THE GENETICALLY SIGNIFICANT RADIATION DOSE FROM DENTAL X-RAY DIAGNOSIS IN JAPAN

(CONTINUED)

BY

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In order to estimate the annual genetically significant radiation dose from dental x-ray diagnosis in Japan, the value of N_{jk}, N_k, w_{jk}, and w_k for each sex were already obtained and given in the preliminary report[1]. But the important value concerning the d_{jk} could not be estimated because we had no reliable dose meter for the measurement of the gonad dose from dental diagnosite x-ray exposure.

In this report, the values of $d_{jk}^{(F)}$ and $d_{jk}^{(M)}$ were estimated from the measurement of gonad dose for the male patient and the final result of calculation of the gentically significant radiation dose is shown.

MATERIALS AND METHODS

Dental x-ray apparatus in this experiment was the type of D-60-S (JIS**)

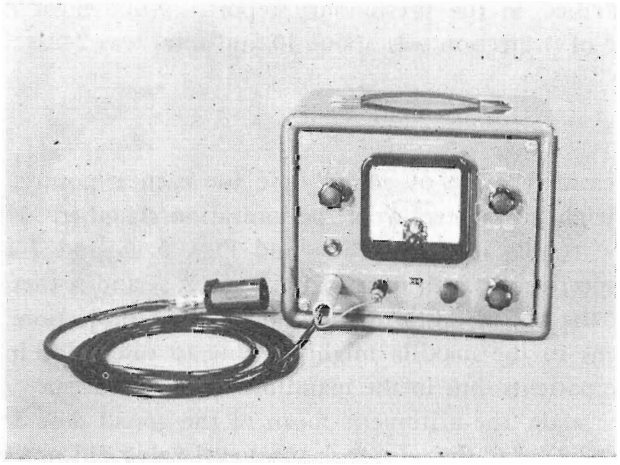

Fig. 1

*村井竹雄，菊地　厚，中村　正，山本　昭: Dept. of Radiology (Chief: Prof. T. Murai) School of Dentistory.
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** Japan Industrial Standard: Dental X-ray High Tension Generators JIS Z-4605 (1959)

This type of apparatus was the most popular in Japan. Physical factors of x-ray were as follows: 60 kVp, 10 mA, H.V.L.=1.1 mm of alminum. Exposure time was given in the Table 1. Radiographic technique was the

Table 1. Exposure time in second

J_1	0.4 sec.	J_4	0.3 sec.
J_2	0.6 sec.	J_5	0.4 sec.
J_3	0.8 sec.	J_6	0.6 sec.

routine intra-oral method using localizing cone. The target skin distance was 15 cm and the field size on the skin of the patient was 7 cm in diameter. For the meausrement of the gonad dose a portable electrometer Model 37A (Fig. 1) was used. The ionization chamber of this dose meter was 38 cc in volume and cylindrical in form. It was calibrated against with the Victoreen dose meter Model 70-5. The measurement of the gonad dose were made for the male out-patients in the routine dental radiography. The ionization chamber was placed on the dental chair between thighs of the patient and 10 cm in front of his scrotum, because it was not allowed to set the chamber adjacent to the scrotum. And on each exposure, the dose in the site of the ionization chamber was considered as the gonad dose for the male. Direct measurement of gonad dose for the female was not able to carry out, so it was estimated from the result of the measurement for the male by a method as described below. The projection of x-ray was devided into six types as described in the preliminary report. Number of measurement for each type of projection was about 40 and total was 242.

Results

Each measured value of gonad dose for each exposure was plotted against the height of eyelevel from the ionization chamber. Figs. 2, 3 and 4 showed the results in the maxilla and Figs. 5, 6, and 7 those in the mandible respectively. As shown in the Figs. 2, 3 and 4 there were some variations in the gonad doses in the same type of projection. Reason of such variations in the maxilla might be due to difference in the sitting height of the patients, but in the mandible it was not clear. As the value of d_{jk} for the male, the arithmetic mean of the gonad dose for each type of projection was taken, because each measured value did not deviate from the mean by a factor of 10. Each mean for each gonad dose and its standard error was given in the Table 2. As to the value of d_{jk} for the female, it was calculated by multiplying the d_{jk} for the male by a factor of 1/5 which was estimated from the data of Stanford[2]. Thus an approximation of

