier been assessed twice and the intra-reliability had been found to be good (4).

Quality standard criteria used in the current study:

1. The teeth should be arranged with a smile-like upward curve.
2. The teeth should be separated from each other, so that no overlapping of approximal surfaces are present.
3. The anterior teeth should be neither too large nor too narrow as to create pseudo-spaces bet ween them.
4. The posterior teeth should not be larger or smaller on one side than the other.
5. The apices and crowns of the maxillary and mandibular anterior teeth should not be cut off.
6. The images of the inferior turbinates and surrounding air spaces should be contained within the nasal cavity.
7. The hard palate shadow (double image) must be seen within the maxillary sinus, well above the apices of the posterior teeth.
8. The tongue should be in contact with the hard palate, with no intervening air between these structures.
9. The inferior border of the mandible should be smooth and continuous. The double image of the hyoid bone should also be absent in this area.
10. The condyles should be inside the image in the upper corners and be of equal size and on the same horizontal line.
11. The ramus of the mandible should be of same width bilaterally.

The number of unsuccessful criteria or simple "errors" according to the "quality standard" for each panoramic radiograph was calculated. The number of the different kinds of errors was also calculated and the different errors analyzed in relation to each other.

Table 1. The distribution of number of errors in the radiographs.

| Number of errors | Frequency | Percent |
|---|---|---|
| 1 | 5 | 2.5 |
| 2 | 35 | 17.6 |
| 3 | 56 | 28.1 |
| 4 | 54 | 27.1 |
| 5 | 32 | 16.1 |
| 6 | 13 | 6.5 |
| 7 | 2 | 1.0 |
| 8 | 1 | 0.5 |
| 9 | 1 | 0.5 |
| Total | 199 | 100 |

## Results

The number of errors ranged from 1 to 9 in the exposed radiographs and none was free from errors. The average number of errors in the radiographs was 3.7 (Table 1).

The most common error was that the teeth were not separated in 24 % of all errors. If we use the radiographs themselves as the unit had 86 % of all radiographs overlappings (Table 2). More than 80 % of these were in the premolar area. The second most common error (16%) was that the apices or crowns of maxillary or mandibular anterior teeth were cut off, indicating that these parts of the teeth were out of the focal through (=sharp imaged layer) during exposure. Other common errors were that the tongue was not in contact with the palate during exposure (16%) and the inferior border of the mandible was not smooth and continuous due to double images of the hyoid bones (15%).

## Discussion

Varying results have been found in studies of errors in panoramic radiographs. *Akarslan et al.* (1) evaluated panoramics taken in a dental college by experienced technicians. They found the rate of error free films to be 38 % according to the criteria followed in their study. One explanation as to why the authors found more error-free radiographs than in this study could be that they used competent technicians with a lot of experience and used a differ-

**Table 2.** Ranking of the differents errors in the panoramic radiographs. Error %=percentage of the radiographs showing this error out of all errors. Radiograph %=percentage of number of radiographs with error.

| Error criteria | Number of radiographs with this error | Error % | Radiograph % |
|---|---|---|---|
| The teeth not separated from each other | 172 | 24 | 86 |
| The apices/crowns of maxillary and mandibular anterior teeth cut off | 188 | 16 | 59 |
| The tongue not in contact with the hard palate, with intervening air between structures | 114 | 16 | 57 |
| The inferior border of the mandible not smooth and continuous. Double image of the hyoid bone here | 109 | 15 | 55 |
| The teeth not arranged with a smile-like upward curve | 50 | 7 | 25 |
| The anterior teeth too large or too narrow creating overlapping/pseudo-spaces between them | 49 | 7 | 25 |
| The ramus of the mandible not of same width bilaterally | 36 | 5 | 18 |
| The condyles not inside the image in the upper corners and not of equal size nor on the same horizontal line | 34 | 5 | 17 |
| The posterior teeth larger or smaller on one side than in the other | 25 | 3 | 13 |
| The inferior turbinates and surrounding air spaces not within the nasal cavity | 15 | 2 | 8 |
| The hard palate shadow (double image) not within the maxillary sinus nor well above all apices | 6 | 1 | 3 |
| Total | 728 | | |

ent "quality standard" for evaluation. *Åkesson et al.* (13) could also verify and conclude, when comparing panoramic radiographs from different types of clinics, that those from a radiology department were superior.

The most common error that *Akarslan el al.* (1) found was the shadow of the airway above the tongue in 46% of the radiographs. The same error was present in 16% in our study and the error has been found frequently in several studies before (6, 10). This error appears when the tongue of the patient is not raised against the palate during exposure, an instruction given to the patient before the exposure. As a result, radiolucent bands appeared above the roots of the maxillary teeth, making their interpretation more difficult.

The most common error in our study was that there was an overlapping of the teeth, which was seen in 86 % of all radiographs. This is a common error, especially in the premolar area and more or less intrinsic to all panoramic units. The main causes of this error are that the chin has been tipped or the head tilted during exposure. This was also a common error found by *Schiff et al.* (10). About 20 % of their errors had these causes. The same authors reported also a rate of 20 % error free films. They had evaluated 1000 panoramic radiographs taken with different machines in a dental school. Positioning errors were more common than technical ones. In panoramic radiography is it very important that the operator pay careful attention in patient positioning during the exposure to get high quality radiographs (11, 12).

In the present study, all the radiographs showed some sort of error. Everything depends upon the definition of defining a good panoramic x-ray. A few errors might not cause a difficulty in diagno-

sis. The standard we used in this study suggested by *Langland et al*. (6) is a very strict system. Panoramic radiographs are mostly used clinically for diagnostic problems requiring broad coverage of the jaws (12) and as a startup choice and help in deciding the need for other projections. When other projections later on are available, the diagnostics mostly rely on these, thus decreasing the need for panoramic radiographs as being of a 100 % diagnostic quality.

In 1999**,** *Rushton et al.* (8) evaluated panoramic radiographs from different general dental practices in UK and the success-rate was only 0.8 %. The radiographs were judged as being "excellent", "diagnostically acceptable" or "unacceptable" and only 0.8 % was classified as excellent. Each radiograph was then scored for the absence or presence of a range of technical and processing errors. The term excellent was used only when the number of errors was nil. If the radiographs were scored as diagnostically acceptable some error/s could exist. *Rumberg et al* (7) found in 1996 that there were major defects in the quality of panoramic x-rays exposed by most clinics managed by general practitioners in the US. Only 33 % were of acceptable quality. One of their recommendations was that a proper education or training should be implemented for dentists who use panoramic units. The study of *Schiff et al* (10) also showed the importance of having a proper training in use of panoramic equipment. They came up with the conclusion that trained technicians made fewer positioning errors.

In our study, we included an average radiograph based on the following characteristics: teeth, which were not separated from each other, some part of the crown or root was cut off due to bad patient positioning, the tongue was in wrong position and ghost images disturbed the outlining of the object. These errors were due to patient positioning and patient instruction error. We used a digital panoramic unit, which eliminates darkroom and also exposure parameter errors if the manual is followed properly. In order to improve the quality of the radiographs, in the future, the staff should be informed about these errors and how to avoid them. An instruction sheet on the different steps to get the patient correctly positioned will be attached to the wall in the panoramic laboratory.

In summary, panoramic radiography is a demanding technique, which requires an experienced user to rectify a variety of errors in the final image. It is recommended that skilled, competent and accurate operators are used to increase the quality of the radiographs. In some countries over the world, it is mandatory to attend a didactic and practical course, before being allowed to operate a panoramic machine. This approach is recommended wherever panoramic machines are used.

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# Abstracts

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1

## Two-year clinical performance of direct resin composite restorations in Class II cavities

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Objectives: The purpose of this study was to evaluate the clinical performance of the resin composite Latitude (Ardent) in stress-bearing premolars and molars.

Methods: Sixty-two patients (age 23-71 years) in need of moderate to large class II restorations received a total of 108 restorations. Twothirds of the estorations were made by a teacher and one third by students in their final clinical training period. At baseline and after 1 and 2 years, the restorations were evaluated using slightly modified USPHS criteria.

Results: After 2 years 104 restorations were available for examination. The results showed that the restorations were still performing at clinically acceptable levels except for two fillings, one with a fracture after one year and one with cervical gap formation after 2 years. No secondary caries lesions were noted. Good approximal contacts were noted in 86% of the restorations after 2 years. No differences in score values were seen between fillings made by a teacher or the students.

Conclusions: It can be concluded that the performance of Latitude was clinically acceptable in stress-bearing posterior cavitites after 2 years. However, further long-term recalls are needed.

2

## Endodontic status of patients receiving high-cost dental care within the Swedish Dental Insurance System: A 20-year follow-up study

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Objectives: A previous study of this sample of patients have shown that most of the patients had fewer teeth with apical periodontitis after a follow-up of 20-years and that tooth extraction had often been the treatment. The aim with the present study is to follow-up the outcome of the endodontic treatments registered at base-line after a 20-year follow-up period and to study the change in endodontic status.

Methods: From all treatment plans sent to the local health insurance offices for approval in 1977-1978, every 5th treatment plan from patients born on the 20th of each month was sampled for baseline studies. In 4 local health insurance districts all 262 patients sampled in 1977-1978 were in 1998 offered a free clinical and radiographic examnation. At follow-up 177 patients (68 %) could be reached and 104 of them (40 % of the original sample) were clinically examined. Records and radiographs from 1978 and 1998 were studied regarding root-filled teeth, periapical status and change in endodontic status during follow-up including tooth extractions.

Results: During the 20-year follow-up period, significantly more incompletely than completely root filled teeth became extracted ($p=0.002$). A significantly larger part of root-filled teeth with apical periodontitis compared to root-filled teeth with normal periapical conditions ($p=0.001$)at baseline became extracted during the follow-up period as well. Teeth with incompletely obturated root canals and normal periapical conditins at base-line developed apical periodontitis during the follow-up period significantly more often than teeth with completely obturated root canals ($p<0.05$).

In 1998, 40 % of the root filled teeth were completely obturated compared to 26 % in 1978. The technical quality of the root fillings ($p<0.001$) and the periapical condition at root filled teeth ($p=0.001$)was significantly better at follow-up than at base-line.

