

Observations of dental disease and anomalies in 9- to 11-year-old Norwegian children

Tore Lervik and Geoffrey C. Cowley

Folketannrøkta, Skien, Norway, and Department of Periodontology and Community Dentistry, University of Dundee, Dundee, Scotland

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Sets of intraoral radiographs consisting of ten periapicals and, in most cases, two posterior bitewings, from 99 girls and 101 boys aged 9–11 years were examined by four dentists. The study was undertaken to quantitate the disease and anomalies present in the sample and investigate the inter-examiner variability of the diagnosis. Each of the examiners independently recorded the disease and anomalies from the radiographs. Knowledge of previous dental treatment and abnormalities noted by the community dental officers were obtained from the children's dental records. The prevalence of disease and anomalies in the sample was low. Considerable examiner variability revealed a need for more objective criteria for the radiographic diagnosis of some of the dental anomalies. Girls had a significantly higher DMFT than boys. Hypodontia was found in 13 children, and dens invaginatus class III/IV (9) was observed on radiographs from 5 children. □ *Radiology; pedodontics; pathology*

Tore Lervik, Distriktstannklinikken, Kongerød Samfunnshus, 3900 Porsgrunn, Norway

Routine use of full-mouth radiographic examination of children is recommended and studies of the use of this aid to detect disease and anomalies in children have been undertaken in different countries (2, 8, 15, 22). Screening is generally only justified when good evidence is available that early diagnosis will lead to substantial improvement in prognosis, that the test has low intra- and inter-examiner variability, and that it has high validity (20).

Studies of the detection of disease and anomalies from full-mouth radiography of children do not usually consider examiner variability. The radiographic diagnosis of abnormalities that are continuous variates does not have objective criteria and the validity of the diagnosis may therefore be questioned.

The present study was undertaken to quantitate the disease and anomalies present in a sample of Norwegian children aged 9–11 years, to investigate examiner variability of the radiographic diagnosis and to assess the need for full-mouth radiography.

Materials and methods

The material consisted of 10 periapical radiographs from 200 9- to 11-year-old Norwegian children, 99 girls (mean age 9.8 years, SD 0.49) and 101 boys (mean age 9.7 years, SD 0.45). In addition, two posterior bitewings were available from 183 of the children. In 19 children the bitewing radiographs had been taken at an earlier or later date than the periapicals. The maximum time difference between periapical and bitewing radiographs was 11 months. Approximately 95% of the children had their yearly dental care completed less than 12 months before the full-mouth radiographic examination.

The radiographic surveys were selected at random from the radiographs of the population of children born in 1968 who were attending the Community Dental Service in the town of Skien, Norway in 1978/79. Boys and girls were kept separate. In 1978/79 Skien had approximately 47,000 inhabitants and there was a total of about 800 children in the age group studied. Most of the children

in the town avail themselves of the services provided by the Community Dental Service but about 30% of them were at the time attending the School Dental Service run by the local authorities. These children were not included in the population from which this sample was drawn, but there was no reason to assume that the oral health of these children was different from those attending the Community Dental Service.

The periapical radiographs of the children in the sample were taken by different operators using the bisecting-angle method. No attempt had been made to standardize the technique. The radiographs from each subject were mounted on acetate sheets and code numbered.

Copies of the children's dental records were available for information about previous dental treatment and anomalies/disease noted by the community dental officers before the radiographic series were taken.

The examination of the radiographs was divided into three different parts and carried out by four examiners, I-IV. The results are presented as numbers, percentages, 'maximum score' (scored by at least one examiner) or 'minimum score' (scored by all examiners). As a measure of inter-examiner variability, proportion of agreement in scores was calculated in the registration of caries and dens invaginatus.

Examination of radiographs without specified criteria

The four examiners were an orthodontist, a dental radiologist, a periodontist and a

community dental officer, who evaluated the radiographs independently. They were given written instructions to report all disease and anomalies, but no criteria were given and no attempt was made to standardize the reading conditions or the examination technique.

