Dental caries, gingival health, and oral hygiene of long term survivors of paediatric malignant diseases

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Abstract

Fifty two children who had had cancer and been treated with chemotherapy, and who were long term event free, were examined for caries prevalence, gingival health, and oral hygiene and compared with a control group. A higher dental caries prevalence for the 14-17 year age group was noted. The restorative index was significantly lower in the age group 10-13. There were no significant differences in gingival index, plaque index, or toothbrushing frequency. It is concluded that these patients should be considered as at high risk for caries after cancer treatment. Professional dental follow up should be integrated in the medical follow up.

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Keywords: antineoplastic agents, caries prevalence.

Dental caries is a multifactorial disease that consists of a progressive demineralisation of the calcified dental tissues. Basically, acids formed by oral bacteria through the metabolism of carbohydrates cause the decalcification. Plaque plays a major part in the development of dental caries but also periodontal disease. The amount of plaque reflects the oral hygiene of the patient. The gingival health is often related to the periodontal status.

Short and long term effects of cancer treatment on the developing dentition have been documented: there is a higher prevalence of dental structural anomalies like hypodontia, microdontia, enamel hypoplasia, and root developing disturbances. Also the direct effects of cytotoxic drugs on the oral mucosa and salivary glands have been studied.¹⁻¹⁰ Oral complications of cancer treatment can be painful and lead to severe discomfort interfering with proper nutrition and may cause significant problems with treatment compliance. Cytotoxic treatment can cause a breach in the mucosal integrity, allowing pathogenic organisms to spread systemically, and could result in a life threatening septicaemia.^{11 12}

Only a few authors have described the late effects of cancer treatment on caries prevalence and gingival health.¹³⁻¹⁶ The studies are not easily compared because of differences in the selection of control groups, in procedures of dental care and oral hygiene, and in the choice of indices of dental health and scoring methods. Therefore general conclusions are not easy to draw.

Before 1994, cancer patients in our centre did not receive any systematic prophylaxis for preventing or diminishing long term dental complications of the antineoplastic treatment. The purpose of this study was to evaluate the prevalence of dental caries, gingival health, and oral hygiene measures taken in these patients after completion of the antineoplastic treatment when compared with normal subjects matched for age.

Patients and methods

Fifty two children, age 2 to 17 years, who had had cancer and were long term event free (one to 10 years, with a median of nine years) were included in the study group. Twenty seven children had been diagnosed with acute lymphoblastic leukaemia, seven with non-Hodgkin's lymphoma, seven with Wilms' tumour, five with rhabdomyosarcoma, and six with different childhood cancers. All children had been treated with chemotherapy at the University Hospital of the Free University of Brussels. The patients had not received any radiotherapy to the oral or the salivary gland region. The children were seen in the Dental Institute of the Free University of Brussels (Unit of Conservative and Preventive Dentistry) by one dentist (FD) in the same dental surgery. The examiner was tested for intraobserver reproducibility (coefficient of variation=1%).¹⁷ Patients were examined approximately two hours after breakfast. Patients were asked not to drink or eat between breakfast and examination.

During the examination, the following methods were used. For caries prevalence the dentition was visually examined using a dental mirror. If there was doubt about the existence of a caries lesion a blunt dental probe was used.¹⁸ For ethical reasons no radiographs were taken. From the results, the DMFT, DMFS score for permanent teeth and dmft, dmfs score for deciduous teeth, were derived. These indices score the number of decayed (D,d), missing (M,m) and filled (F,f) teeth (T,t) and surfaces (S,s), and are often used in epidemiological studies. If the child had a mixed dentition, separate scores for deciduous and permanent teeth were used.

Gingival health and oral hygiene were assessed by the gingival index and plaque index described by Loe.^{19 20} The gingival index reflects the amount of inflammation of the gingiva. Oral hygiene was assessed by the plaque index. Tooth brushing frequency was assessed by questioning the accompanying parent.

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Table 1 Prevalence of caries at different ages; values for DMFT, dmft, DMFS, and dmfs are mean (SD)

Age group (years)	Mean age (years)	No	DMFT	dmft	DMFS	dmfs	RI/PT (%)	RI/DT (%)
14–17								
Study group	15.3	9	7.0 (3.2)	–	10.1 (4.3)	–	92	–
Controls	15.2	13	3.4 (2.3)	–	4.1 (3.0)	–	83	–
10–13								
Study group	11.4	16	3.5 (2.3)	–	5.6 (5.0)	–	38	0
Controls	11.6	17	2.8 (1.4)	–	3.1 (2.0)	–	87	57
6–9								
Study group	7.4	17	1.0 (1.2)	2.5 (2.7)	1.6 (2.0)	6.2 (8.2)	50	50
Controls	7.1	20	1.6 (1.2)	3.1 (2.0)	1.7 (1.4)	4.2 (3.6)	63	72
2–5								
Study group	4.0	10	–	1.6 (3.2)	–	3.4 (8.0)	–	25
Controls	4.4	10	–	0.4 (0.7)	–	0.6 (1.0)	–	33

See 'Patients and methods' for explanation of abbreviations.

