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THE EFFECT OF DIAGNOSTIC DENTAL RADIOGRAPHY ON THE LYMPHOCYTE COUNT AND ON THE DIURNAL TIDE OF HUMAN LEUKOCYTES

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University of California, Berkeley, California

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ABSTRACT

Total leukocyte and differential counts were done on eleven normal persons at hourly intervals for 12 hours beginning immediately after full-mouth dental radiography. These counts were compared with a control set obtained 1 or 2 days previously.

A diurnal tide consisting of a rise in granulocytes and lymphocytes during the day was seen in these normal individuals before irradiation. A significant depression in the absolute lymphocyte count was observed during the period immediately after x-irradiation. No change in the levels of circulating granulocytes was apparent.

Bilobed and binucleated lymphocytes were seen in the circulating blood before and after irradiation. The numbers of these cells seen were small, and it is not possible at this time to correlate changes in their incidence with dental radiography.

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INTRODUCTION

Recent studies of radiation doses received by patients undergoing diagnostic dental x-ray examinations have shown that in many instances a considerable quantity of radiation is delivered to the buccal area, parts of the face, and regions of the head and neck.<sup>1</sup> The pharyngeal region and certain areas of the neck are richly supplied with lymphoid tissue. Since such tissue is known to be particularly radiosensitive,<sup>2, 3, 4, 5</sup> it appeared worth while to examine in detail the peripheral blood of patients receiving dental x-ray exposures, especially for any changes that might be seen in the numbers of lymphocytes and in lymphocyte morphology.

Reported here is a study of the diurnal tide of the white blood cells of eleven normal individuals before and after full-mouth dental radiography.

## METHODS

The patients, four females and seven males, were young adults in good health. Their ages ranged from 22 to 43 years.

The dental x-ray procedures were carried out in several different offices. Radiography in each case was performed in the morning between 8 o'clock and 10 o'clock. The doses of radiation received by these patients were measured by Nolan and Patterson,<sup>1</sup> who reported dose rates from the machines studied ranging from 75 to 270 r per minute, and doses to the cheek areas of the patients from 35 to 315 r.

Hematological examinations consisting of white blood cell counts and differential counts were carried out hourly for a period of 12 hours on a pre-exposure day. These served as control data with which were compared twelve hourly counts taken immediately following the x-ray procedure. Blood samples were taken from the ear lobe. Leukocyte counts were done in duplicate. Pipettes certified by the National Bureau of Standards were used. Differential blood counts were made from blood films stained with Wright's stain. Four separate differential counts of 100 cells each were made from every slide. When agreement was not within 10 cells, an additional 100 cells were counted.

All blood films were scanned microscopically with partially mechanized equipment,<sup>10</sup> allowing observation of 5,000 to 10,000 leukocytes on each slide. Morphological abnormality in the form of bilobed and binucleated lymphocytes was recorded.

## RESULTS AND DISCUSSION

The diurnal tide of leukocytes in this group of eleven persons is shown in Fig. 1. Considerable fluctuations from hour to hour were seen in the counts from any one individual. An upward trend during the day was, however, an observation common to the group. In order to minimize the effect of individual variation, average counts were computed for every hour for the entire group. These are given in Table I, and are the basis of Fig. 1. It is apparent that the increase in total leukocytes for the eleven persons from 10:00 a.m. to 10:00 p.m. amounted to approximately 2,000 cells. A diurnal rhythm in the total white cell count in man was first described by Sabin<sup>6</sup> in 1925 and was subsequently confirmed by others.<sup>7,8</sup> It was generally thought to be due to an increase in the circulating granulocytes. Not until 1945 was there a description of a daily rise and fall in the circulating lymphocytes in man.<sup>9</sup> It is seen from Table I and Fig. 1 that lymphocytes and granulocytes both contributed substantially to the diurnal tide in the group studied here.

Average lymphocyte counts for the group were lower after dental radiography than before. In Table II and Fig. 2 are shown these averages for the eleven persons studied. The postexposure curve in Fig. 2 as seen by inspection is not only suppressed below the control, but rises less steeply during the day. The two curves were compared statistically by covariance

analysis,\* and were shown at the 99% confidence level to be distinctly separate.

In Table III and Fig. 3 pre- and postexposure data on granulocytes are presented. No significant difference is apparent.

Bilobed and binucleated lymphocytes were seen before and after x-ray exposure. Although a difference was noted, the total number of these cells seen was so small as to make statistical evaluation impossible. Since these observations included only the first 12 hours immediately following exposure to radiation, further studies covering a longer postirradiation period and employing more rigorous counting techniques<sup>10</sup> will be necessary to clarify a possible relationship between changes in lymphocyte morphology and dental radiography.

#### SUMMARY

1. Total leukocyte and differential counts were done on eleven normal persons at hourly intervals for 12 hours beginning immediately after full-mouth dental radiography. These counts were compared with a control set obtained 1 or 2 days previously.
2. A diurnal tide consisting of a rise in granulocytes and lymphocytes during the day was seen in these normal individuals before irradiation.
3. A significant depression in the absolute lymphocyte count was observed during the period immediately after x-irradiation.
4. No change in the levels of circulating granulocytes was apparent.
5. Bilobed and binucleated lymphocytes were seen in the circulating blood before and after irradiation. The numbers of these cells seen were small, and it is not possible at this time to correlate changes in their incidence with dental radiography.