For the prevalence of hypodontia and supernumerary teeth in the population, the 95% confidence intervals were determined from tables of the binomial distribution (25). DMFT (13) was calculated using the 'maximum' caries score and information about previous dental care in the dental records. The normal deviate (z) as a two-tailed test was used to find whether the observed difference in the proportion of boys and girls with fillings and decay was statistically significant or not (23) and Student's t test was employed to test the significance of the difference in DMFT between sexes.

Examination for dens invaginatus

In a separate examination, examiners II and III recorded the prevalence of dens invaginatus according to Hallett (9). The examiners used the same viewing box and all examinations were made without knowledge of previous results.

Examination for caries of dentin

An examination was made where only decay of the dentin of permanent teeth was registered. The two examiners recorded decay where the radiolucency could be observed in the dentin and they were instructed to score negative if they were in

Table 1. Filled or decayed occlusal and mesial surfaces of first permanent molars. Numbers of decayed tooth surfaces was the total score of four examiners and information about the filled surfaces was from the dental records. Number of girls = 99 and boys = 101

Tooth surface	Filled surfaces (%)		Decayed surfaces		Percentage of children with			
					Decay		Filling	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
16, 26 occlusal	144 (73.1)	141 (69.8)						
36, 46 occlusal	159 (81.1)	145 (72.1)	2	8	2.0	3.0	90.9	81.8
16, 26 mesial	50 (25.3)	49 (24.3)						
36, 46 mesial	41 (20.9)	49 (24.3)	35	44	28.2	20.7		

Table 2. Filled or decayed surfaces in permanent incisors. Number of decayed tooth surfaces was the total score of four examiners, and information about the filled surfaces was from the dental records. Number of girls = 99 and boys = 101

Tooth surface	Filled surfaces (%)		Decayed surfaces		Percentage of children with			
	Girls	Boys	Girls	Boys	Decay		Filling	
					Girls	Boys	Girls	Boys
11, 12, 21, 22 mesial, distal	22 (3.0)	8 (1.0)	12	8	12.1	5.9	15.2	4.0
31, 32, 41, 42 mesial, distal	19 (2.4)	3 (0.4)	8	4				
11, 12, 21, 22 palatal	0	7 (1.7)					0	3.0

doubt. The periapical and bitewing radiographs were examined separately and the examinations were made without knowledge of previous results. The same viewing box was used.

Results

Examination of radiographs without specified criteria

The children's dental records revealed that four first permanent molars had been extracted. A total of 17 permanent teeth from 13 children were recorded as congenitally absent. None of the examiners reported all the missing permanent teeth, but each of the teeth was noted as missing by more than one examiner. The teeth involved were one upper lateral, 12 lower and four upper second premolars. The 95% confidence interval for hypodontia in the population was 3.5%–10.9%. Only the missing lateral and one of the missing premolars had been noted by the community dental officers prior to the full-mouth radiographic examination.

Four supernumerary teeth had been diagnosed and removed at the age of 7.5–8.3 years. Three of them were found in the maxillary anterior region. In addition, two children were found to have supernumeraries in this region by one of the examiners in this study. The 95% confidence interval for the prevalence of supernumerary teeth in the population was 1.1%–6.5%.

The 'maximum' number of surfaces scored as decayed in permanent teeth was 134 while the 'minimum' score was 7. Proportion of agreement in this registration

ranged between 0.08 and 0.22 (Table 3). Nearly all the decayed tooth surfaces were found in the first permanent molars and the incisors (Tables 1 and 2), and only six surfaces were scored as decayed in premolars ('maximum' score).

The recorded difference in proportion of girls and boys with fillings in the first permanent molars was unlikely to be due to chance ($z = 2.0$, $p < 0.05$) (Table 1). Girls also had significantly more fillings in their front teeth ($z = 2.70$, $p < 0.01$) (Tables 2 and 4).

Ectopic teeth were recorded by at least one examiner in 17 individuals (27 teeth). On only one occasion did all examiners agree that a tooth, an upper canine, was ectopic. Five canines and three premolars were recorded as ectopic by two examiners.

Marginal bone loss was recorded by one of the examiners in five children. One of the examiners also recorded eleven roots of the upper incisors as 'abnormally short'. Only two of the roots were recorded by other examiners.