Conclusions: The root-filled teeth that became extracted during the 20-year follow-up period was dominated by root-filled teeth with incompletely obturated root canals and/or with apical periodontitis. At follow-up in 1998 the technical quality of the root-fillings and the periapical status of root-filled teeth

was better than at base-line 1978. However only 40 % of the root filled teeth were completely obturated at follow-up. Since teeth with incompletely obturated root-canals frequently became extracted during the follow-up period this must be considered a treatment problem.

◎ ◎ ◎ 3

## Detection of biofilms in the periapical region of teeth

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Objectives: The purpose of the study was to investigate the occurrence of microbial biofilms in root canals and on root surfaces of root filled teeth with apical periodontitis.

Methods: The apical 3-mm portion of 7 root filled teeth were resected during apical surgery because of apical periodontitis. To gain entrance, a sub marginal flap technique was used in order to minimise the risk of microbial contamination from the periodontal pocket. In 3 of the specimens bacterial samples from the rootcanal, rootsurface and from the transport media were taken. These were cultivated in anaerobic environment on blood agar plates. 4 root tips were observed in a Hitachi tabletop electron microscope, and scanned for microbial biofilm aggregations.

Results: In all samples from the transport media, growth of bacteria occurred. 12 different species were found. In one of the specimens microbial growth also occurred in samples from the root canal and the root surface. In that case one species was found. From the SEM observation we could, in one of the specimens, detect formations of microbial biofilm at the external root surface, in the orifice of the root canals and in the space between the root filling and the canal wall in the most apical part of the canal.

Conclusions: In our material we observed a poly microbial infection that was established in a biofilm in the rootcanal and on the external root surface.

◎ ◎ ◎ 4

## A comparative analysis of MRI, CBCT and conventional radiography in patients with atypical odontalgia and symptomatic apical periodontitis: preliminary results

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Objectives: Atypical odontalgia(AO) is a chronic pain condition located in the teeth and jaws. It has been suggested, that AO is best regarded as a neuropathic pain condition, but knowledge regarding the etiology, diagnostics, and management of AO is not yet satisfactory.

This pilot study evaluates the clinical usefulness of more recently developed imaging methods for intraoral pain conditions.

The aim is to compare the diagnostic findings using magnetic resonance imaging(MRI) and cone beam computed tomography(CBCT) with the findings from conventional radiography in patients with atypical odontalgia(AO) and symptomatic apical periodontitis(SAP).

Methods: 12 patients (9 F, 3 M) mean age 50.3 years, range 36 - 63 years participated in the study. The patients were referred to the Orofacial Pain Unit or the Department of Endodontics, Faculty of Odontology, Malmö University.

Inclusion criteria for AO were chronic pain (>6 months) located in a region where a tooth had been endodontically or surgically treated, pain with no pathological cause detectable in clinical or radiological examinations. For SAP, the inclusion criteria were recurrent pain from a tooth diagnosed with apical periodontitis in a clinical and radiographic examination. Ten of the patients in the study were diagnosed with AO and two with SAP.

The patients were clinically assessed with a qualitative somatosensory examination, a dental examination, an examination of the masticatory system (RDC/TMD), and panoramic and intraoral radiographs. A questionnaire was used to gather information about pain characteristics, psychosocial status (SCL-90), and quality of life.

Besides these measures, each patient underwent a CBCT (3D-Accuitomo, J Morita Co) examination and a MRI (Siemens Sonata Vision 1.5 T) exami-

nation with and without contrast enhancement. Contrast was enhanced by injections of Magnevist (469 mg/ml, Schering Nordiska). Bone destruction, sclerosis, and signs of inflammation were the main parameters studied.

Results: In the preliminary results, average pain intensity was 6.3 on a numerical rating scale(NRS) and average pain duration was 3.6 years. 83% exhibited somatosensory abnormalities.

Bone destruction not visible in the intraoral and panoramic radiographs was detected with CBCT in 40% (4/10) of the patients diagnosed with AO, and signs of inflammation were detected in the MRIs of 20% (2/10) of the patients diagnosed with AO.

Conclusions: Preliminary findings indicate that CBCT and MRI can provide additional information to conventional radiography in the diagnosis of intraoral orofacial pain.

Further studies with larger sample sizes of AO and SAP patients are necessary to determine the clinical relevance of these findings.

◎ ◎ ◎ 5

## Base materials for Dental Prothesis: A comparative evaluation of strength and hardness between a light cured and an ordinary heat cured Material

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Objectives: Today, heat cured denture base materials still, are the material mostely used for removable dental prothesis. Light cured base materials have been developed to overcome some of the shortcomings with the heat cured denture base materials and manufactures recently have presented a new type of light curing denture base materials.

The aim of the study was to investigate the difference between a conventional- and a light cured denture base material concerning flexural strength and stiffness after storage under dry and wet conditions respectively. In addition differences in surface hardness before and after storage (dry and wet) was evaluated.

Methods: Forty test samples, 20 of each of the materials Microdent® a conventional denture base material (Esschem Europé LTD, England) and Eclipse®, a light cured denture base material (Dentsply International, USA) were produced according to ISO 1567:1999 (Dentistry - Denture base polymers). Ten samples of each material were stored dry (7 days) and the other ten were stored wet at 37°C for the same period of time. All samples were subjected to Vickers microhardness test (200g kgf, dwell time 25 s) and a three point bending test with a load of 5 mm/min until break according to ISO 1567:1999. Calculation of surface hardness (VHN in MPa), bending stress (MPa), bending modulus (MPa) and deflection (mm) was performed according to established formulas. Statistical comparison between groups was performed using ANOVA and Wilcoxon Rank sum test in SPSS. Level of significance was set to 5%.

Results: The light cured dental base material had a significant higher surface hardness in MPa compared to the conventional cured material. In addition both type of materials displayed a significant higher surface hardness when stored dry. The results of flexural strength and flexural modulus were significantly higher for the light cured polymer base material after water storage compared to the conventional material. All samples tested met the requirement for flexural strength according to the ISO standard

Conclusions: The values for the mechanical properties tested were significantly higher for the light cured polymer base material compared to the conventional.

Water storage seemed to have an influence on the mechanical properties despite of the short storage time (7 days). The light cure polymer base materials tested had a tendency of brittleness when fractured.

◎ ◎ ◎ 6

## Temporary abutments - Surface modifications and retention of provisional crowns

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Objectives: Temporary abutments with provisional crowns are used in the aesthetic area to preserve and contour soft tissue and when healing time is prolonged.

Provisional crowns of dental resin composite on temporary abutments can be made chair side. The aim of the study was to characterise surface topography and study how they influence the interface and the shear strength between composite and abutment.

Methods: 30 temporary titanium abutments were supplied by Astra Tech with 3 different surfaces; original (commercial available), blasted and polished, 10 of each. 2 abutments of each surface were randomly selected and their surfaces were evaluated with a contact stylus instrument. Provisional composite crowns of Tetric® EvoCeram were fabricated on the abutments in a mould. 6 abutments, 2 of each surface, with provisional crowns were embedded in Technovit® and cut in longitudinal halves. The interface between the composite and the surface of the abutment was evaluated in a light microscope. The adhesion between composite and temporary abutments, 8 of each surface, was tested with a push out test, measuring shear strength at maximum load, using a Lloyd universal testing machine. The abutments, used in the push out test, were analysed in a light microscope to see if the fractures were cohesive or not.

Results: The results from the topographical characterisation showed that Sa was higher within the original group than in the other two groups. There were more gap formations at the interface between composite and abutment in the polished group than the others. The results from the push out test showed that a significant difference was recorded in shear strength between each of the different groups, where the original surface showed the highest value and the polished the lowest. Analyses of the abutment surfaces, after the push-out test, showed that there were no composite left on the polished surfaces. On the blasted and original abutments, occasional small islands of composite were detected.

Conclusions: The surface of the commercial available abutment (original) was rougher than the two different modified surfaces, blasted and polished. The polished surface had more gaps at the interface, between composite and abutment, than the original and blasted surfaces, indicating less good wetting properties. The shear strength correlates with the surface roughness, where the rougher surface showed higher shear strength. The fracture at maximum load was not cohesive but ran through the interface between the composite and the abutment.

◎ ◎ ◎ 7

## Bond strengths of different adhesion systems to a sandblasted alumina core material

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Objectives: The traditional zinc phosphate cementation technique for crowns and fixed partial dentures (FPDs) is based on mechanical retention where the geometry of the prepared tooth provides retention for the restoration. In clinical situations where mechanical retention is compromised or regarded insufficient, an adhesive bonding system can be used to provide retention. This study investigates whether the bond strengths of different bonding agents to densely sintered high-strength alumina ceramics are sufficient.

Methods: The surfaces of 120 pairs of industrially manufactured specimens of densely sintered alumina were sandblasted with 110 μm aluminium oxide and bonded with one of six different adhesion systems. Each bonding group of 20 samples was randomly divided into two subgroups (n=10). Both subgroups, A and B, were stored 1 week in distilled water (37°C). During this week, subgroup B samples underwent 5000 thermocycles (5°C -55°C). Following pretreatment, the specimens were loaded until fracture in a universal testing machine to determine shear bond strength. Data were analysed using student's t-test and a one-way ANOVA. Fractured interfaces were examined under a light microscope to classify the failure mode of the debonded area as adhesive, cohesive, or a combination of the two.

Results: The highest bond strengths - 31 MPa (no thermocycling) and 36 MPa(thermocycling) - were significantly higher than the lowest bond strengths - 4 MPa and 2 MPa, respectively - ($p>0.001$). The predominant failure mode for both treated and untreated surfaces was adhesive.

Conclusions: Given the limitations of this study, these results indicate that sufficient bond strength can be established between densely sintered alumina and adhesive cement systems. The strengths of the systems, however, vary.

◎ ◎ ◎ 8

## Human saliva forms a complex film structure on alumina surfaces

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Objectives: Films formed from saliva on surfaces are important for maintenance of oral health and integrity by protection against chemical and/or biological agents. The aim of the present study was to investigate the salivary film structure.