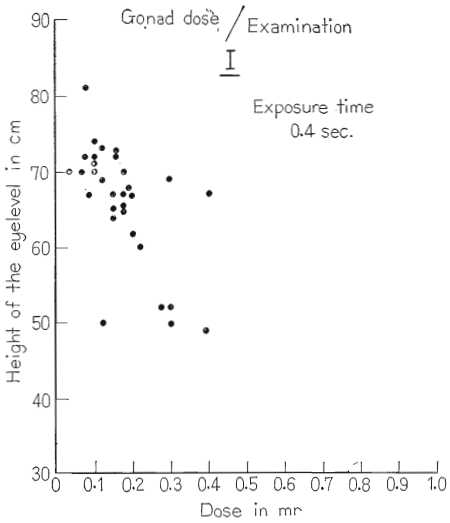

Fig. 2

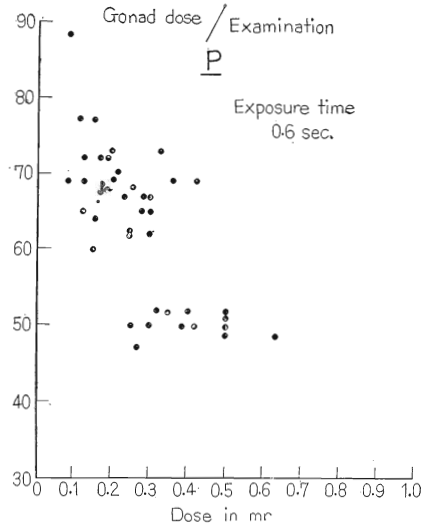

Fig. 3

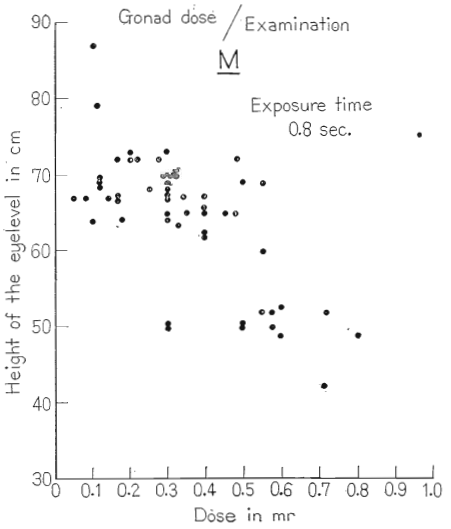

Fig. 4

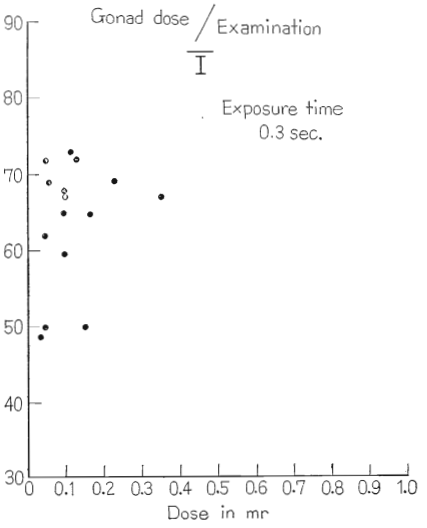

Fig. 5

Table 2. Gonad dose in mr

J_1	0.17 ±0.09	J_4	0.12 ±0.08
J_2	0.267±0.12	J_5	0.16 ±0.07
J_3	0.331±0.17	J_6	0.117±0.08

the annual genetically significant radiation dose from the dental diagnostic x-ray exposure in Japan could be obtained calculating the equation as