Dens invaginatus was registered in 37 of the children by one of the examiners while only 2 cases were registered by other examiners.

Table 3. Proportion of agreement between the examiners in the registration of decayed surfaces of permanent teeth. Number of surfaces recorded as decayed surfaces by at least one examiner = 134

Examiners	I	II	III
II	0.22		
III	0.08	0.20	
IV	0.19	0.22	0.13

Table 4. Decayed, filled and missing permanent teeth expressed in percentages and DMFT. Number of girls = 99 and boys = 101

	Girls	Boys	Total
Children with fillings or decay in front teeth	23.2	8.9	16.0
Children with intact teeth	6.1	11.9	9.0
DMFT (SD)	3.9 (1.9)	3.3 (1.8)	3.6 (1.9)

Examination for dens invaginatus

Most of the invaginations were classified as class I/II (Table 5), and no attempt was made to differentiate between these classes. Although the examiners observed a similar number of invaginations in class I/II, the proportion of the total registrations of class I/II that the examiners agreed upon was 0.49. On the other hand, the examiners agreed upon all the scores of class III and IV.

Examination for caries of dentin

The two examiners recorded 26 carious lesions reaching the dentin of the first molars, while 18 lesions were found in the incisors ('maximum score') (Table 6). Agreement in score as proportion of total registrations was 0.35 for molars and 0.44 for incisors. The percentage of children with one or more lesions involving the dentin was 13.5%.

For the children who had bitewing and periapical radiographs taken on the same occasion, it was found that six of the carious lesions noted from the study of the bitewing

radiographs were not recorded during the examination of the periapicals of the same area. The opposite took place with one decayed tooth surface.

Discussion

National surveys showing the dental health of Norwegian children have not been carried out. Official statistics for the dental care provided by the Community Dental Service are based upon the fillings inserted and are therefore not a precise estimate of the dental health of different age groups.

The average number of filled surfaces in the permanent teeth of 11-year-old children has been found to be approximately 8 in different surveys (3, 26) while the result of the present study was about 6. Differences in examination technique and lack of detail about the samples make direct comparison difficult. Recent reports indicate, however, that the number of fillings inserted in children's teeth in Norway has decreased during the last years (17).

Table 5. Number of children with dens invaginatus in maxillary incisors classified radiographically according to Hallett (9) by two examiners independently. Total means scored by at least one of the examiners. Number of girls = 99 and boys = 101

	Examiner		Total
	II	III	
Class I/II	60	62	82
Class III	3	3	3
Class IV	2	2	2

Table 6. Decayed surfaces of permanent teeth (number of children) where the radiolucency was observed in the dentin. The radiographs were examined independently by the examiners and total means scored by at least one of the examiners. Number of girls = 99 and boys 101

	Examiner		
	II	III	Total
Molars (children)	16 (16)	18 (13)	26 (21)
Incisors (children)	15 (8)	10 (7)	18 (12)

The filled and decayed permanent tooth surfaces of the children in the sample indicated that the total caries experience of the permanent dentition had been higher among girls than boys. Although it is often assumed that girls have a better oral health than boys, studies of different age groups in different populations have shown that girls have a higher DMFT (19) or a higher number of cavities (1) than boys of the same age. Since all the children in the present study received similar dental care regularly, the difference between boys and girls was likely to be due to difference in caries experience between sexes. The observation may be caused by earlier time of eruption of teeth in girls.

Few children had cavities or fillings diagnosed in permanent teeth other than first molars and upper incisors. Radiographic carious lesions reaching dentin were only found in first molars or incisors of 27 children. A true caries score cannot be established from radiographs (21), but it was felt that the radiographic scoring of caries undertaken in the present study was adequate for estimating the prevalence of disease in the population. On the basis of decayed and filled tooth surfaces of the sample, it does not appear to be justified to suggest full-mouth series of radiographs to detect decay or sequelae of caries/restorative dentistry. In addition, periapical radiographs were not found to be a better aid in the radiographic diagnosis of caries than bitewings of the same area.