Methods: We studied adsorbed amounts, thickness, surface morphology and the density profiles of films formed from human whole saliva on alumina surfaces by means of in situ ellipsometry, neutron reflectivity and atomic force microscopy. Alumina ($Al_2O_3$, synthetic sapphire) is a relevant and interesting substrate for saliva adsorption studies as it has an isoelectric point close to that of tooth enamel.

Results: The results showed that saliva adsorbs rapidly on alumina. The film could be modelled in two layers: an inner and dense thin region which forms a uniform layer, and an outer, more diffuse and thicker region that protrudes towards the bulk of the solution.

Conclusions: The film morphology described a uniformly covering dense layer and a second outer layer containing polydisperse adsorbed macromolecules or aggregates.

◎ ◎ ◎ 9

## Levels of gold in plasma after dental gold inlay insertion

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Objectives: Gold alloys are frequently used in dentistry, when patients are in need of oral rehabilitation. Although gold is considered to be biocompatible, several studies report increased frequency of contact allergy to gold. A correlation between the presence of dental gold and contact allergy, as well as a dose-response relationship between dental gold and gold levels in blood clearly indicate that gold is released from dental restorations.

The aim of the present study was to analyze the plasma levels of gold before, within one year after and 15 years after gold inlay insertion.

Methods: Plasma samples from nine persons were taken before and within one year after gold inlay insertion. Fifteen years after new blood samples were taken in 8 of these persons. The plasma samples were analyzed for gold, using an inductively coupled plasma mass spectrometry. An oral examination was also carried out at the before and 15 years after examinations.

Results: Within one year after gold inlay insertion gold in plasma increases (p=0,008). No significant difference was found for the values within one year after and 15 years after (p=0,109). A significant correlation was found between the number of gold alloy surfaces and the amount of Au in plasma 15 years after (p=0,028).

Conclusions: The results of this study further support a dose related release of gold into plasma from dental gold inlays. The release appears stable over time.

◎ ◎ ◎ 10

## The encounter in dental care as interpreted by homeless individuals

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Objectives: To illuminate homeless people's subjective interpretations of dental care in the encounter between them selves, professionals and society.

Methods: In depth interviews were performed with eight homeless individuals a few month after they had received dental treatment. Qualitative content analysis was used to analyse the transcripts of the interviews.

Results: In sentences related to the homeless individual as a person, the underlying meanings of what the text talked about, were interpreted as codes and subthemes labelled as two themes, "Struggle to retain integrity" and "Need for freedom without responsibility". In sentences related to the homeless individual as a patient in dental care, the underlying meanings of what the text said were likewise interpreted in codes and subthemes labelled as two themes "Meeting the patient where he/she is" and "Future dental care".

The homeless individual felt exposed as a person in the society including in the meeting with dental care and this was a frequent underlying meaning of the texts. A common complaint from the homeless patients was disrespect from care providers. There were many ways of facing the dilemma, e.g. to keep a distance, to try to act normal, to deny, to run away. The interviewees changed to a patient perspective when they were specifically talking about the interaction with the dentist, and they mirrored what made them feel comfortable or uncomfortable in the meeting.

Future dental care was talked about with different feelings. Ordinary regular dental contact could be seen as one way back to normal life or as doubtful, and the obstacles were both subjective and objective.

Conclusions: In planning dental care for homeless people it is important not only to acknowledge experiences from clinical research but it is essential to take the feeling and experiences of the homeless individuals into account.

◎ ◎ ◎ 11

## Effects of a reform. Knowledge of and attitude towards oral health and care among nursing home staff in the county of Jönköping, Sweden, five years after the 1999 Dental Care Reform was introduced.

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Objectives: The aim was to
- describe and understand attitudes towards and knowledge of oral care,
- find simple, effective methods of following up the intentions of the reform,
- improve dental attention and care given to care-dependent elderly and disabled persons.

Methods: Subjects were strategically selected from ten nursing homes for broad representation geographically, as to municipality structure and nursing home size. All nursing staff of the wards selected, around 560 persons, constituted the population. Data was collected by a self administered questionnaire with totally 70 questions to the staff. The last one was open for comments. The questionnaire is tested for validity and reliability.

Results: The educational efforts of the reform had reached only 2/3 of the nursing staff. A majority had acceptable or good knowledge of oral health and personal oral care habits but still considered the dental profession responsible for oral health. Oral care in nursing was found to be trying.

Conclusions: There is need for improved basic training in oral care yearly to newly employed nursing staff and brush-up opportunities at intervals to the experienced staff with supervised practical training in between where specific lack of certain knowledge fields should be stressed.

## ◎ ◎ ◎ 12

### Advanced dental hygiene education results in an attitude change for nursing home staff and thereby improved dental hygiene for patients

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Objectives: The purpose of this study was to evaluate a new pedagogical model in advanced education in dental hygiene for staff working in nursing homes. A secondary aim was to suggest adequate measures to optimise dental care in nursing homes.

Methods: Two nursing homes with similar dementia patients groups were included in the study, the staff of one nursing home was given advanced dental hygiene education while the other nursing home served as the control. All patients from the first nursing home that still had their own teeth numbered 41, 42 and 43 were investigated for their oral status including plaque index (PI) assessment. This was done at two occasions, before the education program to the staff and afterwards. The education program consisted of lectures to small groups of staff (4-8 persons) with visual material as well as hands-on training to improve dental hygiene. A dental hygienist performed the education, and she was supported by a psychologist. The nursing staff completed a questionnaire before and after the education program.

Results: The staff from both nursing homes generally considered having enough time and knowledge to perform dental care although there was interest for the education program and hands-on training to improve performance. They are very dedicated to their duties, and daily dental care is considered important. The major result from the questionnaire was the difficulties performing dental hygiene due to the resistance of patients and the feeling of the staff of imposed care. From the patients investigated so far, the total PI (for 41, 42 and 43 together) improved from the first to the second assessment by about 14%, on average, mostly on the messial and buccal side, less so on the lingual side.

## ◎ ◎ ◎ 13

### Malocclusions in prematurely born children - a prospective and controlled study

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Objectives: To evaluate if malocclusions are more common in prematurely born children than in fullterm children.

Methods: After a sample size calculation, 80 prematurely born children of 8-10 years of age were selected from the Medical Birth Register. The premature children were divided into two subgroups according to their gestational age. One group consisted of 40 very preterm children (born in gestational week 29-32), and the other of 40 extremely preterm children (born before the 29th gestational week). The subjects were compared with a control group of 40 fullterm children (born in gestational week 37-42), who were matched for sex, age and nationality. All subjects lived in the southern part of Sweden and were born at the University hospitals of Lund and Malmoe. Data from clinical examinations, study casts and panoramic radiographs were used to determine malocclusions. The examiner conducting the measurement analysis was unaware of the group to which the subject belonged.

Results: The results showed that there were significantly more deep bite in the group of prematurely born children compared to the normal group (p=0.046).

Cross-bite and rotated teeth were also more frequent in the group of prematurely born children, but with no significant difference between the groups. There was not found any significant difference in the frequency of malocclusions between very preterm and extremely preterm children.

Conclusions: The dental clinicians have to pay attention to prematurely born children since malocclusions are more frequent which involves conceivable greater need of orthodontic treatment of these children.

◎ ◎ ◎ 14

## A cost effectiveness analysis of distal molar movement with extraoral and intraoral appliance

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Objectives: Using randomized controlled trial methodology, the cost-effectiveness was analysed of an extraoral appliance (EOA) and an intraoral appliance (IOA) for distal movement of maxillary first molars.

Methods: Forty adolescents (mean 11.5 years SD 1.29) at the Orthodontic Clinic, National Health Service, Malmˆ, Sweden, were randomized to receive treatment with either EOA (cervical headgear) or an IOA using superelastic coils for distal movement of maxillary first molars. The inclusion criteria for all patients were a non extraction treatment plan, a Class II molar relationship and maxillary first molars in occlusion with no erupted maxillary second molars.

The quantity of care in minutes was calculated and the treatment costs, i.e. the costs for dentist chair time including the assistant and overhead costs, the costs for the material including the dental technician, the costs for breakage of the appliance, and the costs for the retention material including the dental technician were evaluated. Finally, the cost-effectiveness was calculated, i.e. the treatment cost was related to the treatment effect (the cost per millimetre of molar movement).

Results: The average quantity of care in minutes was significantly higher for the IOA than for the EOA ($p<.001$). Also, the mean treatment cost was significantly higher for the IOA than for the EOA ($p<.001$). However, when the cost was related to the treatment effect, the average cost per millimetre distal molar movement was lower for the IOA than for the EOA ($p<.01$).

Conclusions: The IOA was significantly more cost-effective than the EOA to create distal molar movement of maxillary first molars.

◎ ◎ ◎ 15

## Changes in the cervical spine of children with juvenile idiopathic arthritis compared with healthy children, evaluated with plain lateral cephalometric radiographs

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Objectives: The aim of this retrospective study was to evaluate whether plain lateral cephalometric radiographs in neutral position could be used as a diagnostic tool to investigate juvenile idiopathic arthritic changes in the cervical spine.

Methods: Lateral cephalometric radiographs of 82 children, 22 boys and 60 girls (8-25 years old), affected with JIA, were taken in order to evaluate facial development. They were compared with 82 controls matched in age and gender. Changes inspected in the cervical spine were erosions of the dens and fusion of the apophyseal joints. Anterior atlantoaxial subluxation (aAAS) of the first vertebra onto the second was examined by measuring the anterior atlantodens interval (aADI). Atlantoaxial impaction (AAI) was studied by using the Sakaguchi-Kauppi method.

Results: In the JIA sample erosion was seen in 12 patients (14.8%) and apophysejoint ankylosis in 15 (19.5%). Four patients had aADI more than 4 mm, which is considered to be abnormally increased, and AAI was noted in 12 (14.8%) patients. Two of the controls showed fusion of the apophyseal joints and one had aADI of 4 mm. Compared to the controls significantly more changes were found in the JIA-group.

Conclusions: It can be concluded that plain lateral cephalometric radiographs show juvenile idiopathic arthritic changes in the cervical spine already in a young age and should be evaluated when available.

