Differences of Saliva Volume Before and After Panoramic Radiography

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Abstract

Panoramic radiography is a type of radiography examination with implementation related to X ray radiation which are administered in low doses. X rays can induce biological effect which affect target organs that are exposed to the radiation. One of the target organs with radiosensitive characteristics in panoramic radiography is salivary glands. The aim of this research is to understand the differences of saliva volume before and after panoramic radiography. The method of this research was comparative analytic by the used quantitative approach. The subjects of this research were 30 people who were indicated conducting panoramic radiography, in the range ages of 15-60 years old. A panoramic radiography machine, EPX−Impla, X ray unit was used for this research with dose 0.0049 Sv. The procedure of collecting saliva volume were taken before and after panoramic radiograph with spitting method. Saliva volume before and after conducted panoramic radiography showed that saliva volumes are significantly increased (p=.025). This research has shown there were differences in saliva volumes before and after exposure to panoramic radiography spesifically the decrease of saliva volume after panoramic radiography.

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Introduction

Just before the turn of the century, Wilhem Conrad Roentgen discovered the basic properties of X-Rays, the properties of ionizing radiation and the possibility of using radiation in dental and medicine.[1] The field of dentistry uses a man made radiation in diagnosis is dental radiography.[2] Dental radiographs are a useful and necessary tool in the diagnosis and treatment of oral diseases. Although radiation doses in dental radiography are low.[3] One of the most commonly used radiography in the field of dentistry is panoramic radiography. Very low doses due to radiation exposure from panoramic radiography do not mean they have no effect on the exposed cells and tissues.[4] The radiation used is x-rays. X-rays have higher energy and can pass through most objects, including the body.[2] Radiation acts on living systems through direct and indirect effects. When the energy of a photon or secondary electron ionizes biologic macromolecules, the effect is termed direct. Alternatively, a photon may be absorbed by water in an organism, ionizing some of its water molecules. The resulting ions form free radicals that interact with and produce changes in biologic molecules. Because intermediate changes involving water molecules are required to alter the biologic molecules, this series of events is termed indirect.[4]

Based on the data from Radiology Laboratory of Dental and Oral Hospital Padjadjaran University, the dose for once exposure to panoramic radiography was 49 x 10^{-3} Sv (0.0049 Sv). X-ray panoramic radiography used is EPX-Impla brand which the latest calibrated on March 31, 2017 and used since 2008. X ray needs to be treated in order to perform its functions remain in accordance with the dose. The calibration test was finally performed in March 2017 and produced a dose of 49 x10^{-3} Sv (0.0049 Sv). Effective dose of X-ray diagnostic examination on panoramic radiography of 9 x10^{-6} until 24 x10^{-6} Sv. The number of doses used in this study exceeds the maximum effective dose. If the low dose released

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by the panoramic exceeds the effective dose it should be, then the possibility of biological effects may occur.

Radiation injury to organisms results from either the killing of large numbers of cells (deterministic effects) or sublethal damage to the genome of individual cells (stochastic effects) that results in cancer formation or heritable mutation. Deterministic effects of radiation are effects seen when the radiation exposure to an organ or tissue exceeds a particular threshold level. The severity of this change is proportional to the dose; greater exposure leads to greater cell killing. At doses below the threshold, the effect does not occur. Stochastic effects are caused by sublethal radiation-induced damage to DNA. They have no minimum threshold for causation. Any dose of radiation has the potential to induce a stochastic effect. The probability of causing a stochastic effect increases as the radiation dose is increased.[4] The biological effect studied in this study was the stochastic effect on saliva volume. Panoramic radiography involves the salivary glands within the radiation exposure area, so radiation exposure to the area results in a disruption of acinar cells in the salivary glands. Salivary glands are exquisitely sensitive to radiation, yet, unlike classically radiosensitive tissue.[5] The acinar cells damage and salivary gland shrinkage may occur during the acute phase, which then affects the composition and volume of saliva. The previous studies by Susanti et al., showed that there was a decrease in pH saliva after exposure to X-ray radiation from panoramic radiography at 0.0042 Sv with an average decrease of 0.0638.[6] Putri study result showed that there was a decrease in saliva volume which is irreversible.[7]

Methods

The type used of research is comparative analytic research with quantitative approach. The sample of the research is the patient who will be done panoramic radiography at Dental Radiology Installation Dental and Oral Hospital of Padjadjaran University. Sample was chosen by purposive sampling method, then can be taken research sample amounted to at least 30 people.

