EFFECTS OF CHEMOTHERAPY ON DENTAL ROOT DEVELOPMENT AND PERMANENT TEETH ERUPTION IN A GROWING CHILD

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Abstract

Objective: The study is aimed to evaluate the effects of chemotherapy on dental root development and permanent teeth eruption in a growing child.

Materials and Methods: The study sample comprised of 66 children. Pediatric subjects were divided into three groups of 22 subjects each. Group A - The Case Group had patients who were undergoing chemotherapy for various malignancies. Group B and C - The Control Group both comprised of children who were healthy and were not receiving any chemotherapy for any malignancy. The three groups were compared for their chronological and dental age.

Results: There was no significant difference in the chronological and dental age of the patients that were treated with chemotherapy compared to the healthy controls. No significant difference was observed in the number of erupted permanent teeth as well between the case and control groups.

Conclusion: The conclusion is that dental maturity or eruption of permanent teeth is not interfered with by the chemotherapy given to children for hematological malignancies.

Keywords: Dental root development, Chemotherapy effects on dentition, Delayed eruption, Stunted dental root growth, Dental growth in cancer patients

INTRODUCTION

There has been an increase in the incidence of malignancies, especially hematological malignancies among children. There is one child below the age of 12 in every six cancer patients. Various non-invasive methods such as radiotherapy, chemotherapy, and molecular therapy have been introduced to cure or restrict cancer with the advancement in medicinal science.

Due to current chemotherapy, hematological malignancies remain in almost complete remission in more than 70% of the standard risk patients (Gustavsson et al. 1981). There is a great interest towards the late sequelae as a result of whether disease or the therapy due to this advancement in chemotherapy (Byrd 1985). The oro-dental health of such children during and after the treatment holds great significance because of a direct effect on their life quality.
There is a wide range of complications that the children undergoing the treatment can experience, such as ulcers, bleeding, infections, whether bacterial or fungal (Fleming and Kinirons 1986; Dahlöf et al. 1988a). Children treated with Chemotherapy only show healthy somatic growth in the long run. (Wells et al. 1983, Robison et al. 1985). Although, when chemotherapy is used in conjunction with cranial irradiation, there is a deficiency observed in growth hormone frequently (Shalet et al. 1976), along with decreased growth estimated as height velocity (Wells et al. 1983; Robison et al. 1985).

Researches are collecting data on the effects of cancer treatment in children on the oro dental tissues in the long run. An increase incidence has been reported among such patients of dental abnormalities such as hypoplastic enamel and dental root disturbances (Maguire et al. 1987; Rosenberg et al. 1987; Dahl et al. 1988). In some patients, delay in eruption of permanent teeth has also been reported (Adatia 1968; Purdell-Lewis et al. 1988).

Tumor cells that are aggressively dividing are the target of chemotherapy or molecular therapies. In childhood years, since most of the cells of the body are also dividing and growing rapidly, so this approach poses a significant disadvantage in such patients resulting in stunning growth in various parts of the body. Retardation of development of Hertwig Root sheath leading to retarded root development is one such example of this phenomenon.

Hence, the purpose of this study is to assess dental development and maturity in children who have undergone chemotherapy for hematological malignancies.

MATERIALS AND METHODS

66 Pediatric patients that presented to Robert Dubrey Hospital in Paris between January 1993 to October 1996 were included in the Study Sample, among which 36 were males, and 30 were females. These 66 patients were divided into three groups, with 22 in each group. Patients that were receiving chemotherapy for various malignancies were included in GROUP A - The Case Group.

While healthy children with no systemic condition were included in GROUP B and C - The Control Group. The sample of all three groups was similar in terms of age and gender.

Methotrexate, vincristine, doxorubicin, cyclophosphamide, and prednisolone were used as a regimen to treat patients with Acute Lymphoblastic Leukemia (ALL). While daunorubicin, cytarabine, and thioguanine were used to treat children with Acute Myeloid Leukemia (AML). After initial diagnosis and beginning of remission induction therapy, a panoramic radiograph was taken of every patient at various intervals (0.1-6.5 years). In different time intervals, the distribution of various subjects is shown in Fig 1.Seven-teeth method by Demirjian and Goldstein (1976) was used to assess dental maturity or dental age. The mineralization stages of the left lower seven teeth are observed by the help of the eight-stage scale in this method, and the development stage of every single tooth is scored according to its maturity. The total sum of each tooth score showed the dental maturity of a patient. With a three week interval, two authors scored all 66 radiographs at two different occasions. Several permanent teeth erupted were also recorded for a thorough clinical examination.