## 16

### Long-term stability of surgically assisted rapid maxillary expansion

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Objectives: Evaluate the treatment effects and long-term stability of surgically assisted rapid maxillary expansion

Methods: The sample consisted of a retrospective consecutive material of 31 patient,17 males and 14 females, treated with a surgically assisted maxillary expansion. Mean age 26.9 years, range 15.7-48.9 years. Mean follow-up time 6.4 years, range 3.1-13.9 years. Control sample was matched concerning age, sex and follow-up time. Measurements of transversal distance between the canines and between the fist molar were taken on study casts before expansion, post expansion and at follow-up. Error of measurments, intraclass correlations for single measurements, were between 0.995 - 0.999.

Results: The mean post expasion measured on cusps of the canines was 3.34 mm SD 2.13, cervically at canines 3.89 mm SD 1.77. Mesiobuccal-cusp of first molar 5.80 mm SD 2.50 and cervically on fist molars 4.55 mm SD 1.91 mm. All expansions were statistically significant at $p<0.001$. Follow-up relaps, cusp tops canines 0.84 mm SD 1.27, canines cervically 0.90 mm SD 1.01, mesiobuccal cusp first molar 1.54 mm SD 1.66 and cervically first molar 0.69 mm SD 1.08. All relaps were statistically significant at $p<0.001$.

However there are no statistically significant differences between treatment group and control group at follow-up except for the transversal distances between the mesiobuccal cusp on first molars and there is no statistic significant difference between the absolute amount of relaps in a short follow-up period (mean 3.7 years) compared with long follow-up period (mean 9.3 years).

Conclusions: The surgically assisted rapid maxillary expansion normalize the transversal discripancy and it is stable 6 years post treatment. Relaps is time related and is most evident the fist 3 years post treatment.

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### Overjet and incisor position as predisposing factors for dental trauma. A retrospective study in orthodontically treated children

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Objectives: Most previous studies have shown the prevalence of traumatic dental injuries in maxillary incisors to increase with increased overjet and inadequate lip coverage. The purpose of this study was to examine this issue of dental injury by case record data in orthodontic patients.

Methods: The data for this study was collected from a public orthodontic clinic in Haninge, a suburb 20 km Southeast of Stockholm. This clinic belongs to the public dental service in Stockholm, operated by the limited company FolktandvÂrden, Stockholms län AB.

This study identifies 47 children and adolescent age 7-19 years from a clinic population of 469 subjects, who had suffered trauma to maxillary incisors. Journal, study models and cephalograms of patients were used. The study population consisted of two groups of orthodontic patients,patients with injured incisors (trauma patients) and patients with no history of trauma to maxillary incisor(controls) selected from the same clinic population. The controls were age and sex matched with trauma patients.

The size of overjet, adequacy of lip coverage, cephalometric skeletal, dental and soft tissue measurement was made. The variables in groups T and C were compared and their predictive values from possible occurrence of trauma were tested by logistic regression analysis.

Results: The frequency for injuries to upper permanent incisors was 10.5 per cent. We found no significant difference between trauma patients and controls in the amount of overjet, lip coverage or any of the cephalometric variables.

Conclusions: How to explain the seemingly contradictory results of this study? The reason might partly be due to the overall low prevalence of traumatic dental injury compared to the studies based on children born 1960-1980. The lifestyle

of children and adolescence has undergone a tremendous changed over the last few years. Children are less active than before. Outdoor physical activities have been substituted by consumption of films, videogames and sustained use of computers. Thus children are nowadays much less exposed to conditions predisposing to trauma.

◎ ◎ ◎ 18

## Histological and MRI findings during Herbst treatment

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Objectives: To develop an experimental animal model for monitoring TMJ growth changes occurring during Herbst treatment and to compare magnetic resonans images(MRI) findings with histological changes.

Methods: One Göttingen minipigT was treated with the Herbst appliance for 2 months. The minipig was 2 months old at start of the experimental period and treatment was thus performed just before sexual maturity which on average occurs at 4-5 months of age. The Herbst appliance comprised of casted splints and the amount of bite jumping was 4-5 mm. The primary cuspids were extracted at the start of the experimental period to avoid interference when the mandible was positioned forward. MRI images of the TMJ were taken before (without and with appliance), after 1 month, and at the end of the experimental period when the minipig was sacrificed. The TMJ complex was embedded in methylacrylate and sagittal histological sections stained with Goldener were analysed. The study was approved by the Animal Experimental Committee at the University of Lund, Sweden.

Results: In the MRI's a distinct bright band was clearly seen on the superior border of the right and left condyles. The band was seen at all stages of treatment and did not seem to change in thickness during the observation period. The band was also identified in the histological sections.

Conclusions: The Göttingen minipig is a suitable experimental animal for investigating condylar growth changes during Herbst treatment. The bright MRI band seen in patients treated with the Herbst appliance can also be identified and analysed in minipigs.

◎ ◎ ◎ 19

## Dental fear in 8-19 year olds as rated by themselves and their parents - more similarities than differences?

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Objectives: This methodological study aimed to evaluate the reliability of dental fear ratings by assessing the agreement between self-ratings and parental ratings of child and adolescent dental fear in two groups of dental patients.

Methods: Two hundred 8-19 year old dental patients referred for specialized paediatric dentistry because of dental behaviour management problems constituted the study group. Two hundred ordinary dental patients in the same age span served as a reference group. Patients and their accompanying parents (mainly mothers) in both groups were, as part of a questionnaire battery, independently requested to fill in self- versus parental ratings versions of the Dental Subscale of Children's Fear Survey Schedule. The patient-parent agreement was evaluated both from ordinally scaled sum-scores and from crosstabulations of fear level categories.

Results: Both patient and parent fear ratings were significantly higher in the study group as compared to the reference group. The patient-parent agreement decreased with increasing fear levels, showing substantial disagreement in single cases, mainly in the study group.

Conclusions: The reliability of parental ratings of child or adolescent dental fear should be questioned, in particular in high fear populations. Self-ratings should, as far as possible, complement parental ratings.

◎ ◎ ◎ 20

## Growth and differentiation of the odontoblast-like cell line MRPC-1 cultured on different supports

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Objectives: When grown on a solid support the odontoblast-like cell line MRPC-1 grow in characteristic confluent double layers separated by a collagenous matrix. The cell line express typical odontoblast characteristics. They express hard tissue forming cell proteins, transport $Ca^{2+}$ and $PO_4^{3-}$ in a polarized way and mineralize in vitro. Properties of cells in culture can be altered by different growth supports. One support is Matrigel®, a soluble basement membrane preparation extracted from a mouse sarcoma containing laminine, collagen type IV, TGF-beta, FGF and heparan sulfate proteoglucans, in addition to an undefined portion of growth factors and regulators. Another growth support is collagen type I, the major protein secreted by odontoblast, and the native support for growth. The aim of this study was to explore if monolayer growth of odontoblast-like MRPC-1 cells could be induced by outgrowth on either Matrigel® or collagen type I supports.

Methods: MRPC-1 cells were seeded on Transwell-chamber membranes with different membrane coatings: Matrigel, collagen type I or plain teflon. The cells were cultured in MEM + 10% FCS medium with 50µg/ul ascorbic acid and 2mM Glutamax at 37°C in 5% $CO_2$. Day 6 $PO_4^{3-}$ (4mM) was added to the medium. On day 7 membranes with cells were fixed with ice cold methanol, cut out, Epon embedded, semi-thin sectioned and stained with toluidine blue. In a microscope mono- or double layer outgrowth was analyzed. In parallel, MRPC-1 cells were cultured on 24 well plates on the same supports as described under similar conditions.

Results: At confluency and 12 days after the cells were fixed with ice cold methanol and stained according to the Von Kossa technique. Cells/µm2 in addition to mineralized nodule size and number were analyzed. MRPC-1 cells cultured on uncoated membranes formed bilayers. The cells were flat and epitheloid. On collagen type I irregular outgrowth in several layers were seen. Matrigel as support induced almost complete outgrowth in monolayers. On day 12 after confluency mineralized nodules were seen in all groups, mostly in the uncoated plastic wells. The nodule size, however, was largest in the collagen group. In the Matrigel group large areas of confluent nodules were seen.

Conclusions: Both Matrigel and collagen type 1 supports are for different reasons considered important for outgrowth of odontoblast-like cells with a high degree of differentiation.

◎ ◎ ◎ 21

## A dental management protocol for Amelogenesis Imperfecta - report from a workshop

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Objectives: Amelogenesis Imperfecta (AI) is a general hereditary enamel disturbance that is characterised by clinical and genetic heterogeneity. It can be divided in three main groups, hypoplasia, hypomaturation, and hypocalcification types of AI. AI can be a severe disability to the growing individual and dental management can be very difficult. The aim was to make a dental management protocol for AI.

Methods: A group of Swedish specialists in orthodontics, paediatric dentistry, and prosthodontics were invited to a two-day workshop in January 2006 in order to establish guidelines for dental management of AI. The participants were B Bergendal, B Bäckman, C Göthberg, E Josefsson, A Lindunger, B Mohlin, J Norderyd, S Scholander, and S Sundell. Available literature was studied before the meeting and this, together with the clinical experience of the workshop participants, was the base for the discussion.

Results: A dental management protocol concerning young patients with AI was agreed upon. The guidelines are general, since specific treatment decisions have to be adapted to the patient's dental and oral status as well as to the individual's physical and psychological development. The aim is to assure that the patient is given adequate treatment at the

right time and that treatment planning is made early and with recurrent intervals by a multidisciplinary group of specialists. Recommended treatment goals are stated together with clinical examples with reference to the primary, mixed, and permanent dentitions respectively. The dental management protocol can be found at www.lj.se/oi.

Conclusions: When a general enamel mineralisation disturbance is suspected, the child should be referred to a specialist in paediatric dentistry for further diagnostics and treatment planning. When it concerns rare disorders guidelines are important for assuring quality in care.

