

# X-ray Imaging and Oral Healthcare

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X-ray examinations provide valuable information about your oral health and play a major role in helping your dentist make an accurate diagnosis and plan appropriate treatment. Patients and parents are often concerned with the use and risk of dental X-rays. The following information was assembled to help explain the nature of X-rays and risks associated with various types of dental imaging.

## What are X-rays?

X-rays are a form of energy like radio waves and light and have the ability to penetrate body tissues. The X-rays that pass through can be captured on film or a digital sensor for viewing.

## History of X-rays



“I have discovered something interesting, but I do not know whether my observations are correct” is what Wilhelm Conrad Roentgen (Fig. 1) remarked in 1895 to a colleague when he had just seen the bones of his hand clearly displayed in an outline of flesh when he held it between a cathode ray tube and a barium coated screen. In December 1895 he reported this to the Wurzburg Physical-Medical Society with a radiograph of his wife’s hand (Fig. 2). Within weeks of Roentgen’s report, newspapers and professional journals exploded with descriptions of his finding. By February 1896, most cities and small towns in the U.S. had seen demonstrations of the “new light”. Healthcare professionals immediately recognized the tremendous benefits to this discovery and within a year, X-rays were being used in diagnosis and therapy.



## The World Discovers X-rays

“NEW LIGHT SEES THROUGH FLESH TO BONES!” was a headline in a U.S. newspaper as inventors such as Thomas Edison and the public were just discovering X-rays. In this age of discovery various uses of X-rays became popular. Footwear was X-



rayed to check the fit (Fig. 3). X-ray studios opened offering to take “bone portraits” of individuals.

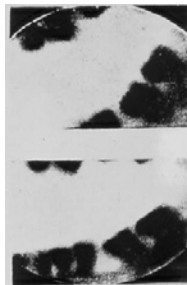
## X-rays in Medicine

The medical world immediately recognized the importance of X-rays and within months of their report images of foreign bodies (Fig. 4), fractures and stones were shown. Some physicians began to apply X-rays to treatment of tuberculosis and cancer, although at that time there was no scientific reason to expect any curative action. Soon “X-ray” therapy boomed in medical care and optimism won over reason as it was thought that X-rays were harmless and could cure almost any illness. Recognition of biological dangers came very slowly as physicians and scientists carefully documented the results of X-rays on biologic tissues. This included temporary effects such as redness of the skin in low doses to inducement of cancer and necrosis of tissues in higher and repeated exposures. The original exuberance was tempered by knowledge of both benefits and harm caused by X-rays.



## X-rays in Dentistry

The importance of X-rays in medicine were also recognized in dentistry as only 14 days after Roentgen published his discovery, Dr. Walkhoff, a dentist in Braunschweig, Germany produced images of teeth (Fig. 5). These images were intraoral x-rays produced with small glass photographic plates wrapped in sheets of black paper and rubber. The exposure time was 25 minutes each! Adoption of X-ray technology was much slower compared to medicine as by 1900 only a dozen or so dentists in the U.S. were using x-rays in their practices. This was largely attributed to the specialized equipment required and the lack of instruction on this topic in dental curricula. Only in 1909 did the Dr. Raper give the first course on dental radiology in Indianapolis.



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## Measurement of Radiation Dosage

The scientific unit of measurement for radiation dose, commonly referred to as the effective dose (E), is the millisievert (mSv) or microsievert ( $\mu\text{Sv}$ ) for smaller doses. The effective dose accounts for varying sensitivity of different tissues to X-ray exposure. It allows for quantification of risk and comparison to more familiar sources of background exposure and to medical X-ray examinations.

### “Background” Exposure

X-rays are naturally occurring! People are exposed to radiation from natural sources all the time. The average person in the U.S. receives an effective dose of about 3000  $\mu\text{Sv}$  per year (~8  $\mu\text{Sv}$  per day) from natural sources such as cosmic radiation from outer space and sources in the soil. The largest source of background radiation comes from radon gas in our homes which is about 2000  $\mu\text{Sv}$  per year. Radon exposure varies from one location in the country to another. Altitude also plays an important role as people living at elevation such as in the plateaus of Colorado or New Mexico receive about 1500  $\mu\text{Sv}$  more per year than those living at sea level. The dose from cosmic X-rays during a coast to coast flight in the U.S. is about 30  $\mu\text{Sv}$ .

### Relative Radiation Exposure

To explain exposure in simple relative terms, the following table compares common dental procedures with comparable natural background exposures and select medical examinations. Note that dental X-ray images are equivalent to less than one day to a couple weeks of natural background radiation.

Examination	Effective Radiation Dose ( $\mu\text{Sv}$ )	Equivalent Natural Background Radiation for:
Panoramic	3-11	Half to One day
Cephalogram	5-7	Half to One day
Occlusal Film	5	Half day
Bitewing	1-4	Half day
Full mouth series	30-170	4-21 days
TMJ series	20-30	3-4 days
<b>CBCT exam</b>	<b>40-135</b>	<b>4-17 days</b>
Medical Examinations		
Chest X-ray	100	10-12 days
Mamography	700	88 days
Medical CT	8000	1000 days

## X-ray safety

X-rays are considered safe when used with care. Dentists and dental assistants have been trained to use the minimum amount of X-ray radiation to obtain valuable diagnostic information. The above table shows that the amount of radiation used in dentistry is very very small and considered “negligible risk” by the Health Protection Agency. The amount of radiation used in dentistry is very small and the benefits greatly outweigh the risk of harm. X-rays are produced only when the device is momentarily turned on. Like a camera flash or flash light, no radiation remains after it is turned off.

### Pregnancy and X-rays

Knowing whether a patient is pregnant or could be pregnant is important information for the dentist. When a patient is pregnant the dentist will provide only select types of care and medications to avoid potential risks to the developing child. This also includes X-ray images. Dental x-ray examinations are not likely to pose a serious risk for the child, since the X-rays do not directly expose the baby, however to avoid any potential risks, elective procedures and X-rays can be postponed. Dental care and X-ray images in emergencies during pregnancy are provided on a risk to benefit basis.

### For the Patient

The effects of X-rays are cumulative over a lifetime. Past exposure to X-rays is important. For those that have had frequent X-ray exams and change dentists, it is a good idea to keep a record of the X-ray images yourself. Although there may be a small fee associated with duplication of images, this information can be helpful for a new dentist and the images may still be used rather than take additional X-rays.

### References:

1. Health Protection Agency ([www.hpa.org.uk](http://www.hpa.org.uk))
2. International Commission on Radiological Protection ([www.icrp.org](http://www.icrp.org))
3. ACR/RSNA ([www.radiologyinfo.org](http://www.radiologyinfo.org))
4. X-rays in Dentistry. JADA, 1982, 104(4),438.