The control group consisted of 60 healthy children without any history of illness. A random selection of children out of 6000 patient files was carried out by computer. A control group with a comparable age distribution, race, and social class was selected. The examination methodology and conditions were the same as for the study group. The examiner was the same person as for the study group. The oral examination was carried out under identical circumstances. None of the children (control group and study group) had special dental prophylactic treatment (for example, fluoride applications, professional tooth cleaning, oral hygiene instructions) before examination, or took any medication at the time of examination. Before cancer treatment, the children of the study group had received no special dental care.

The restorative index (RI), reflecting the degree of treated caries lesions, is an indicator of dental care. It is calculated separately for deciduous (RI/DT) and permanent (RI/PT) dentition using the formula $RI = F/DF \times 100$ (F=filled, D=decayed teeth). For example, a child with two caries and two fillings on different teeth would score a restorative index of 50%. The children were divided in four age groups (numbers in study group/control group): 2–5 years (10/10), 6–9 years (17/20), 10–13 years (16/17), and 14–17 years (9/13).

Statistical analysis was done with the SurveyPlus software package (Providence Software Services). Pearson's correlation coefficient and Student's *t* test were used for statistical evaluation.

Results

The prevalence of dental caries for the different age groups is listed in table 1. In the study group, there was a positive correlation between DMFT-dmft scores and age ($r=0.46$; $p<0.0001$).

Table 2 Caries scores in study group at different ages; values for DMFT, dmft, DMFS, and dmfs are mean (SD)

Age at diagnosis (years)	Mean age at examination (years)	No	DMFT	dmft	DMFS	dmfs	RI/PT (%)	RI/DT (%)
0–5	7.6	30	2.3 (2.7)	2.3 (3.0)	3.3 (4.2)	5.4 (8.5)	50	38
6–10	11.0	17	3.4 (3.2)	1.1 (1.4)	5.7 (5.8)	2.1 (2.4)	56	44

See 'Patients and methods' for explanation of abbreviations.

In the age group 14–17 the caries scores of the study group were significantly higher than in the control group (DMFT: $p<0.01$; DMFS: $p<0.001$). This was mainly due to a rise in the F component (teeth: $p<0.005$; surfaces: $p<0.0005$). Eight per cent of the first molars were decayed in the study group, 6% in the control group.

In the age group 10–13 years, the RI of the permanent teeth in the control group was nearly twice as high as in the study group ($p<0.0005$). This may also have been true for the deciduous dentition but the small number of deciduous teeth in this group did not permit statistical tests to achieve the required power. The D score was significantly higher in the study patients compared with the controls ($p<0.0005$). Thirty eight per cent of the first molars are decayed in cancer patients, 7% in the control group.

In the age group 6–9 years, the study group had significantly lower f(t) score ($p<0.05$). Although the D(T) score in the study subjects was higher and the RI/PT was lower, these differences did not reach a significant level. Nineteen per cent of the first molars were decayed in the study compared with 12% in the control group.

In the youngest age group (2–5 years) we did not find any significant difference between the study and the control subjects. Although we noticed an important difference in the mean, there was a large SD.

Table 2 shows the results of the caries scores in the study group in relation to the age of the patients at diagnosis. Study patients who had their malignancy diagnosed before 5 years had a mean age of 7.6 years at the time of dental examination. This subpopulation had a lower RI with regard to deciduous teeth ($p<0.05$) than a similar control group. Children who had been diagnosed between 6 and 10 years had a mean age of 11 years at the time of dental examination and had a lower RI for permanent teeth ($p<0.005$).

In table 3 the different components of the caries scores are shown. The first subgroup (age of diagnosis 0–5 years) had a lower f(t) score ($p<0.001$). The second subpopulation (age of diagnosis 6–10 years) had a significant higher D (T and S) score ($p<0.05$).

The results regarding gingival health and periodontal status are shown in table 4. There was a negative correlation between age and the plaque index ($r=-0.37$; $p<0.01$) and a negative correlation between age and gingival index ($r=-0.35$; $p<0.05$) in the study group. The study and control groups had similar plaque index and gingival index scores. The frequency of toothbrushing was identical for both groups and did not differ significantly between the age groups.

Discussion

The average dmft, DMFT, dmfs, and DMFS scores in the lower age groups of the study subjects were consistent with the findings in the control group. An epidemiological study of DMFT and dmft scores in 7700 Flemish

Table 3 Different components of caries scores at different ages; values are mean (SD)

Age at diagnosis (years)	FT	ft	FS	fs	DT	dt	DS	ds
0-5								
Study group	1.2 (2.4)	0.7 (1.1)	1.9 (3.4)	1.3 (2.5)	1.1 (1.5)	1.3 (2.2)	1.3 (1.6)	2.8 (6.6)
Controls	1.0 (1.1)	2.0 (1.3)	1.0 (1.1)	2.3 (1.7)	0.6 (1.1)	1.0 (1.3)	0.7 (1.3)	1.4 (2.0)
p Value		<0.001						
6-10								
Study group	2.2 (2.7)	0.6 (1.1)	3.3 (4.0)	1.1 (2.0)	1.1 (1.3)	0.4 (0.8)	1.8 (2.4)	0.4 (0.8)
Controls	2.5 (1.3)	0.8 (0.7)	2.5 (1.4)	1.0 (0.9)	0.3 (0.5)	0.5 (0.5)	0.3 (0.5)	0.6 (0.7)
p Value					<0.05		<0.05	

See 'Patients and methods' for explanation of abbreviations.

schoolchildren by Declerck *et al* in 1991 showed similar results.²¹ Only in the age group 14-17 years were the DMFT and DMFS scores much higher than in the control group; this was because of a higher F score.