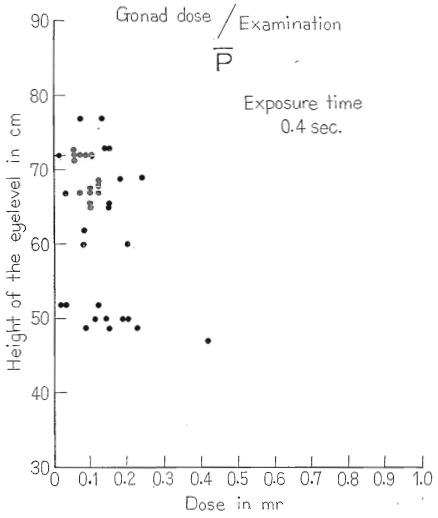

Fig. 6

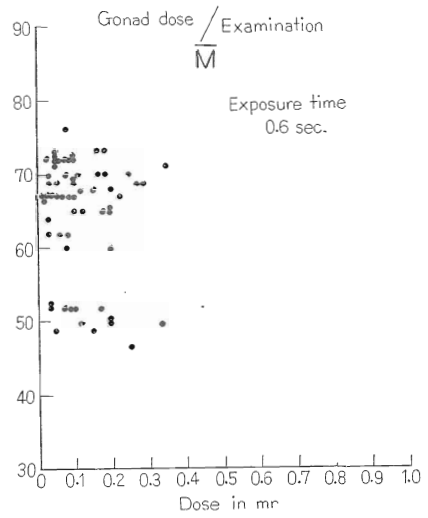

Fig. 7

Table 3. Genetically Significant Radiation Dose in mr

J_1	0.1541×10^{-3}
J_2	0.2878×10^{-3}
J_3	0.3809×10^{-3}
J_4	0.0464×10^{-3}
J_5	0.1630×10^{-3}
J_6	0.2283×10^{-3}
Total	1.215×10^{-3}

given before. And it was 1.2×10^{-3} mr. Each approximation of the genetically significant radiation dose from six different types of projection was given in Table 3.

Discussion

In the estimation of genetically significant radiation dose from the dental diagnostic x-ray exposure, the value of N_{jk} and d_{jk} are the two basic factors. And the former will be greatly influenced by the method of sampling of populations and the latter by the determination of the experimental conditions, i.e., the physical and geometrical factors of x-ray examination, the method of measurement of gonad dose and the photographic condition and so on. Our estimation of the value of N_{jk} was based upon an assumption that the distribution of examination in respect to type, age

and sex throughout Japan was the same as that observed in 10,000 exposures carried out in our hospital*** during a period of 4 months from April to July in 1956. For the estimation of distribution with higher confidence, another survey must be made from the view point of statistics. As to the phsyical factors we used, they were supposed to be reliable average in Japan. The dental x-ray machine of type JIS D-60-S was popular and its distribution was estimated over 60 per cent of all the dental machines in Japan. The dental film supplied by two makers (FUJI and SAKURA) had almost the same sensitivity. Therefore, the estimation of d_{jk} in intra-oral radiography from the measurement of gonad dose were easier than in routine medical radiography which used intensifying screen, grid and so on. As the gonad dose was measured in the routine radiography of the out-patient, the ionization chamber was set at 10 cm in front of the scrotum, instead of the site of scrotum. For the above reason, the obtained value of the gonad dose and the estimated value of d_{jk} were larger than true gonad dose. Therefore, the value of the genetically significant radiation dose estimated in the above experiment should be somewhat higher than the value which would be obtained in the more accurate measurement of gonad dose.

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Summary

1. For the estimation of genetically significant radiation dose from dental x-ray diagnosis, some basic data were obtained from the intra-oral radiography. But the data from other types of radiography were neglected, because they were less frequently used in Japan.

2. Gonad dose from dental x-ray exposure were measured in 242 male out-patients. Gonad dose for the female were estimated from the report given by Stanford.

3. Genetically significant radiation dose from dental x-ray diagnosis in Japan in 1958 was estimated and it was 1.2×10^{-3} mrem. The value was very small, comparing to that from medical diagnostic x-ray procedures[5] in Japan.

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References

1) Murai, T. et al: The genetically significant radiation dose from dental x-ray diagnosis in Japan (Preliminary report). Bulletin of Tokyo Med. & Dent. Univ. 6, 121, 1959.
2) Stanford, R. W. et al.: The quantity of radiation received by the reproductive organs of patients during x-ray examinations. Brit. J. Radiol. 28, 266, 1955.
3) Ardran, G. M. et al.: Obseravtions on the dose from dental x-ray procedures with a note on radiography of the nasal bones. Brit. J. Radiol. 32, 572, 1959.
4) Seelentag, W. et al.: Zur Frage der genetischen Belastung der Bevölkerung durch die Andwendung ionisierender Strahlen in der Medizn. Strahlentherapie Bd. 105, 169, 1958 Bd. 107, 22, 1958 Bd. 107, 537, 1958.
5) Miyakawa, T. et al.: The genetically significant dose by the x-ray diagnostic examinations in Japan. Nipp. Act. Radiol. 21, 565, 1961.