RESULTS

While 9.4 was the mean chronological age of case and control groups, the estimated mean dental age among the Case Group was between 9.0 to 10.2 years, while 10 to 10.5 years of the control groups (Table 2).

Statistical difference between the dental age and chronological age of the case group compared to the two control groups was not significant. (Table 3).

The variation between dental and chronological age in the chemotherapy group was from -0.44 years to -1.06, while the control group ranged from -0.49 to -1.10. Among the three groups, inter-examination variation came out to be between -0.05 to -0.62 years, while the variation upon intra-examination was from -0.06 to -1.16 years. There is no statistical significance of any of these variations. The true chronological age was overestimated continuously in all the groups when the dental maturity was assessed based on Demirjian and Goldstein’s (1976) scoring system.

The number of remission induction therapies showed no correlation with the difference between dental and chronological age (r = 0.158). Also, no association was found between the time from diagno-
Effects of chemotherapy on dental root development and examination and the difference between dental and chronological age ($r = -0.157$). The total count of erupted permanent teeth in the chemotherapy-treated patients and the healthy controls also came out to be similar (Table 3).

### Table 1: Diagnoses and Numbers of Remission Induction Therapies in 22 Children Treated With Chemotherapy

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute lymphoblastic leukemia</td>
<td></td>
</tr>
<tr>
<td>1st remission</td>
<td>1</td>
</tr>
<tr>
<td>2nd remission</td>
<td>9</td>
</tr>
<tr>
<td>3rd-5th remission</td>
<td>3</td>
</tr>
<tr>
<td>Acute myeloid leukemia</td>
<td></td>
</tr>
<tr>
<td>1st remission</td>
<td>4</td>
</tr>
<tr>
<td>2nd remission</td>
<td>2</td>
</tr>
<tr>
<td>Chronic myeloid leukemia</td>
<td>1</td>
</tr>
<tr>
<td>Acute erythrocyte leukemia</td>
<td>1</td>
</tr>
<tr>
<td>Lymphoma</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
</tr>
</tbody>
</table>

### Table 2: Standard Deviations (SD) AND Mean Values (X) of Dental Maturity (Age) and chronological age Scores (Demirjian & Goldstein 1976) in Children Treated With Chemotherapy (N = 22) and Two Control Groups

<table>
<thead>
<tr>
<th></th>
<th>Chemotherapy Group</th>
<th>Control Group 1 (N=22)</th>
<th>Control Group 2 (N=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
<td>X</td>
</tr>
<tr>
<td>Chronological</td>
<td>9.7</td>
<td>3.2</td>
<td>9.7</td>
</tr>
<tr>
<td>age Dental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maturity scores*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examiner 1, 1st</td>
<td>10.0</td>
<td>3.8</td>
<td>10.3</td>
</tr>
<tr>
<td>Examiner 2, 2nd</td>
<td>10.3</td>
<td>3.8</td>
<td>10.3</td>
</tr>
<tr>
<td>Examiner 2, 1st</td>
<td>10.6</td>
<td>3.8</td>
<td>10.8</td>
</tr>
<tr>
<td>Examiner 2, 2nd</td>
<td>10.5</td>
<td>3.8</td>
<td>10.7</td>
</tr>
</tbody>
</table>

*Dental maturity was assessed by two examiners on two separate occasions

### Table 3: Comparison Between Dental Maturity and Chronological Maturity Scores in Case and Control Groups. $d = $ Difference Between Chronological and Dental Age