◎ ◎ ◎ 22

## Oral health of monozygotic twins with and without coronary heart disease - a pilot study

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Objectives: The purpose of this study was to investigate the oral health in monozygotic twins where one twin had coronary heart disease (CHD) and the other twin had no clinical signs of the disease. Monozygotic twin pairs with CHD were identified initially to fulfil study criteria.

Diagnosis of CHD, includes exclusively WHO diagnosis codes ICD 8, 9 and 10.

Methods: Ten monozygotic twin pairs (age 55-81 years, 8 male and 2 female pairs) were recruited from the Swedish Twin Register.This is currently the largest twin registry in the world, it is population-based and it has registered more than 60,000 pairs of twins born in Sweden since 1886. The inclusion criterion for participation was discordance regarding the presence of CHD within every twin pair. All participants underwent a full dental clinical examination including a panoramic radiograph.

The oral examination of the participants consisted of the following parameters: evaluation of the teeth, gums and soft tissues, measurement of periodontal pocket depth with a Hu-Friedy probe, assessment of hygiene (HI-index) and bleeding on probing.The clinical measurement was also combined with the marginal and vertical bone height evaluated from the panoramic radiographs for the assessment of periodontal disease.

Results: Twins with CHD had 51.5% bleeding on probing compared to 21.1% without CHD (p= 0.01), and more pathological pockets (≥4 mm) were detected among those with CHD (20±15 vs. 8±5), p= 0.047). Twins with CHD had a reduced horizontal bone level in comparison to the healthy group (73% vs. 78%, p =0.03). Logistic analyses using odds ratio (OR), showed that twins with ten or more periodontal pockets had an increased risk of belonging to the CHD group (OR 5.22, p 0.049).

Conclusions: This study indicates on worsened periodontal conditions amongst twins with CHD compared to their siblings with no history of CHD. This strengthens the association between periodontal inflammation and the presence of artherosclerosis.

◎ ◎ ◎ 23

## Oral health a powerful predictor for total and cardiovascular mortality. A prospective study in a cohort of 7674 subjects.

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Objectives: To investigate if severity of periodontal disease and number of remaining teeth could be related to the cause of mortality in a larger population.

Methods: 6788 patients referred to the Department of Periodontology and 886 subjects randomly selected from the general population from the same geographic area was examined by a specialists in periodontology between the years 1976 to 2000. Data regarding their oral and general health was registered and saved in a database. The personal number from all 7674 subject was run against the Swedish national cause of death register to investigate how many of the subjects that had deceased and the primary cause of mortality. Severity of periodontitis was estimated by a combination of the amount of bone loss around each tooth investigated from full mouth x-ray and the presence or absence of bleeding on probing (BOP),

and involvement of furcations.

Results: During a median follow up time of 12 years (0.2-29 years) 626 subject deceased. For 288 of the deceased subjects the primary cause of mortality was cardiovascular disease and for 169 of these 288, the primary cause was coronary heart disease, and for 89 subjects it was stroke Number of remaining teeth was related to all cause mortality for the hole sample, even after adjustment for age, sex and smoking ($p<0.0001$), but to severity of periodontal disease (SPD)only in the middle age group (40-59 years) ($p<0.03$). The same pattern was present when the primary cause of mortality was cardiovascular disease, ($p<0.0001$) for number of teeth in the total sample and ($p<0.02$) for SPD in the middle age group. Also when coronary heart disease was primary cause of mortality the same pattern was established with an association to number of teeth in the total sample ($p<0.0001$), and to SPD only in the middle age group ($p<0.04$). There was no relation to stroke as cause of mortality for neither number of remaining teeth nor SPD after above mentioned adjustment.

Conclusions: This prospective study indicates a higher risk of mortality in especially cardiovascular diseases for persons with a substantial amount of missing teeth or severe periodontal disease, further emphasising a possible relationship between oral health and cardiovascular disease.

## ◎ ◎ ◎ 24

### Risk for coronary heart diseases in women with periodontitis

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Objectives: The aim of the present study was to evaluate the involvement of early signs of risk factors for future coronary heart diseases in women with periodontitis.

Methods: In randomly chosen 46 women with periodontitis and 21 periodontally healthy women subjected to a clinical oral examination in 1985, atherosclerotic risk factor analysis and carotid ultrasonography was performed during reexamination 16 years later. Common carotid artery intima-media thickness (IMT) and lumen diameter were measured and intima-media area (cIMA) was calculated. The relationship between IMT and cIMA as dependent variables and periodontal disease, age, gender, body mass index, heredity for atherosclerosis, diabetes mellitus, hypertension, plasma cholesterol, smoking and education as independent variables was evaluated in a multiple logistic regression model.

Results: The mean values of IMT and cIMA were significantly higher in women with periodontal disease than in controls, both at the right ($p<0.05$ for both variables),) and left side ($p<0.001$ and $p<0.01$ respectively). When the means of the bilateral measurements of these two ultrasonographic variables were tested, multiple logistic regression analysis identified periodontitis as a principal independent predictor of both the common carotid artery cIMA (odds ratio 5.15; $p=0.036$) and IMT (odds ratio 6.05; $p=0.019$).

Conclusions: The present results indicate that periodontitis is associated with development atherosclerotic lesions in women already at its early and subclinical stage.

## ◎ ◎ ◎ 25

### Risk markers for atherosclerosis in adults before and after periodontal treatment

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Objectives: The purpose was to investigate if known risk factors for atherosclerosis inpatients with periodontitis are changed compared to an healthy group and to investigate if these risk markers could be changed by periodontal treatment.

Material and Methods: A total of 70 patients (37 men) between 38-73 years of age, mean 53.6 with severe periodontitis and 49 healthy controls (23 men) between 39-69 years of age, mean 53.0 investigated. A fasting venous blood sample was taken and plasma was analysed for risk markers for artherosclerosis e.g. high density lipoproteins, (HDL), total cholesterol, haptogloblin, CRP, IL-6, fibrinogen and glucose at baseline. Among the patients 3 additional blood samples was taken during periodontal treatment 3, and 6 months after baseline. A total of 41 patients have so far completed 3 blood samples.

Results: CRP levels were lower in patients (2.35 vs 1.23, p=0.007) and HDL levels were lower (p=0.042). The glucose level was also higher (p=<0,001) as well as haptoglobin (1.33 vs 1.12, p=0.004) and fibrinogen (2.54 vs 2.17, p=<0,001) in patients., whereas IL-6 did not show any difference. Regarding changes after periodontal treatment, both CRP (p=0.006) and haptoglobin decreases, the latter however not significant. Total cholesterol (p=0.04) and HDL (p=0.001) levels increases after periodontal therapy.

Conclusion: This study indicates that patients with periodontitis have increased levels of CRP and other markers of inflammation. Periodontal treatment seems to, in a positive way, influence certain risk markers for atherosclerosis such as CRP and HDL. This strengthens the association between periodontitis and atherosclerosis.

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## Increased leukotiene concentrations in gingival crevicular fluid from subjects with periodontal disease and atherosclerosis

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Objectives: Recent studies indicate that periodontal disease is associated with development of early atherosclerotic lesions in the carotid artery. Since inflammation is a key feature in both atherosclerosis and periodontal disease, a common mediator of the two diseases could be anticioated. Leukotrienes are lipid-dervied inflammatory mediators recently implicated in the pathogenesis of atherosclerosis and previously shown to be produced in periodontitis.

The aim of the present study was to detect leucotrienes in gingival crevicular fluid (GCF) from subjects with atherosclerosis and periodontal disease.

Methods: In the present study, 35 subjects underwent oral clinical examination and Carotid ultrasonography was performed in 19 periodontitis patients and 16 healthy subjects. During the clinical examination gingival crevicular fluid was sampled. Concentrations of leukotrienes were measured by Enzyme Immuno Assay. Atherosclerotic plaques, defined as localized intima-media thickening of greater than 1 mm.

Results: Elevated concentrations of leukotriene B4 and cysteinyl-leukotrienes were detected in GCF from subjects with a high dental plaque index (PLI>0.3) supporting an increased leukotriene formation in periodontitis. In addition, subjects with atherosclerotic plaques had significant elevated concentrations of cysteinyl-leukotrienes in their GCF as compared with subjects without a visible plaque ($p<0.05$). Finally, the increased cysteinyl-leukotriene concentrations in GCF from atherosclerotic subjects were observed also when sub groups of periodontitis patients and healthy subjects were compared separately ($p<0.05$).

Conclusions: In summery, increased GCF concentrations of cysteinyl-leukotrienes were correlated to measures of both periodontitis and atherosclerosis. These results suggest that increased leukotriene formation may represent a possible link between periodontitis and atherosclerosis and a risk factor maker for both diseases.

◎ ◎ ◎ 27

## Functional effects of female sex hormones in the periodontium

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Objectives: Several studies have addressed the association between changes in the female sex hormones estrogen and progesterone levels and changes in parameters of periodontitis. In order to

understand how these hormones affect periodontal health it is of major importance to obtain information on their physiological importance. We have previously shown that periodontal ligament cells (PDL cells) express estrogen receptor beta (ER beta) but not ER alfa immunoreactivity. The PDL cells express no immunoreactivity for progesterone receptors, suggesting that this cell type is not affected by progesterone. Treatment with a physiological concentration (100 nM) of estrogen increases DNA synthesis in human breast cancer cells but has no effect on PDL cell DNA and collagen synthesis. The purpose of this project is to investigate how and by which mechanisms estrogen influences structure and function of the periodontal ligament by affecting PDL cell functional properties.

Methods: Human PDL cells were obtained from teeth extracted for orthodontic reasons. The cells were cultured from periodontal tissue explants and used in passages 3-5. Subcellular distribution of ER beta was determined by immunogold electron microscopy and confocal imagining using the mitochondrial selective probe MitoTracker and ER beta immunostaining. Expression of mitochondrial protein cytochrome c oxidase subunit I was investigated using Western blotting. The amounts of IL-6 and c-reactive protein (CRP) were determined by ELISA.