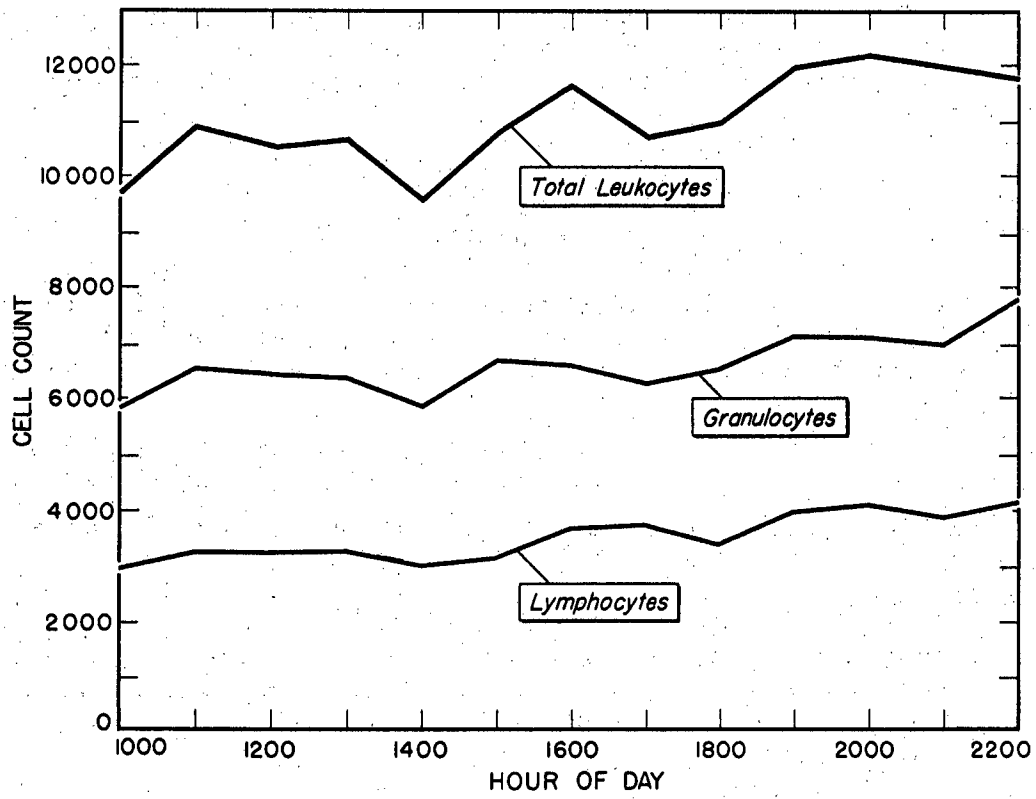
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Fig. 1. The diurnal tide of granulocytes, lymphocytes, and total leukocytes observed in a group of 11 normal individuals.

Table I

Diurnal variation in leukocyte count  
(averages from 11 normal individuals)

Hour	Total Leukocytes	Granulocytes	Lymphocytes
10	9625	5846	2943
11	10892	6542	3214
12	10540	6443	3214
13	10636	6386	3243
14	9587	5861	2978
15	10760	6674	3113
16	11613	6589	3652
17	10695	6236	3694
18	10983	6528	3340
19	11970	7129	3964
20	12180	7090	4089
21	11952	6977	3823
22	11732	7781	4115