The criteria of research subjects consist of inclusion and exclusion criteria. The tool needed in this research is X-ray panoramic Epx Impla type Picasso Trio, conical tube, funnel, handscoon, mask, tissue, and stop watch.

The procedure of this study before the panoramic x-rays, for 5 minutes the patient will collect saliva every 60 seconds for 5 minutes in accordance with spitting method. Saliva is allowed to accumulate in the floor of the mouth and the subject spits it out into the preweighed or graduated test tube every 60 seconds.[8] After saliva was collected in 5 minutes, saliva volume was measured. Measurements were made twice and the results were averaged.

The data which collected then was be processed and analyzed. The next step is comparative data test using Saphiro-Wilk. The data is called to be normally distributed if $p > 0.05$ is obtained. If the data obtained is normally distributed then t-test paired, but if the data is not normally distributed then done Wilcoxon matched pairs sign rank test.[9]

Results

The following characteristics of the research samples are presented in figure form

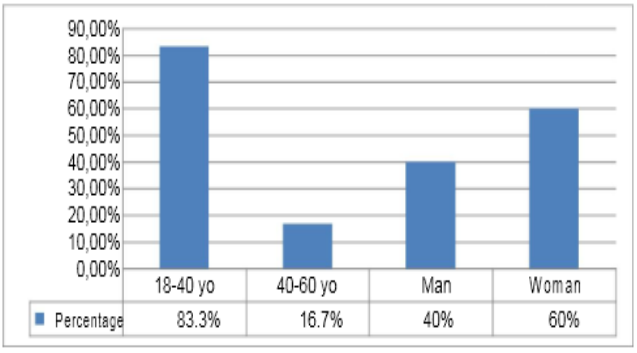

Figure 1. Sample of Research by Age and Gender.

Figure 1 shows that the most sample were in the group of 18-40 years old with 83.3% and woman at 60%. The results of the differences volume saliva in before and after panoramic radiography are shown in the table below.

The highest saliva volume values before and after panoramic based on Table 1 is in the 18-40 age group, while the lowest values are in the 40-60 age group.

Sample	∑	Time	Saliva Volume (Before)	Saliva Volume (After)	Differences
18-40	25	19.5”	2.13 mL	2.01 mL	0.12 mL
40-60	5	20”	1.52 mL	1.12 mL	0.40 mL

Table 1. The Results of Saliva Volume Before and After Panoramic Radiography by Age.

Sample	∑	Time	Saliva Volume (Before)	Saliva Volume (After)	Differences
Man	12	21”	2.08 mL	1.98 mL	0.10 mL
Woman	18	19”	1.94 mL	1.71 mL	0.23 mL

Table 2. The Results of Saliva Volume Before and After Panoramic Radiography by Gender.

According to Table 2, the highest saliva volume difference by gender is found in females, which is 0.23 mL. In men the difference between saliva volume values was 0.10 mL. Overall, the results of differences saliva volume before and after panoramic are shown in the following table.

Saliva Volume	$\bar{X}$	SD
Before panoramic radiography	1.99	0.612
After panoramic radiography	1.86	0.518
Differences of saliva volume	0.27	0.147

SD = standar deviation

Table 3. The Results Differences Saliva Volume Before and After Panoramic Radiography.

The results of this study show a decrease in saliva volume value after panoramic radiography. Data from the research results are then analyzed by using normality test to determine whether in each group normal distribution. Normality test conducted by using Saphiro Wilk shows the significance value of 0.004 is smaller than 0.05, it can be concluded that the data is not normally distributed.

	Saphiro Wilk	
Statistic	Df	Sig.
0.885	30	0.004

p< 0.05 data is not normally distributed

Table 4. Test of Normality.

Furthermore, the Wilcoxon test was performed to determine the presence of salivary before and after panoramic radiographic volume differences. The results of the normality test and Wilcoxon test are presented in the following table.