Results: Confocal imaging revealed that ER beta immunoreactivity was distributed not only in the nucleus but also in the mitochondria. These results were confirmed using immunogold electron microscopy. Incubation with estrogen down-regulated the mitochondrial enzyme cytochrome c oxidase subunit I expression by about 30%, showing functional significance of mitochondrial ER. Preliminary data show that lipopolysaccharide (LPS) induces IL-6 but not CRP expression in PDL cells. The LPS induced IL-6 production is not affected by estrogen.

Conclusions: Our data show that estrogen, preferably via ER beta, affects PDL cell functional properties, suggesting that estrogen and other ER specific ligands may modulate the periodontal tissue structure and function in health and disease.

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## Relationship between smoking and periodontal probing pocket depth profile

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Objectives: The purpose of the present study was to investigate if the periodontal probing pocket depth profile differs significantly between smokers and non-smokers as well as within the smoking group according to the mean daily consumption of tobacco.

Methods: Subjects born 1940-1943 were collected from a computer data base at a specialist clinic of periodontology. Former smokers and patients with uncertain history of smoking habits were excluded. The included patients consisted of 293 individuals 57 to 64 years old examined by nine periodontists. The periodontal probing depth at site level, gender and smoking habits were collected from the data base. Oneway variance analyses were performed in order to study differences between groups according to smoking habits. The partial correlation coefficients between smoking and the percentage share of periodontal pocket depth in different tooth regions were calculated by using multiple regression analyses with the general percentage share of periodontal pockets >6 mm included as an independent variable. Results were considered statistically significant at $p<0.05$.

Results: The relative frequency of non-smokers was 53%. The smokers were stratified into three groups according to the daily consumption of cigarettes (1-10 cig/day, 11-20 cig/day, >20 cig/day). The smokers had significantly fewer teeth and significantly deeper periodontal pockets compared to the non-smokers. The percentage share of palatal pockets >5mm was significantly increased for subjects who smoked >20 cigarettes per day (25 %) compared to non-smokers (4 %) as well as compared to subjects with a daily consumption of 1-20 cigarettes per day (11 %). This difference was significant within all tooth groups in the upper jaw (incisors/canine, premolars and molars). The correlation between smoking and the percentage share of palatal periodontal pockets >5

mm was significant (p=0.001), while the correlations between smoking and approximal, buccal or lingual periodontal pockets >5 mm were not found to be significant.

Conclusions: The periodontal pocket depth profile differed significantly between smokers and non-smokers. Smokers had a significantly deeper palatal periodontal pockets compared to non-smokers within all tooth groups in the upper jaw. In addition, heavy smokers had significantly deeper palatal periodontal pockets compared to the subjects who smoked <20 cigarettes per day. The results support the hypothesis that smoking has a local effect on periodontal pocket depth beside the systemic effect.

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## Tilting of splinted implants: A 2-dimensional, plane stress finite element analysis

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Objectives: To evaluate if tilting of splinted implants affects stress distribution in the bone surrounding the tilted implant cervix and to investigate if the use of tilted implants as distal abutments is biomechanically superior to the use of distal cantilevers.

Methods: 2-dimensional models were constructed of two 13mm Brånemark MkIII implants splinted by a titanium beam 16mm in length and 3mm in height. The implants were embedded in bone blocks. One of the implants was tilted distally at 45˚ and a small crater was created on the marginal bone around the tilted implant to simulate physiologic bone resorption. Finally, a model with a distal cantilever of 7 mm length and an axial distal implant was compared to a model where the distal tilted implant (tilt of 45˚, both a 13mm and a 19 mm implant were tested) was supporting the distal end of the cantilever. A force of 50N was applied on the distal (tilted) implant via the beam or on the cantilever.

Results:
There was no difference in stress comparing axial to tilted implants as distal abutments. The use of cantilevers did not alter the pattern of stress distribution around the implants, but stress in the bone was significantly higher. Substituting the cantilever by a distally placed tilted implant resulted in significantly lower stress, while negligibly less stress was calculated around the 19 mm tilted implant, compared to the 13 mm tilted implant.

Conclusions: Within the limitations of FE analysis, our findings provide evidence that distal tilting of implants splinted in fixed constructions does not pose a risk compared to normally placed, perpendicular implants. Furthermore, there seems to be a biomechanical advantage in using tilted distal implants instead of distal cantilever units.

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## Changes of the lower border of the maxillary sinus in relation to a sinu-nasal baseline after tooth extraction

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Objectives: The present retrospective investigation was performed to study the inferior position of the lower border of the maxillary sinus after tooth extractions in the premolar and molar region of the maxilla, with a new method using anatomic fixed points in panoramic radiographs.

Methods: Nineteen patients suffering from periodontal disease and having implant treatment between the years of 1996 and 2002, at Mälarsjukhuset in Eskilstuna, were included. In panoramic radiographs measurements were performed in ten individuals bilaterally and in nine individuals unilaterally. A total of 29 sites were analysed. Thirteen of the patients were females and 6 were males. The average age of the subjects at the postoperative panoramic radiograph was 61.2, range 40.9 to 81.0 years of age.

The measurements were made from a horizontal reference-baseline between fixed anatomic structures, the radiological cross, bilaterally, formed by the medial wall of the maxillary sinus and the projection of the nasal floor, in a 90 degrees angle vertically from that line to the most inferior position of the lower border of the maxillary sinus. All the measu-

rements were made in the Image Tool program. The intra individual precision of the measurements was 2.6%.
The postoperative panoramic radiograph was exposed 1.0 to 10.9 years after the preoperative panoramic radiograph, mean value 4.4 years.

Results: Comparing the preoperative and the postoperative panoramic radiograph from each individual, the lower border of the maxillary sinus showed a more inferior position in 15 out of 29 sides in the postoperative panoramic radiograph. However, the mean value of the measurements of the vertical line, between the most inferior position of the lower border of the maxillary sinus and the sinu-nasal baseline was -0.3 pixels (approximately -0.1mm), range -17.9 to 9.9 pixels (approximately -6.1 to 3.4 mm).

Conclusions: In this study an increased vertical height, measured between the sinu-nasal baseline and the most inferior position of the lower border of the maxillary sinus, occurred in 52% of the maxillary sinus after tooth extraction in the premolar and molar region.

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## Effects of Porphyromonas gingivalis in mouse bone marrow and RAW 264.7 cell cultures

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Objectives: The aim of the present study is to examine effects of P. gingivalis on osteoclastogenesis.

Methods: P. gingivalis bacteria were added to cultures of mouse bone marrow cells and RAW 264.7 cells. Osteoclastogenesis was evaluated either by counting the number of Tartrate-Resistant Acid Phosphatase (TRAP) positive multinucleated cells formed or by analysing gene expression of osteoclast phenotypic markers (TRAP, Calcitonin Receptor; CT-R and Cathepsin K; CATH K) with RT-PCR. Factors of importance for osteoclastogenesis (Receptor Activator of NFkβ RANK, RANK-Ligand; RANKL, Osteoprotegrin; OPG) and macrophage phenotypic markers F4/80 and Interleukin-1α(IL-1α) were analysed as well.

Results: P. gingivalis alone did not cause any stimulation of osteoclastogenesis but completely blocked osteoclast formation in parathyroid hormone (PTH)-stimulated bone marrow cultures. P.gingivalis clearly reduced the expression of osteoclast phenotypic markers as well as the expression of RANKL and OPG. Furthermore, P.gingivalis reduced the stimulatory effect on osteoclastogenesis when soluble RANKL was added to bone marrow cultures and cultures of RAW 264.7 cells. In contrast, P.gingivalis increased markers for macrophages and the proinflammatory cytokine IL-1α. This suggests that the inhibition of osteoclastogenesis is not only caused by inhibition of RANKL expression but P.gingivalis may have direct inhibitory effects on osteoclast precursor cells in RANKL-stimulated osteoclastogenesis.

Conclusions: Our data suggest that P. gingivalis inhibits osteoclastogenesis acting downstream in the RANK/RANKL pathway and instead cause an up-regulation of macrophage differentiation.

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## The impact of dentures on oral health-related quality of life

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Objectives: The aim of the study was to investigate whether oral health-related quality of life (OHRQOL) in an adult Swedish population could be explained by social attributes; individual attributes; dental status, with a special focus on the role of prosthodontics and dental care attitudes.

Methods: The study was based on responses to a questionnaire sent in 1998 to a random sample of 1,974 persons aged 50-75 years (66% response rate). Three factors representing various aspects of OHRQOL were set as dependent variables in multiple regression models: the oral health impact on everyday activities, on the psychological dimension, and on oral function. Independent variables in the models

were social attributes, individual attributes, number of teeth, denture, and dental care attitudes.

Results: General health in relation to age peers had the strongest association with all three dependent variables, followed by number of teeth and need care-cost barrier. When number of teeth was excluded, removable denture was found to covary with the dependent variables in each of the three regression models.

Conclusions: Number of remaining teeth is more important than type of denture when explaining OHRQOL. It is less important that a denture is fixed for those with few remaining teeth in contrast to all others. Explanations are also found in general health and various aspects of dental care costs.

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## Immediate loading of implants with a fixed provisional prosthesis in the edentulous maxilla.

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Objectives: The aim of this study was to evaluate the success rate of immediately loaded Straumann sand-blasted, large-grit, acid-etched (SLA) solid-screw dental implants in the edentulous maxilla after 20 and 32 months of loading and to compare the outcome with the results from a previous treated reference group (control) according to a conventional 1-stage surgery protocol.

Methods: Twenty-eight patients (mean age 63 years) with edentulous maxillae each received six implants and 1 implant-supported fixed provisional prosthesis within 24 hours after surgery. After a mean healing time of 15 weeks, the patient received a definitive, screw-retained implant-supported fixed prosthesis. A total of 168 implants were placed. Clinical and radiological parameters were registered, 8, 20 and 32 months after implant placement, and after 20 and 32 months compared with the results from a reference group. The reference group comprised 25 patients (mean age 64 years) with 147 implants placed, according to a conventional loading protocol.

Results: The mean marginal bone level in the study group after 20 months of loading was measured at a point 3.62 mm (range 1.50 to 6.00, SD 0.94) apical of the reference point (implant shoulder).The mean marginal bone loss from 20 to 32 months was 0.08 mm (SD 0,49, P = 0.039). The cumulative success rate (CSR) was 98.2 % after 32 months. In the reference group the bone level after 20 months was 4.76 mm from the implant shoulder and the marginal bone loss from 20 to 32 months was 0.15 mm (SD 0.4, P<0.001). The CSR was 96.6% after 32 months.