In the age group 10-13 the RI/PT was significantly lower in the study group, mostly due to a much higher D score. The average age at diagnosis of cancer in this group was 6.5 years. This is about the age at which the first permanent teeth erupt and are very prone to development of caries.^{22, 23} Circumstantial factors such as vomiting, poor oral hygiene, and altered diet, could at this age lead to a high incidence of permanent teeth decay and later to a higher number of treated teeth. This is reflected in a higher percentage of decayed first molars in the 10-13 year old age group and a higher F score in the 14-17 group.

At the age 6-9 the f score is lower than in the control group. The average age of the patients with cancer diagnosed at 0-5 years was 7.6 years. For these children the f score was lower than in a control group of similar age. This results in a lower RI/DT. It is possible that treatment of caries has been postponed because of the cancer treatment or because it was thought that at this age deciduous teeth do not need to be treated anymore.

In two other research projects we studied caries risk factors related to dental decay (F Dens *et al*, unpublished). No evidence was present of long term effects of cytotoxic drugs on the studied caries aetiological parameters for this population. We suggest that at a certain stage in cancer treatment the patient becomes more susceptible to caries, and without specific oral counselling by a specialised dentist the child's dentition will not be taken care of effectively. This leads to a higher caries prevalence and a lower RI. At a later age, probably when the child starts complaining, these teeth will be treated. The primary attention for the cancer treatment and the fact that dental treatment is

postponed because of the transition period from deciduous to permanent dentition could explain these findings.

The plaque index, which reflects oral hygiene, is similar to that of the control group. This is in keeping with the findings regarding the frequency of toothbrushing. Also the gingival index has identical values for all age groups. Late specific periodontal abnormalities have not been elicited in the study group.

The following points have to be taken into account: (1) Our study group consisted of children with a great age difference. Therefore we had rather small subpopulations. (2) Although no evidence is found in the literature, we have to keep in mind that results might have been influenced by the variation of cancer pathologies. (3) As no radiographs were taken, some caries lesions (mostly incipient) were probably not detected; this, however, would be true for both groups. (4) A longitudinal study of the studied parameters would provide more information; we are therefore planning a multi-centre longitudinal study.

Conclusions

As treatment protocols for paediatric oncology patients become more successful in terms of cure rate, more attention should be given to the prevention of the long term effects of the cancer treatment. In the literature, no significant long term influence of cytotoxic chemotherapy on aetiological factors for caries or on caries prevalence in the studied population has been described. In our study we found a significant reduction of the RI in the group aged 10-13 years and a significant rise in DMFT score those aged 14-17 years. These patients should be considered as at high risk for caries. The rise in DMFT in the oldest patients of the study group seems not to be a direct result of the cytotoxic treatment nor of negligence of daily oral hygiene, but a consequence of the lack of professional dental follow up and care during cancer treatment. We strongly suggest that all children with cancer should be counselled by a specialised dentist. Dental follow up should be integrated in the medical follow up procedures.

A good protocol for dental and oral care should be mandatory before, during, and after the cancer treatment. At hospital admission dental consultation should be requested in order to register any specific dental problems, to provide dental treatments to eliminate and control oral infections and haemorrhages, to register basic parameters (for example, radiographs, gingival health), and to instruct

Table 4 Gingival health and periodontal status at different ages; values for plaque index and gingival index are mean (SD)

Age group (years)	Mean age (years)	Plaque index	Gingival index	Brushing frequency
14-17				
Study group	15.3	1.1 (0.1)	1.1 (0.1)	1.2
Controls	15.2	1.1 (0.2)	1.1 (0.1)	1.2
10-13				
Study group	11.4	1.3 (0.1)	1.4 (0.1)	1.3
Controls	11.6	1.3 (0.2)	1.3 (0.2)	1.2
6-9				
Study group	7.4	1.6 (0.3)	1.7 (0.3)	1.0
Controls	7.1	1.5 (0.2)	1.6 (0.2)	1.0
2-5				
Study group	4.0	1.7 (1.2)	1.3 (0.6)	0.9
Controls	4.4	1.3 (0.5)	1.3 (0.5)	1.0

the patient, parents, and all health care workers involved in the treatment on possible oral problems and appropriate hygiene measures. During the cancer treatment the patient should be continuously monitored. The state of eruption of permanent teeth can be examined and oral hygiene procedures evaluated. After cytotoxic treatment patients can be referred to their own dentist. The children should be scheduled for a dental appointment each time they return to the hospital for evaluation.

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