The results from the different examiners varied in the observation of missing teeth. Both bitewings and periapical radiographs were used in the diagnosis, and all the missing permanent teeth were noted by more than one examiner. The 'maximum' score was investigated and found to cover only teeth that were congenitally absent or extracted. Theoretically, the quality of the radiographs may have affected the score of missing teeth. Since the films generally showed the crowns of all the formed teeth completely, except for the second permanent molars (14), and the scoring was based on both posterior bitewings and periapical radiographs, it seems unlikely that any of the teeth recorded as missing were present

in the jaw. The 95% confidence interval for hypodontia in the population (3.5%–10.9%) was not significantly different from the prevalence reported in Hunstadbråten's (11) study of Norwegian school children. The tooth most frequently congenitally absent was the mandibular second premolar which is in accordance with most studies of the anomaly (2, 11).

According to the dental records, only two of the congenitally missing teeth had been diagnosed before the radiographic surveys were taken. Hypodontia should probably be diagnosed at an early age since interceptive treatment in selected cases may lead to less treatment need later (12, 24).

A majority of the supernumerary teeth had already been removed when the radiographic surveys were taken. The two supernumeraries found by one examiner in the present study were checked by different dentists and the diagnosis was confirmed. One of them was removed one year after the radiographic survey was taken, according to the dental record. The radiographic images of the supernumerary teeth found in this study were small and it was difficult to differentiate between them and other structures of the jaw.

No well-defined criteria exist for most of the other anomalies found in the study, and the cut-off point between what is considered normal and abnormal is not clearly defined. Variability between examiners is therefore likely to occur.

Even when criteria exist as for dens invaginatus (9), the classification of borderline cases was difficult, i.e. cases with only a definite cleft on the palatal surfaces or a small invagination extending towards the pulp chamber (class I/II). Better agreement was obtained for more obvious cases (class III/IV) which may be of clinical importance (6). Similar problems with the classification of dens invaginatus has been reported by Grahnèn et al. (6) who decided to exclude class I. Breivik (4) found inconsistencies between class I and II and therefore combined them.

A major part of the radiographs in the study of dens invaginatus by Hallett (9) was excluded because of inferior quality.

Whether or not these results on dens invaginatus have been influenced by the quality of the radiographs is difficult to assess. Most radiographs of the upper front made it possible to differentiate between enamel and dentin (14). Only seven incisors had fillings on the palatal surface so the recording of dens invaginatus was hardly affected by the restorative care.

The frequency of dens invaginatus class III and IV (5 children, 2.5%) found compares well with Breivik's (4) prevalence of class III. No invaginations grouped in class IV were found by Breivik. A comparison of the results indicates, however, that the prevalence of large invaginations was similar in the two samples.

Examiner variability is a well-known phenomenon in clinical research (18). In most studies of dental anomalies there is no or only incomplete data about examiner error, but Loch & Poulsen (16) reported a high intra-examiner variability in the diagnosis of dental anomalies from panoramic radiographs.

The present study showed that there was a large variability between the examiners in the recording of both caries and dental anomalies. It has been stated that training of examiners gives more uniform caries scores and the examiners in the first part of the present study had been given no special training. The examiner variability may also have been increased by the low prevalence of disease and anomalies in the sample (5, 7). Scoring of more advanced carious lesions was not found to reduce examiner error (10), but reduced inter-examiner variability in the present study.

Intraoral radiography in children presents special problems that affect the quality of the radiographs and thus make it more difficult to detect disease and anomalies (14). The reliability and validity of a radiographic diagnosis of dental anomalies that are continuous variates have rarely been tested, and there has been no general agreement that effective treatment, before there is clinical evidence of the anomalies, is available or that early treatment will improve the prognosis.

In the present study, a low prevalence of

abnormalities was found and it ought to be kept in mind that the minimum dose of X rays that causes genetic or somatic damage is not established. Screening with full-mouth series of radiographs in 9- to 11-year-old children in the present population is therefore apparently not justified. Individual radiography where there is clinical evidence of abnormalities seems more appropriate, also when alternative use of resources is considered.

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