Conclusions: ITI SLA solid-screw implants– immediately loaded within 24 hours with provisional fixed prostheses – showed after 32 months of loading no significant difference in survival rate compared to implants treated according to a conventional loading protocol. Immediate loading in the edentulous maxilla with provisional fixed prostheses was found to be a viable treatment alternative.

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## Changes of anterior crown height in patients provided with single implants - a more than 15 years follow-up study

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Objectives: The aim of this study was to measure and compare the long-term changes of clinical crown height in patients treated with single implant crowns with an adult population of normal dentate persons.

Methods: The test group comprised 23 patients, restored with altogether 27 single implant crowns in the anterior maxilla. At the inclusion, the mean age was 25.4 years (SD 10.0). The original master casts were stored after treatment, and the patients were recalled for study casts, on an average 15.8 years (SD 0.74 years) later. The control group comprised 141 dental students with a mean age of 22.9 years (SD 1.21) at inclusion. Study cast were made at inclusion and after 10 years (n-141) and after 20 years (n-60). Clinical crown height was measured for upper front teeth. The data was compared regarding clinical crown height and changes in height.

**Results:** The results showed that implant clinical crowns were on average 0.6 mm (SD 1.04) longer than the contra lateral teeth ($P<0.05$). Central and lateral incisors showed in treated patients mucosal recession on an average of 0.4 mm ± SD 0.53 ($P<0.05$) and 0.6 mm ± SD 0.58 ($P<0.01$), respectively. In the control group, there was no change in mean clinical crown height during the 20 years of follow-up period. However, obvious individual variations of changes could be found in this group, especially for women. During 20 years of follow-up, altogether 14% of measured teeth showed ≥ 1.0 mm increase and 10% showed ≥ 1.0 mm decrease of clinical crown height in the control group. Initially shorter teeth showed a trend ($P<0.05$-$0.001$) of more mucosal recession than longer teeth.

**Conclusions:** Anterior teeth in single implant cases show a higher risk for mucosal recession than in control patients. Mean values of clinical crown height disguise significant individual variations of changes. To perform a risk evaluation for possible future mucosal recession, more recession can be anticipated for implant treated patients as compared to untreated control persons and for women as compared to men.

◎ ◎ ◎ 35

## Implant periapical lesion

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**Objectives:** To elucidate the clinical findings of implant periapical lesions and its prevalence.

**Methods:** A case report was the background for a study of patient records at two specialist clinics in southern Sweden to try to establish the prevalence of the condition.

**Results:** The rehabilitation of a thirty-year-old man, after a trauma to his front teeth in the upper jaw, consisted of a single implant that caused a light sense of pain for a couple of weeks after the installation and a fistula that appeared four months after the implant installation. Proper pharmaceutical intervention was not successful. The fistula did not disappear until the apical part of the implant together with its granulomatous tissue was surgically removed. Thereafter the healing was without complications.

A survey of patient records from the Clinic of Prosthetic Dentistry, Public Dental Health Service, Malmö, Sweden, and the Department of Oral and Maxillofacial Surgery, University Hospital, Lund, Sweden, revealed that the prevalence of implant periapical lesions in the front region of the upper jaw seems to be in the range of 1.5-2%.

**Conclusions:** It is concluded that an extended period of pain after implant installation might be an early indication that the treatment is not uneventful, that a fistula always should require a fistulography, and that the condition can be successfully treated with surgery.

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## Use and outcome of treatment with dental implants in children up to the age of 16 years in Sweden with special reference to hypohidrotic ectodermal dysplasia

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**Objectives:** The aims of the study were to investigate the use of dental implants in children up to the age of 16 years and to evaluate the outcome of treatment in terms of lost implants. Special attention was given to children with hypohidrotic ectodermal dysplasia, HED, and anodontia in the lower jaw, a situation where early implant treatment has been advocated in several case reports and statements from consensus conferences.

**Methods:** A questionnaire was mailed to specialist clinics in oral- and maxillofacial surgery and prosthetic dentistry in Sweden, asking them to report age, gender, diagnosis and implants placed in children. After compilation of the answers, the teams who had treated

children with HED were asked to send radiographs and clinical photographs. The documentation was distributed to three specialists in oral- and maxillofacial surgery who participated in a telephone conference on plausible reasons for implant loss.

Results: Responses were obtained from 30 specialist centres. Six centres reported 26 treated patients, 18 girls and 8 boys, during a twenty year period, 1985-2005. The reasons for treatment were non-syndromic tooth agenesis (14), trauma (7), and HED (5). In all, 47 implants were placed and 11 were lost. In the HED group of five children with anodontia in the lower jaw, 9 out of 14 implants placed in the lower jaw were lost before loading. At the conference with oral surgeons about the high failure rate in children with HED, the small dimensions of the jaws, and preoperative conditions rather than HED per se, were thought to account for the loss of implants.

Conclusions: Dental implants is a rare treatment modality in young children in Sweden. In pati ith HED and anodontia of the lower jaw 9 of 14 implants were lost before loading. Implant surgery in small children with HED must not be considered routine treatment and should ideally be centralized.

Monitoring of outcomes through quality registers is advocated in HED and other rare disorders.

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## Fiber-reinforced composite fixed partial dentures in three young children with hypohidrotic ectodermal dysplasia and oligodontia

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Objectives: Oral habilitation in young children necessitates consideration not only of dental and oral conditions, but also of the growing child's physical and psychological development. This early report aims to show the use of a new technique for temporary tooth replacement with fixed restorations in the primary dentition in three children with hypohidrotic ectodermal dysplasia and oligodontia in both dentitions.

Methods: One girl and two boys aged 6.5, 8 and 10 years at the time of treatment, had all been subject to early multidisciplinary treatment planning. The prosthetic treatment in the two youngest children was performed under nitrous-oxide/oxygen sedation and in co-operation between specialists in paediatric and prosthetic dentistry. The fiber-reinforced composite fixed partial dentures were made in Sinfoni® and StickTech®.

Results: The three children received adhesively cemented fiber-reinforced composite fixed partial dentures with primary canines as abutments, two in the lower and one in the upper jaw. The children have accepted the restorations very well and the treatment has been successful after 1.5 - 3.5 years follow-up. Close monitoring of oral hygiene and occlusal development is necessary.

Conclusions: A multidisciplinary team approach, early treatment planning and treatment start are beneficial in oral habilitation of oligodontia. The patients and their families were more satisfied with the fixed restorations than with earlier removable appliances. Since it is as important to avoid dental fear as to give the child good oral function and appearance, behaviour management methods in combination with the use of sedation and pain control are essential.

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## Prosthetic rehabilitation of a young woman with Goltz Syndrome/Inkontinentia Pigmenti

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Objectives: The presentation describes the prosthodontic rehabilitation of a young woman with the tentative diagnosis Goltz Syndrome.

Methods: The patient was seen by the pediatric dental care at the age of six. At birth the presence of streaked hypo pigmentation of the skin and syndactyly of toes on the left foot was observed. Later impaired eyesight and hearing on the left was diagnosed. In the dentition hypoplasia of enamel and teeth, late eruption and irregular placement were

noticed. At the age of twenty a genetic counselling was accomplished and the ectodermic disorders were considered consistent with Goltz Syndrome but with a considerable overlap of Inkontinentia Pigmenti. The patient has during the childhood been treated with a multidisciplinary team approach.

Minor clinical interventions were adapted to the patient's dental and psychological stage by pediatric dentistry, dentomaxillofacial radiology and orthodontics. The patient was considered for prosthodontic intervention at the age of twenty. Seven permanent teeth were missing in the left jaws and three deciduous teeth remained. Several teeth in the left jaws were malformed with hypoplastic and hypo mineralized enamel. The result of the prosthodontic treatment at the three-year follow-up is presented.

Results: A functional and aesthetic habilitation was performed successfully in two stages resulting in implantat - and tooth supported prosthodontics.

Conclusions: The multidisciplinary team approach has had the advantages of continuity and sound therapy decisions. The overall treatment has been planned and performed over a long period. Thus early extensive irreversible prosthodontic treatment in a growing individual could bee avoided.

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## The effectiveness of a prefabricated occlusal appliance in patients with myofacial pain

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Objectives: To compare the short-term effectiveness of a stabilization appliance with a prefabricated occlusal appliance in myofascial pain patients.

Methods: Sixty-four patients at two centres for Stomatognathic Physiology in Finland and Sweden were included in a randomized controlled trial. The 64 patients were randomly assigned to a stabilization appliance group (S-group) or a prefabricated appliance group (P-group). A general practitioner performed the treatment with the appliances. The mean age of the patients was 37 years (SD 2) and 38 years (SD 3) respectively in the groups. The patients were examined according to Research Diagnostic Criteria (Dworkin & LeResche, 1992). At the 6- and 10-weeks follow-up of the appliance therapy an evaluation of the treatment outcome regarding pain according to the visual analogue scale and overall rating of pain according to the verbal scale was done.

Results: All patients diagnosed with myofascial pain had been suffering from 3 months to 40 years with a mean of 5 and 7 years respectively in the S and P group,. The S-group included 30 women and 2 men and the P-group 27 women and 5 men. At baseline there were no differences between the groups regarding frequency of pain, number of years suffering from the pain or worst or mean pain during the last six months. At 6-weeks follow-up a 30 % pain relief was achieved in 74 % and 72 %, respectively and a 50 % pain relief in 55 % and 56 % in the group S and P. According to the verbal scale the percentage of patients reporting themselves to be better, much better or symptom-free was 84 % and 88 % in the two groups. At the 10-weeks follow-up the percentage of pain relief of both 30%, 50 % as well as according to the verbal scale was similar 69 %, 72 % and 56 % ,66 % and 81 % and 87 % in the S- and P- group respectively.

