Patient Information Sheet – Safety Aspects of CT scans

Radiation exposure in CT examinations
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What are X-rays and what do they do?
X-rays are a form of energy, like light or radio waves. Unlike light, x-rays can penetrate the body, which allows your dentist or a radiologist to produce images of internal structures. These can be viewed on a computer monitor.

Measuring radiation dose

The scientific unit of measurement for radiation dose, commonly referred to as effective dose, is the millisievert (mSv). For comparison, a Dental CBCT scan delivers a dose of 0.05 – 0.150 mSv.
A medical CT scan of the head will deliver a dose of 1 – 5 mSv.
Different organs and tissues have varying sensitivity to radiation exposure and therefore, the actual doses to different parts of the body from an x-ray procedure vary. The term effective dose is used when referring to the dose averaged over the entire body. The effective dose accounts for the relative sensitivities of the different tissues exposed. More importantly it allows for quantification of risk and comparison to more familiar sources of exposure that range from natural background radiation to radiographic medical exposures.

Naturally occurring 'background' radiation exposure

We are exposed to radiation from natural sources all the time. The average person in the UK receives an effective dose of about 2.5 mSv per year from naturally occurring radioactive materials and cosmic radiation from outer space. These natural 'background' doses vary throughout the country. For instance, people living in Cornwall receive more than 10 mSv per year, largely because of radioactive radon contained within granite. These levels are high enough for the natural topsoil and rock to meet the criteria for low-level nuclear waste.

There are some parts of the world, e.g. areas in Iran and India where the background radiation levels are extremely high, greater than 200 mSv, which is several times more than workers in nuclear power stations are exposed to, yet the life expectancy in these areas is very high with no apparent adverse effects and no increased cancer risk.
We are also exposed to a significant dose from cosmic rays during an aeroplane flight e.g. a return flight to New York is equivalent to about 0.08 mSv and a frequent flyer aloft for around 100 hours a year would receive an additional annual dose of approximately 0.4 mSv.

To explain it in simple terms, we can compare the radiation exposure from one chest x-ray (about 0.06 mSv) as equivalent to the amount of radiation exposure one experiences from the natural surroundings in 3 days.

Radiation exposure from CT scans

Radiation dose from CT procedures varies from patient to patient. A particular radiation dose will depend on the size of the body part examined, the type of procedure, and the type of CT equipment and its operation. Dentists and radiologists are aware of the radiation risks of Dental CT and work actively to keep patient radiation exposures from Dental CT scanners as low as possible, while achieving the required imaging quality and medical benefit.

Due to its advanced design, the Vatech Dental CBCT scanner used in this practice typically exposes patients to considerably lower doses of radiation than conventional multi-detector CT scanners used in other centres and the NHS. It is optimised for use in dental surgeries further lowering the radiation dose required.

The Philip Friel Advanced Dentistry clinic is regulated by the Ionising and Medical Exposures Regulations (IRMER) and its independent external Radiation Protection Advisor has calculated the typical effective radiation doses for all the Dental CT scans performed at the centre.

X-ray safety

As with other medical procedures, x-rays are safe when used with care. Dentists, Radiologists and radiographers have been trained to use the minimum amount of radiation necessary to obtain the needed results. The amount of radiation used in most examinations is very small.

X-rays from Dental CT scanners are produced only when a switch is momentarily switched on. As with visible light, no radiation remains after the switch is turned off.

Your dentist looks at every request for a Dental CT scan and ensures that it is the appropriate examination to answer the question asked. If the answer could be better provided by an alternative imaging test which uses less radiation eg periapical or panoramic x-rays, then this will be recommended. Any additional CT imaging a patient has had in the last few years will also be taken into consideration.

There are special regulations for radiation exposure in females of child bearing age and specific questions will be asked as to whether you could be pregnant.

X-rays over your lifetime

The decision to have an x-ray examination is a medical one, based on the likelihood of benefit from the examination and the potential risk of radiation. For low dose examinations, like a small periapical x-ray, this is an easy decision. For higher dose examinations such as Dental CT, the dentist or radiologist will consider your past history of exposure to x-rays. It is a good idea to keep a record of your x-ray history yourself. Your risk factors for developing a specific condition will also be considered.

The probability for absorbed x-rays to induce cancer is thought to be extremely small for radiation doses of the magnitude that are associated with CT procedures. Such estimates of the cancer risk from x-ray exposures have a broad range of statistical uncertainty and there is considerable scientific controversy regarding the effects from very low doses and dose rates.

In the field of radiation protection, there are two schools of thought. No one knows which is correct. One school assumes that the risk for adverse health effects from cancer is directly proportional to the amount of radiation dose absorbed, although there is no definite evidence for this. Using this assumption, it has been estimated that a CT examination with an effective dose of 10 mSv may be associated with an increase in the possibility of fatal cancer of approximately 1 chance in 2000. This increase in the possibility of a fatal cancer from radiation can be compared to the natural incidence of fatal cancer in the general population, about 1 chance in 5. In other words, for any one person the risk of radiation induced cancer is vastly smaller than the natural risk of cancer (1).

To put things further into perspective, it has been recently estimated that the delivery of 10 mSv to the breast of a woman of 30 years old increases the risk of breast cancer by about 0.2% **over** the spontaneous rate for the general population (2).

To look at it another way, approximately 23% of all individuals die from cancer; one can calculate that of every 100,000 patients scanned, 40 might have a life threatening cancer induced by radiation in their lifetimes. On the other hand, of the same 100,000 people, 23000 are likely to die from cancer.
However, it should be noted that there is uncertainty regarding the risk estimates for low levels of radiation exposure as commonly experienced in diagnostic radiology procedures. There is no definite evidence that the risk of cancer increases linearly with the dose of radiation exposure, and certainly for low doses. Indeed the other school of thought suggests that a small dose of radiation is actually good for us, by weeding out potential cancer forming cells. People living in parts of the world (e.g
Iran) with extremely high levels of background radiation (>200 mSv) do not appear to have an increased rate of cancers and indeed if anything have an increased life expectancy (3).

Will I be exposed to more radiation if my scan shows an incidental finding?

Incidental (unexpected) findings are found on up to 25 % of all CT scans and most of these require no further clarification. The most commonly encountered abnormalities which need further imaging to confirm their exact nature are simple cysts. The dentist may refer your scan to a specialist radiologist for further investigation, this should not require further exposure to x-rays.

References and further information:

(1) www.fda.gov/cdrh/ct
(2) Allen C. Radiation risks overestimated. Radiology 2006;240:613-614
(3) http://www.sciencemag.org/cgi/content/full/309/5736/883

If you have any concerns or wish for additional information regarding radiation exposure and Dental CT, please do not hesitate to contact us at the Philip Friel Advanced Dentistry clinic and we will attempt to provide you with satisfactory answers according to the current literature.