PROTOCOL OF EXPERIMENT INVOLVING HUMAN VOLUNTEERS

1. Title: Patient Absorbed Radiation: A Comparative Study of Standard Full Mouth Series Opposed to Panoramic Radiography

2. Project/Task/Work Unit: 7755/12

3. Principle Investigators: Colonel Charles R. Morris, CLDC, USAFSAM; Major Earl L. Kinsley, RAH, USAFSAM; Major Albert C. Jerman, CLD, USAFSAM; Colonel Vincent A. Segreto, CLD, USAFSAM.

4. Medical Consultant: Colonel Frank R. Lecocq, MC, USAFSAM.

5. Technical Objectives: To determine the radiation absorbed dose by patients undergoing a radiographic examination which includes a standard full mouth periapical dental series with the conventional dental radiographic machine as opposed to the patient having the examination by panoramic radiography.

6. Background: It is generally agreed in the dental literature that the less radiation a patient is exposed to the better. In the past fifteen years, the amount of radiation required to accomplish an acceptable full mouth radiographic survey has dropped drastically. In 1958, Richards (a) determined a complete periapical conventional dental radiographic examination of the adult patient resulted in 23.8 roentgens being administered to the face. In 1964, the same author (b) indicated that by using a faster film, only 3.0 roentgens were administered to the patient for the same survey. The dental radiographic film emulsion has been improved by the manufacturers to allow adequate resolution on faster, more sensitive film. Additional filters have been added to the x-ray machines to cut down on secondary radiation. Improved columation has also been accomplished to reduce the patient absorbed radiation. The standard dental x-ray cone on the head of the machine is being replaced by most knowledgeable dental practitioners to reduce scatter radiation. Even with all of the improvements, it is our belief that a more comprehensive dental radiographic examination can be accomplished with a considerable reduction in the radiation absorbed dose to the patient. A pilot study accomplished utilizing two of us as subjects revealed the following: (1) A more comprehensive examination was accomplished utilizing the panoramic radiograph; (2) Utilizing thermal luminescent dosimetry, it was found that the greatest reading from the panoramic radiographic exposure was near the center of rotation of the beam and this measurement was approximately one-half the reading of the lowest reading from the central beam of any one area exposed utilizing the routine conventional dental radiographic techniques at 65 KVP, 15 MA with one second exposure per film. The accepted routine of dental practitioners for a full mouth series varies between 14 and 20 exposures. Even if 20 exposures were utilized, the exposure is well within the limits suggested by the Council on Dental Materials and Devices and the Council on Dental Research of the American Dental Association.

7. Hazards: Subjects will receive no more radiation than they would receive from a routine series of dental film for diagnostic purposes. The subjects will be accepted only if a dental radiographic survey is indicated for screening and diagnostic purposes. The subjects will not be authorized hazardous duty pay.

8. Requirements for Human Volunteers:

a. Number required: 16

b. Date and number of days required: As patients present themselves for a full mouth diagnostic series of x-rays, they will be given the opportunity to participate in the study. The study will not interfere with the diagnostic usefulness of the film. Participation in the study will require approximately an additional 45 minutes above the normal time.

c. Schedule of experiment: The study will progress as subjects present themselves for diagnostic radiographs and volunteer for the subject.

d. Duties and procedures to be performed by human volunteers: Impressions will be taken of the maxillary and mandibular arches. On the resultant models polystyrene bite rims will be constructed. Thermal luminescent dosimeters will be placed at prescribed positions in the bite rims to coincide as nearly as possible with the central ray of each periapical exposure, near the center of rotation of the panoramic radiographic ray and at selected other points. The radioluscent bite rim will be placed in the subject's mouth prior to taking the x-rays. After the exposures are made, the bite rims will be removed and the dosimeters removed for reading. The film will be processed in the usual manner for diagnostic purposes.

e. Special requirements: An adult individual having a requirement for a dental x-ray survey not having had one in the past year. Lead aprons will be provided to all individuals involved.

f. Prior screening required: Only to the extent the determination be made that the patient has not had prior excessive radiation.

9. Experimental Protocol:

a. Parameters to be explored:

(1) Patient absorbed radiation during full mouth series of periapical radiographs as recorded on thermal luminescent dosimeter chips. Calcium fluoride chips will be pre-annealed as follows: 90 minutes at 450°C followed by 24 hours at 80°C. This will release all traps within the floor and erase background along with any previous radiation history. The TLD chips will then be

pre-positioned into the dental impressions and irradiated. After irradiation a delay of at least 72 hours will be employed before readout. This will eliminate the necessity of pre-reading annealing to remove extraneous low energy peaks which decay out within this 72-hour period. This is a necessity since the container to be utilized cannot withstand the 100°C temperature necessary for this process.

(2) Special low dose reading techniques will be utilized in conjunction with the Harshaw 2000 reader. All accessories including the heating pan will be extensively cleaned to eliminate the possibility of contamination with powder grains which have been exposed to high doses. A nitrogen atmosphere will be utilized during reading to reduce triboluminescence which could add significantly to background at these low dose levels. A 30 second reading cycle will be utilized with a second reading taken to enable subtraction of background and dark current from each individual sample. This resulting integrated current readings will then be converted to dose via a calibration curve. Comparisons will then be made of dose points with both Panorex and conventional dental x-ray machines.

b. Stresses to be incurred: None.

c. Drugs: None.

d. Physiological, psychological, biochemical measurements: None.

e. Pertinent references:

(1) Howley, J. R., Robbins, C., and Dickinson, M. B. Thermoluminescent radiation dosimetry applied to dental x-ray exposures. Technical Notes, pp 397-401, August 1968.

(2) Laney, W. R., and D. E. Tolman. The use of panoramic radiography in the medical center. Oral Surg, Oral Med. and Oral Path. Vol 26:465-474, October, 1968.

(3) Stewart, J. L., and L. F. Fieser. Panoramic roentgenograms compared with conventional intraoral roentgenograms. Oral Surg., Oral Med. and Oral Path. Vol 26:39-42, July, 1968.

(4) Kuba, R. K., and J. O. Beck. Radiation dosimetry in panorex roentgenography. Part I. Use of phantoms in dental radiation dosimetric research. Oral Surg., Oral Med. and Oral Path. Vol 25:380-385, March, 1968.

(5) Kuba, R. K., and J. O. Beck. Radiation dosimetry in panorex roentgenography. Part II. Pattern of radiation distribution. Oral Surg., Oral Med. and Oral Path. Vol 25:386-392, March, 1968.

10. Potential Danger to Human Volunteers/Safety Measures: The units of interest in the proposed study will be the Panorex dental x-ray machine, 90 Kvp, 15 ma located in Room 153, Building 100 and the standard General Electric x-ray dental machine, also 90 Kvp, 15 ma located in Room 152D, Building 100. Both radiographic dental units have had a recent radiation protection survey and are in radiologically safe areas. Both radiographic dental units have had a recent Radiation Protection Survey and are in radiologically safe areas. All subjects will have a lead apron provided during the radiographic experiment to reduce the gonadal dose to zero. The operator will be required to remain within the shielded area during all exposures. Monitoring equipment will be provided by the Health Physics Branch.

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