Conclusions: In a short-term perspective the stabilisation appliance as well as the prefabricated occlusal appliance seemed to have a good effectiveness on the patients suffering from symptoms of myofascial pain. The prefabricated appliance could therefore be recommended as a short-term therapy in patients with myofascial pain.

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## Patients with TMD pain do they have a weak sense of coherence?

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Objectives: To investigate correlations between sense of coherence (SOC), level of depression and somatisation and treatment outcome of appliance therapy in patients with TMD pain.

Methods: 1584 patients were referred for temporomandibular disorder (TMD) to the Department of Stomatognathic Physiology, Faculty of Odontology, Malmö University. Sixty-seven patients with chronic TMD pain were according to inclusion and exclusion criteria consecutively selected for the study. The patients had to answer the following questionnaires: SOC, SCL 90-R and visual analogue scale (VAS) of worst experienced TMD pain at baseline as well as after 10 weeks of treatment.

Results: All patients had a moderate level of SOC, and the men showed the strongest SOC. The SOC increased with age. Patients with a severe depression scores showed weak SOC, but levels of no and moderate depression scores had a strong SOC.

Scores of somatisation were not correlated to weak SOC. Patients having a positive treatment outcome (30% reduction of worst experienced TMD pain registered on VAS) of appliance therapy showed moderate to strong SOC and a negative treatment outcome was correlated to weak SOC.

Conclusions: This preliminary report showed that SOC could be correlated to scores of depression in patients with TMD pain. The treatment outcome was correlated to SOC.

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## Socioeconomic factors, lifestyle habits and headache disorders – a population-based study in Sweden

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Objectives: To study the association between socioeconomic factors, lifestyle habits and recurrent headache/migraine (RH/M) in a general population.

Material and methods: The study population comprised a random population sample of men and women aged 18-79 years. The data were obtained using a postal survey questionnaire during March-May 2000. The overall response rate was 65%. The area investigated covers 58 municipalities with about one million inhabitants in central part of Sweden. The study is based on 43,770 respondents. Odds ratios for RH/M were calculated for a range of variables using multiple logistic regression models.

Results: The overall prevalence of RH/M was 10% among men and 23% among women and decreased with increasing age.

Physically inactive subjects were more likely to suffer from headache disorders than physically active subjects. Smoking was only moderately associated with RH/M. There was an inverse relationship between heavy alcohol use and RH/M. Underweight and obesity were not associated with headache disorders when adjusted for socioeconomic factors.

Subjects with frequent economical problems had almost twice the risk of RH/M compared with subjects with no economical problems. Poor social support was associated with headache disorders. In addition, subjects who had been belittled during the last three months were more than twice as likely to suffer from RH/M as subjects who had not been belittled. The effect of educational level was modest. Lone parents and subjects living with partner and children had a slightly increased risk of RH/M. Marital status and country of origin was not associated with headache disorders after adjustment for other socioeconomic factors.

Dissatisfaction with work, worry about losing job and absenteeism due to illness were associated with headache disorders. Physical working conditions and working hours were not statistically significantly associated with RH/M.

Conclusion: Headache disorders mainly affect young and middle-aged adults. There are, however, socioeconomic inequalities in recurrent headache and migraine. The relationship was particularly evident for economical problems and psychosocial factors. Of lifestyle factors, physical inactivity was strongly associated with headache disorders independent of economic and psychosocial factors.

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## Do dento-skeletal deformities effect jaw-neck motor behaviour?

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Background: From previous studies we have proposed that "functional jaw movements" are the result of activation of jaw as well as neck muscles leading to simultaneous movements in the temporomandibular, atlanto-occipital and cervical spine joints. Thus, head-neck movements are an integral part of natural jaw function. We have also shown that neck injury can result in a diverse jaw-neck motor behaviour. Furthermore, we have reported that peripheral input in terms of texture and size of bolus modulate jaw-neck behaviour. This study was undertaken to test the hypothesis that growth related discrepancies in the maxillo-mandibular relationship (GDM) are associated with diverse jaw-neck behaviour during jaw function.

Objectives: To elucidate integrative jaw-neck behaviour in subjects with GDM by evaluating characteristics of concomitant mandibular and head-neck movements during rhythmic jaw actions.

Subjects and methods: Eight females and six males (mean age 25 years; SD 5) with GDM participated in this study. They were consecutive patients referred to the Dept of Oral and Maxillofacial Surgery, Umeå University for orthognathic surgery. A wireless optoelectronic technique for three dimensional (3D) movement recording was used to simultaneously record movements of the mandible and the head-neck during continuous maximal jaw-opening-closing tasks at self-paced rate during a 30-seconds period. Each test was recorded twice. Subjects were seated in an upright position, with back support up to mid-scapular level without headrest. Data from the first five consecutive jaw opening-closing movement cycles from each test were analysed. The results were compared with data from subjects with normal maxillo-mandibular relationship of same age group.

Results: Compared with control group, the GDM group showed smaller head amplitude ($p=0.045$), shorter duration of occlusal phase between subsequent jaw opening-closing cycles ($p=0.004$) and a changed coordination pattern for mandibular and head movements, i.e delayed head-neck movements at start of jaw openings. Qualitative analysis showed irregular and uncoordinated head-neck movements during jaw opening-closing tasks in the GDM group.

Conclusions: ***The finding of a diverse jaw-neck motor behaviour in the GDM group suggests that growth related discrepancies in the maxillo-mandibular relationship are associated with special settings for integrative jaw-neck motor control in natural jaw function. The results will be a basis for post-operative comparison.***

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## Motor mechanisms of balance during quiet standing involve the jaw-neck sensorimotor system.

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Background: The postural control system has three main functions, to support the body against gravity, to stabilize body portions when other body parts are moved and to balance the body on its base of support. Somatosensory (proprioception), vestibular and visual receptors, and many CNS regions interact. Intrinsic muscle stiffness plays a role. Loss of balance is a sign of disturbed postural control.

Objectives: To investigate the possible involvement of the jaw-neck sensory-motor system in postural control mechanisms by examining balance ability, specifically body sway during quiet standing.

Materials and Methods: Six consecutive patients, four females and two males 26 to 70 years of age, median age 51, were examined. All suffered from longstanding neuro-musculo-skeletal disorders and pain in the jaw-neck-shoulder regions. Body sway was recorded at quiet standing with feet together for 120 s, using an optoelectronic technique for wireless movement recording. The test protocol included repeated sets of recordings with closed eyes (CE) and alternatively without and with a custom made intraoral appliance (IOA) attached to the upper teeth. Similar sets of recordings were performed also with open eyes (OE). Patients were free to terminate the recording at any time due to pain or exhaustion. Parameters for evaluation of body sway included speed, acceleration and jerkiness of movement and circumference of sway area. Twelve healthy subjects, 6 females and and 6 males, were also examined.

Results: For the CE recordings, intraindividual comparisons between tests without and tests with IOA showed an instantaneous improvement of balance in tests with IOA, documented by a significant decrease in body sway ($p <= 0.05$). The relative decrease of body sway included all parameters and were 34 % for speed, 18 % for acceleration, 18 % for jerkiness and 36 % for circumference of sway area. No such differences were found in the healthy group.

Conclusions: The finding in the patient group of instantaneous improvement of body stability by intraoral intervention suggests involvement of the jaw-neck sensorimotor system in postural control mechanisms. These mechanisms include brainstem, cerebellar, subcortical and cortical pathways. Data provide new insight into human postural control mechanisms and the pathophysiology behind balance loss, and have scientific as well as clinical implications.

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## Gender differences in neuromusculoskeletal disorders and pain (NMSD) among dental students and dentists

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Background: A previous study (Jegers and Lindgren, 2002) demonstrated symtoms of workrelated neuromusculoskeletal disorders and pain among dental students. Higher prevalence in female students suggested gender differences.

Objectives: The present aim was to perform crossectional and longitudinal studies of the prevalence of NMSD among dental students and dentists, and compare the results with data from the 2002 study.

Materials and Methods: The questionnaire that was used in the 2002 study about state of health, physical exercise, level of stress, pain and treatment was answered by totally 129 students. Of these, 80 were preclinical students at the start of the education and 48 were clinical students at the end of the education. The same questionnaire, with additional questions, was answered by 52 dentists. The clinical students and the dentists were previously examined in the 2002 study.

Results: Among females, almost half of the preclinical students, more than half of the clinical students and two thirds of the dentists reported frequent pain (once a week or more, VAS 5 or more). The corresponding findings for males were: almost half of the preclinical students, one forth of the clinical students and half of the dentists. The most common pain sites were neck and shoulders. For females, pain prevalence was successively higher in the clinical student and dentist groups for neck ($p= 0.023$), shoulder ($p=0.023$), arm ($p=0.011$) and lower back ($p= 0.012$). Less shoulder pain was associated with regular endurance training.

Conclusions: Both students and dentists report more pain than the general population (cf SBU report 2006). Higher prevalence in females suggests significant gender differences. Data indicate a risk for dental students and dentists, especially for females, to develop NMSD with socioeconomic consequences for the individual and the society. Physical training seems to prevent NMSD. The results support and extend the 2002 study and should be acknowledged and used for early prevention of NMSD, included in the undergraduate dental program.

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## Non-specific chronic orofacial pain from the patient's perspective

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Objectives: The aim of this study was to analyse the non-specific chronic orofacial pain patient's lived experience of the pain condition using a qualitative research strategy based on phenomenology.

Methods: Fourteen patients (11 female, 3 male) 21-77 years of age, were strategically selected among those referred to a specialist clinic. All selected patients

agreed to participate. Data were gained through thematic in-depth interviews, which exposed the context of the orofacial pain condition. The two interviews with each patient were audio taped and transcribed verbatim. The text material was analysed to determine the attitude of the patients concerning their lived experience of the pain condition.

Results: The essence of the chronic orofacial pain was expressed by the patients as something that eludes perception and comprehension. The pain was difficult to grasp and to communicate. The consequence of the pain was experienced by the patients as to be stricken by the pain and expressed as living a life permeated by hopelessness, resignation and a lack of faith.

Conclusions: The patients in this study experienced the chronic orofacial pain to have no limits and to repressively permeate all aspects of the existence; social, practical and emotional.

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