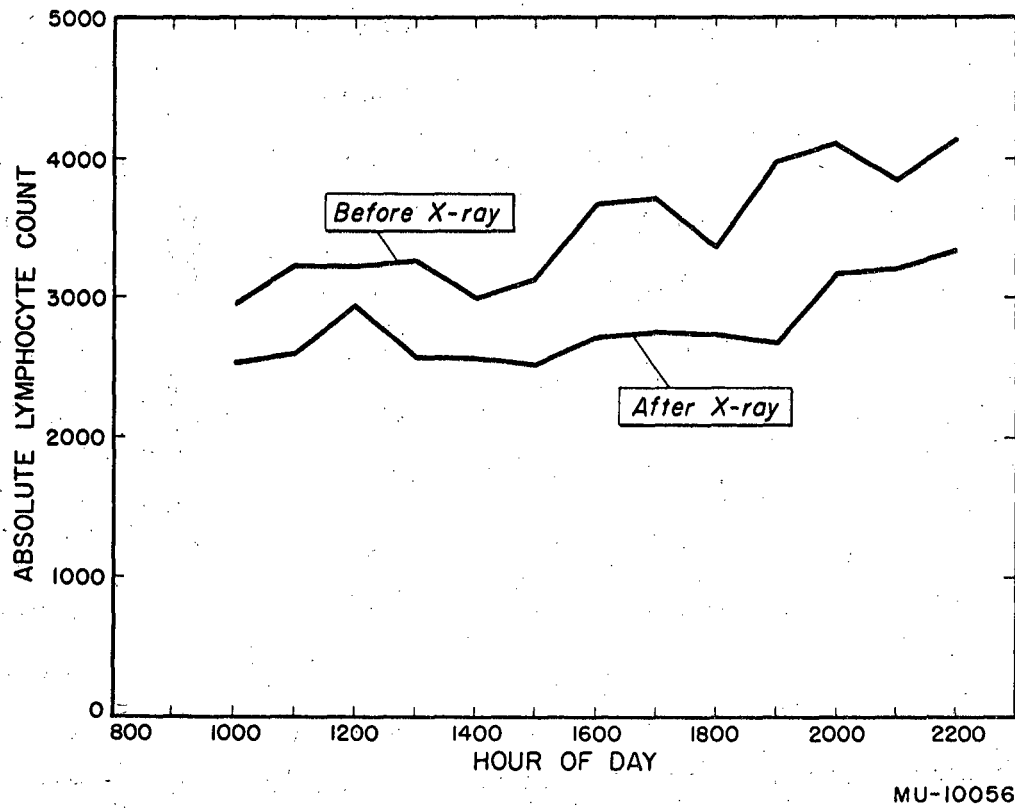
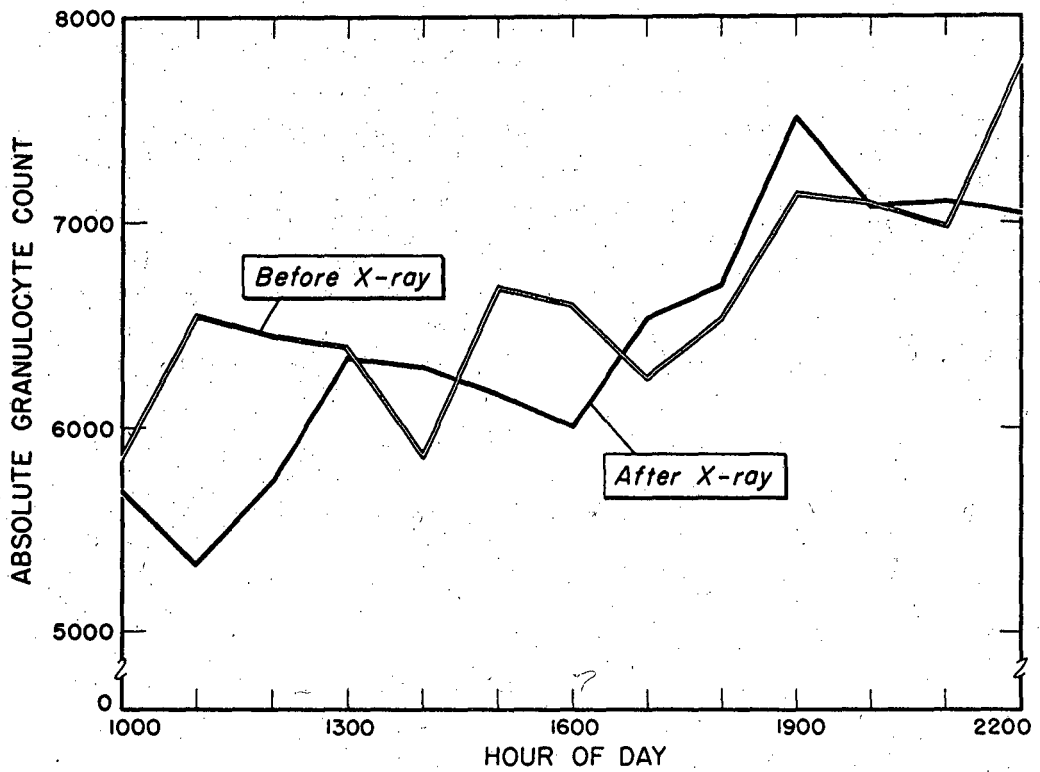


Fig. 2. Lymphocyte levels before and after dental radiography in 11 normal individuals.

Table II

Hourly lymphocyte counts before and after dental radiography (averages from 11 normal individuals)

Hour	Lymphocyte count before exposure	Lymphocyte count after exposure
10	2943	2521
11	3214	2594
12	3214	2936
13	3243	2565
14	2978	2559
15	3113	2506
16	3652	2704
17	3694	2741
18	3340	2725
19	3964	2661
20	4089	3166
21	3823	3204
22	4115	3334



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Fig. 3. Granulocyte levels before and after dental radiography in 11 normal individuals.

Table III

Hourly granulocyte counts before and after dental radiography (averages from 11 normal individuals)

Hour	Granulocyte count before exposure	Granulocyte count after exposure
10	5846	5692
11	6542	5322
12	6443	5736
13	6386	6330
14	5861	6287
15	6674	6154
16	6589	5999
17	6236	6522
18	6528	6680
19	7129	7503
20	7090	7067
21	6977	7090
22	7781	7034

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