<table>
<thead>
<tr>
<th></th>
<th>Chemotherapy Group</th>
<th>Control Group 1</th>
<th>Control Group 1</th>
<th>d1-d2</th>
<th>t-value*</th>
<th>d2-d3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d1</td>
<td>d2</td>
<td>d3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between</td>
<td>Chronol-Exam 1:1</td>
<td>-0.44</td>
<td>-0.50</td>
<td>-0.49</td>
<td>0.26</td>
<td>-0.20</td>
</tr>
<tr>
<td>chronological and</td>
<td>Chronol-Exam 1:2</td>
<td>-0.70</td>
<td>-0.56</td>
<td>-0.76</td>
<td>-0.54</td>
<td>-0.23</td>
</tr>
<tr>
<td>dental age</td>
<td>Chronol-Exam 2:1</td>
<td>-1.06</td>
<td>-0.97</td>
<td>-1.10</td>
<td>-0.36</td>
<td>-0.17</td>
</tr>
<tr>
<td></td>
<td>Chronol-Exam 2:2</td>
<td>-0.89</td>
<td>-0.90</td>
<td>-0.71</td>
<td>-0.04</td>
<td>-0.67</td>
</tr>
</tbody>
</table>

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DISCUSSION

The result of this study shows that dental development in children is not affected by chemotherapy procedure for the treatment of various malignancies. There are several methodologies to estimate the chronological age (review Demirjian 1978). Swedish Board for health and welfare uses Demirjian and Goldstein (1976) system to estimate the age of adopted children. The variation between dental age and chronological age in this study is the same as that reported by Hagg and Matsson (1985). The variation between dental age and chronological age in this study is the same as that reported by Hagg and Matsson (1985). The variation between dental age and chronological age in this study is the same as that reported by Hagg and Matsson (1985).

There was a variation of -0.06 to -0.27 years in examiner I, similar to results Hagg and Matsson (1985). There is also a report of overestimation in the dental age by Hagg and Matsson (1985) as well upon using Demirjian and Goldstein (1976) scoring system to assess dental age. Short-Term retardation in the somatic growth was observed during the treatment with chemotherapy patients of ALL, which also becomes normal after three years of induction therapy. (Herber et al. 1985; Clayton et al. 1988). Although patients are undergoing chemotherapy along with with cranial irradiation show some striking contrast of permeant retardation of somatic growth (Wells et al. 1983; Robison et al. 1985; Kirk et al. 1987). Herber et al. (1985) conducted a study upon children; among them, 29 had received cranial or spinal irradiation and assessed Skeletal age using the TW2-method (Tanner et al. 1975). No remarkable difference was noted between the skeletal and chronological age in this group of patients. The results of dental age in this study are not significantly different from the results regarding skeletal age. Dental maturity in patients treated with chemotherapy has been discussed in two studies conducted before. (Adatia 1968; Purdell-Lewis et al. 1988). Among the children medicated with cy-

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Table 4: Mean Number (X) and Standard Deviations (SD) of Erupted Permanent Teeth in Children Treated With Chemotherapy Compared to Normal Controls

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of patients</th>
<th>Chemotherapy Group (N=22)</th>
<th>Control Group 2 (N=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>5.0</td>
<td>1.4</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>8.3</td>
<td>3.2</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>10.8</td>
<td>2.7</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>13.0</td>
<td>2.1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>15.5</td>
<td>3.3</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>18.0</td>
<td>3.4</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>27.7</td>
<td>0.6</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>27.5</td>
<td>1.0</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>28.0</td>
<td>0.0</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>28.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Dental maturity was assessed by two examiners on two separate occasions

* Student’s t-test, * P < 0.05.
Effects of chemotherapy on dental root development and
clophosphamide, methotrexate, and vincristine for
Burkitt’s tumor, delayed eruption in one patient was
reported by Adatia (1968). While 8 of 45 longterm
survivors of childhood cancer that were medicated
with chemotherapy showed delayed tooth formation
according to Purdell-Lewis et al. (1988). None of
these studies have described the assessment method
of delayed tooth formation. Cytotoxic drugs such as
cyclophosphamide and vincristine, have shown the
temporary effect on amelogenesis and dentinogenesis
in animal studies (Stene 1979; Adatia and Berkovitz
1981). There was no remarkable difference noticed in
the number of permanent erupted teeth among the
case and control groups in this study in contrast to
the study by Purdell-Lewis et al. (1988).

CONCLUSION

In conclusion, this study shows that children
treated with chemotherapy for hematological can-
cers do not affect dental maturity or eruption of
permanent teeth.

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