	After-Before
Z	-2.248[a]
Asymp. Sig. (2-tailed)	0.025

Table 5. Wilcoxon Test Results.

Based on statistical analysis, Wilcoxon test shows that the significance value of data is 0.025, the p value is smaller than α, so it is known that there is difference of saliva before and after panoramic radiography from x ray having dosage 0.0049 Sv.

Discussion

The results of the 30 samples showed the average value of saliva volume before conducted the panoramic radiography with a dose of 49 x 10^{-3}Sv is 1.99±0.61 mL and after conducted the panoramic radiography is 1.86±0.52 mL. The difference result from this research is 0.27±0.15 mL.

Low doses of radiation, such as those emitted during panoramic radiography, are capable of causing deleterious and cumulative biological effects on living organisms.[10] Very low doses due to exposure to panoramic radiography radiation do not mean they have no effect on the exposed cells and tissues. The effective dose released by the panoramic radiography is greater than the maximum effective dose.

Panoramic radiography in this study use X-rays belonging to electromagnetic rays. The effects of radiation rays if exposed to the body

can cause biological effects. Biological effects can occur directly and indirectly. The initial interaction between ionizing radiation and matter occurs at the level of the electron within the first 10^{-13} second after exposure. These changes result in modification of biologic molecules within the following seconds to hours.About two thirds of radiation-induced biologic damage results from indirect effects and 1/3 of them are from direct effects. Direct effects occur in biological molecules that absorb energy from ionizing radiation and form unstable free radicals. Generation of free radicals occurs less than 10^{-10} seconds after interaction with photon. Because water is the predominant molecule in biologic systems (about 70% by weight), it frequently participates in the interactions between x-ray photons and biologic molecules. A complex series of chemical changes occurs in water after exposure to ionizing radiation. Collectively these reactions result in the radiolysis of water $H_2O \quad H_2O + e^-$.[4]

The OH^- free radical is more important than H• in forming organic free radicals. The resulting organic free radicals are unstable and transform into stable, altered molecules as described in the previous section on direct effects. These altered molecules have different chemical and biologic properties from the original molecules. Radiation effects are thus caused primarily by direct effects and the diffusion of OH^-. Both direct effects and indirect effects are completed within 10^{-5} seconds. The resulting damage may take hours to decades to become evident. In addition, ionizing radiation also causes the formation of harmful hydrogen peroxide compounds to the body, which can damage cells in the body by causing broken single /double strand brake, cross-linkage changes and basic changes.[2, 6] The biological effects is occurring in this study included to the cellular level stemming from panoramic plane radiation to salivary glands.[11, 12]

The cells that make up the salivary glands consist of serosa and mucosa. The largest salivary glands affected by radiation are the parotid glands (consisting of the asini serosa cells) and the submandibular glands (consisting of serosa and mucosa asini cells). This is happened because of the serosa asini cells are more radiosensitive than the mucosa asini cells. The content of water molecules is more prevalent in serus and highly reactive cells.[4, 6, 12, 13] Therefore the salivary glands include the radiosensitive glands. Decrease saliva volume in this study occurred due to biological effects of low-dose radiation exposure that occurs in the salivary glands, especially asini cells.

Females produced lower saliva volume values than men in this study. The influence of gender is a factor that can affect salivary secretion, particularly with hormonal changes in women involving the flow of salivary secretions. The gland size is of primary importance for the volume response of the gland Parotid and submandibular gland sizes and flow rates in females were significantly smaller than those in males.[14, 15]

This research uses the same panoramic X-ray device in the Radiology Installation for each sample, the same treatment to the subject, because the subject is indicated for panoramic radiography, and the data taken in the form of primary data, allows researchers to see the patient's condition directly.

However, this study ignores one of the anxious factors, because this study does not measure the level of anxiety in patients who do panoramic radiography, for it is expected to do next research. The hypothesis that has been proposed based on the theory of the previous framework is evidenced by the results of this study.

Conclussion

Based on the result of research, it can be concluded that there is differences of saliva volume between before and after panoramic radiography that is decreasing

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